

Team compares reanalysis datasets with Advanced Himawari Imager measurements over East Asia

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Visual shows the new generation of Fengyun geostationary weather satellites.
Credit: National Satellite Meteorological Center, China Meteorological Administration

Today's weather satellites provide scientists with a unique opportunity to evaluate the abilities of various reanalysis datasets to depict multilayer tropospheric water vapor. A research team undertook a study to assess multilayer water vapor depiction in six representative reanalysis datasets against the measurements from the Advanced Himawari Imager over East Asia.

Because [water vapor](#) is important in the formation of clouds and precipitation, it is vital for scientists to better understand water vapor

and the biases among various datasets. Their work was published in the journal *Advances in Atmospheric Science* on July 29, 2023.

Scientists produce reanalysis datasets when they blend historical observations over a period of time using modern weather forecasting models. Scientists in the climate research community use atmospheric reanalysis datasets to better understand atmospheric processes and variability, identify [climate change](#) and evaluate climate models. However, atmospheric water vapor is one of the most poorly understood atmospheric variables in reanalysis datasets because of its high variability, insufficient measurements and the deficiencies found in reanalysis data.

"Because water vapor plays a key role in the formation of clouds and precipitation and has significant influence on the energy budget of the earth system, it is of great importance to assess the abilities of reanalysis datasets to reproduce the distribution and variability of water vapor, identify water vapor biases or differences among various datasets, and suggest future improvements for reanalysis processing systems," said Jun Li, with the National Satellite Meteorological Center, China Meteorological Administration.

The team used data collected by the Advanced Himawari Imager in 2016. The imager flew onboard the Himawari-8 satellite, collecting daily measurements over East Asia. The team studied the bias features of multilayer water vapor from six reanalysis datasets. These six datasets from major meteorological forecast centers included ERA-Interim, ERA5, CFSR, MERRA-2, JRA-55, and CRA.

"High spatiotemporal resolution radiances from the advanced imagers onboard the new generation of geostationary weather satellites provide a unique opportunity to evaluate the multilayer tropospheric water vapor depicted by various numerical models," said Li. These imagers give

scientists a better understanding of the daily variation of atmospheric water vapor than those from polar orbit satellites.

The team's study indicated that the six widely-used reanalysis datasets show consistent wet biases in the upper troposphere in comparison to satellite water vapor observations. Wet bias describes how some forecasters overestimate the probability of precipitation. The bias is smaller in the mid than upper troposphere.

Meanwhile, the water vapor bias is the most significant over the Tibetan Plateau. "These results could provide a useful tool for the climate modeling community for identifying and solving problems associated with water vapor simulation," said Li.

B. J. Sohn, a professor at Seoul National University, commented on the team's work in a research highlight published in *Advances in Atmospheric Sciences*. He noted that the team took a novel approach by simulating satellite-measured radiances instead of relying on satellite-retrieved water vapor products. "Their study serves as a compelling illustration of how satellite observations can be effectively utilized to enhance our understanding in the climate sciences and meteorology," said Sohn.

Looking ahead, the team hopes to extend their studies. "Since water vapor simulations in current reanalysis data have obvious discrepancies, it is worthwhile to further investigate the deficiencies in cloud and precipitation variables which are highly related to water vapor," said Li. Evaluation work like this can provide useful feedback to the modeling and data assimilation community for improving the reanalysis datasets in the future. These improvements could lead to more accurate weather and climate forecasts.

"The ultimate goal is to improve modeling of the [atmospheric water vapor](#), clouds and precipitation distribution and processes through better

utilization of weather [satellite](#) observations," said Li.

More information: Di Di et al, Consistency of Tropospheric Water Vapor between Reanalyses and Himawari-8/AHI Measurements over East Asia, *Advances in Atmospheric Sciences* (2023). [DOI: 10.1007/s00376-023-2332-2](#)

B. J. Sohn, Water Vapor Information from Satellite and Its Applications, *Advances in Atmospheric Sciences* (2023). [DOI: 10.1007/s00376-023-3008-7](#)

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