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Atmospheric angular momentum from the 20th Century Reanalysis Project

Rodrigo Abarca del Rio (1) and David Salstein (2)

(1) DGEO, Facultad de Ciencias Físicas y Matemáticas, Universidad de Concepción, Concepción, Chile, (2) Atmospheric and Environmental Research (AER), Lexington, MA, USA

Global Atmospheric Angular Momentum (AAM) mirrors many aspects of the signature of climate and weather, and as such is an important index pertaining to climate systems, on time scales from interannual to intraseasonal and the synoptic scales related to weather systems. Along with global temperature, an index of the energy cycle, and global moisture, an index of the hydrologic cycle, the diagnosis of the origin and transport of angular momentum, an index of the atmospheric circulation, is also fundamental to the climate. Angular momentum is a property of mass in motion about a given axis, which in a closed domain is conserved. Therefore, how angular momentum is exchanged across its lower boundary, by means of the interactive torques with the oceans and solid Earth below, is important to quantify so that one can understand how the Earth acts as a system.

As angular momentum is conserved in a closed system, small but measurable changes in the Earth's rotation rate are a consequence of the exchanges of angular momentum between the solid Earth and its fluid envelope, with the atmosphere being the most important component on many time scales. Accordingly, weather and climate signals may be noted in the behavior too of series of Earth Orientation Parameters.

We are using information from part of the new 20th Century Reanalysis Project, an initiative designed to reconstruct the period from 1871-2008 based on all available historical surface pressure observations. Here we help determine how well this set simulates relative AAM about the Earth's mean axis, a fundamental measure of the atmosphere's circulation that depends on the strength and distribution of the zonal winds, partially by comparisons to other detailed reanalysis sets over the more period recent since the mid-20th century. We evaluate the global values over a broad range of timescales, and values of AAM spread among the atmospheric regions vertically and meridionally to see the modes and regional characteristics of the variability.