Food-Energy-Water Nexus:

NSF Opportunities for Support of Research

Bruce Hamilton
NSF Engineering Directorate, and
Cross-NSF INFEWS Working Group

INFEWS: Innovations at the Nexus of Food, Energy, and Water Systems

Growing populations, changes in land use, and increasing geographic and seasonal variability in precipitation patterns are placing ever-increasing stresses on the critical resources of food, energy and water (FEW). INFEWS goals include:

- **Understand the FEW system through integrated systems modeling;**
- **Create methodologies for effective data integration/cyber elements;**
- **Research innovative solutions and technologies; and,**
- **Support education, workforce, and community development.**

Amy Landis studies the feasibility of restoring soils degraded by industrial wastes and other pollutants for growing bioenergy crops. *Credit: Jessica Hochreiter/Arizona State University*

FY16: $75M

What "FY16: $75M" Means

- **NSF has requested Congress to authorize $75M for INFEWS for FY16**
  - **Congress may authorize less**
  - **NSF may not know Congress's decision until well into calendar year 2016**

- **NSF would like to have that amount or more for each of at least 5 years starting with FY16**

What NSF Might Do with $75M for INFEWS in FY16

- **Issue a special INFEWS call-for-proposals ("INFEWS solicitation")**

and/or

- **Issue special purpose INFEWS DCLs ("Dear Colleague Letters") stating the specific interests of some NSF "standing programs" ("core programs") in INFEWS proposals**

FY16 INFEWS Solicitation Scenario

- **Maybe grants on the larger size, say maybe up to $3 million each**
- **Would have to be interdisciplinary**
- **Would have to have content on all three of food, energy, and water**

(Note: the above is only a scenario for illustrative purposes)

NEW INFEWS DCL Just Posted

"Dear Colleague Letter: FY 2016 Innovations at the Nexus of Food, Energy and Water Systems (INFEWS) Funding Opportunity on Nitrogen, Phosphorus, and Water"

For some "standing" (or "core") programs in the following two NSF divisions:

- **Chemistry (all programs)**
- **CBET/ENG (only 3 programs)**

NEW INFEWS DCL Just Posted (continued)

For some "standing" (or "core") programs in the following two NSF divisions:

Chemistry (all programs)

CBET/ENG (only 3 programs):

- **Environmental Sustainability**
- **Environmental Engineering**
- **Catalysis and Biocatalysis**

NEW INFEWS DCL Just Posted (continued)

- **Proposal Due Dates: Regular proposal due dates for unsolicited, EAGERS, INSPIRE**
  - **e.g., for CBET unsolicited, the due date is October 20**

(refer to www.nsf.gov for more detail)

- **Regular proposal dollar sizes and durations**
  - **e.g., for CBET unsolicited, the typical grant size is $300K for 3 years**

NEW INFEWS DCL Just Posted (continued)

Excerpt from the DCL just posted:

"The availability of nitrogen, phosphorus, and water are the three main factors that limit our ability to produce enough food to feed the growing population of the planet"

"INFEWS N/P/H2O"

NEW INFEWS DCL Just Posted (continued)

Another excerpt from the DCL just posted:

"In FY 2016, the topics of interest in INFEWS: N/P/H2O include innovative, fundamental research to:

(1) advance catalytic methods for the reduction of dinitrogen to ammonia and that will permit reductions in the energy requirements for fertilizer production.

(2) develop…"

NEW INFEWS DCL Just Posted (continued)

Continued excerpt from the DCL just posted:

"In FY 2016, the topics of interest in INFEWS: N/P/H2O include innovative, fundamental research to:

(2) develop new sensing modalities that will lead to field-deployable, inexpensive, and environmentally and energetically sustainable sensors for real-time monitoring of nitrogen- or phosphorus-containing species as they move, via agricultural run-off, to other water systems; and

(3) gain…"

NEW INFEWS DCL Just Posted (continued)

