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The ERA-20CM twentieth century atmosphere model ensemble

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This presentation describes the integration of an ensemble of ten atmospheric forecasts for the years 1899 to 2009, performed at the European Centre for Medium-Range Weather Forecasts (ECMWF). Horizontal spectral resolution is T159 (about 125 km in grid-point space), using 91 vertical levels from the surface up to 1 Pa, and a time step of one hour. This ensemble, denoted by ERA-20CM forms the first set of integrations within ERA-CLIM.

Sea-surface temperature and sea-ice cover are prescribed by an ensemble of realizations (HadISST2), as recently produced by the Met Office Hadley Centre within ERA-CLIM. Variation in these realizations reflect uncertainties in the available observational sources on which this product is based. Forcing terms in the model radiation scheme follow CMIP5 recommendations, without variations, i.e. any effect on their uncertainty is neglected. These include solar forcing, greenhouse gases, ozone and aerosols. Both the ocean-surface and radiative forcing incorporate a proper long-term evolution of climate trends in the 20th century, and the occurrence of major events, such as the El Nino-Southern Oscillations and volcanic eruptions.

No atmospheric observations were assimilated. For this reason ERA-20CM is not able to represent actual synoptic situations. The ensemble should, however, be able to provide a statistical estimate of the climate. This is indeed confirmed. Overall, the temperature rise over land is in fair agreement with the CRUTEM4 data set. Over the last two decades the warming over land exceeds the warming over sea, which is consistent with models from the Intergovernmental Panel on Climate Change (IPCC), as well with the currently state-of-the-art ECMWF reanalysis (ERA-Interim). The model response to the Pinatubo eruption in 1991, i.e. a warming in the lower stratosphere and a cooling over the global troposphere, is qualitatively correct.

The results of ERA-20CM are available on the ECMWF web server. This embraces around 35 terabytes of monthly-mean fields for many geophysical parameters, and synoptic fields for a small, essential subset.