Norwegian Meteorological Institute

Operational use and plans with the Harmonie AROME

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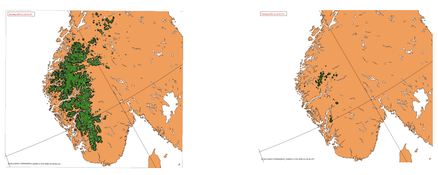
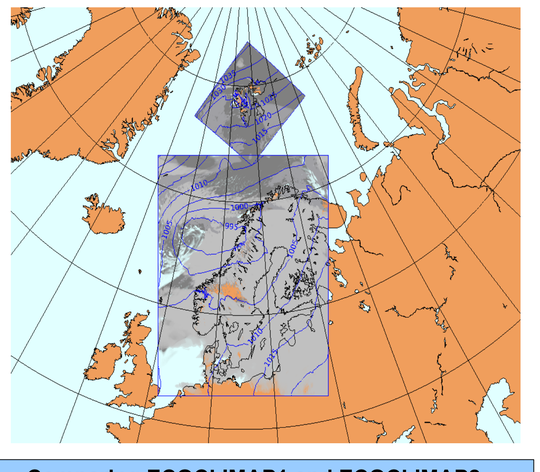
MET

AROME-Norway and AROME-Arctic

Two domains have been set up at 2.5km resolution to cover Norwegian areas of particular interest.
branches/METNO/harmonie-37h1.1_oper

- AROME physical parameterization
- 2.5 km / 65 levels
- 750x960 and 320x360 gridpoints (see right)
- Hourly ECMWF boundaries (~16 km)
- Surface data assimilation
- Blending of ECMWF upper air fields
- Forecast lengths: 66 hours
- Use of ECOCLIMAP 2 (from 27 May 2013)
- AROME-Norway will be used in the web portal yr.no from October 1st, 2013





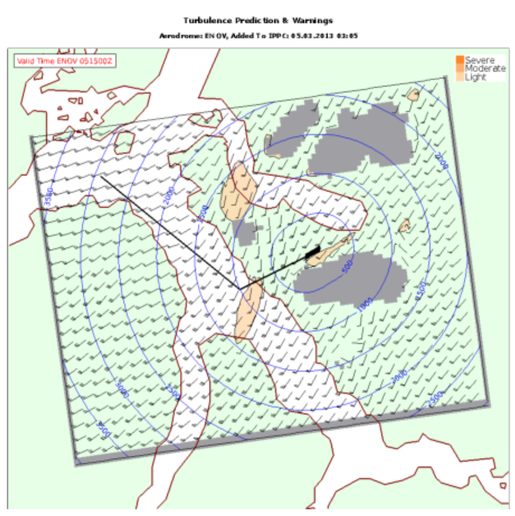
Comparing ECOCLIMAP1 and ECOCLIMAP2

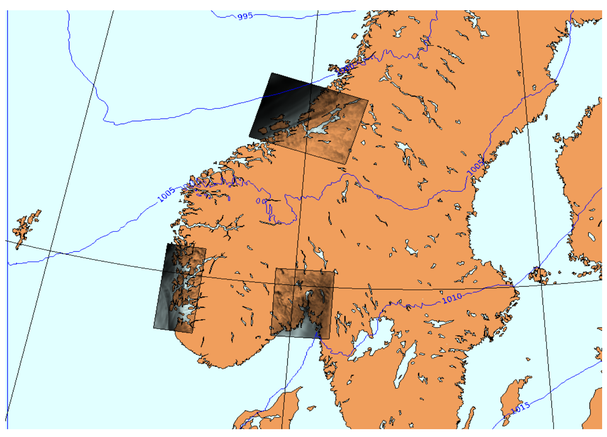
Comparisons and experiments with ECOCLIMAP1/2 on a domain covering Scandinavia show that

- ECOCLIMAP2 gives more realistic geographical distribution of roughness
- the roughness is on average higher with ECOCLIMAP2, implying reduced wind speed
- ECOCLIMAP2 gives less and much more realistic extent of permanent snow (see at left hand side: ECOCLIMAP1 (left) and ECCLIMAP2 (right))

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.





