TN3.1a
Test cases for the L2B processor

Reference: AE-TN-KNMI-GS-0031a

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Change Log

Version	Date	Comment
0.1	6-Jul-2006	Initial version
0.2	27-Jun-2007	GJM: Realistic test cases included
0.3	6-Mar-2008	GJM: pass/fail criteria for realistic scenes, section 4
0.4	10-Jun-2008	GJM: New synthetic scenes, more detailed pass/fail criteria
0.5	17-Jun-2008	JK: updated test descriptions to actual used values, and renumbered the tests (to match the currently implemented testcases)
0.6	10-Feb-2009	JK: updated to include Mispointing tests
0.7	16-Feb-2009	JK: converted to LaTeXto allow better control on the included figures and on formatting in general
0.8	02-Mar-2009	JK: added tests 27, 50, 51, 208 and 209
1.0	15-Feb-2011	JK: added tests 28, 29, 52 upto 56, and test cases for all VAMP rangebin scenarios as tests 301 upto 322
1.1	07-Oct-2011	Synchronise version number with TN3.1b report No further changes since no comments received on the draft version.

Contents

List of Figures

List of Tables

1 Introduction

The present document presents the test cases that have been produced for validating the L2B processor, what functionalities each one of them is targeting, and the associated pass / fail criteria.

All test results will be described in a separate document to allow easier updating when all tests need to be repeated after the arrival of new software versions, see [RD9].

Each test case is associated to a test data set, which is defined as all needed inputs for each processing step, and all generated outputs for each processing step as reference. One data set may serve several test purposes.

The software versions and settings used to run the software, and to produce the test data sets will be described in detail in [RD9].

A test data set is composed of:

- the python script used to generate the scenario. This script is setup in such a way that it has a given collection of defaults, and each test only needs to define its deviations from these defaults. In the same way one test can import the settings of a previous test, and add just a few (or a single) difference in its settings. This makes the test definitions very short and efficient.
- the initial ASCII file that defines the properties of the atmosphere and ground probed by ADM. The format is self-explanatory. The files are stored in folders with an appropriate scenario name, and the name of the file is systematically `date_time_lat_lon_counter.asc, atmosphere.asc,` see [RD10] for details.
- All the E2S input xml files that compose the defined scenario. These have been generated by the mentioned python script from the default files delivered with the software or from newer default files distributed by ESA, based on settings in the python script or data from the atmospheric database.
- The E2S output files [instrumentData files, aisp files]
- The L1bP input files [aisp file, aux. calibration, aux. parameter files]
- The L1bP output files [L1B product, ZWC product, any other calibration files generated]
- The L2B input files [L1B product file, Aux RBC file, Aux Met file, Aux parameter file],
- The L2B output product file
- The L2A input files [L1B product file, Aux parameter file]
- The L2A output product file
- for convenience also all generated plots and statistics are provided.

Note that the original plan was to switch off the DEM for most of the academic test cases. A switch for this purpose is present in the E2S input files. However, this feature seems not properly implemented and cannot be used. Also there are no plans for fixing this E2S functionality. Therefore the requirement to have "no DEM" in these tests has been removed. A workaround would be to select an orbit section entirely above the ocean, for those cases for which this really is essential, but this has not yet been done.

Test cases are presented in sections 4 upto 13. Section 4 provided a base test to demonstrate the proper functioning of all software packages. Section 5 deals with simple, unrealistic atmospheric conditions designed for testing particular aspects or functionalities of the L2B processor (estimation of error levels for instance). Section 6 also assumes simple, unrealistic atmospheric conditions without noise, and aims at verifying that the L2B wind results have acceptable errors and biasses. Section 7 specifically tests the cloud handling properties of the software, and was originally targetted for testing the L2A processor. Section 8 describes the same tests as where defined in section 6, but now poisson noise has been added, after which the results still should be acceptable. Section 9 describes the same tests as where defined in section 7, but again poisson noise has been added, after which the results still should be acceptable. Section 10 describes the a few tests with polar stratospheric clouds, and is intended to verify that these clouds can be detected and that cross-talk correction can be performed on the Rayleigh channel without Mie information. Section 11 describes a number of functional tests on uncommon situations. The first 2 tests probe the far edges of the wind speed range that can be resolved by the L2B processor, and tests that out of range winds are flagged correctly. The next 2 cases have a variation in N,P parameters and range bin definition within a scenario. The next 2 tests use specific N,P combinations that have been used by the L2BP unit testing. The final test is intended to verify that the software components can handle the situation where multiple Rayleigh range bins overlap with a single Mie range bin. In section 12 realistic conditions are addressed. The aim is to check that the L2B processor is able to detect the atmospheric features – broken clouds for instance – that may have a negative impact of L2B output products, and apply the adequate corrective procedure, if existing. Section 13 probes the ability of the software chain to apply ground correction in case of large biases caused by mispointing of the system. Finally in section 14 a series of test cases is defined to perform functional testing on the range bin definitions proposed by the VAMP study.

2 Previous test descriptions

The present document describes all tests that are embedded in the scripting system developed at KNMI. A number of previous manual test efforts have been performed and documented separately. Some of these earlier tests have been incorporated in the current document, and some not or not yet. For this reason this document has been reassigned a KNMI reference code now. For completeness, here is a list of previous documents describing earlier tests and test results:

- AE-TN-MFG-GS-0031: This is the reference code for earlier versions of this document. To reflect the fact that the document has been rewritten from scratch at KNMI, it has been assigned a new reference code. The latest published version of this previous document is version 0.3, dated 06-Mar-2008, but by mistake it says dated 27-Jun-2007, and has an obsolete version nr. 0.2. This document is available from eRoom folder: "AEOLUS > LIBRARY_of_DOCUMENTS > ECMWF-L2B > TECH-NOTES > Task_3" This document defines test cases #0001 upto #0004 (see sections 5.2 upto 5.5), and #0101 upto #0109 (see sections 12.2 upto 12.10) which are incorporated in the current document as well.
- TN 3.1 follow on: "realistic" test cases (tests of the L2bP with actual data), 5 pages[1] This document defines a single test case which was used as basis for the results presented in the Tellus article [RD...]. It has been included in the current document as test case number #0027 (see section 9.5).
- AE-TN-KNMI-L2B-0031: Technical Note as part of TN 3.1, LITE scenes description (16 pages) by Gert-Jan-Marseille, version 0.1, dated 27-Mar-2007. This is a description of the LITE atmospheric data used for constructing tests #0101 upto #0109 (see sections 12.2 upto 12.10) of the current document[2]
- TEST SCENARIOS FOR L1B & L2B PROCESSORS, by Alain Dabas and Ad Stoffelen, written in 2004. Available from the eRoom in folder: "AEOLUS > AEOLUS > LIBRARY_of_TESTS > MFR" filename: TEST_CASES_FOR_L1B_L2B_050225.doc. This document describes a series of synthetic scenarios. Several of these have been included in the atmospheric database, and have been manually tested. They have (not yet) been included in this document. If needed they can easily be added since all meteorological inputs have already been defined.
- Note that, although related, the document AE_TN_ECMWF_L2P_0041, Sensitivity Study Results[3] by Alain Dabas, Marie-Laure Denneulin, Paul Poli, Ad Stoffelen, Gert-Jan Marseille, Erik Andersson, and David Tan, focusses on (manual) testing of individual algorithms, and has not been incorporated in this current document.

[1] distributed 19-Jan-2007 by email by Paul Poli, titled "Re: L2B meeting Toulouse". The attached document was titled tn31_followup.doc

[2] filename AE-TN-KNMI-L2B-0031_070327.doc

[3] filename AE_TN_ECMWF_L2P_0041_v1p1_20061102.pdf, v1.1, dated 02-Nov-2006.

3 Documents and acronyms

3.1 Applicable documents

Code	Title	Reference	Ver.	Date
[AD1]	Statement of Work: Definition & Implementation of Aeolus Level 2 Processing Algorithms	AE-SW-ESA-GS-012	draft	25-Nov-2003
[AD2]	Statement of Work: Implementation of Aeolus Level 2B/2C Processing Facility	AE-SW-ESA-GS-0117	1B	16-Sep-2004
[AD3]	Statement of Work: Enhanced Aeolus Level 2B/2C Functionalities & Pre-Launch Validation	AE-SW-ESA-GS-023	1	29-Nov-2005
[AD4]	Statement of Work: Aeolus Level 2B/C Processor Refinement & Support Tasks	AE-SW-ESA-GS-029	1	12-Jun-2008

3.2 Reference documents

Code	Title	Reference	Ver.	Date
[RD1]	ADM-Aeolus Level-2B Algorithm Theoretical Baseline Document (Mathematical Description of the Aeolus Level-2B Processor)	AE-TN-ECMWF-L2BP-0023	2.1	23-Feb-2007
[RD2]	L2B DPM	????	?.?	??/??/??
[RD3]	ADM-Aeolus Level-2B/2C Processor Input/Output Data Definitions Interface Control Document	AE-IF-ECMWF-L2BP-001	1.32	16-Jan-2008
[RD4]	Generation of the RBC Auxiliary file: Detailed Processing Model	AE-TN-MFG-GS-0001	1.3	11-Apr-2008
[RD5]	Aeolus Level 1b Processor and End-to-End Simulator: End-to-End Simulator Detailed Processing Model	ADM-MA-52-1801	2/4	12-Apr-2007
[RD6]	Technical Note Refined Observational Scenarios	AE-TN-KNMI-L1B-0013	0.2	24-Apr-2007
[RD7]	Marseille, G.J., A. Stoffelen, A. van Lammeren, LITE4ADM – On the use of LITE data for the Atmospheric Dynamics Mission – Aeolus	KNMI internal report IR 2003-01		Oct. 2002
[RD8]	Winker, D.M., Couch, R.H. and McCormick, M.P., 1996, An Overview of LITE; NASA's Lidar In-Space Technology Experiment	Proceedings of the IEEE, vol. 84, No 2, 164-180.		1996
[RD9]	TN3.1b Test results for the L2B processor	AE-TN-KNMI-GS-0031b	0.1	20-Feb-2009
[RD10]	The ADM Atmspheric Database	AE-TN-KNMI-L1B-001	1.5	25-Jun-2008
[RD11]	Lambertian Surface Albedo Climatology at 360 nm from TOMS Data Using Moving Time-Window Technique, published by the Finnish Meteorological Institute. Website: http://promote.fmi.fi/MTW_www/MTW.html			23-May-2008
[RD12]	ADM-Aeolus, Ocean Albedo, Technical note on Ocean Albedo as a function of local wind and wave conditions and its effect on the zero-wind calibration.	AE-TN-KNMI-L1B-001	1.0	15-Apr-2008
[RD13]	Vertical Aeolus Measurement Positioning, Technical note TN1.	AE-TN-KNMI-VAMP-001	1.3	28-Apr-2010

3.3 Acronyms

[note: they are now reordered]

ADM	Atmospheric Dynamics Mission
AISP	Annotated Instrument Source Packet
AOCS	Attitude and Orbit Control System
BRC	Basic Repeat Cycle
CALIPSO	Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation
DE2S	DLR End-To-End Simulator
DEM	Digital Elevation Model
DWL	Doppler Wind Lidar
E2S	End-To-End Simulator
ECMWF	European Centre for Medium Range Weather Forecasting
HBE	Harmonic Bias Estimator
HLOS	Horizontal Line-Of-Sight
L1B	Level 1B
L2B	Level 2B
L2Bp	L2B processor
LITE	Lidar In-space Technology Experiment
LOS	Line-Of-Sight
MDA	MacDonald Dettwiler and Associates
PBL	Planetary Boundary Layer
PSC	Polar Stratospheric Clouds
RBC	Rayleigh-Brillouin Correction
RMA	Reference Model Atmosphere
TDS	Test Data Set
VAMP	Vertical Aeolus Measurement Positioning (ESA study)
ZWC	Zero Wind Calibration

4 General software test case

4.1 Introduction

The following test case #0000 describes the scenario used to test the functionality of the full software chain E2S-L1BP-L2BP in a perfect simple noise free case.

4.2 Test case #0000: Base Reference

Purpose

Test the capability of the E2S-L1B-L2B processor chain to retrieve the exact input winds, within machine precision, for a constant atmosphere and noise-free instrument. This is the case Dorit Huber proposed on 2/6/2008 to close AI12.13 of L2B PM#12.

Test Data Set

Base_Reference_Rms TEST_TN3_1_0000 composed of 15 BRCs (5 segments of each 3 BRCs) corresponding to 5 different wind realizations.

Atmospheric Conditions

Inputs as defined in Base_Reference_Rms.tgz. Horizontally homogeneous case (atmosphere defined between 0 and 17 km as provided as default with the E2S software, but added an additional layer at 30km to cover rangebins above 17 km as well) characterized by a temperature profile of 0° Celcius. For each BRC, the wind is constant, equal to 0 ms^{-1} in BRC#1, 10 ms^{-1} in BRC#2, -10 ms^{-1} in BRC#3, 40 ms^{-1} in BRC#4 and -40 ms^{-1} in BRC#5. A median RMA aerosol profile was used.

E2S Scenario

Inputs as defined in Base_Reference_Rms.tgz. No interpolation within segments, no AOCS errors, no random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (except for the lowerlowest Mie and the upperhighest Rayleigh bin), as defined in WVM1.

L2B Settings

The L2B processing takes the single_RMA_profile_midlat_winter atmosphere as reference AuxMet data, but again with all temperatures set to 0° Celcius. The classification algorithm assumes no clouds are present in this scenario.

Pass/Fail Criteria

L1B/L2B Rayleigh HLOS winds are unbiased for all 5 BRC's and show no altitude-dependence. The maximum allowed bias is 0.001 ms^{-1}, i.e. substantially below the 0.1 ms^{-1} bias requirement for ADM. The standard deviation of HLOS wind errors should be close to zero. The criterion is set at 0.0010.1 ms^{-1} since the noise produced by the discretisation of the signal to an integer number of photons cannot be prevented.

Comments

The non-constant molecular backscatter (and extinction) profile potentially results in height assignment errors (signal weighted minus geographical center bin altitude) of retrieved Rayleigh HLOS winds. However, for a constant wind profile (no vertical wind-shear) no wind biases should occur.

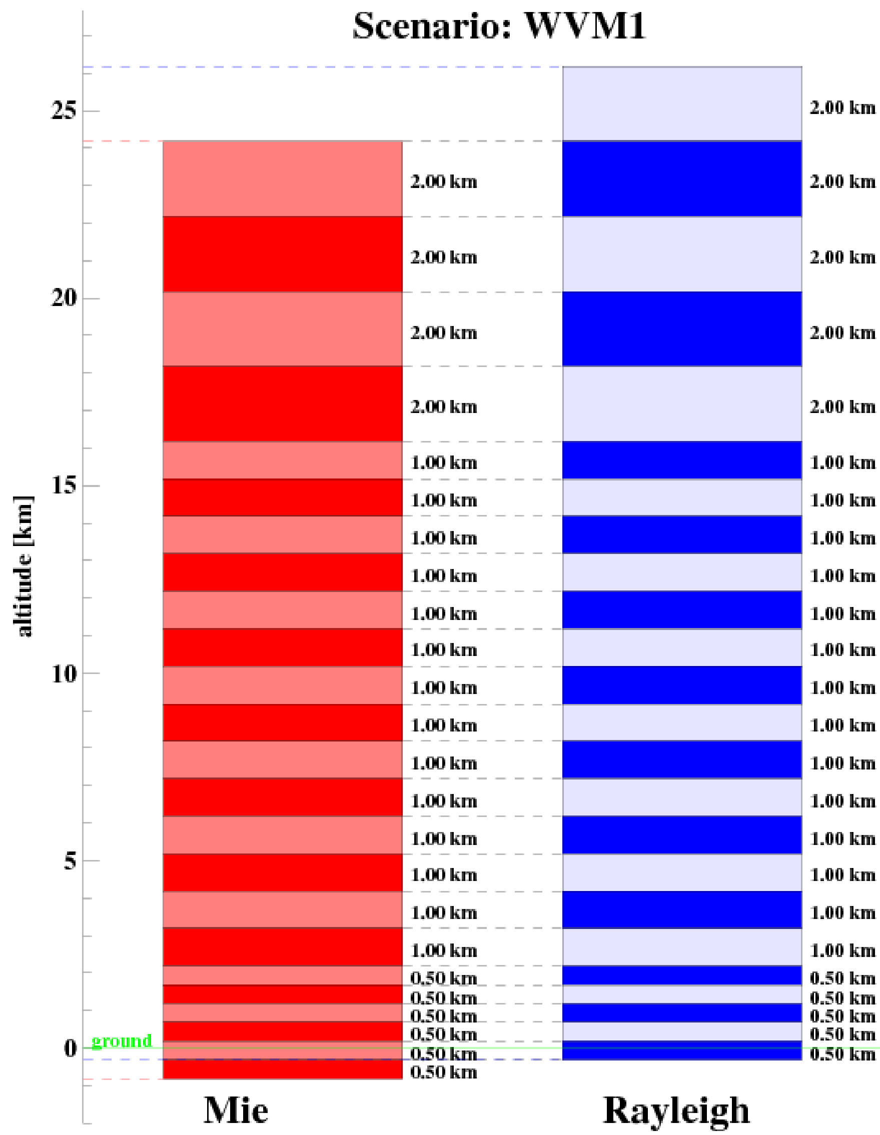

Figure 1: rangebin definition named WVM1 used by tests #0000 upto #0109.

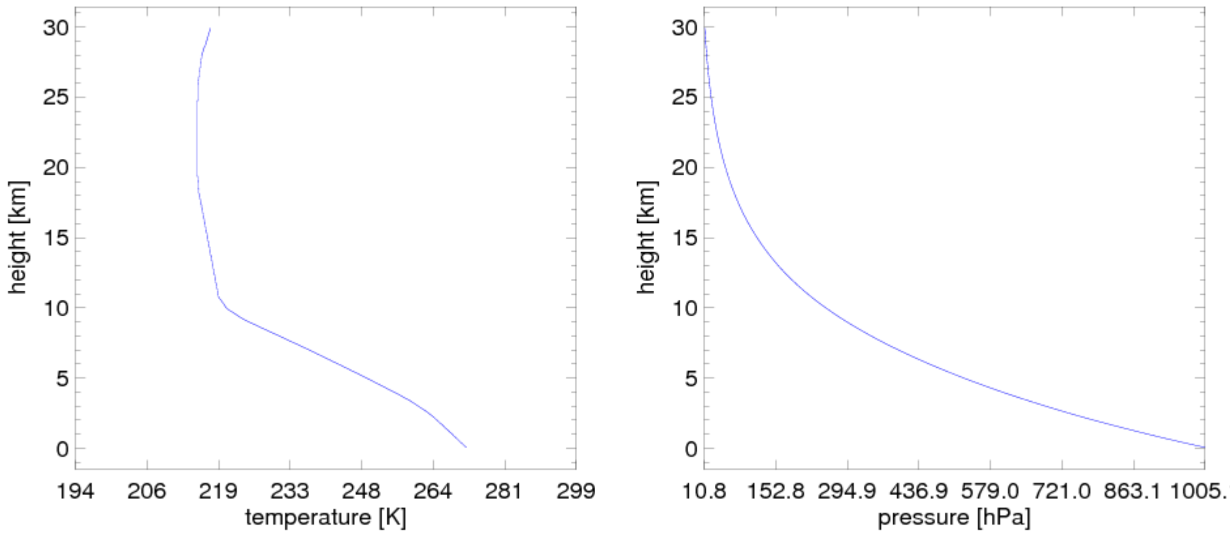

Figure 2: Temperature (left) and pressure (right) profiles defining the horizontally-homogeneous atmospheric scene used in testcase # probed by ADM in L2D_TDS_0001.

5 L2B academic cases defined at Météo-France

5.1 Introduction

The following test cases #0001 - #0004 describe the scenarios used to test specific algorithms of the L2B processor. Question to Meteo France. Are the test cases below 0001 to 0004 still valid ??

5.2 Test case #0001: Molecules only

Purpose

Test the capacity of the L2B processor to correct pressure and temperature biasing effects on Rayleigh winds by applying correctly the Rayleigh-Brillouin correction scheme (RBC - see section 14 in [RD1]) implemented within the L2B processor. Presently, there is no pressure effect in test data because the E2S does not implement it (Rayleigh spectra modeled by the E2S are purely Gaussian, no Brillouin effect is considered). As a consequence, the L2B current version of the L2B processor does not correct pressure effects. However, pressure effects can be included easily by modifying the RBC look-up-tables in auxiliary file AUX_RBC___ (see [RD4]), the RBC algorithm does not need to be changed.

Test Data Set

TEST_TN3_1_0001 composed of 3 BRCs.

Atmospheric Conditions

Horizontally homogeneous case (single_RMA_profile_midlatsubarctic_winter_MF) characterized by the temperature and pressure profiles displayed in Figure 2 (vertical resolution = 125m). For each BRC, the wind is constant, equal to -50 ms^{-1} in BRC#1, 0 ms^{-1} in BRC#2, and +50 ms^{-1} in BRC#3. The scenario contains no aerosol, that is, the aerosol backscatter and extinction is constant, equal to 0 for each BRC.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1).

Figure 3: Aerosol and cloud backscatter (left panel) and Backscatterratio (right panel) as used for test #0002

L2B Settings

The classification algorithm assumes no clouds are present in this scenario.

Pass/Fail Criteria

L2B Rayleigh HLOS winds are unbiased and show no altitude-dependence. Errors in HLOS winds are less than 1 ms^{-1}. The first-order derivative of the HLOS wind with respect to the temperature must be around -10 $cm.s^{-1}K^{-1}$ for BRC#1, 0 $cm.s^{-1}K^{-1}$ for BRC#2 and +10 $cm.s^{-1}K^{-1}$ for BRC#3.

5.3 Test case #0002: aerosol bias correction on Rayleigh channel

Purpose

Test the capacity of the L2B processor to correct the biasing effect of aerosol return on Rayleigh winds (see section 14 in [RD1], based on the scattering ratio estimated by the L1B processor.

Test Data Set

TEST_TN3_1_0002 Composed of 3 BRCs.

Atmospheric Conditions

Same as BRC #0003 of test case #0001, but aerosols (backscatter and extinction from single_RMA_profile_midlatsubarctic. and a cloud layer (cirrus between 12 and 14 km) are added which has a two way transmission of 0.995.

The total particulate (aerosol + cloud) backscatter ($\beta_{(aer+cloud)}$) and extinction profiles are displayed in Figure 3, (left panel) as well as the scattering ratio ($\beta_{(aer+cloud)}/\beta_{mol}$ – right panel). Compared to BRC#12, the aerosol backscatter β_{aer} in BRC#21 and #3 is multiplied by 100.1 and 10010 respectively, going from weak to strong scattering ratios. The aerosol extinction is left unchanged.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

L2B Rayleigh HLOS winds must present no significant bias outside layer affected by the presence of the cirrus (between 10 and 15km), and a bias limited to a few meters per second (less than 5 ms^{-1}) in this layer. The estimates of the scattering ratio must be ... [give a requirement referring to the E2S input here]).

5.4 Test case #0003: Poisson error levels test

Purpose

: Test the estimation of Mie and Rayleigh error levels (see sections 16.2 and 17.2 in [RD1]).

Test Data Set

TEST_TN3_1_0003, Composed of 100 BRCs.

Atmospheric Conditions

Same as in BRC#2 of test case L2B_TDS_0002.

E2S Scenario

No interpolation within segments, no AOCS errors, no DEM, Mie and Rayleigh photo-counts randomized (Poisson + Gaussian, see section 7.9.10 in [RD5]), almost perfect matching between Mie and Rayleigh height-bins (WVM1).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

t.b.d.

Comments

t.b.d.

5.5 Test case #0004: Cloud detection test

Purpose

Test the cloud detection scheme.

Test Data Set

TEST_TN3_1_0004, Composed of 1 BRC.

Atmospheric Conditions

Same as in BRC#2 of test case L2B_TDS_0002 The scene is characterized by a horizontally homogeneous temperature profile as displayed in Figure 2, a constant HLOS wind of 50 ms^{-1}, aerosol properties as in (BRC#2), but the cloud layer is present in the first half of the BRC, and but missing in the second part (see Figure 4). [atm.db scenario??? exact cloud definiton???]

E2S Scenario

No AOCS errors, no DEM, no randomization of photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass / Fail Criteria

t.b.d.

Comments

t.b.d.

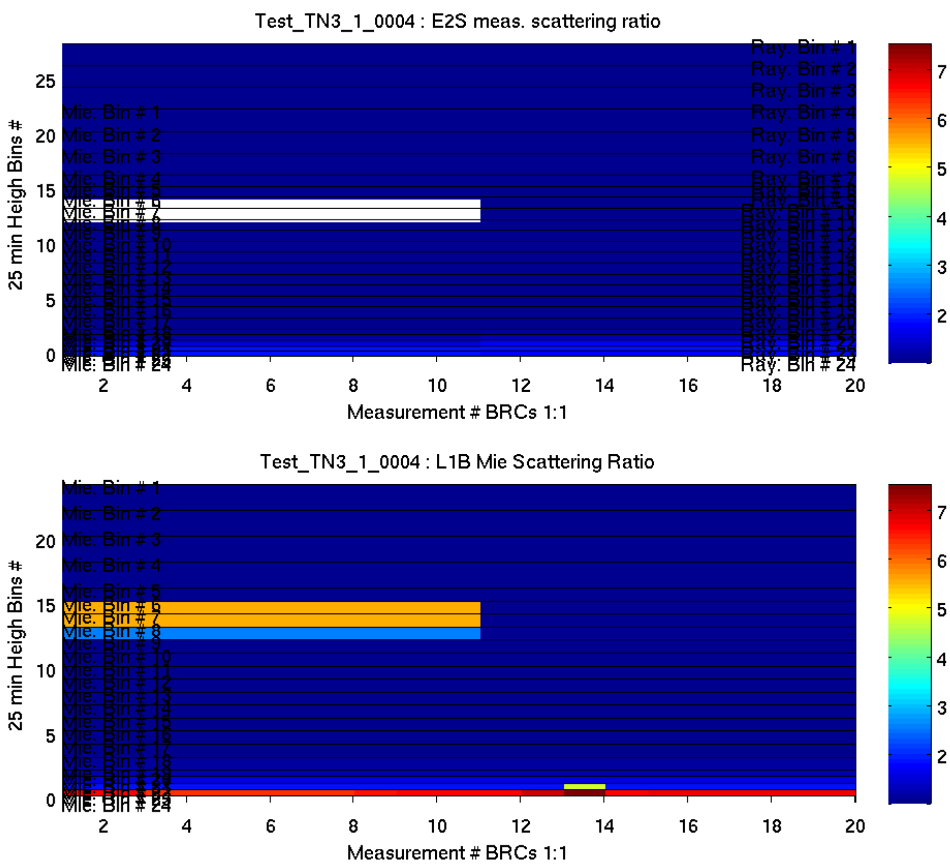

Figure 4: Aerosol and cloud backscatter as used for test #0004

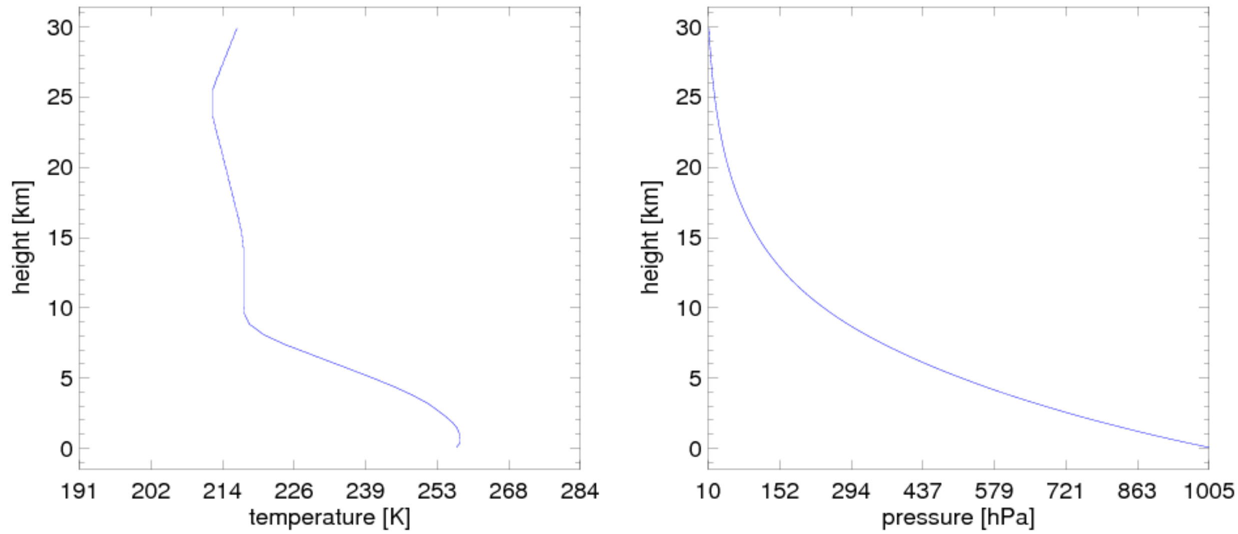

Figure 5: Temperature (left) and pressure (right) profiles defining the horizontally-homogeneous atmospheric scene used in testcase #0005

6 L2B noise free academic cases

6.1 Introduction

The following test cases #0005 - #0012 describe the noise free scenarios used to test the L2B processor.

6.2 Test case #0005 [was 002]: Molecules Only

Purpose

Test the capability of the L2B processor to retrieve the exact input winds, within machine precision, for an idealistic (molecules-only) atmosphere and noise-free instrument.

Test Data Set

TEST_TN3_1_0005, Composed of 3 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winte displayed in Figure 5 (vertical resolution = 125m). For each BRC, the wind is constant, equal to -50 ms^{-1} in BRC#1, 0 ms^{-1} in BRC#2, and +50 ms^{-1} in BRC#3. The scenario contains no aerosol, that is, the aerosol backscatter and extinction is constant, equal to 0 for each BRC.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1).

L2B Settings

The classification algorithm assumes no clouds are present in this scenario.

Pass/Fail Criteria

L2B Rayleigh HLOS winds are unbiased for all three BRC's and show no altitude-dependence. The maximum allowed bias is 0.001 ms^{-1}, i.e. far below the 0.1 ms^{-1} bias requirement for ADM. The standard deviation of HLOS wind errors should be close to zero for this ideal atmosphere. The criterion is set at 0.0010.1 ms^{-1} since the noise produced by the discretisation of the signal to an integer number of photons cannot be prevented.

Comments

The non-constant molecular backscatter (and extinction) profile potentially results in height assignment errors of retrieved Rayleigh HLOS winds. However, for a constant wind profile (no vertical wind-shear) no wind biases should occur. No Mie winds are found because the atmosphere is free of aerosols.

6.3 Test case #0006: Molecules and Aerosol

Purpose

Test the capacity of the L2B processor to correct the biasing effect of aerosol return on Rayleigh winds (see section 14 in [RD1]), based on the scattering ratio estimated by the L1B processor. A noise-free instrument is assumed. This resembles test #0002, but no cloud has been added , and a different RMA profile is used.

Test Data Set

TEST_TN3_1_0006, Composed of 3 BRCs.

Atmospheric Conditions

Same as the 3 BRCs of test case #0005, but including background aerosols (backscatter and extinction) as defined in the single_RMA_profile_subarctic_winter RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

The bias of L2B Rayleigh HLOS winds must be within the ADM requirement of 0.1 ms^{-1}. The bias of L2B Mie HLOS winds must be within the ADM requirement of 0.1 ms^{-1} in the PBL (lowest 2 kilometer near the surface).

Comments

The non-constant aerosol backscatter (and extinction) profile potentially results in height assignment errors of retrieved Mie and Rayleigh HLOS winds. However, for a constant wind profile (no vertical wind-shear) no aerosol induced bias should occur.

