Efficient high resolution 3-D interpolation of meteorological variables for operational use

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(2) consultant, Milan (Italy)

Hourly Observations list:

- Temperature
- Reative humidity
- Wind
- Pressure
- Precipitation

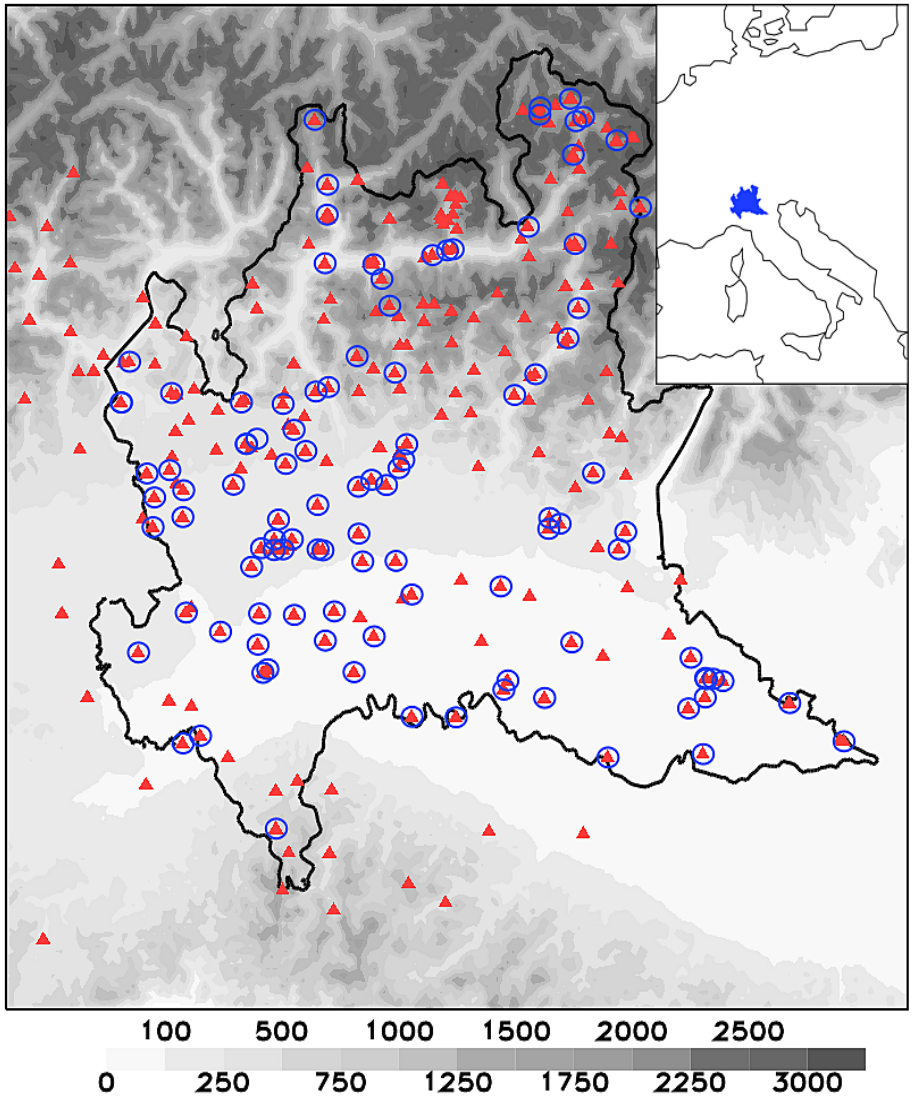
Aggregated variables list:

- Daily minimum and maximum temperature
- Daily minimum and maximum relative humidity
- Daily cumulated precipitation
- Humidex

Meteorological network

- Automatic stations;
- Complex orography;
- Hourly data;
- High station density;
- Station altitudes: 10m – >3000m AMSL;

- Grid: 1.5 Km (177x174);
- Grid orography from a high resolution DEM (250 m) without smoothing;



The spatial analysis scheme for all variables is an implementation of the Optimal Interpolation (***Uboldi et al., 2008***)

Main features:

- Background information derived from observations detrending;
- Background error covariance specified by means of 3D gaussian correlation functions;
- Spatial consistency check based on the interpolation scheme;
- Efficient computation algorithm.

Test cases chosen:

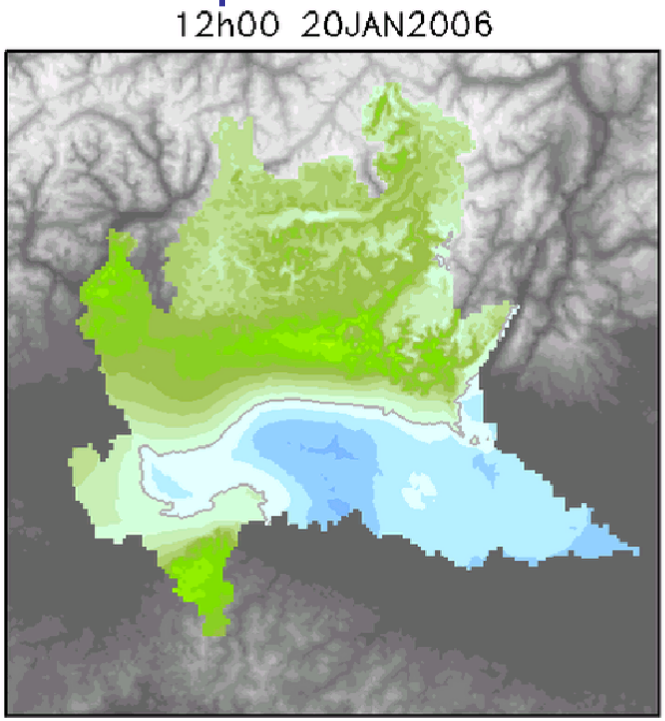
- Fog
- Foehn
- Convective and stratiform precipitation
- Heat wave

Why?

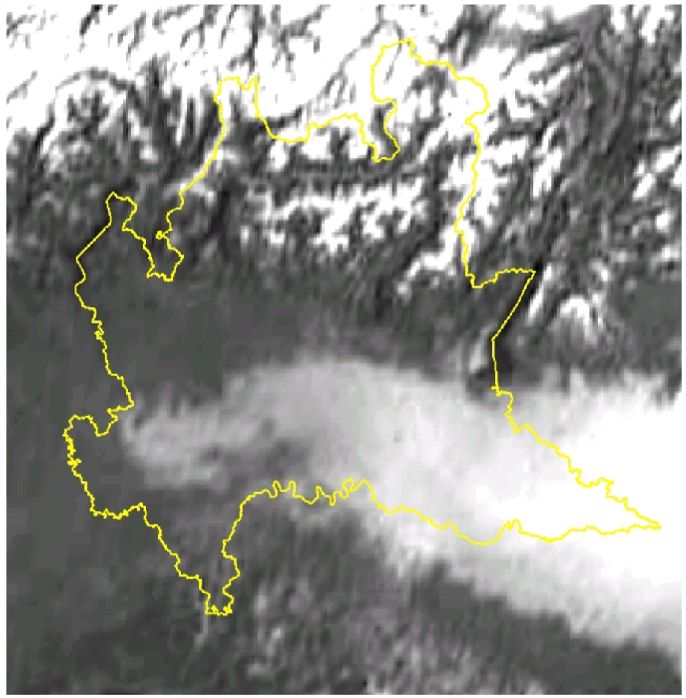
- Strong gradients (stress the OI scheme)
- High impact weather

