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Supervisor: P. LeMoigne, MC2

Offline experiments with externalized ISBA (cycle0.2)

B. Ahrens
Institut für Meteorologie und Geophysik, Universität Wien
E-mail: Bodo.Ahrens@univie.ac.at, Tel.: +43-(0)1-4277-51917

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1 Introductory remarks

At the University of Vienna we are interested in surface–atmosphere interaction at forecast and climate time scales. Our research model is ALADIN which applies ISBA as its SVAT. Thus, the ongoing development of the externalized ISBA package is offering the possibility to apply the same SVAT library in ALADIN and in offline experiments forced by observed or simulated atmospheric data. Within this short stay the goal has been to get experience with the externalized ISBA (eI) package and to perform some first experiments.

2 Setup and configurations

Simulation type/periods: Monthly continuous offline simulations for January and September 1999 initialized at day 1, 06 UTC with ARPEGE analyses (thus with assimilated surface fields, no spinup considered).

Simulation domain: subdomain of the ALADIN/LACE domain 12.2 km grid spacing. Exact grid point matching has been tried (as far as the different implementation of the Lambert conformal projection in eI and old eggx of ALADIN allows – the tool coneo of J.D. Gril's PALADIN package was helpful). As Fig.1 illustrates a small shift in the eI domain relative to the LACE subdomain is not explained and resolved yet.

Atmospheric forcing data: precipitation, snow rate, T2m, etc. from ALADIN/LACE (cycle 25) hindcasts (30 h lead time) nested into ERA40 data. The grid of the forcing data and the eI simulations should be identical.

eI configuations:
(1) eI default 3–layer force-restore offline configuration (see "The externalized ISBA surface user's guide" of 24 Sep. 2004) with 3–layer snow scheme in ISBA, but no TEB (abort due to problems in the TEB 1 layer snow scheme, thus CTOWN="NONE", LRM_TOWN="TRUE" in the PGD namelists),
(2) the former configuration but with 2–layer ISBA and the 1–layer Douville et al (1995) snow scheme (this is close to the now operational scheme in ALADIN).

