

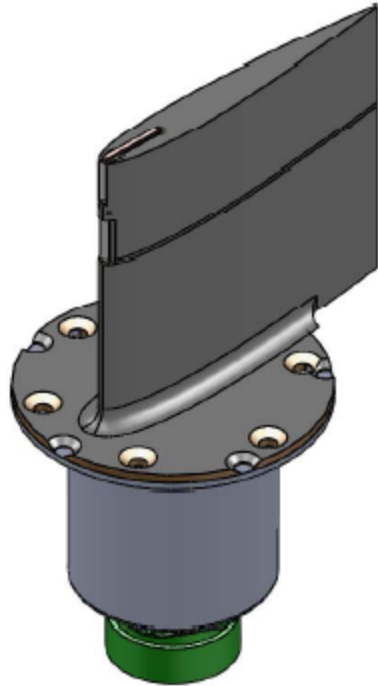
Status of F20 Belly-Mounted Hot-Wire Data, Darwin-2014 and Cayenne 2015

Prepared by Walter Strapp, Lyle Lilie
16-May-2016

Reminders:

- Probes are installed close to the skin of the aircraft, and in what is suspected to be a region of enhanced IWC due to upstream debris from ice crystal collisions on the nose and forward fuselage of the aircraft
- Probes are installed behind the nose-gear of the aircraft, and show step changes and shadowing when gear is down
- LWC probes (0.53, 2.3 mm dia.) are subject to relatively large errors due to false response to IWC (locally enhanced), ~10% of true IWC
- All data may have some degree of smoothing due to M300 settings in hardware – e.g. looks like ~4-second smoothing for the robust probe (TBD)
 - Higher frequency raw data may be recoverable

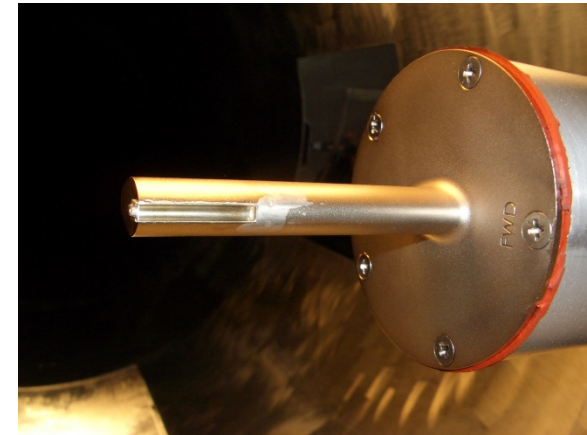
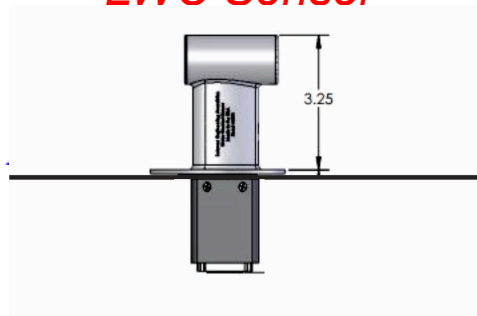
Images of sensors:



