THE ATMOSPHERIC RESERVOIR

Examining the Atmosphere and Atmospheric Resource Management

IMPROVED
LONG-TERM FORECASTS

By Mark D. Schneider

Meteorologists are frequently asked to make long-term weather forecasts. Generally, when weather forecasts are made two weeks or more in advance, forecasters are utilizing climatology, or the average weather conditions that occurred over the most recent 30-year climate period. A new study from Colorado State University (CSU) atmospheric scientists published in Nature Partner Journals *Climate and Atmospheric Science* indicates that we may begin to more accurately predict atmospheric rivers (ARs) and droughts weeks or months ahead of time. ARs are wind flow patterns that carry large amounts of water vapor from the tropics (near Hawaii) to the west coast of the U.S. You may have heard the term "Pineapple Express" used to describe some of the stronger AR events. We typically think of ARs as only affecting the western U.S., especially when California and the Pacific Northwest receive heavy precipitation events. However, the weather patterns that influence North Dakota can be altered by tropical storms thousands of miles away.

There are atmospheric/oceanic interactions such as El Nino and La Nina that are well-known contributors to changes in large-scale weather patterns and a part of the El Nino Southern Oscillation (ENSO). The recent CSU study has revealed the importance of two other players in the Pacific Ocean called the Madden-Julian (MJO) and quasi-biennial (QBO) oscillations in predicting weather patterns more accurately out to approximately two to five weeks. The study began using data from 36 seasons during years 1980-2016. Although ARs can occur in every month of the year, the study focused on only the months of December through March, because during this period "ARs frequently occur near both the British Columbia and California landfall boundaries, teleconnection patterns are expected to be the most robust over the North Pacific, and the MJO-QBO link has been observed."

When we think of oscillations, oscillating fans that rotate back and forth and the swinging of grandfather clock pendulums commonly come to mind. The QBO predictably occurs every two years and the "oscillation" is simply upper level winds making a shift from westerlies to easterlies and back within a two-year period. These winds are located high above the MJO in the stratosphere. The MJO is much more complicated and involves a 30 to 60-day easterly movement of thunderstorm clusters near the equator. When the two oscillations are linked together, atmospheric waves (disturbances) form upstream of the western U.S. coastline and transport large amounts of water vapor across the Pacific Ocean. This water vapor collides with the Cascade, Sierra Nevada, and other coastal mountain ranges producing abundant snowfall (and rain for lower elevations). The positioning of these atmospheric waves will eventually influence North Dakota's weather. After most of an AR's water vapor is used up over the western U.S. coastal ranges, the tropical airmass that moves into the intermountain west and plains states can create strong Chinook winds providing warming and drying effects. This can create very mild winter conditions over portions of our state.

The takeaway from all of this is that atmospheric scientists are getting better at predicting stronger storm events with greater accuracy and lead times. More research will likely shed further light into how changes that occur in the Pacific Ocean upwind of North Dakota effect our weather patterns.

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