Junkyung Kay

Project Scientist V
National Center for Atmospheric Research
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Education

- Ph. D., August 2014, Department of Atmospheric Sciences, Yonsei University, South Korea
  - Dissertation Title: "Development and evaluation of ETKF-based ensemble prediction and data assimilation system"
  - Supervisor: Dr. Hyun Mee Kim
- B. S., August 2007, Department of Atmospheric Sciences, Yonsei University, South Korea

Academic and Research Position

- Earth Observing Laboratory, Remote Sensing Facility, NCAR / Scientist V

October 2025 – Present, Boulder, CO, USA
  - Advisor: Dr. Tammy M. Weckwerth

- **Earth Observing Laboratory, Remote Sensing Facility, NCAR** / Project Scientist II

August 2025 – September, Boulder, CO, USA
  - Advisor: Dr. Tammy M. Weckwerth

- **Earth Observing Laboratory, Remote Sensing Facility, NCAR** / Project Scientist I

March 2021 – Present, Boulder, CO, USA
  - Advisor: Dr. Tammy M. Weckwerth

- **Earth Observing Laboratory, Remote Sensing Facility, NCAR** / Postdoctoral Research Associate

July 2019 – February 2021, Boulder, CO, USA
  - Advisor: Dr. Wen-Chau Lee

- **School of Meteorology, University of Oklahoma** / Postdoctoral Research Associate

August 2015 – June 2019, Norman, OK, USA
  - Advisor: Dr. Xuguang Wang

- **Department of Atmospheric Sciences, Yonsei University** / Postdoctoral Research Associate

September 2014 – July 2015, Seoul, South Korea
  - Advisor: Dr. Hyun Mee Kim

- **Mesoscale & Microscale Meteorology, NCAR** / Visiting Scientist

January 2013 – February 2013, Boulder, CO, USA

- **Department of Atmospheric Sciences, Yonsei University** / Graduate Research Assistant

January 2008 – August 2014, Seoul, South Korea

- **Department of Atmospheric Sciences, Yonsei University** / Teaching Assistant

September 2007 – December 2007, Seoul, South Korea
  - Course: Atmospheric predictability

Research Interest

- Data assimilation of remote sensed and in-situ observations
- Multi-scale data assimilation system
- Ensemble and probabilistic prediction
- Mesoscale meteorology

