REanalysis of the TROpospheric chemical composition over the past 40 years
A long-term modelling study of tropospheric chemistry

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Work Package 2

RETRO report

Report describing collection and use of observations in RETRO

Deliverable D2-6

1 Introduction

The objectives of the RETRO project included exploiting and synthesising a wide range of measurements of tropospheric composition and to understand, detect and assess long-term changes and interannual variability of the tropospheric chemical composition over the last 40 years. This meant that collection and use of data was a central part of the project. It had originally been planned to make extensive use of this data to compare to the 40 year model runs and use the information to increase our understanding of changes of atmospheric composition over the ERA-40 period. Due to problems with the ERA-40 data set and delays in obtaining the emissions required, less has been achieved on this than had been planned but important progress has still been made.

Data collected includes existing data sets from ground based stations, aircraft, and satellite instruments. Many existing data sets are now available on the NILU database which provides an easy to use interface to several key data sets. Other data sets have been made available online elsewhere. Section 2 of this report gives more detail on the collection of observations from the last 40 years.

These data have been used to assess changes in trace compounds over the past 40 years (see section 4.1) and to validate model performance in reproducing concentrations and trends of species. Progress was made though the development of standards for sampling the models and the development of model indices. See section 4.2 and report D3-2 for more details of this work.

2 Collection of information on available data sets

Initially data sets were collected from project partners and data needs were communicated to other scientific colleagues. Data sets were also located by browsing the World Wide Web and links to existing databases created. See Annex 1 for a list of field data for which a metadata record exits at NILU. The next step was to assess the usefulness, data quality, and ease of use of these datasets and prioritize the archiving of them at NILU on this basis.

3 Providing access to data sets

The archiving of different types of data has been handled in different ways. Ground based data have been archived at NILU but separate means of providing data access have been organised for aircraft data and satellite data.

3.1 Ground based data

The focus for collecting and archiving surface data was the NILU database. The meta-data guidelines are based on the ENVISAT Cal/Val guidelines. The files in the RETRO database are formatted according to strictly defined data reporting rules. These rules explain in detail how the data file should be built up, what parameters it must contain and what parameters it may contain. Furthermore, several parameters are connected to a list of legal values. The rules make sure that all files in the data archive are formatted uniformly and they are easy to use in automated processes. An up-to-date description of metadata are found through the link on the left-hand side. The data format used in the RETRO database is HDF4.1r3 and several conversion tools have been provided to create files in this format. The RETRO deliverable D2-2 provides a guideline for users of data and an introduction to formatting of data.

Ozone, SO_2 and NO_2 data from a large number of EMEP stations have been converted and uploaded to the database. For this purpose, ~11500 ozone sonde files were converted into RETRO files and made available at NILU. In addition to these, all the ozone sonde data from the WOUDC has been downloaded to NILU and converted into the same format. This dataset consists of more than 50000 soundings, providing a global coverage of stations where some have done routine measurements since the late 1950-ies. Conversion of sondes was done by developing a program that were able to read such data from a variety of formats. The program furthermore provides some simple checks on the data and rejects measurements that contained obvious errors. The data were finally written to HDF files using the metadata definitions referred to previously. CMDL surface observations of CO are now also included in the database.

3.2 Aircraft and Satellite data

The reanalysis of GOME data for the trace gases NO_2, HCHO and SO_2 has been continued. The standard output for all absorbers are monthly averaged gridded data (0.125x0.125°) using 2-dimensional fields of air mass factors. These files have been made available to all project participants via ftp. A copy is stored at NILU.

RETRO also contributed to extending the TRADEOFF database of aircraft by extending it in time to 2000 from 1998 and also including the ozone data from the Global Atmosphere Sampling Project (GASP) ozone data obtained between1975 and 1979.

4 Use of Observations

4.1 Trend analysis

4.1.1 Trend analysis using aircraft data

UTLS ozone changes between the second half of the 1970s and the 1990s have been investigated from the GASP and MOZAIC datasets.

As deliverable D2-3 describes in detail, the comparison of GASP and MOZAIC ozone can be summarised as follows: In the lowermost stratosphere, ozone decreased by up to -10 % in autumn, winter, and spring in the northern extratropics, most probably attributable to stratospheric ozone depletion. In summer, on the contrary, ozone increased by up to 4 % in the lowermost midlatitude stratosphere, which might have been caused by increasing NO_x emissions from civil aircraft leading to enhanced ozone in-situ production. In the upper troposphere, largest ozone increases were found in tropical Asia, while ozone changes for the North Atlantic, North America, and Europe varied with seasons. The comparison of long-term changes at Wallops Island, USA, with the changes between the two aircraft data for the northeastern part of the US showed that ozone changes were very similar expect in spring. Over Europe, ozone changes from the European balloon sites indicate a strong increase over the whole UT/LS.. In contrast, the regular aircraft data hint to very little, slightly negative changes over the same region. Different factors that might have contributed to the discrepancies in trends include possible problems in the data quality of the measurements, problems in the representativity of the climatologies, or changes in the reporting of the ozonesonde measurements.

4.1.2 Trend analysis using GOME NO2 data

Nitrogen oxides (NO_x) in the troposphere have both natural and anthropogenic sources. Natural emissions are mainly from bacterial soil sources, wild fires and lightning, while anthropogenic emissions mainly result from fossil fuel use and biomass burning. In the industrialised regions of the world, anthropogenic emissions of NO_x dominate.

Over the last decade, measures have been taken to reduce NO_x emissions, mainly by the introduction of filters and catalytic converters, but also by changing to cleaner fuels. These actions are expected to lead to reduced levels of nitrogen oxides in the US and Europe, and pollution monitoring networks have observed a downward trend in NO_x at many stations. At the same time, economic growth in East Asia has lead to a marked increase in fossil fuel use in many countries, in particular in China. This is linked to increasing NO_x emissions which in turn should result in higher NO_x levels in the troposphere.

Measurements from the GOME and SCIAMACHY satellite instruments now cover more than a decade, and therefore have the potential to identify changes in atmospheric composition. Tropospheric NO_2 columns can be retrieved from the measurements of the two instruments, and this data set has been used to asses the changes of NO_2 over the time period 1996 – 2002 which is covered by GOME data [*Richter et al.*, 2005]. For this, annual averages of GOME tropospheric NO_2 columns have been gridded on a 1°x1° resolution, and for each grid box, a linear regression was performed. The slope of this regression is shown in **Figure 1**.

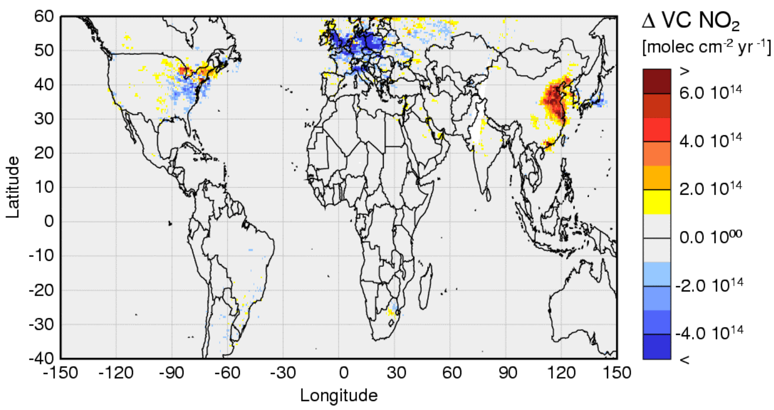


Figure 1: The gradient obtained from a linear regression of the annual averages of tropospheric GOME NO_2 columns, retrieved close to 10.30 am LT from 1996 to 2002. Reductions in NO_2 are observed over Europe and the Central East Coast of the United States, while large increases are evident over China. Figure from Richter et al., 2005.

As can be seen, NO_2 columns have been decreasing over Europe and parts of the US, while at the same time a large positive trend is apparent over the industrialised regions of China. This is in agreement with expectations but constitutes the first direct global observation. It is interesting to note, that no significant changes are observed over biomass burning areas, indicating that the increase in burning activity that has been reported for some regions has not led to a detectable growth in NO_2 columns. Another interesting aspect is the lack of signal over India, which also has witnessed a strong increase in industrial activity which is not reflected in the GOME NO_2 measurements.

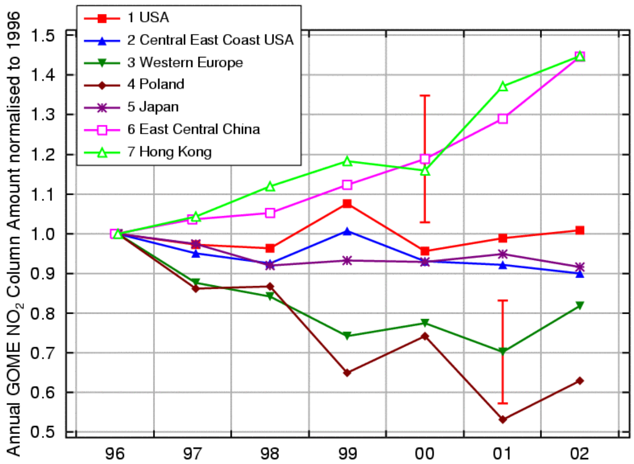


Figure 2: The temporal evolution of tropospheric NO_2 columns from GOME for selected areas. The mean annual NO_2 column amount normalized to that in 1996 for the geographical regions USA, Central East Coast USA, Western Europe, Poland, Japan, East Central China, and Hong Kong. All data are normalized to the values from 1996. The error bars represent the estimated uncertainty (s.d) for an individual year, the values over China being larger as a result of the poorer knowledge and therefore larger uncertainty of the aerosol loading and its changes. Figure from *Richter et al.*, 2005.

In **Figure 2**, the change of NO_2 columns relative to the 1996 values is shown for selected regions, demonstrating the systematic changes over both Europe and China while no significant changes can be observed over the US and Japan. Also included are typical error bars which include both random errors and an estimate of the possible impact of systematic uncertainties in the analysis. A more detailed error analysis can be found in *Richter et al.*, 2005 and the accompanying online material.

Comparing the observed changes with prediction from bottom-up inventories shows good agreement over Western Europe, indicating that the emission estimates are reliable in this area. On the other hand, recent NO_x emission estimates for China while having an upward trend do not predict the steep increase observed. In **Figure 3**, the monthly time series over the central eastern part of China is shown for both GOME and SCIAMACHY. In the period of overlapping measurements, the columns retrieved from data of the two instruments agree very well. Clearly, the upward trend is continuing or even accelerating after 2002, the last year included in the data shown in **Figure 1**. What can also be seen in the figure is the large seasonality of the NO2 columns with a marked winter maximum and low values in summer. This is mainly the result of the increase in NO_x life time in winter, but could also be indicative of a seasonality in NO_x emissions, e.g. as result of increased heating emissions in winter.

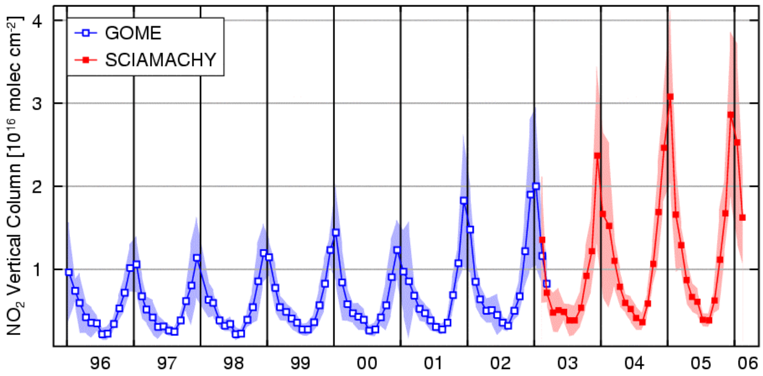


Figure 3: Monthly averages of the tropospheric vertical columns of NO_2 over East Central China. A plot of the monthly mean of the 3 day composite of the tropospheric NO_2 vertical column versus time is presented for the area defined by the latitudes 30°N to 40°N, and longitudes 110°E to 123°E. Both GOME data (open symbols) and SCIAMACHY (filled symbols) are shown. SCIAMACHY nadir measurements started in August 2002, but limited data are currently available prior to February 2003. The shaded areas represent the standard deviation estimated for the monthly mean 3-day composite and take into account the variability of the measurements resulting from changes in NO_2 and data gaps arising from cloud cover and missing observations.

GOME and SCIAMACHY measurements are currently being compared to results from state of the art models using different emission scenarios, and eventually could help to improve NO_x emissions in Asia.

4.2 Model-data comparison strategy

4.2.1 Model output for comparison with observations

In order to allow detailed comparison of model predictions with observations both for validation of models and investigation of modelled/observed trends, it is necessary for the models to produce not just global fields of compounds, but also to output the model results in a format compatible with observations. The details of the output required differ for different types of networks. In order to facilitate the study of the model, both details of the model output and the file format to be used for storing these results have been specified in detail. For full details see deliverable D4-4.

Species mixing ratios were sampled at the geographical location and altitude of all stations from the following networks:

- CMDL (CO and surface ozone network) [beginning: 1977]
- EMEP [beginning: 1990]
- CASTNET [beginning: 1987]
- other global surface stations (from WDCGG and specific Russian sites)
- WOUDC and SHADOZ ozone sondes [beginning: 1957]
- MOZAIC airports [beginning: 1996]
- MAXDOAS sites [beginning: 1996]

Files from one network or measurement programme have been stored as 3- or 6-hourly data in annual files in a subdirectory with lowercase network name (i.e. 'cmdl', 'emep', 'woudc', 'shadoz', 'mozaic', 'maxdoas'). The filename convention is:
modelacronym_expid_YYYY_network_station_tracer.nc
The station codes vary from network to network as follows:

- CMDL: 3-letter uppercase station code (e.g. ALT for Alert)
- EMEP: 2-letter country code plus 2-digit station code (e.g. NO52 for Sandve in Norway)
- WOUDC and SHADOZ ozone sondes: 3-digit station code (e.g. 041 for Jungfraujoch)
- MOZAIC airports: 3-letter IATA airport code (e.g. BOS for Boston)
- MAXDOAS sites: 3-letter station code similar to CMDL

A detailed list of station codes and geographical coordinates is provided in D4-4. Additionally, most models were sampled at the location of aircraft observations using the ETH-MEG (formerly TRADEOFF) code and input files (provided by ETHZ).

