NWCSAF convection products

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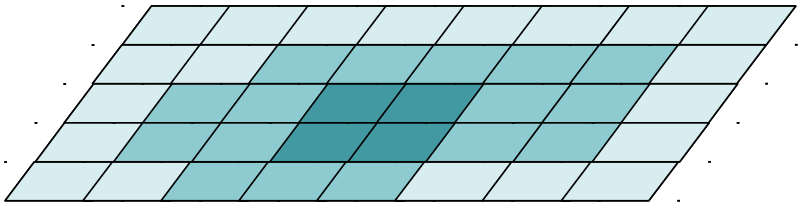
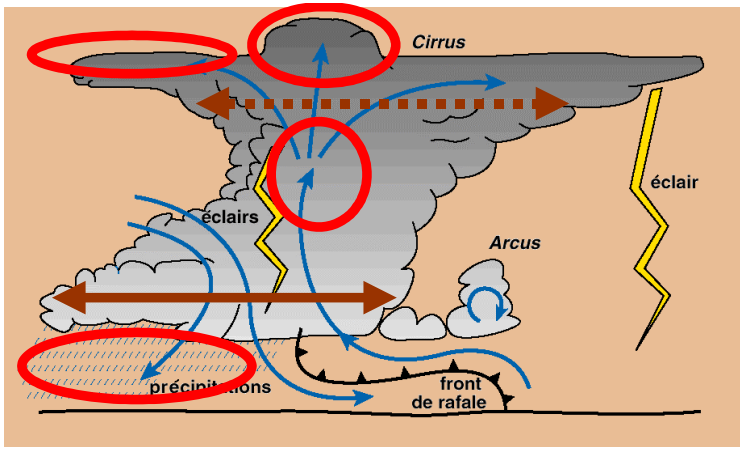
Introduction

- **CI**=Convection Initiation
  - Pixel-based product
  - First delivery NWCSAF v2016

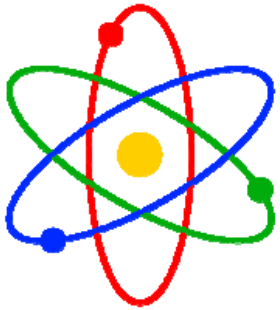


- **RDT**=Rapidly Developing Thunderstorm
  - Object-mode product
  - Actual delivery: v2013
  - Next delivery: v2016



- PGEs in **NWCSAF** package (Convection Group)

Science / Software / Production



CI and RDT take advantage of **scientific** community progress and **new satellites** upcoming.

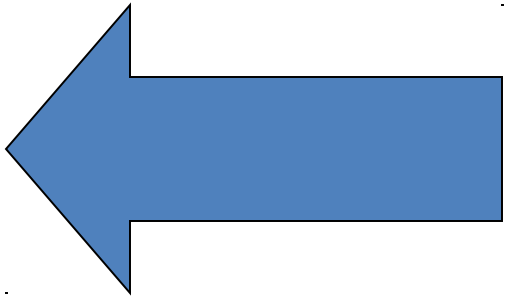
CI and RDT are **softwares** mainly developed in the context of NWCSAF. Integrated inside task manager

RDT is **operated** by many end-users, including Météo-France.

CI soon operated

Overview

1. **CI - Convection initiation**



1. RDT

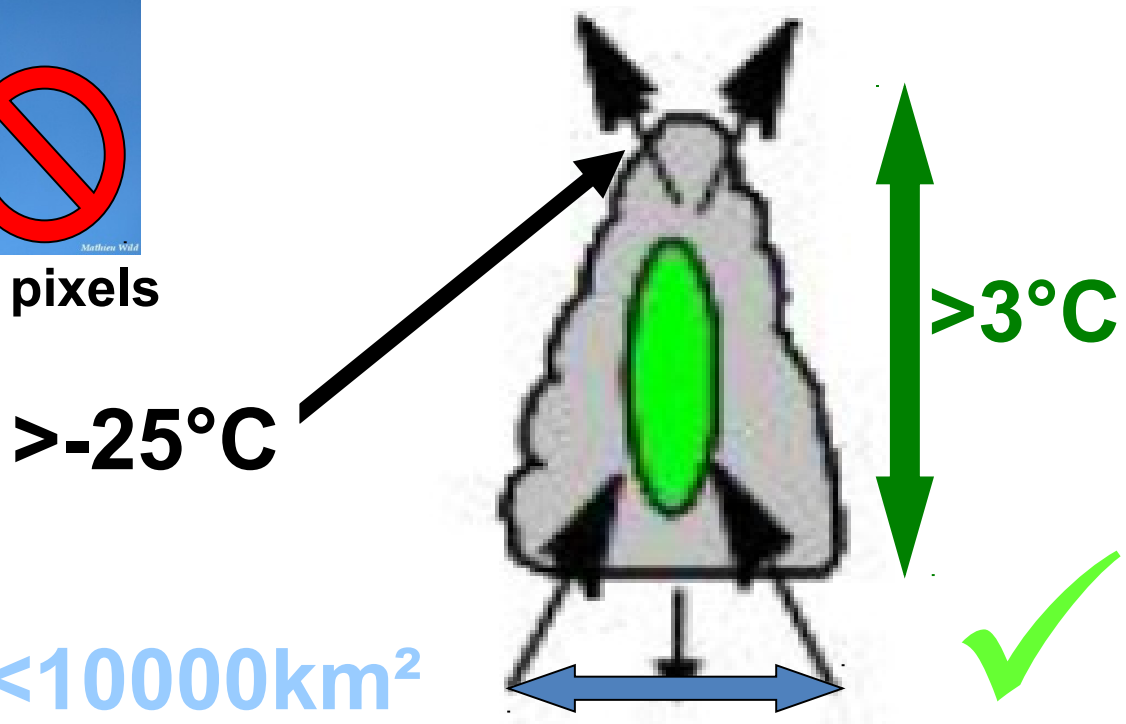
1. Future works

Convection Initiation-Definition

Convective initiation nowcasting: **which clouds will become thunderstorms in the near future**? Definition of CI: radar precipitation echo intensity criteria of 30–40 dBZ

