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• **Editorial Notes** •

Preface to the Special Issue: Predictability, Data Assimilation, and Dynamics of High Impact Weather—In Memory of Dr. Fuqing ZHANG※

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It has been two and a half years since Fuqing ZHANG, a distinguished professor in the Department of Meteorology and Atmospheric Science at the Pennsylvania State University (PSU), passed away unexpectedly on 19 July 2019. This special issue is to commemorate Prof. Fuqing ZHANG, who has made tremendous contributions on predictability, data assimilation, and the dynamics of high impact weather.

Fuqing was incredibly gifted and able to combine research in various areas. He made breakthroughs in multiple major areas of atmospheric science, including, but not limited to, numerical weather prediction, ensemble-based and coupled data assimilation techniques, advanced use of remote sensing data, and the dynamics and predictability of high impact weather systems such as tropical cyclones (TCs), mesoscale convective systems (MCSs), gravity waves, and supercells. His publications cover aspects from theory to methodology and application, as well as from weather to climate and environment. Fuqing was even more gifted in bringing people together and making them feel appreciated and realize their own potential, all through his true love of science and life. He made every workshop, conference, summer school, and group meeting that he organized joyful and fruitful. As a natural extension of those meetings, there were always visitors in his group from all over the world collaborating on various research ideas, most of which originated at those enlightening meetings and discussions.

This festschrift is comprised of nine invited papers by colleagues, friends, collaborators, and former students of Fuqing. The contents cover predictability, including targeting observation and impact of model resolution, ensemble-based assimilation of infrared satellite observation and its correlation with atmospheric state, dynamics of TC genesis, initiation and evolution of MCSs and their associated heavy rainfall, and features of supercells in a landfalling TC. All the authors of this special issue have worked or collaborated with Fuqing in one way or another.

I met Fuqing in Nanjing in 1992 and became Fuqing's Ph.D student in 2003 at Texas A&M University, working on mesoscale application of ensemble Kalman filter (EnKF). My research interests have extended from EnKF to mesoscale dynamics and predictability. Eugene E. CLOTHIAUX was Fuqing's colleague at PSU and his very close friend. They had wonderful collaborations on using remote sensing observations. Meng and Clothiaux (2022, Page 676–683) have summarized the major contributions of Fuqing ZHANG, from research to mentoring and academic service. Special appreciation is given on Fuqing's fascinating contributions to the development of mesoscale meteorology in China and the education of Chinese graduate students and young scientists.

Predictability of multiscale weather systems was one of Fuqing's major research interests, and he proposed a now-famous three-stage error-growth model, highlighting the importance of error propagation from the location of moist convection (Zhang et al., 2006). Yu and Meng (2022, Page 684–696) have examined the impact of moist physics on the identification of sensitive areas for heavy rainfall cases in China using the conditional nonlinear optimal perturbation (CNOP) method. They demonstrate that the CNOP method with moist physics can identify lower-level sensitive areas, which quantitatively

※ This paper is a contribution to the special issue on Predictability, Data Assimilation and Dynamics of High Impact Weather —In Memory of Dr. Fuqing ZHANG.

reveals the important impacts of the initial error from lower-level systems on rainfall forecasts. From a practical predictability perspective, Hock et al. (2022, Page 697–713) have examined the effects of geophysical representations and horizontal resolutions of the WRF model on the simulation of a Florida sea breeze and its interactions with associated convection. They find that accurate representation of the coastline and small lakes apparently improves the location and timing of convection initiation of the sea breeze and the subsequent convection organization due to changes in low-level atmospheric convergence and surface sensible heating.

