

Climate, energy, and the economy:

A New Theory of Everything

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All illustrations borrowed from the www.

First let me apologize for the “ambitious” title.

- ✱ I was just trying to compete with the physicists.
- ✱ To an outsider, the physics version seems incomplete in the extreme.
- ✱ We get some complex equations that, we are told, explain the actions of subatomic particles.
- ✱ Then we are asked for billions of \$ to find out why standard-candle stars light years away are too bright.
- ✱ We should be worried, but not about that.

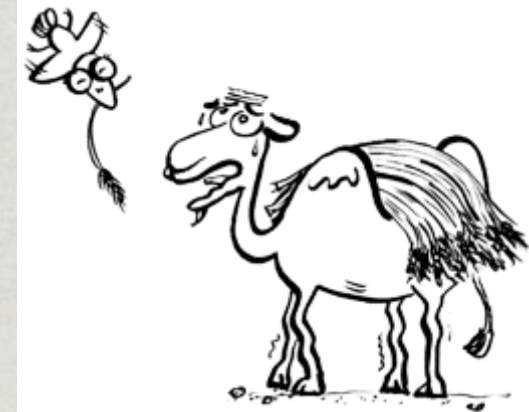
Meanwhile, here on Earth...

Between 1950 and 2000,

(i.e., before China really took off.)

- * Human population has doubled.
- * World economy has grown 700%.
- * Agricultural output has tripled, and now occupies 40% of the Earth's land surface.
- * Water use has tripled and in US exceeds rainfall.
- * Fossil fuel has gone up by 400%.
- * Humans and their animals now represent about 98% of terrestrial, vertebrate biomass.
- * **The planet stayed about the same size.**

What does this have to do with chaos?



Science is (was?) seen as the most reliable source of accurate and reliable knowledge.

What was less stressed was that such knowledge is **always** incomplete. **We didn't talk enough about chaos!**

By emphasizing the profitable aspects of what we knew and ignoring the rest, we have built a society that is very precarious and is much closer to chaotic collapse than we dare admit.

A strong reason for this timidity is that any realistic analysis is likely to destroy the confidence needed to maintain what relative stability we do enjoy. **Don't rock the boat!**

This seems to me to be the perfect chaos conundrum.

Back to those more important worries.

An incomplete list!

- ✱ Existential contradiction: Modern civilization is the child of cheap energy, but if we go on burning carbon, climate will crash, and the resulting lack of food, will produce wars (and CO₂!) that will have drastic effects on the whole planet.
- ✱ Political: Applied psychology has “improved” advertising to the point that Western politics **no longer acts as a stabilizing negative feedback.**
- ✱ If “Growth” cannot be the solution, what can?

And it isn't as though GW is our only problem.

- * 90% of the large fish are gone from the oceans,
- * 98% of the major whales
- * Oceanic absorption of CO₂ seems to be down.
- * <50% of the forest remains, and it's being cut or dying.
- * Fossil fresh water supplies are being exhausted.
- * 40% of planet now used for crops, grazing and housing.
- * Globalsecurity.org lists 36 active conflicts, some 80 yrs old.
- * and the economic system has just collapsed.
- * **Chaos seems to have played a part in all of these.**

Existential cont'd

- ✱ For 30 years, an oversimplified economics has produced not only economic collapse, but also a populace ignorant of the environmental challenges we face, and distrustful of the larger structures in society needed to orchestrate a meaningful response (i.e., a substantial global carbon tax*).
- ✱ Applied psychology in the service of narrow interests has actively abetted this ignorance and distrust.
- ✱ The complexity and “chaos” of the interacting problems we face make “accurate, precise” answers impossible.
- ✱ The caution and “narrowness” that must constrain science is poorly suited to motivating the needed social changes.

*As a barrel of oil contains the energy equivalent of a man working day and night for 3 years, it would be cheap at \$4,000/barrel, but \$100/bl would be a good start.

Some thoughts on how we got into this mess.

GW is about the broadest topic imaginable. It is also new and there are a lot of things we don't understand about it. So we need "university types" to do the unbiased research needed find out what is important and where we stand.

The problem: young university-types are often appointed on the basis of having demonstrated exemplary expertise about some topic.

The need for expertise encourages a narrow focus.

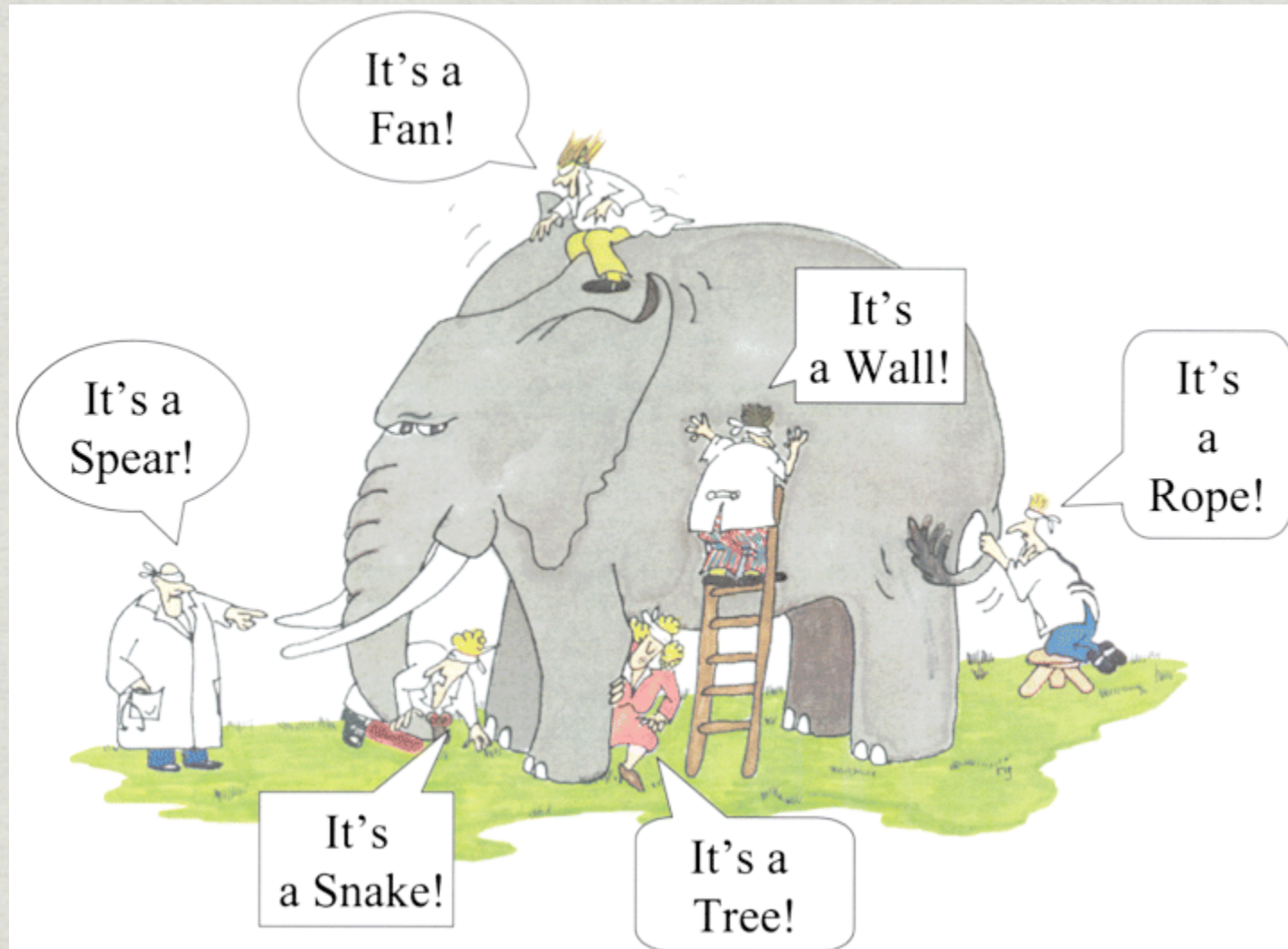
How do we get these "experts" to reach out of their boxes of confidence to confront massive, interacting problems?

