High resolution regional reanalysis for the European CORDEX domain

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Overview

A Retrospective Analysis of Regional Climate is the focus of the joint research group (Climate Monitoring Branch) at the Meteorological Institute, University of Bonn (MIUB) and the Institute for Geophysics und Meteorology, University of Cologne (IGMK) within the Hans-Ertel Centre for Weather Research (HErZ), funded by the Deutscher Wetterdienst (DWD). The reanalysis will be based on the operational NWP system of the DWD with the COSMO model.

Main objectives

- Provide a regional reanalysis for the European CORDEX domain and the COSMO-DE domain covering at least a 5-year period
- Evaluation and Verification of the reanalysis data set
- Development of an passive/active microwave transfer operator
- Development of new methods for the assimilation and disaggregation of precipitation

Technical details of the reanalysis

COSMO-CORDEX

- Horizontal resolution of 0.055° (≈ 6.2km)
- 40 vertical levels
- Domain covering -45 to 65° Longitude and 22 to 72° Latitude
- 3-hourly boundary data from ERA-Interim
- Hourly 3D-Output, 15min 2D-Output
- Continuous data assimilation via nudging

COSMO-DE

- Horizontal resolution of 0.025° (≈ 2.8km)
- 50 vertical levels
- Domain covering 1 to 20° Longitude and 44 to 56° Latitude
- Hourly boundary data from COSMO-CORDEX
- Hourly 3D-Output, 15min 2D-Output
- Continuous data assimilation via nudging

