

# 2<sup>nd</sup> HAIC-HIWC Satellite & Nowcasting Workshop

Assembled by

Eric Defer, CNRS; Julie Haggerty, NCAR



## Satellite & Nowcasting Workshop Toronto 18 May 2016

Analysis of the HAIC/HIWC campaigns

# HAIC/HIWC Satellite & Nowcasting Workshop

## Agenda

Wed 18	Program
09:00	Welcome and Adoption of the Agenda [EDe, JHa]
09:05	Context and objectives of the workshop [EDe, JHa]
9:15	Brief review of each group's approach to satellite detection or nowcasting of HIWC [all]
9:45	Review of ECCC nowcasting research [Howard Barker]
10:15	Results from Darwin case I (23 Jan 2014) [all]
10:45	Results from Darwin case II (17 Feb 2014b) [all]
11:00	break
11:15	Results from Cayenne case I (16 May 2015) [all]
11:45	Results from Cayenne case II (23 May 2015) [all]
12:15	<i>Adjourn for lunch</i>
13:15	Discussion, opportunities for collaboration, next steps
14:30	<i>Adjourn</i>

# HAIC/HIWC Satellite & Nowcasting Workshop

## List of Attendees (in-person and remote participation)

<b>Team</b>	<b>Name</b>
NCAR	J. Haggerty
FAA	T. Bond, S. Di Vito
HAIC	J. De Laat (KNMI), E. Defer (CNRS-LA), J. Delanoë (CNRS-LATMOS), A. Grandin (Airbus), Remote : S. Desbios (Météo-France), A. Gounou (Météo-France), J.-M. Moisselin (Météo-France)
Met Office	P. Francis, C. Bartholomew
NASA LaRC	C. Yost, L. Ngyuen, P. Minnis, K. Bedka
ECCC	A. Korolev, H. Barker

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- **It is currently assumed that deep tropical convection is not** always a threat for aviation, only specific clouds **are, and they are supposed to be constituted of a high concentration of small ice particles**
- If the hypothesis is confirmed **by in situ observations of cloud microphysics and if a signature of hazardous clouds is identified in available space-based observations**, real-time monitoring **of hazardous clouds should then be possible**
- Space-based remote sensing **then seems to be** one of the appropriate detection/awareness techniques, **the other ones being upgraded/new in-situ probes and close-range sensitive weather radar detection on-board the commercial aircraft, to enhance flight safety when flying in such weather conditions**
- Two projects with common interests and activities:
  - ▶ **HAIC : High Altitude Ice Crystals (Europe)**
  - ▶ **HWC : High Ice Water Content (USA)**

- Investigate the HAIC & HIWC satellite-based products for a series of HAIC-HIWC flights (Darwin 2014; Cayenne 2015)
- Discuss on the cases and on the behaviors of the HAIC & HIWC satellite-based products
- Define fair verification methods
- Apply the verification methods to the studied cases
- Assess the performances of HAIC & HIWC satellite-based products
- Identify strengths and weaknesses
- Identify the need or not for further studies
- Keep an eye on HAIC 2016 campaign, HIWC Radar Study follow-on
- Strengthen the collaboration between the two teams
- Way forward, opportunities for collaboration

# HAIC/HIWC Satellite & Nowcasting Workshop

## Brief Review of Each Group's Approach to Satellite Detection or/and Nowcasting of High IWC

**Purpose: each group reminds the audience of what they are doing with 1-3 prepared slides.**

- HAIC (KNMI, CNRS, Météo-France, Airbus)
  - Detection from GEO missions
  - Detection from LEO missions
  - Satellite-based nowcasting
- UK MetOffice activities
- HIWC (NCAR, NASA LaRC, ECCC)
  - Blended diagnosis and nowcasting methods (NCAR)
  - Satellite-based nowcasting (NASA)
  - Model-based nowcasting/forecasting (ECCC)

# HAIC/HIWC Satellite & Nowcasting Workshop

## Cases to Analyze

Campaign	Date	Lat range	Lon range	Time range (UTC)
Darwin 2014	23 Jan 14 <sup>(1)</sup>	16S-12S 20S-10S	127E-132E 122E-134E	17:00-24:00
	17 Feb 14 b	13S-10S	126E-132E	19:00-02:00
Cayenne 2015	16 May 15 <sup>(2)</sup>	2N-5N	55W-51W	14:30-19:30 <i>(revised from previous version)</i>
	23 May 15 b <sup>(3)</sup>	3N-9N	58W-51W	14:30-20:00 <i>(revised from previous version)</i>

- (1) TRMM overpass
- (2) CloudSat/CALIPSO overpass
- (3) MODIS overpass

- For each case
  - Show satellite products and nowcasting images for the geographic range and time period listed in the previous table
    - Images for 2D comparison
    - Time series plots of product compared to in situ IWC (see next slide)
    - Recognize that each system produces a unique indicator of HIWC (e.g., yes/no indicator of convection, HIWC likelihood estimate, IWC value, etc.) and do your best to create the above graphics
  - Discuss the case from the perspective of your product/method (consistency, anomalies, weaknesses...)
  - Extract the satellite-based product/nowcasting data along the track of the aircrafts and store the information in an ASCII file
    - Bring the ASCII files during the workshop if possible
    - Overlay the plots of your parameters as a function of time per 10-min segment for comparison with RASTA profiles (see next slide) or isokinetic probe IWC values.
      - Use provided aircraft flight information to retrieve time and location of the flight track



