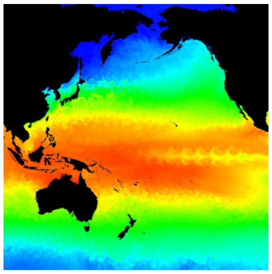
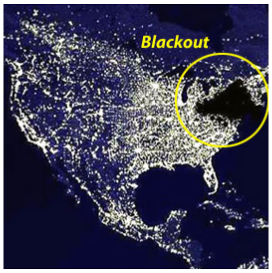
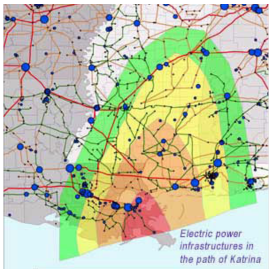


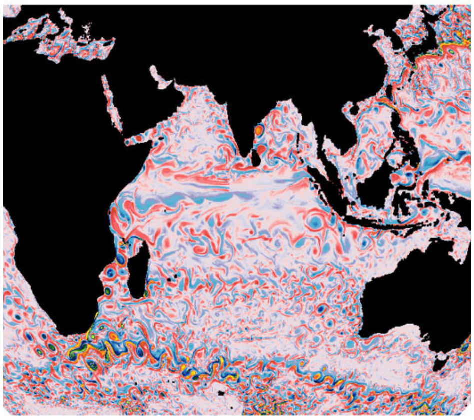




We are combining our climate and infrastructure modeling expertise to provide prediction tools for decision makers.

Science-Based Prediction for Energy Security

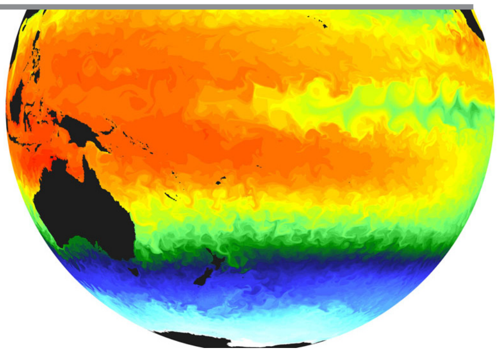
Our world is made up of complex systems—the weather, our economy, our critical infrastructures, natural ecosystems, human health, and others. All of these systems interact to form an even larger complex system that gets more complex all the time as populations, linked in new ways through advanced technologies, grow and impact the environment. All this complexity challenges decision and policy makers who must predict and respond to potential crises. Large-scale, science-based, computer simulations provide the only feasible way to produce accurate quantitative predictions in such a complicated world. Scientific computing has been an essential part of Los Alamos National Laboratory's research since the Manhattan Project and has been key to ensuring the safety and reliability of the nation's nuclear weapons stockpile, but it is also being used to predict the progress of climate change and provide decision makers with the information they need to prepare for and mitigate its effects.



Model showing ocean eddies which are important to understanding climate. The spin of ocean eddies provides the energy to maintain important currents, transport heat and salt, and pump nutrients from the depths to the surface.

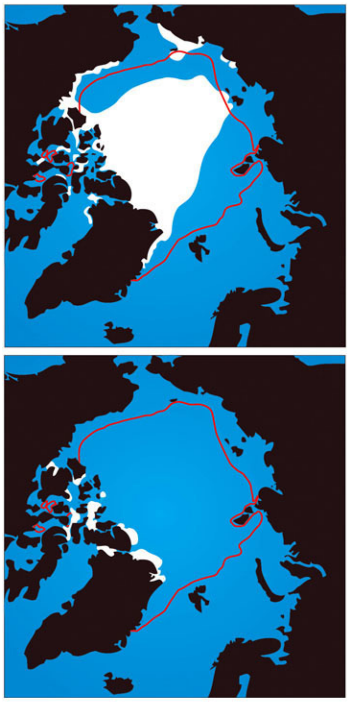
Climate and Infrastructure Modeling

Current climate assessments make projections for global- and continental-scale changes in conditions like precipitation, ocean surface temperature, and sea level rise. But to implement mitigation measures, policy makers must make decisions based on regional changes in climate and their impacts on local energy and water infrastructures. To meet that need, Los Alamos is integrating its strong, existing programs in climate change science and infrastructure.



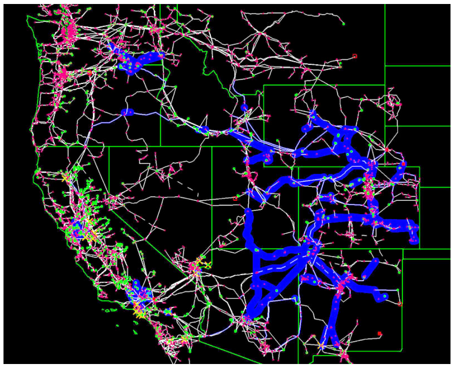
Ocean surface temperatures modeled with Los Alamos' Parallel Ocean Program (POP).

