

### 3.5.6.1 Special Bureau for the Atmosphere

In conjunction with the U.S. National Oceanic and Atmospheric Administration (NOAA) the SB Atmosphere has produced data from 4 different operational meteorological centres. We have also produced data from atmospheric reanalyses, spanning back to 1948. SB Atmosphere organized a system to operate in two modes. In the first, it supplies the data in near-real time through the services at NOAA, including analysis and forecast terms. In the second mode, it updates monthly archives of the data on the FTP server at Atmospheric and Environmental Research, Inc. (AER).

The principal data prepared relate to atmospheric excitations of the Earth rotation vector, as forced by changes in the winds and surface pressure of the atmosphere, known respectively as the motion and mass terms of the atmospheric angular momentum AAM. For the axial component, related to length-of-day, the stronger term is the motion one, and for the equatorial term, related to polar motion, the mass term generally dominates. However, recent interest in the wind-based equatorial terms indicates that it may be contributing more significantly to the Chandler wobble frequency band. An “inverted barometer” correction is produced to the mass terms, designed to model an equilibrium condition of the oceans in which the ocean depresses in response to a higher atmospheric pressure and rises in response to a lower one.

SB Atmosphere also computes the AAM terms locally, in a number of equal-area sectors distributed around the globe, as well as globally. In addition, SB Atmosphere computes the mean atmospheric surface pressure over the globe, and various spherical harmonics, which are related to the Stokes coefficients of the Earth gravity field, of particular interest to recent space-gravity missions. SB Atmosphere archives torques from the NCEP-NCAR reanalyses that relate to the angular momentum transfer from atmosphere to solid Earth, including topographic (mountain), friction, and gravity wave drag torques. Users log in to our ftp sites to obtain the desired information.

During the recent year, we hosted Dr. Yonghong Zhou, who visited from the Shanghai Astronomical Observatory. He helped update our atmospheric series in several ways. First for the NCEP-NCAR reanalyses, he reprocessed the data by integrations with a different lower boundary; second, he reconsidered and updated the constants dependent on Earth properties, and third, an independent set of atmospheric angular momentum was updated, not depending upon the solid Earth physical constants.

Some of his summary material is included here:

The atmospheric angular momentum (AAM) during the period of 1948–2004 is re-processed using the NCEP/NCAR reanalysis 6-

hourly wind and pressure data. In order to consider the Earth's topography effect, the AAM is computed by integrating winds from the Earth surface to 10 hPa, the top of atmospheric model, instead that from a set 1000 hPa bottom level to 10 hPa. For these two cases, only a minor difference ( $\sim 0.004$  milliarcseconds) exists with respect to the Chi-3 wind term. However, considerable differences (5~6 milliarcseconds) are found regarding Chi-1 and Chi-2 wind terms. We then compared the equatorial AAM (with and without the topographic effect) with the observed polar motion excitations during 1980–2003, and the improved coherences are found between the equatorial AAM and the observed excitation when the topography effect is considered.

Atmospheric thermal tides are known to cause diurnal variations in wind, which transfer here to variations in polar motion excitation. The two are seasonally modulated. Two functions (1 and 2) for polar motion, were analysed for all twelve months in 2002, as well as the axial (3) term, which is relatively much smaller. The polar motion terms have strong variations with magnitude of  $\sim 10$  mas. They have distinct 'winter mode' (January to February, October to December) and 'summer mode' (March to September). The axial length of day term has very small daily variation with magnitude of  $\sim 0.009$  ms.

In comparing operational AAM of NCEP, JMA and UKMO during 2004, the following results were obtained:

The NCEP AAM (6-hourly), JMAAAM (6-hourly) and UKMO AAM (twice daily) show similar patterns, though considerable gaps exist in the UKMO operational AAM. While the differences in the axial terms ( $\chi^3$ ) of the NCEP and JMA operational AAM are negligible, those in the equatorial terms ( $\chi^1$  and  $\chi^2$ ) remain significant. The differences in equatorial terms of the NCEP and JMA operational AAM are generally larger for the southern hemisphere than those for the northern hemisphere, which might be due to less observational data in the southern hemisphere.

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