

**Third Interim Report to  
ECMWF Special Project – SPATAB01  
„Alpine regional downscaling of reanalysis data using the LAM ALADIN“**

Alexander Beck, Bodo Ahrens<sup>1</sup>  
Department of Meteorology and Geophysics, University of Vienna  
29th June 2006

The project started on 1 January 2004. Two persons are working on the project: B. Ahrens and A. Beck. In continuation of the sensitivity experiments reported in the previous report (Beck and Ahrens, 2005), dynamical downscaling experiments have been carried out for the time period 1981-1990 using ERA40 analysis data. These hindcasts using reanalysis data serve as reference for simulations from the global climate model ECHAM5 (Roeckner et al. 2006). A control run using ECHAM5 and observed forcing data for the time period 1981-1990 has been carried out in collaboration with ETH Zuerich.

The model applied is the limited-area model (LAM) Aladin with a numerical resolution of about 12km and 41 hybrid-levels in the vertical (please refer to <http://www.cnrm.meteo.fr/aladin/> for additional information). Initial and lateral boundary conditions are taken from ERA40 analyses with a 6h update interval. The atmospheric fields are initialized daily (at 00 UTC) while the surface parameters are allowed to evolve freely within the LAM with a weak relaxation towards the corresponding ERA40 fields. This setup has been chosen on the basis of the sensitivity experiments for the year 1999. For further details about the model setup as well as the sensitivity experiments reference is made to Beck and Ahrens (2005).

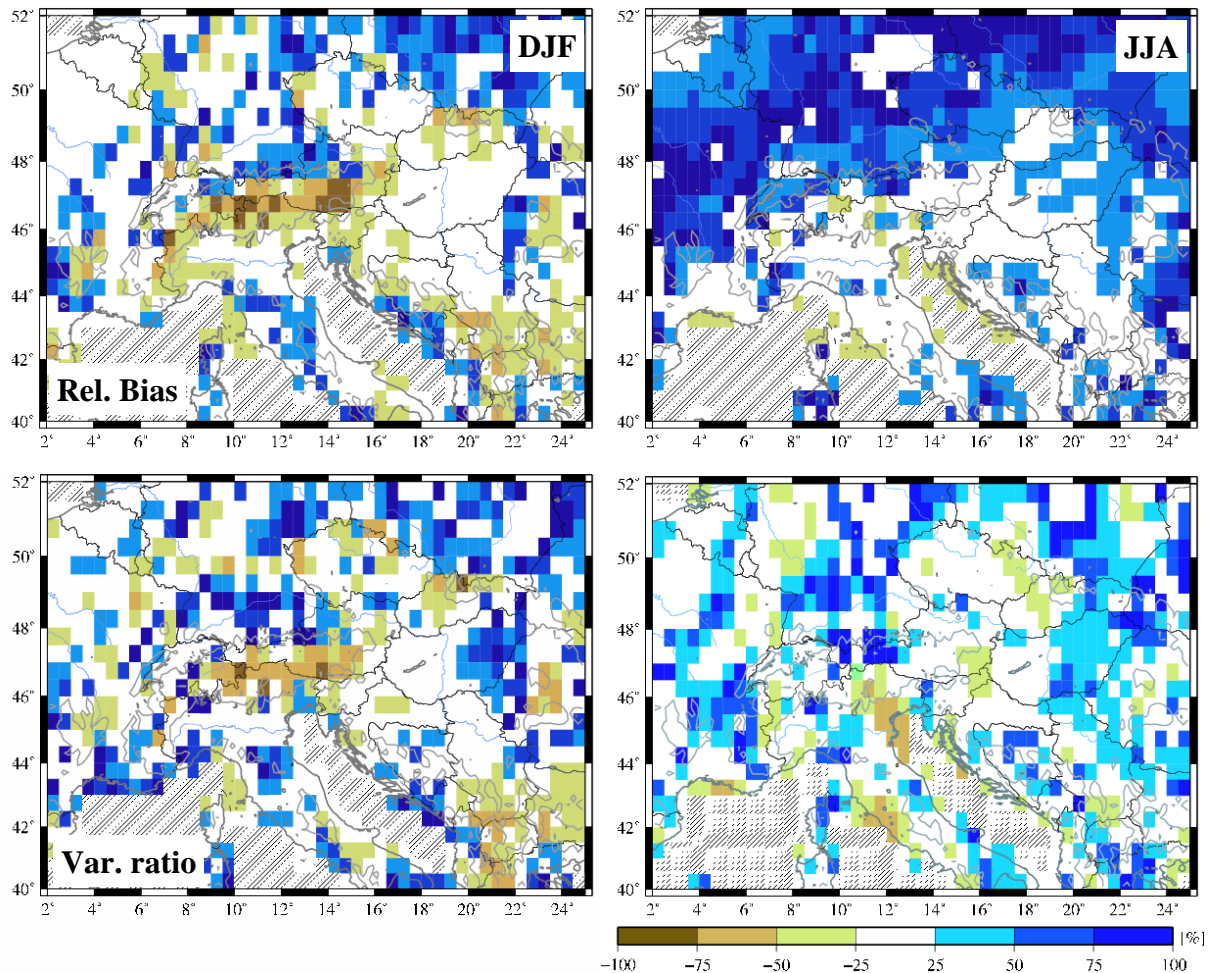
The evaluation of the high resolution ERA40-driven simulations is the basis for assessing the suitability of the control (i.e., ECHAM5 driven) simulations as control run for the interpretation of predicted regional climate scenarios. Thus, comprehensive evaluation has been carried out using observational information in terms of high-resolution analyses from the Vienna Enhanced Resolution Analysis (VERA) system (Steinacker et al. 2000) or gridded datasets (i.e., CRU TS 2.1 dataset; Mitchell and Jones 2005 and the HISTALP dataset; Efthymiadis et al. 2006) as well as upper-air soundings from the Comprehensive Alpine Radiosonde (CALRAS) dataset (Haeberli 2006).