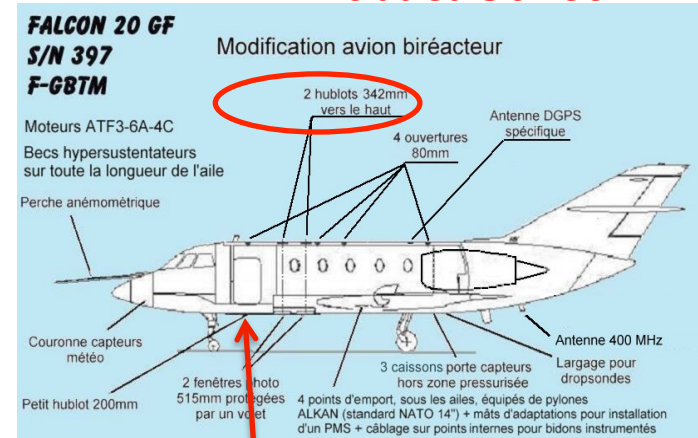
Ice Crystal Detector Sensor



LWC Sensor



Robust Sensor



Location of belly hot-wire

DRW-14 Data and Functionality

Flight#	Probe Installed	S.N.	Status (functionality)
D1	LWC 0.5 mm	2002	probably OK entire flight
D2	LWC 0.5 mm	2002	probably OK, entire flight
D3	LWC 0.5 mm	2002	probably OK entire flight
D4	LWC 0.5 mm	2002	probably OK entire flight, removed because original intention to use 2.1 mm
D5	LWC 2.1 mm	2005	probably OK entire flight
D6	LWC 2.1 mm	2005	probably OK entire flight
D7	LWC 2.1 mm	2005	probably OK entire flight
D8	LWC 2.1 mm	2005	probably OK entire flight
D9	LWC 2.1 mm	2005	probably OK entire flight
D10	LWC 2.1 mm	2005	probably OK entire flight
D11	LWC 2.1 mm	2005	probably OK entire flight, removed because hollow sensor flattening due to impacts. Like TWC sensor at end.
D12	LWC 0.5 mm	2002	Probably OK entire flight
D13	LWC 0.5 mm	2002	Failed during flight
D14	LWC 0.5 mm	2003	New sensor, probably OK entire flight
D15	LWC 0.5 mm	2003	probably OK entire flight
D16	LWC 0.5 mm	2003	probably OK entire flight
D17	LWC 0.5 mm	2003	probably OK entire flight
D18	LWC 0.5 mm	2003	probably OK entire flight
D19	LWC 0.5 mm	2003	probably OK entire flight
D20	LWC 0.5 mm	2003	probably OK entire flight
D21	LWC 0.5 mm	2003	probably OK entire flight
D22	LWC 0.5 mm	2003	probably OK entire flight
D23	LWC 0.5 mm	2003	probably OK entire flight

Status of DRW-14 Data

- Data processed with dry regressions
- Discussion in Melbourne:
 - Very little liquid regions in data set, mostly glaciated
 - Difficult to try to remove false response to ice because IWCs are so large (noise in removal would be larger than any LWC signal)
 - Still, some LWC regions may be discernable using Rosemount Ice Detector, CDP, and other data sets to verify LWC regions
 - Decision to place data set on archive as is, with imbedded warning about danger of misinterpretation due to ice false response
- Still not done due to very busy schedule this past winter, other priorities
- Will provide data at first opportunity after the Toronto meetings

CAY-15 Data and Functionality

Flight#	Probe Installed	S.N.	Status (functionality)
C9	LWC 0.5 mm	2020	probably OK entire flight
C10	LWC 0.5 mm	2020	probably OK, except during M300 reboot 19:21-19:27 (initial climb)
C11	LWC 0.5 mm	2020	probably OK after 21:19:40 (mid-initial-climb)
C12	LWC 0.5 mm	2020	probably OK entire flight
C13	LWC 0.5 mm	2020	probably OK entire flight
C14	Ice Crystal Detector	4005	probably OK entire flight
C15	Ice Crystal Detector	4005	probably OK entire flight
C16	Robust	3015	probably OK entire flight
C17	Robust	3015	probably OK entire flight
C18	Robust	3015	probably OK entire flight
C19	Robust	3015	Circuit breaker troubles, no data from 16:08-16:56 (-10 C in heavy precipitation)
C20	Robust	3015	Circuit breaker troubles, no data from 11:18 to end of flight (final measurements in heavy precipitation)
C21	LWC 0.5 mm	2020	probably OK entire flight
C22	LWC 0.5 mm	2020	probably OK entire flight
C23	LWC 0.5 mm	2020	probably OK entire flight
C24	LWC 0.5 mm	2020	probably OK entire flight
C25	LWC 0.5 mm	2020	no data entire flight
C26	LWC 0.5 mm	2020	no data entire flight

Status of CAY-15 Data

- A little more LWC data than in Darwin, but still only a very small fraction of data, mostly at -10 C
- Same comments about false response to IWC apply here for identifying LWC regions
 - Some LWC regions may be discernable using Rosemount Ice Detector, CDP, and other data sets to verify LWC regions
 - Decision to place data set on archive without attempt to remove ice false response, with imbedded warning about danger of misinterpretation due to ice false response
- Post flight program processing not started yet. Only rough real-time estimates available
- Melbourne target of January 2016 not met due to new priorities related to completion of IKP2 performance testing and documentation
- Will target completion of hot-wire data set by August 2016.