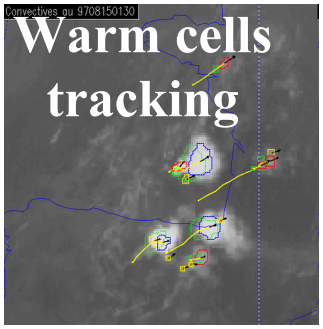
Cloud-free pixels

Too cold pixel

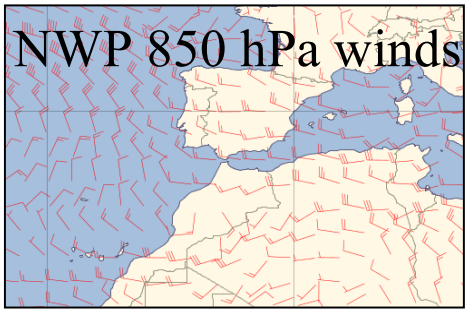


First step=Warm Cells Detection

CI- Necessity to track the pixels



Priority



Second step: Displacement fields

Objective: to determine previous pixels-position (and then to **calculate dynamic trends**)

- ❑ Classical tracking (cell overlap criteria between two consecutive slots)
- ❑ NWP wind data and HRW are combined to determine a 2D displacement fields useful for:
  - ❑Orphan cells
  - ❑Cold start

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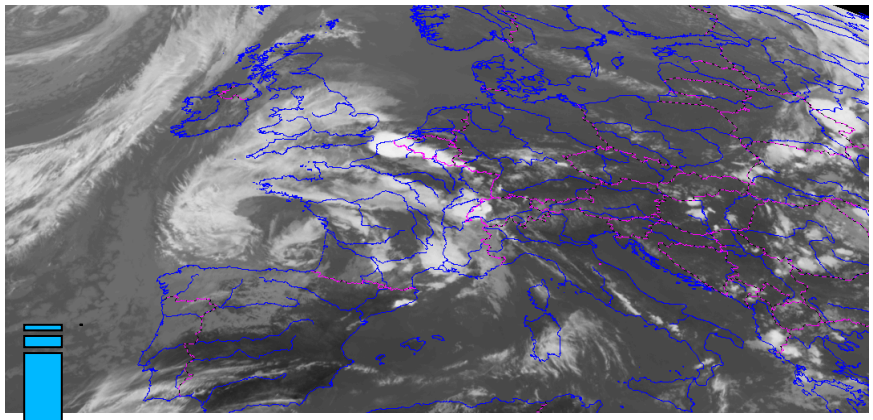
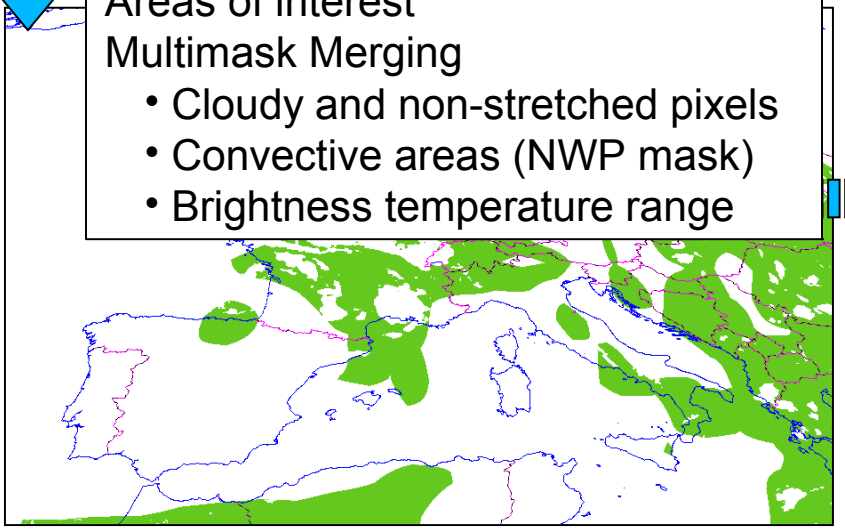
Area of interest, pixel of interest, probability assessment (1/2)

