Presented by

F. Dezitter (AI-F)

Prepared by

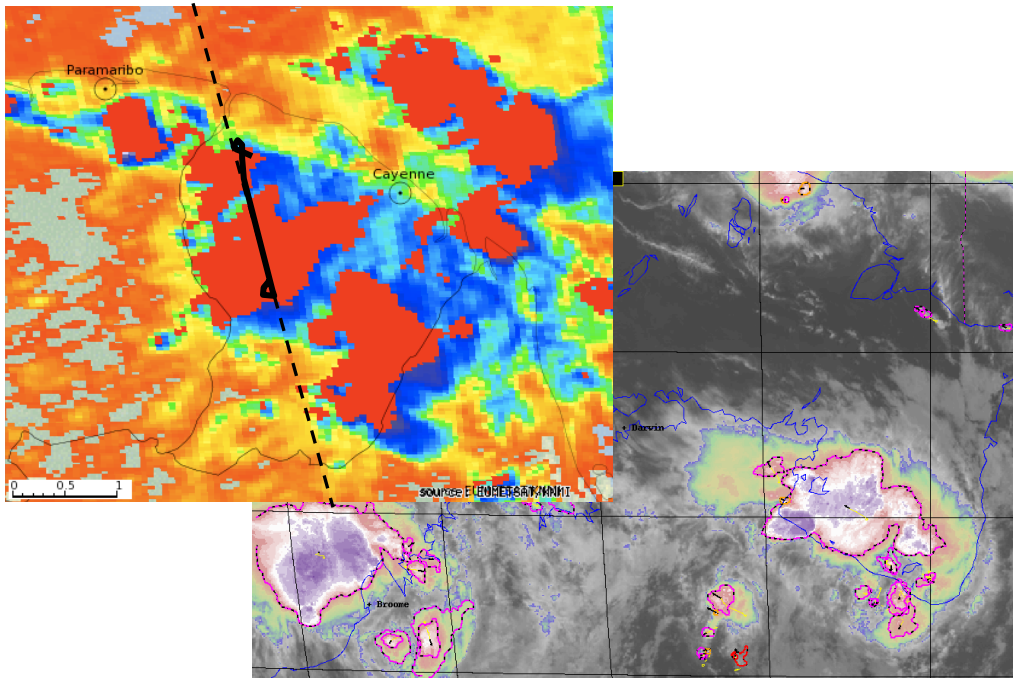
J.-L. Brenguier (MET-FR), J. De Laat (KNMI), E. Defer (CNRS), J. Delanoë (CNRS), F. Dezitter (AI-F), M. Faivre (CNRS), A. Gounou (MET-FR), A. Grandin (AI-F), J. F. Meirink (KNMI), J.-M. Moisselin (MET-FR), F. Parol (CNRS), S. Turner (ATMOSPHERE), C. Vanbauce (CNRS)

