

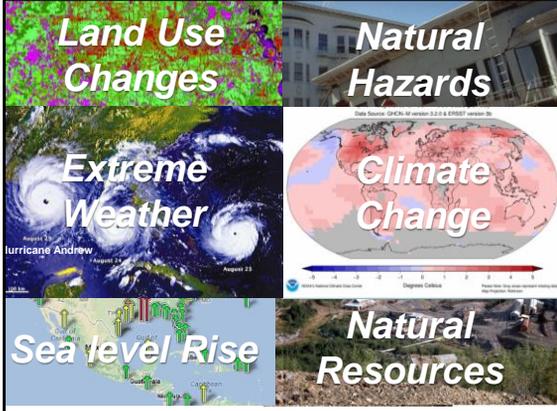
**InTeGrate**  
 Interdisciplinary Teaching of Geoscience  
 for a Sustainable Future



**InTeGrate: Rethinking Geoscience Instruction with the Development of Free Customizable Resources to Address Earth's Grand Challenges in Introductory Courses**

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**Land Use Changes**

**Natural Hazards**

**Extreme Weather**  
 Hurricane Andrew  
 August 21  
 August 23

**Climate Change**  
 Data Source: GPCP v2 version 2.2.0 & CRU3.23 version 2.3

**Sea level Rise**

**Natural Resources**

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**SERC**  
 Science Education Resource Center  
 Carleton College

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**NEW PARADIGM AHEAD**

**InTeGrate**  
 Interdisciplinary Teaching of Geoscience for a Sustainable Future  
 (STEM Talent Enhancement Program)

**InTeGrate: An NSF STEP Center in the Geosciences**

- InTeGrate: Interdisciplinary Teaching of Geoscience for a Sustainable Future
- Goal 1: To develop curricula that will teach geoscience in the context of societal issues across the disciplines
- Goal 2: To create a population of college graduates who are poised to bring geoscience to the creation of viable solutions to current and future societal challenges

Introductory modules  
 Interdisciplinary courses on societal issues  
 Geoscience for engineering and sustainability  
 Teacher prep modules  
 Teaching about Earth in the humanities and social sciences

<http://serc.carleton.edu/integrate>

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**Introductory Geoscience/Env Science Modules**



Teams of three authors from multiple institutions, propose topic, attend intro workshop

Teams work with:

- InTeGrate team leader
- Assessment consultant
- Web-team consultant

→ Create 2-week modules  
 → Evaluate learning/process

Goals for all modules

- Addresses a grand challenge
- Make use of data
- Incorporate systems thinking
- Deal with interdisciplinary problems
- Develop geoscientific thinking

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**Materials Development Process**

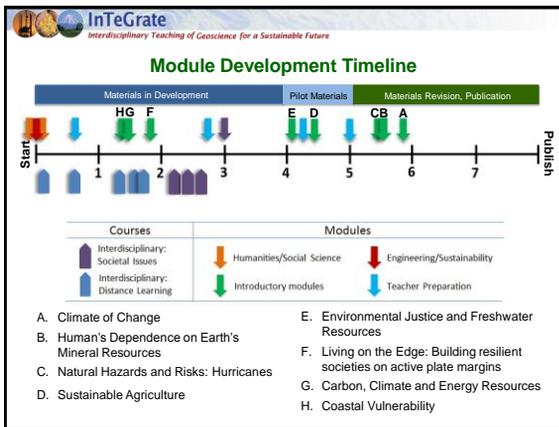
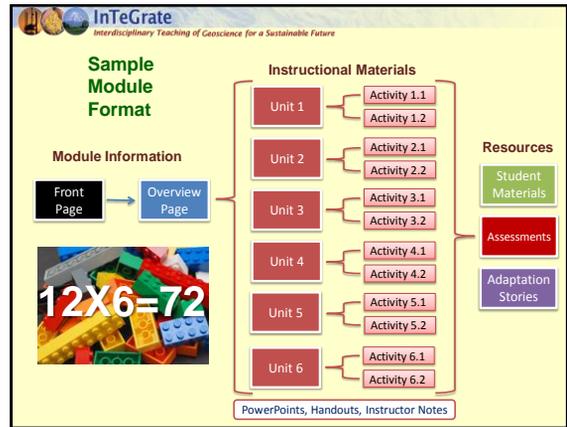
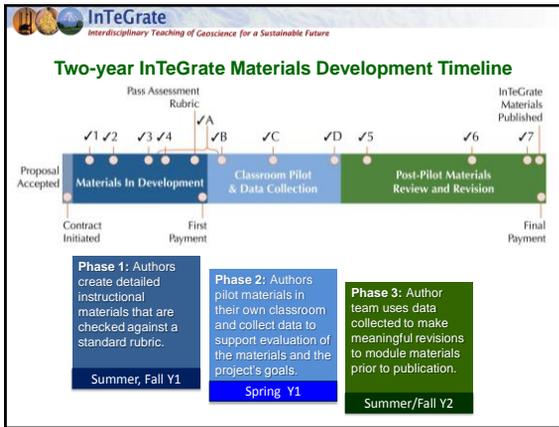
**Pass Assessment Rubric Pilot Materials Use data to make changes**