For comparison with satellite observations (GOME), 10:30 local time output was generated as global daily data in monthly files. This is so that the output is consistent with the satellite observations – the ERS-2 which GOME is on has an equator crossing time of 10:30.

4.2.2 Definition of model quality scores

The MQO (model quality objective) is a measure of deviation of model results from observations. Its intention is to provide an objective measure of model performance in a simple metric comprising of a small set of numbers. (Builtjes et al, 2003) The MQO will always be dependent on the specific objective of a model-data intercomparison. Therefore, specific target objectives need to be defined beforehand, such as "the models should reproduce surface ozone concentrations within 10 ppb or 20% (whichever is smaller)".

A model score is defined for each type of observational data (e.g. EMEP surface ozone, CMDL surface ozone, etc.). The model score for each individual station is defined here as the percentage of model monthly means deviating from the observational value less than a given relative deviation (threshold). See Figure 4 below. The overall model score summarizing the performance of one model for one observational data type is then given as arithmetic average of all station scores.

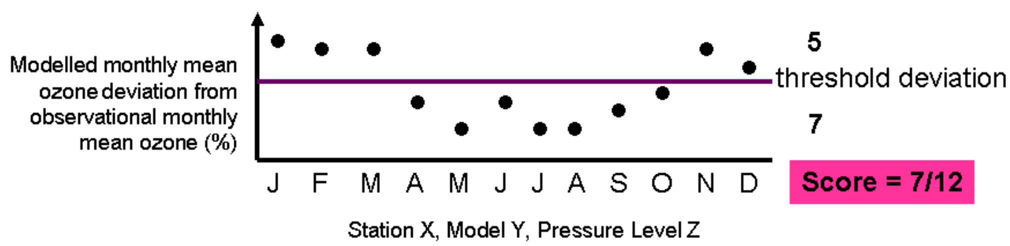


Figure 4: Definition of the MQO

This provides an objective measure of model performance and tools to calculate this using IDL has been developed and made publicly available.

4.2.3 Taylor analysis and other statistics

The MQO score focuses on model biases. In order to get an aggregate measure of the ability of the models to reproduce the variability of observed concentrations, we apply use Taylor diagrams (Taylor, 2001). These diagrams aim to summarise multiple aspects of model performance on a single diagram. The location of a model on the plot is defined by 2 variables - the correlation coefficient gives the cosine of the angle from the x-axis and the model standard deviation normalised by the observed s.d. is plotted as the radial distance along this line. A perfect model would lie on the x-axis with a normalised standard deviation of 1. A model skill score is also defined.

Use has also been made of correlation coefficients, model bias values and normalized standard deviations (i.e. σ_mod/σ_obs).

4.3 Model – data comparison studies

This section summarises some of the results of the project which are discussed in more detail in the report D3-2.

4.3.1 Studies performed using model results for 1997-2000 and CMDL plus WOUDC data

The MQO score and Taylor analysis were applied to the model simulations of the time period 1997 to 2000. We performed an analysis along these measures for the following data sets from the 40-year model simulations (see D3-2): surface ozone from CMDL stations, surface CO from CMDL and ozonesonde data from the WOUDC network.

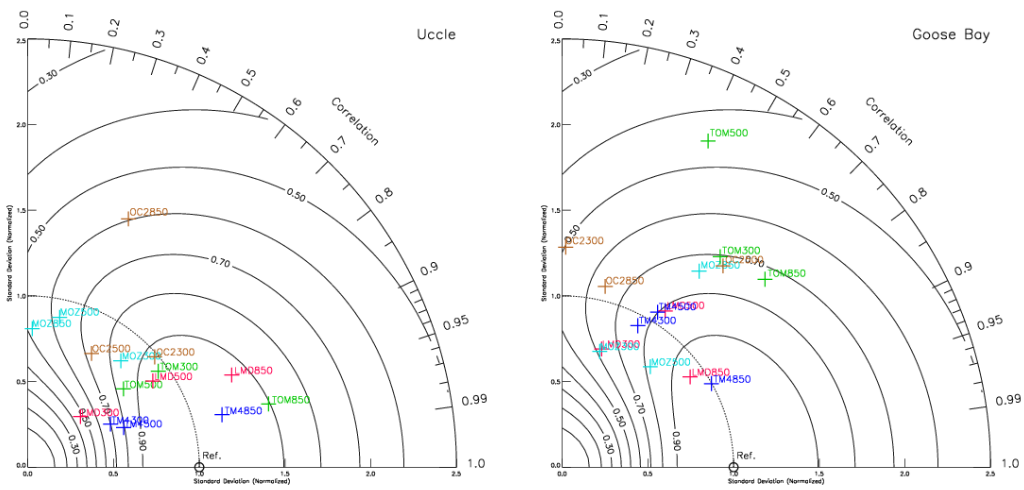


Figure 5: Taylor plots for all models at 2 sonde stations – Uccle and Goose bay

Figure 5 above shows two examples of Taylor plots calculated for WOUDC data. This illustrates that in general the models show a better performance at Uccle than Goose bay (only 4 model points have scores greater than 0.8 at Goose Bay compared to 9 at Uccle) and also shows the differences in performance from one model to another.

Table 1 below shows the model scores for various statistics averaged over all stations and 1997-2000 for carbon monoxide. All models have a negative bias which indicates either too large OH concentrations in the models or emissions of CO which are too low. Given that the methane lifetime of the models are similar to those found in previous studies (or in the case of p-TOCMAT towards the upper end of the range) it seem likely that this indicates that the emissions of CO in the inventory are too low. TM has the highest MQO and LMDZ the highest correlation coefficient.

	PTOMCAT	LMDz INCA	MOZECH	UiO	TM	model mean
MQO 20%	0.44	0.41	0.35	0.31	0.58	0.41
Correl. coeff	0.68	0.72	0.65	0.59	0.69	0.67
Bias (%)	-15.86	-22.12	-21.55	-20.33	-4.06	-16.79

Table 1: Model statistics for CMDL CO data averaged over all stations and years

	PTOMCAT	LMDz INCA	MOZECH	UiO	TM	model mean
850 hPa MQO 20%	0.39	0.77	0.49	0.59	0.73	0.59
Correl. coeff	0.62	0.65	0.46	0.48	0.71	0.58
Bias (%)	24.04	5.02	22.37	-10.57	8.41	9.85
500 hPa MQO 30%	0.59	0.94	0.77	0.91	0.94	0.83
Correl. coeff	0.40	0.58	0.59	0.47	0.51	0.51
Bias (%)	26.57	4.03	18.08	-5.11	0.02	8.72
300 hPa MQO 40%	0.26	0.87	0.60	0.71	0.77	0.64
Correl. coeff	0.48	0.55	0.52	0.41	0.50	0.49
Bias (%)	82.78	-4.72	27.69	15.77	17.35	27.77

Table 2: Model statistics for CMDL CO data at different levels.

At all levels, the TM and LMDZ models are once again the best performing models with generally low biases, reasonable correlation coefficients and high MQOs. The p-TOMCAT model has large positive biases probably results from unresolved problems with excessive STE.

4.3.2 EMEP surface O_3 observations over the 1990-2000 period

A similar analysis was performed for the period 1990 – 2000 using EMEP. As only the 1997 – 2000 period was run by all model we present here Taylor plots for 1997 and averages of the models statistics for 1997 to 2000.

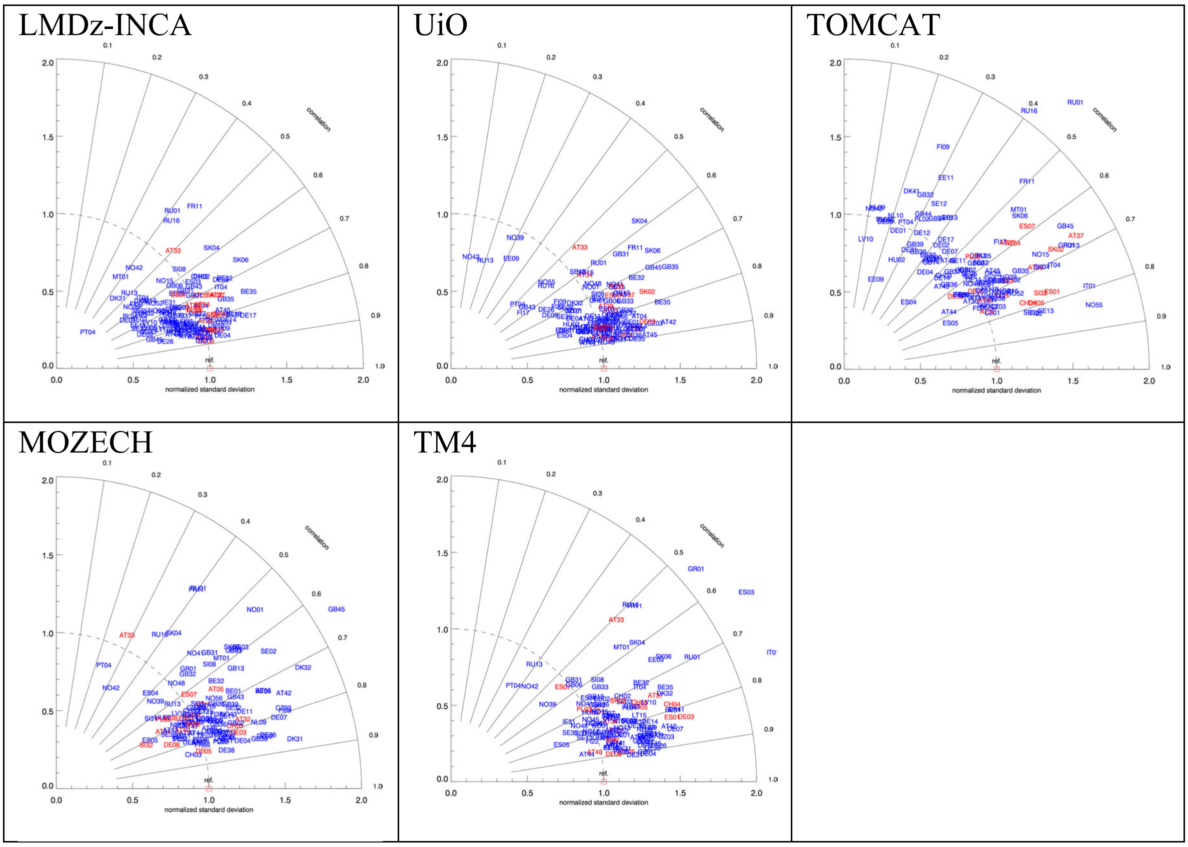


Figure 6: Taylor diagrams for 1997 with 3-day time filtered ozone mixing ratios.

Criteria for good results highlighting		
<10ppb	[0.9 ; 1.1]	>0.7

	Abs bias (ppb)	σ_mod/σ_obs	Correlation	MQO 20%	MQO 30%
UiO	6.97	1.01	0.71	0.53	0.71
MOZECH	11.02	1.13	0.68	0.35	0.51
TOMCAT	15.81	1.28	0.53	0.23	0.34
INCA	9.28	1.02	0.71	0.44	0.58
TM4	10.70	1.25	0.73	0.36	0.50
Model av.	10.76	1.14	0.67	0.38	0.53

Table 3: Average model statistics with EMEP data for the 1997-2000 period

4.3.3 Studies using models and satellite data

An evaluation study of tropospheric NO_2 columns has been performed for the years 1996-2000.

KNMI has performed an analysis based on the GOME NO_2 retrieval by BIRA/KNMI to investigate the extent and causes of variability of NO_2 concentrations during the 1990s. To systematically evaluate the models with the retrieval, the modelled 10:30 local time NO_2 columns are sampled at the time and place of the observations. The method of comparison is described in detail by van Noije et al. (2006), who also present an intercomparison of different GOME retrieval products for the year 2000. In Figure 7 we present maps of the annual mean tropospheric NO_2 column densities for 1997 and 2000, comparing the BIRA/KNMI retrieval with the ensemble mean of the RETRO models (LMDz-INCA, MOZECH, p-TOMCAT, TM4, and UiO-CTM2). The spatial patterns of pollution are qualitatively similar with high NO_2 amounts over major industrial regions and over regions affected by biomass burning, and low values over the oceans. In the retrievals there is an apparent increase over China between 1997 and 2000, which is not captured in the models. However, the regional analysis presented below indicates that the wintertime values retrieved over Eastern China show an anomalous enhancement during the year 2000.

