Plans for ice nuclei measurements for constraining their role in tropical cloud ice formation during ICE-T

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Questions/Objectives for ICE-T

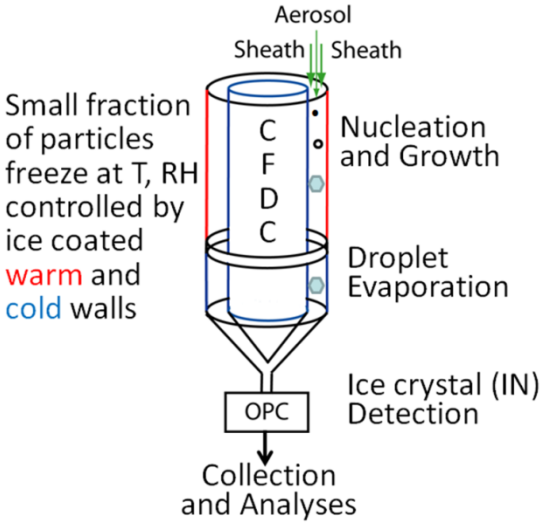
- Does primary nucleation, specifically the number concentrations of ice nuclei, explain the onset and glaciation of tropical cumuli? **– Ice nuclei measurements, especially for T>-20°C, outside and inside clouds**
- Under what circumstances is this not the case (thermo, aerosol chemistry, microphysics)? – **cloud microphysical measurements, state parameters, chemical composition of aerosols and IN**
- Are secondary ice formation processes critical and what concentration of primary IN are sufficient to trigger them? – **cloud microphysical measurements, collaboration with Sonia Lasher-Trapp for modeling**
- What ice nuclei are active in a maritime environment influenced by long range dust transports – are biological IN important (on their own or transported with dust)? – **ATOFMS (Prather) data, IN collection for TEM analyses, aerosol and cloud water sampling for IN processing and DNA analyses**
- Does mid-level entrainment play a role in feeding IN into clouds? – **IN measurement profiles**
- Missing ice formation mechanisms – **Inexplicable ice**

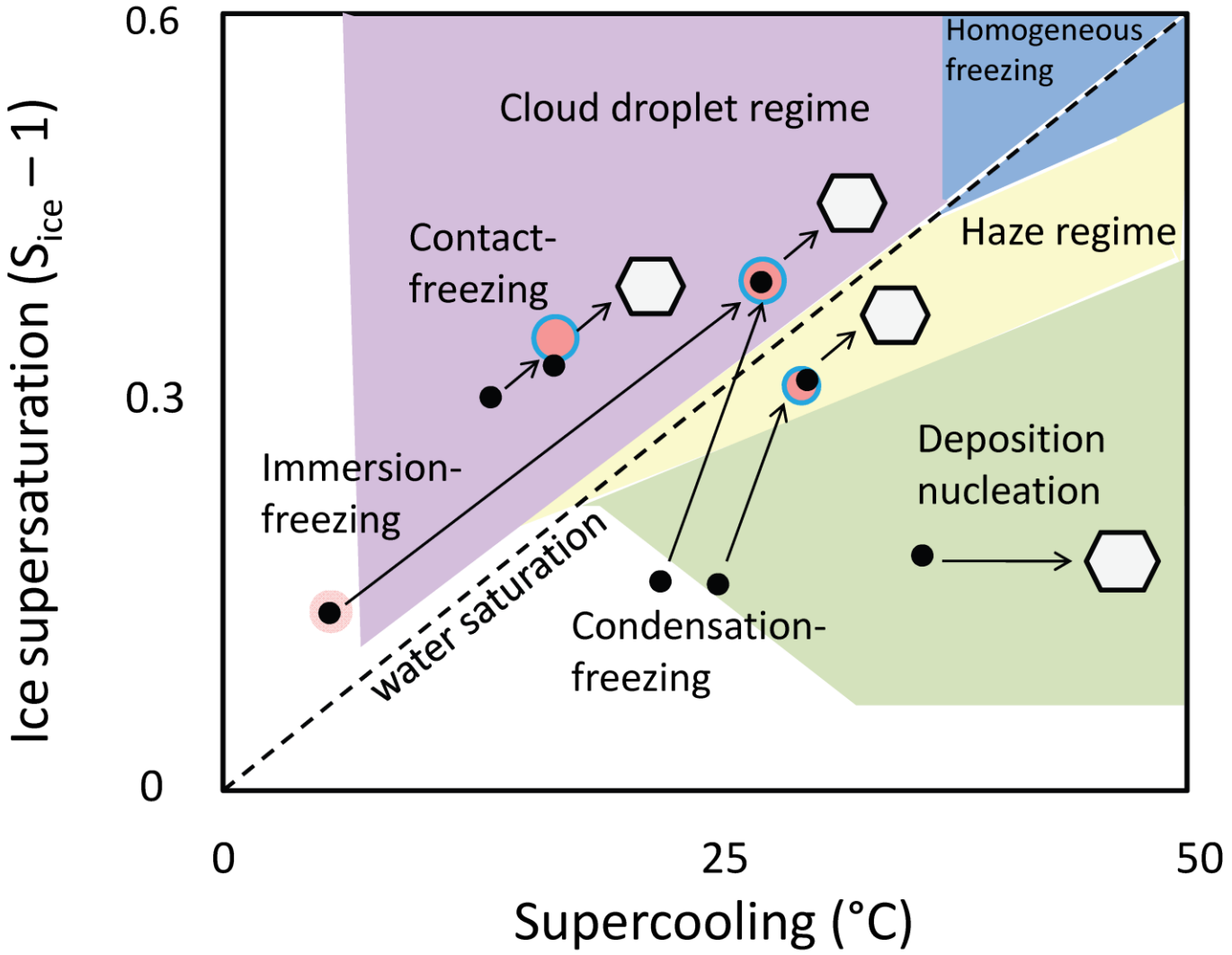
Sampling methods continuous flow diffusion chamber ice nuclei instrument

