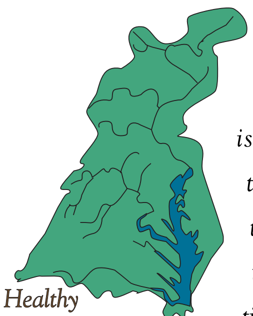
HEALTHY CHESAPEAKE WATERWAYS

integration application network

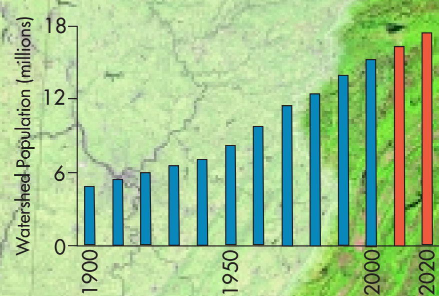
This science newsletter focuses on the role of the Integration and Application Network (IAN) in achieving healthy Chesapeake waterways. This is the first in a series of IAN newsletters on topical issues and is directed towards the scientific and technical audience. IAN is a collection of scientists interested in ***solving****, not just studying environmental problems. The intent of IAN is to inspire, manage and produce timely syntheses and assessments on key environmental issues, with a special emphasis on Chesapeake Bay and its watershed. IAN is an initiative of the faculty of the University of Maryland Center for Environmental Science, but will link with other academic institutions, various resource management agencies and non government organizations.* Healthy Chesapeake Waterways *is a vision for the freshwater, tidal and estuarine portions of Chesapeake Bay and its watershed. The vision is not affiliated with any particular institution, agency or non government organization, but can be used by anyone interested in achieving healthy Chesapeake waterways.*



CHESAPEAKE WATERSHED

The Chesapeake watershed extends north almost to the Finger Lakes in New York, includes much of Pennsylvania and Virginia, virtually all of Maryland and portions of West Virginia and Delaware. The Appalachian Mountains make up most of the western watershed boundary.

CHESAPEAKE WATERSHED POPULATION



http://www.chesapeakebay.net/pop.htm

The human population in the Chesapeake watershed has increased from approximately 5 million in 1900 to greater than 15 million currently, which corresponds to 10 busloads of people arriving every day for the past 100 years!

CHESAPEAKE FACTS

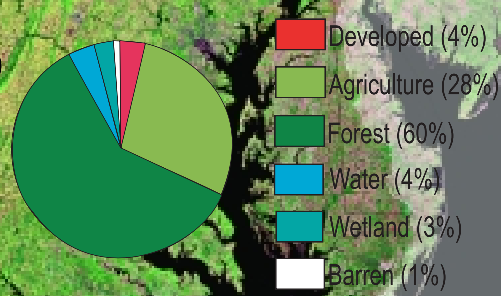
CHESAPEAKE WATERSHED

- **Area: ~ 64,000 sq. miles (165,000 sq. km) (The size of Missouri)**
- **Length: ~360 miles (580 km)**
- **Width: ~180 miles (290 km)**
- **Average Elevation: ~1000 feet (300 m)**
- **Max. Elevation: ~4700 feet (1400 m)**

CHESAPEAKE BAY

- **Area: ~5,200 sq miles (13,000 sq. km) (The size of Connecticut)**
- **Length: ~200 miles (315 km)**
- **Width: ~3-35 miles (5-56 km)**
- **Average Depth: ~30 feet (8.5 m)**
- **Maximum Depth: ~150+ feet (46+ m)**

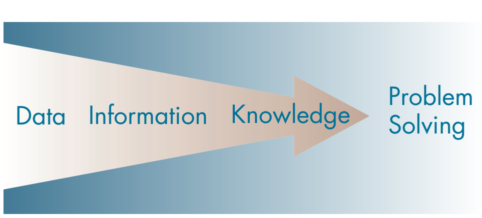
CHESAPEAKE LAND USE



Watershed and Bay area and elevation from digital elevation model with 30m resolution; Bay length, width and average depth from National estuarine Atlas (NOAA, 1985); maximum depth from NOAA Chart 1990 and B. Boicourt (pers. comm); Land use from Chesapeake Bay Program web site (http://www.chesapeakebay.net).

http://chesapeake.usgs.gov/images/cbimag2.jpg

DATA FLOW CRITICAL TO HEALTHY WATERWAYS



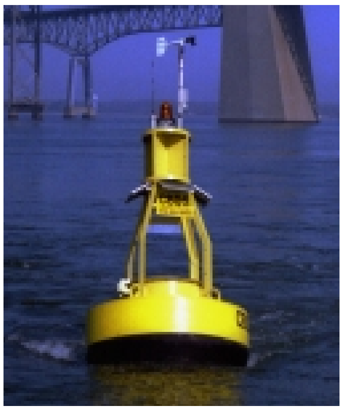
Large amounts of data are used to generate smaller amounts of information. Information is integrated into kernels of knowledge that are applied to environmental problems. The continued flow of data from collection to analysis, integration, and ultimately, application is crucial for achieving Healthy Chesapeake Waterways. The Integration and Application Network will strive to facilitate this process.

