P48 Iterative soil nudging for improved retrospective fine-scale meteorology

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Pleim-Xiu Land-Surface model (PX LSM) was developed for retrospective meteorological simulations to drive chemical transport models. One of the key features of the PX LSM is the indirect soil moisture and temperature nudging. The idea is to provide a three hourly 2-m temperature and moisture analysis that represents the observed values. As WRF integrates, the model estimates are continually compared to analyses, and soil properties are adjusted according to deviation. If the model is too cool during the daytime, the soil moisture is decreased, which changes the surface energy balance towards more sensible heat and, thus, a warmer model prediction. The deep soil temperature nudging is activated at night to force model values closer to the analysis through changes to the heat flux between the first and second layer of the soil model. Model analysis that are often used to generate nudging fields are at minimum 12 km (NCEP's NAM) in grid scale up to 32 km (North American Regional Reanalysis) or sometimes as large as 0.5 degree (NCEP's Global Forecast System) or more. While these are used as background values, and blended with point surface observations using the Obsgrid objective analysis tool, the coarse scale is often not sufficient for nudging simulations at the 4 and 1 km scale. The main problem is a mismatch between the geographical representations of the analysis grid and the finer scale WRF grid. This was discovered after poor results after a poor 1 km simulation of the Mid-Atlantic region of the US. To improve the modeling, two techniques were employed. First, the model was integrated for the study period using the coarser background analyses. The simulated 2-m temperature was then fed back through the Obsgrid system including the blending with surface observations for more appropriate soil nudging fields. In doing this, the new nudging fields have the "fingerprint" of the 1 km topography, landuse, soil texture and land-water interface. The second technique was to employ the vast array of mesonet observations now available in the US to create even more precise bias adjusted nudging fields with much more dense input of observed data. The end result was a 1 km iterative simulation that outperforms a 4 km scale simulation as well as a 4 km iterative simulation that outperforms the 12 km scale WRF. This research demonstrates the iterative nudging technique and expands the Mid-Atlantic application to other domains including Texas and California.