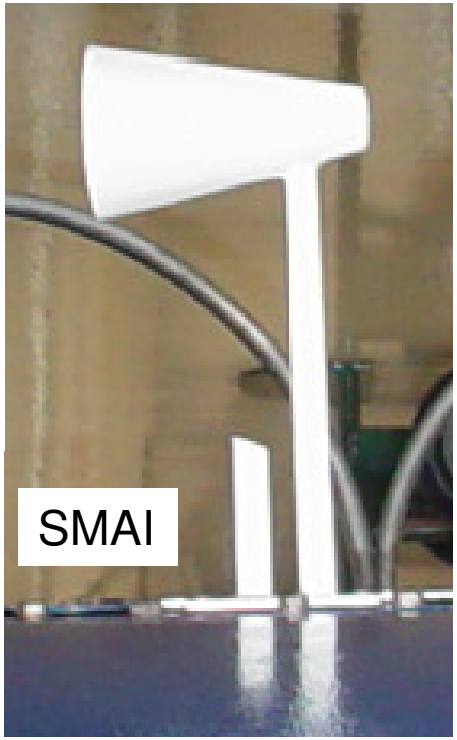
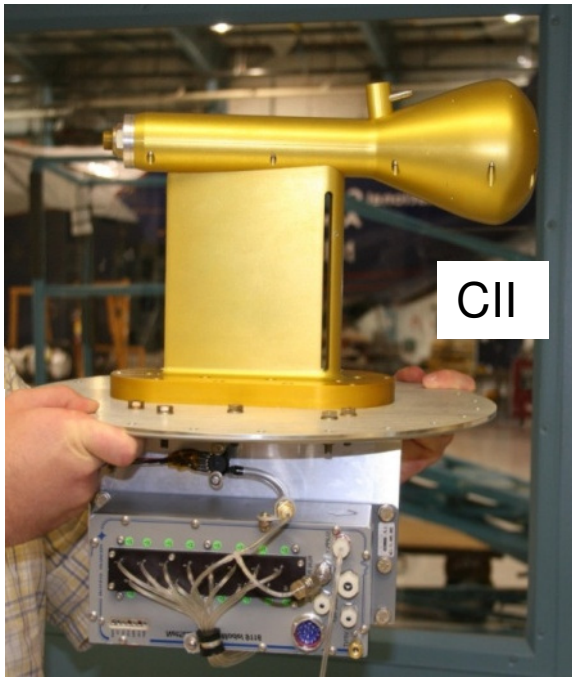
Splash Artifacts from Airborne Aerosol Inlets and Cloud Probes.





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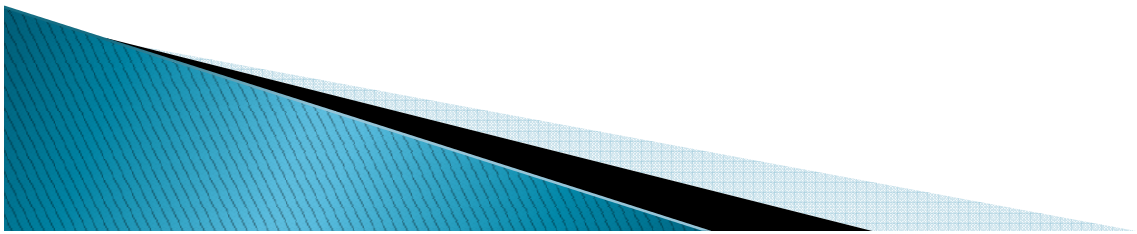
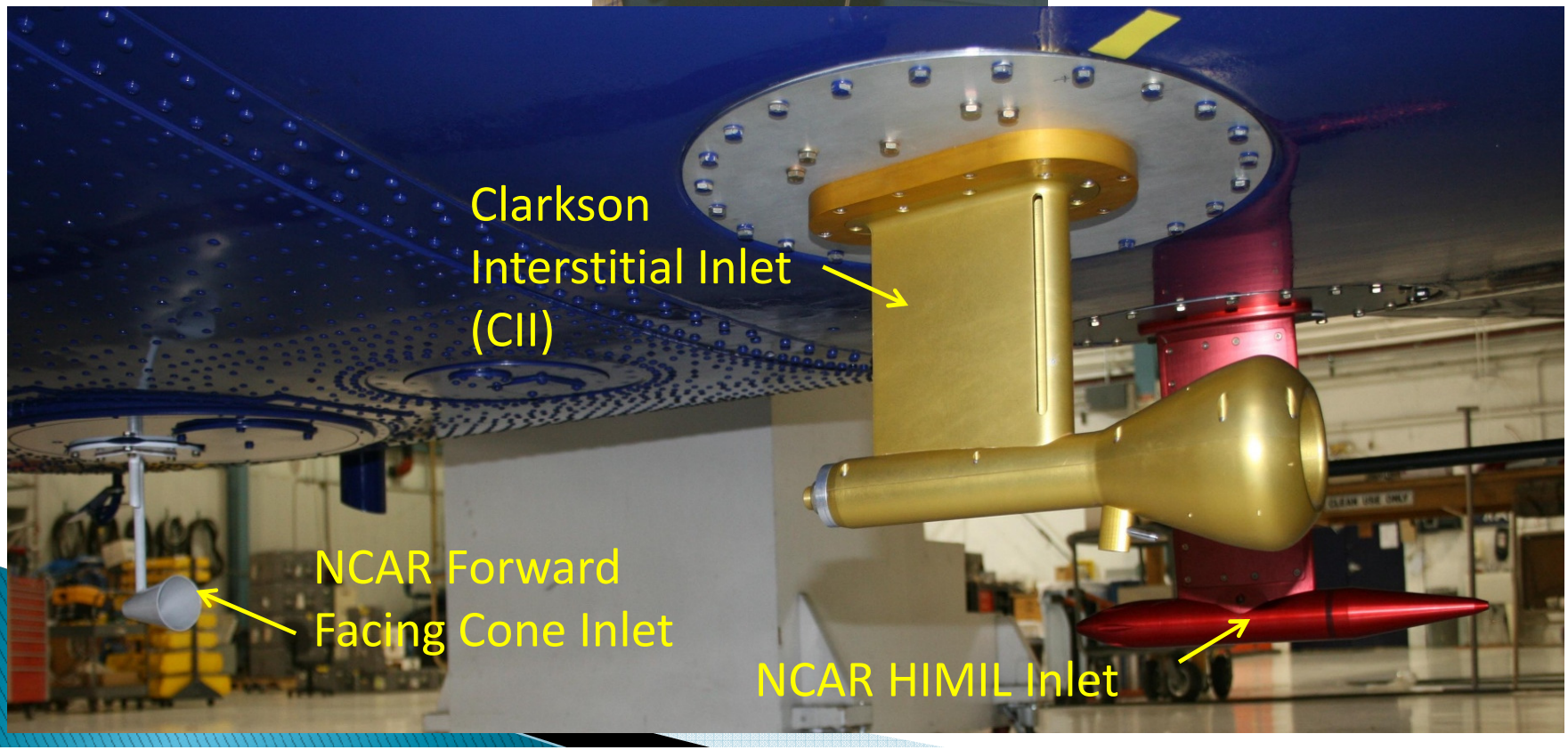
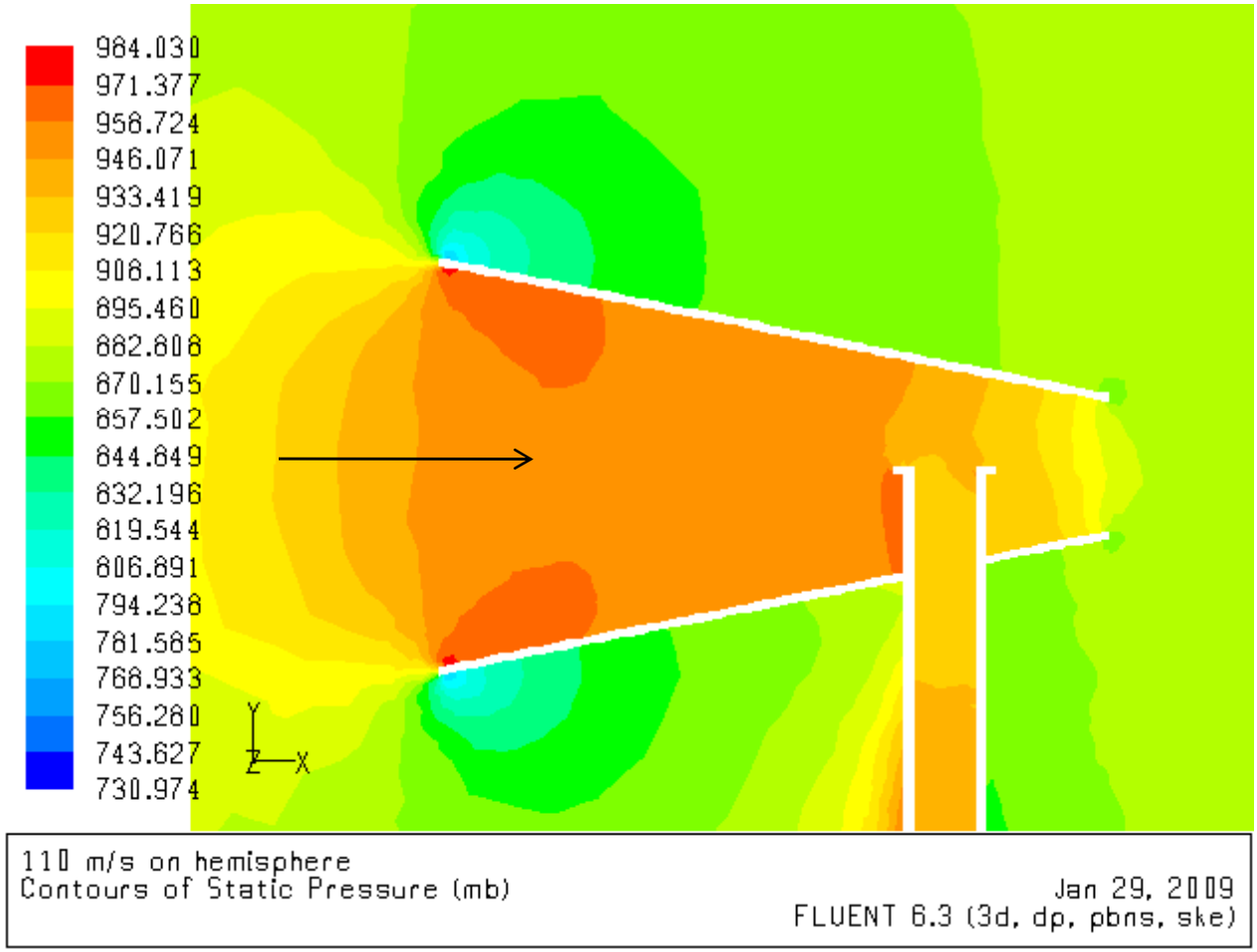
Objectives

