Infrastructural Science
Seeing the Scientific Services Essential to Sustainability

Dr. Roger Turner, Dickinson College and Chemical Heritage Foundation
TurnerR@dickinson.edu

What is Infrastructural Science?

Infrastructural Science is an analytical category that highlights how science stabilizes the technologies that underlie modern life.
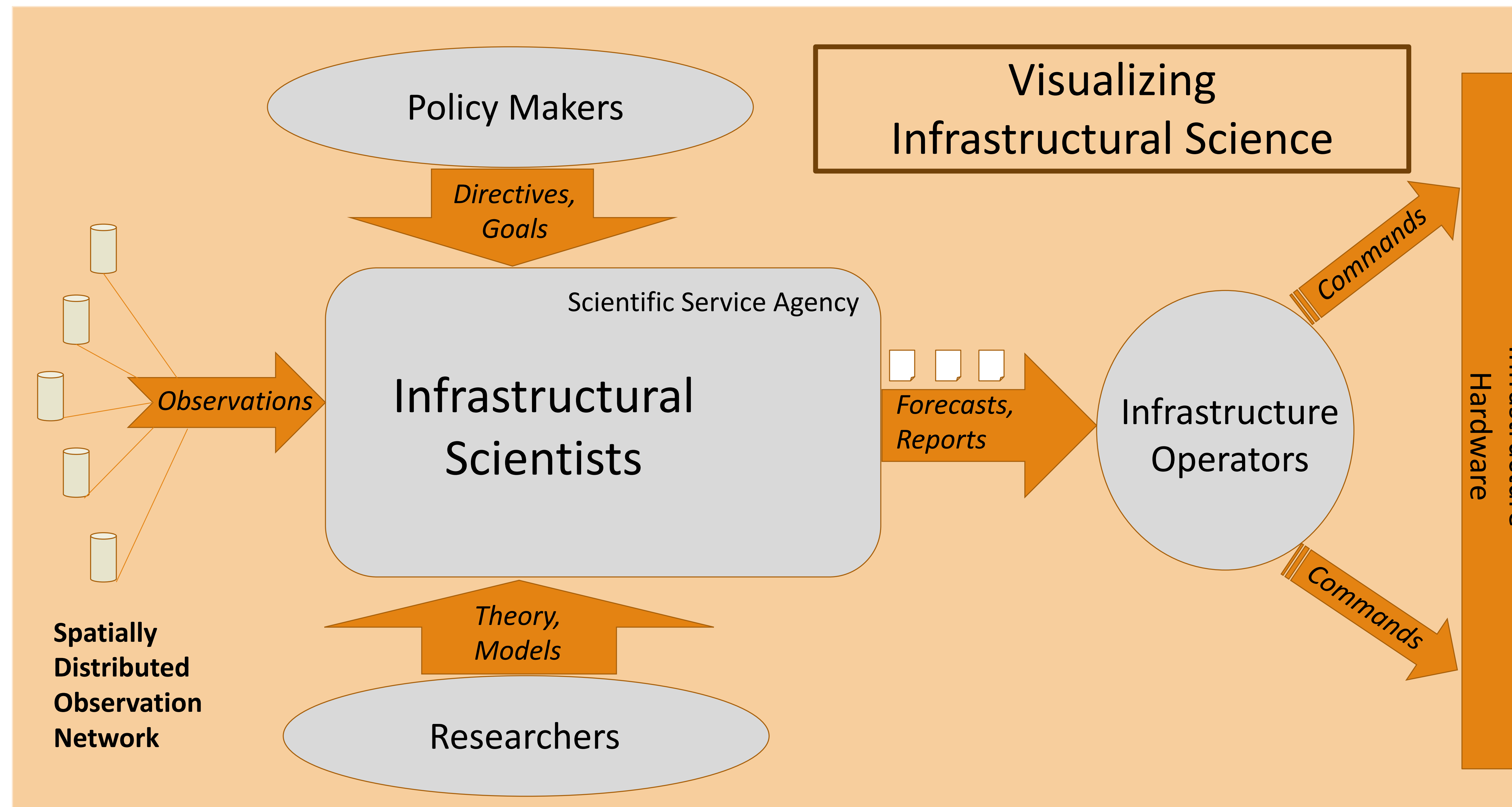
Government agencies routinely monitor many aspects of the natural world.

These observations are compiled into reports, or analyzed to produce forecasts, which are generally provided to users as public goods.

The operators of infrastructures use these products to design and manage the technological systems that we rely upon.

Forecasts and environmental observations help operators keep their systems running smoothly and reliably, even as the natural world changes in ordinary ways from day to day and season to season.

Like Infrastructure, this science is rarely noticed—except when it fails or is defunded.