Preliminary Observations CAY-15:

- Again, very little evidence of significant LWC on 0.5 mm sensor (i.e. response > 10% of IWC) in HIWC conditions, even at -10 C
- IWC enhancement close to skin at belly location (due to ice crystal debris from upwind surfaces) is of the order of a factor of 1.5-2.
 - Helps explain high false response on LWC sensor relative to free stream IWC values (~10%, versus ~3-5% in wind tunnels)

End of Presentation

Merci, Thank You

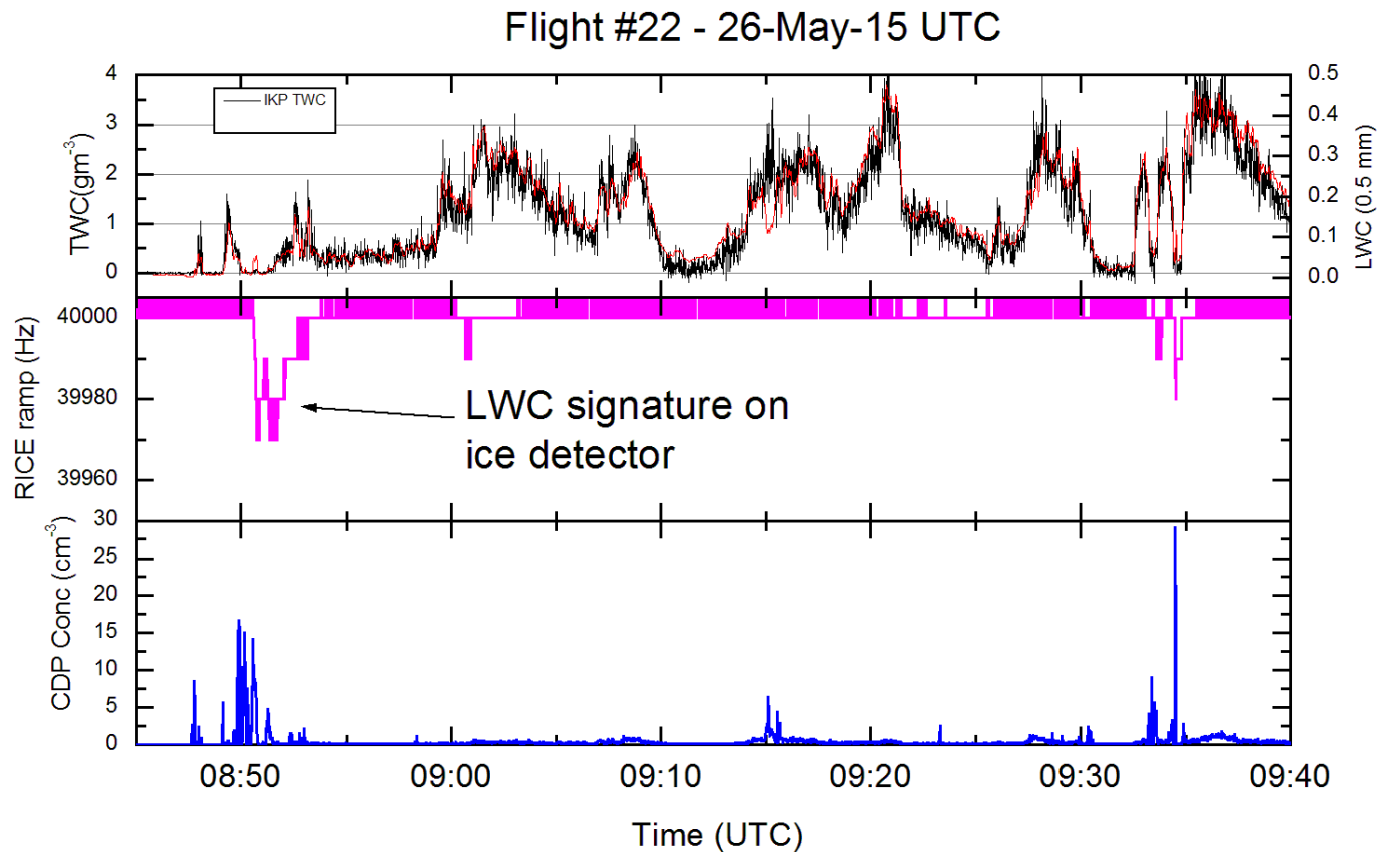
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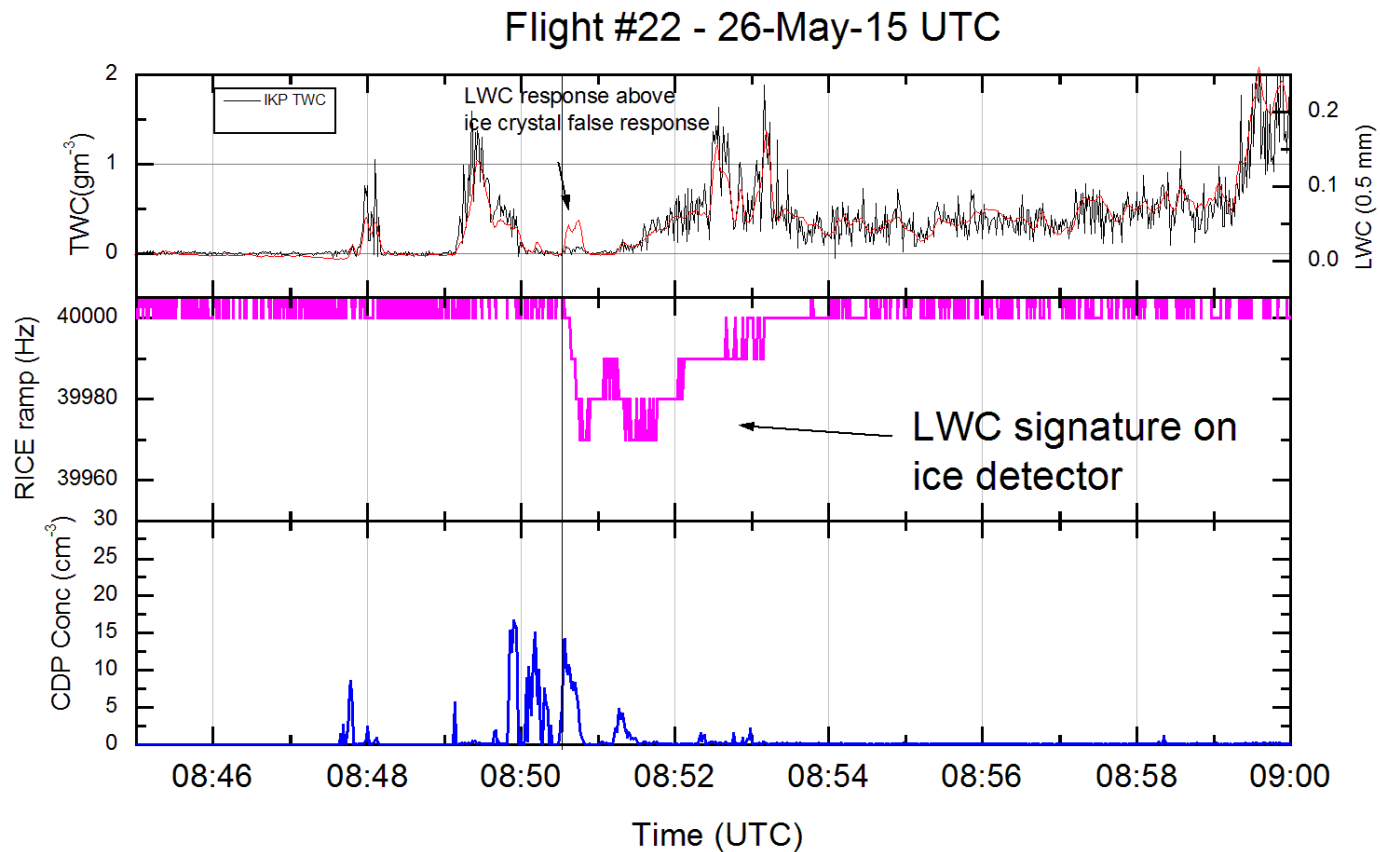
Spare slides

Preliminary Observations CAY15:



