SMHI NWP modelling – operations, development and research 2015/6

Main Operational runs

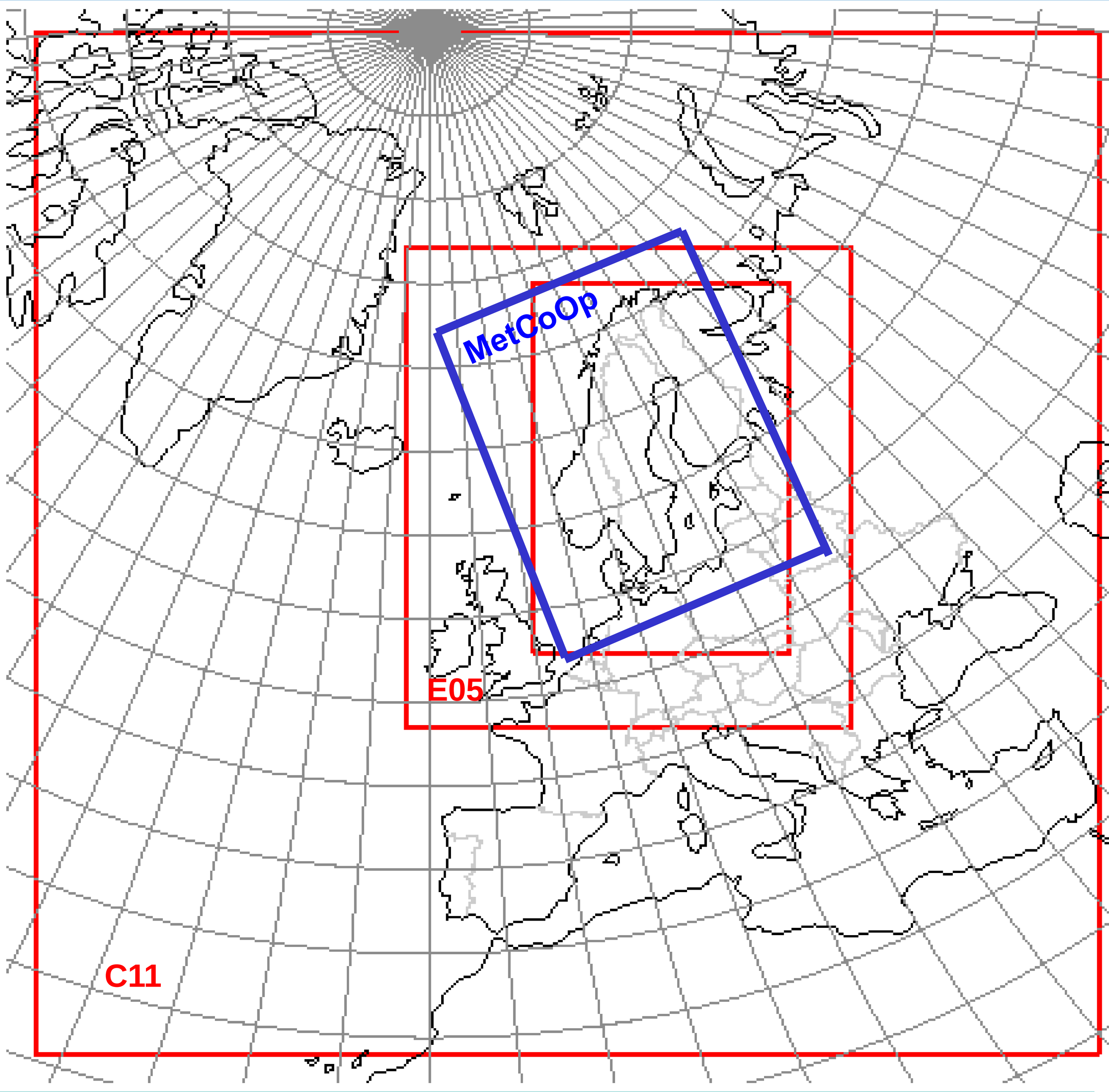
4 analyses and forecasts per day. 00, 06, 12, 18

HARMONIE Arome, 2.5km –
3D-VAR 3h-RUC +60h
HARMONIE-RCR for cy38h1

HIRLAM C 11km –
4D-VAR 2 loop LSMIX +60 h
2 hours data cut-off

HIRLAM E 5 km –
3D-VAR no LSMIX+48 hours
1 hour 20 min data cut-off

1 hourly ECMWF boundaries
ECMWF GTS -> BUFR obs preprocessing
SYNOP,SHIP,TEMP,PILOT,
BUOY,AIREP,AMDAR
BUFR AMDAR
ATOVS AMSU-A radiances – EARS
Radar reflectivities and winds passive in HARMONIE



