Introduction to NCL

PALM group

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Visualization of PALM Output Data

- There are several ways how you can visualize netCDF data
- If you are lacking experience in the visualization of netCDF data or if you have not yet found your favourite way how to visualize netCDF data, here is one recommendation:

NCL – The **N**CAR **C**ommand **L**anguage

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- Developed at the NCAR (and continuously updated)
- Detailed information is available under http://www.ncl.ucar.edu

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- Detailed information is available under http://www.ncl.ucar.edu
- With the information revealed in this talk you will be able to visualize the output of this week's simulations

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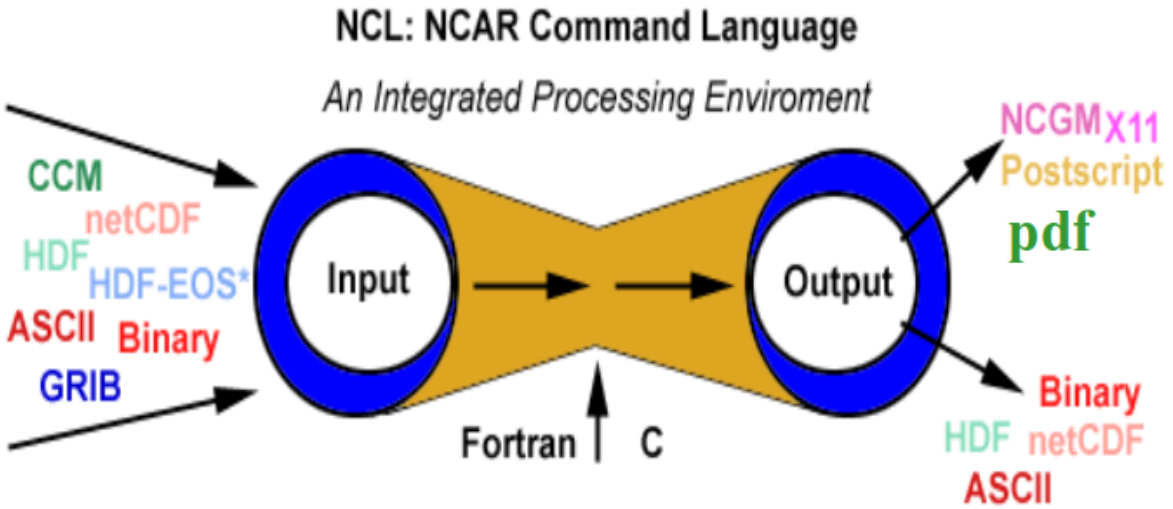
- Interpreted language designed specifically for scientific data processing and visualization, freely available
- Portable: it is running on many different operating systems including Linux, Mac OS X, Windows, ...
- It's a powerful tool for file input and output, visualization and data analysis → integrated processing environment



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- **Interactive mode**: `$ ncl`
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- Each line is interpreted as it is entered
- **Batch mode**: `$ ncl ncl_script.ncl`
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- Interpreter of complete scripts, variables within the NCL script can be steered by providing additional parameters with the NCL call:
  `$ ncl ncl_script.ncl parameter1=value ...`
- Since NCL is an interpreted language, **the excessive usage of loops seriously decrease the performance of NCL!**

What is NCL and Which are its Advantages? (III)

- Complete Programming Language
  - data types (float, double, integer, logical, ...)
  - variables
  - operators
  - expressions
  - loops
  - functions and procedures (e.g., `dim_stat4(data_array)`)

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- Complete Programming Language
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  - variables
  - operators
  - expressions
  - loops
  - functions and procedures (e.g., `dim_stat4(data_array)`)
- Features
  - manipulate meta data
  - import data in a variety of formats (netCDF, ASCII, ...)
  - array syntax / operations
  - can use user FORTRAN/C codes and commercial libraries
  - most functions/procedures ignore missing data

How to Install NCL (Under Linux) (I)?

