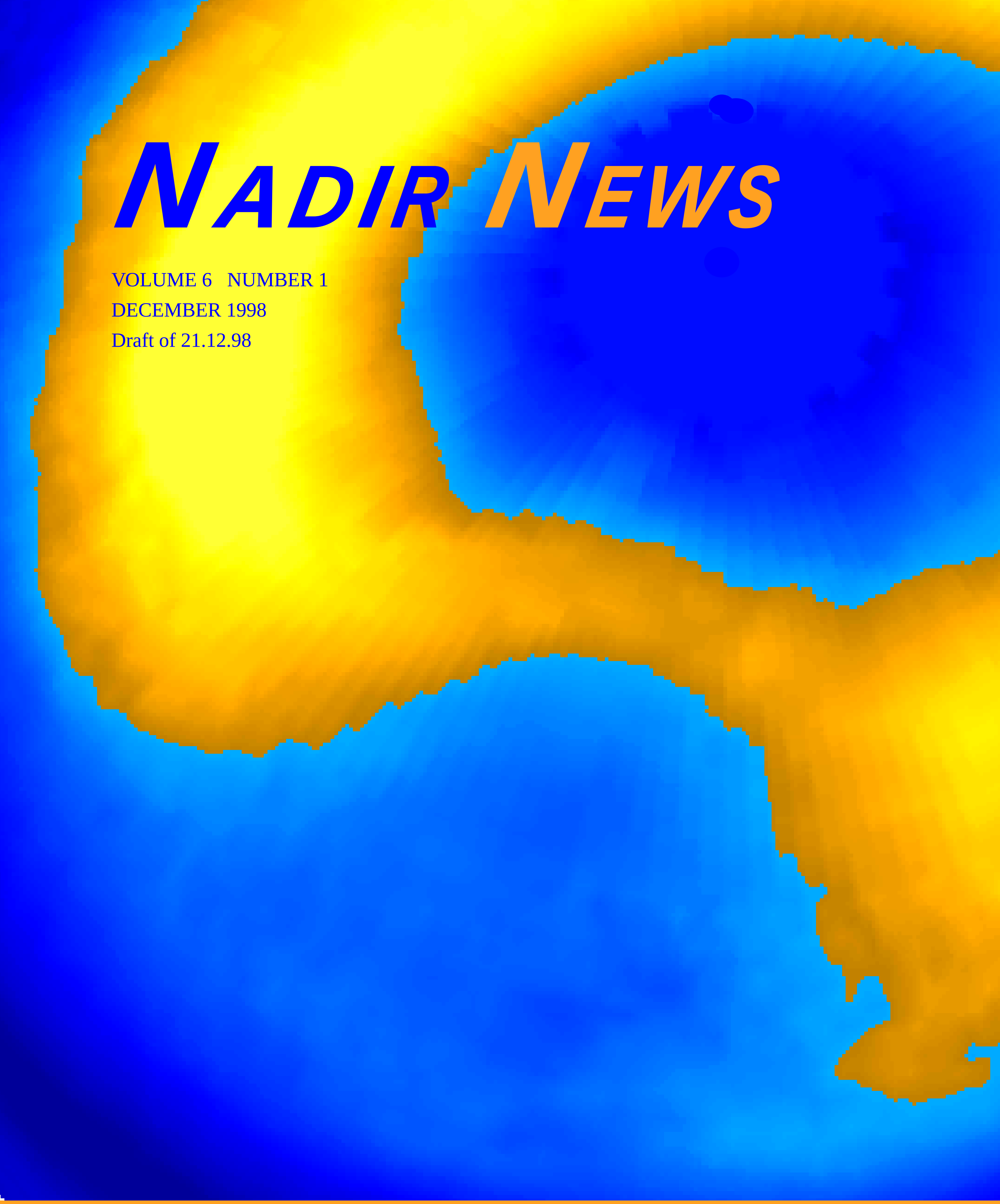
NADIR NEWS



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Third European Stratospheric Experiment on Ozone
THESEO 1998-99

Contents

Editorial

This issue of NADIR NEWS is meant to give information on new developments and products at NADIR since the previous issue (June 1996) and in conjunction with the second THESEO winter. Most of the information given in the previous issue has been kept in this issue so that it constitutes an independent source of information. For those who are not familiar with the NADIR data centre it can be mentioned that NADIR was put into operation in conjunction with the European Arctic Stratospheric Ozone Experiment in 1991-92. NADIR is an abbreviation for NILU's Atmospheric Database for Interactive Retrieval. The central computer, zardoz, is a Sun Sparcstation, and it is connected to other computers that act as file servers. NADIR now has approx. 500 users from all over Europe as well as USA, Canada, Japan and New Zealand. There are more than 300 login sessions per day during the most intensive winter periods.

Nomenclature

We use fonts of different colours and styles in order to improve the readability of the text. In the body text we use `this font` when we refer to directory names, file names and text lines in text files which are to be taken literally. *`This font`* is used for placeholders of text or file names. Such text should not be typed literally but replaced with text that applies to your case. Programs and scripts are referred to by **`this font`**. Commands that you type are shown in **`this font`**. If a command contains placeholders, they are given in ***`this font`***.

New developments

Since the previous issue of NADIR NEWS (June 1996) a number of new developments have taken place at NADIR. Among the new features one can mention: New directory structure to facilitate navigation, leewave plots and plots of minimum temperature. In addition we have also got hold of the ERA-15 reanalysis data set from ECMWF. Extraction of T_{106} data can now be run on a computer called turtle (`rlogin turtle` from zardoz). With this data set we hold global ECMWF fields at T_{106} resolution from 1979 until today. The following sections describe these new items in more detail.

New machine to replace zardoz

Zardoz is a Sparcserver 10, and is not y2k compliant. It will therefore be replaced during summer 1999. At the same time there will be an upgrade from SunOS 4.1.3 to Solaris 7. This means that any cron jobs you have on zardoz must be modified. The way week-days are numbered differs in SunOS 4 and Solaris. Most other programs that run on zardoz today should also run on the new machine. One exception will be Uniras based programs since we will upgrade from v. 6.4 to v. 7.0. The libraries of these two Uniras versions are not compatible, so all programs will have to be recompiled. As we approach the time of the upgrade you will informed via e-mail and login messages on zardoz.

New directory structure

A new directory structure has been implemented at NADIR. This has been done in order to make navigation easier for our customers and also to make the maintenance and back-up of the file systems easier. Most project related directories have been moved to directories located under `/nadir/projects`. The data from the THESEO campaign are found in various subdirectories under `/nadir/projects/theseo`. Other projects that are not directly linked to the THESEO campaign are found under `/nadir/projects/other`. Here one finds projects such as Ape, Godiva, Leewave, Osdoc, Saonas and Topoz as well as several others.

THESEO directory tree

A directory tree has been made for the THESEO data. The

THESEO data are found under the directory /nadir/projects/theseo. Under this directory there are sub-directories for each of the THESEO related projects, such as Halomax, Metro, O_3loss, PSC-analysis, PVC, Stratospheric BrO and Wave. Coordinators for those projects that have not yet got directories should contact the NADIR team as soon as possible in order to get this sorted out. Real time PTU soundings from various stations in the European Arctic and Greenland are to be found in /nadir/projects/theseo/misc/ptu. In addition there are PSC alerts provided by the SAOZ network. Those are to be found in /nadir/projects/theseo/misc/psc_alert.

Daily updated plots

On zardoz you can find ready-made plots of a number of parameters that are updated on a daily basis. The plots are stored as regular postscript files or as gif files. Postscript files can be printed on any postscript printer or can be viewed on-screen with any suitable postscript viewer, such as **ghostview** or **pageview**. GIF files can be viewed on-screen with image viewers such as **xv** or **xanim**. These products are found in various subdirectories under the directory /nadir/plots. Some of the products described here also existed during SESAME but some are new for the THESEO campaign.

Maps of isobaric ECMWF fields

Analysis and forecast maps of temperature and geopotential height at the 13 standard isobaric levels from 1000 to 10 hPa are made every day. The maps are stored as b/w postscript files in /nadir/plots/isobaric/*yymmdd*. Figure 1 shows an example of such a map.

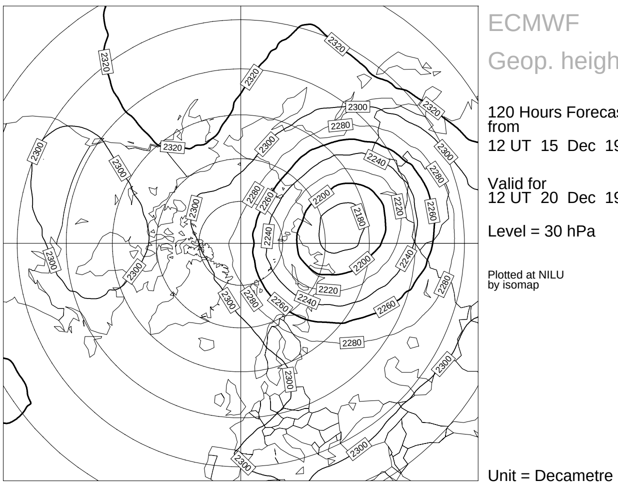

Figure 1*. 120 hours forecast of geopotential height at 30 hPa valid for 12 UT on 20 December 1998.*

Maps of isentropic ECMWF fields

Analysis and forecast maps of temperature and potential vorticity at isentropic levels are stored as b/w postscript files in /nadir/plots/isentrop/yymmdd. Figure 2 shows an example of a temperature map.

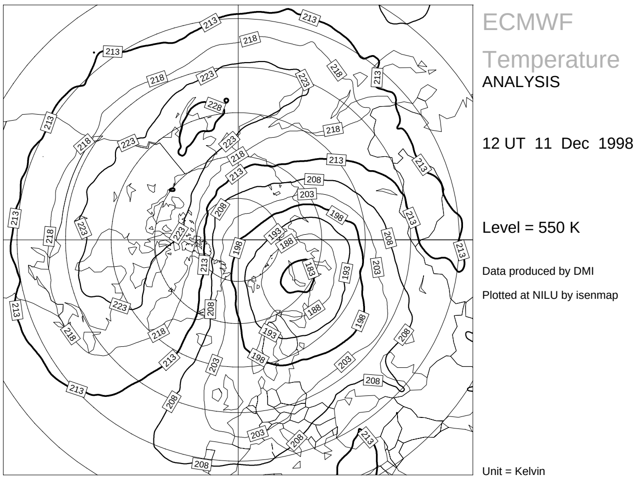

Figure 2*. Temperature map for 11 December 1998 at the 550 K isentropic level (approx. 23 km). A cold spot with temperatures below 183 K can be seen over Novaya Zemlya.*

Maps of filaments

In conjunction with the METRO project, the group at CNRS produces daily maps with analyses and forecasts of potential vorticity. Plots of filaments in GIF format are produced using a high horizontal resolution advection model (18 × 18 km) of PV developed at Service d'Aeronomie du CNRS[1]. The model starts from ECMWF PV analysis on 1st November and computes the

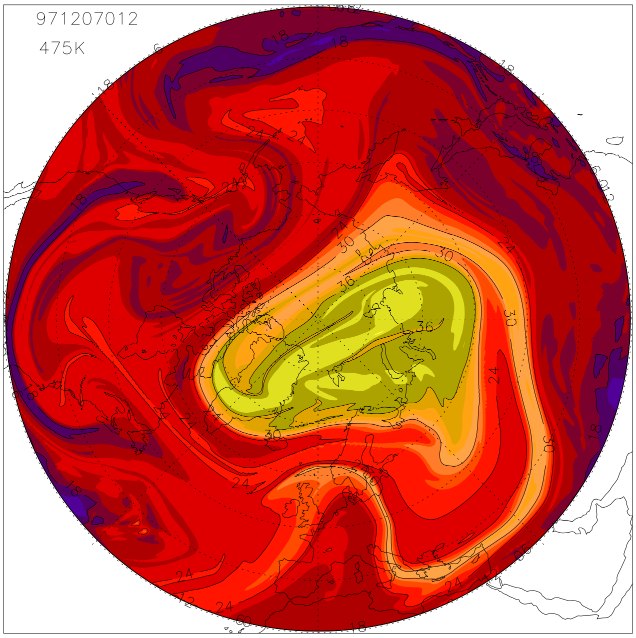

Figure 3*. PV map at 475 K for 7 December 1997. This map has been made with a domain filling trajectory model running at CNRS.*

1. A. Hauchecorne, M. Marchand, S. Godin and C. Souprayen, A high resolution advection model for the interpretation of ozone filaments observed in lower stratospheric ozone lidar profiles at mid-latitudes, to be published in Proceedings of the European Workshop on Mesoscale Processes in the Stratosphere, Bad Tölz, Germany, 9-11 November 1998.

advection of PV using daily ECMWF analyses and forecasts available on NADIR.In order to follow the diabatic evolution of PV during the winter, a relaxation toward the large-scale ECMWF PV field is applied with a 10 days relaxation time. Daily plots of filaments are produced for 7 isentropic levels, 350,380,400, 435,475,550 and 675 K and for 00, 24, 48, 72, 96 and 120 hours forecast. Temperature maps at 475K are also produced on the same format for interpretation. Figure 3 shows one example of such a map. These maps are found as GIF files in `/nadir/plots/filament`.

Maps of leewaves

For the planning of experiments it might be useful to have information on leewave formation. This is of particular interest to those carrying out measurements in northern Scandinavia. Julio Bacmeister of the Naval Research Laboratory has provided us with code that calculates vertical displacement of streamlines from their vertical level in the background flow. The program uses wind data from ECMWF and it contains a database on topography. Figure 4 shows an example of such a map. There are both analyses and forecasts available. These maps are found as postscript files in `/nadir/plots/leewave`.