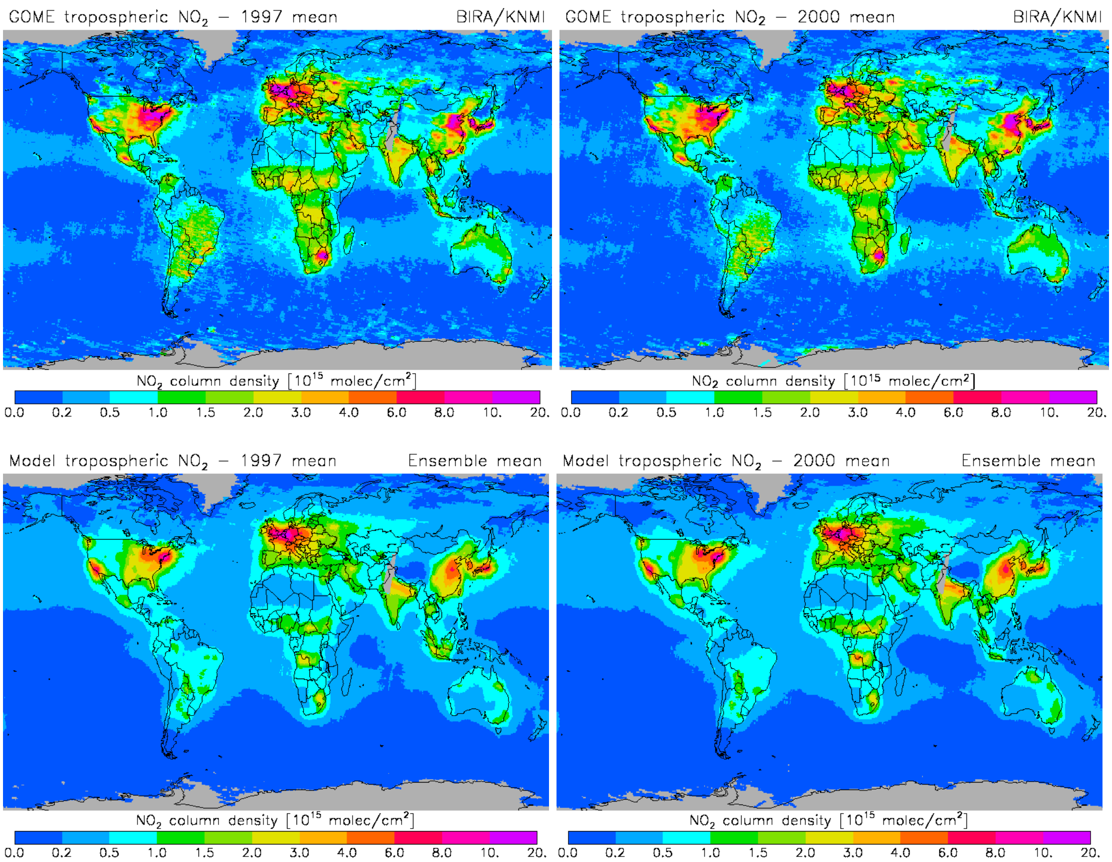


Figure 7: Retrieved and modelled annual mean tropospheric NO_2 column densities for 1997 and 2000. The annual means are constructed by equal weighting of all scenes retrieved during the year.

Figure 8 shows the corresponding maps for September 1997 compared with 1998. Enhanced levels from the 1997 El Niño wildfires in Indonesia are observed in both retrieval and models. A weaker interannual difference is observed over the biomass burning regions of South America and Southern Africa.

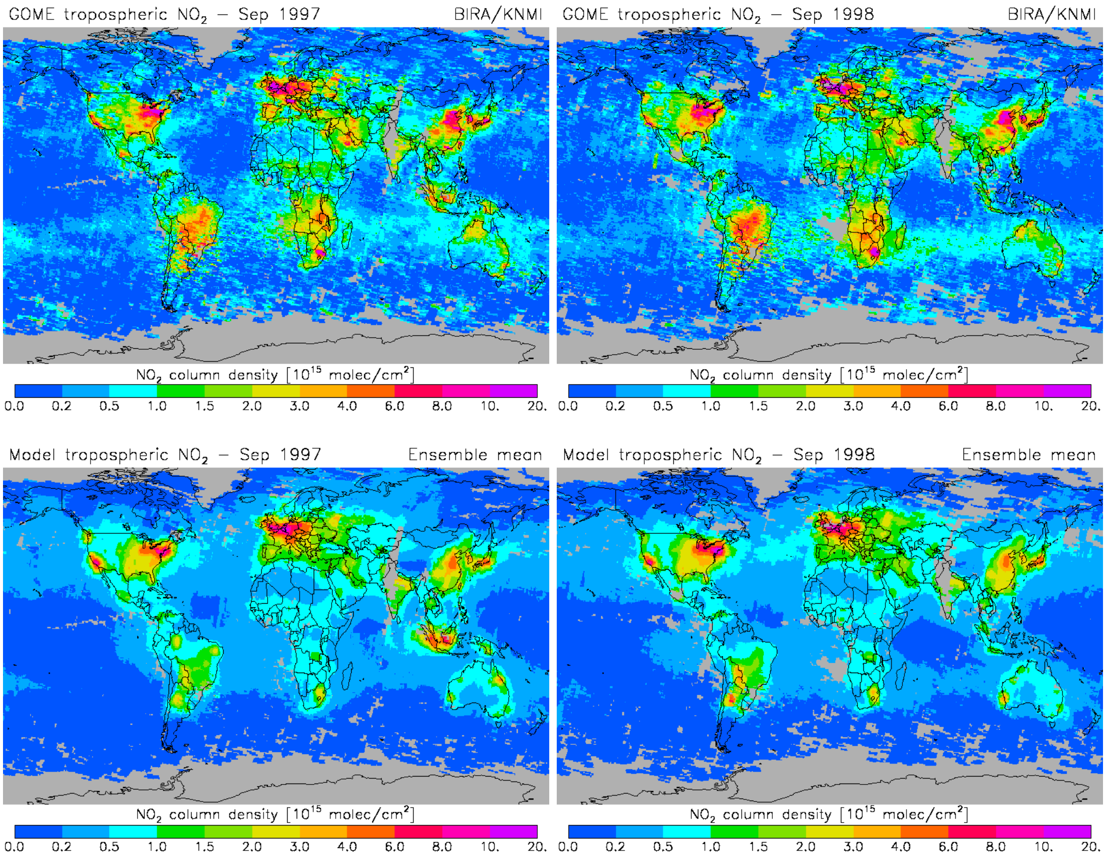


Figure 8: Retrieved and modelled tropospheric NO_2 column densities for September 1997 and 1998.

The seasonal and interannual variability has been analyzed for the regions shown in Figure 9. The resulting time series are presented in Figure 10. Over the Highveld region of South Africa the models give far too low NO_2 compared to the retrieval. This is most likely related to an underestimated of the emissions in this regions. Van Noije et al. (2006) came to the same conclusion based on a recent emission inventory from the International Institute for Applied Systems Analysis (IIASA). Over Eastern China the models generally underestimate the retrieval, especially in wintertime. Only MOZECH and p-TOMCAT come reasonably close to the retrieved values for some years. For the interpretation of the differences it should be emphasized that there is also a large spread among the different retrieval products (van Noije et al., 2006). Over China the retrievals from BIRA/KNMI and from the University of Bremen give significantly higher wintertime values than the retrieval from Dalhousie University, at least for the year 2000 for which the different retrievals have been compared. Over the eastern United States, MOZECH and p-TOMCAT are also in fair agreement with the observations. Over Europe, on the other hand, these two models seem to overestimate the retrieval during winter. Here UiO-CTM2 gives the best agreement, while LMDz-INCA and TM4 systematically underestimate the observations. The spread among the models over industrial regions is to large extent related to differences in the parameterization of the vertical mixing from the boundary layer into the free troposphere. Our results indicate that this mixing may be too fast in LMDz-INCA, TM4, and UiO-CTM2.

For the regions dominated by biomass burning, the models behave quite differently. An additional cause for these differences is the fact that some models (MOZECH, TM4, and UiO-CTM2) apply a specified height distribution to the emissions from wildfires. This generally leads to a reduction of the tropospheric NO_2 columns. Because the vertical emission profile is not given for each emission location, in some instances the wildfire emissions are removed by applying the height distribution. This might explain why TM4 and MOZECH give much lower values during the El Niño wildfires in Indonesia than for instance LMDz-INCA and UiO-Oslo (which releases the emissions at the surface if the profile is not given). This does not seem to be the case over Africa, where TM4 and UiO-Oslo give similar values, somewhat higher than LMDz-INCA. In general the models underestimate the NO_2 columns from biomass burning. An exception to the rule is the Indonesian fire event of August–October 1997, where three models (LMDz-INCA, p-TOMCAT and UiO-Oslo) overestimate the retrieval, indicating that the emissions for this event are too high. The NO_2 columns are neither underestimated by p-TOMCAT during the dry seasons in Central Africa. Also MOZECH gives realistic values over South America during 1997 and 2000 and over Northern and Central Africa during 2000. However, for these regions the interannual variability simulated by MOZECH is much stronger than observed and the column amounts for the other years are strongly underestimated.

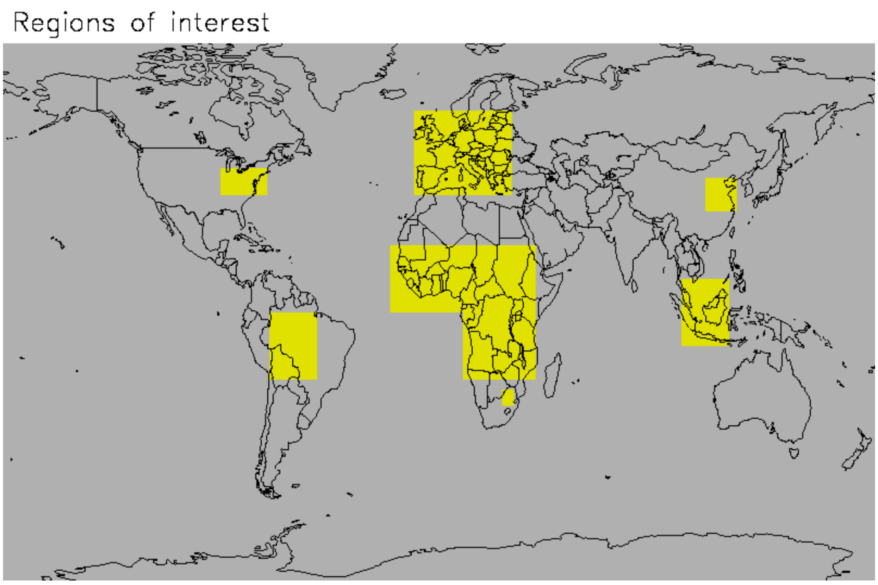
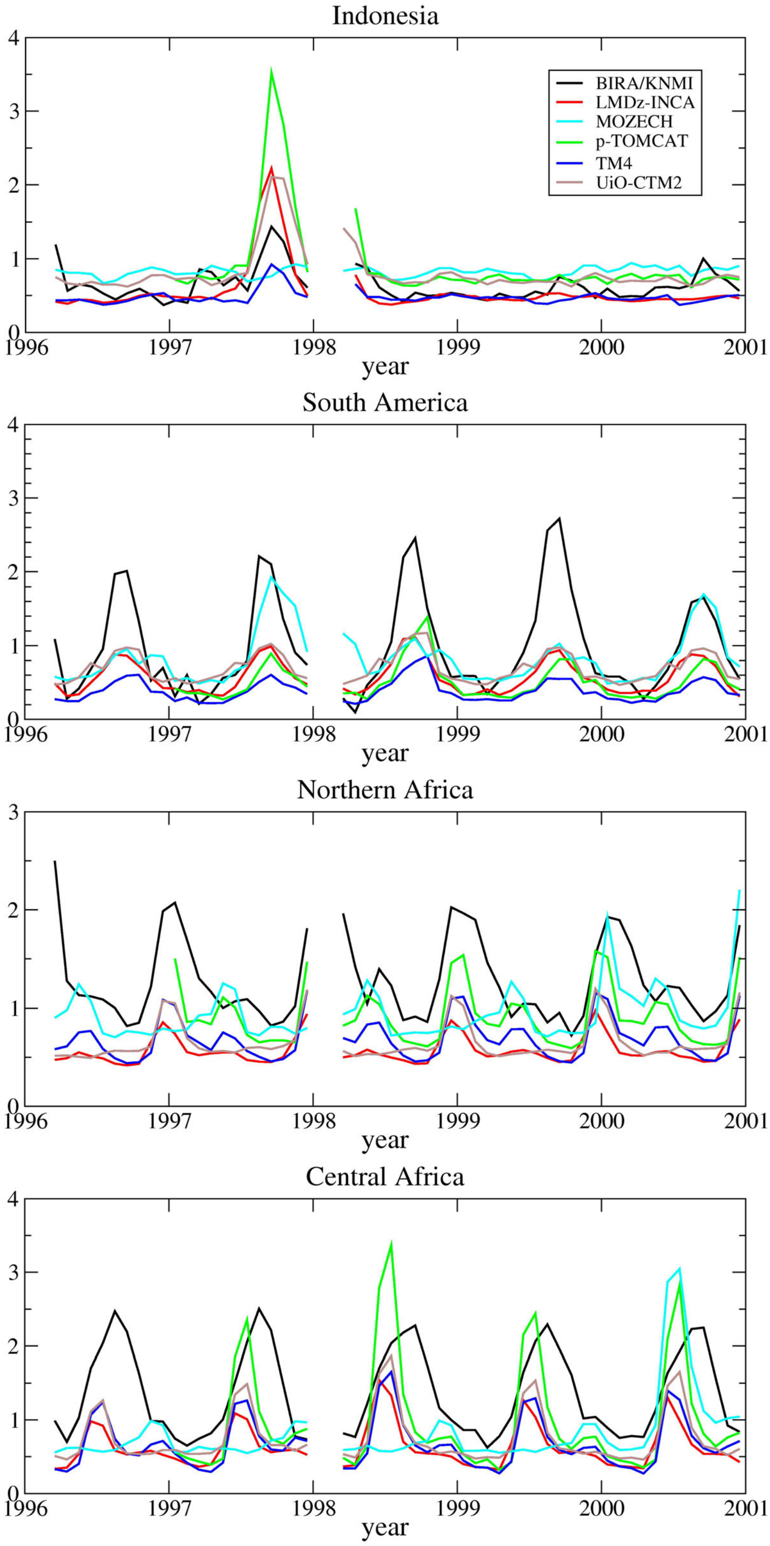


Figure 9: Definition of the regions used in this study.


