Water vapor measurement using propagation delay of digital terrestrial broadcasting waves

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We investigate a new system which observes 2D water vapor distribution using digital terrestrial broadcasting waves. Water vapor is estimated using propagation delay of digital terrestrial broadcasting waves [Kawamura et al., 2017]. Severe weather phenomena such as localized heavy rainstorms in urban areas are social issues these days. Their dimensions are small in time and space, and it is still difficult to predict when and where they occur. Water vapor is an essential parameter for weather forecast because it is the origin of raindrops. However, it is one of the most difficult physical quantities to measure by remote sensing. Our target is to improve the accuracy of numerical weather forecast for severe weather phenomena such as localized heavy rainstorms in urban areas through data assimilation.

The basic idea of using propagation delay is the same as that of retrieving precipitable water vapor (PWV) by using GNSS. In this study, we estimate water vapor near a ground surface from the horizontal propagation delay of digital terrestrial broadcasting waves. A real-time delay measurement system with a software-defined radio technique is developed and tested. The data obtained using digital terrestrial broadcasting waves show good agreement with those obtained by ground-based meteorological observation. The main features of this observation are, no need for transmitters (receiving only), applicability wherever digital terrestrial broadcasting is available, and its high time resolution. In the near future, we will investigate the impact of these data toward numerical weather forecast through data assimilation. We will introduce a plan to develop a system that monitors water vapor near the ground surface with time and space resolutions of 30 s and several km. It would improve the accuracy of the numerical weather forecast of localized severe weather phenomena.

Reference

S. Kawamura, et al., Water vapor estimation using digital terrestrial broadcasting waves, *Radio Sci.*, 2017, doi: 10.1002/2016RS006191.