- Detailed information is available under:
  http://www.ncl.ucar.edu/Download/index.shtml
- For downloading, request an Earth System Grid account:
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- Download the appropriate binaries e.g. `A.tar.gz` for your system e.g. to `$HOME`
- `% gunzip $HOME/A.tar.gz`
- ```
  % mkdir -p /usr/local
  % cd /usr/local
  % tar -xvf $HOME/A.tar
  ```
  ```

How to Install NCL (Under Linux) (II)?

- Set the `NCARG_ROOT` environment variable and your search path to where NCL/NCARG resides:

  csh:
  ```
  setenv NCARG_ROOT /usr/local/
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  ```

  bash/ksh:
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- Test your NCL installation:
  `% ng4ex gsun01n`
  The NCL script gsun01n.ncl is copied to your working directory and executed by NCL. An X11 window should pop up.

NCL Scripts Delivered with PALM (I)

- Together with the PALM installation you have also received four NCL scripts, a configuration file and a manual; they can be found in the directory:
  `$HOME/palm/current_version/trunk/SCRIPTS/NCL/`

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- All standard netCDF data output of PALM can be visualized by one of the scripts:
  - `cross_sections.ncl` (contour or vector plots from 2D/3D data)
  - `profiles.ncl` (profiles from profiles/3D data)
  - `timeseries.ncl` (time series data)
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  `$HOME/palm/current_version/trunk/SCRIPTS`
- The output of the plots can be changed with several parameters; these parameters can be either written in the prompt (when calling the shell script `palmplot`) or set within the configuration file `.ncl.config`

NCL Scripts Delivered with PALM (II)

Using `.ncl.config`:

- Please create a personal configuration file by copying the default configuration file `.ncl.config.default` to the PALM working directory `$HOME/palm/current_version` and naming it `.ncl.config`

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- The configuration file contains all steering parameters with a short description and can be adjusted to personal needs

NCL Scripts Delivered with PALM (III)

Using `palmplot` (I)

- The shell script is used as follows:
  `palmplot <plot_identifier>`
- `<plot_identifier>` has to be `xy`, `xz`, `yz`, `pr`, `sp` or `ts` depending on the data to be plotted

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plot_identifier	**data used**	**ncl script**
xy	xy or 3D data	cross_sections.ncl
xz	xz or 3D data	cross_sections.ncl
yz	yz or 3D data	cross_sections.ncl
pr	profile or 3D data	profiles.ncl
sp	spectra data	spectra.ncl
ts	time series data	timeseries.ncl

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- String parameters which can contain lists (`var`, `c_var`, `vec1`, `vec2`, `plotvec`) have to be set in single quotes and the list itself has to be separated by blanks, e.g. `var='pt u w'`
- A short introduction for using the shell script is given by typing `palmplot ?`

Application Example: Visualization of the Output of the Example Run (example_cbl) (I)

- Starting the example run with the command

  ```
  mrun -d example_cbl ...  -r 'd3# pr# ts# xy# xz#'
  ```

  results in the following output files

  `example_cbl_pr.nc`, `example_cbl_xy.nc`,
  `example_cbl_xz.nc`, `example_cbl_ts.nc`

  located in

  `$HOME/palm/current_version/JOBS/example_cbl/OUTPUT/`

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- Example: Visualization of time series data
- Goal: Output the eps-file `timeseries.eps` (by default the plot would be output to an X11 window)

Application Example: Visualization of the Output of the Example Run (example_cbl) (II)

- In order to reach the goal you can either ...
- ... change to the directory
  `$HOME/palm/current_version/JOBS/example_cbl/OUTPUT/`
  and use the shell script with the command:

  ```
  palmplot ts file_1=example_cbl_ts.nc format_out=eps
  file_out=timeseries
  ```

  Thus, the script `timeseries.ncl` is called and some of the parameters in the configuration file `.ncl.config` are directly set by specifying the related parameters in the command line, e. g.,

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  Thus, the script `timeseries.ncl` is called and some of the parameters in the configuration file `.ncl.config` are directly set by specifying the related parameters in the command line, e. g.,

  ```
  file_1 = <netCDF file> file_out = <output file>
  ```

Application Example: Visualization of the Output of the Example Run (example_cbl) (III)

- ... or you can modify the configuration file `.ncl.config`, e. g.,

```
if(.not.  isvar("file_1"))then
    file_1 = "File in"
end if
```

Application Example: Visualization of the Output of the Example Run (example_cbl) (III)

