# Regional Sea Level Rise Module

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#### Summary

#### This module is framed from the perspective of a city planner trying to determine how much to spend on a local seawall given different scenarios of sea level rise and the associated storm surge and higher flood levels that come with it due to polar ice melt. Students refer to Climate Central’s Risk Finder website for data on the probability of flooding under four different sea level rise scenarios. Combined with data on the number of homes affected under different flood levels, students calculate and graph marginal expected damage curves to make a recommendation on building a seawall based on marginal benefits and costs.

## Learning Goals

1. Increase climate literacy by connecting sea level rise due to ice melt in the polar regions to the local impacts of higher flood levels.
2. Learn tools to apply to decision-making given uncertainty in sea level rise and flooding.
3. Gain computational skills through calculating and graphing marginal damage curves in Excel.

## Context for Use

## This module has been used in a variety of undergraduate intermediate and introductory economics courses and an upper level interdisciplinary course with no economics pre-requisite. Class sizes ranged from 12 to 40 students. The module uses both PowerPoint slides to guide the students through the analysis and an Excel spreadsheet for making calculations and graphing. Some basic economic concepts are required (e.g. marginal benefits and marginal costs) but these concepts could be covered in class prior to starting the module.

## The module contains three parts that can be completed in class over two shorter class periods (~50 min) or one longer class (~80+ min). The module can also be shortened at the instructor’s discretion. Students also complete the introduction to the module before coming to class, which takes about 1 hour.

## Description and Teaching Materials

Outline of Module

* Introduction in PowerPoint – students complete this before class
* Part I: Estimating Marginal Damage Costs from Flooding
* Part II: Graphing Expected Marginal Damage Curves
* Part III: Making Decisions Under Uncertainty
* Discussion Questions
* Follow-up Assignment Prompt

Workflow of module

1. Assign module introduction (in PowerPoint) to be completed before the first day of starting the module in class, which includes an article and video on polar ice melt.

2. Instructor gives a brief PowerPoint presentation on sea level rise scenarios given extreme polar ice melt.

3. Students start Part I of module with Excel. Students are encouraged to work in pairs or small groups and are prompted to answer “Pause for Analysis” questions throughout the module.

4. Students should be able to work through Parts I and II during a 50-minute class (depending on Excel skills). 5 minutes before class is over, the instructor can bring the group back together and go over selected Pause for Analysis questions.

5. The instructor could either assign the rest of the module to complete outside of class as homework, or have the students complete Part III of the module with a wrap up in the first part of the following class period.

6. Wrap up of the module concludes with a discussion on the assumptions and limitations of the analysis and an optional memo assignment.

## Teaching Materials

## Student Module in PowerPoint

## Student Excel spreadsheet

## Instructor Excel spreadsheet Key

## Instructor PowerPoint lecture slides

## Instructions for tailoring the module to different coastal regions

## Teaching Notes and Tips

## For more details on implementing the module in class, see the paper:

## Fortmann, L. Beaudoin, J., Rajbhandari, I., Wright, A., Neshyba, S., and Rowe, P. (2019). Teaching Modules for Estimating Climate Change Impacts in Economics Courses using Computational Guided Inquiry. *Journal of Economic Education*. 51(2).

## Assessment

Assessment of the module largely takes place during class time as the instructor walks around helping students work through the module. Additionally, class discussions on the Pause for Analysis and Discussion Questions at the end of the module allow the instructor to gauge student learning and highlight the key takeaways.

A follow up assignment prompt is also included, which entails the students writing a memo to a local city official that synthesizes their analysis and provides recommendations for addressing rising sea levels based on their results.

## References and Resources

Climate Central. Surging Seas Risk Finder Website: <https://riskfinder.climatecentral.org/>

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Hudson, T., Keating, K., and Pettit, A. (2015). Cost estimation for coastal protection – summary of evidence. Environmental Agency. Report –SC080039/R7

IPCC (2013): Summary for Policymakers. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Kopp, R. E., R.M. Horton, C.M. Little, J.X. Mitrovica, M. Oppenheimer, D.J. Rasmussen, B. Strauss, C. Tebaldi. (2014). Probabilistic 21st and 22nd century sea-level projections at a global network of tide-gauge sites. Earth's Future, 2(8), 383-406.

Murphy, J. October 14, 2015. The Nation. Retrieved from: <https://www.thenation.com/article/3-years-after-hurricane-sandy-is-new-york-prepared-for-the-next-great-storm/>

NOAA 2017: Sweet, W. V., Kopp, R. E., Weaver, C. P., Obeysekara, J., Horton, R. M., Thieler, E. R., and Zervas, C. (2017). Global and Regional Sea Level Rise Scenarios for the United States. NOAA Technical Report NOS CO-OPS 083

Sweet, W. V., Kopp, R. E., Weaver, C. P., Obeysekera, J., Horton, R. M., Thieler, E. R., & Zervas, C. (2017). Global and regional sea level rise scenarios for the United States. NOAA.

Memos: General Introduction (n.d.) Purdue Online Writing Lab. Retrieved from: <https://owl.purdue.edu/owl/subject_specific_writing/professional_technical_writing/memos/index.html>