As the biggest problem, let's look at climate.

In the beginning...

- ✱ some “weather guys” began to worry that the Keeler plot might be important, but few scientists thought that it would affect what “they” studied. “It’s not my department,” said Wehner von Braun.’ (Tom Lehrer)
- ✱ but at meetings, they found others also getting strange results in diverse fields.
- ✱ Each had thought they were the only ones.

The experts that understand some of the details



can miss the big picture.

Worse yet: What if the parts interact?

Climatologist: Current CO₂ use will cause a 4.3° C rise.

Ecologist: 4.3° will change the plants that can thrive.

Agronomist: Human food comes from plants.

Economist: Find substitutes! Lower taxes!

Sociologist: Starving societies are unstable.

General: Instability must be quelled! Increase military spending.

Bean counter: More for military -> less for mitigation.

Publicist: Can't we just fake it until I retire? Fire the ecologists!

Feedbacks: Dead plants give up CO₂, change albedo...etc.

And ALL of these fields are chaotic:

Climatologist: Who thought that dust could be so important?

Ecologist: Well, I meant 4.3° but with the same rainfall...

Agronomist: If you can make people pay for water, ...

Economist: We often change our theories by 180°.

Sociologist: Birth rates can change. Don't waste food!

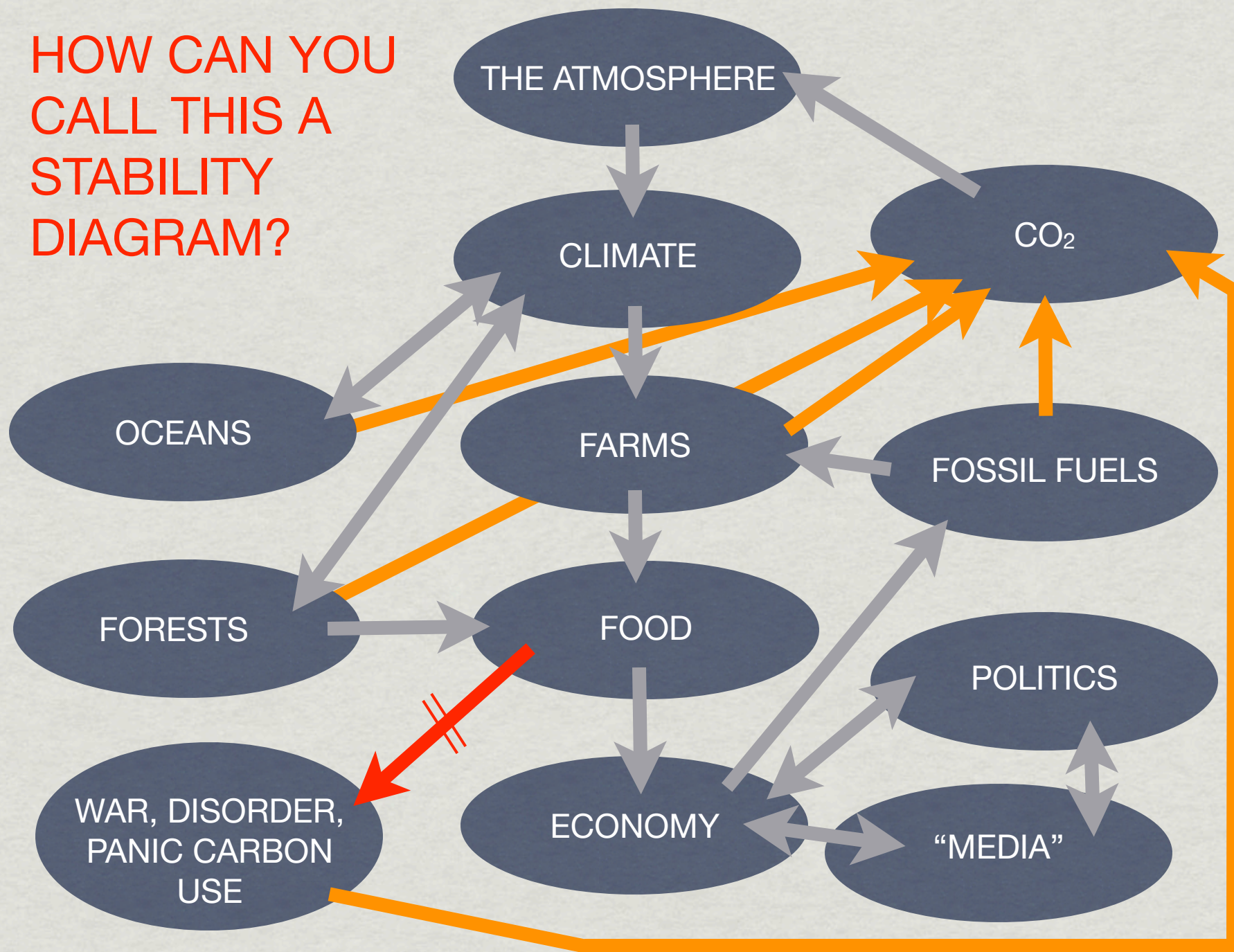
General: Collapsing economies spend more on "defense".

Bean counter: Fewer lobbyists: more critical thinking.

Publicist: We **could try** putting over accurate info instead!

Otherwise, manual labor needed when cheap gas is no more.

HOW CAN YOU CALL THIS A STABILITY DIAGRAM?

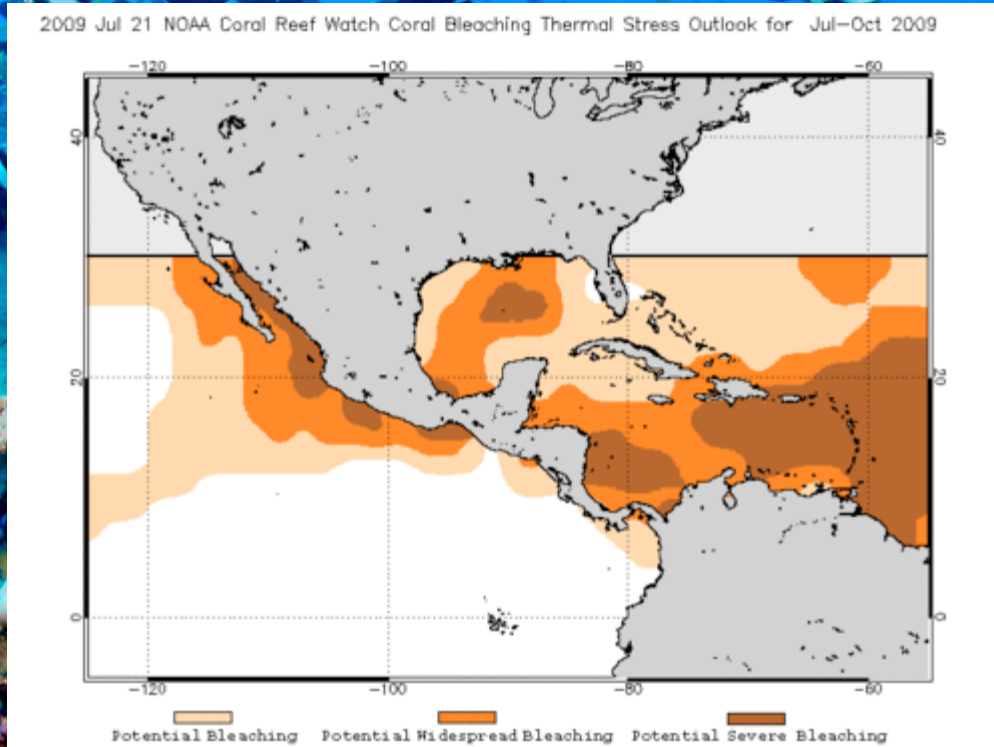


The importance of coral reefs is widely appreciated.