HAIC-HIWC Science Meeting 9-12 November 2015 BoM, Melbourne, Australia

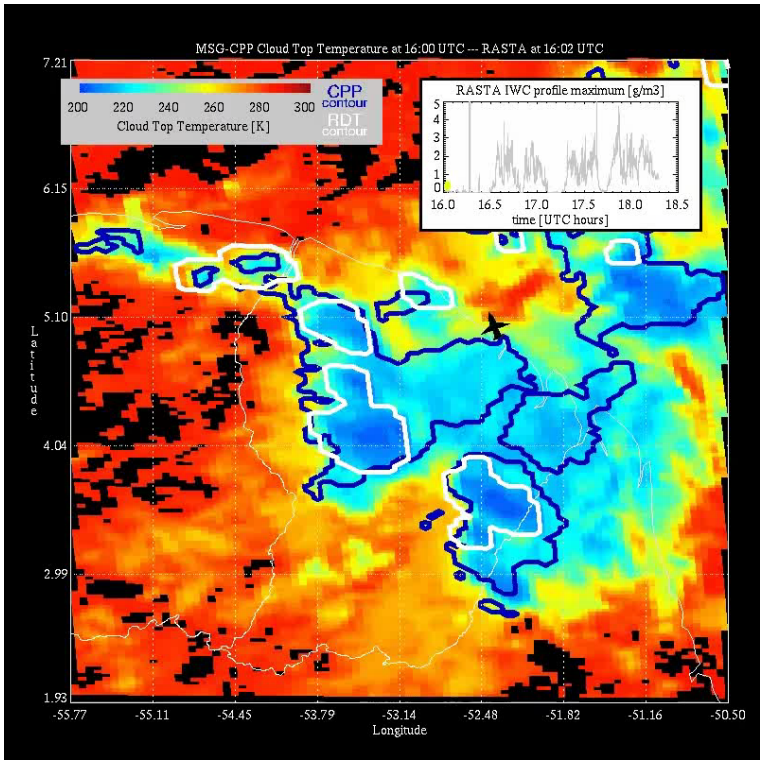
SP3: SPACE-BORNE OBSERVATION & NOWCASTING OF HIGH IWC REGIONS

High Altitude ice Crystals
Objectives & Main achievements

To develop **space-borne remote detection and nowcasting techniques** to support the flight test campaigns and ultimately provide near real-time weather data through ATM as being studied as part of SESAR.



KNMI High IWC mask & MET-FR Rapid Development Thunderstorm products



➢ **HAIC TRL5 gate review successfuly achieved**

High Altitude Ice Crystals
CPP (Cloud Physical Properties) products

Technology Overview

Object:

Detection of high ice water content (High IWC) situations derived from geostationary satellite imagers, in particular the MSG-SEVIRI instrument.

Change:

Currently, no such High IWC detection product exists.
The product does build on general cloud property retrieval techniques that have been developed over the past decades.

Key Requirement:

The key requirement is a successful detection of High IWC occurrence. This is expressed in terms of POD (probability of detection) and FAR (false alarm rate).
The threshold IWC to be detected remains to be fine tuned (1g/m3 considered so far).

Limitations:

Day time product

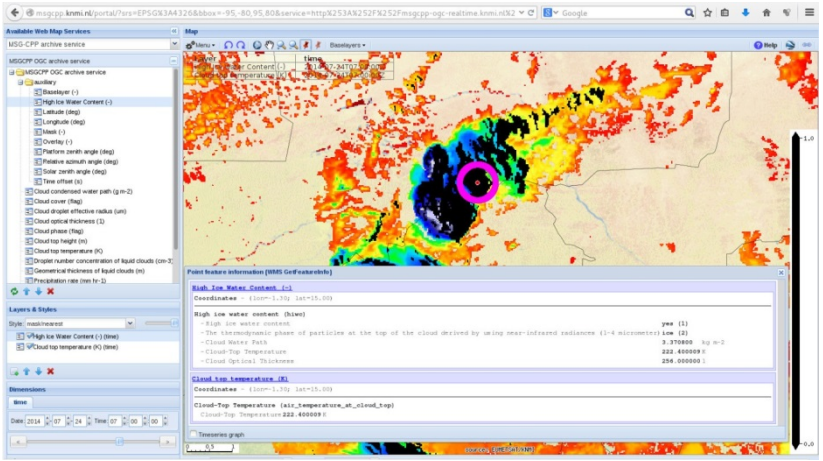
Product environment:

MSG cloud algorithms have mainly been developed in the context of the EUMETSAT CM SAF project.
Application to High IWC detection is developed in HAIC.

Deliverable focal point:

J.F. Meirink, KNMI

Product Illustration



Benefits:

Warning for potential High IWC occurrence allows pilots to avoid these dangerous situations, with obvious benefits for aviation safety.

Position vs. Competition:

Currently no such product exists, but similar developments are ongoing in the US HIWC project.

The multi-wavelength-channel approach means that this method can be applied to a number of existing low earth orbit satellites like MODIS and VIIRS, also for the recently launched new Japanese geostationary satellite HIMAWARI and with some modifications possibly also on the American geostationary GOES satellites.

