

Tools for a Changing Ocean



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Changing Oceans

⊕ Oceans are undergoing profound changes

- Increase in CO₂ and other greenhouse gases causing increasing temperature, ocean acidification, sea ice retreat, sea level rise, etc.
- Over and destructive fishing, habitat alteration, invasive species, land-based pollution, energy extraction, etc.

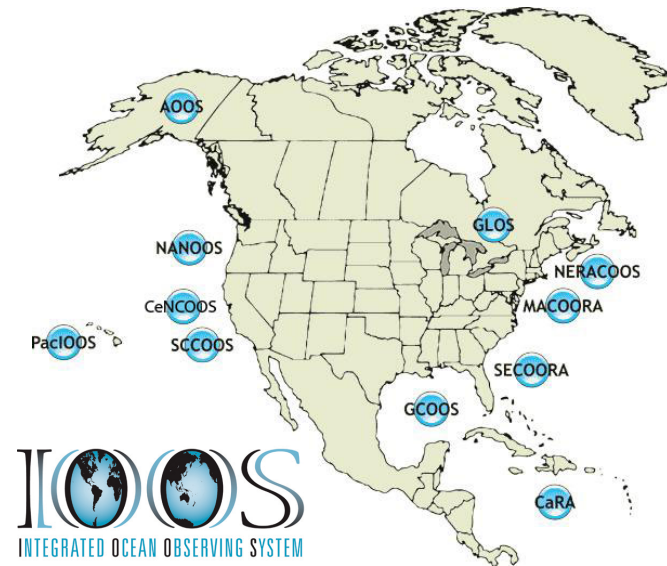
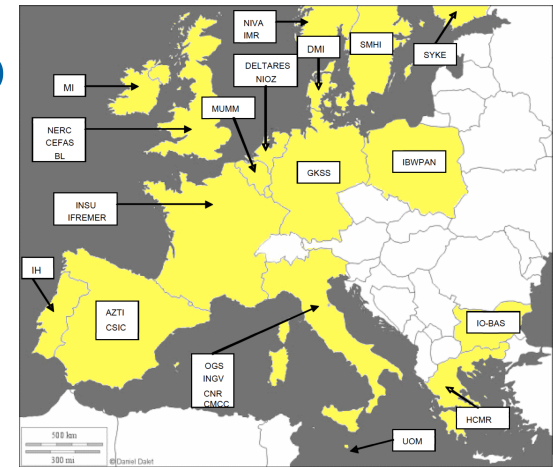
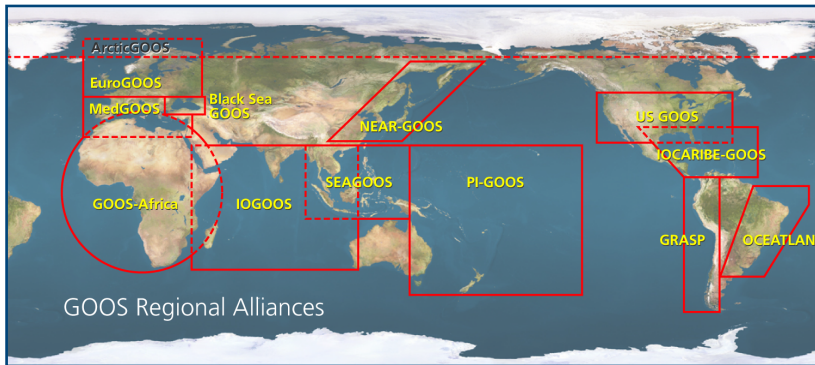


⊕ Ocean science will need to change

- Science needs to quantify, understand, and predict changes and impacts
- Science needs to be the foundation for developing strategies to adapt to changing oceans and to mitigate the impacts on society and economies



Coastal and Ocean Observing



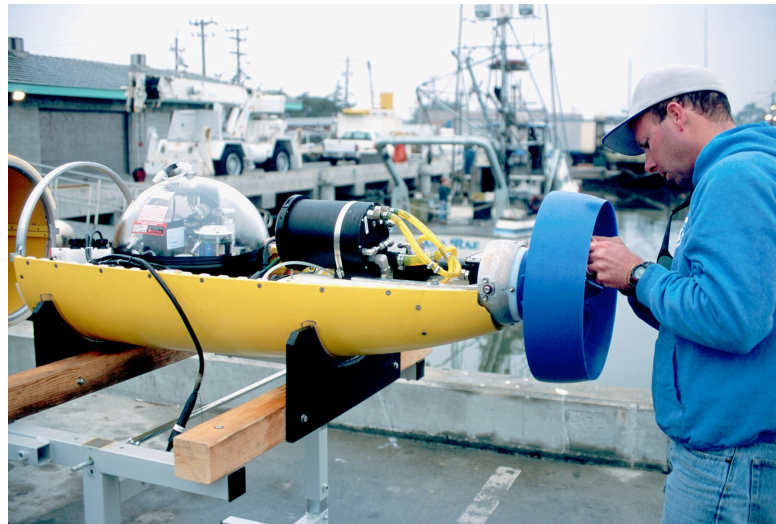
NRC Ocean Infrastructure 2030



How Do We Get There?

⊕ Technology Requirements and New Innovations

- **Reliable/robust, accurate/precise instrumentation**
- **High spatial and temporal resolution observations with innovative in situ and remote sensing**
- **Going beyond physical and chemical measurements with bio- and geno-sensors**
- **Significant and sustained local, national and international commitment**



Alliance for Coastal Technologies

ACT Priorities

- ⊕ Transition emerging technologies to operational use rapidly and effectively
- ⊕ Maintain a dialogue among technology users, developers, and providers
- ⊕ Identify technology needs and novel technologies
- ⊕ Document technology performance and potential
- ⊕ Provide the information required for deployment of reliable and cost-effective observing networks

ACT Services

- ⊕ A third-party testbed for evaluating technologies
- ⊕ A forum for capacity and consensus building
- ⊕ An information clearinghouse for environmental technologies

Technology Evaluations

✦ Types of Evaluations:

- Performance Verification
- Performance Demonstration

✦ Purpose:

- Document performance under third party tests
- NO certifications, recommendations, or comparisons

✦ Benefits:

- Access to relevant, reliable performance information
- Enhanced ability to identify appropriate technologies
- Level playing field among manufacturers
- Accelerated adoption of innovative technologies

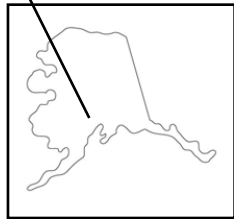
✦ Credibility:

- Objective testing
- Skilled, trained personnel
- Sound methodologies with statistical rigor
- Comprehensive documentation
- Rigorous QA/QC



ACT Partner Institutions

Arctic



Great Lakes



University of Michigan
Cooperative Institute for
Limnology & Ecosystems Research



Pacific

Moss Landing
Marine Laboratories

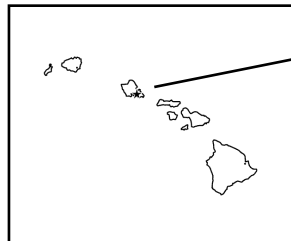


Atlantic



University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE
Chesapeake Biological Laboratory