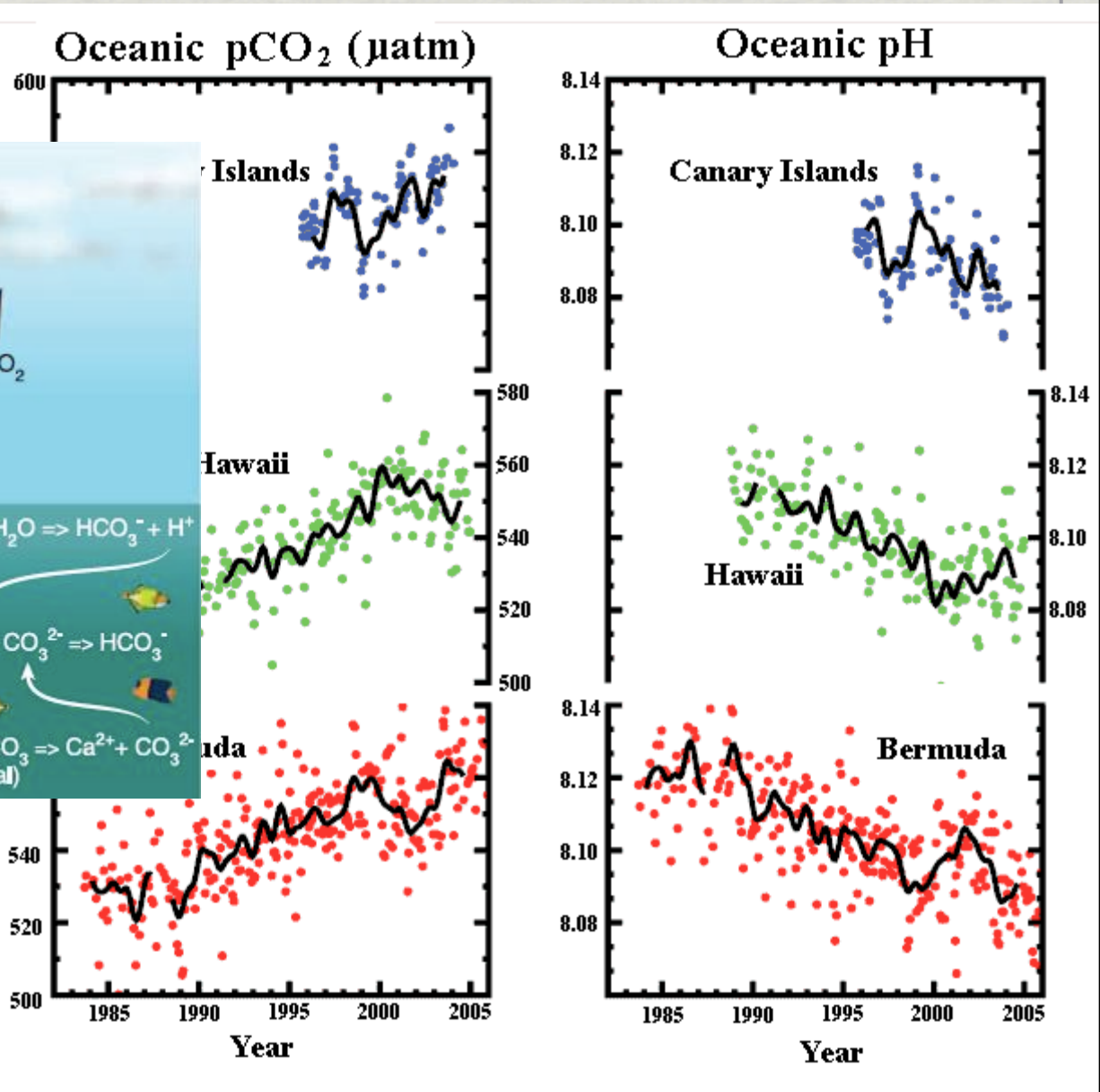
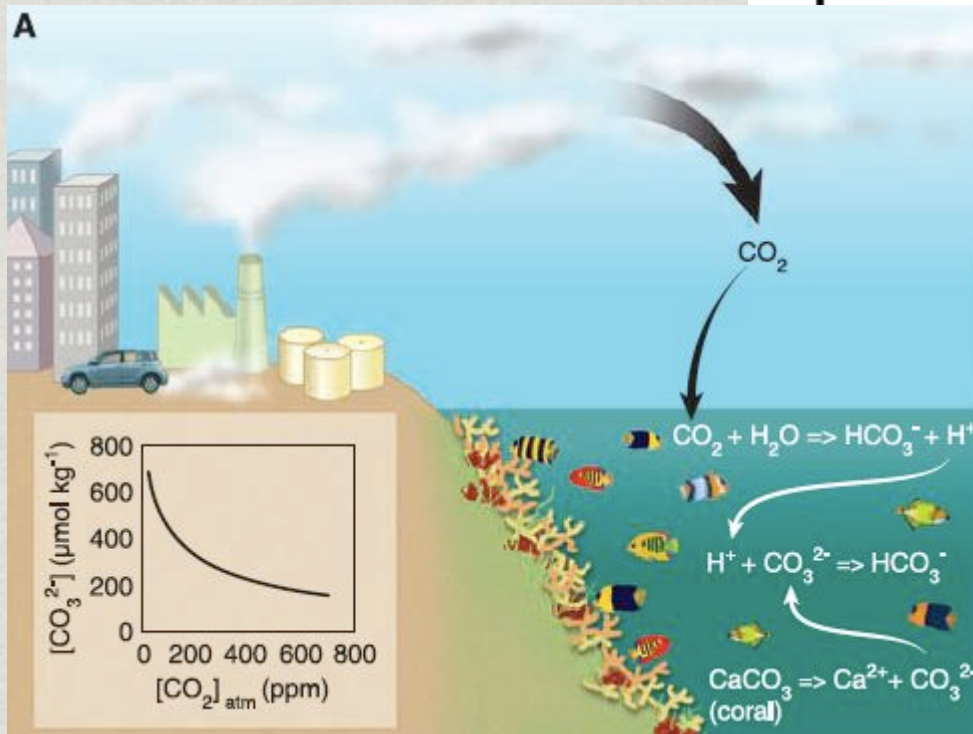
- Warmer ocean surface bleaches coral.



- More CO₂ in the air makes ocean more acidic, hindering the coral growth that otherwise would sequester CO₂.

