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Comparison of observation level versus 24-hour average atmospheric loading corrections in VLBI analysis

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Variations in the horizontal distribution of atmospheric mass induce displacements of the Earth's surface. Theoretical estimates of the amplitude of the surface displacement indicate that the predicted surface displacement is often large enough to be detected by current geodetic techniques. In fact, the effects of atmospheric pressure loading have been detected in Global Positioning System (GPS) coordinate time series [van Dam et al., 1994; Dong et al., 2002; Scherneck et al., 2003; Zerbini et al., 2004] and very long baseline interferometery (VLBI) coordinates [Rabble and Schuh, 1986; Manabe et al., 1991; van Dam and Herring, 1994; Schuh et al., 2003; MacMillan and Gipson, 1994; and Petrov and Boy, 2004]. Some of these studies applied the atmospheric displacement at the observation level and in other studies, the predicted atmospheric and observed geodetic surface displacements have been averaged over 24 hours. A direct comparison of observation level and 24 hour corrections has not been carried out for VLBI to determine if one or the other approach is superior.

In this presentation, we address the following questions:
1) Is it better to correct geodetic data at the observation level rather than applying corrections averaged over 24 hours to estimated geodetic coordinates a posteriori?
2) At the sub-daily periods, the atmospheric mass signal is composed of two components: a tidal component and a non-tidal component. If observation level corrections reduce the scatter of VLBI data more than a posteriori correction, is it sufficient to only model the atmospheric tides or must the entire atmospheric load signal be incorporated into the corrections?
3) When solutions from different geodetic techniques (or analysis centers within a technique) are combined (e.g., for ITRF2008), not all solutions may have applied atmospheric loading corrections. Are any systematic effects on the estimated TRF introduced when atmospheric loading is applied?