6.4 Test case #0007: Optically Thin Cloud

Purpose

Test the capacity of the L2B processor to correct the biasing effect of aerosol return on Rayleigh winds (see section 14 in [RD1]) for bins covering an optically thin cloud layer, based on the scattering ratio estimated by the L1B processor. A noise-free instrument is assumed. This resembles #0002, but the windspeed is varied now , and the cloud parameters differ.

Test Data Set

TEST_TN3_1_0007, Composed of 3 BRCs.

Atmospheric Conditions

Same as the 3 BRCs of test case #0006, so including background aerosols (backscatter and extinction). In addition an optically thin cirrus layer is added, located between 12 and 14 km and with a total 2-way transmission of 0.8. The total particulate (aerosol + cloud) backscatter ($\beta_{(aer+cloud)}$) and extinction profiles are displayed in Figure (left panel), as well as the scattering ratio ($\beta_{(aer+cloud)}/\beta_{mol}$ – right panel). Note that the extinction is more severe in this case then what was used in test #0002 (2-way transmission of 0.8 in stead of 0.995) and the cloud backscatter is much less (3.9×10^{-6} in stead of 22×10^{-6}). It is t.b.d. whether this is desired, or should be adapted.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

The bias of L2B Rayleigh HLOS winds must be within the ADM requirement of 0.1 ms^{-1}. The bias of L2B Mie HLOS winds must be within the ADM requirement of 0.1 ms^{-1} in bins covering the cirrus layer and PBL.

Comments

The non-constant aerosol backscatter (and extinction) profile potentially results in height assignment errors (measured (or signal averaged) minus geographical center bin altitude) of retrieved Mie and Rayleigh HLOS winds. However, for a constant wind profile no aerosol induced bias should occur.

6.5 Test case #0008: Dense Clouds

Purpose

Test the capacity of the L2B processor to correct the biasing effect of aerosol return on Rayleigh winds (see section 14 in [RD1]), for bins covering an optically more dense and opaque cloud layer, based on the scattering ratio estimated by the L1B processor. A noise-free instrument is assumed.

Test Data Set

TEST_TN3_1_0008, Composed of 3 BRCs

Atmospheric Conditions

Same as the 3 BRCs of test case #0006, so including background aerosols (backscatter and extinction). In addition 2 clouds are added:

i) an optically dense cloud layer located between 6 and 7 km and with a total 2-way transmission of 0.4 and

ii) an opaque stratus cloud between 2 and 3 km with transmission 0.001 Note that a zero transmission is not possible for numerical reasons. [Gert-Jan: 0 is onmogelijk, dan krijg je oneindige extincties e.d.]

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

The bias of L2B Rayleigh HLOS winds must be within the ADM requirement of 0.1 ms^{-1} above the stratus cloud. The bias of L2B Mie HLOS winds must be within the ADM requirement of 0.1 ms^{-1} in bins covering the dense cloud layer above the stratus cloud. No Rayleigh and Mie HLOS winds should be reported below the stratus cloud.

Comments

The non-constant aerosol backscatter (and extinction) profile potentially results in height assignment errors (measured (or signal averaged) minus geographical center bin altitude) of retrieved Mie and Rayleigh HLOS winds. However, for a constant wind profile no aerosol induced biases occur.

6.6 Test case #0009: Molecules Only and variable wind

Purpose

Test the capability of the L2B processor to retrieve HLOS winds within the ADM requirements for an idealistic (molecules-only) atmosphere and noise-free instrument. This case is similar to case #0005 but with a non-constant wind profile and different p,T profiles.

Test Data Set

TEST_TN3_1_0009, Composed of 1 BRC.

Atmospheric Conditions

One BRC, characterized by the temperature and pressure profiles displayed in Figure 6 (vertical resolution = 125m). An example wind profile from the MERCI database is taken (MERCI profile #50, extracted from the ECMWF NWP model), see Figure 7. Note that for now the u-component is taken to be the hlos input wind, since no proper u,v,w to hlos conversion has been implemented yet. The scenario contains no aerosol, that is, the aerosol backscatter and extinction is constant, equal to 0 for each BRC.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1).

L2B Settings

The classification algorithm assumes no clouds are present in this scenario.

Pass/Fail Criteria

The bias of L2B Rayleigh HLOS winds must be within the ADM requirement of 0.1 ms^{-1} and show a small altitude-dependence.

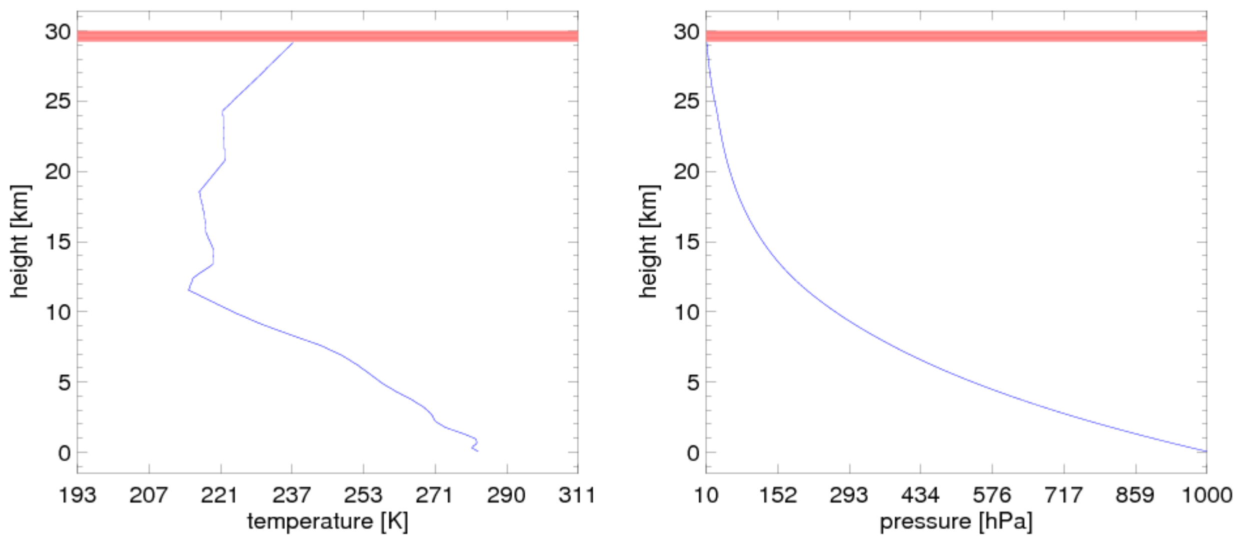

Figure 6: Temperature (left) and pressure (right) profiles defining the atmospheric scene used in testcase #0009. The red bar indicates a region with missing data, but with the current choice for rangebin definition this does not affect the test results.

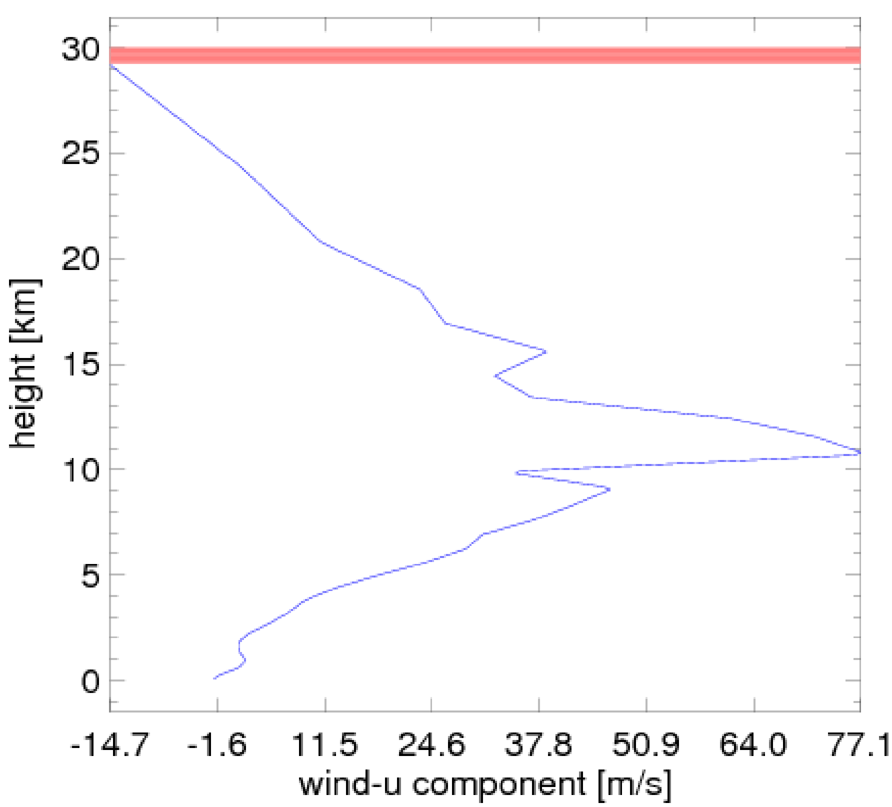

Figure 7: Wind profile as used in testcase #0009. The red bar indicates a region with missing data, but with the current choice for rangebin definition this does not affect the test results.

Comments

The non-constant molecular backscatter (and extinction) profile in combination with a non-constant wind profile results in height assignment errors and subsequent HLOS wind errors of retrieved Rayleigh HLOS winds. However, the HLOS error should be small for the considered wind profile because the vertical wind-shear is small throughout the profile (I have to check this, GJM). No Mie winds are found because the atmosphere is free of aerosols.

6.7 Test case #0010: Molecules, aerosol and variable wind

Purpose

Test the capacity of the L2B processor to correct the biasing effect of aerosol return on Rayleigh winds (see section 14 in [RD1]), based on the scattering ratio estimated by the L1B processor. A noise-free instrument is assumed. This case is equal similar to case #0006 but with a non-constant wind profile and different p,T profiles.

Test Data Set

TEST_TN3_1_0010, Composed of 1 BRC.

Atmospheric Conditions

Same asSimilar to the test case #0006, but including background aerosols (backscatter and extinction). u, p,T profiles as defined by the MERCI case used for test #0009, profile #50, extracted from the ECMWF NWP model.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

The bias of L2B Rayleigh HLOS winds must be within the ADM requirement of 0.1 ms^{-1}. The bias of L2B Mie HLOS winds must be within the ADM requirement of 0.1 ms^{-1} in the PBL.

Comments

The non-constant aerosol backscatter (and extinction) profile in combination with a non-constant wind profile results in height assignment errors of retrieved Mie and Rayleigh HLOS winds. However, HLOS wind errors should be small for small vertical wind-shears and a smooth background aerosol profile.

6.8 Test case #0011: Optically thin cloud and variable wind

Purpose

Test the capacity of the L2B processor to correct the biasing effect of aerosol return on Rayleigh winds (see section 14 in [RD1]), based on the scattering ratio estimated by the L1B processor. A noise-free instrument is assumed. This case is equalsimilar to case #0007 but with a non-constant wind profile and different p,T profiles.

Test Data Set

TEST_TN3_1_0011, Composed of 1 BRC.

Atmospheric Conditions

Same asSimilar to test case #0007, so including background aerosols (backscatter and extinction). In addition an optically thin cirrus layer is added, located between 12 and 14 km and with a total 2-way transmission of 0.8. The aerosol backscatter and extinction profiles are identical to what was used for test #0007. The total particulate (aerosol + cloud) backscatter and extinction profiles are displayed in (left panel), as well as the scattering ration ($\beta_{aer+cloud)}/\beta_{mol}$ – right panel). u, p,T profiles as defined by the MERCI case used for test #0009, profile #50, extracted from the ECMWF NWP model.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

The bias of L2B Rayleigh HLOS winds must be within the ADM requirement of 0.1 ms^{-1} throughout the profile outside the cloud layer. The bias of L2B Mie HLOS winds must be within the ADM requirement of 0.1 ms^{-1} within the PBL. The bias in the Mie and Rayleigh HLOS winds in the cirrus layer should be identified by QC, i.e. by identifying a large atmospheric heterogeneity (both optical and dynamical) inside and at the boundaries of the cirrus layer or by comparing Mie and Rayleigh winds.

Comments

For an optically thin cloud layer (small extinction), the signal loss in the Raleigh channel will generally be small and thus only marginally affecting the bias of the Rayleigh HLOS wind. The bias of L2B Mie HLOS wind within the cloud layer will most probably not meet the ADM requirement of 0.1 ms^{-1} but depending on the location of the cloud inside the ADM bins and the vertical wind-shear over the bins covering the cloud layer.

6.9 Test case #0012: Dense clouds and variable wind

Purpose

Test the capacity of the L2B processor to correct the biasing effect of aerosol return on Rayleigh winds (see section 14 in [RD1]), based on the scattering ratio estimated by the L1B processor. A noise-free instrument is assumed. This case is equal similar to case #0008 but with a non-constant wind profile and different p,T profiles.

Test Data Set

TEST_TN3_1_0012, Composed of 1 BRC.

Atmospheric Conditions

Same as test case #0010, so including background aerosols (backscatter and extinction). In addition 2 clouds are added (identical to what was used in test #0008):

i) an optically dense cloud layer located between 6 and 7 km and with a total 2-way transmission of 0.4 and

ii) an opaque stratus cloud between 2 and 3 km with transmission 0.001 Note that a zero transmission is not possible for numerical reasons. [Gert-Jan: 0 is onmogelijk, dan krijg je oneindige extincties e.d.]

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts, perfect matching between Mie and Rayleigh height-bins.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

The bias of L2B Rayleigh HLOS winds must be within of 0.1 ms^{-1} above the stratus cloud and outside the top cloud. The bias in the Mie and Rayleigh HLOS winds in the dense cloud layer should be identified by QC, i.e. by identifying a large atmospheric heterogeneity (both optical and dynamical) inside and at the boundaries of the cirrus layer or by comparing Mie and Rayleigh winds. No Rayleigh and Mie HLOS winds are measured below the stratus cloud.

Comments

For an optically thick cloud layer (large extinction), the signal loss in the Raleigh channel will be substantial and thus giving a bias of the Rayleigh HLOS wind. The bias of L2B Mie HLOS wind within the cloud layer will most probably not meet the ADM requirement of 0.1 ms^{-1} but depending on the location of the cloud inside the ADM bins and the vertical wind-shear over the bins covering the cloud layer.

7 L2A noise free academic cases

7.1 Introduction

The following test cases #0013 - #0015 describe the scenarios used to test the L2A processor as discussed during the L1B PM12 of January 2008. The temperature profile of these scenes are identical. Zero wind profiles are considered for all scenes. All scenes assume a cloud layer at various altitudes. All scenes have the same background aerosol backscatter and extinction.

7.2 Test case #0013: 1km Cloud Scan

Purpose

Test the capacity of the L2B processor to correct the biasing effect of aerosol return on Rayleigh winds for bins covering a cloud layer, based on the scattering ratio estimated by the L1B processor. A noise-free instrument is assumed.

Test Data Set

TEST_TN3_1_0013, composed of 8 BRC's.

Atmospheric Conditions

Variable temperature profile, zero wind profile, background aerosols (backscatter and extinction). Each BRC contains a cloud layer of 1 km thickness, and a constant backscatter of 1.423×10^{-5} m^{-1}sr^{-1} and constant aerosol extinction in the cloud of 2.012×10^{-4} m^{-1}. This results in a two-way transmission of 0.669. The location of the cloud layers is different for each BRC, see Table 1 and Figure 8.

Table 1: Cloud definitions as used for test #0013

BRC :	Bottom altitude of the layer	Top altitude of the layer
#1	8000 m	9000 m
#2	8125 m	9125 m
#3	8250 m	9250 m
#4	8375 m	9375 m
#5	8500 m	9500 m
#6	8625 m	9625 m
#7	8750 m	9750 m
#8	8875 m	9875 m

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

The bias of L2B Rayleigh HLOS winds must be within the ADM requirement of 0.1 ms^{-1}. The bias of L2B Mie HLOS winds must be within the ADM requirement of 0.1 ms^{-1} in bins covering the cirrus layer and PBL.

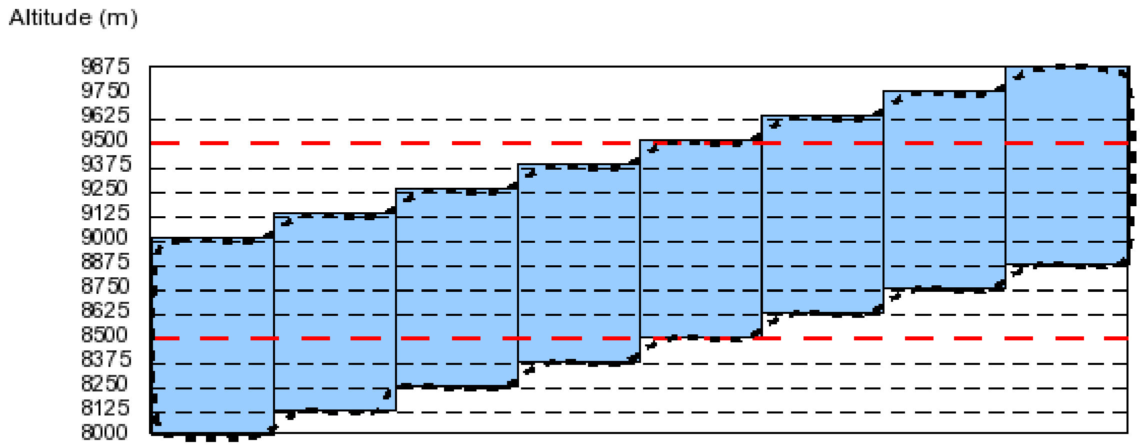

Figure 8: Location of 8 clouds. Each cloud covers one BRC of test case #0013.

Comments

The non-constant molecular and aerosol backscatter (and extinction) profile potentially results in height assignment errors of retrieved Rayleigh HLOS winds. However, for a constant wind profile (no vertical wind-shear) no wind biases should occur.

7.3 Test case #0014: 500m Cloud Scan

Purpose

Test the capacity of the L2B processor to correct the biasing effect of aerosol return on Rayleigh winds for bins that are partly covered by a thin cloud layer, based on the scattering ratio estimated by the L1B processor. A noise-free instrument is assumed.

Test Data Set

TEST_TN3_1_0014, Composed of 4 BRC's.

Atmospheric Conditions

variable temperature profile, zero wind profile, background aerosols (backscatter and extinction). Each BRC contains a cloud layer of less than 1 km thickness, and a constant backscatter of 1.423×10^{-5} m^{-1}sr^{-1} and constant aerosol extinction in the cloud of 2.012×10^{-4} m^{-1}. This results in a two-way transmission of 0.818 (500 m cloud) or 0.739 (750 m cloud). The location of the cloud layers is different for each BRC, see Table 2 and Figure 9.

Table 2: Cloud definitions as used for test #0014

BRC :	Bottom altitude of the layer	Top altitude of the layer
#1	6875 m	7625 m
#2	6625 m	7375 m
#3	7125 m	7625 m
#4	6625 m	7125 m

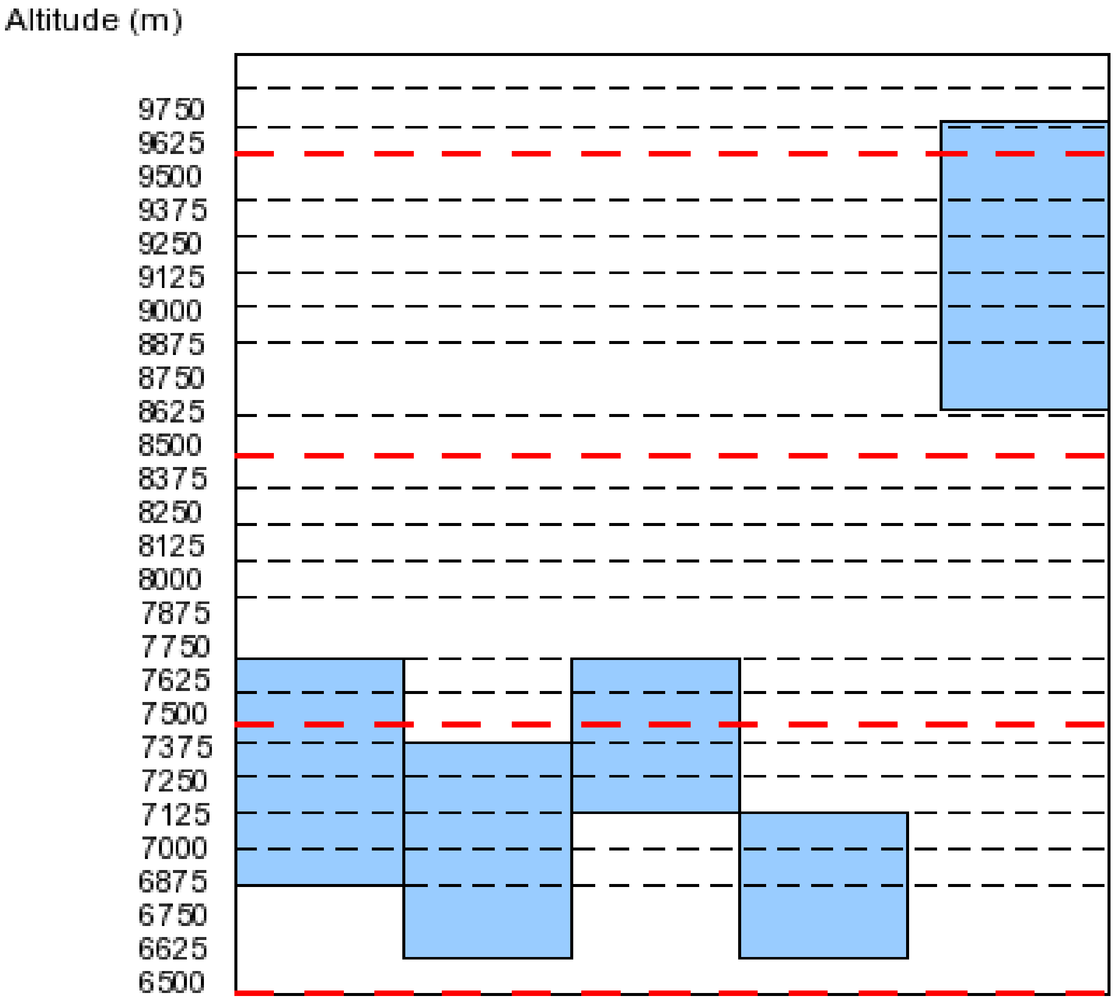

Figure 9: 4 clouds with thickness less than 1 km (as used by test cases 0014 and 0015), and 1 cloud with a thickness of 1 km (as used by test case 0015).

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

The bias of L2B Rayleigh HLOS winds must be within the ADM requirement of 0.1 ms^{-1}. The bias of L2B Mie HLOS winds must be within the ADM requirement of 0.1 ms^{-1} in bins covering the cirrus layer and PBL.

Comments

The non-constant molecular and aerosol backscatter (and extinction) profile potentially results in height assignment errors of retrieved Rayleigh HLOS winds. However, for a constant wind profile (no vertical wind-shear) no wind biases should occur.

7.4 Test case #0015: Dense cloud

Purpose

Test the capacity of the L2B processor to correct the biasing effect of aerosol return on Rayleigh winds for bins that are partly covered by a thin cloud layer, based on the scattering ratio estimated by the L1B processor. A noise-free instrument is assumed.

Test Data Set

TEST_TN3_1_0015, Composed of 1 BRC's.

Atmospheric Conditions

Variable temperature profile, zero wind profile, background aerosols (backscatter and extinction). An optically dense cloud layer of 1 km thickness is located between 8625 and 9625 m, see Figure 9. The backscatter has a constant value of 7.115×10^{-5} m^{-1}sr^{-1}and the aerosol extinction in the cloud equals 1.006×10^{-3} m^{-1}. This results in a two-way transmission of 0.134.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

The bias of L2B Rayleigh HLOS winds must be within the ADM requirement of 0.1 ms^{-1}. The bias of L2B Mie HLOS winds must be within the ADM requirement of 0.1 ms^{-1} in bins covering the cirrus layer and PBL.

Comments

The non-constant molecular and aerosol backscatter (and extinction) profile potentially results in height assignment errors of retrieved Rayleigh HLOS winds. However, for a constant wind profile (no vertical wind-shear) no wind biases should occur.

8 L2B noisy academic cases

8.1 Introduction

The following test cases are copies of the test cases #005-#012 above, with the only difference that photon counting noise is added. The focus of the pass/fail criteria will be on the standard deviation of the errors of the retrieved HLOS wind.

8.2 Test case #0016: Molecules Only and Photon Noise

Purpose

Test the capability of the L2B processor to meet the ADM requirements for Rayleigh winds, for an idealistic (molecules-only) atmosphere taking into account instrument noise. This case is almost identical to test case #0005, but including photon noise.

Test Data Set

TEST_TN3_1_0016, composed of 3 BRCs.

Atmospheric Conditions

see test case #0005 defined in section 6.2.

E2S Scenario

No interpolation within segments, no AOCS errors, random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1).

L2B Settings

The classification algorithm assumes no clouds are present in this scenario.

Pass/Fail Criteria

The standard deviation of the L2B Rayleigh HLOS wind error must be within the ADM requirement of 3 ms^{-1} throughout the atmosphere.

Comments

No Mie winds are found because the atmosphere is free of aerosols.

8.3 Test case #0017: Molecules, Aerosol and Photon Noise

Purpose

Test the capacity of the L2B processor to correct the biasing effect of aerosol return on Rayleigh winds (see section 14 in [RD1]), based on the scattering ratio estimated by the L1B processor and taking into account instrument noise. This case is almost identical to test case #0006, but including photon noise.

Test Data Set

TEST_TN3_1_0017, composed of 3 BRCs.

Atmospheric Conditions

See test case #0006 defined in section 6.3.

E2S Scenario

No interpolation within segments, no AOCS errors, random fluctuations in photocounts, perfect matching between Mie and Rayleigh height-bins.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

The standard deviation of the L2B Rayleigh HLOS wind error must be within the ADM requirement of 3 ms^{-1} throughout the atmosphere. The standard deviation of L2B Mie HLOS wind error must be within the ADM requirement of 2 ms^{-1} in the PBL (lowest 2 kilometer near the surface).

8.4 Test case #0018: Optically thin cloud and photon noise

Purpose

Test the capacity of the L2B processor to correct the biasing effect of aerosol return on Rayleigh winds (see section 14 in [RD1]) for bins covering an optically thin cloud layer, based on the scattering ratio estimated by the L1B processor and taking into account instrument noise. This case is almost identical to test case #0007, but including photon noise.

Test Data Set

TEST_TN3_1_0018, composed of 3 BRCs.

Atmospheric Conditions

See test case #0007 defined in section 6.4.

E2S Scenario

No interpolation within segments, no AOCS errors, random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

The standard deviation of the L2B Rayleigh HLOS wind error must be within the ADM requirement of 3 ms^{-1} above the cirrus cloud and more relaxed (3.4 ms^{-1}) inside and below the cloud, because of signal loss through cloud extinction. The standard deviation of L2B Mie HLOS wind error must be better than the ADM requirement of 2 ms^{-1} for bins covering the cloud and slightly relaxed (2.1 ms^{-1}) in the PBL (lowest 2 kilometer near the surface).

8.5 Test case #0019: Dense Clouds and Photon Noise

Purpose

Test the capacity of the L2B processor to correct the biasing effect of aerosol return on Rayleigh winds (see section 14 in [RD1]), for bins covering an optically more dense and opaque cloud layer, based on the scattering ratio estimated by the L1B processor and taking into account instrument noise. This case is almost identical to test case #0008, but including photon noise.

Test Data Set

TEST_TN3_1_0019, Composed of 3 BRCs.

Atmospheric Conditions

See test case #0008 defined in section 6.5.

E2S Scenario

No interpolation within segments, no AOCS errors, random fluctuations in photocounts, perfect matching between Mie and Rayleigh height-bins.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

The standard deviation of the L2B Rayleigh HLOS wind error must be within the ADM requirement of 3 ms^{-1} above the dense cloud and more relaxed (5 ms^{-1}) below the cloud, because of signal loss through cloud extinction. The standard deviation of L2B Mie HLOS wind error must be better than the ADM requirement of 2 $ms^{-1}$for bins covering the clouds and below 3.5 ms^{-1}in the PBL (lowest 2 kilometer near the surface). No Rayleigh and Mie HLOS winds are measured below the stratus cloud.

8.6 Test case #0020: Molecules Only, Variable Wind and Photon Noise

Purpose

Test the capability of the L2B processor to retrieve HLOS winds within the ADM requirements for an idealistic (molecules-only) atmosphere. This case is almost identical to test case #0009, but including photon noise.

Test Data Set

TEST_TN3_1_0020, composed of 1 BRC.

Atmospheric Conditions

See test case #0009 defined in section 6.6.

E2S Scenario

No interpolation within segments, no AOCS errors, random fluctuations in photocounts, perfect matching between Mie and Rayleigh height-bins.

L2B Settings

The classification algorithm assumes no clouds are present in this scenario.

Pass/Fail Criteria

The standard deviation of the L2B Rayleigh HLOS wind error must be within the ADM requirement of 3 ms^{-1} throughout the atmosphere.

Comments

No Mie winds are found because the atmosphere is free of aerosols.

8.7 Test case #0021: Molecules, Aerosols, Variable Wind and Photon Noise

Purpose

Test the capacity of the L2B processor to correct the biasing effect of aerosol return on Rayleigh winds (see section 14 in [RD1]), based on the scattering ratio estimated by the L1B processor. This case is almost identical to test case #0010, but including photon noise.

Test Data Set

TEST_TN3_1_0021, composed of 1 BRC.

Atmospheric Conditions

See test case #0010 defined in section 6.7.

E2S Scenario

No interpolation within segments, no AOCS errors, random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

The standard deviation of the L2B Rayleigh HLOS wind error must be within the ADM requirement of 3 ms^{-1} throughout the atmosphere. The standard deviation of L2B Mie HLOS wind error must be within the ADM requirement of 2 ms^{-1} in the PBL (lowest 2 kilometer near the surface).

Comments

The non-constant aerosol backscatter (and extinction) profile in combination with a non-constant wind profile results in height assignment errors of retrieved Mie and Rayleigh HLOS winds. However, HLOS wind errors should be small for small vertical wind-shears and a smooth background aerosol profile.

8.8 Test case #0022: Optically Thin Cloud, Variable Wind, and Photon Noise

Purpose

Test the capacity of the L2B processor to correct the biasing effect of aerosol return on Rayleigh winds (see section 14 in [RD1]), based on the scattering ratio estimated by the L1B processor. This case is almost identical to test case #0011, but including photon noise.

Test Data Set

TEST_TN3_1_0022, composed of 1 BRC.

Atmospheric Conditions

See test case #0011 defined in section 6.8.

E2S Scenario

No interpolation within segments, no AOCS errors, random fluctuations in photocounts, perfect matching between Mie and Rayleigh height-bins.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

The standard deviation of the L2B Rayleigh HLOS wind error must be within the ADM requirement of 3 ms^{-1} above the cirrus cloud and more relaxed (3.4 ms^{-1}) inside and below the cloud, because of signal loss through cloud extinction. The standard deviation of L2B Mie HLOS wind error in The PBL is slightly relaxed (2.1 ms^{-1}) as compared to the 2 ms^{-1} ADM requirement. The bias in the Mie and Rayleigh HLOS winds in the cirrus layer should be identified by QC, i.e. by identifying a large atmospheric heterogeneity (both optical and dynamical) inside and at the boundaries of the cirrus layer or by comparing Mie and Rayleigh winds.

Comments

For an optically thin cloud layer (small extinction), the signal loss in the Raleigh channel will generally be small and thus only marginally affecting the bias of the Rayleigh HLOS wind. The bias of L2B Mie HLOS wind within the cloud layer may be substantial but depending on the location of the cloud inside the ADM bins and the vertical wind-shear over the bins covering the cloud layer.

8.9 Test case #0023: Dense Clouds, Variable Wind, and Photon Noise

Purpose

Test the capacity of the L2B processor to correct the biasing effect of aerosol return on Rayleigh winds (see section 14 in [RD1]), based on the scattering ratio estimated by the L1B processor. This case is almost identical to test case #0012, but including photon noise.