As an example, simulated daily rainfall is compared to CRU data on a seasonal basis for the years 1981 to 1990. Data from the model simulations are aggregated to the 0.5° x 0.5° grid of the CRU dataset as block-medians. Figure 1 (top panel) shows relative bias [%] of ERA40-driven Aladin simulations computed with respect to CRU data for winter (DJF; left figure) and summer (JJA; right figure). No shading is applied for grid boxes with bias values of +/- 25 %. Hatched boxes are not taken into account due to the lack of observational data. The performance of Aladin is satisfactory for winter despite the apparent underestimation of precipitation within or south of the Alps. However, the observational reference (i.e., the CRU dataset) is likely to underestimate precipitation amounts in particular over the Alps. More detailed investigations using high-resolution alpine precipitation analyses (e.g., the Frei-Schaer dataset from ETH Zurich) support this hypothesis (not shown). The model strongly overestimates precipitation during the summer

---

<sup>1</sup> Present affiliation: Institute for Atmospheric and Climate Science (IACETH), ETH Zuerich, Switzerland

season (Fig 1, top left figure). Investigation of the year-to-year variability, shown as variance ratios in Fig 1 (lower panel), reveals a better agreement between the model and the observational dataset for summer than for winter. The patchy structure might, at least partly, be explained as a consequence of the limited number of years available. Nevertheless, the model seems to overestimate the year-to-year variability, except for the central Alpine region. However, the reference dataset is likely to underestimate the variability due to the limited number of observations.



**Figure 1: Relative precipitation bias [%] (upper panel) and variance ratio [%] (lower panel) of Aladin simulations (1981-1990) with respect to CRU data for winter (DJF; left) and summer (JJA; right figures).**

As mentioned, this is just one example of a thorough evaluation of the ERA40-driven simulations carried out or presently underway. On the basis of these results, the realism of the GCM-driven Aladin simulations is assessed. As a preliminary example, Figure 2 shows results from the comparison of the ECHAM5-driven simulations to the reanalysis-driven simulations: Generally speaking, a better agreement is found for the summer season than for winter where precipitation amounts are higher due to the increased moisture content in ECHAM5 compared to ERA40 resulting in enhanced stratiform precipitation.

