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*Supplement of*

## **A microphysics guide to cirrus – Part 2: Climatologies of clouds and humidity from observations**

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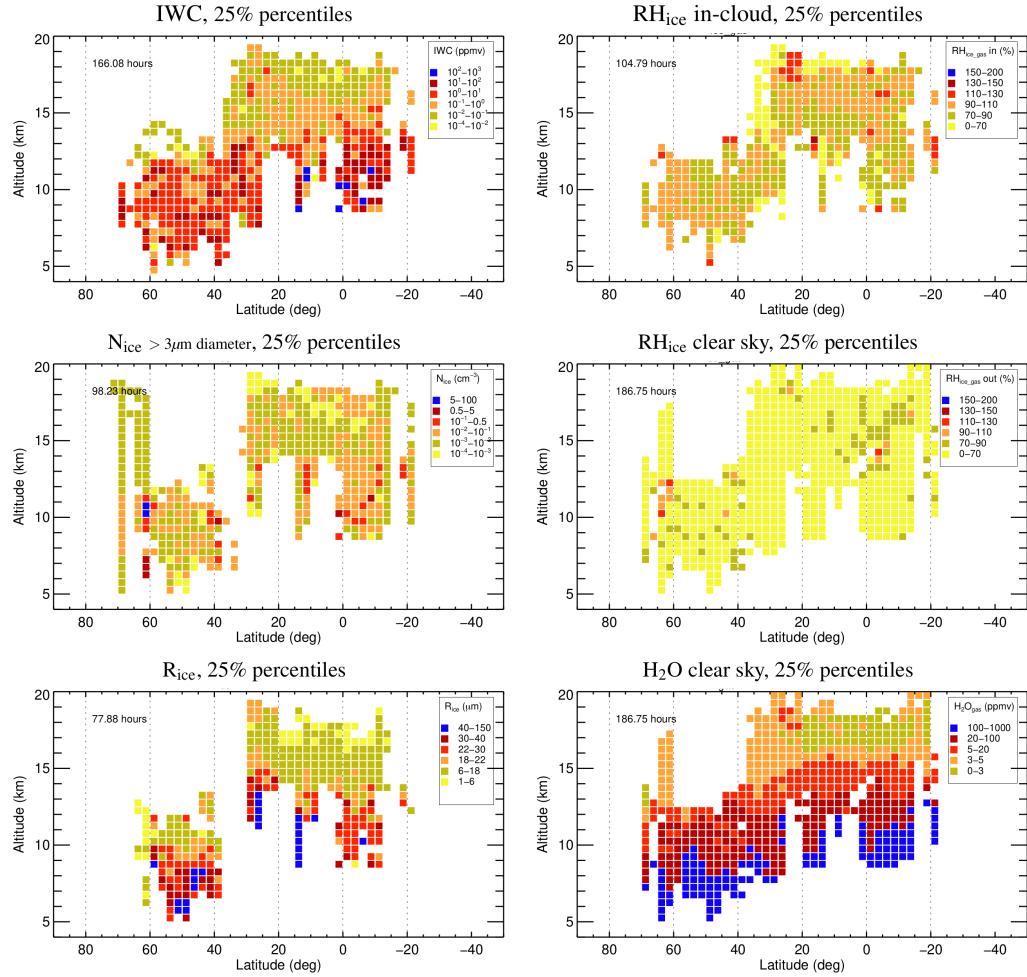
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The supplementary material contains 25, 50 (median) and 75% percentiles of in situ  $N_{ice}$ ,  $R_{ice}$  and  $RH_{ice}$  with respect to latitude and altitude (Figures S1 to S3) and in the temperature - IWC parameter space (Figure S4). In addition, the respective DARDAR-Nice percentiles in the temperature - IWC parameter space are presented (Figure S5).

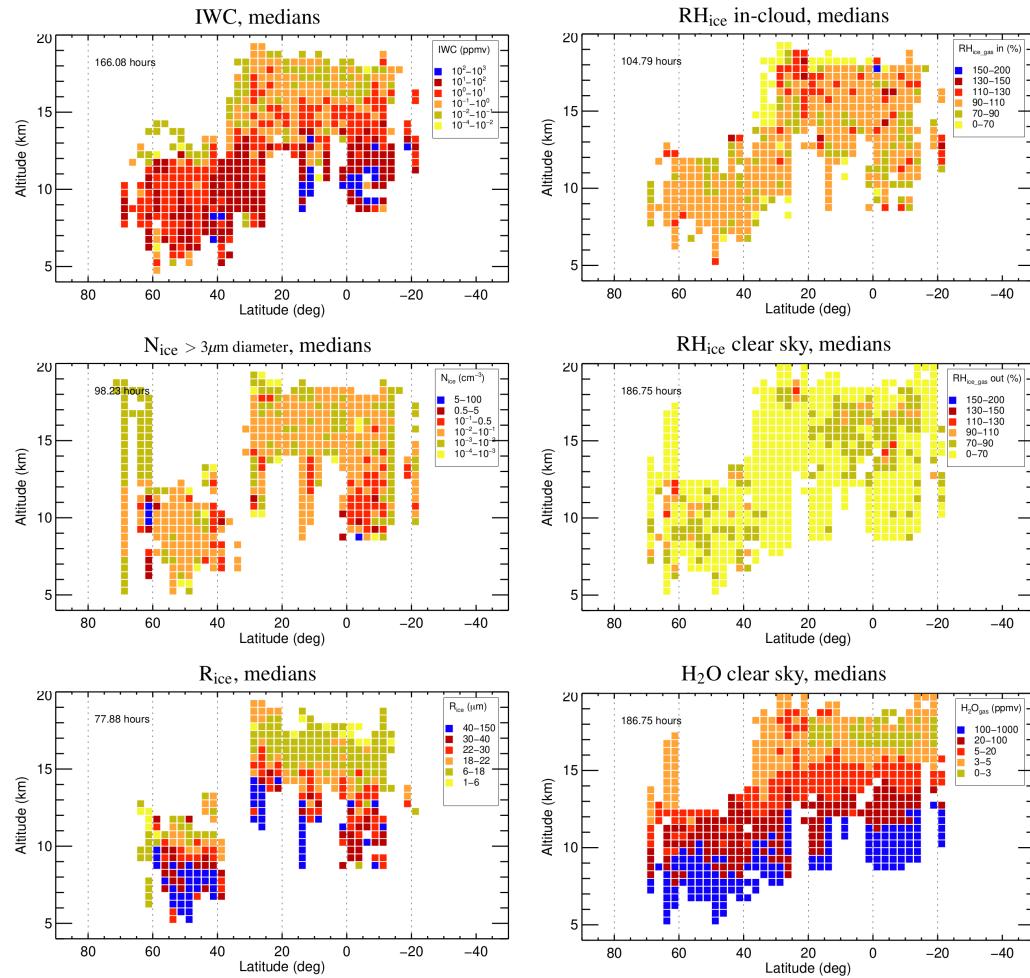
5 Also, an overview of the individual field campaigns of the Cirrus Guide II data set is compiled. In Figures S6 to S21, for each field campaign a plot of frequencies of occurrence in dependence on temperature, binned in 1K intervals (corresponding to Figure 7 of the Cirrus Guide II) is given for:

