Problem 1: The aerosol

Figure 16 of the class notes shows profile of the atmospheric aerosol. Based on this figure:

- Summarize the main differences between polluted and non-polluted regions.
- How does the ratio between the non-volatile CN (CNHot) and the total CN (CNCold) depend on pollution amount?
- In the remote Pacific the scattering cross section of the atmosphere increases markedly in the lower layers of the atmosphere, but the aerosol concentrations decrease. Is this behavior evident in other regions? What might explain it?
- Of the different regions/panels which are most characteristic of a pristine aerosol, and how does this aerosol characteristically differ from more polluted regions.

It is often said that the biggest unsolved problem in cloud microphysics is that of warm rain formation. What do you think is meant by this statement. Here looking a bit in the literature might be useful.

Problem 2: The aerosol

- What are some different ways to characterize the atmospheric aerosol.
- How would the aerosol particle size spectrum evolve as a result of repeated cycling through clouds. You can show this by a sequence of sketches.
- What is the difference between primary and secondary production of the aerosol.
- What is a typical CCN concentration over land, and over the ocean.
- Which types of aerosol particles are most directly related to human activities?

Problem 3: Cloud model

- In Eq. 97 of the notes, which term represents the effect of condensational growth of the evolution of the size distribution?
- Imagine a parametric distribution model for warm rain microphysics, in which cloud droplets and rain drops are modeled by separated distribution functions. Make a list of the different sources and sinks of: (i) raindrop mass; and (ii) of raindrop number.
- What are the principle differences between distribution and particle based microphysical models. List advantages and disadvantages for each.

Problem 4: Remote sensing

Why is there not a unique relationship between radar reflectivity and rain rate for water clouds?