Dynamics of weather fueled by plankton

Microscopic ocean plants called phytoplankton may exert an important influence on Indian monsoons and other weather patterns across the globe, reports a team of oceanographers from Canada and India.

Shubha Sathyendranath at Dalhousie University in Halifax, Nova Scotia, and her colleagues reached that conclusion after examining the role of phytoplankton in the Arabian Sea, which lies west of India. The researchers used satellite measurements and a computer model to determine whether these one-celled plants have a significant effect on sea-surface temperatures in the region. In the Jan. 3 NATURE, they report that the "distribution of phytoplankton exerts a controlling influence on the seasonal evolution of sea-surface temperatures."

Phytoplankton contain photosynthetic pigments such as chlorophyll, which absorb solar energy, warming the surrounding water.

Computer simulations by Sathyendranath's group revealed that phytoplankton could significantly warm the surface of the Arabian Sea, boosting temperatures by as much as 4°C during summer months.

Because the pattern of ocean temperatures in the tropics influences the development of storms, fluctuations in phytoplankton concentrations might affect the location or strength of Indian monsoons. The researchers suggest that forecasters might use satellite measurements of oceanic chlorophyll concentrations to improve the accuracy of seasonal weather predictions for the tropics.

The new findings fit with other recent research exploring the role of phytoplankton. In a study of the tropical Pacific, Marlon R. Lewis of Dalhousie and his colleagues found that the tiny plants greatly reduce the water's transparency and could account for geographic variations in sea-surface temperature patterns. They suggest in the Oct. 11, 1990 NATURE that sporadic phytoplankton "blooms" may play a role in starting El Niño-Southern Oscillations, which wreak havoc on global weather patterns.

Some researchers have proposed that phytoplankton partially control the world's climate because they emit a sulfur compound that stimulates the "seeding" of cloud particles (SN: 12/5/87, p.362). In general, Lewis says, scientists are developing a greater appreciation for the importance of these plants. "Biological organisms are not just passive and at the mercy of the climate and their physical environment," he says, "but in fact can carry out fairly significant modifications of the physical climate system."

– R. Monastersky

New light on bacterial DNA protection

Some people get going. Others go shopping. But with bacteria, says Scott C. Mohr, "when the going gets tough, the tough sporulate."

The Boston University chemist is referring to the process by which some bacteria encase themselves in tough protein coatings and go into states of near-suspended animation to weather periods of harsh environmental conditions. Bacterial spores can sit in bone-dry soil for 60 years or more, then spring to life when conditions again become conducive to growth. "You have to cook the bejesus out of these things to kill them," Mohr says.

Researchers have puzzled over how sporulated bacteria protect their precious genetic cargo from heat, desiccation and doses of ultraviolet light lethal to their sporeless siblings. Mohr and Peter Setlow of the University of Connecticut Health Center in Farmington, working with two Boston University colleagues, now appear to have solved the riddle of how these hardy microbes protect their genes from ultraviolet radiation. Their report appears in the January PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES (Vol.88, No.1).

Previous work had shown that bacteria in the early stages of sporulation produce large quantities of proteins called small acid-soluble spore proteins (SASPs), which seem to help protect DNA from the ravages of ultraviolet light. In cells lacking SASPs, ultraviolet light has a deadly effect on DNA sections that have two thymine molecules next to each other. Ultraviolet rays permanently transmogrify these adjoining thymines into gnarled, double-looped structures that interfere with DNA replication and repair.

In the new work, the mechanism by which SASPs prevent this fatal reaction comes to light. The team's laboratory experiments show that SASPs bind to DNA, unwinding it ever so slightly. This changes the geometry of the DNA's thymine pairs, leaving them relatively nonreactive to ultraviolet light.

By studying SASPs, scientists may learn more about how the earliest cells survived the high ultraviolet levels present before the emergence of Earth's radiation-filtering stratospheric ozone layer, Mohr says. Moreover, he says, ongoing studies of the mechanics behind SASPs' arm-twisting of DNA may someday aid researchers seeking biological tools to alter the structure and function of DNA sequences in bacteria and higher cells.

– R. Weiss

Panel prods NASA to seek unknown planets

Beyond the solar system may lie other planets or planets aborning, and a scientific advisory panel recommends that NASA undertake "a major scientific effort" to find them.

In a report released last week, the National Research Council's Committee on Planetary and Lunar Exploration asserts that technology is "on the brink of major advances" that will allow scientists to determine over the next 10 to 30 years whether "extrasolar" planets with masses between those of Jupiter and Uranus are "common or very rare."

Committee chairman Larry W. Esposito of the University of Colorado in Boulder says work on the report began in 1984, prompted by ground-based observations that some scientists interpreted as evidence of a planet orbiting the star Van Biesbroeck 8 (SN: 8/20/83, p.116) and by the discovery of a disk of small particles around a star called Beta Pictoris—a finding that some thought might be associated with planet formation.

No one has confirmed the existence of Van Biesbroeck 8's planetary "companion." Astronomers have not detected any planet-like objects in the Beta Pictoris disk, nor have they confirmed the existence of planets orbiting any other star, Esposito says.

Yet intensive scrutiny just might turn up such phenomena. The panel recommends that NASA start a program to measure the motions of 100 or more nearby stars to see whether they wobble due to the masses of planets that might encircle them. The advisory committee also wants the agency to examine the spectra of these and other stars to see whether the wavelengths of any star's light are being "Doppler shifted" due to one or more orbiting planets.

For a better understanding of our own solar system's formation, the report urges NASA to emphasize studies of the materials from which planetary systems form, such as rare grains in primitive meteorites, interplanetary dust and comets. The committee also wants NASA to support a range of theoretical studies, with the aim of enabling scientists to make "specific predictions regarding the observational properties of planetary systems at all stages of their evolution."

The new report, spanning planetary science, astronomy and astrophysics, is "unlike any that the Space Science Board [the panel's parent group] has ever tried before," says Robert O. Pepin of the University of Minnesota in Minneapolis, former chairman of the committee.

– J. Eberhart