- Ice Water Content (IWC); in the plots the black solid/dotted lines represent the median, min/max IWC of the core IWC band, from Schiller et al. (2008)).
- 10 – Ice crystal number ( $N_{ice}$ ) for ice particle sizes  $> 3 \mu\text{m}$  diameter; the black lines in the plots are the 25, 50, 90%  $N_{ice}$  percentiles from the Cirrus Guide II in situ data set, see Figure 6 of Cirrus Guide II.
- 15 – Mass mean radius ( $R_{ice}$ ) calculated from  $\left(\frac{3 \cdot IWC}{4\pi\rho \cdot N_{ice}}\right)^{1/3}$  with  $\rho = 0.92 \text{ g/cm}^3$ ; black lines in the plots: 25, 50, 75%  $R_{ice}$  percentiles of the Cirrus Guide II in situ data set, see Figure 6 of Cirrus Guide II.
- In-cloud and clear sky relative humidity wrt ice ( $RH_{ice}$ ).
- Latitude - altitude distribution of IWC (as in Figure 3 of the Cirrus Guide II).

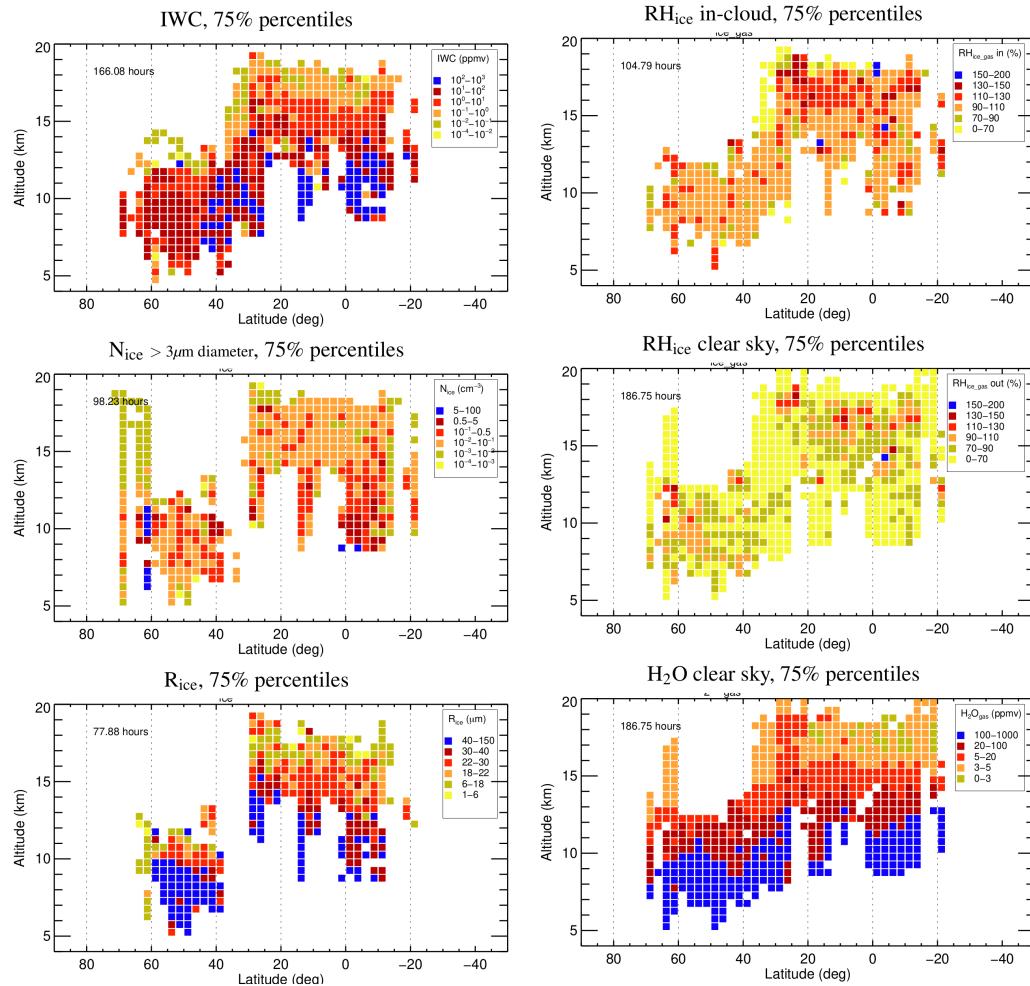
The field campaigns included in the data set are listed in Tables A1 and A2 of the Cirrus Guide II. Data evaluation methods and detection ranges of the parameters are described in Appendix A2. For 20 each campaign, the parameters available for the respective campaign, as listed in Table A2 of the Appendix A2, are shown.



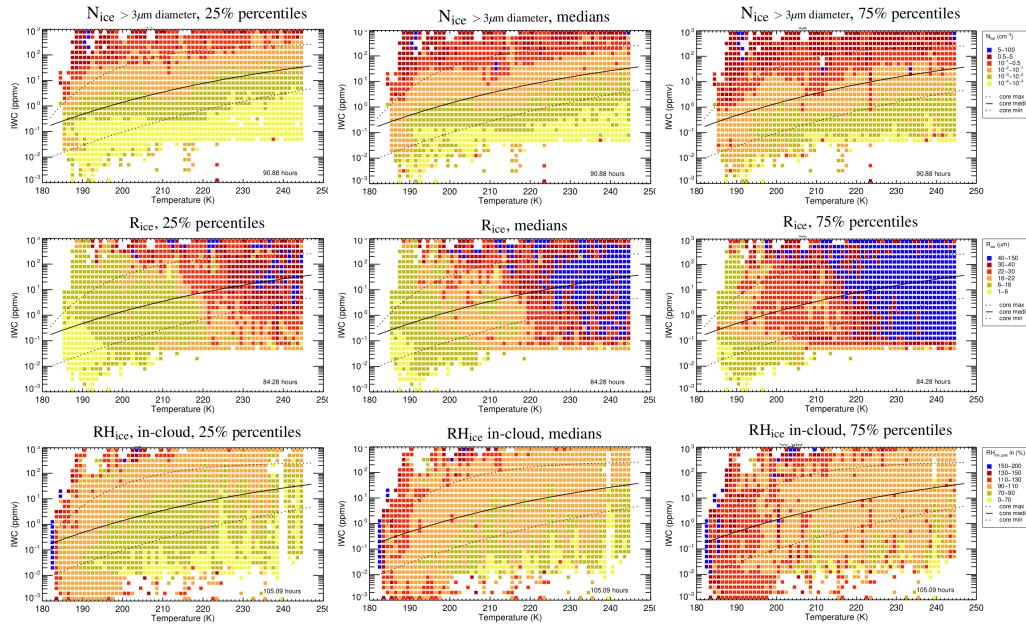
**Supplemental Material, Figure S1.** Latitude-altitude 25 % percentiles of cirrus and humidity.



