NWCSAF Convection Products : outcome of CDOP3 and CDOP4 plans
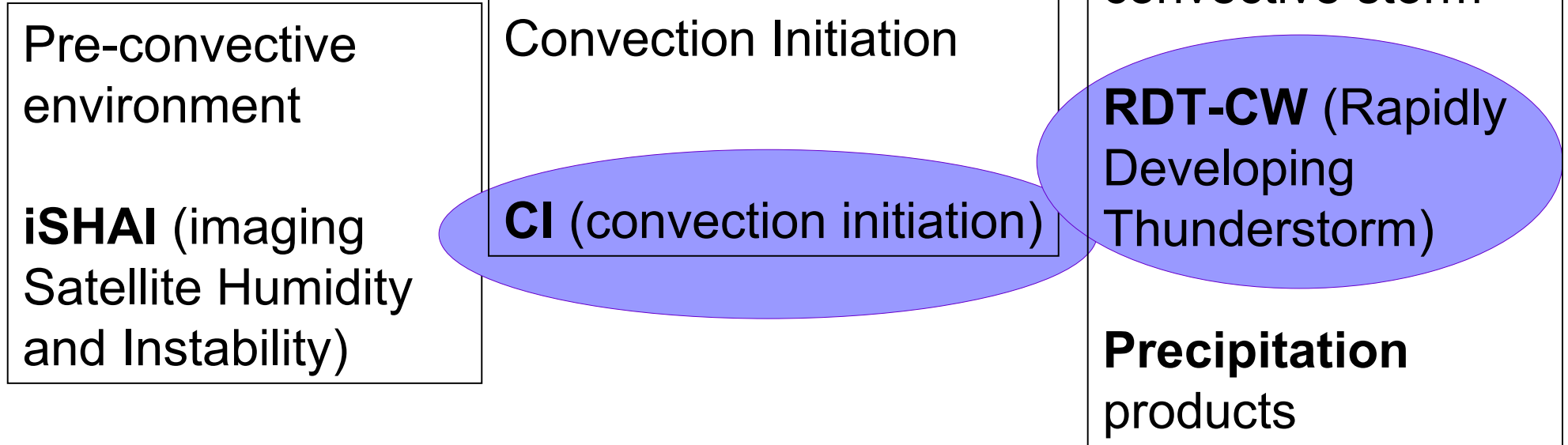
Moisselin, J.-M., Autonès, F. Claudon, M.,

Convection Working group Meeting
16-20/5/2022

Two products developed by MFT

Courtesy NWCSAF LE

Pre-convective environment

iSHAI (imaging Satellite Humidity and Instability)

Convection Initiation

CI (convection initiation)

Developing convective storm

RDT-CW (Rapidly Developing Thunderstorm)

Precipitation products

Time

Any time
Cloud products (**CMA**, **CT**, **CTTH**, **CMIC**), High Resolution Winds (**HRW**), ASII

Plan

1) Outcome of CDOP3

2) CDOP4 plans

CWG meeting May 2022
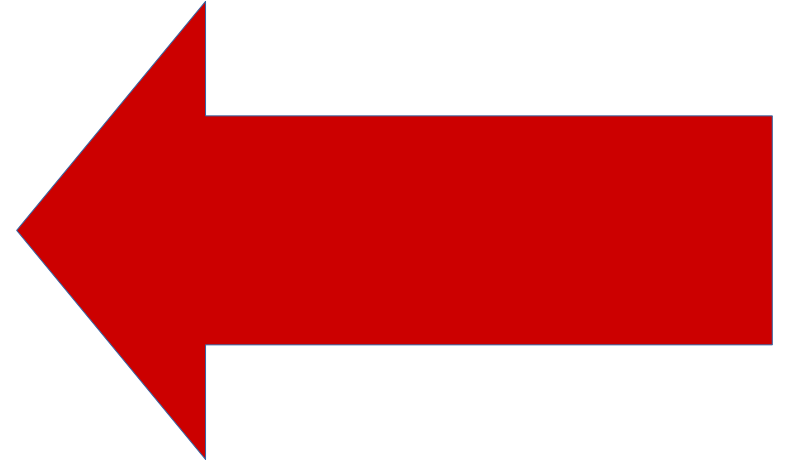
Human ressources

MFT in CDOP3 is

- In Toulouse, part of Nowcasting Department

- Composed of 3 people : Jean-Marc Moisselin (LM), Frédéric Autonès, Michael Claudon

- Collaboration with TROPOS institute for a AS on CI product verification

CDOP3 Deliveries (1/2)

- v2018:
- Convection Initiation (CI)
  - 2nde release of CI
  - Better Tuning, use of cloud-type as filter, Cloud microphysic as filter, better estimate of motion fields
  - Increased validation and product at the boundary of the requirements
  - Status : from <u>demonstrational up to pre-operational</u>
- Rapidly Developing Thunderstorm (RDT)
  - Feedback from aeronautical end-users taken into account
  - New discrimination scheme (CAL)
 - Implementation of Lighting Jump (LJ) algorithm
  - Status : still operational

- v2018.1:
- CI and RDT: GOES16/ABI compliant
- CI and RDT: configurable values for thresholds that define stability/neutral/unstability areas of NWP indices
- CI and RDT: main channel choice configurable
- RDT: CAL by default
- RDT: new tuning with 10 minutes update rate

CDOP3 Deliveries (2/2)

- v2021 (mainly developed during CDOP3, official delivery expected in CDOP4). More details in release note or ATBD – Also provided by M. Claudon in ESSL joint meeting last Monday