- To test the new Clarkson Interstitial Inlet (CII) – PLOWS
- Characterize the splash artifacts associated with aerosol inlets – PLOWS, VOCALS
- Obtain a splash model by combining CFD modeling with the flight data for different inlet designs – PLOWS, VOCALS
- Use the developed splash model to characterize artifacts in cloud probes




Clarkson
Interstitial Inlet
(CII)
NCAR Forward
Facing Cone Inlet
NCAR HIMIL Inlet

SMAI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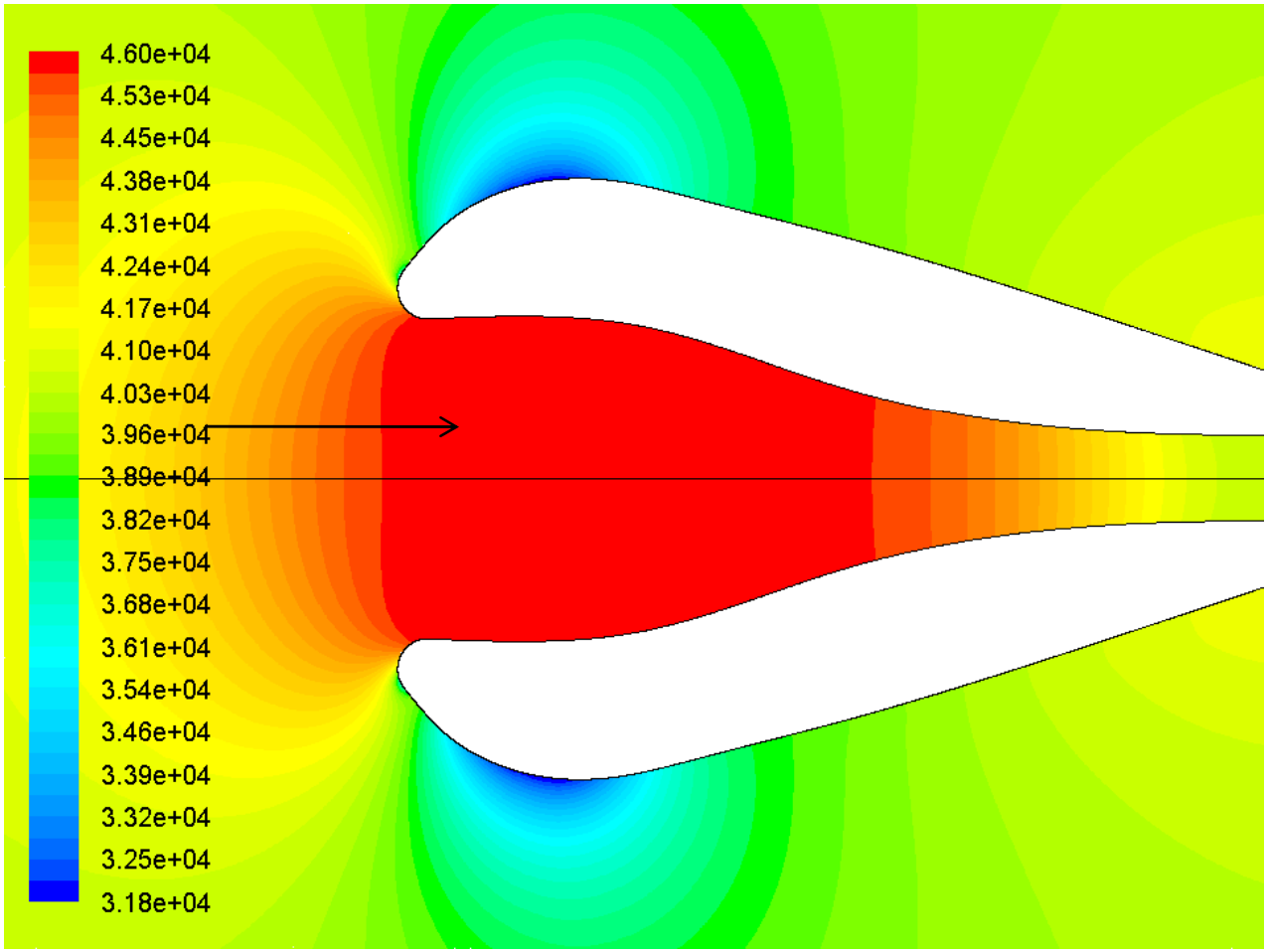
971.377
958.724
946.071
933.419
920.766
908.113
895.460
882.806
870.155
857.502
844.849
832.196
819.544
806.891
794.238
781.585
768.933
756.280
743.627
730.974
Y
Z
X
110 m/s on hemisphere
Contours of Static Pressure (mb)
Jan 29, 2009
FLUENT 6.3 (3d, dp, pbns, ske)