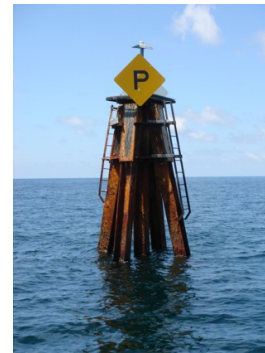
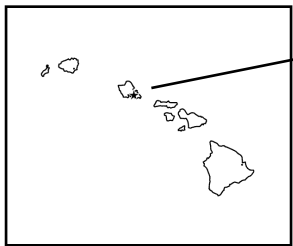
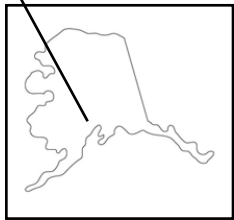
Tropical



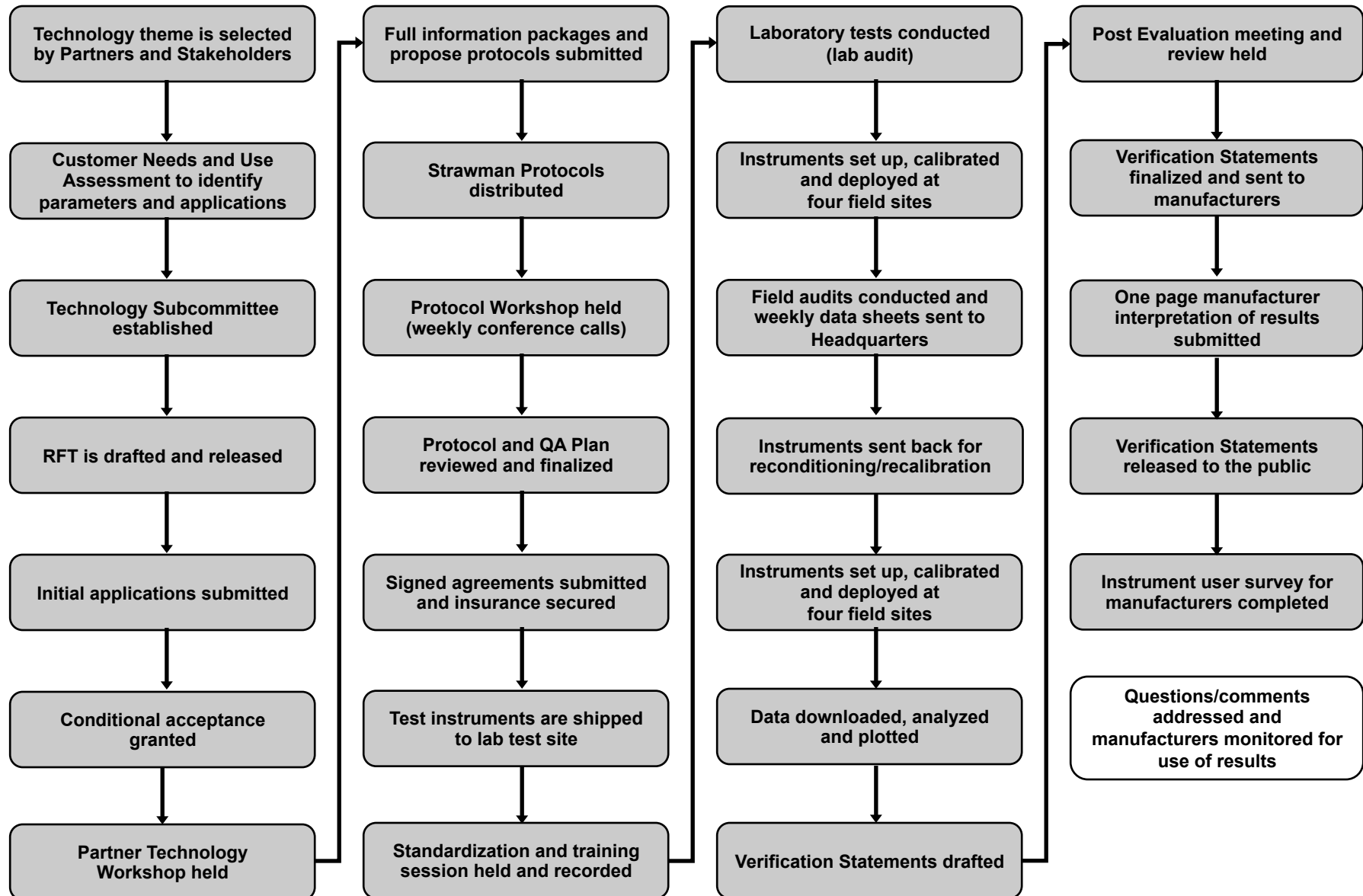
Gulf



Diverse Environments & Applications



Technology Evaluation Process



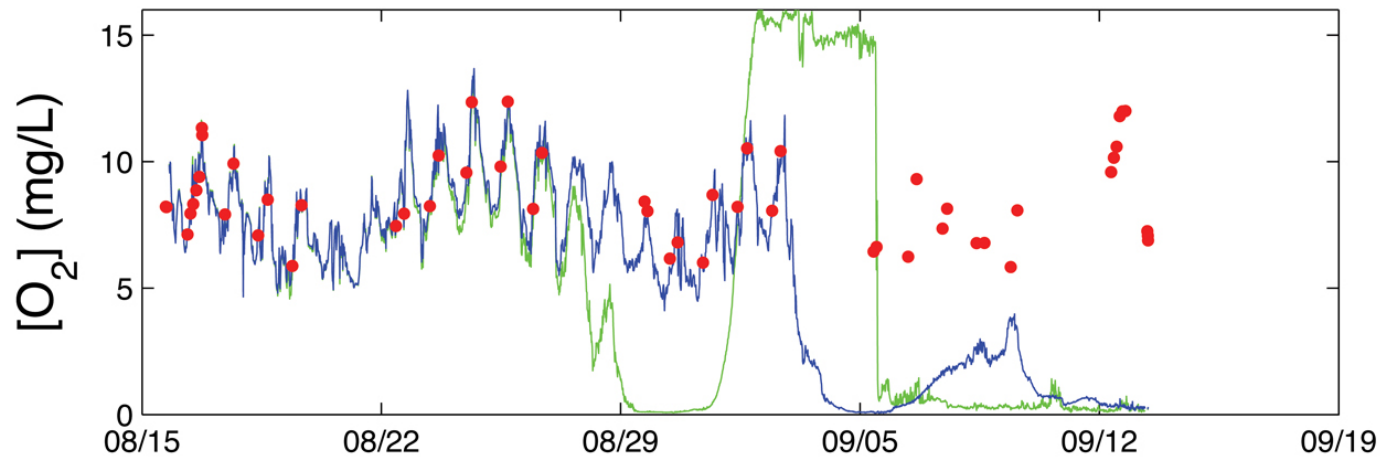
Performance Verifications/Demonstrations

- ⊕ **DO Sensors (2004)** - Aanderaa (optode), Greenspan (galvanic cell), In-Situ (optode), YSI (Clark cell)
- ⊕ **Chl-a Fluorometers (2005)** - bbe Moldaenke, Chelsea (2), Hydrolab, Turner (2), WET Labs, YSI
- ⊕ **Turbidity Sensors (2006)** - Aquatec, In-Situ, McVan, WET Labs, YSI
- ⊕ **Nutrient Analyzers (2007)** - American EcoTech, Satlantic, WET Labs, YSI
- ⊕ **C-T Sensors for In Situ Salinity (2008)** - Aanderaa, Campbell, Falmouth, Greenspan, In-Situ, RBR, Rockland, YSI
- ⊕ **pCO₂ Analyzers (2009/2010)** - Contros, NOAA/PMEL (Battelle), Pro-Oceanus, Sunburst, YSI
- ⊕ **Hydrocarbon Sensors (2011)** - Aquatec, Chelsea (3), Hach, S:can, Turner Designs, and WET Labs
- ⊕ **pH Sensors (2012)** - Aanderaa, Campbell, Idronaut, In-Situ, Satlantic, Sunburst, YSI