**Assessment Rubric**

- Overarching Goals (5)
- Learning Objectives & Outcomes (5)
- Assessment & Measurement (5)
- Resources & Materials (6)
- Instructional Strategies (5)
- Alignment (2)

**Backward design process**

- Identify Module Learning Goals
- Identify learning objectives for individual lessons
- Determine how to assess and measure student success on goals and objectives
- Design teaching resources and materials to match assessments
- Plan Instructional Strategies to implement teaching resources



**InTeGrate**  
Interdisciplinary Teaching of Geoscience for a Sustainable Future

For Faculty and Instructors: Undergraduate Teaching for a Sustainable Future

For Program Directors and Administrators: Laying the Foundation for Tomorrow's Sustainability Workforce

Get Involved!

Why InTeGrate?

<http://serc.carleton.edu/integrate>

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### Climate of Change: Interactions and Feedbacks Between Water, Air, and Ice

City, Buffalo, University of Northern Colorado; Sheng Wang, UC San Diego; College, Gupta Palani, Eastern Oregon

**Summary:** In this 2-3 week module, students explore short-term climate variability resulting from atmosphere-ocean-ice interactions. The module promotes awareness of past and contemporary climate and regions strongly affected by permanently altered or increasingly uncertain climate as students consider human adaptation to climate fluctuations. Students investigate the dynamics and impacts associated with climate variability by examining and analyzing atmospheric, ocean, and ice data, completing a series of readings, and engaging in group discussions. Materials and teaching descriptions for gallery walks, in-classroom discussions, group work, and lab activities are provided.

**Strengths of the Module:**

- This module provides opportunities to change the way you teach about climate change. It can be adapted for use in large and small-enrollment courses at different institution types, and instructors have the option to use the entire module to implement individual activities and materials into the existing curriculum.
- This module has a positive focus on data and adaptations to climate change.
- Distance-based.
- Students use real, current ocean, atmospheric, and ice data to learn about climate change.
- Classroom-based.
- Engage students and their chairs.
- Distance-based.

**Context:** This module is appropriate for introductory-level science and social science courses. The module is designed to fit into one semester and can be easily adapted to many courses and formats large or small-enrollment classes, introductory-level science, and interdisciplinary courses. Its flexibility, versatility, the module includes individual units with self-referencing and short-to-long activities. These individual units are also designed to stand alone. The module and individual units are appropriate for in-person or introductory environmental science, meteorology, geology, geophysics, geoscience, and general geology courses. With some modification, the module could also be adapted to upper-division courses at those levels.

**Outline:**

- UNIT 1: Atmospheric climate variability and change: a matter of context
- UNIT 2: Describing short-term climate variability
- UNIT 3: Oceanic climate variability and change: a matter of context
- UNIT 4: Assessing climate variability and change: a matter of context
- UNIT 5: Assessing climate variability and change: a matter of context
- UNIT 6: Assessing climate variability and change: a matter of context

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### Module Overview

Module goal: Understand that climate impacts human societies and that the climate system has interacting components (comprised by feedbacks, uncertainties, and human behavioral decisions).

