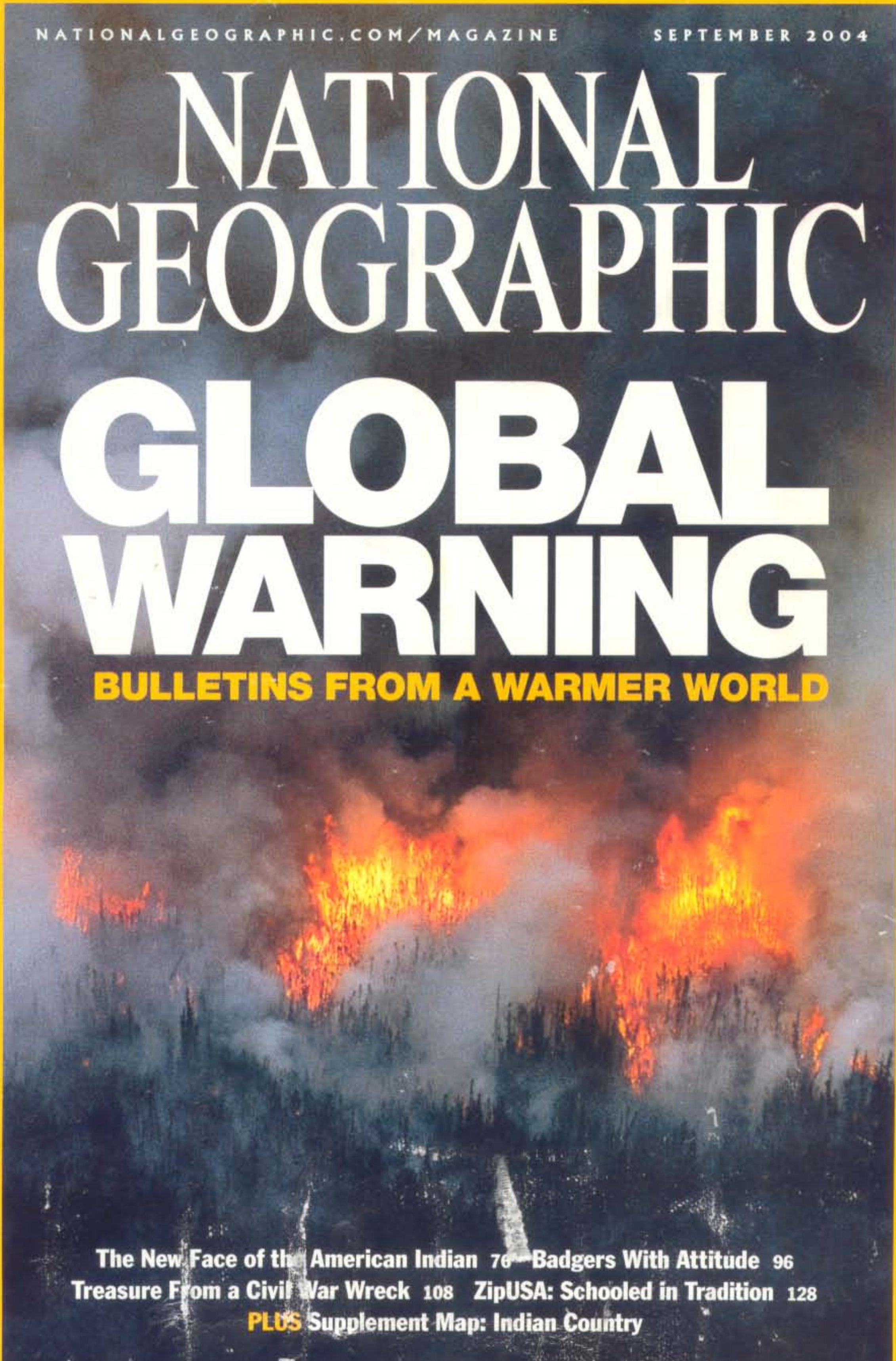
NATIONAL GEOGRAPHIC CHANNEL'S MOST AMAZING DISCOVERIES, SEPT. 6-10 AT 9 P.M. ET/PT

NATIONALGEOGRAPHIC.COM/MAGAZINE SEPTEMBER 2004

NATIONAL GEOGRAPHIC



GLOBAL WARNING

BULLETINS FROM A WARMER WORLD

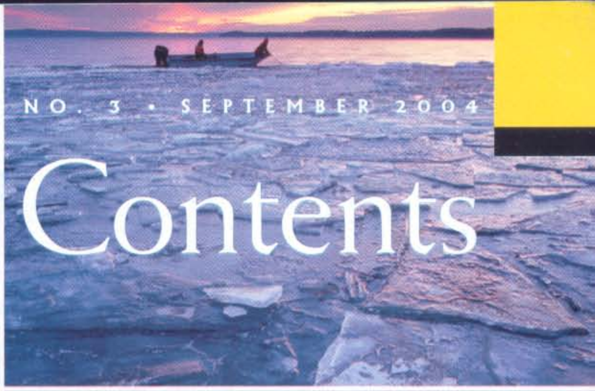
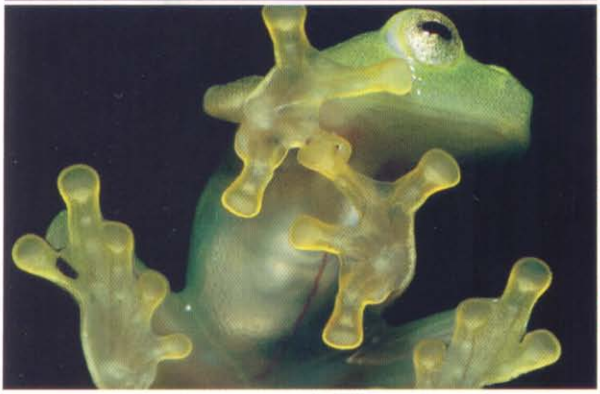
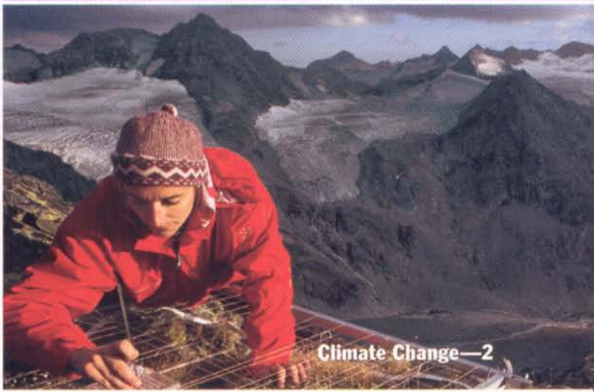
The New Face of the American Indian 76 Badgers With Attitude 96

