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Abstract for an Invited Paper
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Prediction and predictability of hurricanes with high-performance computers and cloud-resolving ensembles[1]

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This talk will be primarily devoted to the use of high-performance computing facilities to perform ensemble-based state estimation of hurricanes with cloud-resolving numerical weather prediction models. I will be sharing our recent experience in using approximately 30,000 cluster cores simultaneously at the Texas Advanced Computing Center which successfully assimilates high-resolution airborne Doppler radar observations in realtime and subsequently delivers 2 deterministic and 60-member ensemble forecasts running at 4.5/1.5-km effective horizontal grid spacings in a timely fashion. Since the predictability of hurricanes may be fundamentally limited by chaotic moist convection and subsequent upscale error growth, I would advocate that besides the need of continuously improving the hurricane forecast models and ingesting high-resolution observations into the models to better initialize the storm, the hurricane state estimation is fundamentally probabilistic that demands cloud-solving ensemble-based data assimilation and forecasting. Improvements of forecast models may come from ever increasing computer power to better resolve the storms numerically and from improved fundamental understanding of the dynamics and impact of subgrid-scale turbulence in hurricanes. Improvements of better state estimation may also come from development of new theories that are applicable for high-dimensional, non-linear, non-Gaussian dynamic systems such as in hurricanes.

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