Documentation of leewave code

From Stephen Eckermann (Naval Research Lab.) we have received the following documentation on the leewave calculations:

The Naval Research Laboratory Mountain Wave Forecast Model (NRL/MWFM)

Stephen D. Eckermann
E. O. Hulburt Center for Space Research, Code 7641.2,
Naval Research Laboratory, Washington, DC 20375, USA
(mailto:eckerman@map.nrl.navy.mil)

Introduction

The Planetary Atmospheres Section of the Upper Atmospheric

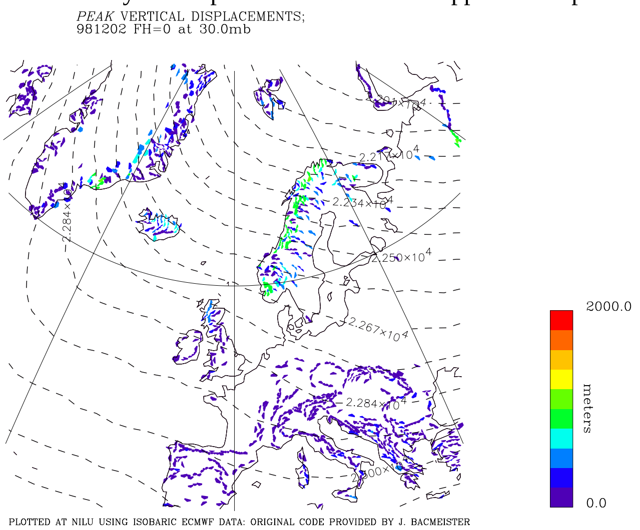

***Figure 4**. Map of vertical displacements at 30 hPa for 2 December 1998. The map is based on wind data from ECMWF and topography data.*

Physics Branch[1] at the Naval Research Laboratory[2] in Washington, DC conducts research into the chemistry and dynamics of the middle atmosphere. The section has an ongoing commitment to developing global models of gravity wave effects in the lower and middle atmospheres.

The **Naval Research Laboratory Mountain Wave Forecast Model (NRL/MWFM)**[3] is one of these models. The earliest version of the model was developed by Julio Bacmeister as a research tool aimed at investigating possible mountain wave effects in the middle atmosphere [*Bacmeister, 1993]. From there, an extended operational version of the model was developed with a forecasting capability [Bacmeister et al., 1994], which has gone on to become NRL/MWFM. NADIR provides forecasts from the most current operational version of the NRL/MWFM code.*

NRL/MWFM has been used operationally for some years now to forecast stratospheric turbulence produced by mountain wave breaking in the stratosphere, as an aid to safe flight planning during NASA aircraft campaigns. Recently the model has been extended to either forecast or "postcast" mountain wave-induced mesoscale temperature fluctuations (MTF's) in the stratosphere, in response to the needs of modelers in the stratospheric microphysics and chemistry communities [e.g., Carslaw et al., 1998, 1999; *Eckermann and Bacmeister,* 1998]. It is these latter forecasts (using ECMWF data) that are being made available through the NADIR data centre at NILU (thanks to Liv Aanesland at NILU for her work in setting this up).

Salient features of the model are provided below. More details are provided in some of the papers cited above, as well as at the NRL/MWFM web site (see footnote #3 for the URL). A number of plots of previous results and daily mountain wave forecast maps are provided on the web site. Users with any questions or comments about the NRL/MWFM MTF forecasts are encouraged to contact Steve Eckermann via email.

Model details

Full details of the modeling methodology can be found in *Bacmeister* [1993] and *Bacmeister et al*. [1994]. Briefly, the model utilizes a data base of dominant quasi-two-dimensional ridge structures[4], which are identified and characterized from high-resolution measurements of global topographic elevation. Global wind and temperature data from various sources (e.g., NCEP, ECMWF) are used to simulate isentropic flow over these ridges, which may force mountain waves locally. Two-dimensional hydrostatic wave equations[5], together with the upper-level wind and temperature data, are used to simulate any subsequent vertical propagation and amplitude evolution of these mountain waves. Simulated mountain wave properties (e.g., vertical displacement amplitude ζ') are recorded at standard pressure levels.

NRL/MWFM predicts mountain wave temperature amplitudes T' using a standard isentropic advection analysis [e.g., Ecker-

1. http://uap-www.nrl.navy.mil
2. http://www.nrl.navy.mil
3. http://uap-www.nrl.navy.mil/dynamics/html/mwforc.html
4. http://uap-www.nrl.navy.mil/dynamics/html/ridges.html
5. http://uap-www.nrl.navy.mil/dynamics/html/wavemod.html

mann et al. 1998], which yields the simple relation

$$\frac{T'}{T_0} = \frac{N^2}{g}\zeta'$$

where T_0 is background temperature, N is the background Brunt-Väisälä frequency, g is gravitational acceleration and T' is the mountain-wave-induced peak mesoscale temperature fluctuation (MTF) amplitude.

References

Bacmeister, J. T., Mountain-wave drag in the stratosphere and mesosphere inferred from observed winds and a simple mountain wave parameterization scheme, *J. Atmos. Sci.*, *50*, 377-399, 1993.

Bacmeister, J. T., *et al.*, An algorithm for forecasting mountain wave-related turbulence in the stratosphere, *Wea. Forecasting*, *9*, 241-253, 1994.

Carslaw, K. S., *et al.*, Increased stratospheric ozone depletion due to mountain-induced atmospheric waves, *Nature*, *391*, 675-678, 1998.

Carslaw, K. S., T. Peter, J. T. Bacmeister and S. D. Eckermann, Widespread solid particle formation by mountain waves in the Arctic stratosphere, *J. Geophys. Res.*, (in press), 1999.

Eckermann, S. D., and J. T. Bacmeister, Global parameterization of gravity wave temperature perturbations for chemical and microphysical models, to appear in the Proceedings of the European workshop on mesoscale processes in the stratosphere, Bad Tölz, Germany, 9-11 November, 1998[1].

Eckermann, S. D., D. E. Gibson-Wilde, and J. T. Bacmeister, Gravity wave perturbations of minor constituents: a parcel advection methodology, *J. Atmos. Sci.*, *55*, 3521-3539, 1998.

Time series of minimum temperature

The minimum temperature found anywhere north of 40˚N is a commonly used indicator of the temperature conditions in the polar vortex. However, this parameter does not say anything about the geographical extent of the cold spot or about the average temperature conditions in the vortex. A time series of the minimum temperature is updated every day and the plot is stored in `/nadir/plots/minT`. In addition to the plots the data used to make the plots are available as ascii files in `/nadir/plots/minT/data`. Figure 5 shows such a time series for the 1997-98 winter and Figure 6 shows the time series for the 1998-99 winter as of 17 December 1998.

Total ozone maps

The WMO real time ozone mapping unit at the University of Thessaloniki produces daily maps of total ozone based on the GO_3OS, i.e. the Dobson and Brewer network of spectrophotometers. These map are found as postscript files in `/nadir/plots/wmo`. Figure 7 shows such a map.

The PVC project and the ERA-15 data set

PVC (Polar Vortex Change) is an EU project aiming at studying the climatology of the north Polar vortex. For this project we have acquired parts of the ERA-15 reanalysis data set from ECMWF. This data set dates from January 1979 through February 1994. So far we have acquired daily (noon) temperature and

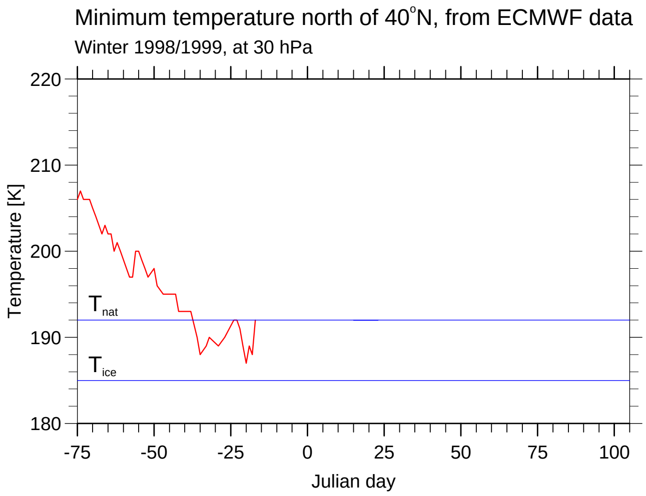

***Figure 6**. Same as Figure 5 but for the 1998-99 winter updated as of 17 December 1998.*

wind data for all the winter months of these years. For the time being access to this data set is limited to the PVC partner, but investigators interested in this data set should contact the NADIR team.

The COSE project

Compilation of ground based measurements in support of Satellite measurements over Europe (COSE) is an EU project under Theme 3.3 (Centre for Earth Observation) of the Environment and Climate work programme. This project is the successor of the previous ESMOS project and can be considered as EU's contribution to the NDSC network. This project encompasses many of the ground based measurements carried out in Europe with UV-Vis spectrometers, lidars, FT-IRs and microwave instruments. The commencement date was 1.10.98, so it does not appear on the official list of THESEO projects. Nonetheless, this project will give an important contribution to the second winter of the THESEO campaign.

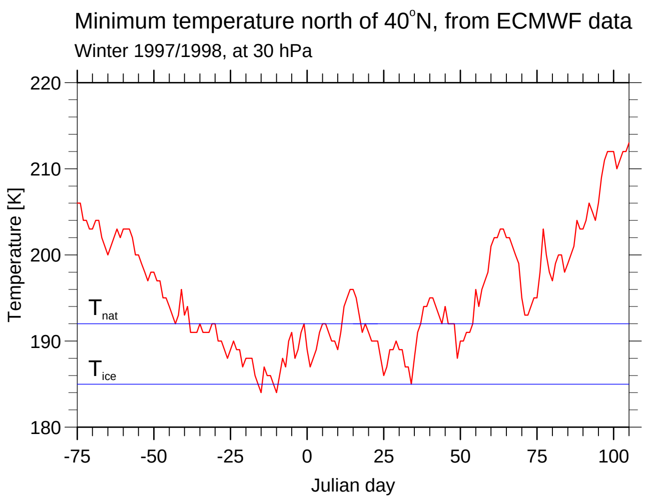

***Figure 5**. Minimum temperatures anywhere north of 40˚N for the 1997-98 winter at 30 hPa. The two horizontal blue lines indicate the formation temperatures for NAT and ice particles, respectively.*

1. http://www.mpch-mainz.mpg.de/~weers/nwg/workshop.html

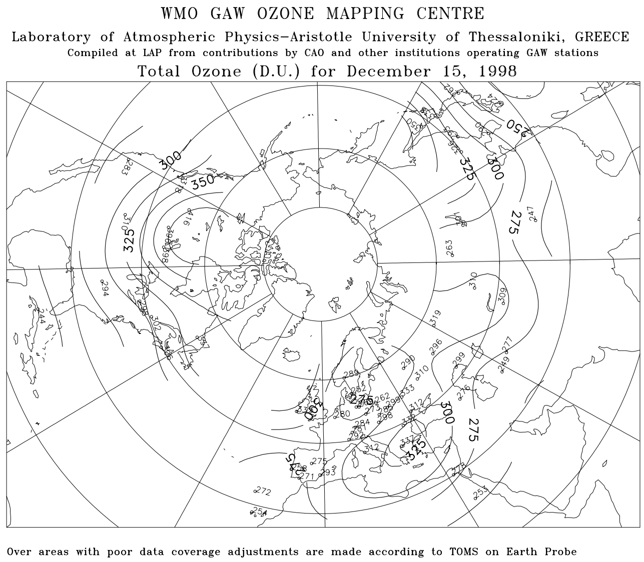

***Figure 7**. Total ozone for 15 December 1998 based on the GO_3OS.*

Overview of the THESEO projects

The THESEO campaign consists of a number of projects funded by the European Commission (DG XII) and by various national agencies. The table below lists these projects.

Projects participating in or linked to THESEO

Acronym	Coordinator
O3LOSS	Geir Braathen, NILU
HALOMAX	Andreas Engel, JW Goethe Univ.
HIMSPEC	Herman Oelhaf, K.Fz. Karlsruhe
Lagrangian	Jean-Pierre Pommereau, CNRS
METRO	Alain Hauchecorne, CNRS
PSC	Niels Larsen, DMI
Stratospheric BrO	Michel van Roozendael, IASB
STREAM	Joss Lelieveld, Univ. Utrecht
TOPOZ II	Warwick Norton, Univ. of Oxford
TRACAS	Gérard Ancellet, CNRS
TRACES/APE	Leopoldo Stefanutti, CNR
WAVE	Jerôme de la Noë, Obs. de Bordeaux
CASSIS	John Pyle, Ozone Secretariat
PVC	Esko Kyrö, FMI
COSE	Martine de Mazière, IASB

More information on these projects can be found on the web pages of the Ozone Secretariat; `http://www.ozone-sec.ch.cam.ac.uk/`

Network for the Detection of Stratospheric Change (NDSC)

What is the NDSC?

The Network for the Detection for Stratospheric Change (NDSC) is a set of high-quality remote-sensing research stations for observing and understanding the physical and chemical state of the stratosphere and assessing the impact of any stratospheric changes on the underlying troposphere and on global climate. The measurement priorities concern ozone and key ozone related parameters such as temperature, aerosols and tracers of chemistry and atmospheric motion. The current NDSC network of approx. 50 stations is supported by other existing ground-based monitoring networks, by ozonesondes and by measurements from satellites. Over 100 scientists from 15 countries are involved with NDSC research activities world wide. The NDSC is a major component of the international upper atmosphere research effort and has been endorsed by national and international scientific agencies, including the International Ozone Commission, the United Nations Environment Programme (UNEP), and the World Meteorological Organization (WMO).