Treasure From a Civil War Wreck 108 ZipUSA: Schooled in Tradition 128

PLUS Supplement Map: Indian Country

VOL. 206 NO. 3 • SEPTEMBER 2004

Contents

FEATURES

DEPARTMENTS

THE COVER

With Alaska's climate heating up, wildfires are on the rise.

BY PETER ESSICK

Cover printed on recycled-content paper

ON THE WEBSITE

nationalgeographic.com/magazine

STORYTELLING Listen to traditional American Indian stories.

VIDEO See the small but ferocious honey badger in action.

INTERACTIVE ART Explore a shipwreck on the ocean floor.

FORUM Voice your opinion about global warming.

For membership information call 1-800-NGS-LINE (647-5463)

Carbon Dioxide Levels Rise · Mercury Climbs · Oceans Warm · Glaciers Melt · Sea Level Rises · Sea Ice Thins · Permafrost Thaws · Wildfires Increase · Lakes Shrink · Lakes Freeze Up Later · Ice Shelves Collapse · Droughts Linger · Precipitation Increases · Mountain Streams Run Dry · Winter Loses Its Bite · Spring Arrives Earlier · Autumn Comes Later ·

Signs from Earth

Plants Flower Sooner · Migration Times Vary · Habitats Change · Birds Nest Earlier · Diseases Spread · Coral Reefs Bleach · Snowpacks Decline · Exotic Species Invade · Amphibians Disappear · Coastlines Erode · Cloud Forests Dry · Temperatures Spike At High Latitudes ·

What in the World Is Going On?

SIGNS FROM EARTH

Global warming can seem too remote to worry about, or too uncertain—something projected by the same computer techniques that often can't get next week's weather right. On a raw winter day you might think that a few degrees of warming wouldn't be such a bad thing anyway. And no doubt about it: Warnings about climate change can sound like an environmentalist scare tactic, meant to force us out of our cars and cramp our lifestyles.

Comforting thoughts, perhaps. But turn to "GeoSigns," the first chapter in our report on the changing planet. The Earth has some unsettling news.

From Alaska to the snowy peaks of the Andes the world is heating up right now, and fast. Globally, the temperature is up 1°F over the past century, but some of the coldest, most remote spots have warmed much more. The results aren't pretty. Ice is melting, rivers are running dry, and coasts are eroding, threatening communities. Flora and fauna are feeling the heat too, as you'll read in "EcoSigns." These aren't projections; they are facts on the ground.

The changes are happening largely out of sight. But they shouldn't be out of mind, because they are omens of what's in store for the rest of the planet.

Wait a minute, some doubters say. Climate is notoriously fickle. A thousand years ago Europe was balmy and wine grapes grew in England; by 400 years ago the climate had turned chilly and the Thames froze repeatedly. Maybe the current warming is another natural vagary, just a passing thing?

Don't bet on it, say climate experts. Sure, the natural rhythms of climate might explain a few of the warming signs you'll read about in the following pages. But something else is driving the planet-wide fever.

For centuries we've been clearing forests and burning coal, oil, and gas, pouring carbon dioxide and other heat-trapping gases into the atmosphere faster than plants and oceans can soak them up (see "The Case of the Missing Carbon," February 2004). The atmosphere's level of carbon dioxide now is higher than it has been for hundreds of thousands of years. "We're now geological agents, capable of affecting the processes that determine climate,"



says George Philander, a climate expert at Princeton University. In effect, we're piling extra blankets on our planet.

Human activity almost certainly drove most of the past century's warming, a landmark report from the United Nations Intergovernmental Panel on Climate Change (IPCC) declared in 2001. Global temperatures are shooting up faster than at any other time in the past thousand years. And climate models show that natural forces, such as volcanic eruptions and the slow flickers of the sun, can't explain all that warming.

As CO_2 continues to rise, so will the mercury—another 3°F to 10°F by the end of the century, the IPCC projects. But the warming may not be gradual. The records of ancient climate described in "TimeSigns" suggest that the planet has a sticky thermostat. Some experts fear today's temperature rise could accelerate into a devastating climate lurch. Continuing to fiddle with the global thermostat, says Philander, "is just not a wise thing to do."

Already we've pumped out enough greenhouse gases to warm the planet for many decades to come. "We have created the environment in which our children and grandchildren are going to live," says Tim Barnett of the Scripps Institution of Oceanography. We owe it to them to prepare for higher temperatures and changed weather—and to avoid compounding the damage.

It won't be easy for a world addicted to fossil fuels to limit emissions. Three years ago the United States spurned the Kyoto Protocol, citing cost. But even Kyoto would barely slow the rise in heat-trapping gases. Controlling the increase "would take 40 successful Kyotos," says Jerry Mahlman of the National Center for Atmospheric Research. "But we've got to do it."

