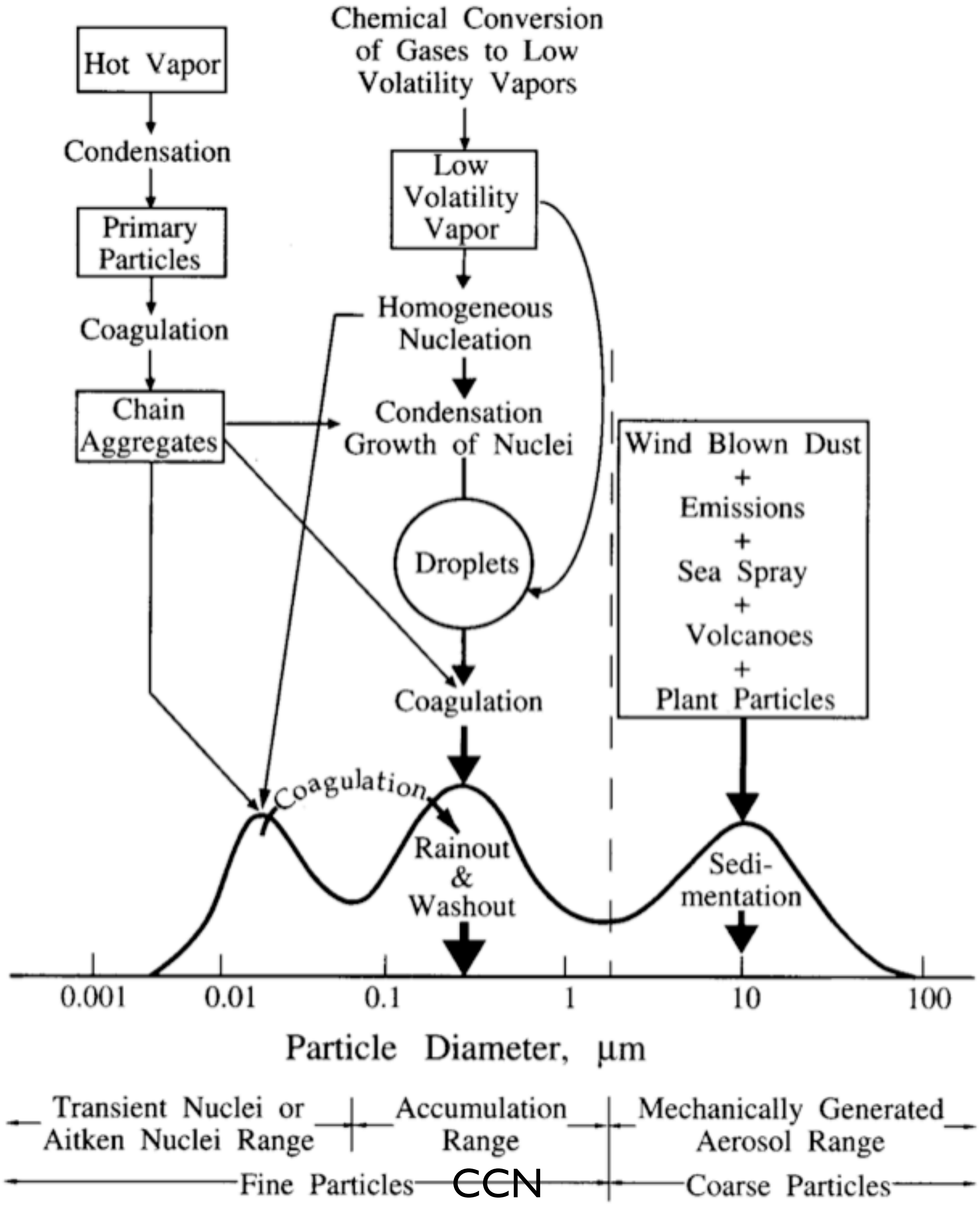
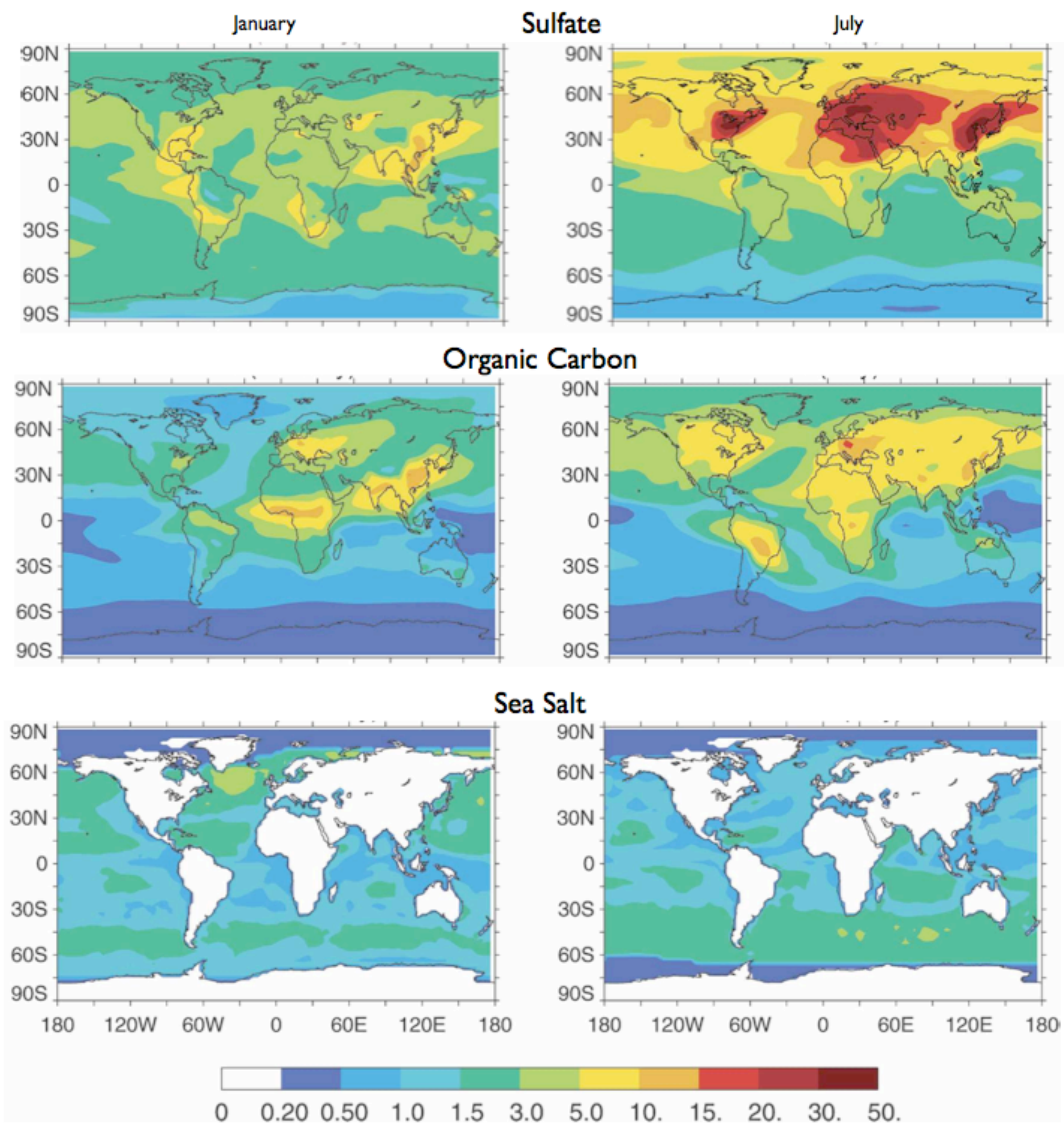
Aerosols: Tri-modal distribution