CII


4.60e+04
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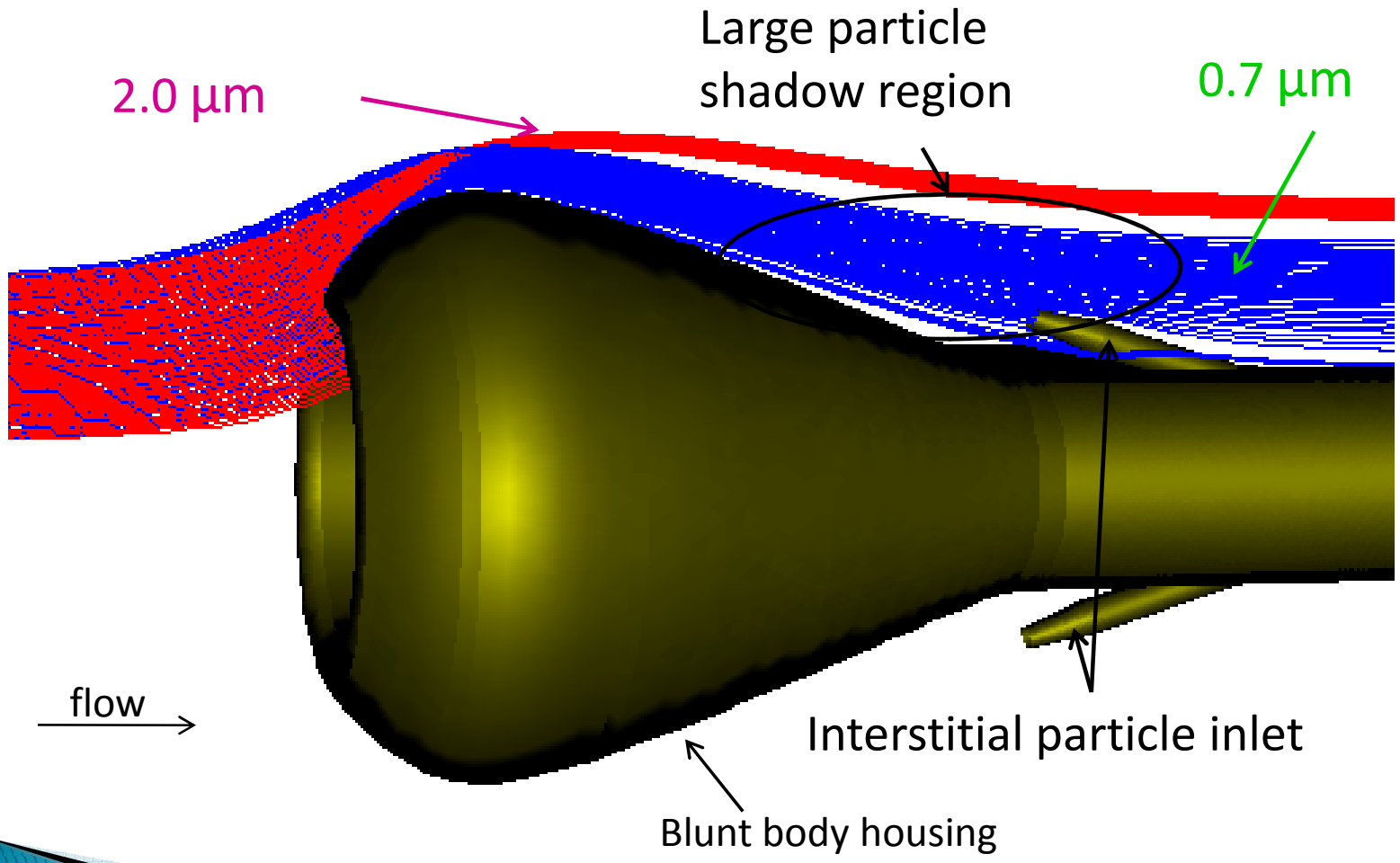
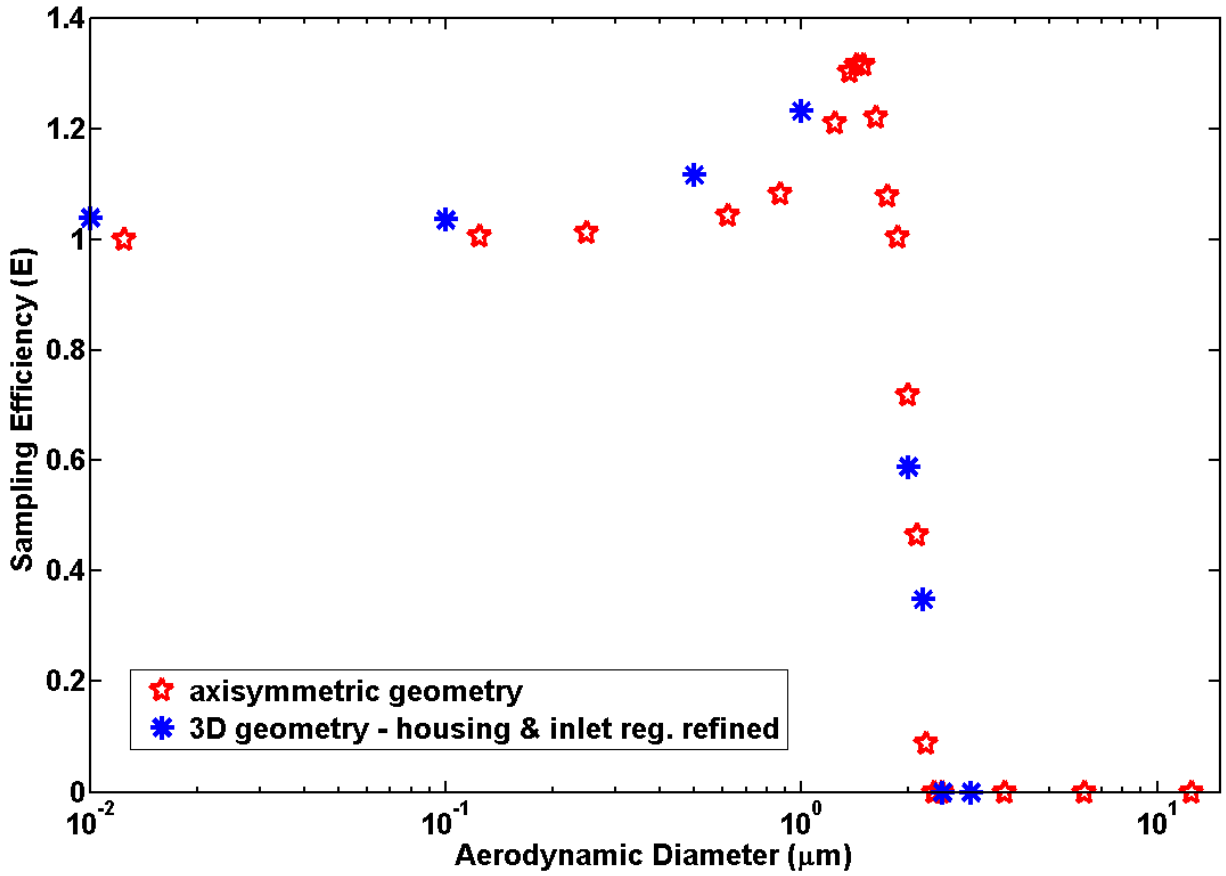
4.03e+04
3.96e+04
3.89e+04
3.82e+04
3.75e+04
3.68e+04
3.61e+04
3.54e+04
3.46e+04
3.39e+04
3.32e+04
3.25e+04
3.18e+04

