



# Environment and Climate Change Canada research update

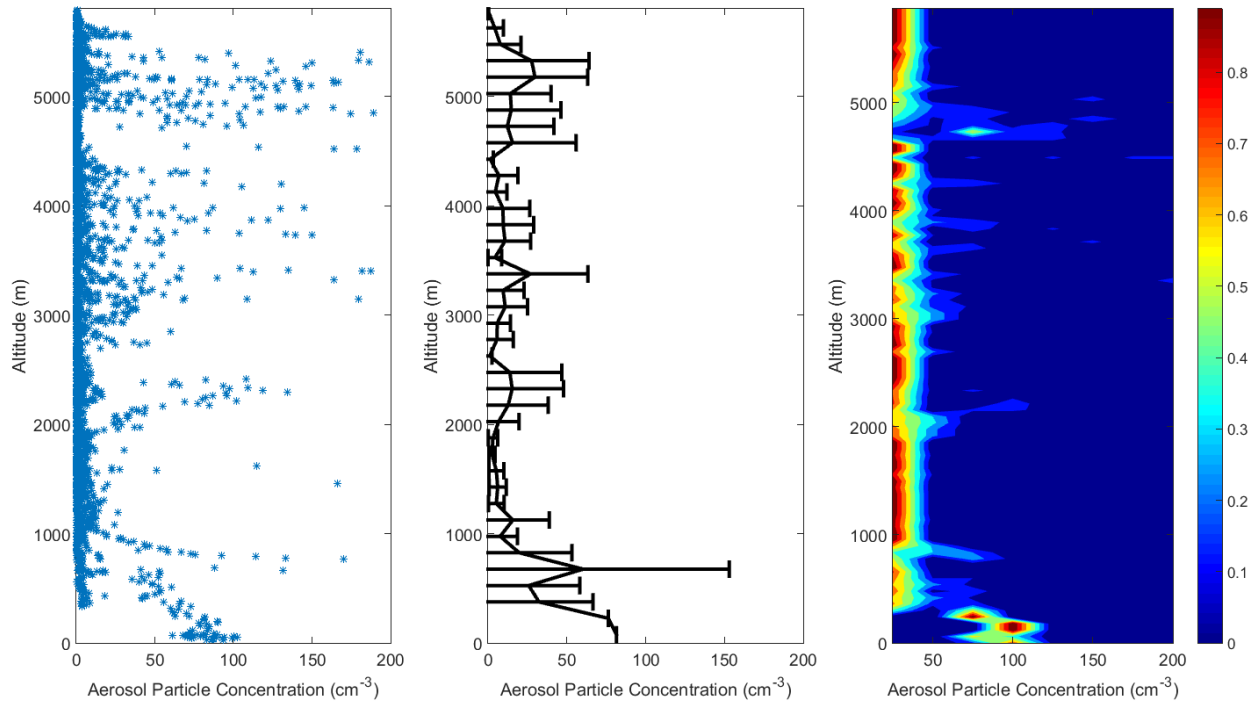
Prepared by:

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*Cloud Physics and Severe Weather Section  
Environment and Climate Change Canada*

HAIC-HIWC Science Team meeting, 16-19 May, 2016



## Average Aerosol Concentration Vertical Profile

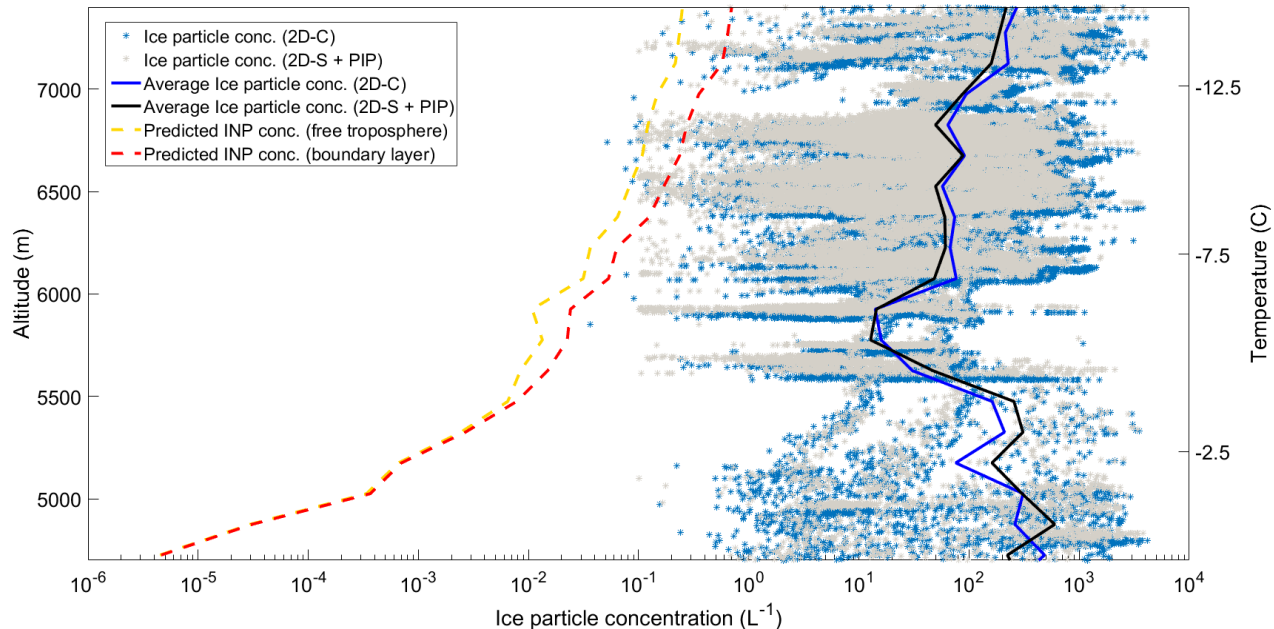


It was found that in the free troposphere the aerosol concentration ( $d_p > 200 \text{ nm}$ ) is on average approximately  $25 \text{ cm}^{-3}$ , whereas in the boundary layer it ranges between 25 and  $75 \text{ cm}^{-3}$





## Comparisons of measured ice particle concentration vs. predicted INP concentration estimated from UHSAS aerosol measurements



