User Manual Measurement Space Visualisation Package

Version 1.0

J.A. Verspeek

Royal Netherlands Meteorological Institute (KNMI)
De Bilt, Netherlands

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1. Contents

2. Introduction

This document describes the visualization software for the measurement space and Geophysical Model Function for use with ERS and ASCAT data. The visualization software is developed in IDL for the OSISAF [FIGA 2004]. A 3D measurement space is defined in which the three coordinates correspond to a σ^0-triplet, so (x, y, z) = (σ^0_{fore} , σ^0_{aft} , σ^0_{mid}). See also [STOFFELEN 1998]. The Geophysical Model Function (GMF) is represented by a cone-shaped surface with mirror symmetry in the σ^0_{fore}=σ^0_{aft} plane. The ice line is lying in the σ^0_{fore}=σ^0_{aft} plane. The GMF can be shown, as well as the ice line and measurement triplets in σ^0-space. The use can choose between linear or logarithmic scale, as well as representation in z-space, a transformation of the σ^0-space. For 2D visualization the use can select the plane on which the 3D visualization is projected. Measurement points within a certain distance from this plane are shown. The use can provide the value of this distance.

3. Running the program

The IDL source code “sigmaspace.pro” is located in CVS repository NWPSAF module “icemodel”. This module can be retrieved with the command:

```
vbcvs checkout –P icemodel
```

The visualization software is located in subdirectory

$CVSDIR/icemodel/idl6/sigmaspace/sigmaspace2d

Where CVSDIR is the directory where the CVS checkout command has been given.
Example runs are located in the example subdirectory

$CVSDIR/icemodel/idl6/sigmaspace/sigmaspace2d/example

The IDL sourcefile sigmaspace.pro contains the subroutines sigmaspace2d and sigmaspace3d for 2D and 3D visualization respectively. It also contains subroutines for the windcone (CMOD5 and CMOD4) and for the iceline.

In the same directory the Python scripts sigmaspace2d.py and sigmaspace3d.py are located, which are best used for a first run of the visualization.

```
sigmaspace2d.py|sigmaspace3d.py <, datafile>
      <datafile>  -    File containing the measurement triplets
```

The Python scripts generate an IDL-script with extension .idl added to the data input file: <datafile>.idl. The Python scripts call IDL to execute this script. The IDL scriptfile can then be modified with an ASCII editor and executed directly:

idl <idlfile>

<idlfile> - IDL scriptfile

The graph has zoom, rotate and translate options. Both versions have print options via the "export" menu option in several graphical output formats, including postscript, bitmap, and png format.

Command Line Options

The programs have a lot of optional parameters which may be specified. When omitted they will get their default value.

sigmaspace2d <, inFile> [, option=<optionValue>]

with <> indicating non-obligatory input, [] indicating obligatory input, and | indicating alternatives. The following command line options are available:

inFile This Name of the input file containing the data to be plotted. When inFile is defined, the use of metaInfile is overruled. When inFile and metaInfile are omitted no data points will be plotted.

metaInfile Name of the metafile containing the filenames to read the data from. When meatInfile is omitted, parameter inFile is used.

nNode Node number [1..19] for ERS, [1..21] for ASCAT

plotTitle Plot title

plotIceline =1 plot iceline, =0 don't plot iceline

plotWindcone =1 plot windcone, =0 don't plot windcone

satellite =1 ERS1, =2 ERS2, =4 METOP-A

cmod =5 use CMOD5, =4 use CMOD4

v_phi_const ='v=c' plot curves of constant speed
='phi=c' plot curves of constant azimuth angle

iMax, jMax Mesh parameters. In the wind velocity (v) direction the cone is divided in iMax meshes. In order to plot curve of constant v set vMax = vMin and iMax = 1

In the wind azimuth coordinate (phi) direction the cone is divided in jMax meshes. In order to plot curve of constant phi set phiMax = phiMin and jMax = 1

vMin, vMax — minimum/maximum value of wind velocity. In order to plot curve of constant v set vMax = vMin and iMax = 1

phiMin, phiMax — minimum/maximum value of wind azimuth coordinate in degrees Intervals [0., 180.] and [180., 360.] correspond to a single windcone . Interval [0., 360.] corresponds to the double windcone.