Test Data Set

TEST_TN3_1_0023, composed of 1 BRC.

Atmospheric Conditions

See test case #0012 defined in section 6.9.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts, perfect matching between Mie and Rayleigh height-bins.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

The standard deviation of the L2B Rayleigh HLOS wind error must be within the ADM requirement of 3 ms^{-1} above the dense cloud and more relaxed (5 ms^{-1}) below the cloud, because of signal loss through cloud extinction. The standard deviation of L2B Mie HLOS wind error must be below 3.5 ms^{-1} in the PBL (lowest 2 kilometer near the surface). The bias in the Mie and Rayleigh HLOS winds in the cirrus layer should be identified by QC, i.e. by identifying a large atmospheric heterogeneity (both optical and dynamical) inside and at the boundaries of the cirrus layer or by comparing Mie and Rayleigh winds. No Rayleigh and Mie HLOS winds are measured below the stratus cloud.

Comments

For an optically thick cloud layer (large extinction), the signal loss in the Raleigh channel will be substantial and thus giving a bias of the Rayleigh HLOS wind. The bias of L2B Mie HLOS wind within the cloud layer will most probably be substantial ms^{-1}but depending on the location of the cloud inside the ADM bins and the vertical wind-shear over the bins covering the cloud layer.

9 L2A and L2B noisy academic cases

9.1 Introduction

The following test cases are copies of the test cases #005-#015 above, with the only difference that photon counting noise is added. The focus of the pass/fail criteria will be on the standard deviation of the errors of the retrieved HLOS wind. In addition a test case with 3 cloud layers as used for the Tellus paper has been added as number #0027.

9.2 Test case #0024: 1km Cloud Scan, and Photon Noise

Purpose

Test the capacity of the L2B processor to correct the biasing effect of aerosol return on Rayleigh winds, for bins covering a cloud layer, based on the scattering ratio estimated by the L1B processor and taking into account instrument noise. This case is almost identical to test case #0013, but including photon noise.

Test Data Set

TEST_TN3_1_0024, composed of 8 BRCs., see section 3.13

Atmospheric Conditions

See test case #0013 defined in section 7.2.

E2S Scenario

No interpolation within segments, no AOCS errors, random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

The standard deviation of the L2B Rayleigh HLOS wind error must be within the ADM requirement of 3 ms^{-1} above the cloud layer and more relaxed (3.5 ms^{-1}) below the cloud, because of signal loss through cloud extinction. The standard deviation of L2B Mie HLOS wind error must be better than the ADM requirement of 2 ms^{-1} for bins covering the clouds and below 2.5 ms^{-1} in the PBL (lowest 2 kilometer near the surface).

Comments

No wind biases are expected because the vertical wind-shear is zero for the complete profile.

9.3 Test case #0025: 500m Cloud Scan, and Photon Noise

Purpose

Test the capacity of the L2B processor to correct the biasing effect of aerosol return on Rayleigh winds, for bins partly covering a cloud layer, based on the scattering ratio estimated by the L1B processor and taking into account instrument noise. This case is identical to test case #0014, but with instrument noise added.

Test Data Set

TEST_TN3_1_0025, composed of 4 BRCs., see section 3.14

Atmospheric Conditions:

See test case #0014 defined in section 7.3.

E2S Scenario

No interpolation within segments, no AOCS errors, random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

The standard deviation of the L2B Rayleigh HLOS wind error must be within the ADM requirement of 3 ms^{-1} above the cloud layer and more relaxed (3.5 ms^{-1}) below the cloud, because of signal loss through cloud extinction. The standard deviation of L2B Mie HLOS wind error must be better than the ADM requirement of 2 ms^{-1} for bins covering the clouds and below 2.5 ms^{-1} in the PBL (lowest 2 kilometer near the surface).

Comments

No wind biases are expected because the vertical wind-shear is zero for the complete profile.

9.4 Test case #0026: Mix of 500m and 1km Clouds, and Photon Noise

Purpose

Test the capacity of the L2B processor to correct the biasing effect of aerosol return on Rayleigh winds, for bins partly covering a cloud layer, based on the scattering ratio estimated by the L1B processor and taking into account instrument noise. This case is identical to test case #0015, but with instrument noise added.

Test Data Set

TEST_TN3_1_0026, composed of 1 BRCs , see section 3.15

Atmospheric Conditions

See test case #0015 defined in section 7.4.

E2S Scenario

No interpolation within segments, no AOCS errors, random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

The standard deviation of the L2B Rayleigh HLOS wind error must be within the ADM requirement of 3 ms^{-1} above the cloud layer and more relaxed (5 ms^{-1}) below the cloud, because of signal loss through cloud extinction. The standard deviation of L2B Mie HLOS wind error must be better than the ADM requirement of 2 ms^{-1} for bins covering the clouds and below 3 ms^{-1} in the PBL (lowest 2 kilometer near the surface).

Comments

No wind biases are expected because the vertical wind-shear is zero for the complete profile.

9.5 Test case #0027: 3 cloud layer 4 BRC case

Purpose

The purpose of this test is to verify the ability of the processor to:

- read an L1b file containing four BRCs generated by the L1b processor
- read the Rayleigh- Brillouin look- up table file
- perform a scene classification based on L1b scattering ratio
- process Rayleigh measurements and apply the Rayleigh- Brillouin correction
- process Mie measurements by applying the Mie Core algorithm
- derive estimates of errors arising from measurement error for both retrieval types.

Test Data Set

TEST_Pauls_4BRC_case, composed of 4 BRCs. (Todo: rename to TEST_TN3_1_0027)

Atmospheric Conditions

Horizontally homogeneous case, temperature, pressure and aerosol properties are taken from the atmospheric scene single_RMA_profile_midlat_winter_PP_4BRC. A constant input hlos wind of 50 ms^{-1} was taken. In addition successive layers of clouds at 4 km, 9 km, and 16 km altitudes have been added.

E2S Scenario

No interpolation within segments, no AOCS errors, random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method. A threshold of 1.5 was used.

Pass/Fail Criteria

The L2B should report

- the number of BRCs must equal 4
- the number of valid Mie profiles must equal 8
- the number of clear Mie profiles must equal 4
- the number of cloud Mie profiles must equal 4
- the number of valid Rayleigh profiles must equal 8
- the number of clear Rayleigh profiles must equal 4
- the number of cloud Rayleigh profiles must equal 4

The 2D array Map_of_L1_Measurements_Used contained in the L2b Rayleigh and Mie Wind DSRs should resemble Figure 10

Comments

This is the testcase described in the L2B Tellus publication.

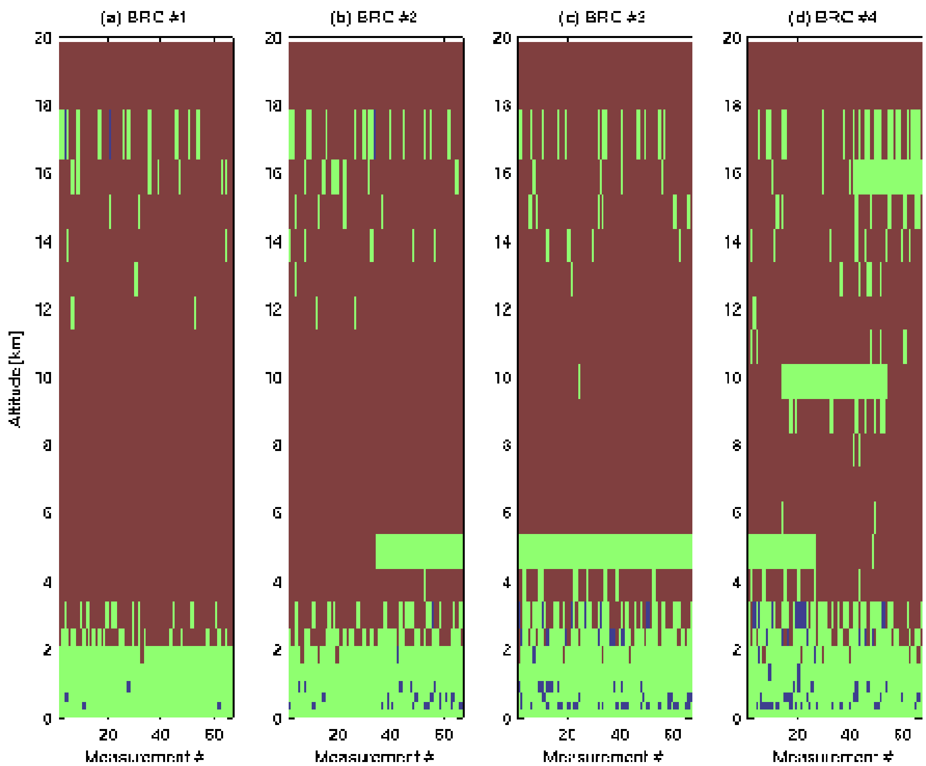

Figure 10: Expected classification result for test case #0027.

10 Polar Stratospheric Clouds (PSC) test cases

10.1 Introduction

The following test cases are a few tests with polar stratospheric clouds. These are intended to verify that these clouds can be detected and that cross-talk correction can be performed on the Rayleigh channel without Mie information. The first test is noise free, the second test adds photon counting noise.

10.2 Test case #0028. Polar Stratospheric Clouds (PSCs), ECMWF wind, without noise

Purpose

Test the ability to detect a Polar Stratospheric Cloud (PSC) in the Rayleigh channel, estimate the cross-talk caused by it, and verify that if needed this can be corrected for,

Test Data Set

TEST_TN3_1_0028, Composed of 1 BRC.

Atmospheric Conditions

CALIPSO data is used to define the optical properties, wind components are taken from the ECMWF operational model, and are collocated to the CALIPSO data.

E2S Scenario

No interpolation within segments, no AOCS errors, random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1_1km).

L2B Settings

The classification algorithm uses the the backscatter ratio threshold method.

Pass / Fail Criteria

No significant bias should occur at the location of the PSCs.

Comments

t.b.d.

10.3 Test case #0029. Polar Stratospheric Clouds (PSCs), ECMWF wind, including photocounts noise

Purpose

Test the ability to detect a Polar Stratospheric Cloud (PSC) in the Rayleigh channel, estimate the cross-talk caused by it, and verify that if needed this can be corrected for,

Test Data Set

TEST_TN3_1_0029, Composed of 1 BRC.

Atmospheric Conditions

CALIPSO data is used to define the optical properties, wind components are taken from the ECMWF operational model, and are collocated to the CALIPSO data.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts, perfect matching between Mie and Rayleigh height-bins (WVM1_1km).

L2B Settings

The classification algorithm uses the the backscatter ratio threshold method.

Pass / Fail Criteria

No significant bias should occur at the location of the PSCs.

Comments

t.b.d.

11 Sanity test cases

11.1 Introduction

The following test cases #0050 upto #0056 describe a number of functional tests on uncommon situations. The first 2 tests probe the far edges of the wind speed range that can be resolved by the L2B processor. It tests how the L2BP reacts to input winds that are slightly and well out of range, and that out of range winds are flagged correctly. The next 2 cases have a variation in N,P parameters and range bin definition within a scenario. The following 2 tests use specific N,P combinations that have been used by the L2BP unit testing. The final test is intended to verify that the software components can handle the situation where multiple Rayleigh range bins overlap with a single Mie range bin.

11.2 Test case #0050: Huge input windspeed

Purpose

Test the ability of the L2B processor to detect and flag out of range input winds in the Mie channel.

Test Data Set

TEST_TN3_1_0050, Composed of 6 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter) displayed in Figure 5 (vertical resolution = 125m).

For each BRC, the wind is constant, equal to -250 ms^{-1} in BRC#1, -220 ms^{-1} in BRC#2, -200 ms^{-1} in BRC#3, 200 ms^{-1} in BRC#4, 220 ms^{-1} in BRC#5, and 250 ms^{-1} in BRC#6. The value of 200 ms^{-1} should be fully out of range for the Mie channel, 220 ms^{-1} is just on the edge of the Fizeau USR and 200 ms^{-1} should be just within range.

Background aerosols (backscatter and extinction) are as defined in the single_RMA_profile_subarctic_winter RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

For input winds outside the USR the L2B should not produce a result or flag the result as suspicious. For input winds inside the USR the bias of L2B Rayleigh HLOS winds must be within the ADM requirement of 0.1 ms^{-1}.

Comments

Whether or not the L2B can handle this kind of extreme case remains to be seen. QC has not yet been tuned to handle this specific case.

11.3 Test case #0051: Huge input windspeed scan

Purpose

Test the ability of the L2B processor to detect and flag out of range input winds in the Rayleigh channel.

Note that I do not yet know what reasonable boundaries are for testing the Rayleigh channel. The response approaches -0.5 or +0.5 very slowly when both channels are in the tail of the Rayleigh spectral peak, so sensitivity will go down. When this falls below a certain threshold the errors in windretrieval become unacceptable. The value of this threshold is not yet known, but my be discovered by doing this test. (a first result indicates the result seems reasonable upto 250 ms^{-1}).

Test Data Set

TEST_TN3_1_0051, Composed of 6 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winte displayed in Figure 5 (vertical resolution = 125m).

For each BRC, the wind is constant, equal to -400 ms^{-1} in BRC#1, -350 ms^{-1} in BRC#2, -300 ms^{-1} in BRC#3, -250 ms^{-1} in BRC#4, -200 ms^{-1} in BRC#5, -150 ms^{-1} in BRC#6, -100 ms^{-1} in BRC#7, -50 ms^{-1} in BRC#8, 0 ms^{-1} in BRC#9, 50 ms^{-1} in BRC#10, 100 ms^{-1} in BRC#11, 150 ms^{-1} in BRC#12, 200 ms^{-1} in BRC#13, 250 ms^{-1} in BRC#14, 300 ms^{-1} in BRC#15, 350 ms^{-1} in BRC#16 and 400 ms^{-1} in BRC#17.

The results should indicate when the sensitivity of the response of the Fabri Perot channels drop below a usefull value.

Background aerosols (backscatter and extinction) are as defined in the single_RMA_profile_subarctic_winter RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

For input winds outside the valid range of winds the L2B should not produce a result or flag the result as suspicious. However, I do not yet know what this range is for the Rayleigh channel. For input winds inside the USR the bias of L2B Rayleigh HLOS winds must be within the ADM requirement of 0.1 ms^{-1}.

Comments

Whether or not the L2B can handle this kind of extreme case remains to be seen. QC has not yet been tuned to handle this specific case.

11.4 Test case #0052: variation in N and P

Purpose

Test the ability of the L2B processor to handle different values of the number of measurements N per BRC and the number of pulses per measurement P. The processing and datastructures should be flexible enough to cope with this. In addition the first and third BRC do not use warmup pulses, the second and fourth BRC do use them. No significant wind quality difference should be visible between the 2 cases without warmup pulses. Also no significant wind quality difference should be visible between the 2 cases that use warmup pulses, since thay have an (almost) identical total number of laser pulses, so an (almost) identical number of photons probing the atmosphere.

Test Data Set

TEST_TN3_1_0052, Composed of 4 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter) displayed in Figure 5 (vertical resolution = 125m). A constant zero wind is used. Background aerosols (backscatter and extinction) are as defined in the single_RMA_profile_subarctic_winter RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1_1km).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

All processing stages should run without crashing, and since this is a simple noiseless case biases in HLOS winds must be within the ADM requirement of 0.1 ms^{-1}. For BRC 1 and 3 no quality difference should be visible, they should have comparable standard deviations in their HLOS wind error. Also for BRC 2 and 4 no quality difference should be visible, they should have comparable standard deviations in their HLOS wind error. BRC 2 and 4 have more accumulated power, so it is expected they will have lower standard deviations in their HLOS wind error than will be present in BRC 1 and 3. The plotting tools should be able to handle the change in BRC settings and still produce sensible figures.

Comments

t.b.d.

11.5 Test case #0053: variation in range bin definition

Purpose

Test the ability of the L2B processor to handle different different range bin definitions within a single scenario. This is mainly a functional test for all processing stages including the matlab plotting tools. However, since this is an academic noiseless case, the wind error standard deviation and bias should be very small.

Test Data Set

TEST_TN3_1_0053, Composed of 4 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter) displayed in Figure 5 (vertical resolution = 125m). A constant zero wind is used. Background aerosols (backscatter and extinction) are as defined in the single_RMA_profile_subarctic_winter RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts. The rangebin definition is switched 4 times:

- BRC#1 uses WVM1_ET_ZWC1_1km.
- BRC#2 uses WVM1_TR_NOZWC1_1km.
- BRC#3 uses WVM1_TR_ZWC2_1km.
- BRC#4 uses WVM1_ET_NOZWC2_1km.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

All processing stages should run without crashing, and since this is a simple noiseless case biases in HLOS winds must be within the ADM requirement of 0.1 ms^{-1}. The plotting tools should be able to handle the change in rangebin settings from BRC to BRC and still produce sensible figures. Especially the 2D plots should be able to handle the different altitude definitions for the different BRC's.

Comments

t.b.d.

11.6 Test case #0054: N=67, P=15 unit test for L2BP

Purpose

This test was added in the first place to be able to create one of the unit tests for the L2BP. This test is based on an old reference L1B product from one of the older MDA L1BP versions and has been carried along ever since. Because this reference file is no longer provided with the L1BP and we still wish to use it as unit test in the L2BP this test case is used to generate it. However, since this is an academic noiseless case, the wind error standard deviation and bias should be very small.

Test Data Set

TEST_TN3_1_0054, Composed of 2 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter) displayed in Figure 5 (vertical resolution = 125m). A constant zero wind is used. Background aerosols (backscatter and extinction) are as defined in the single_RMA_profile_subarctic_winter RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1_1km).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

All processing stages should run without crashing, and since this is a simple noiseless case biases in HLOS winds must be within the ADM requirement of 0.1 ms^{-1}.

Comments

t.b.d.

11.7 Test case #0055: N=30, P=33 unit test for L2BP

Purpose

This test was added in the first place to be able to create one of the unit tests for the L2BP. This test is based on an old reference L1B product from one of the older MDA L1BP versions and has been carried along ever since. Because this reference file is no longer provided with the L1BP and we still wish to use it as unit test in the L2BP this test case is used to generate it. However, since this is an academic noiseless case, the wind error standard deviation and bias should be very small.

Test Data Set

TEST_TN3_1_0055, Composed of 2 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter) displayed in Figure 5 (vertical resolution = 125m). A constant zero wind is used. Background aerosols (backscatter and extinction) are as defined in the single_RMA_profile_subarctic_winter RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1_1km).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

All processing stages should run without crashing, and since this is a simple noiseless case biases in HLOS winds must be within the ADM requirement of 0.1 ms^{-1}.

Comments

t.b.d.

11.8 Test case #0056: Multiple Rayleigh

Purpose

This test was added as a functional test and is intended to verify that the software components can handle the situation where multiple Rayleigh range bins overlap with a single Mie range bin. To achieve this an unrealistic cloud layer has been positioned between the altitude region of 20-22 km.

However, since this is an academic noiseless case, the wind error standard deviation and bias should be very small.

Test Data Set

TEST_TN3_1_0056, Composed of 1 BRC.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter) displayed in Figure 5 (vertical resolution = 125m). A constant zero wind is used. Background aerosols (backscatter and extinction) are as defined in the single_RMA_profile_subarctic_winter RMA profiles. In addition an optically thin cirrus layer is added, located between 20 and 22 km and with a total 2-way transmission of 0.8.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts. around 20 km a number of 2 km Mie range bins are overlapping with 2 Rayleigh 1 km bins (WVM1_multirayleigh).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

All processing stages should run without crashing, and since this is a simple noiseless case biases in HLOS winds must be within the ADM requirement of 0.1 ms^{-1}. Especially the handling of the cloud layer, and the cross-talk correction in this region should work as intended.

Comments

t.b.d.

12 Realistic cases

12.1 Introduction

The Lidar In-space Technology Experiment (LITE) instrumentation demonstrated the capabilities of a lidar in space for, amongst others, cloud, aerosol, and molecular scattering [RD8]. The lidars were operated at the wavelengths of 1.064, 0.532, and 0.355 μm, the latter corresponding to the ADM DWL wavelength. On board of the Space Shuttle it performed more than 50 hours of valid near-nadir measurements orbiting at a height of about 250 km above the earth's surface in September 1994. The Space Shuttle flew at an inclination of 57 degrees, thereby covering most of the earth's geographical regions. With LITE a vertical resolution of 15 m up to 40 km height and a FOV of 280 m were obtained. The LITE lidars were operating at 10 Hz giving measurement nodes separated by 740 m, thus providing a sampling that can be used to simulate the ADM DWL. LITE provided observations in the for ADM relevant tropical, sub-tropical, and storm-track regions, between 60°S and 60°N, including measurements in meteorologically active disturbances with extensive cloud, and in areas with high aerosol, such as due to Sahara dust or cities (http://www-lite.larc.nasa.gov/). In addition, events of cirrus and cirrus anvils were observed that are penetrated in most cases, except near centers of convective activity.

The selected scenes from the LITE database to test the validity of the L2B processor are described in [RD6]. These scenes include:

- Heterogeneous (within a single BRC) clouds covers (different types / optical properties / thickness) at different distances / heights along the LOS.
- Cirrus scenes
- Variable aerosol extinction within a BRC basic repeat cycle (BRC).
- Horizontal gradients in atmospheric state parameters (pressure, temperature, wind, . . .).

These scenes will be simulated using the Lite data available in the atmospheric database. This data is converted to input files for the E2S. Then AISP data will be simulated and processed with the MDA E2S, the MDA L1B and the L2B processors. Pass/fail criteria for the L2B processor performance are defined for each test case.

The Tests #0101 - #0103 as defined in sections 12.2, 12.3, and 12.4 are based on the same atmospheric optical LITE scenario (a cirrus case above Indonesia). The difference is in the addition of measurement noise and a more realistic description of the atmospheric dynamics.

Tests #0104 until #0109 as defined in sections 12.5 until 12.10 describe the tests for the other atmospheric LITE scenes.

12.2 Test case #0101: The Indonesian Cirrus Scenario (part 1), constant wind, no photocounts noise

Purpose

Test the bias in the Rayleigh and Mie channel retrieved HLOS winds.

Test Data Set

TEST_TN3_1_0101, 800 km data along LITE track, 4 BRCs.

Atmospheric Conditions

The scene uses atmospheric database scenario LiteScene_A_and_RMA_3.6km and is characterized by an optically thin cirrus layer at 15 km altitude, heterogeneously distributed aerosol up to 4 km, optically thick cloud at 7 km, see Figure 11 (upper panel). A constant HLOS wind of 50 ms^{-1} is assumed. Interpolation between atmospheric profiles is switched on.

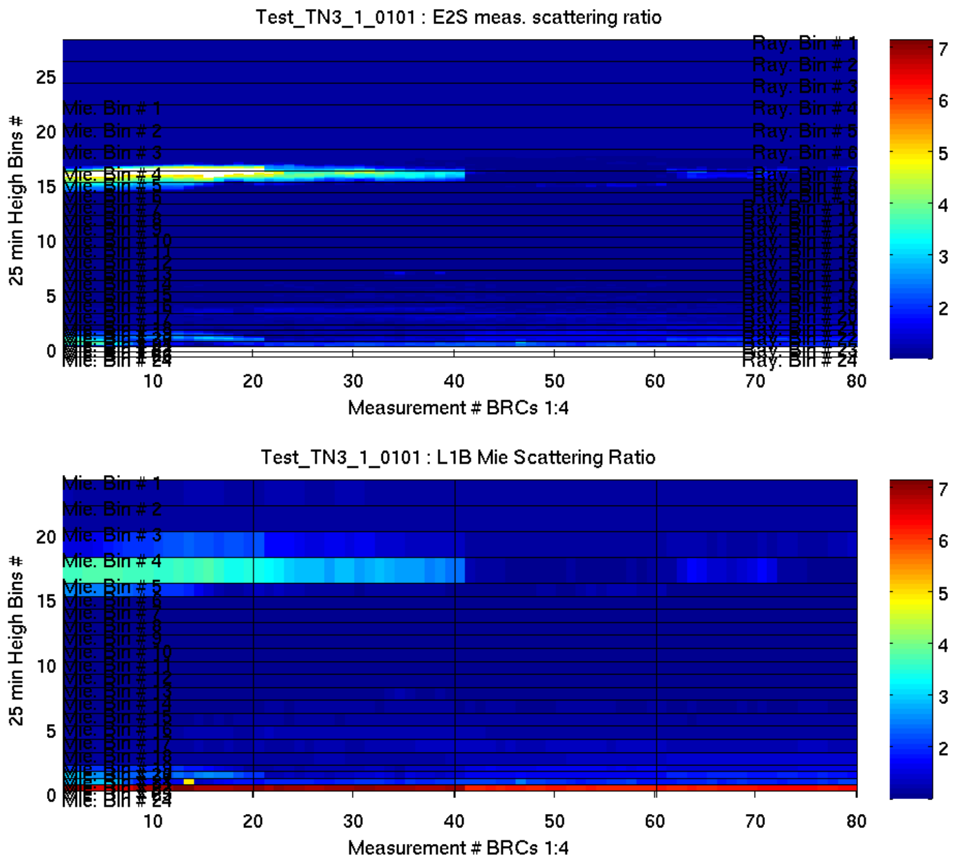

Figure 11: Scattering ratio as used for input by test #0101 (upper panel) and as retrieved by the L1B processor (lower panel).

E2S Scenario

No AOCS errors, no DEM, no randomization of photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1). constant wind profile.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass / Fail Criteria

The bias of L2B Rayleigh HLOS winds must be within the ADM requirement of 0.1 ms^{-1} inside and outside the layer affected by the presence of the cirrus (near 15km). The bias of L2B Mie HLOS winds must be within the ADM requirement of 0.1 ms^{-1} for bins covering the cloud layer and in the PBL.

Comments

The non-constant backscatter (and extinction) profile potentially results in height assignment errors of retrieved Mie (in bins containing the cloud layer) and Rayleigh HLOS winds. However, for a constant wind profile (no vertical wind-shear) no wind biases should occur.

12.3 Test case #0102: The Indonesian Cirrus Scenario (part 1), constant wind, including photocounts noise

Purpose

Test the standard deviation of errors in the Rayleigh and Mie channel retrieved HLOS winds.

Test Data Set

TEST_TN3_1_0102, 800 km data along LITE track, 4 BRCs.

Atmospheric Conditions

See test case #0101.

E2S Scenario

No AOCS errors, no DEM, randomization of photocounts, perfect matching between Mie and Rayleigh height-bins. constant wind profile.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass / Fail Criteria

The standard deviation of the L2B Rayleigh HLOS wind error must be within the ADM requirement of 3 ms^{-1} above the cirrus cloud and more relaxed (3.5 ms^{-1}) inside and below the cloud, because of signal loss through cloud extinction. The standard deviation of L2B Mie HLOS wind error is below the 2 ms^{-1} ADM requirement inside the cloud and is slightly relaxed to 2.2 ms^{-1} in the PBL.

Comments

t.b.d.

12.4 Test case #0103: The Indonesian Cirrus Scenario (part 1), ECMWF wind, including photocounts noise

Purpose

Test the standard deviation of errors in the Rayleigh and Mie channel retrieved HLOS winds.

Test Data Set

TEST_TN3_1_0103, 800 km data along LITE track, 4 BRCs.

Atmospheric Conditions

See test case #0101, but now model winds are used from collocating the LITE orbit with ECMWF model fields, see Figure 12.

E2S Scenario

No AOCS errors, no DEM, randomization of photocounts, perfect matching between Mie and Rayleigh height-bins ECMWF model winds along the LITE orbit are used to describe the dynamics.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

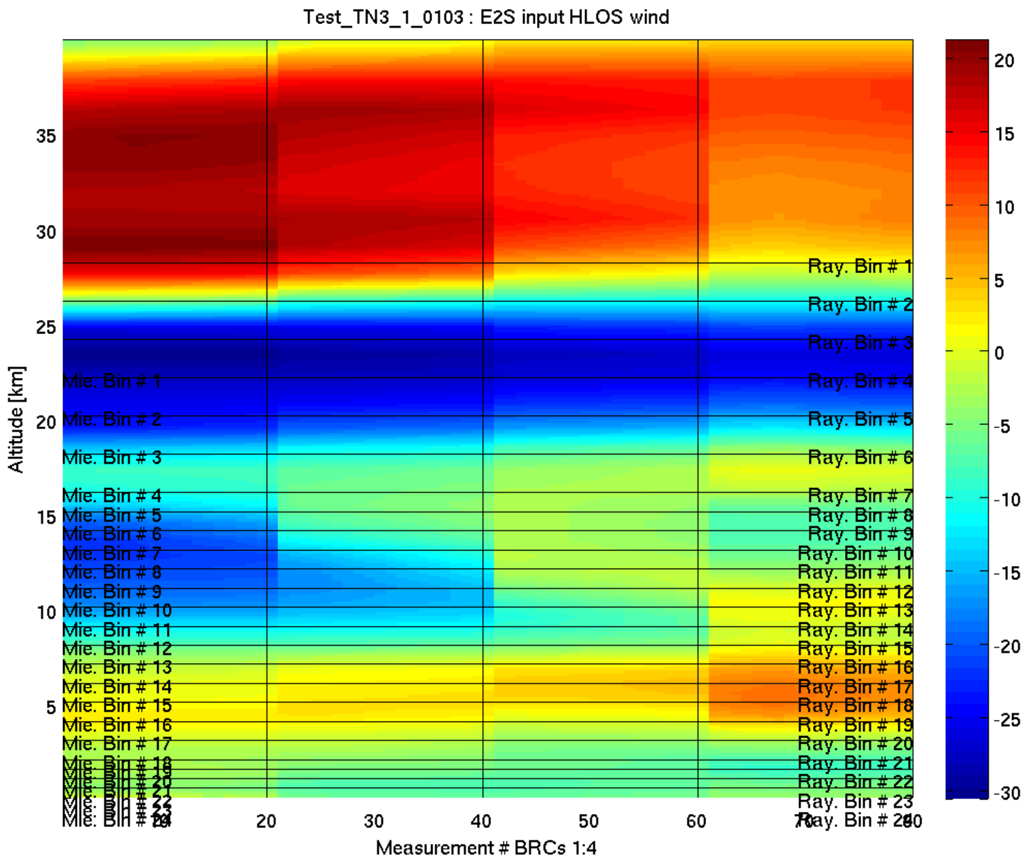

Figure 12: Input hlos wind as used by test #0103 (color scale is in ms^{-1}).

Pass / Fail Criteria

The bias and standard deviation of the errors of L2B HLOS winds from the Rayleigh channel should be within the ADM requirements above the cloud layer, i.e. a bias smaller than 0.1 ms^{-1} and standard deviation below 3 ms^{-1}. Below the cloud the standard deviation criterion is relaxed to 3.5 ms^{-1}, the bias should remain below 0.1 ms^{-1}. The bias of L2B Mie HLOS winds in the PBL is below 0.1 ms^{-1}, the standard deviation is slightly relaxed to 2.2 ms^{-1} as compared to the ADM requirement of 2 ms^{-1}. The bias in the Mie and Rayleigh HLOS winds in the cirrus layer and PBL should be identified by QC, i.e. by identifying a large atmospheric heterogeneity (both optical and dynamical) inside and at the boundaries of the cirrus layer or by comparing Mie and Rayleigh winds.

Comments

t.b.d.

12.5 Test case #0104: The Indonesian Cirrus Scenario (part 2), ECMWF wind, including photocounts noise

Purpose

Test the standard deviation of errors in the Rayleigh and Mie channel retrieved HLOS winds.

