I-WATER

Integrated Water, Atmosphere, Ecosystems, Education and Research Program
I-WATER Funding

- I-WATER is funded by the National Science Foundation IGERT program
- IGERT is NSF's Integrative Graduate Education and Research Traineeship program
- IGERT intends to
  - meet the challenges of educating U.S. scientists and engineers with the interdisciplinary background, deep knowledge in a chosen discipline, and the technical, professional, and personal skills needed for the career demands of the future.
  - catalyze a cultural change in graduate education by establishing innovative new models for graduate education and training through collaborative research that transcends traditional disciplinary boundaries.
- NSF funding is for 5 years
- Additional support from CSU
  - Departments of Civil and Environmental Engineering, Atmospheric Science, and Biology
  - Colleges of Engineering and Natural Sciences
  - Graduate School, Office of the Provost, Office of the Vice President for Research
Water management decisions generate conflicts between humans, ecosystem needs, and political jurisdictions. There is a critical need for scientists who can address three important questions:

1) How can limited fresh water be distributed equitably in a socially acceptable and sustainable framework?

2) What are the relative ecological and societal benefits and drawbacks of management actions?

3) How can science provide answers for wise water management decisions?
I-WATER: Vision and Goals

- I-WATER will produce Ph.D. scientists
  - to work at the interfaces between hydrologic science, atmospheric science, ecosystem science, and socio-economics
  - to work in interdisciplinary team-based activities
  - to incorporate environmental and socio-economic feedbacks, climate variability and scientific uncertainty into scientific and policy analysis

- Our research themes involve interacting teams of hydrologists, meteorologists, ecologists, and management experts.

- I-WATER features problem-focused research to bridge basic and applied science by combining fundamental research on scientific problems with application of scientific knowledge to actual resource issues.
I-WATER: Vision and Goals

- I-WATER will provide a new generation of Ph.D. students with capabilities to work across disciplines and problem-sheds.

- Students will learn to evaluate and analyze complex non-linear systems interactions, environmental variability, and climate change to develop and apply integrative solutions to pressing current problems.
I-WATER: Vision and Goals

- I-WATER is based on an integrated approach to:
  - hydrologic and water resource science and engineering,
  - land-surface-atmosphere interactions,
  - ecosystems science,
  - water management and policy.

- I-WATER will apply three dimensions of integration to scientific solutions of water–based environmental problems:
  - Integration of disciplines,
  - Integration of scales, and
  - Integration of problem–sheds

- Integration will occur through a new problem–focused approach to education and research.
I-WATER: Organizing Concept

Integrated Water, Atmosphere, Ecosystems Education and Research

Hydrologic Cycle Processes

Atmospheric & Climatic Systems

Ecologic/Environmental Systems

Human Systems

I-WATER

Integrated Water, Atmosphere, Ecosystems Education and Research
Research Theme I
Hydrologic, Atmospheric and Ecologic systems (HAE)

- Coupling atmospheric, ecologic, and hydrologic processes understanding the two-way interactions between atmospheric and land-surface processes is critical to understanding climate variability and change, vegetation function, and watershed hydrology.

- Spatial and temporal scaling issues in hydrologic processes
  - Global change, regional hydrology, and interactive ecosystems
  - Feedbacks among climate, hydrology, and ecosystems at regional scales
  - Evaluation of spatial and temporal variability of precipitation, soil moisture, and ecosystem function in the western United States
  - Land surface-atmospheric feedbacks on the complex dynamics of precipitation and soil moisture at seasonal and longer time scales
  - Land surface, vegetation, atmosphere feedbacks on the regional scale
Research Theme II
Hydrologic, Ecologic, and Socio-economic systems (HES)

- Defining changes in water, nutrients and sediment transports due to variability and change in climate/weather, land cover/land use, and water resources management.

