



Data visualization



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Overview

- PALM produces netCDF data output
 - time series
 - profiles
 - 2D cross sections (xy-, xz-, yz-cross-sections)
 - 3D volume data
 - spectra
- Different tools can be used to visualize this data
 - programs with GUI: ncview, Panoply, psy-view, ParaView...
 - NCL-based script delivered with PALM: `palmpLOT`
 - programming languages: NCL, Python, R, ...
- **Goal:**
not presenting the “perfect” tool for visualization,
but get you started visualizing PALM data output

NetCDF introduction

NetCDF: Network Common Data Form

- Developed by the University Corporation for Atmospheric Research (UCAR)
- A set of software libraries and machine independent data formats (freely accessible and usable by everyone)
- Intended for **array**-oriented scientific data
- Data is **self-describing**:
 - Header describes file layout, content and global attributes
 - Metadata containing attributes like units or data types
- Library's core is written in C and provides application programming interfaces (APIs) for C, C++, **Fortran**; separate netCDF-Java library
- Programming interfaces to netCDF are available in R, Perl, Python, Ruby, Haskell, Mathematica, MATLAB, IDL, Octave,...
- Supports **parallel** I/O (PnetCDF, HDF5)

Ncview

Ncview - a simple first look

- Start via command line:


```
ncview <filename>
```
- Select variable of interest
- Display 2D contour plots
- Show line plot along dimensions
- Automatically cycle through time

PALM 5.0 Rev: 3181M run: example_cbl.00 host: default 30-07-18 11:04:50
 displaying pt_xy
 frame 1/4
 displayed range: 299.996 to 301.01 K
 Current: (i=35, j=39) 300.554 (x=1775, y=1975)

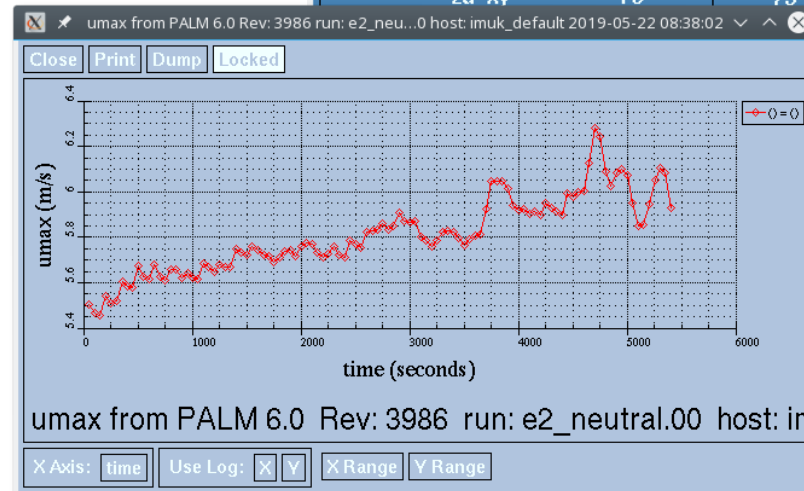
Buttons: Quit, ->1, navigation, Edit, Delay, Opts

Buttons: 3gauss, Inv P, Inv C, M XB, Linear, Axes, Range, BI-lin, Print

Color scale: 300 to 301

Var: ind_z_xy, w_xy, pt_xy

Dim:	Name:	Min:	Current:	Max:	Units:
Scan:	time	911.2	911.2	3612.7	seconds
	zu xy	75	75	475	meters
				1975	meters
				1975	meters



Ncview

The screenshot shows the Ncview 2.1.7 interface. Red circles and arrows highlight the following features:

- color map**: Points to the color bar at the bottom of the plot area.
- animate**: Points to the play button in the control panel.
- animation speed**: Points to the 'Delay' slider in the control panel.
- Interpolation between pixel on/off**: Points to the 'Bi-lin' button in the control panel.
- magnify**: Points to the 'M X8' button in the control panel.
- change time step/cross-section**: Points to the 'Current' input fields in the table below.

Dim:	Name:	Min:	Current:	Max:	Units:
Scan:	time	911.2	911.2	3612.7	seconds
	zu_xy	75	75	475	meters
Y:	y	25	-Y	1975	meters
X:	x	25	-X	1975	meters

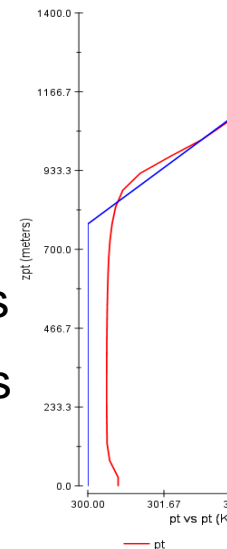
Some useful hints:

- Select “close” to close single plot windows (not shown)
- “Left click” goes forward, “right click” goes backwards (time, slices, ...)
- When typing, the cursor must be within the input-field (changing range,...)

