G06c - Monitoring and Understanding the Dynamic Earth With Geodetic Observations

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Very Long Baseline Interferometry as a tool to probe the solar corona

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The solar corona, the Sun's atmosphere, is a dispersive medium for electromagnetic waves. The effect depends on the electron density, which can be determined by multi-frequency measurements. For example, spacecraft tracking has been successfully used in the past to measure the electron content of the corona.

This talk will give an overview of the efforts using very long baseline interferometry (VLBI) to probe the solar corona. In 2011 and 2012, the International VLBI Service for Geodesy and Astrometry conducted twelve VLBI experiments that included observations with ray paths passing through the solar corona. The development of a new method allowed the estimation of parameters of the corona based on these observations. The electron density was modeled by a radial power law with the parameters $N_{e,0}$ (hypothetical electron density at the Sun's surface) and β (radial falloff parameter). Due to strong correlations between the two parameters, β had to be fixed to a theoretical value, but for the first time, $N_{e,0}$ could be estimated using VLBI data.

In 2017 and 2018, three VLBI experiments were scheduled that included a larger number of observations at even smaller elongation angles than in 2011/2012. The strong coronal signal contained in the observations allowed for a determination of the electron density with unpreceded precision. It was for the first time possible to estimate both power-law parameters at the same time. Comparisons of the electron density models from VLBI data with spacecraft tracking data and coronagraph images showed good agreement.