ENV 320 - Written Final Exam (Part of Prof. A.Nenes)

***Questions are in English, answer in English or French*. If you get stuck on a question, move on to the next one and return to the problematic question afterwards. Good luck!**

1. (6 points) Observations of particle size distributions in the atmosphere are often described in terms of "modes", where the number distribution function peaks at certain sizes.

a) How many of these "modes" are typically found in the atmosphere? Name them if you can, as well provide their characteristic size.

b) Which of these modes and aerosol particle types are thought to contribute to the concentration of cloud condensation nuclei (CCN) and which to the ice nuclei (IN)?

c) What makes some particles a good CCN and what a good INP? Be as detailed as you can, justifying your answers to the extent you can.

d) Consider a large volcanic eruption that emits dust (with size ranges between 50nm and 10 μm), water vapor, carbon dioxide and sulfur dioxide. Which of these components will eventually contribute to the CCN and IN population, how, and, why?

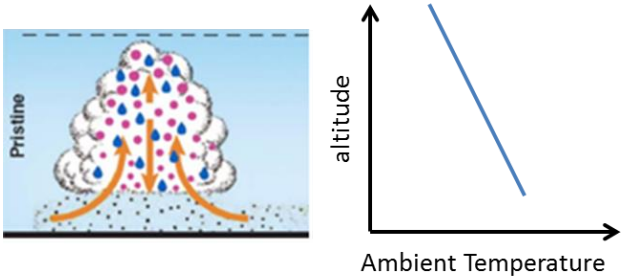
2. (3 points) Explain the main components of the Köhler curve (you don't need to use equations, only sketch on a graph the phenomena that are acting), and why it has a peak at the critical supersaturation. In your explanation, assume the CCN has a dry diameter d.

Nom, prénom : ……..……. No. Sciper: …….

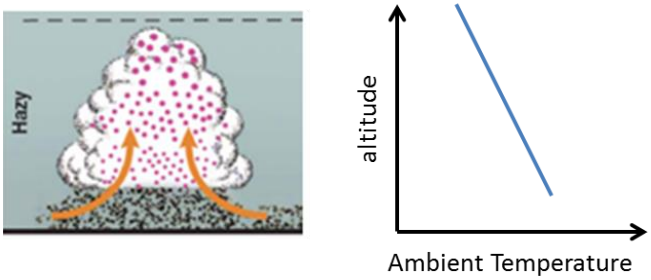
3. (2 points) From the results of question 2, explain how the wet diameter of an aerosol particle responds to a continuously increasing relative humidity. What does it mean to become "activated"?

4. (4 points). Cloud development and lifecycle.

a) Describe the lifecycle and structure of a typical cloud in a moist and warm boundary layer with a weak temperature inversion at the top (like the Amazon) under very pristine (i.e., low CCN) conditions. Refer to the diagram below



b) Then describe what happens to the cloud structure if the number of CCN increases dramatically. Refer to the diagram below. Explain the implications of this transition for the hydrological cycle in the Amazon.



Nom, prénom : ……..……. No. Sciper: …….