LAM-ING IN SLOVENIA

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OF THE REPUBLIC OF SLOVENIA

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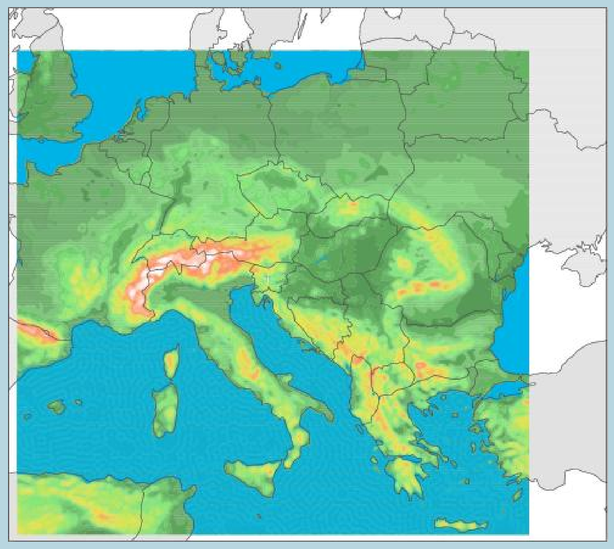
operational ALADIN

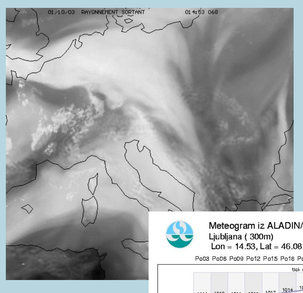
Characteristics of the operational ALADIN/SI model configuration:

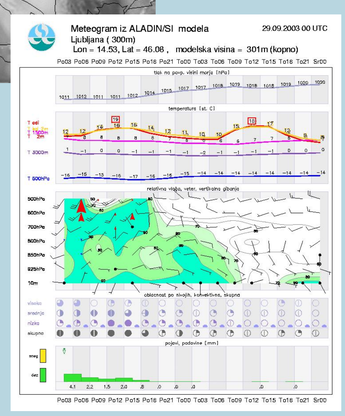
- spectral, elliptic truncation E89x84 (258*244 points, with extension zone 270*256 points on the collocation grid),
- Lambert projection
- 9.5 km horizontal grid spacing on the collocation grid,
- 37 vertical model levels,
- 400 s time-step, range of forecast 48 hour,
- initial and lateral boundary conditions from model ARPEGE,
- coupling at every 3 hours,
- digital filter initialization,
- integration twice per day.



Operational suite (running in Supervisor Monitor Scheduler, ECMWF product) consists of:

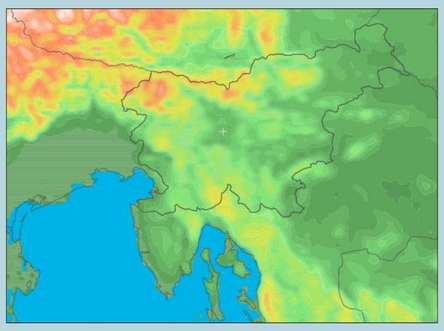
- transfer of ARPEGE files from Meteo-France, Toulouse via Internet
- preparation of files with lateral and boundary conditions
- the model integration - using 22 processors (11 nodes)
- visualization of meteorological fields
  - other products
  - selected fields are written in GRIB format on latitude/longitude regular grid
  - dynamical adaptation of surface wind and precipitation,
  - meteograms with correction of 2m temperature using Kalman filter for selected points,
  - time cross-sections (HRID based on pseudotemps) for selected points
  - simulation of satellite images (pseudo-satellite movie),
  - precipitation amounts needed for hydrological models,
  - vertical cross-sections for predefined directions,
  - some other products for end users inside the Environmental Agency of Slovenia (Internet) and outside users (electric companies),
  - saving the selected model output for verification.





Characteristics of ALADIN model configuration for dynamical adaptation of surface wind and precipitation:

- spectral, elliptic truncation E49x39 (148x108 points, with extension zone 160x120 points),
- 2.5 km horizontal grid spacing on the collocation grid,
- 17 vertical model levels,
- 60 s time-step,
- initial state the forecast of ALADIN/SI,
- performed every 3 hours for the first day, every 6 hours for the second day of forecast.



