Geophysical Research Abstracts
Vol. 16, EGU2014-2318, 2014
EGU General Assembly 2014
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Meteorological excitations of polar motion for an Earth model with frequency-dependent responses

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Polar motion excitation involves the mass redistributions and motions of the Earth system relative to the mantle, as well as the frequency-dependent rheology of the Earth, where the latter has recently been modeled in the form of complex and frequency-dependent Love numbers and polar motion excitation transfer functions. At seasonal and intra-seasonal time scales, polar motions are dominated by angular momentum fluctuations due to mass redistributions and relative motions in the atmosphere, oceans, and continental water, snow and ice. In this study, we compare the geophysical excitations derived from various global atmospheric, oceanic and hydrological models (NCEP, ECCO, ERA40, ERAinterim and ECMWF operational products), and construct two model sets LDC1 and LDC2 by combining the above models with a least difference method, which selects FFT coefficients of the above data series closest to those of the geodetic excitation at each frequency to build a new series. Comparisons between the geodetic excitation (derived from the polar motion series IERS EOP 08 C04) and the geophysical excitations (based on those meteorological models) imply that the atmospheric models are the most reliable while the hydrological ones suffer from significant uncertainties; that the ERAinterim is, in general, the best model set among the original ones, but the combined models LDC1 and LDC2 are much better than ERAinterim; and that applying the frequency-dependent transfer functions to LDC1 and LDC2 improves their agreements with the geodetic excitation. Thus, we conclude that the combined models LDC1 and LDC2 are reliable, and the complex and frequency-dependent Love numbers and polar motion excitation transfer functions are well modeled.
This study is supported in parts by the National 973 Project of China (No. 2013CB733301 and 2013CB733305), the National Natural Science Foundation of China (No. 41174011, 41128003 and 11073044), and the Open Fund of the State Key Laboratory of Geodesy and Earth's Dynamics, Institute of Geodesy and Geophysics, CAS (No. SKLGED2013-2-3-E).