**Outline:**

- UNIT 1: students engage in discussion regarding the basis of climate variability and climate change by first reading an article about the impacts of changes on human society and cultures in the past. Case discussion is facilitated by a gallery walk and focuses on examining the differences between climate change and climate variability through an informal change the different cultures, and the cause of climate change.
- UNIT 2: Describing short-term climate variability
- UNIT 3: Oceanic climate variability and change: a matter of context
- UNIT 4: Assessing climate variability and change: a matter of context
- UNIT 5: Assessing climate variability and change: a matter of context
- UNIT 6: Assessing climate variability and change: a matter of context

**Context for Use**  
Prior to the activity some exposure to El Niño will be necessary. If you are using the rest of [link], which includes lecture material, no additional instruction is necessary.

Year	1998	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
North America	100	100	100	100	100	100	100	100	100	100	100	100
Europe	100	100	100	100	100	100	100	100	100	100	100	100
Asia	100	100	100	100	100	100	100	100	100	100	100	100
Africa	100	100	100	100	100	100	100	100	100	100	100	100
South America	100	100	100	100	100	100	100	100	100	100	100	100
Oceania	100	100	100	100	100	100	100	100	100	100	100	100

**Cindy Shellito - Adaptations for a large lecture course**  
University of Northern Colorado

**Summary**  
How often does a lecture hall full of students in an introductory science class buzz with energy? In my twenty 10 years of teaching introductory meteorology I can say it has been rare. The activities in the Climate of Change module have students in my introductory-level General Meteorology class up and out of their seats, looking at and discussing the same data that scientists use to understand climate variability and climate change. This module prompts students to consider the broad-ranging societal impacts of climate change in the past, present, and future, and that engages them in science.

**Course Information**  
General Meteorology is an introductory survey course in meteorology and climatology. The course meets requirements for the UNIC Liberal Arts Core (LAC) Curriculum. Most students take the course to satisfy the LAC. The course is also taken by first-year students or transfer students who are Earth Science majors emphasizing in Environmental Science, Secondary Education.

**Includes:**

- Course description and syllabus
- Unit-by-unit tips for using materials in similar sized course
- Experience teaching these materials for the first time

**Summary**

- Two-week (6 unit) modules developed for introductory courses with geoscience components to address grand challenges and links of science and society.
- Modules can be combined and/or deconstructed to create a customized fit for different types of classes.
- Modules have been carefully created to support empirically validated instructional practices that have been shown to improve student learning.
- First full modules (Climate of Change, Mineral Resources, Hazards: Hurricanes) will be available soon.

<http://serc.carleton.edu/integrate>

**Questions?**

<http://serc.carleton.edu/integrate>

**Marine, Earth & Atmospheric Sciences, North Carolina State University**

- Looking for a graduate program in geoscience education? Positions available @ NCSU
- See David McConnell or Karen McNeal

**Image Sources**

- Earthquake damage, USGS  
<http://earthquake.usgs.gov/regional/nca/gmap/>
- Sea level trends map, NOAA  
<http://idesandcurrents.noaa.gov/sltrends/sltrends.html>
- Louisiana highway flooding  
<http://www.noaa.gov/features/climate/sealevelchanges.html>
- Red Devil mine, Alaska  
[http://www.blm.gov/gdata/etc/media/blm/ak/af/hazmat/red\\_devil\\_mine\\_...\\_media/images/Par.95407.Image-1-1-1.gif](http://www.blm.gov/gdata/etc/media/blm/ak/af/hazmat/red_devil_mine_..._media/images/Par.95407.Image-1-1-1.gif)
- Houston, land use trends  
[http://earth.rice.edu/mpa/bio/biosphere/hot/urbanization/houston2\\_class.html](http://earth.rice.edu/mpa/bio/biosphere/hot/urbanization/houston2_class.html)
- Temp anomaly map, NASA  
[http://science.nasa.gov/science-news/science-at-nasa/2013/15jan\\_warming/](http://science.nasa.gov/science-news/science-at-nasa/2013/15jan_warming/)
- Crowd photo  
<http://www.flickr.com/photos/jamescridland/613445810/>