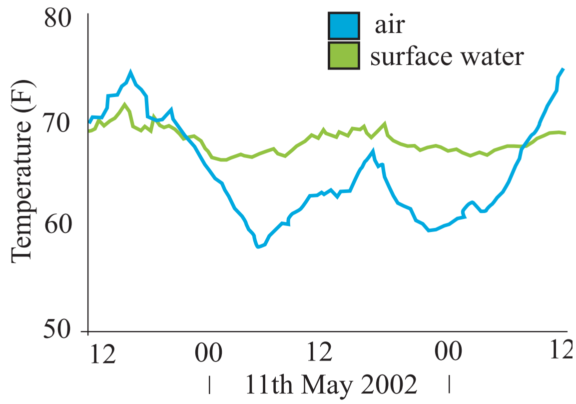
Data Information Knowledge Problem Solving

OBSERVATION REVOLUTION

Data gathering capabilities are dramatically increasing

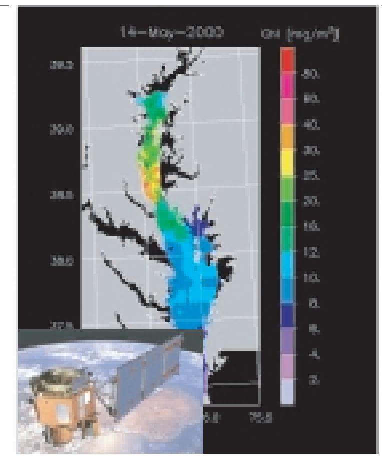
New innovations and technological advances have made it possible to collect unprecedented amounts of environmental data. In particular, two kinds of data collection have fueled the observation revolution: remote sensing and in situ sampling.





IN SITU SAMPLING

Many sensors can be left in situ (in place), automatically collecting data. This has allowed for continuous data streams, revealing fine scale patterns (hours to days). An example is the Chesapeake Bay Observing System (CBOS), which provides real time atmospheric and oceanographic data from in and around Chesapeake Bay. www.cbos.org



http://www.cbrsp.org

http://www.eoc.csiro.a/hswww/EOC_data.htm

REMOTE SENSING

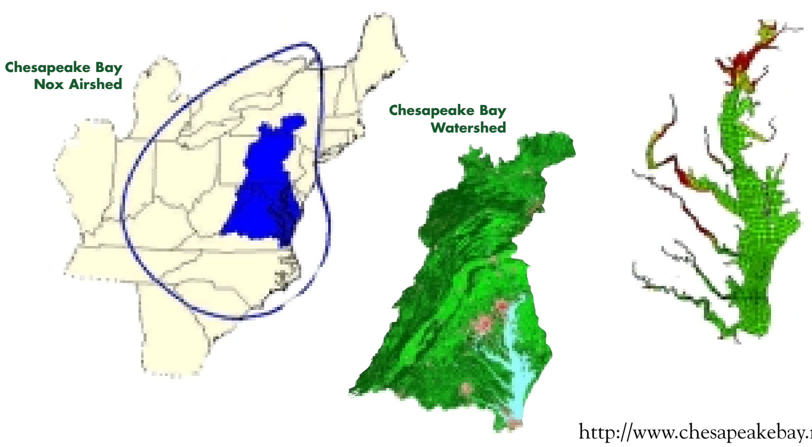
Sensors mounted on aircraft and satellites enable large scale, synoptic sampling. An increasing diversity of sensors is now deployed on an increasing diversity of aircraft and satellites, making remote sensing imagery more available and less expensive.

Data Information Knowledge Problem Solving

INFORMATION GENERATION

Capacity for data analysis is increasing

The challenge of coping with ever larger data streams to generate useful information has led to the development of various quantitative tools, aided by the continuous increase in computing power. Quantitative models are increasingly being used for various data analyses, as well as spatial analyses including geographic information systems (GIS).