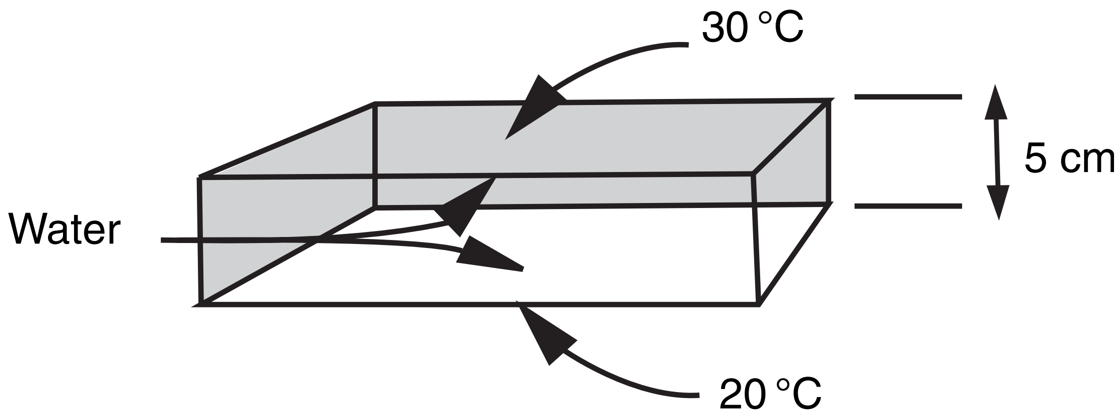
Column burdens (mg/m²) of CCN producing aerosols

