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Impact of atmosphere and land surface initial conditions on seasonal forecast of global surface temperature

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The impact of land surface and atmosphere initialization on the forecast skill of a seasonal prediction system is investigated, and an effort to disentangle the role played by the individual components to the global predictability is done, via a hierarchy of seasonal forecast experiments performed under different initialization strategies.
A realistic atmospheric initial state allows an improved equilibrium between the ocean and overlying atmosphere, mitigating the coupling shock and possibly increasing the model predictive skill in the ocean. In fact, in a few regions characterized by strong air-sea coupling, the atmosphere initial condition affects the forecast skill for several months. In particular, the ENSO region, the eastern tropical Atlantic and the North Pacific benefit significantly from the atmosphere initialization.
On mainland, the impact of atmospheric initial conditions is detected in the early phase of the forecast, while the quality of land surface initialization affects the forecast skill in the following lead seasons. The winter forecast in the high latitude plains of Siberia and Canada benefit from the snow initialization, while the impact of soil moisture initial state 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 the predictive skill: the quality of the forecast is sometimes higher for the non-constrained model.
Overall, the introduction of a realistic initialization of land surface and atmosphere substantially increases skill and accuracy. However, further developments in the operating procedure for land surface initialization are required for more accurate seasonal forecasts.