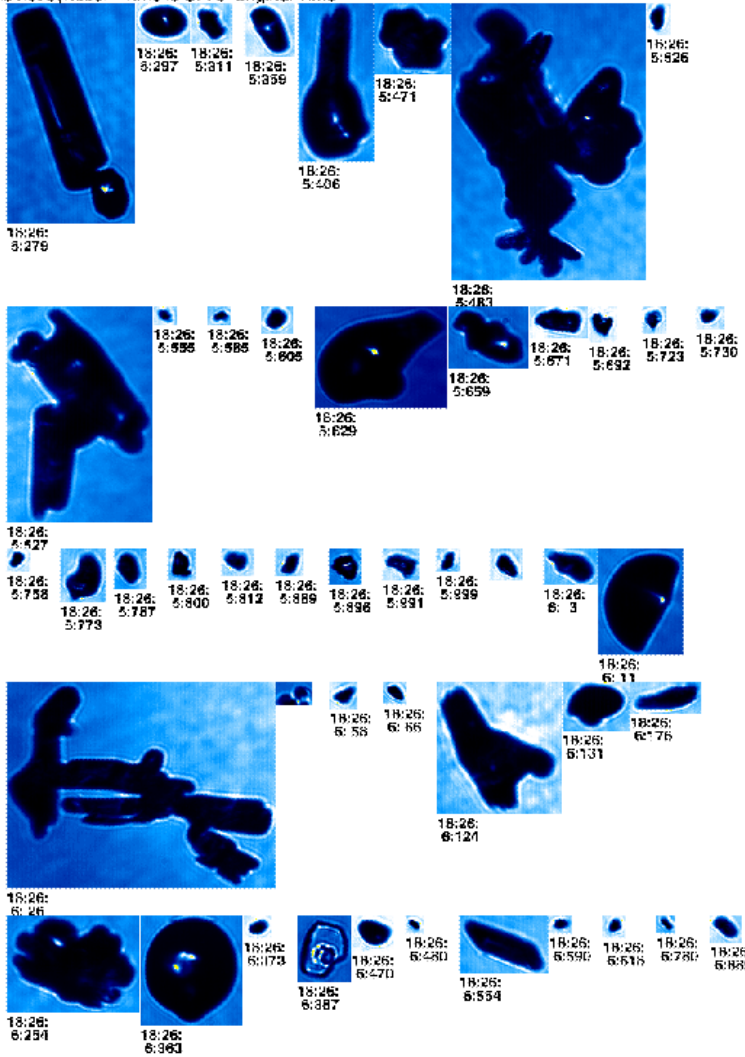
Inter-comparison of the ice crystal number concentration vertical profiles (dots) and their average profile (solid lines) obtained with the 2D-C (blue) and the 2D-S+PIP (grey) with the theoretically predicted ice nucleating particles (dotted lines, DeMott et al., 2010) using the aerosol concentration from the UHSAS.

The obtained aerosol measurements cannot explain observed concentration of ice particles. Ice multiplication process is a favorable explanation of the high concentration of ice observed in Cayenne.

Ladino et al. 2016: in preparation for submission to JGR



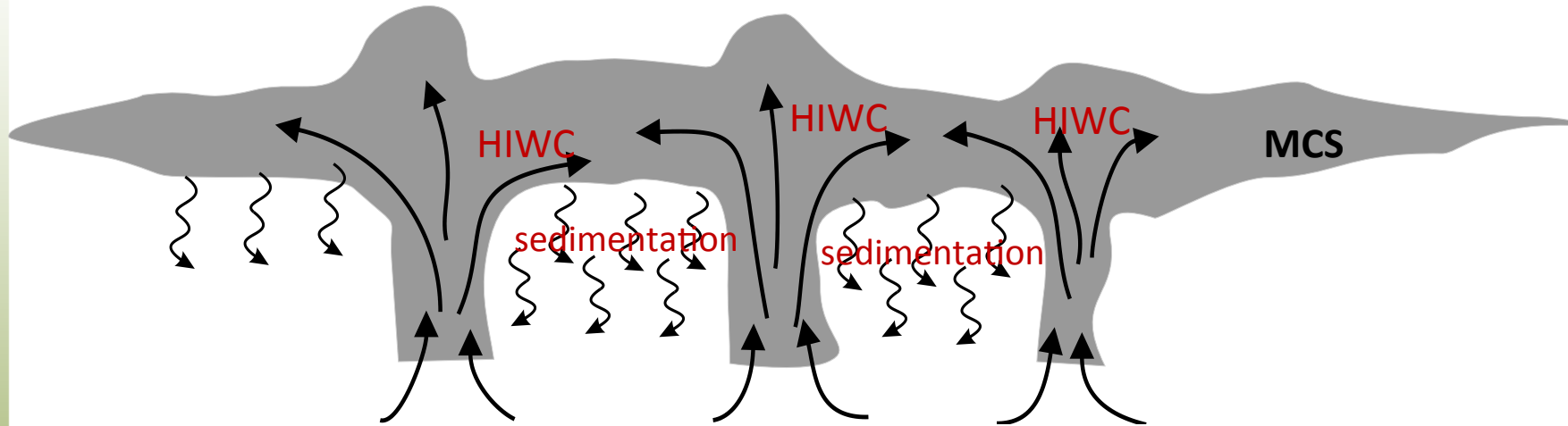
5/23/2015 182605--182606---->200um focus gl 75 and Crystal gl 0  
Time is not synced. Time is CPI's original Time



5/23/2015 182543--182544---->200um Crystal gl 0 and focus gl 75  
Time is not synced. Time is CPI's original Time