Publication

- Risanto, C. B., A. F. Arellano, S. Koch, C. L. Castro, S. Shohan, D. K. Adams, T. M. Weckwerth, J. O. Pinto, **J. K. Kay**, 2025: Improving Monsoon precipitation forecast accuracy over complex terrain in Arizona with GPS-PWV data assimilation, *Monthly Weather Review*, under revision.
- Shohan, S., S. E. Koch, C. L. Castro, A. F. Arellano, **J. K. Kay**, C. B. Risanto, T. M. Weckwerth, J. O. Pinto, D. K. Adams, 2025: Impact of assimilating GPS precipitable water vapor on simulation of two North American Monsoon convective events using Observing System Simulation Experiments, *Journal of Geophysical Research*, 130, e2025JD044491. https://doi.org/10.1029/2025JD044491.
- **Kay, J. K.**, J. O. Pinto, T. M. Weckwerth, G. D. Boer, 2025: Quantifying UAS observation error variance used in data assimilation systems and its impact on predictive skill. *Journal of Advances in Modeling Earth Systems,* 17, e2024MS004601, https://doi.org/10.1029/2024MS004601
- **Kay, J. K.**, T. M. Weckwerth, D. D. Turner, G. Romine, and Y. Ying, 2025: Impact of assimilating thermodynamic and kinematic profiles on a convection initiation forecast. *Monthly Weather Review,* DOI: 10.1175/MWR-D-24-0233.1.
- **Kay, J. K.**, T. M. Weckwerth, 2024: Impact of assimilating of New York State Mesonet Doppler wind lidar on high impact weather predictions in New York State. Atmosphere (in Korean), 34 (4), 481-497, https://doi.org/10.14191/Atmos.2024.34.4.4811598-3560(PISSN)
- Pinto. J. O., S. C.C. Bailey, K. R. Fossell, S. Binau, M. Xu, C. S. Schwartz, **J. K. Kay**, R. D. Nolin, C. N. Vezzi, S. W. Smith, and T. M. Weckwerth, 2024: Impact of Assimilating Uncrewed Aircraft System Observations on Fog Prediction. *Weather and Forecasting,* 39, 1673–1694, https://doi.org/10.1175/WAF-D-23-0087.1.
- Lin, H.-C., J. Sun, T. M. Weckwerth, E. Joseph, and **J. K. Kay**, 2022: Assimilation of New York State Mesonet surface and profiler data for the 21 June 2021 convective event. *Monthly Weather Review*, 151(2), 485-507, https://doi.org/10.1175/MWR-D-22-0136.1.
- **Kay, J. K.**, T. M. Weckwerth, W. Lee, J. Sun, and G. Romine, 2022: An OSSE study of the impact of MicroPulse Differential Absorption lidar (MPD) water vapor profiles on convective weather forecasting, *Monthly Weather Review,* **150(10)**, 2787-2811, https://doi.org/10.1175/MWR-D-21-0284.1.
- **Kay, J. K.**, X. Wang, and M. Yamamoto, 2022: An Observing System Simulation Experiment (OSSE) to Study the Impact of Ocean Surface Observation from the Micro Unmanned Robot Observation Network (MURON) on Tropical Cyclone Forecast, *Atmosphere,* **13(5)**, 779, https://doi.org/10.3390/atmos13050779
- **Kay, J. K.** and X. Wang, 2020: A multiresolution ensemble hybrid 4DEnVar for global numerical prediction, *Monthly Weather Review*, **148(2)**, 825–847, https://doi.org/10.1175/MWR-D-19-0002.1
- Yang, E.-G., H. M. Kim, J. Kim, and **J. K. Kay**, 2014: Effect of observation network design on meteorological forecasts of Asian dust events, *Monthly Weather Review,* **142**, 4679-4695, doi:10.1175/MWR-D-14-00080.1.
- **Kay, J. K.**, and H. M. Kim, 2014: Characteristics of initial perturbations in the ensemble prediction system of the Korea Meteorological Administration, *Weather and Forecasting*, **29**, 563-581, doi:10.1175/WAF-D-13-00097.1.
- Kim, H. M., **J. K. Kay**, E.-G. Yang, S. Kim, M. Lee, 2013: Statistical adjoint sensitivity distributions for meteorological forecast errors of Asian dust transport events in Korea, *Tellus B*, **65**, 20554, http://dx.doi.org/10/3402/tellusb.v65i0.20554.
- **Kay, J. K.**, H. M. Kim, Y.-Y. Park, and J. Son, 2013: Effect of doubling ensemble size on the performance of ensemble prediction in warm season using MOGREPS implemented in KMA, *Advances in Atmospheric Sciences,* **30**(5), 1287-1302.
- Kim, H. M., and **J. K. Kay**, 2010: Forecast sensitivity analysis of an Asian dust event occurred on 6-8 May 2007 in Korea, *Atmosphere*, **20**(4), 399-414.

- Kim, H. M., **J. K. Kay**, and B.-J. Jung, 2008: Application of adjoint-based forecast sensitivities to Asian dust transport events in Korea. *Water, Air, and Soil Pollution*, **195**, 335-343, DOI:10.1007/s11270-008-9750-8