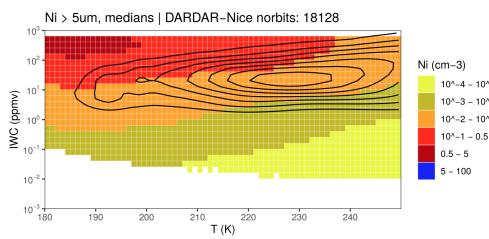
**Supplemental Material, Figure S2.** Latitude-altitude 50 % percentiles (medians) of cirrus and humidity.



**Supplemental Material, Figure S3.** Latitude-altitude 75 % percentiles of cirrus and humidity.



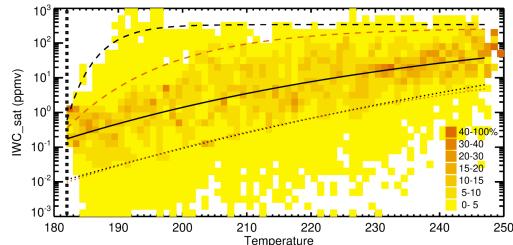
**Supplemental Material, Figure S4.** in situ 25, 50 (median) and 75 % percentiles of  $N_{\text{ice}}$ ,  $R_{\text{ice}}$ ,  $RH_{\text{ice}}$  in the IWC-T parameter space.



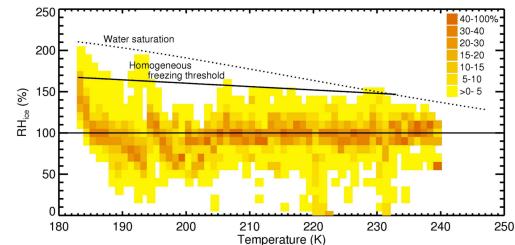
**Supplemental Material, Figure S5.** DARDAR-Nice 50 % (median) percentile of  $N_{\text{ice}}$  in the IWC-T parameter space. Densities of occurrence are indicated by plain isolines.

SCHILLER ET AL. (2008) & KRÄMER ET AL. (2009)

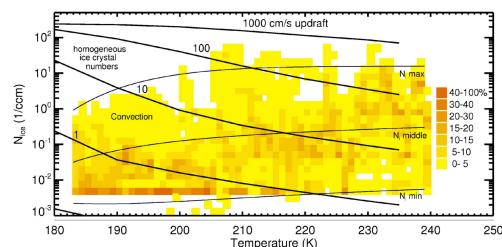
IWC



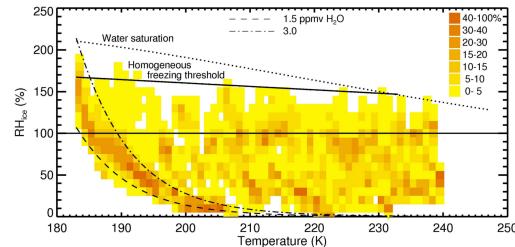
RH<sub>ice</sub> in-cloud



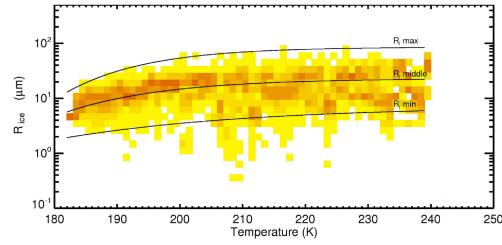
N<sub>ice</sub> > 3 μm diameter



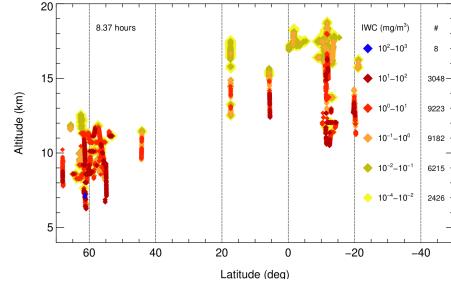
RH<sub>ice</sub> clear sky



R<sub>ice</sub>

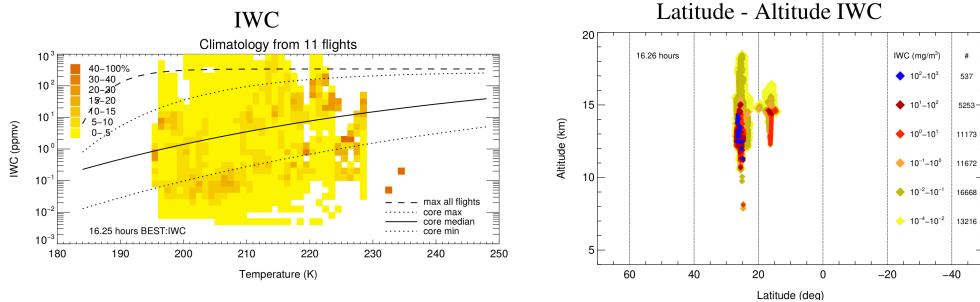


Latitude - Altitude IWC



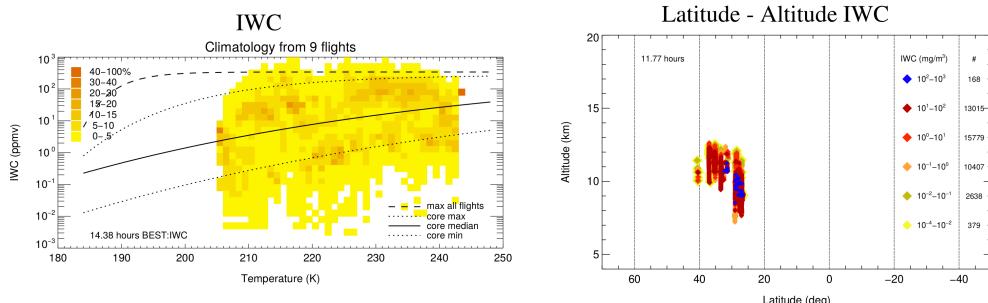
**Supplemental Material, Figure S6.** Summary of 10 field campaigns that are listed in the following: Ape Thesoo 1999 (Geophysica), Envisat 2002-2 (Geophysica), Envisat 2003-1 (Geophysica), Envisat 2003-2 (Geophysica), Euplex 2003 (Geophysica), Cirrus 2003 (GFD Learjet), Cirrus 2004 (GFD Learjet), Scout 2005 (Geophysica), Troccinox 2005 (Geophysica), Cirrus 2006 (GFD Learjet); the frequency plots are adapted from Schiller et al. (2008) and Krämer et al. (2009); same as Figure 7 of Cirrus Guide II.