- GEO-RDT-CW and GEO-CI
  - Added support to GOES17 and Himawari-9
- GEO-RDT-CW
  - Management of data from GLM (GOES16 or GOES17), additionally to data from ground lightning sensor, with specific characteristics.
  - New tuning for all MSG satellites and GOES16
  - Change in overshooting top (OTD) and lightning jump (LJ) diagnosis (toward a reduction of false alarms)
  - IR97, IR134 and high resolution visible data taken into account in OTD algorithm
- GEO-CI
  - Reduction of false alarms : additional pixel filtering and trends computation improvement, particularly for MSG Rapid-Scan mode
  - Improvement of warm cloud cell detection. Improvement of movement fields

- vMTG:
  - RR and PDCR hold in CDOP 2, SIRR and STRR hold in CDOP 3
  - Version git-frozen in October 2021

CI: Additional pixel filtering after the step of cell detection – Illustrated by 20190912 in Spain
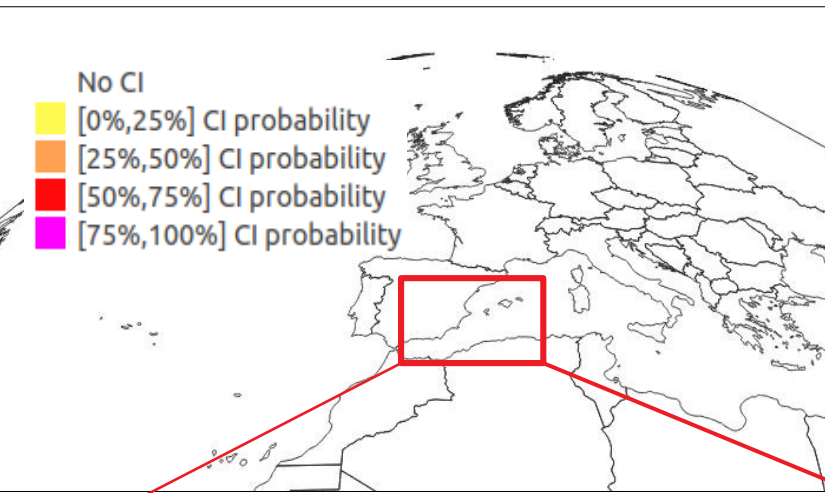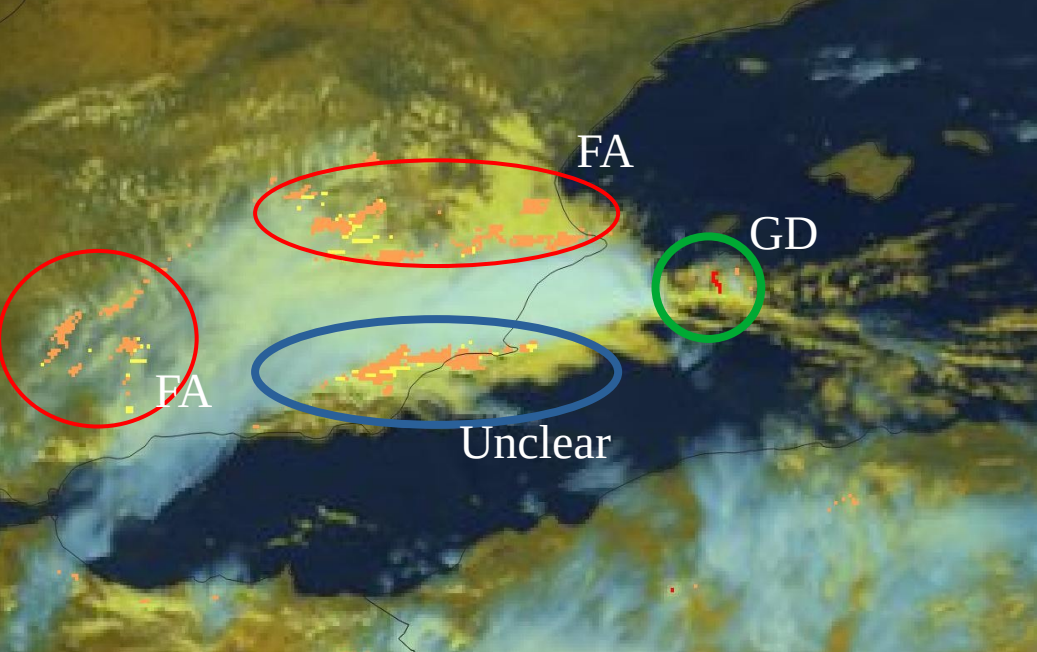

Heavy precipitation event over south-eastern part of Spain.

In v2018.1 version, numerous FA (false alarms) in the vicinity of the main convective system. Suppressed in v2021 version.

Good detection (GD) occurrences in the convergence area over Mediterranean sea with both version.

No CI
[0%,25%] CI probability
[25%,50%] CI probability
[50%,75%] CI probability
[75%,100%] CI probability

2019-09-12T120000Z, MSG-0°, V2018.1 version, CI [0;30min] forecast
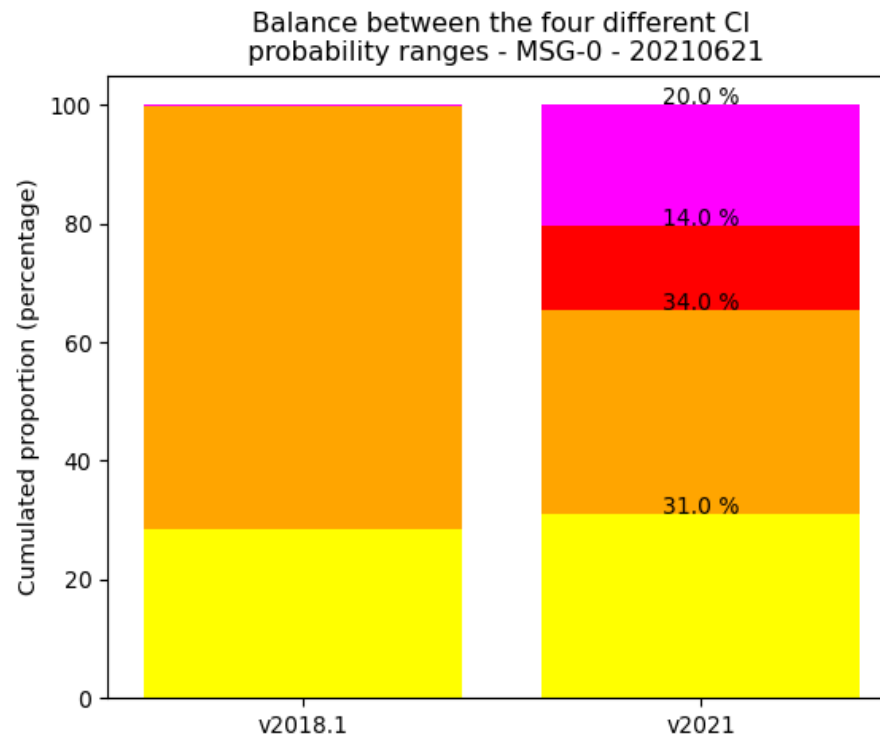
2019-09-12T120000Z, MSG-0°, v2021 version, CI [0;30min] forecast

