AIRCRAFT, SCIENCE AND ATTREX

NASA's Airborne Tropical Tropopause Experiment (ATTREX) used unmanned aircraft to observe small-scale dynamics within the tropical tropopause layer (TTL), the gateway to the stratosphere, that satellites and ground instruments alone could not.

National Aeronautics and Space Administration

HOW DOES WATER GET INTO THE STRATOSPHERE?

Earth is commonly referred to as the "Goldilocks" planet because it is not too hot and not too cold. It maintains this "just right" temperature by absorbing and expelling radiation, or heat, from the sun. How much heat is regulated by many factors, including the amount of water in the stratosphere, which contributes to fewer ozone particles and higher surface temperatures.

ATTREX used its aerial view to better understand the dynamic processes involved in regulating stratospheric water vapor, such as cloud formation and wind fluctuations, that satellites can't see.

Here are three things we wouldn't know without ATTREX aircraft data:

- **THE TROPICAL TROPOPAUSE LAYER IS LEAKING:** The TTL is supposed to dehydrate, or remove water from, the air before it reaches the stratosphere. It does this by freeze drying it and trapping liquid water within ice particles that make up cirrus clouds. However, ATTREX data show the TTL is not as efficient at nucleating ice particles as models currently predict, allowing more water to enter into the stratosphere.
- **GRAVITY WAVES ALSO CONTROL WHEN AND WHERE CIRRUS CLOUDS FORM:** ATTREX provided the first extensive vertical profiles of the TTL, and showed that wave phases, or whether a jet of air is in peak or trough formation, affects the creation of cirrus clouds—not just temperature. As the waves propagate through the TTL, they bring both warm and cold air: ATTREX showed that cirrus clouds are more likely to form in the cold phase of atmospheric waves, ensuring less water makes it into the stratosphere.
- **VERTICAL MIXING PLAYS A MINOR ROLE IN STRATOSPHERIC WATER VAPOR:** Vertical mixing occurs in the atmosphere when two adjacent air masses have differing temperatures and pressures: denser, colder air flows into less dense, warmer air, mixing them. ATTREX data show this process actually contributes very little to stratospheric water vapor, occurring only in very localized, shallow patches.

PLATFORM	SENSORS
Global Hawk	FCDP
	NOAA-H2O
	2D-S
	MMS
	CPL
	NWV
	UCATS
	HU/PCRS
	mini-DOAS
	DLH
	MTP
	SSFR
	AWAS