GPS as a complementary tool for investigations of climate trends

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The signals from Global Navigation Satellite Systems (GNSS), e.g. the Global Positioning System (GPS), are delayed in the neutral atmosphere. This delay has two components: one due to water vapour (wet delay) and one due to other atmospheric gases (hydrostatic delay). The wet delay is closely related to the Integrated Precipitable Water Vapour (IPWV), while the hydrostatic delay can be estimated using measurements of the surface pressure.

The atmospheric delay is typically estimated simultaneously with the site coordinates in high accuracy geodetic processing of GPS data. Using these results it is then possible to obtain accurate estimates of the IPWV. There are two main strategies to process GPS data for high accuracy purposes: a network solution and Precise Point Positioning (PPP) solution. In a network solution the data from a large ($\gtrsim$1000 km) GPS network are processed together, while in PPP each GPS station is processed individually.

The Swedish geodetic network of GPS receivers, SWEPOS, has been operating continuously since 1993. The network consist of 21 stations distributed all over Sweden. This provides a data set that can now be used to assess the long-term trends of GPS derived time series of the IPWV. We have studied the trends as a function of the station's location as well as season and from both a network solution and PPP a solution. Typically the observed trends are in the range $\pm$0.3 mm/year over periods of 5–10 years. We also see systematic differences between summer and winter and between different parts of the country. By comparing the time series from the two solutions we are able to investigate possible errors in the time series introduced by the different assumptions made in the two strategies or due to additional error sources, e.g error due to network hardware changes. The long-term aim of this is to assess the usefulness of the technique for climate monitoring.