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Seasonal variations in GPS site positions in a center of lateral figure (CL) reference frame

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Seasonal degree-one deformation related to loading effects are a source of misfit between observed site coordinates and assumed positions that are based on a linear motion reference frame model. With a Center of Surface Figure (CF) reference frame, this discrepancy may be partly absorbed by the GPS "scale" parameter, producing a pattern of annual apparent "scale" variation. This effect, in turn, spreads annual deformation artifacts to sites elsewhere on the Earth's surface. In the presence of degree-one deformation, a suitable reference frame model should allow for non-linear site motion. The Center of Lateral Figure (CL) reference frame is one possible solution. With the CL frame model, station motions are constrained to move with constant horizontal velocities, and the vertical component is not used in the solution. This solution confines degree-one deformation to the vertical component, which is not constrained to linear motion. A CL reference frame is demonstrated here using time series results from a GIPSY/OASIS II fiducial-free analysis of approximately 1000 globally distributed GPS sites. Applying reference frame constraints is done utilizing only the horizontal component of site positions and the GPS "scale" parameter is omitted in the initial solution. Results show a pattern of seasonal deformation in the vertical component consistent with loading. For sites in North America, peak to peak amplitudes of seasonal vertical deformation are in the range of 8 to 13 mm and vary by location. In general the phase of seasonal motion at sites in the southern portion of North America is advanced compared to more northerly sites. Seasonal horizontal motions are observed in this solution, indicating localized seasonal effects in addition to degree-one deformation. A more comprehensive comparison of seasonal deformation with available loading estimates from climatological models is planned.