- ... or you can modify the configuration file `.ncl.config`, e. g.,

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```

has to be changed to

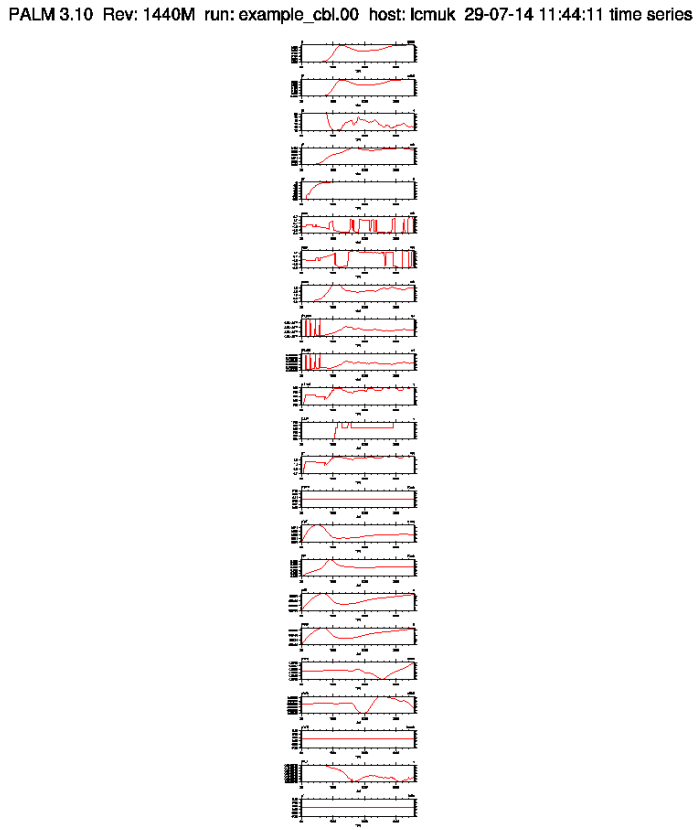
```
if(.not.  isvar("file_1"))then
    file_1 = "$HOME/palm/current_version/JOBS/...
               ...example_cbl/OUTPUT/example_cbl_ts.nc"
end if
```

Application Example: Visualization of the Output of the Example Run (example_cbl) (IV)

- Both ways will create a new file called `timeseries.eps` in the directory `$HOME/palm/current_version/JOBS/example_cbl/OUTPUT/`

Application Example: Visualization of the Output of the Example Run (example_cbl) (IV)

- Both ways will create a new file called `timeseries.eps` in the directory `$HOME/palm/current_version/JOBS/example_cbl/OUTPUT/`



Application Example: Visualization of the Output of the Example Run (example_cbl) (V)

- If you only want to get the plot of the time series of just one variable, e. g., the maximum of the velocity component u, you can add the command line parameter `var='umax'` or modify the configuration file respectively, e. g.,

```
if(.not.  isvar("var"))then
    var = ",umax,"
end if
```

