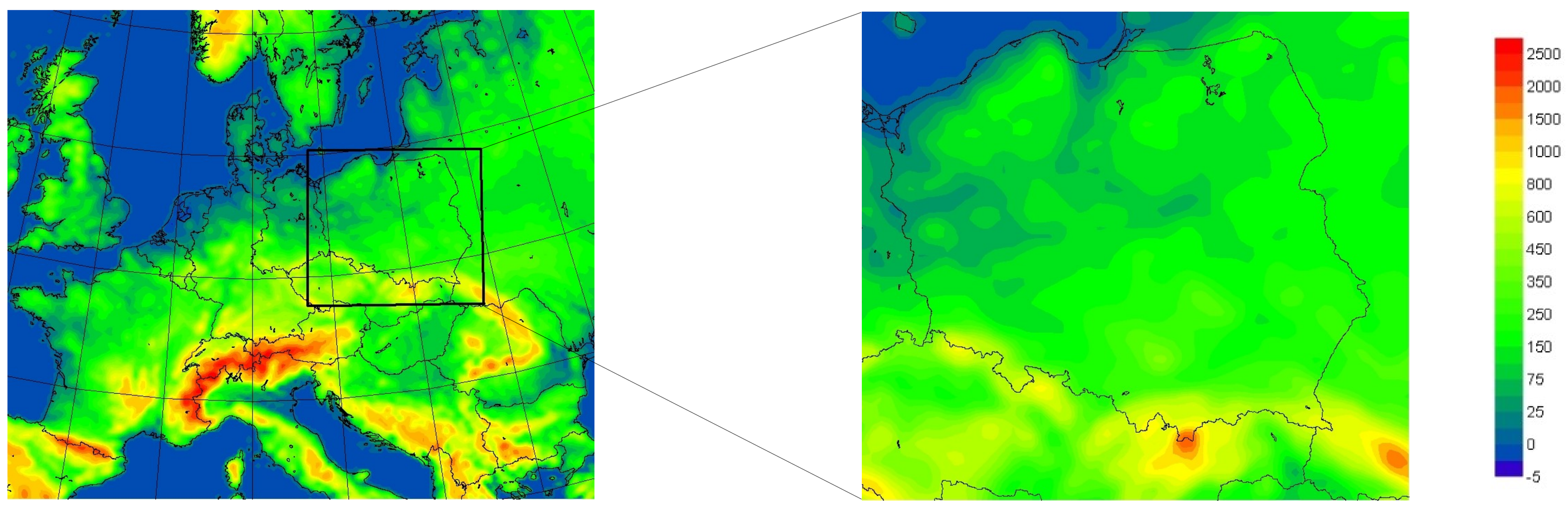
Numerical Weather Prediction at IMGW-PIB

Joanna Linkowska[1], Bogdan Rosa[2], Zbigniew Piotrowski[2], Damian Wójcik[2], Andrzej Mazur[1], Michał Ziemiański[2]

[1] IMGW-PIB Center of Numerical Weather Forecasts, [2] IMGW-PIB, Numerical Methods Development Group, Warsaw, Poland

Status of the operational suite & Computing system

COSMO PL 7 | COSMO PL 2.8



Horizontal Grid Spacing [km]	7	2.8
Domain Size [grid points]	385 x 321	285 x 255
Forecast Range [h]	78	36
Initial Time of Model Runs [UTC]	00 06 12 18	00 12
Model Version Run	4.08	4.08
Lateral Boundary Conditions	Interpolated from GME at 3h intervals	Interpolated from COSMO-PL 7
Initial State	Interpolated from GME	Interpolated from COSMO-PL 7
Data Assimilation	Nudging scheme	none
Prognostic Variables	U, V, W, T, P, PS, Q_V, Q_C, Q_I, Q_{VS},TKE	U, V, W, T, P, Q_V, Q_C, Q_I, Q_{VS}, TKE

- HP Bl460c - 32 blades in 2 racks c7000 - LINUX CLUSTER controlled by 2 managing servers.
- Every blade contains 2 4-core 16 GB processors Intel Xeon X5570.
- Blades interconnected with InfiniBand 4xQDR.
- Computing power above 2,5 T FLOPS.
- Cluster with 2TB storing volume connected with NetApp disks via the Fibre Channel protocol.