The Laboratory has a 15-year history in climate change science. The Climate, Ocean and Sea Ice Modeling (COSIM) project develops and maintains advanced numerical models of the ocean, sea ice, and ice sheets for use in global climate change projections. COSIM models were used extensively in simulations underpinning the recent climate assessment by the Intergovernmental Panel on Climate Change (IPCC) that was awarded the 2007 Nobel Peace Prize. COSIM efforts have focused on understanding high-latitude climate, where the change is already very dramatic and where Arctic ice is rapidly melting. These changes are felt globally through sea level rise and could possibly lead to abrupt climate changes due to collapse of large ice sheets or changes in ocean



Los Alamos models predict a rapid decline in average September sea ice. The red boundary shows the 1990's average. The white areas show the average ice coverage for 2010–2019 (top) and 2040–2049 (bottom).

circulation. Melting ice could also accelerate temperature and precipitation changes across the globe. Accurate simulation of these processes requires fine resolution global models and the computing capacity and modeling expertise that exists at Los Alamos.


The blue in this infrastructure model of the western U.S. shows where transmission lines will be overloaded in 2025 due to population growth.

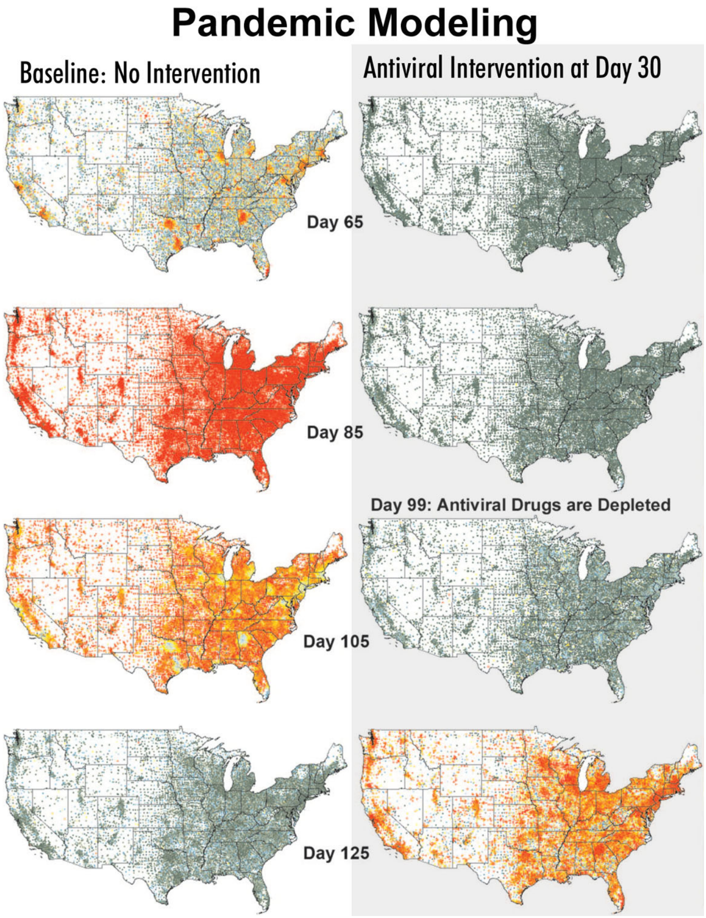
Los Alamos also has two decades of experience modeling the nation's energy infrastructure to understand its vulnerabilities. Since 2000, this capability has advanced greatly through the Lab's involvement in the National Infrastructure Simulation and Analysis Center (NISAC), a collaboration between Sandia and Los Alamos National Laboratories that supports the Department of Homeland Security. NISAC has examined many sub-systems of the national infrastructure including energy, water, telecommunications, transportation, and human health. But most importantly, NISAC looks at the interdependencies between these complex systems to understand how failures in one could disrupt others.

Combining this infrastructure capability with its advanced climate modeling expertise, Los Alamos will be able to predict how impacts from climate change might cascade throughout our infrastructure. These tools have already been used to understand and mitigate the effects of hurricane landfalls and to predict the impacts of climate change on energy demand and delivery in California. NISAC depends heavily on collaboration with infrastructure sector experts at the national, regional, and local levels for data and information about infrastructure processes and operations. This collaboration helps NISAC provide more accurate and complete information to decision makers.

Climate and Human Health

Los Alamos' predictive models are also used in another area where we can expect climate-related changes—human health. Emerging evidence indicates that changing weather patterns are already altering the distribution of infectious diseases, and projections show this trend progressively increasing. The Canadian government is warning their citizens that diseases such as malaria, dengue, and yellow fever could appear in Canada as a result of global warming, and Britain's environment minister has warned that malaria could reach England.

NISAC modelers are already simulating the spread and impacts of disease. In one example, a highly pathogenic influenza virus was tracked as it arrived through major international airports and spread through a population of nearly 300 million people over 180 days (see below). It examined the impacts of various interventions from antiviral therapy to school closures and travel restrictions as the vaccine industry struggled to catch up with the evolving virus. Such simulations can enable rapid public safety decisions and guide precious resources to where they'll have the greatest effect.



Two simulated influenza pandemics. The colors from green to yellow to red indicate low to moderate to severe numbers of infected individuals. The left scenario shows the progress of the pandemic with no intervention. On the right, antiviral treatment controls the spread until supplies of the drug are exhausted.

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