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.

The relevance of atmospheric angular momentum changes to geodetic and many other geophysical properties has been recognized by the formal organization of the Special Bureau for the Atmosphere (SBA) of the International Earth Rotation and Reference System Service (IERS) to qualify test and supply such atmospheric data to geoscientists for purposes of studies of Earth’s properties, and for reference frame purposes involving navigation.

As part of the 20th century reanalysis project, we are evaluating how well the current set simulate relative atmospheric angular momentum (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.

We will diagnose the mean climate and variability of the angular momentum of the atmosphere, and assess errors on mean, seasonal, and interannual time scales by concentrating on one reanalysis (NCAR 1948-2010) and ECMWF (1958-2002) as a benchmark. Here we use principally the NCEP-NCAR between 1958 and 2001.

3.0 METHODOLOGY

We will first show the time series of global AAM (Fig 1) and its spectrum (Fig 2). To compare the model and its hemispheric components (Fig 3). We will then show the interannual variability (Fig 4 and Fig 5). Following, we will concentrate on the tropospheric variability only and analyze main components (southern and northern annual cycle, high and low frequency) (Fig 4). The three frequencies will be detailed, separating them into interannual and decadal time scales (Fig 5).

To show how well transport of momentum during ENSO events is represented in the new reanalyses, we will focus on the evolution of old record interannual time scales in zonal bands in another (Figs 5 and 6). To understand how these differences are coming from, we have compared the power spectrum of the global mean anomalies of AAM (Fig 7) and anomalies of seasonal means (Fig 8). Finally, we will show some evidence of the interannual time series of different reanalyses when data are filtered through the corresponding wavelet analysis.

4.0 RESULTS (FIGURES)

4.1 RESULTS (FIGURES)

4.2 RESULTS (FIGURES)

4.3 RESULTS (FIGURES)

4.4 RESULTS (FIGURES)

4.5 RESULTS (FIGURES)

4.6 RESULTS (FIGURES)

4.7 RESULTS (FIGURES)

4.8 RESULTS (FIGURES)

4.9 RESULTS (FIGURES)

5.0 CONCLUSION

The results presented here are very encouraging for the prospective use of new analysis techniques to understand the atmospheric angular momentum, and its interaction with the solid Earth. This will allow the verification of different claims that are still needed to be understood better, confirmed or disproved, or even discovered. The major exception to the reliability of these analyses is to improve the interannual to interdecadal variability in the atmospheric SBA of the previous reanalyses.

For example, this result will give confidence to use the reanalyses to study various phenomena over a longer time period. Some areas of interest are the diagnosis of the impacts of global warming on the atmosphere, the role of the reanalyses in the understanding of stratospheric AAM of the previous reanalyses.