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Satellite Sees Double Zones of Converging Tropical Winds around the World

by NASA Jet Propulsion Lab

NASA's Quick Scatterometer satellite has confirmed a 30-year-old, largely unproven theory that there are two areas near the equator where the winds converge year after year and drive ocean circulation south of the equator. By observing ocean winds, Quick Scatterometer, also known as Quikscat, has found a year-round southern and northern Intertropical Convergence Zone. This find is important to climate modelers and weather forecasters because it provides more detail on how the oceans and atmosphere interact near the equator.

The Intertropical Convergence Zone is the region that circles Earth near the equator, where the trade winds of both the Northern and Southern hemispheres come together. North of the equator, strong sunshine and warm water of the equator heats the air in the region, drawing air in from north and south and causing the air to rise. As the air rises it cools, releasing the accumulated moisture in an almost perpetual series of thunderstorms. Satellite data, however, have confirmed that there is an Intertropical Convergence Zone north of the equator and a parallel one south of the equator.

Variation in the location of the Intertropical Convergence Zone is important to people around the world because it affects the north-south atmospheric circulation, which redistributes energy. It drastically affects rainfall in many equatorial nations, resulting in the wet and dry seasons of the tropics rather than the cold and warm seasons of higher latitudes. Longer-term changes in the region can result in severe droughts or flooding in nearby areas.

"The double Intertropical Convergence Zone is usually only identified in the Pacific and Atlantic oceans on a limited and seasonal basis," said Dr. Timothy Liu, of NASA's Jet Propulsion Laboratory, Pasadena, Calif., lead researcher on the project. In the eastern Pacific Ocean, the southern zone is usually seen in springtime. In the western Atlantic Ocean, the southern zone was recently clearly identified only in the summertime. However, Quikscat's wind data has seen the southern Intertropical Convergence Zone in all seasons across the entire Atlantic Ocean and the eastern Pacific. "Quikscat's wind data confirms there is a double Intertropical Convergence Zone, and that it exists all year long," Liu said.

Intertropical convergence zone. This graphic depicts both the northern and southern Intertropical Convergence Zones (ITCZ). The northern Intertropical Convergence Zone is created when the surface trade winds from the northeast meet the surface southeast trade winds. This converging, or mixing air is forced to rise, and spawns clouds, showers and thunderstorms. Image credit: Rob Gutro, NASA/GSFC

The southern Intertropical Convergence Zone, below the equator has no interaction with northern trade winds. It is created when southern trade winds are followed by more winds from the south, that create a squeezing effect. The southern Intertropical Convergence Zone does not have the cloud creation capabilities that the northern Intertropical Convergence Zone does.

QuikScat satellite images have for the first time confirmed that both the northern and southern Intertropical Convergence Zones exist almost all year round.

This is a major find, as the existence, location, and seasonality of the double Intertropical Convergence Zone had remained controversial since 1969.

For most of the time, the southern Intertropical Convergence Zone is weaker than the northern one, which is why it has been so hard to detect before. The southern Intertropical Convergence Zone is weaker because it blows over cooler water that comes up from the lower depths of the ocean. Over cooler water, the air doesn't rise as easily as warm air, and the winds from higher altitudes are mixed less than they would with warmer water and air. Cooler water therefore causes weaker surface winds. Therefore, the surface winds from the south slow down as they approach the equator, and this causes the southern Intertropical Convergence Zone because the air gets squeezed together.

What is unique about the southern Intertropical Convergence Zone is that there is not a north and south wind as with the northern Intertropical Convergence Zone. The southern Intertropical Convergence Zone consists of only a southern wind coming into the equator.

"The convergence of winds in the southern hemisphere creates a counter-clockwise rotation, which affects ocean circulation," Liu said. "For the first time, we can give a better explanation of the ocean movements driven by winds."

The SeaWinds instrument on Quikscat is a specialized microwave radar that measures both the speed and direction of winds near the ocean surface. Launched June 19, 1999, from California's Vandenberg Air Force Base, the spacecraft operates in a Sun-synchronous, near-polar orbit, circling Earth every 100 minutes, taking approximately 400,000 measurements over 90 percent of Earth's surface each day. JPL manages the Quikscat mission for NASA.

These findings are being presented at the 2002 Western Pacific Geophysics Meeting, Wellington Convention Centre, Wellington, New Zealand, in a session titled "Southern Intertropical Convergence Zones," on Tuesday, July 9. The results will be published in a paper, entitled "Double Intertropical Convergence Zones - a New Look Using a Scatterometer," in an upcoming issue of Geophysical Research Letters.

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For more information and images, see http://www.jpl.nasa.gov/images/earth/atlantic_ocean/index.html.

For more information on Quikscat, go to http://winds.jpl.nasa.gov/missions/quikscat/quikindex.html.

Twice-daily maps of Quikscat winds over global oceans can be viewed and downloaded in near-real-time at http://airsea-www.jpl.nasa.gov/seaflux.