2006/01/20 – Fog in the Po plain

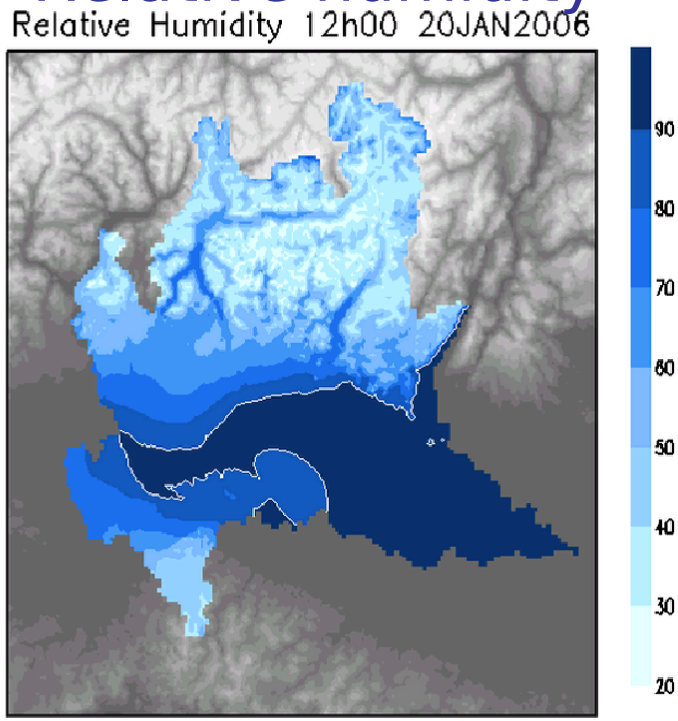
Temperature

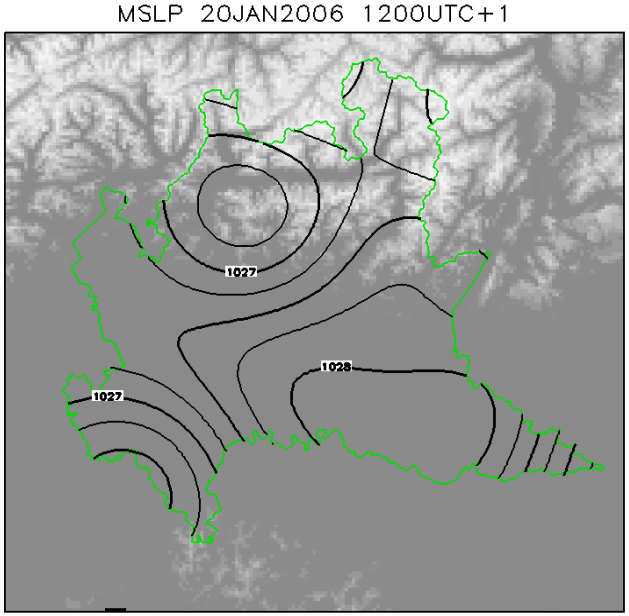


MSG1 - HRV

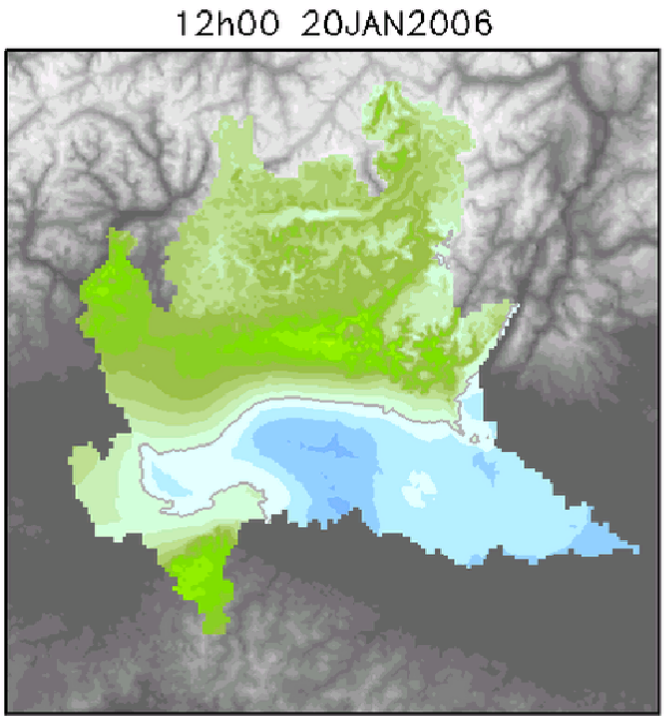


Relative humidity

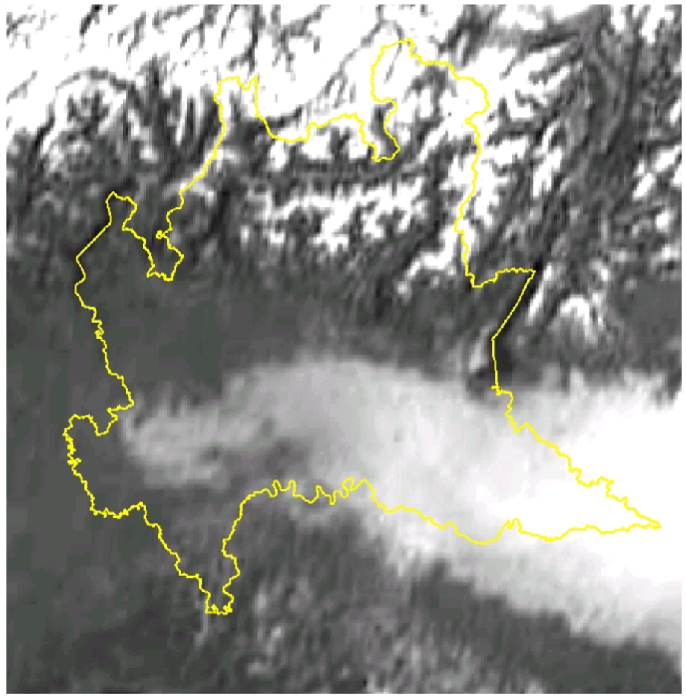




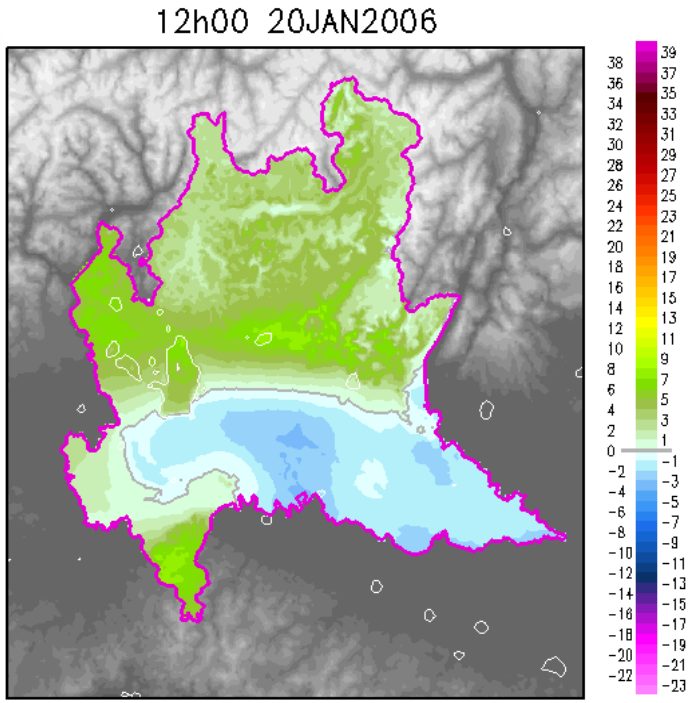
2006/01/20 – Fog in the Po plain



Temperature

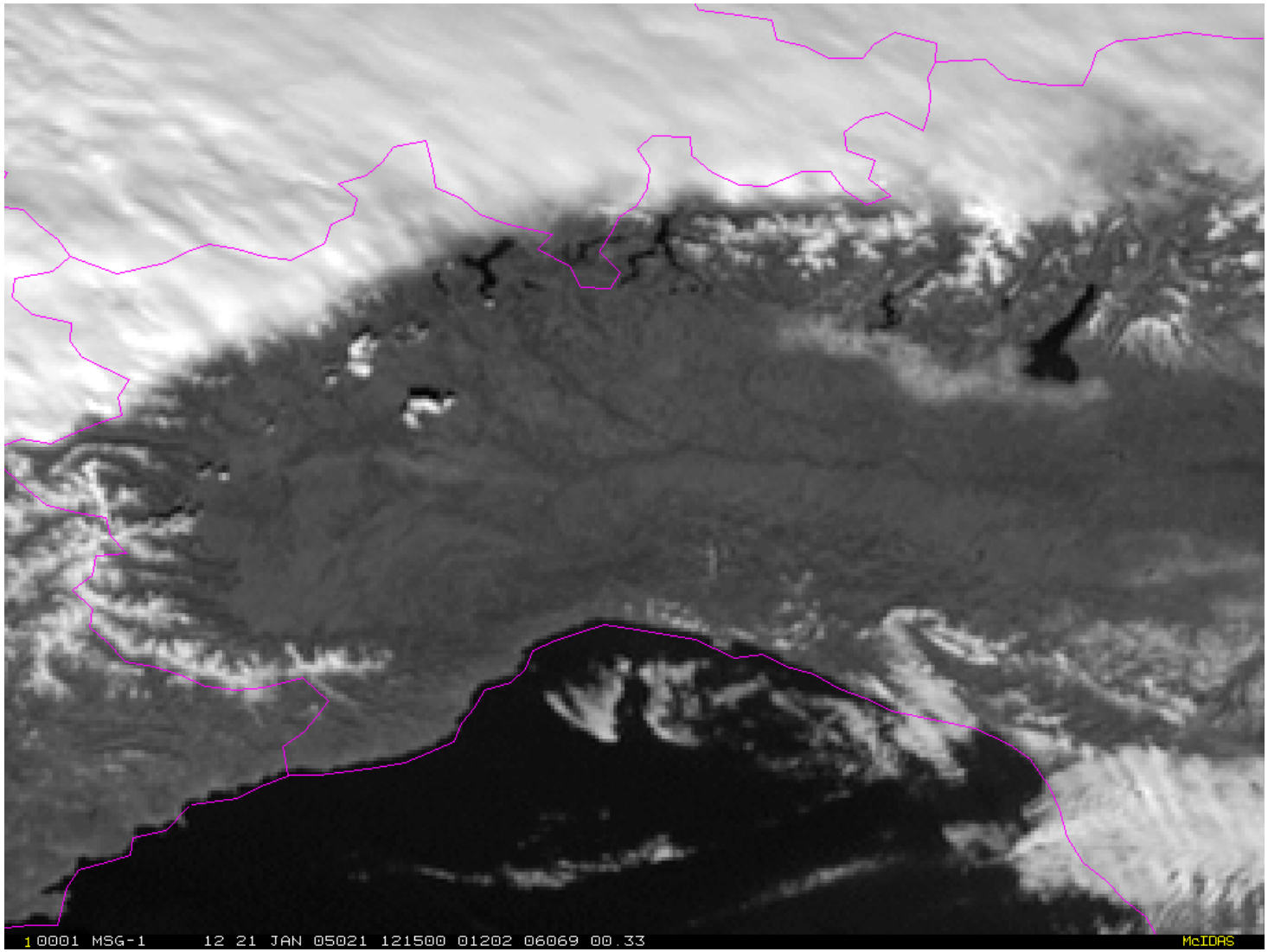


MSG1 - HRV



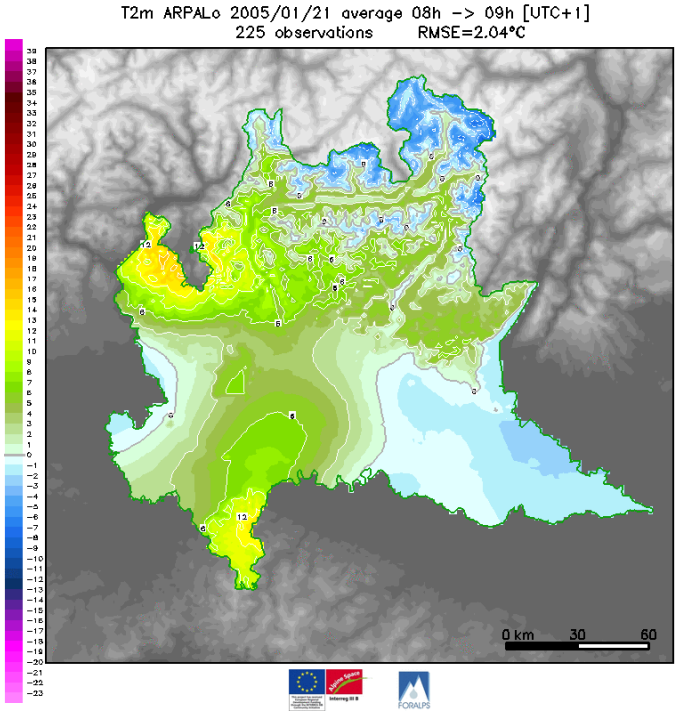
Temperature
land use information used to characterize the urban heat island in the background correlations