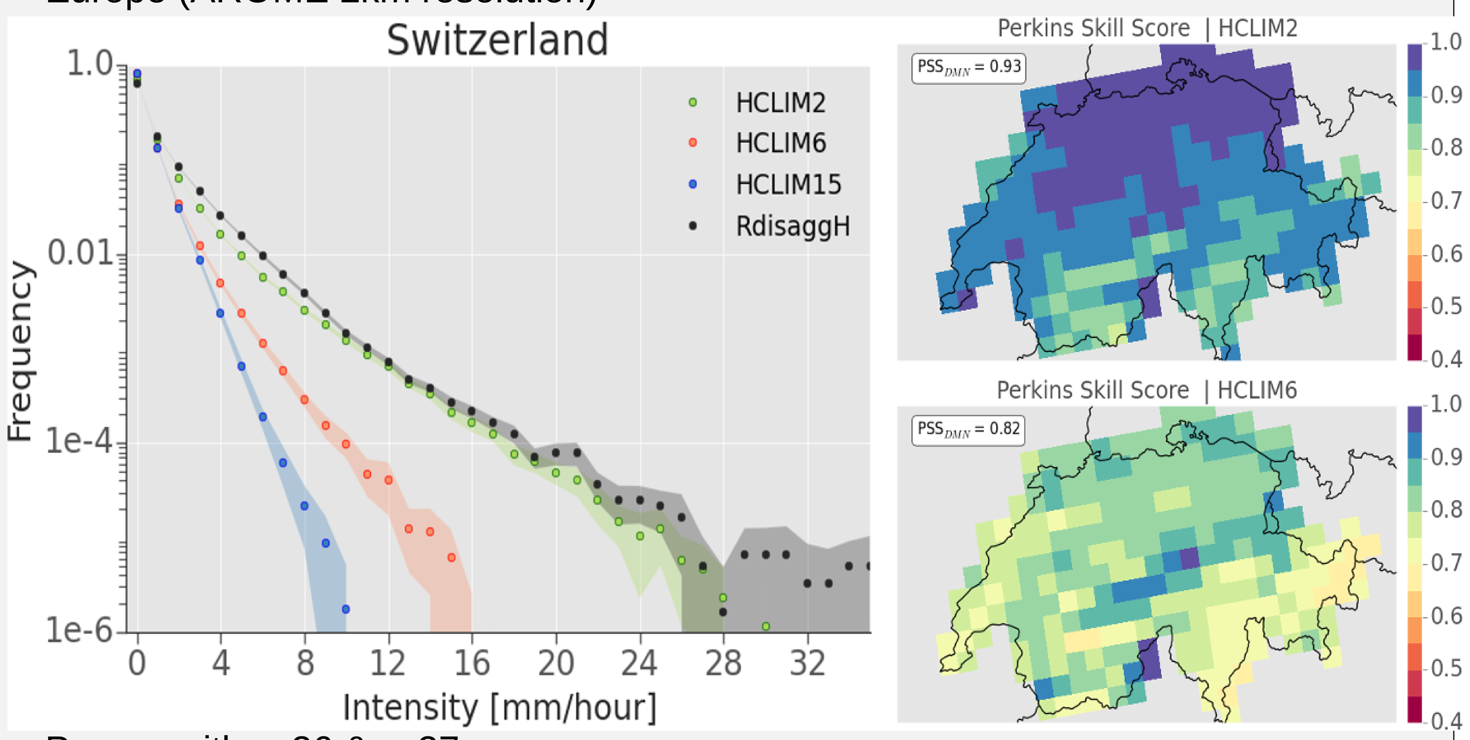
Name	Model	gridpoints	levels	timestep	Assimilation	Boundaries
C11	Hirlam 7.1.2	606x606	60	300 s	4D-Var	ECMWF
E05	Hirlam 7.3	506x574	65	150 s	3D-Var	HIRLAM
MetCoOp AM25	HARMONIE y38h1.1	750x960	65	60 s	3D-Var 3h-RUC	ECMWF

MetCoOp - A joint Swedish-Norwegian NWP production

See separate poster by Ulf Andrae.

