Norwegian Meteorological Institute

Operational use and plans with the Harmonie AROME

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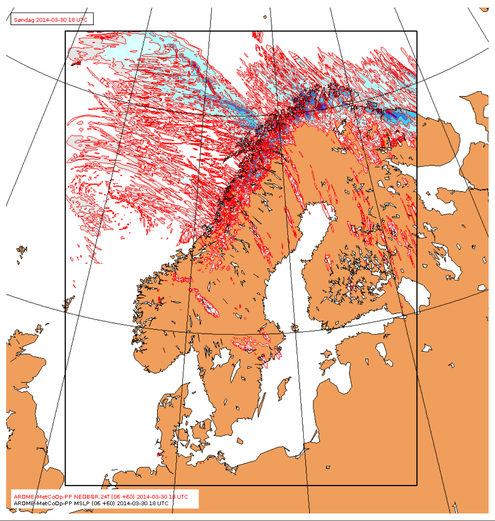


AROME-Norway and MetCoOp

AROME-Norway
- experimental runs since October 2012 , on a smaller domain since May 2011
- on yr.no from1 October 2013

AROME-MetCoOp
- developed in cooperation between SMHI and Met-Norway
- experimental runs since December 2013
- operational from 18 March 2014

AROME-Norway and MetCoOP have much in common:
- AROME physical parametrization
- 2.5 km/65 levels/10 hPa
- domain with 750x960 gridpoints (see left)
- hourly boundaries from ECMWF
- surface assimilation
- forecast length 66 hours
- ECOCLIMAP-2

AROME-MetCoOp

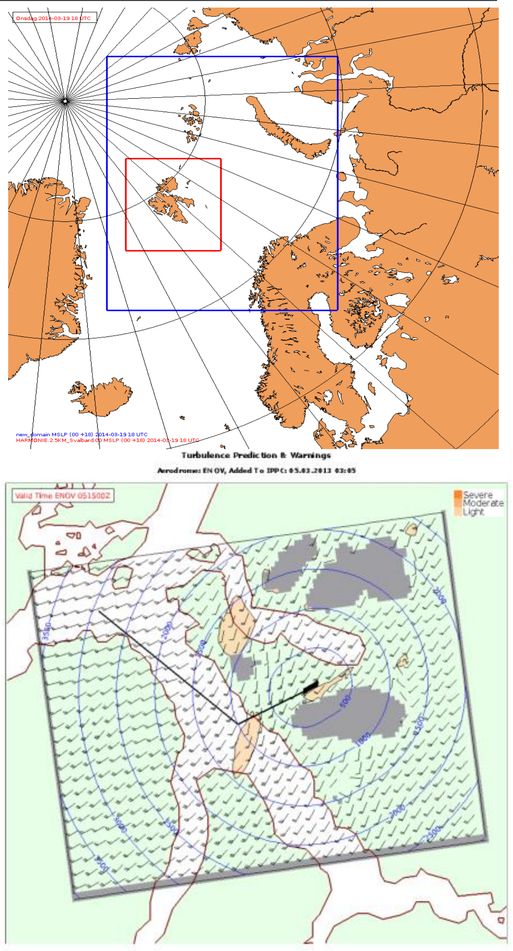
•3DVAR
•3-hourly cycling
•Harmonie cycle 38h1.1

AROME-Norway

•blending of ECMWF upper air fields
•6-hourly cycling
•Harmonie cycle 37h1.1, but with SURFEX namelist settings as in cycle 38h1.1

A brief summary of quality

•Precipitation: VERY GOOD!
•Wind speed 10m – good enough
•Temperature 2m
- good in summer
- much too cold in some winter situations with weak winds (2-6 m/s) (see poster on Nordic challenges)

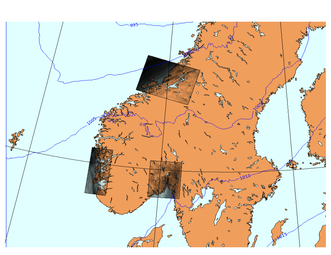


AROME-Arctic

Smaller red domain will be updated to larger blue domain harmonie-38h1.1
▪AROME physical parametrization
▪2.5 km / 65 levels
▪750x960 and 320x360 gridpoints (see right)
▪Hourly ECMWF boundaries (~16 km)
▪ Small domain:
- Surface data assimilation only and blending of ECMWF upper air fields
- Forecast lengths: 66 hours (small domain)
▪Large domain:
- Surface and Upper-Air (3DVAR) analyses
- Experimental runs with 48 hour forecasts

Simra; developed by NTNU and run by MET

The turbulence model Simra has been set up for 19 air fields at mainland Norway, and lately also for Longyear at Spitsbergen. Simra is now nested into AROME-Norway/AROME-Arctic, allowing for a much simpler system than the previous ECMWF - Hirlam 8km - UM 4km - UM 1km - Simra sequence of model runs.



