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Improving and evaluating the IPCC land ice emulator

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The emulator used for projections of the land ice contribution to sea level by 2100 in the Intergovernmental Panel on Climate Change Sixth Assessment Report (Edwards et al., 2021) used a novel approach for incorporating structural uncertainty from the underlying computer models. This statistical (Gaussian Process) emulator represented entire multi-model ensembles at once -- for the Greenland and Antarctic ice sheets, and the world's glaciers, under the model intercomparison projects ISMIP6 and GlacierMIP, respectively -- by using a noise (nugget) term to allow for multiple estimates of sea level contribution for a given set of model input values, analogous to kriging of spatial data.

However, the emulator was rather simple in other respects: in particular, the sea level projection for each year from 2015-2100, and from each region of land ice (splitting Antarctica into 3 regions, and the glaciers into 19), were modelled independently, so temporal correlations emerged only upon smoothing the projections. The emulator was also not formally evaluated with observations, because the underlying simulations were only driven with meaningful climate forcings from 2015. These limitations have presented difficulties for users, who often need continuous time series projections and prefer, of course, these to be assessed with observations.

Here the IPCC land ice emulator is improved for interpretation and use by decision-makers by estimating spatio-temporal correlations directly from the underlying simulations (Rougier, 2008; Rougier et al., 2009), to produce meaningful trajectories of sea level contribution from each land ice source. The extent to which the land ice emulator can be evaluated with data, now and in future, is also discussed.

References:

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