In order to plot curve of constant phi set phiMax = phiMin and jMax = 1

surface — Projection of 3D data on 2D surface:

='x=0'

='y=0'

='z=0'

='x=y'

='(x+y)/sqrt(2)=c'

intersection — =0 : no intersection with surface

=1 : intersection with surface is calculated for surface='x=y' and surface='(x+y)/sqrt(2)=c' (z-space)

c — The value of c in surface='(x+y)/sqrt(2)=c' (z-space)

delta — Determines the thickness of the slice for data points.

Data points within a distance of delta from the plane are accepted, points outside this slice are rejected. (z-space, percentage)

lin_log_z — =0: windcone is plotted on linear scale (sigma_0)

=1: windcone is plotted on logarithmic scale (sigma_0 in dB)

=2: windcone is plotted in z-space (z=sigma_0^0.625)

debuglevel — debug output level

=0: no debug output

sigmaspace3d <, inFile> [, option=<optionValue>]

with <> indicating non-obligatory input, [] indicating obligatory input, and | indicating alternatives. The following command line options are available:

inFile — This Name of the input file containing the data to be plotted. When inFile is defined, the use of metaInfile is overruled. When inFile is empty no data points will be plotted.

metaInfile — Name of the metafile containing the filenames to read the data from.

nNode — Node number [1..19] for ERS, [1..21] for ASCAT

plotIceline — =1 plot iceline, =0 don't plot iceline

plotWindcone — =1 plot windcone, =0 don't plot windcone

`satellite`	=1 ERS1, =2 ERS2, =4 METOP-A
`cmod`	=5 use CMOD5, =4 use CMOD4
`iMax, jMax`	Mesh parameters. In the wind velocity (v) direction the cone is divided in iMax meshes. In the wind azimuth coordinate (phi) direction the cone is divided in jMax meshes.
`vMin, vMax`	minimum/maximum value of wind velocity. In order to plot curve of constant v set vMax = vMin and iMax = 1
`phiMin, phiMax`	minimum/maximum value of wind azimuth coordinate in degrees Intervals [0., 180.] and [180., 360.] correspond to a single windcone . Interval [0., 360.] corresponds to the double windcone. In order to plot curve of constant phi set phiMax = phiMin and jMax = 1
`lin_log_z`	=0: windcone is plotted on linear scale (sigma_0) =1: windcone is plotted on logarithmic scale (sigma_0 in dB) =2: windcone is plotted in z-space (z=sigma_0^0.625)
`hidden_lines`	=0 : all lines are drawn, =1 : hidden lines are not drawn.
`light_sources`	=0 : no light sources, =1 : light sources.
`debuglevel`	debug output level =0: no debug output

Fortran Interface

The IDL program has an interface to a Fortran shared object file (*.so). This is used for the CMOD5 function (cmod5_if.so). The location of this shared object file is hard-coded in the IDL program and can be manually adapted. If the shared object file is not found, the program uses its own IDL CMOD implementation.

Format of the data inputfile

An ASCII data inputfile containing $\tilde{\sigma}$-triplets is read in by the IDL program. The input file may be generated with other software and has a predefined format. See file plot1d.out in the example directory. Program extract.x has an option to read in a BUFR file and produce one ASCII data file per node <nn>, named visualisation<nn>.out. Any line starting with a hash symbol (#) is treated as comment. The other lines each contain the following parameters:

#sigfore sigmid sigaft sigma2(fore) sigma2(mid) sigma2(aft) windspeed2 picegivenx iNode

These represent the sigma triplet in dB, sigma triplet in dB corrected for incidence angle, measured wind speed, ice probability and node number. The sigma triplet values give the location of the measurement in $\tilde{\sigma}^0$-space, the other parameters are used for optional filtering. Most filtering options are still hard-coded, except filtering on node number, which is performed with the parameter “nNode”.

Explanation of some of the options

2D and 3D common parameters:

metaInfile Name of the metafile containing the filenames to read the data from.

For the present version only one input file is supported.

satellite Satellite identifier. For ERS 19 nodes are present. For ASCAT on the METOP satellites 21 nodes are present corresponding to different incidence angles.

vMin, vMax, iMax,
phiMin, phiMax, jMax
The surface of the wind cone is plotted as a wired frame. The v parameter is discretised from vMin to vMax using iMax steps. The phi parameter is disscretised from phiMin to phiMax using jMax steps. The bigger the values of iMax and jMax, the finer the mesh of the wire frame will be.

sigmaspace2d specific parameters:

surface Projection of 3D data on 2D surface:

='x=0'

='y=0'

='z=0'

='x=y'

='(x+y)/sqrt(2)=c'

