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The overview of the operational forecast using ALADIN model with NH dynamics

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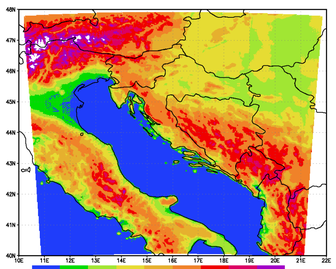
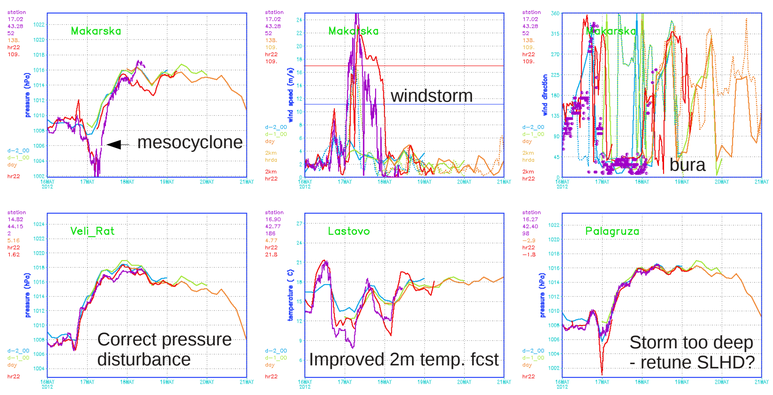
INTRODUCTION

The nonhydrostatic and hydrostatic primitive equation versions of the dynamical kernel are implemented in the ALADIN model as a single package activated through a logical switch. Since both can be used with the same horizontal and vertical discretisation, time-stepping and advection schemes (there is a choice for each of these schemes in ALADIN), it is possible to distinguish the differences in the model forecast due to introduction of nonhydrostatic component in the context of operational numerical weather prediction.



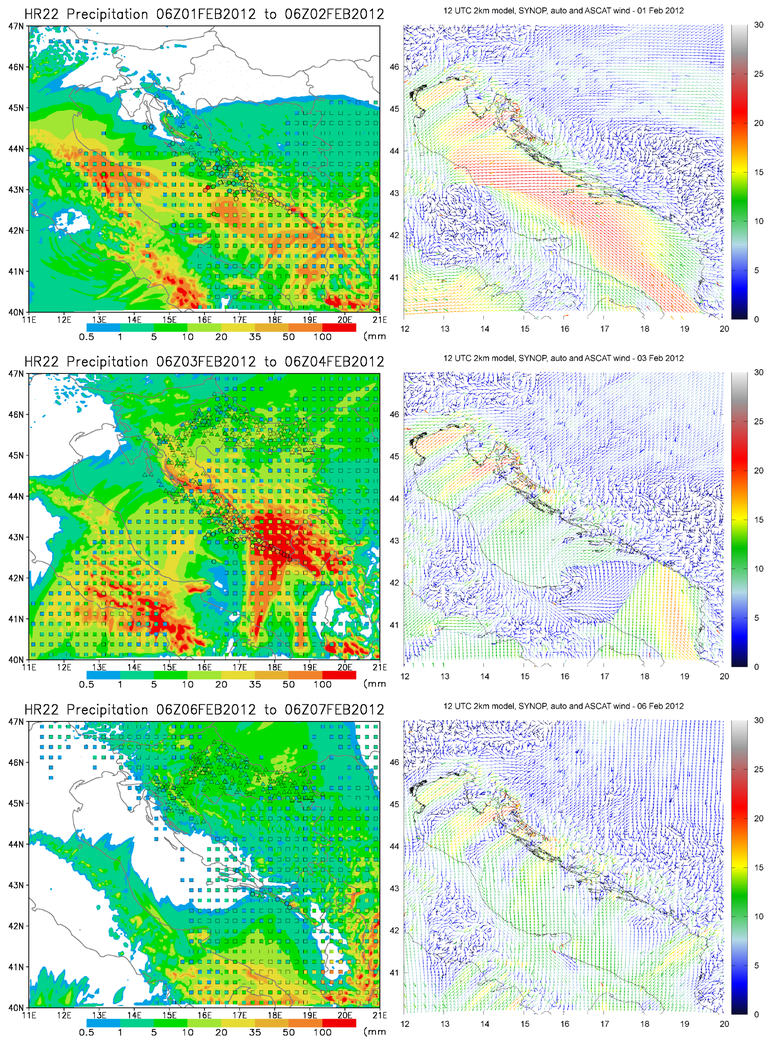
Model domain and terrain height (figure on the left) and figures produced by the operational forecast to measurement comparison (figures below) for the period 16-21 May 2012 for different parameters and stations.