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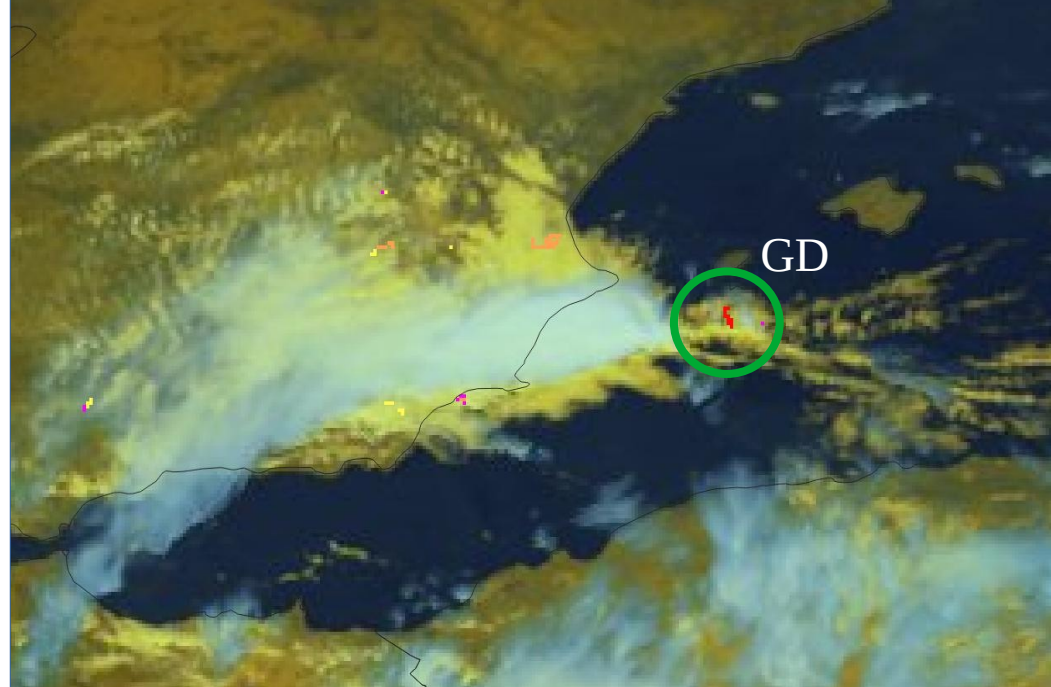
- ■ Objective validation

  — Reduction of the imbalance between the four CI probability ranges as a side-effect of several changes in the algorithm but we still recommend to use CI as a « yes or no » product.

Balance between the four different CI probability ranges - MSG-0 - 20210621

About GEO-CI

A product difficult to validate

FAR problem seems the main one
  - Sometimes explained by spatial double penalty as CI not so far away from new convective clouds
  - Sometimes explained by delayed convection (CI [0-30'] should have been CI [0-60'])

Still improving the tuning/validation database made with radar-based objects

Less relevant in cold-air mass. Explanations:
  - Threshold to be adapted
  - Fractioned cloud type excluded of CI calculation for the moment
  - Movement field more difficult to assess in that case

More a yes/no product than a probabilistic product. Even if distribution in probability classes is better with v2021.

Useful signal for forecasters or other experienced users. To be used as an additional information (rather than replacing other ones)