Visualizing Infrastructural Science

Policy Makers

Directives, Goals

Scientific Service Agency

Infrastructural Scientists

Observations

Spatially Distributed Observation Network

Theory, Models

Researchers

Forecasts, Reports

Infrastructure Operators

Commands

Commands

Infrastructure Hardware

Connecting Science to Infrastructure

Infrastructures Exist in a Dynamic World. The natural world is full of minor hazards that would rapidly degrade infrastructures without constant adjustment and maintenance.

Infrastructures are (Social) Systems. An infrastructure is more than a collection of physical things like pipes, wires, and roads. An infrastructure also includes the human organizations that manage and use the flows enabled by hardware.

Scientists are Part of those Systems. Scientifically trained observers and data interpreters create the information necessary to operate infrastructure safely and reliably within the ordinary changes of the natural world.

What's at Stake?

We Dependent on Them. The infrastructural sciences enable the reliable, large-scale flows of material and information essential to industrialized societies.

Out of Sight. Infrastructural sciences are noticed mainly by people who operate infrastructure. They don't win Nobel Prizes, and have small PR staffs.

Out of Mind. Infrastructural science has become a taken-for-granted part of managing a modern State. They have few advocates.

They're Vulnerable. The infrastructural sciences in the US have been significantly degraded by flat budgets and anti-government policies. When they break down, people die.

Examples of Infrastructural Science

Weather and Climate Forecasting

The National Weather Service observes the weather with a network of satellites, ground stations and floating buoys. These observations initialize computer models, which meteorologists translate into forecasts and emergency warnings. Weather predictions are used by: airlines to route planes; state Departments of Transportation to manage highways; school districts to make closure decisions, and grid operators in dispatching electricity.
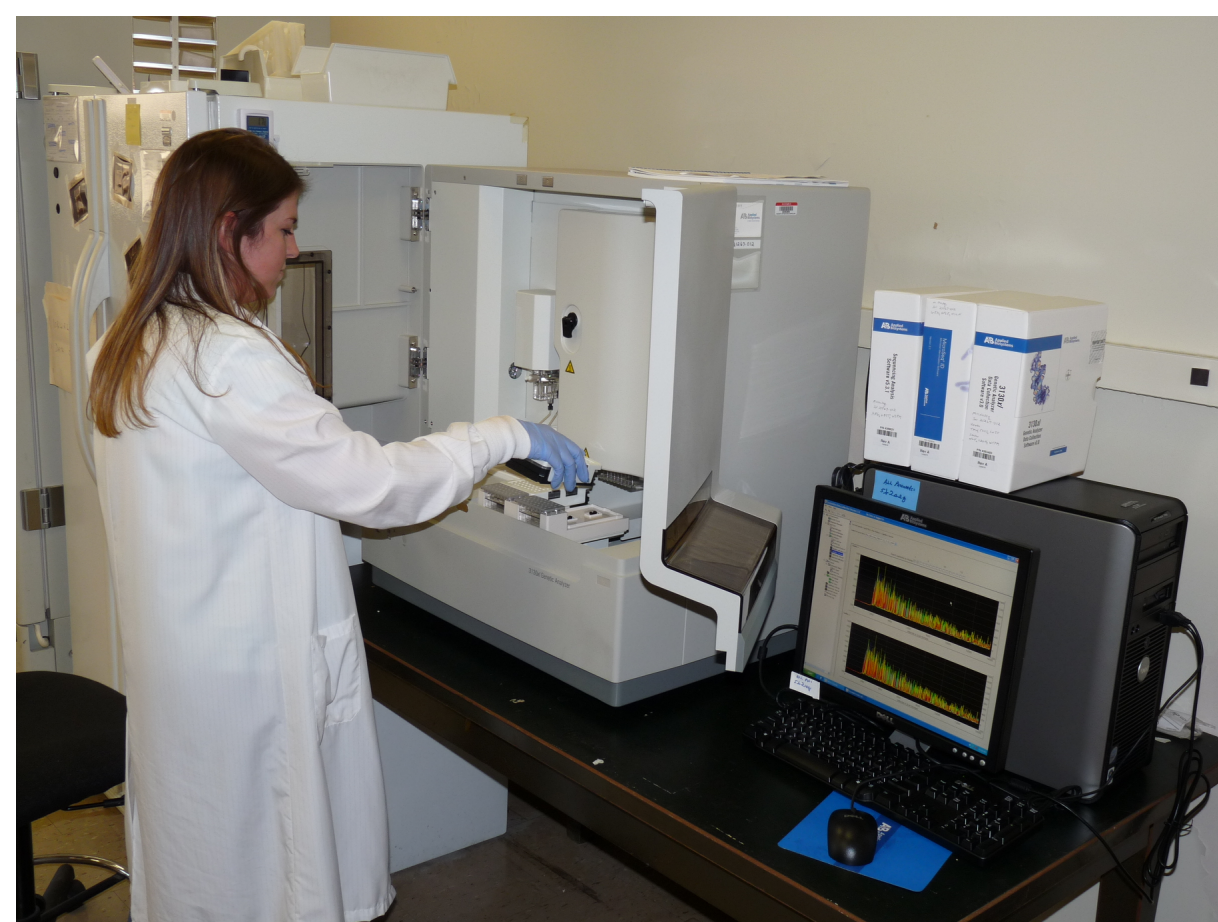
Drinking Water Protection

