UNDERSTANDING OUR OCEANS: THE CLIMATE ENGINE

By **Dr. Dawn Wright**, Chief Scientist, Esri

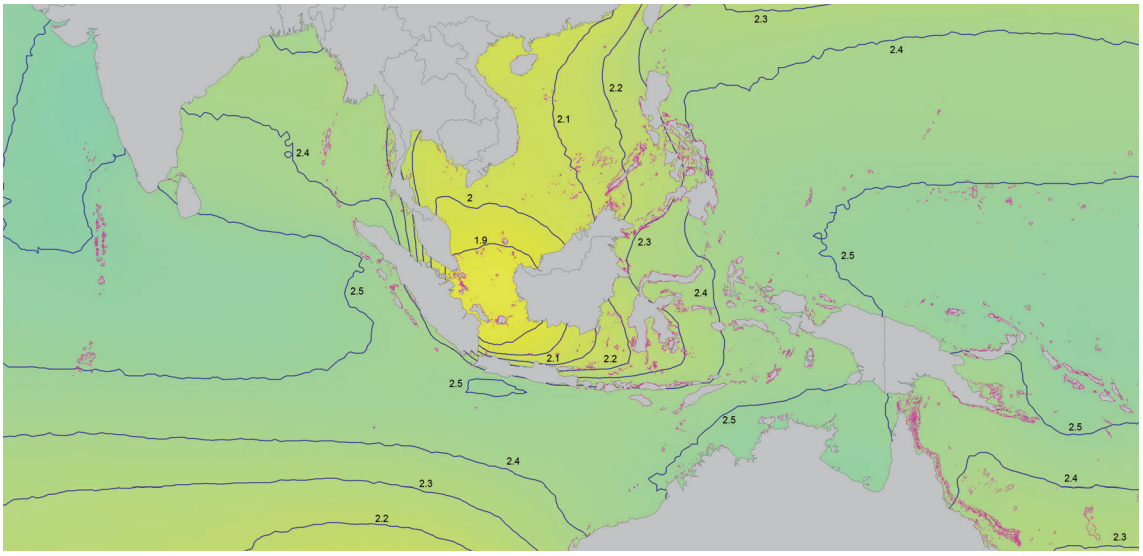
On a planet where 71 percent of the surface is covered by water, the oceans are critical for life itself. They feed us, regulate our weather patterns, provide over half the oxygen that we breathe, and contribute to our energy and economy. And in a world where climate, oceans, and people are tightly linked, we must understand the oceans before we can address the issues of climate change.

A number of ocean factors are critical to climate change, including rising sea surface temperatures, coastal storms, and the harmful impact of ocean acidification which limits the calcification and growth of coral reefs. We need a deeper understanding of how oceans and climate are interrelated; vulnerable coastal communities need to design adaption strategies; and comprehensive risk assessment models need to be developed.

Indeed, ocean scientists are still trying to understand exactly how the ocean modulates Earth's climate, and conversely how climate change affects ocean circulation, the distribution of heat, ocean ecosystems, and sea level rise, how changes in ocean temperature and CO2 concentration will affect the rate of ocean acidification, and so forth. A huge question is: how do we predict the outcomes and impact of climate change, then adapt and mitigate accordingly?

Geographic information systems (GIS) technology, which has long provided effective solutions to the integration, visualization, and analysis of information about land, is now being similarly applied to oceans. Our ability to measure change in the oceans (including open ocean, nearshore, and coast) is increasing, not only because of improved measuring devices and scientific techniques, but also because new GIS technology is aiding us in better understanding this dynamic environment. This domain has progressed from applications that merely collect and display data to complex simulation, modeling, and the development of new research methods and concepts.

A myriad of challenges related to climate change, exploration, ecosystems, and energy face the marine science community. Confronting all these challenges requires a broad, interdisciplinary approach. As a company with the mission to inspire and enable people to positively impact their future through a deeper, geographic understanding of the changing world around them, Esri recognizes that this understanding must involve a strong commitment to the oceans; and that's why Esri recently launched a major Ocean GIS Initiative.