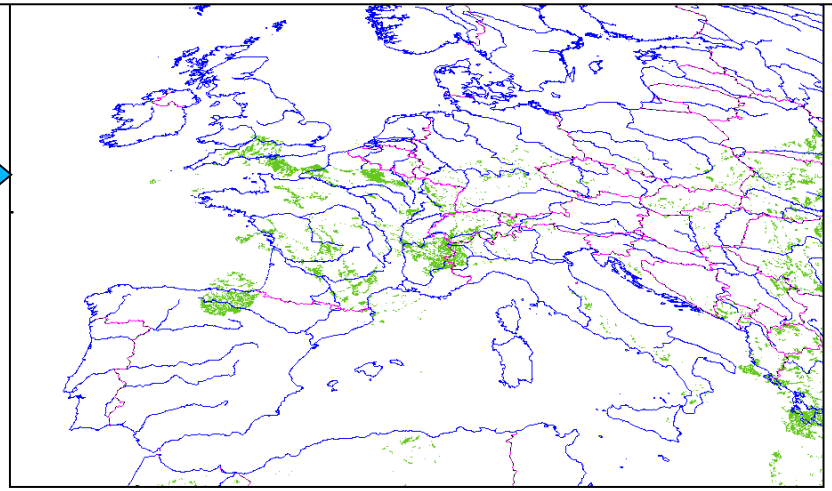


Succession of filters

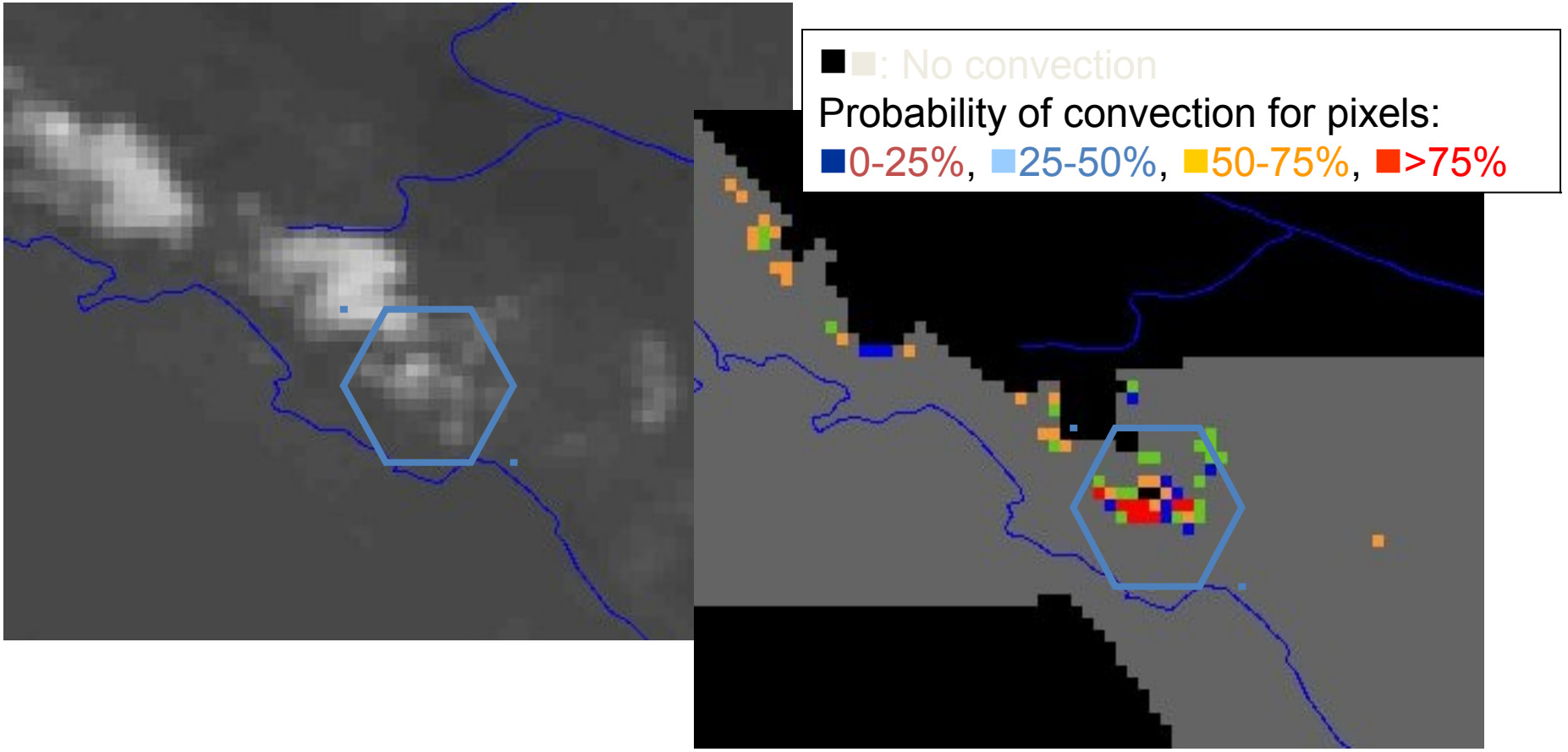
Areas of interest
Multimask Merging
- Cloudy and non-stretched pixels
- Convective areas (NWP mask)
- Brightness temperature range



Pixels of interest Multi-parameters analysis
- Vertical Extension
- Glaciation
- Updraft



Area of interest, pixel of interest, probabilitty assessment (2/2)

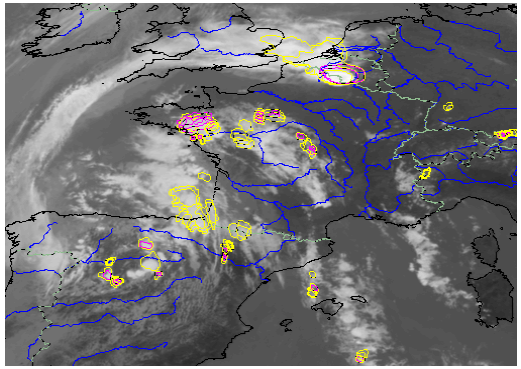


- Vertical extension criteria: BTD 6.2-10.8µm, high BTD 13.4-10.8µm
- Glaciation: cold BT10.8µm, time below 0°C (using BT 10.8µm)
- Updrafts: strong negative trends of BT10.8µm, strong trend of BTD6.2-10.8µm

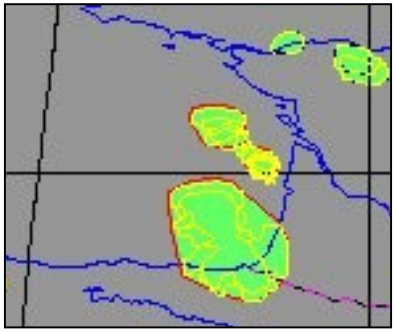
Inspirated by SATCAST methodology, described in « Best Practice Document, 2013, for EUMETSAT Convection Working Group, Eds J.Mecikalski, K. Bedka and M. König »

Tuning and validation: the ground truth

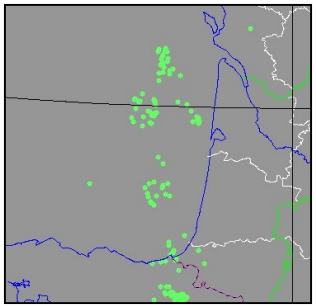
- Smoothed Path tracks from successive RDT convective cells



- Smoothed Path tracks from successive radar-based cells (30 dBZ)



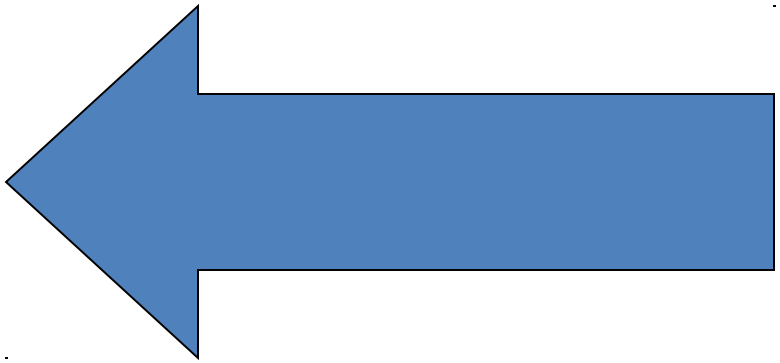
- Enlarged (~10km) plots from cumulated strokes for a given period



Overview

1. CI

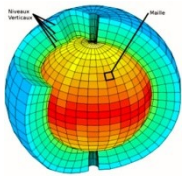
1. **RDT – Rapidly Developing Thunderstorm**