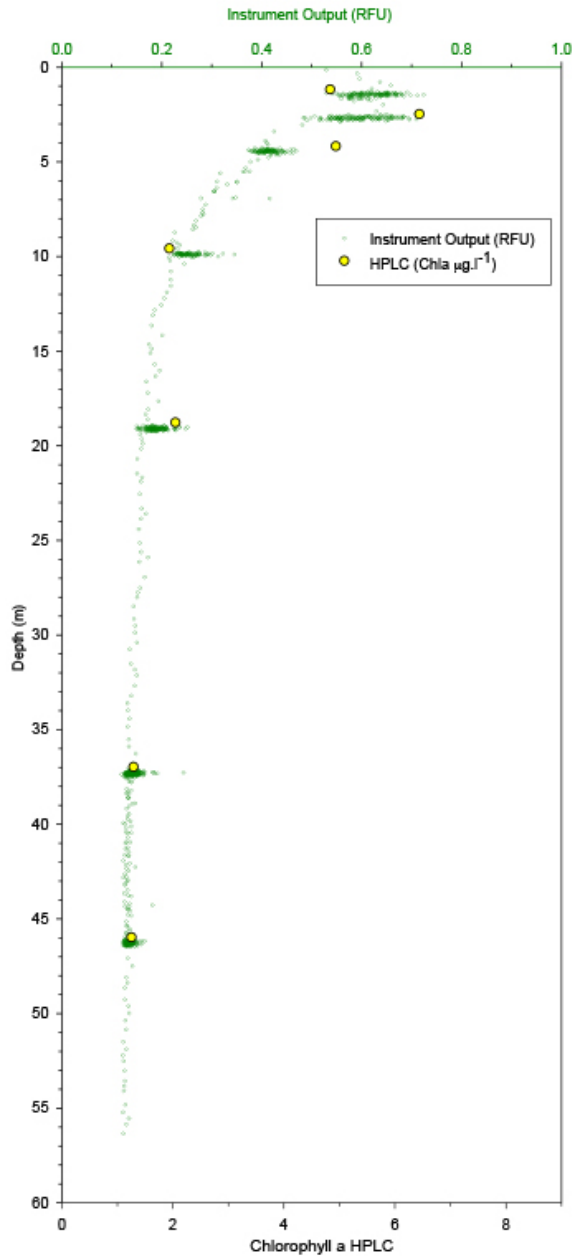
Dissolved Oxygen Performance Verifications

⊕ **Biofouling wins every time**



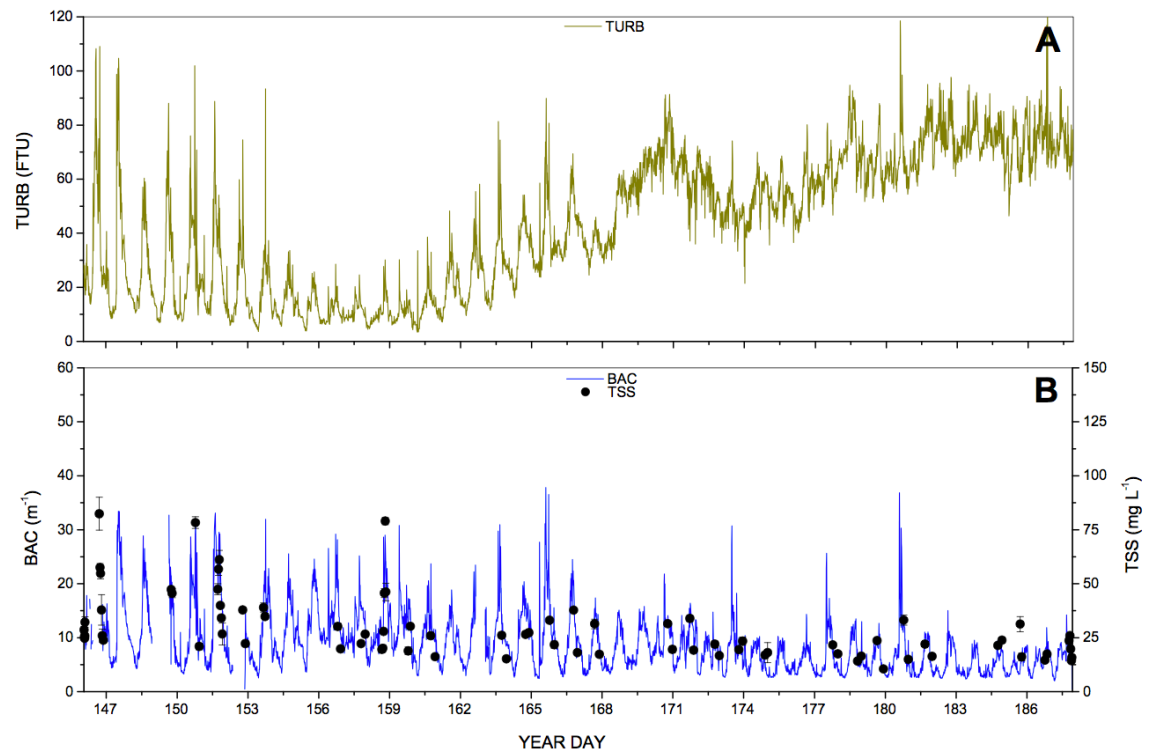
Chl-a & Turbidity Performance Verifications

⊕ What are you really measuring?



