NRT DESE: Risk and Uncertainty Quantification and Communication in Marine Science and Policy

Engaging graduate students in transformative research, education, and professional experiences to address the effects of human actions and climate change on marine systems

Research and Traineeship Program
Prospects for new PhDs in STEM

Prospects for new PhDs in STEM

STEM education concerns

- PhD time to graduation too long, completion rate is low
- MS degree is undervalued
- Narrow training, few transferable skills
- Mentoring focused on academia
- Diversity
- Not aligned with disciplinary, societal, workforce, and student needs
NRT key features

• Advancement of interdisciplinary research in high priority areas.

• Development and testing of innovative models.

• Extension of benefits to broad student population.

• Evidence-based strategies to broaden participation.

• Broad training for academic and non-academic careers.

• Robust assessment that informs and improves practice; facilitates dissemination of models
Engaging graduate students in transformative research, education, and professional experiences to address the effects of human actions and climate change on marine systems.
Motivations

• New ocean observatory platforms and analytic approaches

• Novel drivers of change: global warming, acidification, and expansion of hypoxic regions

• Policy and management component of ocean resources
Learning Outcomes

Working in transdisciplinary teams, OSU-NRT trainees will:

**Analyze** ever expanding data sources in natural and social science to quantify risk and uncertainty of policy actions and environmental change

**Discover** mechanisms that control the response of marine systems to climate change and human pressures

**Engage** with stakeholders to assess their needs and communicate risk and uncertainty of climate change and policy decisions
Training elements

- Orientation to transdisciplinarity (3 cr)
- Minor in R&U quantification (*)
- Internship
- Collaborative thesis chapter

(*) Minor in R&U Quantification
- Big data and uncertainty quantification (3-4 cr)
- Risk analyses (3-4 cr)
- Earth Systems (3-4 cr)
- Human Systems (3-4 cr)
- Professional training (6 cr)
  - Conceptual foundation in R&U (2)
  - Collaborative working structure (2)
  - Communication (2)
Timeline and Training

OSU
Oregon State University

FALL 2015
SUMMER 2016
WINTER 2017

PhD after completion of additional research chapters
or

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Entering students chose disciplines (10 students per cohort)
Research Examples

Group projects
• involving some aspect of marine systems/resources,
• having a policy as well as a science question,
• being based on the analysis of large data sets (e.g., genomics, remote sensing, telemetry, etc),
• involving risk and uncertainty quantification

Existing examples: http://marinerisk.ceoas.oregonstate.edu/research/
1. Ocean Condition Forecasting (Flaxen Conway)
2. Mixed species and stock fisheries (Gil Sylvia)
3. Weather, climate, and biological influences on ocean productivity (Michael Banks)
4. Dungeness crab genomics (Kathleen O’Malley)
5. Wave energy installations and benthic communities (Ciannelli)
**What is it:** Probability of an undesirable event to occur times the cost (magnitude) of that occurrence

**Origins and applications:** depletion and extinction of local populations in a sympatric complex; management strategy evaluations; assessing probability of loss of revenue, loss of capital, or life; structural analyses of marine energy platforms; marine spatial planning; reduction of genetic diversity

**Research opportunities:** Utility and decision theories of Bernoulli, von Neumann, Morgenstern, prisoner’s dilemma and cooperative game theory, Bayesian networks, Nash equilibrium, ruin probability and large deviation theory, optimization theory and dynamic programming, Markov Chain Monte Carlo simulations, mathematical finance and derivative contracts.
Big Data

What is it: Large volume of data with high throughput. Big data can be temporal, spatial, or dynamic; structured or unstructured.

Origins and Applications: scientific instruments, satellites, from ubiquitous sensing and control applications in engineered and natural systems, through multitudes of heterogeneous sensors and controllers instrumenting these systems; social interactional data from social networking sites, twitter feeds and click streams; scientific data from large-scale surveys, large-scale simulations, continuous simulation models, telemetry data, and computational analyses of observational data

Research opportunities: Sensor and sampling development, machine learning, signal processing, data filtering and reduction, visualization, search and query techniques, pattern recognition
Admission: specific requirements

Student letter of interest
• prior research and training experiences
• willingness to work on team
• academic and professional goals
• funding plan

Faculty letter of support
• student success within program
• student ability to work collaboratively
• funding plan
• faculty engagement in NRT program:
  1. follow students progress to finalization of degree through the IDP
  2. participate in NRT activities when requested,
  3. engage with other NRT faculty collaborating with your student.

Send all material to Katherine.Hoffman@oregonstate.edu
May 13th 2016 for 2016-17
Student feedback

• Obtaining facilitated, **inter/cross-disciplinary training** that is supported by faculty

• Further the integration of **big data capabilities** into marine science and policy.

• Gaining experience working with non-academic **collaborators and stakeholders**

• Leaving graduate school with a **tangible product** and experience that showcases scientific application to policy issues

• **Problem solving** opportunity grounded in marine science

• Getting a **fellowship**!

• **Building your network** - you never know where the next opportunity will come from
# OSU Team & Colleges

<table>
<thead>
<tr>
<th>Name</th>
<th>Academic Unit</th>
<th>Discipline</th>
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<tbody>
<tr>
<td>Lorenzo Ciannelli</td>
<td>College of Earth, Ocean, and Atmospheric Sciences</td>
<td>Fisheries Oceanography</td>
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<tr>
<td>Katherine Hoffman</td>
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<td>Julia Jones</td>
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<td>Alexander Kurapov</td>
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<td>Juan Restrepo</td>
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<td>Enrique Thomann</td>
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<td>Michael Banks</td>
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<td>Ana Spalding</td>
<td>School of Public Policy</td>
<td>Policy science</td>
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<tr>
<td><strong>Cynthia Char</strong></td>
<td>Char Associates</td>
<td>Human development</td>
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Get involved!

• Be a student
• Be a mentor
• Be a project client
• Be part of the leadership teams
• Be an instructor
• Give us feedback

Check: http://marinerisk.ceoas.oregonstate.edu/