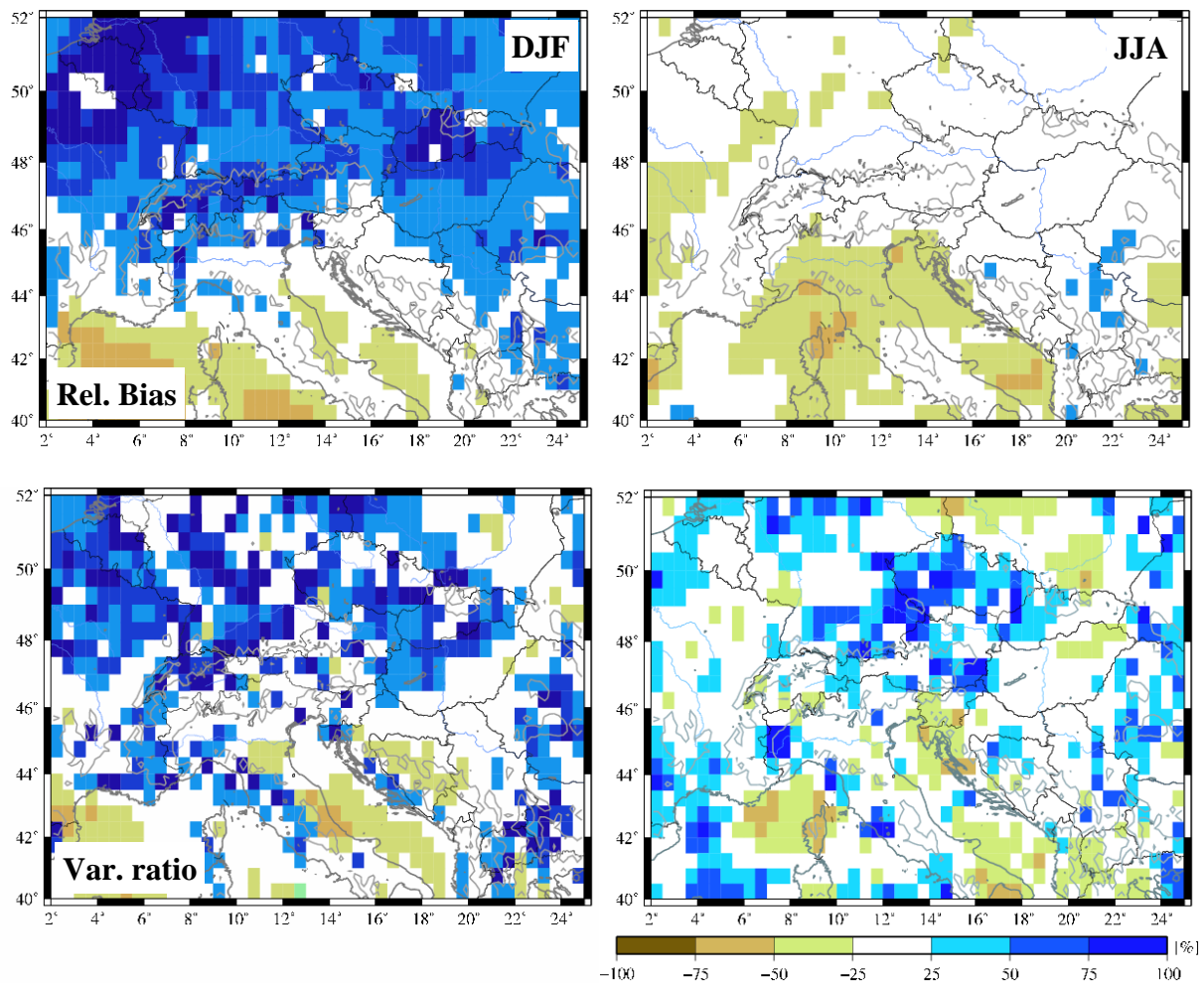


Figure 2: As Fig. 1, but for comparison of ECHAM5-driven control simulations to ERA40-driven simulations.

## References

- Beck, A., and B. Ahrens, 2005: Second interim report to ECMWF Special Project SPATAB01 „Alpine regional downscaling of reanalysis data using the LAM ALADIN“.
- Efthymiadis, D., P.D. Jones, K.R. Briffa, I. Auer, R. Boehm, W. Schoener, C. Frei, and J. Schmidli, 2006: Construction of a 10-min-gridded precipitation data set for the Greater Alpine Region for 1800–2003, *J. Geophys. Research*, **110**, D01105, doi:10.1029/2005JD006120.
- Haeberli, Ch., 2006: *The Comprehensive Alpine Radiosonde Dataset (CALRAS)*. Wiener Meteorologische Schriften, **4**, 297pp.
- Mitchell, T.D., and P.D. Jones, 2005: An improved method of constructing a database of monthly climate observations and associated high-resolution grids. *Int. J. Climat.*, **25**, 693 – 712.
- Roeckner, E., R. Brokopf, M. Esch, M. Giorgetta, S. Hagemann, L. Kornblueh, E. Manzini, U. Schlese, and U. Schulzweida, 2006: Sensitivity of simulated climate to horizontal and vertical resolution in the ECHAM5 atmosphere model, *J. Climate*, in press.
- Steinacker, R., C. Haeberli, and W. Poetschacher, 2000: A transparent method for the analysis and quality evaluation of irregularly distributed and noisy observational data. *Mon. Wea. Rev.*, **128**, 2303–2316.