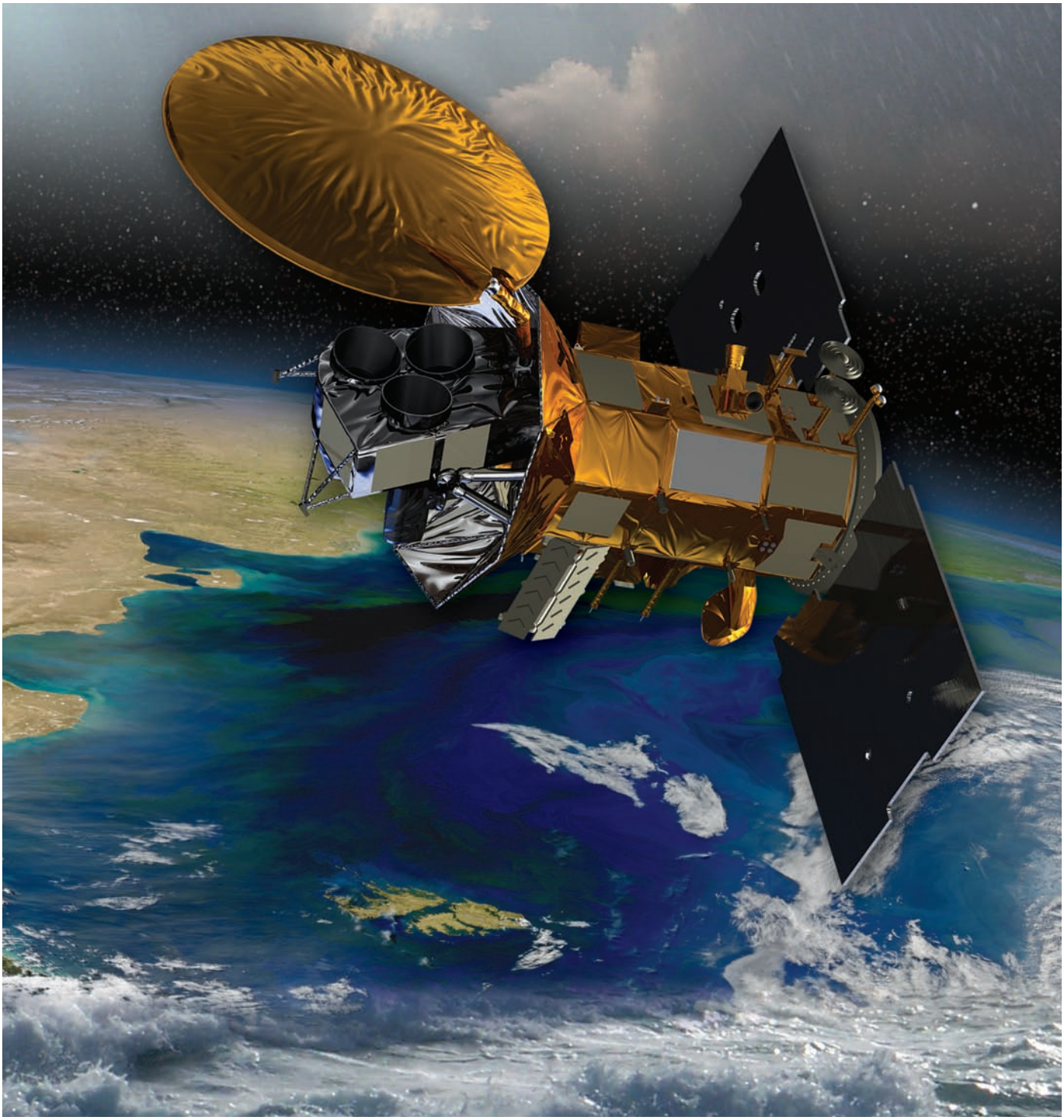
National Aeronautics and Space Administration



AQUARIUS/SAC-D MISSION
Sea Surface Salinity from Space

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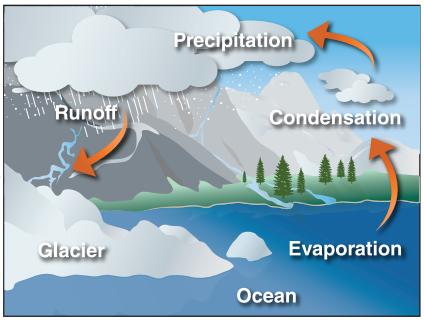
When we think of salt, we usually think of how it affects our everyday lives—how we use it to add flavor to our food, or to keep our sidewalks free of ice in the winter. But the amount of salt in our natural environment impacts us on much longer time scales, through its important role in Earth's climate. The concentration of salt in the ocean, called "salinity," is a key variable for understanding global ocean circulation and the movement of freshwater in the ocean.