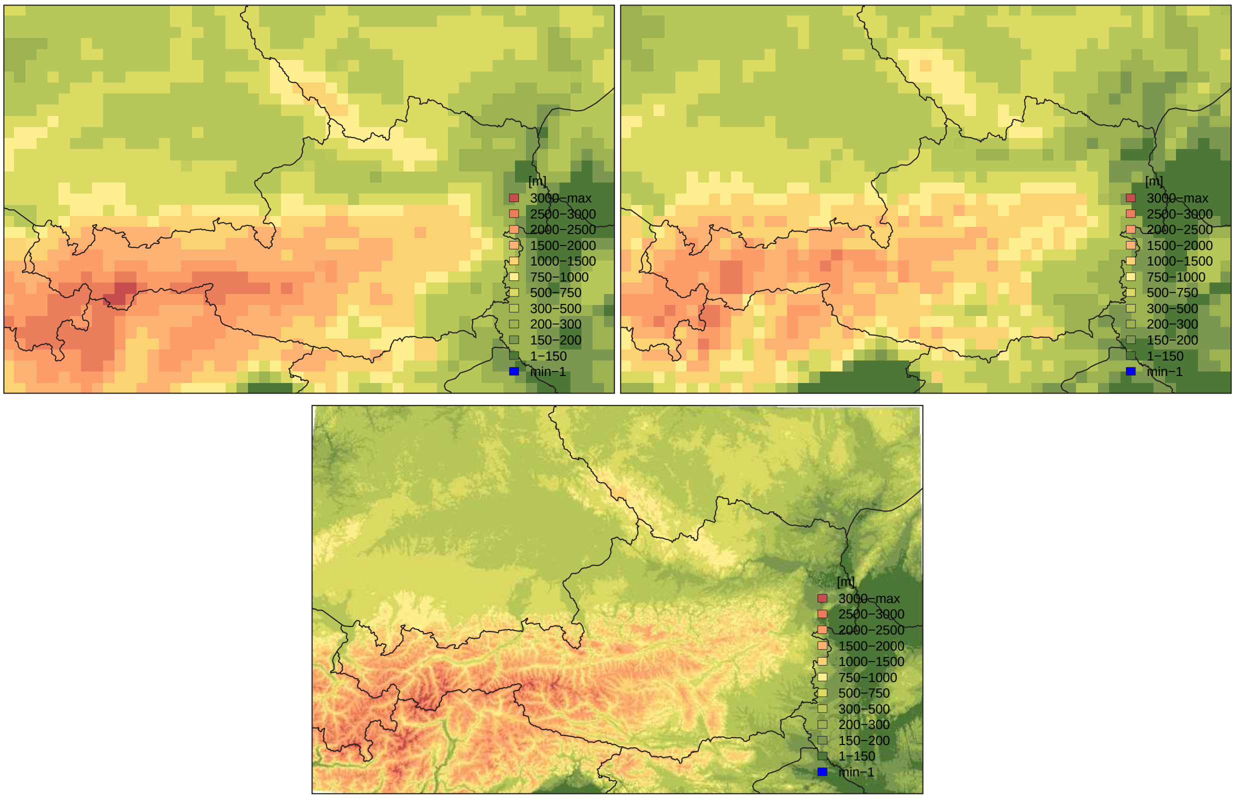

Figure 1: Orography in ALADIN/LACE (upper left panel) and in externalized ISBA (upper right panel). Externalized ISBA applies envelope orography (COROTYPE='ENV') in my configuration. The bottom panel shows orography as given in the globe30 data set. The external ISBA domain is shifted to the south–west, by some yet unresolved error in setup/projection definition.

3 Some results

The following Figs. show surface fluxes averaged over the eI tiles considered for each grid box: nature and water (no sea in the domain and TEB had problems). At the surface the net radiative energy RN flux density is balanced by the sensible H, latent LE, and ground $GFLUX$ heat flux densities:

$$RN = H + LE + GFLUX \qquad [\mathrm{W/m^2}]$$

Therefore, the sign convention is that blue net radiation in the Figs. cools the atmosphere and blue H, LE, and $GFLUX$ cool the superficial surface.

The differences between the 2 and 3–layer versions are small. The relatively largest difference is in evaporation in January probably due to the different snow schemes. Surprising, at least for the author, is that the ground heat flux strongly heats the surface in the central Alpine area (high elevation grid boxes) in September.

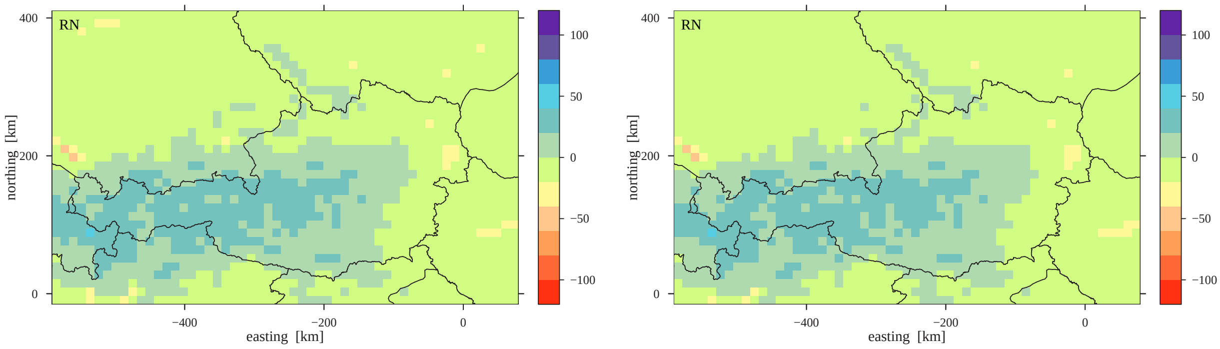

Figure 2: Mean net radiation for January 1999 derived from the 06, 12, 18, 00UTC instantaneous values. The left panel shows results with 2–layer and right panel of 3–layer configuration of ISBA left. The lakes (red) indicate that the domain shift is consistent in all fields, besides in atmospheric forcing. Units are always W/m^2.

