

Led by Chancellor Pradeep K. Khosla, UC San Diego's new strategic plan includes research themes outlining the university's vision for the future. Scripps Institution of Oceanography leads the theme Understanding and Protecting the Planet, which encompasses understanding and communicating environmental change, enhancing the resilience of society to adapt to these changes, and collaborating with other UC San Diego divisions to recommend policy changes and assess their economic impact. The projects below demonstrate the breadth of research and broader outreach under way at Scripps.



SOCIETY AND SUSTAINABILITY BEYOND BOUNDARIES

Scripps Institution of Oceanography Distinguished Professor of Climate and Atmospheric Sciences Veerabhadran Ramanathan led a historic workshop at the Vatican on the common goals of social justice and environmental stewardship.

Ramanathan, who over the course of four decades has led research on the links between greenhouse warming agents, air pollution, and human health, was a co-convenor of the first joint workshop of the Pontifical Academy of Sciences and the Pontifical Academy of Social Sciences in May. It was one of several efforts by Ramanathan and other researchers this year to lower longstanding barriers between science and religion with the goal of harnessing the moral authority of religious leaders to effect change for the common good.

In a brief meeting with Pope Francis, Ramanathan used the opportunity to convey one message: there are three billion poor people in the world who bear only a small responsibility for warming the planet, having never had access to fossil fuels used by the more affluent. Those poor, however, will bear the brunt of the worst effects of climate change. The Pope is expected to include environmental justice in an upcoming encyclical.

Ramanathan and Cambridge economist Partha Dasgupta reinforced the collaboration with the religious world in September when they published in the journal *Science* an appeal to religious leaders to forcefully advocate for the advancement of societal and environmental safeguards.

ADAPTING TO A RISING SEA

Scripps is a global leader in climate change science, as well as of interdisciplinary studies that aim to understand and forecast climate change and its consequences for our planet. Rising seas, caused by the melting of land ice sheets and continental glaciers and by the thermal expansion of oceans, threaten to inundate low-lying coastal areas, erode shorelines, damage property, and destroy ecosystems that protect coasts against storms. Coastal communities, businesses, and resource managers are already confronted with inundation issues that require action.



In May 2014, Scripps, the Annenberg Foundation Trust at Sunnylands, and The Prince Albert II of Monaco Foundation hosted a workshop on sea-level rise adaptation on the Scripps La Jolla campus. The workshop engaged science, engineering, social science, and policy experts to develop a conceptual plan to assist in the development of place-based, sea-level rise adaptation strategies, and prepared a framework for discussions at a retreat at Sunnylands in Rancho Mirage, California, in October. At the Sunnylands retreat, business leaders, policymakers, and scientists discussed how to advance and provide leadership for effective sea-level rise adaptation strategies. A follow-up meeting to identify appropriate protocols for peoples who will be displaced by rising oceans is scheduled to take place in Kiribati in fall 2015.





WESTERN U.S. RISING DUE TO SEVERE DROUGHT

Research by Scripps geophysicists Adrian Borsa and Duncan Agnew and climate researcher Dan Cayan led to the discovery that loss of groundwater due to drought in the western states has been so extreme that land mass rose an average of one-sixth of an inch since 2013. By measuring how much the land has risen, they have developed a more detailed estimate of the West's water deficit. They calculate this deficit to be 240 gigatons, or 64 trillion gallons—equivalent to a four-inch layer of water covering the entire western U.S.

The researchers analyzed ground-positioning data from highly precise GPS stations throughout the west to calculate a rise of more than half an inch in California's mountains and on average 0.15 inches across the western U.S. in recent years. While the results provide further evidence of severe drought in the West, researchers believe the study can lead to new ways to track water resources over broad regions. The U.S. Geological Survey supported this research, and results were published in the September 2014 issue of the journal *Science*.



BIOFUEL PROGRAMS TOP NATIONAL RANKINGS

As the world looks to new sustainable sources of energy, a laboratory at Scripps Institution of Oceanography and a UC San Diego consortium were ranked as the country's best programs in algae technology research and related biofuel projects. The Department of Energy's Bioenergy Technologies Office (BETO) ranked the research lab of Scripps marine biologist Mark Hildebrand and his team as the nation's top program, specifically citing the lab's "outstanding research" in the genetic manipulation of algae to improve the yield of key growth components for biofuel production.

The UC San Diego Consortium for Algal Biofuels Commercialization (CAB-Comm), led by UC San Diego and including several Scripps researchers, was ranked as second best in the country.

The rankings were developed by an external group of experts from industry, academia, government, and the non-profit sector, which evaluated 219 projects across nine technology areas representing \$1.6 billion of BETO-supported research. BETO strategically supports bioenergy research that will reduce dependence on foreign oil, promote sustainable energy resources, establish a domestic bioenergy industry, and reduce carbon emissions from energy production and consumption.