Undergraduate Modeling Workshop

May 20-25, 2018

PROJECT ABSTRACTS

Group Leader:
Christian Sampson

Project I: Arctic Sea-Ice

“Low order models of Arctic sea ice and the effect of process parameterizations for predictions”

Abstract: Covering 7-10% of the Earth’s surface, Sea ice is a critical component of the climate system and is sensitive to changes in global temperature. In the paper “Nonlinear threshold behavior during the loss of Arctic sea ice” (Eisenmann & Wetlaufer 2009) a low order model for sea ice thickness is presented which exhibits hysteresis in sea ice loss as the climate warms. This model considers the most impactful processes affecting sea ice volume and parameterizes them, good representations of these processes is thusly paramount. One such important process is the ice albedo feedback. In the Arctic summer months, snow melt turns into dark ponds which sit atop the sea ice. Dubbed melt ponds, these ponds lower the over albedo (reflectance) of the ice causing the absorption of more incoming solar radiation, promoting more melting and further lowering the ice albedo and continuing. In this project we will investigate how different parameterizations of this process affect model output and hysteresis. We can also examine how changing seasonal temperature variations, such as early warming and melting, will affect the fate of the Arctic sea ice pack.

Group members: Madeleine Braye, Yasmin Eady, Nicole Jacobs, Jesse Liu, Ryan Norlinger, Jose San Martin

Group Leader:
Yawen Guan

Project II: Air Quality

"Data analysis on air pollutant exposures. (We will use R for data analysis)"

Abstract: Fine particulate matter (PM2.5) is a mixture of air pollutants that, at a high concentration level, has adverse effects on human health. An interesting statistics problem is to estimate these pollutant exposures for the entire US, such estimates can be used to inform policy and decision making. During the workshop, we will work on two major source of air quality data that are used by the EPA to estimate pollutant exposures, including monitoring data and the Community Multiscale Air Quality (CMAQ) model. The monitoring stations provide fairly accurate measurements of the pollutants; however, they are sparse in space and take measurements at a coarse time resolution, typically 1-in-3 or 1-in-6 days. On the other hand, the CMAQ model provides daily concentration levels of each component with complete spatial coverage on a grid; these model outputs, however, need to be evaluated and calibrated to the monitoring data. We will explore these air quality data for the summer of 2011 and brainstorm on statistical models to estimate air pollutant exposures.

Group members: Meixi Chen, Vincent Gonzales, Alan Ji, Chandni Malhotra, Hongyu Mao, Sharon Sung

Group Leader:
Mikael Kuusela

Project III: Ocean Temperature

"Spatial statistics for reconstructing ocean temperature fields using Argo float data"

Abstract: Argo floats (http://www.argo.ucsd.edu/) measure ocean temperature and salinity in the upper 2000 meters on a global scale. Spatial statistics provides the tools for reconstructing the full temperature and salinity fields based on sparse point observations from the floats. The large size and complex spatio-temporal dependence structure of the Argo data set mean that state-of-the-art statistical techniques are needed for efficient reconstructions. The goal of this project is to learn to explore, visualize, model and spatially interpolate subsets of Argo data using R. The preliminary plan is to use the "fields" package and to see how far we can push the tools there when reconstructing regional ocean temperature fields.

Group members: Ahmet Hatip, Alex Hayes, Alexa Maxwell, Joseph Struzeski, Ingrid Tchkaoua, Wenbo Wang

Group Leader:
Whitney Huang

Project IV: Southeastern US Rainfall

"Gulf coast rainfall data analysis"

Abstract: In this project the group members will play with daily rainfall data collected in Gulf coast (535stations in total) from 1949 to 2017. The purposes of this exercise are to:
1) to give students an idea of a typical example of a climate data set (spatio-temporal data) and someassociated scientific questions (e.g. how rainfall extremes vary in space and time and how that mightbe affected by other things like greenhouse gases or temperatures).
2) to get students familiar with data analysis using R including data manipulation, data visualization, and data summary.
3) to introduce some statistical methods (e.g. time series analysis, spatial statistics, extreme value analysis) to analyze this kind of data to "answer" (perform statistical inference) the questions of interest.

Group members: Lin Ge, Jianan Jang, Jessica Robinson, Erin Song, Seth Temple, Adam Wu

Group Leader:
Maggie Johnson

Project V: Vegetation

"Analysis of vegetation using remote sensing data"

Abstract: Imaging spectrometers housed on satellites are used to obtain data on vegetated surfaces by measuring reflectance from the Earth's surface. These data are very useful as they provide information on changes in vegetation over time on global scales, which is important to assess the impacts of changes in weather and climate, and the effects of agricultural practices. However, the information provided by these data can be limited due to the resolution of the sensors and inhibiting factors such as cloud cover. In this project we will use two remote sensing sources of the Enhanced Vegetation Index (EVI) to analyze vegetation over Nebraska. The first, Landsat EVI, is available at fine spatial resolution, but is sparse in time. The second, MODIS EVI, is obtained regularly in time, but is available at a much coarser spatial resolution. We will use these data to explore the relationships between vegetation and changes in temperature and landcover (e.g. corn fields versus grasslands), as well as to classify the landcover in unknown regions.

Group members: Samuel Hood, Zhihan Lu, Rita Pradhudesai, Thomas Rechtman, Meghana Tatneni, Ganlin Ye

Group Leader:
Huang Huang

Project VI: Forest Cover

"Inference on forest variables from complete-coverage LiDAR data and sparse observations"

Abstract: We have two sources for forest variables, from direct measurements, which are always expensive and would be sparse in space, and correlated LiDAR data that has complete coverage. The Bonanza Creek Experimental Forest (BCEF) is a Long-Term Ecological Research (LTER) site consisting of vegetation and landforms typical of interior Alaska. People are interested in three forest variables: above-ground biomass (AGB); tree density (TD); basal area (BA). The brightness, greenness, and wetness tasseled cap indices can be used as covariates to explain the forest variables. In the undergraduate workshop project, students can brainstorm from the easiest regression models to more sophisticated spatial models and compare the differences of inferences from different ideas.

Group members: Richard Groenwald, Mehmut Hatip, Katrina Lewis, Jennifer Soter, Astride Tchkaoua, Sylvester Wieb