Climate Dynamics 610: Climate Dynamics (Introduction to the Physical Climate System)

Course Syllabus Spring 2022

Course Instructor: David M. Straus

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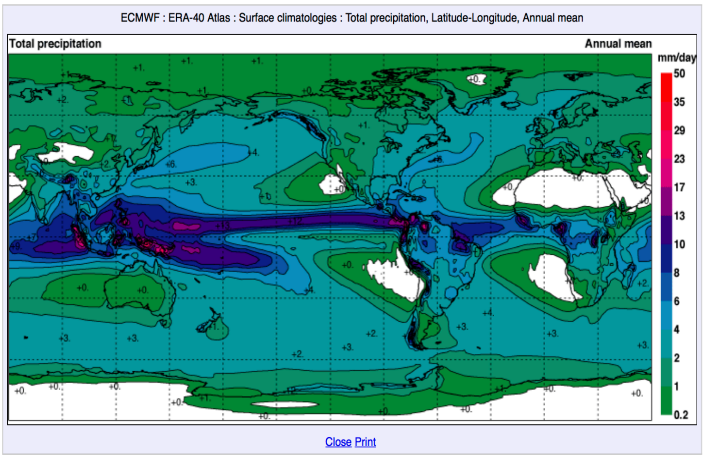
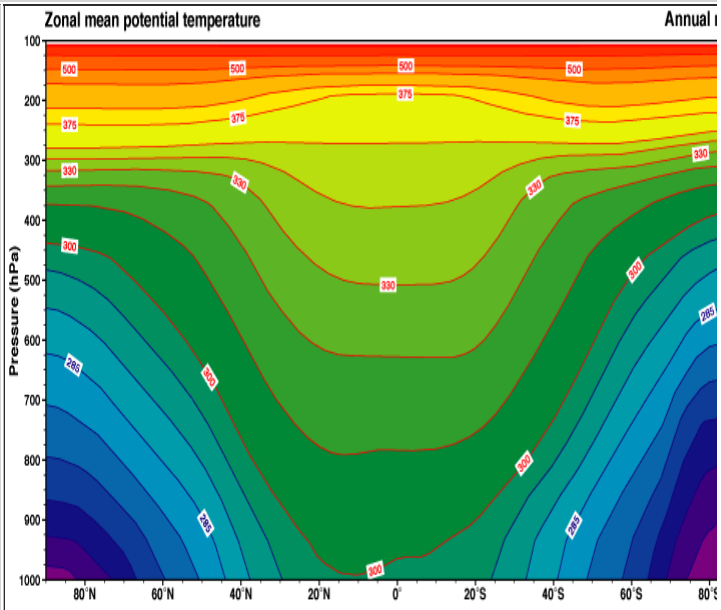


Map of Annual Mean Precipitation (ECMWF)



Zonal Mean of Potential Temperature ECMWF

Class location: Research Hall Room 121. Also available on Zoom.
Note: From Thu. Mar 3 through Thu. Apr 28 the class will be entirely on Zoom.

Class time: Tuesday - Thursday 3:00 PM to 4:15 PM

- **First class: Tuesday Jan 25**
- **Spring Break: Mar 15,17**
- **Mid-Term: TBD**
- **Last class: Thursday May 5**
- **Final Exam: Thursday May 12 1:30 PM - 4:15 PM**

Primary Required Reading (Course Notes):
http://mason.gmu.edu/~dstraus/CLIM_440_syllabus.htm
Note: Course Notes also available on Blackboard.

Primary Reference Books:

- **Hartmann, D. L.: Global Physical Climatology, Second Edition. Elsevier, 2016.**
  - **ISBN-13 978-0-12-328531-7**
- **Andrews, D. G., 2000. An Introduction to Atmospheric Physics., Cambridge University Press, 2000**
  - **ISBN-13: 978-521-62958-4**
  - **ISBN-10: 0-521-62958-4**

Supplementary Reading:

- **Salby, Murry L. Fundamentals of Atmospheric Physics. Academic Press, 1996.**
  - **ISBN-10: 0-12-615160-1**
- **Masaki, Satoh. Atmospheric Circulation Dynamics and General Circulation Models Springer, 2004**
  - **ISBN-10: 3-540-42638-8**

Course Goals and Student Learning Outcomes

- **Acquire knowledge of the basic physics principals that govern weather and climate.**
- **Understand the overall energy balance of the earth-atmosphere-ocean system.**
- **Be able to articulate the reasons for global atmosphere and ocean transport of energy.**
- **Become familiar with the atmospheric structures that trasnport energy and moisture.**
- **Acquire basic skills for examining current data sets of weather and climate variables.**
- **Develop the ability to read basic journal papers on the subject, and report the main findings.**

Student Work Components

1. **Mid-Term Exam = 20% percent of grade**
2. **Final Exam = 20% percent of grade**
3. **Four Homework Sets = 30% percent of grade**
4. **Paper Presentations = 20% of grade** Suggested Journal Articles
5. Personal Class Journal =10% of grade

Homework Policy

Course Topics

(Note: Content of lectures subject to updating!)

Introduction

1. Introductory Lecture by J.Shukla
2. Global Energy Balance
3. Atmospheric Thermal Structure

Journal Entries due

Radiation and Climate Part I

1. Satellite Radiation Maps
2. Planck Function and Blackbody Radiation
3. Radiation: Observations and simple models

Journal Entries due

Radiation and Climate Part II

1. Radiative Transfer
2. Short Wave Radiation Distribution
3. Radiative-Convective Equilibrium

Journal Entries due

Thermodynamics

1. Microscopic Approach to Temperature and Ideal Gas
2. Thermodynamics: General Ideas
   Enlarged Figures for Thermodynamics Part 1
   Entropy and the First Law
3. Thermodynamics: Application to Moist Ideal Gas

Journal Entries due

Thermodynamics (supplementary material)

1. Thermodynamics Notes Part 1
2. Thermodynamics Notes Part 2
3. Thermodynamics Figures 2

Atmospheric General Circulation

1. Atmosphere General Circulation: Introduction

2. Hadley and Ferrel Cells
3. Energy Transport
4. Rotational vs. Divergent Flow
5. Isentropic_Hadley_Cell

Journal Entries due

Atmospheric Circulation: Mid-latitude Disturbances

1. Transient Fluctuations
2. A direct look at Baroclinic Transients
3. Extra-Tropical Energy Flux

Journal Entries due

Role of Precipitation

1. The Hydrological Cycle
2. The Indian Monsoon

Journal Entries due

Oceans and Climate

1. Oceans and Climate

Paleoclimate

1. Paleoclimate: Observations, Theory and Modeling

Journal Entries due

Brief Review

Academic Integrity

George Mason is an Honor Code university. The principal of academic integrity is taken very seriously and violations are treated gravely.
When you as the student are responsible for a task, you will perform that task.
When you rely on someone else's work in an aspect of the performance of that task, you will give full credit in the proper, accepted form.
The homeworks and exams in this course are designed to be undertaken independently.
You may discuss your ideas with others and conference with peers on drafts of the work.
But you are responsible for making certain that the work you hand in is your own.
Please see the Academic Integrity website