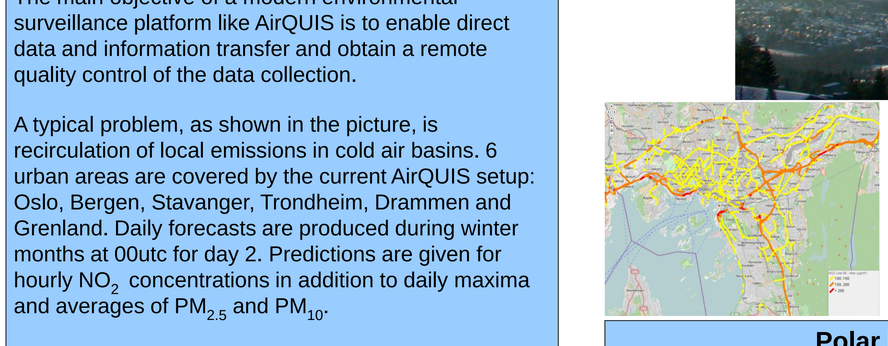
AROME 1km

To serve as input for the air quality model system AirQUIS, AROME has been set up on 3 relatively small domains covering the largest cities in Norway. AROME at 1km is currently nested into AROME-Norway. A few tests have been performed with a larger 1km domain, covering southern parts of Norway, nested directly into the ECMWF model. The current AROME 1km setup replaces the previous, more complicated, model chain: ECMWF - Hirlam 8km - UM 4km - UM 1km - AirQUIS.

AirQUIS; developed by NILU and run by MET

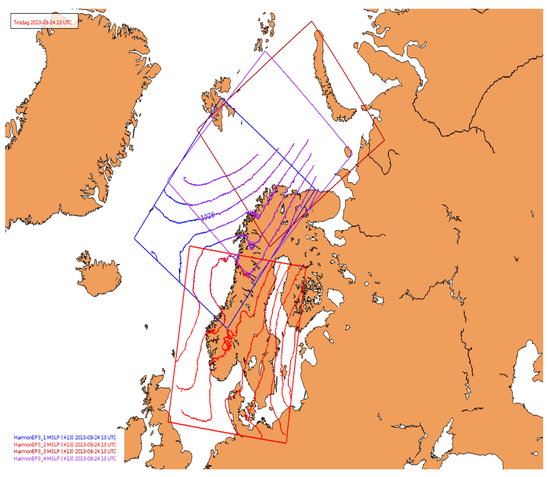
The main objective of a modern environmental surveillance platform like AirQUIS is to enable direct data and information transfer and obtain a remote quality control of the data collection.

A typical problem, as shown in the picture, is recirculation of local emissions in cold air basins. 6 urban areas are covered by the current AirQUIS setup: Oslo, Bergen, Stavanger, Trondheim, Drammen and Grenland. Daily forecasts are produced during winter months at 00utc for day 2. Predictions are given for hourly NO_2 concentrations in addition to daily maxima and averages of $PM_{2.5}$ and PM_{10}.



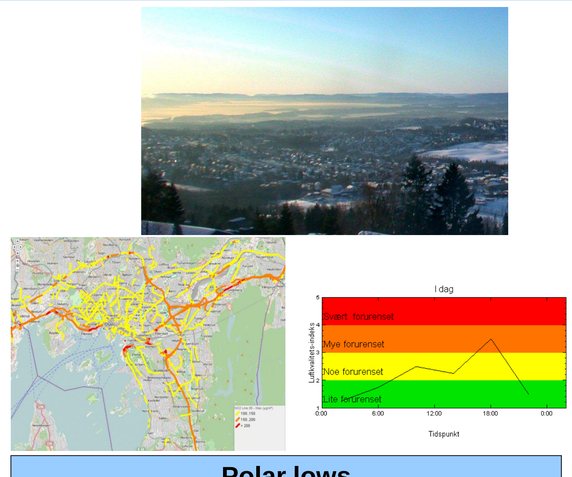
A probabilistic system

▪The ensemble approach enables efficient early warnings of potentially severe weather, as polar lows and heavy convective precipitation
▪Forecast uncertainty is quantified along with probabilities of occurrence of weather events
▪Aim: Forecasting potentially severe weather ranging from 12 hours to ~2 days



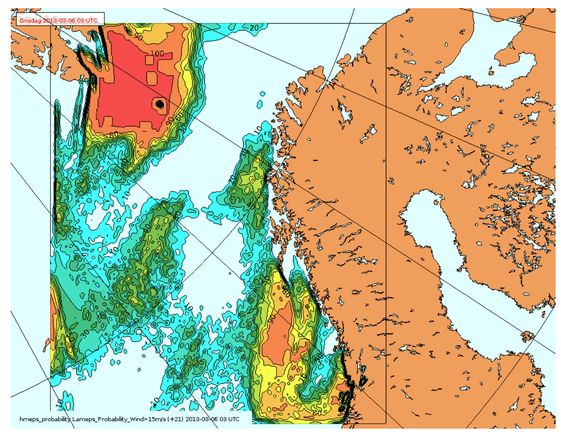
Forecast challenges

▪In-situ observations are often too sparse for an adequate analysis of the atmosphere
▪Only partly compensated by remote sensing data from polar orbiting satellites
▪The model representation of moist convection is crucial, e.g. resolution
▪The size and position of the model domain is important



