Past, present, future of communications

Throughout the history of recorded time, seemingly unrelated discoveries have proven critical to the development of communication technologies that today help scientists investigate the atmosphere and oceans. We take for granted near instantaneous access to National Oceanic and Atmospheric Administration (NOAA) Doppler weather radar imagery and accurate forecasts on the Internet, as well as satellite imagery of hurricanes on the evening news.

However, before the frenetic pace of 19th and 20th century's scientific programs resulted in fiber optic cables and satellite transponders, humans first needed to discover tools (circa 2,000,000 BC), fire (circa 500,000 BC) and writing (3500 BC). Mathematics and astronomy appeared in use first around 1800 BC, alphabets (1500 BC), sea navigation (1100 BC), accurate sundials (700 BC) and geometry (300 BC).

By 1844, the inauguration of the telegraph was almost as influential to oceanographers and meteorologists as the discovery of the alphabet to early man. The American artist Samuel Morris' instantaneous transmission technology and accompanying code made possible near real-time weather data gathering over land lines strung along the spreading railroad lines. In 1853, Mathew Maury proposed his code as a uniform system for collection of volunteer ship weather reports at an international conference of maritime nations in Brussels. The agreement was the forerunner of today's World Meteorological Organization Volunteer Observing Ship's scheme. Real-time observations from ships at sea would await the invention of radio antennas and wireless telegraphy in 1895.

When British economist, L. F. Richardson, published his famed "Weather Prediction by Numerical Process" in 1922, the adequacy of observations to describe the initial state of the atmosphere and the complexity of the subsequent computing process were among his concerns. But Richardson had not foreseen computers. He envisioned a staff of 32 people at each grid point of his model armed with five-digit log tables and a slide rule. For his global model of 2,000 grid points Richardson needed 64,000 humans with manual adding machines housed in a circular forecast factory, like a football stadium, so each could see the others' calculations. Today, it would take those 64,000 human computers working 24 hours a day, seven days a week, for a month to perform instructions that the IBM SP supercomputer at NOAA completes in just one second.

The arrival of the Internet and high speed data transmission in the 1990s brought several upgrades in telecommunications capability at NOAA. Today, over 734,000 weather forecasts, as well as 850,000 river and flood forecasts are available yearly over the Internet. The National Weather Service issues between 45,000 and 50,000 potentially life-saving warnings yearly. In addition, NOAA satellite imagery and the complete suite of National Weather Service products are openly available via

NOAAPORT satellite reception - the product delivery mechanism for National Weather Service field offices across the United States.

Modern era communications capability has sped up not only the pace of discovery, but also the need to discover technology of even greater capability. Advances in communications and telemetry technology have and will prove critical to improved monitoring, measuring and forecasting global changes in the earth's weather, oceans and climate.

Dynamic advances are also at work in our ports. Developments in communications technology and data processing now allow a ship's pilot to navigate a tanker through a narrow channel - and receive real-time observations of water levels, currents and winds. Actual observations allow pilots to navigate more safely, taking full advantage of true available channel depth, every safe foot of draft and favorable currents. This boosts the economic value of every trip. In the nine major port areas where NOAA's National Ocean Service PORTS(R) program operates, data collection and communications technology are coupled with sensors to collect essential observations every six minutes. Observations are then transmitted via a combination of dedicated lines, line-of-sight radio or the newer technology of IP modems to a central acquisition system.

The central system uses both data lines and Internet technology to allow direct human and automated oversight of the data quality, while simultaneously putting the observations out to a customized NOAA website and a centralized toll-free phone system. The sight of a ship's pilot checking this website on a laptop computer with cell phone modem, or dialing directly into the centralized voice system, is commonplace.

This application of practical technology goes beyond navigation safety and efficiency gains for maritime commerce. The recreational boater at the base of a multi-billion dollar marine recreation industry, the marina operator and the windsurfer all have access to these very same observations. The coastal manager preparing for storm surge has access to water levels every six minutes where these communications links are established, or every 18 minutes via satellite transmission for the entire network of water level stations around the country.

To a large extent, tomorrow's science rests on numbers. NOAA's up-to-the-minute satellites, radars, weather buoys, surface observing instruments and widely diverse communications technology deliver ever-increasing volumes of high quality data and imagery - requiring number crunching that will always test the limits of cutting-edge computer processing and storage.