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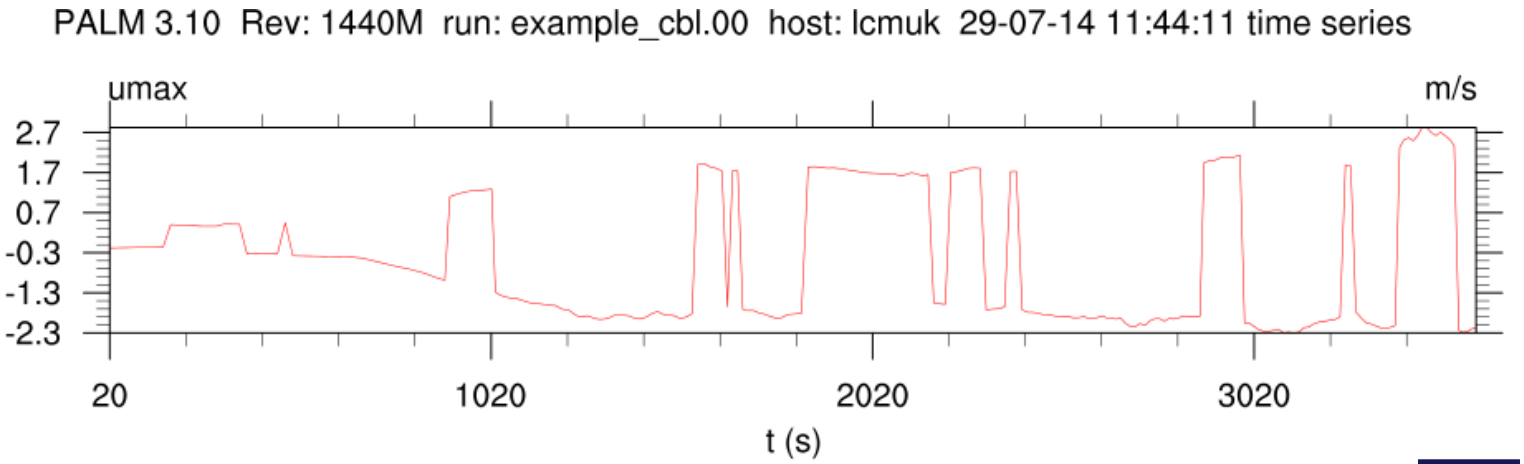
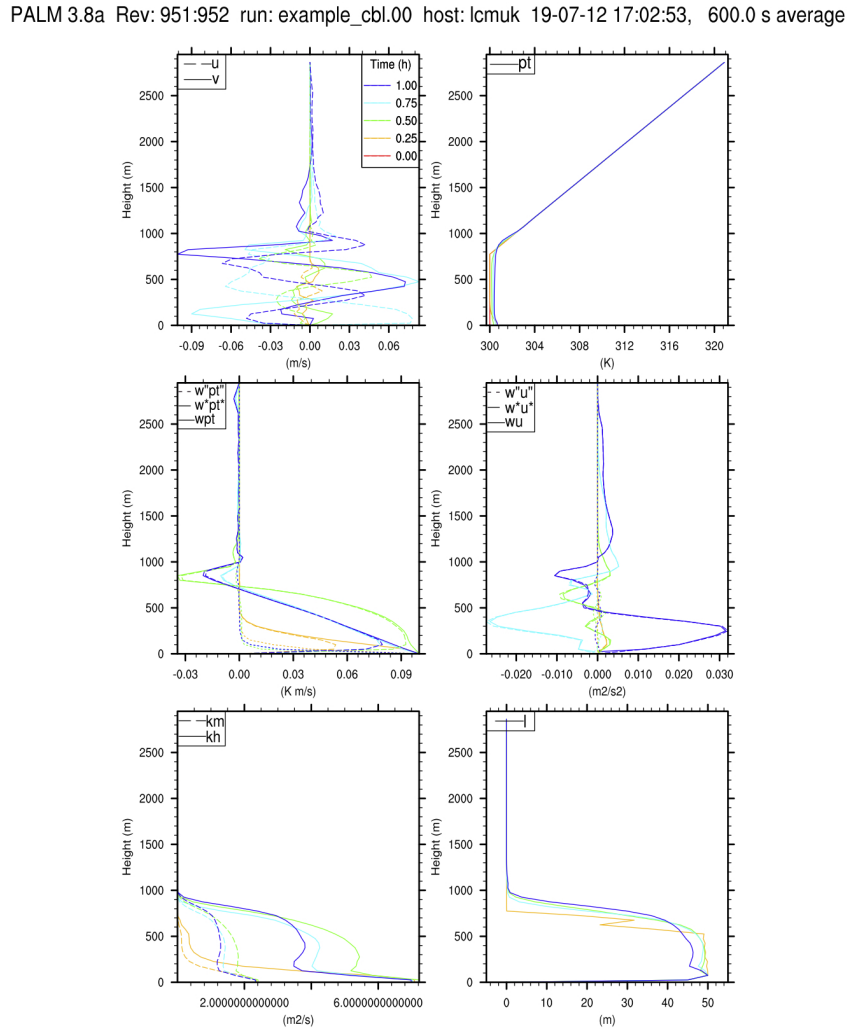


Application Example: Visualization of the Output of the Example Run (example_cbl) (VI)

- Plot profiles with the command
  ```
  palmplot pr
  file_1=example_cbl_pr.nc
  ```
- Profiles of same dimension are plotted together, e. g., total, resolved and sub-grid scale temperature flux (default)
- If you add the parameter `var='all'` to the command, all profiles are plotted separately



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- If one of the programs aborts and there is no comment, check the configuration file! The scripts should not abort with default values. Be sure to use the right data type (e. g., `integer = 2`, `float = 2.0`, `double = 2.0d`, `string = "name"`)!