• MAP currently has **14** members: 1 research scientist, 6 postdoc researchers, 6 graduate students. Still growing!

• Prof. Wang has advised 12 postdocs, 11 Ph.D. students, 8 M.S. students at OU and 3 international visiting students
MAP Student Awards

- MAP students have won **19** awards
  - OU Provost Ph.D. dissertation award (1)
  - AMS fellowship (1)
  - SoM best student publication award (5)
  - SoM best student performance award (2)
  - National conference presentation award (6)
  - International/national conference travel award (4)

SoM: School of Meteorology
i) developing new techniques and novel methodologies for data assimilation and ensemble prediction;

ii) applying these techniques to global scale to convective scale modeling systems assimilating a variety of observations (radar, satellite, ground based remote sensing platforms, aircraft borne observations, in-situ, etc.) to improve numerical prediction skill;

iii) improving the understanding of atmospheric predictability and dynamics through data assimilation and ensemble approaches from global to storm scales;

iv) Interfacing between basic research and US NWS operational numerical weather prediction (NWP) or say transitioning research into operations (R2O).
Data Assimilation Algorithm and Theory

- Advanced the ensemble transform Kalman filter (ETKF) theory and algorithm (e.g. Wang and Bishop 2003, Wang et al. 2004, Huang et al. 2018)

Multi-institutional collaborative efforts (NOAA, NASA, OU MAP lab) on the development of the hybrid data assimilation system based on the US NWS operational data assimilation system GSI.

This collaborative effort led to operational implementation of the 3D and 4D hybrid data assimilation system for US NWS global NWP system GFS in 2012 and 2014 respectively.

Research revealed how and why the hybrid system improved global and hurricane track forecasts (e.g., Wang et al. 2013; Wang and Lei 2014)

Sos.noaa.gov
• Developed fully cycled GSI hybrid data assimilation system for US operational convection allowing hurricane prediction system HWRF (Lu et al. 2016, 2017; Davis et al. 2018)

• The new DA system for HWRF became operational at NWS summer 2017, influencing US real time numerical prediction of hurricanes.
What are the impact of variety of new observations?

Patricia (2015) 12-h forecast

Lu and Wang, 2018

**GOES-13**
- a) GOES-13 band 4 @ 06Z23
- b) Back band 4 @ 06Z23
- c) Base band 4 @ 06Z23
- d) CIMSS band 4 @ 06Z23

**Operational obs.**
- c) Base band 4 @ 06Z23

**CIMSS AMV**
- d) CIMSS band 4 @ 06Z23

**Back**
- a) GOES-13 band 4 @ 06Z23
- b) Back band 4 @ 06Z23
- c) Base band 4 @ 06Z23
- d) CIMSS band 4 @ 06Z23

**Lu and Wang, 2018**
- e) SFMR band 4 @ 06Z23
- f) FL band 4 @ 06Z23
- g) TDR band 4 @ 06Z23
- h) TCI band 4 @ 06Z23
- i) All band 4 @ 06Z23

**SFMR**
- e) SFMR band 4 @ 06Z23

**FL**
- f) FL band 4 @ 06Z23

**TDR**
- g) TDR band 4 @ 06Z23

**TCI drop.**
- h) TCI band 4 @ 06Z23

**ALL**
- i) All band 4 @ 06Z23
What is causing rapid intensification of hurricane?

(a) No Outflow Layer

(b) Assimilate Outflow Layer

Feng and Wang, 2018
High resolution, voluminous observations for convective scale data assimilation

Ground based radar

GOES-16

A new radar data assimilation algorithm is developed and implemented in the US NWS GSI hybrid DA system (Wang and Wang 2017).

May 8th case animation: simulated tornado producing supercell follows the observed tornado track and maintains the strong updraft and vorticity over 1-hour forecast period.
Development of hybrid data assimilation system to improve convective scale prediction over the CONUS

May 25, 2016 convection-allowing prediction by MAP

- Develop and implement new radar data assimilation algorithm to improve CONUS wide convective scale prediction

- New radar reflectivity method is found to improve precipitation forecast compared to the operational cloud analysis (Duda et al. 2018)

- *This new radar DA system is expected to be adopted by the US NWS to improve the nation’s operational convective scale numerical prediction*
Understanding and improving the prediction of nocturnal convection

June 26 2015 nocturnal CI

July 11, 2015 bore

Johnson et al. 2018, Degelia et al. 2018, Chipilski et al. 2018

July 6 2015 new convection along bore
Assimilate observation from advanced remote sensing platforms

Study convective scale “targeted observations” for multi-function phased array radar (Kerr and Wang 2018)

https://www.nssl.noaa.gov
Ensemble Prediction

• How to optimally design the ensemble to effectively sample the errors in the numerical forecasts?

• How to generate, calibrate and evaluate the probabilistic forecasts?

Probabilistic forecast of reflectivity

June 26, 2015

Interdisciplinary research

- Hydrological data assimilation
- Machine learning and data mining
- Economic value of numerical weather forecast

Johnson et al. 2011ab
Opportunities

Please contact Prof. Xuguang Wang for opportunities to join MAP!

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