RESEARCH INSTITUTE FOR SUSTAINABLE URBAN DEVELOPMENT (RISUD)

News Article for RISUD Emerging Frontier Area (EFA) Scheme

		Name	Department
1.	**Principal Investigator**:	Prof. George LIU	LSGI
2.	**Name of EFA:**	Environment and Climate Change Observation and Prediction	
3.	**Project Title:**	Augmenting the Extreme Weather Forecasting Capability in the Greater Bay Area through Improving the Accuracy of Satellite-based Atmospheric Water Vapor Remote Sensing Observations using Continent-based and Ocean-based GNSS Calibration	

4. **Annual Progress/Achievement**

LSGI Graduate Won a Young Author Best Paper Award at the World's Largest GNSS Conference

(21 May 2021, Hong Kong) PhD graduate Yangzhao Gong from the Department of Land Surveying and Geo-Informatics (LSGI), PolyU, recently received a Young Author Best Paper Award (the 3rd order) at the 12th China Satellite Navigation Conference (CSNC), Nanchang, China, during May 26-28, 2021. The awarded paper was entitled "Augmenting GNSS PPP Accuracy in South China Using Water Vapor Correction Data from WRF Assimilation Results," in which atmospheric water vapor data were remotely sensed by a network of GNSS ground receivers and then assimilated into the Numerical Weather Prediction (NWP) model, i.e. the widely used Weather Research and Forecasting (WRF) model.

With the assimilation of remotely sensed water vapor data into the WRF model, our test results (**Fig. 1**) shows that it can improve the accuracy of WRF Precipitable Water Vapor (PWV) forecasting results by 17% for the first 7 hours, which is significant for weather forecasting and other applications.

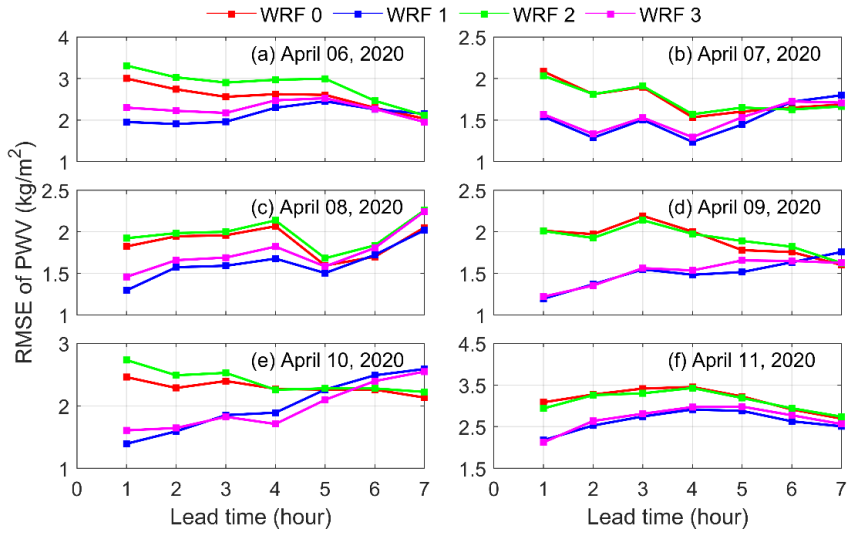

Fig. 1 The hourly PWV RMSE of four WRF schemes evaluated by PWV observations from 27 GNSS stations of the Crustal Movement Observation Network of China (CMONOC) at WRF lead time of 1 h to 7 h for six WRF forecasts from April 06 to 11, 2020. Each WRF forecast is initialized at 0 h UTC of that day. WRF 0: WRF forecasting without data assimilation; WRF 1: WRF forecasting with GNSS PWV assimilation only; WRF 2: WRF forecasting with radiosonde profiles assimilation only; WRF 3: WRF forecasting with both GNSS PWV and radiosonde profiles assimilation.

The water vapor data forecast by the WRF model were also utilized to correct the atmospheric errors in GNSS observations. The test results in the South China region showed that the three-dimension (3D) accuracy of GNSS positioning and navigation solution can be significantly improved by 25% to 35% for static GNSS users (**Fig. 2(a)**) and 15% to 26% when the GNSS receivers are in kinematic mode (**Fig. 2(b)**). Considering the large number of GNSS users including millions of smartphone users, the value of improving the positioning and navigation accuracy is enormous. In addition to its applications in weather forecasting and GNSS positioning and navigation, accurate water vapor products have a wide range of applications in various applications such as climate change, air pollution monitoring, and Earth observations.

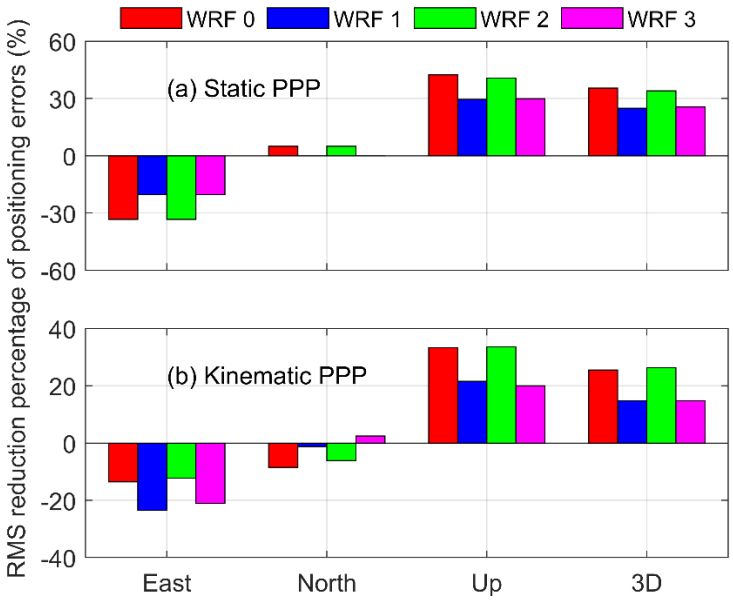

Fig. 2 6-day average RMS reduction percentage of positioning errors for four WRF-augmented PPP schemes in east, north, and up components and overall 3D compared to traditional "Estimated" PPP. GNSS data from seven International GNSS Service (IGS) stations during April 06 to 11, 2020 are used to conduct PPP in both static and kinematic modes. In "Estimated" PPP scheme, wet delay is treated as an unknown parameter to be estimated. In WRF-augmented PPP scheme, water vapor forecasting results from WRF model are used to correct GNSS signal wet delay directly.

This work is conducted under the supervision of Prof. George Liu of LSGI. Coauthored with Prof. George Liu, Mr. Pak Wai Chan and Mr. Kai Kwong Hon, both from the Hong Kong Observatory (HKO). This paper exemplified the significance of cross-disciplinary collaborative research.

The CSNC conference is the largest international conference in the world in the field of Global Navigation Satellite System (GNSS). Annually more than 5000 GNSS-related researchers and engineers worldwide participate in the CSNC conference.