Foehn cases

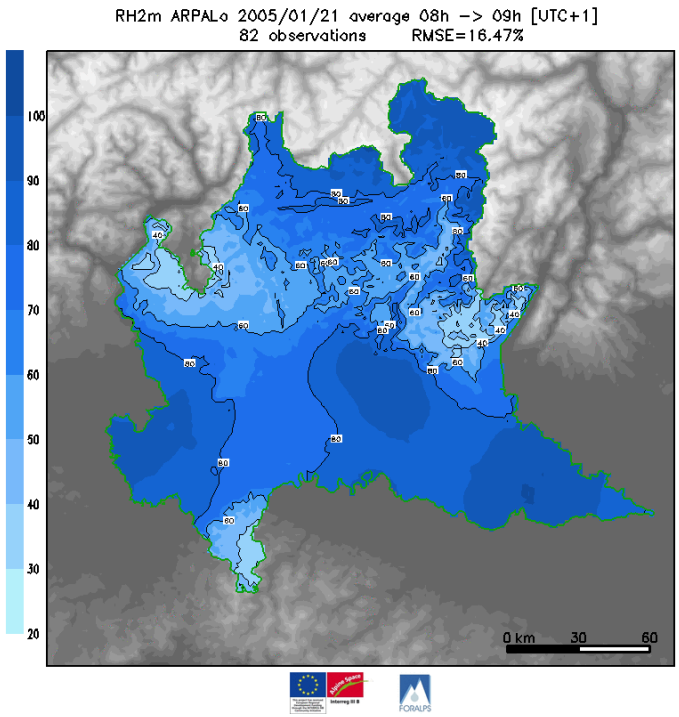


http://oiswww.eumetsat.org/WEBOPS/iotm/iotm/20050121_foehn/20050121_foehn.html

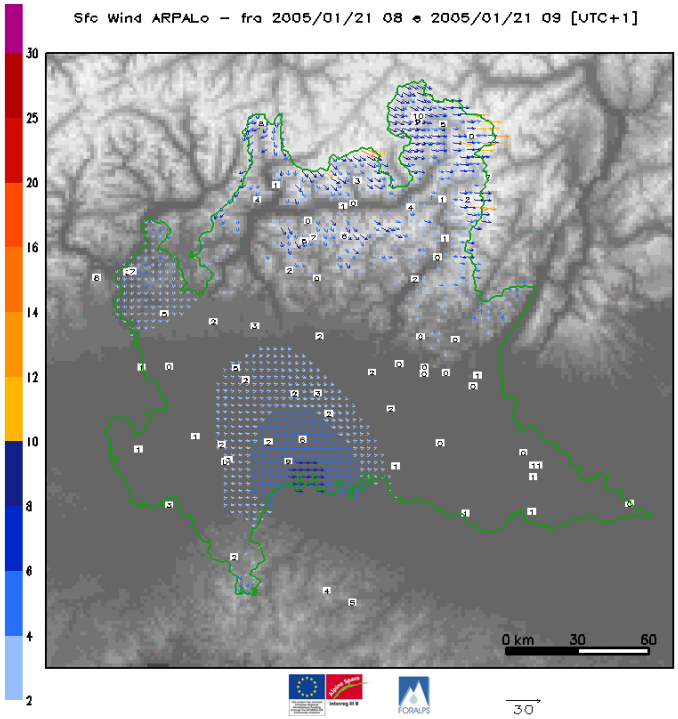
Foehn case: 2005/01/21 08–09 UTC+1



Temperature

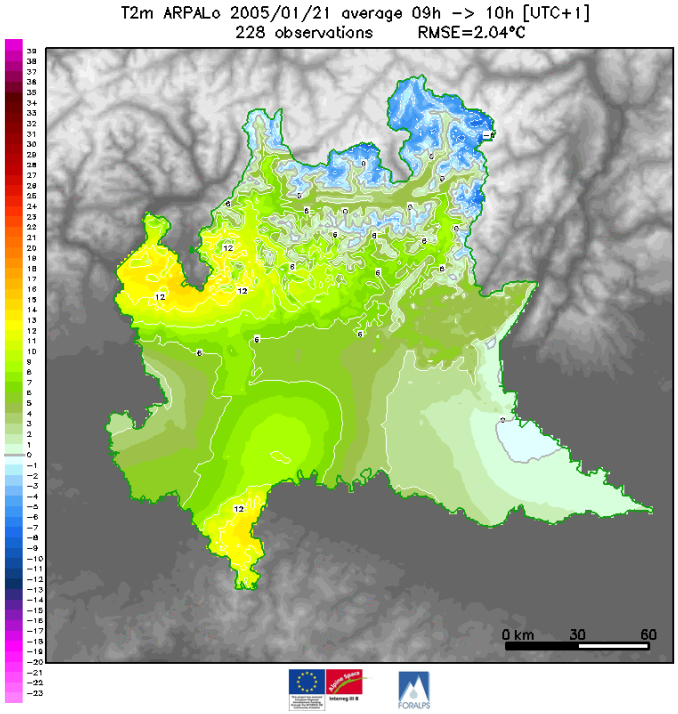


Relative humidity

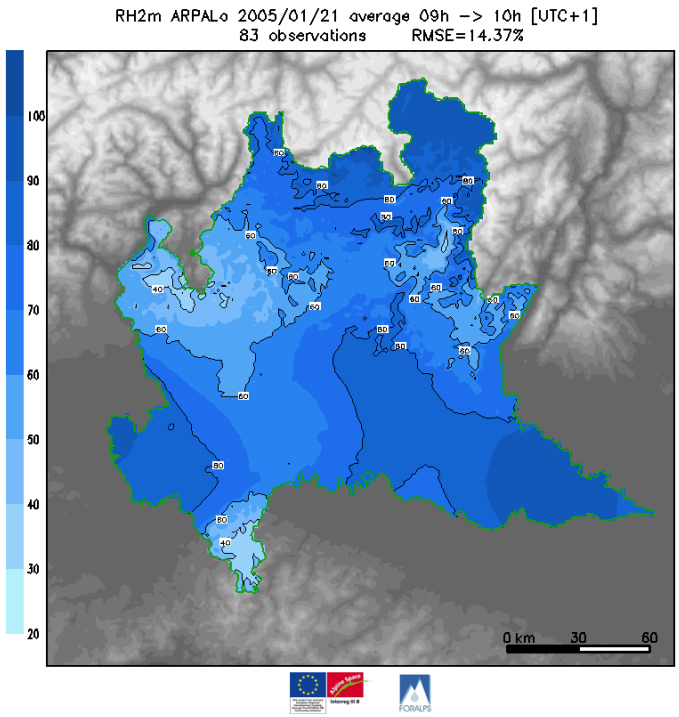


Wind

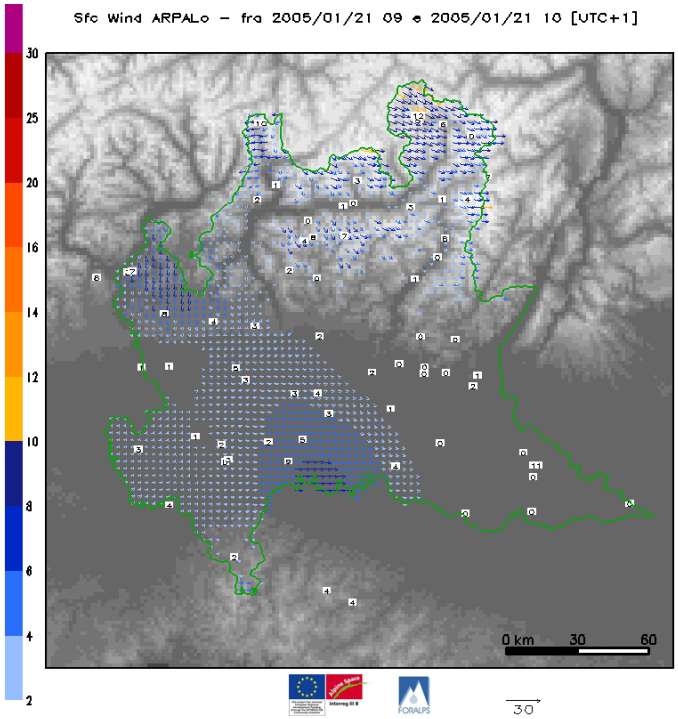
Foehn case: 2005/01/21 09–10 UTC+1



Temperature

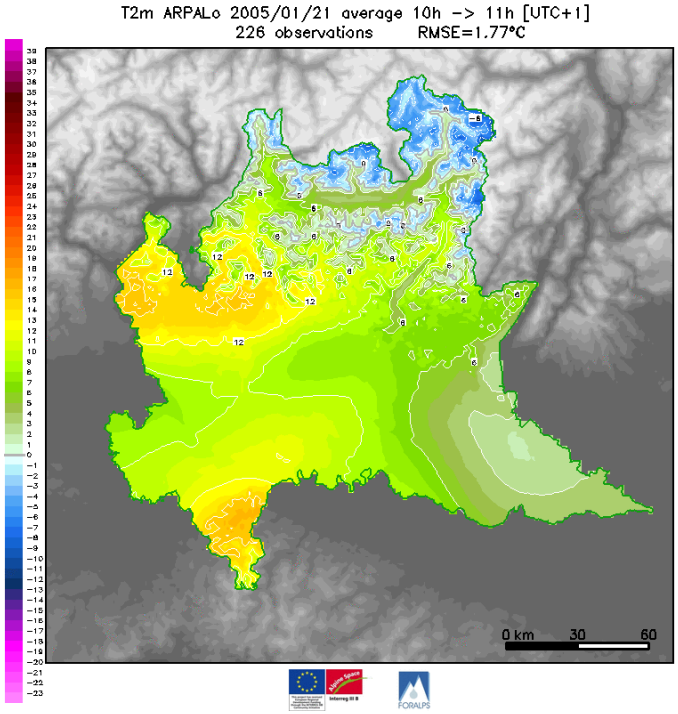


Relative humidity

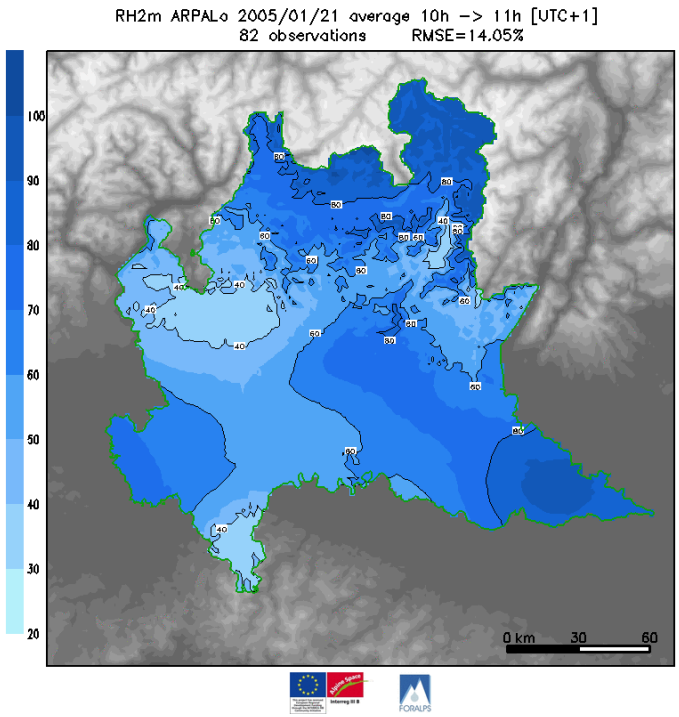


Wind

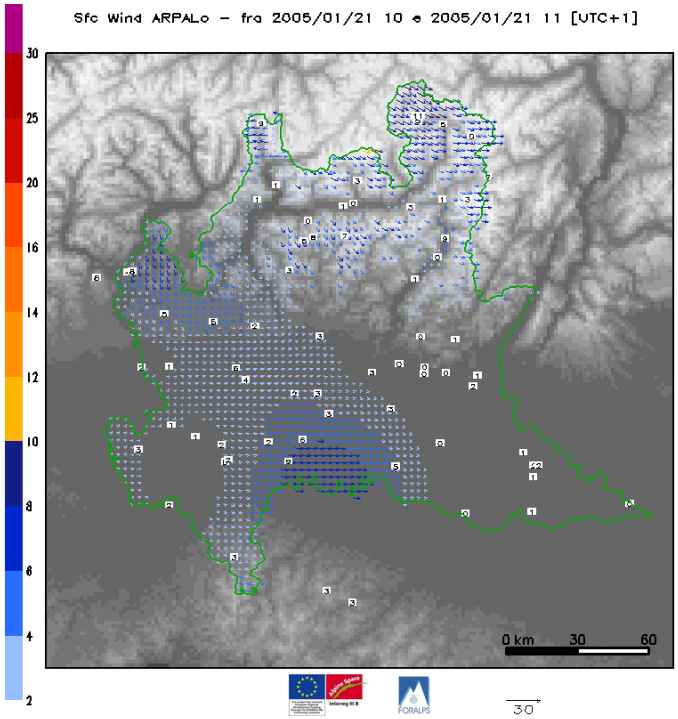
Foehn case: 2005/01/21 10–11 UTC+1



Temperature

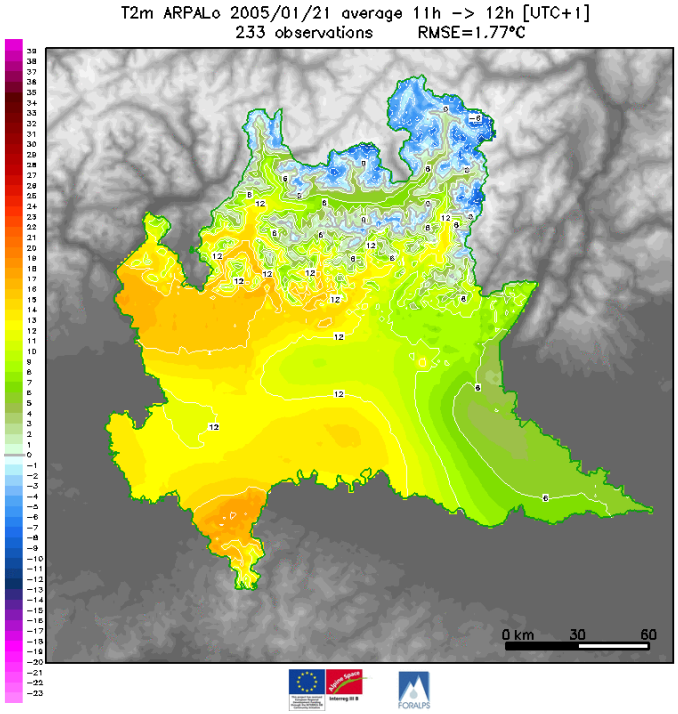


Relative humidity

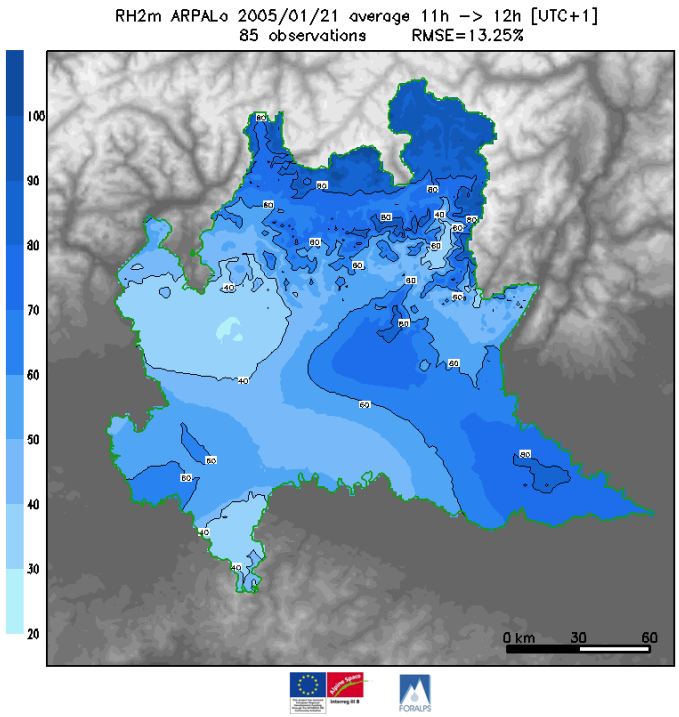


Wind

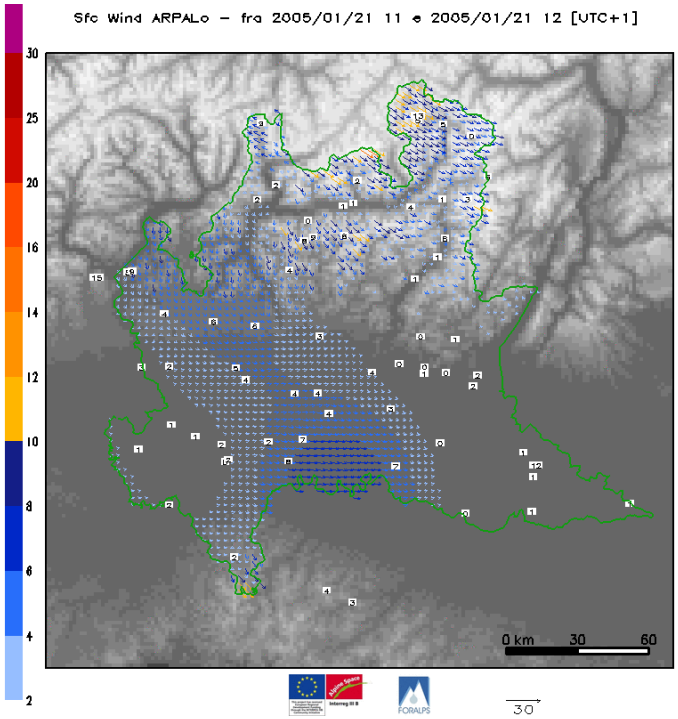
Foehn case: 2005/01/21 11–12 UTC+1



Temperature

