

# Status of F20 IKP2 and Belly-Mounted Hot-Wire Data Sets, Darwin-2014 and Cayenne 2015

Prepared by Walter Strapp  
2-Dec-16

# IKP2 Data sets:

---

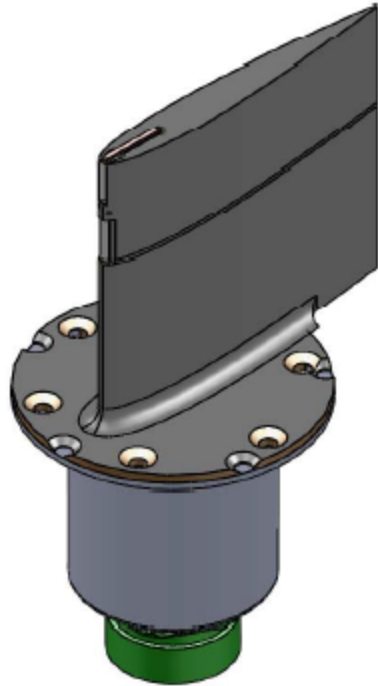
- Cayenne final data set distributed July-2016
  - Available on NCAR and LaMP archives
  - Data are 5 second centered-average data (should pick one value every 5 seconds – done this way to allow for phase shifting with other instruments)
- Darwin final data sets deposited on archives summer 2016
  - same data as first distribution, but 1 second data replaced by 5-second centered averages
  - Notification by email to the group about new data set
- Please do not use 1 second data. Because of overshoot problem, 1-second data probably contain misleading extreme values

# Belly hot-wire probes: 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

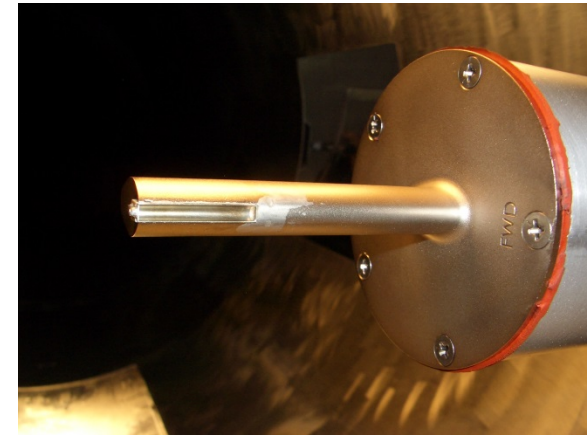
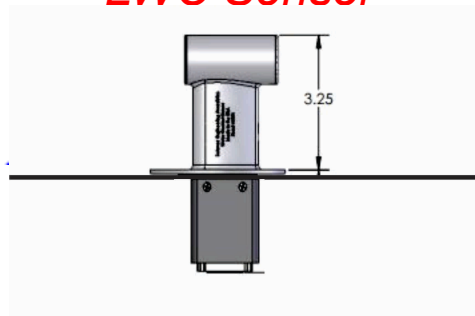
# Images of sensors:



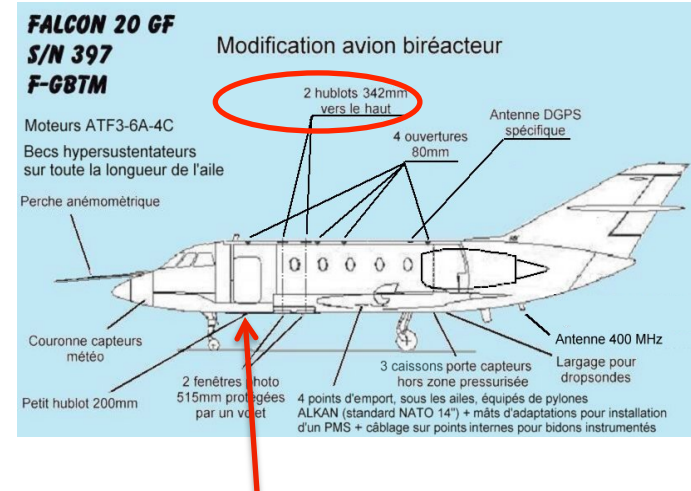
*Ice Crystal Detector Sensor*



*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
- Data delivered to FAA in October 2016. Not on archive yet as far as I know. Need to initiate this.