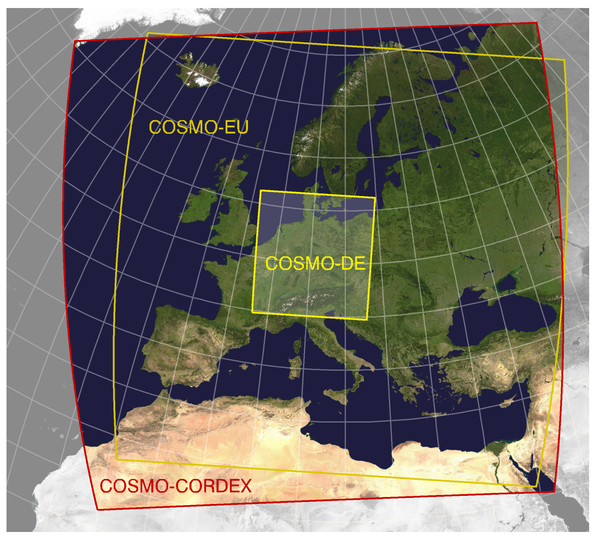

Figure: Domain coverage of COSMO-CORDEX, COSMO-EU and COSMO-DE

Results

Analysis Increments

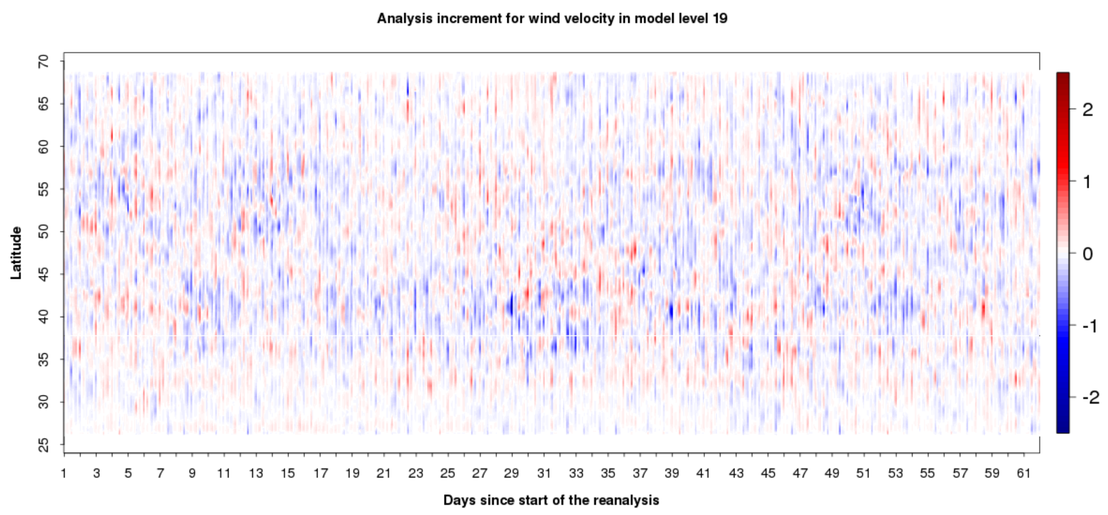

Figure: Zonal mean of the analysis increments for wind speed and temperature in COSMO-CORDEX for Nov-Dec 2010. Wind speed at σ-level 19 (≈ 500hPa) in $\frac{m}{s}$ and temperature at σ-level 29 (≈ 850hPa) in K

- Analysis increments show the influence of the nudging scheme on the reanalysis
- Important diagnostic tool to evaluate performance of the model
- Increments small compared to actual values (as expected)

Results (continued)

Precipitation

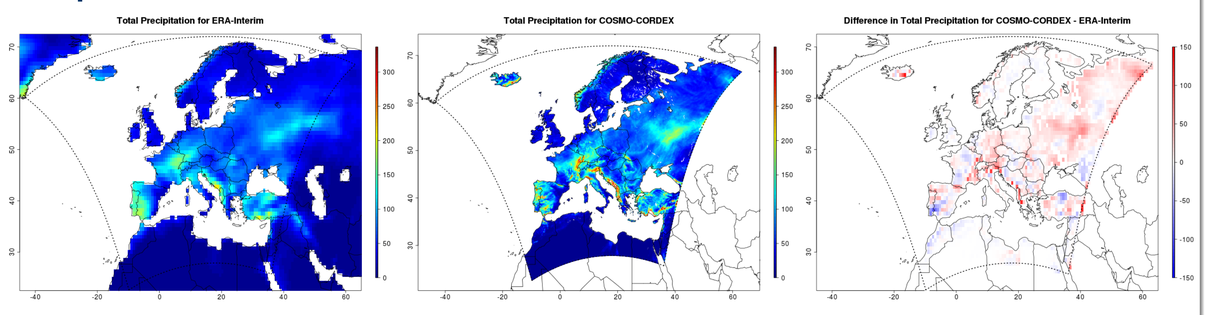

Figure: Accumulated precipitation for November-December 2010 in mm. From left to right: ERA-Interim reanalysis, COSMO-CORDEX reanalysis, COSMO-CORDEX minus ERA-Interim

- The overall precipitation structure compares well with ERA-Interim
- Small scale structures such as higher precipitation in areas with high topography are better represented in COSMO-CORDEX