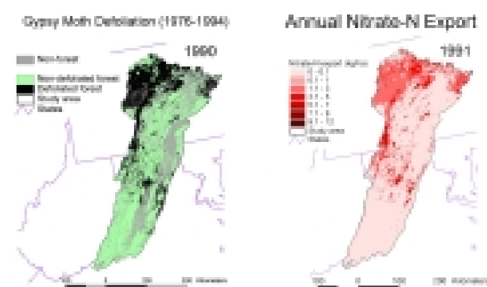


Linked models which predict nutrient inputs to Chesapeake Bay from the airshed and watershed and the effect of these nutrient inputs on the estuary have been formulated.

http://www.chesapeakebay.net/wqcmodeling .htm

QUANTITATIVE MODELS

Quantitative models aim to capture and simplify interacting and complex processes. Chesapeake models estimate the delivery of nutrients and sediments to the Bay by considering atmospheric inputs (airshed model), watershed inputs (watershed model) and processing of these inputs (estuarine models).



Spatial analysis using a geographic information system were used to relate the enhanced runoff of nitrate (NO_3^-) from a forest that had been rapidly defoliated by gypsy moths (Eshleman et al., Hydrological Processes, in review).

SPATIAL ANALYSIS

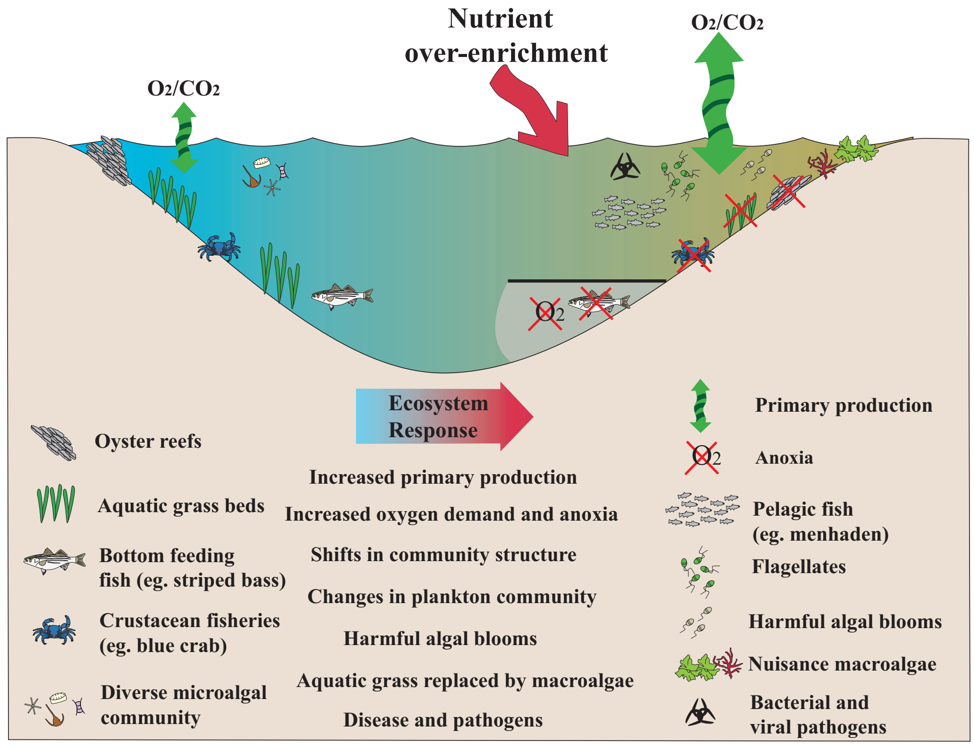
An effective technique to synthesize large multi-dimensional data sets is to create maps in which the individual data points can be linked both geographically and conceptually to other data points. These geographic information systems rely on various spatial statistical analyses to produce scientifically rigorous maps.

KNOWLEDGE BUILDING

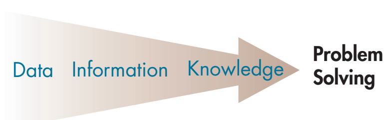
Synthesis and visualization techniques are underutilized

Greater amounts of information, from diverse sources, have increased the difficulty of achieving effective synthesis. However, the need for obtaining an integrated view is increasingly essential to build knowledge and feed into applications of this knowledge. Synthesized information with good visualizations is critically needed, but is often lacking.