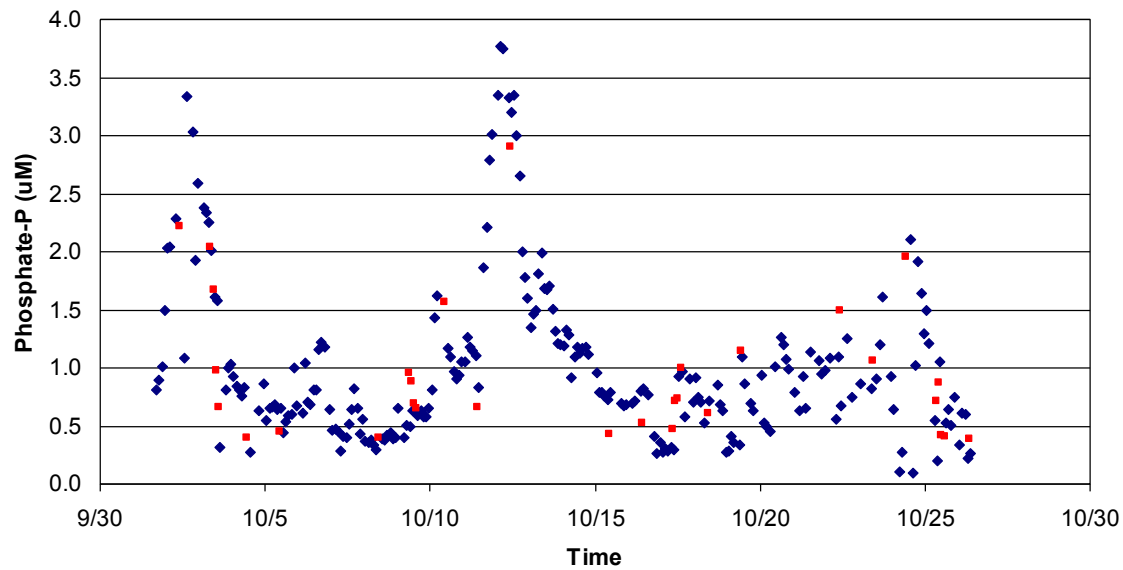
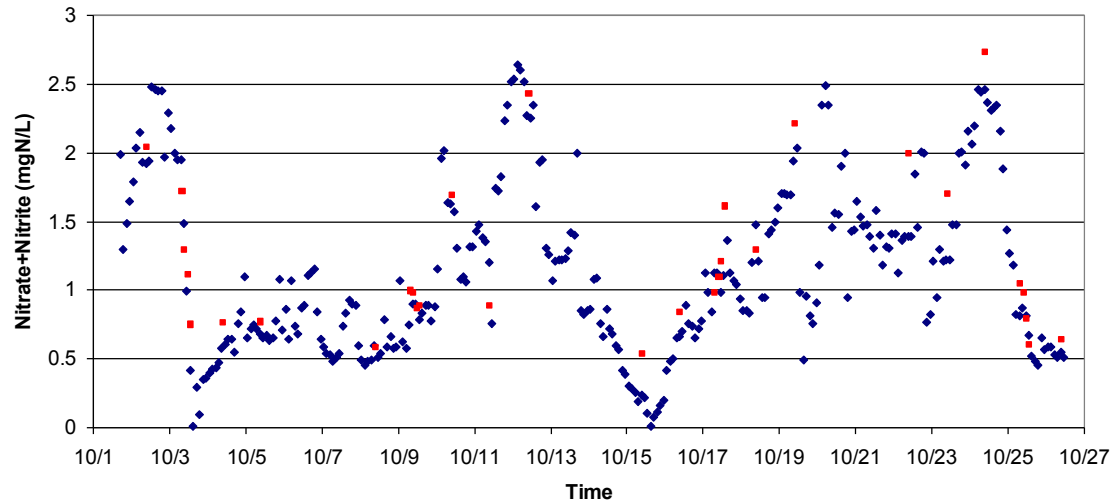
• Chlorophyll Fluorometers

• Turbidity Sensors



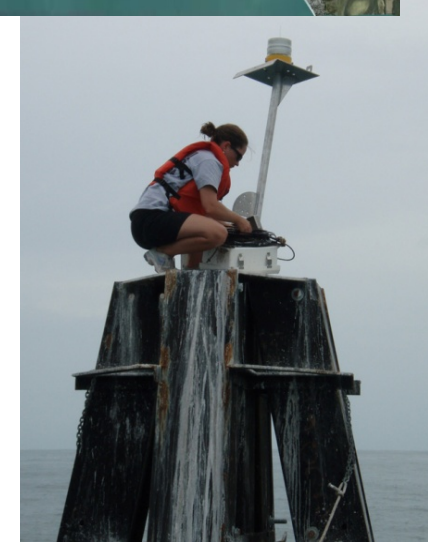
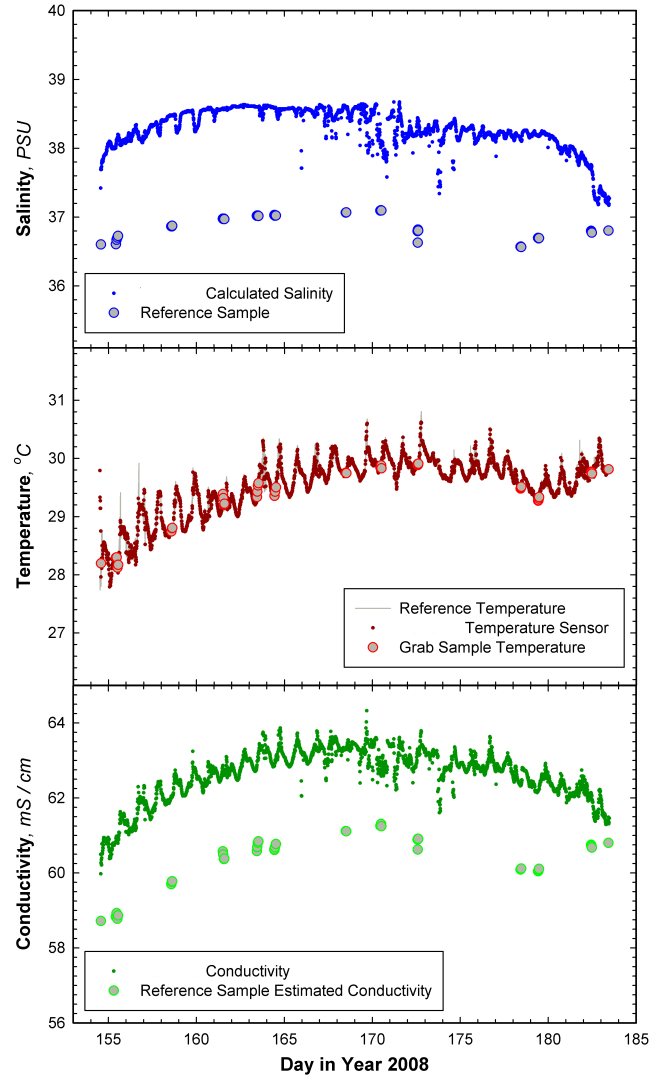
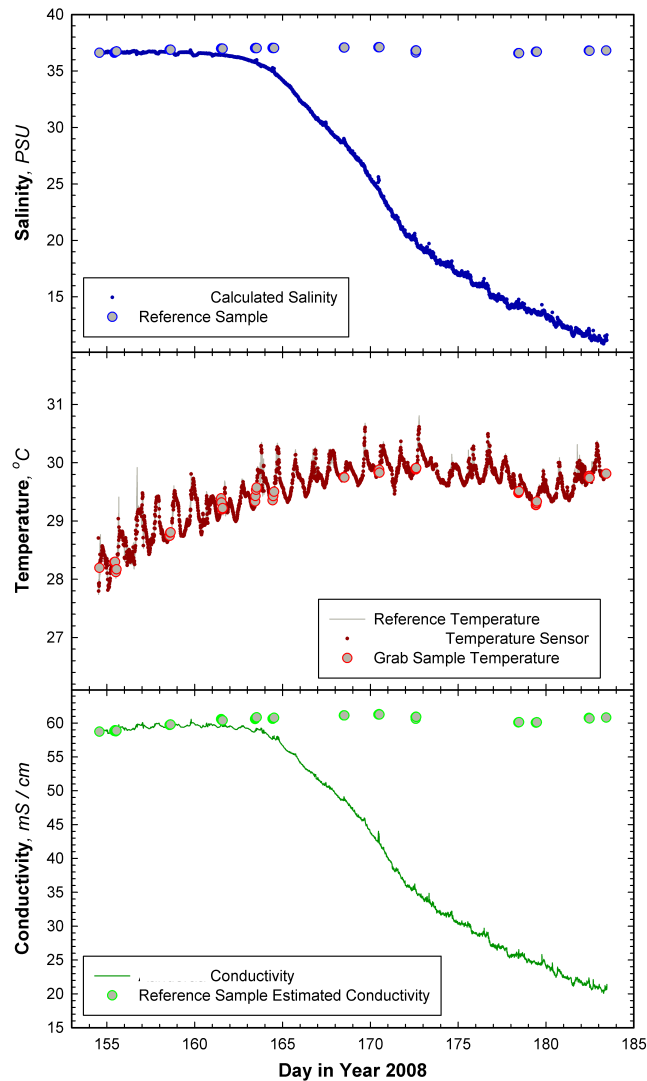
Nutrients Performance Demonstrations