# HAIC/HIWC Satellite & Nowcasting Workshop D 2014 – 23 January 2014 Case Description

<b>Date</b>	<b>23 January 2014</b>
<b>Campaign</b>	Darwin
<b>Weather situation</b>	[NCAR Cat]. Monsoon trough extends from the north Kimberly coast to the top end north coast. There was a convective blowup over the north Kimberly coast overnight, with enough lightning suggesting a possible target.
<b>High IWC encounter</b>	[NCAR Cat]. Good measurements of HIWC region over north Kimberly coast. At 22:35 UTC, 2.3 g/m <sup>3</sup> of ice water content was detected, and 2 g/m <sup>3</sup> were detected over a large area.
<b>Flight times</b>	F20 – 20:11-23:20 UTC
<b>Instrument issues</b>	Questions about Li-Cor background and ice detector performance

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- **Quick description of the actual products of each group (i.e. Images & time series)**
- **Comparison of products**
- **Discussion of sensitivity of products to cloud regions sampled by the planes**
- **Discussion of observations in other cloud regions not samples by the planes but described by remote sensing data**

# HAIC/HIWC Satellite & Nowcasting Workshop D 2014 – 17 February 2014 b Case Description

Date	17 February 2014 b
Campaign	Darwin
Weather situation	Exploration of convective cells west of Darwin, large area of convection on the Darwin side of Broome. A strong monsoonal flow has redeveloped across the northern Top End producing heavy rainfall along the west coast with 24hr totals in excess of 100mm. There has been one relatively long lived MCS just off the coast of Darwin with other short lived deep convective cells in the adjacent areas.
High IWC encounter	Sustained TWC of around 2 g/m <sup>3</sup> , peaking at 2.5 g/m <sup>3</sup> .
Flight times	F20 – 21:43-01:01 UTC
Instrument issues	Replace CDP probe head before flight

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# HAIC/HIWC Satellite & Nowcasting Workshop C 2015 – 16 May 2015 Case Description

Date	16 May 2015
Campaign	Cayenne
Weather situation	Cloudsat overpass - land based convection over French Guiana
High IWC encounter	Multiple encounters with IWC of 1-2 g/m <sup>3</sup>
Flight times	F20, Convair – 15:20-18:30 UTC
Instrument issues	Not reported

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# HAIC/HIWC Satellite & Nowcasting Workshop C 2015 – 23 May 2015 b Case Description

Date	23 May 2015 b
Campaign	Cayenne
Weather situation	Oceanic Convection off Suriname - coordinated sampling
High IWC encounter	Sustained period of HIWC up to 4 g/m <sup>3</sup> (16:00-16:30 UTC)
Flight times	F20, Convair, HWL – 15:30-19:15 UTC
Instrument issues	Not reported

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- Do we have fair verification methods ?
- Assess the performances of HAIC & HIWC satellite-based products
- Identify strengths and weaknesses
- Identify the need or not for further studies
- Required actions?
- Future plans for each team; funding status

- Pursue the analysis...
- ...

# HAIC/HIWC Satellite & Nowcasting Workshop

## Way Forward

- Agreed Upon Activities
- Comparison study set from Cayenne cases for satellite/nowcasting products
  - ▶ Three sources of IWC: IKP (flight level), RASTA (IWCmax), RASTA (IWCmax @ Z > FL270), values averaged on 20-second period; find average first, then extract IWCmax. Note: need to discuss average method (volumes?) for RASTA
  - ▶ Consider in-cloud and transit legs to ascertain false alarm rate
  - ▶ Plot time series on the same chart and overlay contours of the products on same satellite image (for specific legs or times)
    - Parameters; provide from runs before and after in situ measurements
      - ALPHA: yes/no parameter, intermediate interests
      - KNMI: in/out of cell, TWP
      - RDT: in/out
      - Calculate time delay between satellite and in situ measurements at the pixel scale (Eric)
  - ▶ Time stamped on the center of the 20-sec time window
- Identify cases to study (including the Golden case) through the NCAR field catalog for different types of cases (in situ IWC values, in-cloud/transit legs) (Julie propose 3-4 cases with multiple cases, agreement by end of Dec)
- Target date: March 2016; monthly teleconferences to organize (beginning in early Dec).
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# Way forward...

- Part 2
- Verification
  - ▶ Teleconference with J. Delanoe and A. Protat on the use of RATA and DARDAR products as references for the verification
  - ▶ Add special item on verification strategy during each next HAIC-HIWC-Sat teleconference
- Blind test
  - ▶ (Alice, 8-10 cases based on events) at a set of locations within ALPHA , CPP, and RDT domains, include null flight tracks in region; after upgrades to algorithms based on prior verification
  - ▶ MOZAIC/IAGOS cases (Eric)
- Workshop in March