Developing consensus among scientists can be difficult due to different discipline-based perspectives. Yet, a consensus of what is reasonably well understood can be achieved, as well as identifying contentious issues and gaps in knowledge (= future research needs). Providing an integrated perspective to make recommendations explicitly linked to environmental outcomes provides a solid foundation for well informed decision making. Simplified conceptual diagrams are a useful tool in synthesis, visualization and communication.



A simplified conceptual model of ecosystem responses to nutrient over-enrichment in Chesapeake Bay



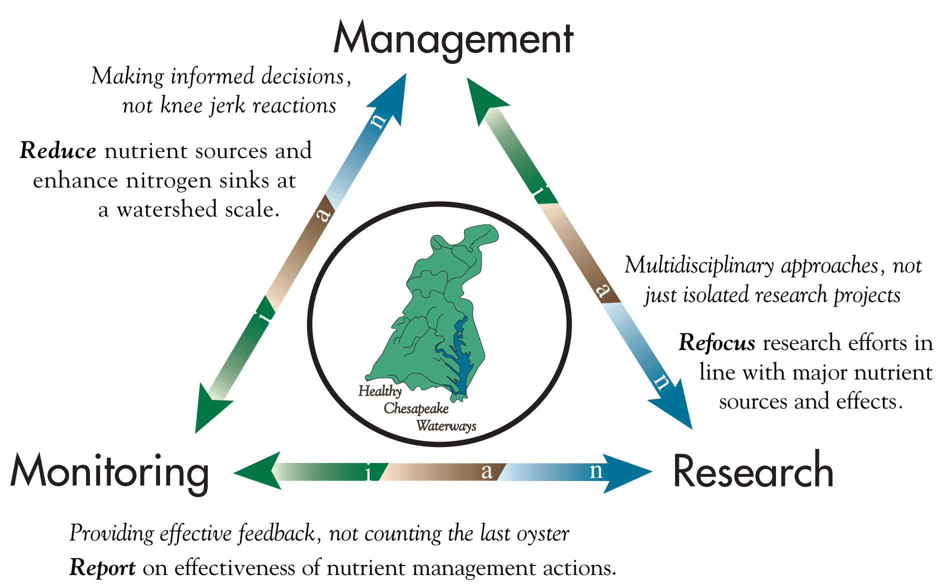
PROBLEM SOLVING

An integrated and applied approach is needed

A FOCUS ON NUTRIENTS

It is proposed that we focus research, monitoring and management activities on nutrient over-enrichment, a major environmental problem in Chesapeake Bay and its watershed. But there are a myriad of environmental problems in the streams, rivers and estuaries that make up the Chesapeake waterways—why focus specifically on nutrient over-enrichment?

