AGU Science Policy: The Changing Ocean and Impacts on Human Health
Washington, DC
June 26, 2013

Frederick L. Tyson, Ph.D.
Program Director

Cellular Organ and Systems Pathobiology Branch

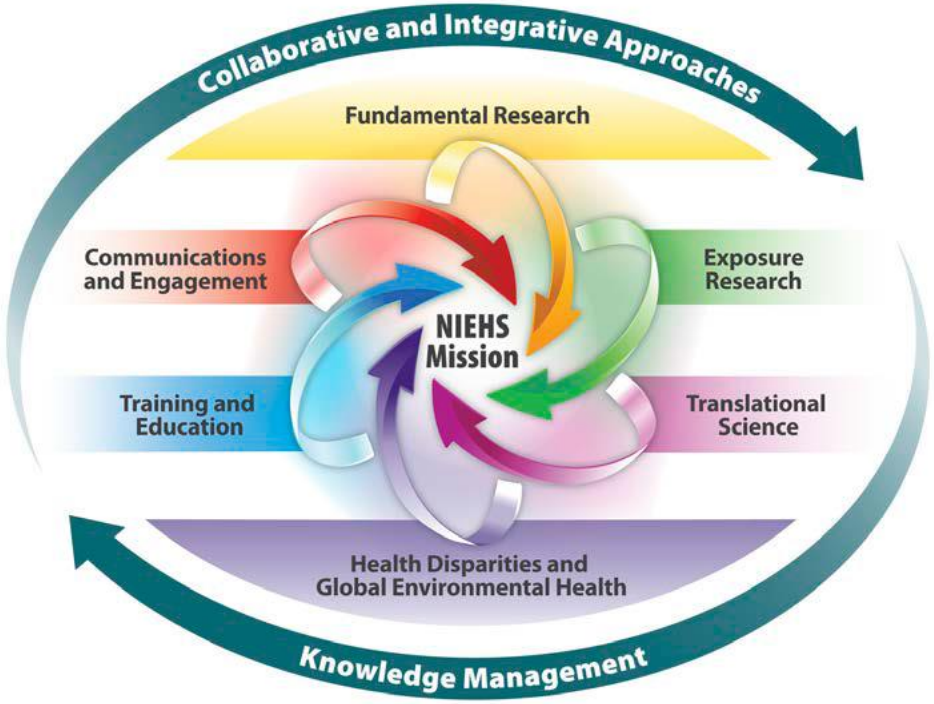
Division of Extramural Research and Training
National Institute of Environmental Health Sciences

Why do we need an OHH research program?

- 60% of the World's population lives near coastal areas
- 53% US population in Coastal Counties with 75% by 2025
- 90% future world population growth in Sub/Tropical areas 6 billion to 8.3 billion (2025)
- Increased use of coastal/marine resources

Involvement in NIEHS Strategic Plan

- Exposure Research
- Translational Science
- Communications and Engagement
- Health Disparities and Global Environmental Health



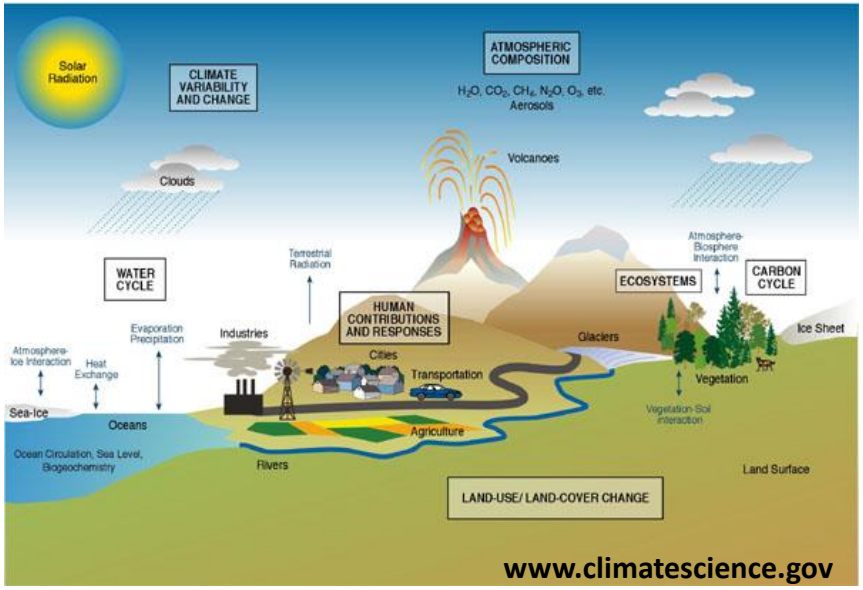
NIEHS-NSF OHH Initiatives

- **Center Program**
  - P01 mechanism
  - HABs
  - Marine Pollution
  - Modeling
  - Global Climate Change
- **Single Projects**
  - R01 mechanism
  - Marine HABs
  - Great Lakes Human Health Research
  - Modeling
  - Global Climate Change