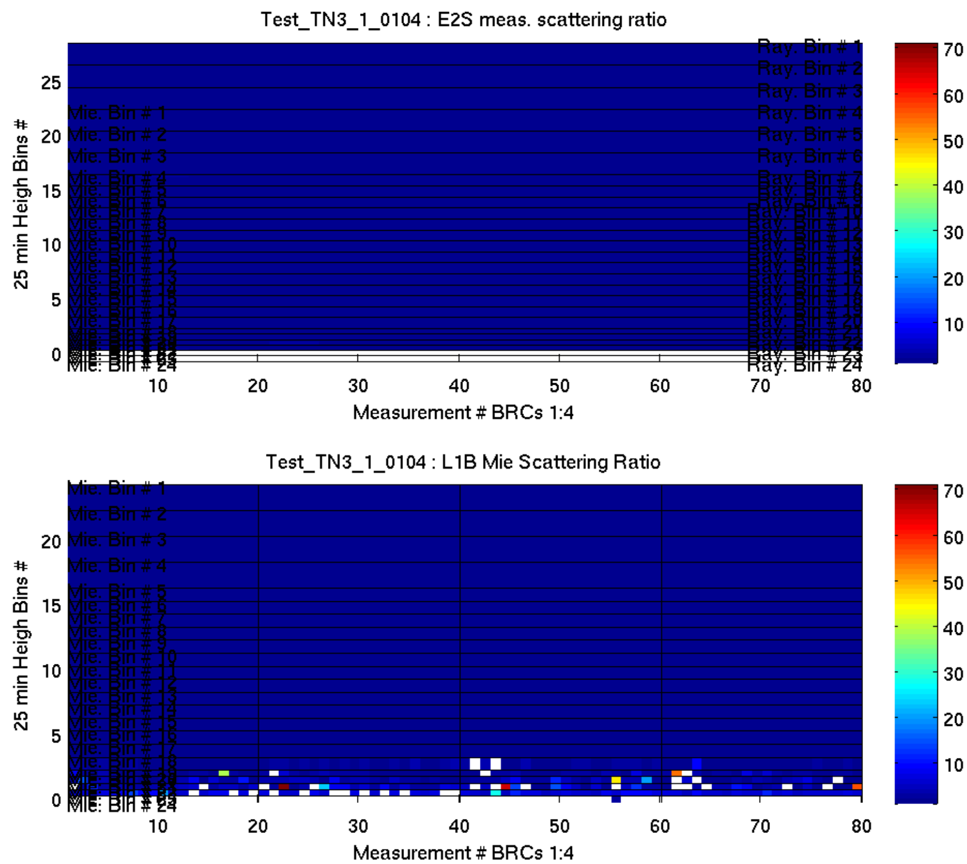

Figure 13: Scattering ratio as used for input by test #0104 (upper panel) and as retrieved by the L1B processor (lower panel).

Test Data Set

TEST_TN3_1_0104, 800 km data along LITE track, 4 BRCs.

Atmospheric Conditions

The scene uses atmospheric database scenario LiteScene_B_and_EcmwfColloc_3.6km and is characterized by an optically thin cirrus layer at 15 km altitude and elevated aerosol layers up to 3 kilometers, see Figure 13 (upper panel). ECMWF model winds along the LITE orbit are used to describe the dynamics, see Figure 14. Interpolation between atmospheric profiles is switched on.

E2S Scenario

No AOCS errors, no DEM, randomization of photocounts, perfect matching between Mie and Rayleigh height-bins, ECMWF wind profiles from collocating the LITE orbit with ECMWF model fields.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

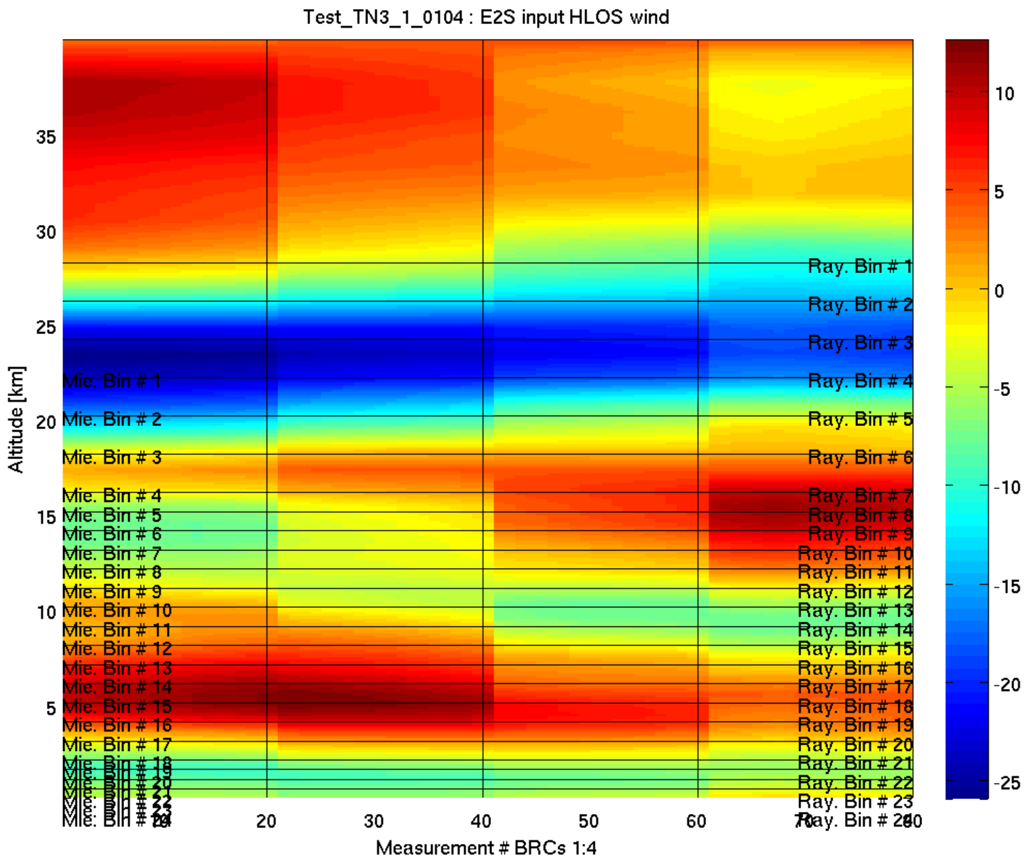

Figure 14: Input hlos wind as used by test #0104 (color scale is in ms^{-1}).

Pass / Fail Criteria

The bias and standard deviation of the errors of L2B HLOS winds from the Mie and Rayleigh channel should be within the ADM requirements outside the cloud layer, i.e. a bias smaller than 0.1 ms^{-1} for Rayleigh winds throughout the profile and for Mie winds in the PBL and a standard deviation for Rayleigh winds smaller than 3 ms^{-1} and for Mie winds in the PBL smaller than 2 ms^{-1}. The bias in the Mie and Rayleigh HLOS winds in the cirrus layer and enhanced aerosol layers should be identified by QC, i.e. by identifying a large atmospheric heterogeneity (both optical and dynamical) inside and at the boundaries of the cirrus layer or by comparing Mie and Rayleigh winds.

Comments

t.b.d.

12.6 Test case #0105: Subtropical low-level cloud, aerosol layer, ECMWF wind, including photocounts noise

Purpose

Test the standard deviation of errors in the Rayleigh and Mie channel retrieved HLOS winds.

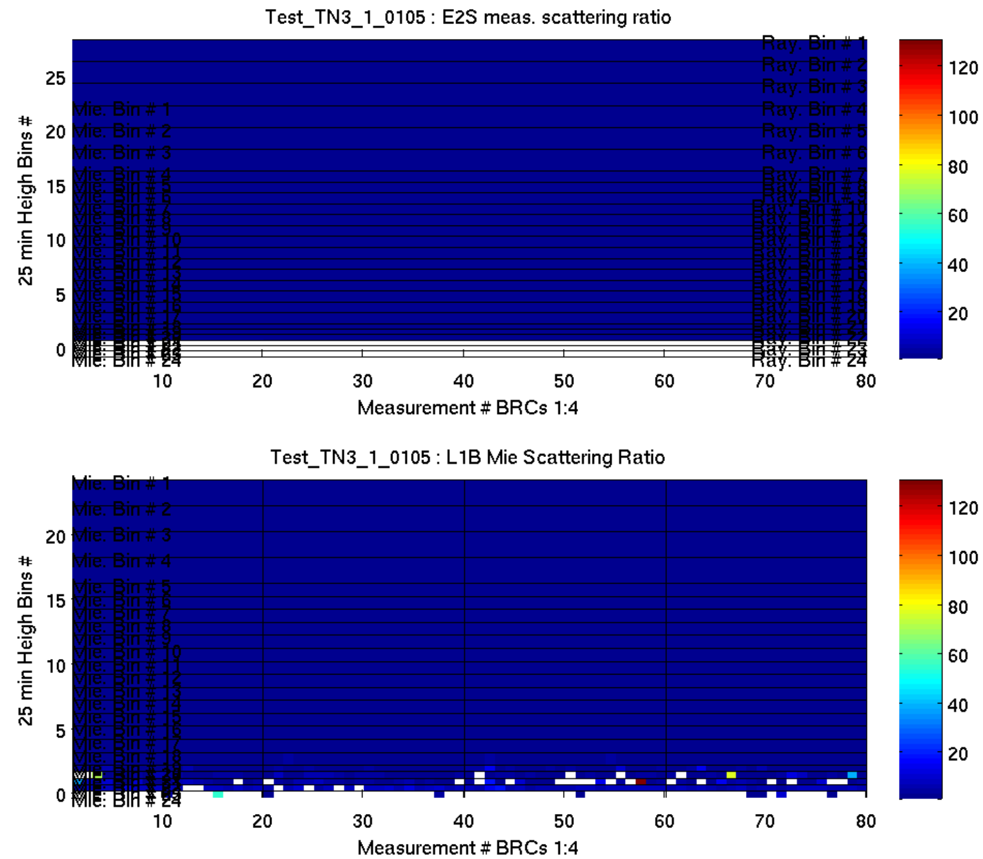

Figure 15: Scattering ratio as used for input by test #0105 (upper panel) and as retrieved by the L1B processor (lower panel).

Test Data Set

TEST_TN3_1_0105, 800 km data along LITE track, 4 BRCs.

Atmospheric Conditions

The scene uses atmospheric database scenario LiteScene_S_and_EcmwfColloc_3.6km and is characterized by aerosol and clouds in the PBL, see Figure 15. ECMWF model winds along the LITE orbit are used to describe the dynamics, see Figure 16. Interpolation between atmospheric profiles is switched on.

E2S Scenario

No AOCS errors, no DEM, randomization of photocounts, perfect matching between Mie and Rayleigh height-bins, ECMWF wind profiles from collocating the LITE orbit with ECMWF model fields.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

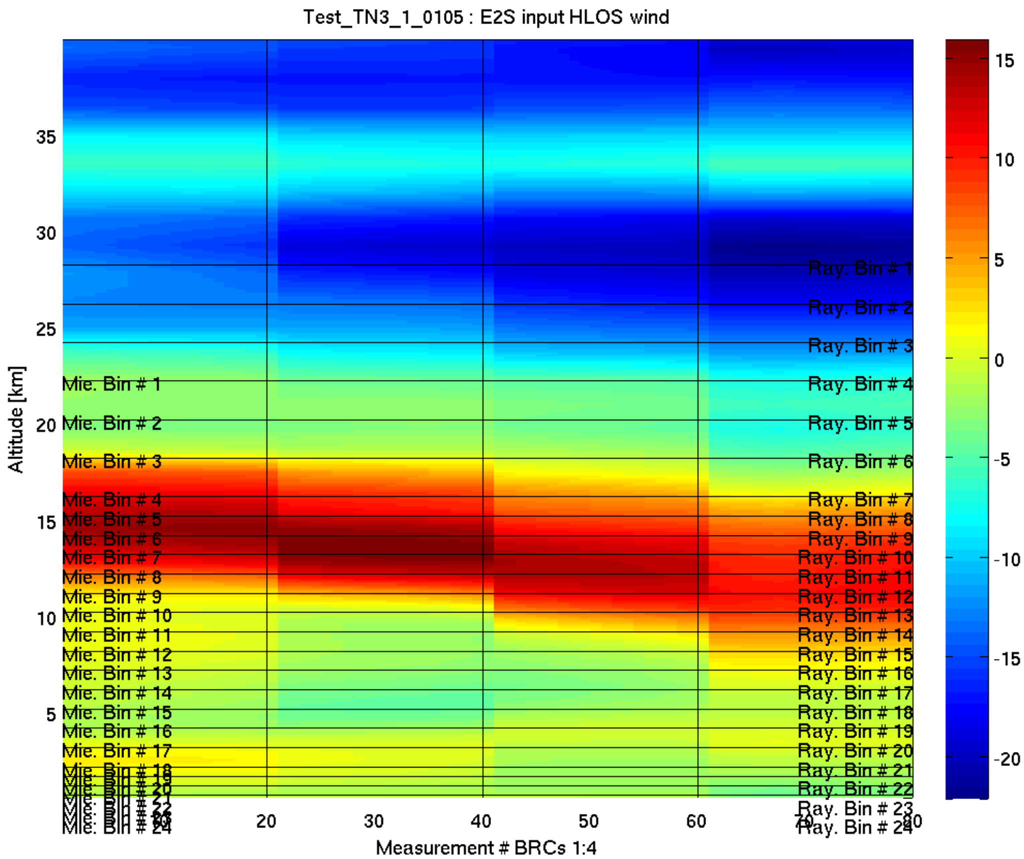

Figure 16: Input hlos wind as used by test #0105 (color scale is in ms-1).

Pass / Fail Criteria

The bias and standard deviation of the errors of L2B HLOS winds from the Mie and Rayleigh channel should be within the ADM requirements outside the cloud layer, i.e. a bias smaller than 0.1 ms-1 for Rayleigh winds throughout the profile and for Mie winds in the PBL and a standard deviation for Rayleigh winds smaller than 3 ms-1 and for Mie winds in the PBL smaller than 2 ms-1. The bias in the Mie and Rayleigh HLOS winds in the cloud and aerosol layers should be identified by QC, i.e. by identifying a large atmospheric heterogeneity (both optical and dynamical) inside and at the boundaries of the cirrus layer or by comparing Mie and Rayleigh winds.

Comments

t.b.d.

12.7 Test case #0106: Tropical cirrus, convection and precipitation, ECMWF wind, including photocounts noise

Purpose

Test the standard deviation of errors in the Rayleigh and Mie channel retrieved HLOS winds and detect and QC measurements with reduced signal due to clouds and rain.

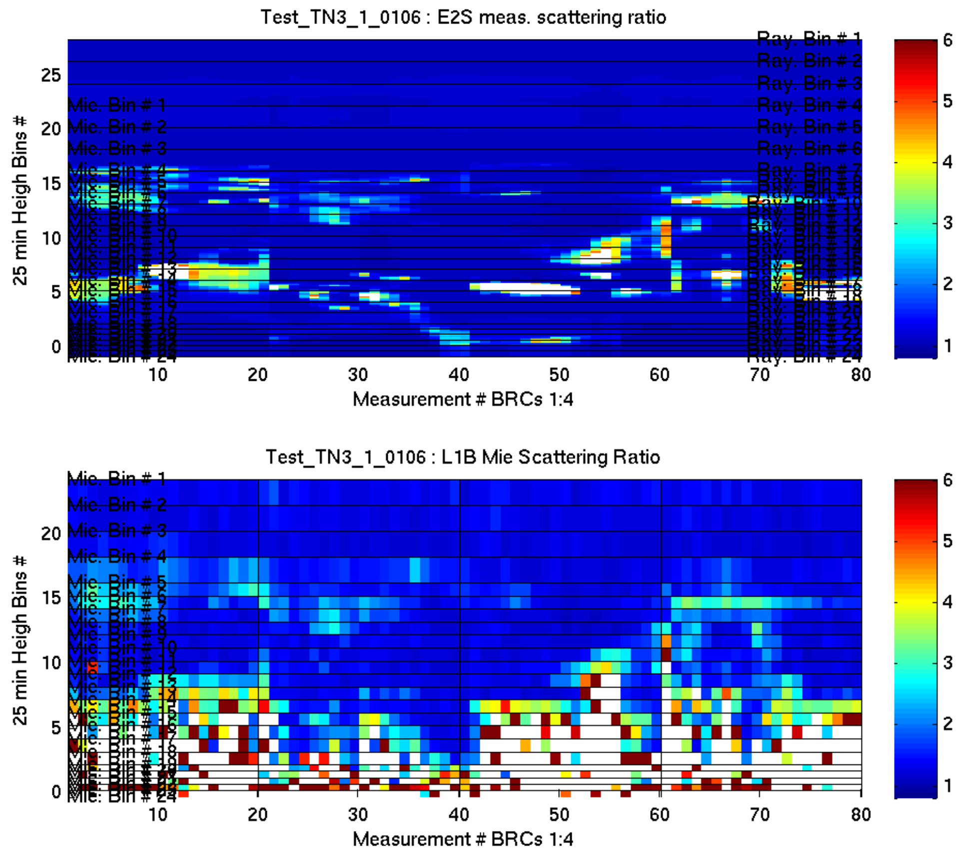

Figure 17: Scattering ratio as used for input by test #0106 (upper panel) and as retrieved by the L1B processor (lower panel).

Test Data Set

TEST_TN3_1_0106, 800 km data along LITE track, 4 BRCs.

Atmospheric Conditions

The scene uses atmospheric database scenario LiteScene_C_and_EcmwfColloc_3.6km and is characterized by a geometrically thick cirrus layer at 15 km and optically thick clouds below, see Figure 17. ECMWF model winds along the LITE orbit are used to describe the dynamics, see Figure 18. Interpolation between atmospheric profiles is switched on.

E2S Scenario

No AOCS errors, no DEM, randomization of photocounts, perfect matching between Mie and Rayleigh height-bins, ECMWF wind profiles from collocating the LITE orbit with ECMWF model fields.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

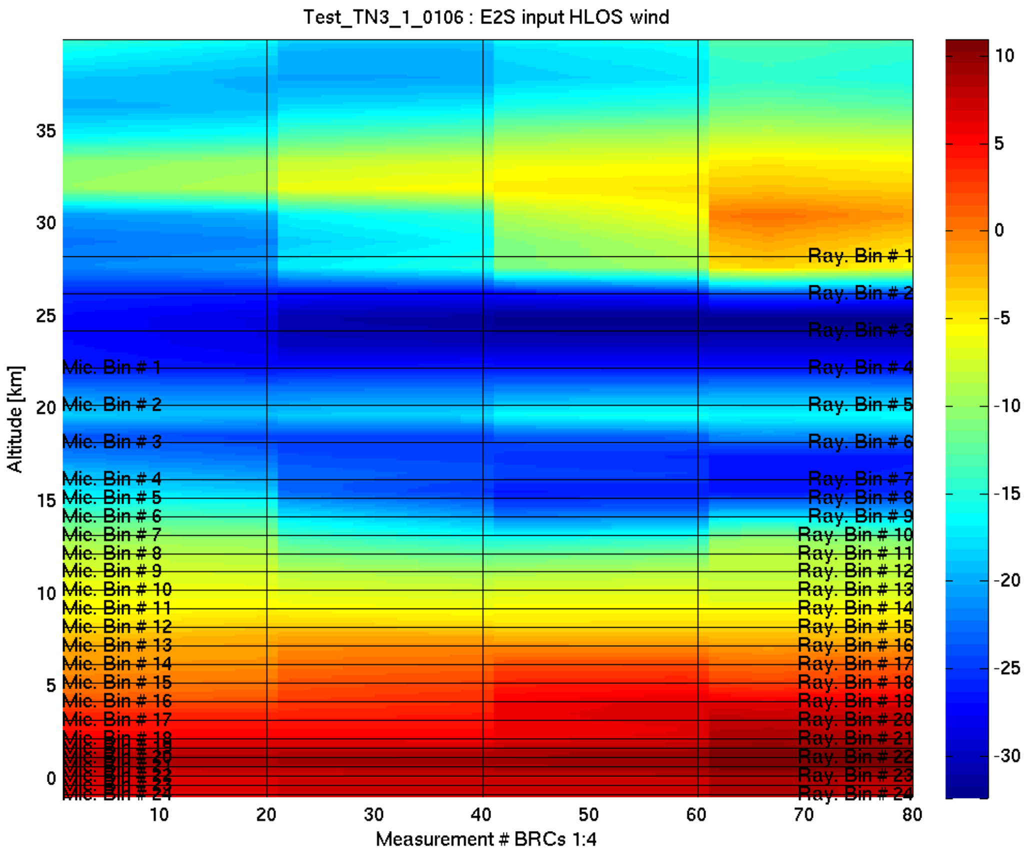

Figure 18: Input hlos wind as used by test #0106 (color scale is in ms^{-1}).

Pass / Fail Criteria

The bias and standard deviation of the errors of L2B HLOS winds from the Rayleigh channel should be within the ADM requirements above the cloud layer, i.e. a bias smaller than 0.1 ms^{-1} and a standard deviation smaller than 3 ms^{-1}. Below optically thin cirrus cloud the bias should still be below 0.1 ms^{-1}, but the standard deviation criterion is relaxed, depending on the cloud optical thickness. The bias in the Mie and Rayleigh HLOS winds inside cloud layers and the PBL should be identified by QC, i.e. by identifying a large atmospheric heterogeneity (both optical and dynamical) inside and at the boundaries of the cirrus layer or by comparing Mie and Rayleigh winds.

Comments

t.b.d.

12.8 Test case #0107: Broken clouds over the Mediterranean and Alps, ECMWF wind, including photocounts noise, ECMWF wind, including photocounts noise

Purpose

Test the standard deviation of errors in the Rayleigh and Mie channel retrieved HLOS winds and detect and QC measurements with reduced signal due to clouds.

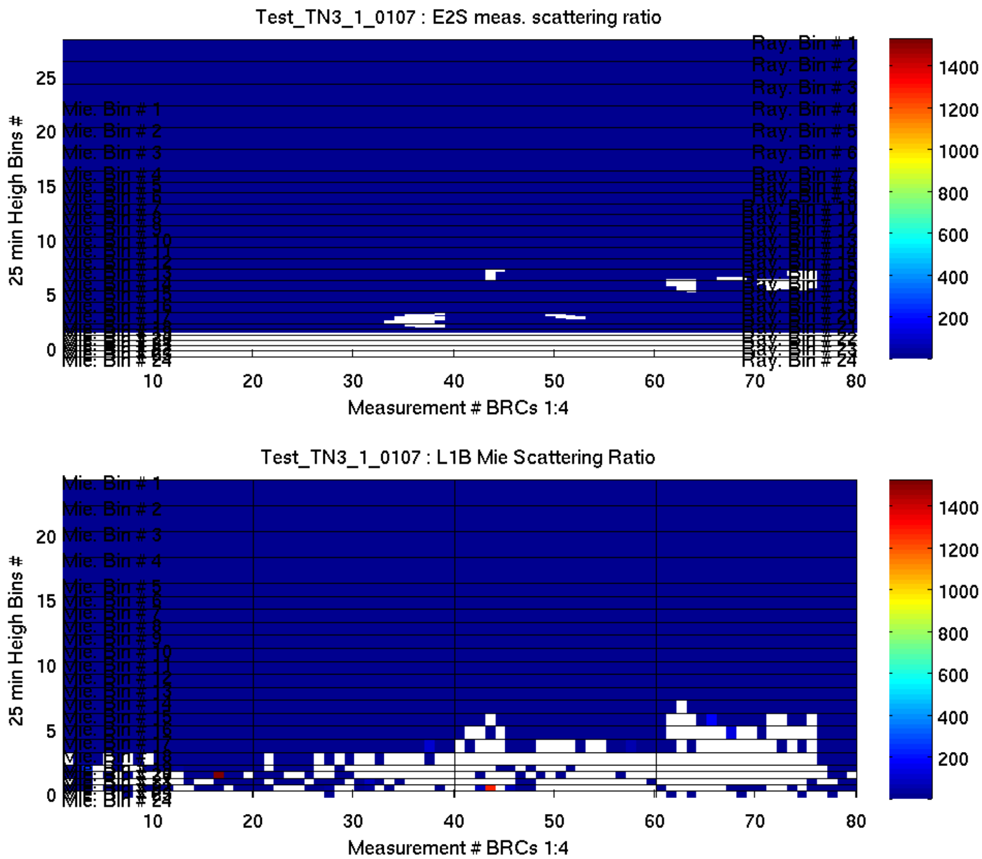

Figure 19: Scattering ratio as used for input by test #0107 (upper panel) and as retrieved by the L1B processor (lower panel).

Test Data Set

TEST_TN3_1_0107, 800 km data along LITE track, 4 BRCs.

Atmospheric Conditions

The scene uses atmospheric database scenario LiteScene_I_and_EcmwfColloc_3.6km and is characterized by broken clouds over mountainous terrain, see Figure 19. ECMWF model winds along the LITE orbit are used to describe the dynamics, see Figure 20. Interpolation between atmospheric profiles is switched on.

E2S Scenario

No AOCS errors, no DEM, randomization of photocounts, perfect matching between Mie and Rayleigh height-bins, ECMWF wind profiles from collocating the LITE orbit with ECMWF model fields.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

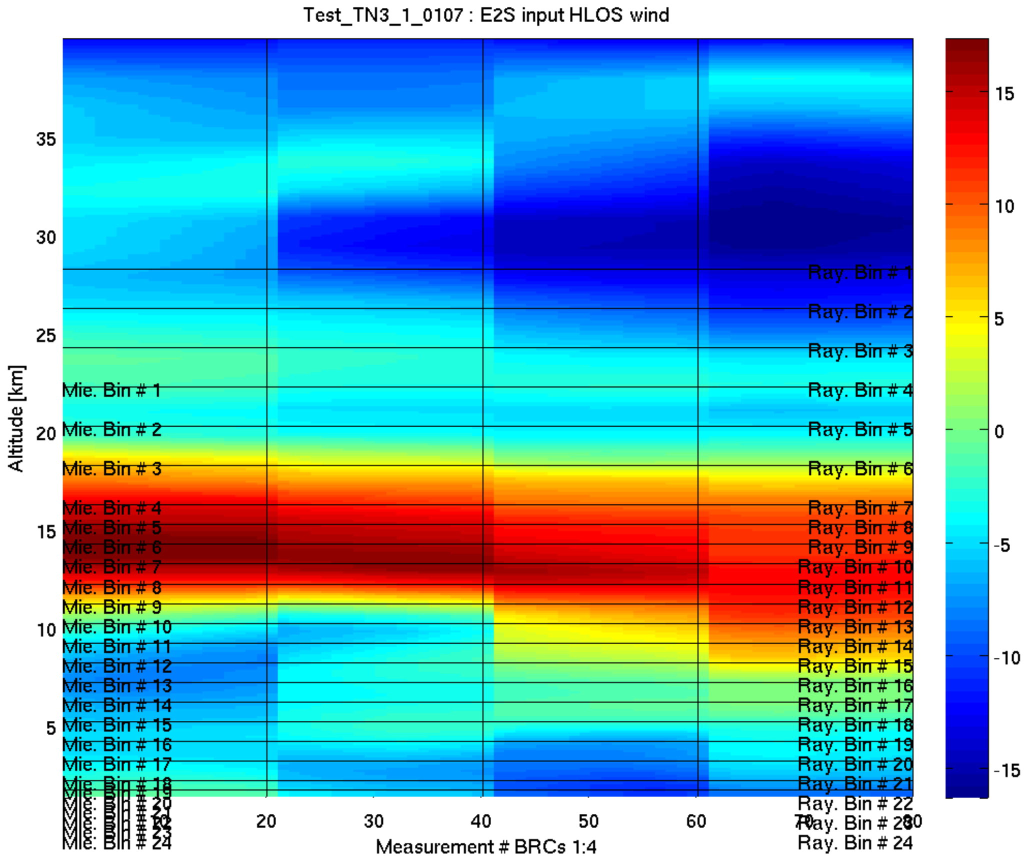

Figure 20: Input hlos wind as used by test #0107 (color scale is in ms^{-1}).

Pass / Fail Criteria

The bias and standard deviation of the errors of L2B HLOS winds from the Rayleigh channel should be within the ADM requirements above the clouds, i.e. a bias smaller than 0.1 ms^{-1} and a standard deviation smaller than 3 ms^{-1}. Below the clouds the bias should still be below 0.1 ms^{-1}, but the standard deviation criterion is relaxed, depending on the cloud optical thickness. The bias in the Mie and Rayleigh HLOS winds inside cloud layers and the PBL should be identified by QC, i.e. by identifying a large atmospheric heterogeneity (both optical and dynamical) inside and at the boundaries of the cirrus layer or by comparing Mie and Rayleigh winds.

Comments

t.b.d.

12.9 Test case #0108: Clean air, ECMWF wind, including photocounts noise

Purpose

Test the standard deviation of errors in the Rayleigh and Mie channel retrieved HLOS winds.

Test Data Set

TEST_TN3_1_0108, 800 km data along LITE track, 4 BRCs.

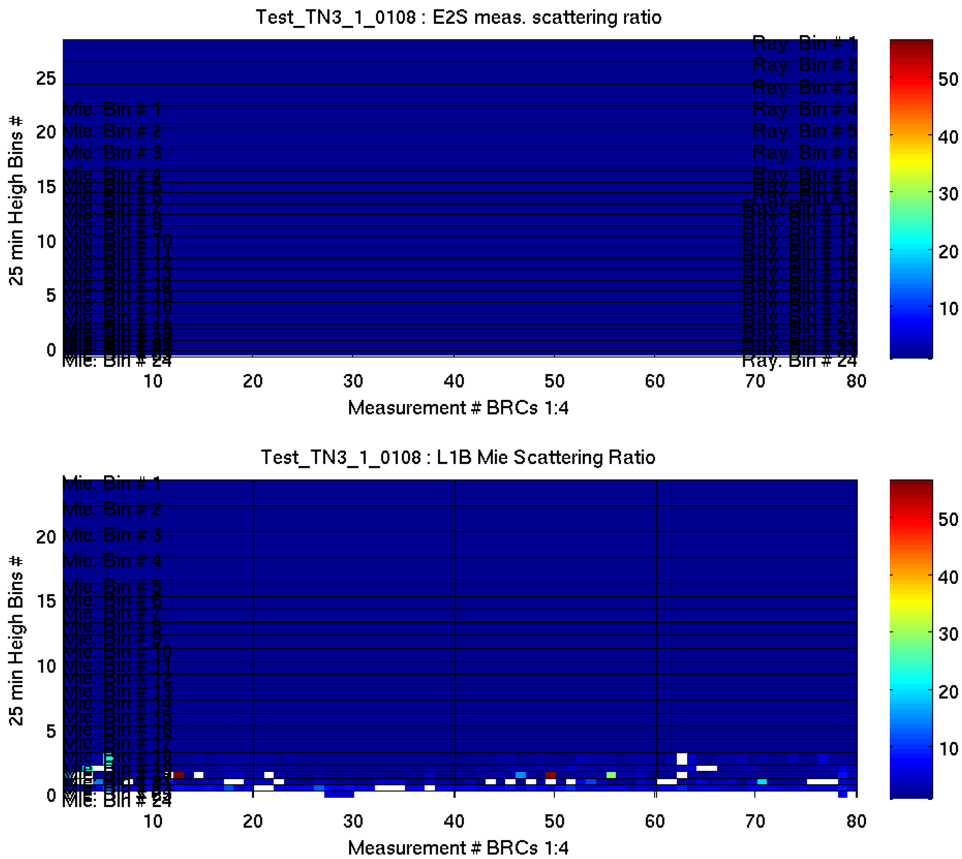

Figure 21: Scattering ratio as used for input by test #0108 (upper panel) and as retrieved by the L1B processor (lower panel).

Atmospheric Conditions

The scene uses atmospheric database scenario LiteScene_G_and_EcmwfColloc_3.6km and is characterized by a minimum aerosol loading and no clouds, see Figure 21. ECMWF model winds along the LITE orbit are used to describe the dynamics, see Figure 22. Interpolation between atmospheric profiles is switched on.

