Earth Science in Global Context (Atmospheric Science Section) NASC 5120

Course objectives: Our goal is to gain a deeper understanding of the:
1. Earth’s radiation balance
2. Structure of the atmosphere and its interaction with solar and terrestrial radiation.
3. Characteristics of molecules, water, and particles in the atmosphere and their interaction with each other and with other atmospheric constituents.
4. International scientific problems of global warming and ozone depletion, including the way that scientific research is translated into common understanding.

We will do this through laboratory exercises, demonstrations, calculations, discussions, and writing. Homework will be assigned and graded. That plus class participation will form the basis for your evaluation.

**Brief Syllabus:**

1) **Radiation I** - Explore relationship between 
   a) Intensity of radiation and distance, and  
   b) Intensity and temperature of emitter (Stefan Boltzmann law).

2) **Radiation II** -
   a) Planetary equilibrium temperatures  
   b) Electromagnetic spectrum (Prisms/diffraction gratings, spectrometers)

3) **Objects in the sky I: Molecules** - Dominant/Trace 
   a) Atmospheric pressure - water barometer  
   b) Ideal gas law - expansion/contraction, boiling  
   c) Temperature profile: Troposphere - Convection, Stratosphere – Stability

4) **Interaction of solar radiation with earth’s atmosphere I – Scattering/Refraction** 
   a) Molecules - Blue sky, Sunsets  
   b) Aerosol particles, water droplets – sunbeams, corona, crepuscular rays, white clouds  
   c) Water drop/Ice –Rainbows, Haloes/ Sun dogs  
   d) Mirages

5) **Interaction of solar and terrestrial radiation with earth’s atmosphere II – Absorption/Emission**  
   a) Solar absorbers - UV absorption by ozone  
   b) Terrestrial absorbers – Water, Carbon Dioxide  
   c) How the atmosphere changes the earth’s equilibrium temperature  
   d) Atmospheric window  
   e) Greenhouse gases (CO₂), Greenhouse warming  
   f) Global climate change
6) **Interaction of solar radiation with earth’s atmosphere III** - Atmospheric motion
   a) Distribution of radiation on the earth
   b) Global heat balance
   c) Global circulation - Prevailing westerlies, Jet Streams, Eddies/cyclones, Easterly trade winds

6) **Object in the sky II - Water and particles – Troposphere**
   a) Water vapor - Evaporation - vapor pressure
   b) Liquid water – condensation
   c) Ice – precipitation, Latent heat release
   d) Aerosol particles and clouds, cloud condensation nuclei, ice nuclei

7) **Objects in the sky III - Water and particles - Stratosphere**
   a) Polar stratospheric clouds
   b) Ozone depletion

8) Open for catch up / suggestions / questions / ??

9) Review and summary (?) - outstanding questions, measurement uncertainties, fringe/formal science, scientific research and public policy, ...

Notes:
1) Course materials will include copies of lecture notes/presentations, and in class notes. Reference material will be mentioned and some made available. There is no text available which covers the material at the appropriate level.
2) Your performance will be evaluated from the daily assignments and class participation. Jim McClurg and I will average our respective evaluations for your overall course grade.
3) The emphasis throughout the course will be on understanding, and that is what I will be looking for in the written assignments. If in the written assignments, I don't see that understanding demonstrated, I will evaluate accordingly. If appropriate you may have a chance to improve your HW discussions on selected assignments.
4) Throughout the course I will also be mentioning the science activities I am involved in. Most of these will be related to what is pressing me at the moment, but there will be some mention of previous activities required of me. I do this in the hopes that it will give you a little more insight into what the life of a scientist is like.