Scientists find inconsistencies and biases in weather forecasting system

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The tiniest of natural phenomena can have a big impact on weather, but an international team of researchers has found that the most widely used system to model meteorological conditions doesn't account for environmental microphysics well at all scales. The researchers published their evaluation in the latest issue of *Advances in Atmospheric Sciences* .

Many forecasting agencies employ the Unified Model (UM), a climate and weather simulation modelling system. The Met Office in the United Kingdom oversees the continual evolution and development of the UM as scientists conduct more analyses.

"This model is designed to run across spatial and time scales and is known to produce skillful predictions for large-scale weather systems," wrote Marcus Johnson, a graduate student in the School of Meteorology at the University of Oklahoma. Johnson is first author on the paper. "However, the model has only recently begun running operationally at horizontal grid spacings of ~1.5 kilometers."

This spacing is meant to account for the explicit treatment of cloud formation, hydrometeor growth, and precipitation: a field known as cloud microphysics.

"Microphysics are important to numerical weather models, but provide a great source of error in weather prediction," Johnson said. "It is crucial that we identify UM microphysics shortcomings not only to alert forecast offices when interpreting model results, but also to allow the microphysics authors to improve the scheme for more accurate results."

The UM's microphysics scheme was originally designed and tuned for large-scale precipitation systems, according to Johnson. When his team analyzed two specific rainfall systems, they found that the scheme produced unrealistic raindrop size distributions that negatively affected the simulated storm structures.

"Microphysics schemes are not all alike, and selecting the 'right' scheme can lead to more accurate prediction of the weather system of interest," Johnson said, noting that one scheme may do better predicting a large-scale snow system but wouldn't do well with a different type of precipitation system.

Johnson and his team compared the numerical UM output to polarimetric radar observations to validate their results. They plan to continue the evaluation of different microphysics schemes and document the weaknesses and biases in each one.

"Ideally, microphysics authors will incorporate this feedback and continue to improve their scheme designs," Johnson said.

More information: Marcus Johnson et al, Evaluation of Unified Model Microphysics in High-resolution NWP Simulations Using Polarimetric Radar Observations, *Advances in Atmospheric Sciences* (2018). DOI: 10.1007/s00376-017-7177-0

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