Project Summary
The proposed project will develop and deploy a Chesapeake Bay Environmental Observatory (CBEO) to serve as a prototype of cyberinfrastructure (CI) for environmental observatories and to demonstrate the transformative power of CI for environmental science and engineering. The project is organized into four concurrent interacting elements. (1) The first of these, the CBEO:T, will construct a CBEO test bed prototype that can be configured rapidly so that progress can be made. It will initially integrate a subset of currently available large data sets characterized by multiple variables and widely disparate time and space scales − grab and continuous sampling at fixed stations, undulating towed sensors, and satellite and aircraft remote sensing. A novel and exciting feature of the CBEO will be the inclusion of the fifteen year (1986-2000) simulated data from the Bay-wide fine spatial (1-10 km) and temporal (0.02-1 hr) scale hydrodynamic and water quality model. This test bed will serve initially as the platform for the development of the data integration, interpolation, and visualization functionalities. (2) The CBEO:N group will incorporate the test bed CI into the national network of environmental observatories by constructing a GEON node for the CBEO and resolving complex cross-disciplinary issues of semantics, syntax and interoperability. (3) The CBEO:T and CBEO:N will be used by the environmental science element (CBEO:S) to demonstrate its utility by addressing the unresolved questions of anthropogenic and climatic factors controlling hypoxia in Chesapeake Bay, a problem it shares with many other estuaries and whose consequences are severe and long lasting. The CBEO:T team will test the CBEO capabilities, suggest modifications and additions, and provide timely user feedback. (4) To expand the user community. the CBEO will be used by the education element (CBEO:E) to translate science and technology for public consumption. Direct participation of multicultural students and a K-12 teacher are planned. The CBEO:T and then the CBEO:N will be the focus of two workshops aimed at users and the wider community including environmental managers and science educators.

Intellectual Merit
The CBEO will be developed by a team of highly qualified computer scientists, marine scientists and environmental engineers who already have a track record of working together on environmental observatory projects and complex cross-discipline research efforts. We appreciate the power of blending CI and domain science to produce new and exciting scientific insights and engineering tools. The CI will produce a joining of disparate and incommensurable Chesapeake Bay data sets, a valuable and important contribution, as demonstrated by the success of the National Virtual Observatory. However, there is much more to be gained. We will provide new interpolation and analysis tools, linked to available visualization software, that can take advantage of the multiple variables and types of data in the 5D joined set. The availability of 15 years of fine-grained hydrodynamic flow and transport information will be used to developed velocity-directed interpolation functions that will greatly expand the utility of the less dense observations. Developing analysis functions that can compute source terms from state variable observations, e.g., nutrient uptake rates corrected for transport losses; volumes of iso-surfaces, e.g., hypoxic water volume progression and duration; and fluxes across planes, e.g. organic matter export from the shallow regions of the Bay, will provide new and heretofore unavailable windows into the workings of the Bay in general and the mechanisms of hypoxia generation in particular. The prospect of converting the available vast and mostly unexamined observational and modeling data resources excites and motivates us to pursue the CBEO.

Broader Impacts
Pursuing the causes of "dead zones" − a widespread problem with current public visibility − has an educational appeal that can be exploited to provide exciting and relevant learning experiences for K-12 as well as adult students. An observatory, with its visualization capability, can provide a direct appreciation and apprehension of the more abstract concepts of marine science. Yearly workshops for users, teachers and managers will have hands on demonstrations of the CBEO. Students will enter and use data collected from yearly cruises of the Hampton University's *MAST* (Multicultural students At Sea Together) project. A teacher-fellow from the UMCES – Maryland Sea Grant Environmental Science Education Partnership (*ESEP*) program will develop a classroom application for K-12, which will be tested in the teacher's classroom during the school year. Society will benefit from both the educational and scientific progress attending the development of the CBEO in particular and environmental observatories in general. They will provide a new and transformative window into the workings of environmental systems.