NWC SAF RDT-CW v2021 GOES16 visualization over oceanic area

20200919T200000Z, ITCZ, <u>over sea</u>. RGB image overlaid with 40-min accumulated GOES16-GLM strokes (yellow/orange dots) and RDT-CW cell contours.
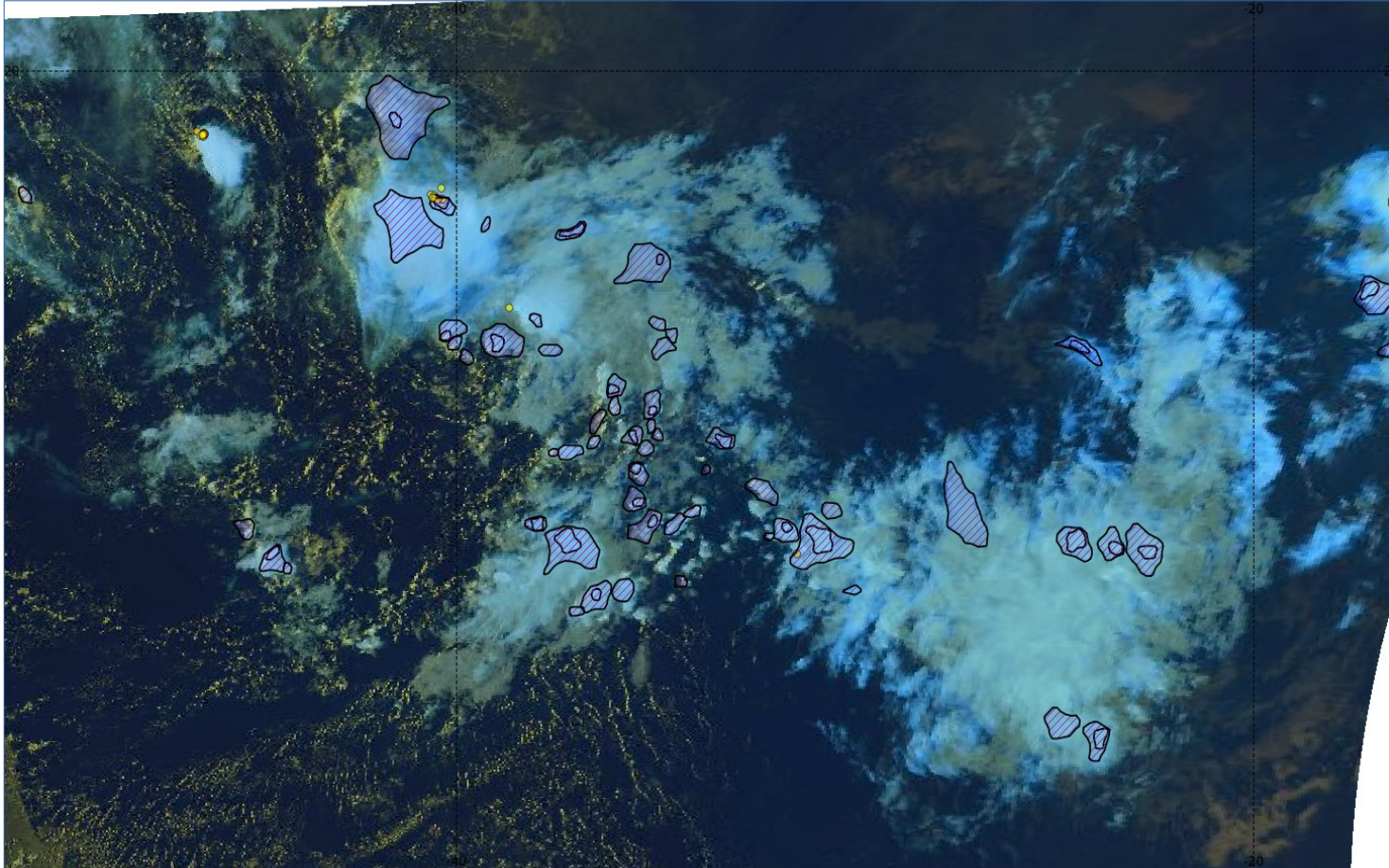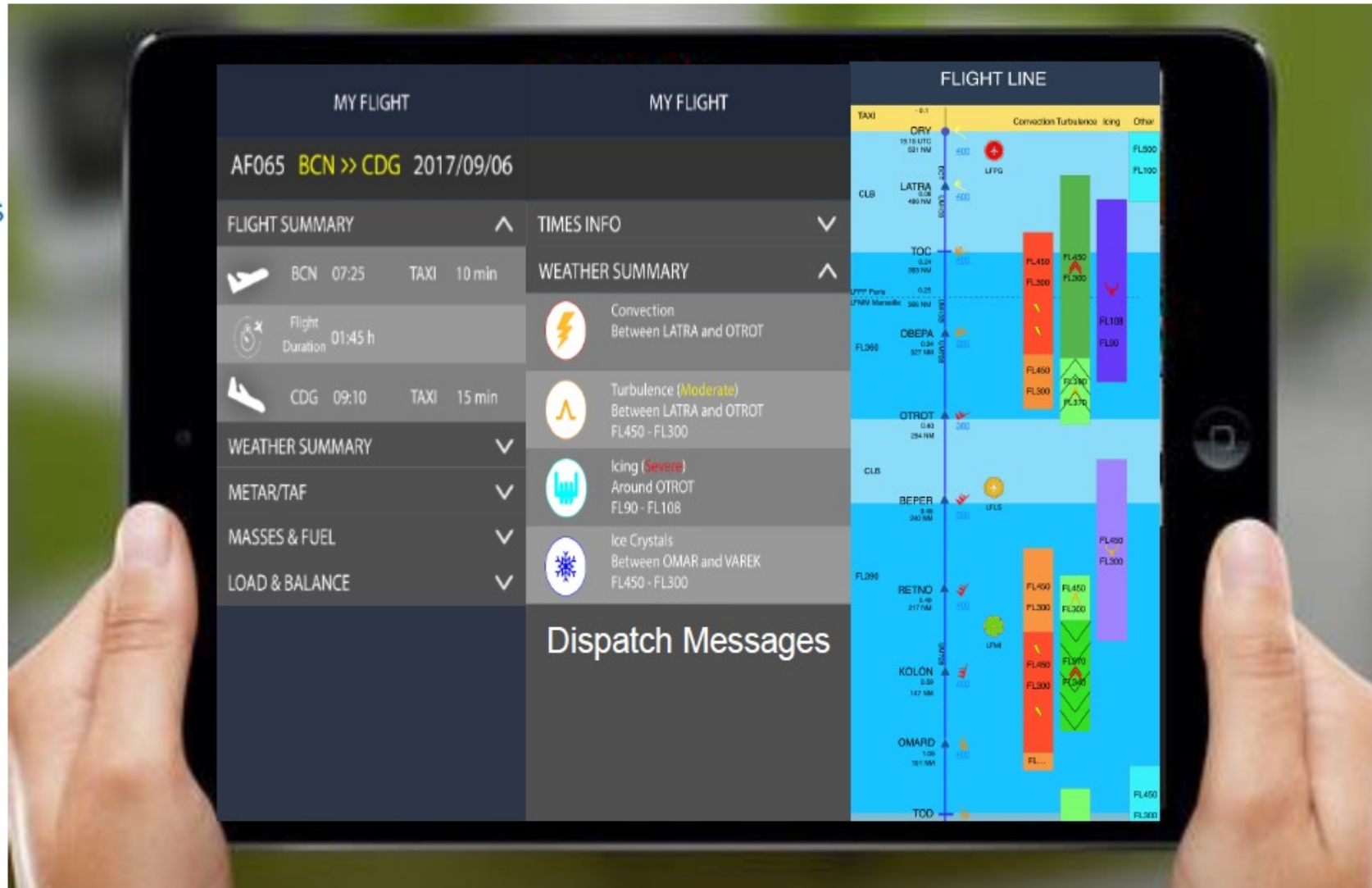

RGB information not always fitted to isolate and identify all stages of convective systems
Lightning activity too sparse to capture all convective systems *over ocean*
RDT-CW helps !