# 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
- At Toronto meeting, completion of IKP2 data and Appendix D analysis was made first priority. Decision to defer completion of hot-wire data sets.
- Post flight program processing not started yet. Only rough real-time estimates available



# 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  $-10\text{ C}$
- 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 ( $\sim 10\%$ , versus  $\sim 3\text{-}5\%$  in wind tunnels)

---

End of Presentation

Merci, Thank You

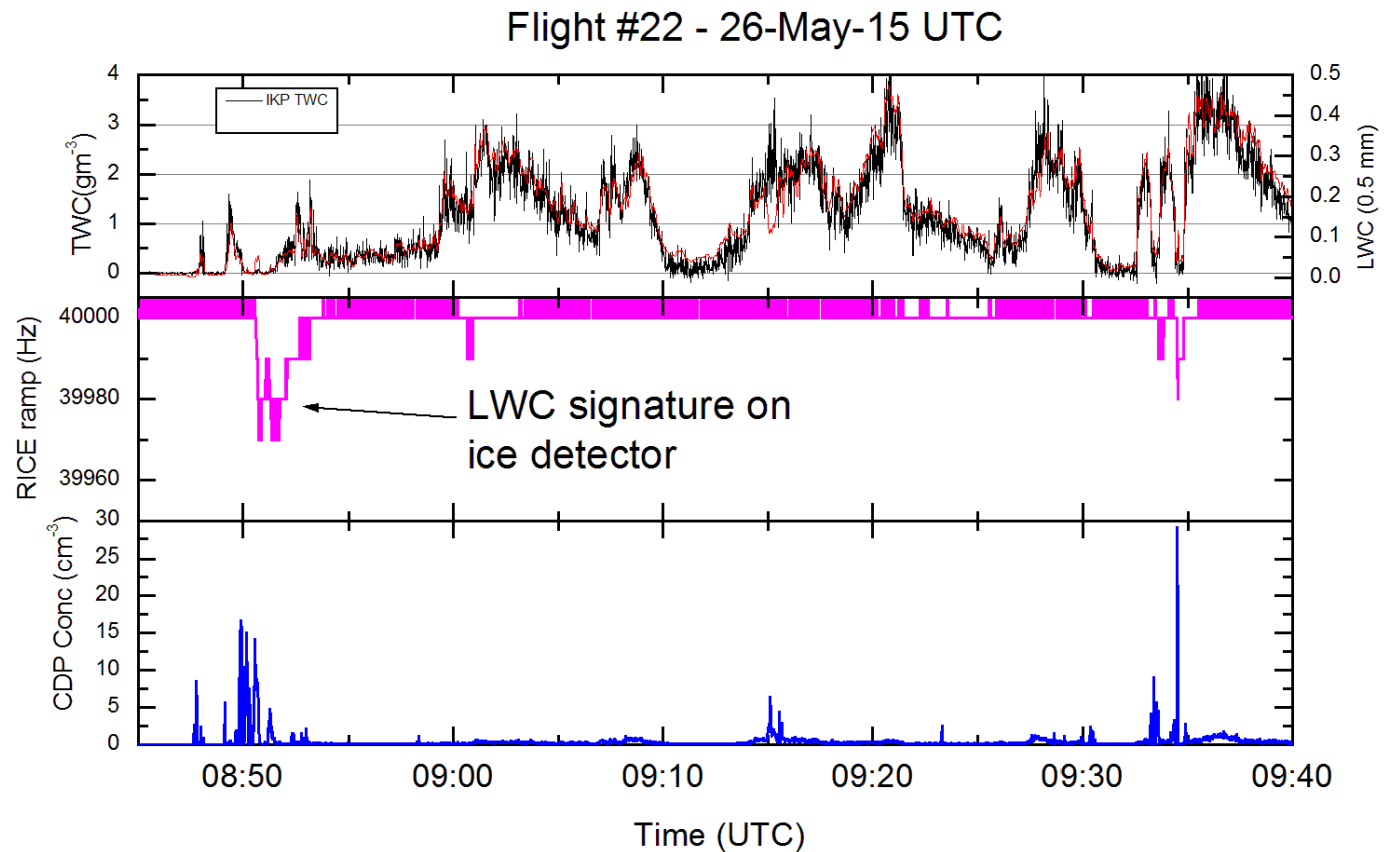
[lylel@scieng.com](mailto:lylel@scieng.com)

