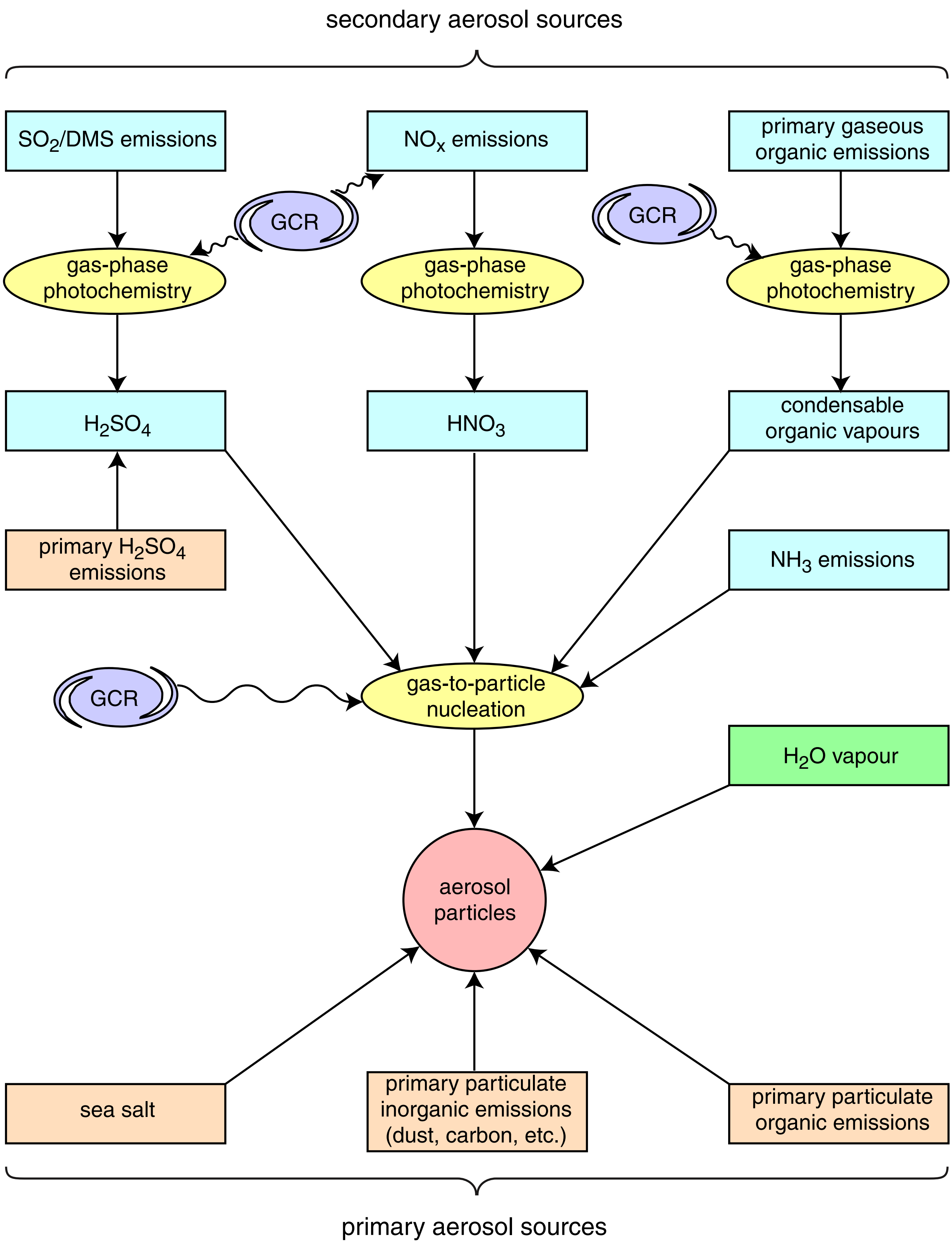