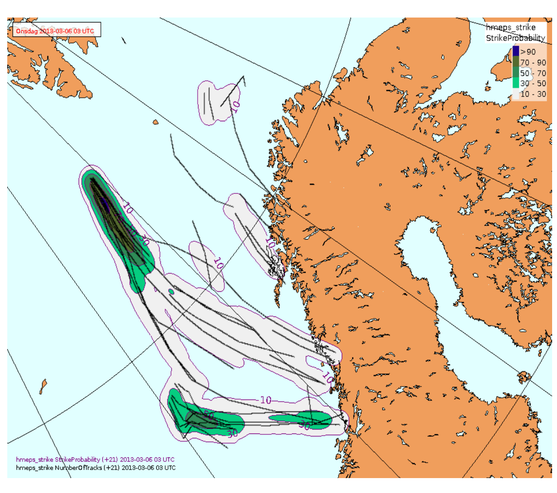
Polar lows

▪Occur frequently but irregularly (on average 4-6 per winter month)•Intense (strong winds and heavy precipitation)
▪Short-lived (1–2 days)
▪Mesoscale (100- to 600-km diameter)
▪Unique to the Polar Regions
▪Associated with cold air outbreaks
▪Decays quickly after landfall
▪Speed of 10–15 m s-1



HarmonEPS-PL

▪Duty forecasters choose one of four domains
▪Control run + 10 members
▪Dynamical downscaling of ECMWF-EPS (initial conditions and 3 hourly LBCs)
▪Forecast length: 42 hours
▪Runs at 06utc and 18utc
▪AROME physics
▪Non-hydrostatic dynamics
▪500x600 horizontal grid at 2.5 km resolution
▪Operational since October 2012
▪Strike probability maps are automatically generated
▪Purple domain is default during winter, red domain during summer



vilje.hpc.ntnu.no, SGI Altix ICE X.

A total of 4 login, 1404 compute and12 io 16-way nodes, dual eight-core Xeon E5-2670@2.60GHz, with 32 GiB per node.
For **operational** use 280 compute + 8 spare nodes are available.

SURFEX/surface related changes introduced in 2013

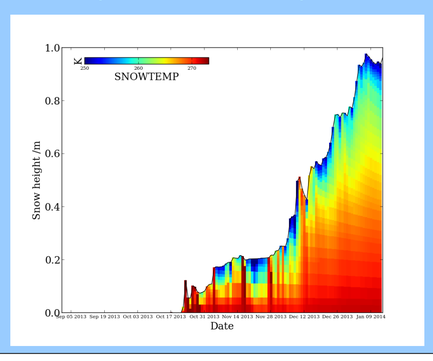
•ECOCLIMAP version1 --> version2
- higher and more realistic roughness, more realistic extent of permanent snow cover
- less wind; generally better, but too low some places

•Reduction of XRIMAX from 0.2 to 0.0
- more realistic drop in temperature in summer nights
- dryer summer nights

•Reduced canopy drag: XCDRAG from 0.05 to 0.01
- increased wind speed in wood lands
- also a positive effect on summer night temperatures and humidity

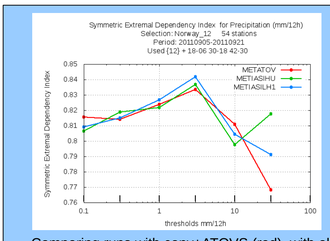
Next steps (HIRLAM/ALADIN work plan):
- 3-layers snow scheme instead of 1-layer to have more realistic modelling of snow properties and surface temperatures
- introduce a simple ‘HIRLAM like’ sea ice model in SURFEX

Seasonal development of the snow pack at Beitostølen.

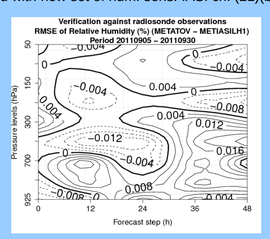


More about current activities on too low winter temperatures and SURFEX offline on a separate poster:

Surface modelling - some Nordic challenges



Comparing runs with conv+ATOVS (red), with all primarily selected hum. sens. 38 IASI ch. (green), and with new set of hum. sens. IASI ch. (21)(blue)



MEATOV- run with conv+ATOVS;
METIASILH1- run with conv+ATOVS+ IASI (hum. Only)

Improving the upper air analysis with relevant observations

We have few projects dealing with the assimilation of remotely sensed data (satellite: **IASI** and **Scatterometer wind**, and radar: **Doppler wind** and **reflectivity**). While the work on IASI data is mainly financed by the Norwegian Space Centre, the studies on Scatterometer are supported by the EUMETSAT, the Norwegian Research centre together with the Norwegian wind energy companies are financing the work for better wind and wind-energy forecasts involving the radar Doppler wind, and the assimilation of radar reflectivity is co-financed by the Hydro-power energy companies together with the Norwegian Research Council.

ACCESS (EU founded), is a project dealing in some extend with all available **observations over the Arctic** region, and aims at improving the forecasts performance over this challenging region.

At left hand side, one can see some verification results of runs with different sets of the IASI humidity sensitive channels. Note that this project is focusing on the use of humidity information from the IASI radiances.