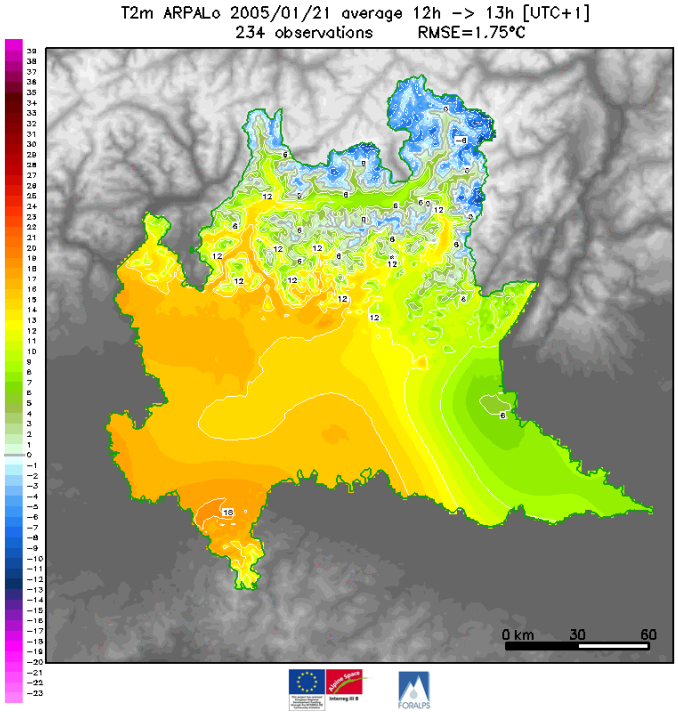


Relative humidity

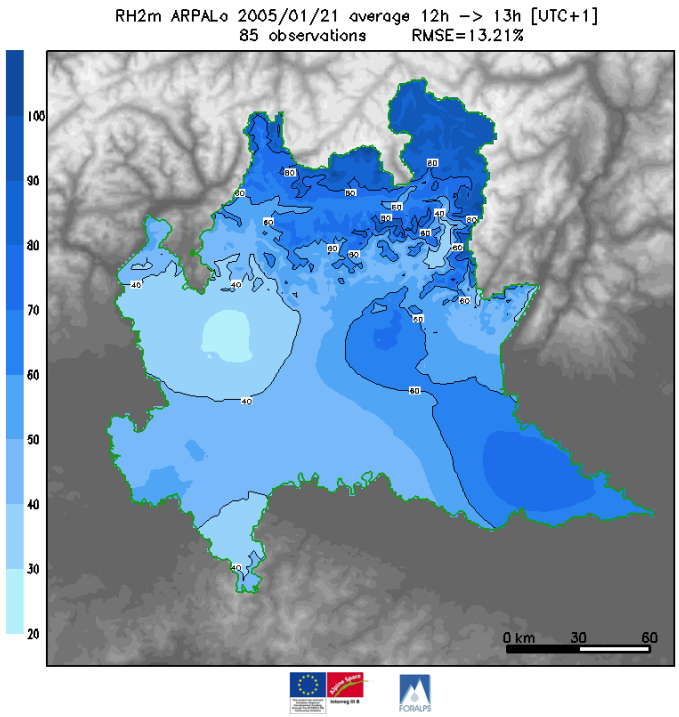


Wind

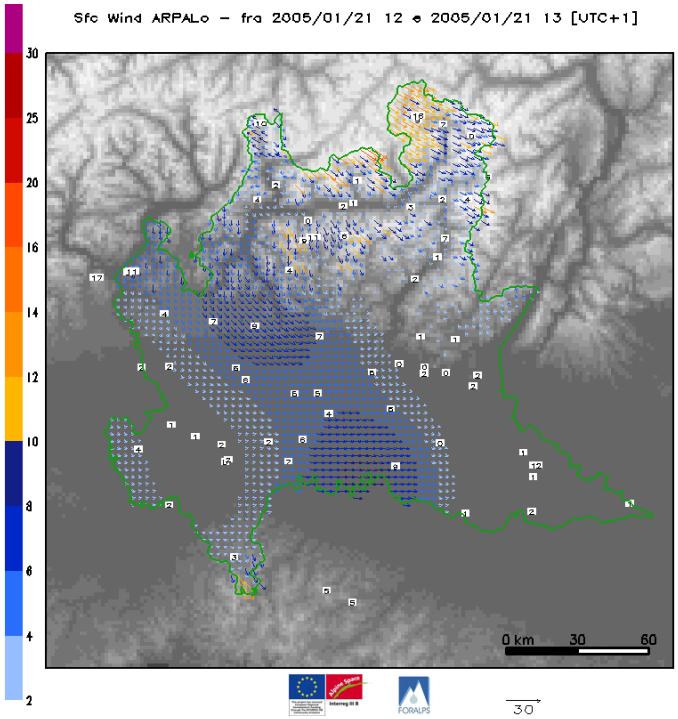
Foehn case: 2005/01/21 12–13 UTC+1



Temperature

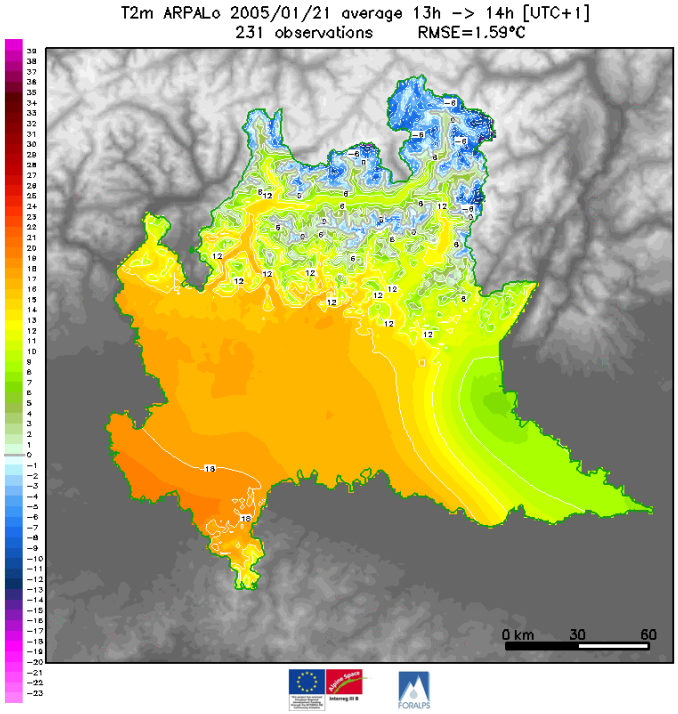


Relative humidity

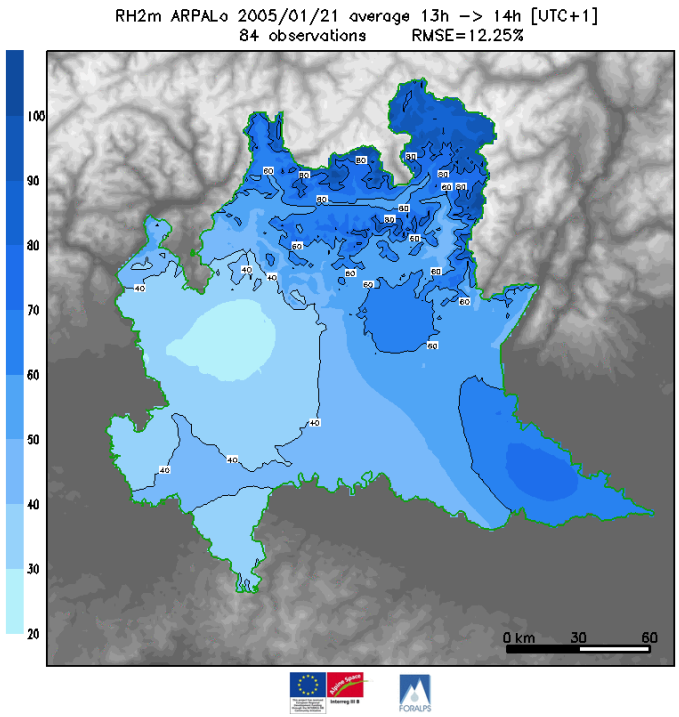


Wind

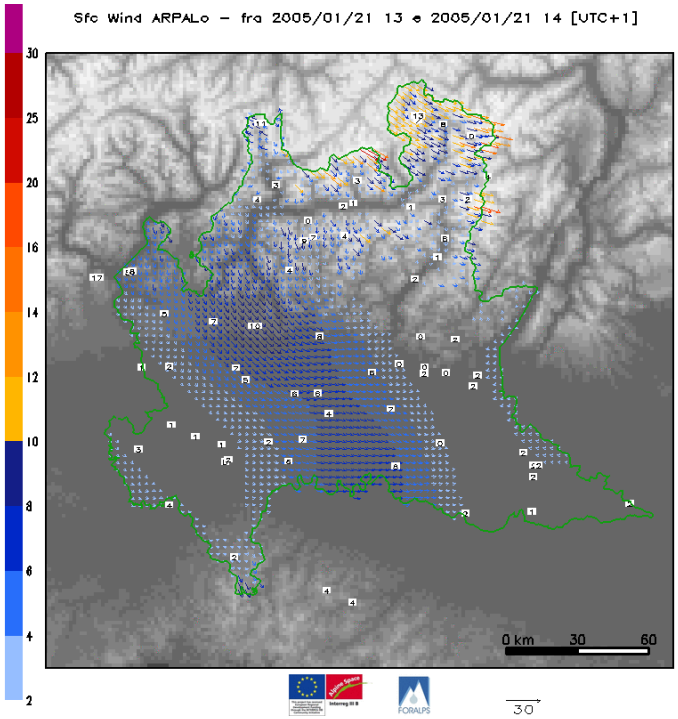
Foehn case: 2005/01/21 13–14 UTC+1



Temperature



Relative humidity

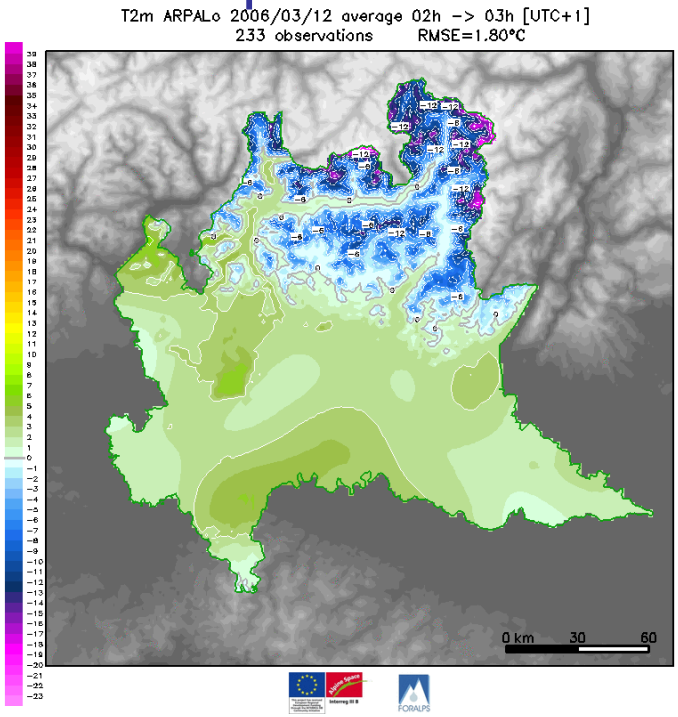


Wind

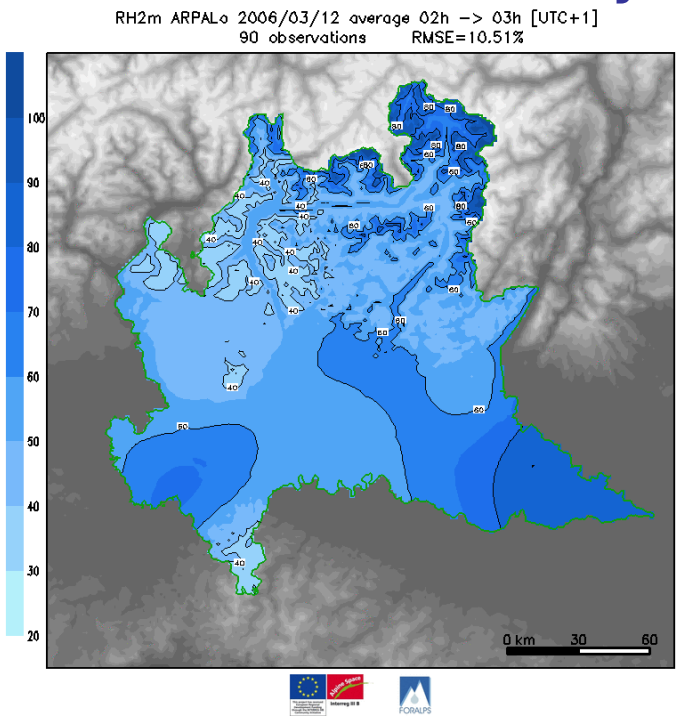
2006/03/12

Foehn case: 2006/03/12 02–03 UTC+1

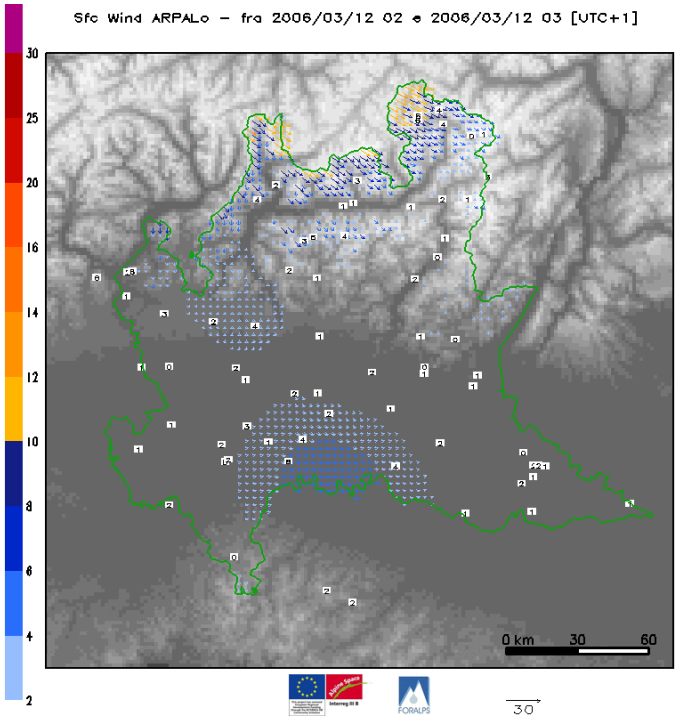
Temperature



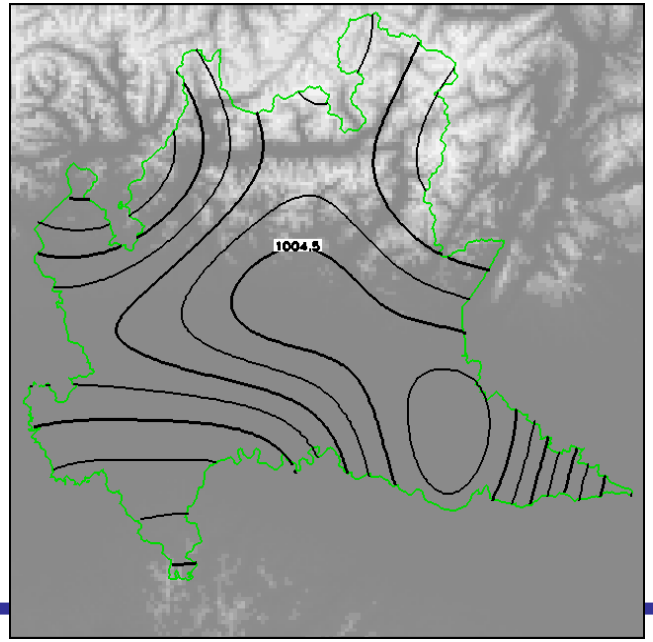
Relative humidity



Wind

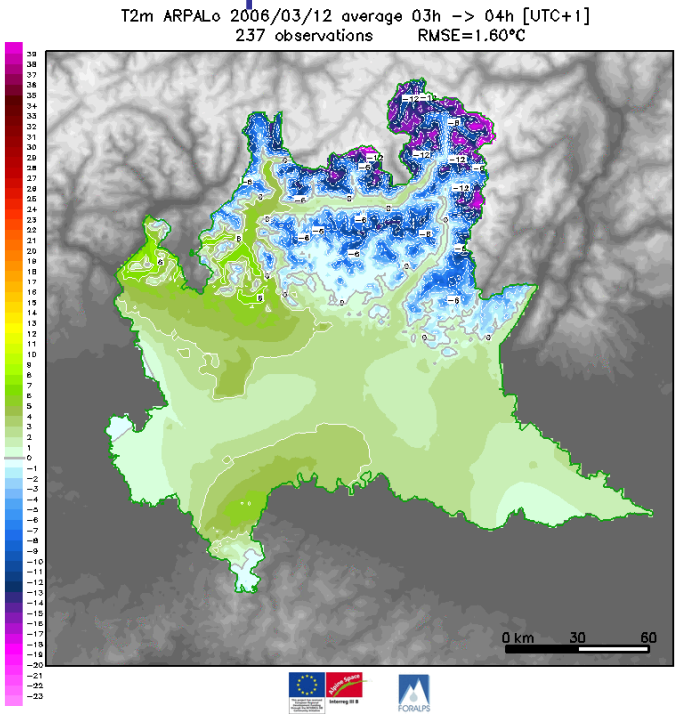


MSLP

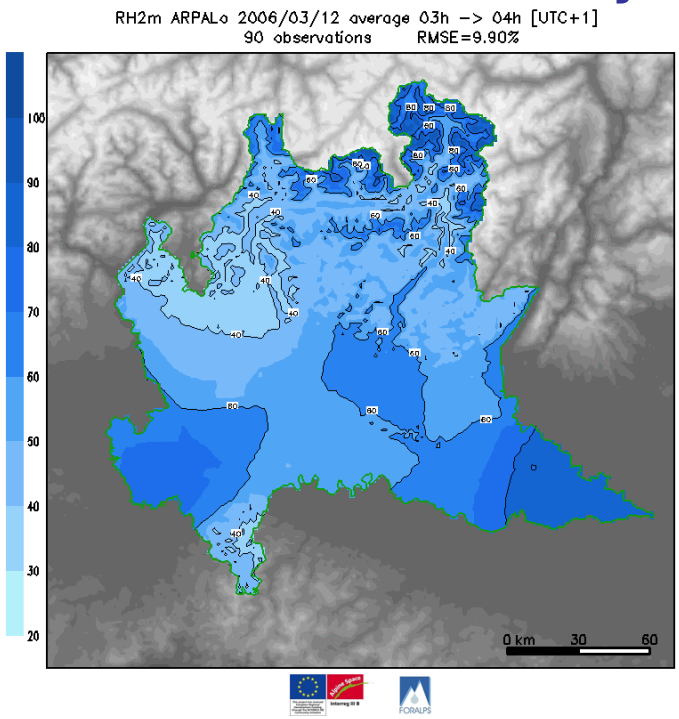


Foehn case: 2006/03/12 03–04 UTC+1

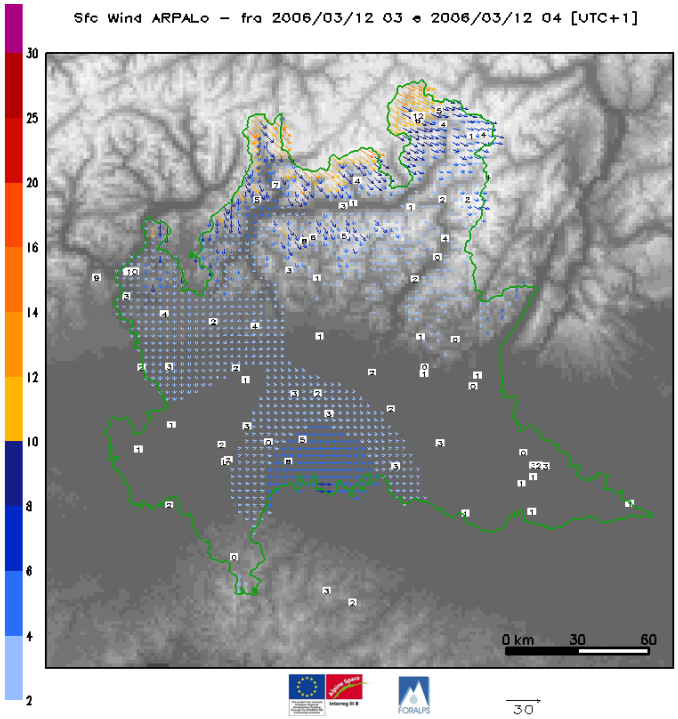