The signs of warming in the following pages are striking enough, but they are just a taste of the havoc the next century could bring. Can we act in time to avert the worst of it? The Earth will tell.

Tim Appenzeller · *Senior Editor, Science*
Dennis R. Dimick · *Senior Editor, Environment and Technology*

BY DANIEL GLICK
PHOTOGRAPHS BY PETER ESSICK

"If we don't have it, we don't need it," pronounces Daniel Fagre as we throw on our backpacks. We're armed with crampons, ice axes, rope, GPS receivers, and bear spray to ward off grizzlies, and we're trudging toward Sperry Glacier in Glacier National Park, Montana. I fall in step with Fagre and two other research scientists from the U.S. Geological Survey Global Change Research Program.

They're doing what they've been doing for more than a decade: measuring how the park's storied glaciers are melting.

So far, the results have been positively chilling. When President Taft created Glacier National Park in 1910, it was home to an estimated 150 glaciers. Since then the number has decreased to fewer than 30, and most of those remaining have shrunk in area by two-thirds. Fagre predicts that within 30 years most if not all of the park's namesake glaciers will disappear.

"Things that normally happen in geologic time are happening during the span of a human lifetime," says Fagre. "It's like watching the Statue of Liberty melt."

Scientists who assess the planet's health see indisputable evidence that Earth has been getting warmer, in some cases rapidly. Most believe that human activity, in particular the burning of fossil fuels and the resulting buildup of greenhouse gases in the atmosphere, have influenced this warming trend. In the past decade scientists have documented record-high average annual surface temperatures and have been observing other signs of change all over the planet: in the distribution of ice, and in the salinity, levels, and temperatures of the oceans.

"This glacier used to be closer," Fagre declares as we crest a steep section, his glasses fogged from exertion. He's only half joking. A trailside sign notes that since 1901, Sperry Glacier has shrunk from more than 800 acres to 300 acres. "That's out of date," Fagre says, stopping to catch his breath. "It's now less than 250 acres."

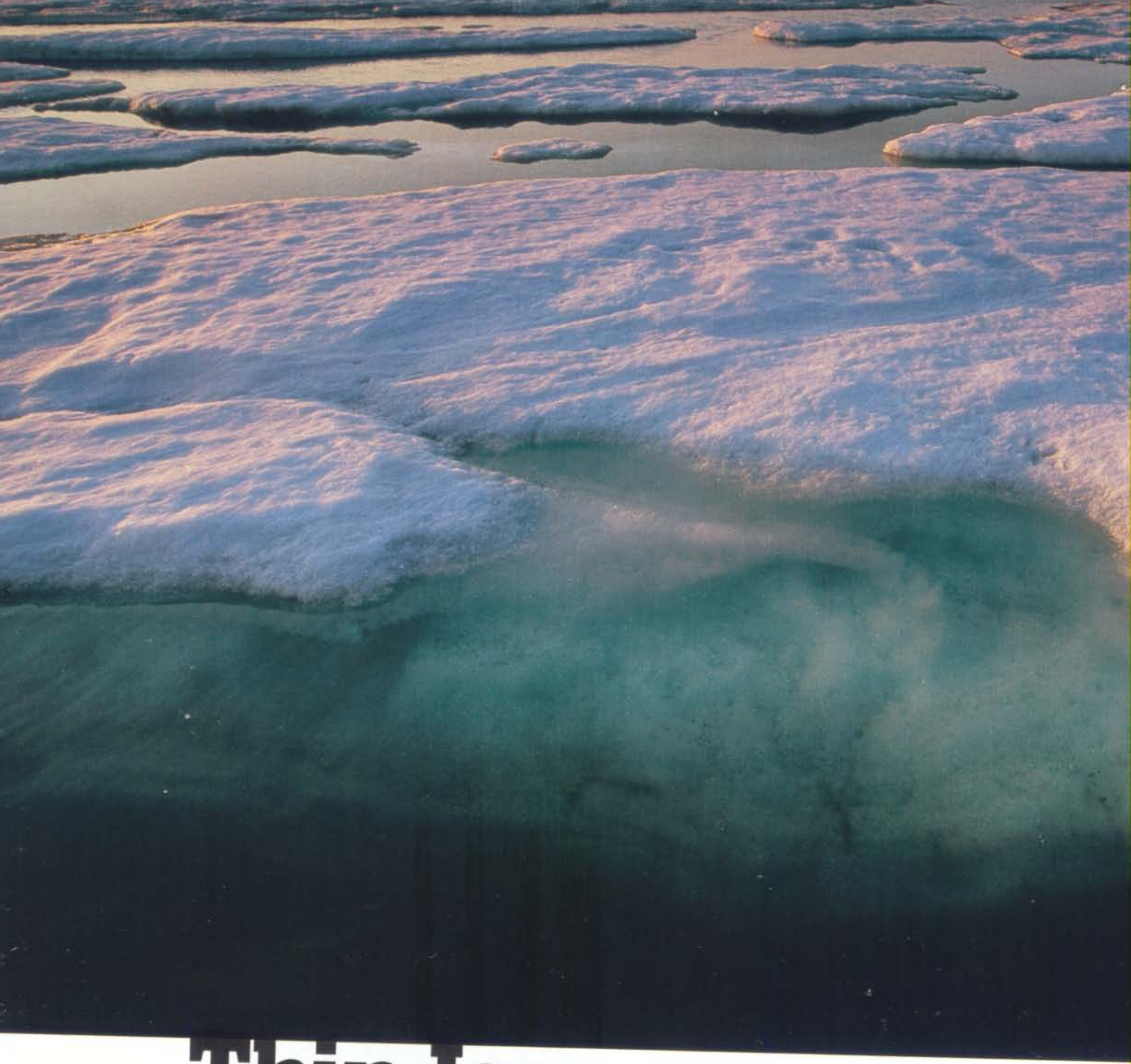
Everywhere on Earth ice is changing. The famed snows of Kilimanjaro have melted more than 80 percent since 1912. Glaciers in the Garhwal Himalaya in India are retreating so fast that researchers believe that most central and eastern Himalayan glaciers could virtually disappear by 2035. Arctic sea ice has thinned significantly over the past half century, and its extent has declined by about 10 percent in the past 30 years. NASA's repeated laser altimeter readings show the edges of Greenland's ice sheet shrinking. Spring freshwater ice breakup in the Northern Hemisphere now occurs nine days earlier than it did 150 years ago, and autumn freeze-up ten days later. Thawing permafrost has caused the ground to subside more than 15 feet in parts of Alaska. From the Arctic to Peru, from Switzerland to the equatorial glaciers of Irian Jaya in Indonesia, massive ice fields, monstrous glaciers, and sea ice are disappearing, fast.