The computer system:

- a cluster system with 14 nodes (1 master and 13 computing nodes),
- each node has 2 Intel Xeon 2.4 GHz processors and 2 GB of memory,
- nodes are connected via gigabit fiber link through powerful Entherasy SSR 8000 gigabit switch,
- 300 GB primary disk space, additionally 3.5 TB external disks array,
- Linux OS enhanced by SCore software (www.pccluster.org),
- queuing system, gang scheduling, checkpointing, parallel shell and simplified administration are available by SCore software,
- Lahey and Intel Fortran compilers, Totalview debugger

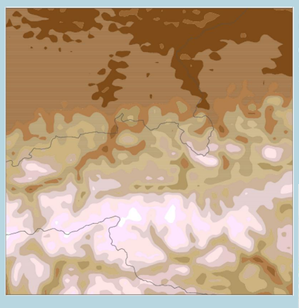
Numerical simulations on very high resolution

The ALADIN model was used to perform forecasting experiments on various domains with resolutions down to 2.5km.

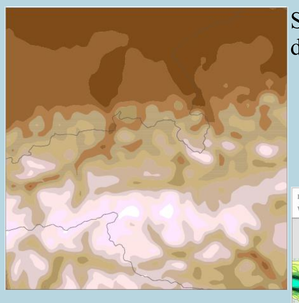
- The influence of a smoothed orography on the forecast fields

The use of a smoother orography seems to make a lot of sense on high resolution model runs, because of the remarkable positive impact on the strongly orographically affected precipitation fields and the fact that other near surface fields are not spoiled in a dramatic way.

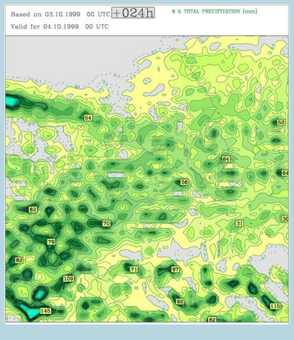
If the orography is smoothed the resulting precipitation field becomes significantly better relating to the pattern as well as to the peak amounts.



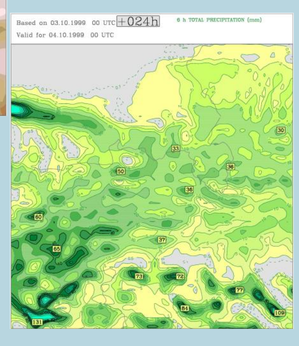
Standard orography of a domain on 2.5 km resolution located in central Austria.



Smoothed orography of a domain on 2.5 km resolution



24h-precipitation forecast (6h-accumulation) for standard orography over central Austria.

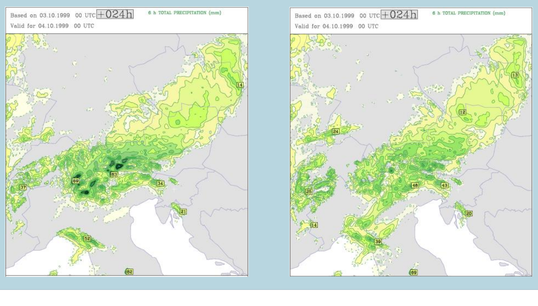


24h-precipitation forecast (6h-accumulation) for smoothed orography over central Austria

- The non-hydrostatic dynamics compared to the hydrostatic ones

In the area of the highest mountains the precipitation amounts (orographically caused, high) are significantly lower for the non-hydrostatic case (which results from a 'damped' and therefore more realistic forecast of the vertical velocity) which means an improved forecast field.

24h-precipitation forecast (6h-accumulation) on 5km resolution with hydrostatic dynamics on the left, with non-hydrostatic dynamics on the right.



Regionalization of ECMWF reanalysis

A project of regionalization of ECMWF reanalysis (ERA) was initiated

- to obtain a long series of consistent model data in order to support climatological studies which suffer from spatial and temporal inhomogeneities,
- to study wind climatology with 10 years of ERA regionalization with 2.5 km dynamical adaptations.

