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Mast verification for NWP model development

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INTRODUCTION

Starting 2002, operative on-line comparison of mast measurements to model forecasts have been performed as a part of HIRLAM RCR operational runs at FMI. The web site at hirlam.org is used as a data pool, to where all comparison participants transfer their data, and from where the data is then retrieved by the plotting routines.

The plots provide a near-real-time information about the performance of the models and can be used for example to study nocturnal winter-time surface temperature inversions, which still pose a difficult challenge to weather forecast models. Statistical plots are also provided.

Being a part of HIRLAM RCR runs at FMI, the plots are produced in connection of each forecast cycle. The resulting comparison plots can be viewed through RCR HIRLAM visualisation web pages at http://fminwp.fmi.fi.

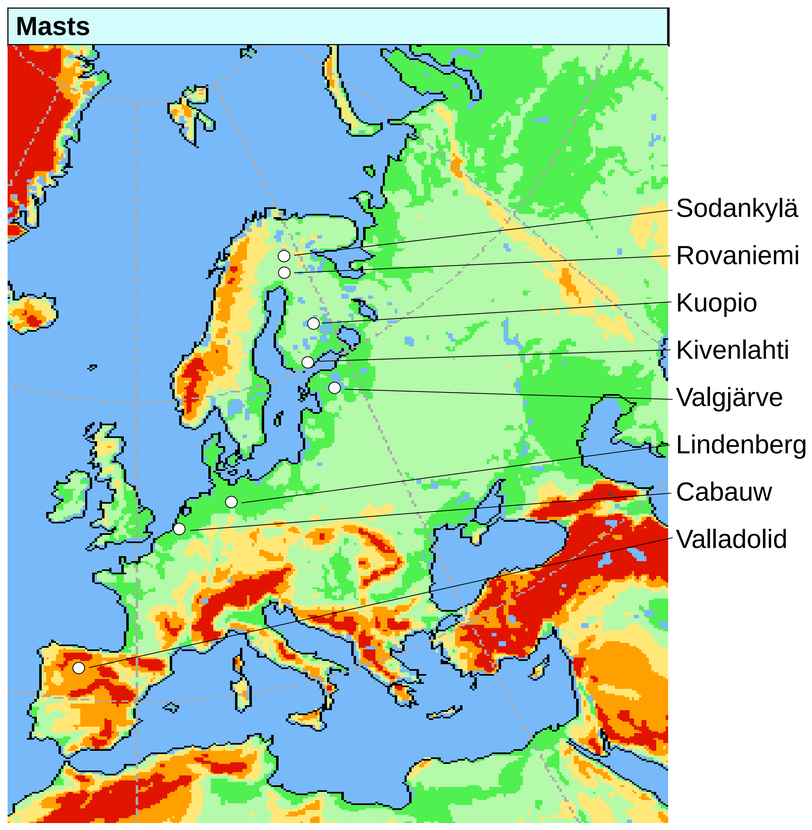
Reference : Markku Kangas, Laura Rontu, Carl Fortelius, Mika Aurela, and Antti Poikonen, *Weather model verification using Sodankylä mast measurements*. Geosci. Instrum. Method. Data Syst., 5, 75–84, 2016, doi:10.5194/gi-5-75-2016. www.geosci-instrum-method-data-syst.net/5/75/2016/.

COMPARISONS

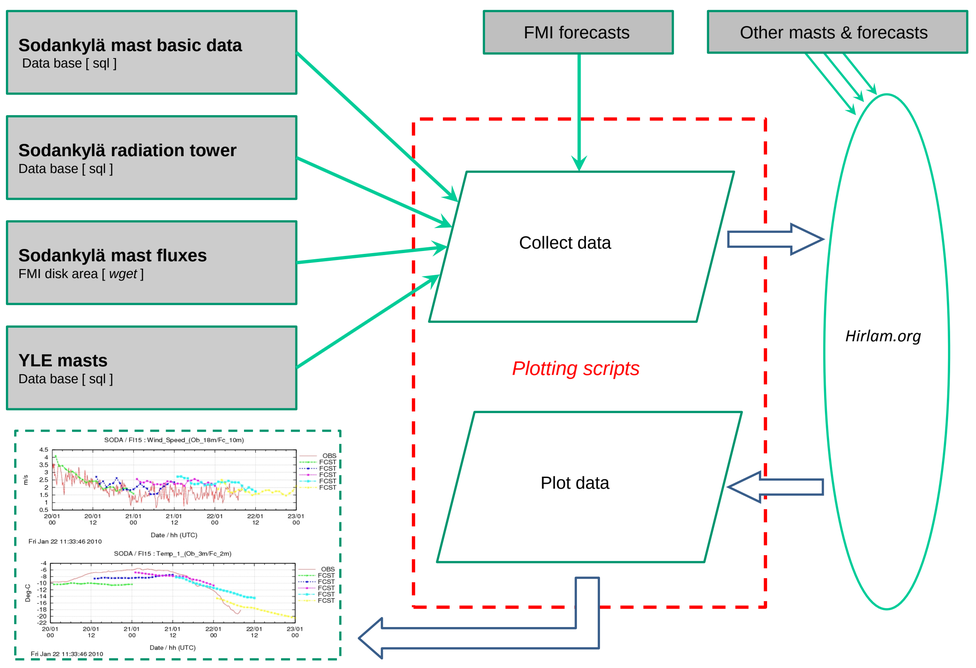
Models
Hirlam RCR (Fin)
Hirlam AEMet (Spa)
Harmonie (Fin)
Harmonie MEPS (MetCoOp)
Arome (Fra)
Arpege (Fra)
Aladin (Fra)
”Mini”Arome (Fra)
IFS (ECMWF)
LAPS analysis (Fin)
Meteorologist's Editor (Fin)