Future developments:

- New computing system: computing power 45 T FLOPS with a possible extension up to 70 T FLOPS
- Initial setup for Ensemble Prediction System (EPS) based on soil/surface perturbations

Post-Processing – example

Soaring forecasts – predictions of conditions for gliders using output from COSMO PL 2.8 km

Radar Simulation – simulation of the radar reflectivity images based on COSMO PL 7 km output

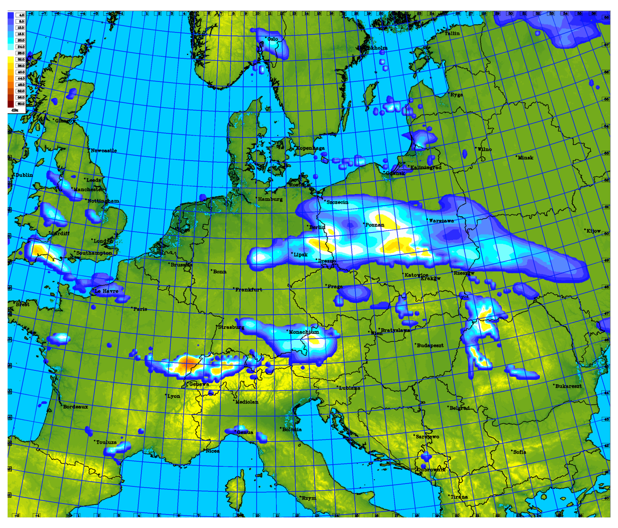
Wave Watch III (WW3) – a sea wave model using output from COSMO PL 7 km

Decision Support System for Forecasters – an expert system to help forecasters to issue warnings or alerts

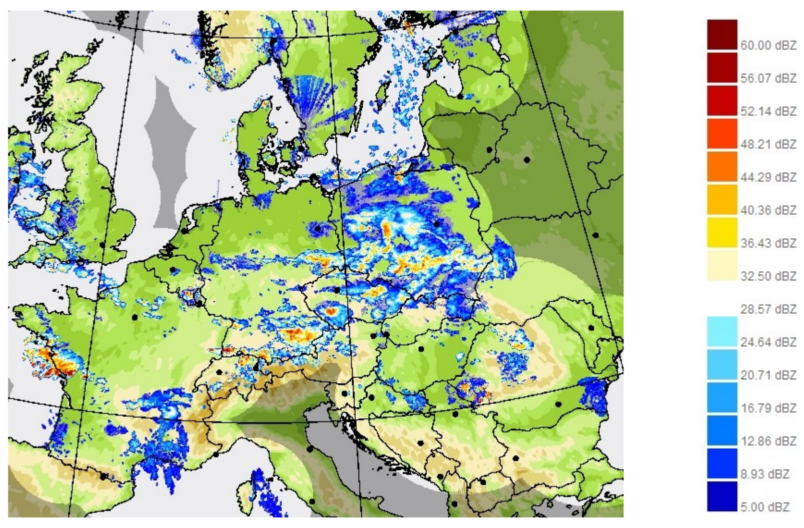
Forecast for Yachtsmen – predictions of wind speed and wind direction for selected water bodies

Dispersion model – predictions of air dispersion of volcano ashes using output from COSMO PL 7 km