aircraft aerosol sample inlet

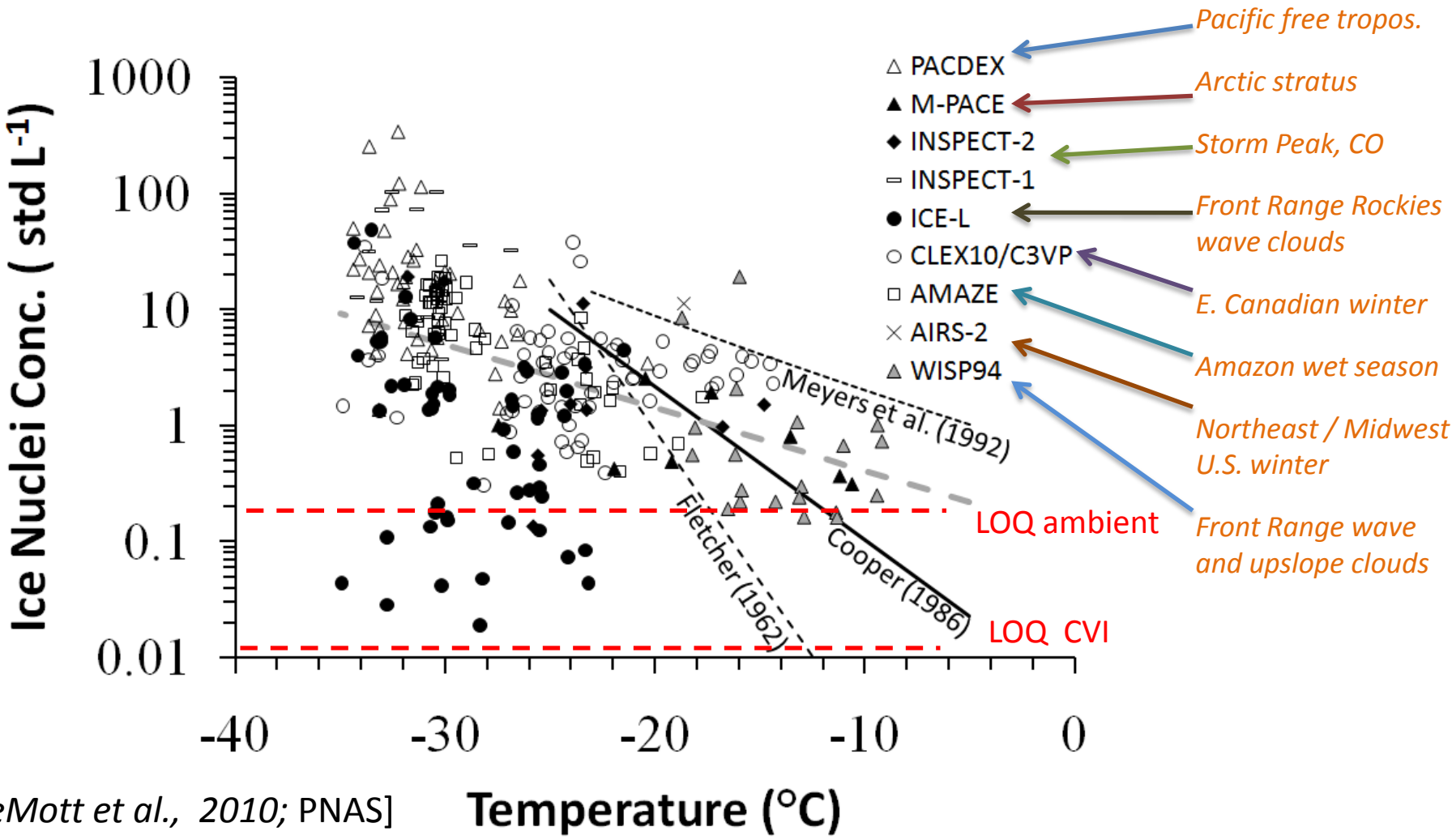
CVI inlet (aerosol from evaporated cloud particles when in clouds)