Main tasks to be defined are:

- coupling strategy

  downscaling of relatively sparse data (T159 horizontal grid with resolution about 200 km) to resolution around 10 km to find balance between driving and coupled model

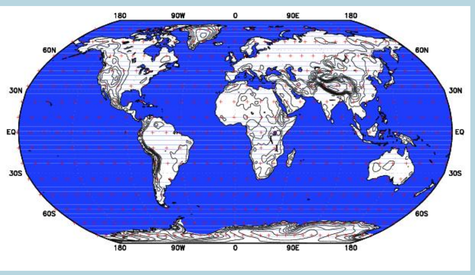
- model integration duration

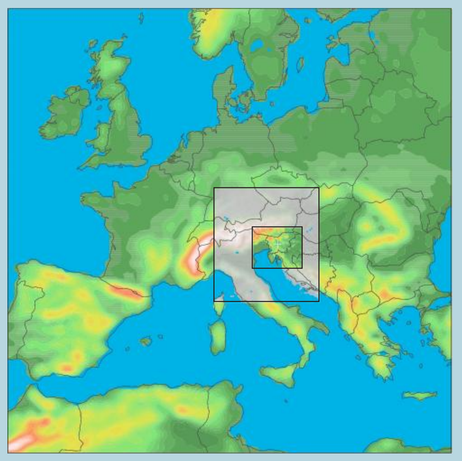
  balance between constant shock due to spin-up by shorter integration times and loose information from initial state by longer-than-necessary integration

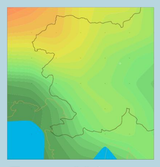
Solution:

- double-coupled run

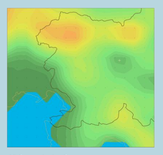
  ERA-T159L60 (grib to FA format), available every 6h,
  ALADIN Europe 30km, coupled every 6h,
  ALADIN SLO 11km, coupled every 3h,
  ALADIN-DADA 2.5km, performed every 3h,
- 60h integration on Europe and SLO domain,
- using fields for forecast ranges 12-57h.



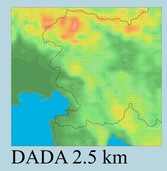




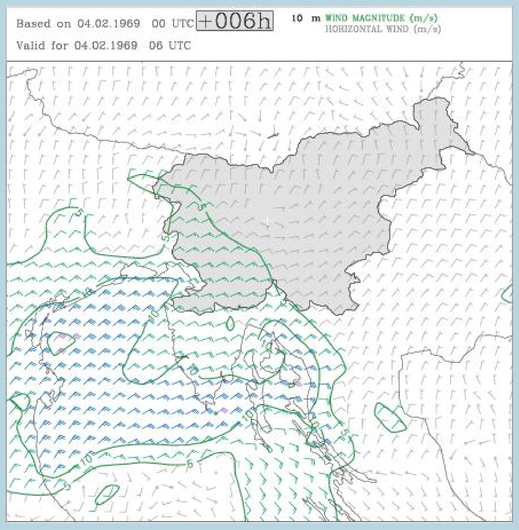
Europe 30 km



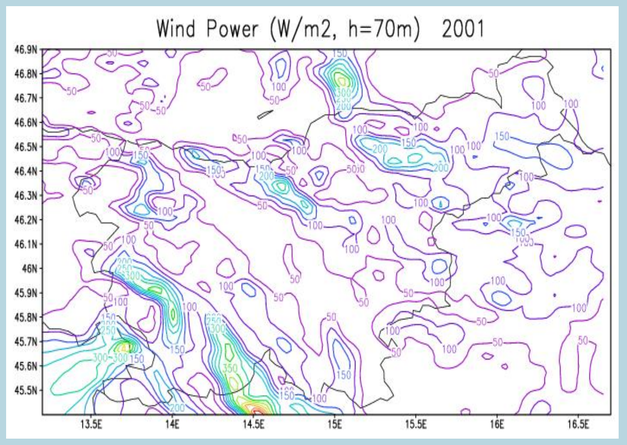
Slo 11 km



DADA 2.5 km



Regional reanalyses enable us to perform model case studies on known historical cases and not only most recent ones; an example is bora case from February 1969 which caused significan damage.

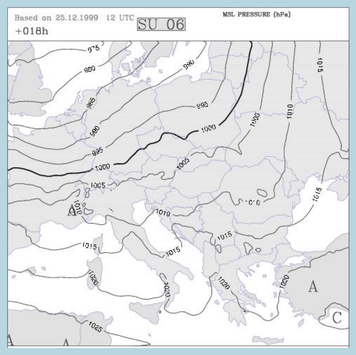


Another possible application of regional reanalysis is wind potential mapping.

