Mast verification plots

Data description

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1. Input data files

The mast verification routines use *two sets* of input files, one for forecast and another for measurements. The data structure is basically similar (see below), the naming differs slightly.

Forecast files

The name of the forecast file is of form

`Fcst_`*Modl*`_`*MastID*`_`*yyyymmdd*`_`*hh*`.txt`

where *Modl* and *MastID* are 4-letter strings identifying the forecast model and measurement mast, respectively, and the timestamp giving the forecast analysis time, is expressed as UTC time:

yyyy = year (four digits)
mm = calendar month (two digits)
dd = calendar month (two digits)
hh = hour (two digits)

The model id (*Modl*) is a four-letter string to be formed as a combination of two (capital) letters identifying the country of origin followed by a two number string identifying the resolution, e.g. "FI22" for the Finnish 22 km resolution model, "NL22" for the corresponding Dutch model. Suggested acronyms are:

`FI`	= Finland	`SW`	= Sweden	`NO`	= Norway
`DK`	= Denmark	`IS`	= Iceland	`NL`	= the Netherlands
`IR`	= Ireland	`SP`	= Spain	`FR`	= France
`UK`	= United Kingdom	`EC`	= ECMWF		

Instead of the suggestions above, another descriptive acronym may be used if needed, as long as it has the length of four characters, e.g. FRAR and FRAL for Arpege and Aladin of Meteo France, respectively. In case of resolution better that 10 km, decimal kilometres can be used, e.g. 75 for the FMI MB71 with 7.5 km resolution. The acronym is purely descriptive, it is not used in any kind of calculations. An underscore ("_") may also be used but is not recommended, as it can be confused with underscores otherwise used in the strings.

The mast string *MastID* is a four-letter string in uppercase letters, suggested acronyms being:

`SODA` = Sodankylä	`CABA` = Cabauw	`VALL` = Valladolid
`LIND` = Lindenberg	`KIVI` = Kivenlahti	`KUOP` = Kuopio
`ROVA` = Rovaniemi		

The model and mast acronyms presented above can be supplemented as necessary and modified in case of naming conflicts or other needs. Table 1 at the end of the document lists model and mast acronyms presently is use.

A separate file is thus used for each forecast. At present, the first 24 hours of each forecast are plotted and should be included in the file.

Mast measurement files

To allow for possibility to supply measurement data at two different time intervals, two sets of measurement data files are used, one for fluxes and another for other measured variables, their names being of form

`Meas_`*`MastID_Type`*`.txt`

where *MastID* and *Type* are 4-letter strings identifying the measurement mast (as described above) and measurement type, respectively. *Type* can take values:

`Flux` = Heat flux measurements `Mast` = other mast measurements

A constant file name (time independent) is used with the mast data files. The data is used by the plotting system according to the time labels inside the file. When plotting, a new file is downloaded from the data pool and substituted for the data to be plotted. No appending of data is done, so each file should cover the whole period to be plotted.

At present, a time period starting from two days backward from the present day midnight, or up to the latest available data is plotted. The data in the file should thus cover at least this period. Older data in the file is allowed, it is cropped away by the plotting routines. For performance reasons, however, not too much data should be included in the files.

2. Input file structure

Both forecast and measurement data files have similar structure. Input files are ASCII files, containing on each line first the timestamp (starting from the first column) and then the data for that time item by item separated by one or more blanks:

```
yyyymmddhhnn  param1  param2  param33  ....
```

where timestamp is expressed as UTC time:

yyyy = year (four digits)
mm = calendar month (two digits)
dd = calendar month (two digits)
hh = hour (two digits)
nn = minutes (two digits)

For example, the beginning of the file with data at 10-minute intervals might look like this:

```
200408310000  432.7  400.2  2.337  2.619  2.746
200408310010  430.7  400  2.867  2.95  2.714  1.633
200408310020  432.9  400  3.556  3.214  -99999  1.676
```

Missing data is represented by -99999 (integer value). Please note that empty data columns for missing data are not allowed as they confuse the plotting program. Real number values -99999.0 and -99999.00 are also possible but not recommended; they are replaced by -99999 by the plot preparation routines.

3. Input file contents

The forecast and mast data files should contain the following data columns (with format as described above).

NOTE : Starting from April, 2013, additional radiation parameters have been included. The system is backwards compatible, however, so that the new parameters are optional (as indicated in the lists below), and need not to be included in the file. The order of the optional parameters is, however, significant, so that if only some of the optional parameter(s) are included, all parameters before it must be included as missing data value(s). E.g., if only forecast parameter 14 ("Short wave solar radiation upwards") is included, parameter 13 must be included as a missing value. In this case, there is no need, however, include parameter 15.