From Model for Ozone and Related Chemical Tracers - MOZART



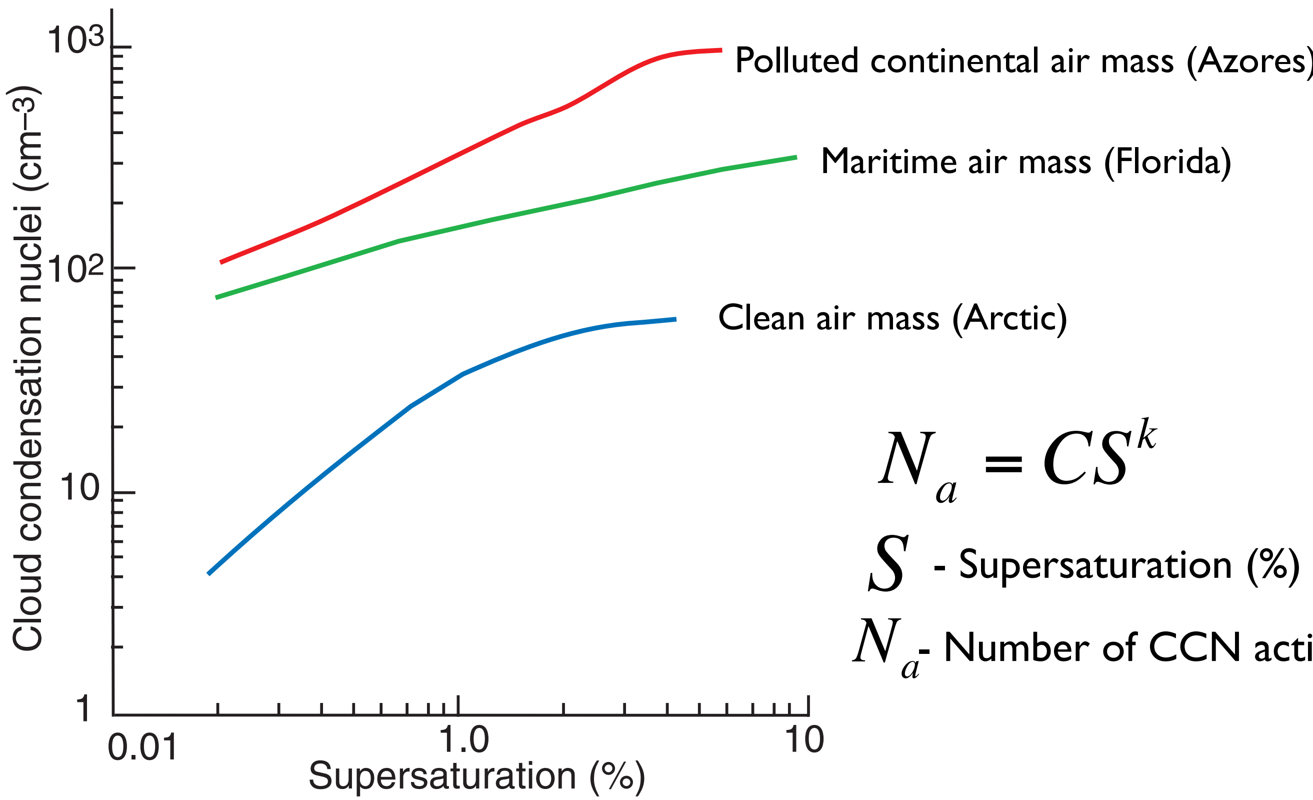
Adopted from Ming et al 2007

Thermal Diffusion Chamber for CCN concentration measurements



- Top and bottom plates are
  - kept wet;
  - maintained at different temperatures;
- Varying temperature difference, different supersaturation can be produced;
- Concentration of activated CCN is measured as concentration of cloud droplets;
- CCN activation spectrum is produced

Typical CCN Spectra



$$N_a = CS^k$$

S - Supersaturation (%)

N_a - Number of CCN activated

Typical values:

For maritime air:	C = 30 to 300 cm^{-3};	k=0.3 to 1.0
For continental air:	C = 300 to 3000 cm^{-3};	k=0.2 to 2.0