HARMONIE-Climate – Combining NWP and climate modelling

High-resolution precipitation over Switzerland: Seven summers sampled over Europe (ALARO, 15/6 km resolution) and Central Europe (AROME 2km resolution)



Papers with cy36 & cy37:
I. Lindstedt, D., P. Lind, E. Kjellström, and C. Jones (2015): A new regional climate model operating at the meso-gamma scale: performance over Europe, *Tellus 67A* (13), 7889-7907.
II. Lind, P., D. Lindstedt, E. Kjellström, and C. Jones (2016): Spatial and temporal characteristics of summer precipitation over Central Europe in a suite of high-resolution climate models, *Journal of Climate* (29), 3501-3518.

Processing and assimilating GNSS

Martin Ridal, Magnus Lindskog

Since the beginning of 2016 new GNSS ZTD data is available from the NGAA processing centre. In total ~680 stations from the Nordic countries (Figure 1). Two solutions, Bernese v5.2 and GIPSY v6.2, are available which will be evaluated against each other. A selection of the available stations from the Bern solution, with a horizontal separation of 100 km (Figure 2), will be introduced in the prep-operational MetCoOp runs.

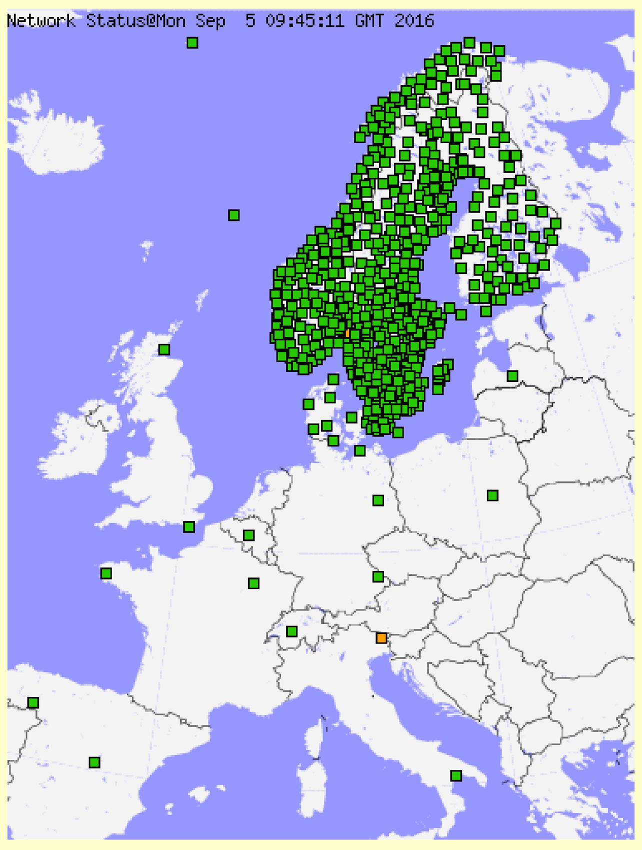


Figure 1: GNSS stations processed by NGAA.

