

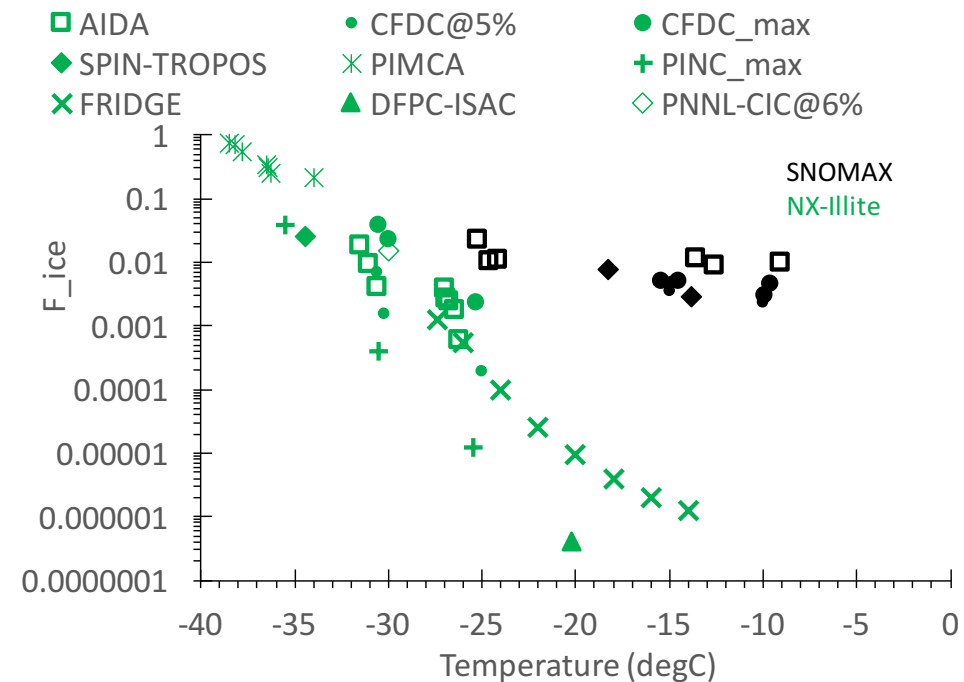
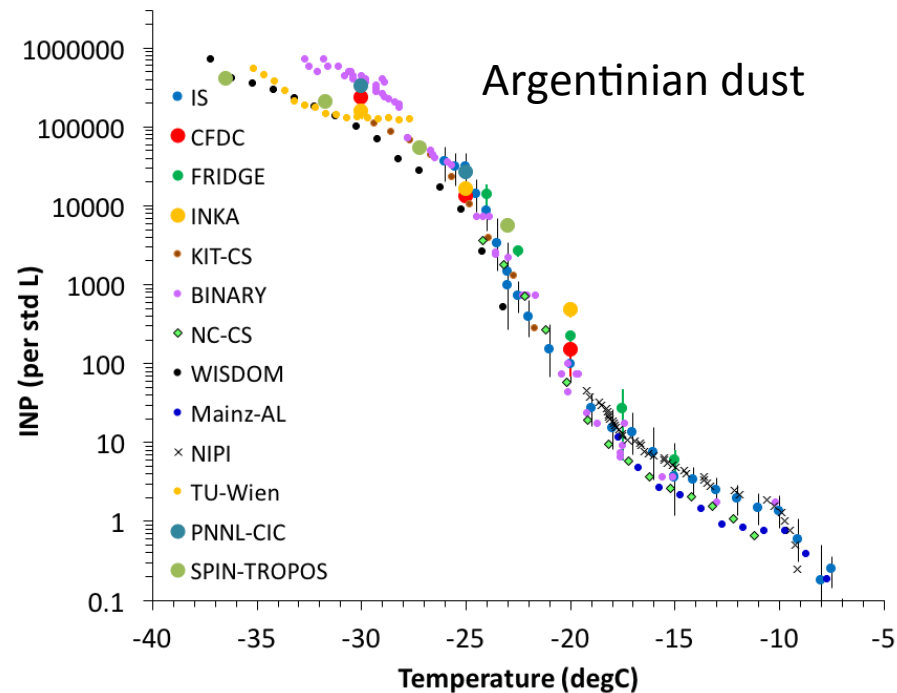
Uncertainties in INP measurements and readiness for long-term studies