Following five years of planning, instrument design and implementation, the NDSC began network operations in January 1991. For more information on the NDSC one can look up the following web site: `http://climon.wwb.noaa.gov`

Several European scientists participate in the NDSC and the former ESMOS projects, funded by the European Commission, have constituted an essential part of Europe's contribution to this network. Scientists with an interest in the stratospheric ozone problem are invited to participate in the network. The following open letter to the scientific community has been published by the NDSC Steering Committee:

Open letter to all those interested in acquiring access to public NDSC data

The NDSC Data Protocol states:

Since the nature of detection of small changes requires an extremely high level of measurement confidence, the Data Protocol recognizes that multiple seasonal analyses may be required for validation of observations from both individual and multiple sites. ***It is expected that such a procedure shall yield the verifiable product referred to as "NDSC data" within a two-year period after acquisition.*** *Co-authorship shall be offered on publications resulting from the verification procedure to those investigators participating in the process.* ***After the above verification period, NDSC data will be available to anyone through centralized scientific data archiving and distribution facilities.***

In this spirit, data that has been so verified and given the status of 'NDSC data', and is more than two years old, is available to the general public. NDSC datasets are outlined in the NDSC

Measurements and Analyses Directory (link to the appropriate web page). Access to this data is through an account on the NDSC database computer. To receive such an account, complete the following application:
http://climon.wwb.noaa.gov/www/invite.html

As with any raw data, additional material is usually required to convert raw data into meaningful information.

Therefore it is strongly recommended that data users will consult the on-line documentation and reference articles to fully understand the scope and limitations of the instruments and resulting data. Scientific users of the data are strongly encouraged to directly contact the NDSC Principal Investigator listed in the data documentation to insure the proper use of specific datasets and ensure the latest and most relevant information relating to the particular data set is being used to help with the interpretation.

Mirror of NDSC database at NILU

The central database for the NDSC is located at the NOAA headquarters in Washington D.C. A mirror image of this database is maintained at NILU. The update is done on a daily basis. For those who have access to the restricted data base at NOAA, such access can also be obtained at NILU. Such access is organised by Jeanette Wild (mailto:wild@ndsc.wwb.noaa.gov) at NOAA. Ask her to send a message to NILU that you can have access to the NDSC database, and we will give you access to the restricted NDSC data.

Existing data and software

The rest of the document describes data and software that were described in the previous issue of NADIR NEWS, but there have been some updates and changes. The section on ozonesonde data has been updated with new developments made as part of the OSDOC project. There are some new programs for plotting of ECMWF data. The section on satellite data has been updated because of the new TOMS instruments on board the Earth Probe and the ADEOS satellite.

SESAME Experimental Data

E experimental data from the SESAME campaign are ready for CD-ROM publication. The data will be published in the spring of 1999 together with the European ozonesonde data collected since 1988 (see below under the description of the OSDOC project). In the meantime the data can be found in /nadir/sesame/data on zardoz. A detailed description of these data was given in the June 1996 issue of NADIR NEWS.

Ozonesonde data and the OSDOC project

Ozonesondes have been launched from more than 30 stations during EASOE, SESAME and the Match campaigns in 1996-97 and 1997-98. Data from these campaigns and from previous years dating back to the winter of 1988-89 will be published on a separate CD-ROM as part of the EU project OSDOC (Ozone Soundings as a tool for Detecting Ozone Change).

EASOE experimental data

The experimental data from the EASOE campaign was issued on CD-ROM in 1995. The data are public domain, so the disk can be obtained by contacting the NADIR team at NILU.

Satellite data

TOMS

Data from TOMS (Nimbus-7, Meteor-3, ADEOS and Earth Probe) can be found in subdirectories located under /nadir/data/satellit/toms. There are data from Nimbus-7 until May 1993 and from Meteor-3 until December 1994. Data from ADEOS go from September 1996 until late June 1997. Data from the Earth Probe started in July 1996 and the instrument is still in operation. Software for plotting of TOMS data is described in the chapter on plotting software. More than 7000 files are stored in these directories.

TOVS

TOVS data were provided for the SESAME campaign by CNRM in Toulouse, and these data can be found in /nadir/sesame/data/satellit/tovs. More than 5600 files were submitted through September 1997, when the service was discontinued. Software for plotting is described on page 23.

The data files are compressed, but you can copy the files you need to `/nadir/tmp` and uncompress them if you want to plot them with the plotting program on zardoz.

ECMWF data on 2.5° × 2.5° grid

These are the data that have been available throughout EASOE and SESAME, and which have also been published on three CD-ROM volumes so far. CD-ROMs with data for the two winters 1993-94 and 1994-95 are under preparation and will be published in the spring of 1999.

Isentropic data

Analyses for 12 UT on the levels 350, 380, 400, 435, 475, 550 and 675 K are made available by the Danish Meteorological Institute for the geographical area from the North Pole to 30°N. Pressure and PV are given, and it is possible to calculate temperature. This is done by several of the programs developed at NILU, such as the Uniras plotting programs. During the campaign phases 1, 2, 3, 4, 5 and 8 days forecasts were available. During the 1995-96 winter 12, 36 and 60 hours forecasts based on the 0 UT analysis were also available. These forecasts were available somewhat later in the morning but still early enough to be useful for that same day. These forecasts are valid for the same times as the 24, 48 and 72 hours forecasts, but the advantage is that they are 12 hours "younger" and hence more accurate. These data normally cover the time interval from 1 November to 30 April. We have recently changed the directory structure so that both analyses and forecasts are found in the directory `/nadir/data/ecmwf/isentrop/`*`yyyy/mm`*
where *`yyyy/mm`* designate the year and month. In this way we limit the number of files in each directory. Forecasts will be deleted when they are a few days old in order to limit the number of files.

Isobaric data

Analyses for 12 UT on the 13 standard levels 1000, 850, 700, 500, 400, 300, 200, 150, 100, 70, 50, 30 and 10 hPa are made by the Norwegian Meteorological Institute. Available parameters are temperature, geopotential height, zonal wind and meridional wind. The geographical area is from the North Pole to 30°N. These data are collected daily around the year. There are also 1, 2, 3, 4 and 5 days forecasts. The analyses and forecasts are now found in `/nadir/data/ecmwf/isobaric/`*`yyyy/mm`*.

Trajectories

Ten days backward trajectories arriving at a large number of end points are provided by the Danish Meteorological Institute. All measurement sites participating in SESAME are included as well as a grid net of 118 end points covering the area from the North Pole to 30°N. There are data for the same seven levels as for the isentropic fields. To begin with, trajectory data were stored in two ways: a) as large collective files (4.5 MBytes) with data for all the end points and b) as a number of small files (approx. 40 kBytes) with data for each end point. This means that the same data was stored twice. As the amount of data accumulated this started to take considerable disk space. We now store the trajectory data only as large collective files. If you want to extract data for a single station, you can use a program called **`traj`**, which is described on page 29. The trajectory data are found in `/nadir/data/ecmwf/trajecto/`*`yyyy/mm`*.

PV at stations

Potential vorticity at the seven standard levels is calculated for a number of stations by the Danish Meteorological Institute by bilinear interpolation in a 1.125° × 1.125° grid. This gives more exact data than one obtains by extraction from the 2.5° × 2.5° data. Software for extraction of data for stations of interest is described on page 27. These data are found in `/nadir/data/ecmwf/pvatstat/`*`yyyy/mm`*

As a novelty PV, temperature and geopotential height on the different isentropic levels are stored for each station for both 0 and 12 UT. This makes it easy to extract PV, temperature or geopotential height for a given level above a station for the whole winter. The data are stored in files named `pv`*`yymmdd.tt`*
where *`tt`* is the analysis time (00 or 12). The files are not in the NASA Ames format, but they are simple and self-explanatory. Work is under way, however, to convert these files to the NASA Ames format.

ECMWF data on 1.125° × 1.125° grid

The demand for meteorological data has been increasing during EASOE and SESAME. At NILU we have therefore implemented a routine for daily transfer of global fields at so-called T_{106} resolution. This corresponds to a maximum latitude/longitude resolution of 1.125° × 1.125°. This routine became operational in early January 1995. We have also acquired data from previous winters (the EASOE winter, the 1992-93 winter and the first SESAME winter) on tape, and these data are also available. The latter data are referred to as archive data in the following. We have developed and implemented programs for extraction of the data and for interpolation of data from model levels to either isobaric or

isentropic levels. It is also possible to obtain potential vorticity at isentropic levels. We have chosen a PV map over Antarctica as the logo for this issue of NADIR NEWS.

Daily data

These data originate from ECMWF and are stored in spectral form, so-called T_{106}. These are model analyses that contain 31 model levels, with model level 31 being the ground or sea surface. The upper four levels are pure pressure levels, and the lower three are pure sigma levels, whereas the other levels are a mixture of the two. At each level several parameters are stored. At present the available parameters are: temperature (T), zonal wind (U), meridional wind (V), vertical wind (W) and the natural logarithm of the surface pressure (LNSP) (LNSP is only present at level 1 (level 0 for 19 level files, prior to 1992)). Programs to extract these model level data are available on zardoz, and routines for interpolation of data to isobaric and isentropic levels are also offered. Software routines are described later.

Data are available from 00 UT on 8 January 1995 onwards, with 6 hours intervals, giving data at 00, 06, 12 and 18 hours. Usually the data are received at NILU one or two days after calculation at ECMWF. Some longer delays have been encountered.

A set of interpolating routines have been written to convert data from model levels to more natural units like pressure or theta surfaces. These programs will interpolate to a wide range of surfaces. Available pressure surfaces are: 10, 30, 50, 70, 90, 100, 110, 130, 150, 180, 200, 225, 250, 275, 300, 325, 350, 400, 450, 500, 550, 600, 650, 700, 750, 800, 850, 900, 925, 960, 980, 1000 hPa; available theta surfaces are all levels from 200 to 700 K in 5 K steps, the only exception being that for potential vorticity the available levels are: 700, 675, 625, 550, 500, 475, 450, 435, 425, 400, 380, 365, 350, 340 330, 325, 320, 315, 310, 305, 300, 295, 290, 285, 280 275, 270, 265, 260, 255, 250, 245, 240, 235, 230, 225 K. Work is under way to increase the number of available levels for PV.

All the parameters contained in the model file can be extracted and interpolated, except for LNSP, which is the logarithm of the surface pressure.

Archive data

These data also originate from ECMWF and are also stored in spectral from, so-called T_{106}. These are model analyses that contain 31 model levels (19 levels before 1992), with model level 31 (19) being the ground or sea surface. The upper four levels are pure pressure levels and the lower three levels are pure sigma levels. At each level several parameters are stored. At the present time the available parameters are: temperature (T), specific humidity (Q), zonal wind (U), meridional wind (V), vertical wind (W) and the natural logarithm of the surface pressure (LNSP). Specific humidity is available until 4 April 1995, after when this parameter is only stored on a Gaussian grid. Work is under way to implement software that can extract this parameter also when it is stored on a Gaussian grid.

Programs to extract these model level data exist on zardoz, and extraction of data to isobaric and isentropic levels is also offered (see following chapter).

Data are available from 1 October 1991 to 7 January 1995, after when the daily data take over. Because of the large data volume, it has, until recently, not been possible to have all the archive data on-line at the same time. Now this problem has been solved through the installation of a high-capacity CD-ROM jukebox. These data can also be shared with those who have signed the ECMWF protocol for SESAME. We have also acquired data for the winter 1988-89, 89-90 and 90-91. If you are interested in access to these data, please contact NILU.

For converting data from model levels to more natural units like pressure or theta surfaces, a set of interpolating programs have been written. These routines will interpolate to a wide range of surfaces. Available pressure surfaces are the same as for the daily data (see above).

All the parameters contained in the model level data can be extracted and interpolated, except for LNSP, which is the logarithm of the surface pressure.

The maximum resolution is $1.125^\circ \times 1.125^\circ$ for the T_{106} data. A lower resolution can be specified to the `sp2ll` program described below. This will produce an output file with fewer grid points.

Extraction of data on $1.125^\circ \times 1.125^\circ$ grid

At NILU we have developed programs to extract portions of the T_{106} data. These programs are based on software provided by ECMWF, but considerable effort has been put into the implementation of these programs and in the development of programs for interpolation of model level data onto isobaric and isentropic levels. We have also developed a code to calculate potential vorticity on isentropic levels. The data are in so-called grib format and in spectral form. In order to get useful data from these files one has to convert to ascii numbers on a latitude longitude grid. We have chosen the NASA Ames format for the ascii files. Thus, a file that you extract from the T_{106} data will be very similar to the

other meteorological data on 2.5˚ x 2.5˚ grid, except that there will be only one parameter and data for only one level. You can extract either the whole globe or a portion of it.

Daily data at model levels

sp2ll

For extraction of data at model levels, only one program has to be used: **sp2ll** (spectral to lat./lon.). This is a program that uses the **gribex** routines provided by ECMWF to "degrib" and extract the T_{106} spectral coefficients and produce data on a regular latitude and longitude grid. The output from this program is an ascii file in NASA Ames format 3010, a plain 7-bit ASCII file. The **sp2ll** program takes the arguments from the command line.