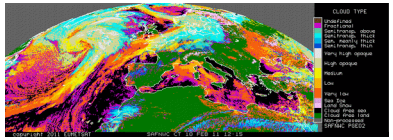
1. Future works

RDT: data fusion for description of convection

Input Data: Multisource



NWP data



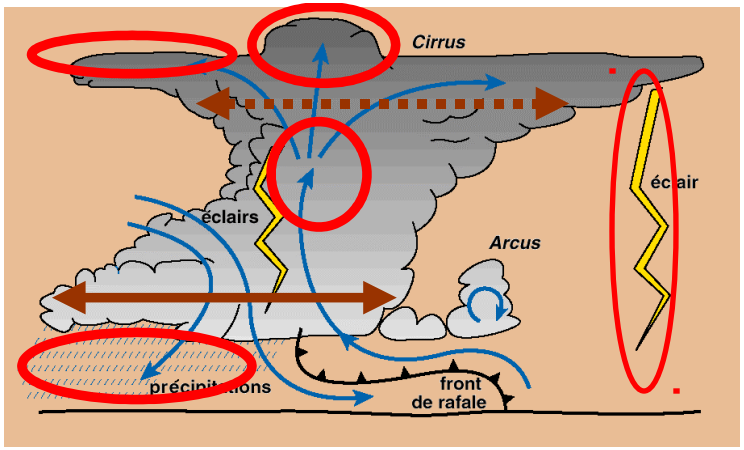
GEO data (5 IR channels + VIS)

RDT

Other NWCSAF products

Lightning Data

Output: Multilevel Description Of Convection



- *Main description of cell: <u>Yes/No convection diagnosis</u>, cell-development phase, position, surface, T, gap to tropopause, cloud type and phase, cloud top pressure. Severity Index high IWC hazard. Displacement Relevant trends are calculated*
- *Overshooting Tops, Lightning Activity, Convective Index, Rainfall Activity*

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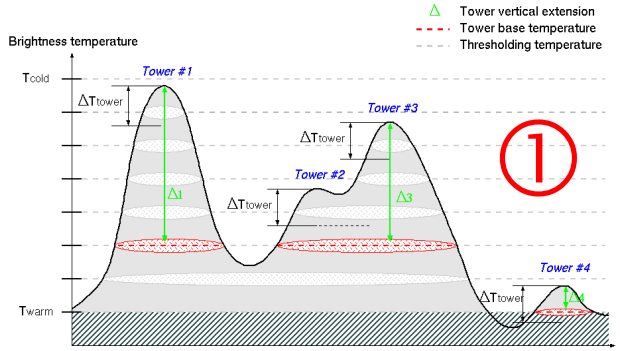
4-steps algorithm of RDT

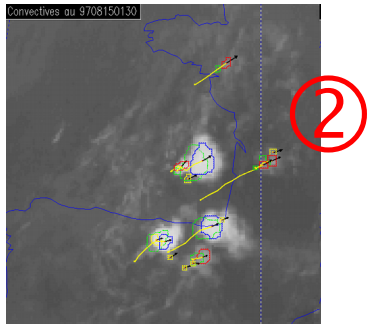
STEP1: 10.8 µm detection

- *In order to detect cells*
- *Vertical extension: at least 6°C*



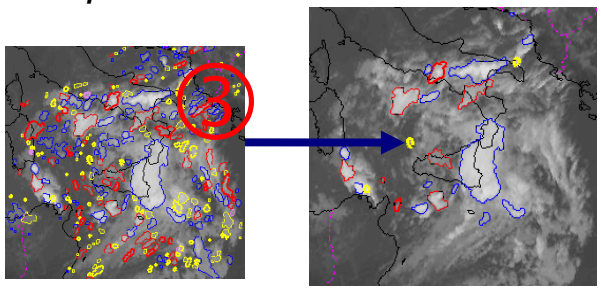
STEP2: Tracking

- *In order to recognize each cell in the previous slot)*
- *Trends calculation is then allowed*



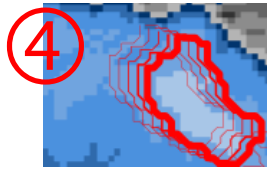
STEP3: Discrimination

- *In order to identify convective cells*
- *Statistical process*



STEP4: Forecast *(v2016)*

- *No creation, no dissipation of cells*
- *Improvement of tracking (NWP, HRW)*



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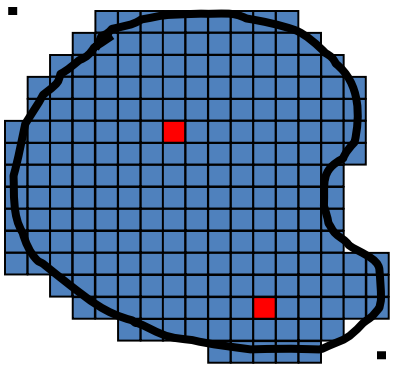
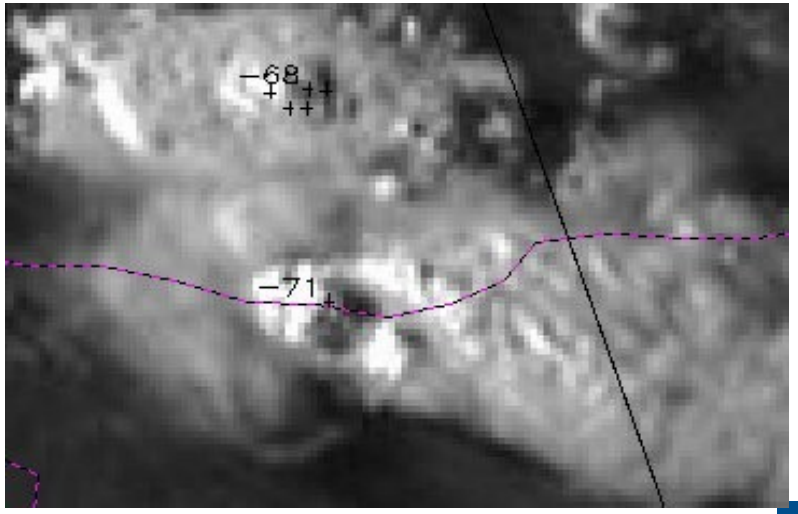
RDT - Overshooting Tops Detection

OT: the challenge of automatic detection

OTD Inside each RDT cell

- ❑ Criteria: temperature of coldest pixel, BTD WV6.2-IR10.8, WBTD WV6.2-WV7.3, reflectance VIS0.6, gap to NWP tropopause.
- ❑ Morphologic criteria to confirm a spot of cold temperatures and to determine the pixels that belong to an OT
- ❑ HRV for tuning/validation

