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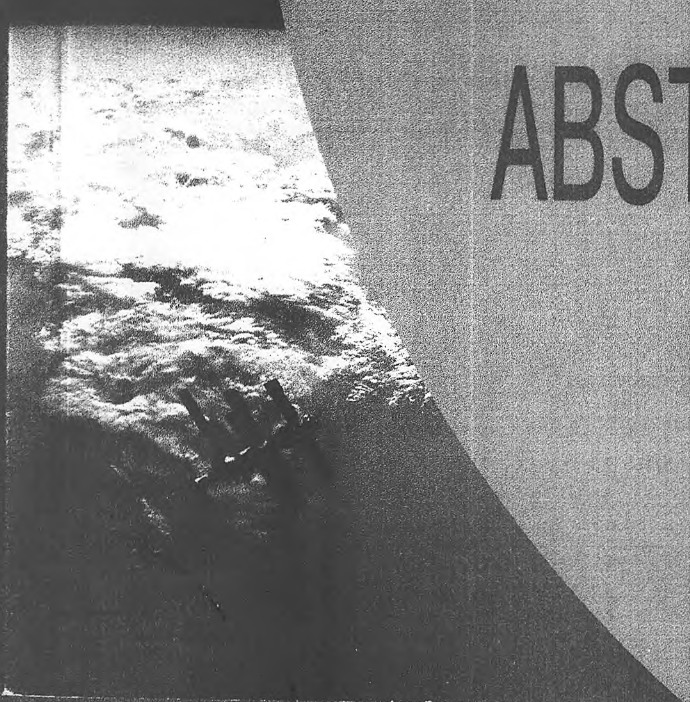

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ДЕРЖАВНЕ КОСМІЧНЕ АГЕНТСТВО УКРАЇНИ
НАЦІОНАЛЬНА АКАДЕМІЯ НАУК УКРАЇНИ
ІНСТИТУТ КОСМІЧНИХ ДОСЛІДЖЕНЬ
ОДЕСЬКИЙ РЕГІОНАЛЬНИЙ ІНСТИТУТ ДЕРЖАВНОГО УПРАВЛІННЯ НАЦІОНАЛЬНОЇ АКАДЕМІЇ ДЕРЖАВНОГО УПРАВЛІННЯ ПРИ ПРЕЗИДЕНТОВІ УКРАЇНИ

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16 УКРАЇНСЬКА КОНФЕРЕНЦІЯ З КОСМІЧНИХ ДОСЛІДЖЕНЬ

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ТЕЗИ ДОПОВІДЕЙ КОНФЕРЕНЦІЇ
ABSTRACTS

Київ * 2016 * Kyiv

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SYSTEM OF GNSS MONITORING OF ATMOSPHERE IN REAL TIME

Nataliya Kablak[1], Stepan Savchuk[2], Oleksandr Reity[1]

1 Uzhhorod National University
2 Lviv Polytechnic National University
nataliya.kablak@gmail.com

Due to the strong correlation between water vapour in the atmosphere and GNSS tropospheric propagation delays, we can estimate the Integrated Precipitable Water Vapour (IPWV) in the atmosphere through GNSS measurements. This parameter is crucial for meteorologists as the water content in the atmosphere is a key parameter in the weather models.

The application of the existing GNSS infrastructure for atmosphere sounding leads to rather inexpensive and reliable measurements of the atmospheric water vapour. Observations from GNSS networks contain information about the spatial and temporal distribution of the water vapour. After elimination of ionospheric effects using a combination of the two GNSS frequencies, the path delay between a GPS satellite and a ground based GNSS receiver depends on the integral effect of the densities of dry air and water vapour along the signal path. The total delay in the signal from each satellite is known as a slant delay because the path is most likely to be non-azimuthal. The slant paths are then transferred into the zenith by an elevation mapping function, and this new parameter is known as the Zenith Total Delay or ZTD.

ZTD gives a measure for the integrated tropospheric condition and is now widely accepted as a standard product from a network of dual frequency GNSS receivers. With further calculation, taking into account surface pressure and temperature, we can then convert a portion of the ZTD into an estimate of the Integrated Water Vapour content of the atmosphere (IWV). The GNSS tropospheric products are Zenith Total Delay (ZTD), Integrated Water Vapour (IWV) and Slant Total Delay (STD). As IWV may potentially change rapidly on a very short timescale, it is the speed at which IWV can be calculated which is of critical importance to short term meteorological forecasting. Often, rapid changes in IWV are associated with high humidity conditions caused by extreme weather events such as thunderstorms. Extreme weather events such as these are typically difficult to predict and track under current operational meteorological systems and, as they have the potential to cause great damage, it is in the interests to both the public and Met Services to significantly improve nowcasting wherever possible. As such the requirement for dense near real-time or real-time GNSS networks for meteorological applications becomes apparent. This manual assesses the quality of GNSS water vapour estimates by comparison against a number of other remote sensing instruments to determine what the true value of the water vapour is and how well GNSS water vapour estimates accurately represent real atmospheric fluctuations.

Different strategies and methods, such as double differencing and precise point positioning, are discussed. Also several GNSS data processing software packages are introduced shortly. The GNSS data are processed and zenith total delay estimated at three institutions to ensure consistent results independent of the software used. The Uzhhorod National University in Ukraine processes all SES stations, using the Alberding GNSS Status Software RT-PPP strategy. In this software used new algorithms for spatially interpolated ZTD and calculation IWV developed by in this University. The Satellite Geodetic Observatory (SGO) of Penc in Hungary processes a subset of EPN stations using the Bernese GNSS software near real-time strategy and has tested both a SES network-processing. The Lviv Polytechnic National University (LPNU) in Ukraine processes the Ukrainian GNSS stations using the GAMIT software and has tested both a SES network-processing and a post-processing/near real-time strategy.

In the framework of project HUSKROUA/1101/252, the system of GNSS monitoring of an atmosphere in real time is created. The database is being automatically updated and helps to monitor an atmosphere status (the change in the dynamics of atmospheric moisture) over selected cross-border areas of Slovakia, Hungary, Romania, and Ukraine in real time. Specially for this project Alberding GmbH has developed software Alberding GNSS Status Software. The system is displayed on the website of the project http://meteognss.net.