EAS 6132 - Introduction to Climate Change
Credits: 3.00
Lecture: 3.00

Textbook: Required: Global Physical Climatology: Dennis L. Hartmann, Academic Press. The curse will in addition use relevant current literature for those topics not addressed in the text and to prepare the students for addressing current research topics.
Course Overview: The climate of the Earth is defined by statistical properties of the complex dynamic system of the atmosphere, oceans, ice, and land surface. Summary statistics are addressed through large scale conservation laws that describe surface and top of the atmosphere energy balances; surface energy balance is described in terms of the balance between net radiation and turbulent fluxes. Top of the atmosphere radiation budget exerts a strong control on global temperatures. Its changes are described in terms of natural variability and anthropogenic activities, in particular, greenhouse gases and their sources and sinks.. Linear statistical techniques are used for the detection and attribution of recent climate change. The course is designed to provide an introduction to the fundamental concepts underlying our current understanding of the climate system. The capstone objective of the course is for students to develop a paper based in part on original work and using the concepts and tools of the class. For this purpose, students will be provided access and requisite training to carry out simulations with a state of the art climate model. Week:

- 1 - Fundamentals: Deterministic and statistic descriptions of a complex dynamical system- controls on statistics by conservation laws. Introduction to observed properties of the climate system.
- 2 – Global energy balance and its consequences for description and modeling of climate
- 3 – Basics of atmospheric radiation in the context of energy balance constraints.
- 4 - Radiative Convective equilibrium
- 5- Hydrological controls on atmospheric radiation: cloud solar and longwave feedbacks; consequences of net energy balance of atmosphere: latent heating versus longwave cooling.
- 6 -Terms describing energy balance at the terrestrial and oceanic surface
- 7- Geographic, seasonal, and diurnal variations of terrestrial energy balance terms
- 8 – Terrestrial water balance in terms of precipitation, evapotranspiration, and runoff.
- 9- Scales of motion from local boundary layers to atmospheric general circulation. Observational description of atmospheric general circulation – dynamic constraints.
- 10 – Ocean general circulation and its connection to climate.
- 11- Linking radiative effects to future and past (paleo) climate change through application of simple climate models.
- 12 – Content and application of comprehensive Earth system models.
- 13 – Elements of linear detection theory: EOFs of natural variability.

- 14 - Combination of models, observations, and linear detection theory to determine the relative contribution of greenhouse gases versus aerosols to the observed current climate change.
- 15-16 Presentation of class papers

Course Evaluation
Problem Sets (6): 20%
Midterm Quiz: 30%
Written and oral paper: 50%