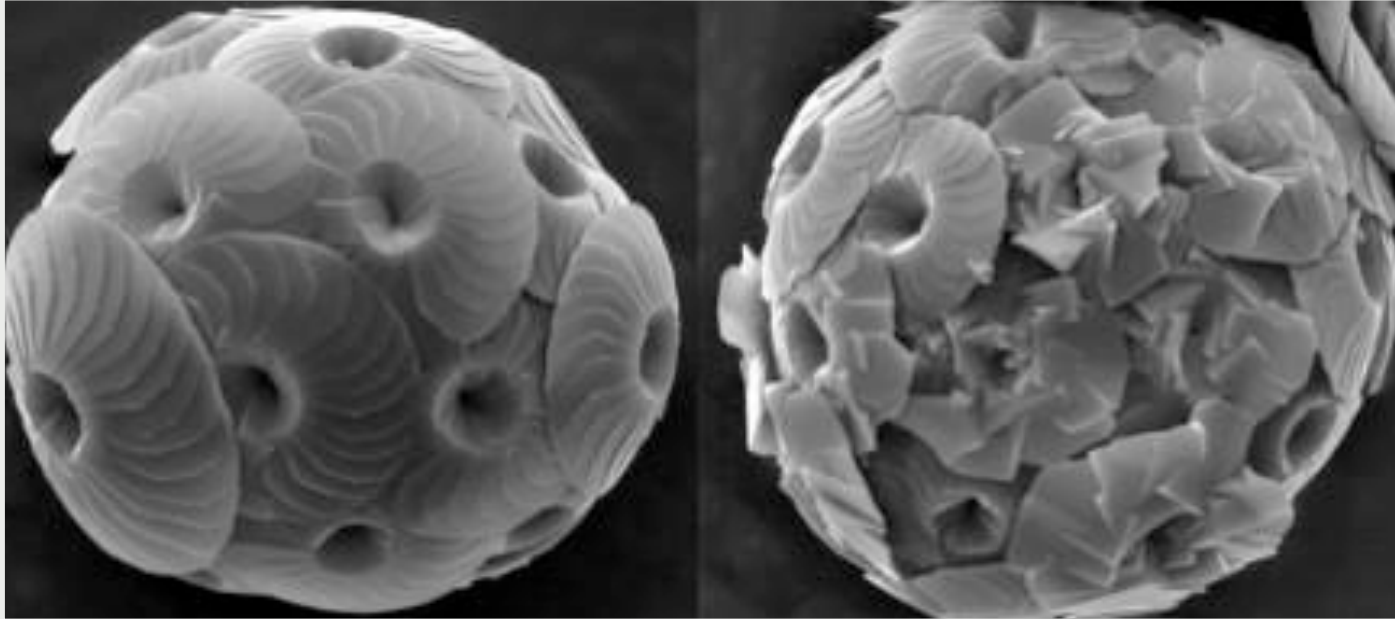


Why does Coke taste acidic?



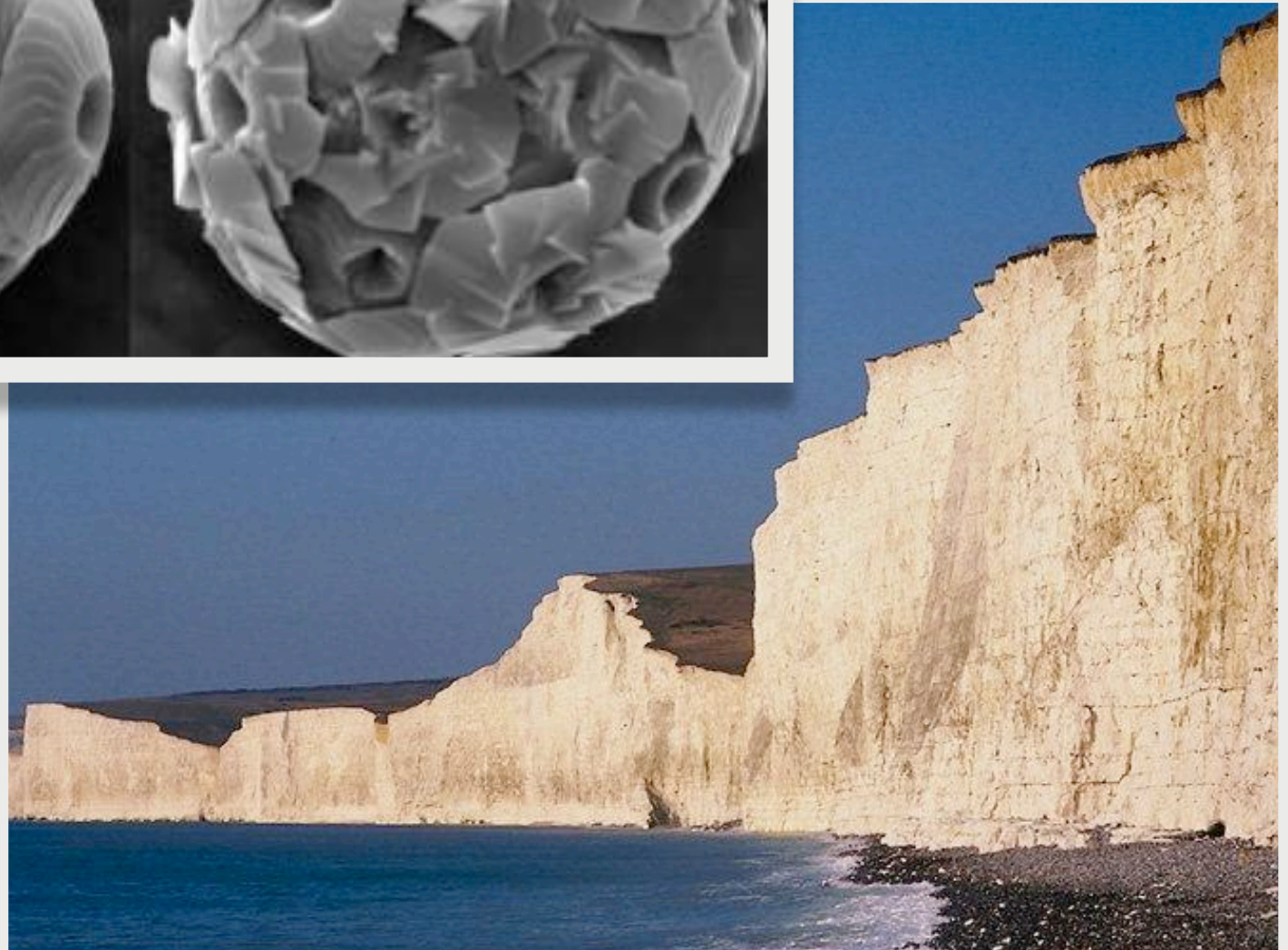
More about acidification

Marine carbonate precipitation today is a biologically controlled process with main contributions by pelagic planktonic organisms (such as coccolithophores, foraminifera, and pteropods).



WHITE CLIFFS OF DOVER

Planktonic calcifiers are particularly significant since they are the main contributors to the export of carbonates from the surface ocean to the sea floor.



Often, you can only identify the keystone when the arch fails.

DAEDEMA ANTILLARUM COLLAPSE...