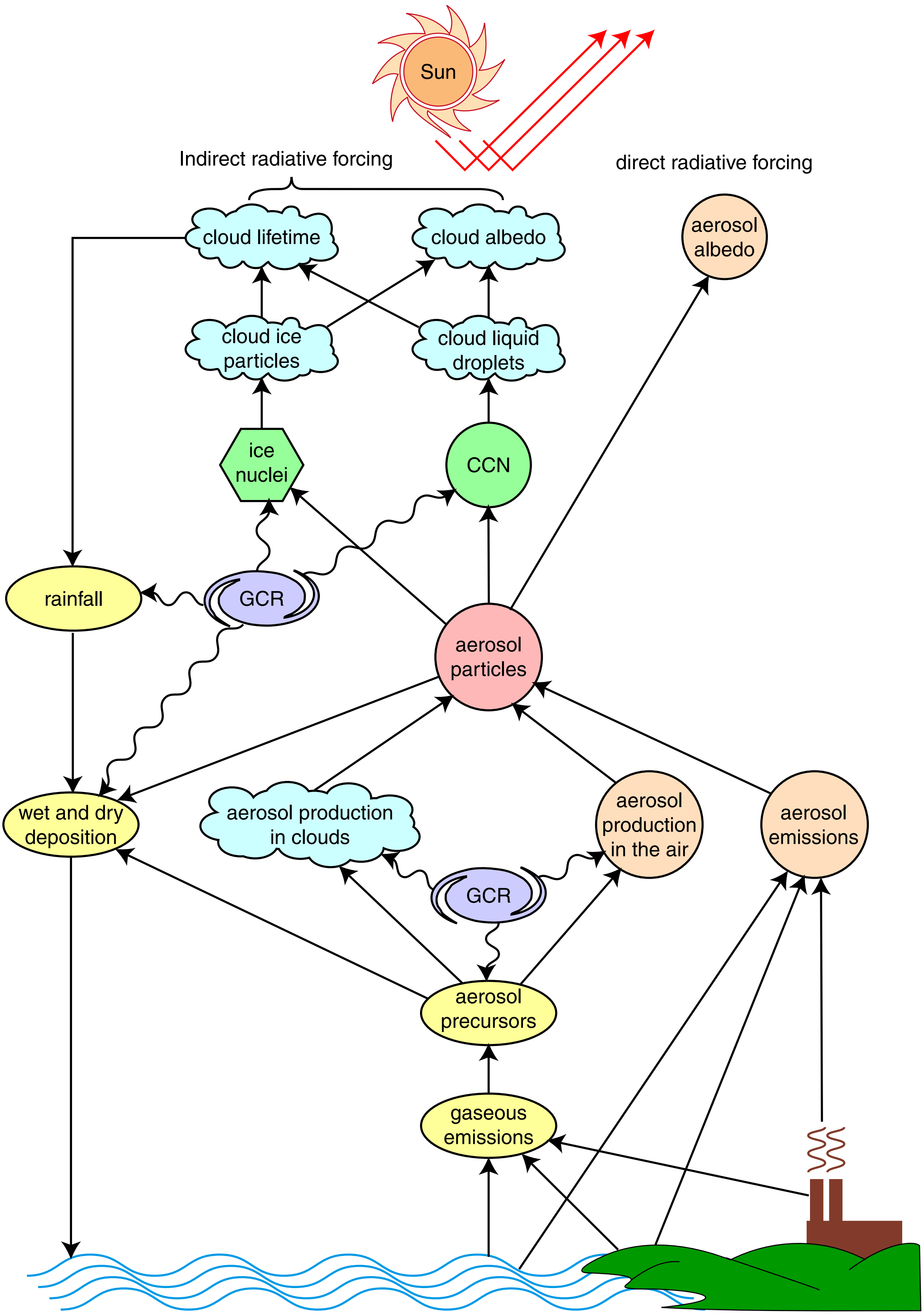
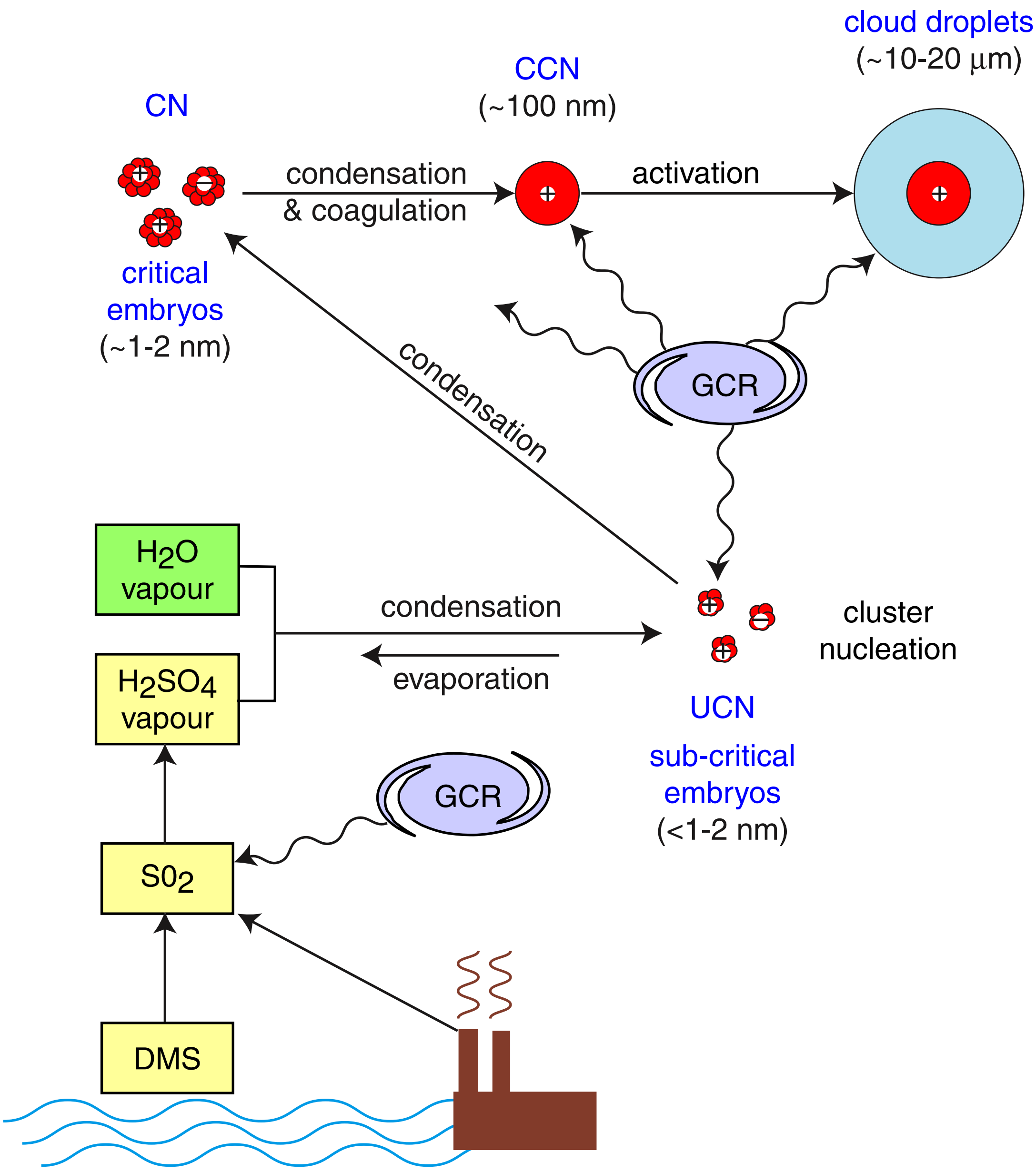
Sources of atmospheric aerosols