Indonesia
BIRA/KNMI
LMDz-INCA
MOZECH
p-TOMCAT
TM4
UiO-CTM2
0
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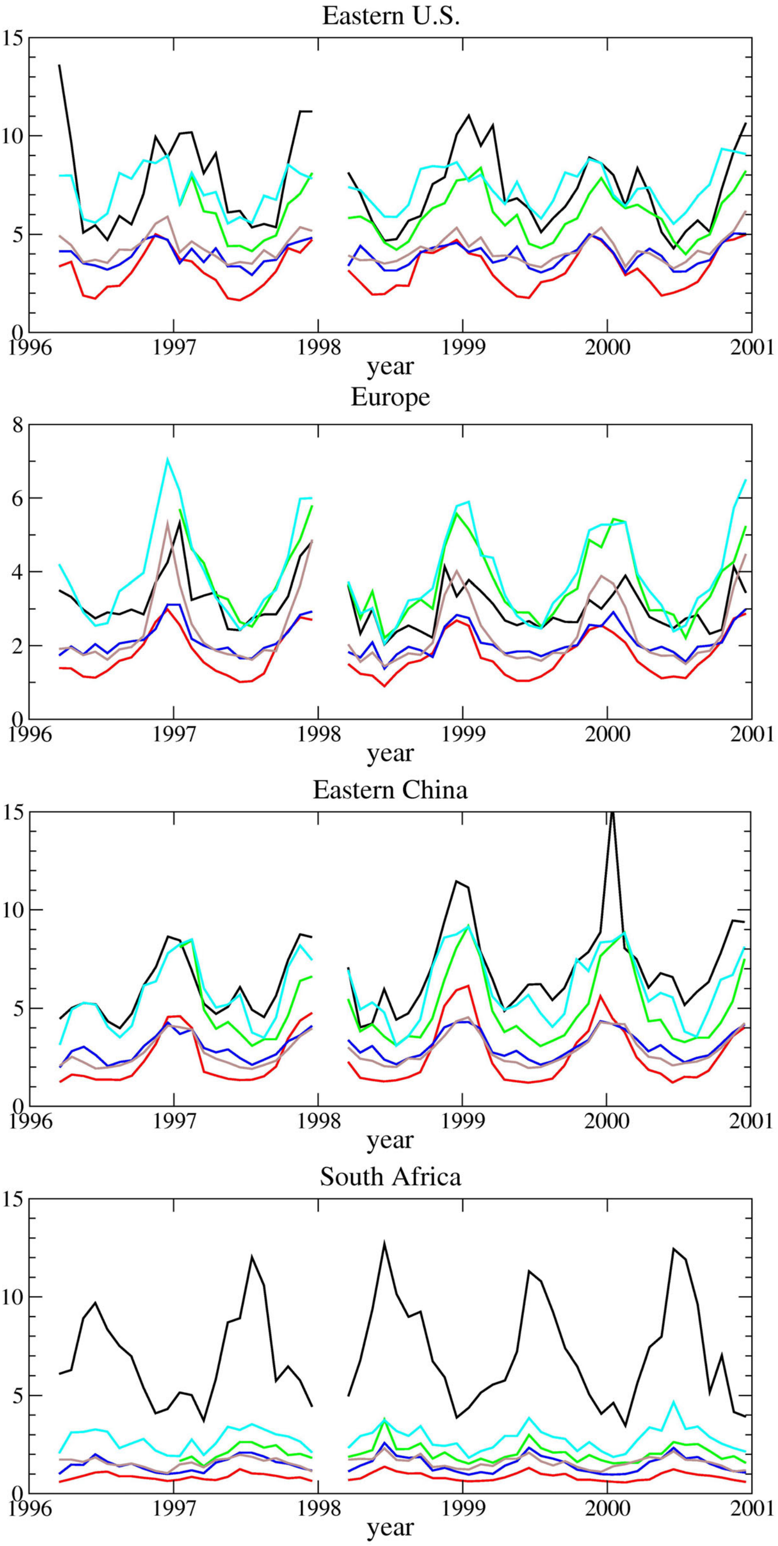

Figure 10. Retrieved and modelled monthly tropospheric NO_2 column densities (10^{15} molec/cm^2) over the regions shown in Figure 4.3.2-3 for the period March 1996–December 2000.

5.Summary and Conclusions

Despite the delays in the project, many important advances have been made during this project on the collection and use of observations. A database of observations has been set up at NILU using a common data format and metadata guidelines which will be an important resource in the future for atmospheric chemistry research. It is also hoped that this database will be able to grow to include other historical datasets and also archive more data from ongoing projects. Some difficulties in accessing some data sets were found due to: the use proprietary formats; data held back by PIs; unsuitable documentation and unknown data quality.

Other important progress has been the use of some of the observations for trend studies, exact specifications of how to sample the models for model-data comparison and the development of metrics for model evaluation.

These achievements will feed into the GMES programme which aims at designing and establishing by 2008 a European capacity for the provision and use of operational services for Global Monitoring of Environment and Security.

6. References

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Annex 1: Access to Field Data – Metadata records on NILU website.

This is a list of all the field data for which a metadata record but not the actual data is held on the NILU database. For most up to date version see: http://nadir.nilu.no/RETRO/index.cfm?fa=public.records&id={F2FC3785-D857-7460-00B3-34FEA13450BE}

- Aerosol Robotic Network
- Air Normand. French Observatory for Air Qualityt
- Air Quality overview . Kanton Basel-Landschaft
- Air quality and meteorological data in Niederoesterreich
- Air quality forecasts and observations in France and Europe
- Air quality in Kärnten
- Air quality in Norway
- Air quality in Tirol
- Air quality in Vienna
- Air quality network in Baden-Württemberg
- Air quality overview of Austria
- Airmaraix surveille la qualite de 'lair de l'Est des Bouches-du-Rhone, du Var et du Vaucluse
- Arctic Monitoring and Assessment Programme (AMAP) - Atmopheric Monitoring Programme
- Baseline Surface Radiation Network
- Bavarian Environmental Protection Agency
- Comprehensive Atmospheric Monitoring Programme
- Construction, use and delivery of an European aerosol database
- Eurotrac/Eurotrac2 Troposheric Ozone Research
- Finnish Meteorological Institute. Air Quality.
- HELCOM air quality database Baltic Sea coastal monitoring
- La qualite de l'air dans les Pays de la Loire
- London Air Quality Network
- Mapping of Polar Stratospheric Clouds and Ozone Levels Relevant to the Region of Europe
- National airquality monitoring in Denmark
- National airquality monitoring in Sweden
- Opanamodel air quality forecast over Leicester (UK)
- Ozone Web of the European Environmental Agency
- Platforme de simulation Meteo/Chimie Airmaraix
- Pollutant-Forecast, Europe, Central Europe, Germany, Northrhine-Westfalia
- Qualitair. Allpes Maritimes, Alpes de Haute-Provence, Hautes-Alpes.
- Smog Warners Data Exchange
- Surveillance de la qualite de l'air en Auvergne
- Sveriges Meteorologiska och Hydrologiska Institut
- System for observation of halogenated greenhouse gases in Europe
- THOR Integrated Air Pollution Forecast and Managment System
- The European Monitoring and Evaluation Programme

- The European Monitoring and Evaluation Programme
- The European air quality information system
- The Federal Environmental Agency of Germany
- The UK National Air Quality Information Archive
- WMO Global Atmoshere Watch - World Data Centre for Aerosols
- WMO Global Atmoshere Watch - World Data Centrer for Greenhouse Gases
- WMO Global Atmoshere Watch - World Ozone and Ultraviolet Radiation Data Centre
- WMO Global Atmoshere Watch - World Precipitation Chemistry Data
- WMO Global Atmosphere Watch - Station Information System
- YourAir, Central London Air Quality Forecast
- l'Association pour la Surveillance et l'Etude de la Pollution Atmospherique (ASPA)

Annex 2: Station lists

a) CMDL and miscellaneous others

Short Code	Code	Station name	Lat	Lon	Alt
ALT	CMDLALT	Alert	82 27 0 N	62 31 12 W	210
ASC	CMDLASC	Ascension Island	7 55 12 S	14 25 12 W	54
ASK	CMDLASK	Assekrem	23 10 48 N	5 25 12 E	2728
AZR	CMDLAZR	Terceira Island	38 46 12 N	27 22 48 W	40
BAL	CMDLBAL	Baltic Sea	55 25 12 N	17 4 12 E	28
BME	CMDLBME	St. Davids Head	32 22 12 N	64 39 0 W	30
BMW	CMDLBMW	Tudor Hill	32 16 12 N	64 52 48 W	30
BRW	CMDLBRW	Barrow	71 19 12 N	156 36 0 W	11
BSC	CMDLBSC	Black Sea	44 10 12 N	28 40 48 E	3
CBA	CMDLCBA	Cold Bay	55 12 0 N	162 43 12 W	25
CGO	CMDLCGO	Cape Grim	40 40 48 S	144 40 48 E	94
CHR	CMDLCHR	Christmas Island	1 42 0 N	157 10 12 W	3
CMO	CMDLCMO	Cape Meares	45 28 48 N	123 58 12 W	30
CRZ	CMDLCRZ	Crozet Island	46 27 0 S	51 51 0 E	120
EIC	CMDLEIC	Easter Island	27 9 0 S	109 27 0 W	50
GMI	CMDLGMI	Mariana Islands	13 25 48 N	144 46 48 E	6
GOZ	CMDLGOZ	Dwejra Point	36 3 0 N	14 10 48 E	30
HBA	CMDLHBA	Halley Station	75 34 48 S	26 30 0 W	33
HUN	CMDLHUN	Hegyhatsal	46 57 0 N	16 39 0 E	344
ICE	CMDLICE	Storhofdi	63 20 24 N	20 17 24 W	127
ITN	CMDLITN	Grifton	35 21 0 N	77 22 48 W	505
IZO	CMDLIZO	Tenerife	28 18 0 N	16 28 48 W	2360
KEY	CMDLKEY	Key Biscayne	25 40 12 N	80 12 0 W	3
KUM	CMDLKUM	Cape Kumukahi	19 31 12 N	154 49 12 W	3
KZD	CMDLKZD	Sary Taukum	44 27 0 N	75 34 12 E	412
KZM	CMDLKZM	Plateau Assy	43 15 0 N	77 52 48 E	2519
LEF	CMDLLEF	Park Falls	45 55 48 N	90 16 12 W	868
MBC	CMDLMBC	Mould Bay	76 15 0 N	119 21 0 W	58
MCM	CMDLMCM	McMurdo Station	77 49 48 S	166 36 0 E	11
MHD	CMDLMHD	Mace Head	53 19 48 N	9 54 0 W	25
MID	CMDLMID	Sand Island	28 12 36 N	177 22 48 W	7
MLO	CMDLMLO	Mauna Loa	19 31 48 N	155 34 48 W	3397
NMB	CMDLNMB	Gobabeb	23 34 48 S	15 1 48 E	461
NWR	CMDLNWR	Niwot Ridge	40 3 0 N	105 34 48 W	3475
PSA	CMDLPSA	Palmer Station	64 55 12 S	0 38 24 W	10
PTA	CMDLPTA	Point Arena	38 57 0 N	123 43 48 W	17
RPB	CMDLRPB	Ragged Point	13 10 12 N	59 25 48 W	45
SEY	CMDLSEY	Mahe Island	4 40 12 S	55 10 12 E	7
SHM	CMDLSHM	Shemya Island	52 43 12 N	174 6 0 E	40
SMO	CMDLSMO	Tutuila	14 14 24 S	170 34 12 W	42
SPO	CMDLSPO	South Pole	89 58 48 S	24 48 0 W	2810
STM	CMDLSTM	Ocean Station M	0 39 36 N	0 1 12 E	5
SUM	CMDLSUM	Summit	72 34 48 N	38 28 48 W	3238
SYO	CMDLSYO	Syowa Station	0 41 24 S	39 34 48 E	14
TAP	CMDLTAP	Tae-ahn Peninsula	36 43 48 N	126 7 48 E	20
TDF	CMDLTDF	Tierra Del Fuego	54 52 12 S	68 28 48 W	20
THD	CMDLTHD	Trinidad Head	41 3 0 N	124 9 0 W	107