⊕ Transitioning into operations



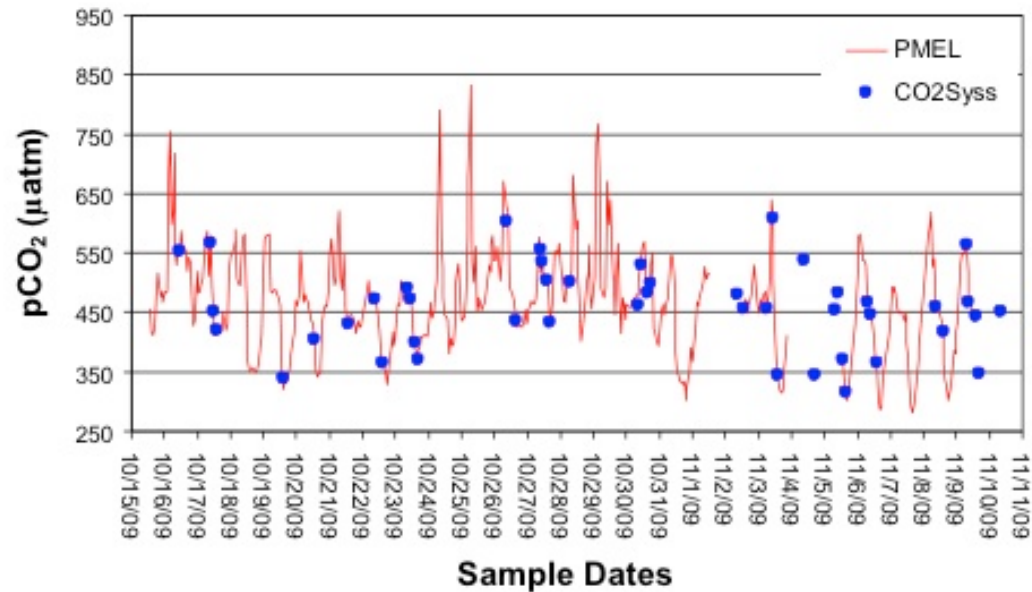
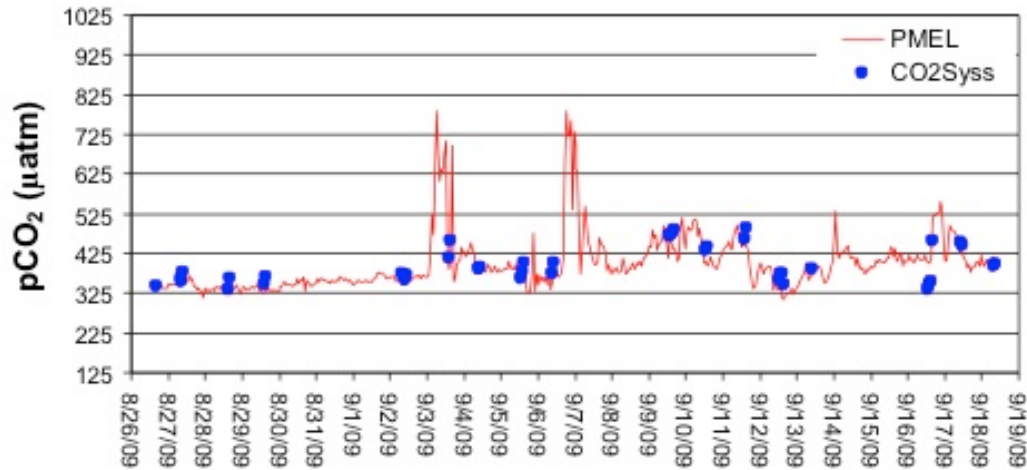
Salinity Performance Verifications

⊕ **Mature ≠ reliable/accurate**



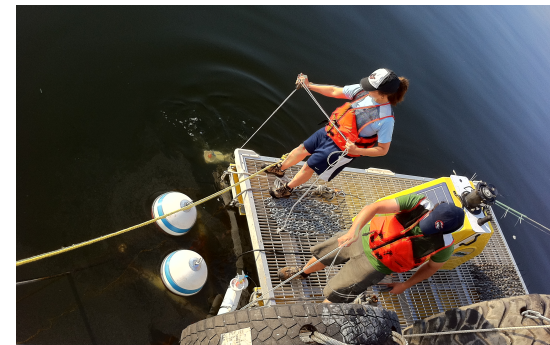
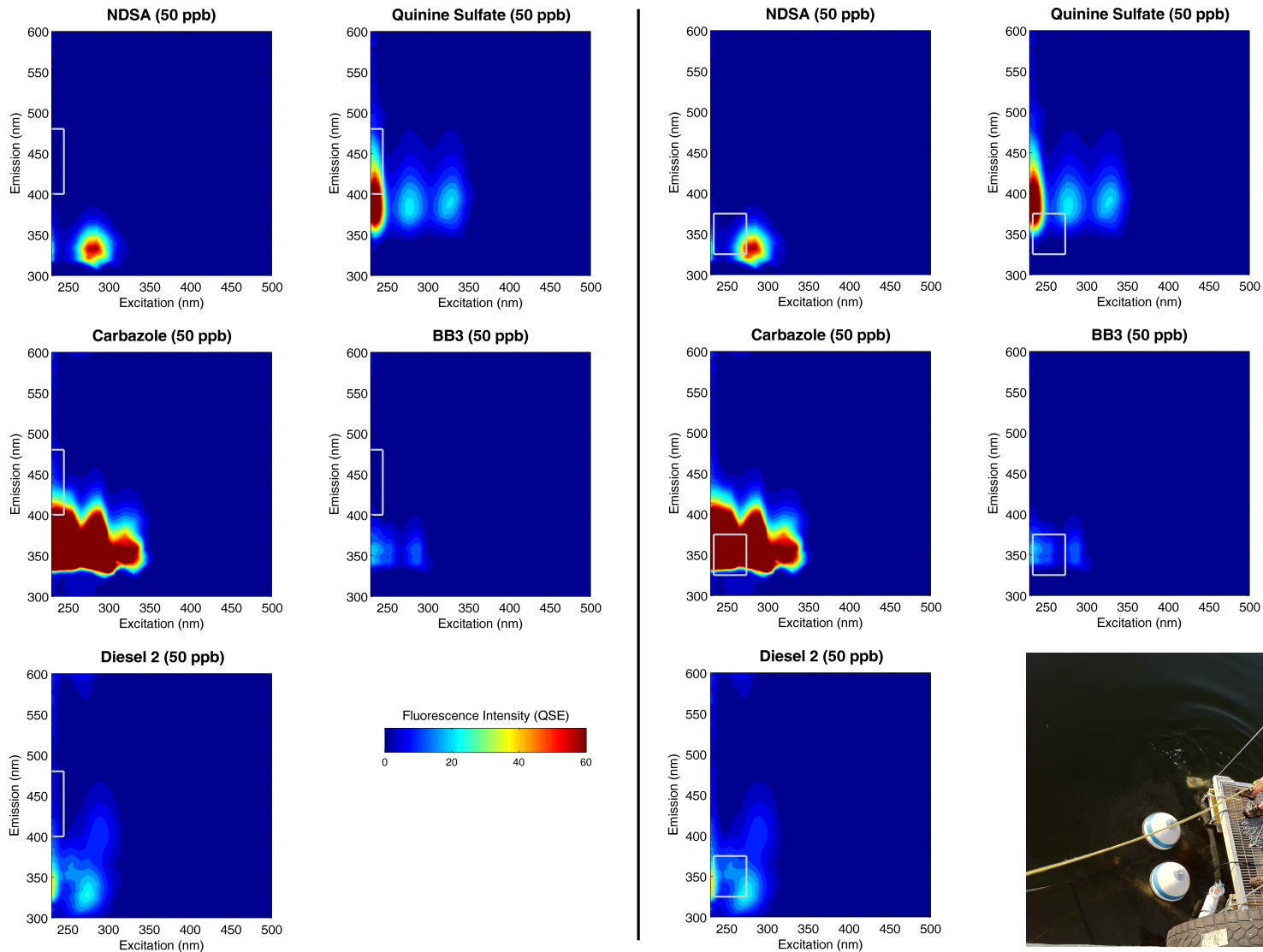
pCO₂ Performance Demonstrations