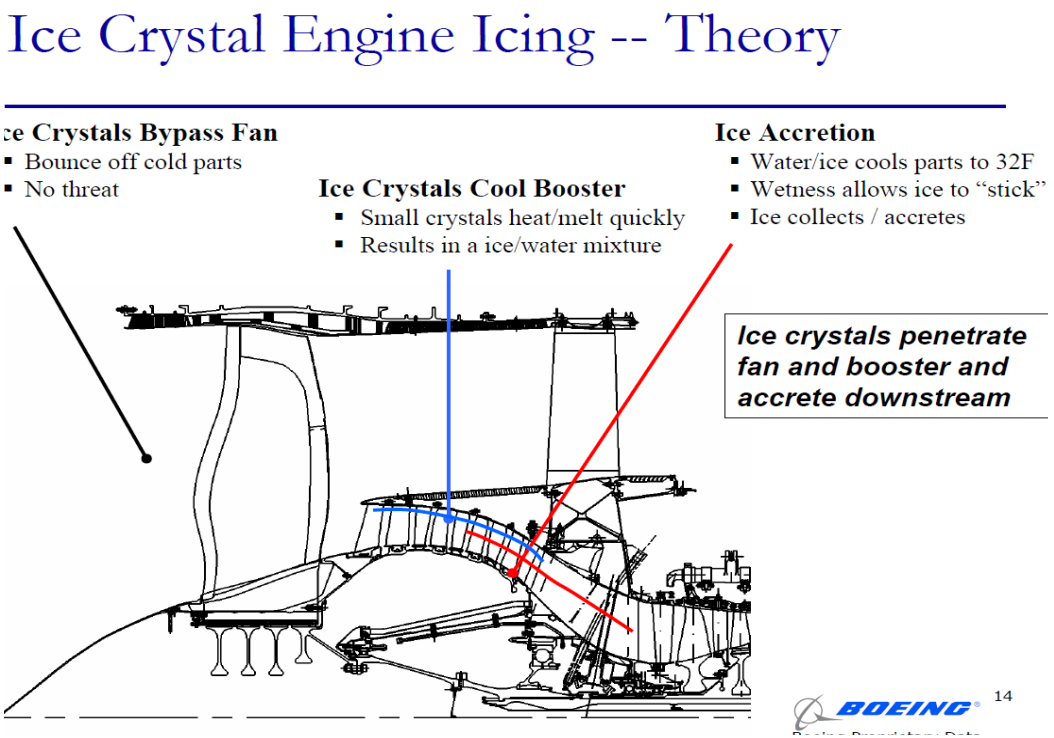




RDT and high IWC (Ice Water Content)

- Ice crystals: cold meteors of very small size. Often non visible though onboard radar.
- Different of classical icing.
- High altitude (>22000 ft), inside or close to convective clouds

- Impact on probes
- Impact on engines

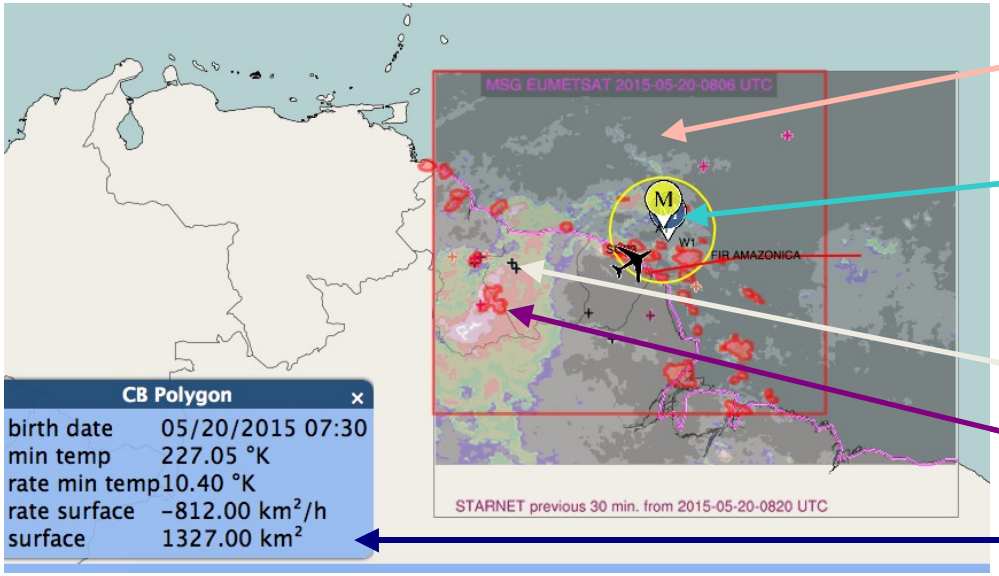


RDT and high IWC (Ice Water Content)

- HAIC project. Project co-funded by the European Commission within the Seventh Framework Programme (2012-2016). http://www.haic
- Use of RDT indirectly by **detecting and tracking convective systems that could generate conditions** of high IWC (Ice Water Content). Uplink of RDT

