Using GPS TEC measurements to probe ionospheric structure associated with scintillation
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As radio signals pass through the ionosphere, their coherence can degrade due to the random structure of plasma depletions and enhancements. This signal degradation is known as scintillation. Typically scintillation becomes more intense as solar activity increases. Modeling scintillation effects on radio frequency signals requires knowledge of the spectrum of scale sizes of ionospheric perturbations associated with scintillation. A power law estimate for scale sizes versus intensity is typically used for modeling studies. However, in this paper, we use GPS total electron content (TEC) measurements from densely spaced ground-based receiver networks to empirically probe this spectrum.

The two dense GPS TEC networks whose data were analyzed for this presentation are Japan GEONET and the Plate Boundary Observatory (PBO, UNAVCO) in the western United States. Japan GEONET is a dense network of GPS receivers (station spacing of tens of km), with fairly evenly spaced positions over all of Japan. The PBO, on the other hand, has several pockets of extremely dense coverage (station spacing within a few km), but is less dense on average. Although both of these networks are in the mid-latitude regions, and therefore do not get much intense scintillation, we choose to analyze a day with a large solar storm (2015/03/17, St. Patrick's Day Storm) to allow high scintillation potential at mid-latitudes. We then perform two-dimensional spatial analyses on the TEC data from these two networks. We compare the spatial resolution that is possible based on the spacing of the two GPS networks. This will allow us to put limits on spatial structure size that can be determined experimentally using GPS ground networks.