ASPIRE (I1479)

Short period variations of Earth rotation are subject to a small but important influence from atmospheric dynamics associated with diurnal and semi-diurnal radiational atmospheric tides. Sharp peaks in the high-frequency spectra of Earth Rotation Parameters (ERP) are engendered by exchanges of angular momentum between the atmosphere and the solid Earth, and also by non-tidal oceanic angular momentum (OAM) caused by the oceanic response to air pressure variations and wind stresses. However, preceding studies have failed to provide truly reliable values and a complete picture of those intriguing effects. The heart of project ASPIRE is thus to determine accurate estimates of the atmosphere-induced daily and sub-daily ERP variations and acquire a deep understanding of the underlying Earth-atmosphere-ocean angular momentum transfer triggered by atmospheric tides. For the purpose of this key task, two distinct but fundamentally equivalent methods – namely, the diagnoses of fluctuations in angular momentum and the analysis of Earth-atmosphere-ocean interaction torques – will be applied in parallel. The first, purely atmospheric part of project ASPIRE builds on state-of-the-art meteorological data from three of the world's important weather and research centers. The particular innovation at this step will be to perform error and reliability considerations for atmospheric angular momentum (AAM) and torque terms based on an unprecedented three-hour resolution across all atmospheric models. Those efforts are supported by a thorough numerical validation of the analytical equivalence between the time derivative of AAM and the total atmospheric torque. Previously unverified at high frequencies, such an AAM balance may now be feasible in light of recent substantial advances in meteorological analysis, and will also be deeply instructive as it allows crosschecking the results obtained from AAM and the torque approach.

The second major area of operation within project ASPIRE will complete the modeling of global geophysical fluids relevant for sub-daily Earth rotation studies by tackling the dynamic ocean response to atmospheric tides using the global numerical Ocean Model for Circulation and Tides (OMCT). Experiments based on the standard configuration of OMCT as well as on regionally refined grids will lead to an unparalleled effort of studying both non-tidal OAM values and the corresponding oceanic torques at three-hourly intervals. The balance of high-frequency OAM shall be critically evaluated. In a final task, the coupled atmosphere-ocean excitation values will be assessed on the evidence of high-accuracy observations of ERP from modern geodetic observing systems, after removal of the generally predictable ocean tidal effects.

The scientific progress implied by these comprehensive efforts will enable the Earth rotation community to better understand the validity of the relevant sub-diurnal signals arising from global circulation models. Project ASPIRE will thus improve the interpretation of observed high-frequency ERP signals and, in a broader sense, foster our understanding of the Earth as a complex system.