CII – Objective & Design Concept

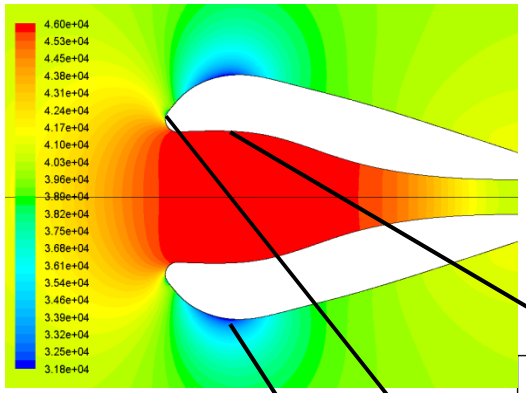
Objective: Sampling Interstitial (non-activated) particles in clouds

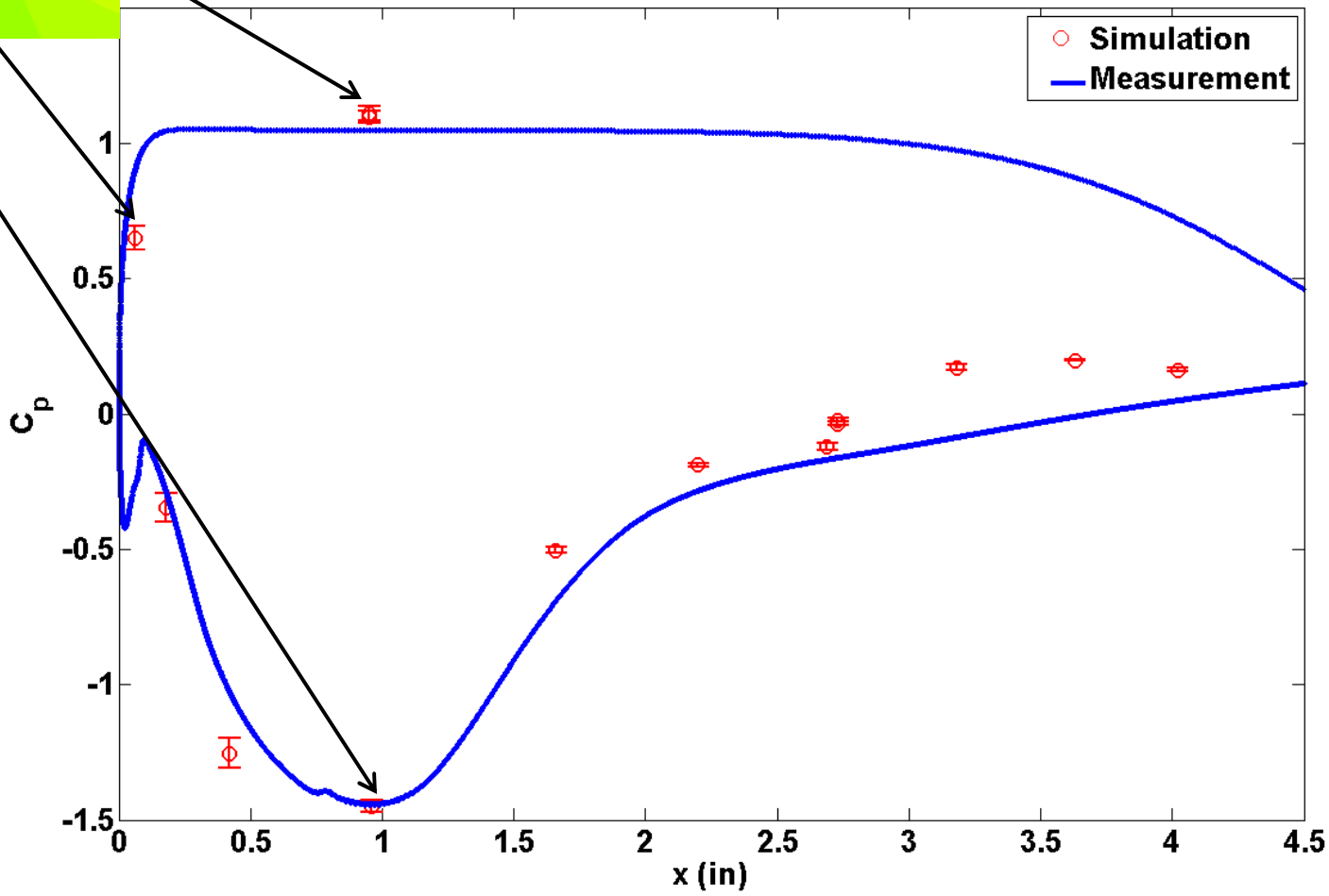