Temperature



Relative humidity



Wind



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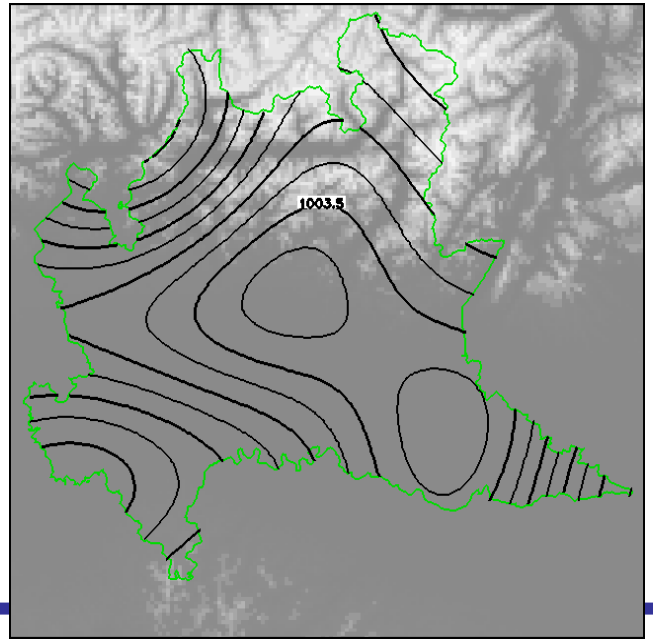
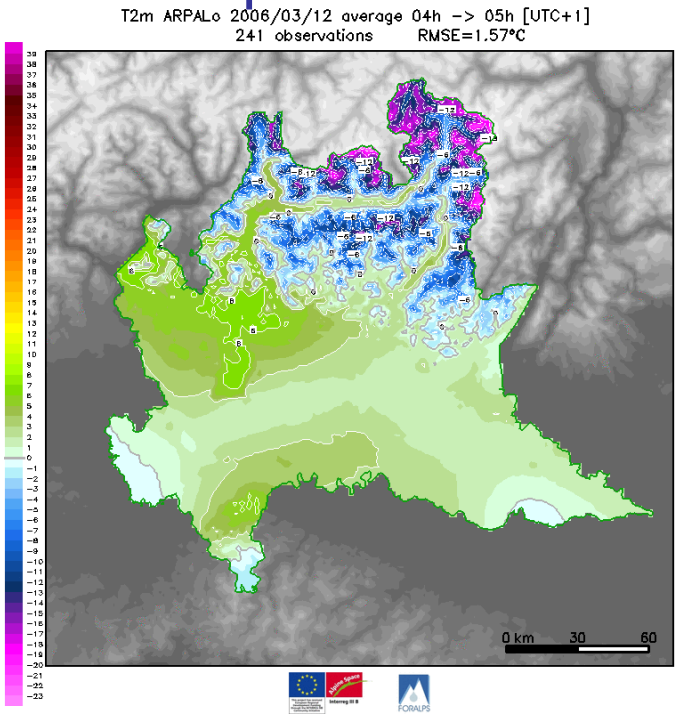
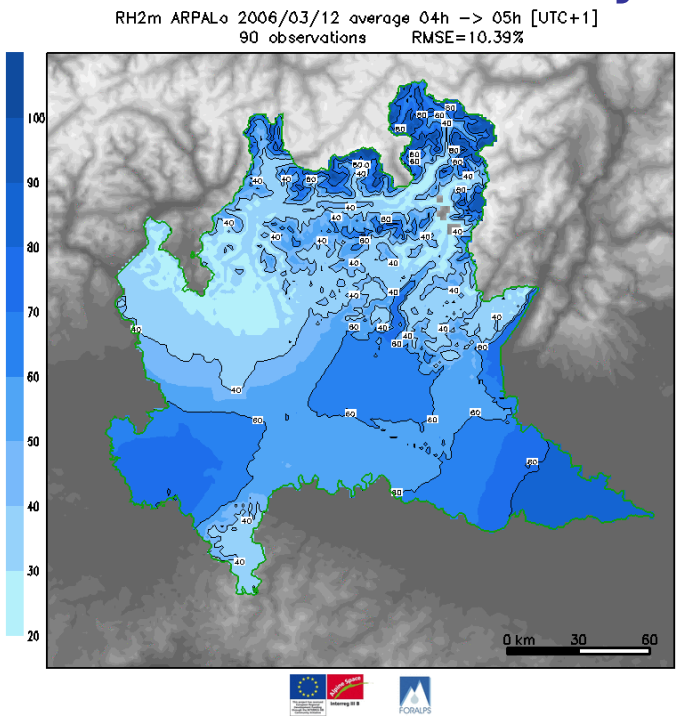


Foehn case: 2006/03/12 04–05 UTC+1

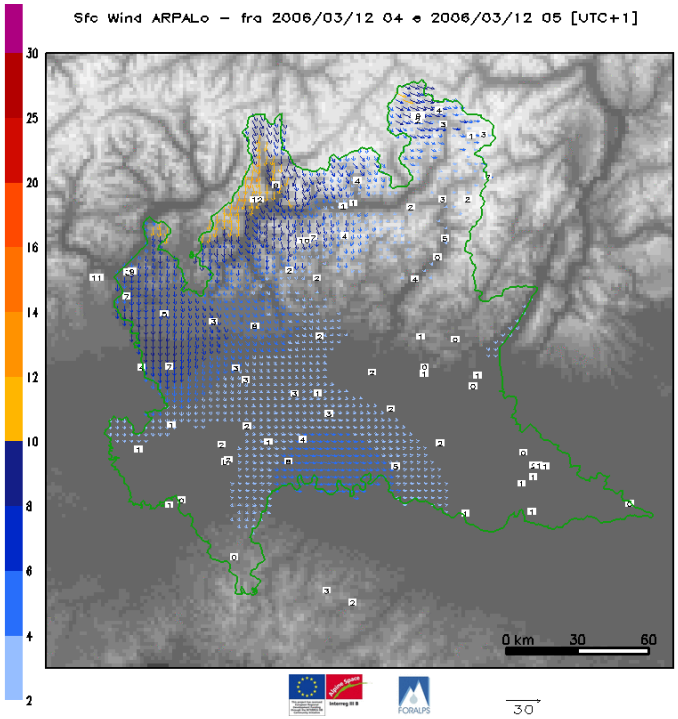
Temperature



Relative humidity



Wind



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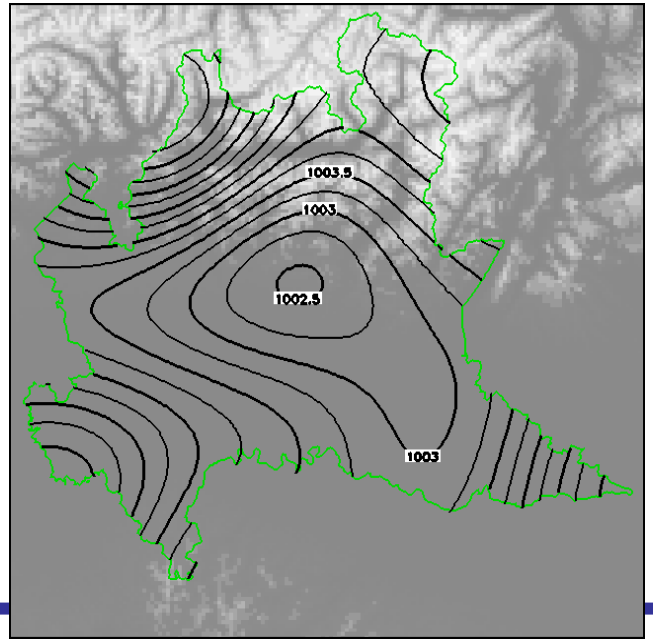
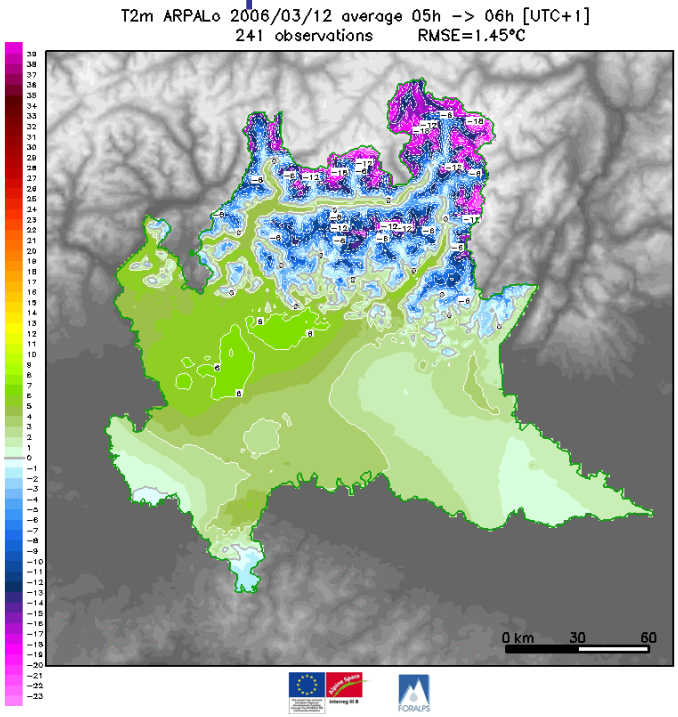
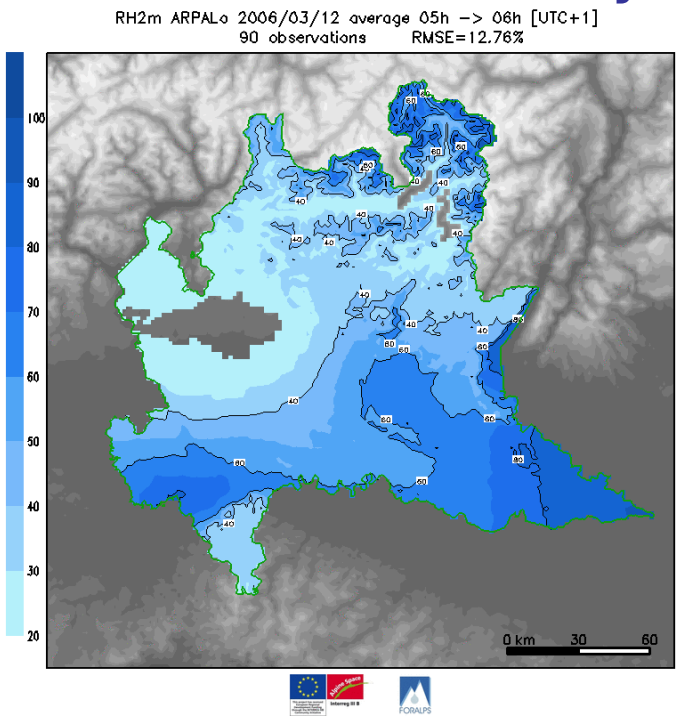


Foehn case: 2006/03/12 05–06 UTC+1

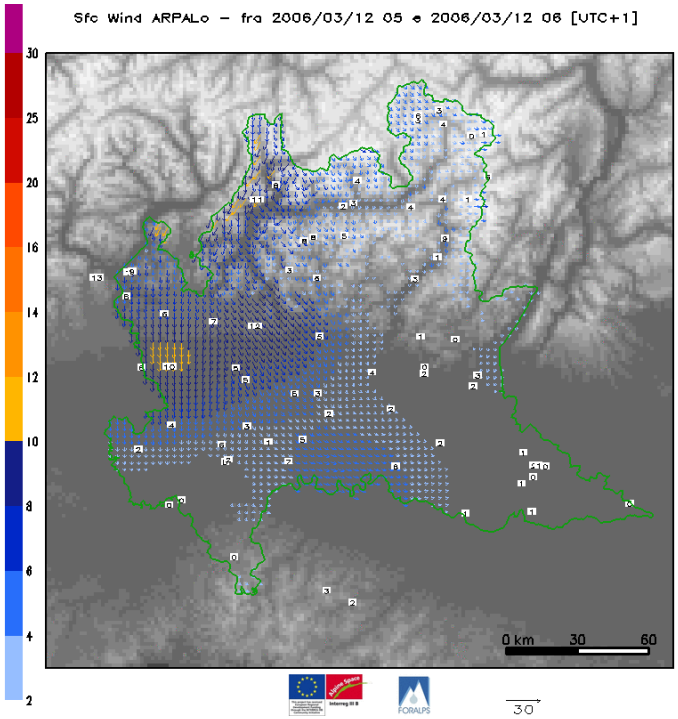
Temperature



Relative humidity



Wind



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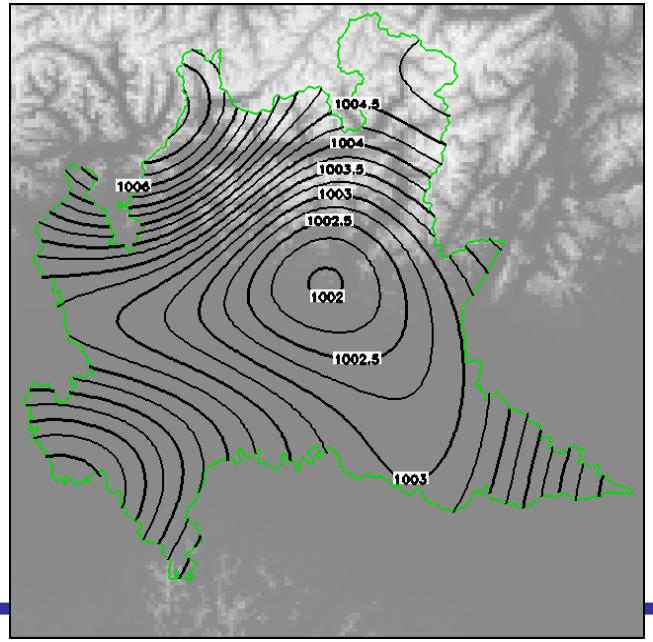
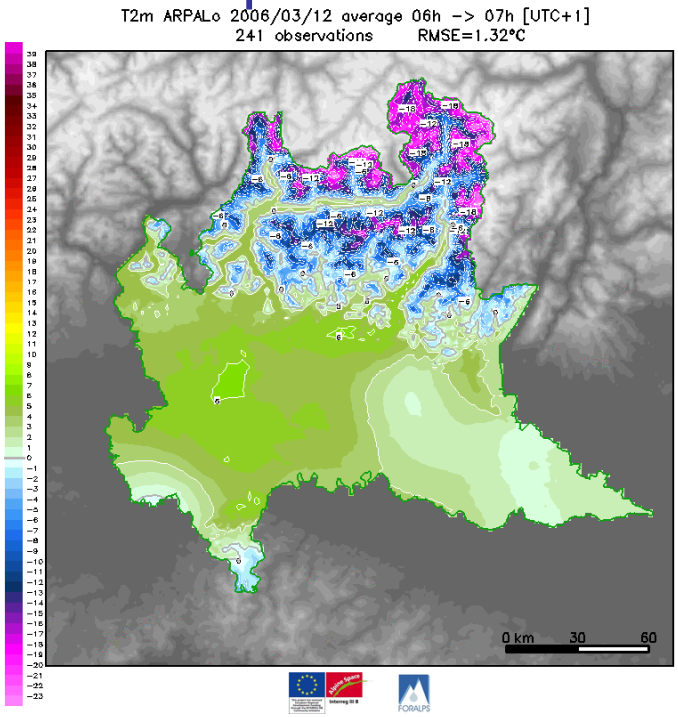
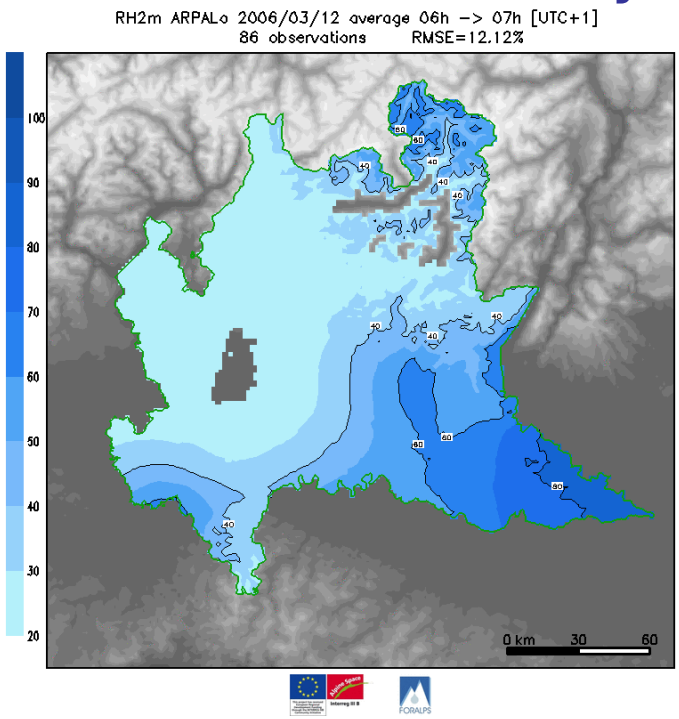