Planet system

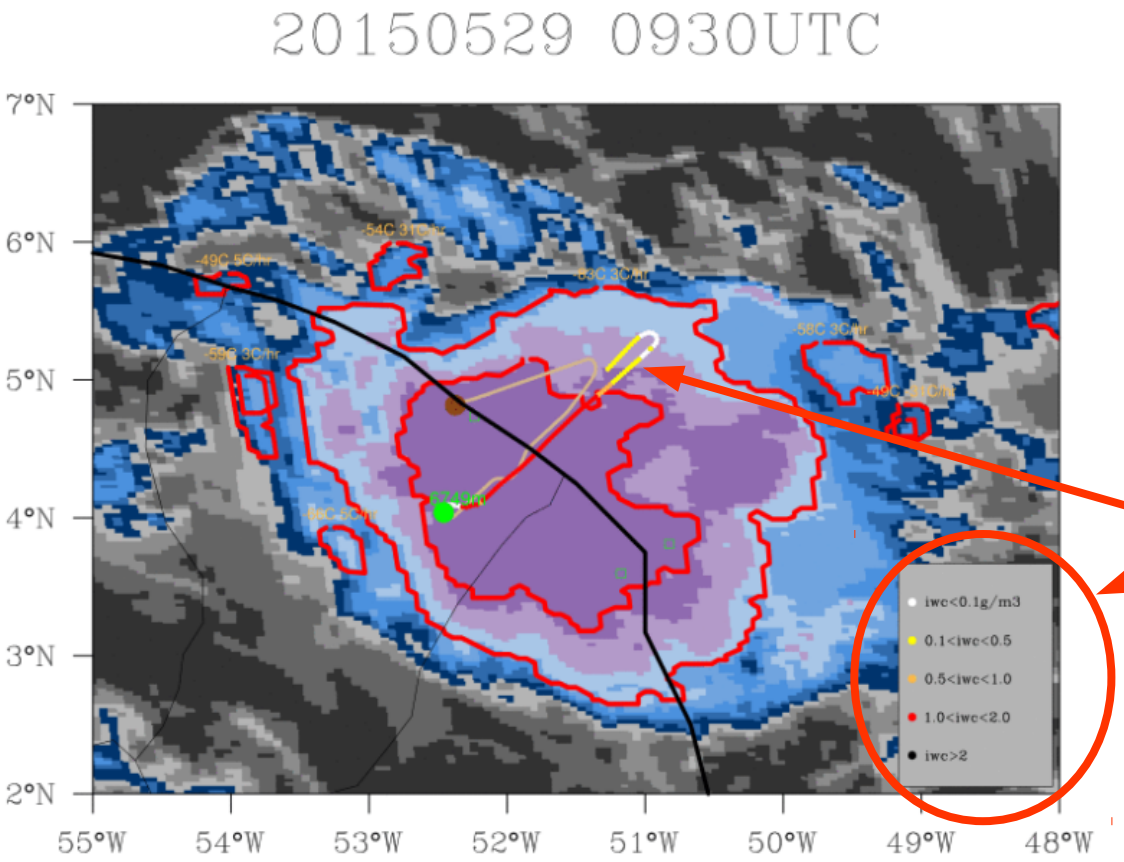
Atmosphere Company courtesy T. Dacla, S. Turner



- Quantitative evaluation of RDT as a **tool for detection of high IWC areas**. New attribute in v2016!

RDT and high IWC (Ice Water Content), evaluation using Cayenne 2015 campaign data

HAIC Guyane 2015 campaign – Flight #17

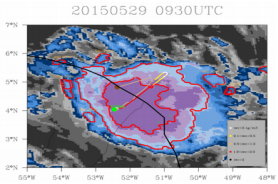


Mesured IWC values

Large MCS with high IWC well detected by RDT.
Interest of 2nd level

RDT and high IWC, RDT evaluation using data from 2015 Cayenne campaign

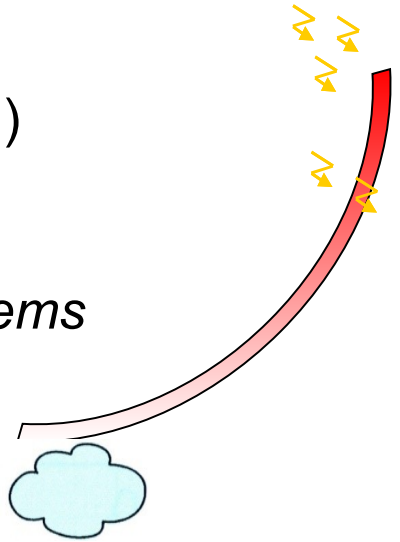
HAIC Guyane 2015 campaign – Flight #17



Animation Cayenne

RDT: validation

- **Subjective** validation by Météo-France experts
- *various case studies, use of topical case for each release.*



- **Objective** validation by Météo-France (v2012)
  - *Accuracy requirements fulfilled*
  - *Detection is superior to 70%*
  - *Early diagnosis for 25% of convective systems*

- Validation by **users**
  - *Research Projects, NMS, other NWCSAF users*
  - *User Survey 2014*
    - *RDT is rated 6.7 (/10) in term of usefulness by users*
    - *Convection Initiation most expected product*