Local drinking water agencies regularly test water throughout their systems for chemicals, metals, and bacteria. Sampling results guide operational choices at treatment plants. When this is done negligently, water can become contaminated and dangerous, as happened in Flint, Michigan.

Agricultural Disease Monitoring

The USDA's Animal and Plant Health Inspection Service uses insect traps, biological samples and veterinary reports to track invasive pests and zoonotic disease outbreaks. APHIS reports inform farmers, timbermen, and ranchers how to intervene as they manage their pieces of the industrial agricultural system.
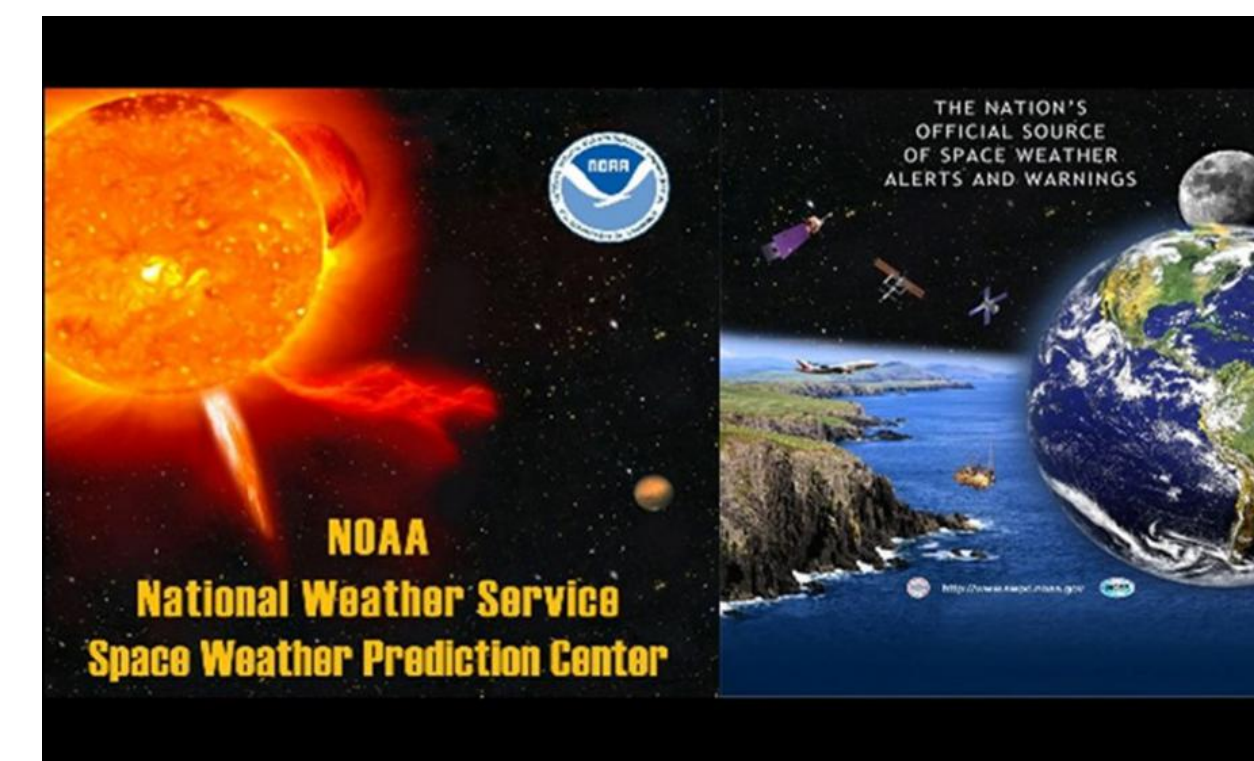
Space Weather Prediction

NOAA's Space Weather Prediction Center uses data from NASA satellites and USGS ground-based magnetometers to predict how solar eruptions will affect the Earth. These predictions are used by NASA, the military, operators of communications satellites and power grids, and industries that depend on high precision GPS signals, like oil drilling and, increasingly, farming.

Flood Prevention and Management

The US Geological Survey maintains a network of stream gauges, which feed observations to River Forecast Centers operated by the National Weather Service. River forecasts are used by operators of reservoirs and dams, as well as by emergency managers during crises.