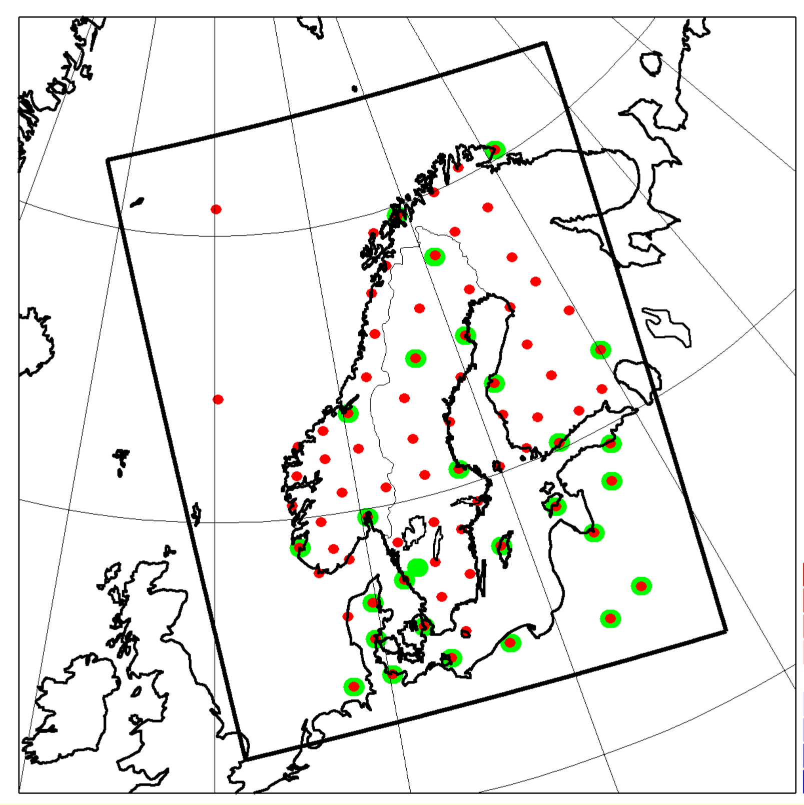


Figure 2: **MetCoOp GNSS stations.**
Operational use: METO and ROBH.
Pre-operational use: NGAA, METO and ROBH.

Improved representation of mixed-phase clouds in AROME model

Lisa Bengtsson, Karl-Ivar Ivarsson

A new microphysics parametrization is introduced to the ice microphysical scheme (ICE3) in the non-hydrostatic weather forecast model AROME. The new parameterization is referred to as OCND2 and is implemented to yield a better representation of mixed-phase and pure ice clouds, and improving the model's meteorological performance in winter. The most important changes in the parametrization of the microphysics are: a better separation of the fast liquid water processes from the slower ice water processes, a reduction of the deposition rate of the ice-phase water species, assumptions of a lower ice nucleolus concentration between 0C and --25C, and addressing lower optical thickness of ice clouds compared to water clouds. With OCND2, the forecasts of especially low clouds and 2m- temperature are improved in winter, whereas the effect in summer is less apparent. The statistical distribution of relative humidity corresponds better to observations with OCND2. A drawback is an increased positive MSLP bias in especially wintertime. Submitted to Mon. Wea. Rev.