Motivation

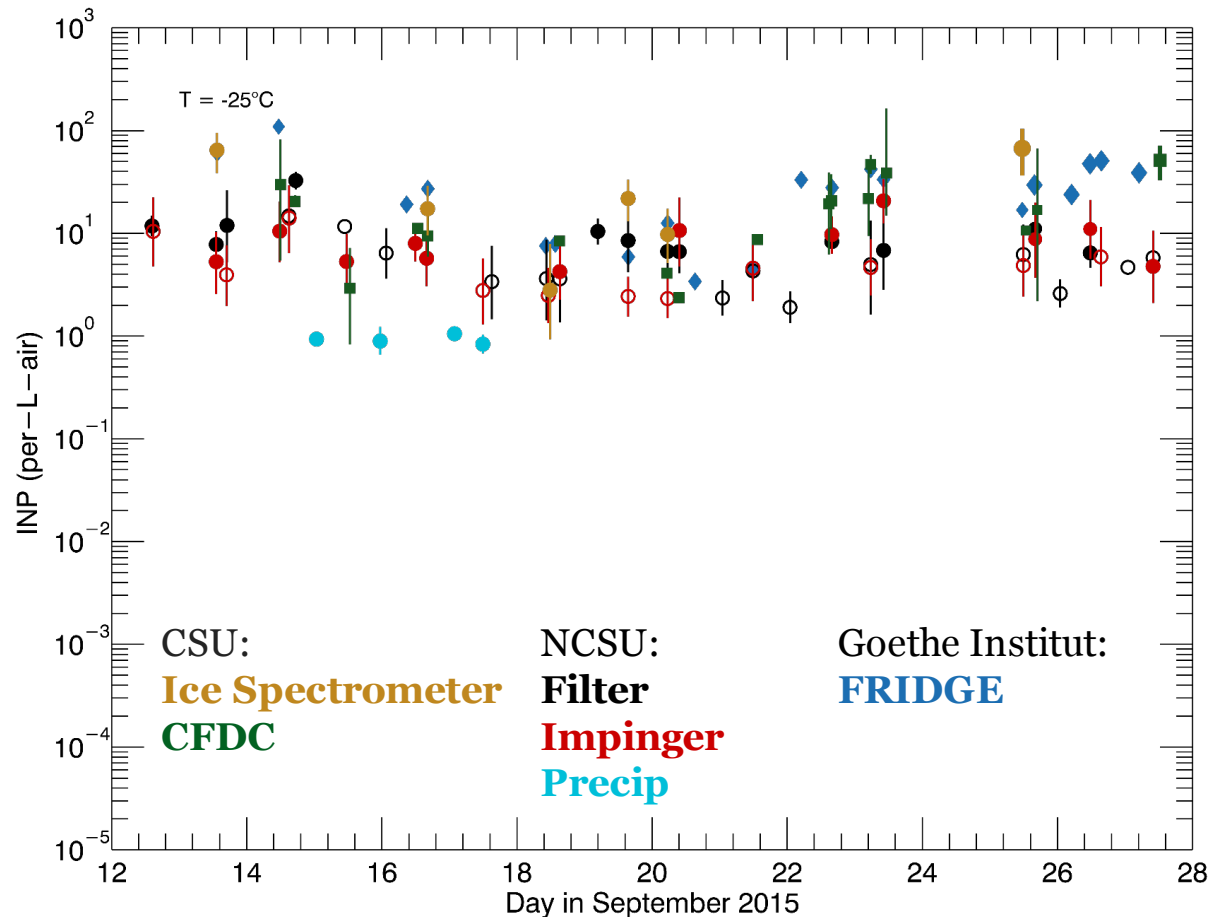
- Many intercomparisons of ice nucleating particle (INP) measurements have occurred in the recent few years, some supported by DOE.
- DOE should be a leader in setting up long-term measurements of this important and climate-relevant populations of particles (my opinion) at their fixed and mobile sites.

