Greenhouses in space: Unearthly findings

One team peered beneath the swirling clouds of Venus, while the other modeled the organic haze shrouding Saturn's largest moon. The two studies, though conducted independently, work together to clarify "greenhouse" phenomena – on Earth as well as in space.

At first glance, Saturn's moon Titan might seem unlikely to harbor Earth-like atmospheric conditions. But scientists have known for more than a decade that its atmospheric pressure and nitrogen-rich environment resemble those of Earth. Moreover, Titan experiences the atmospheric-warming phenomenon known as the greenhouse effect. On Earth, water vapor and carbon dioxide help form a gaseous shield in the atmosphere that lets sunlight through while trapping some of the heat the planet radiates into space. On Titan, methane and molecular hydrogen accomplish a similar warming, explains Christopher P. McKay, an atmospheric scientist at NASA's Ames Research Center in Mountain View, Calif.

He and his colleagues have now turned back the clock on Titan's atmosphere, modeling conditions that existed in the distant past. Their simulation, guided in part by temperature measurements taken by Voyager I, yielded a puzzling result. Millions of years ago, according to the model, Titan had far colder temperatures than can be explained by a simple reduction in greenhouse gases.

The organic haze in Titan's upper atmosphere may hold the solution to this puzzle, McKay and his colleagues assert. They propose that the haze acts as an antigreenhouse layer, exerting a chilling effect that helps counteract the warming created by the methane and hydrogen gases. The chemical contents of the haze partially block sunlight from reaching Titan's surface but permit heat from the satellite to exit, McKay suggests.

His team's report in the Sept. 6 SCIENCE provides the first description of a major antigreenhouse effect anywhere in the solar system, says McKay. Earth's protective ozone layer does not exert a comparable effect, he says, because it filters out only ultraviolet light.

The researchers calculate that greenhouse gases on Titan currently boost its surface temperature by 21 kelvins – more than scientists had assumed – while the haze layer reduces the temperature by 9 kelvins, yielding the net warming effect that now exists. Millions of years ago, low-altitude greenhouse gases may have dissolved into Titan's methane ocean, allowing the haze layer to dominate the temperature equation. This could have caused the colder temperatures seen in the model, McKay says.

Another research team has focused on a greenhouse puzzle much closer to Earth. The absence of water vapor above Venus' cloud bank mystifies scientists, because models of the planet's strong greenhouse effect suggest that vapor plays a key role in maintaining the warming. Researchers have now looked for water *below* the cloud bank and down to the surface – and their search has come up dry.

Using the Anglo-Australian Telescope in Coonabarabran, Australia, the team viewed the night side of Venus at shorter infrared wavelengths than previously observed. Their probe revealed relatively little water, they report in the Sept. 13 SCIENCE.

Evidence of a dry Venus may force researchers to consider whether other chemicals could create and sustain the planet's greenhouse effect, says David Crisp of the Jet Propulsion Laboratory in Pasadena, Calif., who coauthored the new report.

Crisp told SCIENCE NEWS that his team's most recent observations, made in July, revealed new details about an unusually bright oxygen glow from Venus' upper atmosphere. The researchers noted that the glow varies widely in intensity and shifts position dramatically from day to day. Although chemical rather than electrical interactions induce the glow, the phenomenon nonetheless resembles an aurora on Earth, says Crisp. The new observations may provide insight into the chemical mechanism that produces the glow, he adds. – *R. Cowen*

Crisp, David Allen/SCIENCE

Near-infrared image shows cloud distribution on the night side of Venus.

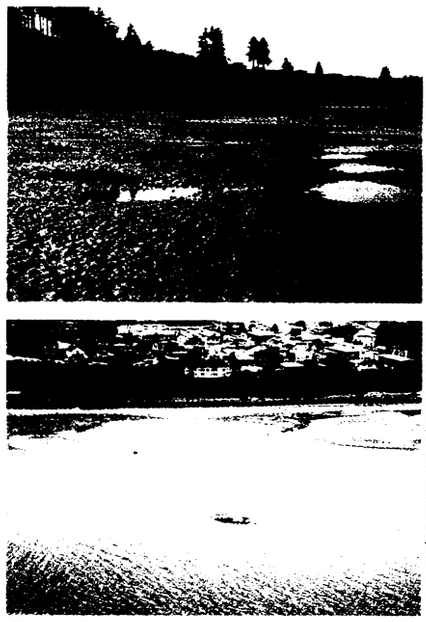
Hungry whales take a bite out of the beach

Some hefty summer residents of Puget Sound have found a nice little seafood place on the beach. These residents are not tourists. They are 35-foot gray whales that chew 10-foot-wide pits from the sand, leaving the shoreline pockmarked with puddles.

The whales are attracted by an abundance of ghost shrimp buried in the sand along Puget Sound, about 30 miles north of Seattle. Fishermen have seen them wallowing on their sides in 12 feet of water at high tide, slurping up their dinners. Each mouthful of beach sediment yields roughly 11 pounds of the small ghost shrimp, which the whales sift from the sand with their baleen filters. They then spit out a plume of sand, leaving a telltale mound along one side of the 6-inch-deep pit.

"It's somewhat startling to see these mammoth animals writhing near the beach," says Jay Odell of the Washington State Department of Fisheries in Seattle. He reported the feeding phenomenon this week at the meeting of the U.S. National Shellfish Association in Vancouver, British Columbia. Although gray whales have been known to scoop sediment from the seafloor, Odell says this is the first known instance of such feeding from the shore.

Working with University of Washington graduate student Laurie Weitkamp, Odell has documented the formation of the thousands of feeding pits, which become clearly visible at low tide. Weitkamp, who studies the importance of ghost shrimp to tidal ecology, determined that the whales extract 80 percent of the shrimp in the pits. She also found ghost shrimp in the stomach contents of a 38-foot gray whale that died near her study site in late June.



Odell

William A. Wood/Wash. State Dept. Fisheries

Low tide reveals feeding pits left by gray whales seeking shrimp. An aerial view shows the pits (light circles in bottom photo) dimpling the shoreline.

Weitkamp and Odell estimate that six gray whales created the pits, which dimple the shore along Saratoga Passage and at Port Susan. By taking bites out of the beach, each whale eats more shrimp in one day than a commercial harvester would glean in one year, they calculate.

Although the researchers are unsure why the whales have started chewing up the shore, Odell says, "It's an extremely rich source of food for them. The beach contains five to 10 times the amount of food they could filter out of ocean water." – *C. Ezzell*