



An assessment of climate state reconstructions obtained using particle filtering methods

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In an idealized framework, we assess reconstructions of the climate state of the southern hemisphere during the past 150 years using the climate model of intermediate complexity LOVECLIM and three data-assimilation methods: a nudging, a particle filter with sequential importance resampling, and an extremely efficient particle filter. The methods constrain the model by pseudo-observations of surface air temperature anomalies obtained from a twin experiment using the same model but different initial conditions. The net of the pseudo-observations is chosen to be either dense (when the pseudo-observations are given at every grid cell of the model) or sparse (when the pseudo-observations are given at the same locations as the dataset of instrumental surface temperature records HADCRUT3). All three data-assimilation methods provide with good estimations of surface air temperature and of sea ice concentration, with the extremely efficient particle filter having the best performance. When reconstructing variables that are not directly linked to the pseudo-observations of surface air temperature as atmospheric circulation and sea surface salinity, the performance of the particle filters is weaker but still satisfactory for many applications. Sea surface salinity reconstructed by the nudging, however, exhibits a patterns opposite to the pseudo-observations, which is due to a spurious impact of the nudging on the ocean mixing.