RDT onboard eWas solution for pilots

- ❑ OFP Details
- ❑ Airports details
- ❑ Weather details
- ❑ Dispatch Messages
- ❑ Fuel information
- ❑ App Launchers
   (Doc, Load &
   Balance)

From eWAS User Forum, Barcelona, 27-28/9/2017
GTD Lecture (now SITA)

RÉPUBLIQUE FRANÇAISE
Liberté
Égalité
Fraternité

METEO FRANCE

RDT-GOES16 Lgh activity for 1972_202102220640 trajectory
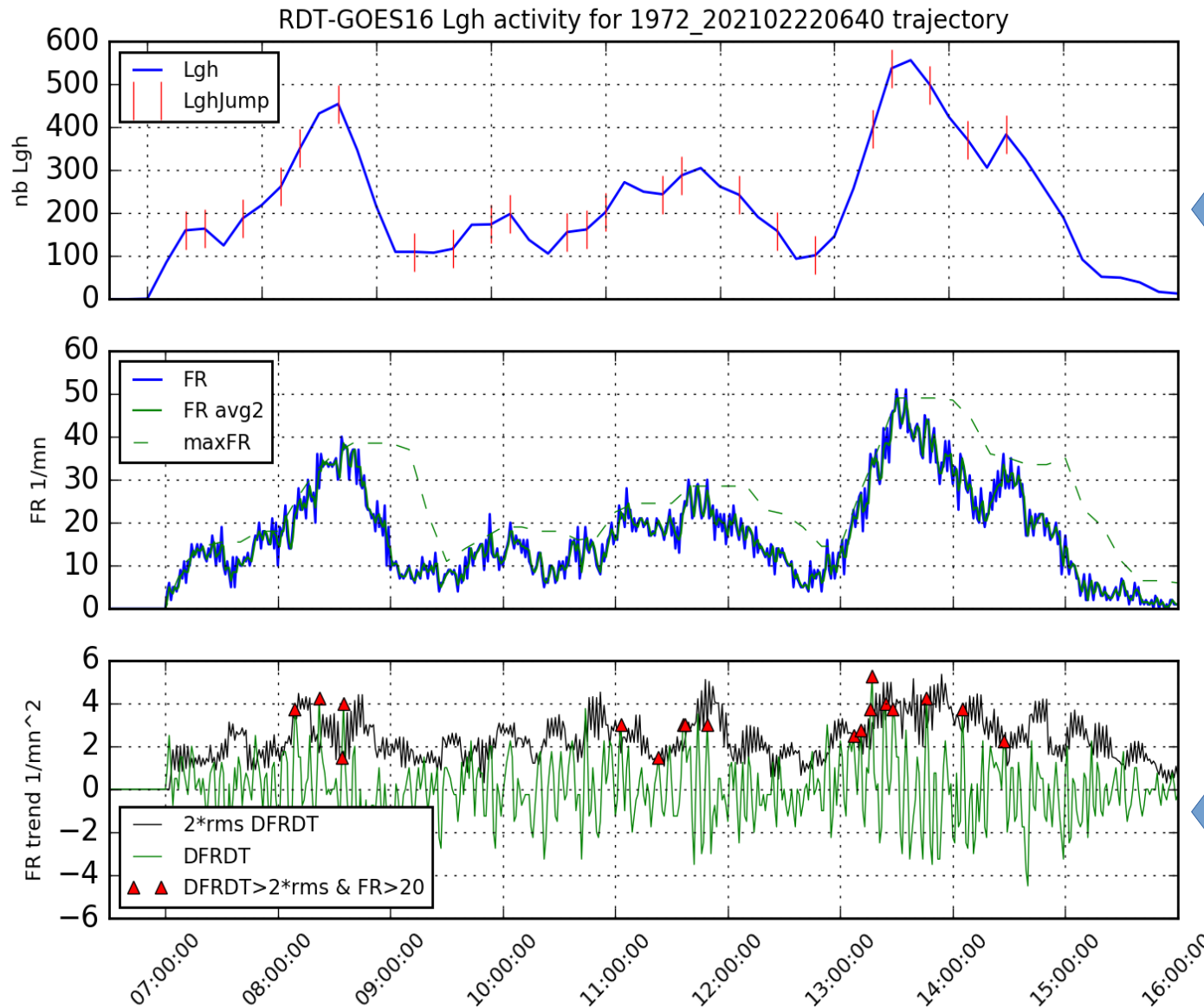
Lightning jumps detected (red bars) with the previous flash rate threshold of 10 min^{-1}