Global Climate Models show how a doubling of atmospheric CO_2 pushes Aragonite below 3.0, marginalizing this essential building block for coral reefs

> "GIS plays a critical role in consolidating and managing the increased flow of ocean data and creating the visualizations to aid ocean industries in the safe and responsible use of the oceans. Expanded information from ocean users will help improve the modeling and predictability of weather, ocean conditions, and climate change, and will support responsible use of ocean space and resources – with clear benefits for science, government, society, and business."
> *– Paul Holthus, Founding Executive Director, World Ocean Council*

CALL TO ACTION

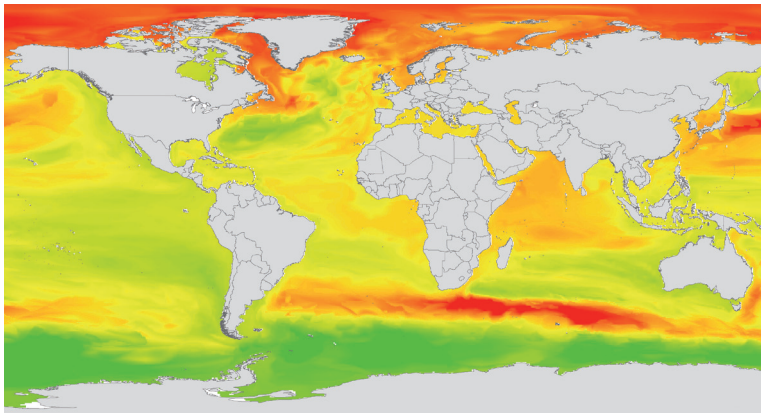
The Ocean GIS Initiative has been motivated in great part by the need to provide effective mapping tools and techniques to respond to recent disasters such as the Deepwater Horizon oil spill in the Gulf of Mexico and the Tohoku-Oki earthquake and tsunami in Japan. It is also motivated by a sincere desire to assist in the implementation of the US National Ocean Policy, particularly in the area of coastal and marine spatial planning (CMSP), in which adaptation to climate change is a critical ingredient, and for which GIS provides a crucial decision-support engine.

As part of this initiative, Esri is pursuing a greater engagement with the ocean science community, as complex ocean science questions and data increasingly inform the responsible use and governance of the oceans, as well as effective management and conservation.

I invite you to explore more details of what Esri is doing and how we can work together by reading our free e-book, "The Ocean GIS Initiative". ■

READ THE FREE E-BOOK:

This free e-book details Esri's Ocean GIS Initiative, including our commitment to and strategic plans for ocean science, resource management, and conservation.
http://www.esri.com/library/ebooks/ocean-gis-initiative.pdf



Local sea level rise: different rates of thermal expansion cause spatial variation from 0.35m to 1.35m, as projected for 2100 by 13 Global Climate Models.

OCEAN GIS RESOURCES

- "Our Reefs at Risk" Story Map
  http://esriurl.com/5099
- University Cooperation for Atmospheric Research/National Center for Atmospheric Research Resources
  http://gisclimatechange.ucar.edu
  http://serc.carleton.edu/eet/ncardatagis/index.html
- Woods Hole Research Center: An Arctic Solution to Global Warming
  http://www.whrc.org/ecosystem/highlatitude/siberian_solution.html
- NOAA Coastal Services Center
  http://www.csc.noaa.gov/climate/
- Esri Oceans Basemap
  www.esri.com/oceanbasemap
- SimCLIM: GIS for Climate Change Adaptation and Risk Assessments
  http://www.climsystems.com/about/activities/News%20Release_GeoSpatial_News.pdf

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Dr. Dawn Wright is Esri's chief scientist, where she helps to formulate and advance the agenda for the environmental, climate, and ocean sciences aspects of GIS.

Dawn Wright, Ph.D., GISP, Esri Chief Scientist, Esri
380 New York Street
Redlands, CA
92373, USA
Tel: 909-793-2853, ext. 2182
Email: dwright@esri.com
Website: esri.com/oceans
Twitter: @deepseadawn
LinkedIn: Dawn Wright