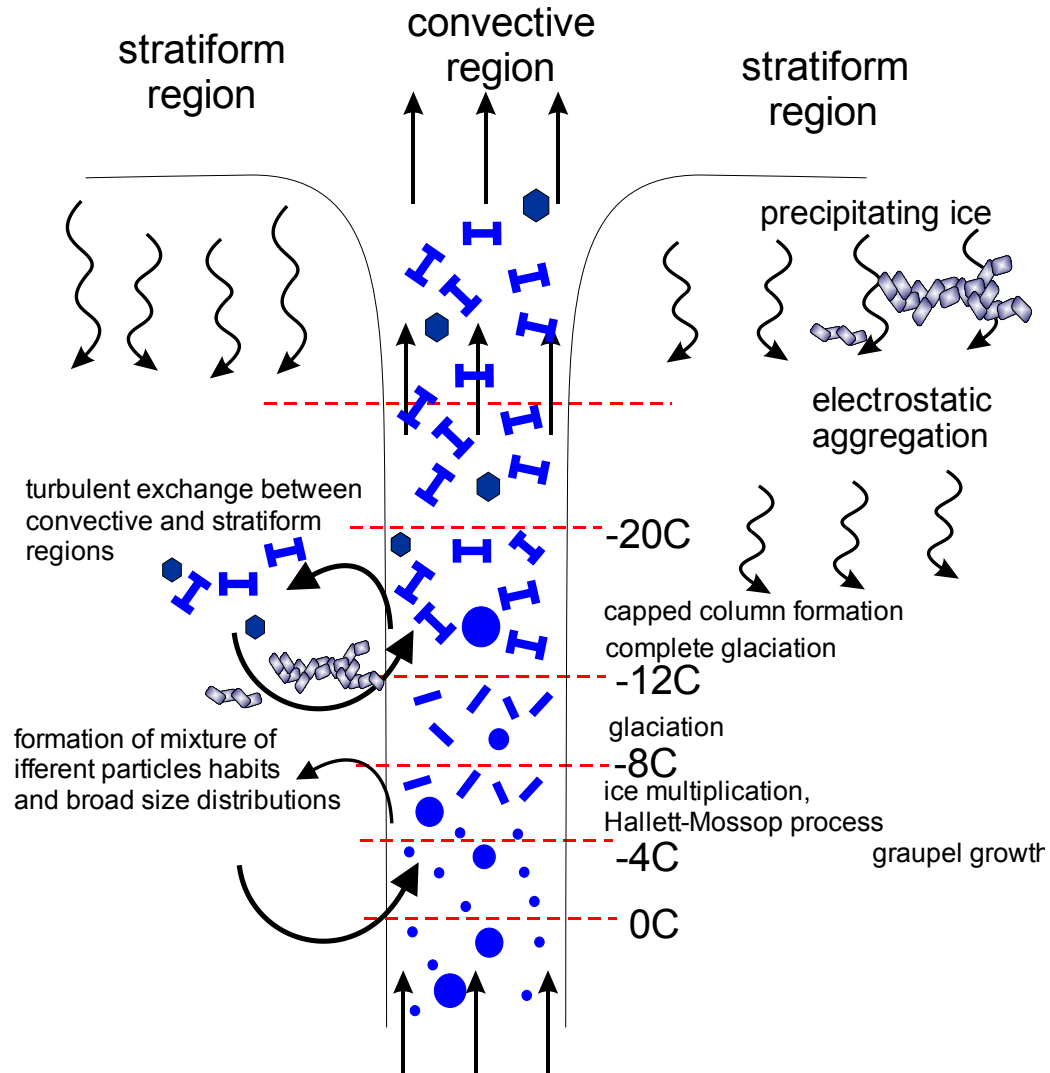


## Conceptual model of HIWC formation in MCSs



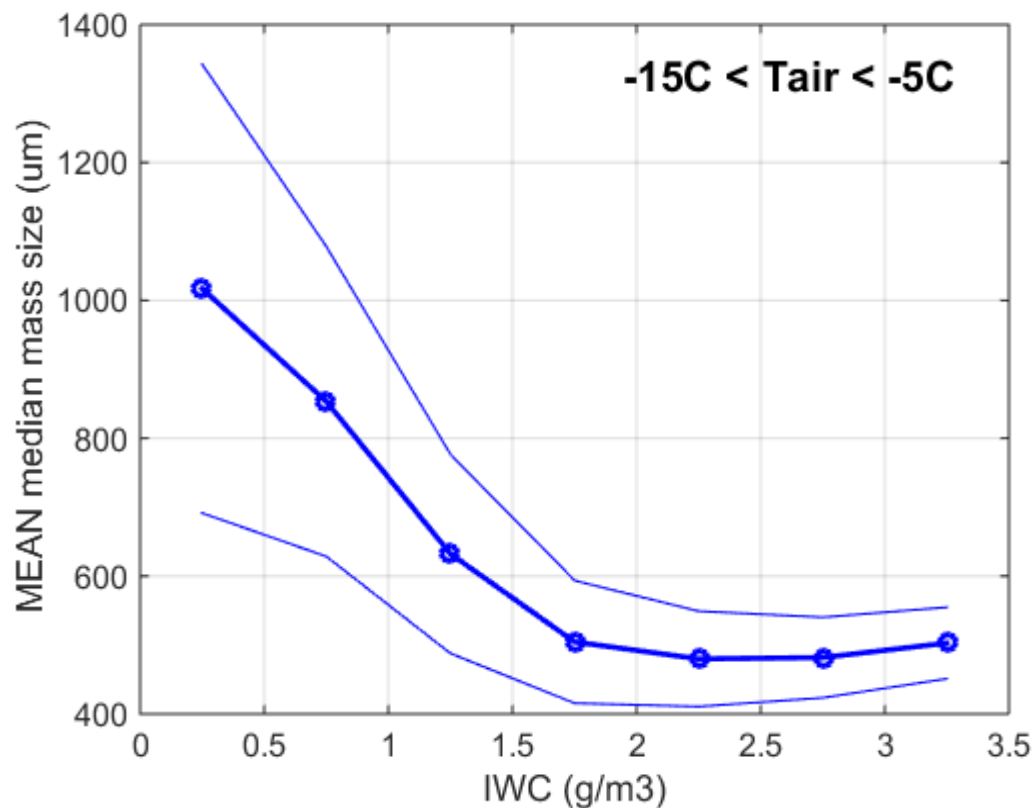
- HIWC in stratiform regions are formed as a result of periodic pumping of condensed water in the stratiform regions of MCSs by convective flows ( $2 < U_z < 15 \text{ m/s}$ ).
- The convection originates in the warm sector of MCSs at  $H < 5 \text{ km}$  and may extend to 12 km or higher.
- HIWC regions are dynamic objects and they form as a result of balance between particle sedimentation and IWC brought up by convection