⊕ pCO₂ is complex



Hydrocarbon Performance Verification

⊕ Are fluorometers the way to monitor of oil spills?



Technology Workshops

⊕ Purpose:

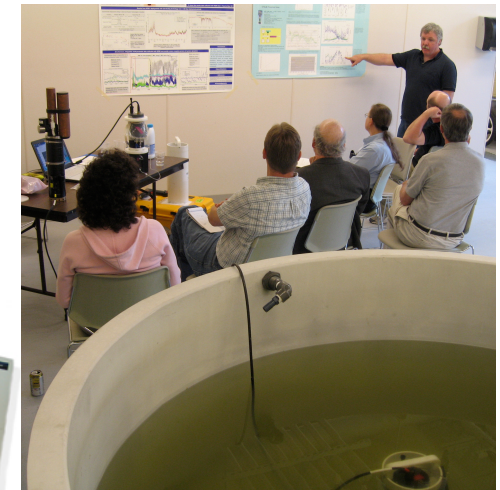
- Review current state of technology
- Discuss limitations to current technologies and identify user needs
- Provide recommendations to ACT and the community
- Enhance connections between users and developers

⊕ Benefits:

- A forum for discussion among users, developers, and manufacturers
- All aspects of community involved in consensus building
- Establish collaborations/partnerships

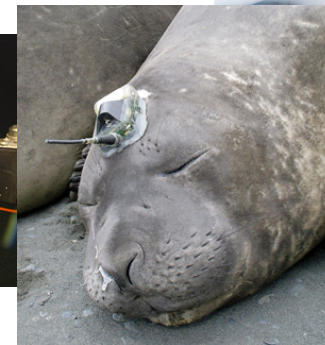
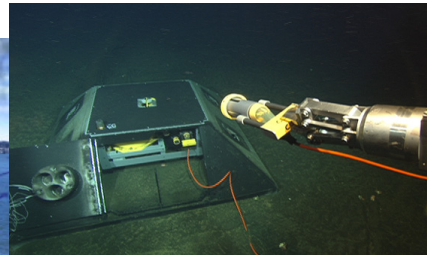
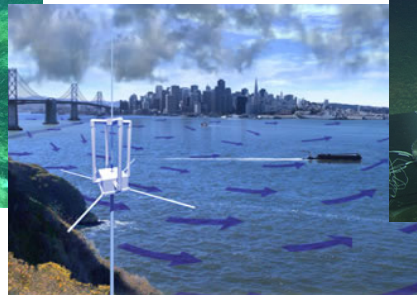
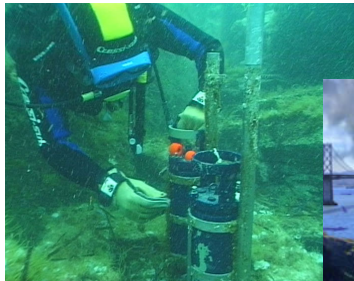
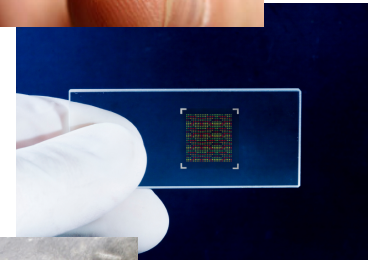
⊕ Outcomes:

- Altered the way data is collected / instruments used
- Altered technology designs / features
- Generated funding opportunities
- Helped focus other ACT activities



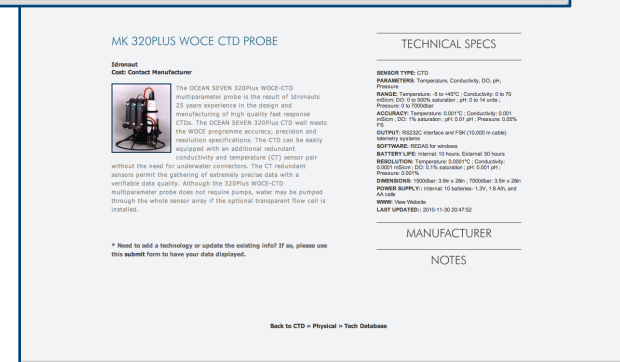
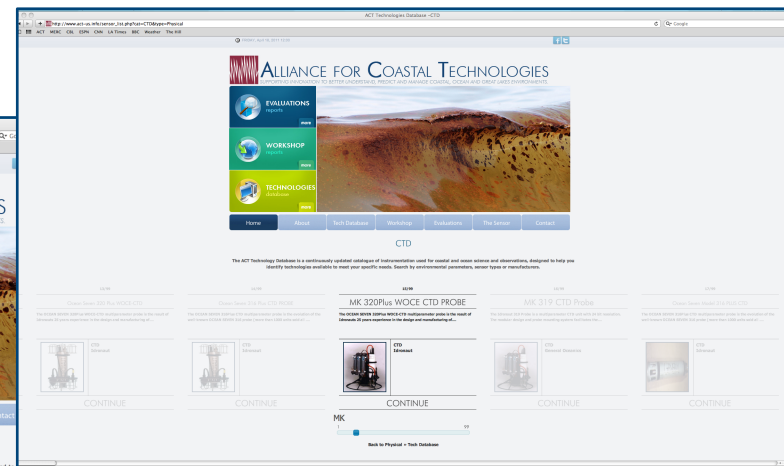
Past Workshops (40)

- ⊕ **Biosensors for Harmful Algal Blooms**
- ⊕ **Management Applications for AUVs and Gliders**
- ⊕ **Surface Current Radar**
- ⊕ **Rapid Identification of Coastal Pathogens**
- ⊕ **Meteorological Sensors for Buoys**
- ⊕ **Integrated Sensor Systems for Vessels of Opportunity**
- ⊕ **Operational Dissolved Oxygen Measures**
- ⊕ **In Situ Measures of Inorganic Carbon Species**
- ⊕ **Hydrocarbon Sensors for Oil Spill Response**
- ⊕ **Data Telemetry From Remote Platforms**
- ⊕ **Sensor Inter-Operability**