When temperatures rise and ice melts, more water flows to the seas from glaciers and ice caps, and ocean water warms and expands in volume. This combination of effects has played the major role in raising average global sea level between four and *(Continued on page 19)*

Going, Going . . .

Peru's Quelccaya ice cap is the largest in the tropics. If it continues to melt at its current rate—contracting more than 600 feet a year in some places—it will be gone by 2100, leaving thousands who rely on its water for drinking and electricity high, dry, and in the dark.

PERUVIAN ANDES



Thin Ice in the Arctic

The annual breakup of sea ice (above and opposite) off the coast of Alaska happens weeks earlier than it once did. Since 1978 the area of perennial Arctic sea ice has decreased by 9 percent per decade, but the degree to which the ice has thinned has been harder to assess. Scientists using submarine sonar data documented a 40 percent thinning in the past 30 years. Others have put the estimate at about 15 percent. Some predict that the ice could be absent in summer by 2100.

A Coastline Redrawn

The epic collapse of a 1,250-square-mile section of the Larsen Ice Shelf took just over a month in early 2002. Melt ponds—visible as dark striations on the floating ice shelf (right) presaged the impending break-up (below right). Scientists are monitoring what effect the further disintegration of Larsen—and of other Antarctic ice shelves—might have on the continent's glaciers. Without ice shelves to act as dams, those glaciers might migrate faster toward the coast, ultimately contributing to rising sea level.

BEAUFORT SEA, ALASKA (ABOVE AND BELOW)

ANTARCTIC PENINSULA, NATIONAL SNOW AND ICE DATA CENTER (TOP AND ABOVE)

(Continued from page 14) eight inches in the past hundred years, according to the Intergovernmental Panel on Climate Change (IPCC).

Scientists point out that sea levels have risen and fallen substantially over Earth's 4.6-billion-year history. But the recent rate of global sea level rise has departed from the average rate of the past two to three thousand years and is rising more rapidly—about one-tenth of an inch a year. A continuation or acceleration of that trend has the potential to cause striking changes in the world's coastlines.

Driving around Louisiana's Gulf Coast, Windell Curole can see the future, and it looks pretty wet. In southern Louisiana coasts are literally sinking by about three feet a century, a process called subsidence. A sinking coastline and a rising ocean combine to yield powerful effects. It's like taking the global sea-level-rise problem and moving it along at fast-forward.

The seventh-generation Cajun and manager of the South Lafourche Levee District navigates his truck down an unpaved mound of dirt that separates civilization from inundation, dry land from a swampy horizon. With his French-tinged lilt, Curole points to places where these bayous, swamps, and fishing villages portend a warmer world: his high school girlfriend's house partly submerged, a cemetery with water lapping against the white tombs, his grandfather's former hunting camp now afloat in a stand of skeleton oak snags. "We live in a place of almost land, almost water," says the 52-year-old Curole.

Rising sea level, sinking land, eroding coasts, and temperamental storms are a fact of life for Curole. Even relatively small storm surges in the past two decades have overwhelmed the system of dikes, levees, and pump stations that he manages, upgraded in the 1990s to forestall the Gulf of Mexico's relentless creep. "I've probably ordered more evacuations than any other person in the country," Curole says.

The current trend is consequential not only in coastal Louisiana but around the world. Never before have so many humans lived so close to the coasts: More than a hundred million people worldwide live within three feet of mean sea level. Vulnerable to sea-level rise, Tuvalu, a small country in the South Pacific, has already begun formulating evacuation plans. Megacities where human populations have concentrated near coastal plains or river deltas—Shanghai, Bangkok, Jakarta, Tokyo, and New York—are at risk. The projected economic and humanitarian impacts on low-lying, densely populated, and desperately poor countries like Bangladesh are potentially catastrophic. The scenarios are disturbing even in wealthy countries like the Netherlands, with nearly half its landmass already at or below sea level.

Rising sea level produces a cascade of effects. Bruce Douglas, a coastal researcher at Florida International University, calculates that every inch of sea-level rise could result in eight feet of horizontal retreat of sandy beach shorelines due to erosion. Furthermore, when salt water intrudes into freshwater aquifers, it threatens sources of drinking water and makes raising crops problematic. In the Nile Delta, where many of Egypt's crops are cultivated, widespread erosion and saltwater intrusion would be disastrous—since the country contains little other arable land.

"I've probably ordered more evacuations than any other person in the country."