Scientific presentation

- **Kay, J. K.**, T. M. Weckwerth, J. O. Pinto, M. B. Wilson, J. Wang, T. Ladwig, S. Murdzek, and C. Speciale, 2025: Systematic evaluation of assimilating ground-based remote-sensing profiling observations of the New York State Mesonet. 105th American Meteorological Society 2025, New Orleans, LA, USA, 12-16 January 2025.
- **Kay, J. K.**, T. M. Weckwerth, J. O. Pinto, M. B. Wilson, J. Wang, T. Ladwig, S. Murdzek, and C. Speciale, 2025: Systematic evaluation of assimilating ground-based remote-sensing profiling observations of the New York State Mesonet., Northeast Regional Operations workshop, Albany, NY, USA, 14-15 November 2024.
- **Kay, J. K.**, T. M. Weckwerth, J. O. Pinto, M. B. Wilson, J. Wang, T. Ladwig, S. Murdzek, and C. Speciale, 2024: Impact of New York State Mesonet profiler observations on high impact weather predictions in New York State. *104th American Meteorological Society 2024,* Baltimore, MD, USA, 28 January-1 February 2024.
- **Kay, J. K.**, J. O. Pinto, K. Fossell, and P. McCarthy, 2023: UAS observation error estimation for data assimilation and its impact on predictive skill. *9th International Symposium on Data Assimilation*, 16-20 October 2023, Bologna, Italy.
- **Kay, J. K.**, T. M. Weckwerth, D. Turner, and G. Romine, 2023: Impact study of lower-atmospheric wind and thermodynamic profiles on convective weather forecasts over the CONUS. *ICMCS-XV*, Fort Collins, CO, USA, 22-25 May 2023.
- **Kay, J. K.**, J. O. Pinto, K. Fossell, and P. McCarthy, 2023: Quantifying UAS observation error variance used in data assimilation systems and its impact on predictive skill. *103rd American Meteorological Society 2023,* virtual meeting, 8-12 January 2023.
- **Kay, J. K.**, T. M. Weckwerth, D. Turner, and G. Romine, 2023: Assimilation of thermodynamic and wind profiles and its impacts on the prediction of ABL evolution under clear skies. *103rd American Meteorological Society 2023,* virtual meeting, 8-12 January 2023.
- **Kay, J. K.**, J. O. Pinto, K. Fossell, and P. McCarthy, 2022: Quantifying UAS observational errors during LAPSE-RATE field campaign. *UAS Weather Technology Forum 2022*, Tulsa, OK, USA, 16 August 2022.
- **Kay, J. K.**, T. M. Weckwerth, G. Romine, D. Turner, and M. Ying, 2022: Impact of assimilating lower-atmospheric wind and thermodynamic profiles on precipitation forecasts. *International Symposium on Data Assimilation 2022*, Fort Collins, CO, USA, 9 June 2021.
- **Kay, J. K.**, T. M. Weckwerth, G. Romine, D. Turner, and M. Ying, 2022: Impact of assimilating low-atmospheric wind and thermodynamic profiles on convective weather forecast over the CONUS. *102nd American Meteorological Society 2022*, virtual meeting, 23-27 January 2022.
- **Kay, J. K.**, T. M. Weckwerth, W. Lee, J. Sun, and G. Romine, 2021: An OSSE study of the impact of MPD (MicroPulse Differential absorption Lidar) water vapor profiling observations on convective weather forecasting. *101st American Meteorological Society 2021*, virtual meeting, 10-15 January 2021.
- **Kay, J. K.**, T. M. Weckwerth, W. Lee, J. Sun, and G. Romine, 2020: An OSSE study of the impact of MPD (MicroPulse Differential absorption Lidar) water vapor profiling observations on convective weather forecasting. *STEP FY19 Workshop*, Boulder, CO, USA, 19 February

