EXERCISE #1 - updated
MEAN GLOBAL CLIMATE PATTERNS:
RADIATION & TEMPERTURE

Step 1: First, briefly review the concepts of radiation and the energy balance by reading the handout distributed in class and pp 1-5 in Chapter 1 of *The Global Climate System.*

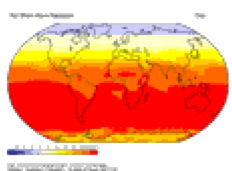
Step 2: Now go to the University of Oregon, Dept of Geography's Global Climate Animations Site. The "animations" shown here are really month-to-month views of the mean (average) global patterns of a variety of different climate elements (or variables) obtained from the model-based output of the NCEP/NCAR 40-Year Reanalysis Project.

Step 3: Visit each animation on this site to familiarize yourself with the mean and seasonal patterns of these major climatic elements. You can click on the images to see a larger version of the animations. Use the flash version of the images to be able to pause on a particular month, click through the year at your own pace, and toggle back and forth between two months. Read through the captions beside each animation and take notes on the main features you see on each map.

Step 4: Answer the questions below. Type out your answers on a separate page by cutting and pasting the questions into a Word document, typing in your answers, and printing out your completed version.

PART A -- Visualization of Mean ENERGY /RADIATION BALANCE Global Climate Patterns via Animations

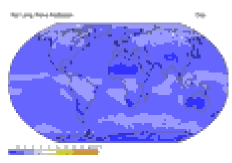
1. The first animation represents the monthly variation of Net Short-Wave Radiation which is the amount of short-wave radiation (i.e., solar radiation (ultraviolet and visible light) coming in *minus* the short-wave radiation going out (or being reflected) at the surface of the Earth.



Question #1a: Where on Earth and during what months and seasons do the lowest values of net short-wave radiation occur?

Question #1b: Speculate on and explain WHY this pattern occurs.

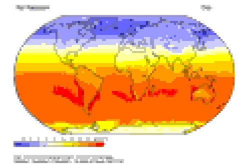
2. The second animation represents the monthly variation of Net Long-Wave Radiation, which is the amount of longwave radiation moving toward the surface from the atmosphere (the Greenhouse Effect) minus the amount of longwave (terrestrial) radiation being given off from the Earth's surface and moving upward and eventually out to space. As indicated in the animation caption, *positive* values (yellow, orange and red shades) represent energy moving *toward* the surface, *negative* values (blue shades) mean energy *moving away* from the surface. The maps are blue everywhere, meaning more longwave energy is moving away from the surface than is coming in, but in some spots the blue color is very dark, indicating *lots* of outgoing terrestrial energy in these locations.



Question #2a: Where and during what months (or seasons) is the Earth's surface radiating the most long-wave radiation out to space?

Question #2b: Speculate on and explain WHY this pattern occurs.

3. The Net Radiation animation represents how much energy is available at the surface of the Earth in different locations and during during months when all the radiation (both shortwave and longwave) moving *away* from the surface is subtracted from all the radiation (both shortwave and longwave) moving *toward*s the surface. Yellow orange and red areas experience a net gain of energy at the surface, blue areas experience a net loss of energy.

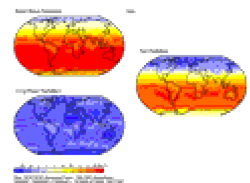


Question #3a: Where and during what months (or seasons) is the Net Radiation the lowest?

Question #3b: Where and during what months (or seasons) is the Net Radiation the highest?

Question #3c: Speculate on and explain WHY this pattern occurs.

4. Now look at all three of the above animations synchronized together on one page:



Question #4a: Which animation (Net Short-wave or Net Long-wave) varies the least (shows the least color changes) geographically (from pole-to-equator-to-pole) and seasonally (from January-December)?

Question #4b: Which animation (Net Short-wave or Net Long-wave) varies the most?

Question #4c: Describe what effect this has on the geographic and seasonal variations in Net Radiation.

5. Now compare the Net Radiation animation with the Air Temperature (at the Surface) animation. *(One way to do this is to open up two windows of your browser and re-size them so that they are both visible on the screen at once. Then open up the flash version of Net Radiation in one window, and the flash version of Surface Temperature in the other and use the "Next Frame" option to click through the months side by side.*)

The patterns of Net Radiation and Surface Temperature have some similarities, but there are also some striking differences. For example, note that the bands of color are zonal (oriented east-west) on the Net Radiation image, while the bands dip poleward and equatorward with the seasons over the continents on the Surface Temperature image. *Now answer the following question:*

Question #5: Speculate on and explain why there is not a perfect correspondence between the patterns of Net Radiation and Surface Temperature? *(HINT: read through the section on Non-Radiative Components and the Surface Temperature section caption.)*

THOUGHT QUESTION *(you do not have to write out the answer to this -- but think about it and be ready with ideas to share in class):*

What role do the components of H (Sensible Heat Flux), LE (Latent Heat Flux) and G (Change in Heat Storage) play in the seasonal variations of mean Surface Temperature in different parts of the globe and how does this happen (explain the processes using concepts of thermodynamics, phase changes, etc.)