- Developing models to ‘optimize’ ecosystem resilience and human economic activity that bear on the hydrologic cycle at regional scales
  - Non-native species invasion and extinction of native species
  - Processes governing grasslands to shrub-land conversions
  - Balancing economic and ecosystem needs for water in heavily-modified river basins.
Research Theme III
Hydrologic, Atmospheric, Socio-economic systems (HAS)

- Regional, integrated assessment of vulnerability and sustainability of hydrologic and water resource systems, ecologic and socio-economic systems to environmental variability and climate change
- Hydrologic-ecologic-socioeconomic vulnerability and sustainability analysis to drought and climate variability
- Regional hydrologic vulnerability and hydrologic extremes
- Coupling among stakeholder sectors and ecological outcomes in a regulated river system: droughts
The fourth Research Theme arises from the need for integration and synthesis.

Trade-offs, alternative solutions, adaptation strategies, global feedbacks, global integration.
I-WATER: Curriculum

- **Gateway Courses**
  - I-WATER scholars will be required to take gateway courses in fields relevant to their research theme areas and complementary to their disciplines.
  - Gateway courses will be selected from existing course offerings.
  - Gateway courses will provide a basic level of language and knowledge in particular fields.
  - Students will be required to take two gateway courses from complementary disciplines during their first two semesters.
  - For example, a scholar in Research Theme I whose background is atmospheric science would be required to take a gateway course in hydrologic science and a gateway course in ecosystem science.
I-WATER: Curriculum

- Core Courses
  - I-WATER will develop a core curriculum that takes an earth system science perspective to address multidisciplinary problems in each research theme with hydrology as an integrative element.
  - I-WATER will develop a new core course in each research theme.
  - I-WATER scholars will be required to enroll in 2 core courses to be taken during the first two years of the program.
  - The development of these courses will be a collaborative and joint effort of the PIs, and other I-WATER faculty associates will be invited to participate, therefore offering an additional opportunity for integration across the disciplines.

- Training in ethics
I-WATER: Academic/Research Progression

- I-WATER scholars will take three years to finish their courses and research training programs
- First two years will be funded through an I-WATER Fellowship
- Third year funded through a research assistantship

<table>
<thead>
<tr>
<th>WATER-IGERT Educational and Research Progression</th>
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<tbody>
<tr>
<td>Semester</td>
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<tr>
<td>First        Second     Third     Fourth    Fifth     Sixth</td>
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<tr>
<td>Departmental Requirements</td>
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<tr>
<td>WATER Core Courses</td>
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<tr>
<td>Gateway Courses</td>
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<td>WATER Dissertation Research</td>
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I-WATER: Activities

- I-WATER scholars will be organized in Research Theme Groups
- Each Research Theme Group will be composed of student-led Research Teams
- Each Research Team will work on a specific multidisciplinary problem within Research Theme
- Each I-WATER scholar will work within the Research Team on a specific research problem
- Integration occurs at the Research Team level and at the Research Group level
I-WATER: Activities

- Fall Semester – Integration at the Interfaces
  - Student-led Research Teams will tackle semester long integrative activities within the context of real-world problems
  - Research teams will produce scientific assessments to define knowledge, knowledge gaps, recommend actions, and propose solutions

- Spring Semester – Global I-WATER Integration
  - Each Research Theme Group will organize a series of 4 workshops. All I-WATER scholars and Faculty are required to participate
  - Annual I-WATER Symposium
Advanced I-WATER scholars will be encouraged to undertake internships.

The internships will typically occur during the third year.

Internship opportunities at:
- U.S. Bureau of Reclamation
- U.S. Geological Survey
- U.S. Forest Service
- NCAR
- NASA Goddard Space Flight Center
- ARS – U.S. Department of Agriculture
- Riverside Technology, Inc.
- Swiss Federal Institute of Technology, Zurich (ETH-Z)
# I-WATER: Recruitment Plan

## WATER-IGERT

**Integrated Water Atmosphere and Ecosystem Education and Research**

- Participation by faculty and outside committee members will invigorate discussions and provide solid feedback to student presenters. This interaction will help establish expectations for quality across the program.
- As students develop their research studies and sharpen them in the IGERT activities, they will present their results at seminars and scientific conferences including:
  - National annual meetings of the American Geophysical Union, American Meteorological Society, Ecological Society of America, American Society of Civil Engineering, etc.
  - Annual AGU Hydrology Days – http://hydrologydays.colostate.edu/
  - Annual Front Range Student Ecology Symposium – http://lamar.colostate.edu/~ecosys

## Recruiting Plan

During the first year of the program, we will recruit 7 scholars, and our recruitment strategy will be targeted in order to ensure that we have at least 2 scholars in each of the Research Themes. As indicated in the diagram below, during the subsequent years of the program we intend to recruit 5, 7, 5, and 4 scholars.

