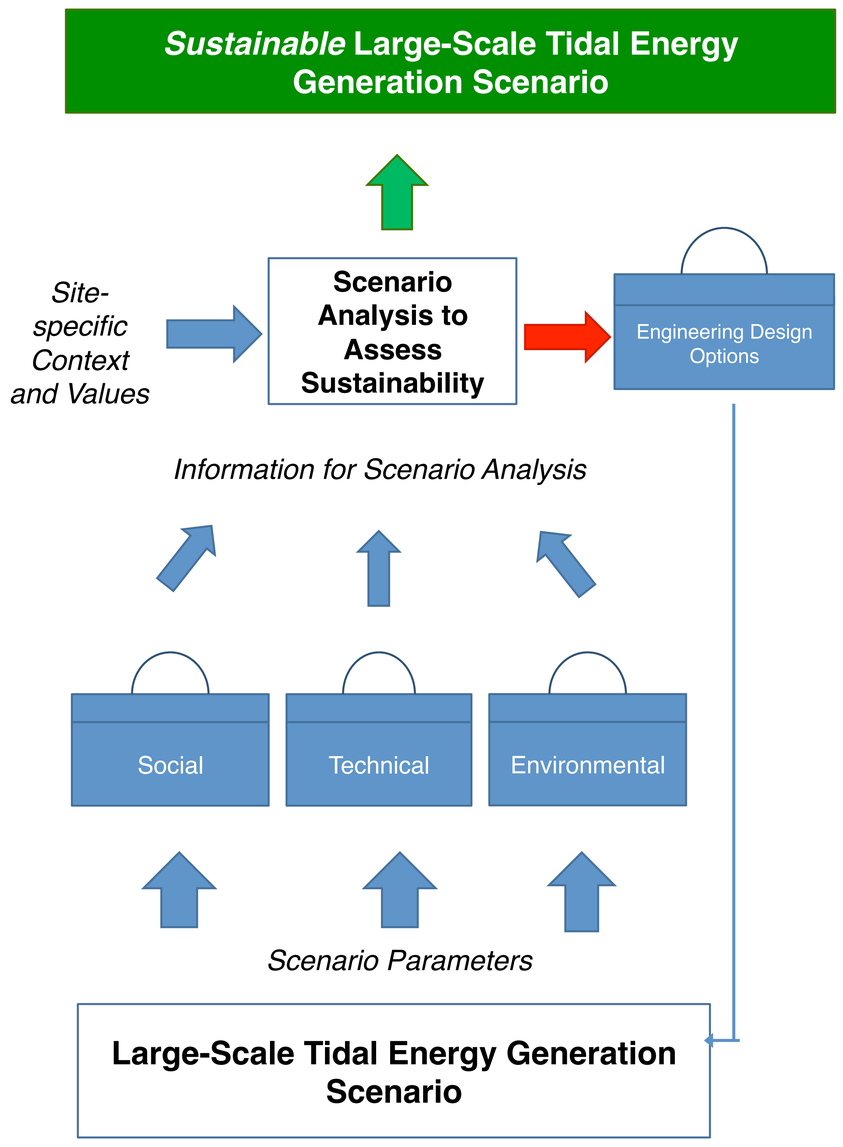
Sustainability of Tidal Energy

Science, Engineering, and Education for Sustainability (SEES): 1230426

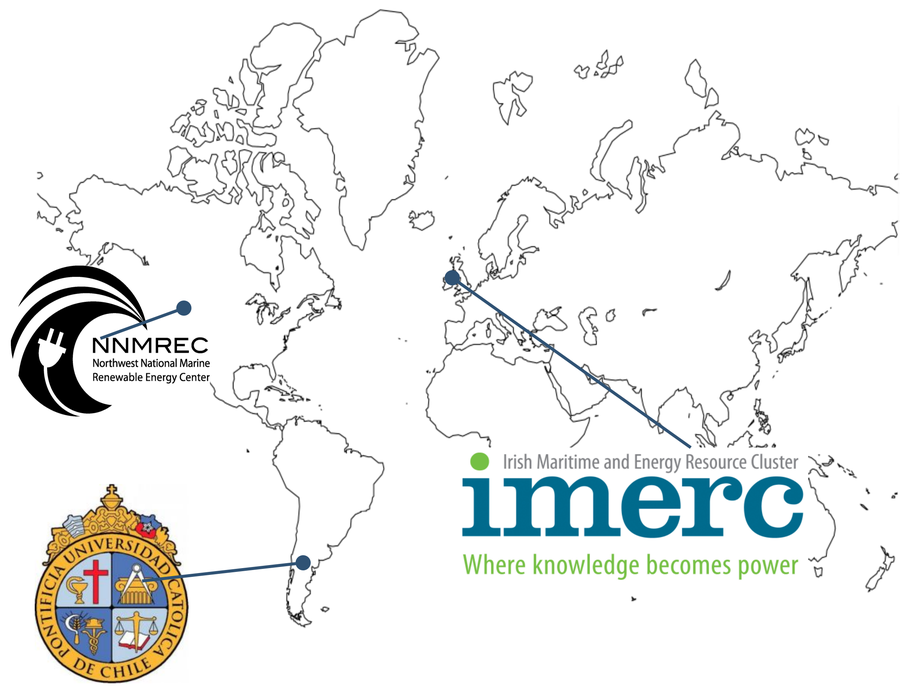
Dr. Brian Polagye, Mechanical Engineering (Lead)
Dr. Alberto Aliseda, Mechanical Engineering
Dr. Peter Dahl, Applied Physics Laboratory & Mechanical Engineering
Dr. Brian Fabien, Mechanical Engineering
Ms. Nicole Faghin, Washington SeaGrant
Dr. John Horne, Fisheries and Aquatic Sciences
Dr. Lekelia Jenkins, Marine and Environmental Affairs
Dr. Mitsuhiro Kawase, Oceanography
Dr. Per Reinhall, Mechanical Engineering
Dr. Jim Thomson, Applied Physics Laboratory & Civil Engineering