The Water Cycle



Credit: Modified from Earth Observatory

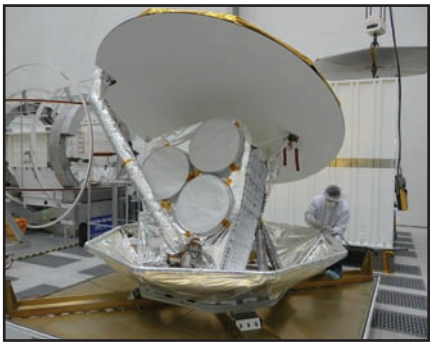
Some of the components of the water cycle

In Earth's "water cycle," water circulates from the ocean to the atmosphere to the land and back again to the ocean. Water moves as a gas (water vapor), liquid (rain), and solid (snow and ice) through the cycle. Evaporation at the sea surface releases energy into the atmosphere as water vapor and, over time, water returns to the ocean through rain or snow. Exchanges between the ocean and atmosphere are a main part of the cycle. In fact, 86 percent of global evaporation and 78 percent of global precipitation occur over the ocean.

Changes in the water cycle manifest themselves as increases or decreases in ocean salinity. The evaporation and freezing of seawater both increase salinity, while runoff from rivers, precipitation in the form of rain and snow, and the melting of ice decrease salinity. These changes in salinity may seem small when you consider the size of the ocean, but they are influential in how water circulates through it. To understand this, scientists need something they don't have: accurate maps of salinity that show how this parameter changes over time.

Aquarius/SAC-D

Aquarius/SAC-D is a pathfinder mission that will provide an observation of salinity at the ocean surface to improve ocean and climate studies. Scheduled for launch in 2011, the mission is a partnership between NASA and Argentina's space agency, Comisión Nacional de Actividades Espaciales (CONAE). The Argentine-built spacecraft, SAC-D, will carry a suite of instruments into space and NASA's Aquarius sensor is its primary instrument. Aquarius will use advanced technologies to make NASA's first space-based measurements of ocean salinity across the globe. This innovative technology will allow Aquarius to detect changes in ocean salinity as small as 0.2 practical salinity units—equivalent to a "pinch" (about 1/8 teaspoon) of salt in a gallon of water.



Credit: NASA/Jet Propulsion Laboratory

Aquarius instrument in "clean room"

Science Objectives

During its nominal three-year mission, Aquarius will map the salinity at the ocean surface to improve our understanding of Earth's water cycle and ocean circulation. Aquarius will help scientists see how freshwater moves between the ocean and the atmosphere. It will monitor changes in the water cycle due to rainfall, evaporation, ice melting, and river runoff. Aquarius will also demonstrate a measurement capability that can be applied to future operational missions.

Credit: NASA/Scientific Visualization Studio

Depiction of ocean circulation, with whiter arrows showing surface flow and bluer arrows showing deeper flow

Ocean Circulation and Climate

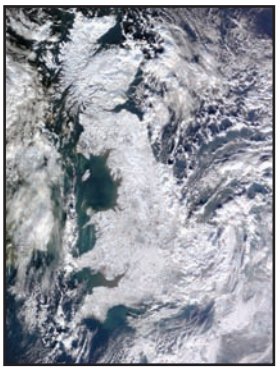
Ocean circulation is driven in large part by changes in water density, which is determined by temperature and salinity. Cold, high-salinity water masses sink and trigger the ocean's "thermohaline circulation"—the surface and deep currents that distribute solar energy to regulate Earth's climate. By measuring salinity, Aquarius will provide new insight into this global process.

Aquarius' measurements of ocean salinity will provide a new perspective on the ocean and its links to climate, greatly expanding upon limited past measurements. Aquarius salinity data—combined with data from other sensors that measure sea level, ocean color, temperature, winds and rainfall—will give us a much clearer picture of how the ocean works, how it is linked to climate, and how it may respond to climate change.

Aquarius will provide information that will help improve predictions of future climate trends and short-term climate events such as El Niño and La Niña. Precise salinity measurements from Aquarius will reveal changes in patterns of global precipitation and evaporation and show how these changes may affect ocean circulation.

Societal Benefits

Throughout Earth's history, salinity changes have disrupted ocean circulation and coincided with cooling episodes, such as the one triggered about 700 years ago, called The Little Ice Age. In recent decades, studies indicate that abnormal surface salinity around the far north Atlantic, called Great Salinity Anomalies, brought unusual weather to Europe. Surface salinity data from Aquarius will give scientists a key to better understanding how ocean circulation is tied to global climate. This critical information is necessary to accurately assess future climate change and its impacts on society.



Credit: NASA/Jeff Schmaltz

Satellite image of snow blanketing Great Britain, January 2010

On the Web

Aquarius http://aquarius.nasa.gov/

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