UTA	CMDLUTA	Wendover	39 54 0 N	113 43 12 W	1320
UUM	CMDLUUM	Ulaan Uul	44 27 0 N	111 6 0 E	914
WIS	CMDLWIS	Sede Boker	31 7 48 N	34 52 48 E	400
WLG	CMDLWLG	Mt. Waliguan	36 17 24 N	100 54 0 E	3810
ZEP	CMDLZEP	Ny-Alesund	78 54 0 N	11 52 48 E	475
JFJ	GAW_JFJ	Jungfraujoch	47 24 36 N	10 54 0 E	2962
	WDCGELA	Experimental Lakes Area Canada	49 40 00 N	93 43 00 W	369
	WDCGSAT	Saturna	48 47 00 N	123 08 00 W	178
	WDCGALG	Algoma	47 20 00 N	84 23 00 W	411
	WDCGCHA	Chalk River	46 40 00 N	77 24 00 W	184
	WDCGKEJ	Kejimkujik	44 26 00 N	65 12 00 W	127
	WDCGPEN	Penhas Douradas	40 25 00 N	7 33 00 W	1380
	WDCGRYO	Ryori	39 20 00 N	141 49 00 E	260
	WDCGTKB	Tsukuba	36 30 00 N	140 08 00 E	25
	WDCGFUN	Funchal	32 39 00 N	16 53 00 W	58
	WDCGBAR	Baring Head	41 25 00 S	174 52 00 E	85
	NTL_NIC	Nicosia Cyprus	35 10 00 N	33 21 00 E	160
	IGACPIC	Pico Mountain Azores	38 28 13 N	28 24 15 W	2225
	ASIAABU	Mt Abu	26 36 00 N	72 42 00 E	160
	ASIAGAD	Gadanki	13 30 00 N	79 12 00 E	375
	ASIAHKG	Hongkong	22 13 00 N	114 15 00 E	60
	ASIAYON	Yonagunijima:	24 28 00 N	123 01 00 E	30
	ASIAHUG	Huangsahn	30 00 00 N	118 00 00 E	1841
	ASIALIN	Linan	30 00 00 N	119 00 00 E	0
	ASIATAI	Taishan	36 00 00 N	177 00 00 E	1524
	ASIAHUA	HuaShan	34 00 00 N	110 00 00 E	2065
	ASIARYO	Ryori	39 02 00 N	141 49 00 E	260
	ASIATSU	Tsukubi	36 03 00 N	140 08 00 E	25
	ASIAOKI	Oki	36 00 00 N	133 00 00 E	0
	ASIAHAP	Happo	36 00 00 N	137 00 00 E	0
	IAP_ZVE	Zvenigorod,Russia	55 41 24 N	36 46 12o	200
	IAP_KIS	Kislovodsk	43 42 00 N	42 42 00 E	2070
	IAP_LOV	Lovozero ,Russia	67 58 12N	35 01 12 E	250
	IAP_ISS	Issyk Kul ,Russia	42 37 12N	76 58 48 E	1650
	IAP_TOM	Tomsk ,Russia	56 28 12 N	84 57 00 E	280

b) EMEP

Short Code	Code	Station name	Lat	Lon	Alt
AT02	AT0002R	Illmitz	47 46 0 N	16 46 0 E	117
AT03	AT0003R	Achenkirch	47 33 0 N	11 43 0 E	960
AT04	AT0004R	St. Koloman	47 39 0 N	13 12 0 E	851
AT05	AT0005R	Vorhegg	46 40 40 N	12 58 20 E	1020
AT30	AT0030R	Pillersdorf bei Retz	48 43 16 N	15 56 32 E	315
AT31	AT0031R	St. Leonhard	47 59 5 N	14 51 10 E	790
AT32	AT0032R	Sulzberg	47 31 45 N	9 55 36 E	1020
AT33	AT0033R	Stolzalpe bei Murau	47 7 45 N	14 12 14 E	1302
AT34	AT0034G	Sonnblick	47 3 16 N	12 57 30 E	3106
AT37	AT0037R	Zillertaler Alpen	47 8 13 N	11 52 12 E	1970
AT38	AT0038R	Gerlitzen	46 41 37 N	13 54 54 E	1895
AT40	AT0040R	Masenberg	47 20 53 N	15 52 56 E	1170
AT41	AT0041R	Haunsberg	47 58 23 N	13 0 58 E	730

AT42	AT0042R	Heidenreichstein	48 52 43 N	15 2 48 E	570
AT43	AT0043R	Forsthof	48 6 22 N	15 55 10 E	581
AT44	AT0044R	Graz Platte	47 6 47 N	15 28 14 E	651
AT45	AT0045R	Dunkelsteinerwald	48 22 16 N	15 32 48 E	320
AT46	AT0046R	Gänserndorf	48 20 5 N	16 43 50 E	161
AT47	AT0047R	Stixneusiedl	48 3 3 N	16 40 36 E	240
BE01	BE0001R	Offagne	49 52 40 N	5 12 13 E	430
BE32	BE0032R	Eupen	50 37 46 N	6 0 10 E	295
BE35	BE0035R	Vezin	50 30 12 N	4 59 22 E	160
CH02	CH0002R	Payerne	46 49 0 N	6 57 0 E	510
CH03	CH0003R	Tänikon	47 29 0 N	8 54 0 E	540
CH04	CH0004R	Chaumont	47 3 4 N	6 58 50 E	1130
CH05	CH0005R	Rigi	47 4 10 N	8 27 56 E	1030
CH31	CH0031R	Sion	46 13 0 N	7 20 0 E	480
CZ01	CZ0001R	Svratouch	49 44 0 N	16 2 0 E	737
CZ03	CZ0003R	Kosetice	49 35 0 N	15 5 0 E	534
DE01	DE0001R	Westerland	54 55 32 N	8 18 35 E	12
DE02	DE0002R	Langenbrügge	52 48 8 N	10 45 34 E	74
DE03	DE0003R	Schauinsland	47 54 53 N	7 54 31 E	1205
DE04	DE0004R	Deuselbach	49 45 53 N	7 3 7 E	480
DE05	DE0005R	Brotjacklriegel	48 49 10 N	13 13 9 E	1016
DE07	DE0007R	Neuglobsow	53 10 0 N	13 2 0 E	62
DE08	DE0008R	Schmücke	50 39 0 N	10 46 0 E	937
DE09	DE0009R	Zingst	54 26 0 N	12 44 0 E	1
DE11	DE0011R	Hohenwestedt	54 6 0 N	9 40 0 E	75
DE12	DE0012R	Bassum	52 51 0 N	8 42 0 E	52
DE14	DE0014R	Meinerzhagen	51 7 0 N	7 38 0 E	510
DE17	DE0017R	Ansbach	49 15 0 N	10 35 0 E	481
DE26	DE0026R	Ueckermünde	53 45 0 N	14 4 0 E	1
DE31	DE0031R	Wiesenburg	52 7 0 N	12 28 0 E	107
DE35	DE0035R	Lückendorf	50 50 0 N	14 46 0 E	490
DE38	DE0038R	Murnauer Moos	47 39 05 N	11 12 12 E	622
DE39	DE0039R	Aukrug	54 4 29 N	9 47 34 E	15
DE42	DE0042R	Öhringen	49 14 36 N	9 26 50 E	283
DK05	DK0005R	Keldsnor	54 44 0 N	10 44 0 E	10
DK31	DK0031R	Ulborg	56 17 0 N	8 26 0 E	10
DK32	DK0032R	Frederiksborg	55 58 0 N	12 20 0 E	10
DK41	DK0041R	Lille Valby	55 41 13 N	12 7 34 E	10
EE09	EE0009R	Lahemaa	59 30 0 N	25 54 0 E	32
EE11	EE0011R	Vilsandy	58 23 0 N	21 49 0 E	6
ES01	ES0001R	San Pablo de los Montes	39 32 52 N	4 20 55 W	917
ES02	ES0002R	Cartuja	37 12 0 N	3 36 0 W	720
ES03	ES0003R	Roquetas	40 49 14 N	0 29 29 E	44
ES04	ES0004R	Logroño	42 27 28 N	2 30 11 W	445
ES05	ES0005R	Noya	42 43 41 N	8 55 25 W	683
ES07	ES0007R	Víznar	37 14 0 N	3 32 0 W	1265
ES08	ES0008R	Niembro	43 26 32 N	4 51 1 W	134
ES09	ES0009R	Campisabalos	41 16 52 N	3 8 34 W	1360
ES10	ES0010R	Cabo de Creus	42 19 10 N	3 19 1 E	23
ES11	ES0011R	Barcarrola	38 28 33 N	6 55 22 W	393
ES12	ES0012R	Zarra	39 5 10 N	1 6 7 W	885
ES13	ES0013R	Penausende	41 17 0 N	5 52 0 W	985
ES14	ES0014R	Els Torms	41 24 0 N	0 43 0 E	470
ES15	ES0015R	Risco Llamo	39 31 0 N	4 21 0 W	1241
ES16	ES0016R	O Saviñao	43 13 52 N	7 41 59 W	506
FI04	FI0004R	Ähtari	62 32 0 N	24 13 18 E	162

FI09	FI0009R	Utö	59 46 45 N	21 22 38 E	7
FI17	FI0017R	Virolahti II	60 31 36 N	27 41 10 E	4
FI22	FI0022R	Oulanka	66 19 13 N	29 24 6 E	310
FI37	FI0037R	Ahtari II	62 35 0 N	24 11 0 E	180
FR08	FR0008R	Donon	48 30 0 N	7 8 0 E	775
FR09	FR0009R	Revin	49 54 0 N	4 38 0 E	390
FR10	FR0010R	Morvan	47 16 0 N	4 5 0 E	620
FR11	FR0011R	Bonnevaux	46 49 0 N	6 11 0 E	836
FR12	FR0012R	Iraty	43 2 0 N	1 5 0 W	1300
FR13	FR0013R	Peyrusse Vieille	43 22 29 N	0 6 16 E	236
FR14	FR0014R	Montandon	47 11 0 N	6 30 0 E	746
GB02	GB0002R	Eskdalemuir	55 18 47 N	3 12 15 W	243
GB06	GB0006R	Lough Navar	54 26 35 N	7 52 12 W	126
GB13	GB0013R	Yarner Wood	50 35 47 N	3 42 47 W	119
GB14	GB0014R	High Muffles	54 20 4 N	0 48 27 W	267
GB15	GB0015R	Strath Vaich Dam	57 44 4 N	4 46 28 W	270
GB31	GB0031R	Aston Hill	52 30 14 N	3 1 59 W	370
GB32	GB0032R	Bottesford	52 55 46 N	0 48 55 W	32
GB33	GB0033R	Bush	55 51 31 N	3 12 18 W	180
GB34	GB0034R	Glazebury	53 27 31 N	2 27 59 W	21
GB35	GB0035R	Great Dun Fell	54 41 2 N	2 26 6 W	847
GB36	GB0036R	Harwell	51 34 23 N	1 19 0 W	137
GB37	GB0037R	Ladybower Res.	53 23 56 N	1 45 12 W	420
GB38	GB0038R	Lullington Heath	50 47 34 N	0 10 46 E	120
GB39	GB0039R	Sibton	52 17 38 N	1 27 47 E	46
GB41	GB0041R	Wharleycroft	54 36 9 N	2 28 6 W	206
GB43	GB0043R	Narberth	51 14 0 N	4 42 0 W	160
GB44	GB0044R	Somerton	51 13 52 N	3 2 53 W	55
GB45	GB0045R	Wicken Fen	52 17 54 N	0 17 34 W	5
GR01	GR0001R	Aliartos	38 22 0 N	23 5 0 E	110
GR02	GR0002R	Finokalia	35 30 0 N	26 10 0 E	0
GR03	GR0003R	Livadi	40 32 0 N	23 15 0 E	850
HU02	HU0002R	K-puszta	46 58 0 N	19 35 0 E	125
IE31	IE0031R	Mace Head	53 10 0 N	9 30 0 W	15
IT01	IT0001R	Montelibretti	42 6 0 N	12 38 0 E	48
IT04	IT0004R	Ispra	45 48 0 N	8 38 0 E	209
LT15	LT0015R	Preila	55 21 0 N	21 4 0 E	5
LV10	LV0010R	Rucava	56 13 0 N	21 13 0 E	5
MT01	MT0001R	Giordan lighthouse	36 6 0 N	14 12 0 E	160
NL02	NL0002R	Witteveen	52 48 49 N	6 40 11 E	17
NL09	NL0009R	Kollumerwaard	53 20 2 N	6 16 38 E	1
NL10	NL0010R	Vredepeel	51 32 28 N	5 51 13 E	28
NO01	NO0001R	Birkenes	58 23 0 N	8 15 0 E	190
NO15	NO0015R	Tustervatn	65 50 0 N	13 55 0 E	439
NO30	NO0030R	Jergul	69 27 0 N	24 36 0 E	255
NO39	NO0039R	Kårvatn	62 47 0 N	8 53 0 E	210
NO41	NO0041R	Osen	61 15 0 N	11 47 0 E	440
NO42	NO0042G	Spitsbergen, Zeppelinfjell	78 54 0 N	11 53 0 E	474
NO43	NO0043R	Prestebakke	59 0 0 N	11 32 0 E	160
NO44	NO0044R	Nordmoen	60 16 0 N	11 6 0 E	200
NO45	NO0045R	Jeløya	59 26 0 N	10 36 0 E	5
NO47	NO0047R	Svanvik	69 27 0 N	30 2 0 E	30
NO48	NO0048R	Voss	60 36 0 N	6 32 0 E	500
NO49	NO0049R	Valle	59 3 0 N	7 34 0 E	250
NO52	NO0052R	Sandve	59 12 0 N	5 12 0 E	15
NO55	NO0055R	Karasjok	69 28 0 N	25 13 0 E	333