Research Overview

- ***Hypothesis***: **A favorable balance can be found between the benefits of significant power production from tidal currents and environmental/societal costs**
- **Overarching Questions:**
  - What is the power production potential from tidal currents?
  - How would tidal power production change the marine environment and affect other users of ocean resources?
  - How can negative effects be minimized?
- **Project outcomes will help guide technology evolution, environmental monitoring, and public perceptions of marine renewable energy development**



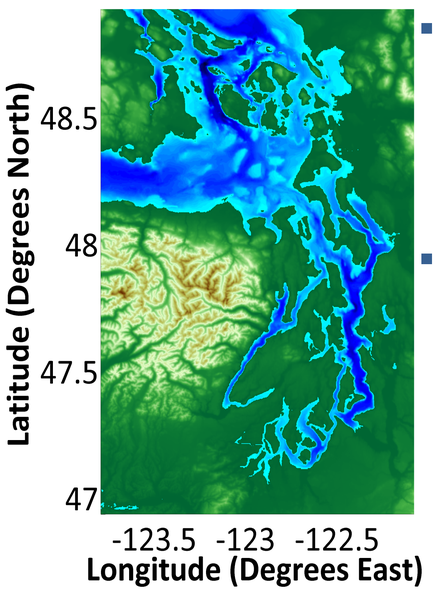
International Research Collaborations



We are looking for further international research partners
Inquire Mitsuhiro Kawase at this conference or kawase@uw.edu

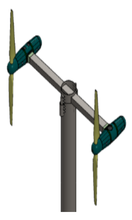
Scenario Analysis

Geographic Scope: Puget Sound, Washington, USA



- ***Relevance***: **Multiple potential tidal energy sites identified in the region**
- ***Leverage:*** **Existing data collection efforts**
  - Multi-year tidal demonstration project by local utility begins in late 2014
- ***Engaged Public***: **Diverse and informed group of stakeholders**

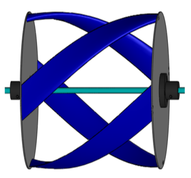
Contrasting Technologies



Axial-flow Turbine

US Department of Energy Reference Model 1 (National Renewable Energy Laboratory)

Cross-flow Turbine

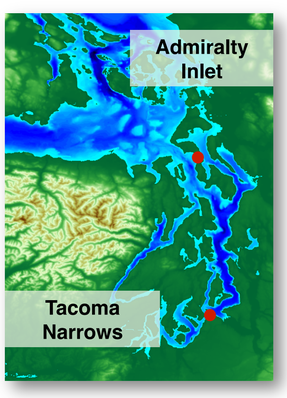


University of Washington Micropower Turbine

Contrasting Scales

- **Distributed Generation**
  - 10 MW
  - 10 turbines
- **Utility Generation**
  - 100 MW
  - 100 turbines