- Typical size of CCN: 0.1 - 1 micron;
- In marine air, 40-60% of all aerosol are CCN;
- In continental air, CCN is only about 1% of all particles (but may be as high as 10%);
- Most of CCN over the land are found in boundary layer; not generally true over the ocean;
- Known sources of CCN: forest fires, diesel engines, sea salt, gas-to-partical conversion, sulfates (pollution over the land; dimethyl sulfide - DMS over the oceans);
- Many sources remain unknown;

Modeling of CCN activation

Dependence of cloud-drop concentration on vertical velocity of updraft at LCL

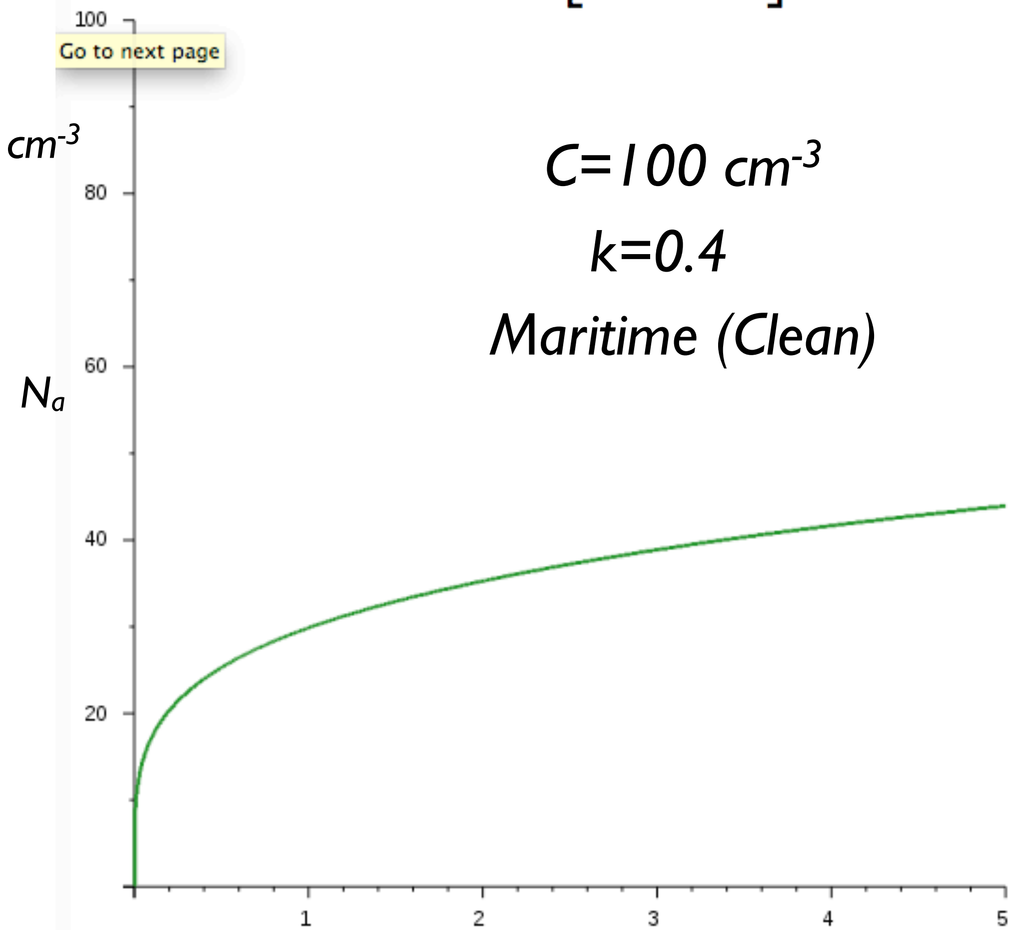
$$N_a = CS^k$$ Power-law activation spectrum