The 2D plots are actually a projection of the 3D space on a plane. With the "surface" parameter the projection plane is selected. The plane 'x=y' is the symmetry plane of the windcone.
The plane '(x+y)/sqrt(2)=c' is perpendicular to the symmetry plane.

v_phi_const ='v=c' plot curves of constant speed
='phi=c' plot curves of constant azimuth angle

With this parameter you can select the curve on the GMF that is projected. This can be either a curve of constant wind speed 'v=c', or a curve of constant wind direction 'phi=c'. These curves are in general 3D-curves, i.e. they do not lie on a plane, so any projection of these curves will give distortion.

intersection =0 : no intersection with surface

=1: intersection with surface is calculated for surface='x=y' and surface='(x+y)/sqrt(2)=c' (z-space)

Instead of plotting lines of constant v or lines of constant phi the intersection of the windcone with the selected plane is calculated using an iteration method. Starting point for the iteration is the point on the windcone defined by the original values of v and phi. Only supported in z-space.

4. Examples

Example runs are located in the example directory:
$CVSDIR/icemodel/idl6/sigmaspace/sigmaspace2d/example

Starting one of the shell scripts "run", "run2d" or "run3d" will execute one or more example runs. The "run" command will run all examples sequentially. The example programs make use of the example data file "plot1d.out" located in the example directory.

IDL scriptfile 2dview_2.idl:

```
.compile
/nobackup/users/verspeek/cvs/icemodel/idl6/sigmaspace/sigmaspace2d/sigmaspace.pro
sigmaspace2d, $
  nNode=9                              , $
  plotTitle='Plot title '              , $
  plotWindCone=1                       , $ # =1 true, =0 false
  plotIceLine=1                        , $ # =1 true, =0 false
  v_phi_const='v=c'                    , $
  iMax= 1, vMin= 7.5, vMax= 7.5        , $
  jMax=60, phiMin= 0., phiMax= 360.    , $
  surface='(x+y)/sqrt(2)=c'            , $
  lin_log_z=2
```

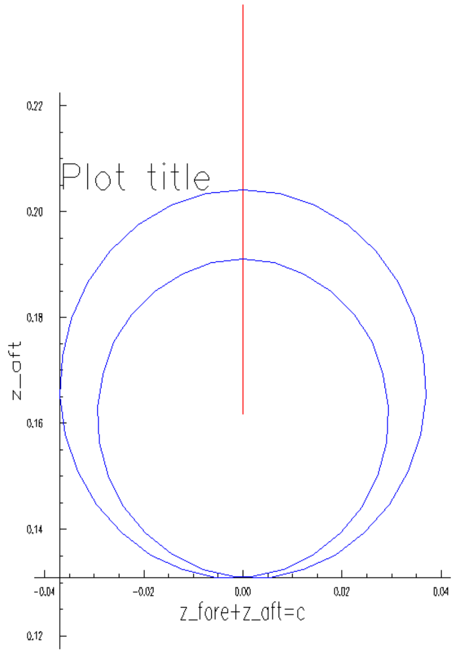

Figure 1 - By specifying v_phi_const='v=c' and iMax=1, vMin=7.5, vMax=7.5 the curve with constant windspeed v=7.5 m/s is selected. It is plotted for phi=0..360 in steps of 6°. The curve is projected on the plane '(x+y)/sqrt(2)=c'. z-space is selected with lin_log_z=2.

IDL scriptfile x_eq_y.idl:

```
.compile
/nobackup/users/verspeek/cvs/icemodel/idl6/sigmaspace/sigmaspace2d/sigm
aspace.pro
sigmaspace2d, 'plot1d.out'          , $
  nNode=9                           , $
  plotTitle='CMOD5 and iceline'     , $
  plotWindCone=1                    , $ # =1 true, =0 false
  plotIceLine=1                     , $ # =1 true, =0 false
  v_phi_const='phi=c'               , $
  iMax=60 , vMin= 0.5, vMax= 22.5   , $
  jMax=4, phiMin= 0., phiMax= 360.  , $
  surface='x=y'                     , $
  lin_log_z=1
```

By specifying v_phi_const=’phi=c’ and jMax=4, phiMin=0., phiMax=360. the curves with constant wind direction phi=0°, 90°, 180°, 270° and 360° are selected. They are plotted for v = 0.5 m/s to 22.5 m/s. The curves are projected on the plane 'x=y’. Logarithmic σ^0-space is selected with lin_log_z=2.