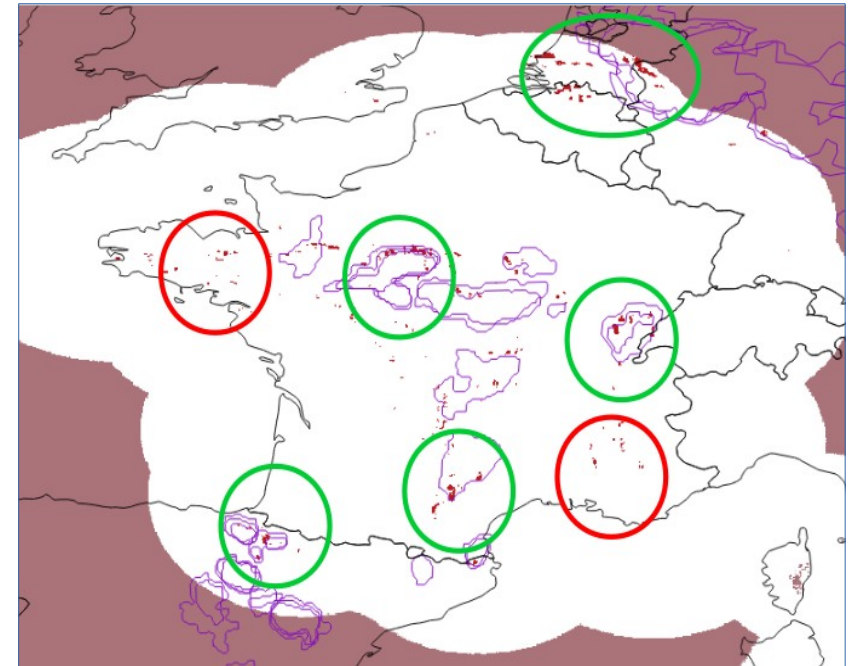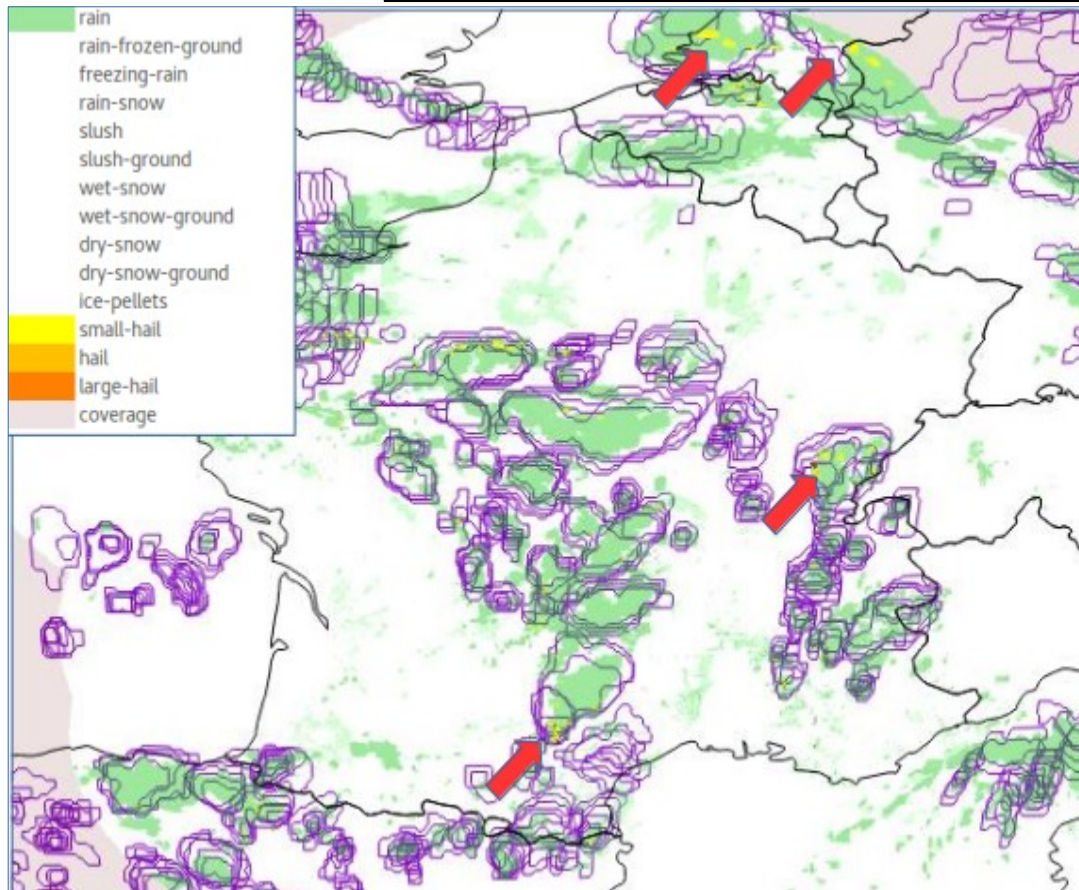Lightning jumps detected (red triangles) with the new flash rate threshold of 20 min^{-1}

Improvement and fine tuning of LJ algorithm needed for GLM data source See Felix Erdmann lecture at CWG
Automated Lightning Jump (LJ) detection from geostationary satellite data (Tuesday 17th May, 15:00 CEST)

Lightning Jump – case study RDT-CW vs. HYDRE

Left: cumulated [15h30;16h00] RDT-CW cells overlaid with [16h00;16h15] HYDRE product.
Right: filter on RDT-CW cells wih LJ and on hail diagnosis with HYDRE (red pixels)

