CE88B: Time Series Analysis: Sea Level Rise and Coastal Flooding
Spring 2017
Instructor: Professor Mark Stacey

Sea level rise and variability is an emerging threat for coastal communities across the Unitied States and around the world. Examples of the combined influence of long-term sea level rise and natural sea level variability include the flooding associated with Hurricane Katrina and Superstorm Sandy, as well as local events that regularly flood highways and intersections around the San Francisco Bay Area. It is evident that the problem of coastal flooding is characterized by a wide range of timescales and responds to a variety of natural and anthropogenic forces.

In this course, we will use long-term records of coastal water levels to understand the dynamics and future impacts of coastal flooding while simultaneously developing capabilities in the analysis of time series data. We will cover the collection, evaluation, visualization and analysis of time series data using long-term records of sea levels at coastal sites around the United States and the world. Oceanic water levels vary on a wide range of timescales, and provide an ideal case study for development of time series analysis tools.

During the semester, students will identify and evaluate data sets describing coastal sea levels and then apply a number of analysis tools to examine aspects of the time variability evident in the records. This activity will culminate in a final project that fully characterizes the threat of coastal flooding at a particular location. Specific data analysis topics will include: visualization techniques for time series data; identification of extreme events; data distribution functions, statistics and moments; averaging and filtering; descriptions in frequency space; identification and evaluation of trends and periodic components; harmonic and wavelet analyses; extrapolations and projections; spatial representations of coastal flooding; and decision making about shoreline protection under uncertainty

When completing this course, students will have a thorough understanding of data constructs and visualization techniques for time series data and an ability to use a range of analysis tools, which will be complemented by an awareness of sea level rise and its impacts, both empirically and theoretically. The use of inferential thinking will be used in developing future projections and to evaluate decision making under uncertainty.

Course Details:

Instructor: Mark Stacey
Lecture/Lab Session: Tuesday 12-2, 277 Cory Hall
Office: 665 Davis Hall
Office Hours: Wednesday 11-1
email, phone: mstacey@berkeley.edu, 510-642-6776
Readings: Will be distributed as needed
Co-requisite: Foundations of Data Science

Detailed Schedule of Topics (Subject to adjustment for coordination with Foundations of Data Science course):

Week 1: Course Logistics, Coastal Flooding
Week 2: Sea Level Rise and Variability: Scientific Background
Week 3: Coastal Water Level Data Collection and Data Structures; Introduction to Signal and Noise
Week 4: Communicating about Sea Level: Data Processing and Visualization Techniques
Week 5: Coastal Flooding Risks: Extreme Events, Distribution Functions

Week 6: Coastal Flooding Risks: Distribution Functions, Statistics and Moments, Event Likelihoods
Week 7: Another View of Variability: Frequency-based Descriptions
Week 8: Analysis of Time Variability: Filtering, Averaging and Smoothing
Week 9: Long-term Sea Level Rise: Identification and Evaluation of Trends in Timeseries
Week 10: Natural Variability: Identification and Evaluation of Periodic Variability, Harmonic Analysis
Week 11: Long-term Trends in Variability: Introduction to Wavelet Analysis
Week 12: Looking to the Future: Extrapolations and Projections [mean trends, extreme events]
Week 13: Impacts of Coastal Flooding: Spatial Representations of Data
Week 14: Decision-Making about Shoreline Protection: Spatial Interactions and Uncertainty
Week 15: Integration and Summary

Requirements and Grading: Roughly 10 homework assignments will cover specific topics related to time series data, and will build up to a cumulative final project analyzing coastal flooding risks at a particular site. Weekly assignments will account for 65% of final grade; final project will account for remaining 35%.