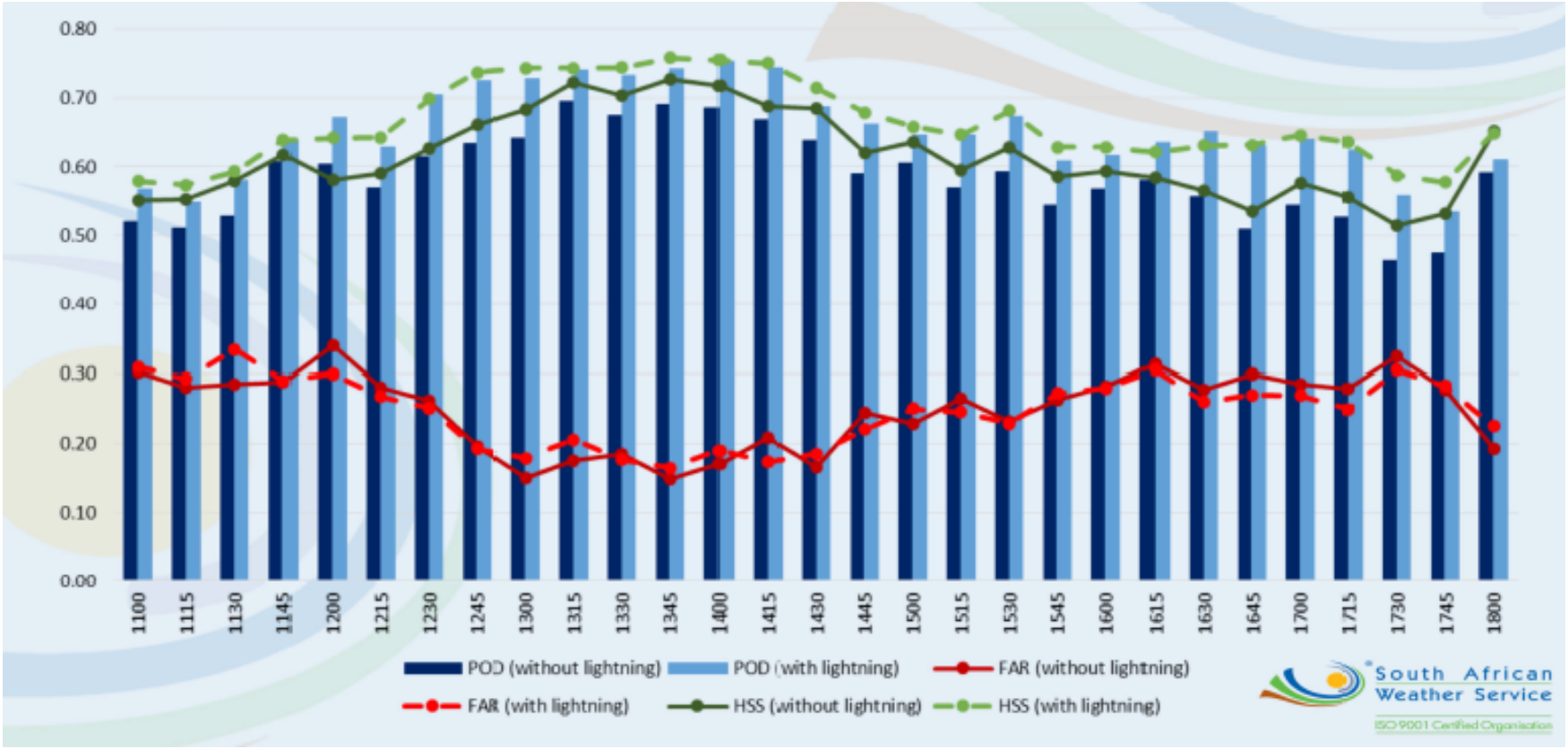
- ***Any feedback is welcome !*** ☎ ✉

RDT Validation by SAWS

Against 35 dBZ radar reflectivity

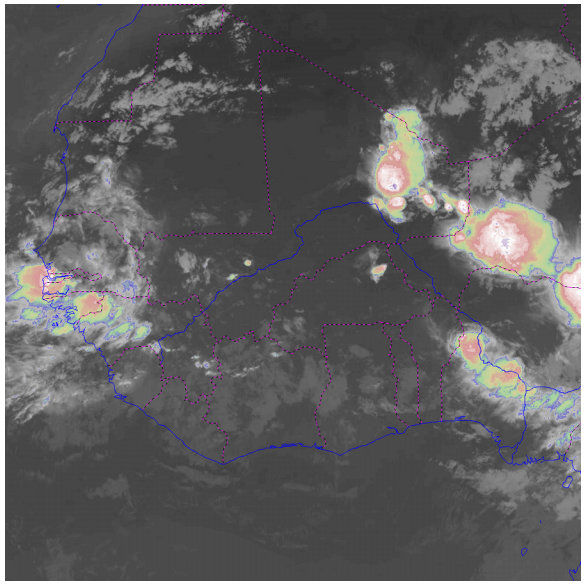
Object-based methodology of verification

RDT operated with and without lightning data (25 cases)



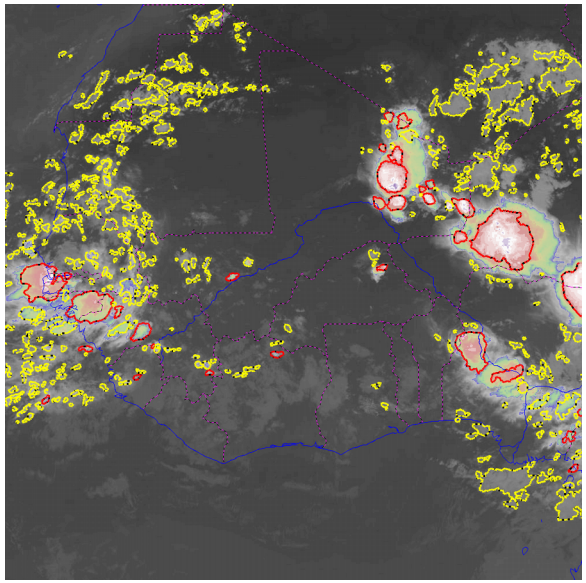
Courtesy E. De Coning (SAWS)

RDT: ready for uplink (1/2)



Enhanced satellite 10.8µm image

Convection is here. *Where precisely*?



Enhanced satellite 10.8µm image + objects that have at least 6°C of vertical extension in yellow and red

If we only focus on convection … (next slide)

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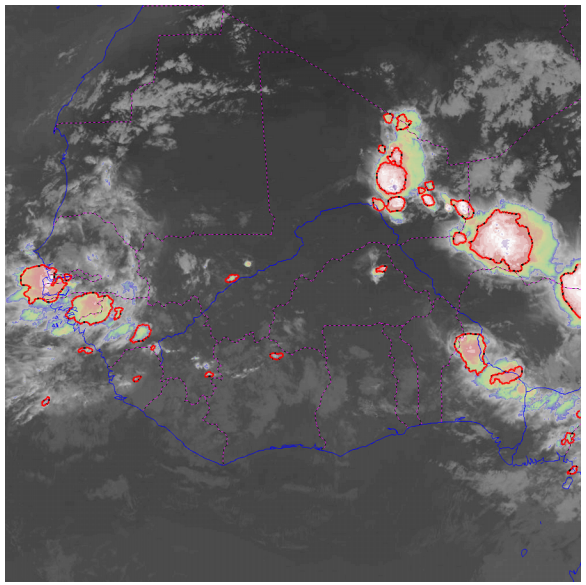
RDT: ready for uplink (2/2)



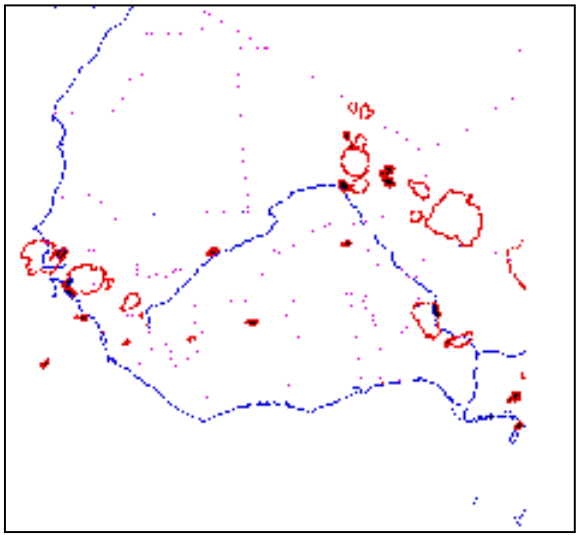
Enhanced satellite 10.8µm image + convective objects