Fifth International Ice Nucleation Workshop (FIN) phase 2: FIN-02 (DOE-ASR and NSF supported lab studies)



- Under certain circumstances (co-sampling and co-distribution of submicron soil/mineral dusts and IN bacteria in these cases), excellent agreement can be obtained between many INP measurement methods
- For aerosols whose character, surface area, active sites are altered by immersion in water, this may not always be the case. Studies continue.

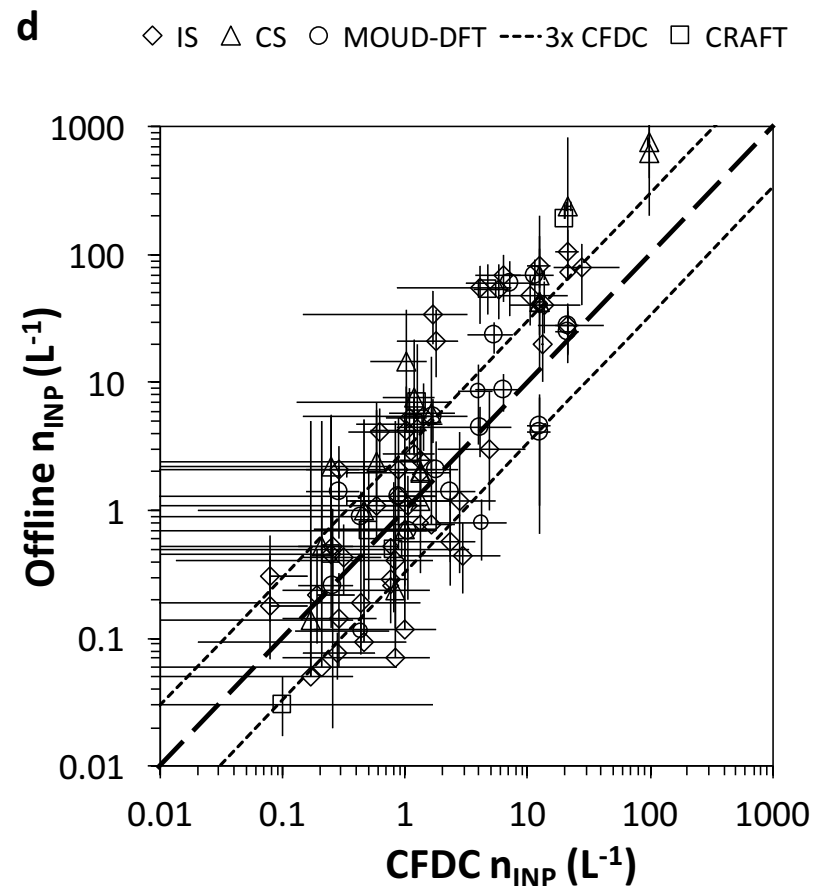
FIN phase 3 (FIN-03) field measurements



- In the field, we presently observe order of magnitude correspondence of INP data (same as lab)
- Must accept that for now, until understood
- Multiple methods are needed to cover the full temperature spectrum and mechanisms applicable to mixed phase clouds

Non-FIN inter-comparisons of continuous flow and other measurements focused on immersion freezing

- All temperatures
- Imperfect temporal overlap
- Includes IS (CSU), CS (NC State), MOUDI-DFT (UBC) and CRAFT (NIPR-Japan) versus CFDC instrument
- Diverse locations



Same story...but involved in the biases present are artifacts in each measurement type, which would take more time to explain. Some issues are quantifiable with future corrections.

Conclusions

- Immersion freezing measurement uncertainty is ~ 1 order of magnitude in comparing different methods.
- Some biases exist and sources remain to be identified.
- While intercomparisons should continue to identify artifacts associated with both bulk and single particle INP analyses, and studies of time dependence are also needed, much can be gained by establishing long-term studies using multiple methods
- DOE sites are ideal for such effort due to ability for shorter-term IOPs and association with other aerosol and cloud property measurements. Let's discuss...