High Altitude Ice Crystals
CPP (Cloud Physical Properties) products

- CPP products performances assessed vs Cayenne 2015 (MSG only)

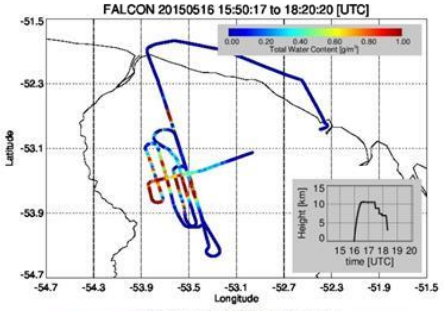
- local total IWC is NOT a proxy for maximum IWC in profile
- local total IWC is NOT representative for cloud profile

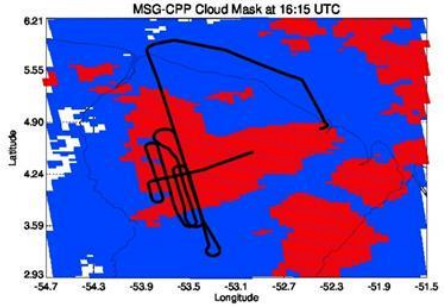
➢ In situ measurements are not very useful for testing performance of MSG-CPP High IWC mask

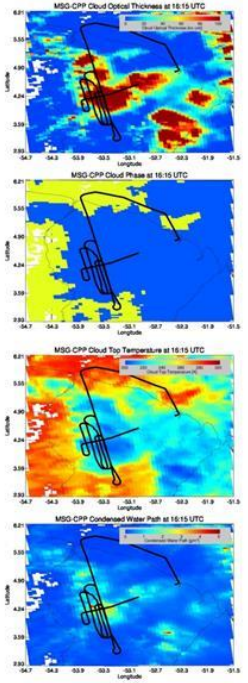
➢ ROBUST is local, *In Situ*; MSG-CPP is top-down view, column integrated

➢ Performances assessed vs RASTA

- POD ~80%







Product	High IWC mask v1 (TRL3)	High IWC mask v2 (TRL5)
Cloud phase	Ice	ice
Effective radius	> 10 µm	No threshold
Condensed water path	> 1 kg/m^2	> 0.1 kg/m^2
Cloud Top Height	> 8 km	No threshold
Cloud Top Temperature	< 225 K	< 270 K
Cloud optical thickness	No threshold	< 20

High Altitude Ice Crystals
CPP (Cloud Physical Properties) products

- **Activities in current period**
  - *CPP Product* operationally available and successfully deployed during 2015 Cayenne campaign
  - Preparation of the TRL5 *CPP Product* closure review with new results on satellite-based product performances. RASTA data very useful for validation
  - Preparation of the HAIC-HIWC Satellite & Nowcasting workshop (HAIC, NCAR, FAA and UKMO)
  - Preparation for support to HAIC 2016 campaign
- **Significant results**
  - TRL5 closure review *CPP Product* assessed CONCLUSIVE (1st generation)
- **Work planned for next period**
  - Preparation to the HAIC 2016 campaign : New satellite (HIMAWARI-8) -> adaptation of the processing chains & tests and evaluation
  - Optimisation of CPP Product: SZA effect, IWC characterization, Merge with RDT product
  - Pursue collaboration with US partners
- **Difficulties:** NTR

High Altitude Ice Crystals
RDT (Rapidly Developing Thunderstorms) tool

Technology Overview

Object:

Detection of tropical convection. Output files containing perimeters of convective zones and their characteristics.

Change:

RDT is also adapted to run over the Tropical Atlantic. A new IWC attribute can be included. The output data format, its content, the units will be adapted to HAIC context. The output file size can be reduced for uplink issues.

Key Requirement:

Key1 : Detection, tracking and forecast of convective areas and following information on each convective cell: altitude, area, vertical and horizontal expansion rates, cloud top temperature, altitude and phase, displacement speed and direction

Key2: Detection requirements concerning convection detection can follow those defined by EUMETSAT. Target accuracy concerns early detection (before first lightning occurrence), late detection (after first lightning occurrence), overall thunderstorm detection skill.

Key3: Detection requirements concerning IWC analyzed with HAIC campaign and In Service Events database. RDT has to include high IWC area.

