

Reservoir of water hides high above Earth

Earth's upper atmosphere, a region drier than the Sahara Desert, harbors unexpected amounts of water vapor, according to data from a pair of satellites. The discovery could bolster a controversial theory that thousands of house-size comets are hitting the atmosphere each day.

"What we have found is astonishing. We really don't have answers," says Robert R. Conway of the Naval Research Laboratory in Washington, D.C.

Conway and his colleagues made their discovery last week using an instrument called the Middle Atmosphere High Resolution Spectrograph Investigation (MAHRSI), part of a satellite released and later picked up by the space shuttle Discovery. The instrument measures hydroxyl (OH) ions in the upper stratosphere and overlying mesosphere, from 35 to 100 kilometers above Earth. The amount of hydroxyl is directly related to the atmosphere's humidity, because at these high altitudes the ion forms when ultraviolet light splits apart molecules of water vapor.

The MAHRSI data revealed a layer with a surprising abundance of hydroxyl in the upper mesosphere above the Arctic, at altitudes of 60 to 80 km. The finding corroborates MAHRSI measurements made during a shuttle flight in 1994. At the time, Conway and his colleagues had questioned their data, which contradicted established atmospheric theory.

The new findings also back up observations made by the Halogen Occultation Experiment (HALOE) on a satellite in orbit since 1991. The HALOE instrument measures water vapor directly by peering through the atmosphere while the sun rises and sets behind Earth.

Originally, HALOE investigators paid scant attention to the upper mesosphere; they expected it would contain too little water vapor for their instrument to detect reliably. While reprocessing their data earlier this year, however, they discovered up to 50 percent more water vapor than expected at altitudes of 75 km. The moisture appeared during summertime above the sunlit polar area.

Many atmospheric scientists discounted the HALOE data at first. "They said it can't be true because it violates our ideas. Now we come along with MAHRSI, and we have clear, strong substantiating evidence," says Conway.

Water vapor is abundant in the stormy lower atmosphere, but it cannot drift upward easily, so the stratosphere and mesosphere remain dry. In theory, water vapor ascends only in the tropics, where lofty thunderheads push moisture into the stratosphere. The scant water vapor then drifts upward into the mesosphere.

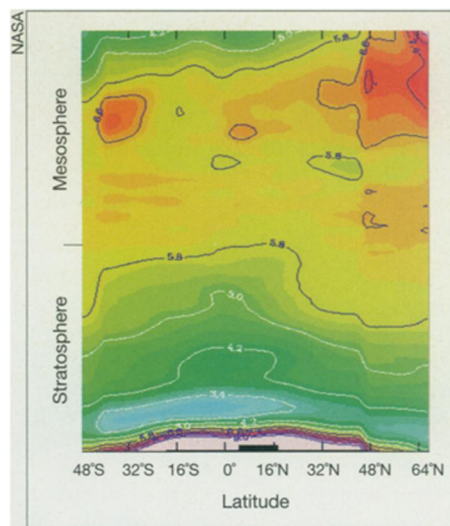
Louis A. Frank of the University of Iowa in Iowa City has proposed an addi-

tional source of water vapor in the upper atmosphere (SN: 5/31/97, p. 332). Thousands of small comets break up high above Earth and deposit a fine spray of water in the mesosphere, from which it rains down onto Earth's surface, he says. Most researchers dismissed this theory when Frank first proposed it a decade ago, but a NASA satellite recently recorded evidence of what appear to be incoming cometlike bodies.

Frank views the new water vapor observations as further support. "When you get that excess of water vapor up there, it just can't come from the Earth. It must come from space," he says.

Other researchers are searching for a more down-to-earth explanation. "I can't deny the fact that Frank predicted what we're observing and what HALOE is seeing. But I have a very hard time with his model, and I can't believe that his explanation is the right answer," says Conway.

HALOE investigators agree. "There's more than one way to explain this," says



HALOE's measurements of water vapor show unanticipated moisture (arrow) above the Arctic in summer. Red areas indicate air with more vapor.

James M. Russell III, HALOE's lead scientist and an atmospheric physicist at Hampton (Va.) University.

—R. Monastersky

Ancient human saunters into limelight

About 117,000 years ago, a person no different anatomically from people living today strode down a sand dune toward a lagoon in southern Africa and made a few lasting impressions. A rainstorm had given the sand a mushy consistency that held three footprints intact; the wind then blew dry sand into the tracks and covered them with material that turned to rock and slowly eroded over tens of thousands of years.

In September 1995, South African geologist David Roberts of the Council for Geoscience in Bellville discovered those tracks, the oldest known footprints of any anatomically modern human. Roberts and Lee R. Berger, an anthropologist at the University of the Witwatersrand in Johannesburg, South Africa, announced the find last week at a press conference at the National Geographic Society in Washington, D.C.

"These footprints are living evidence of an ancient human adventure," Berger says. "They're another piece in a largely empty puzzle we have for human evolution in Africa between 500,000 and 60,000 years ago."

Found in rock along Langebaan Lagoon, about 60 miles north of Capetown, each of the footprints is 8 1/2 inches long. Comparisons with feet of modern South African hunter-gatherers place the ancient stroller at 5 feet to 5 feet 4 inches tall. Being relatively short, the person was probably female, Berger says.

Measurements of radioactive elements in surrounding rock yielded preliminary estimates of the footprints' age. These were narrowed down by consulting independent evidence regarding the timing of periods of global warmth and rising sea levels around 100,000 years ago. The prints were made during one such period, Roberts holds.

The ancient tracks will not resolve the current debate over human origins (SN: 7/19/97, p. 37), but they do come from a group of ancient folks who exhibited sophisticated behaviors (SN: 4/12/97, p. 222).

—B. Bower



K. Garrett/National Geographic Society