Heat fluxes

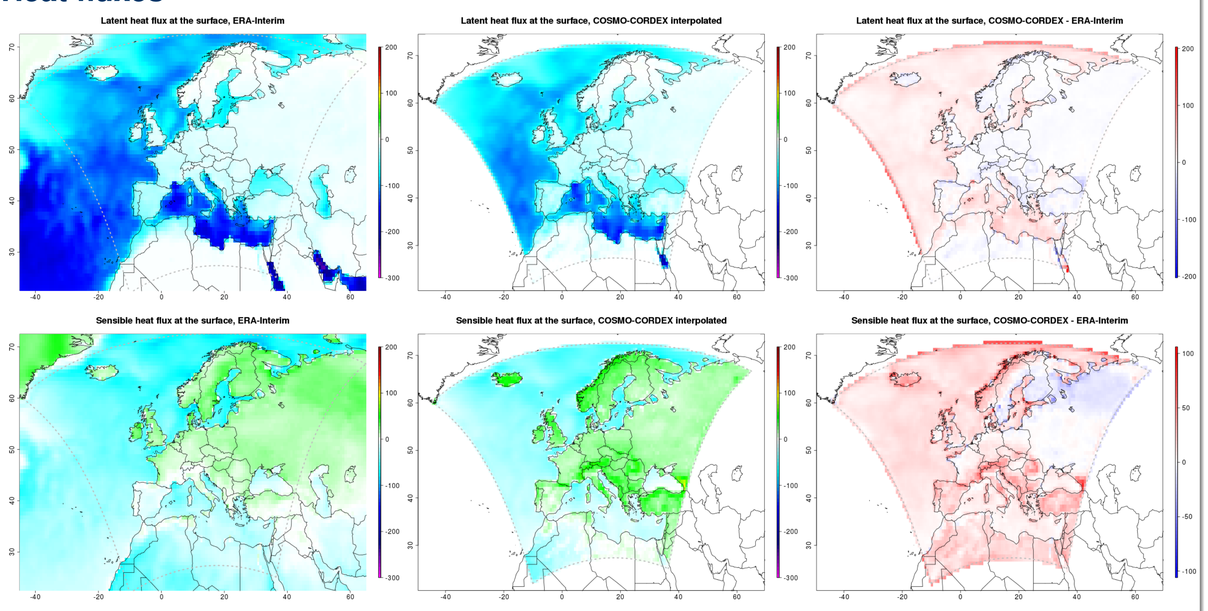

Figure: Latent heat flux (top) and sensible heat flux (bottom) for ERA-Interim (left), COSMO-CORDEX (middle) and the difference between COSMO-CORDEX and ERA-Interim. All figures are in $\frac{W}{m^2}$ and represent mean values over the period November-December 2010

- The sensible and latent heat fluxes in COSMO-CORDEX compare well with ERA-Interim
- The differences mainly result from the higher resolution in COSMO-CORDEX

Synthetic satellite pictures

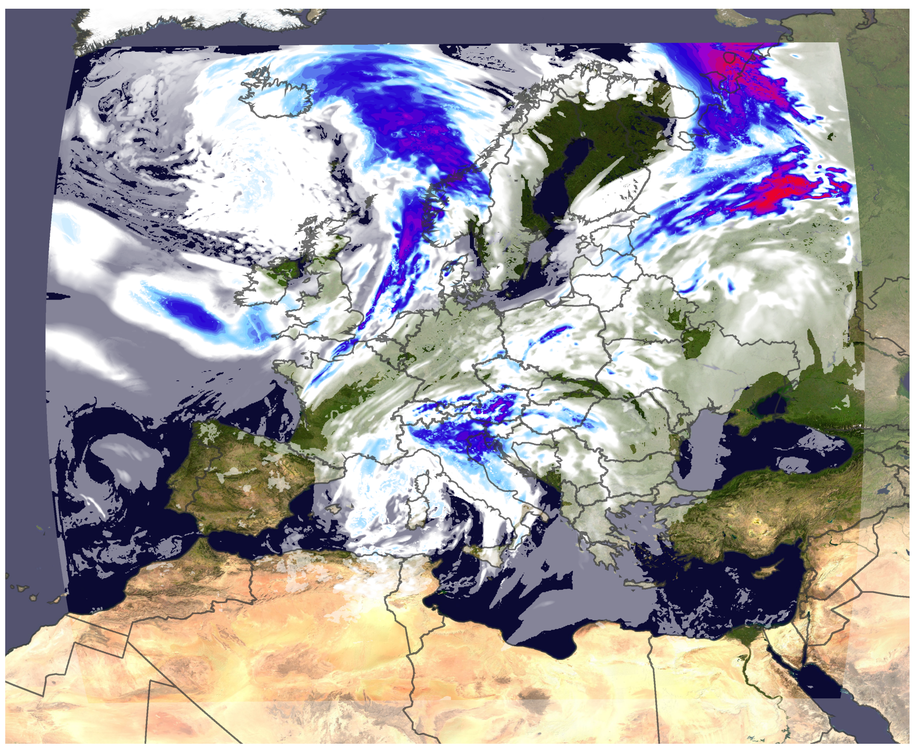

Figure: Synthetic satellite picture created with RTTOV for 2nd November 2010, 00 UTC. White and grey colors show the cloud cover and blue to red colors show the corresponding precipitation

- Synthetic satellite images are produced every 15 mins with RTTOV9, which is implemented in COSMO.
- They are used for verification purposes with the developed microwave operator

Outlook

It is planned to finish at least five years of reanalysis for the COSMO-CORDEX and COSMO-DE domain by the end of 2013. The developed tools will be used to evaluate and verify the quality of the reanalysis.