## CRYSTAL-FACE 2002



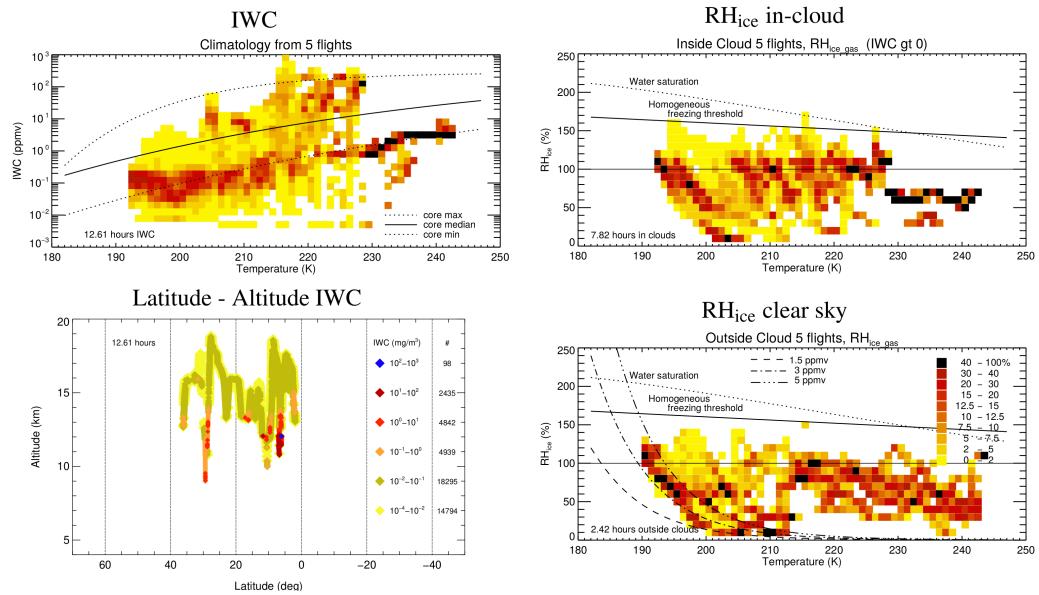
**Supplemental Material, Figure S7.** CRYSTAL-FACE, July - August 2002, WB-57, Florida, USA,  
<https://espo.nasa.gov/crystalface>.

## MIDCIX 2004



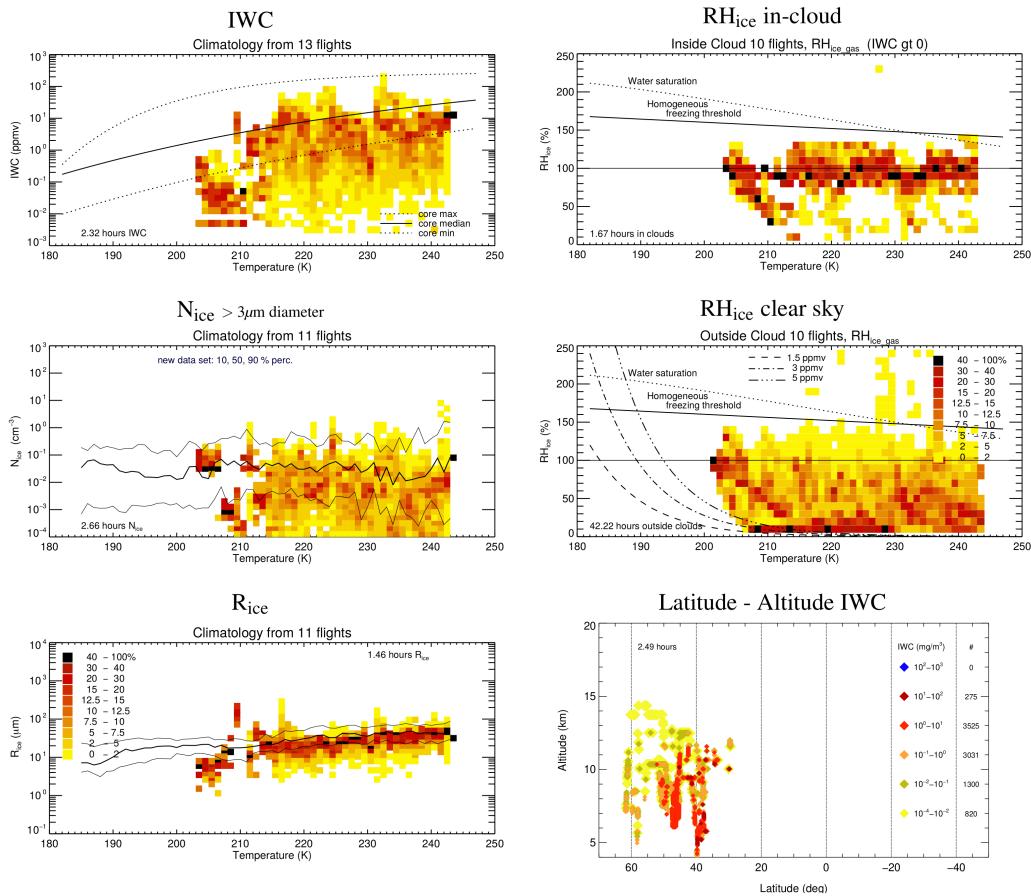
**Supplemental Material, Figure S8.** MidCiX, April - May 2004, WB-57, Houston, USA;  
<https://espoarchive.nasa.gov/archive/browse/midcix/WB57>; Luebke et al. (2013)

### TC4 2007



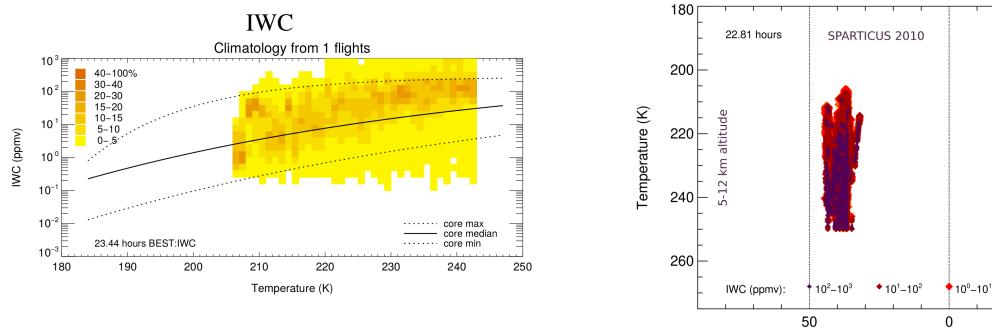
**Supplemental Material, Figure S9.** TC4, July 2007, WB-57, San José, Costa Rica;  
<https://cloud1.arc.nasa.gov/tc4>; Jensen et al. (2009).

