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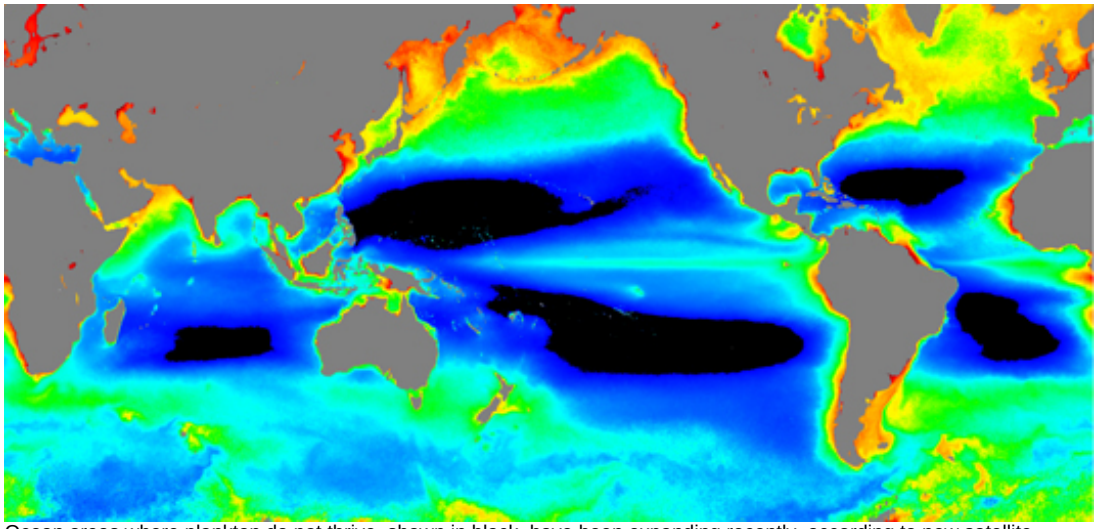
Expanding ‘Deserts,’ by Land and Sea

By Andrew C. Revkin



Ocean areas where plankton do not thrive, shown in black, have been expanding recently, according to new satellite studies. (NOAA)

Scientists have long projected that areas north and south of the tropics will grow drier in a warming world –- from the Middle East through the European Riviera to the American Southwest, from sub-Saharan Africa to parts of Australia.

These regions are too far from the equator to benefit from the moist columns of heated air that result in steamy afternoon downpours. And the additional precipitation foreseen as more water evaporates from the seas is mostly expected to fall at higher latitudes. Essentially, a lot of climate scientists say, these regions may start to feel more like deserts under the influence of global warming.

Now scientists have measured a rapid recent expansion of desert-like barrenness in the subtropical *oceans* –- in places where surface waters have also been steadily warming. There could be a link to human-driven climate change, but it’s too soon to

tell, the scientists said.
[UPDATED below, 3/6, 1 p..m]

As I've written in a brief piece for Thursday's paper, relatively plankton-free (and thus fish-free) stretches of the Atlantic and Pacific Oceans around the tropics that typically cover about 20 percent of the global ocean surface have expanded about 15 percent since 1998, according to the new study. The change was measured using the orbiting SeaWiFS instrument, which can measure the abundance of plankton by tracking color differences in sea water.

The drop in productivity could be related to the hotter surface waters, or changes in winds, the researchers said. Either factor could prevent deeper, nutrient-rich water from rising to nourish plankton and, indirectly, other marine life.

The authors of the study said the change could be temporary, given the short span of observations, but it matches a slight but steady warming trend in the affected ocean regions and also matches a pattern scientists have predicted would occur under human-caused global warming. The researchers, from the National Oceanic and Atmospheric Administration and University of Hawaii, said they have measured similar changes in the Indian Ocean, but with a less measurable trend.

The sea changes could be related to another shift in regions around the equator: A review of several decades of tropical and subtropical atmospheric measurements, published in the inaugural edition of the journal Nature Geoscience, found the tropics are, in essence, expanding, and doing so more rapidly than climate simulations projected (which could mean either that the models are overly conservative or nature is more complicated than anticipated).