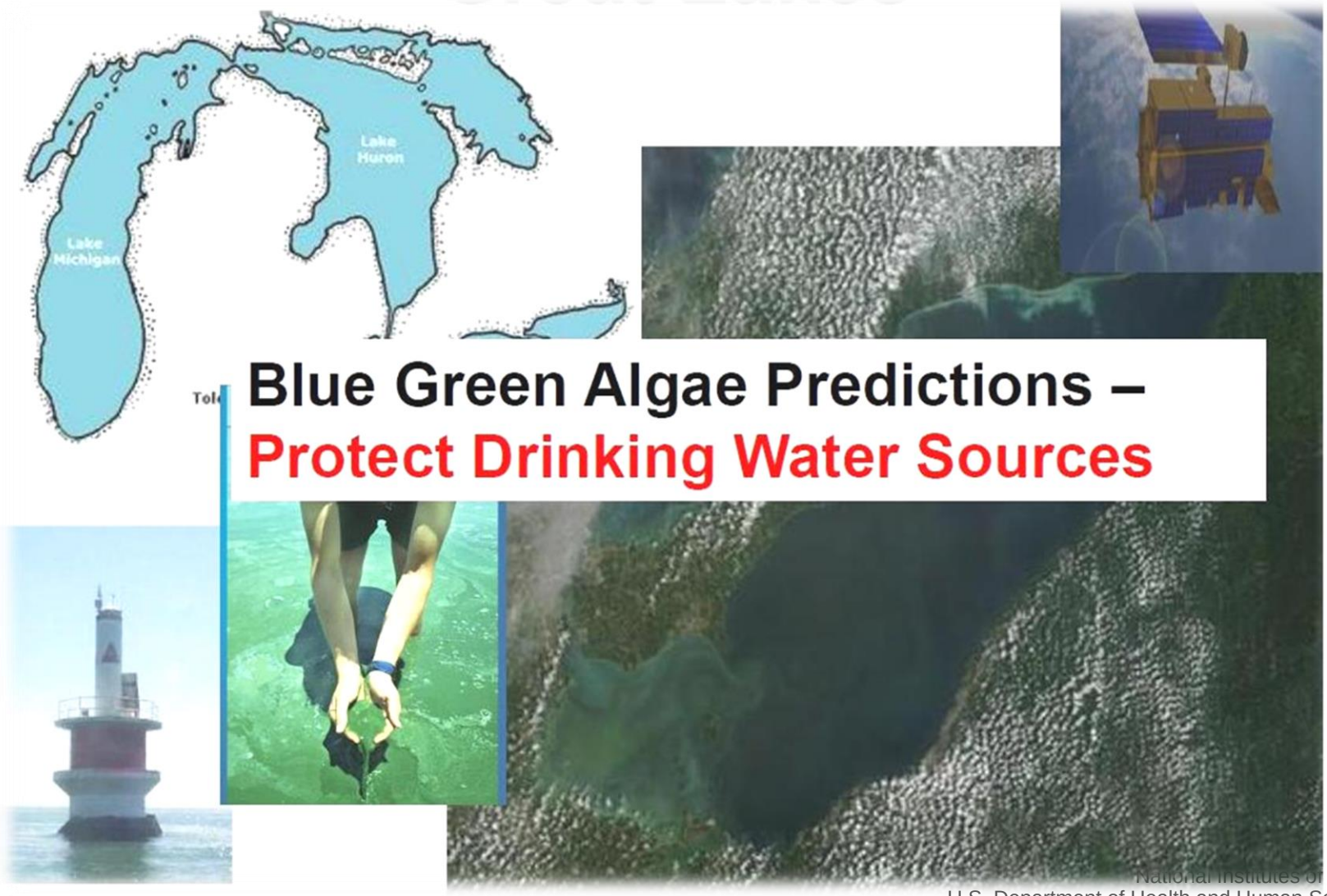
Harmful Algal Bloom Impacts

Global Climate Change

- Increased CO2 and Sea Surface Temperature (SST)
- Sea Level Rise
- Severe Weather
- Infectious Diseases
- Threat to Fisheries
- Marine Microbial
- Harmful Algal Blooms (HABs)
- Other Microbes
- Most Vulnerable are the Developing Nations!



