UC SANTA BARBARA

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Building Resilience Across Africa

Humanity's ability to predict and respond to the changing climate will likely dictate our wellbeing in the coming century. While some regions have employed climate and agricultural forecasting for decades — including the U.S., which uses sophisticated models to maximize and stabilize the food supply — many areas of the world are still developing these capacities.

Researchers at UC Santa Barbara are working to change that.

The university's Climate Hazards Center (CHC) continues to raise the bar in predicting and tracking extreme climate-driven conditions that affect people's lives and livelihoods. The CHC's eminence and success have attracted partners and funding from around the world. Now the group will take on two large new projects — one in Western Africa, the other in Eastern and Southern Africa — over the next three years.

Both are funded through the Applied Science Team (AST) at SERVIR, a joint venture between NASA and the U.S. Agency for International Development that aims to help "developing countries use satellite data to address critical challenges in food security, water resources, weather and climate, land use, and natural disasters." The new projects, each to receive roughly half of the total $1.3 million grant, will be equal partnerships between the CHC and SERVIR's Western Africa and Eastern and Southern Africa hubs, respectively.

Shraddhanand Shukla

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“The Climate Hazards Center has a long record of working in Africa on food and water insecurity-related issues,” said CHC Associate Researcher Shraddhanand Shukla. “And our partners certainly recognize our expertise with both science and capacity-building in this field.”

In Western Africa, the center will help establish a water deficit monitoring and forecasting system. Meanwhile, in Eastern and Southern Africa, the team will work on a grain harvest forecasting system.

“The goal of the West African project is to develop an advanced water deficit monitoring and forecasting system,” explained Shukla, who will be leading the project. The group plans to achieve this by tapping NASA remote sensing datasets to modernize two tools currently in use.

The first is a crop water balance model that estimates the amount of water in the soil that can be used by crops. This model allows scientists and policymakers to predict how well the crops are likely to fare in the near future.

The second is a satellite-based system that monitors water levels in the small ponds that dot the region and are critical to meeting its water requirements. Based on surface area, rainfall data and evapotranspiration data, the system can estimate the amount of water in these holding ponds, which are a critical resource for humans and livestock during the dry season.

“The point is not to provide an exact amount of water,” Shukla said. “Rather our goal is to figure out if the water in a given time of year is going to be below or above what is typical.”

The CHC will partner with a number of organizations and agencies for this project, notably the Comité Permanent Inter-Etats de Lutte contre la Sécheresse dans le Sahel (CILSS), a 13-nation organization that conducts research into food security and the fight against drought and desertification in the semi-arid Sahel region of Africa. AGRHYMET Regional Centre and The African Centre of Meteorological Applications for Development of the CILSS will be the primary partners, and will host the new products made available through this project.

In Eastern and Southern Africa, the CHC group will develop and implement a grain forecast system. Agencies like NASA have several satellite-based products that can be used for modeling grain production, including the rainfall tracking and prediction suite CHIRPS, which was in fact developed by CHC at UC Santa Barbara.

Frank Davenport

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“Our goal with this project is to help various Eastern and Southern African agencies use these products to make regular grain forecasts through the growing season,” said CHC Research Scientist Frank Davenport, who is heading the second SERVIR-AST project. This can be tricky, he noted, because small changes in location or time of year can affect which models provide the most valuable insights. What’s more, many of these systems make grain forecasts for an entire country. The CHC team and their regional partners will work to increase the granularity that these models can output.

The CHC is collaborating with several organizations in this effort. Its primary partner is the SERVIR East Africa Hub, known as the Regional Centre for Mapping of Resources for Development (RCMRD). An intergovernmental organization aimed at promoting sustainable development, it was established under the UN and African Union, and has 20 member nations in Southern and Eastern Africa. RCMRD will be the main client and recipient of technologies developed under this proposal.

Though it’s easy to forget in an industrialized country, agriculture serves as the foundation of society, and food security provides a platform from which further development can take place. Having solid agricultural forecasting abilities decreases

uncertainty and volatility — two of the biggest threats to wellbeing and development — Davenport explained.

“The United States is a prime example of this,” he said. “Having a solid agricultural forecasting product serves as the bedrock of agricultural and economic development for most countries around the world. And the lack of the consistency of these programs, some would argue, has hindered economic development in the regions we’re working in.”

Greg Husak

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Increasing food and water security in these parts of the world can improve health and wellbeing, promote economic development and trade, and stabilize labor markets and migration patterns, according to CHC Principal Investigator Greg Husak. Similar efforts the group was involved with have already made a difference in countries like Kenya, Zambia and Tanzania, he added.

The researchers agree that the key to success will be establishing systems with staying power and reach. They anticipate that much of the work ahead will involve capacity building. “We’ll be taking existing products and tools, making them a bit more streamlined and easier to use, and putting them in the hands of in-country users,” said Davenport. The overlapping goal of both projects is to make sure any useful advancements made in the next three years are self-sustaining.

Complexity is another factor that will influence the projects' legacies. Models always have a tradeoff between the precision and accuracy that comes from including a lot of variables versus the understandability and ease of use characteristic of a simpler model.

"We need to find that balance between your Ferrari versus your Toyota," said Davenport. It's easier to drive a Toyota, but the Ferrari is a more precise machine. Achieving the proper balance is important because the team needs to train people — not all of whom have a background in climate modeling — to use these systems.

They also have to consider data quality and completeness. Many of the datasets are new, and it's often difficult to get data from rural areas. "If you're dealing with limited data, it doesn't matter how awesome your Ferrari is. If there's dirt in your gas it's still going to sputter out," Davenport said. Fortunately, the amount of data at their disposal will only increase as time goes on.

Of course, the projects will need to harness effective communication to ensure they have an impact. News in these regions is often spread via local radio, so tapping into this communication network will be key to effectively provide information and warnings to people, Shukla explained.

"We've built a number of relationships that will benefit both of these projects," Husak added. "Now each individual project can leverage the relationships that we've built and our long track record of success."

The other U.S.-based partners on the Western Africa project are: Desert Research Institute, Reno; University of Minnesota, Minnesota; and Columbia University, New York. Columbia University is the CHC's main partner on the project in Eastern and Southern Africa.

About UC Santa Barbara

The University of California, Santa Barbara is a leading research institution that also provides a comprehensive liberal arts learning experience. Our academic community of faculty, students, and staff is characterized by a culture of interdisciplinary collaboration that is responsive to the needs of our multicultural and global society. All of this takes place within a living and learning environment like no other, as we draw inspiration from the beauty and resources of our extraordinary location at the

edge of the Pacific Ocean.