

OCEANS AND CLIMATE... Earth's thermostat, and more.

Anyone who lives on the coast—and most people on Earth do—knows that proximity to the ocean plays a big role in local weather and climate. Winter nor'easters and summer hurricanes aside, Boston would tend to be a whole lot colder in January and hotter in August were it not for the Atlantic Ocean lapping at—and sometimes punishing—our shores. And this buffering action helps regulate the global to local effects of climate change just as strongly.

“The oceans not only record and react to climate change, they help drive and control its impacts,” said John Marshall, Cecil and Ida Green Professor of Oceanography in MIT's Department of Earth, Atmospheric and Planetary Sciences. “Regional patterns and rates of surface warming are largely determined by the oceans because they set the effective heat capacity of the climate system and strongly influence circulation patterns.”

THE CLIMATE-OCEAN RELATIONSHIP...

- Greenhouse gas (GHG) emissions drive global warming but much of the heat has actually been absorbed by the oceans, thus far limiting the actual near-surface atmospheric warming that has occurred.
- The oceans have also absorbed much of the anthropogenic CO₂—a primary GHG—further moderating the potential surface temperature impacts.

- Absorbing all this heat and CO₂ is making the oceans warmer and more acidic, with profound implications for ocean currents and marine life up and down the food chain.
- Warming ocean waters provide more heat to fuel bigger and more frequent hurricanes and other extreme, marine-based weather events.
- Warming water also expands, guaranteeing tens of centimeters of overall sea level rise per century based on current rates. Sudden melting of glaciers and ice—principally on Greenland and Antarctica—could quickly lead to meters of sea level rise.
- The relatively high ratio of land to ocean in the northern hemisphere, coupled with deep ocean currents that carry cold water toward Antarctica, means that the Arctic stands to experience far more impact from climate change over the coming decades, with profound geopolitical implications.

“What we really have is a strongly coupled, highly dynamic and highly heterogeneous global climate-ocean system,” Marshall said. “We simply cannot understand one without understanding the other.”