[walter.strapp@gmail.com](mailto:walter.strapp@gmail.com)

[thomas.p.ratvasky@nasa.gov](mailto:thomas.p.ratvasky@nasa.gov)

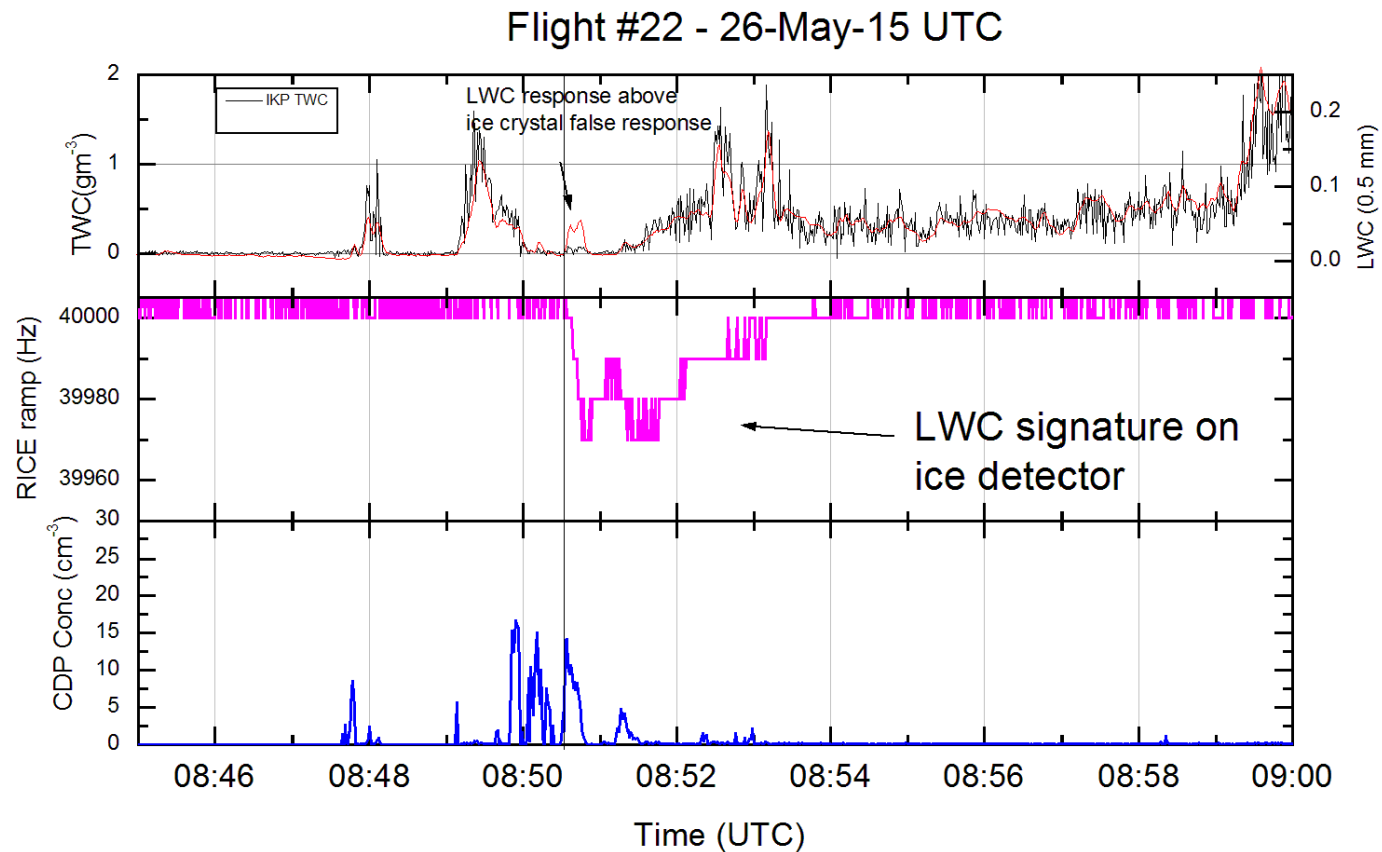
