HIRLAM 3D-VAR dynamical downscaling re-analysis

HIRLAM 3D-VAR is updated every 6 hour with boundaries from ECMWF ERA-Interim and a large scale constraint (J_k) (Dahlgren and Gustafsson, 2012) using vorticity from ERA-Interim. Conventional observations are used in the assimilation scheme: SYNOP (pressure, not wind over land), SHIP, BUOY, DRIBU, AIREP, AMDAR, TEMP, PILOT. The large scale constraint ensures that satellite large scale information from the ERA-Interim data assimilation process is introduced implicitly.

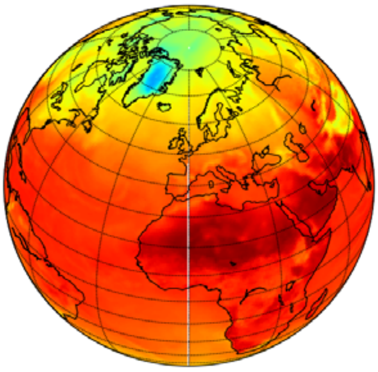

Figure 1: ERA-Interimanalysis of the 2m-temperature.

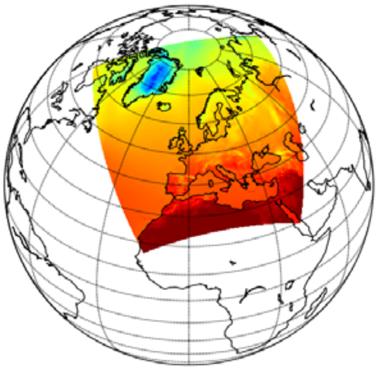

Figure 2: HIRLAM 2m-temperature using ERA-Interim analysis on the borders and as a large scale constraint.

Infobox

SPECIFICATIONS

Output data sets
3D-VAR upper air and OI surface analysis. Upper air and surface fore-cast fields from that analysis.

Data
Spatial resolution: 0.2 by 0.2 ° rotated.
Temporal resolution: 6 hours.
Grid: Rotated spherical.
Format: GRIB ed 1.

Availability
Area: North Atlantic-Europe (EEA).
Time period: 1989 -2010
TIMELINE: partly available, sched-uled for 2014
freely available without restrictions.

Validation
Background and analysis statistics against observations used.
Statistics of analysis increments and forecast tendencies.
Differences from ERA Interim analyses.

Outlook
Further validation / evaluation by 2015.

Releases.
Currently the data sets are not yet available through the EURO4M website. If you are interested in the datasets please contact Per Undén at SMHI: Per.Unden@smhi.se

Description and Validation
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Reference:

Dahlgren, Per and Gustafsson, N, 2012. Assimilating Host Model Information into a Limited Area Model , Tellus A 2012, 64, 15836, DOI: 10.3402/tellusa.v64i0.15836 .

Example of usage:

The HIRLAM-based reanalysis provides 6-hourly information on numerous atmospheric variables with a spatial resolution of 0.2 deg. The available parameters include surface information (e.g., temperature, moisture, wind, radiation, precipitation,), vertically-integrated quantities (e.g., total cloud coverage, precipitable water), and vertically-resolved data (e.g., profiles of the temperature, wind, humidity, cloud). The available long time series allow the calculation of local anomalies and temporal changes.

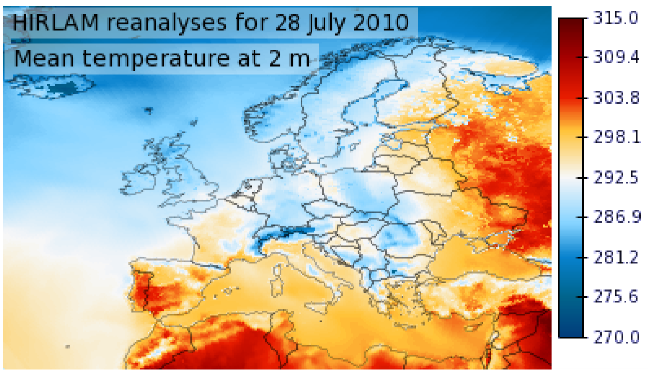

Figure : Mean 2mtemperature for 28 July 2010 based on the HIRLAM reanalysis

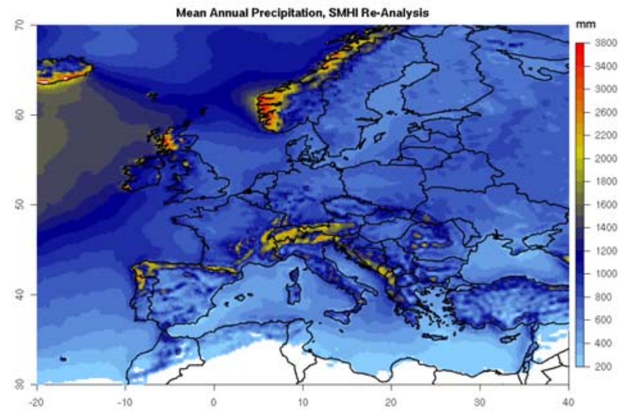

Figure 2: Multi-year mean precipitation in Europe based on the HIRLAM reanalysis.