Parameters
Temperature
Wind speed
Relative humidity
Radiation components
Heat fluxes
Momentum flux

Masts



PLOTTING SYSTEM



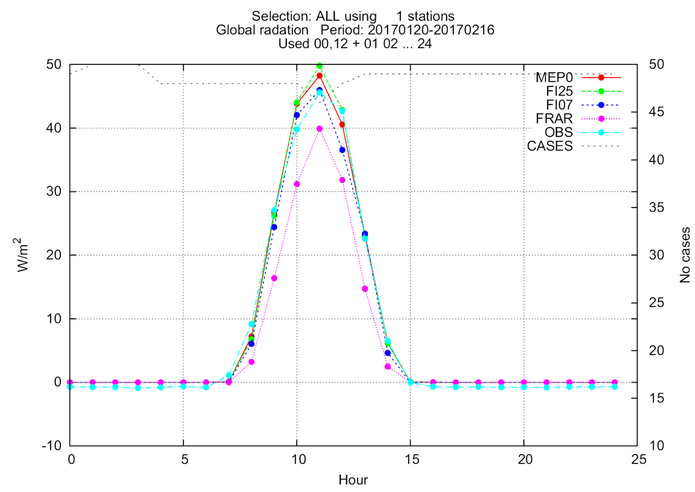
EXAMPLE : SW & LW RADIATION

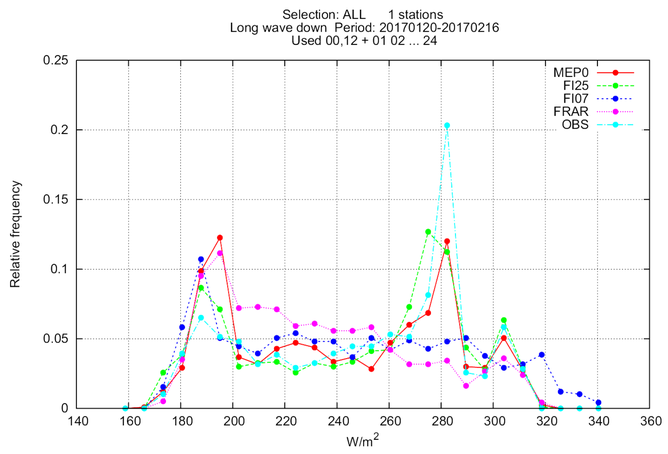
FMI Arctic Research Centre at Sodankylä (67.4ºN, 26.6ºE, 179 m.s.l.) is the site where the mast verification activities were originally started. In addition to micrometeorological mast (48 m), a 18 m tower for radiation measurements is located in the area. As an example, a statistical comparison of downwelling shortwave and longwave radiation for period from January 20, 2017 to February 16, 2017 is presented below. The models included are ('OBS' denotes observations, 'CASES' the amount of data) :

MEP0 : Harmonie cy40h1.1 MEPS member 0 (MetCoOp, resol. 2.5 km)
FI25 : Harmonie cy38h1.2 (FMI, resol. 2.5 km)
FI07 : Hirlam RCR (FMI, resol. 7.5 km)
FRAR : Arpege (Météo France, resol. variable, 2.5 km over France)

Because of various limitations, the comparison period in this example is rather short, so the results may not be generally representative.

FMI ARC as seen from the radiation tower





All the models, except ARPEGE, are seen to overestimate the noon-time maximum in the mean diurnal cycle of global short wave radiation. ARPEGE, by contrast, strongly underestimates the global adiation.

In the histograms of down welling long wave radiation, only the systems running AROME-physics (MEP0,FI25) reproduce the observed u-shape, while the two other models fail to display the observed peak at the high end, presumably related to the presence of low-level clouds. In ARPEGE, low values of radiation are clearly over-represented, leading to an overall negative bias.

The biases in short wave radiation may be directly linked to biases in the presence and/or optical density of the clouds. For the long wave flux, the situation is more complex, as the cloud temperature, too, is of importance, as well as the profiles of temperature and humidity in the cloud-free air. Thus, the underestimated short-wave flux in ARPEGE would be consistent with too many, or too dense clouds in the forecasts, while the underestimated long-wave flux could indicate a lack of clouds at low levels in the atmosphere.