NO56	NO0056R	Hurdal	60 22 0 N	11 4 0 E	300
PL02	PL0002R	Jarczew	51 49 0 N	21 59 0 E	180
PL03	PL0003R	Sniezka	50 44 0 N	15 44 0 E	1603
PL04	PL0004R	Leba	54 45 0 N	17 32 0 E	2
PL05	PL0005R	Diabla Gora	54 9 0 N	22 4 0 E	157
PT04	PT0004R	Monte Velho	38 5 0 N	8 48 0 W	43
RU01	RU0001R	Janiskoski	68 56 0 N	28 51 0 E	118
RU13	RU0013R	Pinega	64 42 0 N	43 24 0 E	28
RU16	RU0016R	Shepeljovo	59 58 0 N	29 7 0 E	4
RU18	RU0018R	Danki	54 54 0 N	37 48 0 E	150
SE02	SE0002R	Rörvik	57 25 0 N	11 56 0 E	10
SE11	SE0011R	Vavihill	56 1 0 N	13 9 0 E	175
SE12	SE0012R	Aspvreten	58 48 0 N	17 23 0 E	20
SE13	SE0013R	Esrange	67 53 0 N	21 4 0 E	475
SE32	SE0032R	Norra-Kvill	57 49 0 N	15 34 0 E	261
SE35	SE0035R	Vindeln	64 15 0 N	19 46 0 E	225
SE39	SE0039R	Grimsö	59 45 0 N	15 35 0 E	120
SI08	SI0008R	Iskrba	45 34 0 N	14 52 0 E	520
SI31	SI0031R	Zarodnje	46 25 43 N	15 0 12 E	770
SI32	SI0032R	Krvavec	46 17 58 N	14 32 19 E	1740
SI33	SI0033R	Kovk	46 7 43 N	15 6 50 E	600
SK02	SK0002R	Chopok	48 56 0 N	19 35 0 E	2008
SK04	SK0004R	Stará Lesná	49 9 0 N	20 17 0 E	808
SK06	SK0006R	Starina	49 3 0 N	22 16 0 E	345
SK07	SK0007R	Topolniky	47 57 36 N	17 51 38 E	113
TR01	TR0001R	Cubuk II	40 30 0 N	33 0 0 E	1169

c) MAXDOAS and Russian Stations

Code ***=Short Code***	Station name	Lat	Lon	Alt
ZEP	Ny-Alesund, Norway	78 54 0 N	11 52 48 E	475
SUM	Summit, Greenland	72 34 48 N	38 28 48 W	3238
BRE	Bremen, Germany	53 05 00 N	8 49 00 E	15
MER	Merida, Venezuela	8 12 00 N	71 06 00 W	15
NAI	Nairobi, Kenya	1 17 00 S	36 49 00 E	1662
ZVE	Zvenigorod,Russia	55 41 24 N	36 46 12o	200
KIS	Kislovodsk ,Russia	43 43 48 N	42 69 36 E;	2070
LOV	Lovozero ,Russia	67 58 12N	35 01 12 E	250
ISK	Issyk Kul ,Russia	42 37 12N	76 58 48 E	1650
TOM	Tomsk ,Russia	56 28 12 N	84 57 00 E	280

d) Ozone Sondes

Short Code	Code	Station name	Lat	Lon	Alt
001	COG001	Leopoldville	04 18 00 S	15 33 00 E	450
002	DZA002	Tamanrasset	22 47 59 N	05 31 01 E	1377
003	KAZ003	Alma-Ata	43 13 58 N	76 55 58 E	847
004	IND004	Banaras	25 00 00 N	83 00 00 E	-1
005	RUS005	Dikson Island	73 30 00 N	80 13 58 E	18

006	IRQ006	Habbaniya	33 22 01 N	43 34 01 E	44
007	JPN007	Kagoshima	31 34 47 N	130 33 54 E	157
008	IND008	Kodaikanal	10 13 58 N	77 28 01 E	2343
009	IND009	Mount Abu	24 35 59 N	72 41 59 E	1220
010	IND010	New Delhi	28 39 00 N	77 13 01 E	220
011	PAK011	Quetta	30 06 36 N	66 34 11 E	1721
012	JPN012	Sapporo	43 03 35 N	141 19 53 E	19
013	IND013	Sprinagar	34 05 59 N	74 48 00 E	1586
014	JPN014	Tateno / Tsukuba	36 03 35 N	140 06 00 E	31
015	JPN015	Torishima	30 28 58 N	140 18 00 E	83
016	RUS016	Vladivostok	43 07 01 N	131 53 59 E	80
017	GBR017	Argentine Islands	65 15 00 S	64 31 01 W	10
018	CAN018	Alert	82 30 00 N	62 19 11 W	62
019	USA019	Bismarck	46 46 01 N	100 45 00 W	511
020	USA020	Caribou	46 52 01 N	68 01 47 W	192
021	CAN021	Edmonton / Stony Plain	53 33 00 N	114 05 59 W	766
022	USA022	Green Bay	44 28 58 N	88 07 58 W	209
023	CAN023	Moosonee	51 16 01 N	80 39 00 W	10
024	CAN024	Resolute	74 43 12 N	94 58 47 W	40
025	USA025	Washington	38 58 58 N	77 28 58 W	84
026	AUS026	Aspendale	38 01 47 S	145 06 00 E	1
027	AUS027	Brisbane	27 25 01 S	153 07 01 E	3
028	ATA028	Dumont D'urville	66 40 01 S	140 01 12 E	40
029	AUS029	Macquarie Island	54 30 00 S	158 58 01 E	6
030	JPN030	Minamitorishima / Marcus Is.	24 17 59 N	153 58 01 E	9
031	USA031	Mauna Loa	19 31 58 N	155 34 26 W	3405
032	NZL032	Wellington	41 16 58 S	174 46 01 E	126
033	GEO033	Abustumani	41 45 00 N	42 49 58 E	1600
034	DNK034	Aarhus	56 10 01 N	10 11 59 E	53
035	CHE035	Arosa	46 46 47 N	09 40 48 E	1840
036	GBR036	Camborne	50 13 01 N	05 19 11 W	88
037	RUS037	Elbrus Mt.	43 19 01 N	42 28 01 E	2100
038	ITA038	Cagliari/Elmas	39 15 00 N	09 03 00 E	240
039	GBR039	Eskdalemuir	55 19 01 N	03 12 00 W	242
040	FRA040	Haute Provence	43 55 58 N	05 41 59 E	674
041	CHE041	Jungfraujoch	47 00 00 N	08 00 00 E	3573
042	RUS042	St. Petersburg	59 58 01 N	30 17 59 E	74
043	GBR043	Lerwick	60 07 53 N	01 10 58 W	80
044	NOR044	Longyear	78 13 01 N	15 34 58 E	1
045	ITA045	Messina	38 11 59 N	15 33 00 E	51
046	NOR046	Murchison Bay	80 00 00 N	18 00 00 E	-1
047	ITA047	Naples	40 50 59 N	15 15 00 E	45
048	GBR048	Oxford	51 45 00 N	01 10 58 W	140
049	FRA049	Paris-Montsouris	48 49 01 N	02 19 58 E	76
050	DEU050	Potsdam	52 13 12 N	13 03 00 E	89
051	ISL051	Reykjavik	64 07 58 N	21 54 00 W	60
052	NOR052	Tromso	69 39 00 N	18 57 00 E	100
053	BEL053	Uccle	50 48 00 N	04 21 00 E	100
054	SWE054	Uppsala	59 50 59 N	17 31 01 E	15
055	ITA055	Vigna Di Valle	42 04 48 N	12 13 11 E	262
056	DEU056	Weissenau	47 46 01 N	09 34 58 E	445
057	GBR057	Halley Bay	73 31 01 S	26 43 58 W	31
058	USA058	Little America	78 00 00 S	162 00 00 W	44
060	DEU060	Dresden	51 07 01 N	13 40 58 E	246
061	COG061	Bunia Ruampara	01 30 00 N	30 12 57 E	1239
062	FRA062	Port Aux Francais	49 20 59 S	70 16 58 E	14

063	USA063	Fort Worth	32 49 58 N	97 03 00 W	176
064	USA064	Sterling	38 58 58 N	77 28 58 W	84
065	CAN065	Toronto	43 46 47 N	79 28 12 W	198
066	USA066	Fort Collins	40 34 01 N	105 04 01 W	1551
067	USA067	Boulder	40 01 47 N	105 15 00 W	1689
068	POL068	Belsk	51 50 24 N	20 47 24 E	180
069	ATA069	Hallett	72 19 01 S	170 13 01 E	5
070	FRA070	Mont Louis	42 30 00 N	02 07 58 E	1650
071	ZAF071	Pretoria	25 43 58 S	28 10 58 E	1369
072	ATA072	Byrd	80 01 47 S	119 31 01 W	1528
073	IND073	Ahmedabad	23 01 47 N	72 39 00 E	55
074	IND074	Varanasi	25 19 01 N	83 01 47 E	76
075	IND075	Dum Dum	22 39 00 N	88 26 59 E	27
076	CAN076	Goose Bay	53 18 00 N	60 21 36 W	40
077	CAN077	Churchill	58 45 00 N	94 04 11 W	35
079	USA079	Tallahassee	30 24 00 N	84 20 59 W	21
080	MDV080	Gan	00 40 58 S	73 09 00 E	2
081	ATA081	Base King Baudoin	70 25 58 S	24 19 01 E	38
082	PRT082	Lisbon	38 46 12 N	09 08 59 W	105
084	AUS084	Darwin	12 25 01 S	130 52 58 E	31
085	RUS085	Irkutsk	52 15 46 N	104 20 59 E	467
086	UKR086	Feodosija	45 01 58 N	35 22 58 E	26
087	UKR087	Kiev	50 24 00 N	30 27 00 E	121
088	ATA088	Mirny	66 33 00 S	93 00 00 E	30
089	NOR089	Ny Alesund	78 55 58 N	11 52 58 E	242
090	TKM090	Ashkhabad	37 58 01 N	58 19 58 E	227
091	ARG091	Buenos Aires	34 34 58 S	58 28 58 W	25
092	AUS092	Hobart	42 49 58 S	147 30 00 E	22
093	AUS093	Salisbury	34 43 01 S	138 38 59 E	1
094	AUS094	Woomera	30 57 00 S	136 30 57 E	146
095	TWN095	Taipei	25 01 12 N	121 28 30 E	25
096	CZE096	Hradec Kralove	50 10 58 N	15 49 58 E	285
097	FRA097	Magny-Les-hameaux	48 43 58 N	02 04 01 E	165
098	FRA098	Val Joyeaux	48 29 23 N	02 01 11 E	114
099	DEU099	Hohenpeissenberg	47 48 00 N	11 01 12 E	975
100	HUN100	Budapest-Lorinc	47 25 58 N	19 10 58 E	139
101	JPN101	Syowa	69 00 00 S	39 34 48 E	21
102	GBR102	Bracknell	51 22 47 N	00 46 47 W	70
103	USA103	Albuquerque	35 04 58 N	106 37 01 W	1575
104	USA104	Bedford	42 26 59 N	71 16 01 W	80
105	USA105	Fairbanks	64 49 01 N	147 52 01 W	138
106	USA106	Nashville	36 15 00 N	86 34 01 W	182
107	USA107	Wallops Island	37 53 52 N	75 28 58 W	13
108	USA108	Canton Island	02 45 35 S	171 41 59 W	3
109	USA109	Hilo	19 34 37 N	155 04 01 W	11
110	PER110	Huancayo	12 03 00 S	75 19 01 W	3313
111	ATA111	Amundsen-Scott	89 58 58 S	24 47 59 W	2810
112	RUS112	Bolshaya Elan	46 55 01 N	142 43 58 E	22
113	TJK113	Dushanbe	38 34 58 N	68 46 58 E	825
114	RUS114	Heiss Island	80 37 11 N	58 05 59 E	20
115	RUS115	Samara (Kuibyshev)	53 15 00 N	50 26 59 E	137
116	RUS116	Moscow	55 45 00 N	37 34 01 E	187
117	RUS117	Murmansk	68 58 01 N	33 03 00 E	46
118	RUS118	Nagaevo	59 34 58 N	150 46 58 E	118
119	UKR119	Odessa	46 28 58 N	30 37 58 E	42
120	RUS120	Omsk	54 55 58 N	73 24 00 E	119

121	LVA121	Riga	57 11 24 N	24 15 00 E	7
122	RUS122	Ekaterinburg	56 48 00 N	60 37 58 E	290
123	RUS123	Yakutsk	62 04 48 N	129 45 00 E	98
124	MEX124	Cerrillos	19 28 58 N	99 43 01 W	2640
125	DZA125	Columb-Bechar	31 37 48 N	02 15 00 W	806
127	USA127	Midland	31 55 58 N	102 11 59 W	872
128	KAZ128	Kararganda	49 48 00 N	73 07 58 E	553
129	RUS129	Pechora	65 07 01 N	57 05 59 E	61
130	RUS130	Petropavlovsk/Kamchatskii	52 58 01 N	158 45 00 E	78
131	CHL131	Puerto Montt	41 26 59 S	72 49 58 W	5
132	BGR132	Sofia	42 49 01 N	23 22 58 E	588
133	FLK133	Stanley	51 41 59 S	57 52 01 W	51
137	USA137	Topeka	39 04 01 N	95 37 58 W	270
138	NZL138	Christchurch	43 28 58 S	172 33 00 E	34
142	RUS142	Igarka	67 28 01 N	86 34 01 E	20
143	RUS143	Krasnoyarsk	56 00 00 N	92 52 58 E	137
144	RUS144	Markovo	64 40 58 N	170 25 01 E	22
145	RUS145	Olenek	68 30 00 N	112 25 58 E	127
147	KAZ147	Semipalatinsk	50 20 59 N	80 15 00 E	206
148	RUS148	Vitim	59 26 59 N	112 34 58 E	186
149	BOL149	Ovejuyo (La Paz)	16 31 01 S	68 01 58 W	3420
150	RUS150	Hanty Mansijsk	60 58 01 N	69 04 01 E	40
152	EGY152	Cairo	30 04 47 N	31 16 58 E	37
153	RUS153	Voronez	51 41 59 N	39 10 01 E	147
155	USA155	White Sands	32 22 58 N	106 28 58 W	1224
156	CHE156	Payerne	46 29 23 N	06 34 11 E	491
157	CHE157	Thalwil	46 49 01 N	08 27 17 E	515
158	MAR158	Casablanca	33 34 11 N	07 40 12 W	55
159	AUS159	Perth	31 55 01 S	115 56 59 E	2
163	USA163	Wilkes	66 15 00 S	110 31 01 E	12
164	USA164	Silver Hill	38 49 58 N	76 56 59 W	89
165	NOR165	Oslo	59 54 35 N	10 43 11 E	90
169	DEU169	Arkona	54 24 35 N	13 15 36 E	42
174	DEU174	Lindenberg	52 12 35 N	14 07 11 E	112
175	KEN175	Nairobi	01 16 01 S	36 48 00 E	1745
180	NZL180	Invercargill	46 25 11 S	168 18 57 E	1
181	DEU181	Berlin/Templehof	52 28 01 N	13 25 58 E	50
182	KAZ182	Aralskoe More	46 46 58 N	61 40 01 E	56
183	KAZ183	Atiray (Gurev)	47 01 47 N	51 50 59 E	-1
184	UKR184	Lwow	49 49 01 N	23 57 00 E	325
185	GEO185	Tbilisi	41 40 58 N	44 56 59 E	490
186	RUS186	Tiksi	71 34 58 N	128 55 01 E	8
187	IND187	Poona	18 31 58 N	73 50 59 E	559
189	NOR189	Svalbard Hornsund	77 00 00 N	15 33 00 E	11
190	JPN190	Naha	26 12 00 N	127 40 58 E	27
191	ASM191	Samoa	14 15 00 S	170 33 35 W	82
192	MEX192	Mexico City	19 19 58 N	99 10 58 W	2268
193	AUS193	Cairns	16 52 58 S	145 45 00 E	3
194	CAN194	Yorkton	51 15 46 N	102 28 01 W	504
195	GBR195	Sibton	51 30 00 N	00 07 01 W	50
197	FRA197	Biscarrosse/Sms	44 22 01 N	01 13 58 W	18
198	CAN198	Cold Lake	54 46 58 N	110 03 00 W	702
199	USA199	Barrow	71 19 01 N	156 36 00 W	11
200	BRA200	Cachoeira Paulista	22 40 58 S	45 00 00 W	573
201	ITA201	Sestola	44 13 12 N	10 46 12 E	1030
202	DEU202	Neuglobson	53 09 00 N	13 01 58 E	62