## START 08



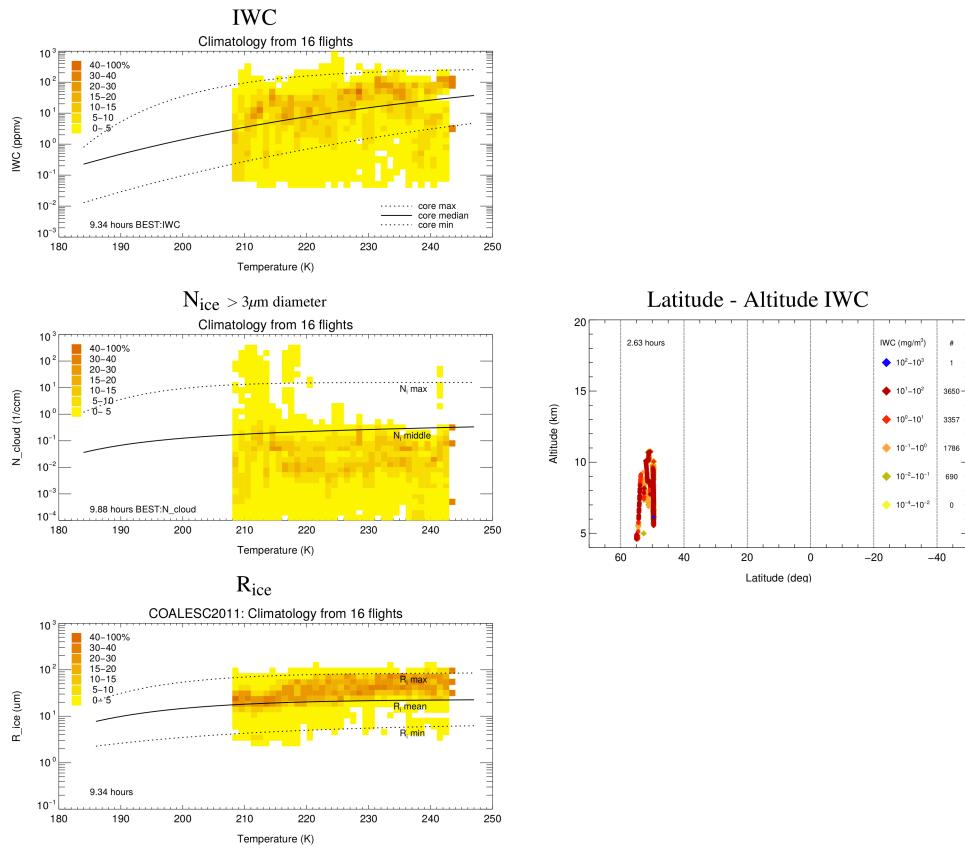
**Supplemental Material, Figure S10.** START 2008, April - June 2008, GV HIAPER, Boulder, USA;  
<https://www.acom.ucar.edu/start>; Pan et al. (2010).

## SPARTICUS 2010



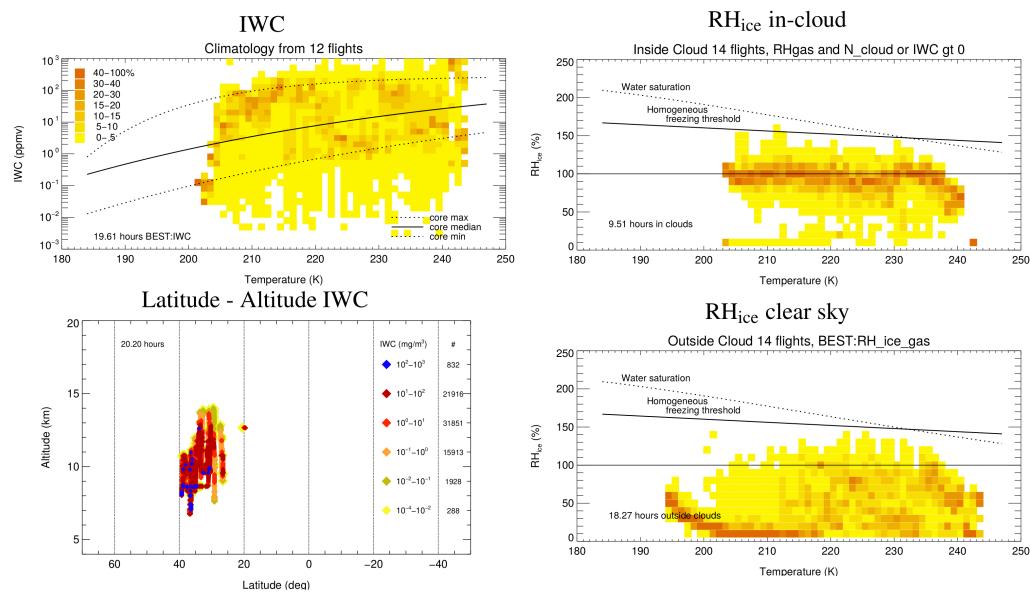
**Supplemental Material, Figure S11.** SPARTICUS, March - April 2010, SPEC Learjet, Boulder, USA; Muhlbauer et al. (2014); Jackson et al. (2015)

## COALESC 2011



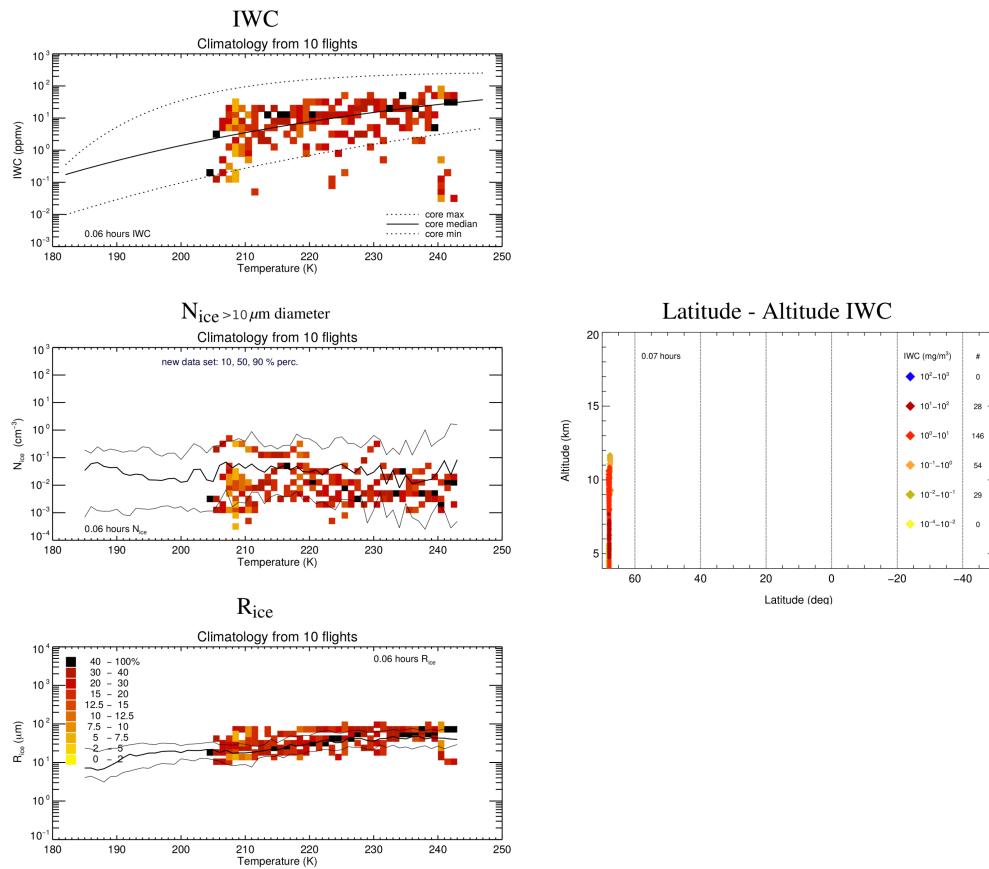
**Supplemental Material, Figure S12.** COALESC, February - March 2011, Exeter, UK, BAE-146; <https://catalogue.ceda.ac.uk/uuid/43346eb0a2e54ef2fb544862b38b018>; Jones et al. (2012).

