Ocean Bridge Links Climate In Mid-Latitudes And Tropics

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It's no surprise when a tropical El Niño brings wet storms to the U.S. Southwest; now researchers are finding that the relationship may be two-way, with atmospheric variability outside of the tropics impacting the formation of El Niños and La Niñas through upper-ocean pathways called "ocean bridges."

"Earlier climate studies suggest that the El Niño-Southern Oscillation (ENSO), which affects weather around the world, evolves independently of interannual-to-decadal North Pacific Ocean climate variability. Our study shows that the two are really quite connected through a large-scale atmosphere-ocean tropical-subtropical feedback loop," said Amy Solomon of the CU-Boulder and NOAA Cooperative Institute for Research in Environmental Sciences, or CIRES.

As the lead author of a study that will appear in the January 31st issue of *Climate Dynamics*, Solomon will present her group's findings at the American Meteorological Society's annual meeting in New Orleans on Wednesday, January 23rd.

Solomon's study is the first to separate feedbacks one at a time in an atmosphere-ocean coupled model. Through this process, Solomon and her colleagues found a clear extra-tropical signal in the El Niño-Southern Oscillation (ENSO) cycle.

"When we didn't allow the northern Pacific to interact with the equatorial Pacific area, we observed a sharp 2-year ENSO cycle, with El

Niños happening every other year, which is not what we see in real life. By adding in the extra-tropical feedback, we produced a more realistic 4-6 year ENSO cycle, with El Niños occurring every few years," explained Solomon.

The mechanism that connects the two latitudinal regions is an ocean subduction zone, around 30 degrees North, where water sinks and moves south until it rises again at the equator. The subduction is caused by wind stress where the tropical easterlies meet the mid-latitude westerlies. This subduction process can change tropical sea surface temperature by up to one degree Celcius.

Specifically, strong westerlies in the North Pacific during the spring increase cold water circulation towards the equator, tipping the ENSO cycle towards its warm, or El Niño, phase.

All told, it takes the extra-tropical signal up to 52 months to manifest itself in the tropics. The researchers can track the signal as a sea surface temperature anomaly as it snakes around the Pacific gyre, southwest and then along the western boundary of the Pacific basin to the equator, where it then moves eastward.

"A model isn't absolutely representative of reality, but it is an important scientific tool. What our model suggests is that the ocean bridge has a significant impact on the frequency of the ENSO cycle," said Solomon.

"We can't accurately predict ENSO and how it will affect temperatures and precipitation around the globe if we don't fully understand what modulates the cycle," she said.

Source: University of Colorado at Boulder, by Adriana Raudzens Bailey