Earth Science

Tasmanian trees track recent warming

Scientists peering inside Tasmanian pine trees have discovered hints that greenhouse gas pollution is currently warming the atmosphere. A study of the annual growth rings in these trees indicates Tasmania has been warmer during the last few decades than during any other period since A.D. 900.

U.S. and Australian scientists measured the rings of 23 Huon pine trees on a small mountain in western Tasmania. The rings serve as a climate record because trees grow more during warm years, laying down wider rings. By counting backwards, the researchers used the tree rings to compile a 1,089-year-long record, one of the longest high-resolution climate records from the Southern Hemisphere, they report in the Sept. 13 SCIENCE.

The tree rings revealed several warm periods over the last millennium, but none was as consistently warm as Tasmania has been since 1965. The researchers say this finding supports the idea that the greenhouse warming has already started. However, they caution, "we do not consider our results as added proof of that assertion yet." The recent warming is still small enough that it could represent a natural climate variation rather than a human-induced change, they say.

Curiously, the coldest period in the record also occurred relatively recently, during the early 1900s. Climate records from locations in New Zealand and elsewhere also show a cooling then, suggesting that the ocean and atmosphere in the Southern Hemisphere underwent a significant change at that time.

Climate: Don't look for shortcuts

Atmospheric scientists know that climate and weather belong to that mathematic netherworld known as chaos, in which systems exhibit complex behavior because of internal instabilities. But not all chaos is the same. Several studies over the past few years have suggested that the atmosphere has a low-dimensional attractor, making it one of the simpler chaotic systems. Such findings have raised hopes that scientists could devise a new breed of weather forecasting models that are much less complex than those now in use. However, one of the originators of chaos theory now contends that the optimistic studies have underestimated the complexity of the atmosphere.

Edward N. Lorenz, a meteorologist at the Massachusetts Institute of Technology in Cambridge, tested the dimension-gauging technique used in these studies by applying it to an artificial system whose dimension is known. Because the procedure underestimated the dimensions of this system, Lorenz suggests the technique has made similar mistakes in analyzing weather and climate data. His findings deflate hopes for finding the hypothesized forecasting shortcut.

Weather Service picks no-GOES option

The National Weather Service faced a dilemma this summer: The sole geostationary satellite used to monitor weather conditions over the United States would reach the end of its scheduled lifetime next year, yet equipment malfunctions and construction delays continued to plague the NASA-built replacement (SN: 7/6/91, p.5).

Rather than rely on NASA's promise to complete the new satellite by December 1992, the National Oceanic and Atmospheric Administration announced this month that it would borrow an orbiting satellite owned by the European Space Agency. Under the agreement now being negotiated, a European satellite called Meteosat-3 – now hovering over part of South America – would move farther west in order to provide crucial coverage of U.S. weather in case the U.S. craft fails. Meteosat-3's expected lifetime exceeds that of the aging U.S. craft, known as GOES-7, by more than a year.

Technology

Make medical imaging effervesce . . .

Patients with heart problems may one day get an injection of tiny bubbles as part of ultrasound technology for imaging blood flow. No ordinary bubbles, these microspheres exist as protein envelopes that encase the air bubbles as they bounce through the heart's turbulent channels, says Kenneth S. Suslick, a chemist at the University of Illinois at Urbana-Champaign.

Different materials reflect sound differently, but the similar acoustic properties of blood and muscle make them difficult to distinguish. "It's just not that easy to see anything," says Suslick.

Years ago, however, other researchers demonstrated that adding bubbles to blood makes its flow stand out because air reflects ultrasound so strongly. They also discovered that albumin-coated bubbles – made by zapping dissolved albumin with long pulses of low-frequency, high-intensity sound – worked well for this purpose.

Now, Suslick and Mark W. Grinstaff have learned how these sound blasts make albumin, a common body protein, encircle air to form tough microbubbles. They first found that the process requires oxygen and involves chemical modification of the albumin. The blast of sound draws air into the albumin solution and disperses it, like a milkshake, Suslick explains. At the same time, this energy produces a reactive, negatively charged oxygen molecule called a superoxide. The superoxide attacks the albumin that has wrapped around the air bubbles.

The albumin contains lots of the amino acid cysteine. The superoxide breaks the chemical bonds between the cysteine's sulfur atoms. Those bonds then reform, this time between more distant sulfur atoms, thereby crosslinking the albumin and locking it into position around the air, Suslick and Grinstaff conclude in the Sept. 1 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

"[This research] tells you what kinds of proteins you can use and how to make the microspheres more efficiently," says Suslick.

Last year, Molecular Biosystems Inc. in San Diego applied for FDA approval to market the bubbles as a contrast agent for echocardiography, which uses short, high-frequency sound pulses for imaging. Suslick suggests microbubbles may also prove useful as drug delivery systems or as oxygen carriers in artificial blood. "They are very biologically compatible, so that's one of the advantages of the protein bubbles," he adds.

. . . with particles called bubbicles

Two researchers at the University of Rochester (N.Y.) have applied for a patent on their "bubbicles" – long-lasting, air-packed particles that enhance the utility of ultrasound for imaging liver tumors. This contrast agent consists of a synthetic, iodine-packed chemical called iodipamide ethyl ester, says physical chemist and inventor Michael R. Violante.

The porous bubbicle, 1 micrometer in diameter, resembles a hard, air-filled sponge. It holds its air much better than albumin-coated microspheres, according to Violante and co-inventor Kevin J. Parker.

As a result, the bubbicles – which are one-sixth the size of red blood cells – stay in the blood until liver cells filter them out. Once in the liver, they "produce a tremendous increase in brightness," says Parker. Cancer cells in the liver do not absorb the bubbicles, so tumors appear much darker than surrounding tissue in ultrasound images.

Medisperse Limited Partnership in Rochester plans to develop and test the bubbicles for clinical applications, says Violante, the company's managing director. He thinks bubbicles may also prove useful for imaging blood flow in the body's deep-seated vessels.