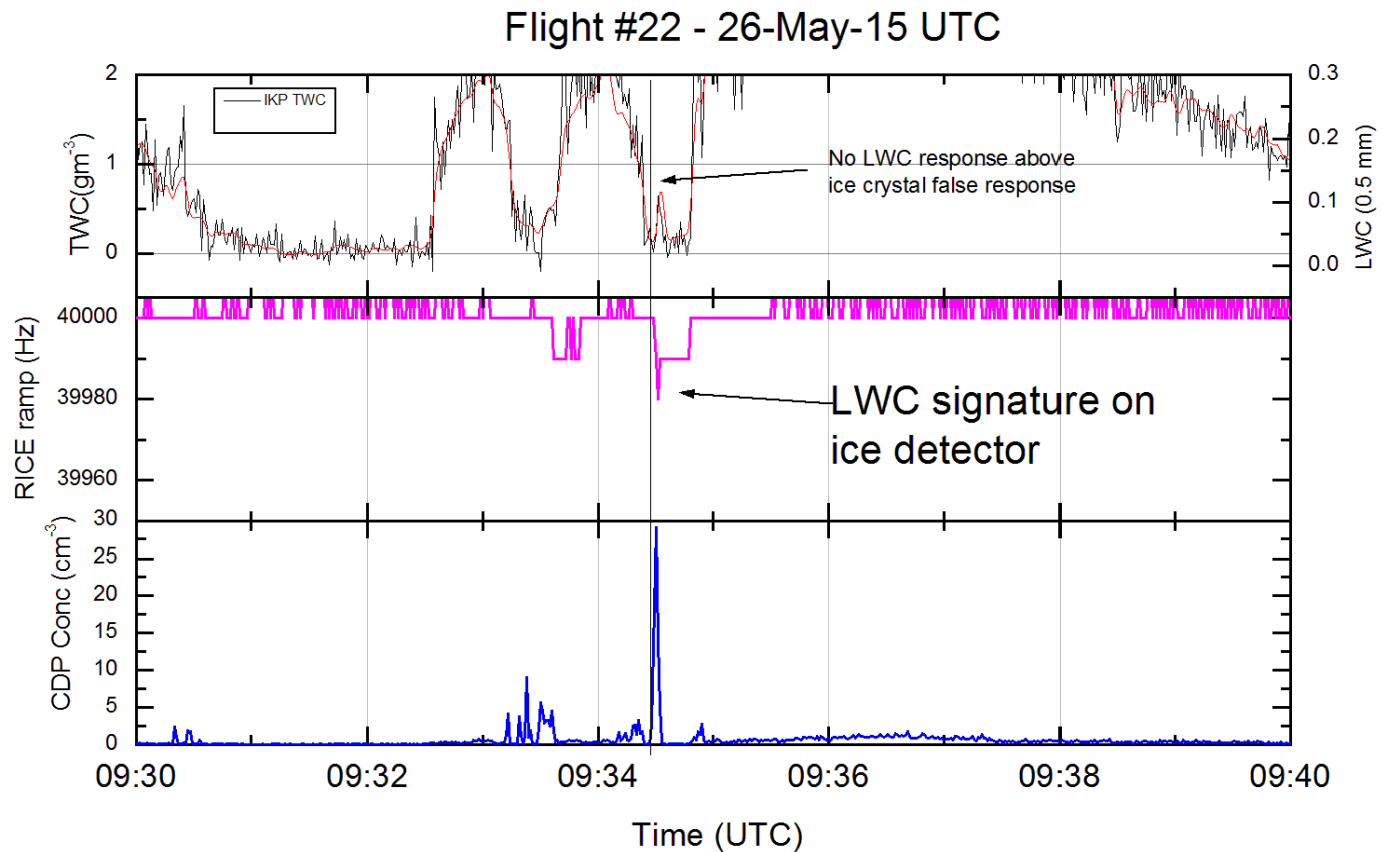
Note LWC trace top panel on a scale ~ 10 times more sensitive than IKP TWC

Preliminary Observations:



