NASA's KORUS-OC campaign takes to seas

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R/V Onnuri is one of two research vessels conducting research into the ocean and atmosphere of the waters surrounding South Korea, part of the Korea-United States Ocean Color (KORUS-OC) expedition. Credit: Melissa Melendez Oyola/University of New Hampshire

In a South Korean port, two research ships are being equipped with instruments that will measure sunlight interacting with the ocean and capture the microscopic life that ebbs and flows with the currents. As part of the Korea-United States Ocean Color (KORUS-OC) expedition, scientists from the Korean Institute of Ocean Science and Technology

(KIOST), NASA and other U.S. institutions are launching an 18-day field campaign to characterize the daily changes of the seas surrounding South Korea.

"The ocean is very dynamic, and changes happen on very short time scales - from minutes to hours," said Antonio Mannino of NASA's Goddard Space Flight Center in Greenbelt, Maryland, one of the campaign's lead scientists.

One of the dynamic players that KORUS-OC will focus on is phytoplankton, the tiny plants at the base of the marine food web that also play a key role in Earth's carbon cycle. To get a complete picture of a day-in-the-life of these organisms, the campaign's researchers will combine ship-based and airborne observations with data from a South Korean satellite called the Geostationary Ocean Color Imager (GOCI), which takes hourly measurements eight times a day. While satellites carrying instruments like the Moderate Resolution Imaging Spectroradiometer (MODIS) and the Visible Infrared Imaging Radiometer Suite (VIIRS) provide ocean color information, they collect information once a day. GOCI is the only geostationary satellite sensor - meaning that it observes a fixed area, instead of orbiting the globe - that has the proper instrument capabilities to measure ocean color throughout a day.

Korean and NASA-supported researchers are hoping to better understand how oxygen and carbon flow between the ocean and atmosphere, and the role that phytoplankton plays in these and other processes, said Joe Salisbury, a research associate professor at the University of New Hampshire, Durham, and KORUS-OC's chief scientist.

"We'll have our feet right in the water, with the best instruments available to science, characterizing the process itself - how the carbon is

moving and changing," Salisbury said. Phytoplankton play a role in absorbing carbon dioxide from the atmosphere, sometimes taking it out of the carbon cycle as they die and sink to the bottom of the ocean. And although individuals are tiny, the sheer number of them means that about half of the oxygen that people breathe was produced by phytoplankton.

KORUS-OC will investigate phytoplankton with instruments that measure the light reflected from the ocean. Because different species of phytoplankton absorb different wavelengths of light, the measurements will allow scientists to get a picture of the mix.

The two research vessels - a smaller one that ventures out during the day and returns to port at night, and a larger one that will go out for the entire time - will be equipped with dozens of instruments to measure the ocean and atmosphere. In addition to the optical measurements, researchers will gather data on the water salinity, temperatures, particulate matter and pollutant concentration, dissolved gasses and more. They'll dip devices into the ocean to take samples, and classify which phytoplankton are where. Some ship instruments will also look upward - to measure aerosols and trace gases in the atmosphere.

The field work is a sister campaign to the KORUS-AQ effort focusing on air quality, and will also include flights of NASA's B-200 aircraft over some of the same routes as the ships. The plane will carry two Goddard instruments developed by Ball Aerosopace to look down at the ocean color and atmosphere, called the Geostationary Trace gas and Aerosol Sensor Optimization (Geo-TASO) and the Multi-slit Optimized Spectrometer (MOS). These add an intermediary set of measurements between the ships and the satellite.

As the tides, currents, upwelling and winds move coastal waters around, the researchers will use this range of tools to monitor changes in the phytoplankton and ocean chemistry and biology. These changes can shed

light on connections between ocean properties and harmful algal blooms, oil spills, pollution, fisheries and more.

NASA is developing future ocean color-monitoring satellites, and the KORUS-OC mission is designed to provide information about what kind of capabilities those satellites should have, Mannino said. The campaign could also lead to information about what instrument wavelengths, timing and sensitivities are best for other ocean color satellites as well.

"We know there's going to be variability through the day, because of the tides, the dynamics of surface currents, the activity of the living organisms within the ocean," Mannino said. "The question is, what sensitivity do the satellite sensors need to be, in order to detect it?"

The agreement between NASA and the Korean ocean science agency goes beyond the May 20 through June 6, 2016, field campaign. The two countries have signed a memorandum of understanding, which provides KIOST's approval for NASA's Ocean Biology Processing Group at Goddard to process data from the GOCI satellite instrument into ocean color products. Goddard's Ocean Biology Distributed Active Archive Center will provide the raw and processed data products, for free, to researchers worldwide.

Provided by NASA's Goddard Space Flight Center