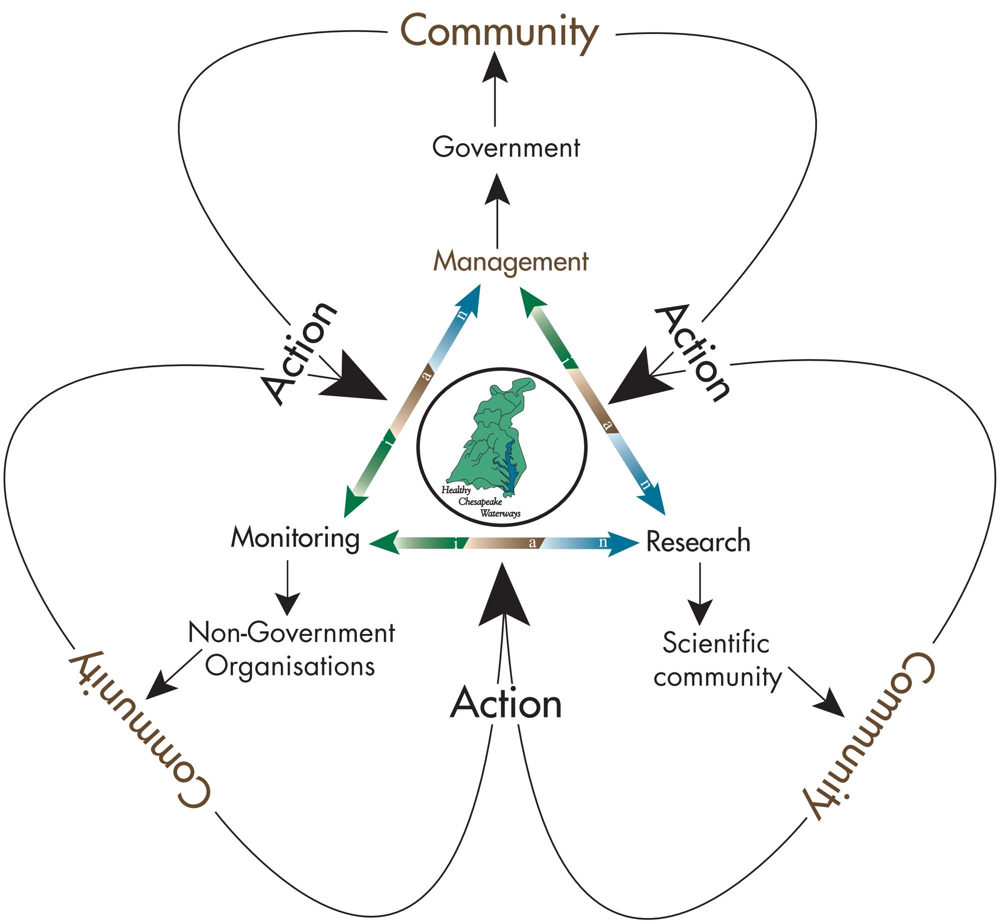
- Without losing sight of the complexity of environmental issues facing Chesapeake Bay and its watershed, a nutrient focus will help integrate research, monitoring and management activities. Other environmental issues (such as fishing, dredging, invasive species and diseases) affect nutrient cycling and their influence needs to be evaluated and managed.
- Management interventions regarding nutrients have the potential to effect positive results over reasonable time scales (years, not decades or centuries).
- Nutrient over-enrichment has been directly implicated in Chesapeake Bay anoxia and harmful algal blooms.
- Solving the nutrient over-enrichment problem involves diffuse and point sources, solutions that also reduce other contaminants.



INTEGRATION AND APPLICATION NETWORK

Meeting the coastal management challenge

Our coastal management challenge is to cope with increasing population pressures without irreversibly damaging coastal ecosystems. Chesapeake Bay is the most studied estuary in the world, yet major problems persist. Better integration and application of scientific findings is critically needed. The Integration and Application Network will facilitate various synthesis activities (e.g. workshops, publications, presentations). Specific projects to be undertaken in the next year include the following projects: Communication and Data Exchange (CODEX), On-line conceptual diagrams, Report cards, and an eChesapeake web portal.



In order to SOLVE environmental problems, science within the Chesapeake watershed needs the following features: Shared vision (e.g., Healthy Chesapeake Waterways), Organized individuals (e.g., Chesapeake Bay and watershed organizations), Linked and balanced approach (management, research and monitoring), Varied communication (internal and external) and Effective actions (community responses to environmental problems). The Integration and Application Network will focus on the links and communication aspects of environmental problem solving.

COMMUNICATION AND DATA EXCHANGE

Communication and Data Exchange (CODEX) will consolidate various data on the Chesapeake watershed, with particular emphasis on geographical information system (GIS) data. It will utilize land use maps, remote sensing data, photographs, conceptual diagrams, and animations to produce a functional, web-accessible and searchable data resource.

ON-LINE CONCEPTUAL DIAGRAMS

A simple software program will be developed for general use that will allow users to 'click and drag' various icons to create conceptual diagrams. Visual conceptual diagrams can be very effective at presenting fundamental messages in a clear and concise format.

REPORT CARD

A geographically explicit report card on Cheseapeake Bay and its watershed will be produced, based on rigorous scientific results. This report card will use ecosystem health indicators that are based on management objectives and help focus future research and management.

eCHESAPEAKE WEB PORTAL

A typical web search on "Chesapeake Bay" results in over 300,000 sites and a bewildering amount of information, but little context in which to place this information. A portal that provides both a geographical context as well as a conceptual framework for the key Chesapeake web sites will be created.

Science newsletters produced through IAN will provide a vehicle for direct expression of a scientific perspective on coastal management issues. These newsletters will synthesize scientific findings and therefore augment, not replace, various other science communication activities. The style and format of these newsletters will be similar to this initial Healthy Chesapeake Waterways newsletter.

PRIMARY OBJECTIVES FOR IAN

- **Foster** problem-solving using integration of scientific data and information
- **Support** the application of scientific understanding to forecast consequences of environmental policy options
- **Provide** a rich training ground in complex problem solving and science applications
- **Facilitate** a productive interaction between scientists and the broader community

integration application network

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