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On the role of Eurasian autumn snow cover in dynamical seasonal predictions

Paolo Ruggieri[1,2], Marianna Benassi[2], Stefano Materia[2], Daniele Peano[2], Constantin Ardilouze[3], Lauriane Batté[3], and Silvio Gualdi[2,4]

[1]University of Bologna, DIFA, Bologna, Italy (paolo.ruggieri2@unibo.it)
[2]Fondazione CMCC, Bologna, Italy
[3]CNRM, Météo-France, CNR
[4]INGV, Bologna, Italy

Seasonal climate predictions leverage on many predictable or persistent components of the Earth system that can modify the state of the atmosphere and of relant weather related variable such as temprature and precipitation. With a dominant role of the ocean, the land surface provides predictability through various mechanisms, including snow cover, with particular reference to Autumn snow cover over the Eurasian continent. The snow cover alters the energy exchange between land surface and atmosphere and induces a diabatic cooling that in turn can affect the atmosphere both locally and remotely. Lagged relationships between snow cover in Eurasia and atmospheric modes of variability in the Northern Hemisphere have been investigated and documented but are deemed to be non-stationary and climate models typically do not reproduce observed relationships with consensus. The role of Autumn Eurasian snow in recent dynamical seasonal forecasts is therefore unclear. In this study we assess the role of Eurasian snow cover in a set of 5 operational seasonal forecast system characterized by a large ensemble size and a high atmospheric and oceanic resolution. Results are compemented with a set of targeted idealised simulations with atmospheric general circulation models forced by different snow cover conditions. Forecast systems reproduce realistically regional changes of the surface energy balance associated with snow cover variability. Retrospective forecasts and idealised sensitivity experiments converge in identifying a coherent change of the circulation in the Northern Hemisphere. This is compatible with a lagged but fast feedback from the snow to the Arctic Oscillation trough a tropospheric pathway.