<table>
<thead>
<tr>
<th>Year</th>
<th>First Year</th>
<th>Second Year</th>
<th>Third Year</th>
<th>Fourth Year</th>
<th>Fifth Year</th>
<th>Sixth Year</th>
<th>Seventh Year</th>
<th>New students per year</th>
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<td>9</td>
<td>4</td>
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<td>28</td>
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</table>
I-WATER: Scholar Applications

- Eligibility: Only US citizens or permanent residents are eligible to apply.
- Students must apply directly to the department in which they wish to obtain their PhD.
  - Applicants must comply with all departmental deadlines and application procedures.
  - Applicants must inform department that they wish to be nominated for an NSF I-WATER IGERT Traineeship.
- Students must also apply directly to the I-WATER program.
  - Complete I-WATER application form
  - Include a Department/Faculty sponsor form.
- Application form at: [http://I-WATER.ColoState.edu/](http://I-WATER.ColoState.edu/)
I-WATER Fellowship Application

NSF IGERT Eligibility: Only US citizens or permanent residents are eligible to apply to the I-WATER Program at CSU

1. Contact Information

   Name:
   Email Address:
   Mailing Address:
   Telephone Number:
   PhD program to which you are applying:
   Citizenship:

2. Statement of Interest

   Please write a 3-5 page statement that describes:
   - your research interests and how they, and your academic and research backgrounds, contribute to achieving the interdisciplinary and integrative research vision of the I-WATER program
   - how the I-WATER program fits your current and future academic, research and career goals

3. Statement of Support from Faculty Mentor

   Please submit your application by e-mail to i-water@engr.colostate.edu

   Review of applications begins on January 15th
I-WATER Fellowship Application
Faculty/Department Support Form

1. I-WATER Fellow Candidate
   - Name:
   - E-mail address:

2. Sponsors
   - Admitting department:
   - Contact information for sponsoring department:
   - Contact information for faculty sponsor:
     - Name:
     - E-mail address:
   - Description of support commitments to student:
     - Amount of support (it must be at least one year of full-time GRA support):
     - Source of support:
   - Evaluation by admitting department\(^1\):

I-WATER fellowships are for two years. However, the program is three years long. All I-WATER Fellows are guaranteed a third year of support. The third year of support must be provided by the I-WATER Faculty Mentor. Please provide a letter of commitment to provide one year of full-time, GRA support to the student you are nominating, as well as evidence that the funds to do so are available.

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\(^1\) Please attach a copy of the application submitted by the student.
I-WATER Fellowships are only for two years. However, the I-WATER training program is three years long.

Therefore, Faculty interested in participating in the I-WATER program as Faculty Mentors must:

- Submit a research proposal that fits and furthers the concept, mission, goals and the research vision of the I-WATER program.
- Demonstrate that they will be able to provide funding for the third year of the training program and commit to it.

Application form at: [http://I-WATER.ColoState.edu/](http://I-WATER.ColoState.edu/)
I-WATER Faculty Mentor

Research Proposal

1. I-WATER Faculty Mentor
   - Name:
   - Department:
   - E-mail address:

2. I-WATER Fellow
   - Name:
   - Email Address:

3. Description of support commitments to student:
   - Amount of support (it must be at least one year of full-time GRA support)
   - Source of support

4. Description of Research
   - Please include a 3-5 page proposal describing the research your I-WATER Fellow will carry out, making sure to indicate how such research fits the I-WATER research paradigm and how it will contribute to achieving the I-WATER research and training objectives.