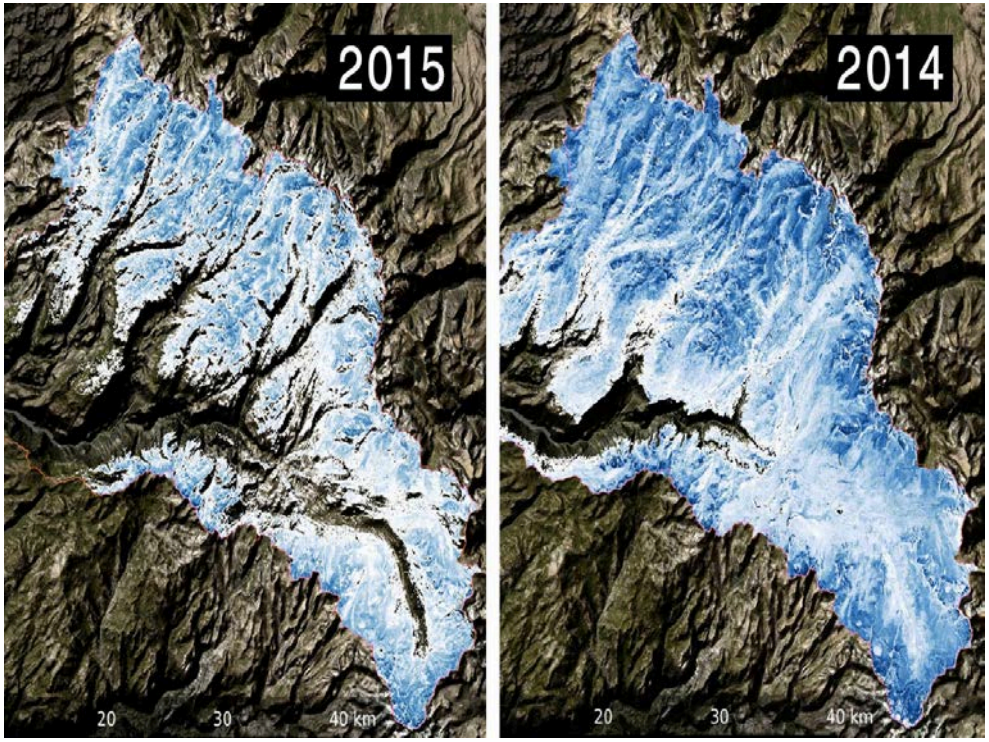
Continued excerpt from the DCL just posted:

"In FY 2016, the topics of interest in INFEWS: N/P/H2O include innovative, fundamental research to:

(3) gain understanding of the supramolecular recognition and binding of environmentally-relevant nitrogen- and phosphorus-containing species. Such efforts are essential for the selective and efficient detection, sequestration/separation, and recycling of these elements as well as for water purification efforts."

Food-Energy-Water in FY15

- **Food-Energy-Water DCL (due March 2015)**
  - **Supplements, Workshops and Conferences, EAGERs**
- **In response, received 149 proposals across NSF; Result: 27 NSF FEW workshops are being planned, mostly across the country, some overseas**



Spatial distribution of the total volume of water in the snowpack across the Tuolumne River Basin on March 25, 2015 (left) and April 7, 2014 (right) as measured by NASA's Airborne Snow Observatory. Credit: NASA/JPL-Caltech

FEW DCL Workshop Goals

(in anticipation of INFEWS FY16)

1. **Accelerate fundamental understanding and stimulate basic research on food systems and their couplings to energy and water systems**
2. **Integrate Scientific Communities, including those at other federal agencies; enhance communication**
3. **Define fundamental science and engineering research needs/questions in FEW Systems**



FEW Workshop Example #1

1541868

"FEW Workshop: Water- and Energy-Efficient Food Production: Solutions for America's Bread Basket"

PI = Mary Rezac (Kansas State U.)

Workshop Date: November 19-20, 2015
Workshop Location: Manhattan, Kansas

FEW Workshop Example #2

1541790

"FEW: Coupling Economic Models with Agronomic, Hydrologic, and Bioenergy Models for Sustainable Food, Energy, and Water Systems"

PI = Catherine Kling (Iowa State U.)

Tentative Workshop Date: October 11-12, 2015
Workshop location: Iowa State U.

FEW Workshop Example #3

1541844

“FEW: Conference on Environmental Change, Mitigation, and the Resilience of Regional Food, Water, and Energy Systems”

FEW Workshop Example #2

PI = Elena Irwin (Ohio State U.)

Tentative Workshop Date: November 4-5, 2015
Workshop location: Ohio State U.

FEW Workshop Example #4

1541771

"FEW: Food-Energy-Water Infrastructure Systems, Engineering Solutions, and Institutions"

PI = John Sabo (Arizona State U.)

Workshop Date: October 13-15, 2015

Workshop Location: ASU campus

INFEWS

FY16 – Planned ~$75M

- Understanding the complex nature of the FEW system through integrated systems modelling
- Creating methodologies for effective data integration/cyber elements at multiple temporal and spatial scales of terrestrial systems
- Supporting fundamental science and engineering research to create new technologies and solutions to FEW problems
- Supporting education, workforce and community development

INFEWS at NSF

Questions?