- **Syntax**

sp2ll *yy mm dd hh Var Level Resolution West East North South Outfile*

yy mm dd and ***hh*** are year, month, day and hour, respectively. ***Var*** is the meteorological parameter you want. ***Level*** is the model level number, and it has to be in the range 1 to 31. ***Resolution*** is the geographical resolution in degrees. The best resolution you can obtain from T_{106} is 1.125˚ × 1.125˚, so normally you would give 1.125 here, but you can also specify poorer resolutions, such as 2.5. ***West*** is the western limit. It has to be in the range -180 to 180. ***East*** is the eastern limit. It has to be in range -180 to 180, and it has to be larger than ***West***. ***North*** is the northern limit. It has to be in the range 90 to -90. ***South*** is the southern limit. It has to be in the range 90 to -90, and it has to be smaller than ***North***. ***Outfile*** is the name of the file to contain the resulting data.

Invoked without command line parameters, **sp2ll** prints out a usage list. This is helpful when trying to remember the syntax.

The **sp2ll** program reads the contents of the environment variable MARSPATH. This variable must be set by the user before **sp2ll** is used. MARSPATH must be set to:

`/nadir/data/ecmwf/t106/yyyy/mm`

This done with the command:

setenv MARSPATH /nadir/data/ecmwf/t106/*yyyy/mm*

This command can be put in your `.login` file if you plan to extract much model level data.

- **Example 1**

```
setenv MARSPATH /nadir/data/ecmwf/t106/1995/02
```

```
sp2ll 95 02 25 18 T 18 1.125 -180 180 90 -90
global.T.dat
```

This command extracts temperature from 18 UT on 25 February 1995 for the whole globe at model level 18. The output is stored in the file `global.T.dat`.

- **Example 2**

```
setenv MARSPATH /nadir/data/ecmwf/t106/1995/01
```

```
sp2ll 95 01 30 06 U 31 1.125 -50 50 90 30
europe.U.dat
```

This command produces zonal wind from 06 UT on 30 January 1995 for a region stretching from 50˚W to 50˚E and 90˚N to 30˚N, and the result is stored in the file `europe.U.dat`.

Archive data at model levels

For archive data (i.e. data which has been acquired on tape from ECMWF) the process of extracting data on model levels is identical to the one for daily data.

Daily & Archive data at pressure and theta levels

met-mars

In order to obtain T_{106} data at pressure and theta levels an additional set of programs have to be used. These are the interpolating programs **hy2p**, **hy2th** etc. A normal user will not need to be concerned about the usage of these programs, since a script called **met-mars** in most cases performs the task of extracting and interpolating by calling the necessary programs. The script **met-mars** is invoked by the user and will extract and interpolate. It will automatically set MARSPATH, so the user does not need to set this environment variable.

- **Syntax**

met-mars *yy mm dd hh West East North South Resolution Surface Level Variable Outfile*

where ***yy***, ***mm***, ***dd***, ***hh***, ***West***, ***East***, ***North***, ***South*** and ***Resolution*** have the same meaning as above. The latter should be 1.125 (only this resolution works at the moment). ***Surface*** is the type of surface and can be either **th** or **p**. ***Level*** is the numerical value of the level (see the chapter describing the data on page 13 for allowed levels). ***Variable*** is the name of the meteorological parameter and can be one of the following: **T**, **U**, **V**, **W**, **Z**, **PV** and, in addition for archive data, **Q**. All of these variables can be interpolated to any of the available surfaces. The *`outfile`* from this script is in NASA Ames format number 3010. This is a plain 7 bit-ASCII file that can be transferred by ftp or e-mail.

- **Example 1**

```
met-mars 90 11 10 12 -180 180 90 30 1.125 th 475
T t901110.12.475
```

This will extract temperature on a theta surface at 475 Kelvin for the 10 November 12 UT producing a NASA Ames output file named `t901110.12.475`. The geographical area is from the North Pole to 30˚N.

- **Example 2**

```
met-mars 95 8 10 12 -180 180 90 30 1.125 th 435 PV
pv950810.12.435
```

This will give potential vorticity at 435 Kelvin over the Northern Hemisphere down to 30˚N.

- **Example 3**

Potential Vorticity over the south polar area at a theta surface:

```
met-mars 95 9 20 18 -180 180 -50 -90 1.125 th 650
PV pv950920.18.650
```

This gives PV between 50˚S and 90˚S at 650K.

- **Example 4**

met-mars 95 9 23 06 -180 180 -60 -90 1.125 p 100 T t950923.06.100

This gives temperature over the south polar area (60˚S to 90˚S) at the 100hPa pressure surface.

- **Example 5**

met-mars 95 9 26 12 -180 180 90 -90 1.125 th 500 PV pv950926.12.500

This gives a global field of PV at 500K for 26 September 1995.

At present *only* the 1.125 degree resolution can be used in the **met-mars** script, although the **sp2ll** program can accept any resolution.

The script **met-mars** is resident in /nadir/bin and can be copied and changed by the experienced user. The script is written in the Bourne shell. This script utilizes the programs **sp2ll**, **hy2pv**, **hy2th**, **hy2p**, **hy2z** and 19 level versions of these. Not all kinds of variations are covered by this script, and some users may have to change the script to fit the individual needs.

Any problems that you might have using these programs should be reported to Bojan R. Bojkov at NILU.

Graphical presentation of data

New Uniras programs have been developed to plot data at T_{106} resolution. Some of the old Uniras programs have been rewritten, so that they are easier to install, modify and maintain. All programs described in the following can either be run on zardoz, where they have been installed, or you can transfer the source code to your local computer and install it there. The syntax of the old programs is as before, but the number of necessary input files has been drastically reduced. In order to plot data at T_{106} resolution, you first have to extract the data you want to plot, and then start the plotting program.

Introduction

The Uniras plotting programs **isenplot**, **isencol**, **isenbw**, **isocol** and **isobw** have been rewritten so that they no longer depend on the Unix shell scripts that were used to run the first versions of these programs. The number of input files needed to customize these programs is also drastically reduced, making this suite of programs easier to use. **isenplot** has been renamed to **isenplo**, but **isencol** and **isenbw** have been replaced by one program, **isenmap**, which can plot both colour and black and white maps. **isobw** and **isocol** have likewise been replaced by **isomap**. There are also new plotting programs for plotting of T_{106} data, which are described below. If you experience any problems using these the plotting programs, or if you have any ideas for improvements, please contact Geir Braathen at NILU.

Structure of programs and input files

The old programs had to be run by complicated shell scripts (in fact the programs **isenplot**, **isenbw** etc. are scripts that call the necessary fortran programs). The new programs are run without such scripts since they can take the input directly from the command line. The Sun Fortran specific function iargc and the subroutine getarg are used for this purpose. Program lines with these command must be replaced if you want to port these programs to your site and your compiler does not support these functions. The old programs needed a large number of input files, which had to reside in different directories depending on the program. The new programs run with just a very limited number of input files, and they are all supposed to reside in ~/.uniras, where "~" symbolizes your home directory. Most plotting parameters can be varied by editing the file ~/.uniras/Uniras.inp. The programs can run without this file, because default values for all variables are defined within the programs. The only two input files which are mandatory are mclass.inp and colour.inp. If you, through editing of Uniras.inp, choose to plot just isolines and no colour shaded map, you also need a file with data on the thickness of isolines (e.g. mdash.inp). All these input files are available in /nadir/src/uniras/metplot_input. If you run the command **metplot_install** on zardoz, the directory ~/.uniras will be created, and the necessary input files will be copied to this directory. This command will also add the following line to your .cshrc file:

```
setenv ECMWFPATH /nadir/data/ecmwf
```

The plotting programs read this environment variable in order to find the ECMWF data. If you plan to use the programs on your local site, reading data from a local disk or from one of the CD-ROMs that will appear soon, you can set this environment variable according to your local installation. You have to use the same directory structure as we do below this point, since the rest of the path to the file name is calculated by the plotting programs as a function of date and data type. The plots can be customized by editing the file Uniras.inp. Each line in this file has this structure:

program.subroutine.parameter_name=value

where *program* is the name of plotting program that you invoke, such as **isenplo**, **isenmap** etc., and where *subroutine* is the name of the subroutine for which you want to provide a parameter. These subroutines are called by the programs: **mapsiz** to determine the size of the plot and the geographical coverage, mclass to determine the class limits, colour to specify the colour scale, mdash to specify the thickness of individual isolines, ugplot to plot the shaded map and isolines (isenplo only). The program t106glob, which is fundamentally different from the other programs, also calls a subroutine called ortparam. In Uniras.inp, it is possible to replace the program name with an asterisk. A parameter specified this way will be valid for all the plotting programs unless it is overruled by a program specific line.

• Example 1

```
*.mapsiz.x_size=180
*.mapsiz.y_size=180
*.mapsiz.lower_left_latitude=30.0D0
*.mapsiz.upper_right_latitude=30.0D0
*.mapsiz.lower_left_longitude=-45.0D0
*.mapsiz.upper_right_longitude=135.0D0
```

These lines specify that the map will be 180 mm by 180 mm, that the geographical coverage will be so that the lower left corner is at 30˚N, 45˚W and the upper right corner at 30˚N, 135˚E. Since the program name is replaced by an asterisk, these settings will be valid for all the plotting programs that use the mapsiz subroutine, unless the same parameters are also defined with a specific program name, such as in the example below.

• Example 2

```
isenmap.mapsiz.lower_left_latitude=20.0D0
isenmap.mapsiz.upper_right_latitude=20.0D0
```

In this case these two lines will overrule the lines in Example 1, where the program name was replaced with an asterisk. The other parameters, though, will be as determined in Example 1. The order of lines with and without asterisks is immaterial, since the subroutines that read these lines read all lines with asterisks first and then the program specific lines next. This means that a program specific line will overrule the asterisk lines.

Installing the plotting programs at your own site

If Uniras is available at your site you can copy the source codes, header files and sample input files from zardoz. The program codes will also be available on the CD-ROMs with ECMWF data from the SESAME campaign. If you transfer the source files from zardoz you have to fetch the files in these four directories:

/nadir/src/uniras/metplot for the Makefile and the Fortran code for the main programs (isenmap.f, isomap.f etc.), /nadir/src/uniras/lib for the include files (*.h) and the subroutines (such as mclass2.f, mapsiz2.f etc.), from /nadir/src/uniras/geomaps for the country maps, and from /nadir/src/uniras/metplot_inp for sample input files. The files from the latter directory have to be put in ~/.uniras. In order to simplify the installation, we have also put all these files together with the script metplot_install in a tar file named /nadir/src/uniras/metplot.tar. Copy this file with ftp to your local computer. Make sure that the tar file resides in the directory under which you want the programs installed. In the following we call this directory *$sourcetop*. Then carry out the following steps:

1. **tar xvf metplot.tar**. The files will now be found in *$sourcetop*/metplot, *$sourcetop*/lib, *$sourcetop*/geomaps and *$sourcetop*/metplot_inp.
2. **cd *$sourcetop*/metplot**
3. Open Makefile in a text editor and edit the line that says INSTALLTOP=/nadir/bin to something which is suitable for your site.
4. Open the metplot_install script file in a text editor and edit the line that says INPUTDIR=/nadir/src/uniras/metplot_input to *$sourcetop*/metplot_inp. Then edit the line that says setenv ECMWFPATH /nadir/data/ecmwf to the corresponding path for your site. If you read the data directly from one of the CD-ROMs provided by NILU you should set this path to /cdrom/data/ecmwf. We refer to this path as *$datapath* in the following.
5. Make sure that you are still in *$sourcetop*/metplot and issue this command: **make install**. This will compile and link all the programs and move the Uniras executables and metplot_install to $INSTALLTOP.
6. Make sure that the access rights of the Uniras executables and metplot_install are so that you and your colleagues can access them.
7. Make sure that your PATH variable points to $INSTALLTOP. If it doesn't, edit your .cshrc file accordingly. Type **source ~/.cshrc** or open a new window. Also type **rehash**.
8. Go to your home directory. Issue this command: **metplot_install**. The necessary input files are now in ~/.uniras, and the line setenv ECMWFPATH $datapath has been appended to your .cshrc file.
9. Issue this command: **source ~/.cshrc**
10. Run any of the plotting programs following the instructions in the sections below.
11. If the look and size of the plot don't correspond to what you want, go to ~/.uniras and edit the file Uniras.inp.

A note on device drivers

In the Uniras plotting examples used throughout this document we use either mx11 or htp3a4 as the device driver. The mx11 driver is the general driver for plotting on the screen if your computer runs an X-11 windows system. The htp3a4 device driver has been chosen as an example of a driver that produces colour postscript output. Most of the Uniras plots shown in this newsletter have been made with the htp3a4 driver. The postscript file has then been converted to epsi (Encapsulated PostScript Interchange) format with a shareware program called ps2epsi before importing it into the word processor. Some of the plots have been made with the driver hcposteps. This driver produces an eps file (Encapsulated Postscript), which can be imported directly into many word processors. In version 7 of Uniras we have had problems with the htp3a4 driver since it only produced black and white output. We have therefore switched to the driver called hcposta4, which works fine.

Plotting of isentropic data on 2.5° × 2.5° grid

There are two programs available for plotting of isentropic data on the 2.5° × 2.5° grid: **isenplo** and **isenmap**. There is also a program for plotting of vertical sections of isentropic data, **isenvert**.

isenplo

This program uses the Uniras routines **gcnw2s** and **gcnw2v** for the plotting of the colour shaded map and isolines, respectively. These routines do not support annotated isolines, which make them useless for b/w isoline plots. However, these routines can plot the gridded data directly without calling any interpolation routines, which means that **isenplo** runs faster than the other programs. This program is ideal for colour plots. Alternatively, one can plot a grey tone map.