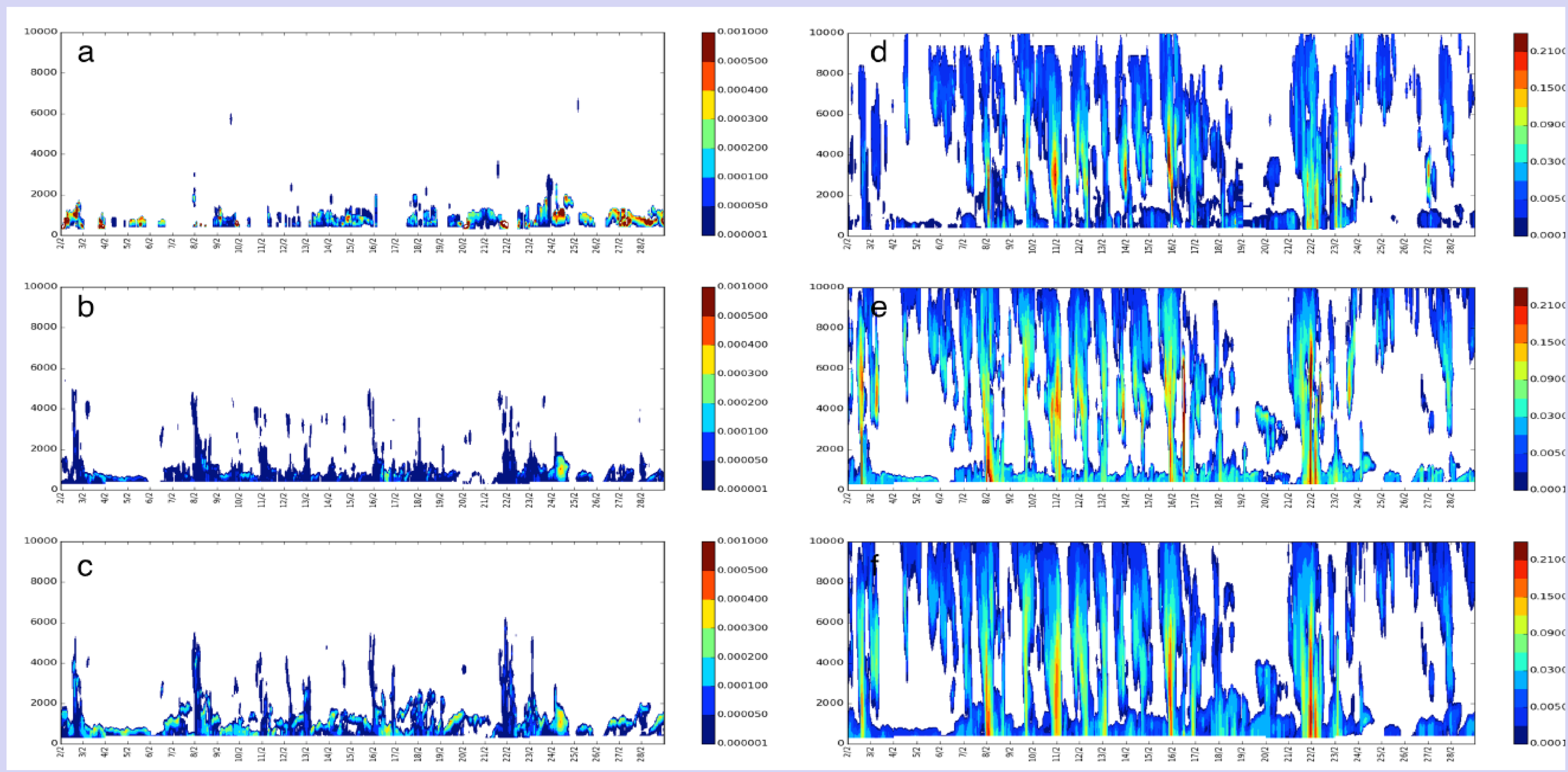


Fig. 1: a) Wintertime observed liquid water, b) REF forecast liquid and c) OCND2 forecast liquid water. d) Wintertime observed ice water content, e) REF forecast ice+snow+graupel and f) OCND2 forecast ice+snow+graupel. Time (day/month) on the horizontal axis and height at the vertical axis.

NWP for Direct Normal Irradiance by Utilizing MSG Data

Magnus Lindskog, Tomas Landelius, Heiner Körnich

HARMONIE-AROME Cycle 38h1.1 with 2.5 km horizontal grid resolution and 65 vertical levels. 15-minute output up to fc+9h. Period: April 2013

Control experiment: 3D-Var, conventional obs., AMSU.

Experiments with
- assimilating SEVIRI radiances
- Initialize clouds with MSG cloud product
- 4D-Var

Aim: To improve DNI forecasts with NWP by assimilating MSG data.

Results: Assimilation of SEVIRI radiances: positive impact on humidity forecast.

• Initialisation with MSG-based cloud product: promising, but too cloudy still.

• 4D-Var comparable to 3D-Var so far.

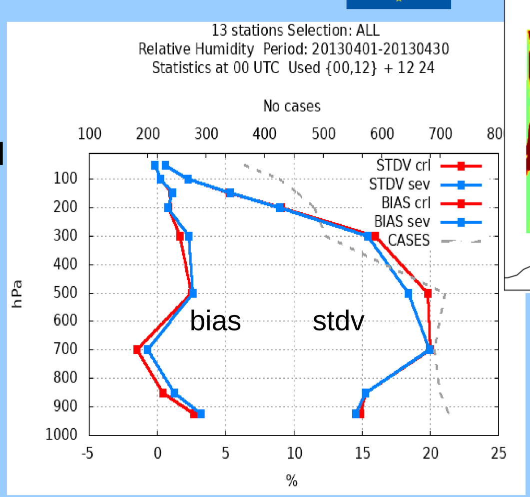


Fig. 1: FC-error for relative humidity for control experiment (red) and experiment with assimilation of clear-sky SEVIRI data (blue).

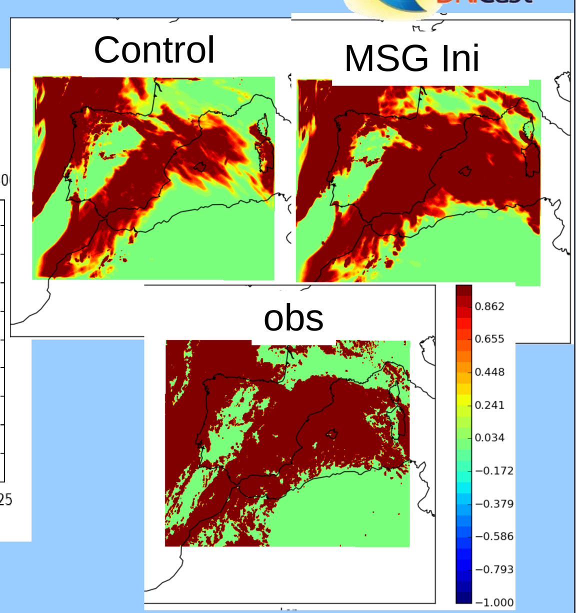


Fig. 2: Case study, valid for 2013-03-21 21UTC. Left two panels: +3h forecast of total cloud cover. Right: MSG-based cloud product.

