Using GPS TEC Measurements to Model Ionospheric Variability with Local Oceanic Tidal Modes

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Using GPS measurements, the total electron content (TEC) of the ionosphere above the receiver can be inferred. This technique is utilized here to explore the ionospheric coupling with local oceanic tidal modes in coastal and marine environments.

There is a long history of study into the ionospheric consequences of solar, lunar, geologic, oceanic, and man-made phenomena. These include a wide range of events such as solar storms, eclipses, earthquakes, tsunamis, volcanoes, tropical cyclones, space shuttle launches, and nuclear weapon detonations. With the decreasing cost of highly accurate GPS hardware, scientists are able to cheaply acquire rough estimates of the ionospheric structure at any location they require. This allows for rapid testing of hypotheses pertaining to what phenomena may have marked ionospheric effects.

The link between a GPS satellite and receiver is established on two different UHF frequencies, which are diffracted differently as they pass through the upper atmosphere according to the Appleton formula. This difference manifests as a time delay, which is proportional to the total number of electrons encountered along the line of sight. Therefore, a reasonably simple approach to deriving vertical ionospheric TEC is always available while GPS satellites are overhead.

This project is a long-term collection of GPS TEC measurements to explore the relation between oceanic tides and the ionosphere. The frequencies of interest are the principle lunar semi-diurnal (M2) and the principle solar (S2), which have the largest magnitude. The amplitudes of tidal modes, including surface displacement and velocity components, vary with location within the oceanic basin, so locality is considered as well.