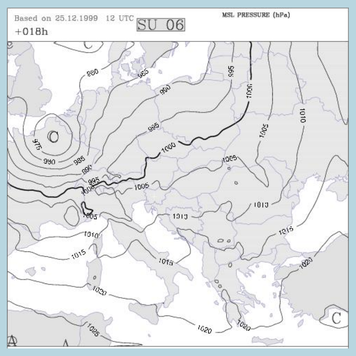
Spectral coupling approach

The deficiency of the Davies flow-relaxation scheme, a method generally used for coupling a high resolution model with a low resolution one, is in detecting the fast moving cyclones. To solve the scales unresolved by this classic method the spectral coupling approach was developed by the ALADIN team. In this method the calculations in the Fourier space are added to the calculations in grid point space. It is important to find a suitable tuning of the spectral relaxation parameters and a proper interpolation method for the spectral coefficients.

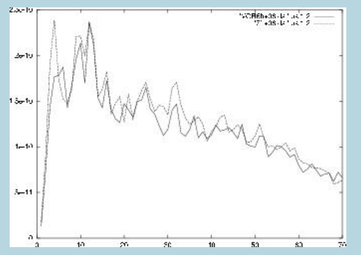
The spectral coupling method succeeds to provide the possibly missing large-scale spectral information. Idea is to use this approach just in extreme situations, but the procedure to identify them has to be set.



The missing cyclone case where the classic coupling scheme was used at 6h interval of coupling the models



The 'catching' cyclone case which shows that using a spectral coupling every time step with 6h interval of updating the boundary information can avoid the forecast failures in some extreme meteorological situations.

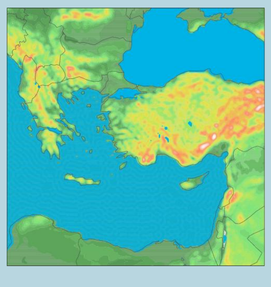


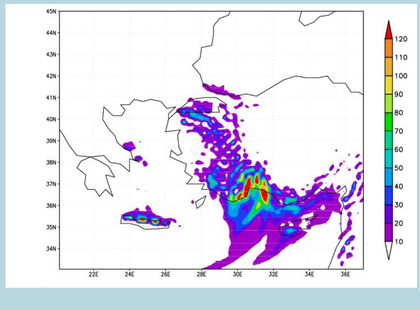
A comparison of the spectrum of vorticity in relation to the total wavenumber for simulation with 6h frequency of classic coupling (full line) and for simulation with spectral coupling every hour (dashed line)for the case without the cyclone inside. This can help us identify the missing cyclone frequency band in the LAM.

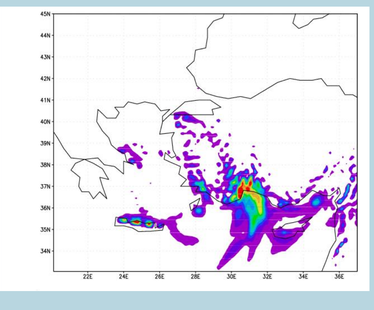
Numerical simulation of precipitation events in the East Mediterranean

University of Ljubljana in cooperation with EARS is taking part in the Voltaire project (5th framework programme Project for validation of precipitation fields in preparation for the global precipitation measurement mission). Part of the project, which the group from University is co-responsible for, is comparison of numerical weather simulations with the measurements of precipitation (raingauges, ground radars, TRMM satellite precipitation radar).

First experiments with ALADIN model were performed. Domain with 10km resolution is covering the Eastern Mediterranean. Four cases with high amounts of precipitation on Cyprus were found in the Voltaire database (2002-2003). The initial and coupling files were prepared from ARPEGE global model forecasts. Forecast precipitation amounts were compared with measurements over Cyprus, in two cases were higher, almost the same in one case and underestimated in one other one.







24-hour accumulation of precipitation for 6th March 2003. On the left from the model run 5th March 2003 00UTC with 6h spin-up time, on the right from the model run 4th March 2003 12UTC with 18h spin-up time. Some differences are the conseqence of different assimilation data in global ARPEGE runs.