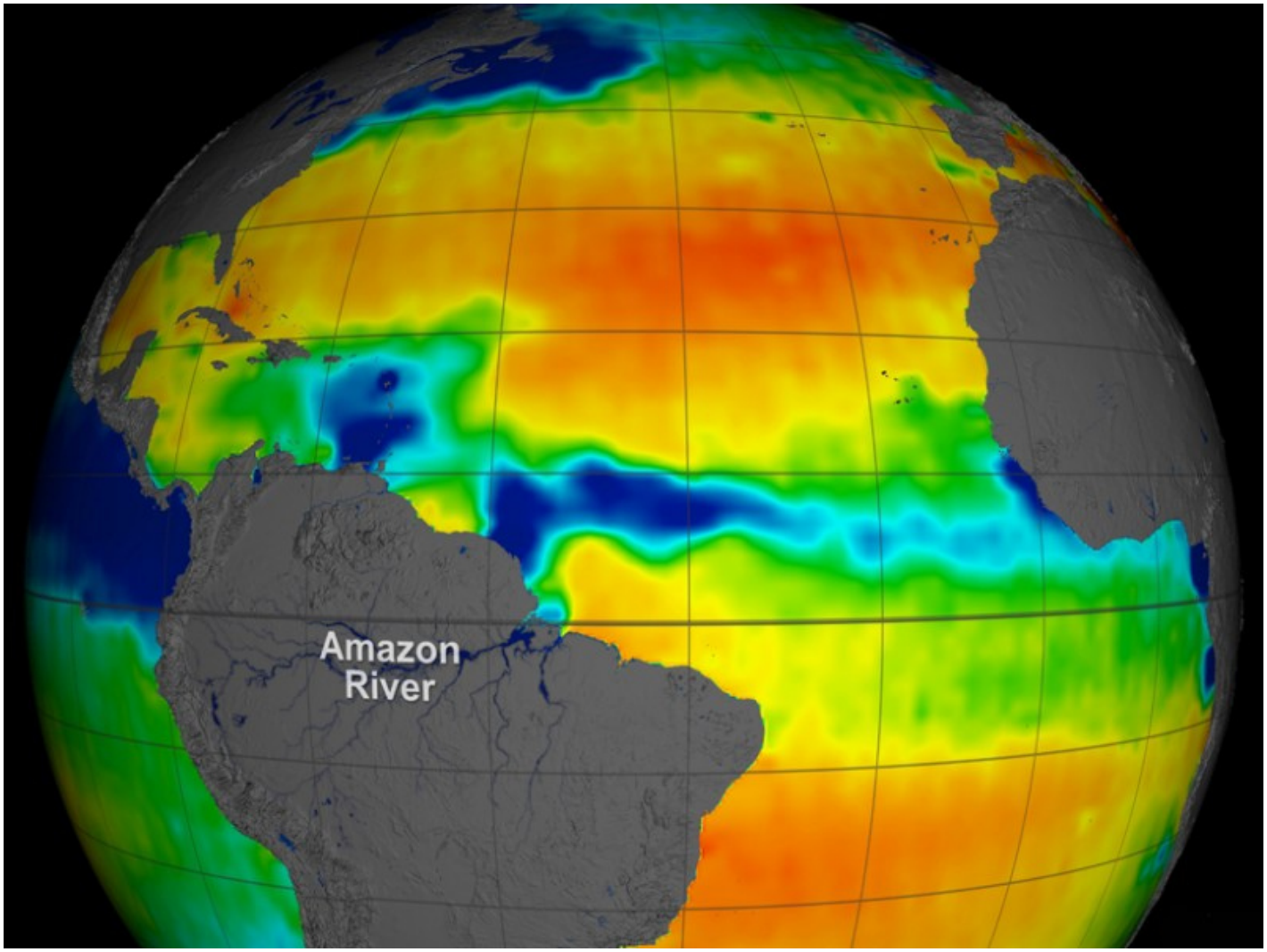
Salinity Monitoring Gives Insight into the Global Water Cycle

Salinity and Water Cycle over the Oceans: Recent Progress and Future Challenges; Hamburg, Germany, 12–15 October 2015



Data from NASA's Aquarius instrument reveal seasonal changes in the Amazon River's plume. (This map shows conditions on 27 February 2013. Red indicates high salinity, and blue indicates low salinity.) Depending on the prevailing currents, the river's freshwater outflow heads east toward Africa or bends north toward the Caribbean. Salinity variations are one of the main drivers of ocean circulation. Credit: NASA Goddard Space Flight Center, CC BY 2.0

By Detlef Stammer 11 April 2016

The global water cycle is one of the fundamental elements of the Earth's climate system, involving the exchange of freshwater within the entire ocean-land-atmosphere system. Predicting changes in this cycle over the next decades and beyond provides critical information to societies for making decisions on water management, agriculture, and other factors.

The ocean is the world's largest reservoir of water, providing more than 75% of Earth's evaporated and precipitated water. Thus, to successfully predict the future of the global water cycle, we need to understand the changes in transport of freshwater in the ocean. Studying these changes requires investigating changes in salinity, the primary indicator of regional changes of freshwater in the ocean.

A workshop (https://for1740.zmaw.de/Salinity-and-Freshwater-Changes-in-the-Ocean-Con.3078.0.html) held at the Center for Earth System Research and Sustainability (Universität Hamburg, Germany) reviewed recent progress on salinity and freshwater research and included discussions of problems that must be solved to improve our understanding of future changes in the water cycle.

Innovations in the salinity observing system recently began providing near-instantaneous snapshots of the global salinity field.
The workshop brought together nearly 100 scientists from around the world. Their results emphasized the importance of salinity changes to changes in the density field of the ocean, which influences a wide range of processes affecting ocean dynamics, including sea level height, interocean water exchange, propagation of planetary and tropical instability waves, and mesoscale variability in ocean fronts and eddies.

At the workshop, advances in understanding the ocean's water cycle, made possible by innovations in the salinity observing system that recently began providing near-instantaneous snapshots of the global salinity field, were reported. These advances include the near-global three-dimensional sampling by the Argo array (http://www.argo.ucsd.edu/) of temperature and salinity profiling floats and spaceborne measurements of sea surface salinity using the European Space Agency's Soil Moisture and Ocean Salinity (http://www.esa.int/Our_Activities/Observing_the_Earth/SMOS/Mapping_moisture) (SMOS) spacecraft and NASA's Aquarius (http://aquarius.nasa.gov/) mission aboard the Argentine SAC-D spacecraft (which ceased operations in June 2015).

A major recommendation of the workshop is to maintain data streams from surface and satellite observing systems. This includes maintaining the Argo array, continuing salinity satellite missions, and, especially, expanding satellite constellations to observe the entire global hydrological cycle, including processes over the ocean, in the cryosphere, on land, and in the atmosphere.

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Existing observations of salinity changes provide strong evidence for changes in the ocean water cycle over recent decades. Climate projections suggest that those changes will further amplify in a warming world. The next challenge is to reconcile available information over land and over the ocean and to strengthen the link between efforts concerning the oceanic and terrestrial components of the global hydrological cycle. Providing better estimates of precipitation over the ocean is a step in this direction.

This workshop was sponsored by the Deutsche Forschungsgemeinschaft–funded research effort FOR1740 on salinity changes and by the European Space Agency, NASA, and the National Oceanic and Atmospheric Administration. It was endorsed by Climate and Ocean: Variability, Predictability and Change (CLIVAR), US CLIVAR, and the Global Energy and Water Cycle Exchanges Project (GEWEX).

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