203	PAN203	Ft. Sherman	09 19 47 N	79 58 58 E	57
204	SHN204	St. Helena	15 55 58 S	05 38 59 W	460
205	IND205	Thivandrum	08 28 58 N	76 56 59 E	60
206	IND206	Bombay	19 07 01 N	72 50 59 E	145
207	SYC207	Mahe (Seychelles)	04 40 58 S	55 31 58 E	6
208	CHN208	Xianghe	39 58 29 N	116 22 11 E	80
209	CHN209	Kunming	25 01 47 N	102 40 58 E	1917
210	USA210	Palestine	31 47 59 N	95 43 01 W	121
213	ESP213	El Arenosillo	37 05 59 N	06 43 58 W	41
214	SGP214	Singapore	01 19 58 N	103 52 58 E	14
215	DEU215	Garmisch-Partenkir	47 28 58 N	11 04 01 E	740
216	THA216	Bangkok	13 40 01 N	100 36 43 E	53
217	USA217	Poker Flat	65 07 58 N	147 26 59 W	357
218	PHL218	Manila	14 37 58 N	121 49 58 E	61
219	BRA219	Natal	05 50 24 S	35 12 35 W	32
221	POL221	Legionowo	52 24 00 N	20 58 01 E	96
222	MOZ222	Maputo	25 58 01 S	32 35 59 E	70
223	MOZ223	Nampula	15 06 00 S	39 16 58 E	440
224	PER224	Chilca	12 30 00 S	76 48 00 W	-1
225	GUF225	Kourou	05 19 58 N	52 39 00 W	4
226	ROM226	Bucharest	44 28 58 N	26 07 58 E	100
227	USA227	Mcdonald Observatory	30 39 57 N	90 55 58 W	2081
228	CAN228	Gimli	50 37 58 N	97 03 00 W	228
229	PAN229	Albrook	08 58 58 N	79 33 00 W	66
230	AUS230	Cape Grim	40 40 58 S	144 40 58 E	94
231	USA231	Spokane	47 40 01 N	117 25 01 W	576
232	ATA232	Vernadsky / Faraday	65 15 00 S	64 16 12 W	7
233	ATA233	Marambio	64 13 58 S	56 43 01 W	196
234	PRI234	San Juan	18 28 58 N	66 07 58 W	17
235	USA235	Long View	32 30 00 N	94 45 00 W	103
236	ATG236	Coolidge Field	17 16 58 N	61 46 58 W	10
237	USA237	Great Falls	47 28 58 N	111 20 59 W	1118
238	USA238	Denver	39 46 01 N	104 52 58 W	1611
239	USA239	San Diego	32 26 59 N	117 06 36 W	124
241	CAN241	Saskatoon	52 06 36 N	106 42 35 W	530
242	CZE242	Praha	50 01 12 N	14 26 59 E	304
243	ITA243	Brindisi	40 39 00 N	17 57 00 E	5
244	USA244	Fresno	36 46 01 N	119 43 01 W	100
245	EGY245	Aswan	23 58 01 N	32 46 47 E	193
252	KOR252	Seoul	37 34 01 N	126 56 59 E	84
253	AUS253	Melbourne	37 48 00 S	144 58 01 E	125
254	AUS254	Laverton	37 52 01 S	144 45 00 E	21
255	USA255	Ainsworth (Airport)	42 34 58 N	100 00 00 W	789
256	NZL256	Lauder	45 01 47 S	169 40 58 E	370
257	CAN257	Vanscoy	52 11 59 N	107 18 00 W	510
259	DEU259	Zugspitze	47 15 00 N	11 00 00 E	-1
260	USA260	Table Mountain	34 13 47 N	117 24 36 W	2286
261	GRC261	Thessaloniki	40 31 12 N	22 58 12 E	50
262	FIN262	Sodankyla	67 20 05 N	26 30 18 E	179
265	ZAF265	Irene	25 33 35 S	28 11 16 E	1524
266	LTU266	Preila	55 19 58 N	21 13 01 E	3
267	GRL267	Sondrestrom	67 00 00 N	50 37 12 W	300
268	ATA268	Arrival Heights / Mcmurdo	77 49 53 S	166 40 04 E	250
269	GBR269	Strath Vaich	57 43 58 N	04 46 58 W	270
271	RUS271	Arhangelsk	64 34 58 N	40 30 00 E	-1
272	RUS272	Volgograd	48 34 58 N	45 43 01 E	-1

273	RUS273	Kotelnyj Island	76 00 00 N	137 53 59 E	-1
274	RUS274	Nikolaevsk-Na-amure	53 09 00 N	140 41 59 E	46
275	RUS275	Skovorodino	54 00 00 N	123 58 01 E	-1
276	RUS276	Tura	64 10 01 N	100 04 01 E	-1
277	RUS277	Cimljansk	47 43 58 N	42 15 00 E	64
278	TKM278	Cardzou	39 04 58 N	63 35 59 E	191
279	SWE279	Norrkoeping	58 34 48 N	16 09 00 E	43
280	ATA280	Novolasarevskaya / Forster	70 46 01 S	11 52 01 E	110
281	ATA281	Vostok	78 16 12 S	106 30 36 E	-1
282	RUS282	Kislovodsk	43 43 58 N	42 39 39 E	2070
284	SWE284	Vindeln	64 14 23 N	19 46 12 E	225
285	BGR285	Cape Kaliakra	43 22 01 N	28 28 01 E	59
286	BGR286	Primorsko	42 16 58 N	27 45 00 E	13
287	PRT287	Funchal (Madeira Is.)	32 38 23 N	16 53 23 W	49
288	PRT288	Penhas Douradas	40 25 01 N	07 33 00 W	1380
289	GBR289	Lullington Heath	52 00 00 N	00 30 00 E	50
290	CAN290	Saturna Island	48 46 47 N	123 07 48 W	178
291	CAN291	Asquith (Grandora)	52 08 23 N	107 03 35 W	519
293	GRC293	Athens	37 58 47 N	23 43 58 E	110
295	CHN295	Mt. Waliguan	36 17 13 N	100 53 52 E	3810
296	CAN296	London (Ontario)	43 00 36 N	81 16 12 W	100
297	ITA297	S.Pietro Capofiume	44 39 00 N	11 37 01 E	11
298	SYR298	Aleppo	36 08 23 N	37 05 59 E	502
300	ESP300	Iza╤a (Tenerife)	28 17 24 N	16 29 23 W	2367
301	ITA301	J.R.c. Ispra (Varese)	45 48 10 N	08 37 37 E	240
302	JPN302	Ryori	39 03 00 N	141 49 58 E	230
303	CAN303	Iqualuit	63 45 00 N	68 33 00 W	20
304	CHN304	Gonghe	36 16 01 N	100 37 11 E	-1
305	ITA305	Rome University	41 54 00 N	12 31 12 E	60
306	TWN306	Chengkung	23 05 59 N	121 21 53 E	10
307	RUS307	Obninsk	55 07 12 N	36 18 00 E	100
308	ESP308	Madrid	40 26 59 N	03 43 12 W	-1
311	CUB311	Havana	23 16 47 N	82 33 00 W	50
312	LTU312	Kaunas	54 31 12 N	23 32 24 E	77
314	ATA314	Belgrano Ii	77 52 01 S	34 37 58 W	255
315	CAN315	Eureka	80 02 24 N	86 10 30 W	315
316	NLD316	Debilt	52 05 59 N	05 10 53 E	9
317	NGA317	Lagos	06 36 00 N	03 19 58 E	10
318	IRL318	Valentia Observatory	51 55 48 N	10 15 00 W	14
319	CAN319	Montreal (Dorval)	45 28 47 N	73 45 00 W	31
320	CAN320	Winnipeg	49 54 00 N	97 14 23 W	239
321	CAN321	Halifax (Bedford)	44 42 00 N	63 36 36 W	50
322	MYS322	Petaling Jaya	03 05 59 N	101 39 00 E	46
323	ATA323	Neumayer	70 39 00 S	08 15 00 W	42
324	ITA324	Scott Base	77 48 00 S	165 36 00 E	22
325	CHN325	Linan	30 17 59 N	119 43 47 E	132
326	CHN326	Longfengshan	44 43 47 N	127 35 59 E	317
327	PRT327	Angra Do Heroismo (Terceica I)	38 39 28 N	27 13 19 W	74
328	COG328	Ascension Island	07 58 48 S	14 25 12 W	91
329	COG329	Brazzaville	04 16 47 S	15 15 00 E	314
330	VNM330	Hanoi	21 01 58 N	105 50 59 E	5
331	SVK331	Poprad-Ganovce	49 01 47 N	20 19 11 E	706
332	KOR332	Pohang	36 01 58 N	129 22 58 E	6
333	BRA333	Porto Nacional	10 48 00 S	48 24 00 W	240
334	BRA334	Cuiaba	15 36 00 S	56 05 59 W	990

335	NAM335	Etosha Pan	19 12 00 S	15 53 59 E	1100
336	IRN336	Isfahan	32 28 37 N	51 25 29 E	1550
338	CAN338	Bratts Lake (Regina)	50 12 18 N	104 42 18 W	592
339	ARG339	Ushuaia	54 50 59 S	68 18 28 W	7
340	ZAF340	Springbok	29 40 01 S	17 54 00 E	1006
341	USA341	Hanford	36 19 01 N	119 37 58 W	73
342	ARG342	Comodoro Rivadavia	45 46 58 S	67 30 00 W	43
343	URY343	Salto	31 23 42 S	57 58 12 W	31
344	HKG344	Hong Kong Observatory	22 18 36 N	114 10 11 E	66
345	THA345	Songkhla	07 11 59 N	100 35 59 E	13
346	ESP346	Murcia	38 00 10 N	01 10 09 W	69
347	KGZ347	Issyk-Kul	42 37 12 N	76 58 47 E	1640
348	TUR348	Ankara	39 56 59 N	32 52 58 E	891
349	CHN349	Lasha	29 24 00 N	91 01 47 E	3633
350	EST350	Tahkuse	58 31 12 N	24 56 23 E	23
351	URY351	King George Island	62 10 48 S	58 54 00 W	10
353	GBR353	Reading	51 26 59 N	00 55 47 W	66
354	BLR354	Minsk	53 49 58 N	27 28 08 E	240
355	USA355	Baton Rouge (La)	30 21 36 N	91 10 11 W	7
356	USA356	Big Bend (Castolon)	29 07 48 N	103 31 12 W	670
357	USA357	Bondville (Il)	40 03 00 N	88 22 11 W	213
358	USA358	Nunn (Co)	40 47 24 N	104 45 36 W	1641
359	USA359	Davis (Ca)	38 31 47 N	121 45 36 W	18
360	USA360	Pellston (Mi)	45 33 35 N	84 40 11 W	238
361	USA361	Holtville (Ca)	32 48 35 N	115 26 24 W	-18
362	USA362	Poplar (Mt)	48 18 35 N	105 05 59 W	634
363	USA363	Geneva (Ny)	42 52 47 N	77 01 47 W	218
364	USA364	Grand Canyon	36 03 35 N	112 10 48 W	2073
365	USA365	Grand Rapids (Mn)	47 10 48 N	93 31 47 W	390
366	USA366	Griffin (Ga)	33 10 48 N	84 24 36 W	270
367	USA367	Las Cruces (Nm)	32 37 12 N	106 44 23 W	1317
368	USA368	Dancy (Wi)	44 42 35 N	89 46 12 W	381
369	USA369	Logan (Ut)	41 40 11 N	111 54 00 W	1368
370	USA370	Mead (Ne)	41 07 47 N	96 28 47 W	353
371	USA371	Oxford (Oh)	39 31 47 N	84 43 12 W	286
372	USA372	Presque Isle (Me)	46 40 48 N	68 02 24 W	144
373	USA373	Pullman (Wa)	46 45 00 N	117 10 48 W	804
374	USA374	Burlington (Vt)	44 31 47 N	72 51 36 W	408
375	USA375	Wye (Md)	38 55 11 N	76 09 00 W	5
376	EGY376	Mrsa Matrouh	31 19 47 N	27 13 12 E	35
387	USA387	Everglades	25 23 23 N	80 40 48 W	2
394	AUS394	Broadmeadows	37 41 29 S	144 56 48 E	108
398	HKG398	Hong Kong University	22 16 30 N	114 11 59 E	113
399	ARG399	Ushuaia Ii	54 49 11 S	68 19 11 W	30
400	ATA400	Maitri	70 27 35 S	11 26 59 E	330
401	ESP401	Santa Cruz	28 25 12 N	16 15 36 W	36
404	FIN404	Jokioinen	60 48 35 N	23 30 00 E	103
409	EGY409	Hurghada	27 16 47 N	33 45 00 E	7
410	ARM410	Amberd	40 22 47 N	44 15 00 E	2070
412	LUX412	Diekirch	49 52 12 N	06 10 12 E	218
418	USA418	Huntsville	35 16 47 N	86 34 48 W	196
419	FRA419	Bordeaux	44 50 24 N	00 31 47 W	73
420	USA420	Beltsville (Md)	39 01 12 N	76 56 59 W	64
421	USA421	Billings (Ok)	36 37 12 N	97 30 00 W	317
422	USA422	Starkville (Ms)	33 28 12 N	88 46 47 W	85
423	USA423	Steamboat Springs (Co)	40 26 59 N	106 43 47 W	3220

