The Near Real-Time Processing Systems

The hourly and sub-hourly NRT systems are based on Bernese GPS Software 5.0 and run on a UNIX server. Table 2 summarizes the features of both systems. In Figure 3, we present the operation of the NRT systems which is divided into database management, data and products handling, processing and archiving parts. The strategy of normal equation stacking used in the NRT systems is illustrated in Figure 3. The results of an evaluation of the NRT systems have been shown in the following box.

Using GNSS data in weather forecasting has many benefits over conventional methods, such as high temporal and spatial resolution, easy access to the observational data, and low operational costs. Recent developments in GNSS now provide exciting new possibilities and challenges for GNSS meteorologists and some of these are the introduction of new models from modernized and new GNSS, such as ELONASES and Galileo (as well as their optional combination), development of GNSS processing strategies that are efficient in terms of time (there is a drive towards real-time for non-encoding applications), and improving computing power, and the assimilation of GNSS-derived products into the numerical weather models itself.

The potential of Precipitable Water Vapour Measurements using Global Navigation Satellite Systems in Luxembourg (PWVGLUX) is a collaborative research project between the University of Luxembourg and the University of Nottingham and is funded by the Fonds National de la Recherche (FNR) Luxembourg. The research objectives of this project are to study the potential for GNSS meteorology and climatology for Luxembourg and the surrounding regions of Belgium, France and Germany. For this reason, we call it the “Greater Region.” To achieve the research objectives, systems are being set up at the University of Luxembourg which process ground-based GNSS data for the provision of zenith total delay (ZTD) and integrated precipitable water vapour (IWV) estimates in real-time, near real-time and post-processing modes. Figure 1 shows the GPS stations used by the near real-time (NRT) system, and Table 1 provides information on contributing networks. In the following box, we describe the features of the hourly and sub-hourly NRT processing systems which have already been developed.

NRT Systems Evaluation

The NRT systems have been evaluated by comparing their COST-716 format output to that of two equivalent systems in operation at the University of Nottingham. In this regard, the NRT15m system has been compared to the E-GVAP system and the sub-hourly system (NRT115m) has been compared to the E-IWS solution. Figures 4 and 5 show example time series of IWV and ZTD for this comparison. The numerical results for 10 selection stations are shown in Tables 3 and 4. Table 5 compares the NRT15m with the E-IWS and the NRT115m with the E-GVAP.

Conclusions

Two NRT processing systems, NRT15m and NRT115m, developed at the University of Luxembourg to estimate ZTD and IWV with hourly and 15-minute update cycles respectively, have been presented. An initial evaluation of the equivalent systems E-IWS and E-GVAP has been carried out by comparing them to the NRT systems. The research results indicate that the systems show sub-millimetre and millimetre level agreements in ZTD and IWV respectively. The results suggest that the differences between the two sub-hourly systems are smaller than the differences between the sub-hourly and hourly systems. This is a result of the higher similarities in the networks used by the sub-hourly systems (NRT15m, E-IWS). The results for the hourly NRT system for a weather system crossing over Luxembourg and the Greater Region on 23-25 February 2012 are presented. We compared the maps of IWV with precipitation maps from weather radar data and show good agreement in the location of the foremost extent of the precipitation events. These results are encouraging and show that the NRT systems at the University of Luxembourg can very conveniently be used to the other NRT systems.

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