Great Lakes


Lake Huron
Lake Michigan
Blue Green Algae Predictions –
Protect Drinking Water Sources

Anthropogenic Contamination

- **Synthetic Organic Chemicals include:**
  - Pesticides & Herbicides (DDT), PCBs
  - Metals (Hg)
  - Pharmaceutically Active Compounds
- **– Characterized by persistence:**
  - bioavailability,
  - tendency to bio-accumulate,
  - toxicity
- **Found in fish, shellfish, birds, marine mammals, & human populations**

Research Scope of OHH Projects

Exposures	Models	Research Focus	Health Outcomes
MeHg, As, HOCs, PCBs, PFCs	Mouse	Remote HAB Sensing	Immunotoxicity
Oil Spill Pollutants	Zebrafish	Epigenetic Mechanisms of Developmental Toxicities	Neurobehavioral
Cyanotoxins	Gulf Killifish	ABC Transporter Mechanism Mediated Bioaccumulation of Toxins	Neurological Disorders
Domoic acid	Human Populations	Novel Prediction Algorithms	Epilepsy
Brevetoxin	Sea Lions	Seafood Safety	Endocrine & Thyroid Disorders
Saxitoxin		Translational Regulation of Gene Express in Dinoflagellates	Reproductive Toxicity
Microcystins			
Cylindrospermopsin			
Anatoxin			
BMAA			

WHCOHH: Harmful algal bloom dynamics and epigenetic mechanisms of toxic action

This Program Project employs novel remote sampling technologies to achieve new insights into the population dynamics of known and emerging HAB threats, and to address critical mechanisms of toxin action, linking developmental exposures to adult consequences.

The ultimate mission of the Center is to improve the public health through enhanced understanding of how oceanic and environmental processes affect the production, distribution and persistence of toxin producing organisms, and the risks from exposure to their potent neurotoxins.

Dartmouth: Climate impact on coastal ecosystem methylmercury: human exposure implications

Methyl mercury (MeHg) is a global toxin impacting human health, and marine ecosystems are dominant sources of human exposure through consumption of marine fish and shellfish. Estuarine ecosystems are both a major source of MeHg to marine food webs and locations where climate induced changes and nutrient and carbon loading will have complex effects on the production, transfer, and bioaccumulation of MeHg. The investigators are examining these interactive effects which are critical to understanding the future impact of MeHg on human exposure and health.

University of New Hampshire: Development of novel detection and prediction algorithms for Microcystis blooms

During HAB events, toxin concentration limits in the Great Lakes drinking water supply are often exceeded. The investigators' research will improve current detection and prediction capabilities of HABs in the Great Lakes region, and will be directly beneficial to health and economic aspects of the many U.S. citizens who live in the region. The investigators bring a broad range of experience in remote sensing, in situ observational technology, and phytoplankton ecology that can help address the health and science issues related to toxic blooms in the Great Lakes.

Lake Superior State U: Development of novel toxin detection methodologies applicable to marine and freshwater systems

Algal blooms cause serious water quality and human health issues; however, their ecology remains poorly understood. The goal is to develop and employ a flexible real-time multiplex quantitative polymerase chain reaction (MqPCR) assay for the simultaneous quantification of co-occurring toxic HAB genera in a single reaction. Using a cutting-edge genetic method the investigators will further their understanding of the environmental factors promoting these toxic algae. This will allow for the further development of successful predictive models and algal remediation strategies that will help protect humans from the negative human health effects of algal toxin exposure.

UT-Arlington: In Situ Sensing System for the Selective and Sensitive Detection of Biological Toxins in HABs

The overall goal of this study is to real-time monitor the level of microcystins (MCs) in situ using an innovative wireless sensor network (WSN). The in situ wireless sensing network can monitor various lethal biological toxins, microcystins in water resources sustainably and responsively and communicate the information to remote authorities in real-time for establishing an early warning system to protect public health. Monitoring general algal bloom activities gives an idea on "potential hazard" while monitoring actual biological toxin release gives an insight on "imminent hazard".