More than any statistical parameter, these figures reveal which processes are well forecast, which are misplaced (in space or time) and which are exaggerated.

Operational cases - February 2012

The beginning of February 2012 brought cold weather with intensive snow fall over mountains and coastline.



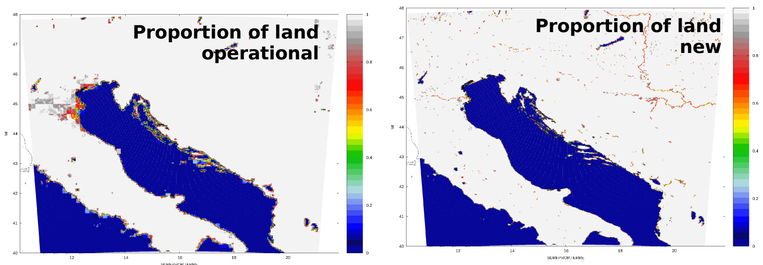
Left column shows accumulated 24 hourly precipitation forecast fields (shaded background), measured data from TRMM estimates using satellite data 3B42RT (squares), rain gauges (triangles for snow, circles for rain).
Right column shows 10m wind model forecast (thin arrows on regular grid), measurements (thicker arrows at points of measurement) from SYNOP and automatic stations and MetOp ASCAT.

OPERATIONAL MODEL

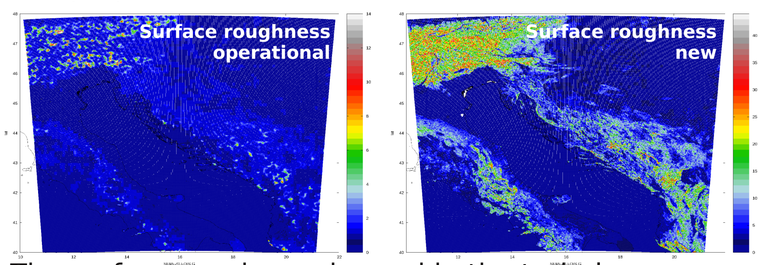
Operational numerical weather prediction in the Croatian Meteorological and Hydrological Service relies on a high resolution dynamical adaptation of wind field that has proven to be essential for the prediction of severe wind events in mountainous terrain along the Adriatic coast.
In the operational suite, a 2 km resolution 24 hour forecast was established since 1 July 2011, that uses non-hydrostatic (NH) dynamics and the full parametrization set, including radiation, microphysics and convection schemes. It runs on the same domain as the hydrostatic dynamical adaptation.
The NH run uses semi-implicit semi-lagrangian scheme to solve the dynamical and advection terms and semi-lagrangian horizontal diffusion. ALADIN uses a simple microphysics scheme with prognostic cloud water and ice, rain and snow and a statistical approach for sedimentation of precipitation. The operational radiation scheme that describes the transfer, scattering, absorption and reflection of the shortwave solar radiation and longwave thermal radiation of the Earth's surface and clouds is simple and computationally cheap since it uses only one spectral band for long-wave and one for short-wave radiation computations. The turbulent exchange coefficients are computed using prognostic values of turbulent kinetic energy (TKE).
The surface scheme used in the operational forecast is ISBA (Interaction Soil Biosphere Atmosphere). The parametrization of convection is used even in the 2 km resolution forecast since its formulations disables double counting for the convection in the resolved and stratiform part. The deep convection is a prognostic mass-flux scheme where convective processes are treated with the use of prognostic variables for updraft and downdraft vertical velocities and mesh fractions.

RESULTS

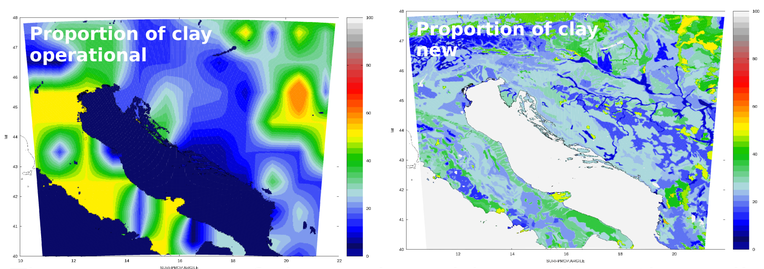
The NH run has been able to predict short duration events of severe bura as well as calm periods in the long bura events that were not predicted by other runs in the operational suite. However, its forecast also yields errors due to wrong timing of such events (by few hours). The errors in the model forecast have revealed the need for better representation of the surface characteristics especially in the mountainous terrain. The fields computed from the new, high resolution database are more realistic.



The proportion of land is used in the surface scheme.