# Conceptual model of microstructure formation in MCS





## Median mass size vs IWC



Median mass size decreases with increase of IWC approaching to MMD~500μm and IWC>1.5g/m<sup>3</sup>







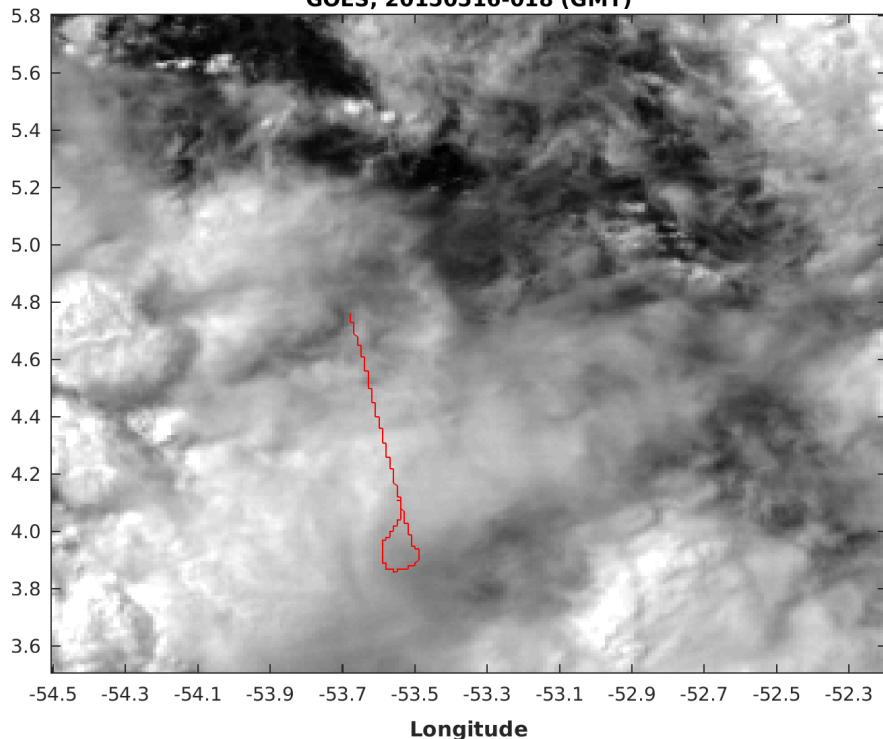
Developing nowcasting tools  
High resolution simulation of MCSs

Comparisons with in-situ and satellite data using Cayenne and Darwin data sets

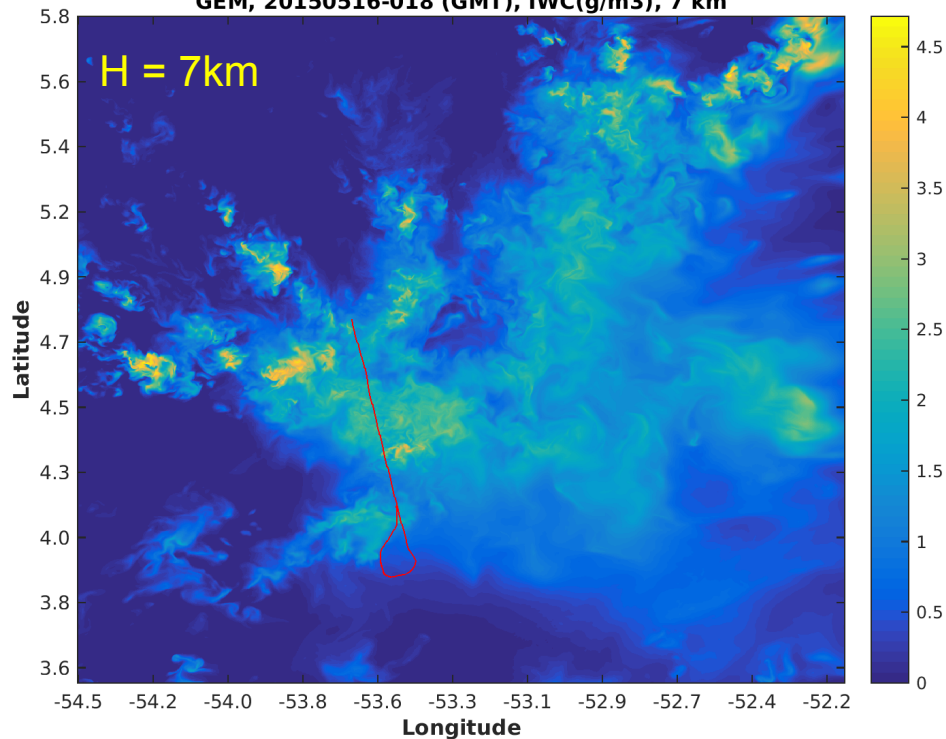
### Case 1: 2015-05-16 (PM)

### Convair-580 (0.25 km)

GOES, 20150516-018 (GMT)



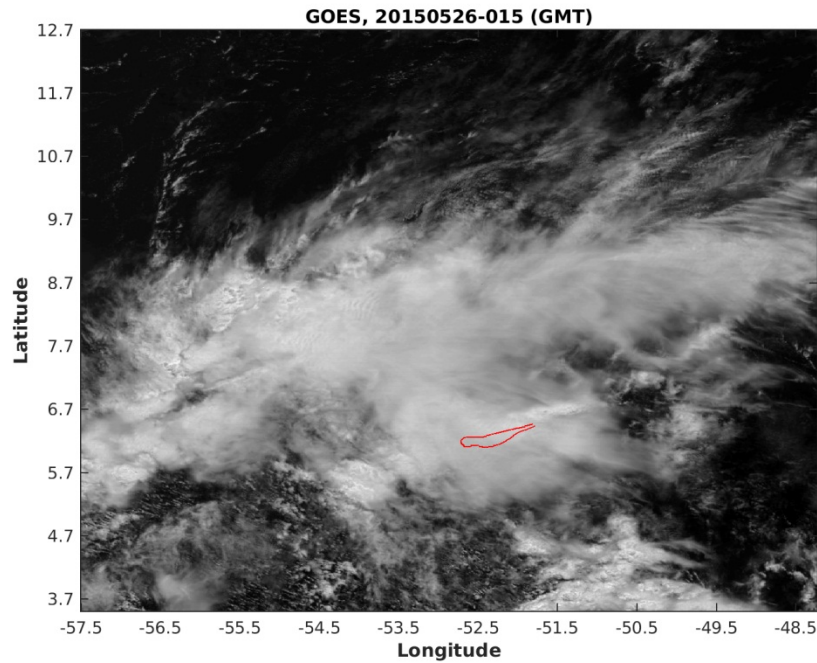
GEM, 20150516-018 (GMT), IWC(g/m3), 7 km