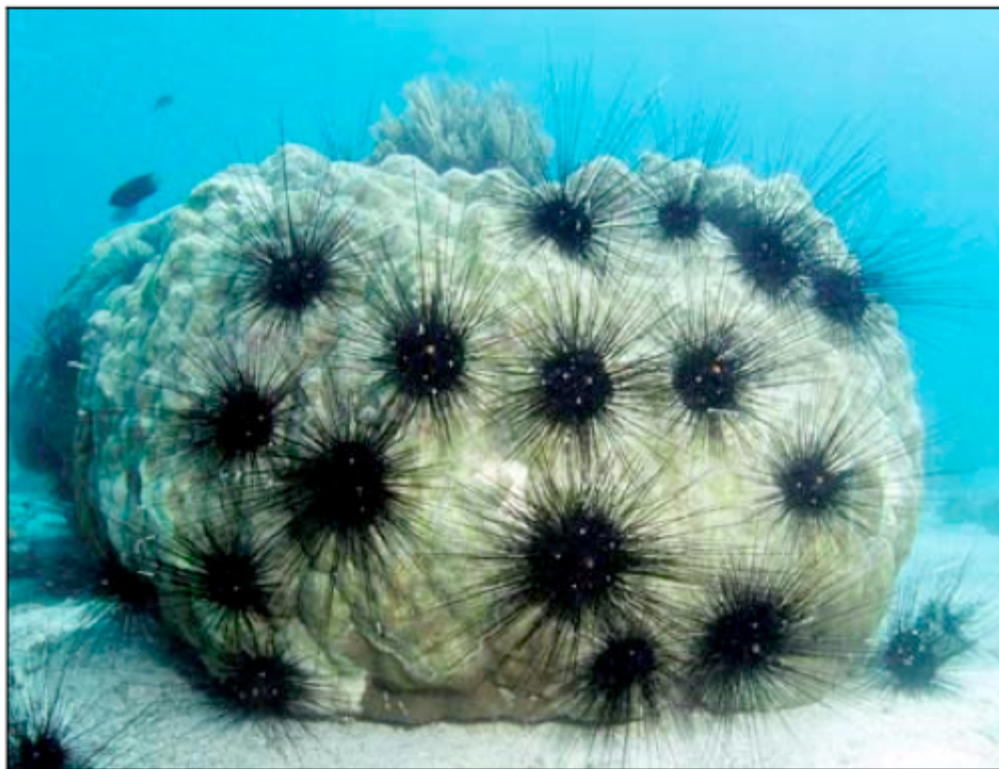
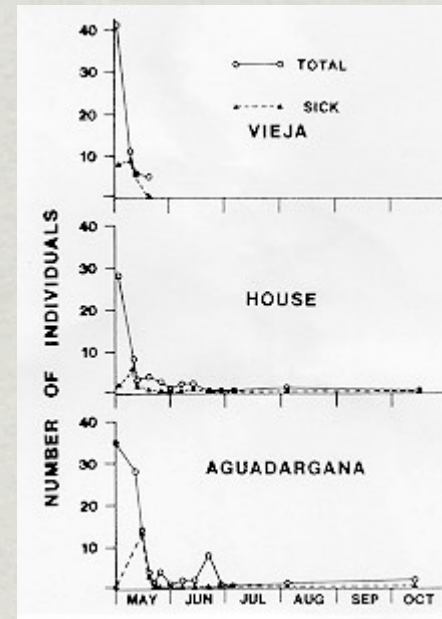
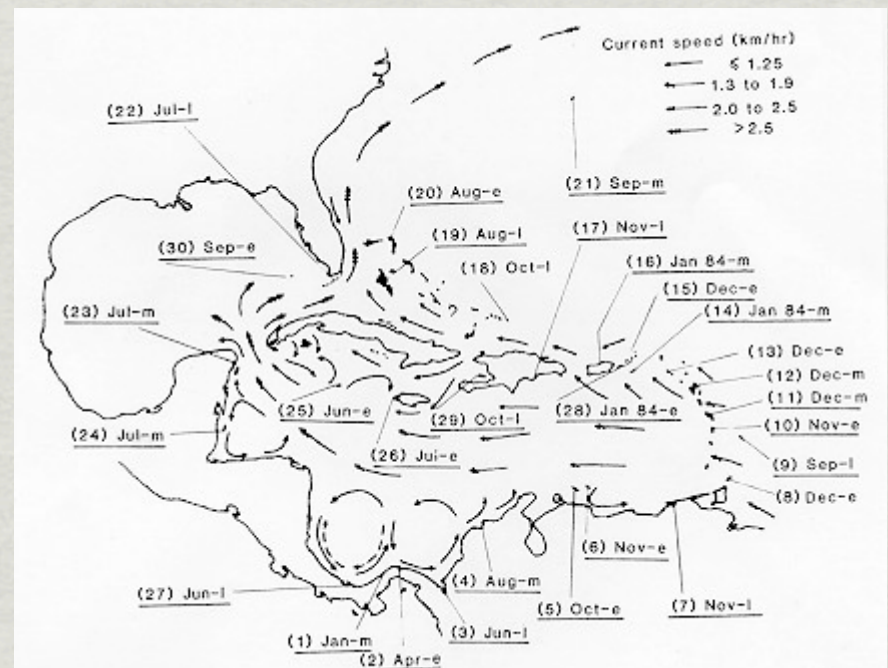


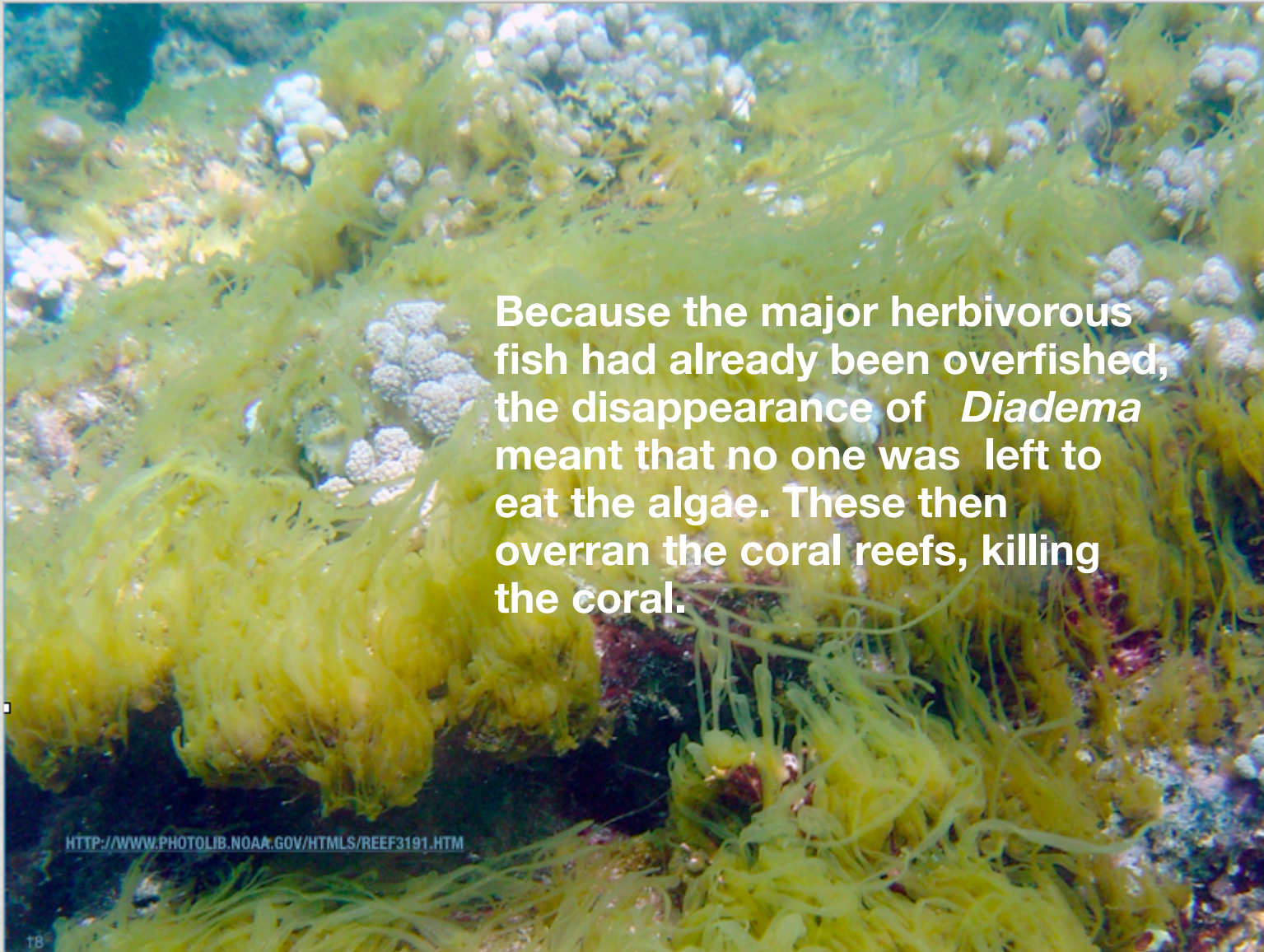
Fig. 2. Sea urchins feeding on coral (photo by Lokrantz).