E2S Scenario

No AOCS errors, no DEM, randomization of photocounts, perfect matching between Mie and Rayleigh height-bins, ECMWF wind profiles from collocating the LITE orbit with ECMWF model fields.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass / Fail Criteria

The bias and standard deviation of the errors of L2B HLOS winds from the Rayleigh channel should be within the ADM requirements throughout the profile, i.e. a bias smaller than 0.1 ms^{-1} and a standard deviation smaller than 3 ms^{-1}. The bias in the Mie and Rayleigh HLOS winds in the PBL should be identified by QC, i.e. by identifying a large atmospheric heterogeneity (both optical and dynamical) inside and at the boundaries of the cirrus layer or by comparing Mie and Rayleigh winds.

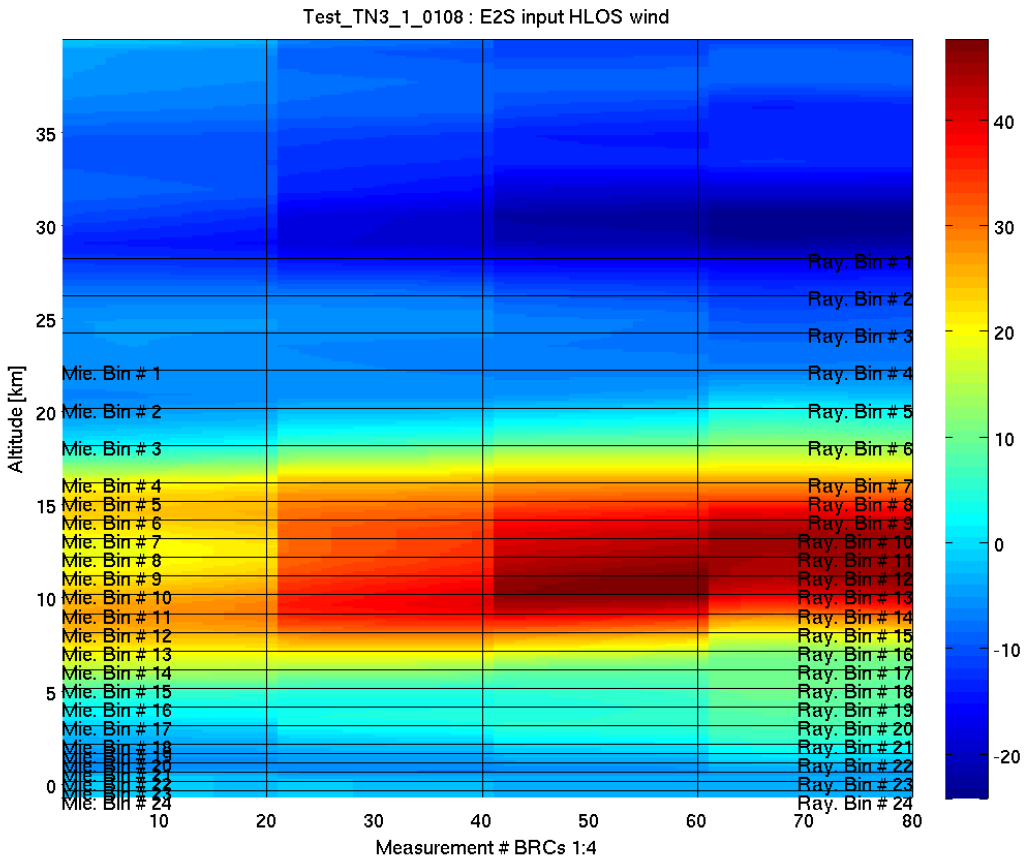

Figure 22: Input hlos wind as used by test #0108 (color scale is in ms^{-1}).

Comments

t.b.d.

12.10 Test case #0109: Sub-Tropical dust layer, ECMWF wind, including photocounts noise

Purpose

Test the standard deviation of errors in the Rayleigh and Mie channel retrieved HLOS winds.

Test Data Set

TEST_TN3_1_0109, 800 km data along LITE track, 4 BRCs.

Atmospheric Conditions

The scene uses atmospheric database scenario LiteScene_J_and_EcmwfColloc_3.6km and is characterized by a thick aerosol layer at 4 km, giving reduced signal in the PBL, see Figure 23. ECMWF model winds along the LITE orbit are used to describe the dynamics, see Figure 24. Interpolation between atmospheric profiles is switched on.

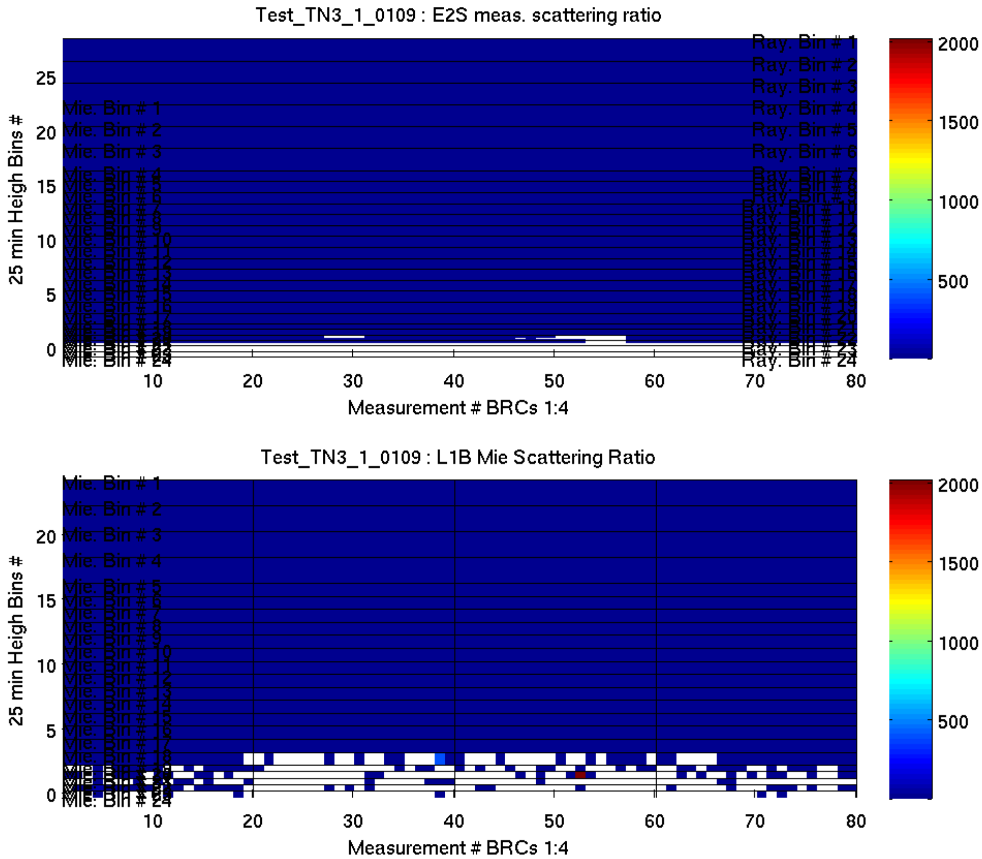

Figure 23: Scattering ratio as used for input by test #0109 (upper panel) and as retrieved by the L1B processor (lower panel).

E2S Scenario

No AOCS errors, no DEM, randomization of photocounts, perfect matching between Mie and Rayleigh height-bins, ECMWF wind profiles from collocating the LITE orbit with ECMWF model fields.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass / Fail Criteria

The bias and standard deviation of the errors of L2B HLOS winds from the Rayleigh channel should be within the ADM requirements throughout the profile, i.e. a bias smaller than 0.1 ms^{-1} and a standard deviation smaller than 3 ms^{-1}. The bias in the Mie and Rayleigh HLOS winds in the dust layer and PBL should be identified by QC, i.e. by identifying a large atmospheric heterogeneity (both optical and dynamical) inside and at the boundaries of the cirrus layer or by comparing Mie and Rayleigh winds.

Comments

t.b.d.

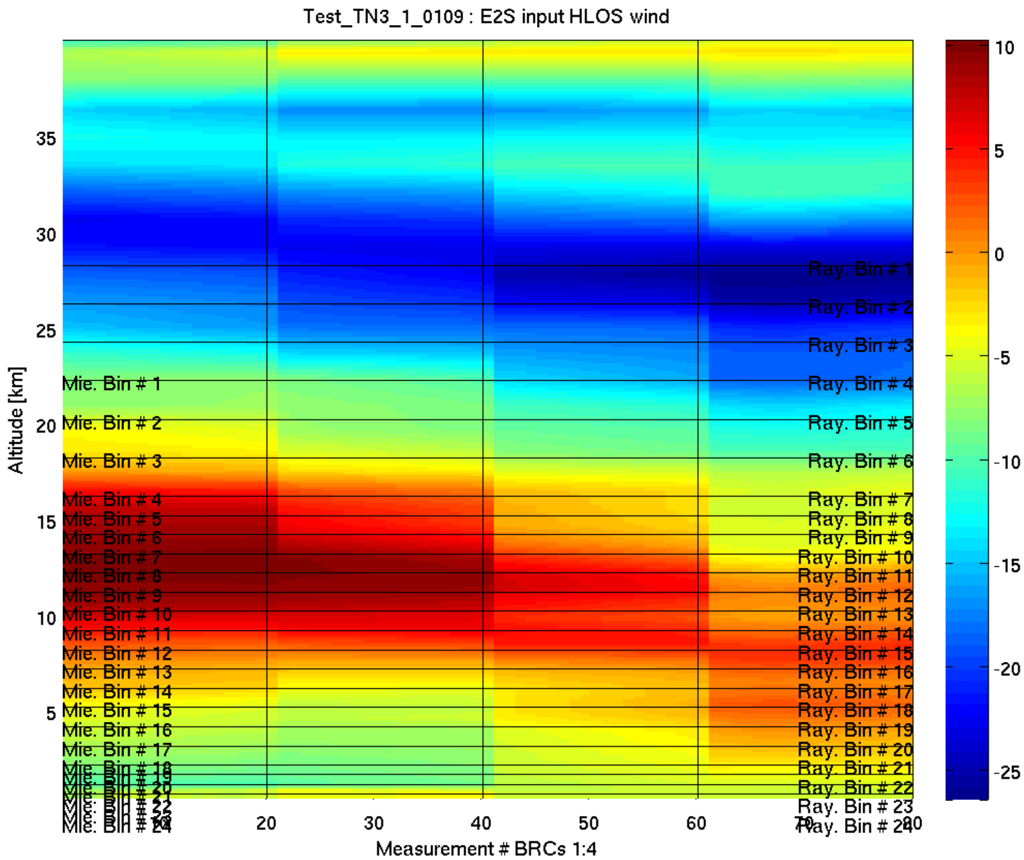

Figure 24: Input hlos wind as used by test #0109 (color scale is in ms^{-1}).

12.11 Test case #0110: Mountains, ECMWF wind, including photocounts noise

Purpose

Test the standard deviation of errors in the Rayleigh and Mie channel retrieved HLOS winds.

Test Data Set

TEST_TN3_1_0110, 800 km data along LITE track, 4 BRCs.

Atmospheric Conditions

The scene uses atmospheric database scenario LiteScene_D_and_EcmwfColloc_3.6km and is characterized by a mountains ... , see Figure 25. ECMWF model winds along the LITE orbit are used to describe the dynamics, see Figure 26. Interpolation between atmospheric profiles is switched on.

E2S Scenario

No AOCS errors, no DEM, randomization of photocounts, perfect matching between Mie and Rayleigh height-bins, ECMWF wind profiles from collocating the LITE orbit with ECMWF model fields.

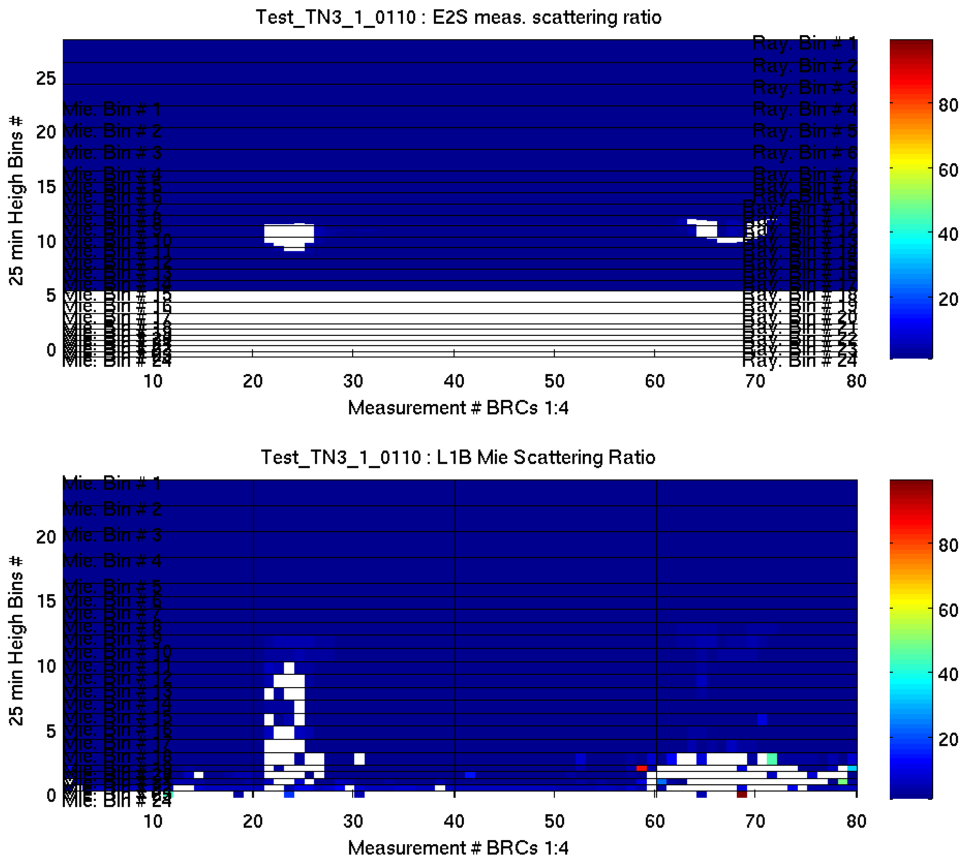

Figure 25: Scattering ratio as used for input by test #0110 (upper panel) and as retrieved by the L1B processor (lower panel).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass / Fail Criteria

The bias and standard deviation of the errors of L2B HLOS winds from the Rayleigh channel should be within the ADM requirements throughout the profile, i.e. a bias smaller than 0.1 ms^{-1} and a standard deviation smaller than 3 ms^{-1}. ...

Comments

t.b.d.

12.12 Test case #0111: Ocean case, ECMWF wind, including photocounts noise

Purpose

Test the standard deviation of errors in the Rayleigh and Mie channel retrieved HLOS winds.

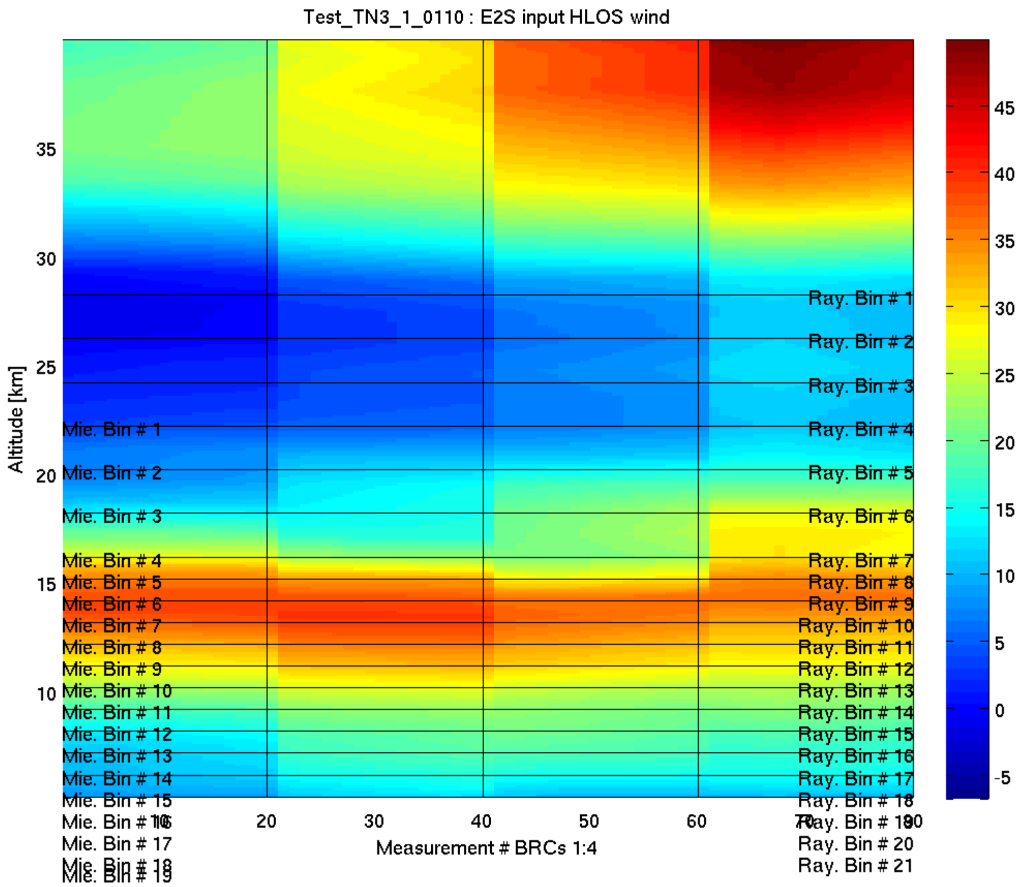

Figure 26: Input hlos wind as used by test #0110 (color scale is in ms^{-1}).

Test Data Set

TEST_TN3_1_0111, 800 km data along LITE track, 4 BRCs.

Atmospheric Conditions

The scene uses atmospheric database scenario LiteScene_E_and_EcmwfColloc_3.6km and is characterized by a ... , see Figure 27. ECMWF model winds along the LITE orbit are used to describe the dynamics, see Figure 28. Interpolation between atmospheric profiles is switched on.

E2S Scenario

No AOCS errors, no DEM, randomization of photocounts, perfect matching between Mie and Rayleigh height-bins, ECMWF wind profiles from collocating the LITE orbit with ECMWF model fields.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass / Fail Criteria

The bias and standard deviation of the errors of L2B HLOS winds from the Rayleigh channel should be within the ADM requirements throughout the profile, i.e. a bias smaller than 0.1 ms^{-1} and a standard

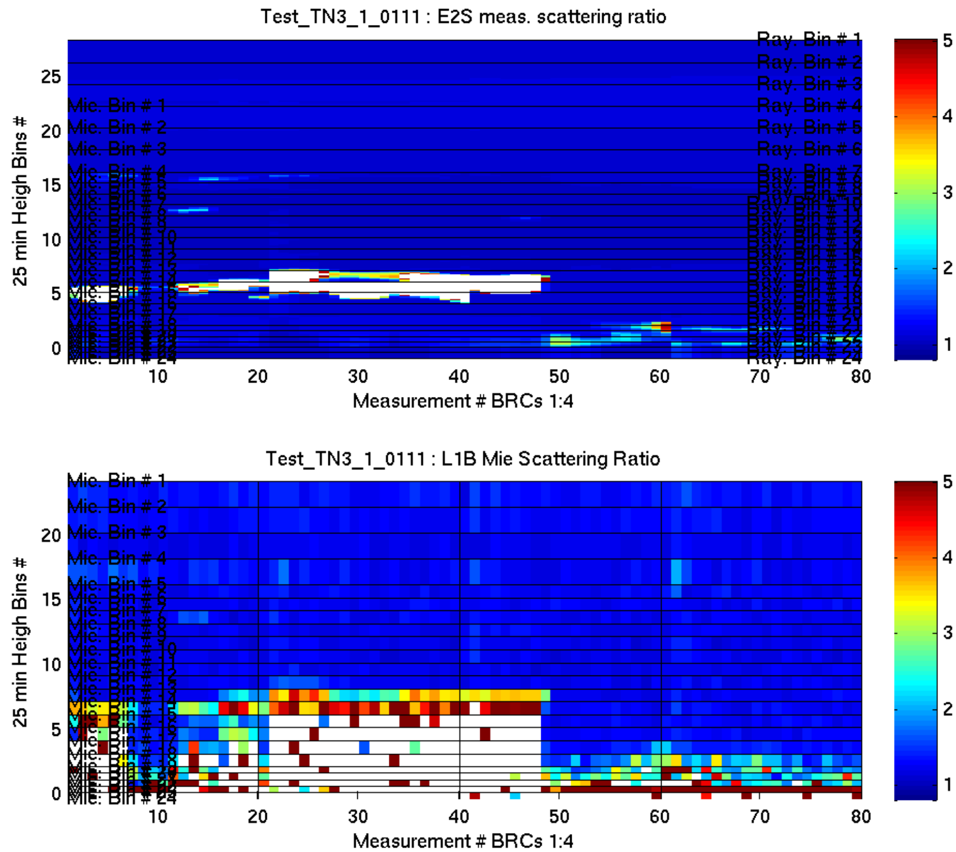

Figure 27: Scattering ratio as used for input by test #0111 (upper panel) and as retrieved by the L1B processor (lower panel).

deviation smaller than 3 ms^{-1}. ...

Comments

t.b.d.

12.13 Test case #0112: Ocean case, ECMWF wind, including photocounts noise

Purpose

Test the standard deviation of errors in the Rayleigh and Mie channel retrieved HLOS winds.

Test Data Set

TEST_TN3_1_0112, 800 km data along LITE track, 4 BRCs.

Atmospheric Conditions

The scene uses atmospheric database scenario LiteScene_F_and_EcmwfColloc_3.6km and is characterized by a ... , see Figure 29. ECMWF model winds along the LITE orbit are used to describe the dynamics, see Figure 30. Interpolation between atmospheric profiles is switched on.

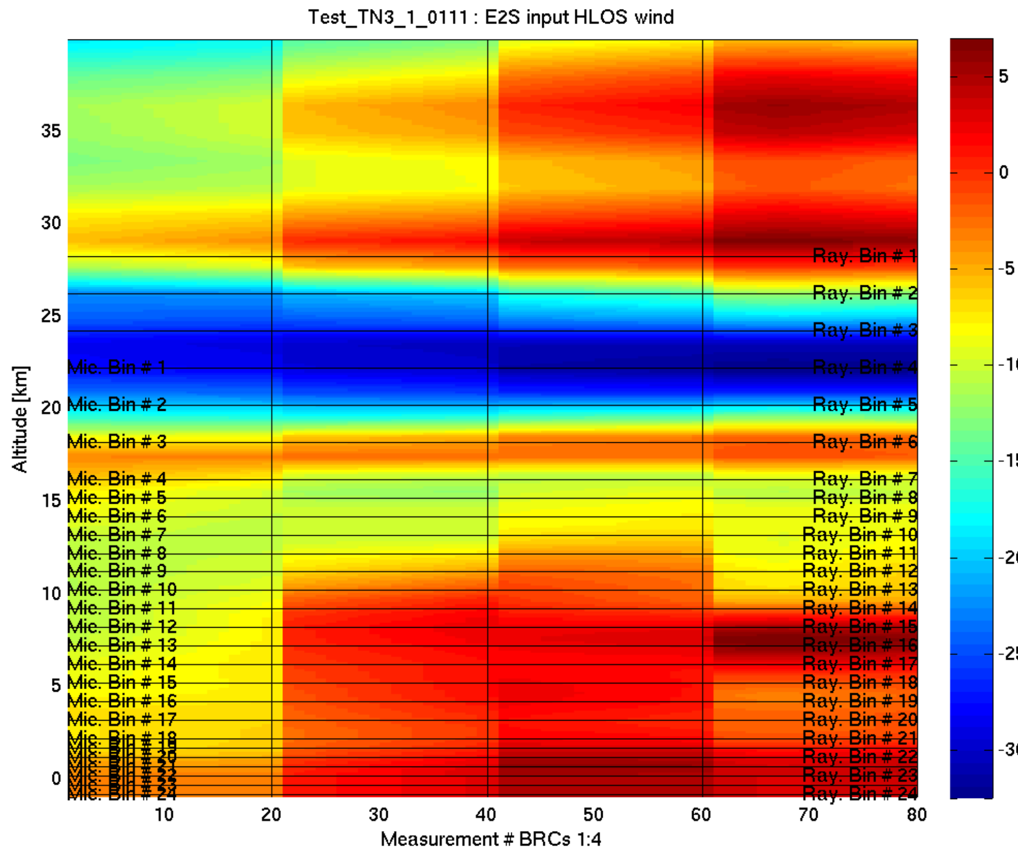

Figure 28: Input hlos wind as used by test #0111 (color scale is in ms^{-1}).

E2S Scenario

No AOCS errors, no DEM, randomization of photocounts, perfect matching between Mie and Rayleigh height-bins, ECMWF wind profiles from collocating the LITE orbit with ECMWF model fields.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass / Fail Criteria

The bias and standard deviation of the errors of L2B HLOS winds from the Rayleigh channel should be within the ADM requirements throughout the profile, i.e. a bias smaller than 0.1 ms^{-1} and a standard deviation smaller than 3 ms^{-1}. ...

Comments

t.b.d.

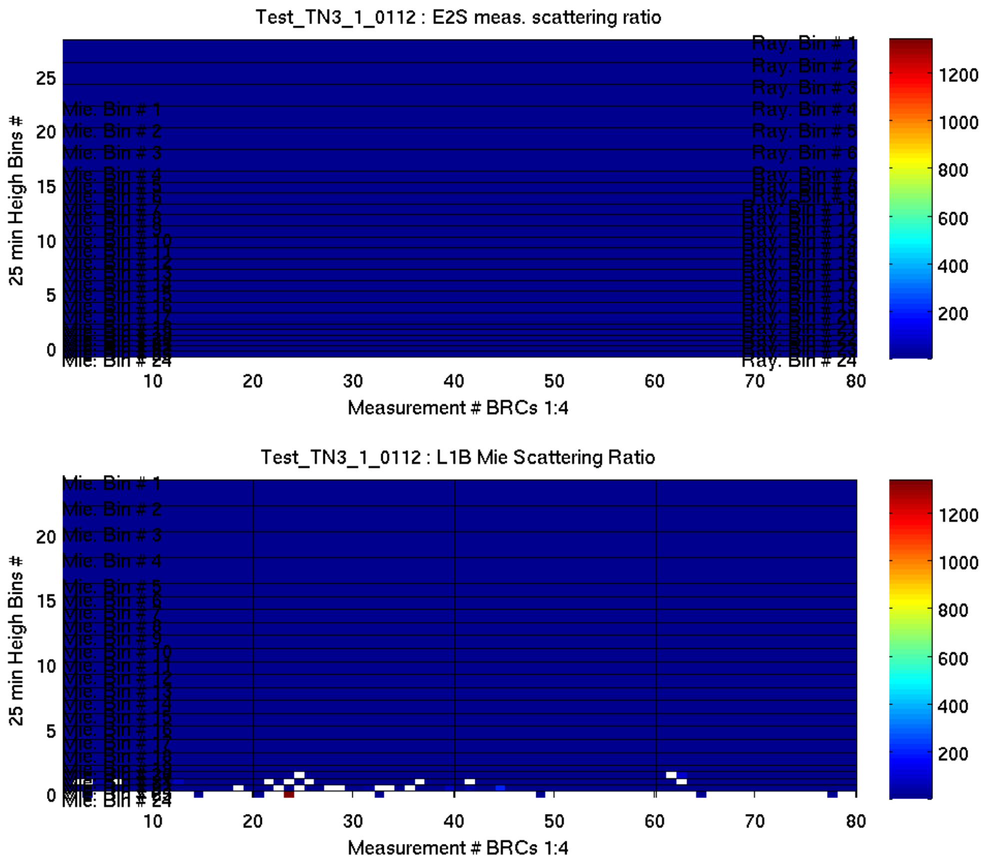

Figure 29: Scattering ratio as used for input by test #0111 (upper panel) and as retrieved by the L1B processor (lower panel).

12.14 Test case #0113: Mid Latitude Ocean case, ECMWF wind, including photocounts noise

Purpose

Test the standard deviation of errors in the Rayleigh and Mie channel retrieved HLOS winds.

Test Data Set

TEST_TN3_1_0113, 800 km data along LITE track, 4 BRCs.

Atmospheric Conditions

The scene uses atmospheric database scenario LiteScene_H_and_EcmwfColloc_3.6km and is characterized by a ... , see Figure 31. ECMWF model winds along the LITE orbit are used to describe the dynamics, see Figure 32. Interpolation between atmospheric profiles is switched on.

E2S Scenario

No AOCS errors, no DEM, randomization of photocounts, perfect matching between Mie and Rayleigh height-bins, ECMWF wind profiles from collocating the LITE orbit with ECMWF model fields.

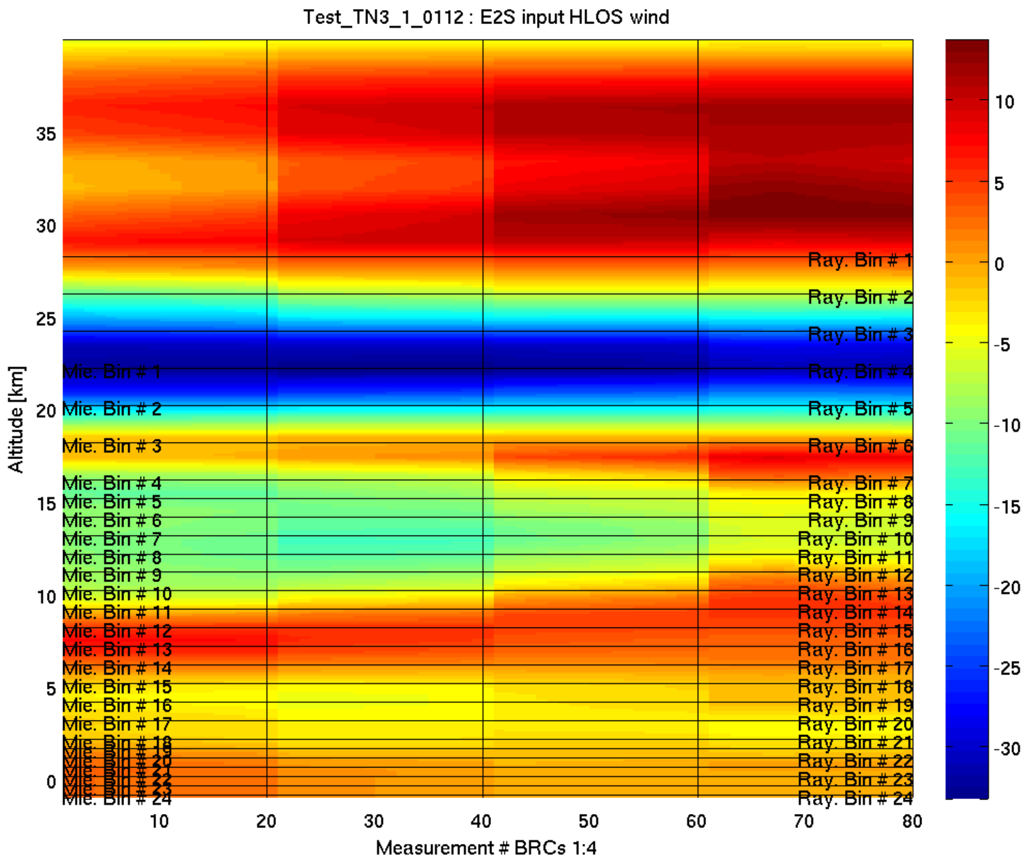

Figure 30: Input hlos wind as used by test #0112 (color scale is in ms^{-1}).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass / Fail Criteria

The bias and standard deviation of the errors of L2B HLOS winds from the Rayleigh channel should be within the ADM requirements throughout the profile, i.e. a bias smaller than 0.1 ms^{-1} and a standard deviation smaller than 3 ms^{-1}. ...

Comments

t.b.d.