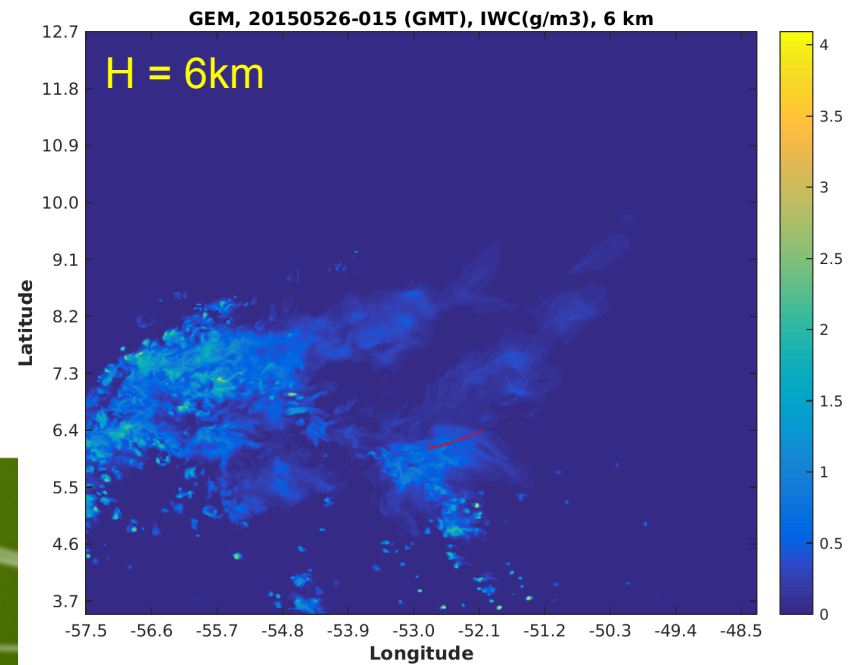
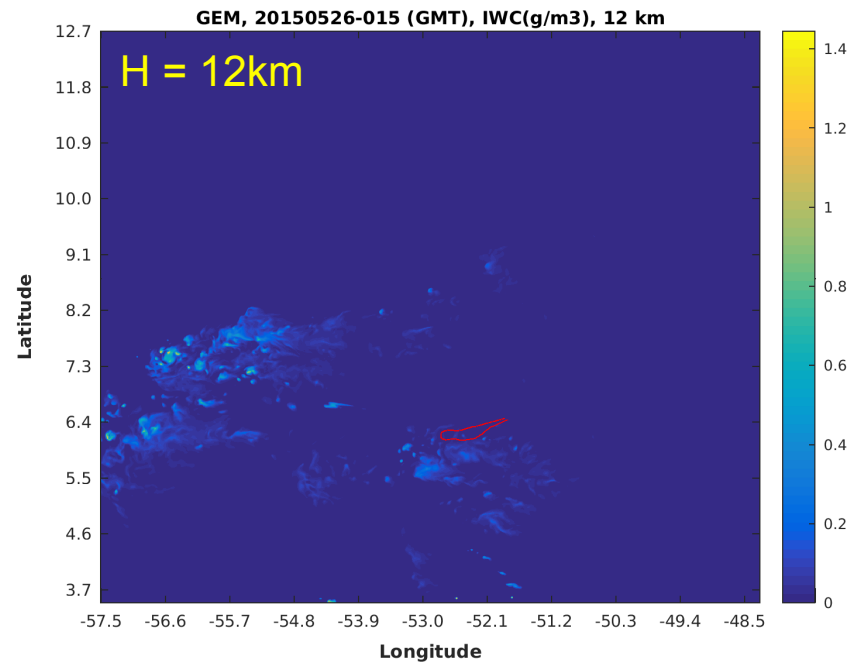