Key4: Reasonable elaboration/dissemination delay of the product

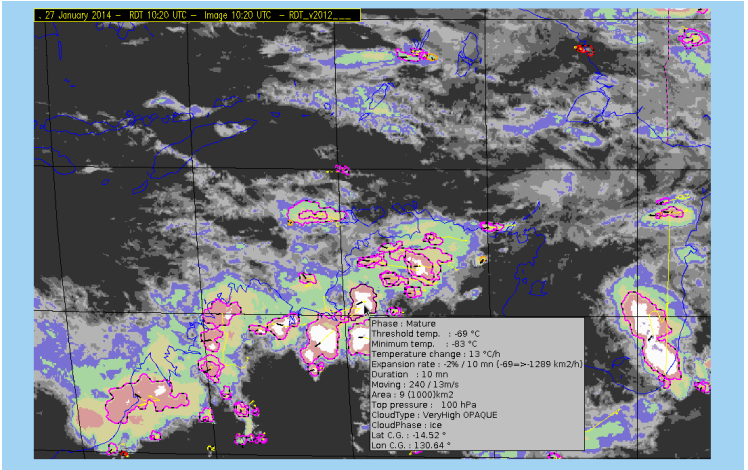
Product environment:

- Main scientific development in the context of NWCSAF
- Fields campaign case studies, Airbus event database analysis, HAIC specific development and operation suite. HAIC and SESAR programs

Deliverable focal point:

Jean-Marc Moisselin, MET-FR

Product Illustration



Benefits:

Warning of convective areas for aviation. Possibility to estimate the intensity of storm via its radiative, dynamical and morphological characteristics. Possibility to plan and adjust the flight trajectory according to the forecast of the thunderstorm position.

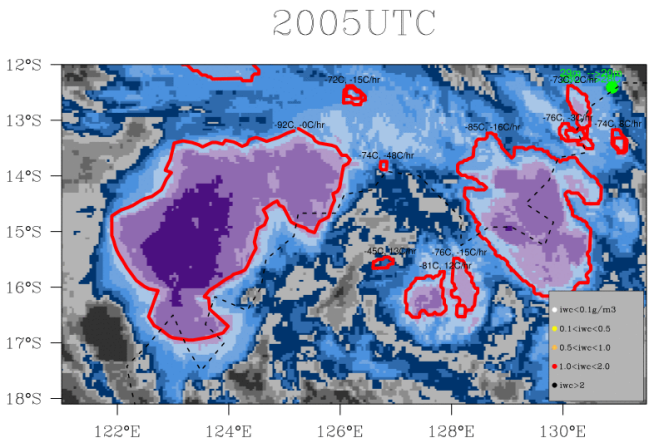
Position vs. Competition:

Other satellite-based products, developed for example by DLR Institute of Atmospheric Institute (Germany), NCAR (US).

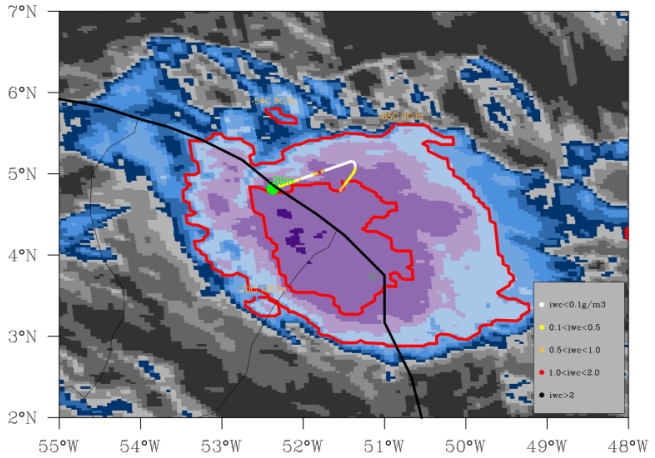
Numerous convection products based on meteorological radars. RDT can used different kind of GEO satellites

High Altitude Ice Crystals
RDT (Rapidly Developing Thunderstorms) tool

- HAIC Lessons learnt (from works of A. Gounou, MET-FR)
- Darwin 2014 RDT properly located the area of high IWC within a mature convective system with a minimum top temperature of -90C
- RDT detects convective cell at the growing stage, meaning that it is able to give an early warning (Guyane feedback)
- As the convection is dying, the RDT stop tracking these cells while the ice particles can remain for a longer time (Guyane feedback)
- Some under-detection of oceanic systems (Guyane feedback).
- POD ~75%