- **Syntax**

`isenplo` ***`type date fc_hours level device`***

where ***type*** is either **te**, **pv**, **pr** or **ps** depending on whether you want temperature, PV, pressure or PSCs, respectively, where ***date*** is the date on the form yymmdd, ***fc_hours*** is the number of forecast hours relative to 0 or 12 UT on ***date***, where ***level*** is the isentropic level you want the plot for, and where ***device*** is the name of the Uniras device you want the output on. Typical devices are: **mx11** for X windows (screen) and **htp3a4** for colour postscript. You should set ***fc_hour*** to 0 if you want the analysis. The permitted values for ***fc_hour*** are 24, 48, 72, 96, 120 and 192 if you want forecasts based on the 12 UT analysis and 12, 36 and 60 if you want forecasts based on the 0 UT analysis (see the chapter on isentropic data on page 13).

- **Example 1**

`isenplo pv 950125 0 475 htp3a4`

This will give a plot of potential vorticity for 25 January 1995 at 475 K as a postscript file. Figure 8 shows the resulting plot.

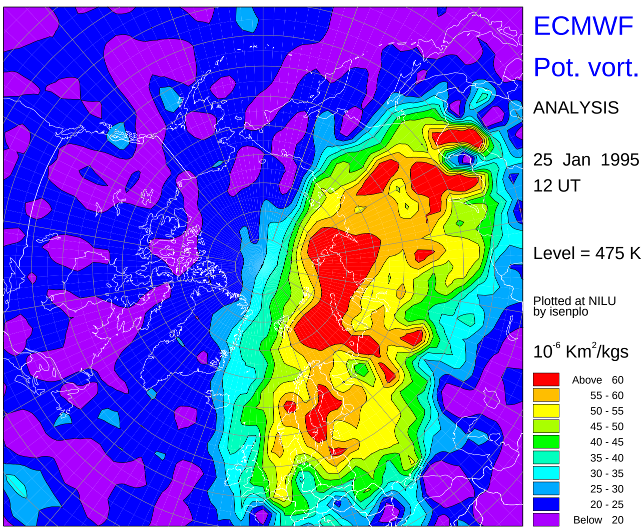

Figure 8*. Potential vorticity at 475 K on 25 January 1995.*

- **Example 2**

`isenplo te 960114 0 550 mx11`

This will give a plot of temperature at 550 K for 12 UT on 14 January 1996. The picture will be sent to your X11 screen.

- **Example 3**

`isenplo pv 950205 192 475 mx11`

This will give a plot of a 192 hours forecast of potential vorticity relative to 5 February 1995. The level is 475 K.

isenplo_min

This program is identical to isenplo, but it marks the minimum and maximum values of the temperature and pressure fields and the maximum for the PV field.

Isenmap

This program uses the Uniras routines **gcnr2s** and **gcnr2v** for the plotting of the colour shaded map and isolines, respectively. These routines do support annotated isolines, which make them useful for b/w isoline plots. However, these routines need the data on a rectangular grid, which means that the data have to go through an interpolation routine. Thus, this program takes some more time to execute than **isenplo**.

- **Syntax**

`isenmap` ***`type date fc_hours level device`***

where ***type*** is either **te**, **pv**, **pr** or **ps** depending on whether you want temperature, PV, pressure or PSCs, respectively, where ***date*** is the date on the form yymmdd, ***fc_hours*** is the number of forecast hours relative to 0 or 12 UT on ***date*** (see explanation above in section on **isenplo**), where ***level*** is the isentropic level you want the plot for, and where ***device*** is the name of the Uniras device you want the output on. Typical devices are: **mx11** for X windows (screen) and **htp3a4** for colour postscript.

- **Example**

`isenmap pv 950225 0 550 htp3a4`

This will give a plot of potential vorticity for 25 February 1995 at 550 K to a postscript file. Figure 9 shows the resulting plot.

Isenvert

This program plots a vertical section of potential vorticity, pressure, temperature or PSC incidence along a meridian. This program is useful for investigating the vertical distribution of these parameters.

- **Syntax**

`isenvert` ***`type date longitude device`***

where ***type*** is either **te**, **pv**, **pr** or **ps** depending on whether you want temperature, PV, pressure or PSCs, respectively, where ***date*** is the date on the form yymmdd, where ***longitude*** should be in the range 0 to 357.5,and where ***device*** is the name of the Uniras device you want the output on.

The following two examples show how this program can be used to localize the vortex edge as a function of altitude and the vertical extent of a PSC cloud, respectively.

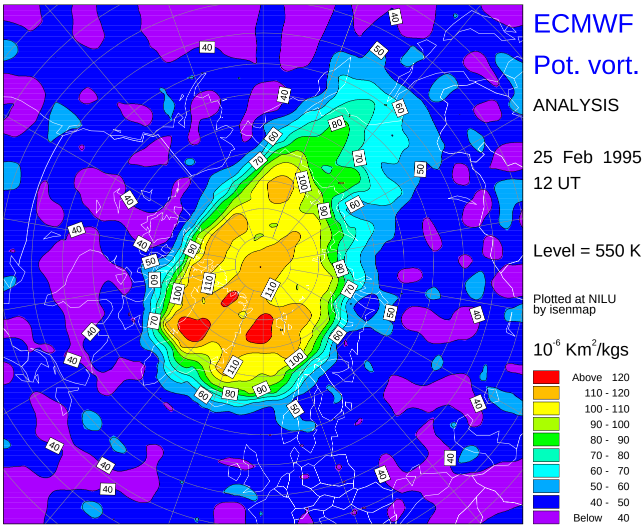

Figure 9. *Potential vorticity at 475 K on 25 February 1995.*

• Example 1

isenvert pv 960212 180 htp3a4

This will produce a plot of PV along the International Date Line for 12 February 1996. The resulting plot is shown in Figure 10.

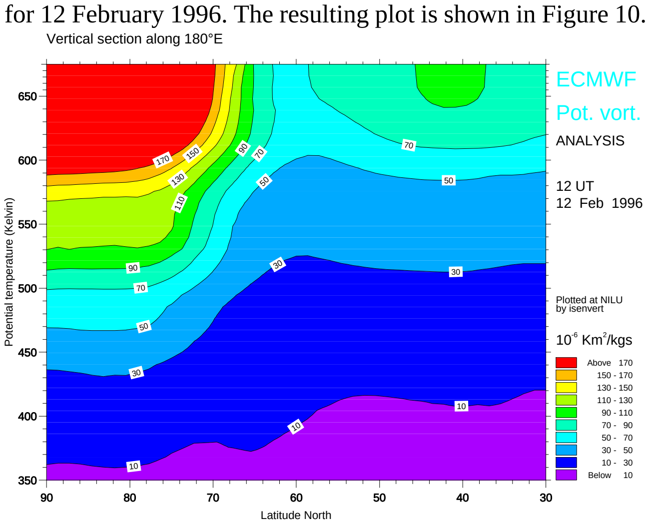

Figure 10. *Potential vorticity along 180˚E on 12 February 1996.*

• Example 2

isenvert ps 960112 20 mx11

This command will give a plot of the vertical extent of PSCs along 20˚E on 12 January 1996. The resulting plot is shown in Figure 11.

Plotting of isobaric data at 2.5˚ × 2.5˚ resolution

isomap

There is now only one program for plotting of low resolution isobaric data; **isomap**.

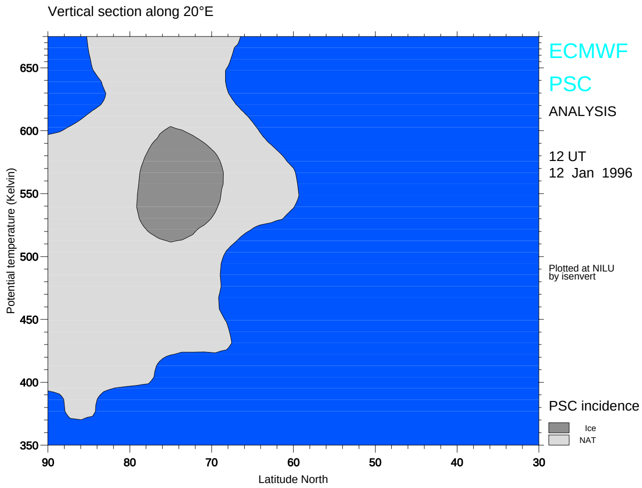

Figure 11. *Vertical PSC distribution along 20˚E on 12 January 1996.*

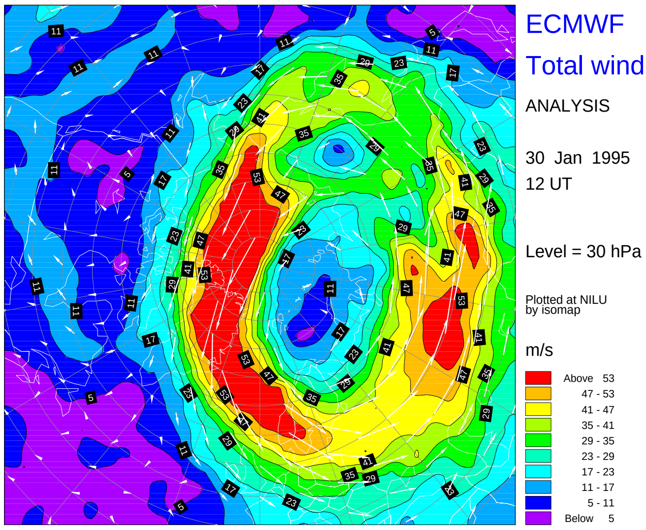

Figure 12. *Total wind for 12 UT on 30 January 1995.*

• Syntax

isomap *type date fc_hour level device*

The input parameters are as described above for isenmap, except that ***type*** can be one of **gp** (geopotential height), **te** (temperature), **mw** (meridional wind), **zw** (zonal wind), **tw** (total wind) or **ps** (PSC). ***level*** now has to be one of the 13 standard isobaric levels.

• Example

isomap tw 950130 0 30 htp3a4

This will produce a map of total wind (the vector sum of u and v) for 12 UT on 30 January 1995 at 30 hPa. Figure 12 shows the plot.

isoplo

This is new program that was developed in early 1997. It plots isobaric data using the same plotting technique as the program isenplo (see above). The advantage of this program over isomap is that the plotting is quicker since there is no need for interpolation to a rectangular grid. This program also marks on the map the position of the maximum and the minimum temperatures in the field.

• **Syntax**

isoplo ***type date fc_hour level device***

The input parameters are as described above for isomap.

• **Example**

isoplo te 981211 0 30 htp3a4

This will produce a map of temperature for 11 December (12 UT) at 30 hPa. The resulting plot is shown in Figure 13. Here the geographical limits in `Uniras.inp` have been set so that the whole field from 30˚N is included.

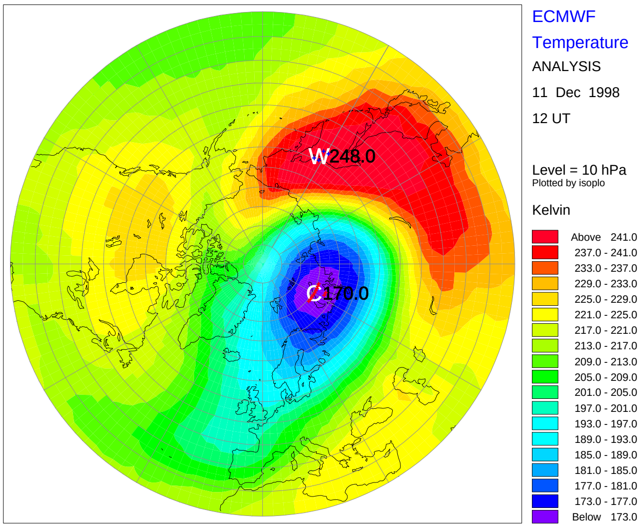

Figure 13. *Temperature at 10 hPa on 11 December 1998. A minimum temperature of 170 K was found over Novaya Zemlya.*

Plotting of trajectories

trajplo

The **trajplo** program is a modified version of the old program **trajplot**, and it now runs without the aid of a script. It plots isentropic trajectories at seven levels.

• **Syntax**

trajplo ***date_1 station_1 level_1 date_2 station_2 level_2 ... date_n station_n level_n device***

where ***n*** can be in the range 1-6. The station name can be either one of the measurement sites or one of the grid points. The measurement sites have eight character codes, which normally are the first eight characters of the stations name. The grid points should be referred to as:

gridpoin, ***lat, lon***

Available stations have varied during the EASOE and SESAME campaigns. In order to obtain a list of stations in a file you can run the program **statlist**.

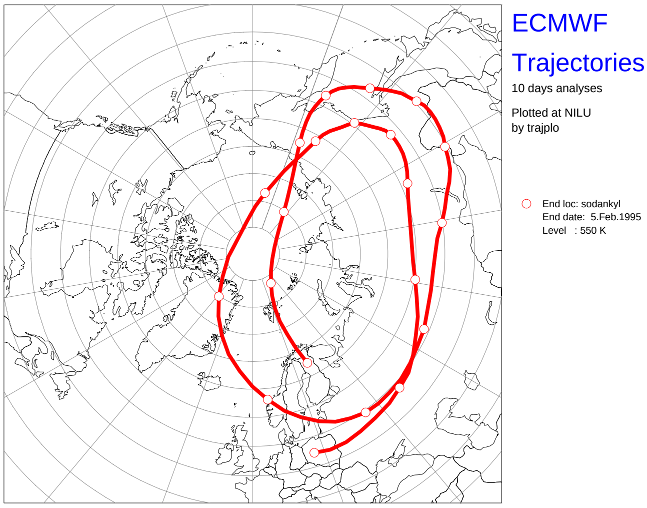

Figure 14. *Trajectory ending at 550 K above Sodankylä on 5 February 1995.*

• **Syntax**

statlist ***date outfile***

• **Example**

statlist 950205 stations.out

This produces a text file with all the stations names in it.