Simulation of the composite radar image 26.09.2013, 00+09 UTC



Reflectivity dBZ, radar network 26.09.2013, 09 UTC



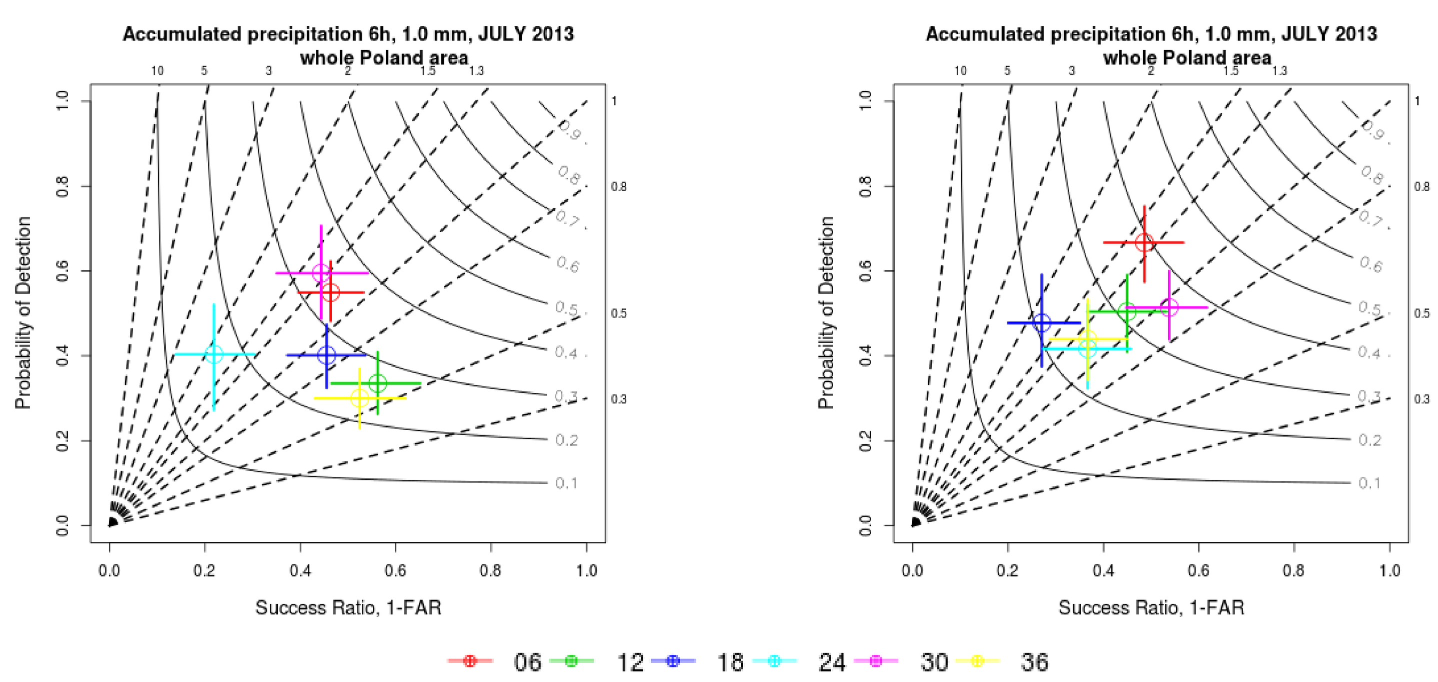
The simulation (model forecast) of the composite radar image for model domain shows reflectivity in dBZ

Verification – example

The distribution of precipitation varies greatly in space and time. A performance diagram technique applied to precipitation forecast allows multiple characteristics of a dichotomous forecast to be shown in a single diagram. For good forecasts, POD, SR, BS, CSI approach unity and a perfect forecast lies in the top right hand corner of the diagram (P.J. Roebber, 2009). The charts present the verification example of 6h accumulated precipitation forecasts over whole Poland area. The POD and SR results show better forecast performance for COSMO PL 2.8.

Accumulated precipitation 06 h, 1.0 mm, performance diagram, terrain: whole Poland area forecast run 00 UTC, July 2013

