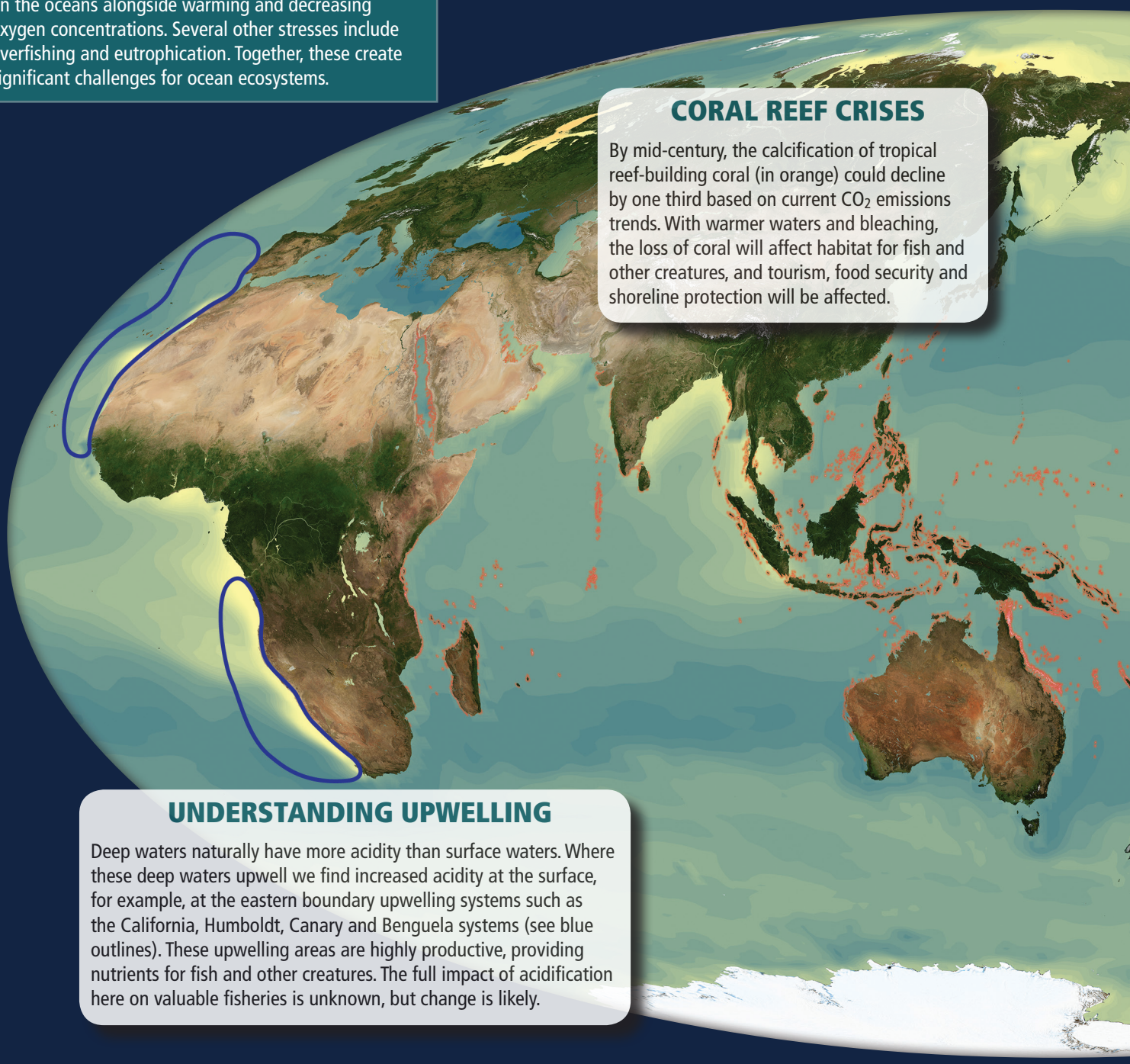
"HOT, SOUR & BREATHLESS"

Ocean acidification is one of the big three stressors on the oceans alongside warming and decreasing oxygen concentrations. Several other stresses include overfishing and eutrophication. Together, these create significant challenges for ocean ecosystems.



CORAL REEF CRISES

By mid-century, the calcification of tropical reef-building coral (in orange) could decline by one third based on current CO_2 emissions trends. With warmer waters and bleaching, the loss of coral will affect habitat for fish and other creatures, and tourism, food security and shoreline protection will be affected.

UNDERSTANDING UPWELLING

Deep waters naturally have more acidity than surface waters. Where these deep waters upwell we find increased acidity at the surface, for example, at the eastern boundary upwelling systems such as the California, Humboldt, Canary and Benguela systems (see blue outlines). These upwelling areas are highly productive, providing nutrients for fish and other creatures. The full impact of acidification here on valuable fisheries is unknown, but change is likely.

FACTS

- Without a doubt, the pH of the world's ocean is falling as a result of human CO_2 emissions to the atmosphere. To date, acidity has increased by 30%.
- Ocean acidification is caused by carbon dioxide gas (CO_2). The ocean absorbs about a quarter of the CO_2 added to the atmosphere from human activities each year. Ocean storage of CO_2 greatly reduces the impact of this greenhouse gas on climate.
- When CO_2 gas dissolves in seawater, carbonic acid is formed, changing the chemical composition of the ocean: ocean acidification. The current rate of change is unprecedented in the past 300 million years.
- As the ocean becomes warmer and its acidity increases, its capacity to absorb CO_2 from the atmosphere decreases.
- We do not fully understand the biogeochemical feedbacks to the climate system that may arise from ocean acidification.
- The impact of these changes on marine ecosystems is also not fully understood. However, earlier in Earth's history, a rapid shift in ocean acidification has been linked to mass extinction of species in the oceans.

POLAR PROBLEMS

The Arctic Ocean is acidifying and warming faster than the global average. Sea ice extent and thickness are falling. Within decades, large parts of both polar oceans are predicted to become corrosive to shells of marine organisms. This will affect ecosystems and people who depend on them.

SHELLFISH SETBACK

Molluscs such as mussels and oysters are economically valuable but highly sensitive to ocean acidification. Some shellfisheries already have had to adapt to higher acidity levels that are a result of natural and human causes.

SPECIES SHIFTS

Ocean chemistry may be changing too rapidly for many species or populations to adapt through evolution. As parts of the food chain disappear or move, species could shift in numbers and distribution. Some organisms might tolerate higher CO_2 in the water, and others, such as some seagrasses, may even thrive.

Upwelling

Coral reefs

pH

Year 1850

7.1 7.7 8.3

1850

ACIDIFYING WATERS

In 1850, average ocean pH was about 8.2 (small map). According to models based on business-as-usual scenarios, with no action taken to decrease carbon emissions, average ocean pH will drop to about 7.8 by 2100 (large map).

This map and other information will be reported in an upcoming summary for policymakers from IGBP and its partners.

MAPS: Félix Pharand-Deschênes, Globaia; pH DATA: Tatiana Ilyina, Max Planck Institute for Meteorology; INFORMATION: IGBP/SCOR/IOC Summary for policymakers on ocean acidification (2013)