Here follow some examples of trajectory plotting commands:

• **Example 1**

trajplo 950205 sodankyl 550 mx11

This will give a plot of a trajectory ending at the 550 level above Sodankylä. The plot in Figure 14 shows the result.

• **Example 2**

trajplo 950205 gridpoin, 40,0 550 htp3a4

This will give a plot of a trajectory ending at a grid point located at 40˚N and 0˚E at 550 K.

• **Example 3**

trajplo 950101 sodankyl 475 950101 thule 475 950101 uccle 475 950101 aberystw 475 950101 nyalesun 475 950101 kiruna 475 mx11

This will produce a plot on the screen of six trajectories at 475 K ending at the given stations.

Plotting of T_{106} data

Introduction

Three programs are available for plotting of T_{106} data. One program, **t106map**, gives the same type of maps as **isenmap**, whereas the second program, **t106glob** plots data in an orthographic projection. The former is well suited for plots over the Northern Hemisphere, whereas the latter can be used to plot either hemisphere. Both these programs plot arbitrary files resulting from the extraction of T_{106} data described above. Since the programs don't know which parameter to plot, the lower and upper class limits have to be given on the command line. These programs hence don't use the `mclass` subroutine.

The third program, `t106plot`, follows the same syntax as `isenmap` and `isomap`. This program produces the same type of plot as `t106map`, but it is restricted to plotting PV, temperature and PSC incidence (calculated from the temperature). The instructions and examples below will make the use of these programs a bit clearer.

Common to all three programs is that the data have to be on 1.125° × 1.125° grid, but the programs handle any geographical coverage. The data array is dimensioned to contain a global field at this resolution, but before data is read it is filled with missing values. The area covered by the data file is specified in the data file header, so that the data are put into the appropriate array elements.

t106map

Use this program if you want to plot a map over the Northern Hemisphere of any arbitrary parameter that you have extracted from the spectral T_{106} data.

• Syntax

```
t106map data_file min max device
```

where ***data_file*** is the name of a NASA Ames file that you have extracted using `met-mars` described above, where ***min*** and ***max*** are the lower and upper class limits, respectively, and where ***device*** is the name of a Uniras device.

• Example

Assume that you want to plot a PV map of the Northern Hemisphere from 30°N to the Pole for 18 UT on 16 February 1995 at 550 K. First you have to extract the data with `met-mars`:

```
met-mars 95 2 16 18 -180 180 90 30 1.125 th 550 PV
pv95021618.550
```

Then you specify the output file from this command as the data input to the plotting program:

```
t106map pv95021618.550 40 120 mx11
```

The resulting plot is given in Figure 15.

t106glob

Use this program if you want to plot a map of any arbitrary portion of the globe. This program uses the orthographic projection (i.e. the globe looks like it does from space). You specify on the command line the latitude and longitude of the centre of the map. This way you can see the globe from any vantage point you want. This program is ideal if you want to plot a map over the Southern Hemisphere, such as Antarctica.

• Syntax

```
t106glob data_file min max centre_lat centre_lon
device
```

where ***data_file*** is the name of a NASA Ames file that you have extracted using `met-mars` described above, where ***min*** and ***max*** are the lower and upper class limits, respectively, where ***centre_lat*** is the latitude of the map centre, where

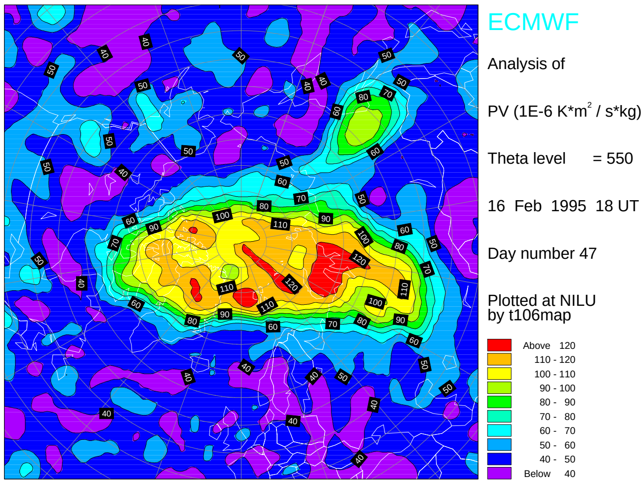

Figure 15*. Potential vorticity at 550 K on 16 February 1995 18 UT over the Northern Hemisphere.*

centre_lon is the longitude of the world centre, and where ***device*** is the name of a Uniras device. The lower and upper class values are determined by min and max, and the number of classes will be determined by the number of colours in the colour file (e.g. `colour.inp`) pointed to in `Uniras.inp`.

• Example 1

Assume that you want to plot a temperature map at 475 K over the Northern Hemisphere for 12 UT on 10 January 1995, centred over Kiruna.

First, you extract the data with `met-mars`:

```
met-mars 95 1 10 12 -180 180 90 -90 1.125 th 475
T t95011012.475
```

The output from this program is used as input for the plotting program:

```
t106glob t95011012.475 183 223 68 21 mx11
```

The plot will look like Figure 16.

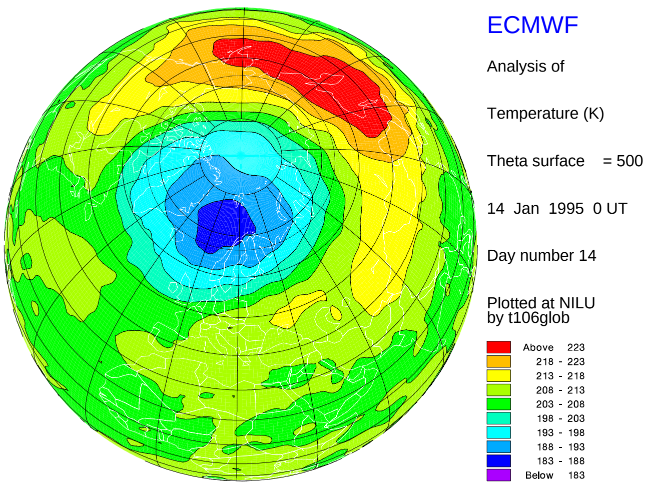

Figure 16*. Orthographic plot of temperature at 475 K on 10 January 1995 at 12 UT. The map is centred over Kiruna.*

- **Example 2**

Let us assume that you want to make a plot of PV at 475 K over the south polar region for 19 October 1995, 12 UT, centred over the Antarctic Peninsula. First, you extract the PV field:

```
met-mars 95 10 19 12 -180 180 90 -90 1.125 th 475
PV pv951019.12.475
```

Then make the plot:

```
t106glob pv951019.12.475 -70 -20 -68 -60 mx11
```

The plot is shown in Figure 17.

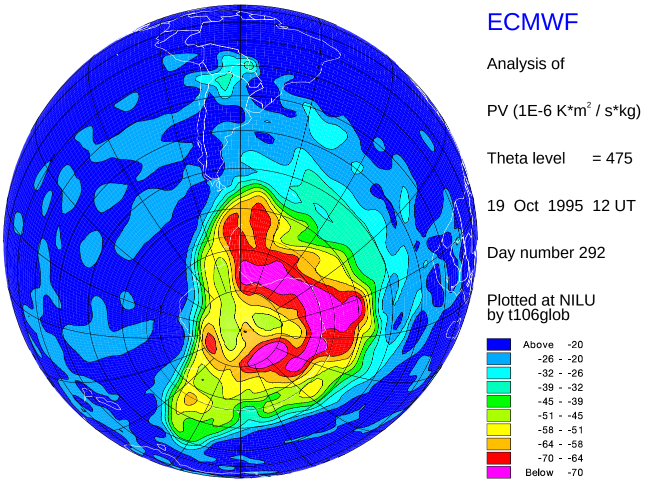

***Figure 17**. Orthographic plot of potential vorticity at 475 K on 19 October 1995 at 12 UT. The map is centred over the Antarctic Peninsula. Note that PV is negative in the Southern Hemisphere.*

t106plot

This program can plot temperature, PV and PSC incidence (based on temperature data) from NASA Ames files with 1.125° × 1.125° resolution. This program reads the class values from `~/.uniras/mclass.inp` or any other file that you specify. In this sense it works in the same way as **`isenmap`**.

- **Syntax**

`t106plot` ***`data_file parameter device`***

where ***`data_file`*** is the full path to the file containing the data, where ***`parameter`*** is one of **`te`**, **`pv`** or **`ps`**, and where ***`device`*** is the Uniras device name.

- **Example**

Let us assume that you want a PSC map at 475 K for 12 UT on 14 January 1995. First, you extract temperature data for this date and time:

```
met-mars 95 1 14 12 -180 180 90 30 1.125 th 475 T
t95011412.475
```

The you plot the PSC map using the temperature data:

```
t106plot t95011412.475 ps mx11
```

The resulting plot is given in Figure 18.

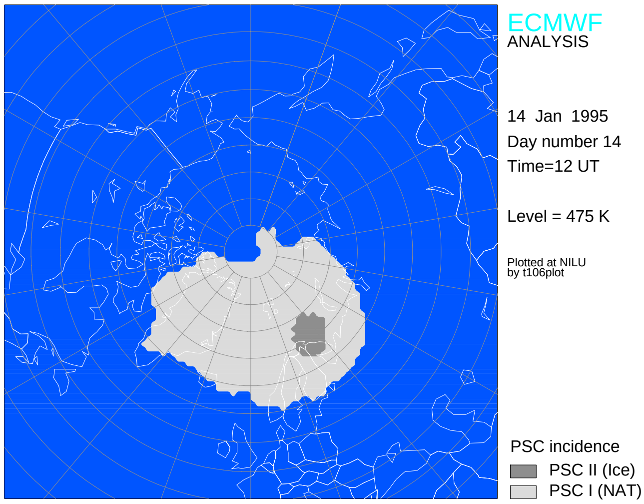

***Figure 18**. Stereographic plot of PSC incidence at 475 K on 14 January 1995 at 12 UT.*

Plotting of TOMS data

There are two programs to plot TOMS data, one that plots a stereographic map of the Northern Hemisphere and one that plots an orthographic map of any part of the globe.

tomsplot

This program plots an azimuthal stereographic plot of TOMS data over the Northern Hemisphere.

- **Syntax**

`tomsplot` ***`data_file min max device`***

where ***`data_file`*** is the full path to the TOMS data file (which should be in the normal NASA TOMS format (not NASA Ames format)), where ***`min`*** and ***`max`*** are the lower and upper class limits, respectively, and where ***`device`*** is the Uniras device.

- **Example**

```
tomsplot /nadir/data/satellit/toms/nimbus7/
d930315.n7 250 450 mx11
```

Figure 19 shows the resulting plot. We have used 16 colours, rather than the 10 normally used. This is done by editing the file `~/.uniras/Uniras.inp`. Go to the line which says: `tomsplot.colour.input_file_name`, and edit this line so it looks like this:

```
tomsplot.colour.input_file_name=
~/.uniras/colour16.inp
```

The file `colour16.inp` can be found in `/nadir/src/uniras/metplot_inp`.

tomsglob

This program is quite similar to **`t106glob`** since it can plot the globe from any vantage point.

- **Syntax**

`tomsglob` ***`data_file min max centre_lat centre_lon`***

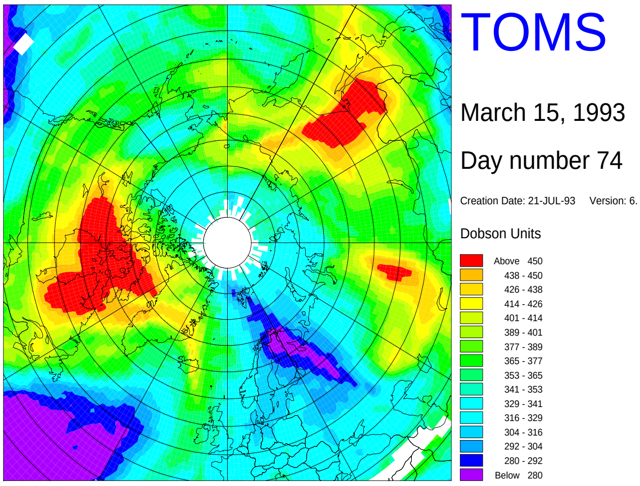

Figure 19*. Stereographic plot of TOMS total ozone for 15 March 1993.*

device

where ***data_file*** is the full path to the TOMS data file (which should be in the normal NASA TOMS format (not NASA Ames format), where ***min*** and ***max*** are the minimum and maximum class values in Dobson units, where ***centre_lat*** and ***centre_lon*** are the latitude and longitude of the centre of the map, respectively, and where ***device*** is the Uniras device.

- **Example**

```
tomsglob /nadir/data/satellit/toms/meteor3/
oz94/ga941017.m3t 180 400 -68 -60 mx11
```

This command will produce a total ozone plot on the screen with the Antarctic Peninsula in the centre of the map. The map is shown in Figure 20.

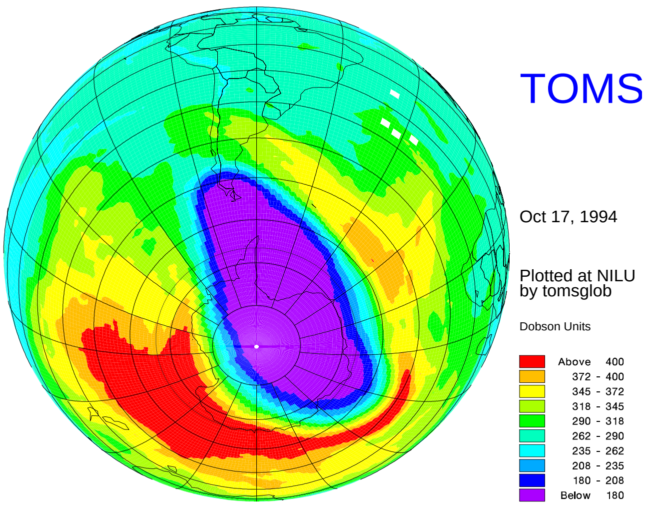

Figure 20*. Orthographic plot of Meteor 3 TOMS total ozone for 17 October 1994. One can see how the ozone hole (the region with total ozone < 180 DU) touches the southern tip of South America.*

Plotting of TOVS data

tovsplot

This program plots a stereographic map of total ozone from TOVS as provided by CNRM in Toulouse.