# High resolution simulation

## Case 2: 2015-05-26 (PM)

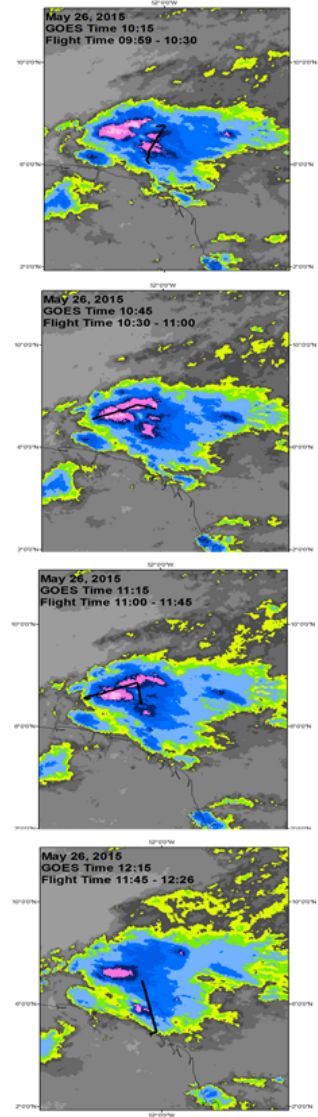
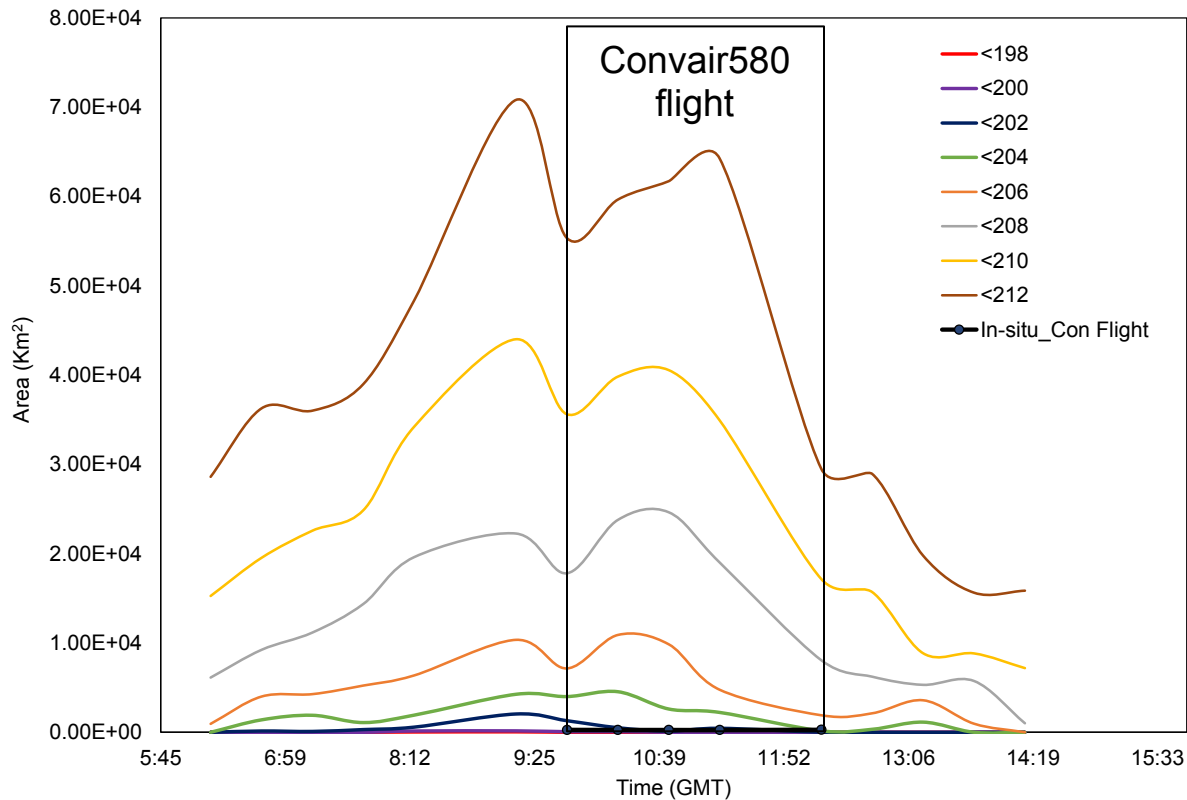


Convair-580





# Developing nowcasting tools Comparisons of satellite products with in-situ data from Cayenne and Darwin data sets



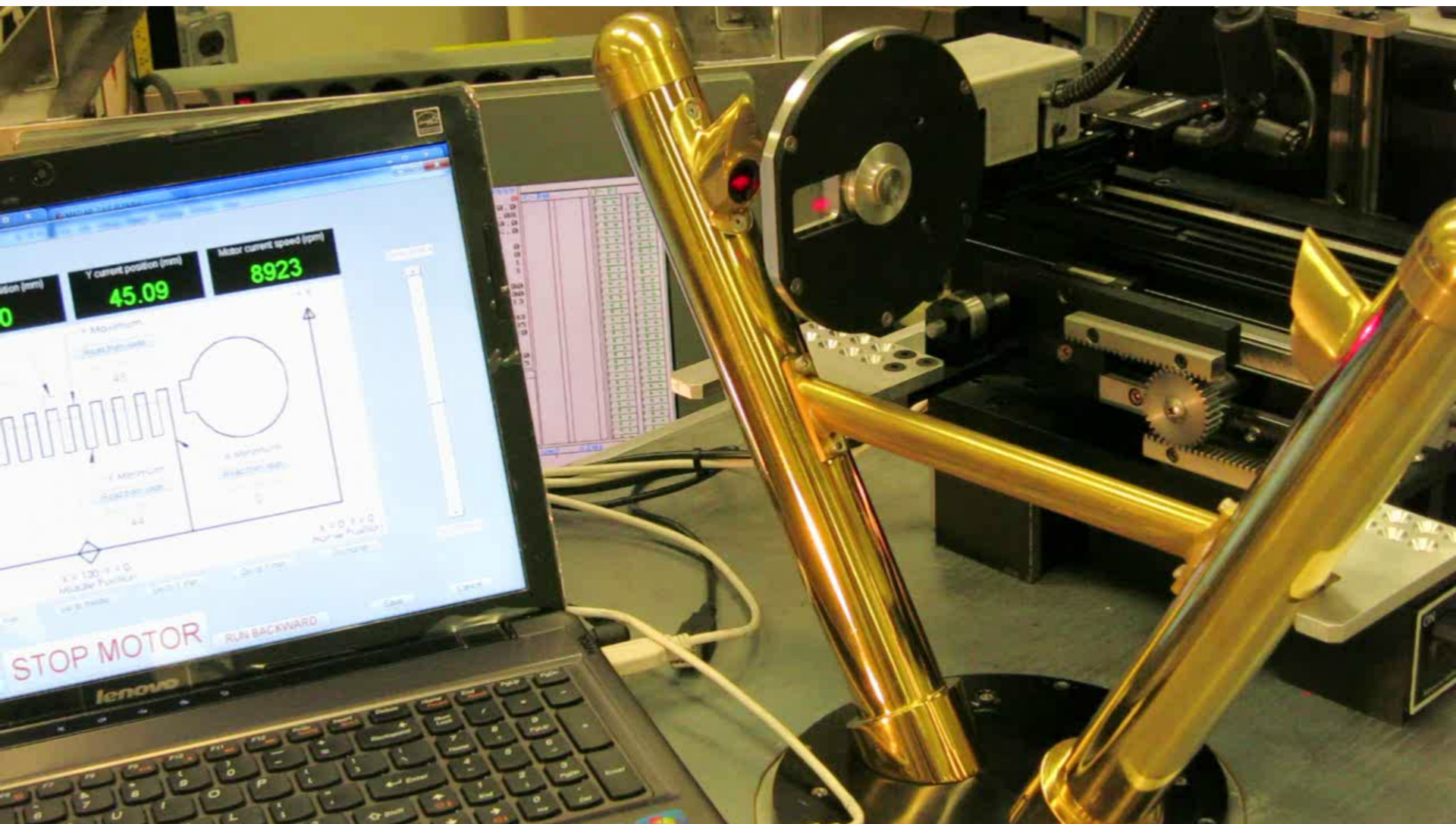




1. Instrumentation supporting HIWC program  
(temperature sensors, humidity inlets, extinction mods,  
refurbishing FSSP, hot-wires)
2. Accuracy and error analysis
3. Calibrations
4. Data processing algorithms
5. Processing software