### MACPEX 2011



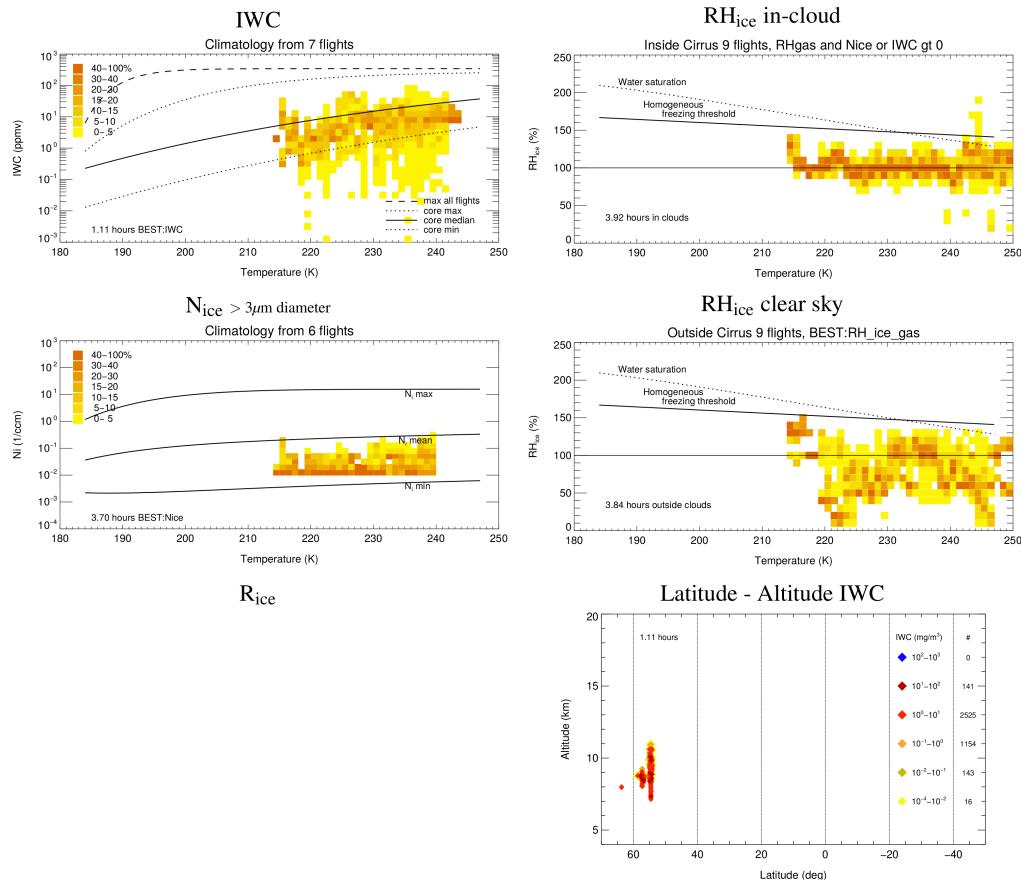
**Supplemental Material, Figure S13.** MACPEX, March - April 2011, WB-57, Houston, USA;  
<https://espo.nasa.gov/macpex/content/MACPEX>; Jensen et al. (2013); Luebke et al. (2013).

### LTU 2012-2018



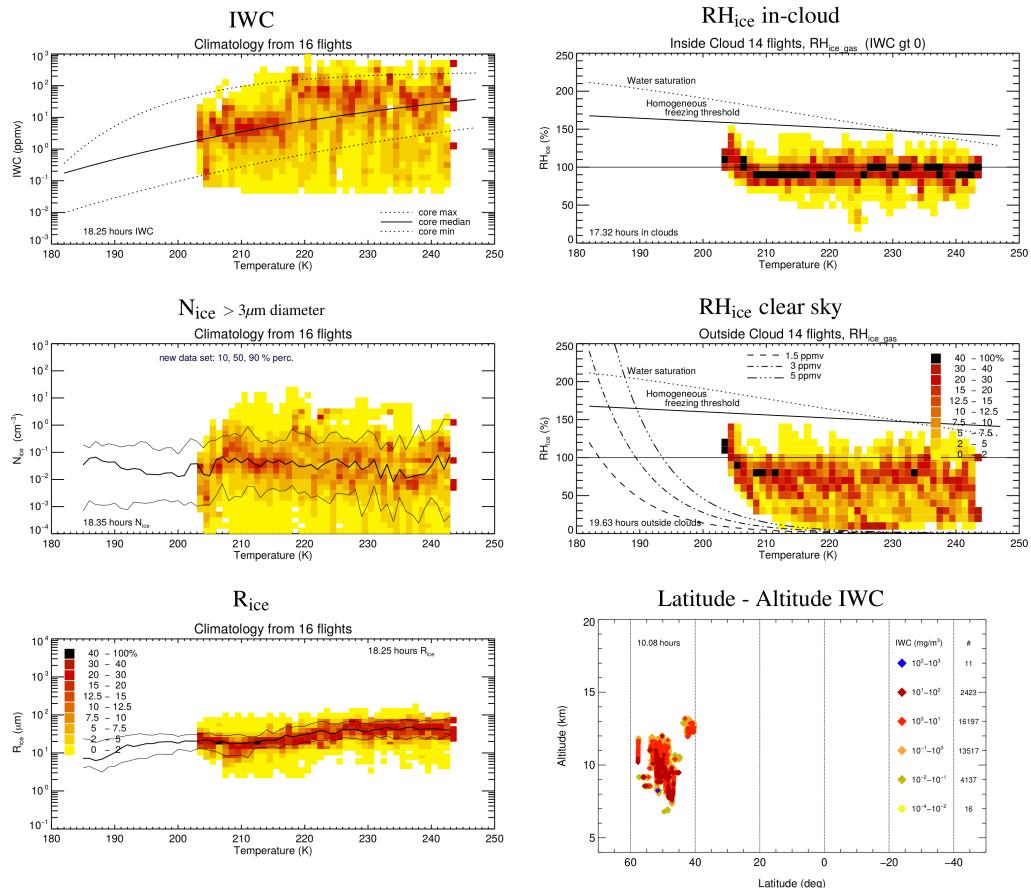
**Supplemental Material, Figure S14.** Balloon borne measurements 2012-2018 (Wolf et al., 2018, 2019).