- **Syntax**

tovsplot *file_name device*

where ***file_name*** includes the full path of the file to plot and ***device*** is the Uniras device.

- **Example**

Let us assume that you want to plot a TOVS map for 27 February 1996. First you copy the compressed TOVS file to `/nadir/tmp`, so that you can uncompress it:

```
cp /nadir/sesame/data/satellit
/tovs/tv960227.oz2.Z /nadir/tmp
```

Then you uncompress it:

```
cd /nadir/tmp
```

```
uncompress tv960227.oz2.Z
```

Now the file can be plotted:

```
tovsplot tv960227.oz2 htp3a4
```

This gives a file called `POST` that you can ftp to your local computer and print on your local printer. The result is shown in Figure 21.

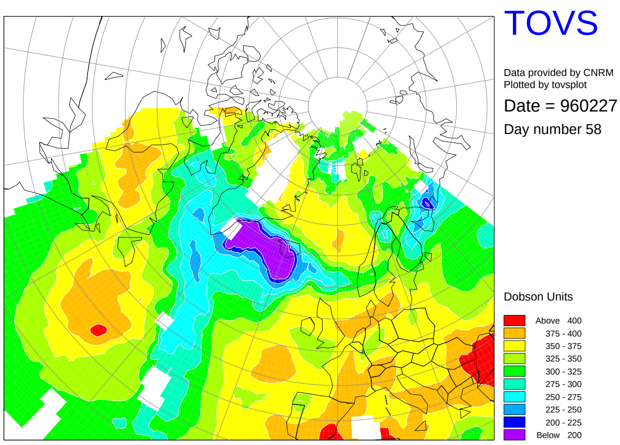

Figure 21*. Stereographic plot of TOVS total ozone for 27 February 1996.*

Plotting of ozonesonde data

sondeplo

This program is ideal for plotting individual ozone profiles from specific stations.

- **Syntax**

sondeplo *station date_hour device*

where ***station*** is the name of the launch site, ***date_hour*** is the date and hour of launch on the form yymmddhh and ***device*** is the Uniras device for the output.

- **Example**

```
sondeplo thule 95022314 htp3a4
```

The result is shown in Figure 22.

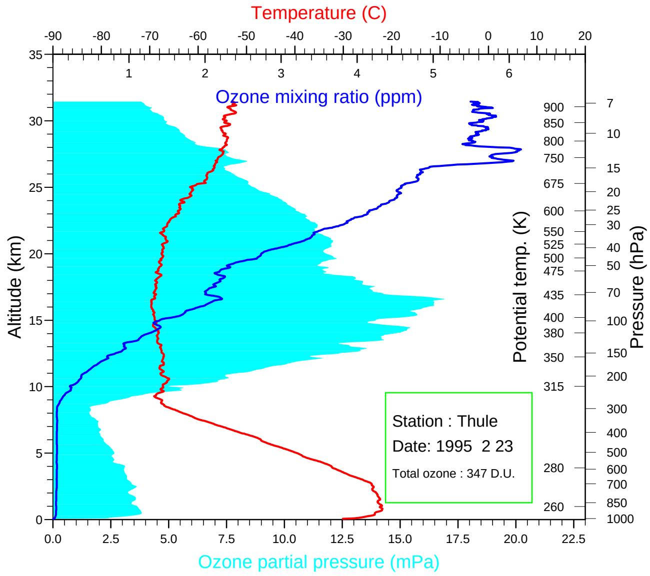

Figure 22*. Plot of an ozonesonde profile from Thule (Greenland) on 23 February 1995.*

meanprof

This program calculates and plots an average profile from any number of individual profiles. The program takes as input the name of a file that contains a list of ozonesonde data file names.

- **Syntax**

```
meanprof file_list device
```

where ***file_list*** is the name of the file that contains a list of sonde data files and ***device*** is as before.

- **Example 1**

```
meanprof iv9203.dir htp3a4
```

- **Example 2**

```
meanprof iv9503.dir htp3a4
```

The resulting plots from these two commands are shown in Figure 23 and Figure 24.

profile

This program can be used to inspect a large number of profiles on the computer screen. The program takes a file list as input, and one profile is displayed after the other by pressing the space bar or a mouse button.

- **Syntax**

```
profile file_list
```

where ***file_list*** is a file with a list of file names of ozonesonde data.

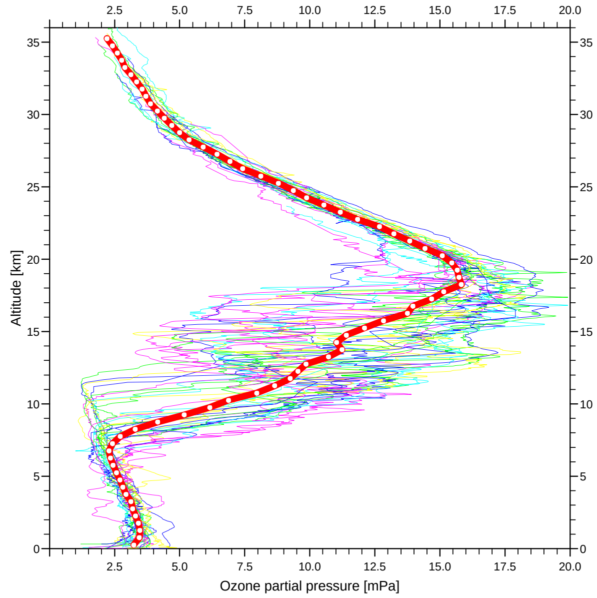

Figure 23*. Plot of a mean ozone profile resulting from averaging approx. 30 ozone soundings carried out inside the polar vortex during March 1992. Each profile is plotted as a thin curve in different colours. The mean profile is plotted as a thick red curve with white dots marking every 500 m.*

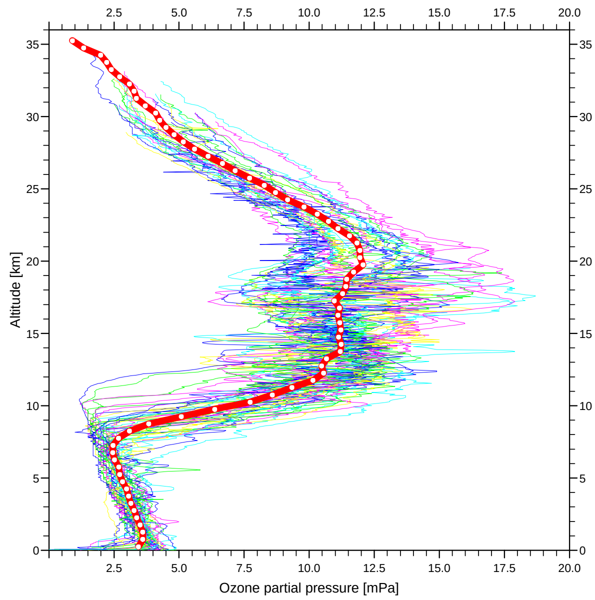

Figure 24*. Plot of a mean ozone profile resulting from averaging approx. 40 ozone soundings carried out inside the polar vortex during March 1995. One can clearly see the ozone deficit in the 15-20 km range which was caused by chemical destruction.*

Time series of data on 2.5° × 2.5° grid

Isentropic data

isen_ts

The program **isen_ts** will make a time series of any of the parameters temperature, pressure, potential vorticity and PSC incidence for a given grid point. The output is to an ascii file. The program reads the necessary input parameters from the command line.

- **Syntax**

`isen_ts` ***`start_date end_date data_type level lat lon outfile`***

where ***start_date*** and ***end_date*** are the start and end dates of the time series on the form yymmdd, where ***data_type*** can be **te**, **pv**, **pr** or **ps** for temperature, potential vorticity, pressure and psc incidence, respectively, where ***level*** is the isentropic level in the range 350 to 675 K, where ***lat*** and ***lon*** are the latitude (multiple of 2.5 in the range 30 to 90) and longitude (multiple of 2.5 in the range -177.5 to 180) of the site you want data for, and where ***outfile*** is the name of the file to contain the output.

- **Example**

```
isen_ts 941201 950330 te 475 52.5 -5.0 te475.dat
```

Here are the first few lines of output:

```
Parmeter=te Level=475 Lat.= 52.5  Lon.=  -5.0
 Date   Jul     TEMP
941201  335    212.3
941202  336    212.4
941203  337    214.2
941204  338    214.5
941205  339    214.9
941206  340    215.7
941207  341    220.1
941208  342    214.1
941209  343    211.8
941210  344    207.3
```

The source code can be found on zardoz in `/nadir/src/nongraph/meteorol/isen_ts.f`

isen_minmax

The program **isen_minmax** will make a time series of the maximum and minimum temperature anywhere north of 40°N. The input parameters are taken from the command line.

- **Syntax**

`isen_minmax` ***`start_date end_date level outfile`***

where the parameters have the same meaning as for the previous program.

- **Example**

```
isen_minmax 940101 940430 475 tmin.dat
```

The first few lines of the output file will look like this:

```
Level = 475.
Date    Julian  Min     Max     Mean
940101    1    191.3   228.8   212.9
940102    2    192.2   228.9   213.6
940103    3    194.8   231.4   213.3
940104    4    195.9   230.3   213.0
940105    5    194.3   231.4   212.8
940106    6    193.1   231.2   212.2
```

isen_mincoor

This program will make a time series of the minimum and maximum temperature in the same way as isen_minmax. In addition, isen_mincoor also gives the latitude and longitude of the minimum temperature points. The input parameters are taken from the command line.

- **Syntax**

`isen_mincoor` ***`start_date end_date level outfile`***

where the parameters have the same meaning as for the previous program.

- **Example**

```
isen_mincoor 981201 981210 475 tmin.dat
```

The first few lines of the output file will look like this:

```
Level = 475
Date    Julian Min    Max    Mean  min_lat min_lon  max_lat max_lon
981201 335 192.6 226.4 209.6 70.0 22.5   62.5   70.0
981202 336 195.1 225.9 210.0 70.0 77.5   67.5   70.0
```

```
981203 337 197.0 229.1 210.0 72.5 70.0   55.0   72.5
981204 338 197.0 230.8 210.1 65.0 30.0   60.0   65.0
```

Isobaric data

iso_ts

The program **iso_ts** is analogous to **isen_ts**, and the syntax is the same. Running **iso_ts** without parameters gives a list of allowed parameters.

iso_minmax

This program is analogous to **isen_minmax** and the syntax is the same. Running **iso_minmax** without parameters gives a list of all the input parameters.

iso_mincoor

This program is analogous to isen_mincoor and the syntax is the same. Running **iso_mincoor** without parameters gives a list of all the input parameters.

Time series of T_{106} data

We will here show how you can use the **met-mars** script to extract time series from the T_{106} data. This will be shown through a couple of examples.

- **Example 1**

Let's assume that you want to make a time series of the possible PSC area at 475 K during the last four winters. By possible PSC area we mean the geographical area covered by PSCs. This means that we have to find the number of grid cells with temperatures lower than a certain threshold, determined by the partial pressures of water vapour and nitric acid, and then add the area of all these grid cells. In order to find this we have to extract a temperature field for each day of these four winters. In this chapter we will show how you can extract a time series of temperatures from the T_{106} data available at NADIR.

In order to extract the temperature fields we will use **met-mars**. Because of the large number of extractions (one per day) it will be best to do this with a script. Since the extraction and interpolation of T_{106} data is quite time consuming, we recommend that you do one month at a time. You can make one script for each month and then run these scripts individually. Here follows a script that will extract data for January 1993. We extract data for 12 UT only.

```
#!/bin/csh
foreach date ( 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 )
   met-mars 93 01 $date 12 -180 180 90 30 1.125 th 475 T t.93.01.$date.12.475
end
```

- **Example 2**

Let's assume that you want to see how the vortex has moved over a period of one month. The T_{106} data will give you a much better time resolution than the $2.5^{\circ}\times2.5^{\circ}$ data, since we have analyses for every 6 hours. The time period of interest is February 1995. The following script will extract the data:

```
#!/bin/csh
foreach date ( 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 )
    foreach hour ( 00 06 12 18 )
       met-mars 95 02 $date $hour -180 180 90 30 1.125 th 475 PV pv.95.02.$date.$hour.475
    end
end
```

These data can then be plotted with **t106map** to give postscript files. These postscript files can then be converted to GIF files, so that they can be animated with **xanim**. On zardoz you find a routine called convert that converts postscript files to GIF files. The following script will plot the extracted data and convert the plot files to GIF format:

```
#!/bin/csh
foreach date ( 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 )
    foreach hour ( 00 06 12 18 )
        t106plot pv.95.02.$date.$hour.475 pv htp3a4
        mv POST pv.95.02.$date.$hour.ps
        convert pv.95.02.$date.$hour.ps pv.95.02.$date.$hour.gif
     end
end
```

Time series of PV at individual stations

The Danish Meteorological Institute provides more exact PV data for a number of stations. These files are not in the NASA Ames format, and we have written a special program, **`pvatstat`**, to read these files and make a time series of PV for an individual station. The program works on data files from before 1 November 1995. Files from after this date can be read with **`pvatstat2`**.