NOTE 2: New forecast data is plotted automatically, but new parameters in the mast measurement data require a change in the plotting configuration file. Especially with mast measurement data but also, for clarity, with forecast data, please inform about new parameters in the data files.

Forecast data (Fcst_*Modl_Mast_yyyymmdd_hh*.txt)

1.	Time stamp	yyyymmddhhnn
2.	Air temperature, level 1 (2m)	degrees Celsius
3.	Air temperature, level 2 (lowest model level)	degrees Celsius
4.	Temperature difference levels 1 and 2 (t1-t2)	degrees Celsius
5.	Relative humidity (2m)	%
6.	Wind speed (10m)	m/s
7.	Short wave solar radiation **downwards** (global)	W/m^2
8.	Long wave radiation **upwards**	W/m^2
9.	Sensible heat flux **upwards**	W/m^2
10.	Latent heat flux **upwards**	W/m^2
11.	Evaporation	mm/h
12.	Momentum flux	N/m^2
	optional :	
13.	*Long wave radiation **downwards***	*W/m^2*
14.	*Short wave solar radiation **upwards** (reflected)*	*W/m^2*
15.	*Diffuse short wave solar radiation*	*W/m^2*
16.	*Direct NORMAL short wave solar radiation (DNI)*	*W/m^2*

Mast measurement data (Meas_*MastID*_Mast.txt)

1.	Time stamp	yyyymmddhhnn
2.	Air temperature, level 1 (2m)	degrees Celsius
3.	Air temperature, level 2 (first model level)	degrees Celsius
4.	Temperature difference levels 1 and 2 (t1-t2)	degrees Celsius
5.	Relative humidity (2m)	%
6.	Wind speed (10m)	m/s
7.	Global (short wave solar) radiation **downwards**	W/m^2
8.	Long wave radiation **upwards**	W/m^2
	optional :	
9.	*Long wave radiation **downwards***	*W/m^2*
10.	*Short wave solar radiation **upwards** (reflected)*	*W/m^2*
11.	*Diffuse short wave solar radiation*	*W/m^2*
12.	*Direct NORMAL short wave solar radiation (DNI)*	*W/m^2*

Heat flux measurement data (Meas_*MastID*_Flux.txt)

1.	Time stamp	yyyymmddhhnn
2.	Sensible heat flux **upwards**	W/m2
3.	Latent heat flux **upwards**	W/m2
4.	Evaporation	mm/h
5.	Momentum flux	N/m2

Please note the sign convention of the fluxes. The flux values can represent either instantaneous or average values.

As to air temperature, the aim is to have level 1 at the screen level (2m) and level 2 somewhat higher, to get an indication about the temperature inversion from the difference of these two values. The actual value of the level 2 height depends on the measurement mast. The measurement value is taken as the "truth" and should not be interpolated. As to model value, the closest height or an interpolated value can be used, as desired, if value at the exactly correct level is not available. The aim is to have model and mast values at heights as close to each other as possible.

4. Data transfer

A data pool at ***hirlam.org*** has been set up. The data providers are requested to transfer their data to this data pool, from where its then downloaded to FMI for plotting by the mast verification routines. The address at hirlam.org to transfer data to is

```
/home/hirlam/mastdata/
```

The transfer method is **scp**. Data providers should contact hirlam.org maintenance personnel for details of the data transfer and for setting up the required permits and ssh keys. At present (February 2023), the person to contact is Daniel Santos Munoz (DSM@dmi.dk) or Martin Birch (mbi@dmi.dk).

Assuming that the ssh-key *mastkey* needed for the data connection is located in the directory */myhome/.ssh*, the scp command to transfer data to hirlam.org looks like

```
scp -i /myhome/.ssh/mastkey fname uID@hirlam.org:/home/hirlam/mastdata/
```

where *uID* is the user-id at hirlam.org connected to the ssh key.

Table 1 : *Mast and models included in the mast verification system (February 2023).*

Mast		**Model**	
Acronym	***Name***	***Acronym***	***Name***
SODA	Sodankylä (Finland)	MEP0	MetCoOp Harmonie MEPS ctrl mbr
CABA	Cabauw (the Netherlands)	FRAR	Arpege (Météo-France)
LIND	Lindenberg (Germany)	FRAL	Aladin (Météo-France)
VALG	Valgjärve (Estonia)	AARC	Arome-Arctic (MetNO)
KIVI	Kivenlahti (Finland)	FARO	Arome (Météo-France)
KUOP	Kuopio (Finland)	FRAM	"Mini-Arome" (Météo-France)
ROVA	Rovaniemi (Finland)	EC01	IFS (ECMWF)
		ECFM	IFS disseminated to FMI
		EDIT	Meteorologist's editor (FMI)