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Climate Change impact on Polar motion excitation in a comparison of Coupled General Circulation Models

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Earth orientation parameters (EOPs) are strongly influenced by atmospheric and oceanic mass and motion variations, and therefore may help provide an independent measure of climate variability. Coupled Atmosphere-Ocean General Circulation Models (GCMs) simulate the variations in the atmosphere and the ocean in a physically consistent way. Thus, the GCMs can be inter-compared with respect to the derived EOP variations.
Global warming has been shown to exert a major effect on Length-of-Day, caused by an enhancement in atmospheric motion. However, a comprehensive assessment of the impact of climate change on polar motion excitation has not yet been presented.
In this paper, an inter-model comparison of a Climate Change signal (A1B – 20C) in Polar Motion is provided for a set of model runs from the WCRP CMIP-3 campaign. The models used in the comparison are the ECHAM5/OM1, GFDL CM2, NCAR CCSM3, and UK MetOffice HadCM3. As an additional fifth model, we use tidal and non-tidal runs from the ECOCTH model, which consists of the ECHAM5/OM1 with a tidal coupler.
First, a basic consistency check was performed for multi-century control runs of the models. The twodimensional excitation fields for atmospheric mass and motion, as well as oceanic mass and motion are compared. Also, the globally integrated EOPs are analysed both in time and spectral domain.
The comparison yields, e.g., for the atmospheric mass component of polar motion excitation, very good agreement between the models with respect to the annual cycle. In the Taylor diagrams comparing the main EOFs from the two-dimensional excitation fields calculated from the atmospheric mass distribution, we also obtain good agreement. All five main EOFs show correlations in the range of 0.75 to 0.98 in the inter-model comparison.
In a second step, the impact of climate change signal, i.e. the difference between two 30-year periods from the beginning and the end of the A1B run, is analysed.