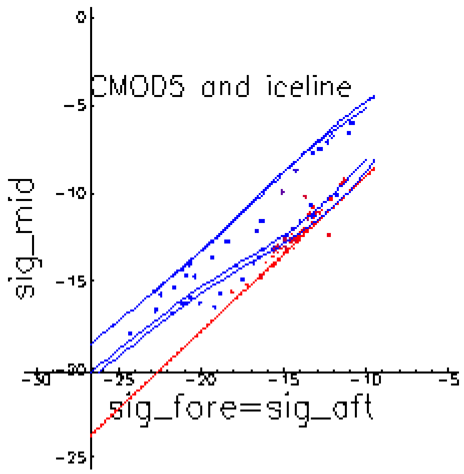

Figure 2 - By specifying v_phi_const=’phi=c’ and jMax=4, phiMin=0., phiMax=360. the curves with constant wind direction phi=0°, 90°, 180°, 270° and 360° are selected. They are plotted for v = 0.5 m/s to 22.5 m/s. The curves are projected on the plane 'x=y’. Logarithmic □-space is selected with lin_log_z=2.

IDL scriptfile 3dview.idl:

```
.compile
/nobackup/users/verspeek/cvs/icemodel/idl6/sigmaspace/sigmaspace2d/sigm
aspace.pro

sigmaspace3d, 'plot1d.out'            , $
  nNode=9                             , $
  plotWindCone=1                      , $ # =1 true, =0 false
  plotIceLine=1                       , $ # =1 true, =0 false
  iMax=25, vMin= 1.0, vMax= 25.0      , $
  jMax=300, phiMin= 0., phiMax= 360. , $
  hidden_lines=1                      , $
  light_sources=1                     , $
  lin_log_z=2
```

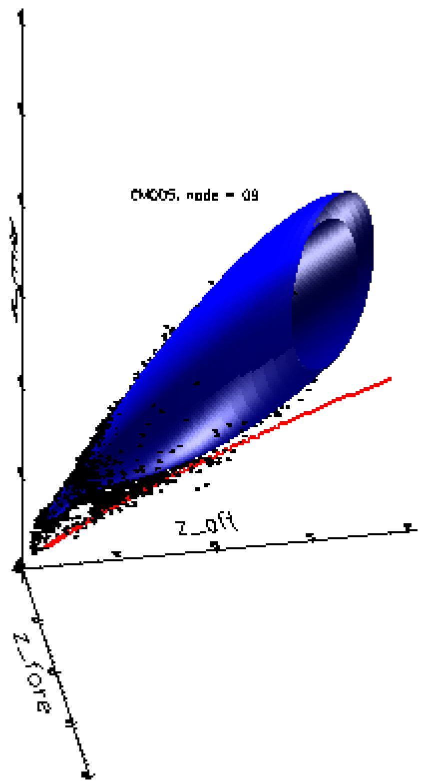

Figure 3 – The windcone wire frame is drawn with a resolution of 1 m/s for the windspeed and a high resolution of 1.2° for the wind direction. Hidden lines are not shown, i.e. you cannot see through the mesh of the windcone. The mesh is filled and shone by a light source. When light_sources=0 would have been specified, only the wire frame would have been shown.

5. Acronyms and abbreviations

Name	Description
ASCAT	Advanced scatterometer
CMOD	C-band geophysical model function used for ERS and ASCAT
CVS	Concurrent Versions System
ECMWF	European Centre for Medium-Range Weather Forecasts
ERS	European Remote sensing Satellite
EUMETSAT	European Organization for the Exploitation of Meteorological Satellites
GMF	Geophysical model function
IDL	Interactive Data Language
KNMI	Koninklijk Nederlands Meteorologisch Instituut (Royal Netherlands Meteorological Institute)
NWP	Numerical Weather Prediction

Table E.1 List of acronyms and abbreviations.

6. References

[FIGA 2004] Figa, Julia, “ASCAT calibration and validation plan”, EUMETSAT, EPS programme, Darmstardt Germany, 2004

[STOFFELEN 1998] Stoffelen, Ad, “Scatterometry”, KNMI, PhD thesis, de Bilt, 1998

7. Documentation history

2006-01-16 - First version distributed in KNMI scat group
2006-07-14 - sigma2 triplet in ascii input files added. This represents
the sigma triplet corrected for incidence angle (measured incidence angle
versus incidence angle from table and CMOD5 windcone.