## AIRTOSS 2013



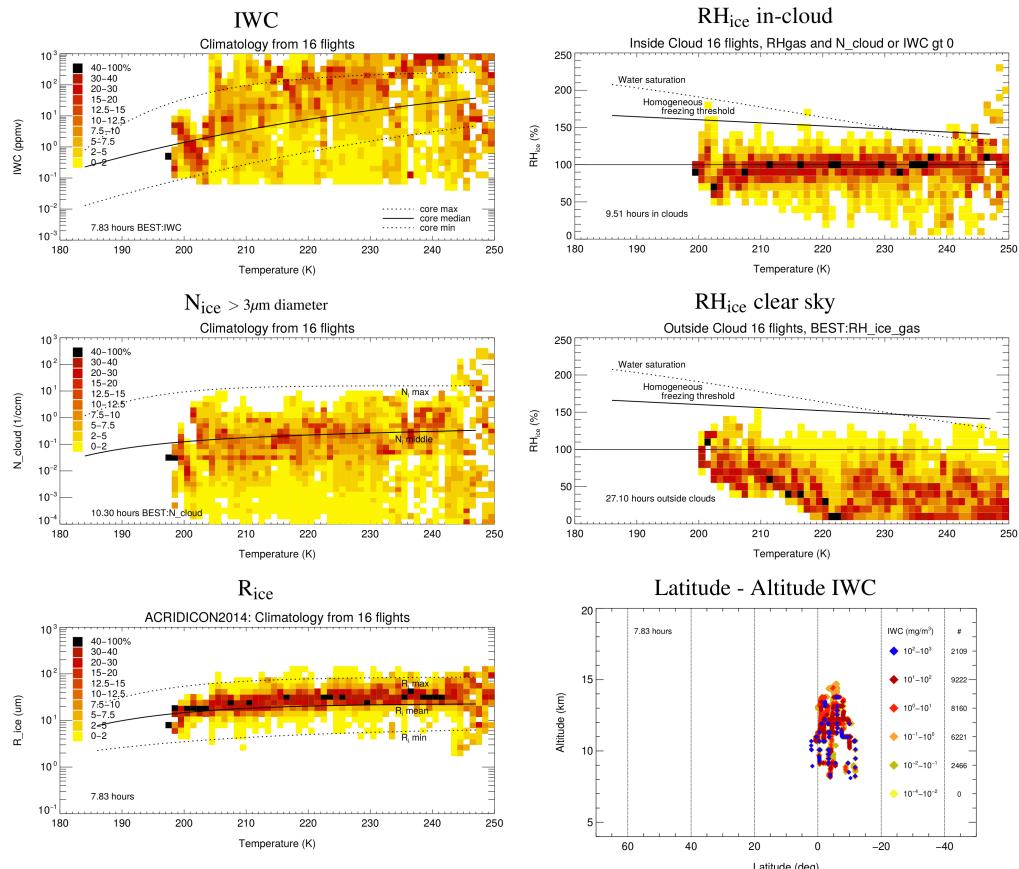
**Supplemental Material, Figure S15.** AIRTOSS-ICE, September 2013, GFD Learjet, Hohn, Germany;  
<https://www.ipa.uni-mainz.de/airtoss-ice-2013>; Finger et al. (2015).

## ML-CIRRUS 2014



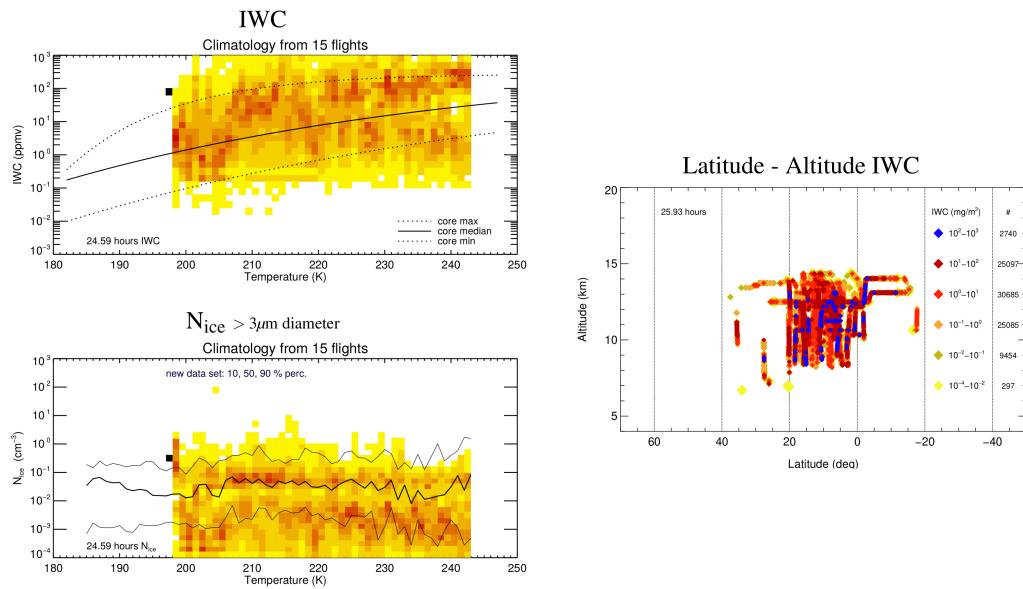
**Supplemental Material, Figure S16.** ML-CIRRUS, March -April 2014, Oberpfaffenhofen, Germany, HALO;  
<http://www.pa.op.dlr.de/ML-CIRRUS>; Voigt et al. (2017).

## ACRIDICON 2014



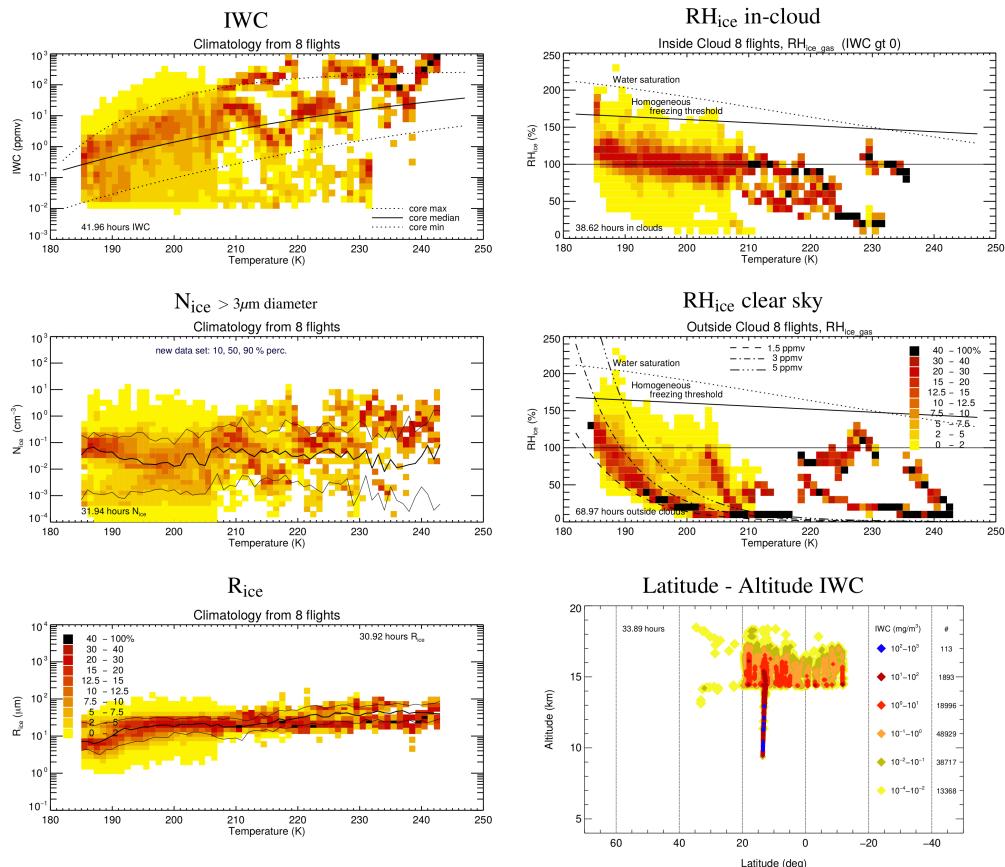
**Supplemental Material, Figure S17.** ACRIDICON-CHUVA, September-October 2014, Manaus, Brazil, HALO; <http://meteo.physgeo.uni-leipzig.de/acridicon-chuva> Wendisch et al. (2016).