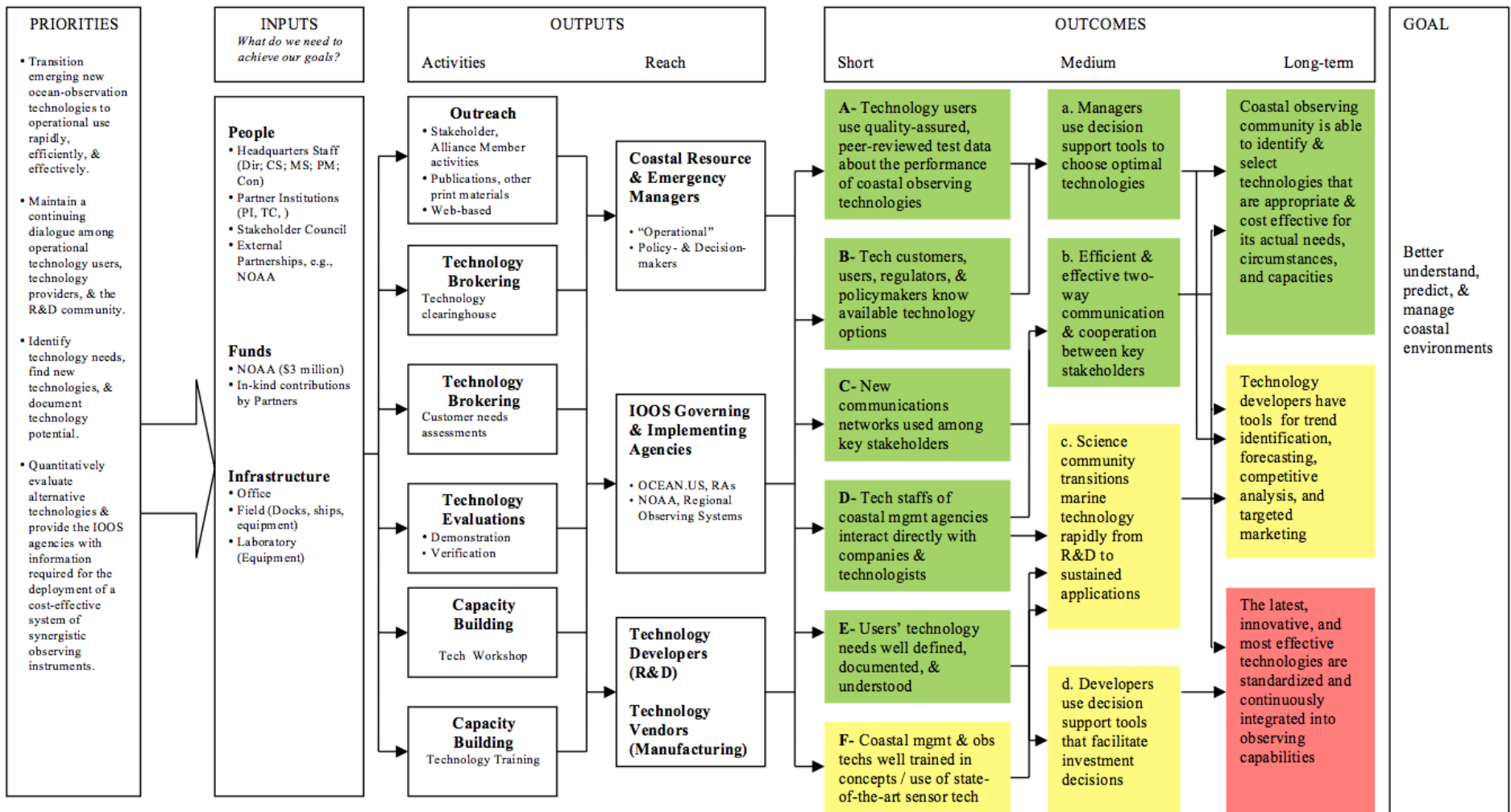


Information Clearinghouse Web and Searchable Technology Database

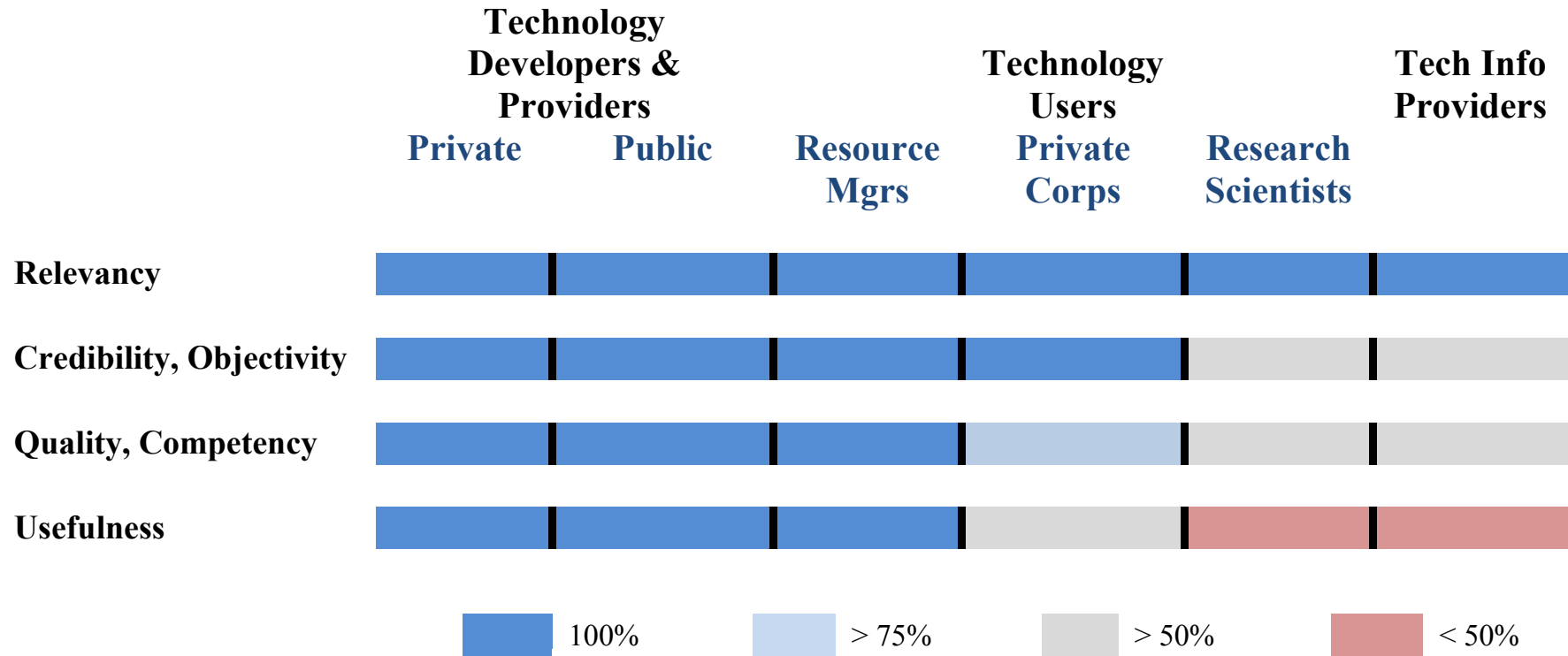
- Organized and standardized relevant information
- Linked to reports and discussions
- Linked to the National Environmental Methods Index