Spare slides

# Preliminary Observations CAY15:



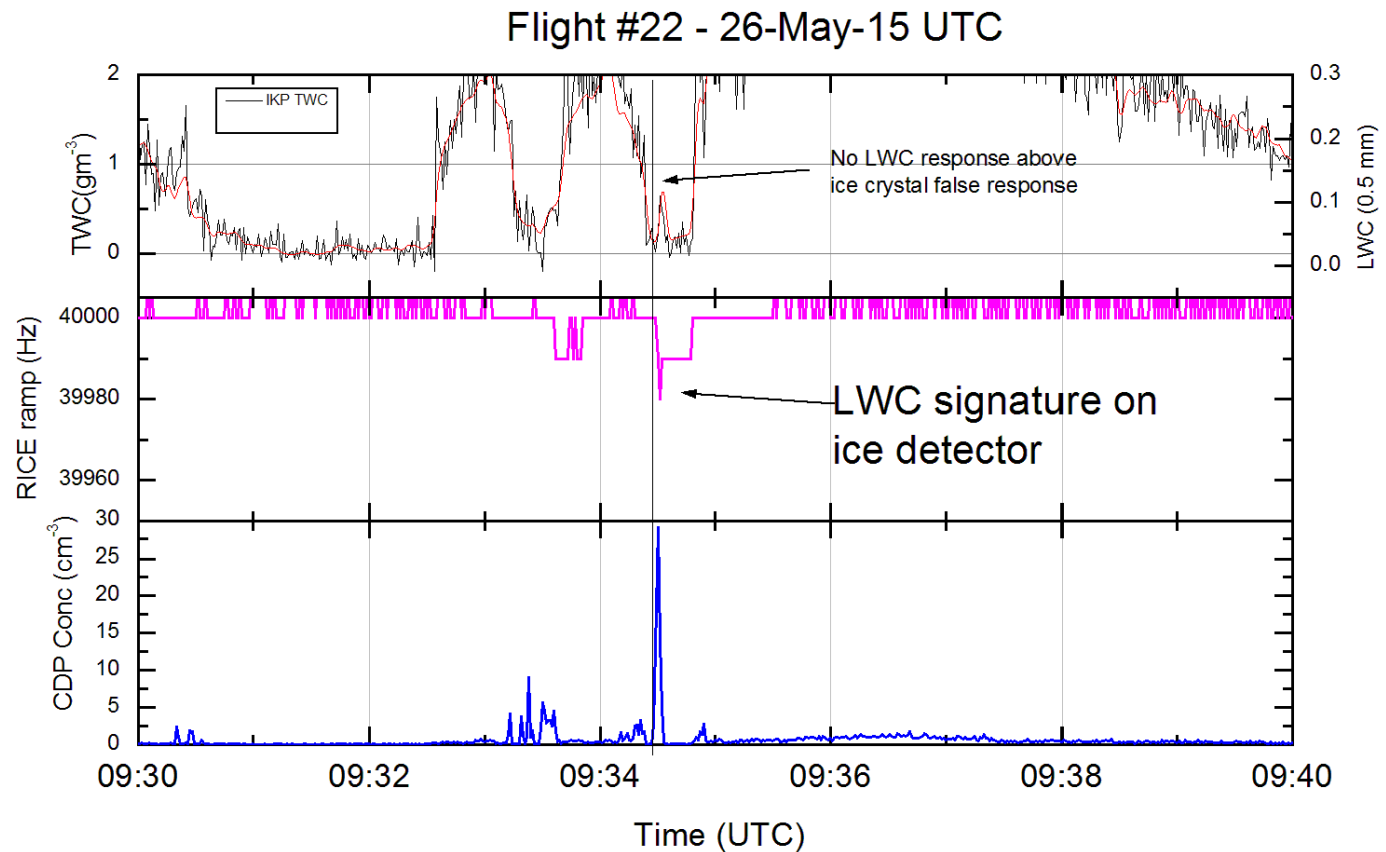
Note LWC trace top panel on a scale ~ 10 times more sensitive than IKP TWC

