



Moody's Mega Math Challenge® 2017

A contest for high school students

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From Sea to Shining Sea: *Looking ahead with the National Park Service*

The National Park System of the United States comprises 417 official units covering more than 84 million acres. The 100-year old U.S. National Park Service (NPS) is the federal bureau within the Department of the Interior responsible for managing, protecting, and maintaining all units within the National Park system, including national parks, monuments, seashores, and other historical sites.

Global change factors such as climate are likely to affect both park resources and visitor experience [1] and, as a result, the NPS's mission to "preserve unimpaired the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this and future generations." Your team can provide insight and help strategize with the NPS as it starts its second century of stewardship of our nation's park system.

1. **TIDES OF CHANGE**—Build a mathematical model to determine a sea level change risk rating of high, medium, or low for each of the five parks below for the next 10, 20, and 50 years.

Acadia National Park, Maine
Cape Hatteras National Seashore, North Carolina
Kenai Fjords National Park, Alaska
Olympic National Park, Washington
Padre Island National Seashore, Texas

You may use provided data on sea level to build the model (**see link on reverse**). Explain your interpretation of high, medium, and low. Could your model realistically predict those levels for the next 100 years?

2. **THE COAST IS CLEAR?**—In addition to the phenomena listed above, the NPS is investigating the effects of all climate-related events on coastal park units. Develop a mathematical model that is capable of assigning a single climate vulnerability score to any NPS coastal unit. Your model should take into account both the likelihood and severity of climate-related events occurring in the park within the next 50 years. Some or all of the provided data may be used to assign scores to the five national park units identified in Question 1.

3. **LET NATURE TAKE ITS COURSE?**—NPS works to achieve its mission with limited financial resources that may vary from year to year. In the event that costs—such as those caused by climate-related events—exceed revenues and funding, NPS must prioritize where to spend monies.

Consider incorporating visitor statistics and your vulnerability scores (and possibly other variables that may be considered priorities) to create a new model that predicts long-term changes in visitors for each park. Use this output to advise NPS where future financial resources should go.

Your submission should include a one-page executive summary with recommendations for the NPS, followed by your solution paper – for a maximum of 20 pages.

[1] National Park Service (NPS). *National Park Service Climate Change Response Strategy*. Fort Collins, CO: National Park Service Climate Change Response Program; 2010.

MORE ON REVERSE

DATA STATEMENT

Multiple government agencies collect a wealth of data on a regular basis. A portion of this data has been compiled and provided. You may choose none, some, or all of this data and/or any additional data sources you may identify while working on this problem. Be sure to cite all resources used.

The actual data files (names below) and descriptions of each are linked to from this page:

<https://m3challenge.siam.org/node/336>.

To access the data page, you must be logged in at *mym3challenge.siam.org*.

- NPS_MeanSeaLevel
- NPS_Heat_Index
- NPS_Hurricanes
- NPS_Wildfires
- NPS_Temperature
- NPS_air_quality
- NPS_visitor_stats

Links you may find useful:

<https://www.nps.gov/subjects/socialscience/vse.htm>

<http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0128226>

<https://www.nature.nps.gov/ParkScience/index.cfm?ArticleID=624&Page=1>

<https://www.epa.gov/climatechange>

<https://www.ncdc.noaa.gov/climate-information/extreme-events>