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Assessment of three different dynamical downscaling approaches with the ALARO-0 model over Belgium

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When using Regional Climate Models (RCMs) one is by construction obliged to prescribe Lateral Boundary Conditions (LBCs) and Initial Conditions (ICs) from coarse resolution Global Climate Models (GCMs) or Re-Analyses (RA). The rationale behind this setup is that RCMs introduce high resolution added value to the LBCs that drive them. However, for this downscaling to be effective the RCM should not alter the large scale circulation imposed by the LBCs to such a degree that it would lead to inconsistent results or numerical artifacts. The balance sought for in regional climate modelling is therefore one between staying 'close' to the LBCs while still being able to produce high resolution data which has added value.

To test a thread of this balance three different simulations were performed using ERA-INTERIM as LBCs and ICs to drive the RCM ALARO-0 at 4km resolution coupled to the surface scheme SURFEX. One simulation consisted of the classical 'continuous run', where the model is initialized once and driven by ERA-INTERIM over the complete simulation period. In a second simulation, the 'daily re-initialization', the model was initialized each day and then driven for 24 hours by ERA-INTERIM, which is equivalent to some kind of data-assimilation which should prevent model drift. The third simulation, the 'free surface', lies in between these two extreme approaches, since the atmosphere is re-initialized daily, but the surface (SURFEX) is not and free to evolve continuously. We discuss the (dis)advantages of the individual approaches and compare their results with respect to temperature and precipitation.