COSMO PL 7 | COSMO PL 2.8



Research & Development

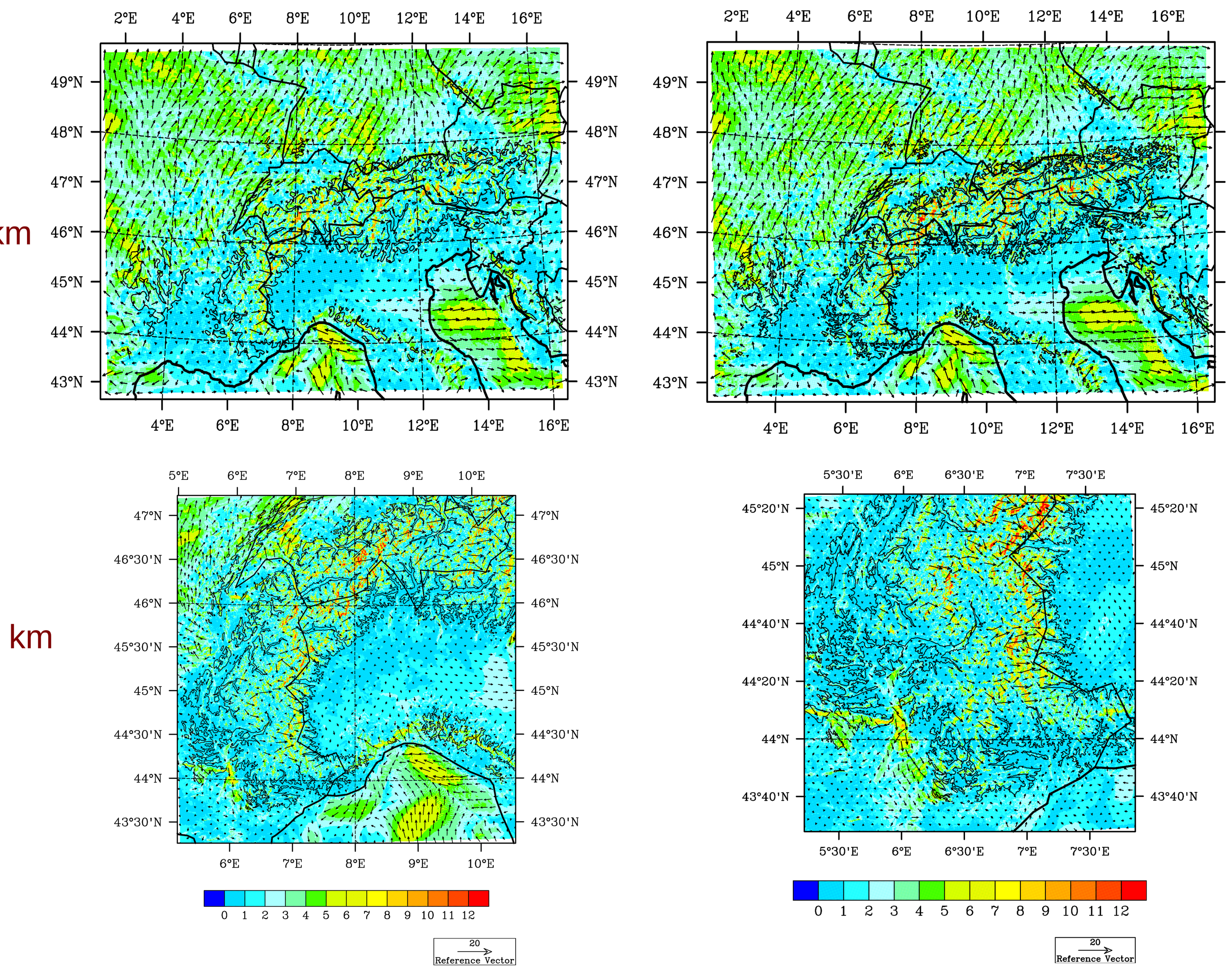
COSMO – EULAG Operationalization (CELO)
COSMO Priority Project

The main tasks of the project are consolidation and optimization of the setup of the anelastic EULAG dynamical core for the high-resolution NWP, full integration of EULAG with COSMO framework, optimization and tuning of the COSMO physical parameterizations, and testing and exploiting forecasting capabilities of the integrated model.

