# A New Index Indicating the Degree of Water Vapor Inhomogeneity Utilizing GNSS Slant Path Delay and its Relation with Short-term Heavy Rainfall

*Yoshinori Shoji[1]

1. The Second Laboratory of Meteorological Satellite and Observation System Research Department, Meteorological Research Institute

Water vapor plays a significant role on development of hazardous cumulus convection. Water vapor monitoring with high temporal and spatial resolution is indispensable for both predicting and monitoring of such disastrous weather phenomenon. In Japan, a nationwide dense continuous ground based GNSS (global navigation satellite system) network named GEONET (GNSS Earth Observation Network, http://www.gsi.go.jp/ENGLISH/page_e30030.html) has also been utilized as a continuous water vapor monitoring network by the Japan Meteorological Agency since 2009.

In order to capture finer water vapor variation, we have been developing GNSS slant-path delay (SPD) utilization to detect strong horizontal water vapor gradient within several kilometer which associated with convective activities.

Shoji (2013) developed procedures for retrieving two indices indicating the degree of inhomogeneity of water vapor using the carrier phase of GNSS measured by each GNSS receiver. One index (WVC) describes the spatial concentration of water vapor, while the other (WVI) indicates higher-order water vapor inhomogeneity. Horizontal scales of the two indices are approximately considered to be 60 km and 2-3 km, respectively. A statistical assessment indicates that the two inhomogeneity indices are correlated with strong rainfall.

One of the most important points of the application is its real-time availability. We have tested MADOCA (Multi-GNSS Advanced Demonstration tool for Orbit and Clock Analysis) real-time ephemerides (https://ssl.tksc.jaxa.jp/madoca/public/public_index_en.html) applied to the program package for GNSS positioning “RTKLIB (http://www.rtklib.com/)” version 2.4.2 (patch 11).

A three-month comparison of WVI index and short-time heavy precipitation in summer (July –September, 2016) in Japan revealed potential of the WVI index for monitoring development hazardous cumulus convection.

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