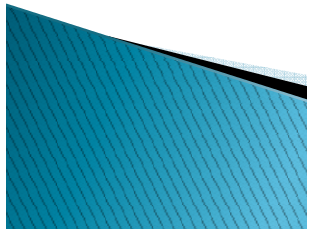
CII sampling efficiency



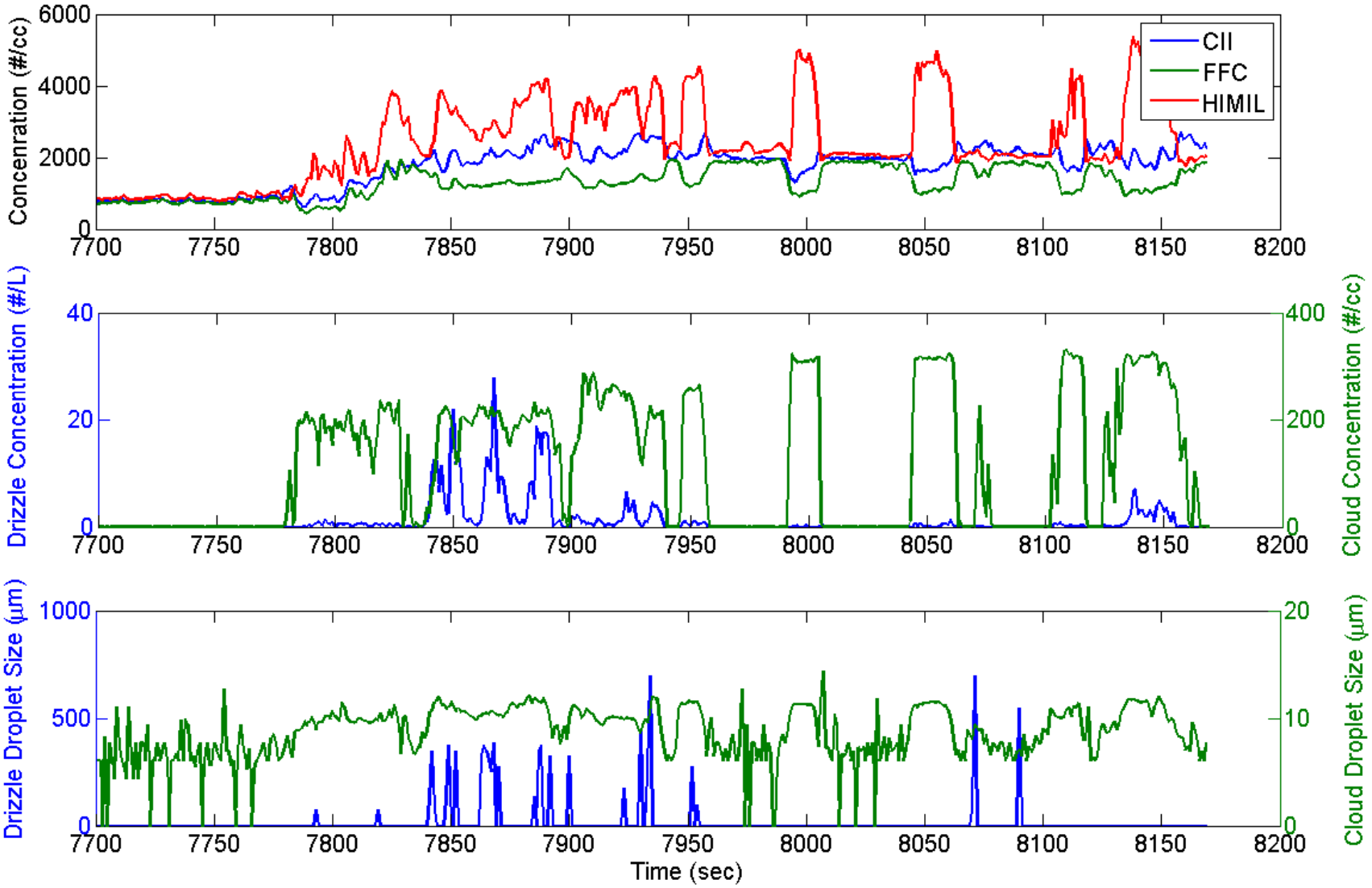
Pressure measurement on the inlet



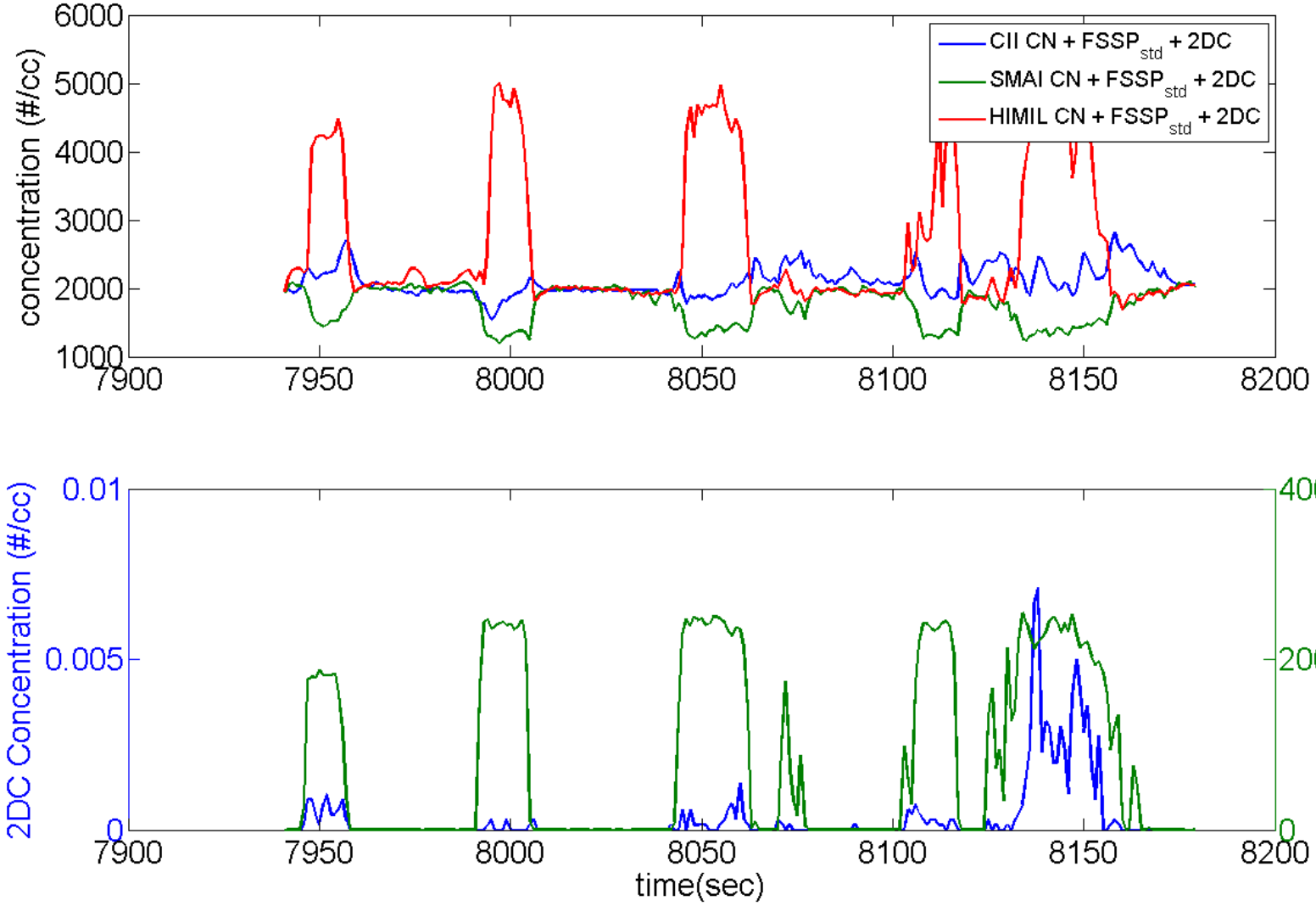