Green circles: Good detections from RDT-CW
Red circles: Misses

Conclusion: usefulness of LJ diagnosis as precursor of hail

Overshooting Tops Detection: validation
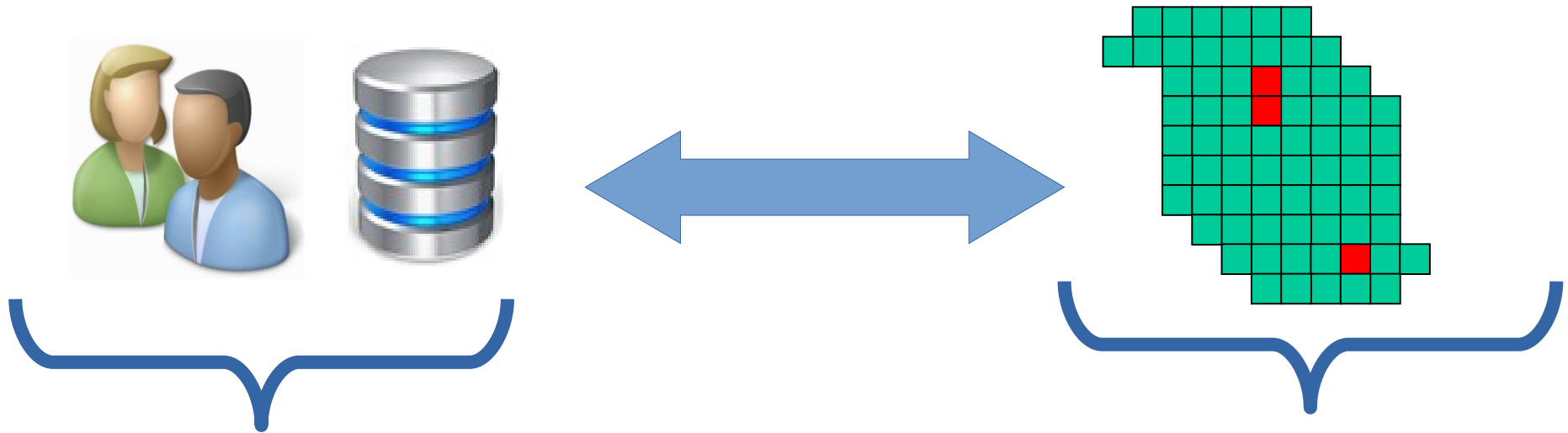
Expertised **CHMI OT database**
- **2.5'** experimental MSG1 scan *20130620 [09h-19h30] and 20130729 [13h-18h30]*
- *1800 OT identified over Central Europe*

Reprocessed **RDT** : 4 configurations
- *FDSS-15' and RSS-5'*
- *v2018 and v2021 version with use of HRV*

Pairing method between CHMI-OT and RDT-OT
- *Time tolerance: maximum 5' (RSS) or 15' (FDSS) between RDT-OT and CHMI-OT*
- *Spatial tolerance: 20 km maximum distance (~ mean OT size)*
- *Score calculation:*
  - ✔ *HIT: at least one RDT-OT associated to a CHMI-OT*
  - ✔ *MISS : CHMI-OT without associated RDT-OT*
  - ✔ *FA : RDT-OT without associated CHMI-OT*

Overshooting Tops Detection: scores
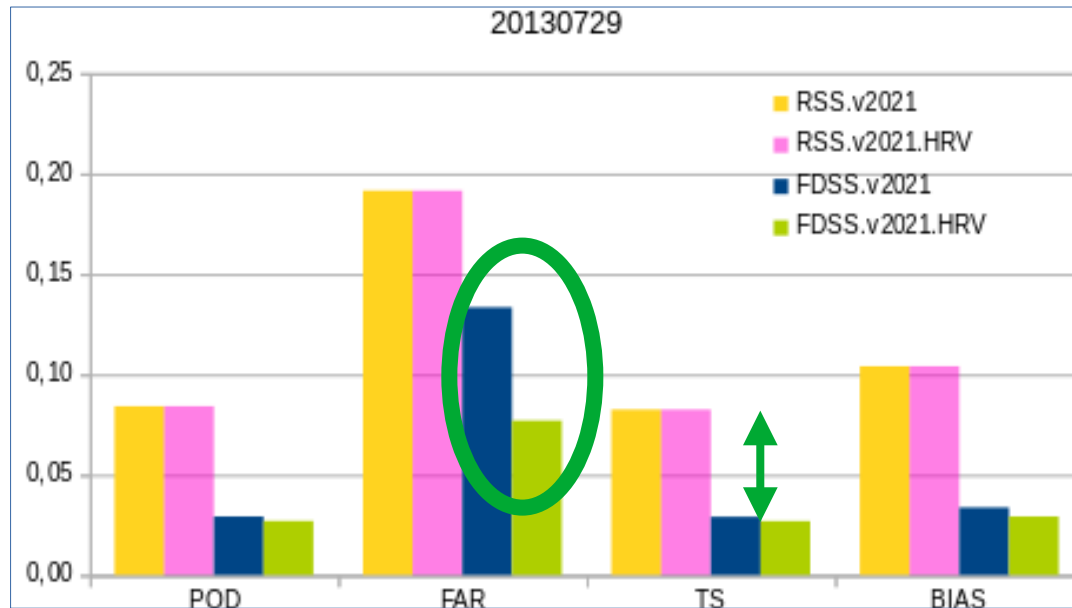
Probability of Detection, False Alarm Ratio, Threat Score and bias for a case study and the 4 different RDT-CW experiments (FDSS vs RSS mode, HRV vs no HRV use)
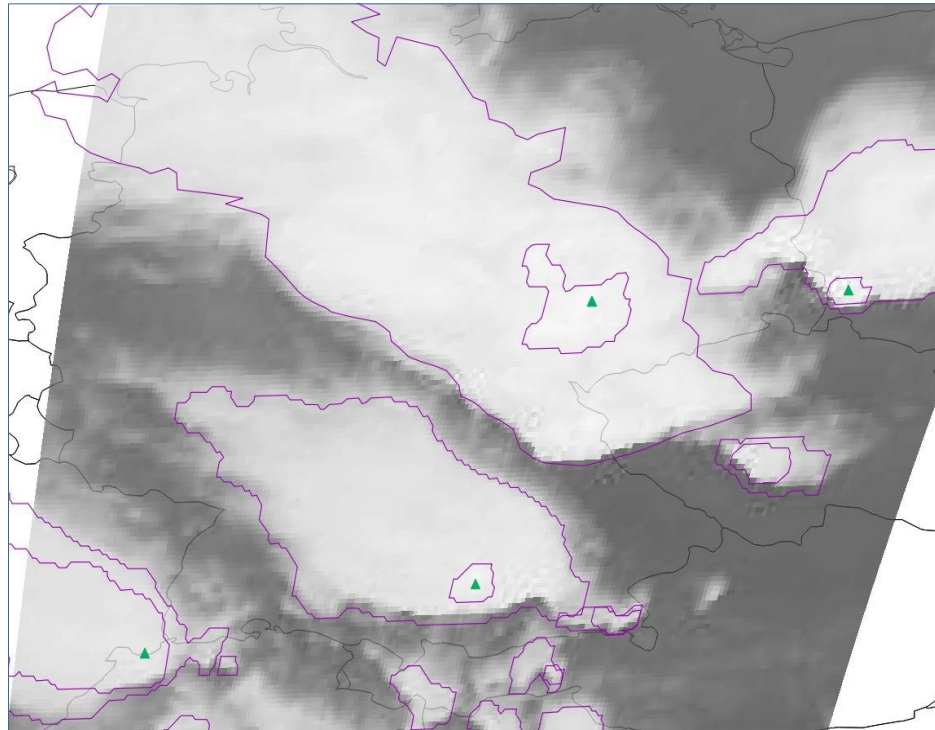
— Low POD (below 10 %) and quite high FAR