In some places marvels of human engineering worsen effects from rising seas in a warming world. The system of channels and levees along the Mississippi effectively stopped the millennia-old natural process of rebuilding the river delta with rich sediment deposits. In the 1930s, oil and gas companies began to dredge shipping and exploratory canals, tearing up the marshland buffers that helped dissipate tidal surges. Energy drilling removed vast quantities of subsurface liquid, which studies suggest increased the rate at which the land is sinking. Now Louisiana is losing approximately 25 square miles of wetlands every (Continued on page 27)

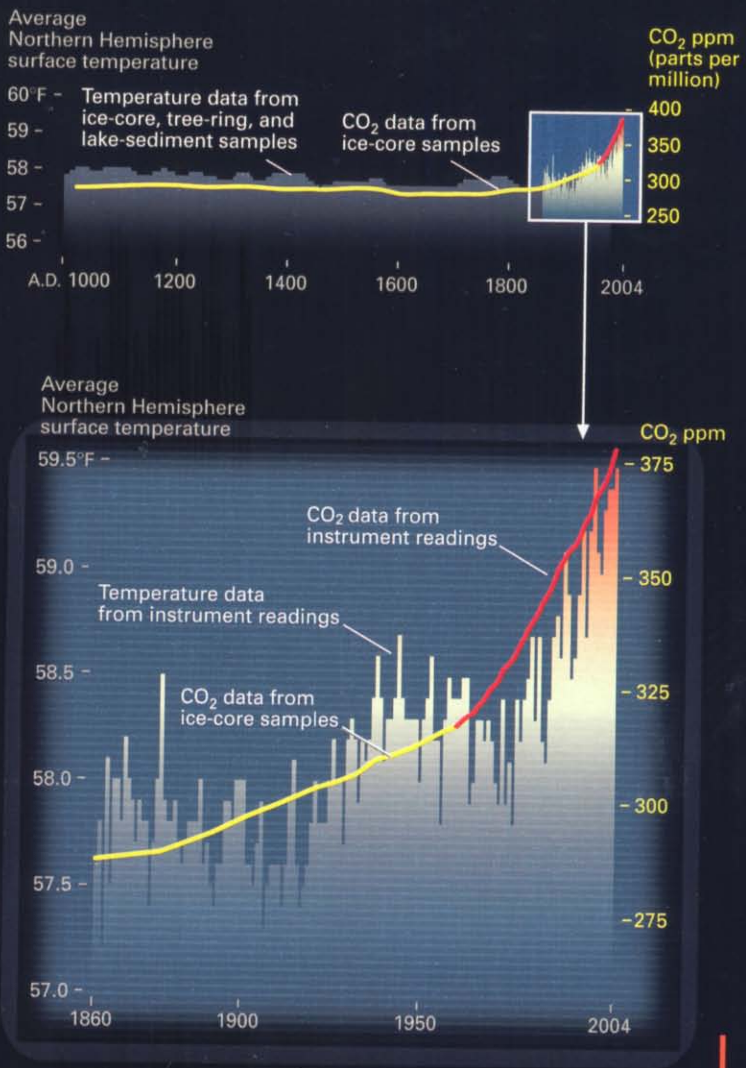
G E O S I G N

Temperature rising

Temperature and CO_2 records >>>>>>>

■ **Warming trends** The concentration of carbon dioxide in the atmosphere helps determine Earth's surface temperature. Both CO_2 and temperature have risen sharply since 1950.

■ Over the past 140 years, forest clearing and fossil-fuel burning have pushed up the atmosphere's CO_2 level by nearly 100 parts per million. The average surface temperature of the Northern Hemisphere has mirrored the rise in CO_2. The 1990s was the warmest decade since the mid-1800s, and 1998 the warmest year.



One Degree of Change

A big difference Climate fluctuates naturally between warm and cool periods. But the 20th century has seen the greatest warming in at least a thousand years, and natural forces can't account for it all. The rise of CO_2 and other heat-trapping gases in the atmosphere has contributed; both greenhouse gases and temperature are expected to continue rising.

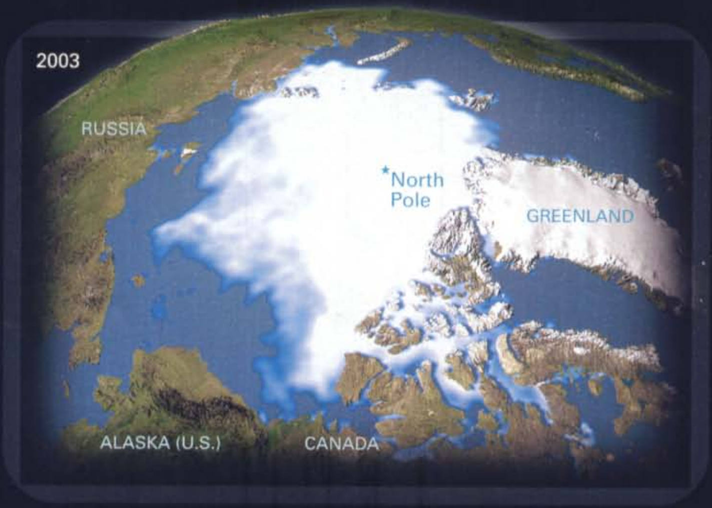
GEOSIGN

Ice melting

Arctic sea ice coverage >>>>>>>>>>>>>

Shrinking sea ice An image based on satellite data shows perennial ice cover in 1979, when the ice extended over the Arctic Ocean from edge to edge. Since then the area of coverage has decreased by 9 percent per decade.

A similar image from 2003 shows dramatically reduced perennial ice cover. Large areas of open ocean have appeared near Russia, Alaska, and Canada. Some climate models project that the ice will be gone in summer by the end of this century.