- **Syntax**

`pvatstat` ***`f_date l_date level outfile`*** **`m|n`**

where ***`f_date`*** and ***`l_date`*** are the first and last date, respectively, ***`level`*** is the isentropic level and ***`outfile`*** is the name of the file to contain the result. The last parameter should either be the letter `m` (literally) for manual interaction or a number (***`n`***) indicating which station number you want. If you are not sure what the number of your station is, you should type `m` in order to get a list of the stations' coordinates. From this list you can choose a station number. Beware that the station numbers can change between different time periods, since the number of stations included has changed during the years. Hence, the first time you run **`pvatstat`** for a given time period you should choose `m` as the last parameter.

- **Example 1**

`pvatstat 941201 950331 475 pv475.dat m`

This will give you a time series of PV at 475 K between the given dates. The output will be written to the file `pv475.dat`, and since we have typed `m` at the end, the program will list the station coordinates and ask you to choose one of them.

- **Example 2**

`pvatstat 941201 950331 475 pv475.dat 12`

This will give you PV time series for station number 12 in the pvatstat data.

Here is an example of output from this program:

```
Latitude=66.80  Longitude=123.40   Level=475
Date     Julian     PV
941225    -6      55.31
941226    -5      61.41
941227    -4      69.23
941228    -3      60.03
941229    -2      48.48
941230    -1      52.86
941231     0      55.20
950101     1      52.19
950102     2      48.91
```

Listing of data for single days

Introduction

The NASA Ames files with ECMWF data are not easy to read manually. Because of this, we have made some programs that can read these files (or portions of them) and make a more readable output.

Isentropic data

isen_extr

The program **`isen_extr`** takes out a portion of the data for a given meteorological variable, date, level and within certain geographical limits. The output is directed to the screen.

- **Syntax**

`isen_extr` ***`date forecast_hours type level lat lon`***

where ***`lat`*** and ***`lon`*** give the latitude and longitude of the upper right corner of the geographical area to extract.

- **Example**

`isen_extr 941225 0 pv 550 80 20`

Isobaric data

isolist

The program **`isolist`** makes a listing of the contents of an isobaric file where the four parameters temperature, GPH, u and v are listed on one line for each grid point.

- **Syntax**

`isolist date forecast_hours level outfile`

The meaning of the input parameters is as before.

- **Example**

`isolist 950101 0 100 isodat.100`

Here are some lines from the output file:

date=950101 forecast hours= 0 level=100 hPa

lat	lon	T[K]	Z[dam]	u[m/s]	v[m/s]
90.0	0.0	200	1483	9.4	7.4
87.5	-177.5	200	1489	15.8	9.3
87.5	-175.0	200	1489	16.3	8.7
87.5	-172.5	200	1489	16.8	8.0
...					
...					
52.5	-170.0	226	1585	8.1	12.6
52.5	-167.5	227	1588	5.7	15.4
52.5	-165.0	226	1592	2.6	16.3

isoprof

The program **isoprof** takes out data for all the 13 isobaric levels for a given date and a given location.

- **Syntax**

`isoprof date forecast_hours lat lon outfile`

where the input parameters are as before.

- **Example**

`isoprof 950101 120 67.5 20.0 profile.dat`

Here follows a listing of `profile.dat`:

date=950101 forec hours=120 lat=67.5 lon= 20.0

Pressure	T[K]	Z[dam]	u[m/s]	v[m/s]
1000	267	-4	-0.2	-4.3
850	261	121	-6.0	-4.0
700	253	267	-8.0	-3.8
500	234	506	0.0	-5.3
400	223	656	10.0	3.1
300	210	837	20.3	9.1
200	210	1085	14.5	5.3
150	207	1261	12.1	3.1
100	206	1505	20.6	-1.0
70	199	1717	26.3	1.2
50	198	1912	30.4	0.7
30	197	2206	33.7	1.4
10	196	2838	37.0	2.4

iso_extr

The program **iso_extr** takes out a portion of the data for a given meteorological variable, date, level and within certain geographical limits. The output is directed to the screen.

- **Syntax**

`iso_extr date forecast_hours type level lat lon`

where *lat* and *lon* give the latitude and longitude of the upper right corner of the geographical area to extract.

- **Example**

`iso_extr 941225 0 T 50 80 20`

How to make XY diagrams

xyplot

This is a Uniras program for making XY plots, for example of time series. The program takes two parameters on the command line; the device name and the orientation of the plot. The rest of the input comes from an input file, `xyplot.inp`, which has to reside in `~/.uniras`. The source code and a sample input file can be found on zardoz in `/nadir/src/uniras/xyplot`. With this program several curves can be plotted in different colours and/or line styles. It is also possible to specify text strings and their location on the plot in the input file. Let us assume that you want to plot a time series of minimum temperatures in the Northern Hemisphere for the last few winters. First, you run the program **isen_minmax**, which is described on page 25. From the output one can extract columns 2 and 3 with the **awk** command:

`awk ´{print $2, $3}´ tmin.dat > tmin.jul`

The file `tmin.jul` can then be used as input data for **xyplot**. Make one such data file per winter, e.g. `tmin92.jul`, `tmin93.jul`, `tmin94.jul` and `tmin95.jul`. Specify these files in the `xyplot.inp` input file. In this input file one can also decide on the width, line style and colour of each curve.

- **Syntax**

`xyplot device orien [julopt]`

where *device* is the Uniras device, *orien* is the orientation of the plot (1-4) and *julopt* is an optional parameter which should either be omitted or set equal to `jul`. If *julopt* is set to `jul`, day numbers larger than 250 will have 365 subtracted from them, so that one can make plots of time series covering the whole winter, and where dates before 1 January will get negative day numbers.

- **Example**

`xyplot hcposteps 1 jul`

The path to the data files must be given in the input file `~/.uniras/xyplot.inp`.

Figure 25 shows what the plot will look like.

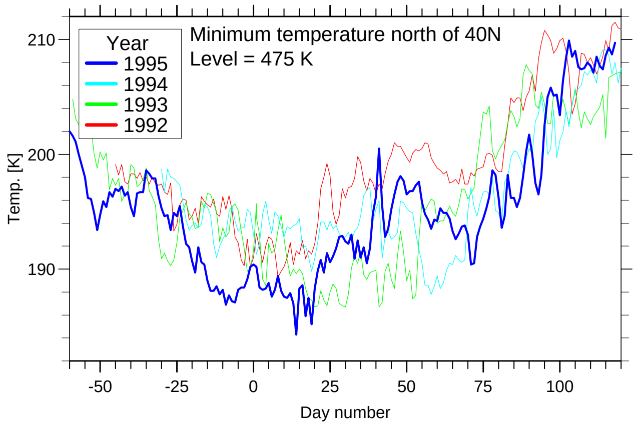

***Figure 25**. Time series of Northern Hemisphere minimum temperatures for the last few winters. The 1994-95 winter has been enhanced with a thicker curve.*

Other programs

Picking out data inside the vortex

pvpick

If you have a large set of data files for a given station, such as spectrometer data, lidar data or ozonesonde data, it can be useful to pick out only those data files that represent measurements carried out inside the polar vortex. It might be tedious to make this selection manually. This can be done quite easily with the program **pvpick**. As input it needs a file with the file names of the data files and a file with PV data. This latter file will typically be the output file from the **pvatstat** program. The program picks out the date part of a file name by searching for a “/” followed by “8” or “9” three characters later. If your files names follow the convention adopted by NADIR, this should be a good criterion for picking out the date part of the file names. From the PV data file those dates that have PV above a certain threshold are picked. These dates are compared with the dates found from the file with data file names, and a list of file names satisfying the PV criterion are written to an output file. The PV limits for the most common levels are given in the source code, but these can be changed by copying the source code to your home directory or to your local computer. The program can be found in `/nadir/src/nongraph/meteorol`.

- **Syntax**

pvpick ***dirfile pvfile level outfile***

where ***dirfile*** is the file containing the file names, ***pvfile*** is a file with a time series of PV data for the station, ***level*** is the isentropic level, and ***outfile*** will contain a list of files that satisfy the PV criterion defined in the program.

Extraction of trajectories for individual stations

Trajectory data used to be stored both as large collective files containing data for all stations, and as smaller files for each station. In order to save disk space these data are now only stored as large collective files. If you are interested in transferring trajectory data for only one or a small number of stations, you can extract data for single stations. The extraction program is called **traj**. This program will extract trajectories for all the isentropic levels ending at one station for a specific date. When logged on to zardoz, run

traj -help

to get instructions on how to use this program.

Listing of TOMS data

The program **tomslist** lists a portion of TOMS data on the screen.

- **Syntax**

tomslist ***data_file lat lon***

where ***data_file*** is the name of the TOMS data file and ***lat*** and ***lon*** are the coordinates of the upper left corner of the window you want to list.

- **Example**

tomslist /nadir/data/satellit/toms/nimbus7/ d930315.n7 89.5 -178.75

This command will produce a listing of total ozone values on the screen (10 columns and 21 lines).

A summary of all the programs

Here follows an alphabetical list of all the programs described in this newsletter together with a short description of their purpose.

Table 1. Program summary.

Program name	Purpose	Page
isen_extr	Lists a lat./lon. portion of isentropic ECMWF data on the screen.	27
isenmap	Plots a map of isentropic ECMWF data at 2.5° × 2.5° resolution. Isolines can be annotated, so this program is useful for b/w plots.	18
isen_mincoor	Makes a time series of the maximum and minimum temperature anywhere north of 40°N from the isentropic ECMWF data. Also gives the coordinates of the max and min points.	25
isen_minmax	Makes a time series of the maximum and minimum temperature anywhere north of 40°N from the isentropic ECMWF data.	25
isenplo	Plots a map of isentropic ECMWF data at 2.5° × 2.5° resolution.	18
isenplo_min	Plots a map of isentropic ECMWF data at 2.5° × 2.5° resolution. Marks on the map the position and value of maximum and minimum values.	18
isen_ts	Extracts a time series of isentropic ECMWF data for a given grid point and level.	25

Table 1. *(Continued)* Program summary.

Program name	Purpose	Page
isenvert	Plots a vertical section of isentropic ECMWF data along a meridian	18
iso_extr	Extracts a portion of the isobaric ECMWF data. Output is written to the screen.	28
isolist	Writes out the contents of an isobaric ECMWF file with one line per grid point. The output is written to a file.	27
isomap	Plots a map of isobaric ECMWF data at 2.5° × 2.5° resolution.	19
iso_mincoor	Makes a time series of the maximum and minimum temperature anywhere north of 40°N from the isobaric ECMWF data. Also gives the coordinates of the max and min points.	26
iso_minmax	Makes a time series of the maximum and minimum temperature anywhere north of 40°N from the isobaric ECMWF data.	26
isoplo	Plots a map of isobaric ECMWF data at 2.5° × 2.5° resolution.	19
isoprof	Extracts the four parameters of an isobaric ECMWF file for all 13 levels at a specified grid point.	28
iso_ts	Extracts a time series of isobaric ECMWF data for a given grid point and level.	26
meanprof	Calculates and plots a mean ozone profile from a list of ozonesonde files.	24
met-mars	Extracts and interpolates gribbed spectral ECMWF data. This program must be run before you can use the plotting programs t106glob, t106map and t106plot.	15
profile	Interactive Uniras program that displays a list of ozonesonde profiles in succession.	24
pvatstat	Extracts time series of PV data for individual stations. Works on data through October 1995.	27
pvatstat2	Same as pvatstat, but works on data files starting 1 November 1995	27
pvpick	Picks out data files for a station according to certain PV criteria.	29
sondeplo	Plots individual ozonesonde profiles.	23
sp2ll	Extracts spectral ECMWF data onto a latitude/longitude grid. Data will be on model levels. We recommend the use of met-mars for extraction of spectral data.	15
statlist	Produces a list of end points in a trajectory data file.	20
t106glob	Plots T_{106} data in orthographic projection. met-mars must be run first to extract the data.	21
t106map	Plots T_{106} data (any parameter) in stereographic projection. met-mars must be run first to extract the data.	21
t106plot	Plots T_{106} data (T, PV or PSC) in stereographic projection. met-mars must be run first to extract the data.	22
tomsglob	Plots TOMS data in orthographic projection.	22
tomslist	Lists a lat./lon. portion of a TOMS file on the screen.	29
tomsplot	Plots TOMS data over the Northern Hemisphere in stereographic projection.	22
tovsplot	Plots TOVS data in stereographic projection.	23
traj	Extracts trajectory data for a single station from the large collective trajectory files.	29
trajplo	Plots up to six trajectories.	20
xyplot	Plots one or more curves in an XY diagram.	28

NADIR on the Web

Information about NILU and NADIR is now available on the World Wide Web. Updated information about the activities within stratospheric ozone research at NILU and news about NADIR can be found at `http://www.nilu.no`. The Web server is under development, so new information will be added constantly. If you have any ideas about information that ought to be available on the Web server, please contact us.

Who to contact at NILU?

If you have any questions regarding the NADIR services, please contact one of the following persons:

Liv Aanesland (general questions, user accounts, access to data, protocols).
Tel: +47 63 89 81 85
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Roland Paltiell (technical questions regarding the computer system).
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If you are in doubt about who to contact you can send an E-mail to nadirteam@nilu.no. The request will then be handled within a few days.

Access to ECMWF data

ECMWF data can be accessed by those who are affiliated with certain EU projects within atmospheric chemistry research and who have signed the ECMWF data protocol. An agreement has been made with ECMWF for the THESEO time period, and a new protocol has been made. This protocol can be obtained by contacting Liv Aanesland (see above).

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