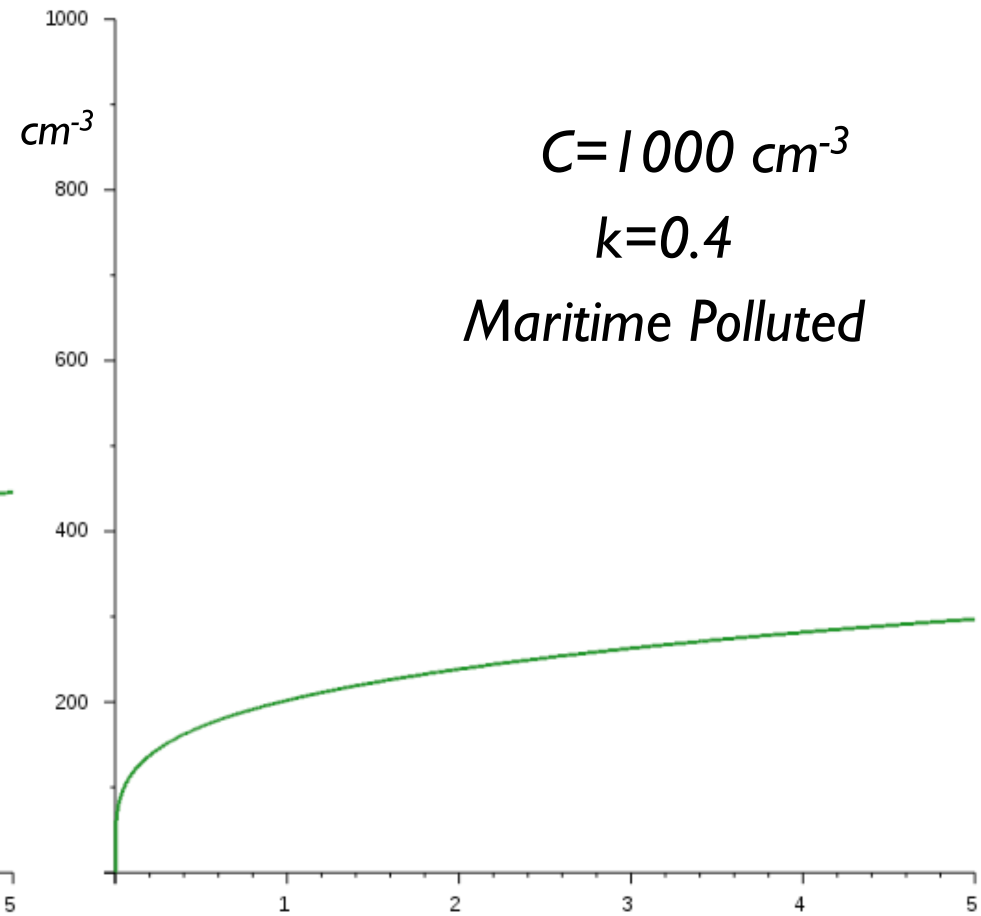
$$N_a = 0.88C^{\frac{2}{k+2}}\left[0.07w^{\frac{3}{2}}\right]^{\frac{k}{k+2}}$$ (Twomey 1959)

S - Supersaturation (%)

N_a - Number of CCN activated (cm^{-3})

w - Vertical velocity at cloud base (cm/s)





Note that the vertical axes maxima are different between the plots