# Preliminary Observations:



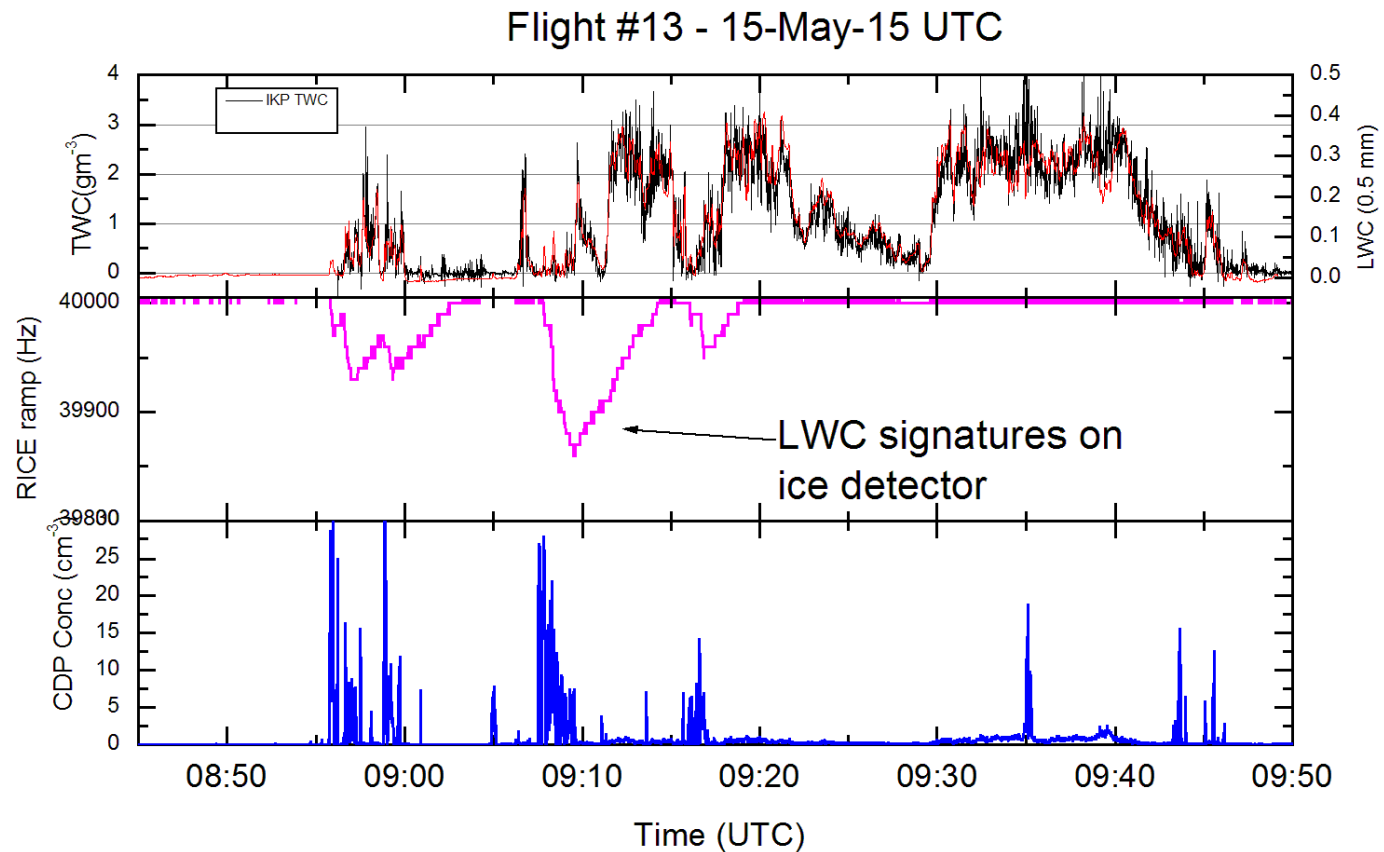
Note LWC trace top panel on a scale ~ 10 times more sensitive than IKP TWC

