GeoHazard: Modeling Natural Hazards & Assessing Risks

The Concord Consortium
NSF
PennState

“Changes in climate not only affect average temperatures, but also extreme temperatures, increasing the likelihood of weather-related natural disasters.”

-Earth Observatory, NASA

Context of the Work

Students explore the scientific factors that influence the risk and severity of hurricanes, wildfires, and inland flooding. Students use models and real-world data to investigate the risks and impacts that these natural hazards bring to people and their communities.

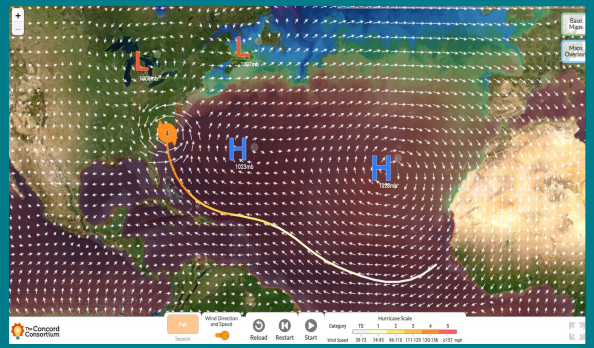
Photo Credit: National Geographic

Research Questions

Research on student learning and teacher practice is guided by the following questions:

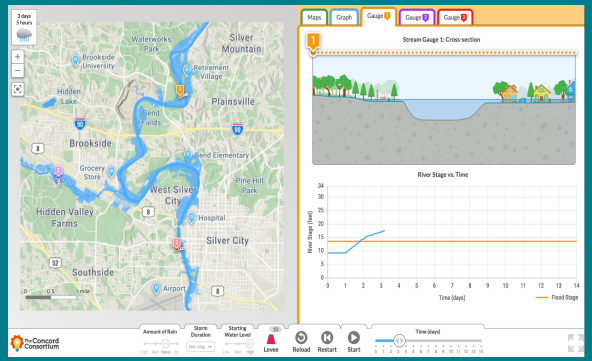
- How do students use data visualizations to make sense of data and build and refine conceptual models about natural hazards?
- How do students incorporate data from models and the real world when formulating scientific arguments? How do students use scientific uncertainty to assess risks based on their understanding of a natural hazard system? How do students quantify and explain risks to humans and compare different sources of risks?
- Do GeoHazard curriculum modules help students make gains in risk-infused scientific argumentation practice and conceptual understanding underlying natural hazards?

Products



Hurricane Explorer

Wildfire Explorer



Flood Explorer

We have created three Earth systems models that allow students to investigate the formation, progression, and severity of three different natural hazards: hurricanes, wildfires, and inland floods. **Each model is also embedded in a five activity curriculum module** in which students use the model to develop scientific arguments focused on risk analysis and uncertainty related to risk. The models and curriculum allow students to engage in authentic science practices and simulate a wide variety of possible scenarios. Students can then compare the outcomes in the model to real world scenarios and explore the limitations of the model.

Curriculum Design Principles

1. Frame risk as uncertainty in likelihood of event and severity of consequence.
2. Develop learning goals that combine domain knowledge and practice.
3. Connect geohazard risks to climate change to develop a broader perspective.
4. Address knowledge about factors influencing geohazard progression as a way to support student understanding of risks.
5. Develop scientifically-informed explanations in evaluating actions taken to avoid, mitigate, or manage risks.
6. Use simulations to help students learn about each factor influencing the natural phenomenon and apply their understanding to real-world situations.
7. Make activities authentic to students' real-world experience.

Data Collection & Results

2019-2020

Pilot testing of Hurricane Module and Assessment

- 193 students completed the module as well as the pre- and post-assessments.
- 52% were male, 35% non-white students; 6% were English Language Learners; 94% used computers for science learning prior to the hurricane module.
- The assessment has 29 items: 13 multiple choice, 6 true/false, and 10 open-ended items.
- Open-ended items were scored from 0 to 4. A total of 60 points were possible.
- The reliability was 0.78 using Cronbach's alpha. The Effect Size for the student pre-posttest gains was 0.97 SD. Wilcoxon matched-pair signed rank tests indicated that students significantly improved on 22 out of 29 items (8 multiple-choice, 4 t/f, and 10 explanation items).

Data Collection & Results

2020-2021

Data Collection in Progress

- Wide dissemination of Hurricane Module and Assessment
- Pilot testing of Wildfire Module and Assessment
- Pilot testing of Flood Module and Assessment

Project Impacts

- The Hurricane Module was released to the public at the start of the 2020-2021 school year. So far, it has been used by 4279 students in 236 classes with 130 teachers.
- The Wildfire Module is still in field testing and has been used by 1312 students in 60 classes with 28 teachers.
- The Flood Module is currently being pilot tested.
- The Hurricane and Wildfire Modules will be promoted by National Geographic starting this summer.

To learn more, visit:

concord.org/geohazard
and
learn.concord.org/earth

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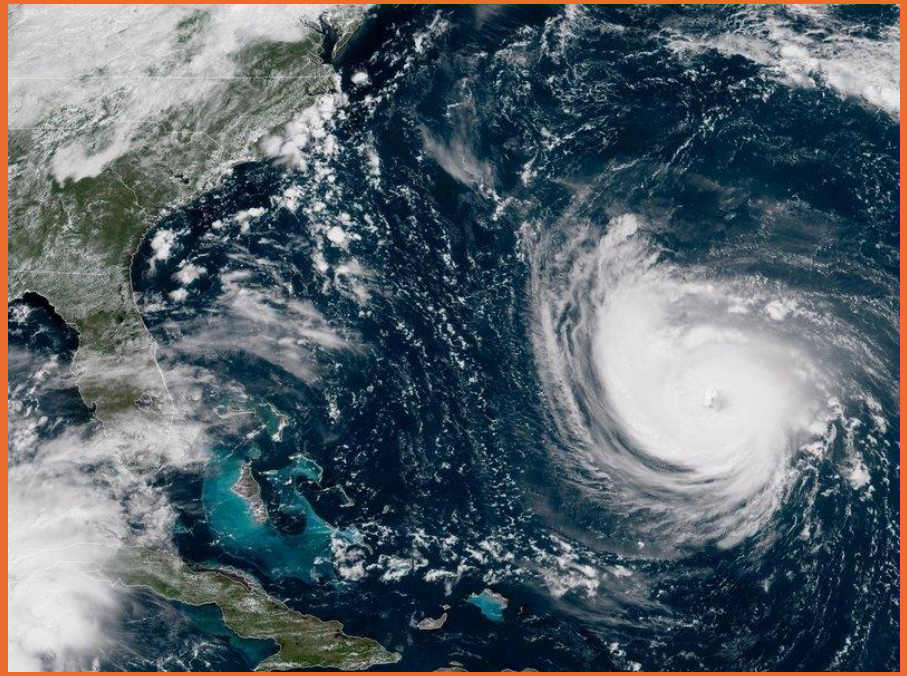

Photo Credit: NOAA