12.15 Test case #0114: Sub-Tropical dust layer, ECMWF wind, including photocounts noise

Purpose

Test the standard deviation of errors in the Rayleigh and Mie channel retrieved HLOS winds.

Test Data Set

TEST_TN3_1_0114, 800 km data along LITE track, 4 BRCs.

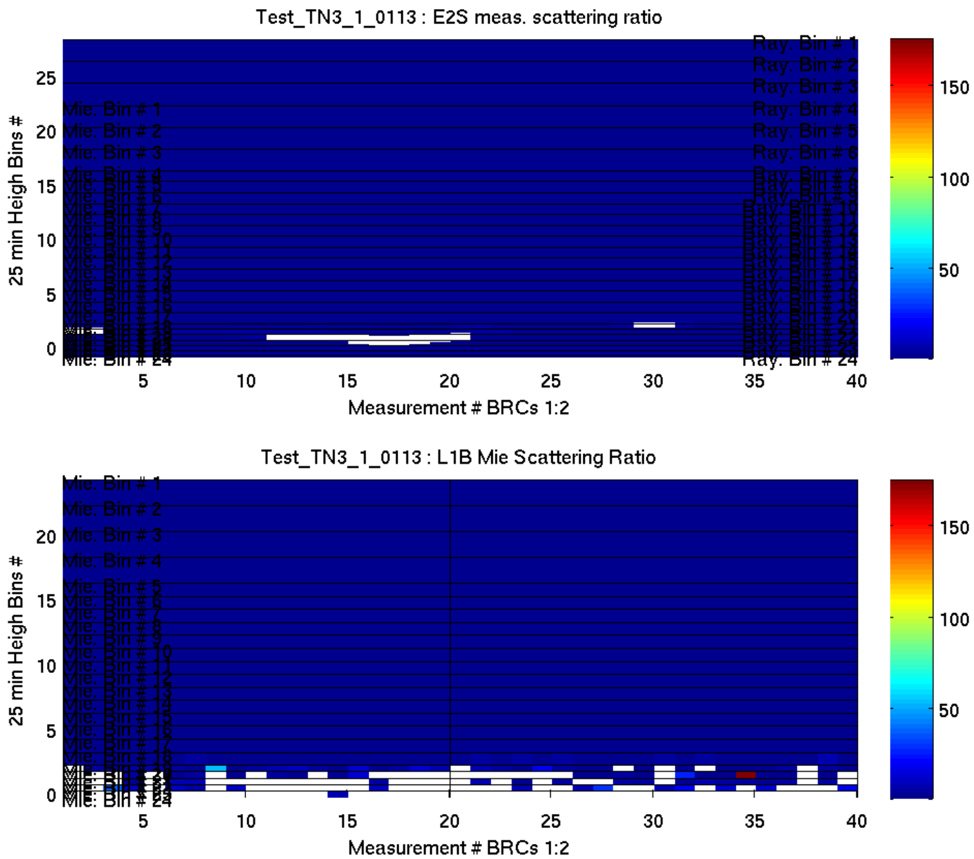

Figure 31: Scattering ratio as used for input by test #0111 (upper panel) and as retrieved by the L1B processor (lower panel).

Atmospheric Conditions

The scene uses atmospheric database scenario LiteScene_K_and_EcmwfColloc_3.6km and is characterized by a ... , see Figure 33. ECMWF model winds along the LITE orbit are used to describe the dynamics, see Figure 34. Interpolation between atmospheric profiles is switched on.

E2S Scenario

No AOCS errors, no DEM, randomization of photocounts, perfect matching between Mie and Rayleigh height-bins, ECMWF wind profiles from collocating the LITE orbit with ECMWF model fields.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass / Fail Criteria

The bias and standard deviation of the errors of L2B HLOS winds from the Rayleigh channel should be within the ADM requirements throughout the profile, i.e. a bias smaller than 0.1 ms^{-1} and a standard deviation smaller than 3 ms^{-1}. ...

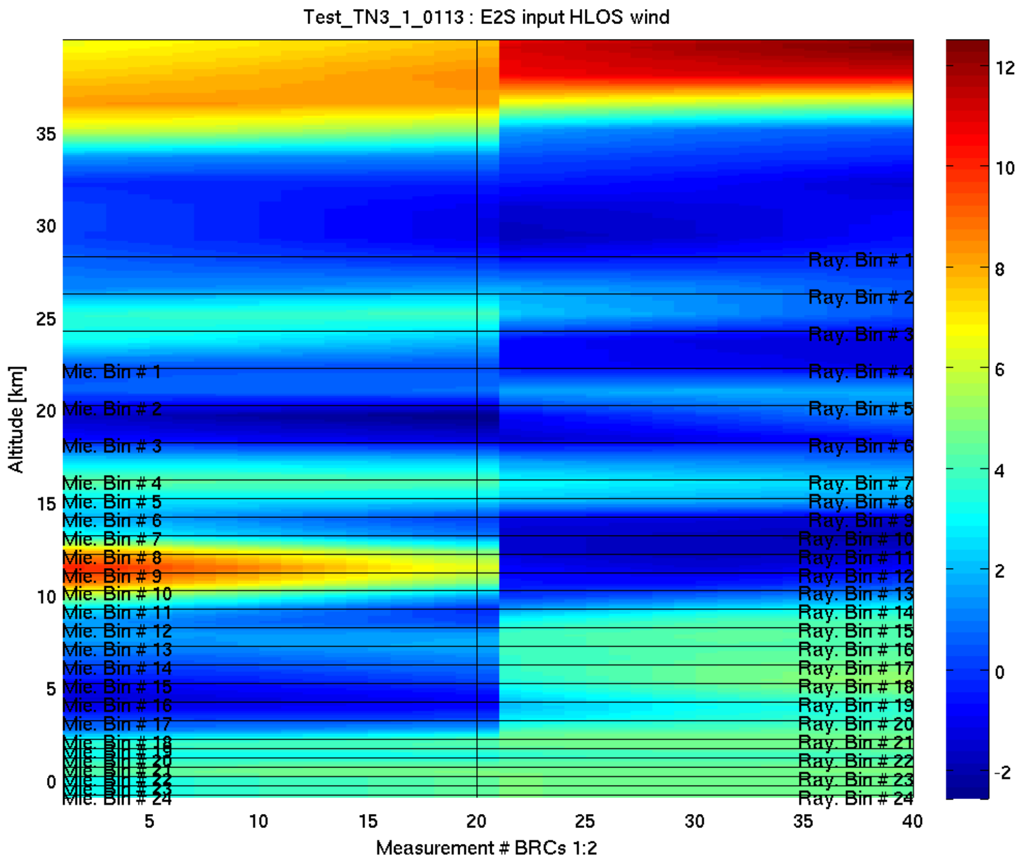

Figure 32: Input hlos wind as used by test #0113 (color scale is in ms^{-1}).

Comments

t.b.d.

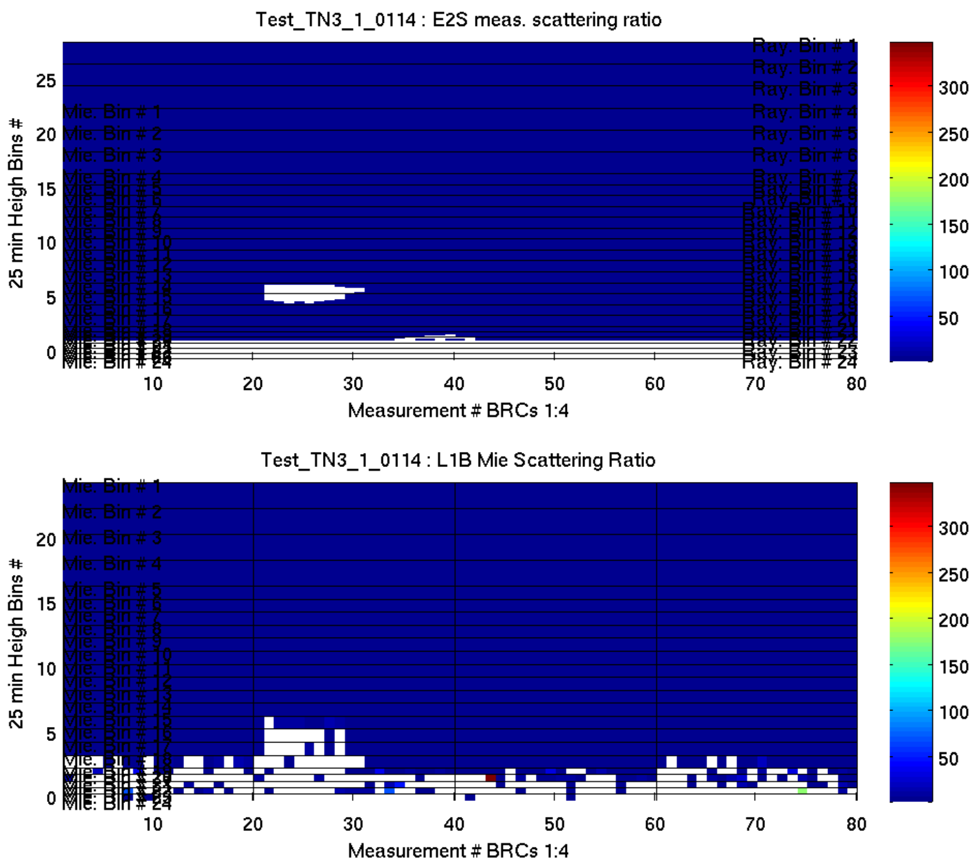

Figure 33: Scattering ratio as used for input by test #0111 (upper panel) and as retrieved by the L1B processor (lower panel).

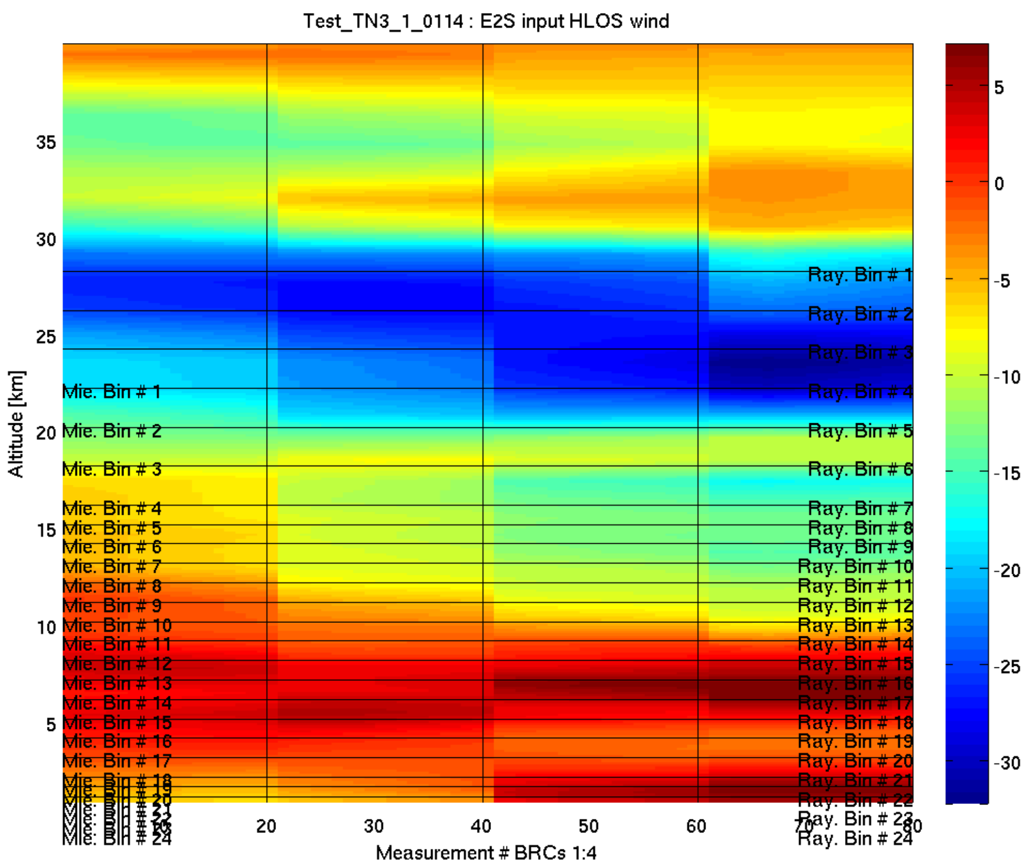

Figure 34: Input hlos wind as used by test #0114 (color scale is in ms^{-1}).

13 Ground calibration and mispointing cases

13.1 Introduction

The ADM-Aeolus system is extremely sensitive to mispointing of the lidar system. Uncertainties in the knowledge of the laser pointing will result in significant wind errors. Mispointing effects may be detected and corrected for by observing ground echos, which will give a zero reference for the wind. The test cases in this section test the ability of the system by provoking different mispointing effects and assuming different ground reflection properties. These tests have been proposed by Herbert Nett in his email of 23-May-2008, titled "specific L1B-L2B test cases (AI-12.3 of last L2B-PM)", in response to AI 12.3 defined on progress meeting L2B PM12 of 14-May-2008 (see Appendix A). Since the L1BP and L2BP share the same algorithms and switches related to ground corrections, all these tests are equally relevant for the L1B and L2B stage.

Tests #0201 until #0209 as defined in sections 13.2 until 13.10 describe these tests in detail.

13.2 Test case #0201: Functional ZWC test

This testcase is split into two scripts. First the E2S and L1BP stage are run by script TEST_Mispointing_1a.py, then the L2BP and plotting tools are run by script TEST_Mispointing_2a.py.

Purpose

Functional test of a simple atmospheric case with constant albedo, to demonstrate that ZWC using the currently found ground echo works as intended.

Test Data Sets

Test_Mispointing_1a.tgz and Test_Mispointing_2a.tgz, each composed of one full orbit, which equals 40.000 km of data, 200 BRCs. TDS 1a contains the E2S and L1B inputs and results, TDS 2a contains the L2B inputs and results, and the plotting tool results.

Atmospheric Conditions

This test uses RMA profile "midlat_winter" from the atmospheric database for temperature, pressure and aerosol properties, and assumes a constant albedo of 0.8 everywhere. A constant HLOS wind of 0 ms^{-1} is assumed. No clouds are present. No interpolation between profiles.

E2S Scenario

No AOCS errors, no randomization of photocounts, Mie rangebins are concentrated on the lower 16 km of the profile, while Rayleigh rangebins extend to above 27 km (WVM2).

L1B Settings

The switches Mie_Ground_Correction_Weighting_Factor and Rayleigh_Ground_Correction_Weighting_Factor are both set to 1.0 to allow the zero wind correction algorithm to be tested.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass / Fail Criteria

Since no mispointing was provoked in this functional test, all ground velocities must be close to zero. They must have no bias (bias less then 0.1 ms^{-1}) and due to the expected high signal levels and the absense of noise, the standard deviation of the Mie results must be very low (less then 0.15 ms^{-1}). The Rayleigh results may show some contamination by the atmosphere just above the surface, but since a zero surface wind is assumed this should not cause any additional error. Therefore also Rayleigh results must have very low standard deviation (less then 0.15 ms^{-1}).

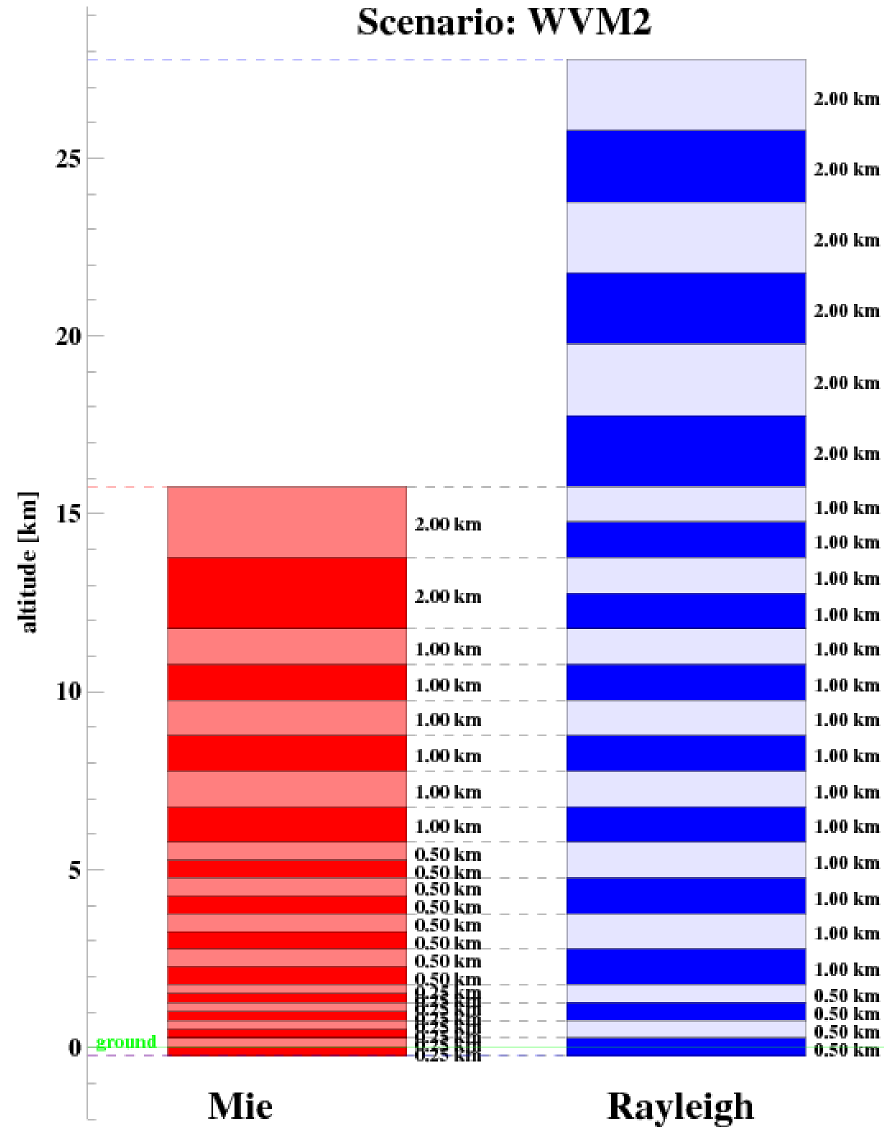

Figure 35: rangebin definition named WVM2 used by tests #0201 upto #0207.

The L2BP should not generate cloudy profiles for either channel. Any elevated scattering ratio level is due to the ground, and must be flagged by the L2BP accordingly.

No constraints are placed on the atmospheric results, since this test focusses mainly on ground calibration issues.

Comments

This test probably does not add much interesting results, and is mainly intended as reference base for the following 2 test cases described in sections 13.3 and 13.4.

13.3 Test case #0202: correct Rayleigh with Mie

This testcase is split into three scripts. The E2S stage is identical to the one from test 13.2, so that test must be run first before starting this one. Then L1BP stage is run by script TEST_Mispointing_1b.py, finally the L2BP and plotting tools are run by script TEST_Mispointing_2b.py.

Purpose

Functional test of a simple atmospheric case with constant albedo, to demonstrate that ZWC using the currently found ground echo works as intended. In this case the Rayleigh channel is to be corrected with the ground velocities found from the Mie channel.

Test Data Sets

Test_Mispointing_1a.tgz, Test_Mispointing_1b.tgz and Test_Mispointing_2b.tgz, each composed of one full orbit, which equals 40.000 km of data, 200 BRCs. TDS 1a contains the E2S inputs and results, TDS 1b contains the L1B inputs and results, TDS 2b contains the L2B inputs and results, and the plotting tool results.

Atmospheric Conditions

See test case #0201 defined in section 13.2.

E2S Scenario

No AOCS errors, no randomization of photocounts, Mie rangebins are concentrated on the lower 16 km of the profile, while Rayleigh rangebins extend to above 27 km (WVM2).

L1B Settings

The switch Mie_Ground_Correction_Weighting_Factor is set to 1.0 The switch Rayleigh_Ground_Correction_Weighting_Fac is set to the value of 0.0.

A dummy ground correction value of 7.77 ms^{-1} for the Mie_Rayleigh_Ground_Correction_Offset term has been inserted in the L1B AuxPar file and the switch Rayleigh_Correction_With_Mie_Ground_Echo_Weighting_Factor is set to 1.0. This should make the applied correction clearly visible in the Rayleigh channel wind results.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass / Fail Criteria

Since no mispointing was provoked in this functional test, all ground velocities must be close to zero. They must have no bias (bias less then 0.1 ms^{-1}) and due to the expected high signal levels and the absense of noise, the standard deviation of the Mie results must be very low (less then 0.15 ms^{-1}). The Rayleigh results may show some contamination by the atmosphere just above the surface, but since the Rayleigh channel is corrected with the Mie ground echo result, this may not show up in the results. However, since a zero surface wind is assumed this should not cause any additional error. Therefore also Rayleigh results must have very low standard deviation (less then 0.15 ms^{-1}).

NOTE: we could consider changing the input wind in this case to a constant value of say 50 ms^{-1} to demonstrate the effect of surface wind contamination on the Rayleigh ground velocity.

The L2BP should not generate cloudy profiles for either channel. Any elevated scattering ratio level is due to the ground, and must be flagged by the L2BP accordingly.

No constraints are placed on the atmospheric results, since this test focusses mainly on ground calibration issues.

Comments

t.b.d.

13.4 Test case #0203: correct wind using HBE

This testcase is split into three scripts. The E2S stage is identical to the one from test 13.2, so that test must be run first before starting this one. Then L1BP stage is run by script TEST_Mispointing_1c.py, finally the L2BP and plotting tools are run by script TEST_Mispointing_2c.py.

Purpose

Functional test of a simple atmospheric case with constant albedo, to demonstrate that ZWC using the Harmonic Bias Estimator (HBE) results works as intended. In this case both channels will be corrected with the ground velocities reported by the Harmonic Bias Estimator fitting tool. However, since this HBE tool is not part of the current sequence of tested executables, all Harmonic coefficients are forced to be zero, and this test remains only a functional test (i.e. it verifies the software accepts the input switches related to HBE usage, and it verifies that the software does not generate wrong results due to uninitialised variables and related kinds of bugs).

Test Data Sets

Test_Mispointing_1a.tgz, Test_Mispointing_1c.tgz and Test_Mispointing_2c.tgz, each composed of one full orbit, which equals 40.000 km of data, 200 BRCs. TDS 1a contains the E2S inputs and results, TDS 1c contains the L1B inputs and results, TDS 2c contains the L2B inputs and results, and the plotting tool results.

Atmospheric Conditions

See test case #0201 defined in section 13.2.

E2S Scenario

No AOCS errors, no randomization of photocounts, Mie rangebins are concentrated on the lower 16 km of the profile, while Rayleigh rangebins extend to above 27 km (WVM2).

L1B Settings

The switches Mie_Ground_Correction_Weighting_Factor and Rayleigh_Ground_Correction_Weighting_Factor are both set back to the default value of 0.0.

The Mie_Harmonic_Correction_Factor and Rayleigh_Harmonic_Correction_Factor are both set to 1.0, to allow the zero wind correction based on the HBE results to be tested.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass / Fail Criteria

Since no mispointing was provoked in this functional test, all ground velocities must be close to zero. They must have no bias (bias less then 0.1 ms^{-1}) and very low standard deviation (less then 0.15 ms^{-1}). Since the HBE correction is set to zero be forcing the harmonic coefficients to be zero,

The L2BP should not generate cloudy profiles for either channel. Any elevated scattering ratio level is due to the ground, and must be flagged by the L2BP accordingly.

No constraints are placed on the atmospheric results, since this test focusses mainly on ground calibration issues.

Comments

t.b.d.

13.5 Test case #0204: Verify ZWC without mispointing

This testcase is split into four scripts, named: TEST_Mispointing_3_1_orb1.py, TEST_Mispointing_3_1_orb2.py, TEST_Mispointing_3_1_orb3.py, and TEST_Mispointing_3_1_orb4.py. Each script processes about half an orbit of data, so together about 2 whole orbits of data are simulated.

Purpose

Functional test of an atmospheric case with constant albedo, realistic variable backscatter and extinction, realistic temperature and pressure profiles, but a constant hlos wind profile.

Test Data Sets

Test_Mispointing_3_1_orb1.tgz, Test_Mispointing_3_1_orb2.tgz, Test_Mispointing_3_1_orb3.tgz, and Test_Mispointing_3_1_o
each composed of almost half an orbit, which together form 75.200 km of data, 376 BRCs.

Atmospheric Conditions

Aerosol extinction and backscatter are taken from 4 nighttime CALIPSO half-orbits, see Figure 36. Pressure and temperature are taken from ECMWF NWP model fields collocated to the location and time of the CALIPSO data. The albedo is taken to be a constant value of 0.8. The input hlos wind is taken to be 0 ms^{-1} everywhere.

Interpolation between atmospheric profiles is switched on.

The 2 orbits simulated by the E2S for which this data is assumed to be the atmospheric truth are depicted in Figure 37.

TODO: add locations of the CALIPSO data used for this test.

E2S Scenario

No AOCS errors, no randomization of photocounts, Mie rangebins are concentrated on the lower 16 km of the profile, while Rayleigh rangebins extend to above 27 km (WVM2).

L1B Settings

The switches Mie_Ground_Correction_Weighting_Factor and Rayleigh_Ground_Correction_Weighting_Factor are both set to the value of 0.0, so no ZWC corrections are applied.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass / Fail Criteria

Since no mispointing was provoked in this functional test, all ground velocities must be close to zero. They must have no bias (bias less then 0.1 ms^{-1}) and very low standard deviation (less then 0.15 ms^{-1}).

No constraints are placed on the atmospheric results, since this test focusses mainly on ground calibration issues.

Comments

This test serves as a reference run to be compared with the following 3 testcases, as described in sections 13.6, and ....

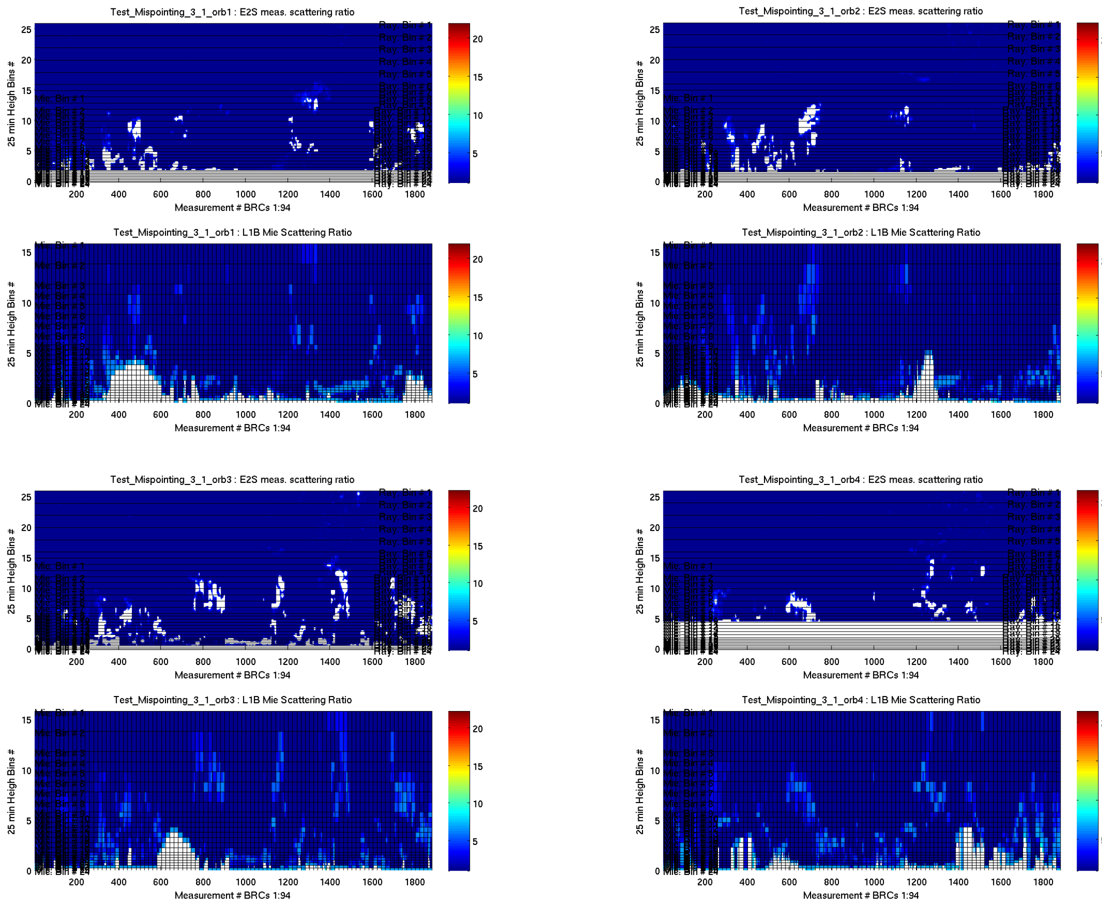

Figure 36: Scattering ratio as used for input by test #0204. Each pair of 2 plots gives in the upper panel the E2S inputs and in the lower panel the values retrieved by the L1B processor. The areas indicated in white in the L1B results indicate the location of orography superimposed on the scenario by the choosen orbit.

13.6 Test case #0205: Yaw-angle mispointing

This testcase is split into four scripts, named: TEST_Mispointing_3_2_orb1.py, TEST_Mispointing_3_2_orb2.py, TEST_Mispointing_3_2_orb3.py, and TEST_Mispointing_3_2_orb4.py. Each script processes about half an orbit of data, so together about 2 whole orbits of data are simulated.

Purpose

This test case has a clear mis pointing error, and allows to test the Harmonic Bias Estimator (HBE) tool. A yaw angle bias will cause a fraction of the forward satellite to be projected onto the line-of-sight, en thus to enter the hlos measurement. At a later stage it must be verified that the produced bias in hlos winds can be corrected for by using the ZWC correction mechanism.

Test Data Sets

Test_Mispointing_3_2_orb1.tgz, Test_Mispointing_3_2_orb2.tgz, Test_Mispointing_3_2_orb3.tgz, and Test_Mispointing_3_2_o
each composed of almost half an orbit, which together form 75.200 km of data, 376 BRCs.

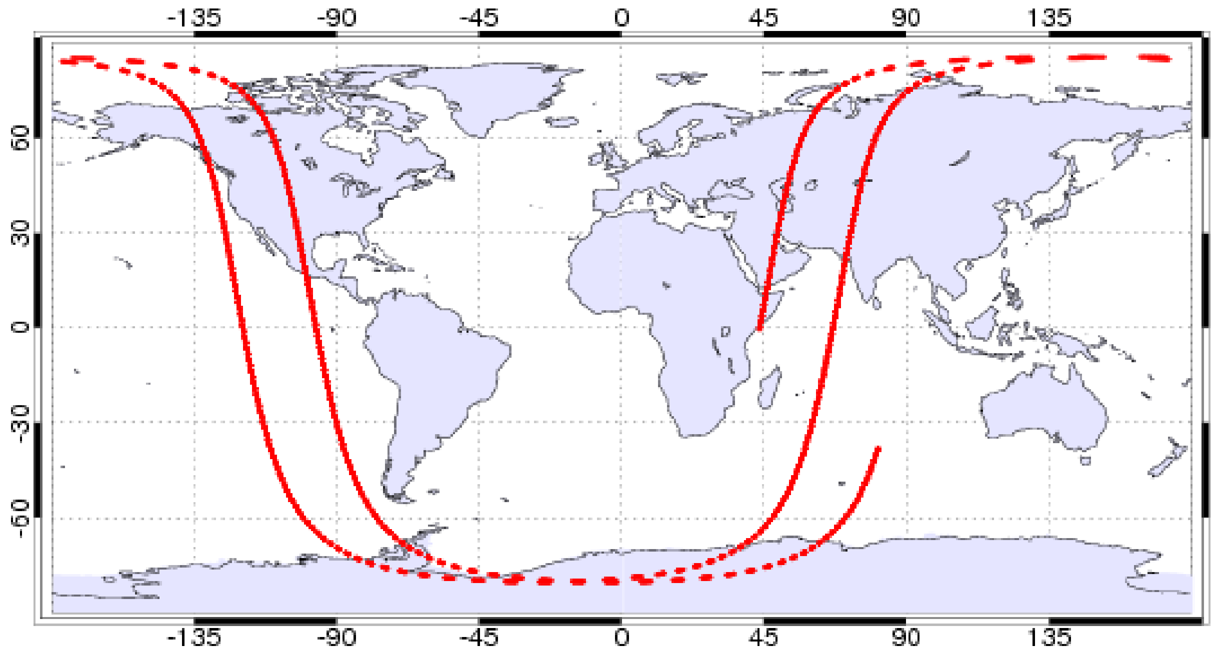

Figure 37: Simulated orbit for experiment #0204, measurement positions as extracted from the L1B product files.

