Researchers train software to help monitor climate change

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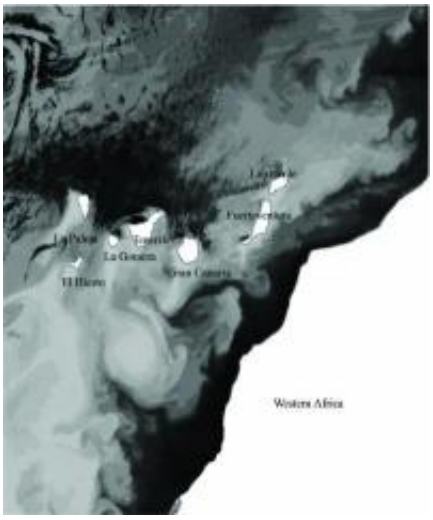

This is a black and white satellite map of the ocean off the west coast of Africa. The Canary Islands are visible. Credit: Jose A. Piedra-Fernandez, University of Almeria, Spain

(PhysOrg.com) -- A computer program that automatically analyzes mounds of satellite images and other data could help climate scientists keep track of complex, constantly changing environmental conditions, according to an international team of researchers.

"All of the data and information that is continually collected by satellites and sensors can cause tons of problems for scientists, who simply don't have the time to analyze every pixel of every satellite image," said James

Wang, professor of information sciences and technology, Penn State. "Our goal has been to provide a tool that would create useful information or knowledge from this large pool of data.."

The program uses probability to analyze and extract environmental information from satellite images and sensor data about ocean structures like wakes, upwellings and cold and warm eddies, the researchers reported in the current issue of *IEEE Transactions on Geoscience and Remote Sensing.*

Researchers first built a database of ocean structures and then used the knowledge of human experts to train the program to recognize and identify changes in the ocean.

"We're particularly interested in the analysis of mesoscale regional ocean structures in satellite images," said Jose A. Piedra-Fernandez, a visiting professor in information sciences and technology at Penn State during the project and currently an assistant professor at the University of Almeria, Spain.

Researchers tested the technology on satellite images provided by the National Oceanographic and Atmospheric Administration and the Advanced Very High Resolution Radiometer of sections of oceans in the Iberian Atlantic, the Mediterranean coast and near the Canary Islands. The tests included 1,000 cases of real ocean features, including 472 upwellings, 119 cloudy upwellings, 180 wakes, 10 anticyclonic eddies, 40 cyclonic eddies and 180 misclassified regions.

The best combination of filter and classification method developed by the researchers accurately identified the ocean features more than 89 percent of the time.

"In almost all cases, the proposed methodology improves the accuracy

rate and reduces the number of features necessary to get a good ocean structures classification," Piedra-Fernandez said.

The researchers think that data on these oceanic features could offer clues on subtle changes in the temperature of the oceans and global climate conditions.

The system involves several steps, including adjusting for possible earth- and solar-based interference sources, separating ocean regions from land regions and extracting and identifying features from specific regions of ocean. In the feature selection process, the system filters the regions of the images by ranking strong and weak--or, relevant and irrelevant--relationships between the features, said Piedra-Fernandez. After the filtering process, the system can better identify and classify the upwellings, wakes and eddies.

Bayesian networks, which use probability to make decisions, are the preferred technology for classifying the features because they are easy to design and evaluate, said Piedra-Fernandez. Just as the presence of sniffles and a cough increases the probability that a doctor will diagnose that a patient is suffering from a cold, a Bayesian network can determine that the color or shading of certain pixels in an image indicates an upwelling, or other oceanic features studied by the researchers.

Because the design of the Bayesian system requires less data for learning than other probability-based decision systems, such as Markov networks, the Bayesian networks reduce the computational cost of the system, another key goal for the system's design.

The team next plans to add more features, such as salinity and chlorophyll concentrations, and improve the accuracy of the image classification system.

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