[HTTP://WWW.SALUBRIO.COM/MIKE/THESIS/CHAP4.HTML](http://www.salubrio.com/mike/thesis/chap4.html)



mass mortality through two major study sites in Panamá



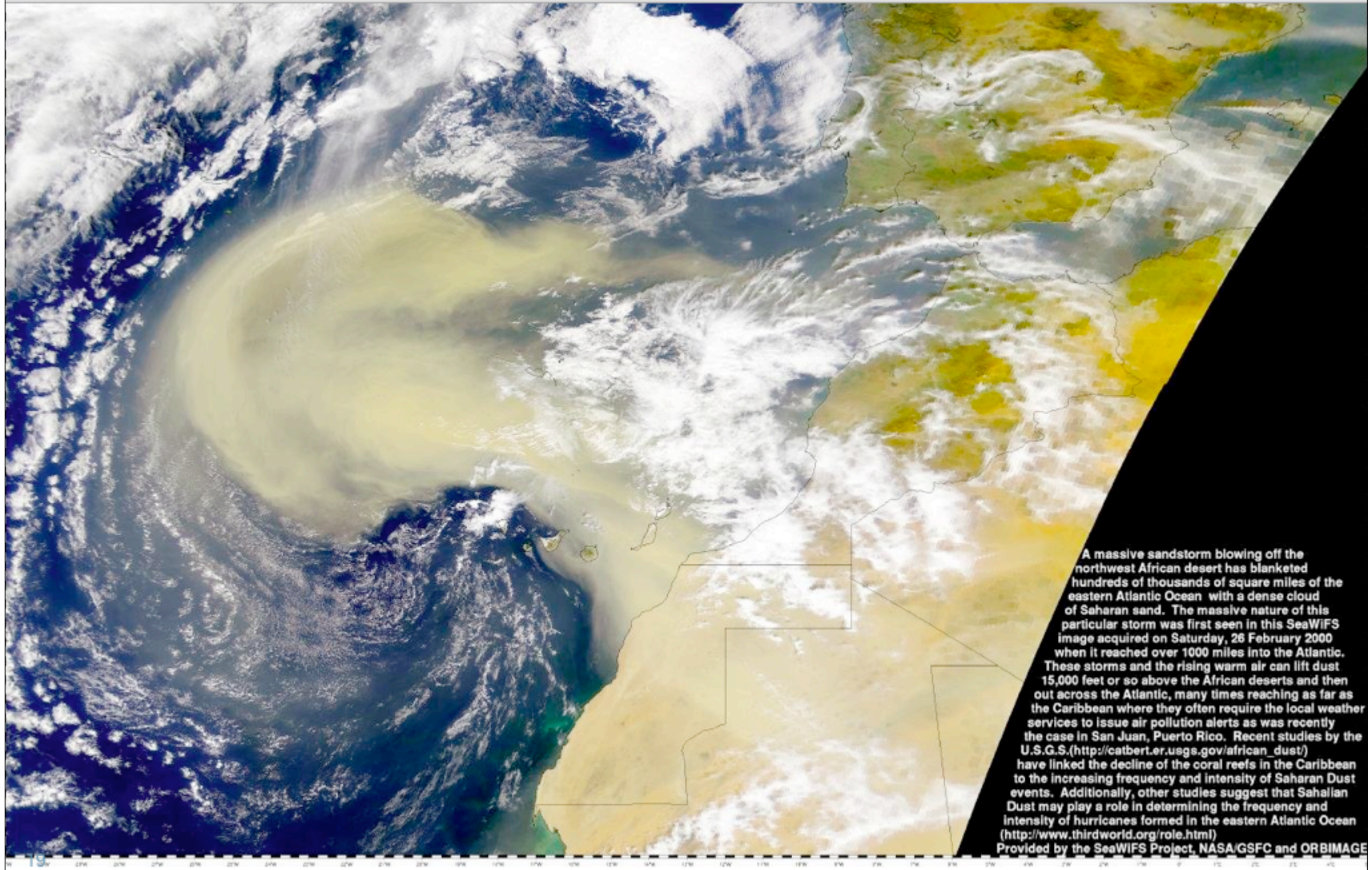


Because the major herbivorous fish had already been overfished, the disappearance of *Diadema* meant that no one was left to eat the algae. These then overran the coral reefs, killing the coral.

[HTTP://WWW.PHOTOLIB.NOAA.GOV/HTMLS/REEF3191.HTM](http://www.photolib.noaa.gov/htmls/reef3191.htm)

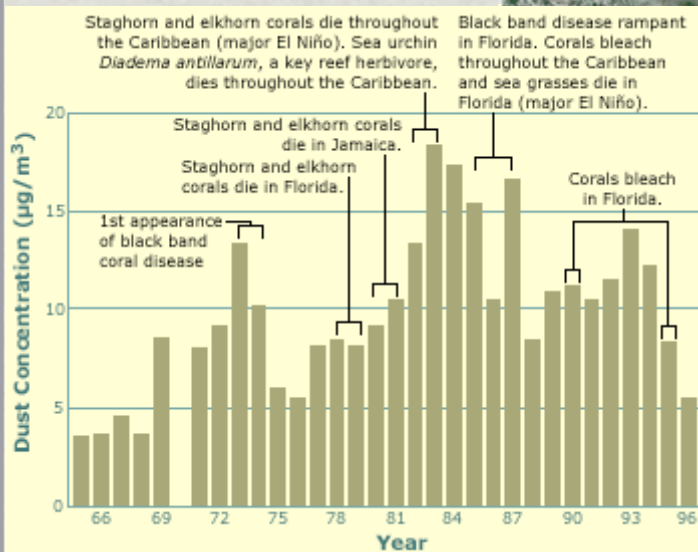
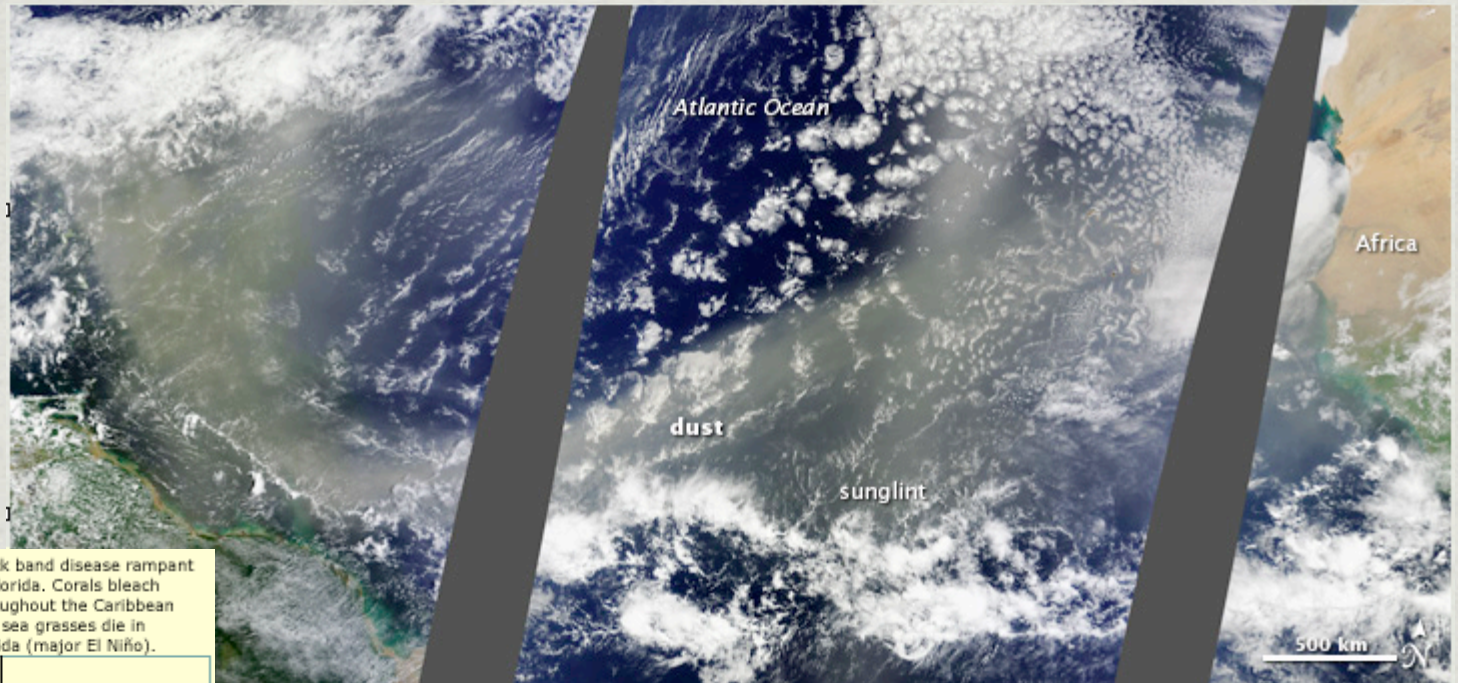
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which in turn had a strange “climate” connection.