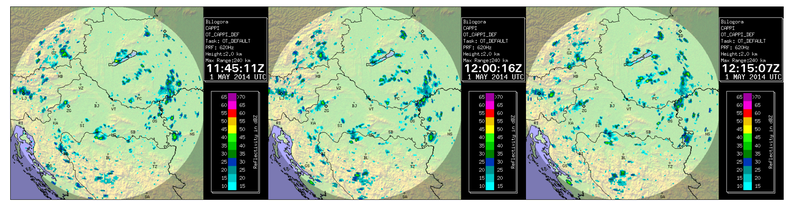
The surface roughness is used in the turbulence scheme. Large differences require serious retuning.

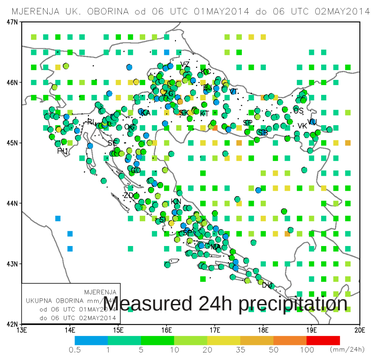


The proportions of clay and sand (as well as other soil properties) for operational files are taken from a low resolution database and have rather unnatural features. Fields computed from the new database are more realistic.

Small scale convection - stationary

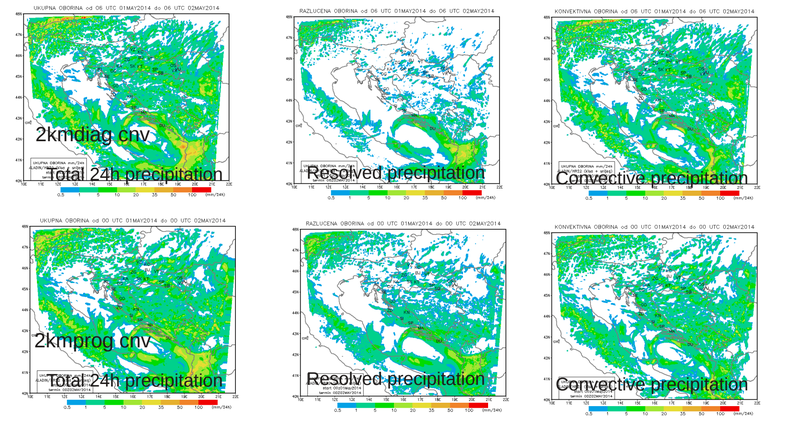
This is a case with small scale convection that remained stationary in space but evolved rather quickly in time. More precipitation is resolved when prognostic convection is used.





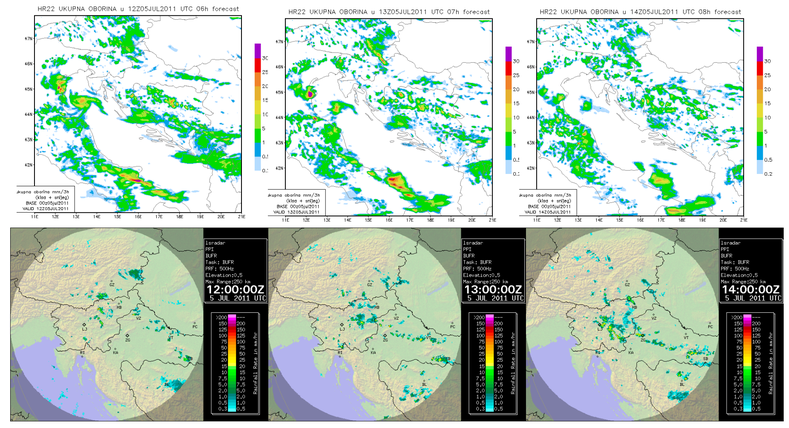
Radar figures show small scale convective activity.

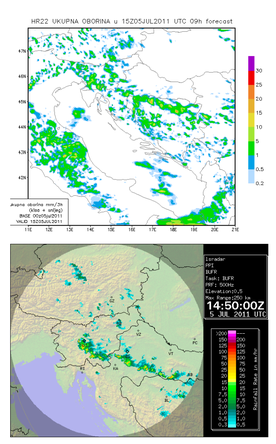
Figure on the left shows measured accumulated 24 hourly precipitation from TRMM estimates using satellite data 3B42RT (squares), and rain gauges (circles).



Small scale convection - moving

Small scale convection that remained stationary in space over mountains and evolved rather quickly in time while a narrow precipitation band moved over the valley. This is one of the first cases from the operational forecast. The forecasters complained that precipitation forecast is “spotty as the radar picture”.





Hourly accumulated precipitation from the operational 2km resolution forecast (top) and radar figures with instantaneous values (be aware that the values close to edges are less reliable). The precipitation band moves (faster in the model than in nature) and interacts with hills and mountains on the way that can both enhance or reduce the precipitation intensity.

LITERATURE

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