Foehn case: 2006/03/12 06–07 UTC+1

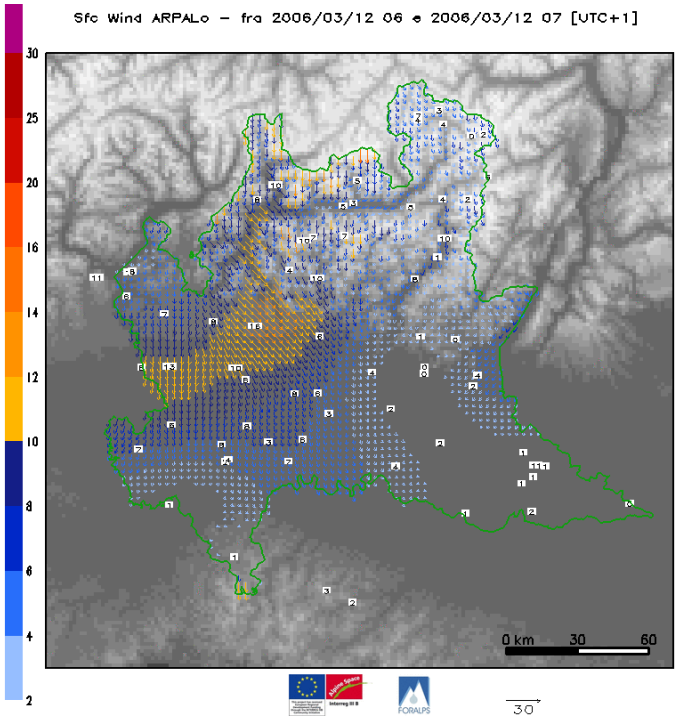
Temperature



Relative humidity



Wind



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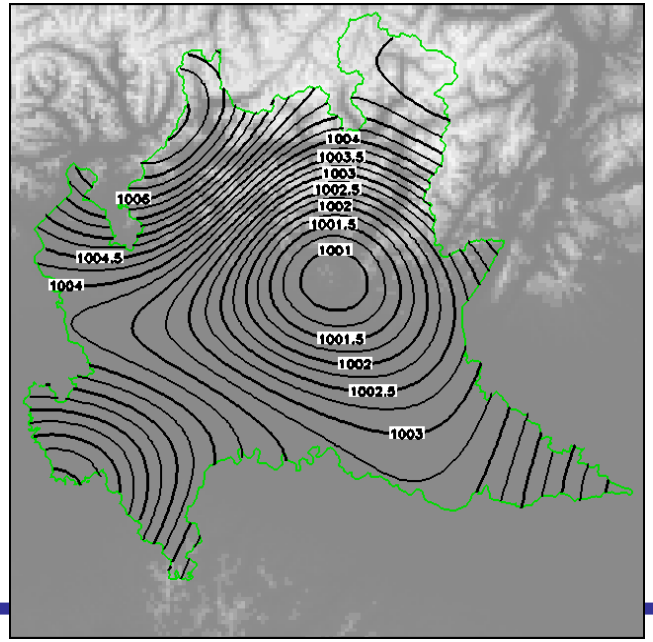
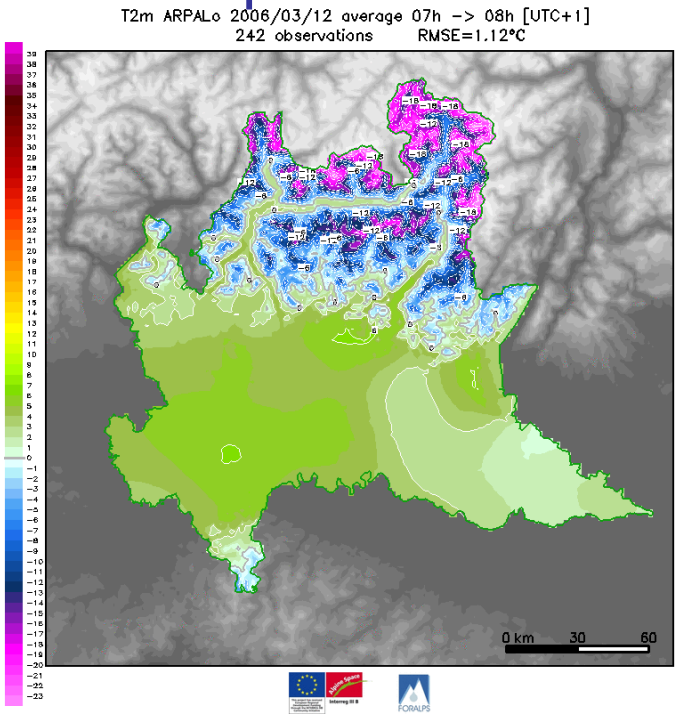
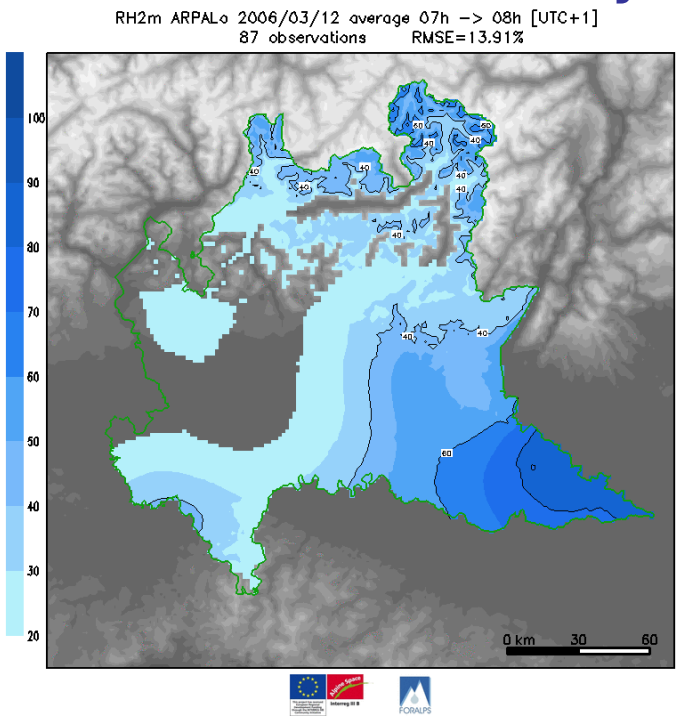