Surface data assimilation activities

Magnus Lindskog, Tomas Lindskog, Patrick Samuelsson, David Gustafsson

Surface data assimilation activities concerns both methodology and increased use of observations. We work with improvements regarding horizontally varying background error statistics (Fig. 1), Kalman filter based surface data assimilation techniques and development of observation operators for direct use of radiances (Fig. 2). Our primary focus is on assimilation of radiances that contain information about soil moisture and snow characteristics. We employ the radiative transfer models CMEM, for SMOS and AMSR2, and MEMLS3a for Sentinel-1 SAR.

Fig. 1: Impact of one single SYNOP Relative Humidity observation at the 2 meters height unit (%). The observation is located close to the west coast of France and the observed relative humidity is approximately 15% less than the corresponding model value.

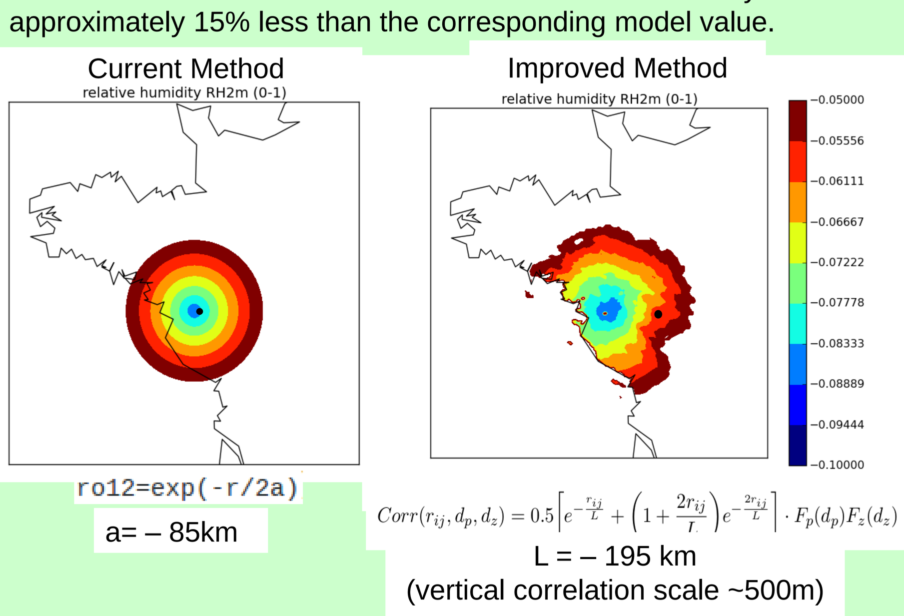
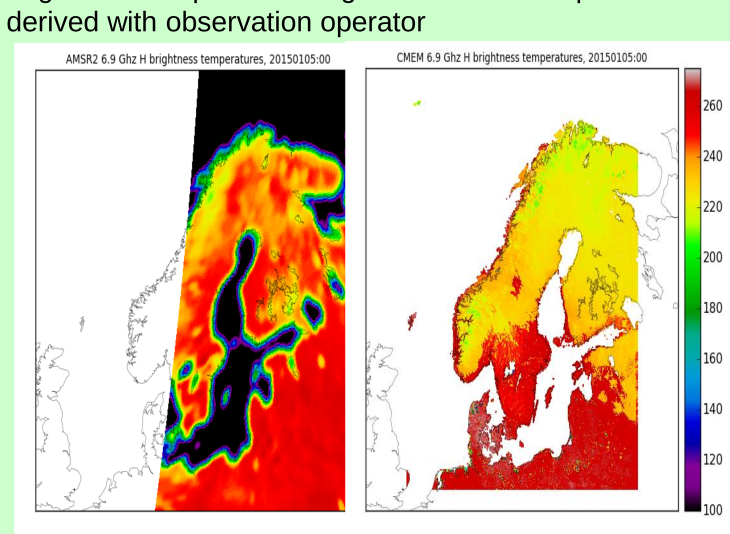