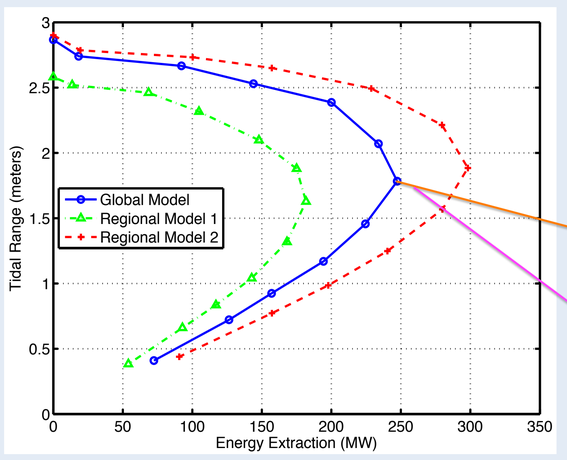
Contrasting Locations



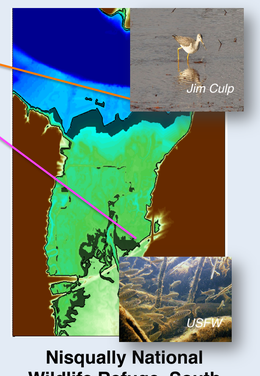
Effect on Tidal Range

Dr. Mitsuhiro Kawase

Environmental



- **Maximum extraction would result in loss of 24% of the intertidal area**



Nisqually National Wildlife Refuge, South Puget Sound

Anticipatory Governance

Dr. Lekelia Jenkins

Social

1. Social Scientist (SS) Embeds with Energy Researchers (ER)
- SS learns research firsthand by helping collect noise data

2. SS Uses Future Visioning with Latent Stakeholders to Identify Concerns
- NGO identifies that noise from the tidal installation might disrupt migration of marine mammals

3. SS Presents Concern To ER and Guides Brainstorming for Addressing Concern
- ER modifies analysis to include overlaps between installation noise and the animals' hearing ability and migratory pathways

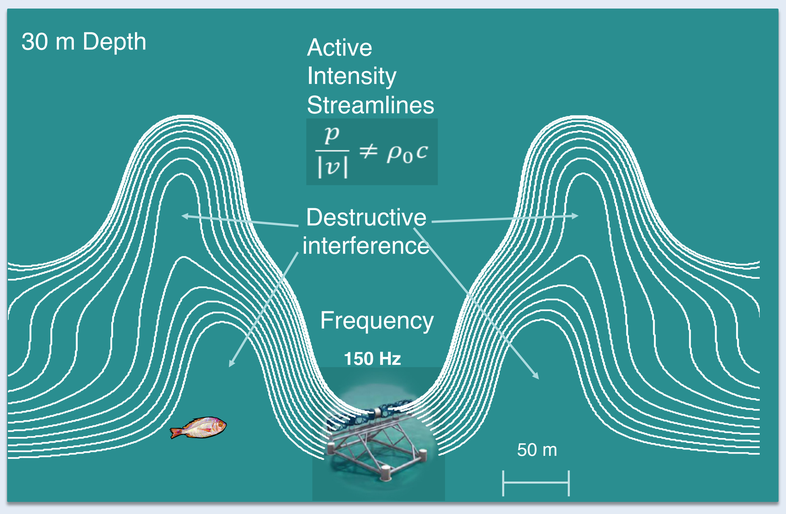
4. ER Change Design or Inform Improved Governance Measures
- Noise overlap analysis informs possible management options that stakeholders find workable

Turbine Sound

Dr. Peter Dahl

Technical

Environmental



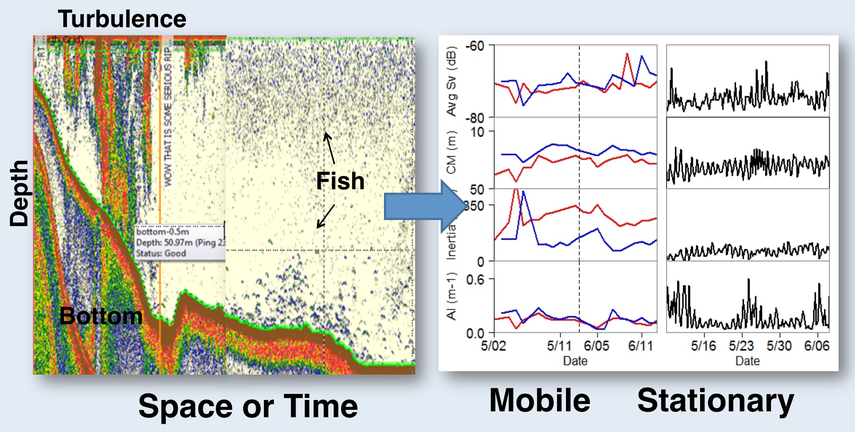
- **Active intensity represents transport of acoustic energy**
- **Measurements of acoustic pressure and particle velocity planned for fall 2014 at a cross-flow turbine in Maine**

Effect on Fisheries

Dr. John Horne

Environmental

Acoustic Data → **Monitoring Metrics**



Space or Time — **Mobile** **Stationary**

- **Characterize distributions, dynamics, and abundances of fish and macrozooplankton**
- **Identify variables to quantify change, effect, and impact**
- **Develop metric suit to monitor variables**
- **Compare sites and technologies to evaluate generality**