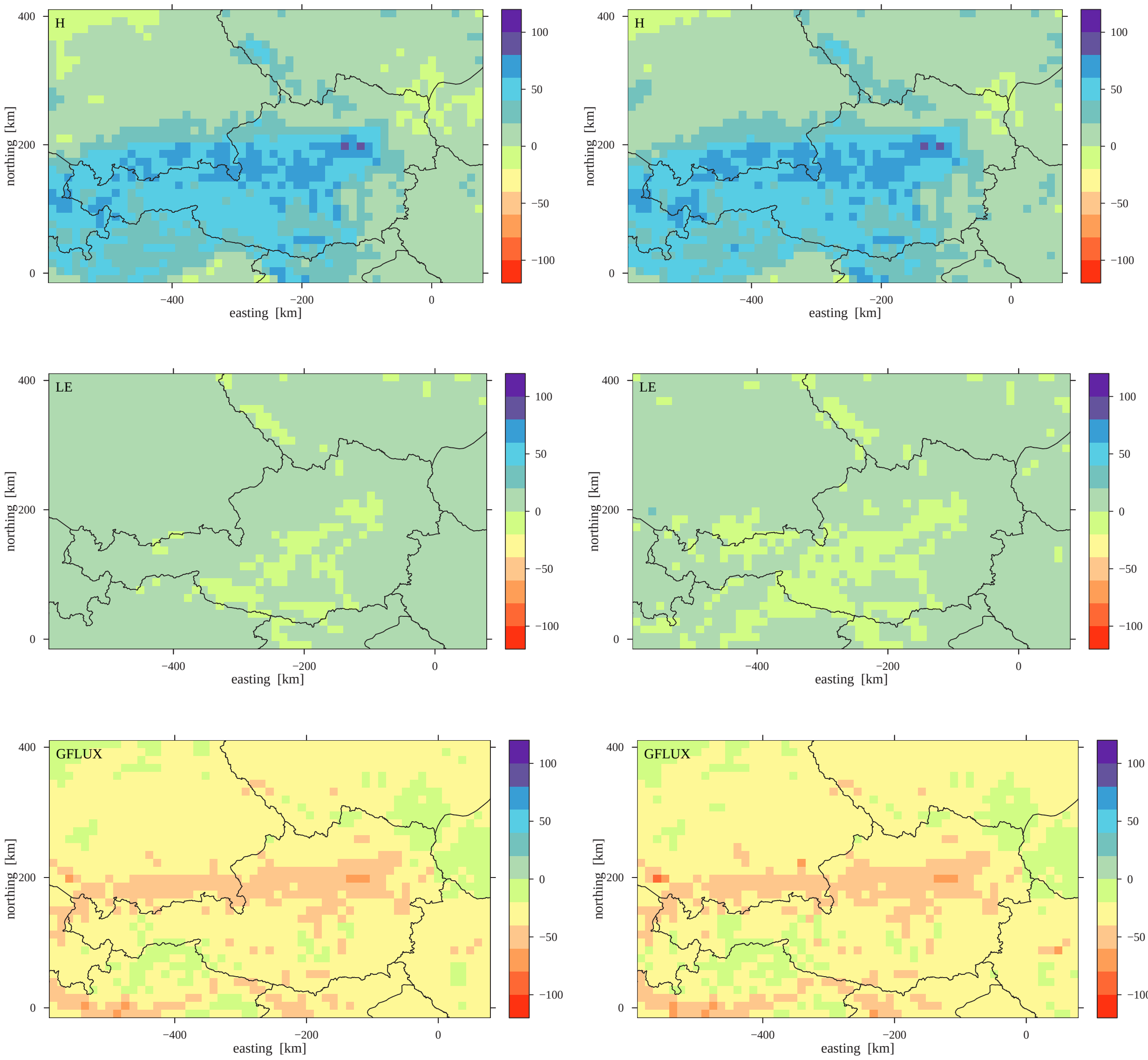

Figure 3: Same as in Fig.2, but for sensible heat flux (upper panel), latent heat flux (middle panel), and ground heat flux (bottom panel). Sum up these columns and you get the net radiative fluxes.

