ATM 306 mid-term (and final exams) check-list:

Exams will be open-book. Therefore it is important for students to have a good overview on the concepts and physical principles that we use when to explain and describe the Earth physical climate system. Questions in the exams will ask students to explain selected aspects of the climate system. A few calculations similar to the homework problems may be asked from students.
Most important will be to answer the questions with the right physical concepts and combine the learned information in a consistent way to explain why we observe certain types of climate states or climate variability.

- **Vertical structure of the standard atmosphere (Peixoto & Oort 2.3.1):**
  - temperature profile as function of pressure
  - concept of geopotential height

- **Radiative energy fluxes and Earth radiative energy budget (Coakley and Young 1.1-1.4):**
  - **Geometry of the Earth: radius, diameter, area!**
  - Radiative budget of the earth: Shortwave and longwave radiation fluxes
  - Wien's displacement law, (qualitatively, not the full derivations of the equations)
  - Stefan-Boltzmann law and Black-body radiation (irradiation - temperature dependence)
  - Quantitative calculation using specific heat capacity, mass, density, volume and energy fluxes (homework #2!)

- **General circulation and climate (Peixoto & Oort Ch. 7)**
  - zonally averaged winds, temperatures, shortwave, longwave, and net energy fluxes
  - Hadley Cell
  - Walker Circulation
  - Mean sea level pressure during winter and summer and location of major pressure pattern
  - Geopotential Height of pressure surfaces
  - horizontal pressure gradients, Coriolis force, Geostrophic wind

- **Ocean circulation (Peixoto & Oort Ch. 8):**
  - Wind-driven circulation:
    - Ekman spiral, Ekman transport
    - Ekman pumping (eg. coastal upwelling/ downwelling, equatorial upwelling)
    - Gyre circulation
    - Geostrophic flow (pressure – Coriolis force balance)
    - cyclonic, anticyclonic circulation

- **Climate variability 101 (Peixoto & Oort 2.1, 2.2.1,2.4.1-2.4.3):**
  - Difference weather – climate
  - Climatological mean states (= 'climate normals', 'normal conditions'), climate anomalies

- **Tropical Pacific climate variability**
  (Lecture notes, and Online Textbook "Introduction to Tropical Meteorology", http://www.goesr.gov/users/comet/tropical/textbook_2nd_edition/navmenu.php_tab_5_page_2.0.0.htm**) :**
  - normal conditions in the tropical Pacific:
    - SST, SLP, Thermocline, winds!
  - Southern Oscillation
  - El Niño, La Niña
  - Bjerknes Feedback and El Niño Southern Oscillation (ENSO)
  - Tropical ocean waves:
    - Physical description of waves: wavelength, period, frequency, phase speed
    - Kelvin waves, Rossby waves: propagation, and main latitude range in the tropical Pacific, where the two wave-types are found.
  - Delayed oscillator conceptual model for ENSO variability (role of the waves for change from El Niño to La Niña conditions)