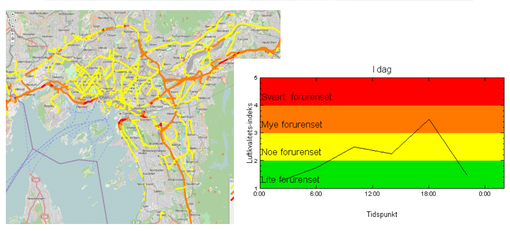
AROME 1km

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 consentrations in addition to daily maxima and averages of $PM_{2.5}$ and PM_{10}.

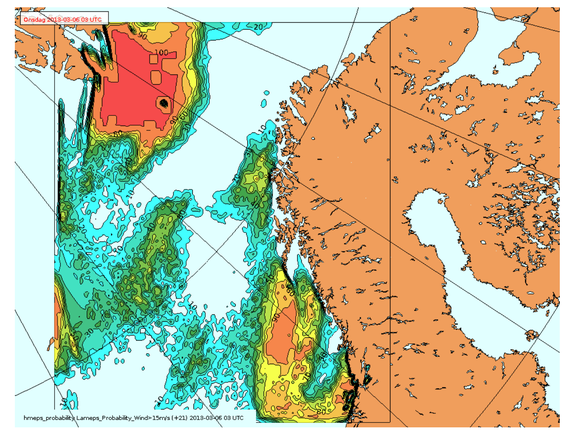


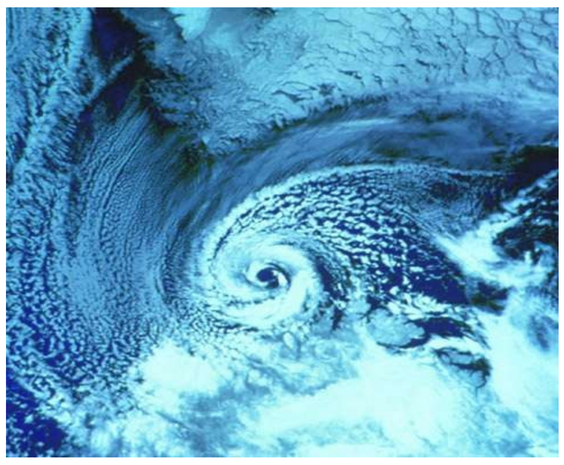
A probabilistic system

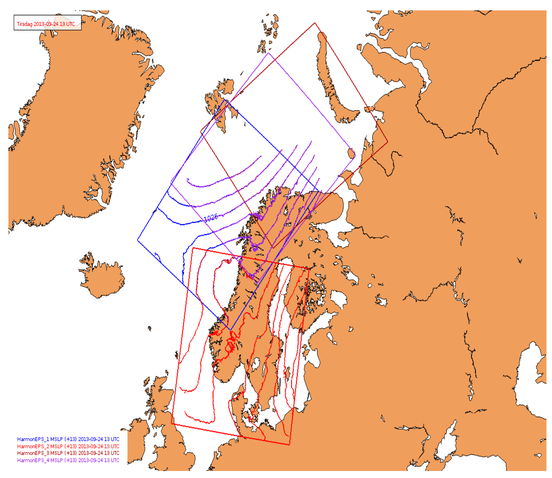
- The ensemble approach enables efficient early warnings of potentially severe weather, as polar lows and heavy convective precipitation
- Forecast uncertainty is quantified along with probabilities of occurrence of weather events
- Aim: Forecasting potentially severe weather ranging from 12 hours to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

Polar lows

- Occur frequently but irregularly (on average 4-6 per winter month)•Intense (strong winds and heavy precipitation)
- Short-lived (1–2 days)
- Meso-scale (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