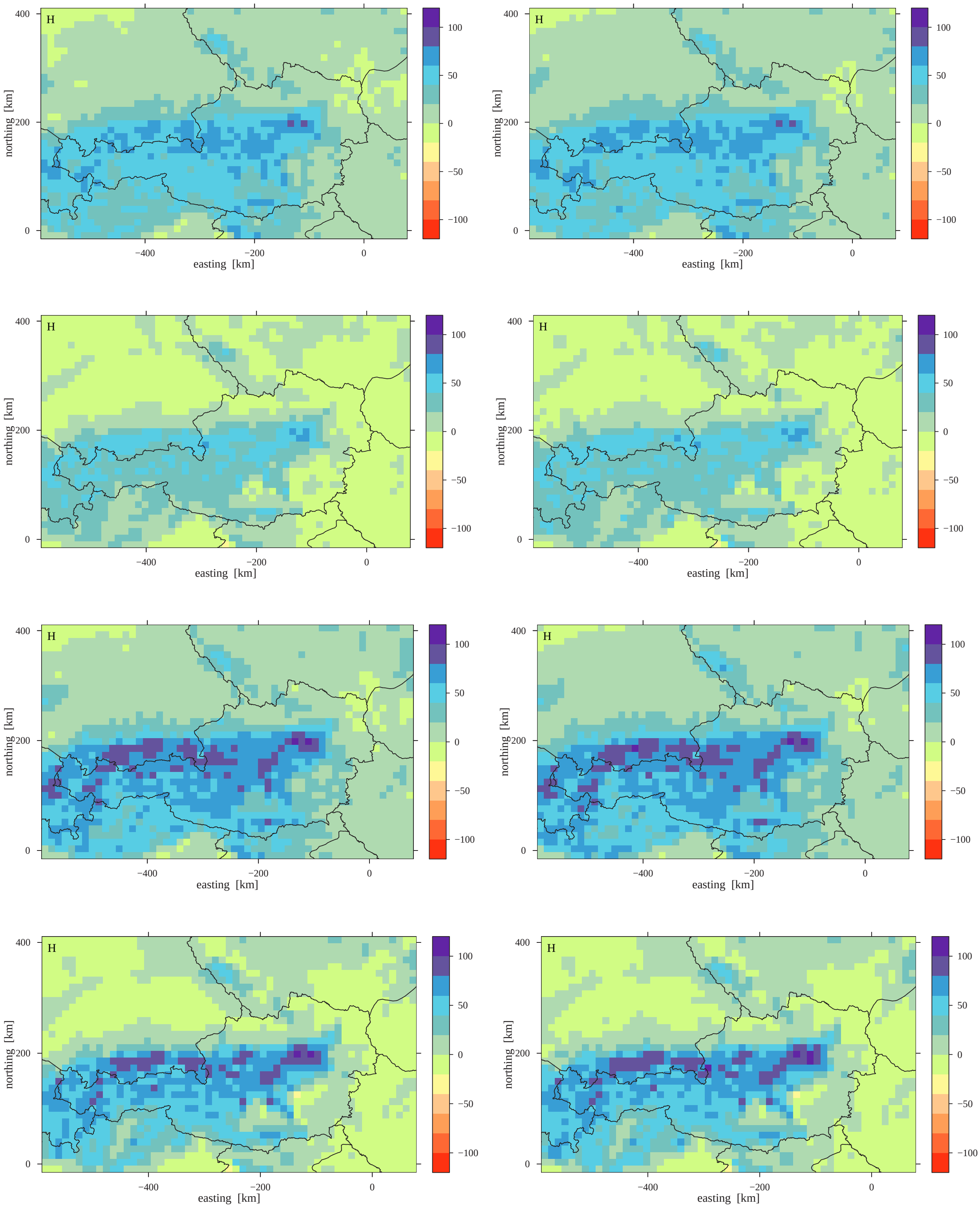

Figure 4: Monthly mean of the 06 (top row),12 (second row), 18 (third row),00 (bottom row) UTC sensible heat fluxes of January. Left column: 2–layer and right column: 3–layer ISBA configurations.