## CONTRAST 2014



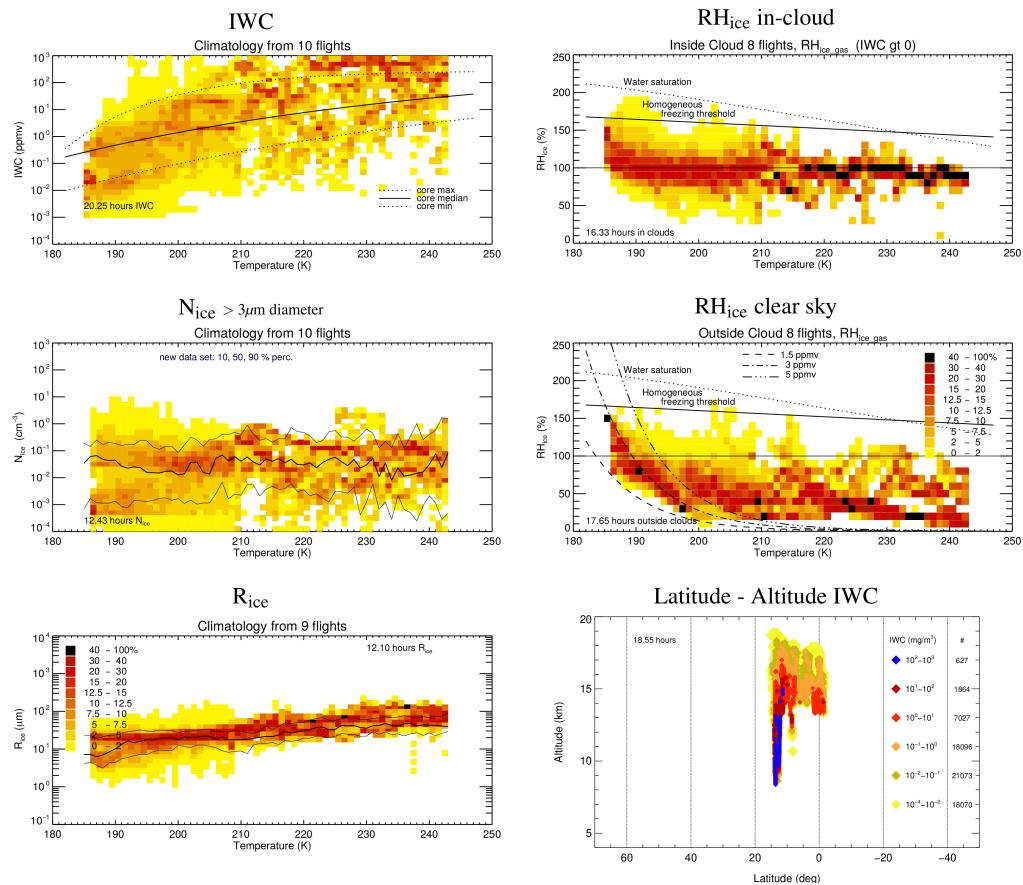
**Supplemental Material, Figure S18.** CONTRAST, January - February 2014, Guam, GV HIAPER;  
<https://www2.acom.ucar.edu/contrast>; Pan et al. (2017).

## ATTREX 2014



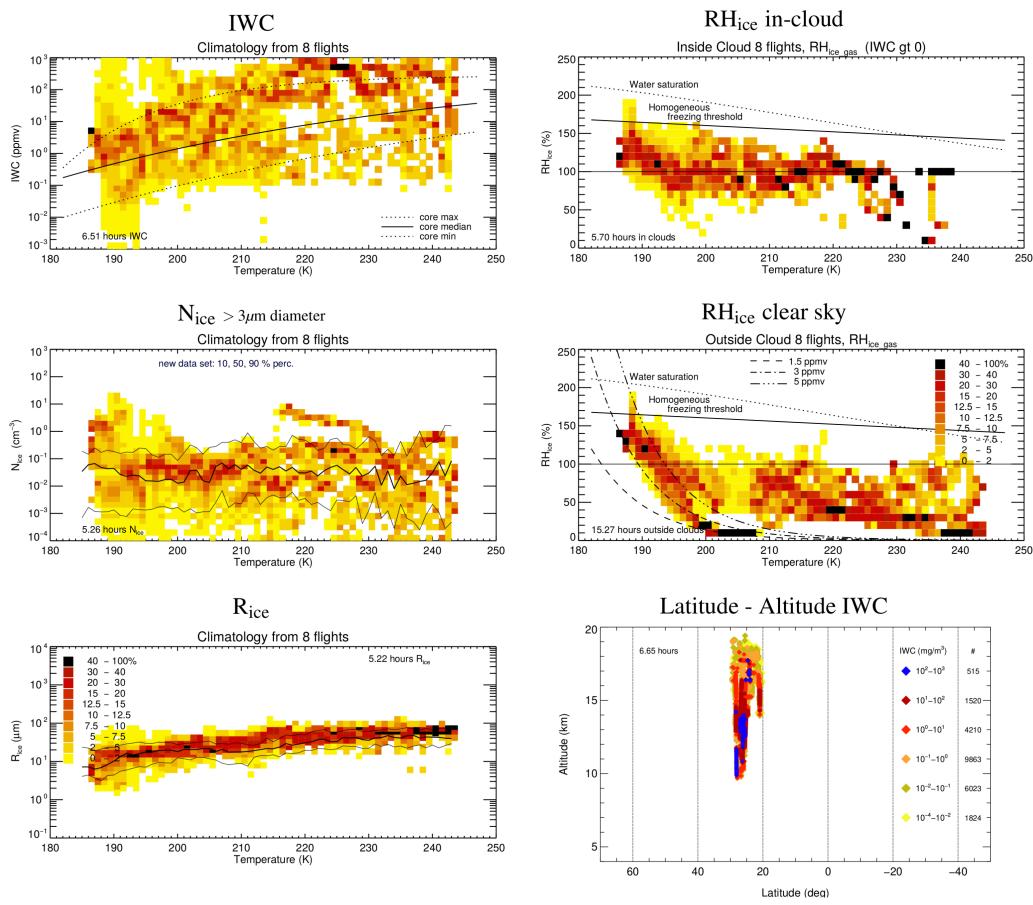
**Supplemental Material, Figure S19.** ATTREX, January - March 2014, Guam, Global Hawk;  
<https://espo.nasa.gov/attrex>; Jensen et al. (2017).

## POSIDON 2016



**Supplemental Material, Figure S20.** POSIDON, October 2016, Guam, WB-57; <https://espo.nasa.gov/posidon>.

## STRATOCLIM 2017



**Supplemental Material, Figure S21.** StratoClim, July - August 2017, Khatmandu, Nepal, Geophysica;  
<http://www.stratoclim.org>.

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