Foehn case: 2006/03/12 07–08 UTC+1

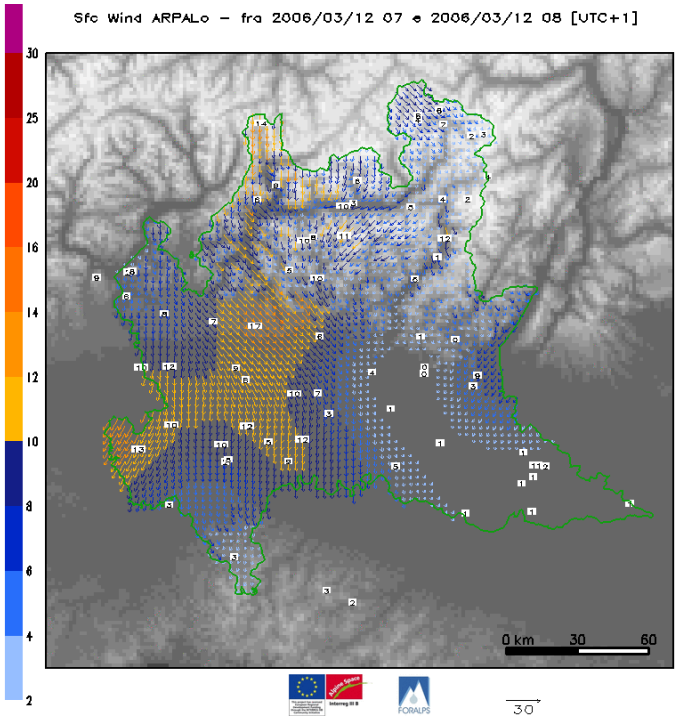
Temperature



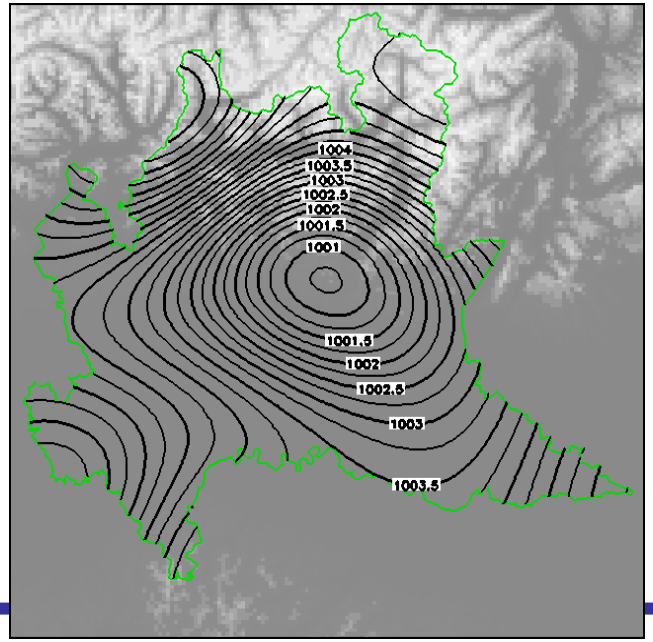
Relative humidity



Wind

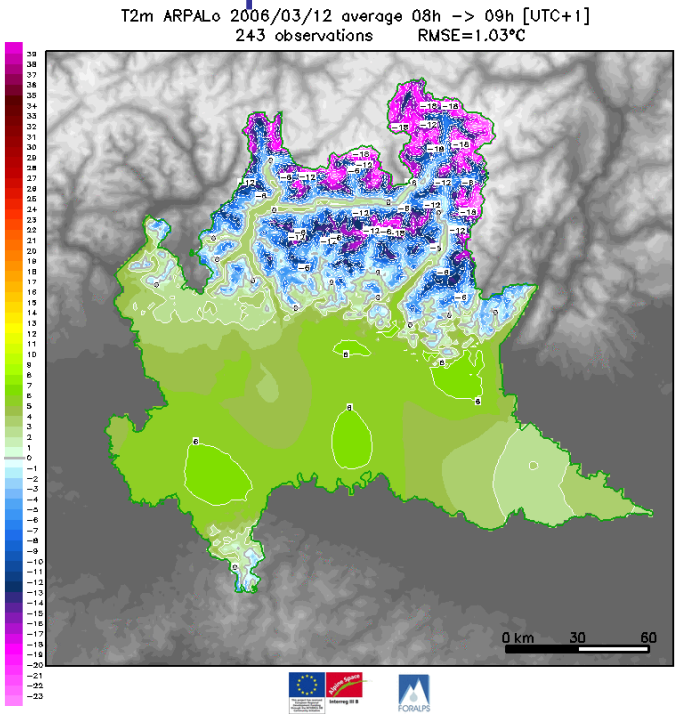


MSLP

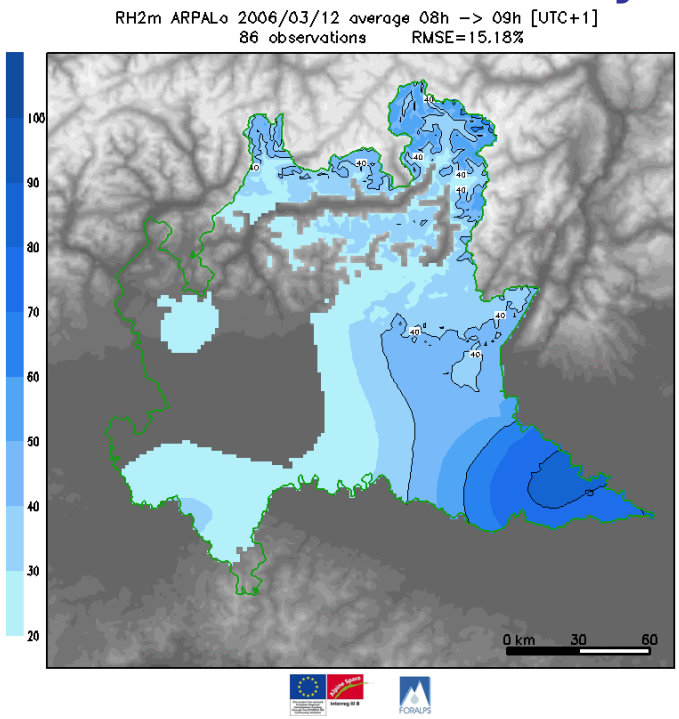


Foehn case: 2006/03/12 08–09 UTC+1

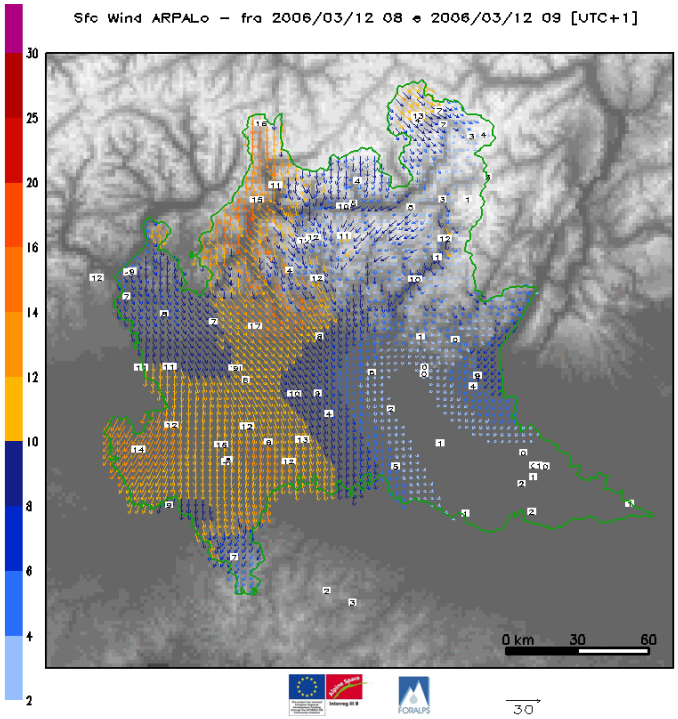
Temperature



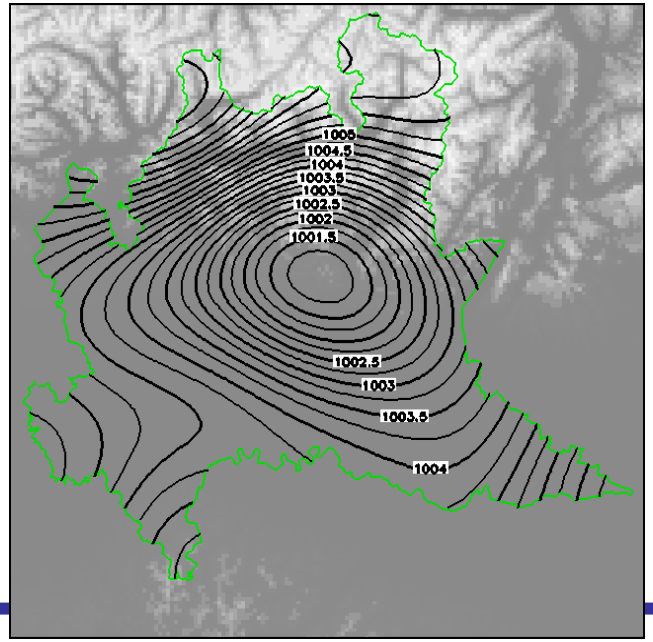
Relative humidity



Wind

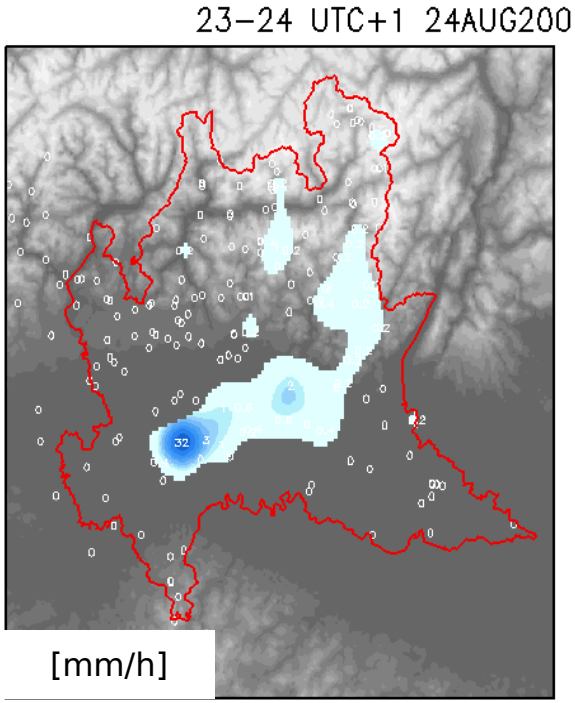


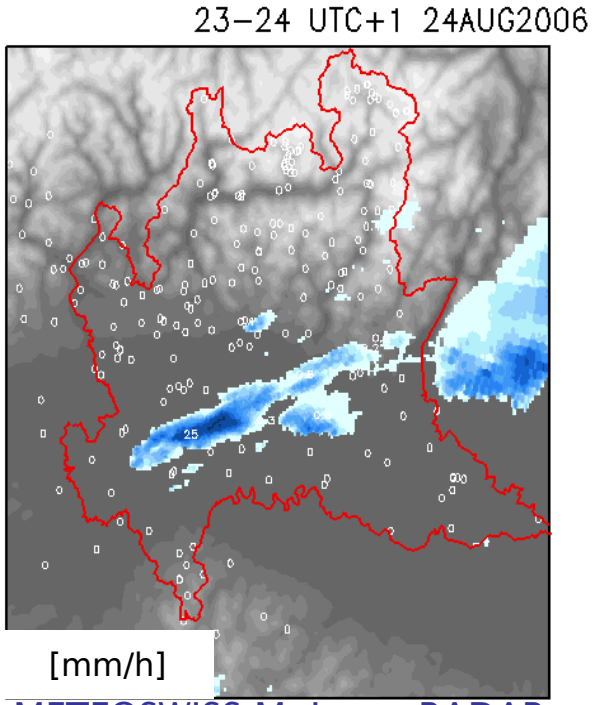
MSLP

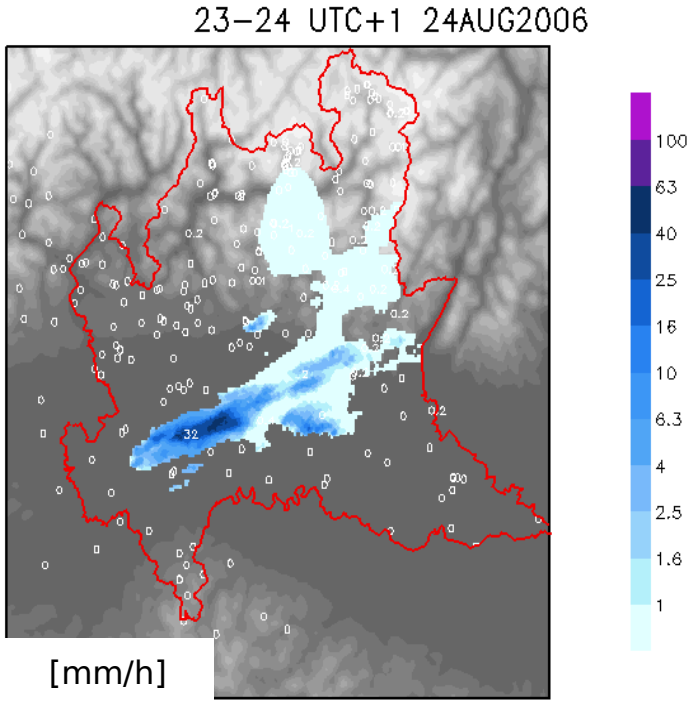


Precipitation

Convective precipitation



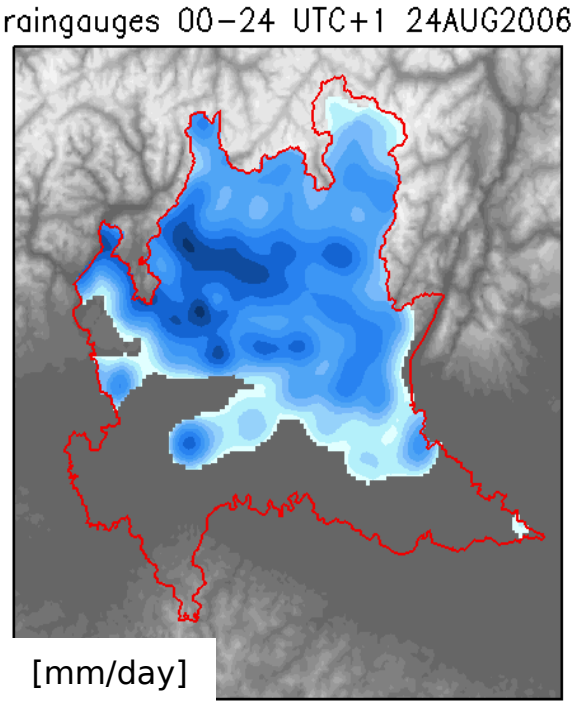


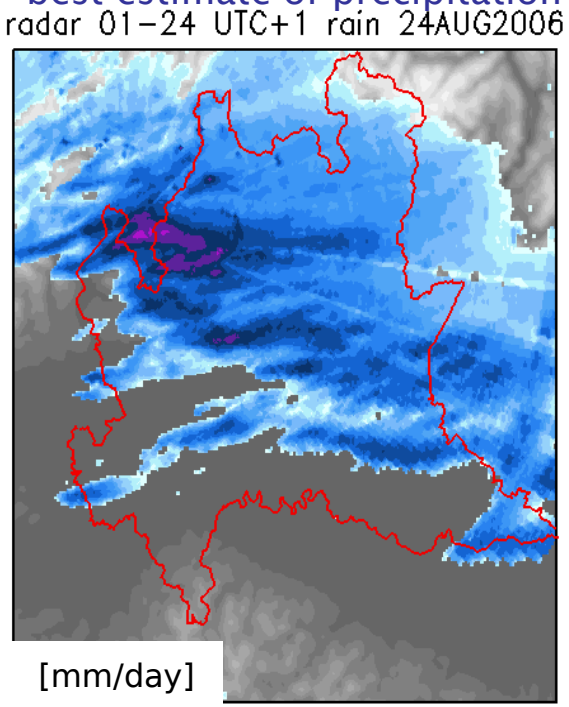


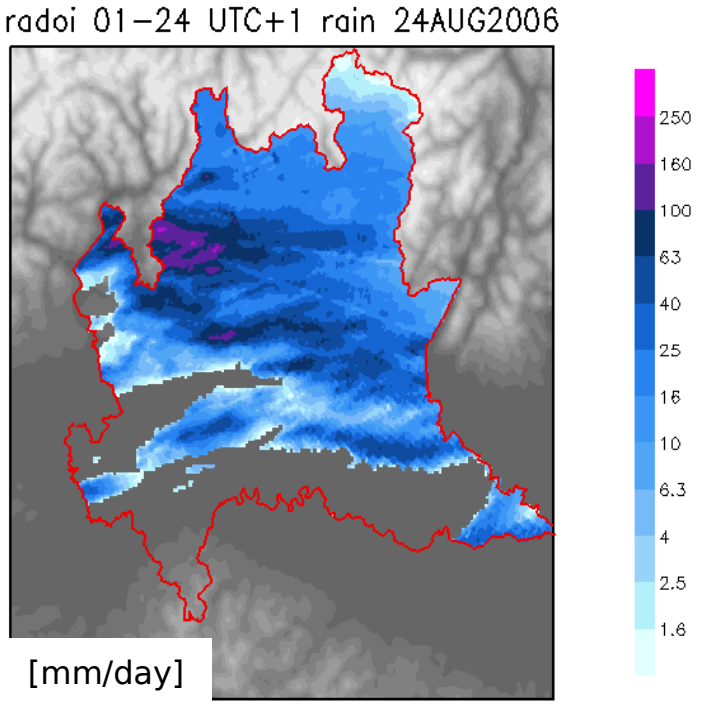
Raingauges

METEOSWISS M. Lema RADAR best estimate of precipitation

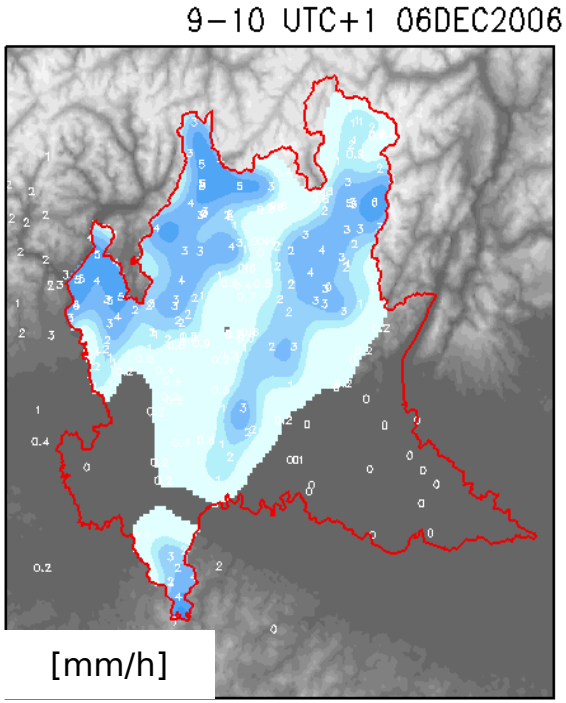
Raingauges + Radar



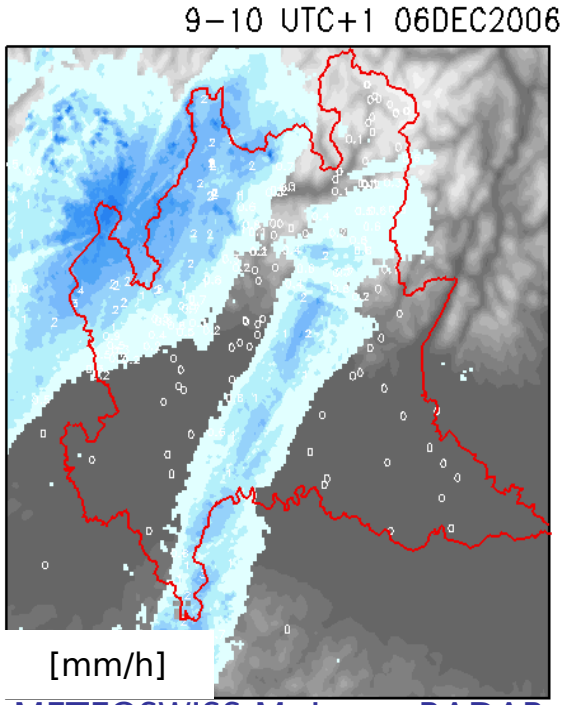




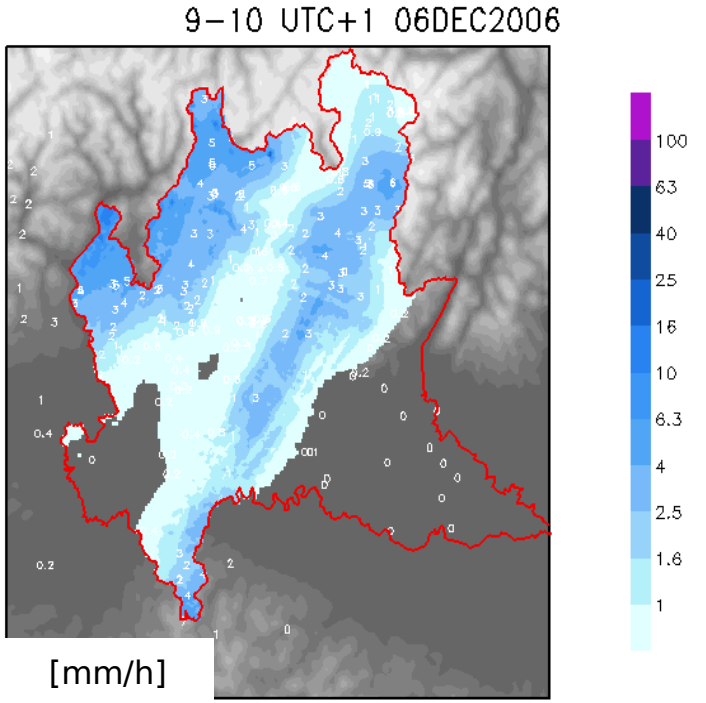
Stratiform precipitation



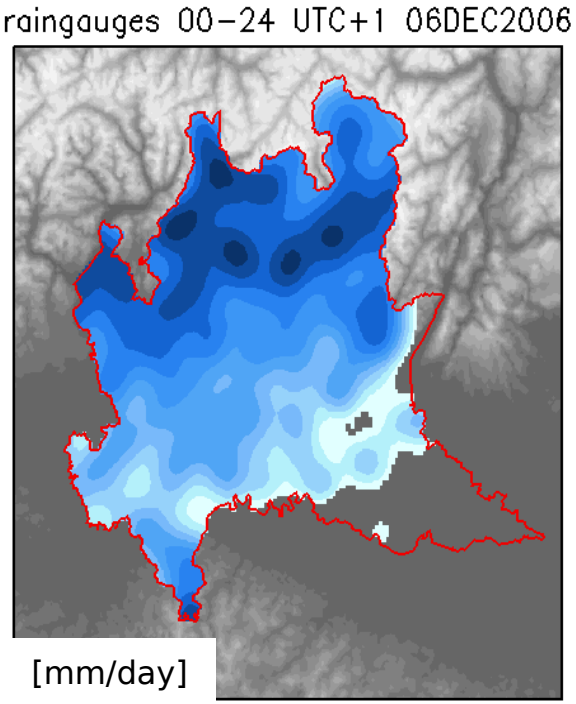
Raingauges

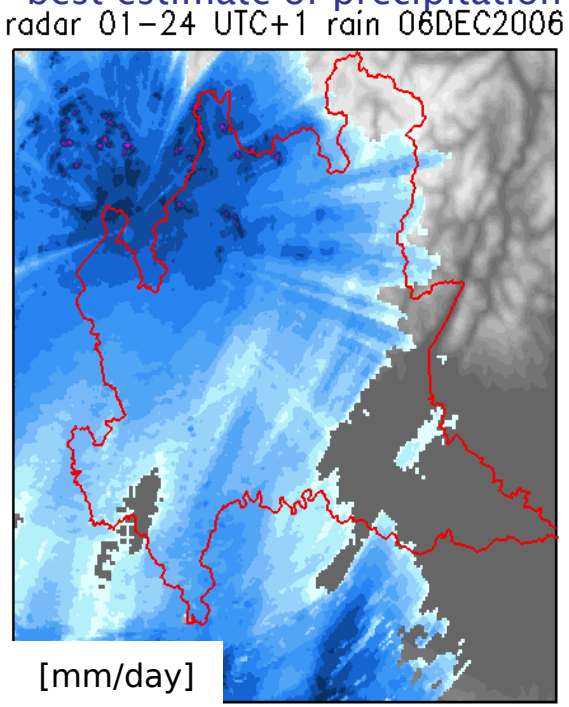


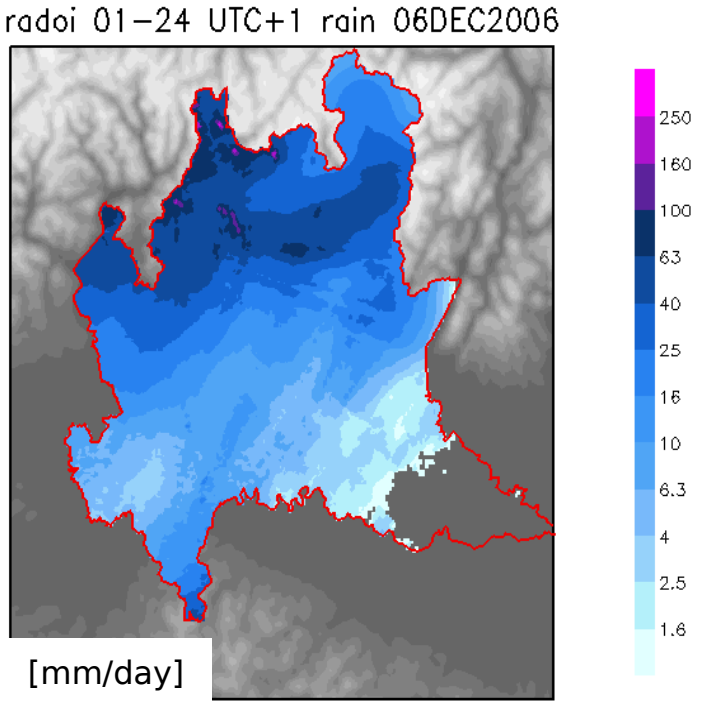
METEOSWISS M. Lema RADAR
best estimate of precipitation



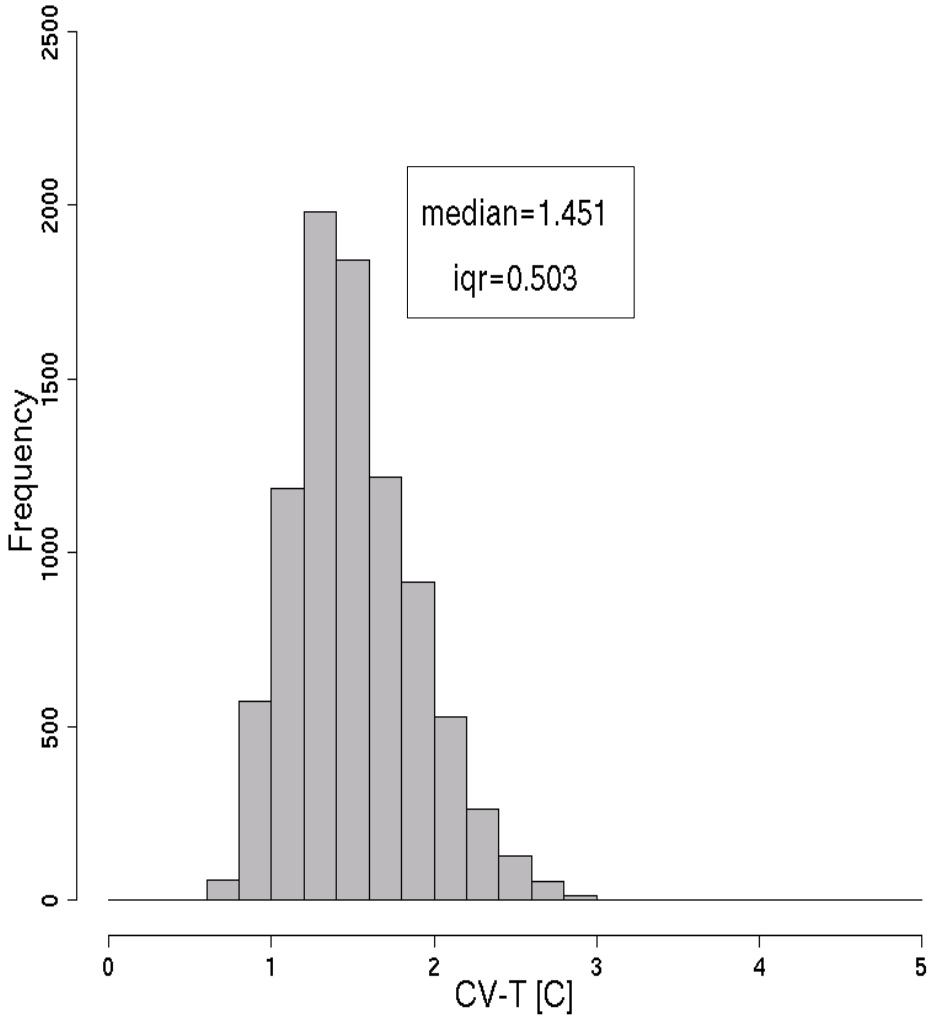
Raingauges + Radar