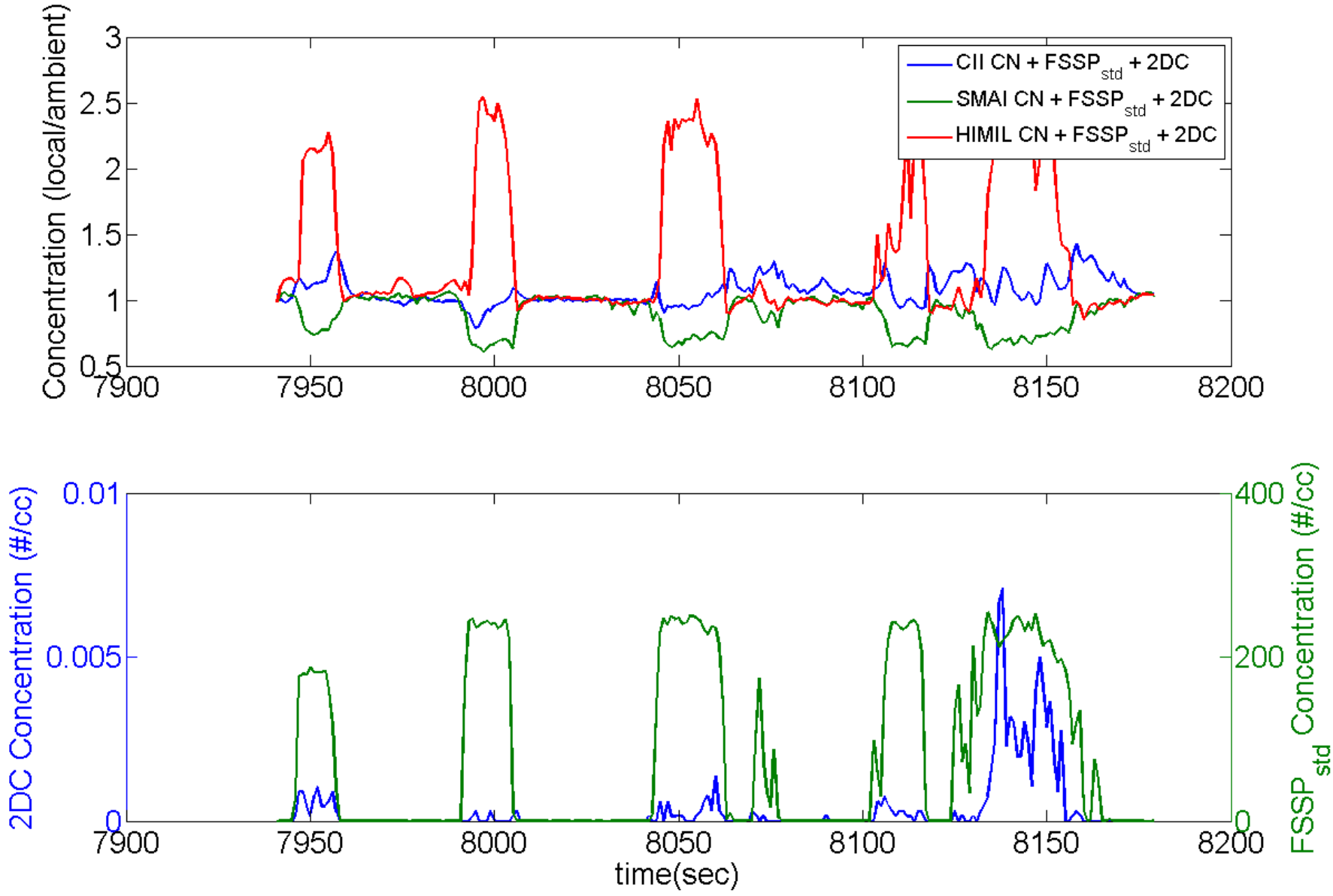
Aerosol measurements: FF03



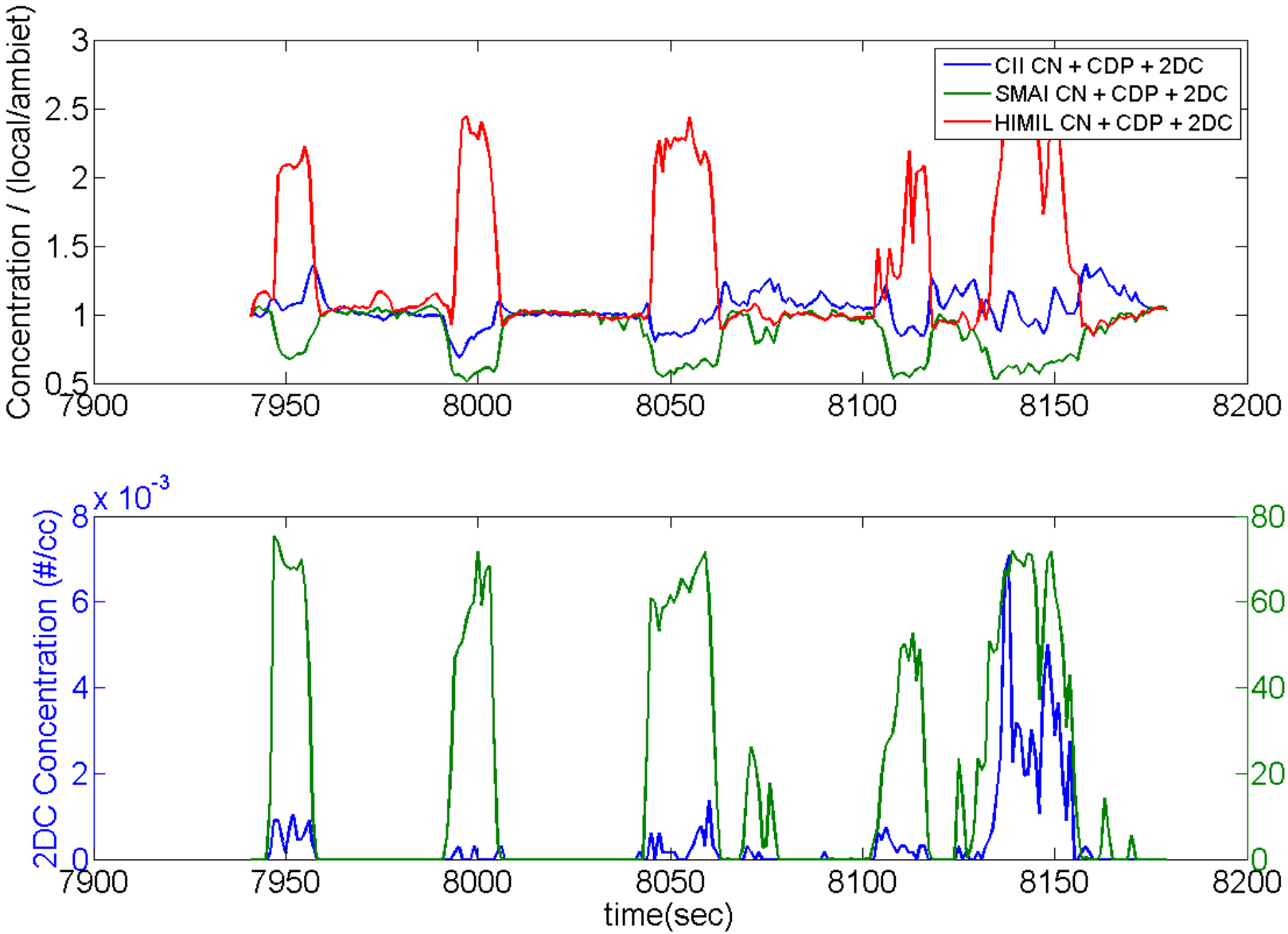
Aerosol measurements – FF03; $FSSP_{mod}$ (no shroud) used for cloud conc