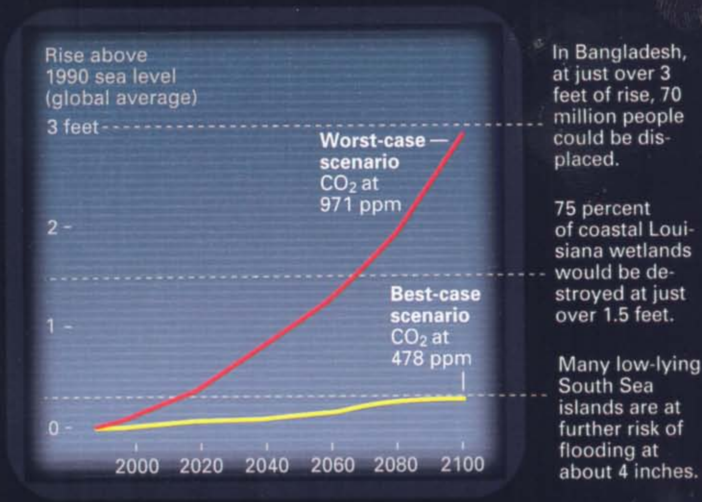
Hot zone The Arctic is warming several times faster than most of the planet; ice there is melting on land and at sea. The release of fresh water into the oceans could change the course of currents that play a vital role in climate. Runoff from glaciers on land is already contributing to a global rise in sea level.

GEOSIGN

Sea level rising

Sea level change projections >>>>>>>>>>>>

Coasts threatened As ice melts and warmer seawater expands, the oceans will rise. How much depends largely on how much CO_2 and other greenhouse gases we continue to emit. This model projects rises of between a few inches and a few feet over the next century.



GEOSIGN

Weather turning wild?

Projected weather and climate changes >>>>>>>>

Storm warnings Higher global temperatures could fuel extreme weather. At right are computer-model projections of the chance that various weather events will be more frequent in a warmer world.

ART BY 5W INFOGRAPHIC, JUAN VELASCO. TEMPERATURE DATA: MANN AND JONES, "GEOPHYSICAL RESEARCH LETTERS," VOL. 30, NO. 15 (FAR LEFT, TOP); PHIL JONES, CLIMATIC RESEARCH UNIT, UNIVERSITY OF EAST ANGLIA, U.K. (FAR LEFT, BOTTOM). CO_2 DATA: ETHERIDGE ET AL., COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION, AUSTRALIA, AND AUSTRALIAN ANTARCTIC DIVISION (FAR LEFT, TOP); C. D. KEELING, SCRIPPS INSTITUTION OF OCEANOGRAPHY (FAR LEFT, BOTTOM). ARCTIC SEA ICE DATA (MIDDLE, TOP AND BOTTOM): J. COMISO, NASA. PROJECTED SEA LEVEL CHANGE SCENARIOS (ABOVE, TOP): INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC). WEATHER PROJECTIONS (ABOVE, BOTTOM): IPCC. CO_2 PPM DATA (ABOVE): TOM WIGLEY, NATIONAL CENTER FOR ATMOSPHERIC RESEARCH

Uncertain scenarios In the next century some coastlines could migrate miles inland, displacing tens of millions of people. Siberia and northern Canada could experience a warmer, wetter climate. Other regions could suffer more frequent and severe droughts. Taking steps now to rein in greenhouse gas emissions could limit these impacts.

DENALI NATIONAL PARK AND PRESERVE, ALASKA

the Heat

Thick smoke towers over a forest near Fairbanks (left), one more sign that Alaska is getting hotter. In three decades the average temperature rose 4.16°F in the northern city of Barrow. The capital, Juneau, saw a 3.54° increase, and Anchorage, the state's most populous city, is 2.26° warmer. Northern coniferous forests, which become fire prone in hot weather, could be hit hard. Computer models predict that CO_2–induced warming could eventually raise the incidence

BETWEEN KAKTOVIC AND DEADHORSE, ALASKA

of fires by more than half.

Climate warming hits hard in cold regions partly because of albedo feedback. Snow and ice have a high albedo—that is, they reflect a lot of solar energy. But as heat melts snow and ice, darker, less reflective land or water is exposed (above). More heat is absorbed, giving rise to further melting and warming.

NORTH OF FAIRBANKS, ALASKA

OUTSIDE FAIRBANKS, ALASKA

Alaska's spectacular glaciers—among them Buckskin Glacier in Denali National Park and Preserve (top)—are disappearing. An estimated 23 cubic miles of water now runs off each year, the largest glacial contribution to sea-level rise on Earth. The heat is also melting permafrost that supports roads, buildings, and other infrastructure across most of the state. It's a bumpy ride on a bike path (above right) near Fairbanks, where once frozen soil has softened and chunks of

FAIRBANKS, ALASKA

underground ice have melted. The result is sharp dips and rises in what once was level ground. Even trees are susceptible to softening ground, leading to the phenomenon of the "drunken" forest (above left). In Shishmaref (below) waves undermine bluffs softened by permafrost melt. The early retreat of sea ice each year—in addition to making it harder for villagers to locate prey during traditional spring hunts—magnifies sea swells, causing further erosion.

SHISHMAREF, ALASKA

More than a hundred million people worldwide live within three feet of mean sea level.

The future breakdown of the thermohaline circulation remains a disturbing, if remote, possibility. But the link between changing atmospheric chemistry and the changing oceans is indisputable, says Nicholas Bates, a principal investigator for the Bermuda Atlantic Time-series Study station, which monitors the temperature, chemical composition, and salinity of deep-ocean water in the Sargasso Sea southeast of the Bermuda Triangle.

Oceans are important sinks, or absorption centers, for carbon dioxide, and take up about a third of human-generated CO_2. Data from the Bermuda monitoring programs show that CO_2 levels at the ocean surface are rising at about the same rate as atmospheric CO_2. But it is in the deeper levels where Bates has observed even greater change. In the waters between 250 and 450 meters (820 and 1,476 feet) deep, CO_2 levels are rising at nearly twice the rate as in the surface waters. "It's not a belief system; it's an observable scientific fact," Bates says. "And it shouldn't be doing that unless something fundamental has changed in this part of the ocean."