Fig. 2: CMEM observation operator for AMSR2 radiances, level 1C at 6.9 GHz. Left: Observed radiances as H brightness temperature. Right: model counterparts derived with observation operator



Project supported by H2020-project IMPREX and SNSB-project RSLandDA

Urban SIS - Downscalled climate service for European cities

Jorge Amorim, David Segersson, Lars Gidhagen

Existing climate data are relevant at the regional scale, but less informative on **intra-city gradients.**

Need to accurately account for **urban fluxes** aiming to better understand how different cities react to climate signals and what planning actions can be taken to meet **climate change adaptation.**

Downscale existing climate data by running HARMONIE-AROME in NWP and climate mode with a spatial resolution of 1x1 km^2

Post-process the urban ECVs aiming to generate **urban impact indicators**

Input data type	Product	Spatial resolution (m)	Source data type	Webpage
Spatial coverage of land cover types	Copernicus Land Monitoring Services: Urban Atlas 2012	100	Satellite data PROBAV v1.4	http://land.copernicus.eu/local/urban-atlas
Building polygons	OpenStreetMap	nd	Different sources	https://www.openstreetmap.org
Building/tree heights	Swedish Forest Agency	12.5	Lidar measurements	http://www.skogsstyrelsen.se/Myndigheten/Om-oss/Oppna-data/
Time-series of LAI	Copernicus Global Land Service	1000	Satellite data	http://land.copernicus.eu/global/themes/vegetation

Table 1: Refining the physiography with available high-resolution input.

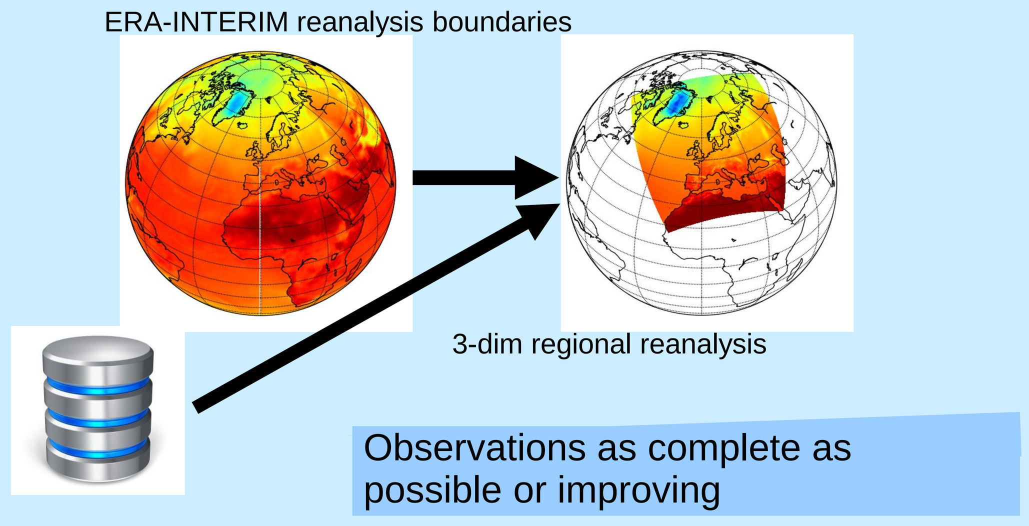
European regional reanalysis project UERRA

Per Undén, Martin Ridal, Esbjörn Olsson, Jelena Bojarova (SMHI)

UERRA Uncertainties in Ensembles of Regional ReAnalyses

SMHI runs variational 3D-VAR with a large scale constraint added from ERA . **ALADIN** and **ALARO** of the shared ALADIN-HIRLAM system are used within **HARMONIE - Hirlam Aladin Regional/Mesoscale Operational NWP In Europe.**
Resolution: 11 km
1961 – 2014: deterministic (ALADIN)
2006-2010: ensemble of two (ALARO and ALADIN)

ERA-INTERIM reanalysis boundaries



3-dim regional reanalysis

OBSERVATIONS

Observations as complete as possible or improving

NWP model and analysis system remain fixed

Reanalysis quality remains the same or improving

1961 → 2014

ARCHIVING IN MARS
Data Services
+ *The common UERRA archive is MARS at ECMWF*
Common set of parameters chosen for all models
GRIB2 (some new definitions)
+ *Data services from MARS and ESGF interface*
+ *Web Map Servers*
+ *Visualisation through Metview and WMS*