Flight #16



Flight #17

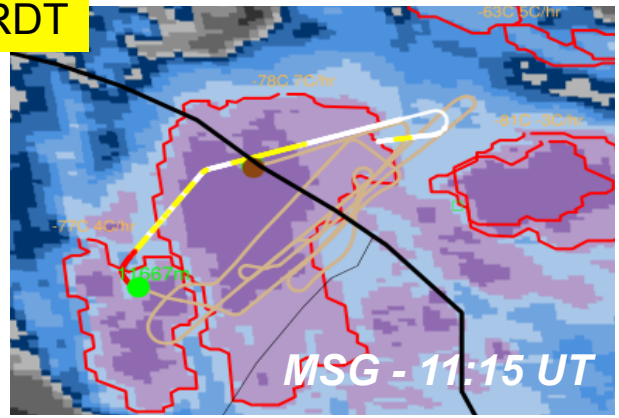
High Altitude Ice Crystals
RDT (Rapidly Developing Thunderstorms) tool

- **Activities in current period**
  - *RDT Product* operationally available and successfully deployed during 2015 Cayenne campaign
  - Preparation of the TRL5 *RDT Product* closure review with new results on satellite-based product performances. RASTA data very useful for validation
  - Preparation of the HAIC-HIWC Satellite & Nowcasting workshop (HAIC, NCAR, FAA and UKMO)
  - Preparation for support to HAIC 2016 campaign
- **Significant results**
  - TRL5 closure review *RDT Product* assessed CONCLUSIVE (1st generation)
- **Work planned for next period**
  - Preparation to the HAIC 2016 campaign: New satellite (HIMAWARI) -> adaptation of the processing chains & tests and evaluation
  - Optimisation of *RDT Product*: long lasting convection tracking, merging with CPP Product, HighIWC attribute, advection scheme, GOES-R,…
  - Refine the methodologies for the validation of *RDT product* from Cayenne 2015 data, with feedback on validation exercises performed with Darwin 2014 data
  - Pursue collaboration with US partners
- **Difficulties:** NTR

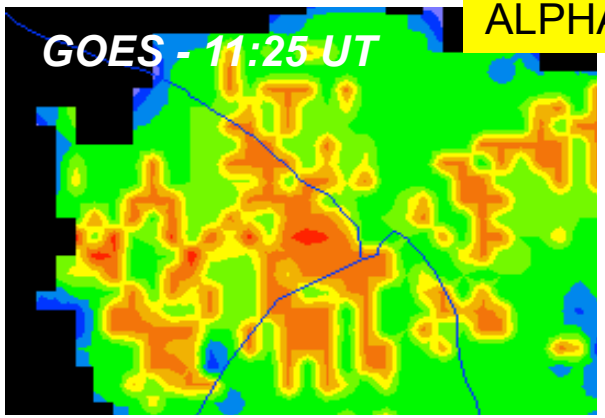
High Altitude Ice Crystals
HAIC-HIWC Satellite & Nowcasting Workshop

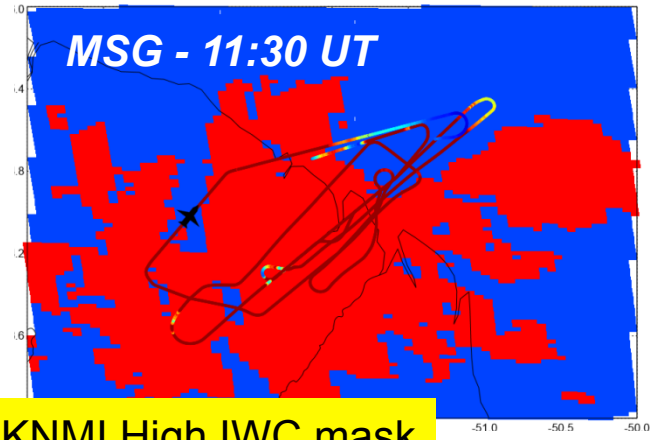
- HAIC-HIWC Satellite & Nowcasting Workshop (27-28 Oct 2015, Toulouse)
- Consistent outputs between products
- Next analysis steps defined during the workshop

RDT



ALPHA





KNMI High IWC mask

HAIC-HIWC Cayenne 29 May 2015

High Altitude Ice Crystals (HAIC, 314314)

Project co-funded by the European Commission within the Seventh Framework Programme (2012-2016)