424	USA424	Table Mountain (Co)	40 10 48 N	105 16 47 W	1689
425	USA425	West Lafayette (In)	40 28 47 N	86 59 23 W	216
426	ARG426	San Julian	49 18 00 S	67 45 18 W	62
427	ATA427	Doctor Sobral	81 04 01 S	40 30 00 W	100
429	PER429	Marcapomacocha	11 23 59 S	76 19 11 W	4479
432	PYF432	Papeete (Tahiti)	18 00 00 S	149 00 00 W	2
434	ECU434	San Cristobal	00 55 11 S	89 35 59 W	8
435	SUR435	Paramaribo	05 48 36 N	55 12 35 W	22
436	REU436	La Reunion Island	21 04 30 S	55 28 47 E	24
437	IDN437	Watukosek (Java)	07 34 11 S	112 38 59 E	50
438	FJI438	Suva (Fiji)	18 07 48 S	178 18 54 E	6
439	MDV439	Kaashidhoo	05 00 00 N	73 30 00 E	1
441	CHL441	Easter Island	27 10 12 S	109 25 11 W	62
442	ARG442	Pilar	31 39 35 S	63 52 58 W	338
443	MYS443	Sepang Airport	02 43 48 N	101 41 59 E	17
444	KOR444	Cheju	33 30 00 N	126 30 00 E	300
445	USA445	Trinidad Head	40 48 00 N	124 09 36 W	0
447	USA447	Goddard	38 59 23 N	76 49 58 W	100
448	KEN448	Malindi	02 59 23 S	40 11 24 E	-6
450	ATA450	Davis	68 34 37 S	77 58 22 E	16
452	MNG452	Sainshand	45 00 00 N	110 00 00 E	940
453	NOR453	Dombas	62 05 59 N	09 06 00 E	659
454	ATA454	San Martin	68 07 48 S	67 05 59 W	30
455	MDA455	Kishinev	47 00 00 N	28 48 57 E	202
459	GRL459	Scoresbysund	70 30 00 N	22 00 00 W	51
460	GRL460	Thule	76 31 47 N	68 44 23 W	57
461	USA461	Raleigh (Nc)	35 43 44 N	78 40 48 W	124
462	USA462	Seguin (Tx)	29 34 15 N	97 59 34 W	172
467	BWA467	Maun	19 58 47 S	23 25 48 E	950

e) MOZAIC Airports

CODE ***=Short Code***	Station name	Lat	Lon	Alt(m)
NRT	Tokyo, Japan	35 33 8 N	139 46 47 E	8
FRA	Frankfurt, Germany	50 1 35 N	8 32 35 E	113
JFK	New York, USA	40 38 23 N	73 46 44 W	4
BRU	Brussels, Belgium	50 54 5 N	4 29 4 E	58
VIE	Vienna, Austria	48 6 37 N	16 34 11 E	190
ORD	Chicago, USA	41 58 43 N	87 54 17 W	204
DFW	Dallas, USA	32 53 49 N	97 02 17 W	185
LAX	Los Angeles, USA	33 56 33 N	118 24 29 W	38
MUC	Muenchen, Germany	48 21 14 N	11 47 10 E	453
CDG	Paris, France	49 0 46 N	2 33 0 E	109
DEL	New Delhi, India	28 33 59 N	77 6 11 E	233
IAD	Washington, USA	38 56 40 N	77 27 21 W	95
LOS	Lagos, Nigeria	6 34 39 N	3 19 16 E	35
THR	Tehran, Iran	35 41 21 N	51 18 48 E	1208
TLV	Tel Aviv, Israel	32 0 34 N	34 52 37 E	49
BOS	Boston, USA	42 21 52 N	71 0 19 E	6
OSA	Osaka, Japan	34 47 8 N	135 26 18 E	15
ATL	Atlanta, USA	33 38 26 N	84 25 37 W	313
DXB	Dubai, United Emirates	25 15 18 N	55 21 52 E	10

MAA	Madras, India	12 59 40 N	80 10 50 E	16
THF	Berlin, Germany	52 28 23 N	13 24 14 E	51
IAH	Houston, USA	29 59 04 N	95 20 29 W	30
YVR	Vancouver, Canada	49 11 42 N	123 10 55 W	4
CAI	Cairo, Egypt	30 07 19 N	31 24 20 E	116
CCS	Caracars, Venzuela	10 29 06 N	66 50 37 W	835
DLA	Douala, Cameroon	4 00 22 N	9 43 10 E	10
RUH	Riyadh, Saudi Arabia	24 57 28 N	46 41 56 E	625
COO	Cotonou, Benin	6 21 25 N	2 23 4 E	6
YYZ	Toronto, Canada	43 40 38 N	79 37 50 W	173
JNB	Johannesburg, S.Africa	26 08 21 S	28 14 46 E	1694
ABJ	Abidjan, Ivory Coast	5 15 41 N	3 55 35 W	6
DEN	Denver, USA	39 51 42 N	104 40 23 W	1655

f) CASTNET

Code	Station name	Lat	Lon	Alt(m)
cABT147	Abington	41 50 24 N	72 0 36 W	209
cACA416	Acadia NP	44 22 37 N	68 15 39 W	158
cALC188	Alabama-Coushatta	30 25 15 N	94 24 16 W	101
cALH157	Alhambra	38 52 8 N	89 37 22 W	164
cANA115	Ann Arbor	42 24 59 N	83 54 7 W	267
cANL146	Argonne NL	41 42 0 N	87 59 23 W	229
cARE128	Arendtsville	39 55 23 N	77 18 28 W	269
cASH135	Ashland	46 36 14 N	68 24 48 W	235
cBBE401	Big Bend NP	29 18 7 N	103 10 37 W	1052
cBEL116	Beltsville	39 1 42 N	76 49 1 W	46
cBFT142	Beaufort	34 53 5 N	76 37 13 W	2
cBVL130	Bondville	40 3 6 N	88 22 20 W	212
cBWR139	Blackwater NWR	38 26 42 N	76 6 41 W	4
cCAD150	Caddo Valley	34 10 46 N	93 5 55 W	71
cCAN407	Canyonlands NP	38 27 29 N	109 49 15 W	1814
cCAT175	Claryville	41 56 31 N	74 33 7 W	765
cCDR119	Cedar Creek	38 52 46 N	80 50 51 W	234
cCDZ171	Cadiz	36 47 2 N	87 50 59 W	189
cCDZ571	Cadiz Aerosol	36 47 2 N	87 50 59 W	189
cCHA467	Chiricahua NM	32 0 33 N	109 23 21 W	1570
cCHE185	Cherokee Nation	35 45 2 N	94 40 12 W	299
cCKT136	Crockett	37 55 17 N	83 3 58 W	455
cCND125	Candor	35 15 47 N	79 50 11 W	198
cCNT169	Centennial	41 21 51 N	106 14 23 W	3178
cCON186	Converse Station	34 11 38 N	116 54 46 W	1837
cCOW137	Coweeta	35 3 38 N	83 25 49 W	686
cCTH110	Connecticut Hill	42 24 2 N	76 39 13 W	501
cCVL151	Coffeeville	34 0 9 N	89 47 56 W	134
cDCP114	Deer Creek	39 38 9 N	83 15 37 W	267
cDEN417	Denali NP	63 43 32 N	148 57 47 W	661
cDEV412	Death Valley NM	36 30 33 N	116 50 53 W	125
cEGB181	Egbert	44 13 55 N	79 46 52 W	251
cESP127	Edgar Evins	36 2 19 N	85 43 59 W	302
cEVE419	Everglades NP	25 23 27 N	80 40 50 W	2
cGAS153	Georgia Station	33 10 43 N	84 24 18 W	270
cGLR468	Glacier NP	48 30 37 N	113 59 44 W	976

cGRB411	Great Basin NP	39 0 19 N	114 12 56 W	2060
cGRC474	Grand Canyon NP	36 3 34 N	112 10 55 W	2073
cGRS420	Great Smoky NP - Look Rock	35 37 59 N	83 56 31 W	793
cGTH161	Gothic	38 57 23 N	106 59 8 W	2926
cHOW132	Howland	45 12 56 N	68 42 29 W	69
cHOX148	Hoxeyville	44 10 51 N	85 44 20 W	305
cHVT424	Hawaii Volcanoes NP	19 25 10 N	155 14 24 W	1199
cHWF187	Huntington Wildlife Forest	43 58 23 N	74 13 23 W	502
cIRL141	Indian River Lagoon	27 50 57 N	80 27 19 W	2
cJOT403	Joshua Tree NM	34 4 17 N	116 23 26 W	1244
cKEF112	Kane Exp. Forest	41 35 52 N	78 46 2 W	622
cKNZ184	Konza Prairie	39 6 7 N	96 36 34 W	348
cKVA428	Kobuk Valley National Park	67 10 50 N	157 53 30 W	88
cLAV410	Lassen Volcanic NP	40 32 25 N	121 34 35 W	1756
cLCW121	Lilley C. Woods	37 7 48 N	82 59 23 W	335
cLIV573	Livonia Aerosol	38 32 4 N	86 15 38 W	299
cLRL117	Laurel Hill	39 59 16 N	79 15 5 W	615
cLYE145	Lye Brook	43 3 3 N	73 3 41 W	730
cLYK123	Lykens	40 55 2 N	82 59 53 W	303
cMAC426	Mammoth Cave NP	37 16 50 N	86 15 50 W	236
cMCK131	Mackville	37 42 16 N	85 2 54 W	353
cMEV405	Mesa Verde NP	37 11 53 N	108 29 25 W	2165
cMKG113	M.K. Goddard	41 25 37 N	80 8 42 W	384
cMOR409	Mount Rainier NP	46 45 29 N	122 7 19 W	421
cNCS415	North Cascades NP	48 32 22 N	121 26 20 W	109
cOLY421	Olympic NP	48 5 50 N	123 25 32 W	125
cONL102	Oak Ridge	35 57 36 N	84 17 24 W	180
cOXF122	Oxford	39 31 57 N	84 43 42 W	284
cPAR107	Parsons	39 5 25 N	79 39 42 W	510
cPBF129	Perryville	37 40 47 N	84 58 11 W	279
cPED108	Prince Edward	37 9 55 N	78 18 24 W	150
cPET427	Petrified Forest	34 52 30 N	109 58 9 W	1723
cPIN414	Pinnacles NM	36 29 5 N	121 9 20 W	335
cPND165	Pinedale	42 55 43 N	109 47 16 W	2388
cPNF126	Cranberry	36 6 20 N	82 2 43 W	1219
cPOF425	Poker Flats, Yukon Flats NM	65 7 4 N	147 25 59 W	495
cPRK134	Perkinstown	45 12 23 N	90 35 48 W	472
cPSU106	Penn State	40 43 14 N	77 55 54 W	378
cQAK172	Quaker City	39 56 34 N	81 20 14 W	372
cRCK163	Reynolds Creek	43 12 36 N	116 45 0 W	1198
cROM406	Rocky Mtn NP	40 16 40 N	105 32 43 W	2743
cRTP101	Res. Triangle Pk.	35 54 35 N	78 52 47 W	94
cSAL133	Salamonie Reservoir	40 48 57 N	85 39 39 W	250
cSAV164	Saval Ranch	41 17 23 N	115 51 35 W	1873
cSCR180	Scotia Range	40 47 18 N	77 56 47 W	376
cSEK402	Sequoia NP - Lookout Pt	36 25 45 N	118 45 45 W	1225
cSHN418	Shenandoah NP - Big Meadows	38 31 23 N	78 26 4 W	1073
cSIK570	Sikes	32 3 26 N	92 26 7 W	68
cSND152	Sand Mountain	34 17 19 N	85 58 11 W	352
cSPD111	Speedwell	36 28 11 N	83 49 36 W	361
cSTK138	Stockton	42 17 12 N	89 59 58 W	274
cSUM156	Sumatra	30 6 37 N	84 59 25 W	14
cTHR422	Theodore Roosevelt NP	46 53 40 N	103 22 40 W	850

cUIN162	Uinta	40 32 59 N	110 19 11 W	2500
cUVL124	Unionville	43 36 49 N	83 21 32 W	201
cVII423	Virgin Islands NP - Lind Pt	18 20 11 N	64 47 47 W	80
cVIN140	Vincennes	38 44 26 N	87 29 7 W	134
cVOY413	Voyageurs NP	48 24 46 N	92 49 45 W	429
cVPI120	Horton Station	37 19 46 N	80 33 28 W	920
cWEL149	Wellston	44 13 29 N	85 49 11 W	295
cWFM105	Whiteface Mountain	44 23 24 N	73 51 35 W	570
cWNC429	Wind Cave National Park	43 34 59 N	103 35 59 W	1300
cWPA103	West Point A	41 21 0 N	74 2 59 W	203
cWSP144	Wash. Crossing	40 18 45 N	74 52 22 W	61
cWST109	Woodstock	43 56 42 N	71 42 2 W	258
cYEL408	Yellowstone NP	44 33 34 N	110 24 2 W	2400
cYOS404	Yosemite NP - Turtleback Dome	37 42 47 N	119 42 21 W	1605
cHAR999	Harvard Forest	52 54 00 N	72 18 00 W	340