Atmospheric Conditions

See test case #0204 defined in section 13.5.

E2S Scenario

A yaw-angle pointing error of 2 mrad is assumed. No randomization of photocounts, Mie rangebins are concentrated on the lower 16 km of the profile, while Rayleigh rangebins extend to above 27 km (WVM2).

L1B Settings

The switches Mie_Ground_Correction_Weighting_Factor and Rayleigh_Ground_Correction_Weighting_Factor are both set to the value of 0.0, so no ZWC corrections are applied.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass / Fail Criteria

Due to the yaw-angle mispointing a constant strong hlos bias is expected in the output, both in ground and atmospheric returns. The bias in ground and atmospheric retrievals must be in the same order of magnitude, and the correction reported in the L1B ZWC file should allow correcting the bias completely. Since a constant input wind of 0 ms^{-1} was assumed, the std of the ground returns, both from hlos retrievals and from the ZWC algorithm should be low (less then 0.15 ms^{-1}).

No constraints are placed on the atmospheric results, since this test focusses mainly on ground calibration issues.

Comments

t.b.d.

13.7 Test case #0206: Yaw-angle mispointing and varying albedo

This testcase is split into eight scripts, named: TEST_Mispointing_3_3_orb1.py, TEST_Mispointing_3_3_orb2.py, TEST_Mispointing_3_3_orb3.py, TEST_Mispointing_3_3_orb4.py, TEST_Mispointing_3_3_orb5.py, TEST_Mispointing_3_3_ TEST_Mispointing_3_3_orb7.py, and TEST_Mispointing_3_3_orb8.py. Each script processes about half an orbit of data, so together about 4 whole orbits of data are simulated.

Purpose

This test case has a clear mis pointing error, and allows to test the Harmonic Bias Estimator (HBE) tool. At a later stage it must be verified that the produced bias in hlos winds can be corrected for by using the ZWC correction mechanism. This test assumes a variable albedo, depending on location (land, sea or ice), to test the effect of less ideal ground returns.

Test Data Sets

Test_Mispointing_3_3_orb1.tgz, Test_Mispointing_3_3_orb2.tgz, Test_Mispointing_3_3_orb3.tgz, Test_Mispointing_3_3_orb4. Test_Mispointing_3_3_orb5.tgz, Test_Mispointing_3_3_orb6.tgz, Test_Mispointing_3_3_orb7.tgz, and Test_Mispointing_3_3_o each composed of almost half an orbit, which together form 150.400 km of data, 752 BRCs.

Albedo conditions

This test uses a variable albedo that has been constructed in the following way.

First a Lambertian Surface Albedo Climatology at 360 nm was downloaded from [RD11]. This gives a dataset for the albedo as a function of latitude, longitude and day of the year. From this data at each latitude the albedo was calculated by averaging over all longitudes and all days of the year. In a similar way a separate land and sea albedo was constructed for each latitude, by applying a land-sea mask and averaging the data over all land or all sea points (and all days of the year). The elevation map used for this exercise was the example file available with in the standard IDL software installation[4] The result of these calculations are given in Figure 38.

This data was then simplified by assuming an albedo level of 0.05 above land and 1.0 above snow and ice in the ploar regions. For now it is assumed that above sea no usefull ground echos will be found due to the unpredictable bias caused by the motion of the waves. As detailed in [RD11] the net water movement due to the waves may not cancel after averaging many datapoints, but may add up to a not non-zero result. Since no land-sea mask has been implemented yet in the software chain it is safest to exclude these points by taking a zero albedo above sea.

As a next step, the average land fraction was calculated as a function of latitude. The elevation map used for this exercise again was the example file available with in the standard IDL software installation (see footnote [4] on page 82). The land fractions found in this way have been rounded to levels of a multiple of 25%, see Figure 39. This way it is easy to construct a scenario with (a multiple of) 4 orbits representing the real land fraction of the world.

The thus found albedo levels and land fractions have been used to construct the albedo sequence gives in Table 3. For this map it was assumed that all land between -60 and +60 degrees latitude has albedo 0.05. All land above +60 or below -60 latitude is assumed to be highly reflecting snow or ice with an albedo of 1. Sea-ice is not taken into account. For each latitude the landfraction was rounded to a multiple of 25%. The rounded value means that when for example 100% land is present at a given latitude, all 4 orbits have an albedo above zero. If the land fraction is 50% 2 orbits pass above land and 2 above sea at this latitude, etc.

[4] The file is typically named /usr/local/appl/installed/idl70/examples/data/worldelv.dat and can be used within IDL by loading it as a binary file like this file = FILEPATH('worldelv.dat', SUBDIRECTORY = ['examples', 'data']).

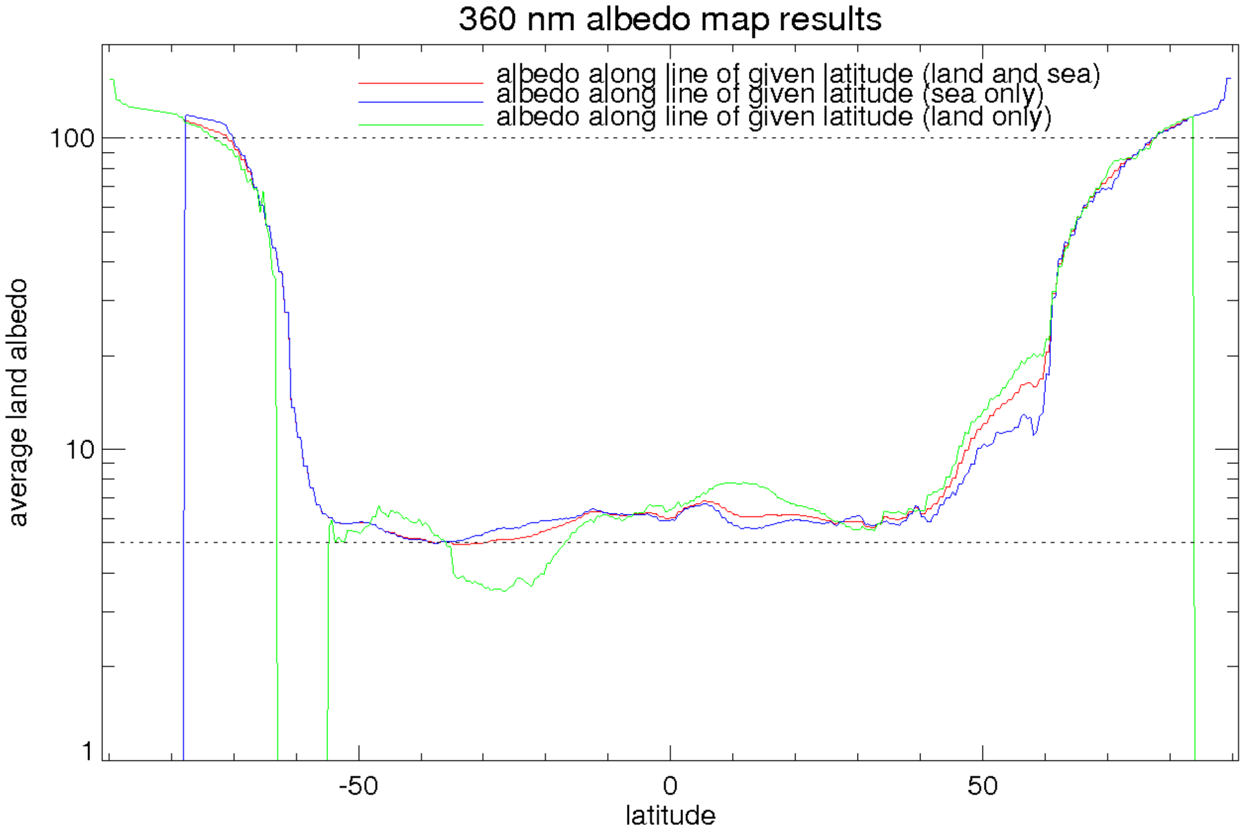

Figure 38: Albedo as function of latitude, uses as basis for constructing the variable albedo of experiments test #0206 and test #207. The levels 0.05 and 1.0 are shown as dashed lines.

Table 3: Albedo values as used for test #0206 and #207 for each BRC number. Landfraction and albedos are given in percent. The latitude values are actual E2S simulation results for a single orbit, and are re-used for the 3 next orbits.

BRC	latitude	landfraction	orbit1 albedo	orbit2 albedo	orbit3 albedo	orbit4 albedo
#1	-38.47	0	0	0	0	0
#2	-40.25	0	0	0	0	0
#3	-42.03	0	0	0	0	0
#4	-43.81	0	0	0	0	0
#5	-45.58	0	0	0	0	0
#6	-47.34	0	0	0	0	0
#7	-49.11	0	0	0	0	0
#8	-50.86	0	0	0	0	0
#9	-52.61	0	0	0	0	0
#10	-54.36	0	0	0	0	0
#11	-56.10	0	0	0	0	0
#12	-57.83	0	0	0	0	0
#13	-59.55	0	0	0	0	0
#14	-61.25	0	0	0	0	0
#15	-62.95	0	0	0	0	0

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Table 3 – Continued						
BRC	latitude	landfraction	orbit1 albedo	orbit2 albedo	orbit3 albedo	orbit4 albedo
#16	-64.63	0	0	0	0	0
#17	-66.29	0	0	0	0	0
#18	-67.92	0	0	0	0	0
#19	-69.53	0	0	0	0	0
#20	-71.11	0	0	0	0	0
#21	-72.63	100	100	100	100	100
#22	-74.10	100	100	100	100	100
#23	-75.50	100	100	100	100	100
#24	-76.79	100	100	100	100	100
#25	-77.96	100	100	100	100	100
#26	-78.95	100	100	100	100	100
#27	-79.72	100	100	100	100	100
#28	-80.21	100	100	100	100	100
#29	-80.34	100	100	100	100	100
#30	-80.23	100	100	100	100	100
#31	-79.75	100	100	100	100	100
#32	-78.99	100	100	100	100	100
#33	-78.01	100	100	100	100	100
#34	-76.86	100	100	100	100	100
#35	-75.57	100	100	100	100	100
#36	-74.18	100	100	100	100	100
#37	-72.71	100	100	100	100	100
#38	-71.19	0	0	0	0	0
#39	-69.62	0	0	0	0	0
#40	-68.01	0	0	0	0	0
#41	-66.38	0	0	0	0	0
#42	-64.72	0	0	0	0	0
#43	-63.04	0	0	0	0	0
#44	-61.35	0	0	0	0	0
#45	-59.64	0	0	0	0	0
#46	-57.92	0	0	0	0	0
#47	-56.19	0	0	0	0	0
#48	-54.45	0	0	0	0	0
#49	-52.71	0	0	0	0	0
#50	-50.96	0	0	0	0	0
#51	-49.20	0	0	0	0	0
#52	-47.44	0	0	0	0	0
#53	-45.67	0	0	0	0	0
#54	-43.90	0	0	0	0	0
#55	-42.13	0	0	0	0	0
#56	-40.35	0	0	0	0	0
#57	-38.57	0	0	0	0	0
#58	-36.78	0	0	0	0	0
#59	-34.99	0	0	0	0	0
#60	-33.20	25	5	0	0	0
#61	-31.41	25	5	0	0	0
#62	-29.62	25	5	0	0	0
#63	-27.82	25	5	0	0	0
#64	-26.02	25	5	0	0	0

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Table 3 – Continued

BRC	latitude	landfraction	orbit1 albedo	orbit2 albedo	orbit3 albedo	orbit4 albedo
#65	-24.22	25	5	0	0	0
#66	-22.42	25	5	0	0	0
#67	-20.62	25	5	0	0	0
#68	-18.82	25	5	0	0	0
#69	-17.01	25	5	0	0	0
#70	-15.20	25	5	0	0	0
#71	-13.40	25	5	0	0	0
#72	-11.59	25	5	0	0	0
#73	-9.78	25	5	0	0	0
#74	-7.97	25	5	0	0	0
#75	-6.15	25	5	0	0	0
#76	-4.34	25	5	0	0	0
#77	-2.53	25	5	0	0	0
#78	-0.72	25	5	0	0	0
#79	+1.09	25	5	0	0	0
#80	+2.90	25	5	0	0	0
#81	+4.71	25	5	0	0	0
#82	+6.53	25	5	0	0	0
#83	+8.34	25	5	0	0	0
#84	+10.16	25	5	0	0	0
#85	+11.97	25	5	0	0	0
#86	+13.79	25	5	0	0	0
#87	+15.60	25	5	0	0	0
#88	+17.41	25	5	0	0	0
#89	+19.23	25	5	0	0	0
#90	+21.04	25	5	0	0	0
#91	+22.85	25	5	0	0	0
#92	+24.66	25	5	0	0	0
#93	+26.47	50	5	5	0	0
#94	+28.28	50	5	5	0	0
#95	+30.09	50	5	5	0	0
#96	+31.90	50	5	5	0	0
#97	+33.71	50	5	5	0	0
#98	+35.52	50	5	5	0	0
#99	+37.32	50	5	5	0	0
#100	+39.13	50	5	5	0	0
#101	+40.93	50	5	5	0	0
#102	+42.73	50	5	5	0	0
#103	+44.53	50	5	5	0	0
#104	+46.33	50	5	5	0	0
#105	+48.13	50	5	5	0	0
#106	+49.93	50	5	5	0	0
#107	+51.72	50	5	5	0	0
#108	+53.52	50	5	5	0	0
#109	+55.31	50	5	5	0	0
#110	+57.10	50	5	5	0	0
#111	+58.88	50	5	5	0	0
#112	+60.67	75	100	100	100	0
#113	+62.45	75	100	100	100	0

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Table 3 – Continued

BRC	latitude	landfraction	orbit1 albedo	orbit2 albedo	orbit3 albedo	orbit4 albedo
#114	+64.22	75	100	100	100	0
#115	+66.00	75	100	100	100	0
#116	+67.76	75	100	100	100	0
#117	+69.52	75	100	100	100	0
#118	+71.28	75	100	100	100	0
#119	+73.02	25	100	0	0	0
#120	+74.75	25	100	0	0	0
#121	+76.46	25	100	0	0	0
#122	+78.14	25	100	0	0	0
#123	+79.78	25	100	0	0	0
#124	+81.37	25	100	0	0	0
#125	+82.85	0	0	0	0	0
#126	+84.14	0	0	0	0	0
#127	+85.11	0	0	0	0	0
#128	+85.53	0	0	0	0	0
#129	+85.26	0	0	0	0	0
#130	+84.39	0	0	0	0	0
#131	+83.15	0	0	0	0	0
#132	+81.70	25	100	0	0	0
#133	+80.14	25	100	0	0	0
#134	+78.50	25	100	0	0	0
#135	+76.83	25	100	0	0	0
#136	+75.12	25	100	0	0	0
#137	+73.40	25	100	0	0	0
#138	+71.66	75	100	100	100	0
#139	+69.91	75	100	100	100	0
#140	+68.15	75	100	100	100	0
#141	+66.38	75	100	100	100	0
#142	+64.61	75	100	100	100	0
#143	+62.84	75	100	100	100	0
#144	+61.06	75	100	100	100	0
#145	+59.27	50	5	5	0	0
#146	+57.49	50	5	5	0	0
#147	+55.70	50	5	5	0	0
#148	+53.91	50	5	5	0	0
#149	+52.12	50	5	5	0	0
#150	+50.32	50	5	5	0	0
#151	+48.52	50	5	5	0	0
#152	+46.73	50	5	5	0	0
#153	+44.93	50	5	5	0	0
#154	+43.13	50	5	5	0	0
#155	+41.32	50	5	5	0	0
#156	+39.52	50	5	5	0	0
#157	+37.72	50	5	5	0	0
#158	+35.91	50	5	5	0	0
#159	+34.10	50	5	5	0	0
#160	+32.02	50	5	5	0	0
#161	+30.49	50	5	5	0	0
#162	+28.68	50	5	5	0	0

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Table 3 – Continued						
BRC	latitude	landfraction	orbit1 albedo	orbit2 albedo	orbit3 albedo	orbit4 albedo
#163	+26.87	50	5	5	0	0
#164	+25.06	50	5	5	0	0
#165	+23.25	25	5	0	0	0
#166	+21.44	25	5	0	0	0
#167	+19.62	25	5	0	0	0
#168	+17.81	25	5	0	0	0
#169	+16.00	25	5	0	0	0
#170	+14.18	25	5	0	0	0
#171	+12.37	25	5	0	0	0
#172	+10.55	25	5	0	0	0
#173	+8.74	25	5	0	0	0
#174	+6.93	25	5	0	0	0
#175	+5.11	25	5	0	0	0
#176	+3.30	25	5	0	0	0
#177	+1.48	25	5	0	0	0
#178	-0.32	25	5	0	0	0
#179	-2.13	25	5	0	0	0
#180	-3.95	25	5	0	0	0
#181	-5.76	25	5	0	0	0
#182	-7.57	25	5	0	0	0
#183	-9.38	25	5	0	0	0
#184	-11.19	25	5	0	0	0
#185	-13.00	25	5	0	0	0
#186	-14.81	25	5	0	0	0
#187	-16.61	25	5	0	0	0
#188	-18.42	25	5	0	0	0
#189	-20.23	25	5	0	0	0
#190	-22.03	25	5	0	0	0
#191	-23.83	25	5	0	0	0
#192	-25.63	25	5	0	0	0
#193	-27.43	25	5	0	0	0
#194	-29.23	25	5	0	0	0
#195	-31.02	25	5	0	0	0
#196	-32.81	25	5	0	0	0
#197	-34.60	0	0	0	0	0
#198	-36.39	0	0	0	0	0
#199	-38.18	0	0	0	0	0
#200	-39.96	0	0	0	0	0

Atmospheric Conditions

Similar to test case #0205 defined in section 13.6.

E2S Scenario

A yaw-angle pointing error of 2 mrad is assumed. No randomization of photocounts, Mie rangebins are concentrated on the lower 16 km of the profile, while Rayleigh rangebins extend to above 27 km (WVM2).

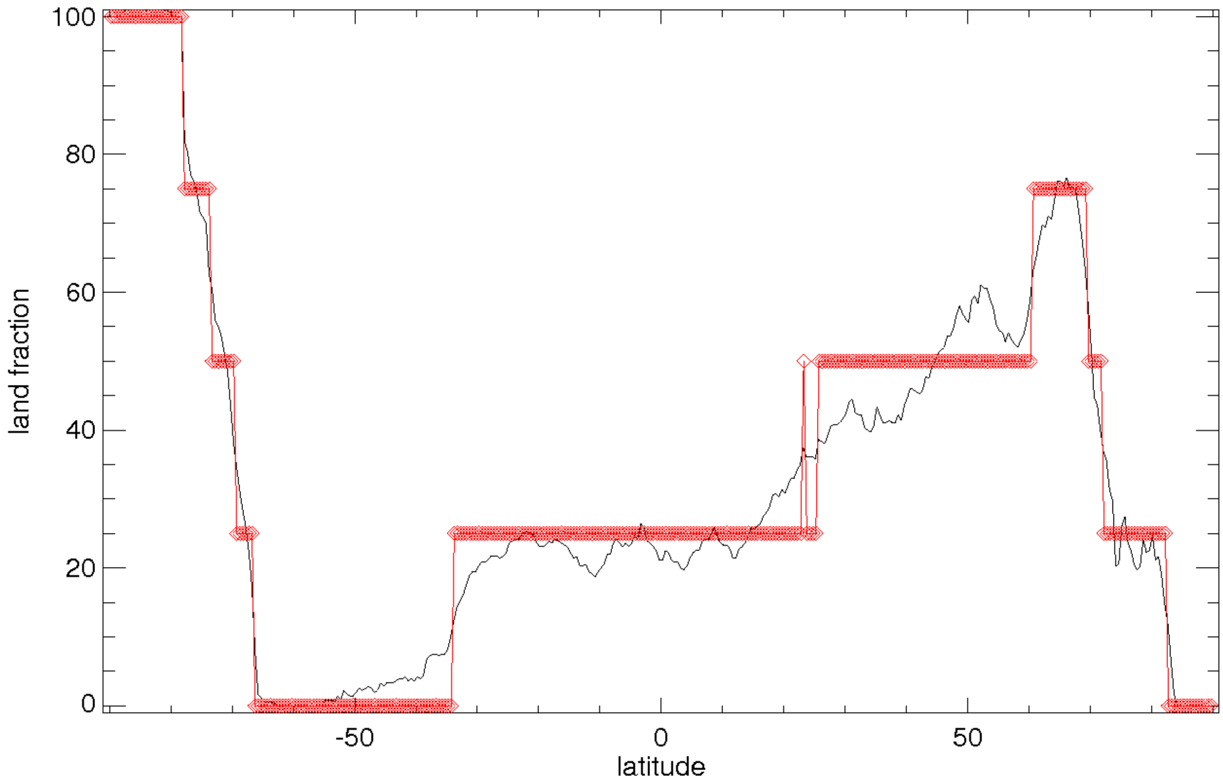

Figure 39: Land fraction as function of latitude, used as basis for constructing the variable albedo of experiments test #0206 and test #207. The levels 0, 25%, 50%, 75% and 100% are indicated by the red diamonds.

L1B Settings

The switches Mie_Ground_Correction_Weighting_Factor and Rayleigh_Ground_Correction_Weighting_Factor are both set to the value of 0.0, so no ZWC corrections are applied.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass / Fail Criteria

Due to the yaw-angle mispointing a strong hlos bias is expected in the output, both in ground and atmospheric returns. The bias in ground and atmospheric retrievals must be in the same order of magnitude, and the correction reported in the L1B ZWC file should allow correcting the bias completely. Since a constant input wind of 0 ms^{-1} was assumed, the std of the ground returns, both from hlos retrievals and from the ZWC algorithm should be low (less then 0.15 ms^{-1}). The amount of valid ground returns should be substantially less than what was reported in experiment #0205 in section 13.7 because of the many BRC's with low and zero albedo in this text.

No constraints are placed on the atmospheric results, since this test focusses mainly on ground calibration issues.

Comments

t.b.d.

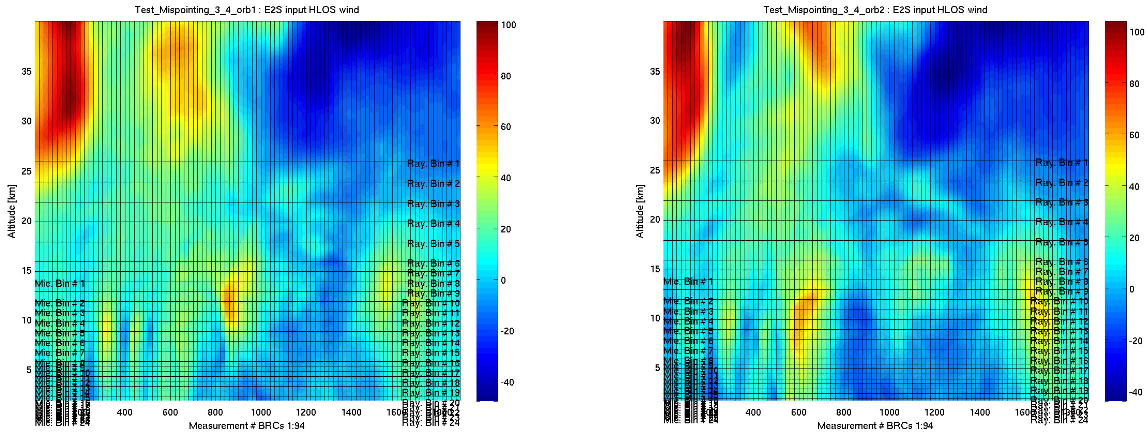

Figure 40: Input hlos wind as used for input by test #0207, for the first (left panel) and second (right panel) half orbit.

13.8 Test case #0207: Yaw-angle mispointing, varying albedo and variable wind

This testcase is split into eight scripts, named: TEST_Mispointing_3_4_orb1.py, TEST_Mispointing_3_4_orb2.py, TEST_Mispointing_3_4_orb3.py, TEST_Mispointing_3_4_orb4.py, TEST_Mispointing_3_4_orb5.py, TEST_Mispointing_3_4_ TEST_Mispointing_3_4_orb7.py, and TEST_Mispointing_3_4_orb8.py. Each script processes about half an orbit of data, so together about 4 whole orbits of data are simulated.

Purpose

This test case has a clear mis pointing error, and allows to test the Harmonic Bias Estimator (HBE) tool. At a later stage it must be verified that the produced bias in hlos winds can be corrected for by using the ZWC correction mechanism. This test assumes a variable albedo, depending on location (land, sea or ice), and ads a variable wind taken from a NWP model to include surface wind contamination in the ground echo result. This should allow to test more realistic ground returns than simulated in the 3 earlier tests.

Test Data Sets

Test_Mispointing_3_4_orb1.tgz, Test_Mispointing_3_4_orb2.tgz, Test_Mispointing_3_4_orb3.tgz, Test_Mispointing_3_4_orb4. Test_Mispointing_3_4_orb5.tgz, Test_Mispointing_3_4_orb6.tgz, Test_Mispointing_3_4_orb7.tgz, and Test_Mispointing_3_4_o each composed of almost half an orbit, which together form 150.400 km of data, 752 BRCs.

Albedo conditions

This test uses the same variable albedo as test #0206, as defined in section 13.7.

Atmospheric Conditions

Similar to test case #0205 defined in section 13.6. Now also NWP winds are used as input. These are taken along the orbit of the CALIPSO data at the appropriate time, see Figures 40, 41, 42 and 43. Interpolation between atmospheric profiles is switched on.

E2S Scenario

A yaw-angle pointing error of 2 mrad is assumed. No randomization of photocounts, Mie rangebins are concentrated on the lower 16 km of the profile, while Rayleigh rangebins extend to above 27 km (WVM2).

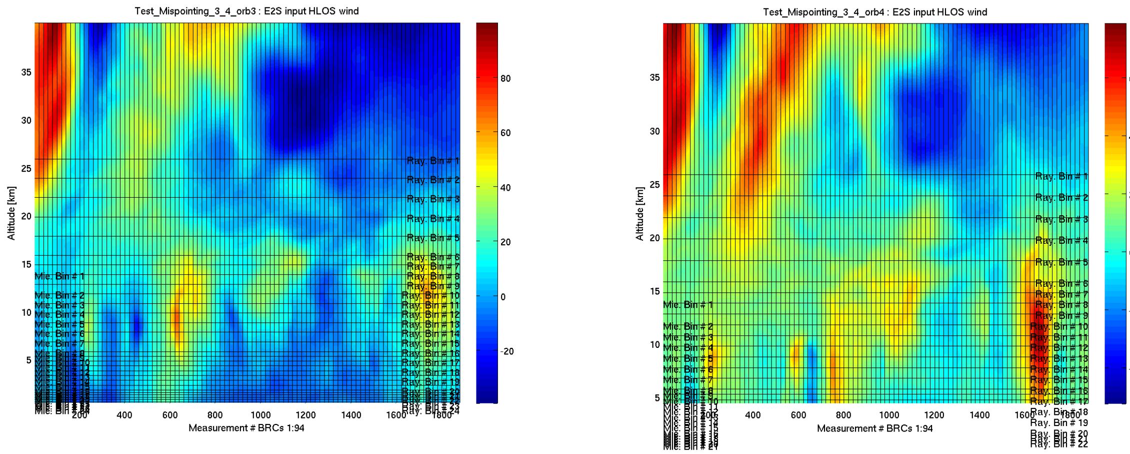

Figure 41: Input hlos wind as used for input by test #0207, for the third (left panel) and fourth (right panel) half orbit.

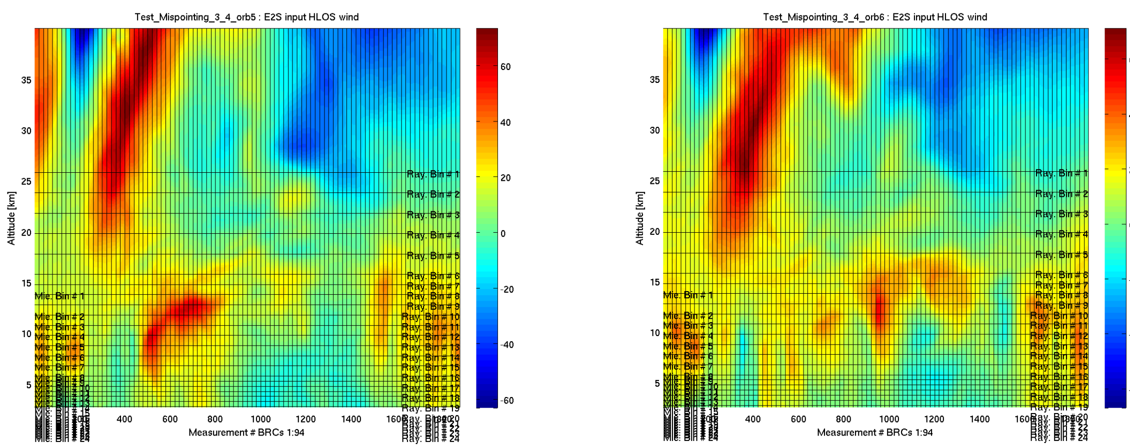

Figure 42: Input hlos wind as used for input by test #0207, for the fifth (left panel) and sixth (right panel) half orbit.

L1B Settings

The switches Mie_Ground_Correction_Weighting_Factor and Rayleigh_Ground_Correction_Weighting_Factor are both set to the value of 0.0, so no ZWC corrections are applied.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass / Fail Criteria

Due to the yaw-angle mispointing a strong hlos bias is expected in the output, both in ground and atmospheric returns. The bias in ground and atmospheric retrievals must be in the same order of magnitude, and the correction reported in the L1B ZWC file should allow correcting the bias completely. Since a variable surface input wind is present, the std of the ground returns, both from hlos retrievals and from the ZWC

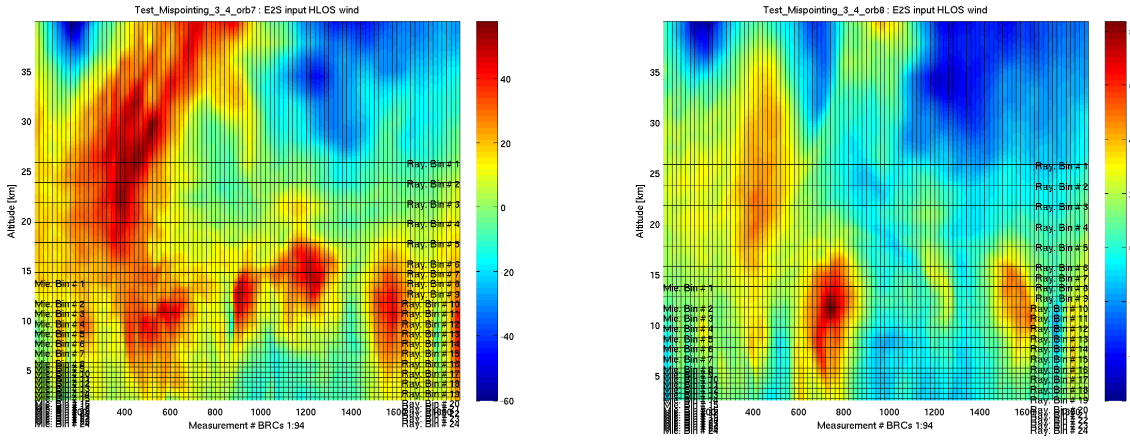

Figure 43: Input hlos wind as used for input by test #0207, for the seventh (left panel) and eigth (right panel) half orbit.

algorithm will be high. However, on average the corrections should be equal to the correction found in the previous tests (for example test #0204 defined in section 13.5).