After the “discrimination” phase of the RDT algorithm

Each object is described with a

complete set of attributes

If we want to reduce the information to its kernel



Convective objects outlines alone

+ Possibility to reduce the set of attributes

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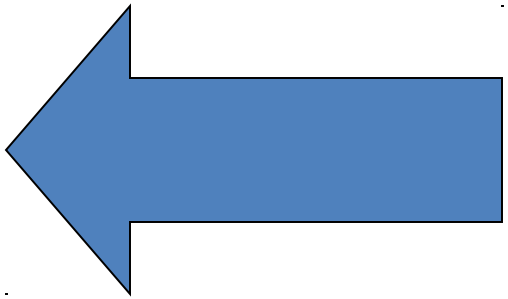
Overview

1. CI - Convection initiation

1. RDT

1. Future works



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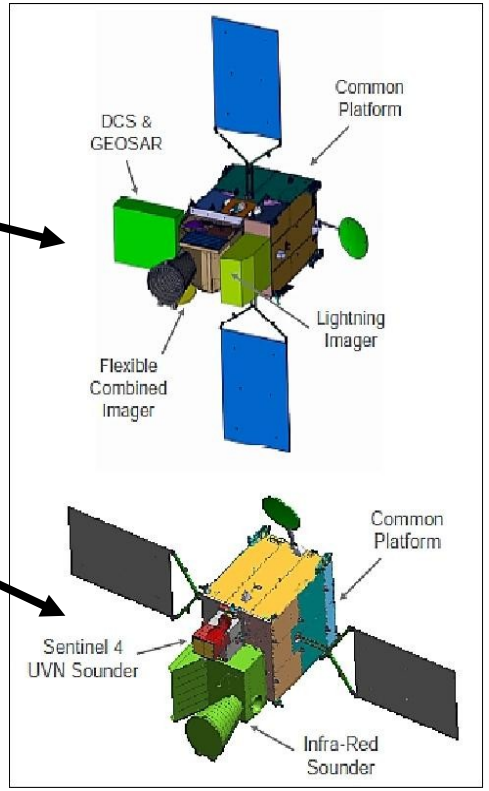
CDOP3 proposal for CI and RDT

- Products will be developped during next phase
  - CI from Demonstational/Pre-operational to Operational
    - CDOP2 v2016 1st release
    - CDOP3: v2018, v2021
  - RDT. Still ways of improvment. Road to MTG
    - CDOP2 v2013 last release (OTD)
    - CDOP2 v2016 next release (advection scheme, netcdf, etc.)
    - CDOP3: v2018, V2021
- New satellites : Himawari-8, MTG

MTG – The next GEO satellite generation

- 6 satellites: 4 MTG-I (radiometer+Lightning Imager) and 2 MTG-S (sounding)
- Op: 2019 – 2039
- Imager mission with 2 satellites MTG-I
  - FCI=Flexible Combined Imager
    - Full disk: 10 minutes, 16 spectral bands
    - Rapid scan: Europe 2,5 minutes
  - Lighnting Imager
- Hyperspectral Infrared Sounder mission with MTG-S:
  - IRS (infrared Sounder) : the 4D atmosphere every 30 minutes over Europe
  - Air qualit with UV Sentinelle-4 (Copernicus)



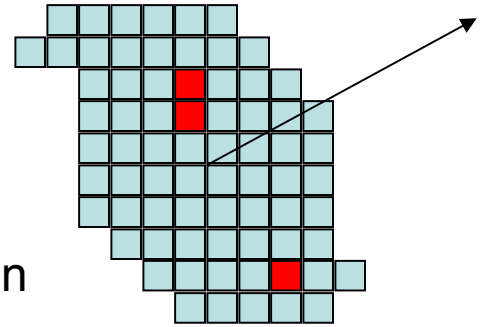
MTG Context for Convection Products

FCI Number of channels:
Experienced.
Expected.
New physical properties (e.g. 0.91µm for total column precipitable water)

Spectral accuracy:
Experienced
Expected
Better estimate of BT

FCI Resolution:
Experienced
Expected
Small scale phenomena detection

RSS issue and NWCSAF needs



LI
un-experienced.
Highly expected.
Impact on RDT validation, tuning, description, real-time mode, monitoring
Will Change a Lot Of Things!

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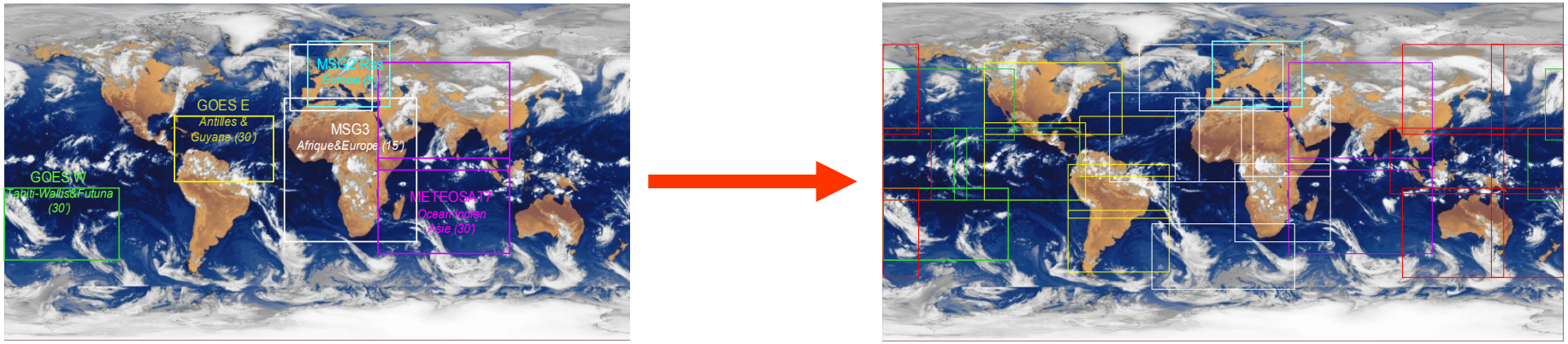
RDT production

RDT is a software inside NWCSAF distribution

RDT is also a product operated over varipous area and with various satellite input data

Météo-France has extended the production area. Initialy the production was made for forecasters (France, Africa, overseas territories). Now the production aims at responding all global demand.



Thanks for your attention

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Toujours un temps d'avance