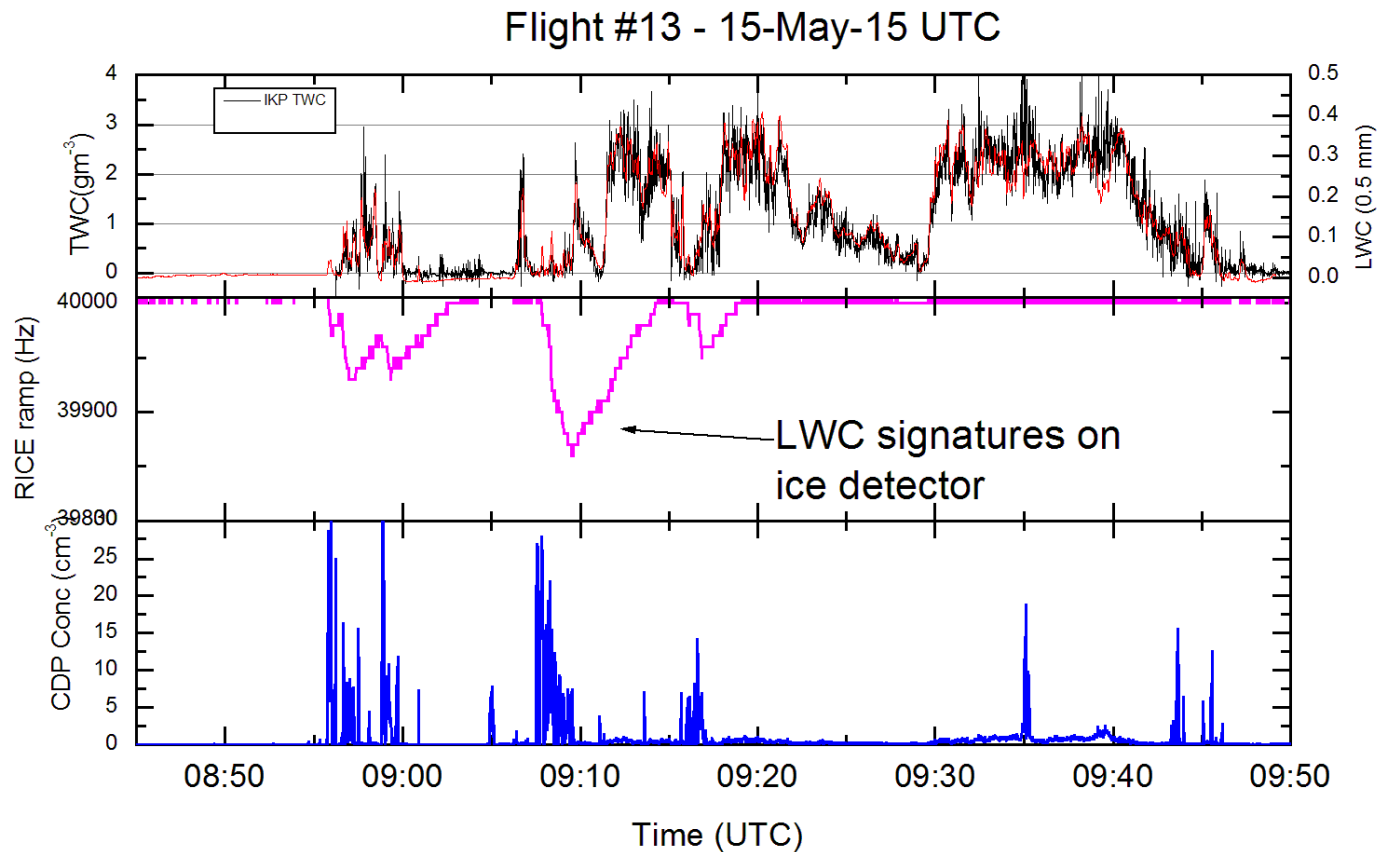
Note LWC trace top panel on a scale ~ 10 times more sensitive than IKP TWC

Preliminary Observations:



