# Atmospheric effects resolved in airborne GNSS reflectometry by data fusion processing

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## Abstract

The advent of the Global Satellite Navigation Systems (GNSS) allowed the emergence of multiple satellite, airborne and terrestrial systems for remote sensing and Earth observation that make use of GNSS signals for navigation and positioning. However, GNSS signals can be also used as a remote sensing technique to obtain characteristics of the Earth's surface once they get reflected. This technique is nowadays called GNSS Reflectometry (GNSS-R) and offers different applications such as sea state, soil moisture, and sea ice concentration.

GNSS reflectometry relies on bistatic radar configuration. Therefore, it is necessary to integrate multiple data sources to produce more accurate, useful, and consistent information from the transmitter-surface-receiver interaction. In this study, we fuse GNSS and ancillary data to resolve the tropospheric residual from the signal path change over the observed period. The experiment consisted of four flights performed with a gyrocopter in July 2019 along the coast between Calais and Boulogne-Sur-Mer, France. The processing comprises the integration of aircraft trajectory, broadcasted GNSS satellites orbits, and geoid model for direct and reflected signal path difference modeling. The latter is used for GNSS-R data processing by means of a model-aided software receiver. The resulting reflected signal is passed through a retracking module to obtain the corrected phase residual observable comparable with the tropospheric residual retrieved from ray-tracing modeling. Initial results have shown promising performance at calm sea and grazing angles. Satellites with low elevations ($E < 10°$) reveal coherent observations that allow resolving atmospheric effects from GNSS-R airborne data.