- **Kay, J. K.**, T. M. Weckwerth, W. Lee, J. Sun, and G. Romine, 2019: Data assimilation of NCAR's new lower tropospheric water vapor observation: 1. Introduction to the principles and methods of data assimilation. *EOL science group meeting*, Boulder, CO. USA, 13 November.
- Wang, X., **J. K. Kay**, B. Huang, D. Kleist, and T. Lei, 2018: Development of the GSI-based Hybrid 4DEnVar System with Multi-resolution Ensembles and Multi-scale Covariance Localization for Global Numerical Weather Prediction, *8th EnKF data assimilation workshop 2018*, Québec, Canada, 7-10 May 2018.
- **Kay, J. K.**, and X. Wang, 2018[1]: The Development of the GFS Hybrid 4DEnVar System with Multi-Resolution Ensembles. *98th American Meteorological society 2018*. Austin, USA, 7-11 January 2018.
- **Kay, J. K.**, and X. Wang, 2018[2]: An OSSE Study of the Impact of the Micro Unmanned Robot Observation Network (MURON) Ocean Surface Observation on Tropical Cyclone Prediction Using GSI Based EnKF. *98th American Meteorological society 2018*. Austin, USA, 7-11 January 2018.
- **Kay, J. K.**, and X. Wang, 2016: A study of the impact of MURON ocean surface observations on the tropical cyclone analysis and forecasts using Observing System Simulation Experiments. *6th OU/WNI workshop 2016*, Norman, OK, USA, 2 November 2016.
- **Kay, J. K.**, H. M. Kim, S-Y. Ha, 2015: Effect of soil moisture perturbations on the ensemble forecast over the Korean Peninsula. *95th American Meteorological society 2015*. Phoenix, USA, 3-8 January 2015.
- **Kay, J. K.**, H. M. Kim, S. H. Kim, S. W. Lee, 2014: Development of LETKF for the regional unified model (UM) of KMA and evaluation with operational 3DVAR. *11th Asia Oceania Geosciences Society (AOGS) annual meeting 2014*, Sapporo, Japan, 28 July-01 August 2014.
- **Kay, J. K.**, H. M. Kim, 2014: The effect of new additive inflation factor on the ensemble prediction. *94th American Meteorological society 2014*. Georgia, USA, 2-6 February 2014.
- **Kay, J. K.**, H. M. Kim, Y. Y. Park, J. Son, 2011: Analysis of initial ensemble perturbations using a new ensemble prediction system of Korea Meteorological Administration. *Asia Oceania Geosciences Society (AOGS) 8th Annual Meeting 2011*. Taipei, Taiwan, 8-12 August 2011
- **Kay, J. K.**, H. M. Kim, Y. Y. Park, J Son, 2010: the effect of member configuration of Ensemble Transform Kalman Filter on the performance of ensemble prediction. *European Geoscience Union (EGU) General Assembly 2010*, Vienna, Austria, 2-7 May 2010.
- **Kay, J. K.**, H. M. Kim, Y. Y. Park, J. Son, S. Moon, H. D. Yoo, 2009: The sensitivity of ensemble size in UM of KMA. *THE 5TH WMO INTERNATIONAL SYMPOSIUM ON DATA ASSIMILATION*, Melbourne Exhibition Centre: Melbourne, 5-9 October 2009.

Invited presentations

- "Development and evaluation of ETKF-based ensemble prediction and data assimilation system" **Korea Institute of Atmospheric Prediction System**, Seoul, Korea, 23 December 2014.
- "The role of MPD water vapor profiles in improving convective-scale weather prediction" **National Center for Atmospheric Research/Earth Observing Laboratory seminar**, Boulder, CO, USA, 15 March 2022.
- "Assessment of the impact of the new profiling instruments on the skill of high impact weather predictions" **Korea Meteorological Administration**, Daejeon, Korea, 16 January 2023.

Scientific Grants

- (CO-PI) NSF $157,772, "Collaborative Research: Convective responses to the non-Gaussian assimilation of ground-based thermodynamic profilers", Submitted

- (CO-PI) NOAA $591,616, “Assessment of the impact of New York State Mesonet profiler network and new profiling instruments on the skill of high impact weather predictions in New York State”, 08/01/2023 – 07/31/2025
- (PI) KMA $203,725, “Development of Technology to Unitize Intensive Observation Data to Identify Cause of Heavy Rain, Snowfall, and Gust Winds”, 04/01/2023 – 03/01/2027

Honors and Awards

- 2019 Service Recognition Award, Korean Meteorological Society
- 2014 Best Ph.D. Thesis Award, Korean Meteorological Society
- 2014 Best paper award, Brain Korea 21 plus
- Seoul fellowship from Seoul scholarship foundation, 2009-2010
- Undergraduate scholarship from Yonsei University, 2007

Professional Societies and Activities

- Member of American Geophysical Union
- Member of American Meteorological Society
- Advanced data assimilation for geosciences international summer school, Les Houches, 2012

Mentoring and Graduate Committee Service

- Graduate student mentored
  - Hsiao-Chun Lin: The State University of New York at Albany
  - Samkeyat Shohan: University of Arizona
- Graduate committees served
  - Stephen Asare: Florida State University

Job-related skills and experiences

- Software platforms: Fortran, C++, Unix script, NCL, MATLAB, Python
- Model simulations: Model for Prediction Across Scales (MPAS), Global Forecast System (GFS), Global and regional Unified Model (UM), Advanced Research Weather Research & Forecast (ARW-WRF)
- Data assimilation system: Joint Effort for Data Assimilation Integration (JEDI), Gridpoint Statistical Interpolation (GSI), WRF Data Assimilation (WRFDA) system, Data Assimilation Research Testbed (DART), UM data assimilation system