# Laboratory installation for spinning disc calibrations of 2D probes





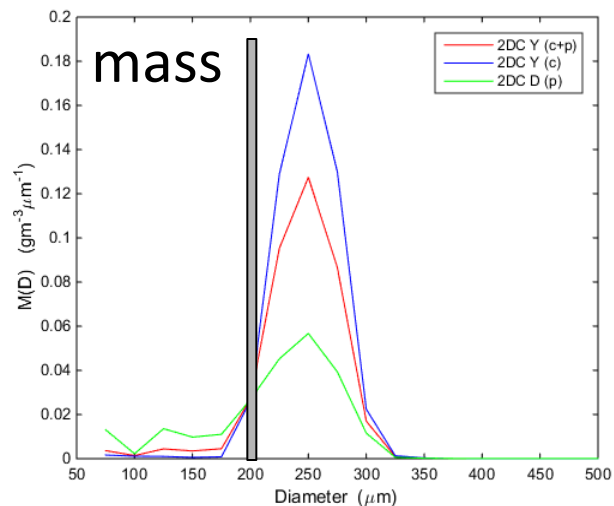
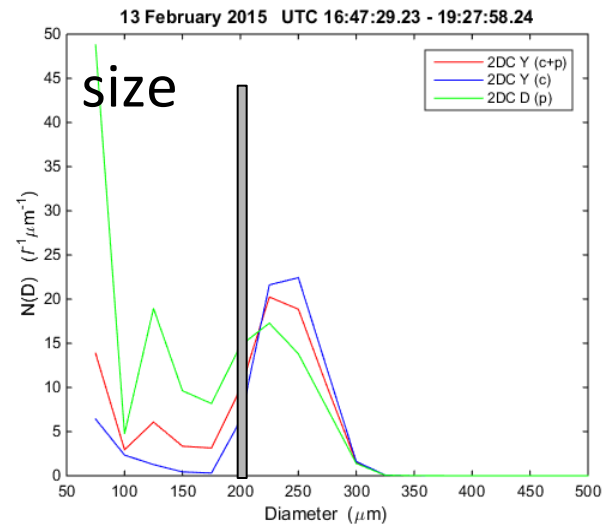
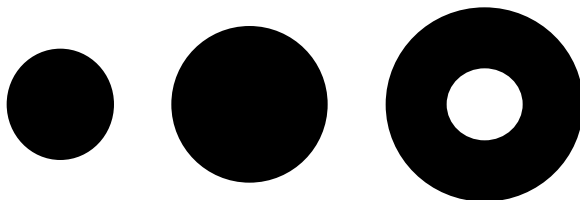
## Some results:

Measured size and mass distributions  
for monodisperse 200 $\mu\text{m}$  dots



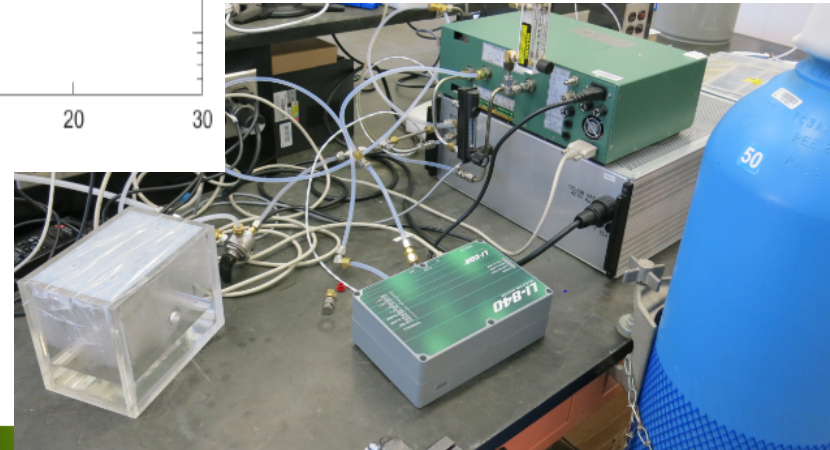
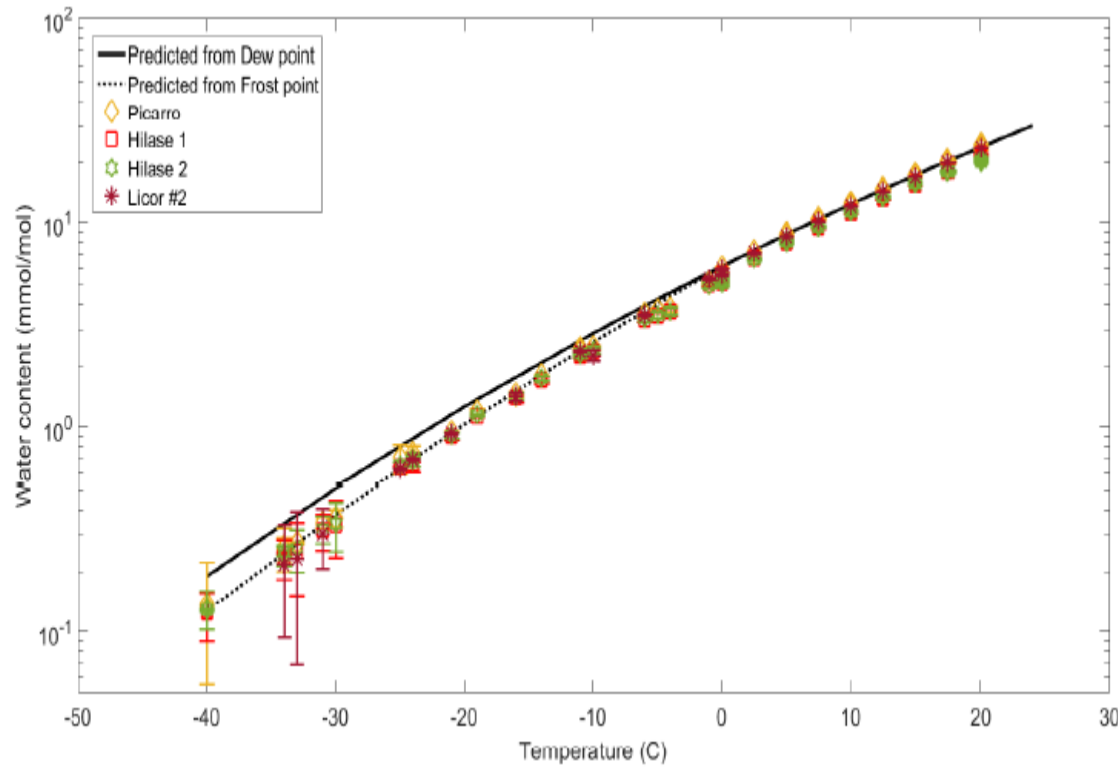
Overestimation of measured mass  
and particle size.

