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Land and atmosphere initial states influence surface temperature forecast in dynamical seasonal predictions

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A hierarchy of forecast experiments was run to investigate the impact of land surface and atmosphere initial state on the overall skill of seasonal predictions, and an effort to disentangle the individual contribution of the two components to global and regional predictability was made.
Overall, the model performance is substancially enhanced by the introduction of a realistic initialization of land surface and atmosphere. On land, predictive skill and accuracy associated with surface temperature are largely improved in the first weeks, and after a decline, they recover by the final months of the forecast. In the ocean the early refinement is less pronounced, but lasts to the end of the forecast.
The early improvements on continents are mostly due to the atmospheric component, whose memory is quickly lost, whereas the effect of land surface initial state becomes more important in the following months. The forecast for the winter season in the high latitude plains of Russia and Canada benefit from the snow initialization, while the effect of soil moisture initial conditions is particularly effective in the Mediterranean region, in central Asia and Australia. However, initialization through land surface reanalysis does not systematically guarantee an enhancement of seasonal forecast, which sometimes responds better to the non-constrained model.
The ocean is only marginally influenced by the land surface state, whereas in a few areas, characterized by strong air-sea coupling, the atmosphere initial condition considerably affects the forecast skill. In particular, the ENSO region, the eastern tropical Atlantic and the North Pacific benefit from the atmosphere initialization.
Overall, the fully-initialized seasonal prediction system demonstrates good skill and accuracy at forecasting surface temperature, improving the performance of the system initialized in the ocean state only. However, further developments in the representation of land surface initial state are required for more accurate seasonal forecast.