No constraints are placed on the atmospheric results, since this test focusses mainly on ground calibration issues.

Comments

t.b.d.

13.9 Test case #0208: Scan-angle mispointing

This testcase is split into two scripts, named: TEST_Mispointing_4_1_orb1.py, and TEST_Mispointing_4_1_orb2.py. Each script processes about half an orbit of data, so together about 1 orbit of data is simulated. It was added as requested on L1B PM15.

Purpose

This test case has a clear mis pointing error, and allows to test the Harmonic Bias Estimator (HBE) tool. A scan angle bias (also known as roll angle) will cause a conversion error when going from los to hlos and vice versa. At a later stage it must be verified that the produced bias in hlos winds can be corrected for by using the ZWC correction mechanism.

Test Data Sets

Test_Mispointing_4_1_orb1.tgz, and Test_Mispointing_4_1_orb1.tgz, each composed of almost half an orbit, which together form 37.600 km of data, 188 BRCs.

Atmospheric Conditions

See test case #0204 defined in section 13.5, but for this test only the first 2 half orbits are used.

E2S Scenario

A scan-angle pointing error of 2 mrad is assumed. No randomization of photocounts, Mie rangebins are concentrated on the lower 16 km of the profile, while Rayleigh rangebins extend to above 27 km (WVM2).

L1B Settings

The switches Mie_Ground_Correction_Weighting_Factor and Rayleigh_Ground_Correction_Weighting_Factor are both set to the value of 0.0, so no ZWC corrections are applied.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass / Fail Criteria

Due to the scan-angle mispointing the los to hlos conversion introduces errors. However, since this test case uses zero input wind no hlos bias is expected in the output, both in ground and atmospheric returns. Since a constant input wind of 0 ms^{-1} was assumed, the std of the ground returns, both from hlos retrievals and from the ZWC algorithm should be low (less then 0.15 ms^{-1}).

No constraints are placed on the atmospheric results, since this test focusses mainly on ground calibration issues.

Comments

t.b.d.

13.10 Test case #0209: Scan-angle mispointing, varying albedo, variable wind

This testcase is split into two scripts, named: TEST_Mispointing_4_2_orb1.py, and TEST_Mispointing_4_2_orb2.py. Each script processes about half an orbit of data, so together about 1 orbit of data is simulated. It was added as requested on L1B PM15.

Purpose

This test case has a clear mis pointing error, and allows to test the Harmonic Bias Estimator (HBE) tool. A scan angle bias (also known as roll angle) will cause a conversion error when going from los to hlos and vice versa. At a later stage it must be verified that the produced bias in hlos winds can be corrected for by using the ZWC correction mechanism. This test has variable albedo and variable input wind.

Test Data Sets

Test_Mispointing_4_2_orb1.tgz, and Test_Mispointing_4_2_orb1.tgz, each composed of almost half an orbit, which together form 37.600 km of data, 188 BRCs.

Atmospheric Conditions

See test case #0208 defined in section 13.9. In addition the variable albedo as defined in the first orbit of section 13.7 is used. Also the input wind as defined in the first orbit of section 13.8 has been used.

E2S Scenario

A scan-angle pointing error of 2 mrad is assumed. No randomization of photocounts, Mie rangebins are concentrated on the lower 16 km of the profile, while Rayleigh rangebins extend to above 27 km (WVM2).

L1B Settings

The switches Mie_Ground_Correction_Weighting_Factor and Rayleigh_Ground_Correction_Weighting_Factor are both set to the value of 0.0, so no ZWC corrections are applied.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass / Fail Criteria

Due to the scan-angle mispointing the los to hlos conversion introduces errors. Due to the variable non-zero input wind this will result in noticable bias in the output, both in ground and atmospheric returns. Due to the variable albedo and atmosphere only a limited number of usable ground returns for ZWC is expected. The spread of the ground echo should be sufficient to resolve at least the highest order harmonic by the HBE tool.

No constraints are placed on the atmospheric results, since this test focusses mainly on ground calibration issues.

Comments

t.b.d.

14 VAMP alternative range bin cases

14.1 Introduction

Tests #0301 until #0322 as defined in sections 14.2 until 14.23 have been defined to perform functional testing on the range bin definitions proposed by the VAMP study (see [RD13]). The main purpose of these tests is to verify that the proposed range bin definitions can be handled by all processing stages. This includes range bin definitions without ground echoes, definitions with limited overlap between the Mie and Rayleigh channel, and definitions with large overlap (several Mie bins inside a single Rayleigh bin). The opposite case, several Rayleigh bins inside a single Mie bin has not yet been defined (todo: define a functional test case for this situation as well).

14.2 Test case #0301: VAMP test: DEFAULT range bin definition

Purpose

Test the ability of the L2B processor to handle the DEFAULT range bin definition. This is the default definition provided with the E2S software. This is mainly a functional test for all processing stages including the matlab plotting tools. However, since this is an academic noiseless case, the wind error standard deviation and bias should be very small.

Test Data Set

TEST_TN3_1_0301, Composed of 2 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter_and_cirrus) displayed in Figure 5 (vertical resolution = 125m). A constant zero wind is used. Background aerosols (backscatter and extinction) and the cloud layer are as defined in the single_RMA_profile_subarctic_winter_and_cirrus RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts. The default range bin definition named DEFAULT has been used.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

All processing stages should run without crashing, and since this is a simple noiseless case biases in HLOS winds must be within the ADM requirement of 0.1 ms^{-1}.

Comments

t.b.d.

14.3 Test case #0302: VAMP test: WVM1 range bin definition

Purpose

Test the ability of the L2B processor to handle the WVM1 range bin definition. This definition was provided by ESA and has been designed to have maximum 1-to-1 overlap between the Rayleigh and Mie channel, as well as ground returns for both channels (see [RD13], section 6.1.1).

This is mainly a functional test for all processing stages including the matlab plotting tools. However, since this is an academic noiseless case, the wind error standard deviation and bias should be very small.

This test is identical to test #0301 except for the difference in range bin definition.

Test Data Set

TEST_TN3_1_0302, Composed of 2 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter_and_cirrus) displayed in Figure 5 (vertical resolution = 125m). A constant zero wind is used. Background aerosols (backscatter and extinction) and the cloud layer are as defined in the single_RMA_profile_subarctic_winter_and_cirrus RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

All processing stages should run without crashing, and since this is a simple noiseless case biases in HLOS winds must be within the ADM requirement of 0.1 ms^{-1}.

Comments

t.b.d.

14.4 Test case #0303: VAMP test: WVM2 range bin definition

Purpose

Test the ability of the L2B processor to handle the WVM2 range bin definition. This definition was provided by ESA and has been designed to have optimal zero-wind-calibration results for the Mie channel, and puts many range bins in the PBL. (see [RD13], section 6.1.2). The Rayleigh bins are streched upto 28 km. Both channels are configured to observe ground returns.

This is mainly a functional test for all processing stages including the matlab plotting tools. However, since this is an academic noiseless case, the wind error standard deviation and bias should be very small.

This test is identical to test #0301 except for the difference in range bin definition.

Test Data Set

TEST_TN3_1_0303, Composed of 2 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter_and_cirrus) displayed in Figure 5 (vertical resolution = 125m). A constant zero wind is used. Background aerosols (backscatter and extinction) and the cloud layer are as defined in the single_RMA_profile_subarctic_winter_and_cirrus RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts. The range bin definition WVM2 has been used.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

All processing stages should run without crashing, and since this is a simple noiseless case biases in HLOS winds must be within the ADM requirement of 0.1 ms^{-1}.

Comments

t.b.d.

14.5 Test case #0304: VAMP test: WVM_TR_ZWC1 range bin definition

Purpose

Test the ability of the L2B processor to handle the WVM_TR_ZWC1 range bin definition. This definition has been composed in the VAMP project, focusses on the tropical atmosphere, and does include ground overlap for the Mie channel (see [RD13], section 6.2.1).

This is mainly a functional test for all processing stages including the matlab plotting tools. However, since this is an academic noiseless case, the wind error standard deviation and bias should be very small.

This test is identical to test #0301 except for the difference in range bin definition.

Test Data Set

TEST_TN3_1_0304, Composed of 2 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter_and_cirrus) displayed in Figure 5 (vertical resolution = 125m). A constant zero wind is used. Background aerosols (backscatter and extinction) and the cloud layer are as defined in the single_RMA_profile_subarctic_winter_and_cirrus RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts. The range bin definition WVM_TR_ZWC1 has been used.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

All processing stages should run without crashing, and since this is a simple noiseless case biases in HLOS winds must be within the ADM requirement of 0.1 ms^{-1}.

Comments

t.b.d.

14.6 Test case #0305: VAMP test: WVM_TR_NOZWC1 range bin definition

Purpose

Test the ability of the L2B processor to handle the WVM_TR_NOZWC1 range bin definition. This definition has been composed in the VAMP project, focusses on the tropical atmosphere, and does not include ground overlap for the Mie channel (see [RD13], section 6.2.2).

This is mainly a functional test for all processing stages including the matlab plotting tools. However, since this is an academic noiseless case, the wind error standard deviation and bias should be very small.

This test is identical to test #0301 except for the difference in range bin definition.

Test Data Set

TEST_TN3_1_0305, Composed of 2 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter_and_cirrus) displayed in Figure 5 (vertical resolution = 125m). A constant zero wind is used. Background aerosols (backscatter and extinction) and the cloud layer are as defined in the single_RMA_profile_subarctic_winter_and_cirrus RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts. The range bin definition WVM_TR_NOZWC1 has been used.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

All processing stages should run without crashing, and since this is a simple noiseless case biases in HLOS winds must be within the ADM requirement of 0.1 ms^{-1}.

Comments

t.b.d.

14.7 Test case #0306: VAMP test: WVM_ET_ZWC1 range bin definition

Purpose

Test the ability of the L2B processor to handle the WVM_ET_ZWC1 range bin definition. This definition has been composed in the VAMP project, focusses on the tropical atmosphere, and does include ground overlap for the Mie channel (see [RD13], section 6.2.3).

This is mainly a functional test for all processing stages including the matlab plotting tools. However, since this is an academic noiseless case, the wind error standard deviation and bias should be very small.

This test is identical to test #0301 except for the difference in range bin definition.

Test Data Set

TEST_TN3_1_0306, Composed of 2 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter_and_cirrus) displayed in Figure 5 (vertical resolution = 125m). A constant zero wind is used. Background aerosols (backscatter and extinction) and the cloud layer are as defined in the single_RMA_profile_subarctic_winter_and_cirrus RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts. The range bin definition WVM_ET_ZWC1 has been used.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

All processing stages should run without crashing, and since this is a simple noiseless case biases in HLOS winds must be within the ADM requirement of 0.1 ms^{-1}.

Comments

t.b.d.

14.8 Test case #0307: VAMP test: WVM_ET_NOZWC1 range bin definition

Purpose

Test the ability of the L2B processor to handle the WVM_ET_NOZWC1 range bin definition. This definition has been composed in the VAMP project, focusses on the tropical atmosphere, and does not include ground overlap for the Mie channel (see [RD13], section 6.2.4).

This is mainly a functional test for all processing stages including the matlab plotting tools. However, since this is an academic noiseless case, the wind error standard deviation and bias should be very small.

This test is identical to test #0301 except for the difference in range bin definition.

Test Data Set

TEST_TN3_1_0307, Composed of 2 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter_and_cirrus) displayed in Figure 5 (vertical resolution = 125m). A constant zero wind is used. Background aerosols (backscatter and extinction) and the cloud layer are as defined in the single_RMA_profile_subarctic_winter_and_cirrus RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts. The range bin definition WVM_ET_NOZWC1 has been used.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

All processing stages should run without crashing, and since this is a simple noiseless case biases in HLOS winds must be within the ADM requirement of 0.1 ms^{-1}.

Comments

t.b.d.

14.9 Test case #0308: VAMP test: WVM_TR_ZWC2 range bin definition

Purpose

Test the ability of the L2B processor to handle the WVM_TR_ZWC2 range bin definition. This definition has been composed in the VAMP project, focusses on the tropical atmosphere, and does include ground overlap for the Mie channel (see [RD13], section 6.3.1). It differs from WVM_TR_ZWC1 by putting more Mie bins around tropopause level.

This is mainly a functional test for all processing stages including the matlab plotting tools. However, since this is an academic noiseless case, the wind error standard deviation and bias should be very small.

This test is identical to test #0301 except for the difference in range bin definition.

Test Data Set

TEST_TN3_1_0308, Composed of 2 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter_and_cirrus) displayed in Figure 5 (vertical resolution = 125m). A constant zero wind is used. Background aerosols (backscatter and extinction) and the cloud layer are as defined in the single_RMA_profile_subarctic_winter_and_cirrus RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts. The range bin definition WVM_TR_ZWC2 has been used.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

All processing stages should run without crashing, and since this is a simple noiseless case biases in HLOS winds must be within the ADM requirement of 0.1 ms^{-1}.

Comments

t.b.d.

14.10 Test case #0309: VAMP test: WVM_TR_NOZWC2 range bin definition

Purpose

Test the ability of the L2B processor to handle the WVM_TR_NOZWC2 range bin definition. This definition has been composed in the VAMP project, focusses on the tropical atmosphere, and does not include ground overlap for the Mie channel (see [RD13], section 6.3.2). It differs from WVM_TR_NOZWC1 by putting more Mie bins around tropopause level.

This is mainly a functional test for all processing stages including the matlab plotting tools. However, since this is an academic noiseless case, the wind error standard deviation and bias should be very small.

This test is identical to test #0301 except for the difference in range bin definition.

Test Data Set

TEST_TN3_1_0309, Composed of 2 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter_and_cirrus) displayed in Figure 5 (vertical resolution = 125m). A constant zero wind is used. Background aerosols (backscatter and extinction) and the cloud layer are as defined in the single_RMA_profile_subarctic_winter_and_cirrus RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts. The range bin definition WVM_TR_NOZWC2 has been used.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

All processing stages should run without crashing, and since this is a simple noiseless case biases in HLOS winds must be within the ADM requirement of 0.1 ms^{-1}.

Comments

t.b.d.

14.11 Test case #0310: VAMP test: WVM_ET_ZWC2 range bin definition

Purpose

Test the ability of the L2B processor to handle the WVM_ET_ZWC2 range bin definition. This definition has been composed in the VAMP project, focusses on the tropical atmosphere, and does include ground overlap for the Mie channel (see [RD13], section 6.3.3). It differs from WVM_ET_ZWC1 by putting more Mie bins around tropopause level.

This is mainly a functional test for all processing stages including the matlab plotting tools. However, since this is an academic noiseless case, the wind error standard deviation and bias should be very small.

This test is identical to test #0301 except for the difference in range bin definition.

Test Data Set

TEST_TN3_1_0310, Composed of 2 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter_and_cirrus) displayed in Figure 5 (vertical resolution = 125m). A constant zero wind is used. Background aerosols (backscatter and extinction) and the cloud layer are as defined in the single_RMA_profile_subarctic_winter_and_cirrus RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts. The range bin definition WVM_ET_ZWC2 has been used.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

All processing stages should run without crashing, and since this is a simple noiseless case biases in HLOS winds must be within the ADM requirement of 0.1 ms^{-1}.

Comments

t.b.d.

14.12 Test case #0311: VAMP test: WVM_ET_NOZWC2 range bin definition

Purpose

Test the ability of the L2B processor to handle the WVM_ET_NOZWC2 range bin definition. This definition has been composed in the VAMP project, focusses on the tropical atmosphere, and does not include ground overlap for the Mie channel (see [RD13], section 6.3.4). It differs from WVM_ET_NOZWC1 by putting more Mie bins around tropopause level.

This is mainly a functional test for all processing stages including the matlab plotting tools. However, since this is an academic noiseless case, the wind error standard deviation and bias should be very small.

This test is identical to test #0301 except for the difference in range bin definition.

Test Data Set

TEST_TN3_1_0311, Composed of 2 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter_and_cirrus) displayed in Figure 5 (vertical resolution = 125m). A constant zero wind is used. Background aerosols (backscatter and extinction) and the cloud layer are as defined in the single_RMA_profile_subarctic_winter_and_cirrus RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts. The range bin definition WVM_ET_NOZWC2 has been used.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

All processing stages should run without crashing, and since this is a simple noiseless case biases in HLOS winds must be within the ADM requirement of 0.1 ms^{-1}.

Comments

t.b.d.

14.13 Test case #0312: VAMP test: WVM1_1km range bin definition

Purpose

Test the ability of the L2B processor to handle the WVM1_1km range bin definition. This is a modified version of the WVM1 definition and has changed the Rayleigh range bins to have a minimum size of 1 km (see [RD13], section 6.4.1).

This is mainly a functional test for all processing stages including the matlab plotting tools. However, since this is an academic noiseless case, the wind error standard deviation and bias should be very small.

This test is identical to test #0301 except for the difference in range bin definition.

Test Data Set

TEST_TN3_1_0312, Composed of 2 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter_and_cirrus) displayed in Figure 5 (vertical resolution = 125m). A constant zero wind is used. Background aerosols (backscatter and extinction) and the cloud layer are as defined in the single_RMA_profile_subarctic_winter_and_cirrus RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1_1km).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

All processing stages should run without crashing, and since this is a simple noiseless case biases in HLOS winds must be within the ADM requirement of 0.1 ms^{-1}.

Comments

t.b.d.

14.14 Test case #0313: VAMP test: WVM2_1km range bin definition

Purpose

Test the ability of the L2B processor to handle the WVM2_1km range bin definition. This is a modified version of the WVM2 definition and has changed the Rayleigh range bins to have a minimum size of 1 km (see [RD13], section 6.4.2).

This is mainly a functional test for all processing stages including the matlab plotting tools. However, since this is an academic noiseless case, the wind error standard deviation and bias should be very small.

This test is identical to test #0301 except for the difference in range bin definition.

Test Data Set

TEST_TN3_1_0313, Composed of 2 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter_and_cirrus) displayed in Figure 5 (vertical resolution = 125m). A constant zero wind is used. Background aerosols (backscatter and extinction) and the cloud layer are as defined in the single_RMA_profile_subarctic_winter_and_cirrus RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts. The range bin definition WVM2_1km has been used.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

All processing stages should run without crashing, and since this is a simple noiseless case biases in HLOS winds must be within the ADM requirement of 0.1 ms^{-1}.

Comments

t.b.d.

14.15 Test case #0314: VAMP test: WVM_TR_ZWC1_1km range bin definition

Purpose

Test the ability of the L2B processor to handle the WVM_TR_ZWC1_1km range bin definition. This is a modified version of the WVM_TR_ZWC1 definition and has changed the Rayleigh range bins to have a minimum size of 1 km (see [RD13], section 6.4.3).

This is mainly a functional test for all processing stages including the matlab plotting tools. However, since this is an academic noiseless case, the wind error standard deviation and bias should be very small.

This test is identical to test #0301 except for the difference in range bin definition.

Test Data Set

TEST_TN3_1_0314, Composed of 2 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter_and_cirrus) displayed in Figure 5 (vertical resolution = 125m). A constant zero wind is used. Background aerosols (backscatter and extinction) and the cloud layer are as defined in the single_RMA_profile_subarctic_winter_and_cirrus RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts. The range bin definition WVM_TR_ZWC1_1km has been used.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

All processing stages should run without crashing, and since this is a simple noiseless case biases in HLOS winds must be within the ADM requirement of 0.1 ms^{-1}.

Comments

t.b.d.

14.16 Test case #0315: VAMP test: WVM_TR_NOZWC1_1km range bin definition

Purpose

Test the ability of the L2B processor to handle the WVM_TR_NOZWC1_1km range bin definition. This is a modified version of the WVM_TR_NOZWC1 definition and has changed the Rayleigh range bins to have a minimum size of 1 km (see [RD13], section 6.4.4).

This is mainly a functional test for all processing stages including the matlab plotting tools. However, since this is an academic noiseless case, the wind error standard deviation and bias should be very small.

This test is identical to test #0301 except for the difference in range bin definition.

Test Data Set

TEST_TN3_1_0315, Composed of 2 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter_and_cirrus) displayed in Figure 5 (vertical resolution = 125m). A constant zero wind is used. Background aerosols (backscatter and extinction) and the cloud layer are as defined in the single_RMA_profile_subarctic_winter_and_cirrus RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts. The range bin definition WVM_TR_NOZWC1_1km has been used.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

All processing stages should run without crashing, and since this is a simple noiseless case biases in HLOS winds must be within the ADM requirement of 0.1 ms^{-1}.

Comments

t.b.d.

14.17 Test case #0316: VAMP test: WVM_ET_ZWC1_1km range bin definition

Purpose

Test the ability of the L2B processor to handle the WVM_ET_ZWC1_1km range bin definition. This is a modified version of the WVM_ET_ZWC1 definition and has changed the Rayleigh range bins to have a minimum size of 1 km (see [RD13], section 6.4.5).

This is mainly a functional test for all processing stages including the matlab plotting tools. However, since this is an academic noiseless case, the wind error standard deviation and bias should be very small.

This test is identical to test #0301 except for the difference in range bin definition.

Test Data Set

TEST_TN3_1_0316, Composed of 2 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter_and_cirrus) displayed in Figure 5 (vertical resolution = 125m). A constant zero wind is used. Background aerosols (backscatter and extinction) and the cloud layer are as defined in the single_RMA_profile_subarctic_winter_and_cirrus RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts. The range bin definition WVM_ET_ZWC1_1km has been used.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

All processing stages should run without crashing, and since this is a simple noiseless case biases in HLOS winds must be within the ADM requirement of 0.1 ms^{-1}.

Comments

t.b.d.

14.18 Test case #0317: VAMP test: WVM_ET_NOZWC1_1km range bin definition

Purpose

Test the ability of the L2B processor to handle the WVM_ET_NOZWC1_1km range bin definition. This is a modified version of the WVM_ET_NOZWC1 definition and has changed the Rayleigh range bins to have a minimum size of 1 km (see [RD13], section 6.4.6).

This is mainly a functional test for all processing stages including the matlab plotting tools. However, since this is an academic noiseless case, the wind error standard deviation and bias should be very small.

This test is identical to test #0301 except for the difference in range bin definition.

Test Data Set

TEST_TN3_1_0317, Composed of 2 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter_and_cirrus) displayed in Figure 5 (vertical resolution = 125m). A constant zero wind is used. Background aerosols (backscatter and extinction) and the cloud layer are as defined in the single_RMA_profile_subarctic_winter_and_cirrus RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts. The range bin definition WVM_ET_NOZWC1_1km has been used.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

All processing stages should run without crashing, and since this is a simple noiseless case biases in HLOS winds must be within the ADM requirement of 0.1 ms^{-1}.

Comments

t.b.d.

14.19 Test case #0318: VAMP test: WVM_TR_ZWC2_1km range bin definition

Purpose

Test the ability of the L2B processor to handle the WVM_TR_ZWC2_1km range bin definition. This is a modified version of the WVM_TR_ZWC2 definition and has changed the Rayleigh range bins to have a minimum size of 1 km (see [RD13], section 6.4.7).

This is mainly a functional test for all processing stages including the matlab plotting tools. However, since this is an academic noiseless case, the wind error standard deviation and bias should be very small.

This test is identical to test #0301 except for the difference in range bin definition.

Test Data Set

TEST_TN3_1_0318, Composed of 2 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter_and_cirrus) displayed in Figure 5 (vertical resolution = 125m). A constant zero wind is used. Background aerosols (backscatter and extinction) and the cloud layer are as defined in the single_RMA_profile_subarctic_winter_and_cirrus RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts. The range bin definition WVM_TR_ZWC2_1km has been used.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

All processing stages should run without crashing, and since this is a simple noiseless case biases in HLOS winds must be within the ADM requirement of 0.1 ms^{-1}.

Comments

t.b.d.

14.20 Test case #0319: VAMP test: WVM_TR_NOZWC2_1km range bin definition

Purpose

Test the ability of the L2B processor to handle the WVM_TR_NOZWC2_1km range bin definition. This is a modified version of the WVM_TR_NOZWC2 definition and has changed the Rayleigh range bins to have a minimum size of 1 km (see [RD13], section 6.4.8).

This is mainly a functional test for all processing stages including the matlab plotting tools. However, since this is an academic noiseless case, the wind error standard deviation and bias should be very small.

This test is identical to test #0301 except for the difference in range bin definition.

Test Data Set

TEST_TN3_1_0319, Composed of 2 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter_and_cirrus) displayed in Figure 5 (vertical resolution = 125m). A constant zero wind is used. Background aerosols (backscatter and extinction) and the cloud layer are as defined in the single_RMA_profile_subarctic_winter_and_cirrus RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts. The range bin definition WVM_TR_NOZWC2_1km has been used.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

All processing stages should run without crashing, and since this is a simple noiseless case biases in HLOS winds must be within the ADM requirement of 0.1 ms^{-1}.

Comments

t.b.d.

14.21 Test case #0320: VAMP test: WVM_ET_ZWC2_1km range bin definition

Purpose

Test the ability of the L2B processor to handle the WVM_ET_ZWC2_1km range bin definition. This is a modified version of the WVM_ET_ZWC2 definition and has changed the Rayleigh range bins to have a minimum size of 1 km (see [RD13], section 6.4.9).

This is mainly a functional test for all processing stages including the matlab plotting tools. However, since this is an academic noiseless case, the wind error standard deviation and bias should be very small.

This test is identical to test #0301 except for the difference in range bin definition.

Test Data Set

TEST_TN3_1_0320, Composed of 2 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter_and_cirrus) displayed in Figure 5 (vertical resolution = 125m). A constant zero wind is used. Background aerosols (backscatter and extinction) and the cloud layer are as defined in the single_RMA_profile_subarctic_winter_and_cirrus RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts. The range bin definition WVM_ET_ZWC2_1km has been used.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

All processing stages should run without crashing, and since this is a simple noiseless case biases in HLOS winds must be within the ADM requirement of 0.1 ms^{-1}.

Comments

t.b.d.

14.22 Test case #0321: VAMP test: WVM_ET_NOZWC2_1km range bin definition

Purpose

Test the ability of the L2B processor to handle the WVM_ET_NOZWC2_1km range bin definition. This is a modified version of the WVM_ET_NOZWC2 definition and has changed the Rayleigh range bins to have a minimum size of 1 km (see [RD13], section 6.4.10).

This is mainly a functional test for all processing stages including the matlab plotting tools. However, since this is an academic noiseless case, the wind error standard deviation and bias should be very small.

This test is identical to test #0301 except for the difference in range bin definition.

Test Data Set

TEST_TN3_1_0321, Composed of 2 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter_and_cirrus) displayed in Figure 5 (vertical resolution = 125m). A constant zero wind is used. Background aerosols (backscatter and extinction) and the cloud layer are as defined in the single_RMA_profile_subarctic_winter_and_cirrus RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts. The range bin definition WVM_ET_NOZWC2_1km has been used.

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

All processing stages should run without crashing, and since this is a simple noiseless case biases in HLOS winds must be within the ADM requirement of 0.1 ms^{-1}.

Comments

t.b.d.

14.23 Test case #0322: VAMP test: STRATOS range bin definition

Purpose

Test the ability of the L2B processor to handle the STRATOS range bin definition. This definition has been composed in the VAMP project, and tries to obtain Rayleigh measurements at very high altitudes in the stratosphere (see [RD13], section 6.5). Note that there is still uncertainty whether this particular definition is allowed, because some limits imposed in the on board software are maybe violated. It is not clear if these limits can be modified, or if any workaround is possible, but for the sake of scientific interest this definition has been added anyway. This is mainly a functional test for all processing stages including the matlab plotting tools. However, since this is an academic noiseless case, the wind error standard deviation and bias should be very small.

Test Data Set

TEST_TN3_1_0322, Composed of 2 BRCs.

Atmospheric Conditions

Horizontally homogeneous case characterized by the temperature and pressure profiles (single_RMA_profile_subarctic_winter_and_cirrus) displayed in Figure 5 (vertical resolution = 125m). A constant zero wind is used. Background aerosols (backscatter and extinction) and the cloud layer are as defined in the single_RMA_profile_subarctic_winter_and_cirrus RMA profiles.

E2S Scenario

No interpolation within segments, no AOCS errors, no random fluctuations in photocounts, almost perfect matching between Mie and Rayleigh height-bins (WVM1_1km).

L2B Settings

The classification algorithm uses the backscatter ratio threshold method.

Pass/Fail Criteria

All processing stages should run without crashing, and since this is a simple noiseless case biases in HLOS winds must be within the ADM requirement of 0.1 ms^{-1}.

Comments

t.b.d.

Appendix A

This is a copy of the email by Herbert Nett, send 23-May-2008, titled "specific L1B-L2B test cases (AI-12.3 of last L2B-PM)", in which the sequence of mispointing tests is proposed.

```
dear all,

In response to AI 12.3 of last week's L2B progress meeting I include
below a first outline of a test strategy related to mispointing effects
and zero wind correction handling.
Note that a total of 1 orbits would have to be simulated (using E2S)
for step 1, and 7 orbits for step 3.

Some optimization in the overall number of L1B/L2B processing runs
should be possible.

Any comments are welcome.

best regards,

Herbert


step 1
======
purpose:    verify correct functioning of L1bP, generation of
            M, R vecocity data, PCDs, ZWR data

Simulation: 1 full orbit of wind mode data, constant albedo,
            no mispointing  ('academic case')

scope / configuration:
conduct initial functional tests of L1B stage only. Cover the
following settings for handling of the zero wind reference
(M=Mie, R=Rayleigh):
a) use local zero wind reference (ZWR) per observation, ZWR-M for
   Mie channel and ZWR-R for Rayleigh
b) same as a) but use ZWR-M (plus offset, tbc) also for Rayleigh
c) use harmonic bias correction as per coefficients in file AUX_CHAR;
   all coefficients set to zero

step 2
======
(conditional to successful completion of step 1)

purpose:    verify correct functioning of L1bP+L2bP, specifically that
            correct ZWR references are extracted from L1B

Simulation: none, re-use L1B files from step 1

scope / configuration:
run L2B stage using L1B files produced under a)-c)


step 3
```

```
======
(conditional to successful completion of step 2)

purpose:    verify performance of L1bP & L2B stage, using realistic
            scenarios with and without pointing errors

Simulation: 1) two full orbit (#1, 2) with valid Mie ground echoes, no
               mispointing
            2) same as 1) but with pointing error included (e.g. yaw
               axis only, 2 mrad)
            3) same as 2) but with some segments with variable albedo,
               cloud scenes and some variable surface winds included
            4) 1 full orbit (#3) of wind mode data, realistic scenes
               (variable albedo, some cloud scenes included, ...)

scope / configuration:

a) run L1bP to produce ZWR aux files for two orbits, for cases 1)-3)
b) run harmonic bias estimator (HBE) using ZWR aux files produced for
   each of the cases 1)-3) as input. Generate a new AUX_CHAR file
   for each case.
c) run L1bP using full orbit under case 4), using different AUX_CHAR
   files obtained from simulations 1) - 3).
d) run L2B stage twice using the three different L1B files produced
   under c).
   -> Analyze random and systematic errors in L2B output.


Remark:
As Ad noted earlier, it may not be really necessary to run the entire
chain up to L2B each time, since the performance of the ZWC correction
in L1B (with or without HBE) provides information on systematic
zero wind errors expected in L2.
Also, a comparison of the HBE results for different qualities of input
data (simulations 1)-3) in step 3) should provide some information on
errors to be expected in the l2B output.
```

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