Through assimilating radar data, Fuqing's research group achieved the greatest progress in TC intensity forecasting in decades. In addition to radar data, they also demonstrated the effectiveness of satellite, especially all-sky satellite, data assimilation in improving TC intensity forecasts. Members of Fuqing's group are currently applying infrared satellite assimilation to storm-scale weather systems. and his colleagues at PSU (Zhang et al., 2022b, Page 714–732) explored the structures of the correlations between infrared brightness temperatures (BTs) from the three water vapor channels of the Advanced Baseline Imager (ABI) onboard the GOES-16 satellite and the atmospheric state of storms. Their research provides valuable information on the proper choice of different water vapor channels and cut-off radii in horizontal and vertical localization schemes for the assimilation of BTs. Chan and Chen (2022, Page 733–746) have applied the PSU EnKF system in assimilating all-sky upper-tropospheric infrared radiance observations for a tropical squall line, demonstrating a clear improvement in the outflow positions and cloud fields of the target convective system.

Fuqing's studies on predictability and prediction were rooted in his deep understanding of the dynamics of mesoscale processes such as gravity waves, tropical cyclones, and convective systems. Gravity waves are where Fuqing started his dynamic journey, and the same is true for his former student Shuguang WANG, whose research interests have currently expanded to tropical disturbances. Juan FANG, Xiaodong TANG, and Zhemin TAN all had close collaborations with Fuqing on the dynamics of TC genesis. In this special issue, Wang et al. (2022, Page 747–762) have presented a statistical relationship between intraseasonal Equatorial Rossby Waves (ERWs) and TC genesis (TCG) over major global TC basins. They find that the ERWs significantly modulate TC genesis, especially where the ERWs propagate through the climatological TCG hotspots.

In addition to the dynamics of gravity waves and TCs, that of MCSs in the unique climate regime and over the unique terrain of China had been another major area where Fuqing developed close collaborations with many Chinese scientists, including most of the authors of this special issue (e.g., Zhiyong MENG, Jianhua SUN, Yu DU, and Yuanchun ZHANG). As an extension of a collaboration with Fuqing on the diurnal evolution and structure of long-lived mesoscale convective vortices along the mei-yu front over the East China Plains (Zhang et al., 2018), Zhang et al. (2022a, Page 763–781) have further explored the initiation and evolution of long-lived eastward-propagating MCSs over the second-step terrain along the Yangtze-Huai River Valley. They reveal the non-negligible impact of these types of MCSs on the development and enhancement of convection and vortices in the downstream areas. Du et al. (2022, Page 782–801) have examined the influence of coastal marine boundary layer jets on rainfall in South China. They find that the rainfall occurs mainly downstream of coastal marine boundary layer jets, resulting from a joint interaction of dynamic lifting, moisture flux convergence, and relevant atmospheric stratification. Bai et al. (2022, Page 802–818) have investigated the radar-based characteristics and formation environment of supercells that formed both onshore and offshore during the landfalling process of Typhoon Mujigae (2015). They demonstrate the validation of using traditional parameters obtained from midlatitude supercells to assess the supercell potential in a TC envelope.

As stated by Prof. David STENSRUD (Stensrud, 2020) from PSU, Fuqing was a powerful, positive force in our community, where his contributions have been and will be remembered. To my knowledge, there have been memorials following Fuqing's passing in published paper (Ruppert et al., 2022) and in symposium sessions, such as the special evening session on 30 July 2019 at the 18th AMS conference on mesoscale processes, the special memorial session on 22 December 2019 at the second mesoscale meteorology forum in China, and the joint session on scale interactions and predictability in memory of Fuqing ZHANG on 14 January 2020 at the 100th AMS annual meeting. Also, in planning are a symposium to celebrate and honor the professional accomplishments of Fuqing ZHANG by PSU following the 9th EnKF data assimilation workshop and the Fuqing Symposium at the 35th AMS conference on hurricanes and tropical meteorology in May 2022. With Fuqing's passing, our community lost a leading scientist, and many of us lost a great friend. However, Fuqing's contributions to our community will carry on through his students and collaborators, and also through enlightening new ideas via his journal publications.

Finally, I want to sincerely thank all authors and co-authors, anonymous reviewers, and the AAS editorial team. A special thanks also goes to Dr. Juanzhen SUN from NCAR for proposing this special issue. It is their great contributions that make this special issue possible.

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