Physical Climatology

Lecture	1:25–2:15 Monday, Wednesday & Friday	Allison Hall 132
Lab Section 20	4:00–6:00 Monday	Pearson Hall 203
Lab Section 21	4:00–6:00 Wednesday	Pearson Hall 203

Brian Hanson 209 Pearson Hall
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1:30–2:30 Tuesday
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Global climate is controlled by physical processes, and by-and-large we understand what processes are involved and how they work. Actually calculating the climate that results from a given set of forcings is a much more difficult problem. This course is about how physical processes create global climate, and how changes in the rates and intensities of those processes can change climate. Along the way, we will develop a better understanding of what "climate" really means.

Three phases of growing to understand climate include getting the basic physical science background (you have already done this), understanding how the observed climate system behaves in response to physical forcings (this course), and learning how to predict the climatic response to changed forcing (barely touched in this course, but see Geog 657).

Primary course text: D. L. Hartmann, 2016. *Global Physical Climatolgy, 2nd ed.* Elsevier.

Course web sites: http://hanson.geog.udel.edu/Physical_Climate.html and UD Canvas site. (All assignments will be turned in on Canvas. All material and datasets for the labs and anything else not covered by copyright should also be available on the open web site.)

Prerequisites: A first semester of calculus and an introductory meteorology course are expected background. Completion of the labs also requires some computational ability, for which Excel will suffice but facility with Python or Fortran will be better.

Grades for the course will be based on a series of lab exercises (25%), six quizzes (35%), a short term-paper project (15%), and a group project leading to class presentations (10%), and a comprehensive final exam (15%). Quizzes will be each Friday from February 17 through May 12.

Tentative Course Outline

1. Defining the balanced climate (1 week; Ch. 1)
   a) Bretherton Diagram, Robock Diagram
   b) Turning Kiehl & Trenberth 1997 into a model
2. Survey of the observed climate. (3 weeks, Ch. 2, 3)
   a) Looking at the atmosphere vertically and horizontally. (§2.1)
   b) Basics of the ocean. (§2.3)
   c) Diurnal and seasonal forcings and cycles. (§3.1)
   d) Internal oscillations and variability (§3.2–3.4)
   e) History of the earth and its atmosphere (§3.5)
3. Radiative transfers. (4 weeks, Ch. 4)
   a) Planck, Wien, Stefan-Boltzmann (§4.1)
   b) Planetary solar constants (§4.2–4.3)
   c) Absorption in the atmosphere (§4.4–4.5)
   d) Layers, clouds, lapse rates (§4.6–4.7)
4. Energy Balance Revisited. (3 weeks, Ch. 5)
   a) Nonradiative heat transers. (§5.3)
   b) Revisiting Kiehl & Trenberth 1997, with imbalance (§5.4)
5. Hydrologic Cycle. (2 weeks, §2.3–2.4, Ch. 9)
6. Forcing changes. (1 week, Ch. 10)