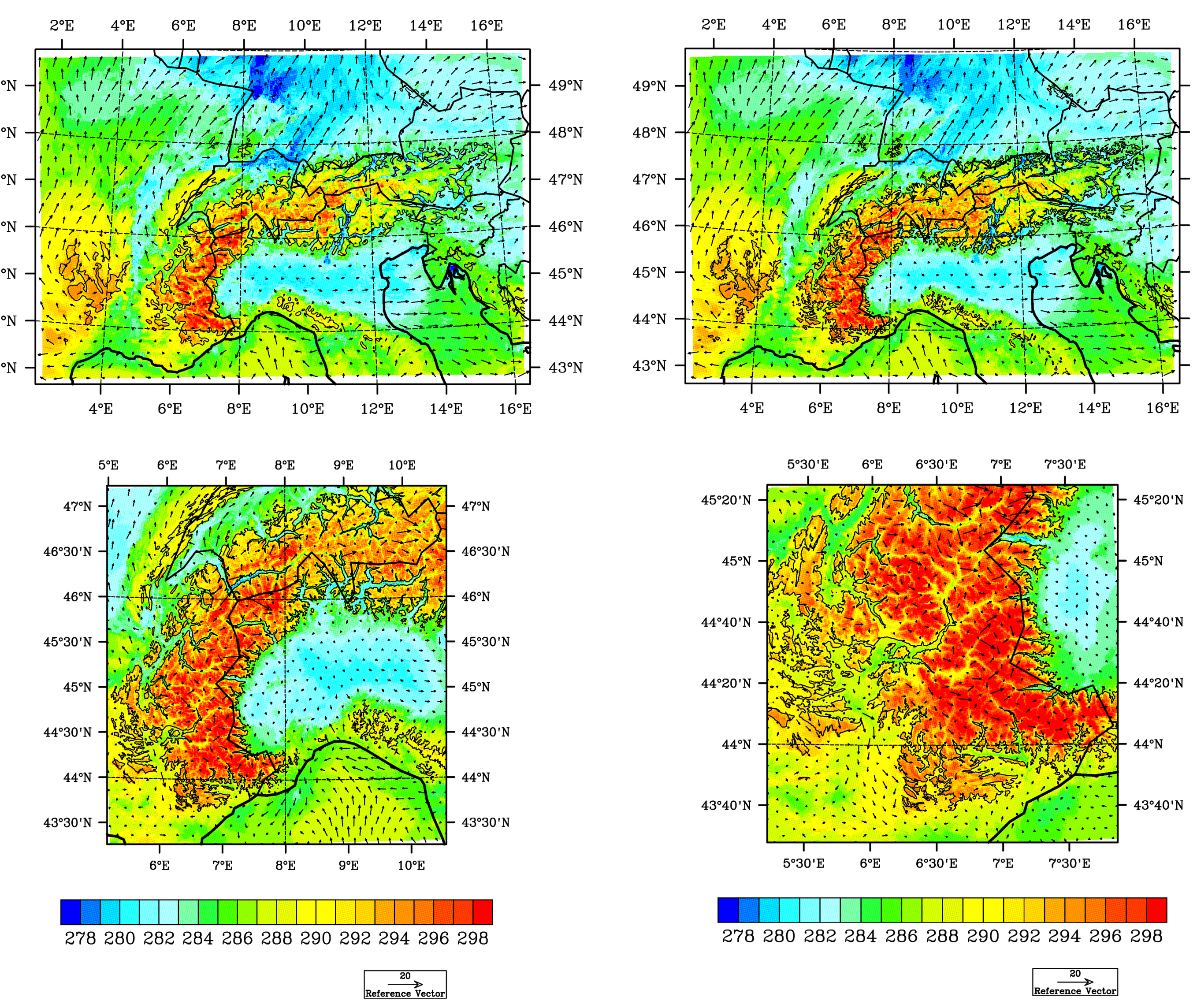
The experiment setup

The tests are based on the 24-hour simulation of an Alpine flow using the COSMO model with EULAG dynamical core (CE). The employed parameterizations are: vertical turbulence diffusion, surface fluxes (Louis, 1979), radiative transfer scheme (Ritter & Geleyn, 1992), multilayer soil model, moist microphysics with prognostic variables including rain, snow, ice and graupel. Advection of the moisture quantities is operated with MPDATA (Multidimentional Positive Definite Advection Transport Algorithm). The figures below show results of the 12 h forecast on 12.11.2009, performed with horizontal resolutions 2.2 km, 1.1 km, 0.55 km, 0.28 km.

