EAS 30800 – EES: Modeling & Databases
Fall 2019

Instructor: Prof. Z. Johnny Luo, MR-927, 212-650-8936
Time: Friday 9:30am – 12:00pm; **Location**: MR O44
Office hours: after class or by appointment
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Description:

(Bulletin) Applications of the principles of Earth Systems Science (EES) to the diagnosis and modeling of global and local environmental problems. Introduction to remote sensing techniques, processing and analysis of global datasets, and numerical models of the Earth Systems.

(This semester) EES examples will be drawn mostly from atmospheric and climate sciences. Since this class emphasizes quantitative data analysis and numerical modeling, programming is an important component. I will use mainly Matlab (sample code will be provided in Matlab). Excel is useful sometimes, but will be insufficient in many cases. Matlab tutorial will be given to equip students with basic skills needed for the class.

Objectives:

At the completion of this course, students should be able to:

- Build simple numerical models to describe EES problems (e.g., energy balance of the Earth-atmosphere system)
- Understand data structure of climate datasets
- Understand basic principles of remote sensing and applications to Earth Observations
- Apply simple statistical analysis, as well as graphing, to climate and remote sensing data

Prerequisite:

EAS21700 (EES: Systems Analysis of the Earth), or permission of instructor. Knowledge of programming is highly desirable.

Textbooks:

Materials for this class are spread out over a number of textbooks. They include:

- *Global Physical Climatology*, Dennis L. Hartmann, Academic Press
- *Matlab Recipes for Earth Sciences*, M. H. Trauth, Springer
- *Statistical Methods in Atmospheric Sciences*, Daniel S. Wilks, Academic Press

Grading:

Lab reports: 30%; midterm: 30%; final exam (cumulative): 40%

Course Outline
(Note: Schedule may be subject to adjustments depending students' progress):

Dates	Topic	Other Activities
8/30	Intro: what is modeling & what is database in EES?	
9/6	Matlab Programming I: simple analysis and graphing of data (e.g., histogram, scatterplot, contour, ...)	
9/13	Matlab Programming II: handling of multi-dimensional arrays	Lab 1: analysis of SST data
9/20	Earth-atmosphere system's energy balance: radiative energy & other forms of energy fluxes	
9/27	Modeling energy balance: radiative equilibrium (RE) & radiative-convective equilibrium (RCE)	Lab 2: modeling RE & RCE
10/4	Guest lecture; Continuing with Lab 2	
10/11	Modeling energy balance: Equator-to-pole energy transport (Budyko energy balance model or EBM)	Lab 3: Budyko EBM
10/18	Global Climate Model (GCM): basics, current topics, and exploration of IRI database	
10/25	Remote Sensing basics	Midterm
11/1	Applications of Remote Sensing to satellite observations	
11/8	Database example 1: satellite observation of clouds	
11/15	Database example 2: Atmospheric Reanalysis	
11/22	Statistical analysis of climate data I (fit statistical distributions to data, e.g., Gaussian)	
12/6	Statistical analysis of climate data II (Linear Regression)	Lab 4: analysis of NCEP/NCAR reanalysis