A massive sandstorm blowing off the northwest African desert has blanketed hundreds of thousands of square miles of the eastern Atlantic Ocean with a dense cloud of Saharan sand. The massive nature of this particular storm was first seen in this SeaWiFS image acquired on Saturday, 26 February 2000 when it reached over 1000 miles into the Atlantic. These storms and the rising warm air can lift dust 15,000 feet or so above the African deserts and then out across the Atlantic, many times reaching as far as the Caribbean where they often require the local weather services to issue air pollution alerts as was recently the case in San Juan, Puerto Rico. Recent studies by the U.S.G.S. (http://catbert.er.usgs.gov/african_dust/) have linked the decline of the coral reefs in the Caribbean to the increasing frequency and intensity of Saharan Dust events. Additionally, other studies suggest that Sahalian Dust may play a role in determining the frequency and intensity of hurricanes formed in the eastern Atlantic Ocean (<http://www.thirdworld.org/role.html>)
Provided by the SeaWiFS Project, NASA/GSFC and ORBIMAGE

It seems that the disease that killed *Diadema* may have come from far away.



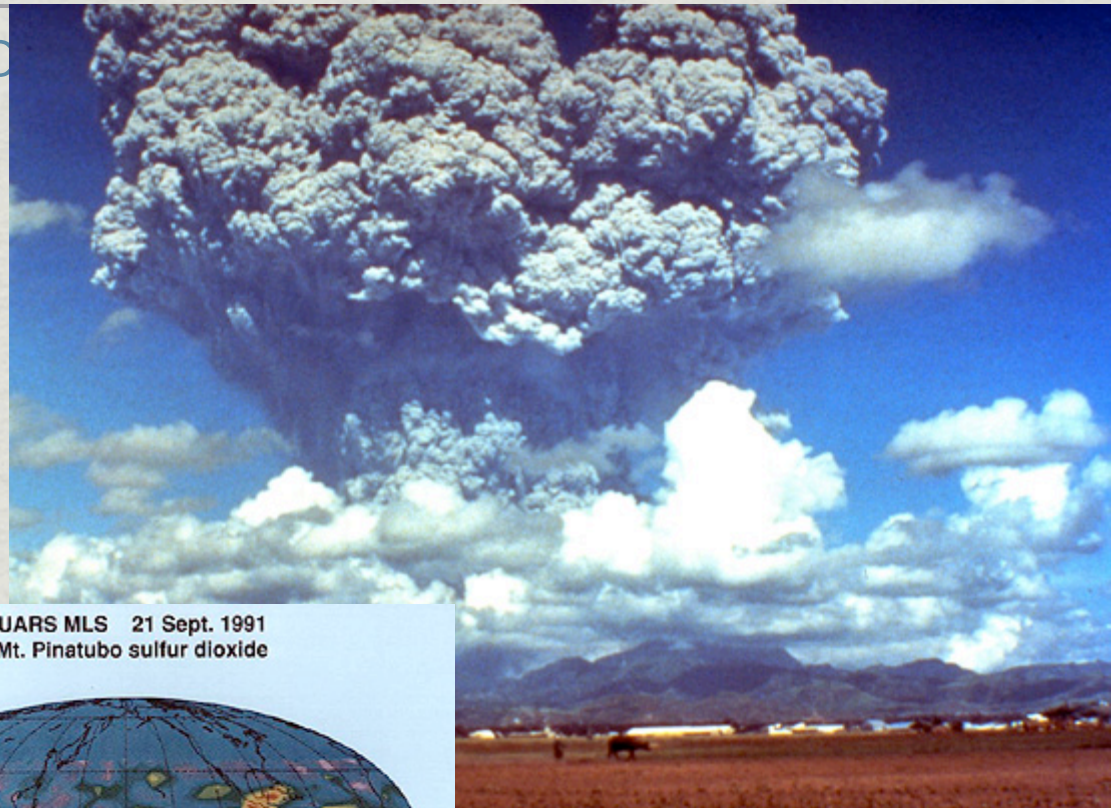
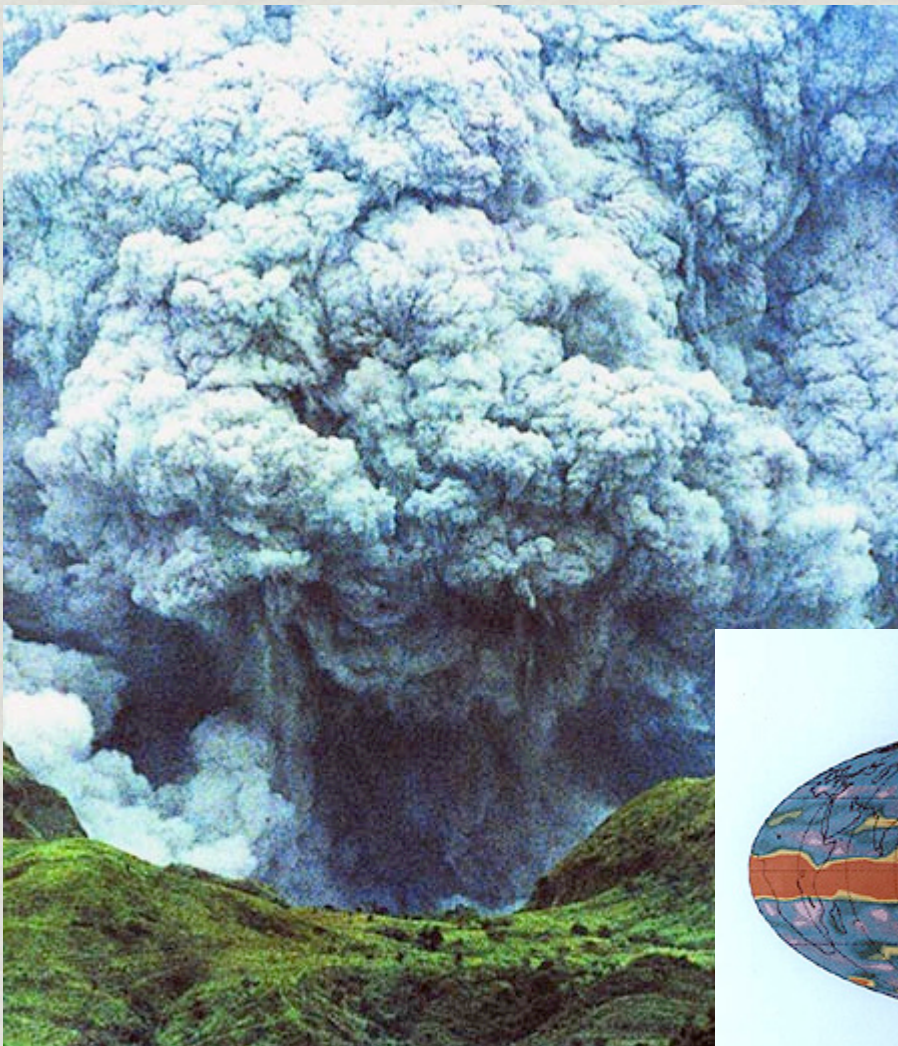
**Talk about being
“...sensitive to
initial conditions”!!!**

"We typically isolate about two colonies of fungi from clear air samples, whereas we might recover 20 to 40 isolates of fungi and bacteria from samples taken during dust events," said Griffin. Griffin's studies also show the presence of viruses in the dust, ...