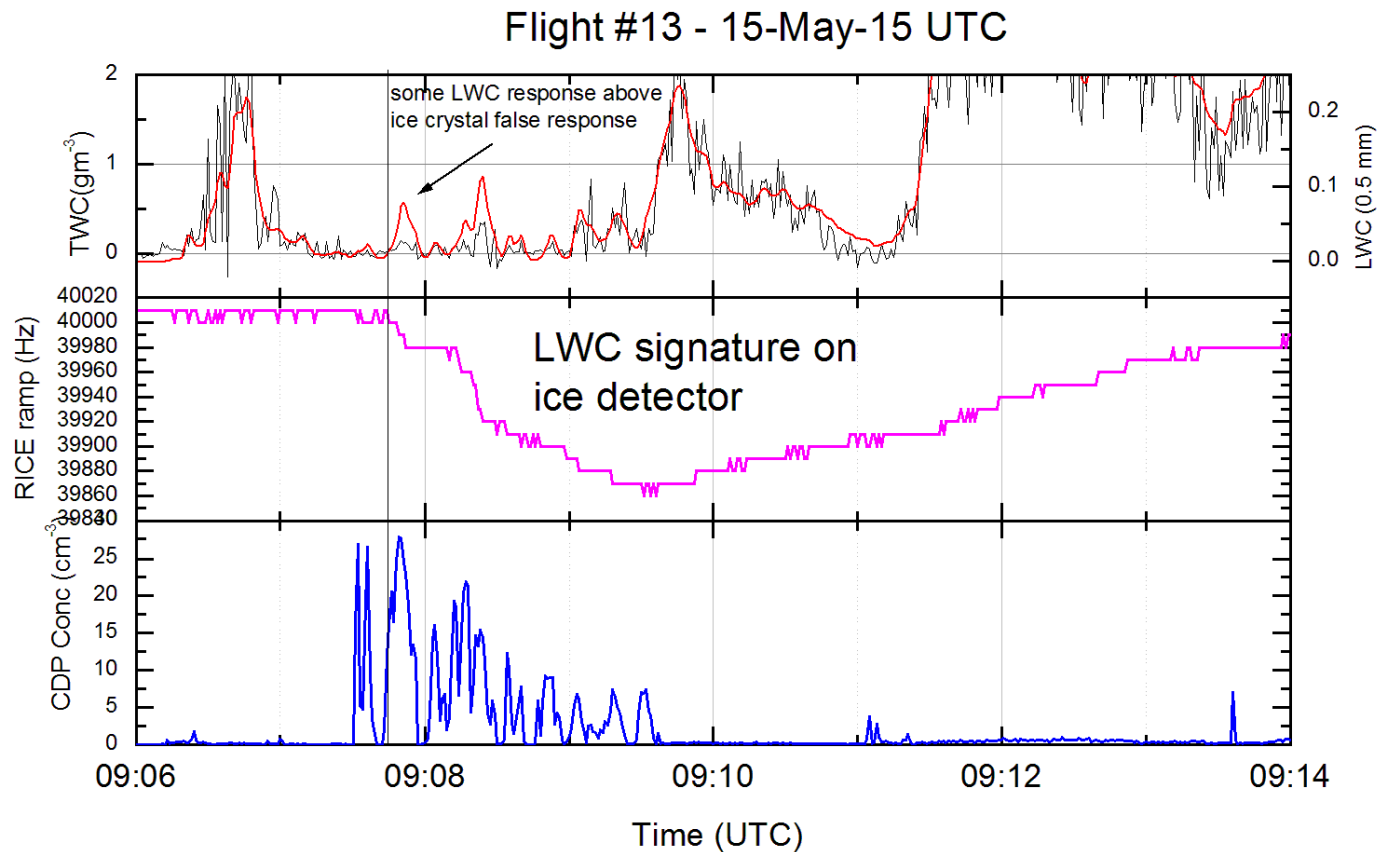
Note LWC trace top panel on a scale ~ 10 times more sensitive than IKP TWC

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Data Processing Status:

ICD, Robust, 0.5 mm LWC

- Not very far advanced: only rough calculations available (not intending to distribute rough version)
- Lilie and Strapp to provide Robust gm^{-3} and ICD TWC gm^{-3} in approximately January 2016.
- 0.5 mm LWC, TBD – not sure if it is worthwhile to provide this data set, given potential for misinterpretation (given the large false response)
 - Data are more useful to establish the lack of a significant LWC rather than an absolute estimate of IWC.
 - Cannot detect trace amounts of LWC in HIWC conditions
 - Goodrich Ice Detector may be more useful
 - May decide to provide data without false response removal with explanation in data file that any LWC estimates are contaminated by ice crystal response, especially in HIWC conditions