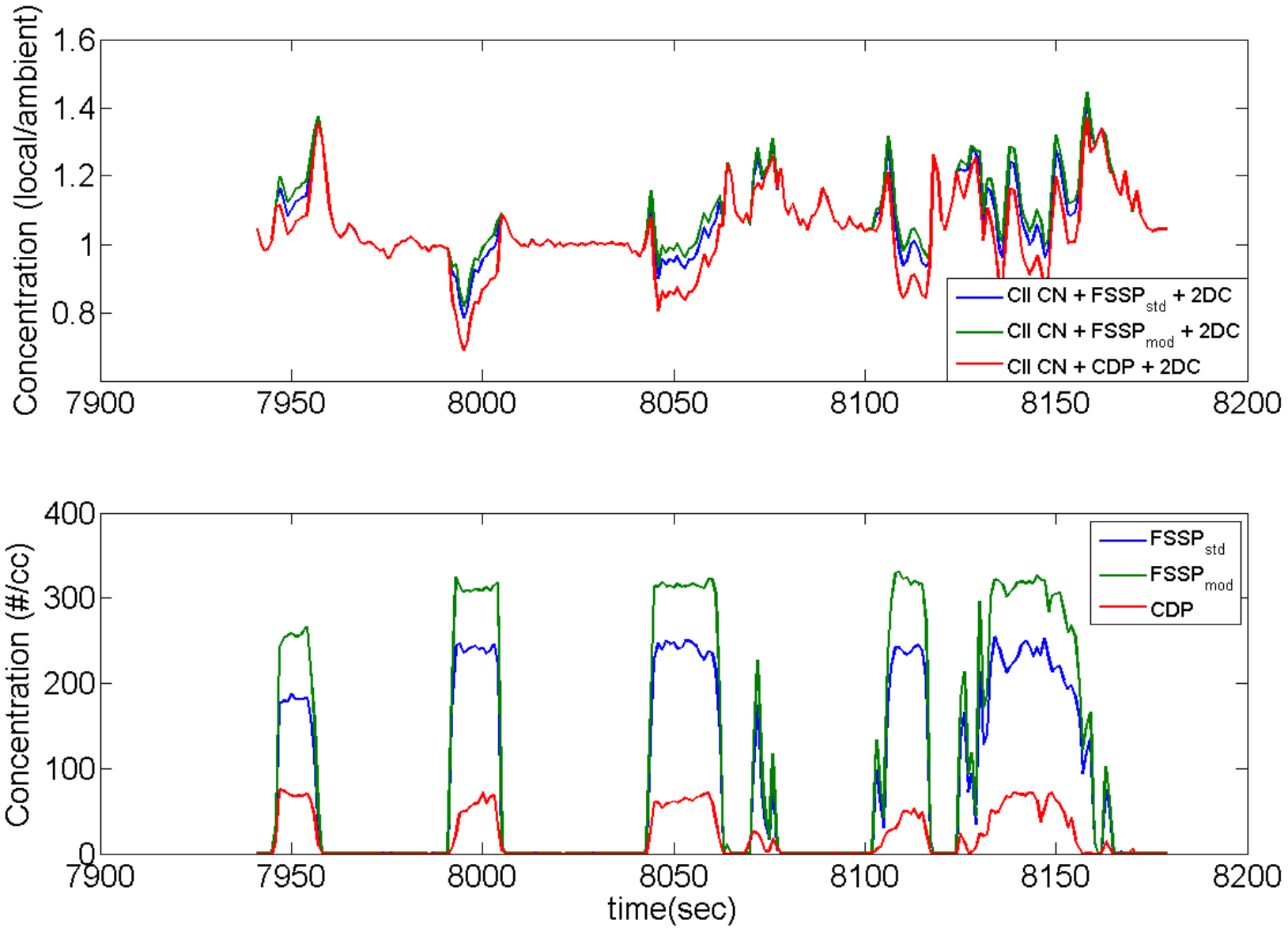
Aerosol measurements – FF03; $FSSP_{std}$ (standard FSSP) for cloud conc