For now, there's no way to link the atmospheric and oceanic changes, said Jeffrey J. Polovina, an oceanographer with the National Marine Fisheries Service in Honolulu and an author of the analysis, which has been published in Geophysical Research Letters. "The fact that we are seeing an expansion of the ocean's least productive areas as the subtropical gyres warm is consistent with our understanding of the impact of global warming," he said. "But with a nine-year time series, it is difficult to rule out decadal variation."

Yet again, society is left with building evidence of looming troubles from human-caused global warming. But, as an army of experts has been saying for two decades, if people wait around for perfect evidence, it will be that much harder to start trying to blunt the trend.

[UPDATE 3/6, 1 p.m.:] Isaac Held, a climate modeler at the Geophysical Fluid

Dynamics Laboratory in Princeton, N.J., responded today with some caution about seeking relationships between the ocean and atmospheric changes around the tropics, and also drawing conclusions about their relationship to global warming. His note is pasted below in full.

He also suggests it'd be valuable for me to do a story more broadly examining the tension over interpreting dramatic shortish-term events in a realm still beset by a paucity of data, and in some cases, even hypotheses. I wrote back that my to-do list does include a look at **the notion of tipping points** in this context. That expression has become almost boilerplate of late in discussions of climate projections.

But it appears hard to justify, according to several scientists I've talked to of late, including Ken Caldeira at the Carnegie Institution. Thresholds toward big abrupt changes are likely out there, but which transitions are truly like a "one-way door" to a new state?

Efforts to identify real nonlinear thresholds seem mired in uncertainty and incomplete characterization of things like ice-sheet dynamics. Consider this an open call to scientists who have views on the merits, and drawbacks, of this description of the climate system and related arenas.

Here's Dr. Held's note on subtropical changes in the oceans and air:

> I do not see a very close connection between the observations of a poleward expansion of the atmospheric circulation and the (primarily eastward) expansion of low-productivity waters described in Polovina et al. Jorge Sarmiento and his group here at Princeton have discussed this paper and Jorge can give you more details on reservations that he has..., but one bottom line is that 9 years is obviously a very short time for detection of global warming trends. In models at least, this kind of response would be most directly related to increases in stratification due to surface warming, as I understand it, and not directly to the kind of change in atmospheric circulation discussed in Dian's paper.
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> So, while it is tempting to bring together the expansion of atmospheric and oceanic "deserts", I would advise keeping them as separate issues — although I can see how this might be very difficult. I guess I would feel better about this kind of juxtaposition if the expansion of the low-productivity zones described here were primarily poleward.

There is another important angle to the ocean productivity issue that you might consider — there is a very real danger that the satellites that provide climate-research quality observations of this kind will not be available in the near future due to limited budgets and other priorities. Jorge and others here can provide you with more details if you are interested.

I think it would be great if you did focus on the atmospheric poleward expansion and some of its implications in another article. This is a very active area of research at present, and its pretty complicated. On the one hand, models do pretty well at capturing the poleward expansion in the Southern hemisphere but only if they include the effects of the Antarctic ozone hole! (I recall that we discussed the Australian drought as a nice focus for this question once.) In the Northern Hemisphere, the trends seem to be much larger than what our models are suggesting, a familiar theme once again.

Pursuing this last point, it is clear that in the coming few decades we are going to be continually confronted with observations of trends or events of just this type — relatively short records; much larger magnitudes than our models suggest — raising the question of whether, on the one hand, models/theories are underestimating the rapidity of the response or missing something fundamental or, conversely, whether it is internal variability. You can make your own list, I am sure — the retreat of the Arctic ice last summer, Greenland melt, trends in Atlantic hurricanes over the past 20 years, etc. Our models are conservative in the sense that they invariably predict slow steady trends, typically very difficult to observe over, say, a 9-year period, so this question comes up automatically for just about anything that we see that is big and fast. There might be value in a more generic piece focusing on this kind of tension, which is going to be with us for some time — the slow steady responses predicted by current models, the concern that some observations of faster and bigger changes might actually be the greenhouse gas-forced signal and not just internal variability, the patience required before new observations and better theories/models sort things out.