Continuous flow diffusion chamber (CFDC) in aircraft




0.6
0.3
0
Ice supersaturation (S_{ice} – 1)
0
25
50
Supercooling (°C)
Cloud droplet regime
Homogeneous freezing
Haze regime
Contact-freezing
Immersion-freezing
Deposition nucleation
Condensation-freezing
water saturation

Ice nuclei concentrations (RH_w>100%) in projects over 14 years (292, 10-30 min. averages, coincident aerosol data)

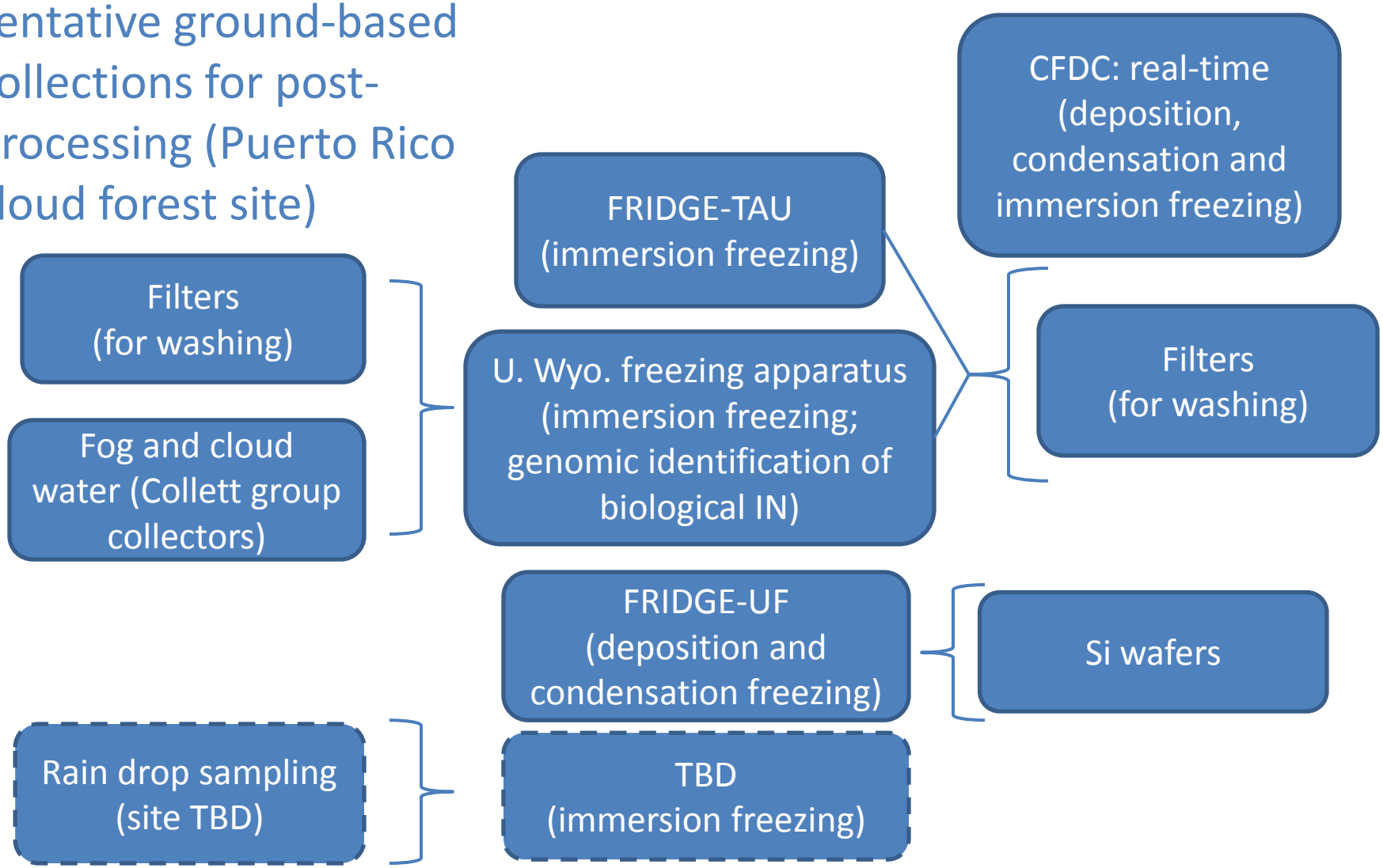


[*DeMott et al., 2010;* PNAS]

Various types of ice nuclei sampling and measurements planned

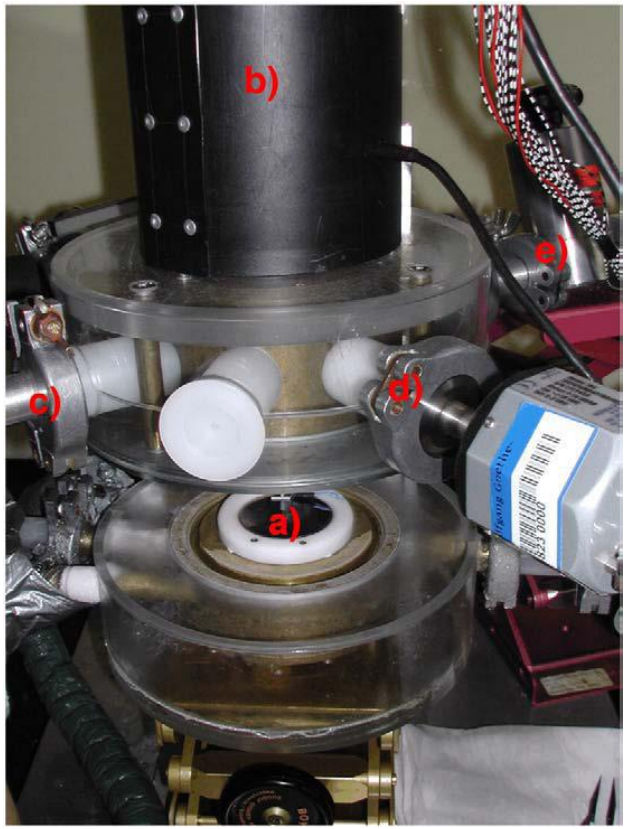
Tentative ground-based collections for post-processing (Puerto Rico cloud forest site)

Aircraft collections (BL, SAL, mid-levels)

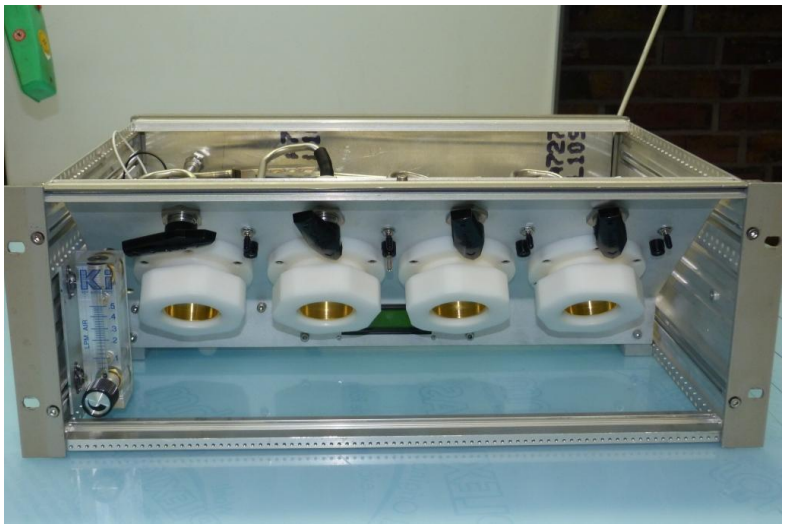


FRIDGE-UF (Bingemer) and FRIDGE-TAU(Levin)

