Assimilation of 2-meter Temperature (T2m) with Hybrid-3DEnVar over the Alps in AROME-Austria

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Abstract

2-meter temperature (T2m) is a surface measurement directly affecting boundary layer processes, such as a warmer T2m developing convection and contributing to a well-mixed boundary layer. However, T2m can degrade forecast accuracy if not assimilated carefully, especially in complex terrains like the Alps. The horizontal and vertical covariances of climatological background error covariances used in the three-dimensional variational (3DVar) data assimilation (DA) method can produce unrealistic increments over sloped terrain, leading to spotty convection. We used a hybrid three-dimensional ensemble variational (Hybrid-3DEnVar) DA method with a 50-member convection-permitting ensemble to address this issue. The ensemble-based covariances in Hybrid-3DEnVar include information on recent atmospheric flow into the assimilation, providing different increments in the valley and mountains. Hybrid-3DEnVar was recently tested in Geosphere Austria's convective scale limited-area NWP model AROME at a 2.5 km horizontal resolution. We assimilated T2m from surface stations, including the Austrian TAWES network and SYNOP observations from neighbouring countries. We present T2m forecast verification to show the effectiveness of Hybrid-3DEnVar against GeoSphere Austria's operational 3DVar over complex Alpine terrain.

Keywords: Hybrid-3DEnVar, a 50-member ensemble, AROME-Austria, 2-meter temperature, the Alps.