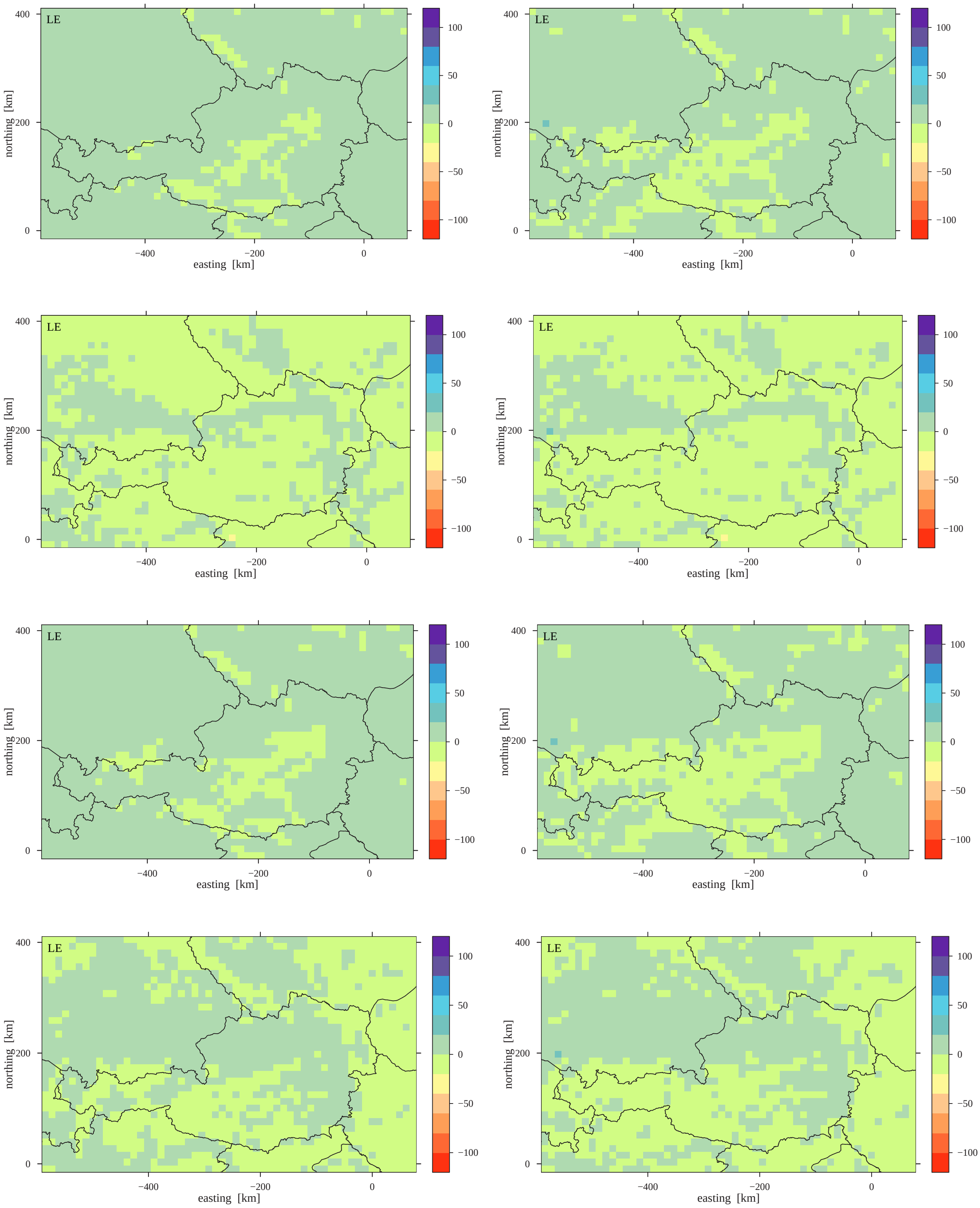

Figure 5: Same as Fig. 4, but for latent heat fluxes.