PART B. Comparing Two Kinds of TEMPERATURE MAPS **UPDATED**
Create the following maps, saving each as a .gif file which you insert in an MS Word document:

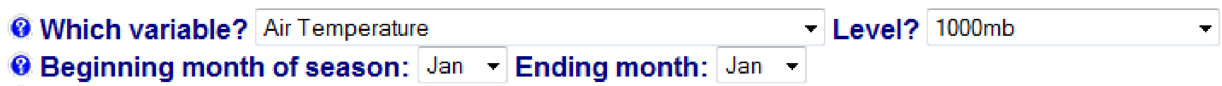
NOTE: these are revised instructions for making the temperature maps -- the directions posted last week won't work now because of "transition" changes at the "Visualize NCEP Data" website.

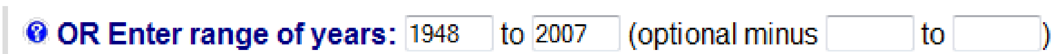
Go to the following link: **ESRL-PSD Interactive Plotting and Analysis Pages for Monthly/Seasonal Climate Composites:**
http://www.cdc.noaa.gov/cgi-bin/data/composites/printpage.pl/

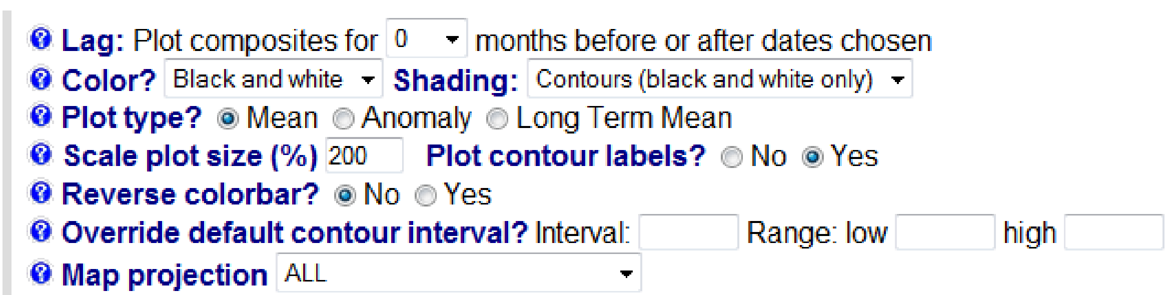
Then select the menu choices exactly as indicated below to plot simple black & white contour plots maps for two kinds of temperature maps:

Map #1 - Air temperature adjusted to sea level (1000 mb) *Month:* January
Map #2 - Air temperature adjusted to sea level (1000 mb) *Month:* July
Map #3 - Air temperature at the surface *Month:* January
Map #4 - Air temperature at the surface *Month:* July

Map #1 -- Air temperature adjusted to sea level (1000 mb) for January:



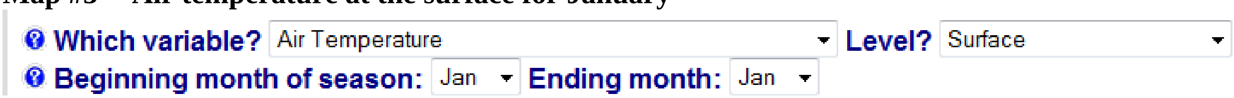




Map #2 -- Air temperature adjusted to sea level (1000 mb) for July

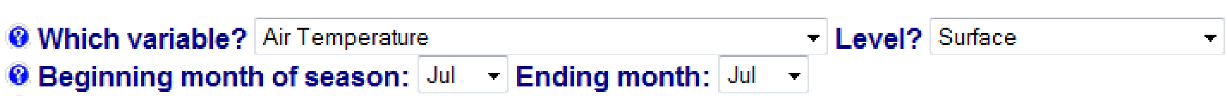
Repeat the above, but for month enter:

Map #3 -- Air temperature at the surface for January



. . . and then repeat the rest of the steps

Map #4 -- Air temperature at the surface for July



. . . and then repeat the rest of the steps

Then, for Maps #5 - #8 (temperatures in months following the equinoxes) repeat as above selecting April & October for the months.

Question #6: Compare and contrast the two ways of mapping temperature patterns by comparing the two January maps and the two July maps that you constructed. In your comparison, discuss: a) where in the world the map patterns are similar, b) where they are different, and c) what accounts for any differences you've observed.

Now construct four more maps to examine the mean monthly temperature patterns for the months occurring just after the March and September Equinoxes:

Map #5 - Air temperature adjusted to sea level (1000 mb) *Month:* April
Map #6 - Air temperature adjusted to sea level (1000 mb) *Month:* October
Map #7 - Air temperature at the surface *Month:* April
Map #8 - Air temperature at the surface *Month:* October

Question #7a: Since the equinox times represent (theoretically) the time when the Northern and Southern Hemispheres are each receiving roughly the same latitudinal inputs of solar radiation, we might expect the global temperature patterns during the post-equinox months of April and October to be similar to each other. Are they?

Question #7b: Speculate on why or why not, pointing out and explaining specific locations (if any) where the patterns differ between April and October. As you explore this questions, also compare the sea level vs. surface temperature maps in April and October and note similarities or differences between the two types of maps.

THOUGHT QUESTION: *(you do not have to write out the answer to this -- but think about it and be ready with ideas to share in class):*

WHEN and WHY might you want to use a map of air temperature adjusted to sea level and WHEN and WHY might you want to use a map of air temperature at the surface?