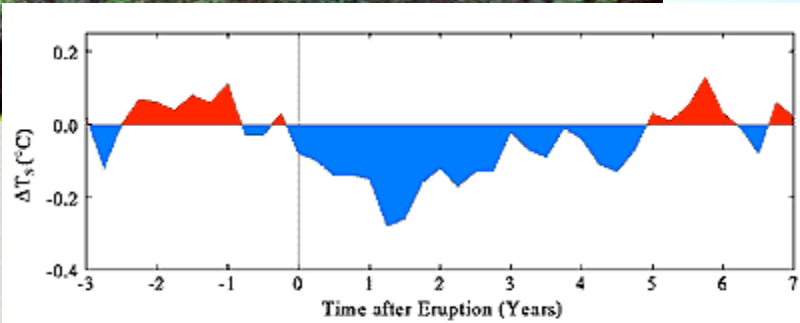
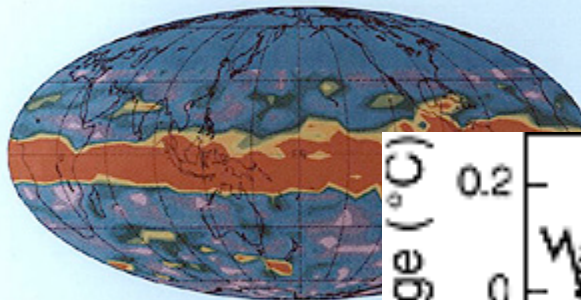
So far, Griffin and team member Christina Kellogg have cultivated over 130 bacteria and fungi isolates, most of which came from samples collected during Caribbean dust events that occurred in 2000...

Smith and colleagues isolated *Aspergillus sydowii* from the dust samples and inoculated healthy sea fans with the culture, achieving a 50 percent positive reaction."

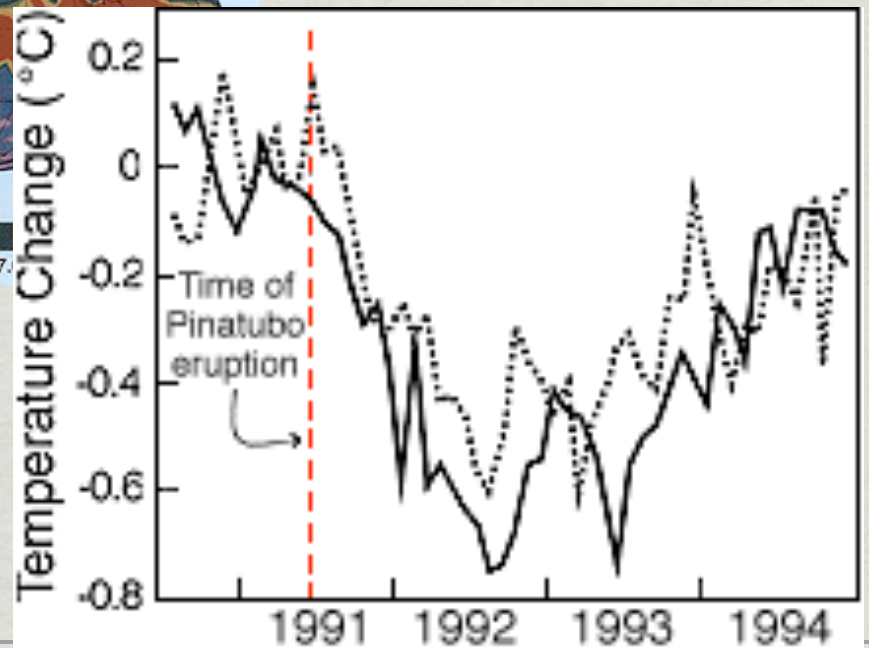
[HTTP://EARTH OBSERVATORY.NASA.GOV/FEATURES/DUST/](http://earthobservatory.nasa.gov/features/dust/)



UARS MLS 21 Sept. 1991
Mt. Pinatubo sulfur dioxide



Composite global surface temperature change near the time of the five volcanos producing the greatest optical depths since 1880: Krakatau (1883), Santa Maria (1902), Agung (1963), El Chichon (1982) and Pinatubo (1991).



Some arrive with the best of intentions..

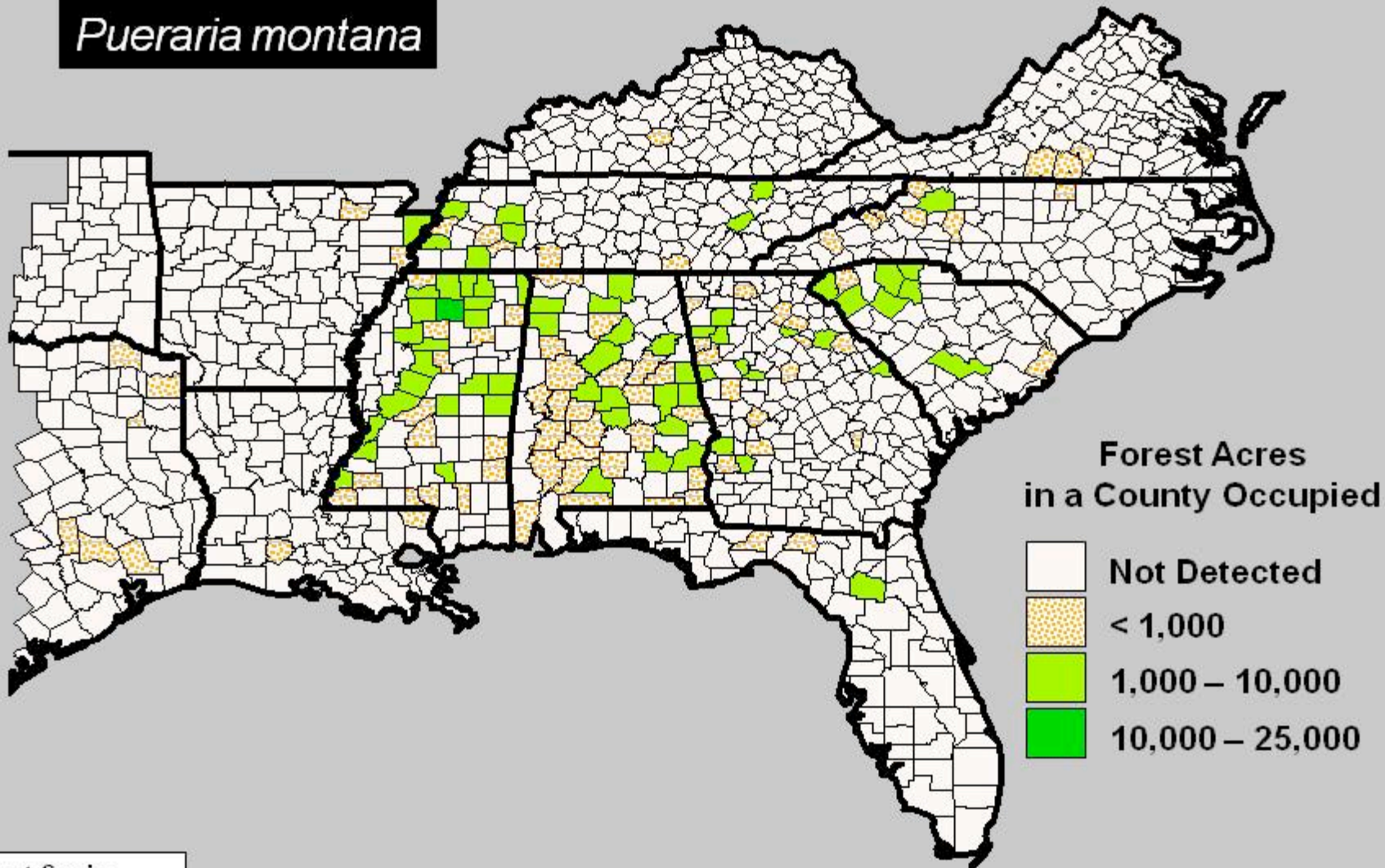
Kudzu was introduced from Japan into the [United States](#) in 1876 for forage and to stabilize aqueduct margins.

It is now common throughout most of the southeastern United States and has been spreading at the rate of 150,000 acres (61,000 ha) annually.



Kudzu

Pueraria montana



USDA Forest Service
SRS FIA database March 2008
Miller and Chambliss, Auburn

While others result from sloppiness..

Z is for Zebra mussels



First detected in the [Great Lakes](#) in 1988, the cost of protecting power plants etc. is now \$500 million a year.