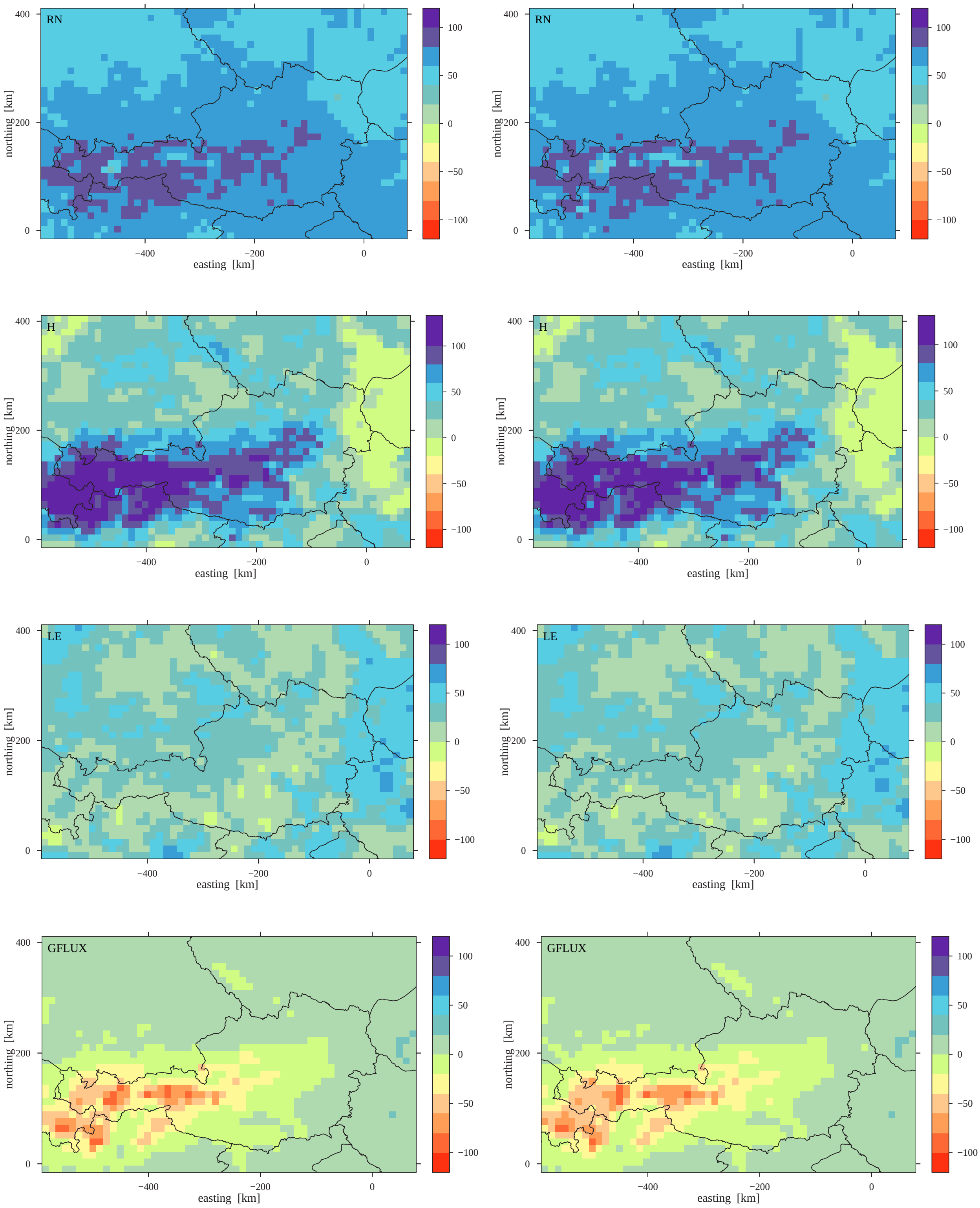

Figure 6: The surface energy balance for September 1999. From top to bottom row net radiative flux, sensible, latent, and ground heat flux. Left column is simulated with the 2 and right column with the 3–layer ISBA configuration.

4 Outlook

Do these results indicate that the 2–layer scheme should be applied in climate models instead of the more expensive 3–layer scheme. Not at all! Year long continuous simulations might well show some drift and should therefore be done. In operational forecast mode the drift will probably always be small because of surface data assimilation and frequent reinitialization. But small differences in evaporation might trigger positive feedback mechanisms and increase or decrease convective precipitation (the investigation of this is the main objective of an ongoing project of the author named "Sources of precipitation in Alpine watersheds"). The offline version of externalized ISBA will allow model–model SVAT comparisons with different surface data and/or more expensive simulations, e.g. with the diffusive configuration. Applying simulated atmospheric forcing data and observed forcing data could help validating the simulated atmospheric data, especially if observed discharges are considered additionally.

Acknowledgments

Patrick LeMoigne introduced me into external ISBA as far as it is possible in a two–week period. It was a pleasure for me working in GMME/Meteo France. Several people at Meteo France helped organizing this stay (D. Giard, GMAP, shall be named especially). Meteo France and the project reclip:more supported this stay.