Atmospheric and oceanic Excitation 01 Polar Motion During 1992–1994

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Atmospheric wind and pressure changes arc known to be an important source of polar motion excitation on time scales of a few days to a few years. For example, during 1992– 1994, the variance of the observed complex-valued SPACE96 polar motion excitation series is reduced from 1767 mas^2 to 957 mas^2 upon removing atmospheric wind and inverted barometer pressure effects computed from products of the NCEP/NCAR reanalysis system. Since the square of the mean uncertainty of the complex-valued SPACE96 polar motion excitation series during 1992–1994 is 172 mas^2, 785 mas^2, or nearly half, of the observed variance remains to be explained by non-atmospheric excitation mechanisms, or by errors in the modeled atmospheric effects. Here, nontidal oceanic current and sea level height variations are investigated as a possible source of the missing polar motion excitation.

Two global ocean general circulation models have been used to compute the angular momentum of nontidal oceanic current and sea level height variations: (1) the Princeton Modular Ocean Model (MOM) having 22 vertical layers and a rigid lid, and (2) the Miami Isopycnic-Coordinate Ocean Model (MICOM) having 11 vertical layers with a mixed layer and a free surface. Both models were run on the same 2 degree longitude by 1 degree latitude grid spanning 80 S to 80 N latitude. Following a 10-year spin-up with climatological air-sea fluxes, both models were forced during 1992–1 994 with daily wind and heat flux from the NCEP operational analysis and sea surface salinity restoring to Levitus climatology. After correcting for the effects of mass non-conservation in these models, they are shown to predict similar effects on polar motion excitation of sea level height variations, but the effect of currents predicted by MOM is much larger than that predicted by MICOM. Upon removing atmospheric effects from the observed polar motion excitation series, the predicted effect of the sum of the current and sea level height variations of MICOM are shown to reduce the residual polar motion excitation variance from 957 mas^2 to 723 mas^2, whereas removing the MOM results increases the residual variance to 1408 mas^2, indicating that the non-axial components of the angular momentum of the MOM currents are too large. Thus, during 1992– 1994, atmospheric effects modeled by the NCEP/NCAR reanalysis system, oceanic effects modeled by MICOM, and polar motion excitation measurement uncertainty can account for 1216 mas^2, or 69°/0, of the observed 1767 mas^2 polar motion excitation variance. The remaining 551 mas^2, or 31%, of the observed variance remains to be explained by errors in the atmospheric and/or oceanic models, and by other excitation mechanisms such as hydrologic effects.