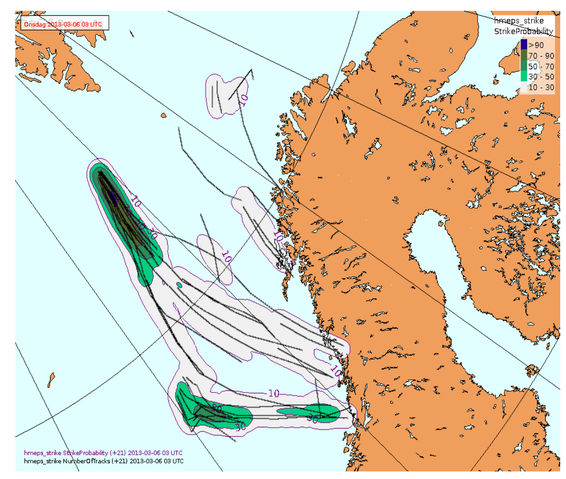


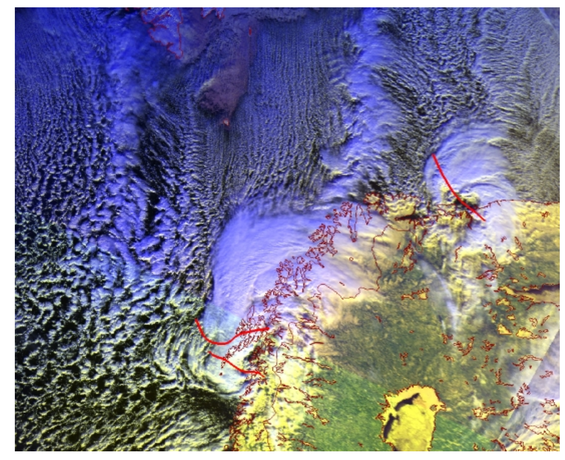
Forecast challenges

- 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

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
- Blue domain is default during winter, red domain during summer





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

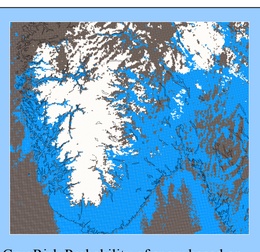
A total of 4 login, 1404 compute and12 io 16-way nodes, dual eight-core Xeon E5-2670@2.60GHz, with 32 GiB per node.
For **operational** use 280 compute + 8 spare nodes are available.

Improving the surface analysis

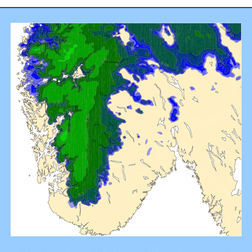
Generalization of the surface analysis interface by developing SODA (Surfex Offline Data Assimilation)

Snow aspects and ongoing activity in HARMONIE

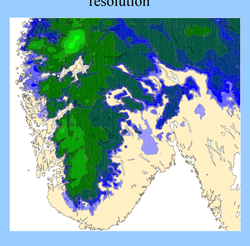
- the snow analysis is performed by Optimum Interpolation using snow depths observations. The performance is good in domains with representative observations;
- snow analysis experiments March-May 2012 show:
  1) significant improvements, both of snow cover and of surface temperatures, when using additional snow depth observations from Norwegian climate stations available in real time from 12 March 2013;
  2) CryoRisk satellite data shows potential to discriminate between snow free/covered ground, and also improve the quality of surface temperature, particularly in the melting season;
- next steps (HIRLAM/ALADIN work plan):
  – experiments with other sources of satellite data, e.g. Globsnow and MODIS;
  – 3-layers snow scheme instead of 1-layer to have more realistic modelling of snow properties and surface temperatures



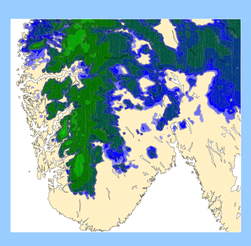
CryoRisk Probability of snow based on AVHRR on NOAA and METOP, 1.5 km resolution



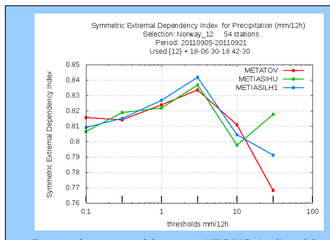
REF + CryoRisk satellite data with 15 km resolution



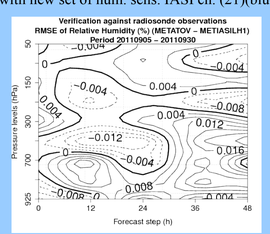
REF: Harmonie analysis: 37h1.beta.2



REF + snow depths from climate stations



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.