Size corrections are important





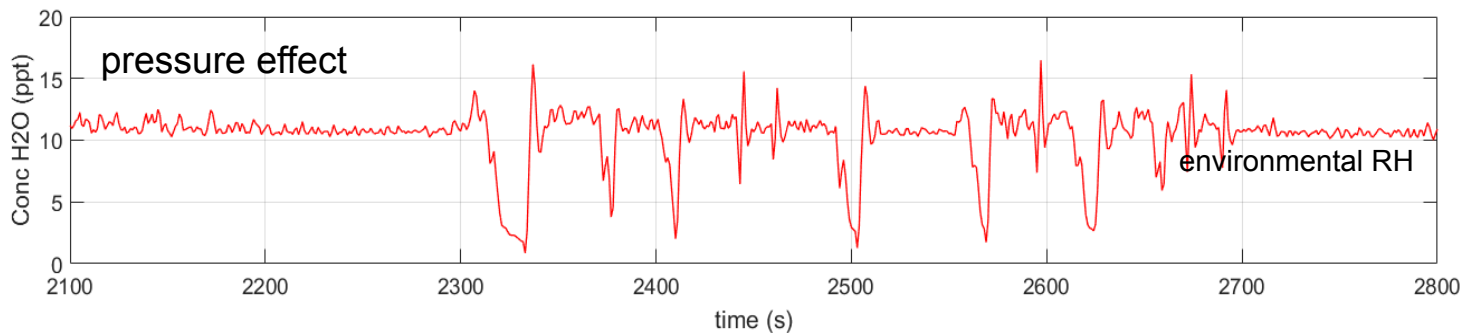
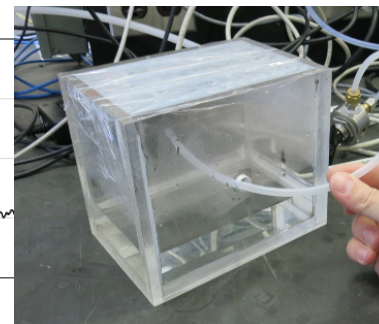
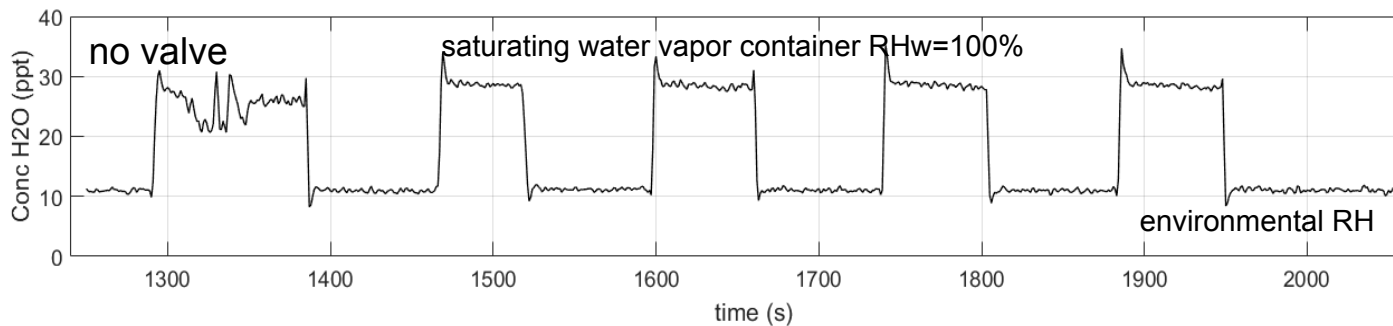
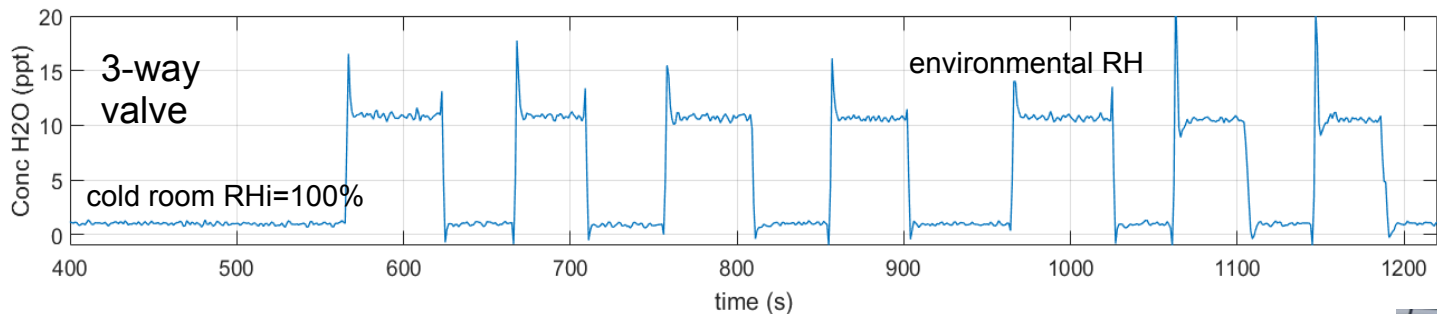
# Humidity probes calibrations







# Lab tests of Licor 840





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## **High Ice Water Content (HIWC) Program**

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