Educational Opportunities in GLISA: M. Eng. Applied Climate & Climate Impacts Engineering (U.G.)

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Great Lakes Integrated Sciences & Assessments

GLISA
Goals:

- To accelerate the use of climate knowledge in design, planning and management
  - Making potentially useful information into usable knowledge
- Climate interpreters / translators
- Ability to combine with other professional degrees
  - Urban planning
  - Public health
  - Public policy
From the *A National Strategy for Advancing Climate Modeling* (NRC, 2012)

- Identified the need for, “professionals who could perform tasks that are being done in boundary organizations at the interface between climate science and decision makers.”

- **Recommendation**: “To promote the effective application of climate models, the United States should develop climate interpretation certification and continuing education programs to train a cadre of climate interpreters who can facilitate the interpretation of climate model output into usable information for a variety of decision makers and communicate user needs to climate modelers.”
Knowledge System: Translation

- Need to bring together disparate information and different points of view to develop strategies for applied problem solving
- Key to development of successful strategies: iterative process or co-development with information providers and information users

Cash et al: 2002
Lemos & Morehouse, 2005
Dilling & Lemos, 2011
Skills and Subject Areas

• Scientific foundation in climate science
• Where to get data and information (Informatics)
  – Make that data and information usable
  – What are the barriers?
• Place that data and information in context
  – Knowledge of uncertainty
  – Knowledge of uncertainty in context
  – Place uncertainty into context
• Statistics, statistics, statistics
• Geographical Information Systems
• Problem Solving Skills
  – Theory
  – Application → Practicum
MEng. Curriculum

- Courses required of Applied Climate Program students fall into three categories:
  - Departmental Core Courses (5): Required of all AOSS MEng Applied Climate graduate students, includes 2 semester Practicum sequence
  - Program Core Courses (2): Required courses in this MEng Program, and those required of a concentration, if one is chosen.
  - Program Elective Courses (2): The AOSS courses or/and additional non-AOSS courses that support student’s area of interest.
• **Graham – AOSS (MOU):** This Memo of Understanding (MOU) recognizes that the educational, research, and applications goals of both AOSS’s MEng in Applied Climate and Graham benefit from a partnership that includes incorporation of AOSS students and faculty into the real-world projects associated with the Graham and its family of centers and programs. This is a unique alignment of interests and capabilities will accelerate the use of climate knowledge in the broader contexts of sustainable engineering, planning and management essential for our societal success.
Example Projects

• Lake Levels (Sustained Assessment)
  – Water Center
  – GLISA
  – National Park Service
• Freezing Rain Climatology
• Great Lakes “Ensemble”
  – Localizing climate-model projections to account for important lake-weather processes
• Guidance on use of Concentration Pathways.
• Freeze-thaw cycles
• Coupling Lake with Land Observations
• What can we say about trends in heavy precipitation?
Things we are doing

- **MEng Applied Climate**
- **Climate Impacts Engineering**
- **Climate Change Problem Solving (Blogs)**
  - AOSS / NRE 480

- Thinking about
  - 3rd Century Initiative
  - One-year certificate
  - Executive Masters
  - Joint program with School of Business
Questions?
Is there demand?
Some relevant references

- Lemos and Rood, Climate Projections and their Impact on Policy and Practice, WIREScc, 2010
  - Useful vs Usability (not the only ones)
  - Uncertainty Fallacy
  - Improving the usability of data systems and data services, data systems to support translation
- Barsugli et al., Practitioners Dilemma, EOS, 2013
  - Existence and access to data and knowledge not the primary problem, it is how to make the data and knowledge relevant to applications
Useful and Usability

- Scientists often talk about the usefulness of their data (observations or projections)
- Practitioners talk about the usability of data, information and knowledge
  - Practitioners?
    - Urban planners
    - Public health
    - Ecosystem managers
    - Water managers
    - ...
Motivator: Interest (are there jobs?)

• In our RISA center, GLISA, we provide small grants to boundary organizations, we fund maybe 5 out of 50 good proposals

• There is no shortage of climate-change problems brought to us by NGOs, local governments, academic interests, (corporations?)
“Hands-on” real-world projects have proved, uniquely, to move potentially useful knowledge about climate change into usable information in planning and management. Through participation in real-world projects, patterns of problem solving emerge, which allow structuring of end-to-end systems that link data, information, knowledge, planning, decisions, and actions.
Foundation of Course / Program

- Theory
- Engagement model
- What it means for data
Loading Dock Doesn’t Work
Knowledge System: Translation

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Motivator: Environmental Behavior

  - We need to correct “[t]he erroneous assumption…that skills evolve naturally from knowledge”
  - What to do and the skills to do it

Translation, Interpretation

• The chain from useful to usable can be viewed as translation
• What is translation?
Types of **Translational Information**

**Basic Data**
- Digital Information
  - Indices
  - Downscaled GIS Formats
  - Seasonality

**Model Output**
- Assessments
  - IPCC
  - NCA
  - Local
- Narratives
  - What has happened?
  - What will happen?
  - What are the impacts?

**Observations**
- Guidance
  - Judgment
- Uncertainty Descriptions
  - Risk Assessments

**Applications**
- Global
- Regional
- Local
Engagement Model
Engagement with cities (and others)

• Often the first question is what data are available and how do we get it?

• After discussions of data quality, uncertainty, evaluation and data manipulation we move to three questions:
  – What has happened?
  – What will happen?
  – What are the impacts or consequences?

• GLISA Climate Information Guide
Experience from Climate Change Problem
(We are early in this process)
http://www.glisacclimate.org/climate-information-guide

What Has Happened?

What Will Happen?
How Does Data Fit In?
Which Data?

• With our clients, most requested data sets
  – Station data from NCDC (National Climatic Data Center)
  – Model projections from Coupled Model Intercomparison Project (CMIP)
    • Tailored datasets derived from CMIP
  – Local data that represent region or application
    • Lake ice, stream flow, high resolution temperature,
    • Census data, built environment, …
  – Reanalysis data and satellite data
Data consequences of questions

• What has happened leads almost inevitably to weather station data
  – Trusted by locals and planners
• What will happen leads to use of projections
  – Climate Model Intercomparison Project (CMIP)
  – Downscaled versions of CMIP
  – Other sources of projection information
Data consequences of questions

• Linking what has happened (station data) to what will happen (model projections) requires evaluation of models relevant to the problem at hand
  – In most cases that we work on, handing the climate projections or downscaling data to practitioner is of little value
  – What is desired is a context based narrative description
Evaluation / Salience / Tailoring

• Evaluation of the data, information knowledge for the specific application is essential to usability.

• The need to provide data to be used in evaluation rather than to be plotted and used is a challenge to how we design data systems.
  – Especially because of the data use in applications
    • Need for application relevant data / indices
Alignment of information

• Here we see
  – Local observation or experience
  – Alignment with regional observations
  – Alignment with the narrative of the models
    • More precipitation in extreme events
  – Vulnerability

• Likely success in integrating climate knowledge in policy and planning
MEng Applied Climate & Climate Impacts Engineering (UG)

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