Flow : V [m/s], 10 m, 12 UTC

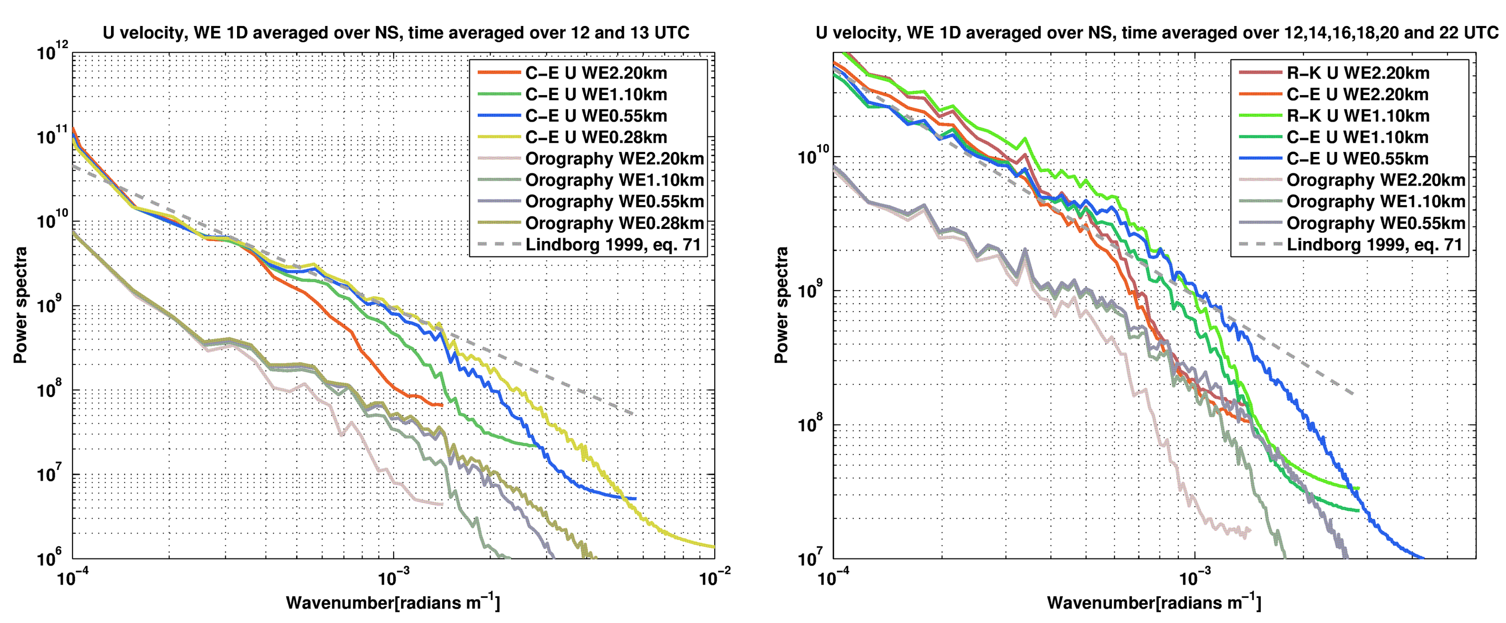


Potential temperature [K], 10 m, 12 UTC



The results show that increasing the horizontal resolution leads to increase of the small scale variability of the wind velocity and the potential temperature with the appearance of many small scale details in the near surface layer.

Kinetic energy spectra of 2.2 km, 1.1 km, 0.55 km and 0.28 km on limited domain



EULAG and RK dynamical cores produce similar spectral kinetic energy response at 2.2 km and 1.1 km for the scenario at hand. Effective resolution of the CE model increases with increasing horizontal grid spacing. For small wave numbers, power spectra are consistent with the analytical formula development by Lindborg (1999). The spectrum shape, especially at large wave numbers, is closely related to the power spectrum of the orography.

35 th EWGLAM and 20 th SRNWP meetings, 30 th September - 03 rd October 2013, Antalya, Turkey