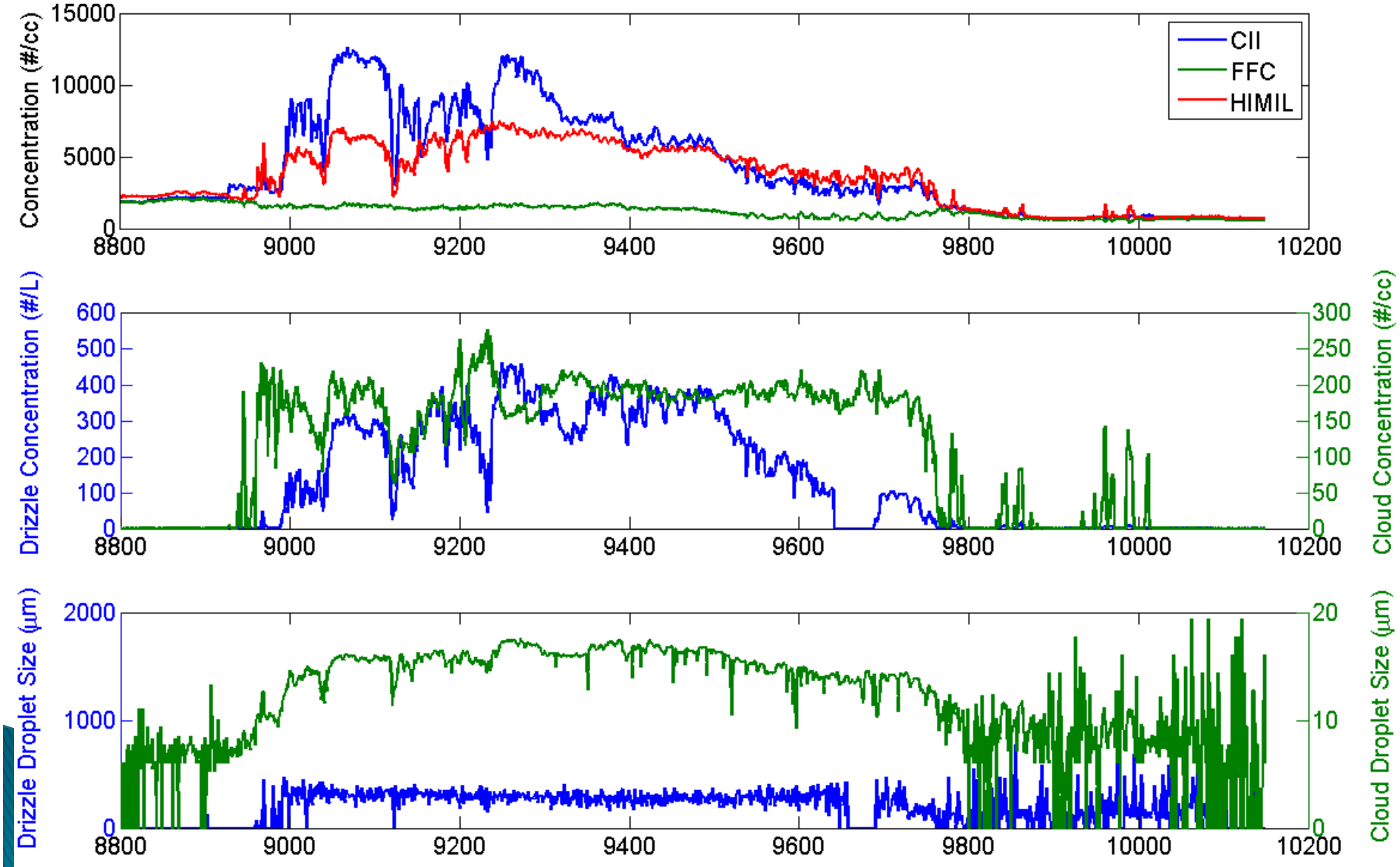
Aerosol measurements – FF03; CDP used for cloud conc



Closure study with CII inlet considering the three cloud probes



CII splash artifacts in the presence of drizzle (ff03)



Splash Artifacts (droplet breakup): Aerodynamic vs. Impaction

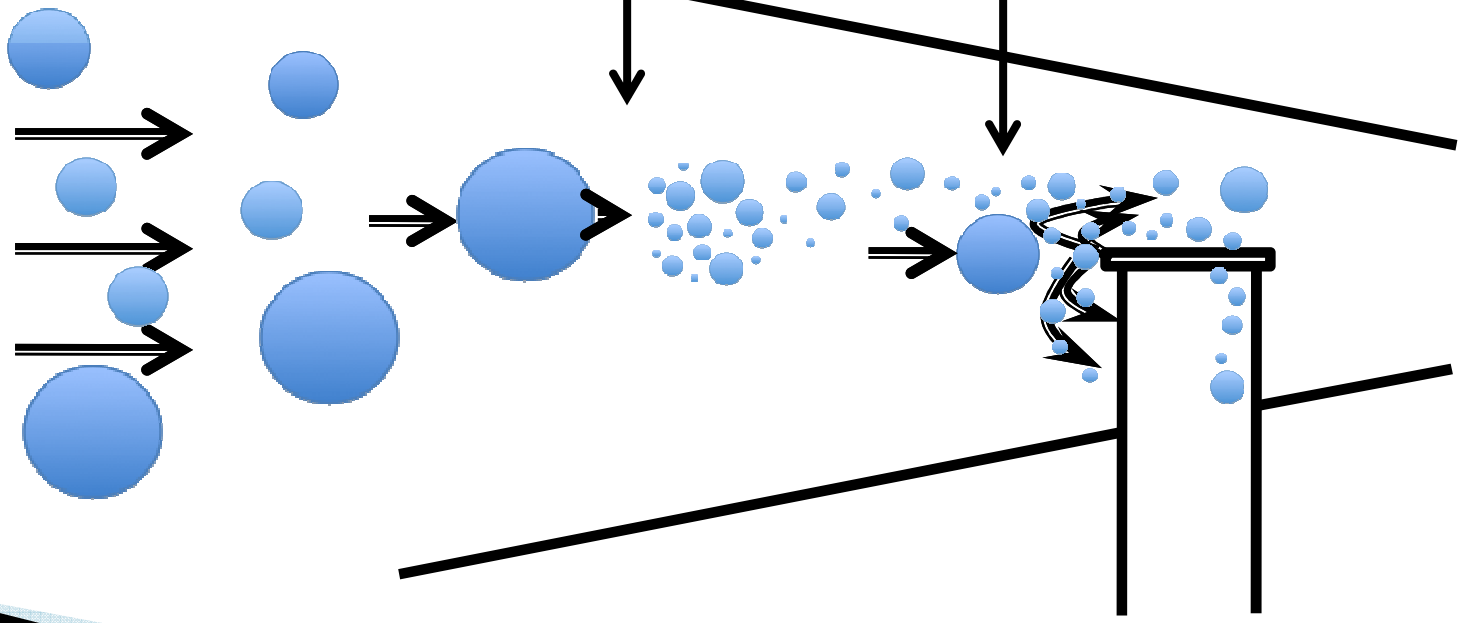
- Aerodynamic breakup – breakup from non-wall impingement…e.g. velocity differences, pressure gradients, oscillations, etc.

$$We = \frac{V^2 \rho D_p}{\sigma} > 12$$

- Droplets Impaction – breakup from wall impingement

$$K = Oh\,\mathrm{Re}^{1.25} > 57.7$$

$$Oh = \frac{We^{\frac{1}{2}}}{\mathrm{Re}}$$

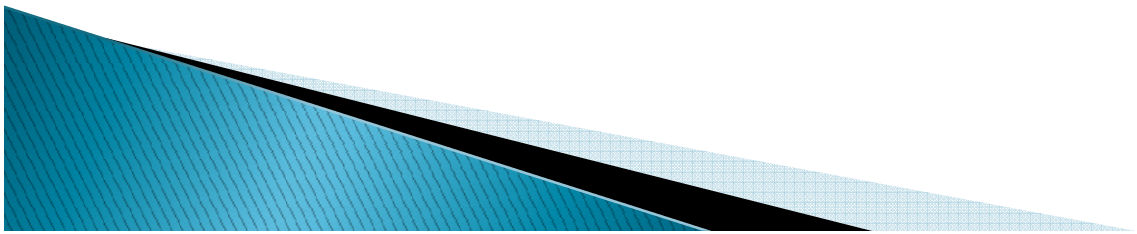


Splash model development

- To determine the distribution of particle sizes and velocities generated by impaction of droplets/ice particles on the different inlets

- Assume distributions of particle sizes and velocities as a function of Weber number and combining with CFD modeling, we will predict the observations of the different inlets

  - Determine the optimal size/velocity distribution of splatter particles that best matches the observations of the different inlets.
  - Data to be used: Cloud probes, 2D-C
  - This model might be eventually applicable for determining splatter artifacts in cloud probes



Sample size distributions (UHSAS)