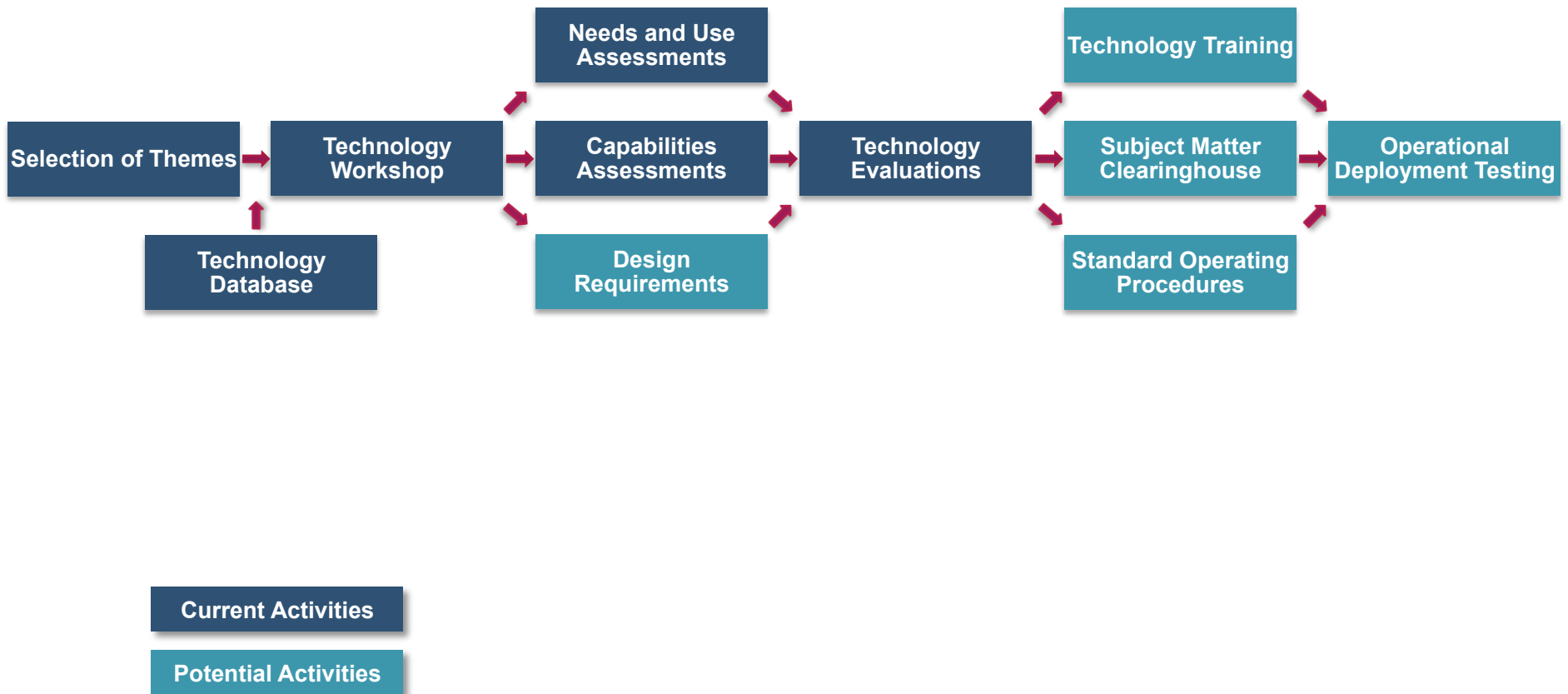
ACT Program Evaluation – Where are we?



ACT Program Evaluation – Where are we?

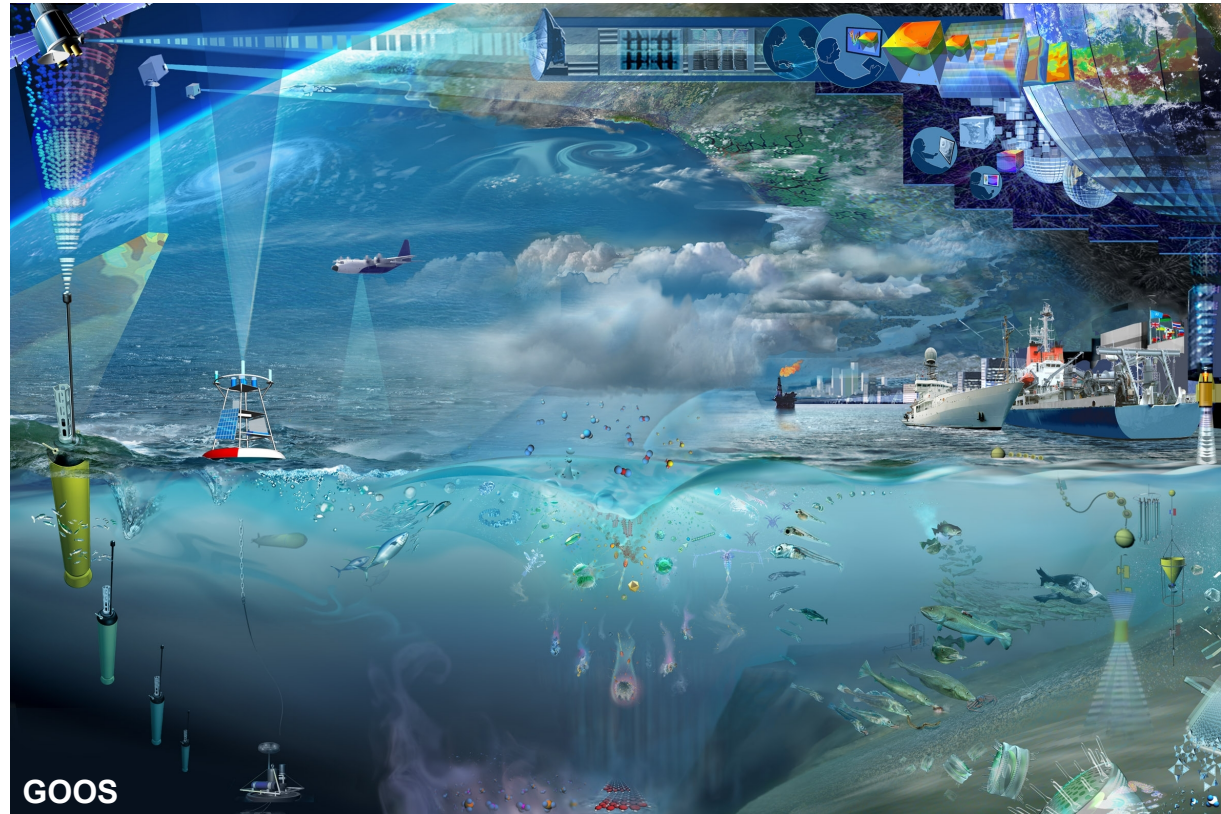


ACT Program Evaluation – Where are we going?



Why aren't we there yet?

- ⊕ Limited resources
- ⊕ Different requirements for different users
- ⊕ Parameters and technologies are complex
- ⊕ Nice to have but not must have



Summary

- ⊕ **Our basic science understanding, forecasting, and management decisions are only as good as the data they are based on.**
- ⊕ **ACT facilitates the development and adoption of novel instrumentation, while minimizing the risks and problems associated with young technology.**
- ⊕ **Long-established instruments still require validation of accuracy, reliability, etc.**
- ⊕ **ACT provides a unique community forum, and basic information, on environmental sensors and platforms.**
- ⊕ **ACT is evolving to address additional community needs and looks forward to partnering with FCT.**

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