# Preliminary Observations:



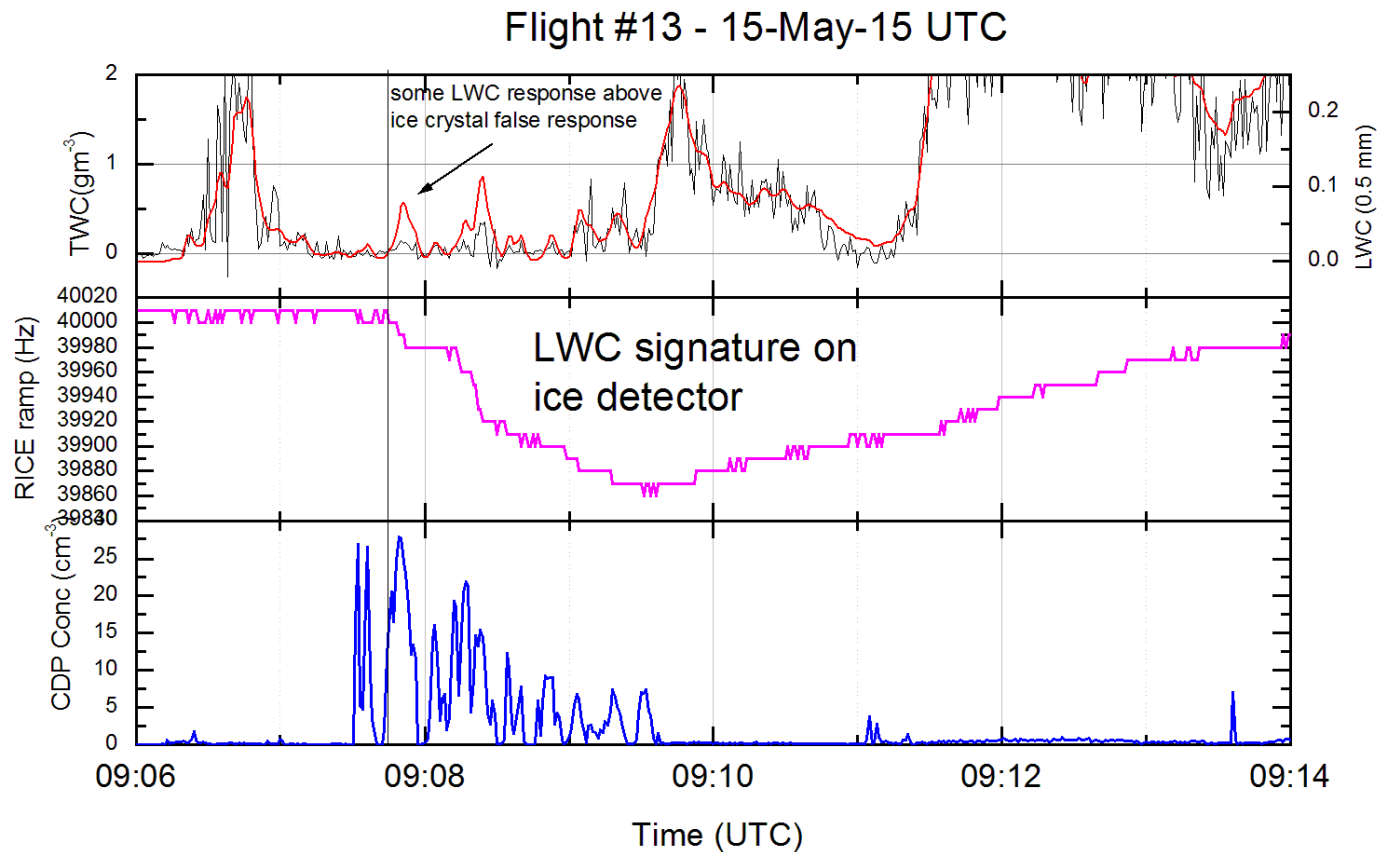
Note LWC trace top panel on a scale ~ 10 times more sensitive than IKP TWC

# 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



# 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  $\text{gm}^{-3}$  and ICD TWC  $\text{gm}^{-3}$  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