GCR-aerosol-cloud-climate paths



Influence of GCR on aerosol nucleation and growth

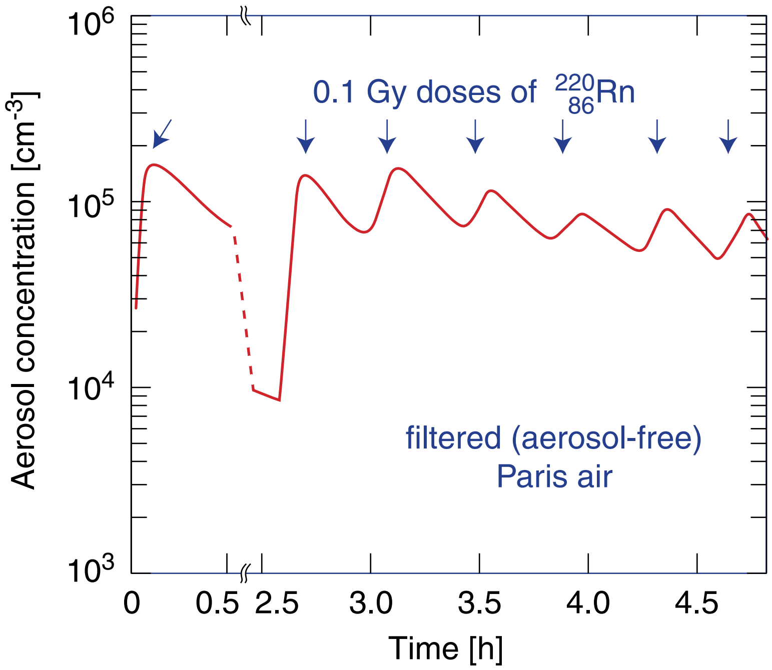


- clusters scavenge charge
- charge stabilises embryos

Experimental observations of CN production by ionising particle radiation

Filtered (aerosol-free) Paris air exposed to high radiation doses:

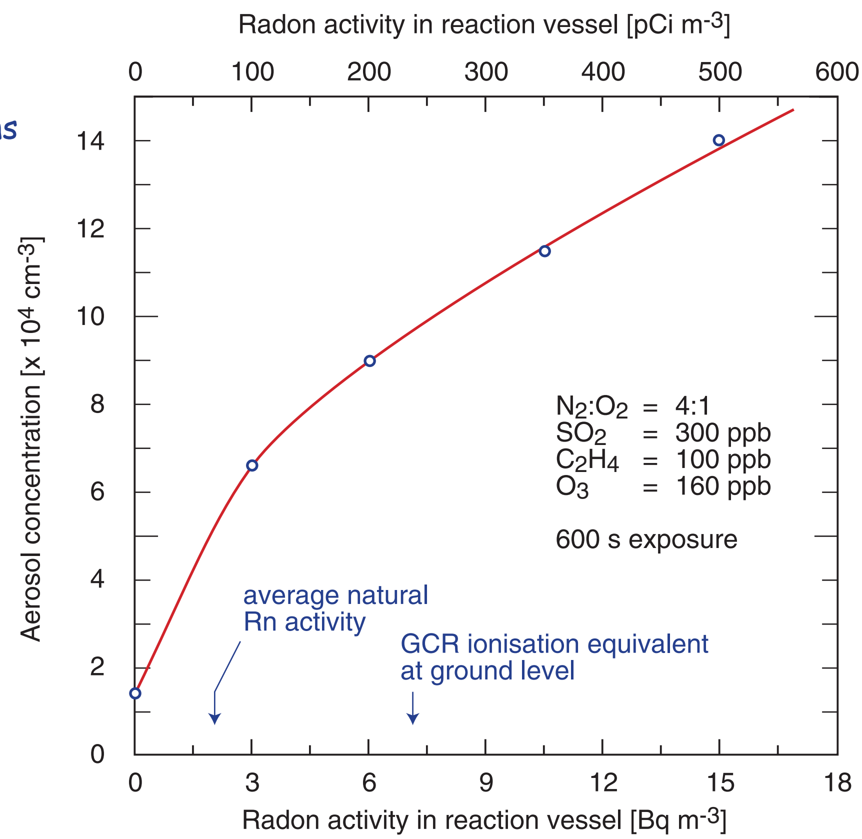
J.Bricard et al.,
JGR 73 (1968) 4487



Artificial air exposed to natural radiation levels

...but high trace gas concentrations

K.G. Vohra et al.,
Atmos. Env. 18 (1984) 1653



Ice nuclei

- Clouds contains a lot of supercooled liquid water in range

  $-40^{o}C < T < 0^{o}C$

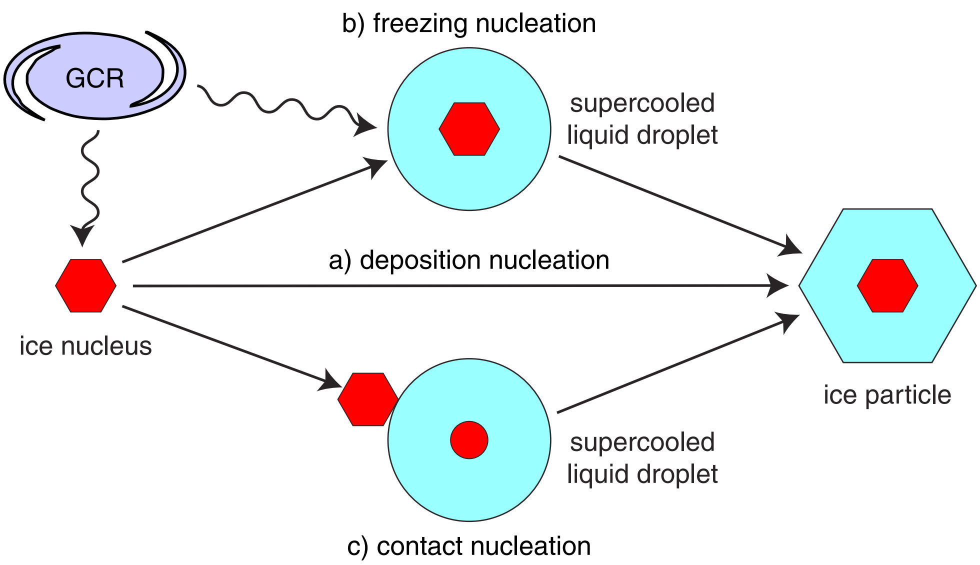
- Ice nuclei are very rare in the atmosphere:

  ~1 /litre @ $-20^{o}C$ cf ~10^{6} CCN /litre

- But many more ice particles are found in clouds (by factor ~100)

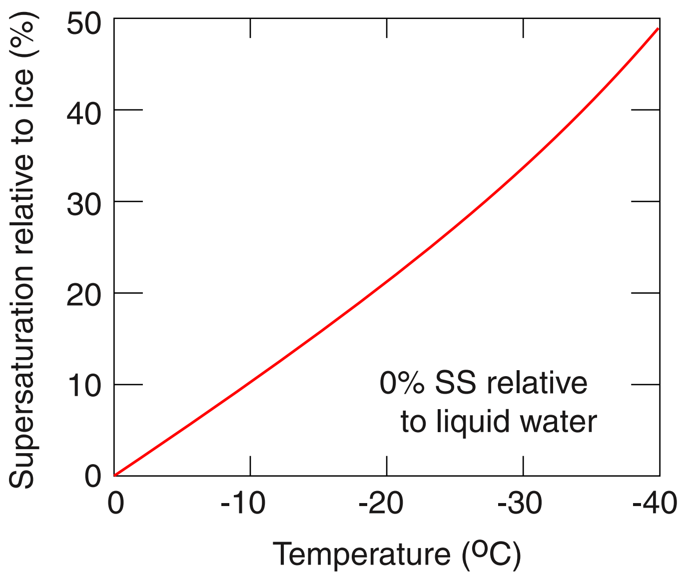
  => What causes ice particles to form?

Processes for ice particle formation in clouds



Importance of ice particles in clouds

1. Ice particles grow at expense of liquid water droplets
   => sedimentation -> rain
   (eg. AgI seeding of clouds)



2. Freezing of super-cooled water releases latent heat
   => cloud dynamics

3. Polar stratospheric clouds: freezing of PSC clouds (nitric acid trihydrate, NAT) in polar winter leads to de-nitrification (sedimentation), which leads to conversion of Cl to active species and subsequent ozone destruction.

   - "Ice nucleus" (T~190-195K) for PSCs is unknown
   - Requirements:
     - widespread (100's km)
     - homogeneous
     - low no. concentration or efficiency
     - suitable for NAT ice nucleation

   => GCRs?