Panoply

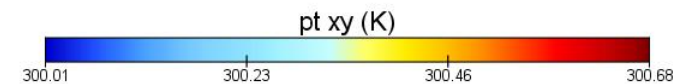
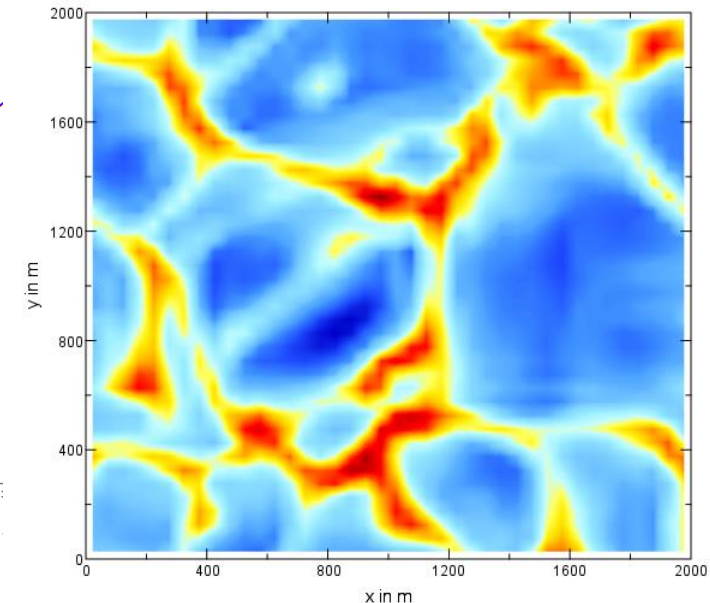
Panoply – a netCDF, HDF and GRIB Data Viewer

- Developed by NASA (<https://www.giss.nasa.gov/tools/panoply/>)
- Intuitive and easy access to content of data file
- Edit plot easily
 - plot range/scale
 - area
 - labels
- Creation of presentable figures
- Export pictures and animations



cross section of potential temperature

t = 1805s z = 75 m



Palmpilot

NCL-script `palmpilot` (outdated)

- Shell script delivered with palm (mainly used during the seminar)
- **Idea:** Explicitly developed for PALM output to standardize/unify visualization among the community
- Based on **NCL** (NCAR Command Language)
 - Interpreted language (no compilation) designed for scientific data processing
 - Capable of data analysis and visualization
 - Supports NetCDF3/4, GRIB 1/2, HDF4/5, ASCII, binary, etc.
 - See here: www.ncl.ucar.edu/
- Find the NCL scripts at `palm_model_system-*/packages/visualization/palmpilot/src/`
- Find the documentation at <https://palm.muk.uni-hannover.de/trac/wiki/doc/app/ncl>
- Due to stopped development of NCL: new, python-based `palmpilot` might come in near future
- **Attention:** Results of `palmpilot` might contain wrong height information

Palmpplot

Creating the `palmpplot` command line

(execution within `JOBS/<run_identifier>/OUTPUT`):

```
palmpplot <plot_identifier> \  
    file_1=<file> \  
    file_out=<file> \  
    format_out=<format>
```

- Possible options for `<plot_identifier>`:

<code><plot_identifier></code>	data set	used ncl script (.ncl)
xy	xy or 3D	cross_sections
xz	xz or 3D	cross_sections
yz	yz or 3D	cross_sections
pr	profile or 3D	profiles
ts	time series	timeseries
sp	spectra	spectra

Palmpilot

Creating the `palmpilot` command line

(execution within `JOBS/<run_identifier>/OUTPUT`):

```
palmpilot <plot_identifier> \  
    file_1=<file> \  
    file_out=<file> \  
    format_out=<format>
```

- Further parameters can be given depending on the setting of `<plot_identifier>`
- List of available parameters:
<https://palm.muk.uni-hannover.de/trac/wiki/doc/app/nclparlist>
- A short help text can be displayed by typing: `palmpilot ?`
- Example palmpilot commands are given during the exercises

References

palmpplot

- Documentation
<https://palm.muk.uni-hannover.de/trac/wiki/doc/app/ncl>
- List of available parameters
<https://palm.muk.uni-hannover.de/trac/wiki/doc/app/nclparlist>

NCL

- www.ncl.ucar.edu/

ncview

- http://meteora.ucsd.edu/~pierce/ncview_home_page.html

panoply

- <https://www.giss.nasa.gov/tools/panoply/>

netCDF

- <https://www.unidata.ucar.edu/software/netcdf/>

ParaView

- <https://www.paraview.org/>

└ The end



PALM online:

<https://palm.muk.uni-hannover.de>

Our YouTube channel:

<https://youtube.com/user/palmhannover>