While scientists like Bates monitor changes in the oceans, others evaluate CO_2 levels in the atmosphere. In Vestmannaeyjar, Iceland, a lighthouse attendant opens a large silver suitcase that looks like something out of a James Bond movie, telescopes out an attached 15-foot rod, and flips a switch, activating a computer that controls several motors, valves, and stopcocks. Two two-and-a-half-liter flasks in the suitcase fill with ambient air. In North Africa, an Algerian monk at Assekrem does the same. Around the world, collectors like these are monitoring the cocoon of gases that compose our atmosphere and permit life as we know it to persist.

When the weekly collection is done, all the flasks are sent to Boulder, Colorado. There, Pieter Tans, a Dutch-born atmospheric scientist with NOAA's Climate Monitoring and Diagnostics Laboratory, oversees a slew of sensitive instruments that test the air in the flasks for its chemical composition. In this way Tans helps assess the state of the world's atmosphere.

By all accounts it has changed significantly in the past 150 years.

Walking through the various labs filled with cylinders of standardized gas mixtures, absolute manometers, and gas chromatographs, Tans offers up a short history of atmospheric monitoring. In the late 1950s a researcher named Charles Keeling began measuring CO_2 in the atmosphere above Hawaii's 13,679-foot Mauna Loa. The first thing that caught Keeling's eye was how CO_2

Soggy Future

Young Bangladeshis improvise shelter in the face of a downpour. The annual monsoon rains that sweep into southern and eastern Asia on the heels of the dry season may increase in intensity as a result of climate warming. Rising ocean temperatures could increase the incidence of cholera, and more rain could lead to crop reductions and increased malnutrition.

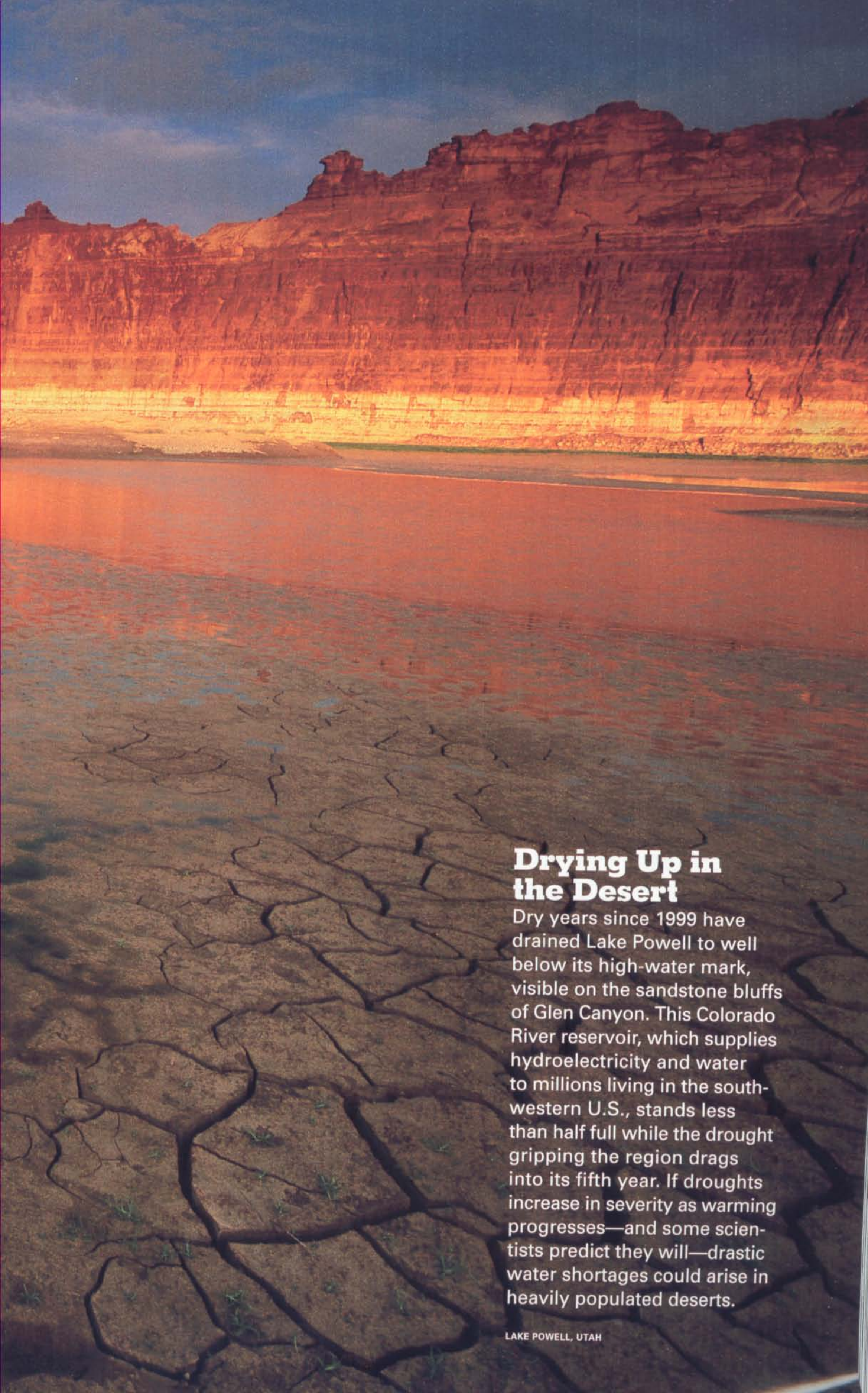
level rose and fell seasonally. That made sense since, during spring and summer, plants take in CO_2 during photosynthesis and produce oxygen in the atmosphere. In the fall and winter, when plants decay, they release greater quantities of CO_2 through respiration and decay. Keeling's vacillating seasonal curve became famous as a visual representation of the Earth "breathing."

