1. **Assigned January 24, due February 2**

To get up and running computationally:

a. Nadir look from space at a 100 km-thick spherical atmosphere: Program, calculate, and plot the total geometric path through the atmosphere versus solar zenith angle (SZA) for SZA = 0-90^o (later, we will add refraction to calculations).

b. Limb view from space, 100 km spherical atmosphere: Program, calculate, and plot the path through the atmosphere versus tangent height over the range 0-100 km (later we will add refraction and a more realistic atmosphere).

2. **Assigned January 26, due February 7:** Use the data in us**76.dat** to determine the atmospheric scale height from the ground to the stratopause. Plot it against altitude and also against temperature.

3. **Assigned January 26, due February 7: On units – MKS versus cgs, wavelengths versus wavenumbers and frequencies.** Construct a table showing wavelengths and frequencies (nm, µm, cm^{-1}, MHz, GHz, and THz) for: CO 1→0 and 2←0 band centers (2143.272 cm^{-1}; 4260.063 cm^{-1}); ClO MLS emission line (204.35 GHz); O_2 *A* band center (13120.909 cm^{-1}); CO_2 15 µm "greenhouse" band (667.380 cm^{-1}); O_3 TOMS "on" wavelength (317.35 nm).

4. **Assigned January 31, due February 9:** Determine blackbody ***ster***radiancy (erg s^{-1} cm^{-2} sr^{-1}) by invoking Lambertian emission and integrating over solid angle.

5. **Assigned January 31, due February 9:** Construct an example where one observes an extended source (*e.g.*, a cloud) with an instrument having a given étendue. Show that the étendue is the same for the cloud observing you.

6. **Assigned February 2, due February 14:** Using a 100-meter radio telescope, calculating the beam in radians as the diffraction limit ($1.22\lambda/d$ where λ is the wavelength and d the telescope diameter), what T_{sys} is needed to detect Jupiter to 10% @ 10 cm wavelength in 5 hours? Ignore the CMB.

   At what angular resolution does Jupiter match the CMB? If I include the CMB, can I make the measurement with this telescope?

7. **Assigned February 7, due February 23:** Calculate and plot the intensity of blackbody radiation arriving at the Earth from the mean solar distance for temperatures corresponding to the bottom and the top of the solar photosphere. Do this for 1 nm intervals, 300-500. Compare these results with the solar irradiance spectrum. Your conclusions?

8. **Assigned February 23, due March 8:** Pick a planet or moon of your choice (with an atmosphere, please) and prepare a short (~10 minute) presentation for the class on its properties.

9. **Assigned February 28, due March 6:** Calculate the Doppler hw1e and pressure broadening HWHM for the following lines, using the temperature/pressure profile of the US1976 atmosphere:

Molecule	position	Pressure broadening coefficient (cm^{-1} atm^{-1})
ClO	650 GHz	0.06
HCl	125 cm^{-1}	0.08
O_3	9.6 μm	0.05
H_2O	1.02 μm	0.08
O_2	762 nm	0.03

Calculate for sea level, tropopause, mid-stratosphere (25 km), and stratopause.

10. **Assigned February 28, due March 8:** Select a combination of spectral line and atmospheric location from problem #9 where the Doppler and Lorentz widths are comparable. For a range of (line intensity, *S*) × (column density, *N*), ranging from very small to quite large (optically thin to optically very thick), calculate the Voigt function, *V*, versus position and plot the results as either an emission line ($1-e^{-SNV(\sigma)}$) or an absorption line ($e^{-SNV(\sigma)}$).