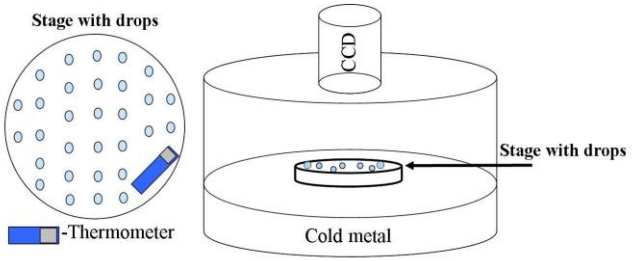
Low pressure chamber for precise water vapor exposure (vs. T) of particles collected onto silicon wafer substrates



Multi-sample collector for silicon wafers for 19” rack (50 watts)



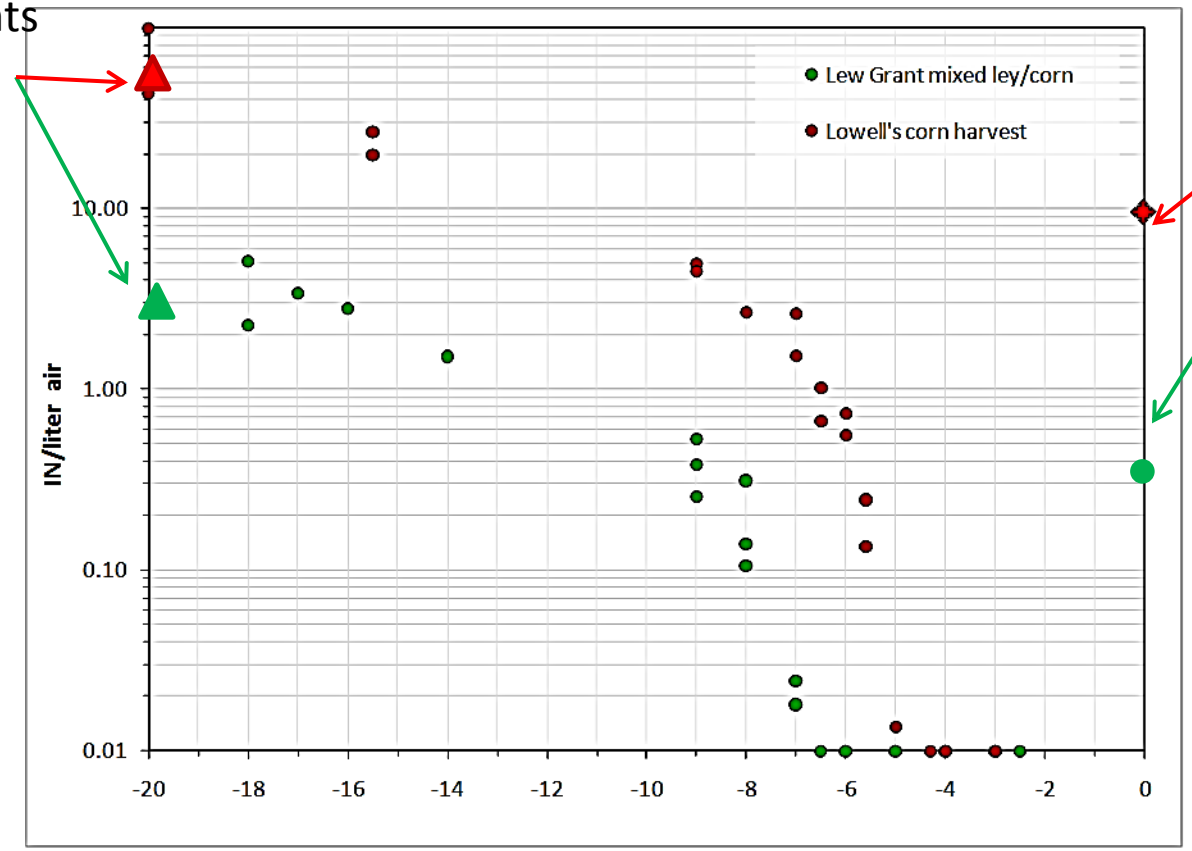
Modification of method for immersion freezing studies



Washed filters and collected cloud water for immersion freezing and biological IN studies (Franc and Hill, U. Wyo.)

CFDC IN measurements in real-time

Measured number of INA bacterial cells in air based on genomic analyses



We’re ready!