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1 Please provide a letter of commitment to provide one year of full-time, GRA support to the student you are nominating, as well as evidence that the funds to do so are available.
I-WATER: People

- Jorge A. Ramírez, P.I. and Project Director
  - Department of Civil and Environmental Engineering
- A. Scott Denning, Co-P.I.
  - Department of Atmospheric Science
- Neil S. Grigg, Co-P.I.
  - Department of Civil and Environmental Engineering
- N. LeRoy Poff, Co-P.I.
  - Department of Biology
- Karleene Schindler, Program Coordinator
  - Department of Civil and Environmental Engineering
I-WATER: Current Scholars and Faculty Mentors

- Joel Sholtes and Brian Bledsoe, Civil and Environmental Engineering
  - Scale Dependency of Fluvial Morpho-dynamics and Sensitivities to Environmental Change

- David Martin and LeRoy Poff, GDPE
  - Socio-ecological optimization for the provision of environmental flows

- Aaron Piña and Scott Denning, Atmospheric Science

- Isaac Medina and Scott Denning, Atmospheric Science
  - Climate change and water resources in semiarid regions

- Dylan Harrison-Atlas and Dave Theobald, GDPE
  - Integrated flow-based model to assess trade-offs under watershed management scenarios

- Vanessa Vincente and Russ Schumacher, Atmospheric Science
I-WATER: Incoming Scholars and Faculty Mentors

- Erick Carlson and David Cooper, GDPE
  - Understanding ecological functions provided by remnant natural riparian wetland complexes and wetlands created by and supported by agriculture water networks and storage reservoirs

- Laurel Lynch and Matthew Wallenstein, NREL
  - Climate warming effects on production and transport of dissolved organic carbon at the terrestrial-aquatic interface in arctic Alaska

- Alexander Maas and Christopher Goemans, Ag and Resource Economics
  - Understanding of the social value of water across geographic and sector boundaries (with a particular focus on the South Platte River basin) and their integration with the values of water dependent entities using a water hydrologic model able to capture the physical changes caused by particular water transactions

- Grace Lloyd and Bill Bauerle, Horticulture
  - Toward improved species and seasonal cycle metrics of stomatal conductance in Earth system models

- Nick Sutfin and Ellen Wohl, Geosciences
  - Carbon dynamics and storage in headwater channels of the Colorado Rocky Mountains
I-WATER: Participating Faculty

- Civil and Environmental Engineering
  - Jorge A Ramirez, Neil S. Grigg, Brian Bledsoe, Mazdak Arabi, Jeff Niemann, Pierre Julien

- Atmospheric Science
  - Scott Denning, Chris Kummerow, Steve Rutledge, David Randall, Russ Schumacher

- Biology
  - LeRoy Poff, Diana Wall

- NREL
  - Jill Baron, Lara Prihodko, Bill Parton, Dennis Ojima, Mike Coughenour
I-WATER: Participating Faculty

- Human Dimensions of Natural Resources
  - Joshua Goldstein
  - Jessica Thompson

- History
  - Mark Fiege

- Political Science
  - Michelle Betsill

- Ag and Resource Economics
  - John Loomis
  - Christopher Goemans
I-WATER: Participating Faculty

- Forest, Rangeland and Watershed Stewardship
  - Lee MacDonald
  - Stephanie Kampf
  - David Cooper
  - Melinda Laituri

- Soil and Crop Sciences
  - Reagan Waskom

- Sociology
  - Evan Vlachos
NSF IGERT Program in WATER Research at Colorado State University

- Interdisciplinary doctoral program
- Integrated research in:
  - Hydrologic Science
  - Atmospheric/Climate Science
  - Eco-System Science
  - Social Science
  - WATER Management and Engineering
- Internships opportunities at:
  - USBR, ARS, USFS, USGS, NASA, NCAR, RTi
- International collaborators: ETH-Zurich
- Fellowship opportunities for outstanding students
- $30,000 per year for 2 years + 1 year additional funding
- Application review begins in January

For information contact Jorge A. Ramírez: Jorge.Ramirez@ColoState.edu
or browse: http://I-WATER.colostate.edu/