NWP research in Austria

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1. Operational forecast system

Operational limited area weather forecasts in Austria are made using version AL25 of the ARPEGE/ALADIN modelling system. ALADIN forecasts are made on two Central European domains, with horizontal resolutions of 12.1 km and 9.6 km, respectively. The number of levels in the vertical is 37 in both cases. The model is spectral, run in hydrostatic mode, with a semi-implicit, semi-Lagrangian advection scheme. Initial and boundary conditions are taken from the global model ARPEGE. A modified Bougeault scheme is used for deep convection, a first-oder closure for turbulent vertical transports, and the ISBA (Interaction Soil-Biosphere-Atmosphere) scheme is used to represent surface processes. Coupling frequency is 3 hours. Integrations up to +48 hours are performed twice a day.

2. Research

a. Numerical prediction of inversion fog and low stratus

The underprediction of low stratus capped by an inversion is a major forecasting problem in eastern central Europe. The negative bias in low cloud cover is one of the primary sources of error in 2m temperature forecasts during wintertime (Greilberger and Haiden, 2003). Low stratus events are typically of large scale in the horizontal, and quasi-stationary over several days. Radiation and vertical mixing are the dominant cloud forcing mechanisms. According to 1-d and 3-d modelling studies the underprediction of inversion cloudiness is due to a too smooth temperature profile across the inversion. Current work focuses on the development stage of the inversion, and on the comparison of first order and prognostic TKE turbulence closures in the prediction of inversion development. Also, alternative formulations for the cloudiness parameterizations are being tested (Kann, 2003; Haiden, 2004). The work is part of COST Action 722 ‘Short-Range Forecasting Methods of Fog, Visibility and Low Clouds’.

b. Deep convection triggering

The problem of the diurnal cycle of convective precipitation, i.e. that the precipitating stage is reached too early in NWP models, is well known. Previous studies with ALADIN have shown that using a prognostic deep convection scheme tends to improve the mesoscale precipitation structures but does not solve the timing problem as long as the trigger function is kept unchanged. Simply using CAPE triggering does not solve the problem either. Experiments are made with improved trigger functions which address more explicitly the convective inhibition (CIN) as well as cloud growth from Cu to Cu-cong into Cb (Wimmer, 2003).

c. Prediction of cold air pools and katabatic flows

The fact that NWP models usually employ a terrain-following coordinate system at low levels poses a problem in the forecasting of cold air pools in complex terrain. Problems also occur as a result of the use of envelope orography, such that generally cold air pools contained within alpine basins are not simulated well. In an ongoing research initiative, the mechanisms of katabatic flow formation and basin cooling are investigated in detail (Haiden, 2003a; Haiden, 2003c; Haiden and Whiteman, 2004; Whiteman et al., 2004).

d. Prediction of heavy rainfall

As a response to the August 2002 floods in Central Europe, which severely affected large parts of Austria (Haiden, 2003b), research has started on combining radar data and model results in the nowcasting of rainfall amounts for hydrological applications. The orographic component of heavy precipitation is studied by Wang (2003) using different initial conditions based on data gathered during the Mesoscale Alpine Programme (MAP).

e. High-resolution non-hydrostatic simulations

In order to improve the simulation of terrain-related phenomena, experiments are made with a high resolution (2-3 km) non-hydrostatic version of the ALADIN model (Stadlbacher, 2003). The performance of high-resolution wind and precipitation forecasts is compared to the operational one (10 km), as well as to statistically downscaled wind forecasts.

References

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