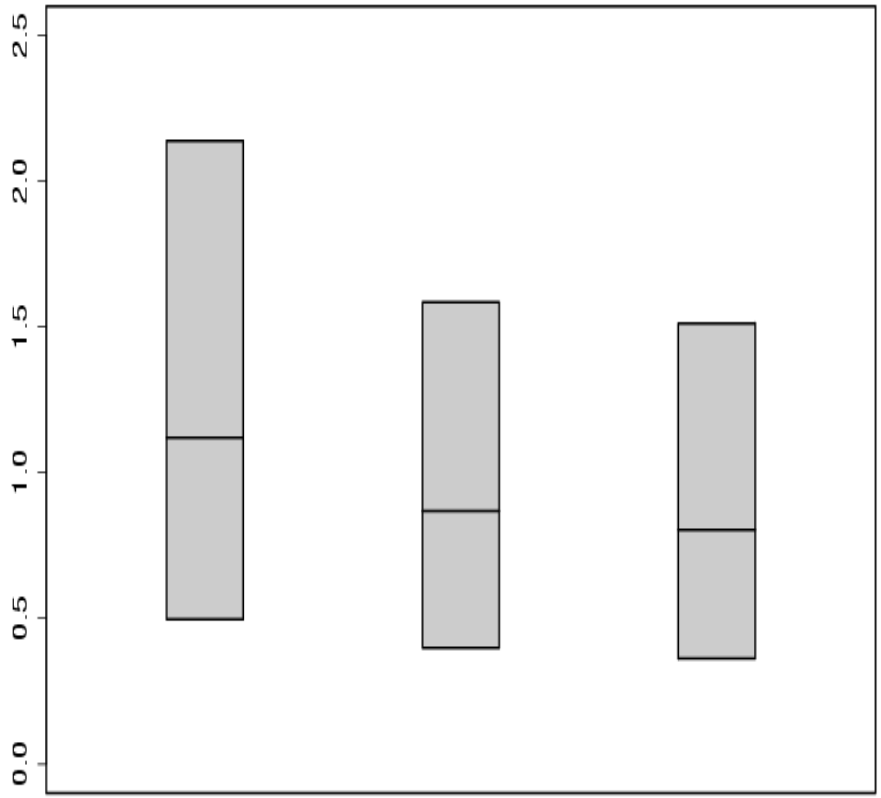






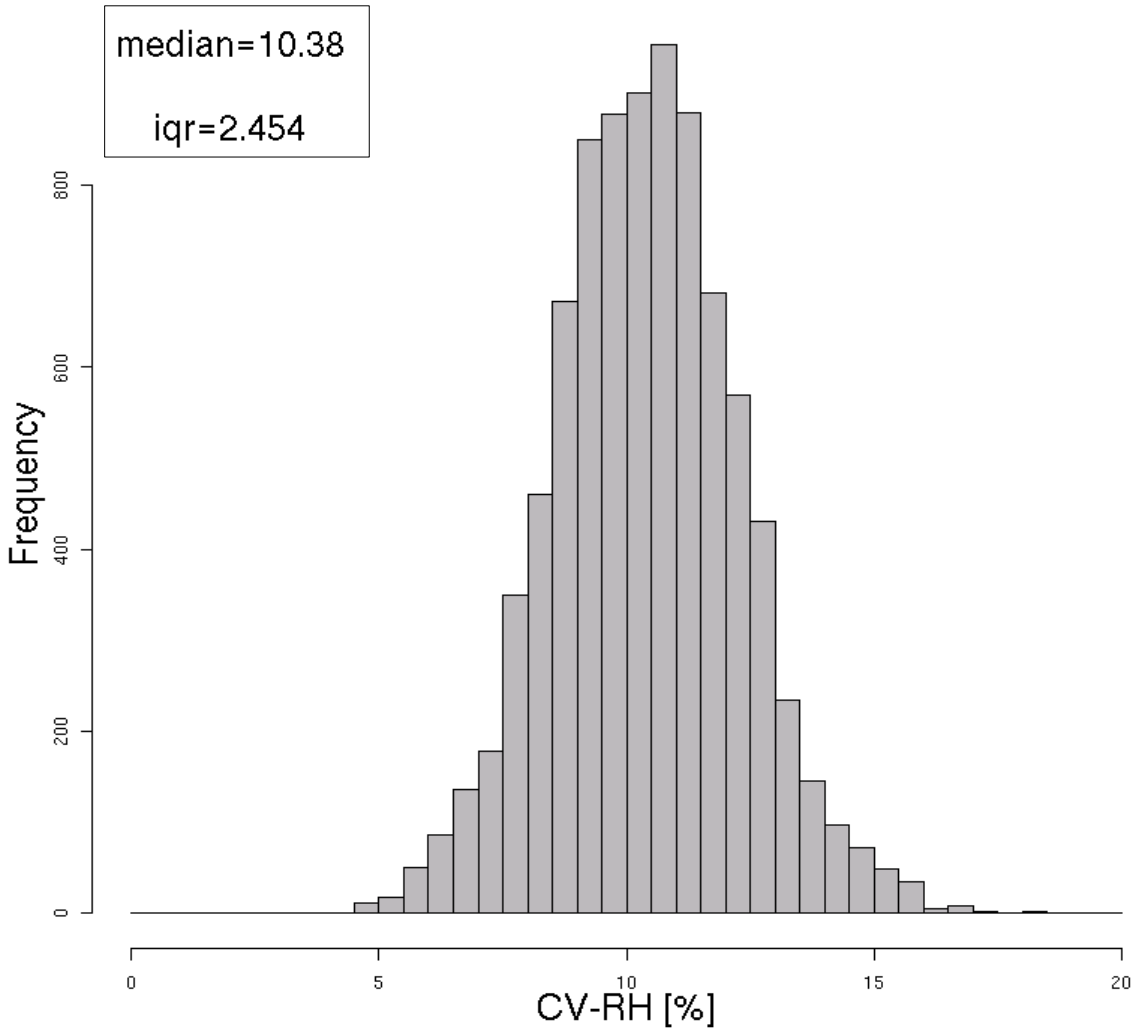
CV scores – Temperature





isolated stations → dense area

CV scores – Relative humidity



Conclusions

- Observations from high-resolution local networks, despite the presence of important representativity errors and the complex topography of Lombardia, do provide useful mesoscale information that is correctly recovered by the interpolation.

- The presented scheme has been running daily for over two years in the Lombardia weather service, producing quite satisfactory hourly maps of several variables

- A better knowledge on reliability and errors of the observational network also resulted from the studies carried out to implement the OI scheme

Thanks to:
FORALPS project INTERREG IIIB Alpine Space Programme Project (www.foralps.net)

References:

Uboldi F., C. Lussana and M. Salvati, 2008.
Three-dimensional spatial interpolation of surface meteorological observations from high-resolution local networks.
Meteorological Applications, **15**, 331-345.

See also:
http://magritte.it/francesco.uboldi
http://ita.arpalombardia.it/ITA/meteo/foralps_interpolazione.asp

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