Shown are examples from the HIRLAM reanalysis data set. The mean 2-m temperature from 28 July 2010 shows cold air from the Northern European regions stretching far south. The frequencies and the extent of such events can be assessed using the reanalysis data set.
The spatial distribution of the mean surface precipitation in Europe shows the well know maximum along the Scandinavian coastal mountain range and numerous small scale structures. The high spatial resolution of the data set is also highlighted in the mean July cloud coverage, which shows high spatial details over land and over sea.

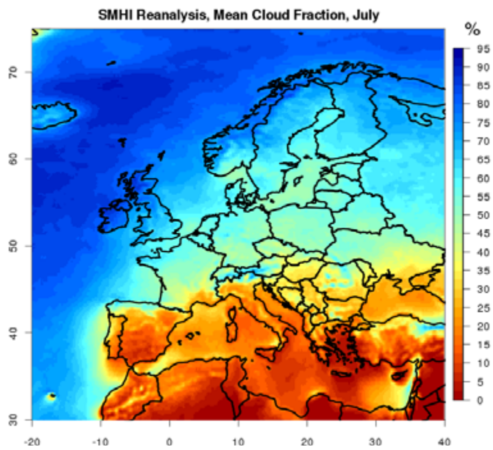

Figure 3: Multi-year mean cloud coverage for July in Europe based on the HIRLAM reanalysis

Validation methods, consistency and uncertainty:

Departurestatisticsfromobservationsusedinthere-analyishavebeenassembledandscruti-nised.Theanalysissystemdrawstoobservationsandthefieldsareasclosetoobservationsas canbeexpected.

The analysed temperatures agree well with observations where there is good data coverage. The cloudiness agrees well with SYNOP observations. Some differences exist compared to satellite data (CM SAF), especially in Southern Europe.The surface solar radiation in the HIRLAM data set is higher than derived from satellite; the annual variability is well depicted by the re-analysis data. The precipitation in the reanalysis in general agrees quite well with ERA-Interim and GPCC gridded data. In mountainous regions (Alps, Scandinavia) there are indications for an overestimation of summer precipitation in the reanalysis data.

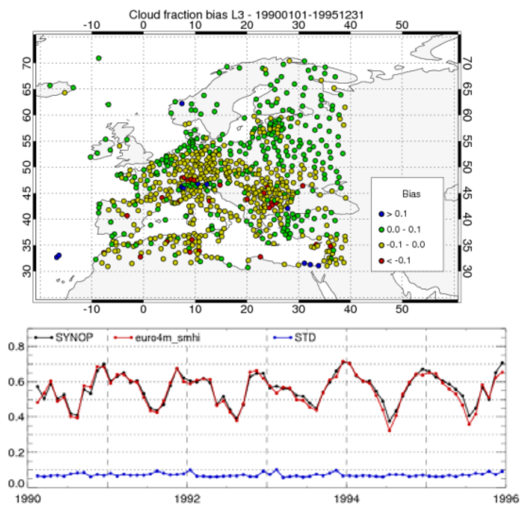

Figure 4: Comparison oft he cloud fraction derived from the SMHI Reanalysis with SYNOP surface observations.

Selected HIRLAM EURO4M fields and their GRIB codes and level type:

Upper air parameters (60 vertical levels)

U-component of Wind (33, 109, 60)
V-component of Wind (34, 109, 60)
Temperature (11, 109, 60)
Specific Humidity (51, 109, 60)
Cloud Water (76, 109, 60)
Total Cloud Cover (71, 109, 60)
Turbulent Kinetic Energy (200, 109, 60)
Cloud ice (58, 109, 60)
Total Precipitation (61, 109, 40)

10 m parameters

U-component of Wind (33, 105, 10)
V-component of Wind (34, 105, 10)
Wind gust 10 meter (228, 105, 10)
Wind gust 10 meter (228, 105, 11)
Max wind 10 meter(135, 105, 10)
Min wind 10 meter(136, 105, 10)

2 m parameters

Temperature (11, 105, 2)
Specific Humidity (51, 105, 2)
Temperature over land (140, 105, 2)
Spec Humover land (141, 105, 2)
Dewpoint (17, 105, 2)
Relative Humidity (52, 105, 2)
Rel. Hum. 2m over land (142, 105, 2)
Dewpoint over land (143, 105, 2)
Maximum Temperature (15, 105, 2)
Minimum Temperature (16, 105, 2)

Soil parameters

Temperature (11, 105, 998)
Soil Moisture Content (86, 105, 998)

Surface parameters

Geopotential Height (6, 105, 0)
Pressure (1, 105, 0)
Albedo (84, 105, 0)
Total Precipitation (61, 105, 0)
Total Snowfall (65, 105, 0)
Total Cloud Cover(71, 105, 0)
Surface Temperature (11, 105, 0)
Downwelling (global) shortwave radiation (117, 105,0)
Diffuse surface shortwave radiation (118, 105,0)
Downwellingsurface longwave radiation (115, 105,0)
Surface evaporation (57, 105, 0)
Latent heat flux (122, 105, 0)
Sensible heat flux (125, 105, 0)