Something else about the way the Earth was breathing attracted Keeling's attention. He watched as CO_2 level not only fluctuated seasonally, but also rose year after year. Carbon dioxide level has climbed from about 315 parts per million (ppm) from Keeling's first readings in 1958 to more than 375 ppm today. A primary source for this rise is indisputable: humans' prodigious burning of carbon-laden fossil fuels for their factories, homes, and cars.

Tans shows me a graph depicting levels of three key greenhouse gases—CO_2, methane, and nitrous oxide—from the year 1000 to the present. The three gases together help keep Earth, which would otherwise be an inhospitably cold orbiting rock, temperate by orchestrating an intricate dance between the radiation of heat from Earth back to space (cooling the planet) and the absorption of radiation in the atmosphere (trapping it near the surface and thus warming the planet).

Tans and most other scientists believe that greenhouse gases are at the root of our changing climate. "These gases are a climate-change driver," says Tans, poking his graph definitively with his index finger. The three lines on the graph follow almost identical patterns: basically flat until the mid-1800s, then all three move upward in a trend that turns even more sharply upward after 1950. "This is what we did," says Tans, pointing to the parallel spikes. "We have very significantly changed the atmospheric concentration of these gases. We know their radiative properties," he says.

BANGLADESH



Drying Up in the Desert

Dry years since 1999 have drained Lake Powell to well below its high-water mark, visible on the sandstone bluffs of Glen Canyon. This Colorado River reservoir, which supplies hydroelectricity and water to millions living in the southwestern U.S., stands less than half full while the drought gripping the region drags into its fifth year. If droughts increase in severity as warming progresses—and some scientists predict they will—drastic water shortages could arise in heavily populated deserts.

LAKE POWELL, UTAH

Seasons Shift

SIERRA NEVADA, CALIFORNIA

As warmer temperatures creep up the slopes of California's Sierra Nevada, snowpack melts earlier, leaving some mountain streams (above) dry by summer. Downstream, the Sacramento River gets 12 percent less spring and summer snowmelt than it did a century ago, sparking worry in California about looming water deficits. In Madison, Wisconsin (below), winter is milder than in years past. Researchers monitoring ice on Lake Mendota find that ice cover on the lake averages about 40 fewer days now than it did 150 years ago. Says University of Wisconsin researcher John Magnuson, "Wisconsin is losing winter as we knew it."

MADISON, WISCONSIN

"It is inconceivable to me that the increase would not have a significant effect on climate."

Exactly how large that effect might be on the planet's health and respiratory system will continue to be a subject of great scientific and political debate—especially if the lines on the graph continue their upward trajectory.

Eugene Brower, an Inupiat Eskimo and president of the Barrow Whaling Captains' Association, doesn't need fancy parts-per-million measurements of CO_2 concentrations or long-term sea-level gauges to tell him that his world is changing.

"It's happening as we speak," the 56-year-old Brower says as we drive around his home in Barrow, Alaska—the United States' northernmost city—on a late August day. In his fire chief's truck, Brower takes me to his family's traditional ice cellars, painstakingly dug into the permafrost, and points out how his stores of muktuk—whale skin and blubber—recently began spoiling in the fall because melting water drips down to his food stores. Our next stop is the old Bureau of Indian Affairs school building. The once impenetrable permafrost that kept the foundation solid has bucked and heaved so much that walking through the school is almost like walking down the halls of an amusement park fun house. We head to the eroding beach and gaze out over open water. "Normally by now the ice would be coming in," Brower says, scrunching up his eyes and scanning the blue horizon.

"It's not a belief system; it's an observable scientific fact."

We continue our tour. Barrow looks like a coastal community under siege. The ramshackle conglomeration of weather-beaten houses along the seaside gravel road stands protected from fall storm surges by miles-long berms of gravel and mud that block views of migrating gray whales. Yellow bulldozers and graders patrol the coast like sentries.

The Inupiat language has words that describe many kinds of ice. *Piqaluyak* is salt-free multiyear sea ice. *Ivuniq* is a pressure ridge. *Sarri* is the word for pack ice, *tuvaqtaq* is bottom-fast ice, and shore-fast ice is *tuvaq*. For Brower, these words are the currency of hunters who must know and follow ice patterns to track bearded seals, walruses, and bowhead whales.

Average temperature increase on the West Antarctic Peninsula since 1950:
- **winter: 8.8°F**
- **annual: 4.5°F**

There are no words, though, to describe how much, and how fast, the ice is changing. Researchers long ago predicted that the most visible impacts from a globally warmer world would occur first at high latitudes: rising air and sea temperatures, earlier snowmelt, later ice freeze-up, reductions in sea ice, thawing permafrost, more erosion, increases in storm intensity. Now all those impacts have been documented in Alaska. "The changes observed here provide an early warning system for the rest of the planet," says Amanda Lynch, an Australian researcher who is the principal investigator on a project that works with Barrow's residents to help them incorporate scientific data into management decisions for the city's threatened infrastructure.

Before leaving the Arctic, I drive to Point Barrow alone. There, at the tip of Alaska, roughshod hunting shacks dot the spit of land that marks the dividing line between the Chukchi and Beaufort Seas. Next to one shack someone has planted three eight-foot sticks of white driftwood in the sand, then crisscrossed their tops with whale baleen, a horny substance that whales of the same name use to filter life-sustaining plankton out of seawater. The baleen, curiously, looks like palm fronds.

So there, on the North Slope of Alaska, stand three makeshift palm trees. Perhaps they are no more than an elaborate Inupiat joke, but these Arctic palms seem an enigmatic metaphor for the Earth's future. □

MELTDOWN What's happening to Earth's climate, and what are the implications for our future? Share your thoughts in our forum. Then explore the best the Web has to offer on global climate change with a listing of related websites and resources *from our Research Division at* **nationalgeographic.com/magazine/0409**.