— Higher POD -but also higher FAR- with rapid-scan mode

— The use of high resolution for visible channel improves the scores of objective validation in some situations.

— NWCSAF Scientific report Q3 2022

Overshooting Tops Detection: case study

IR image with RDT-MSG cells from 16h30Z slot (+11 minutes for exact radiometer date) and OTDs as green triangles
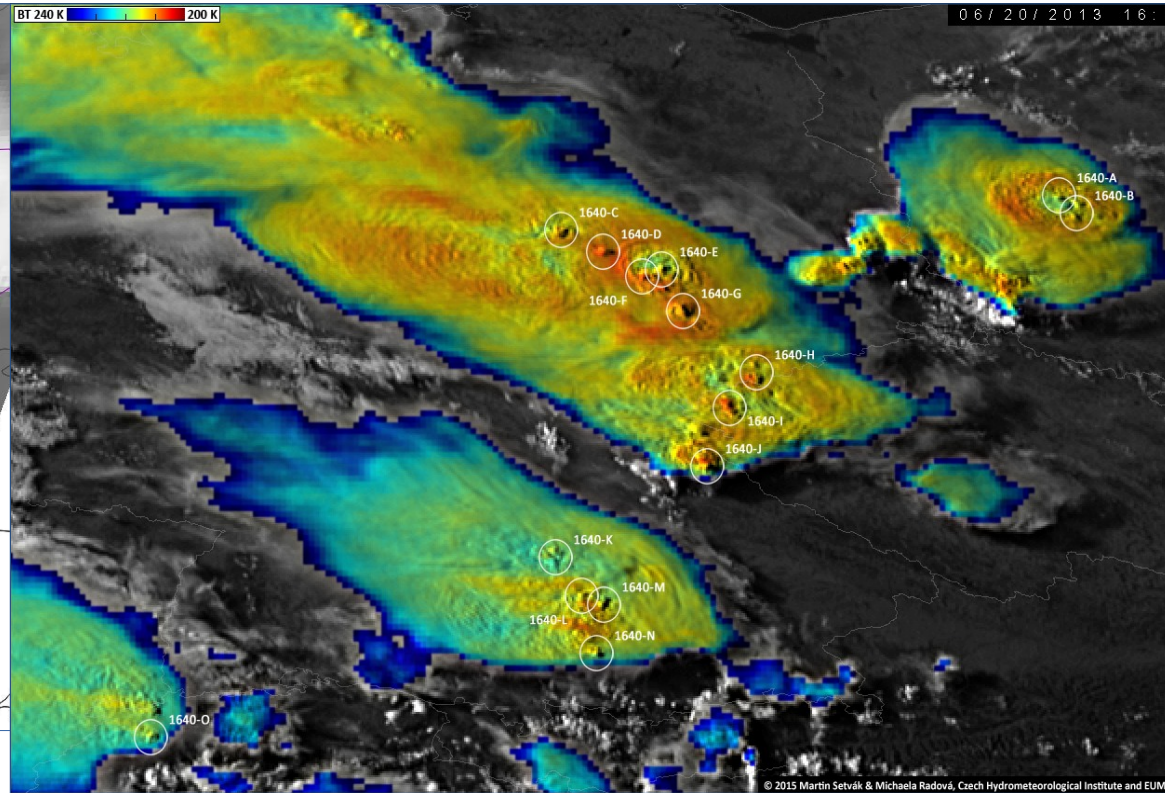
Sandwich image (HRV + IR10.8) with expertised OT for 16h40Z on 20th June 2013.

— 15 overshooting tops detected by the experts

— With RDT-CW, only one OT detection by cloud system

— 3 out of 4 are very closed to an expert-assessed OT. The fourth one is in the colder part of the system.

CWG meeting May 2022

ESSL Workshop 2022 MF feedback (1/2)

- "ESSL-EUMETSAT expert workshop on convective initiation and mature convective storms", 16-17/May/2022

- A first informal "NRT" feedback by MF, before ESSL final report of the workshop.

- ESSL feedback helps, for example several improvements of convection products in NWCSAF v2021 version inherits from previous ESSL workshop feedbacks

- Using handly and ergonomic ESSL Weather Data Displayer
- Four case studies exhibiting
  - Some <u>complex embedded</u> deep convection: limited added value of RDT and CI
  - Rapidly developing deep and intense convection: with appreciated behaviour of CI and RDT

NWCSAF Convection products

- Thanks for always constructive feedback
- CI: many FA. High importance of the environment. Up to now no prior Cumiliform/Stratiform distinction (foreseen in CDOP4) and limited use of NWP data

      1) Product to be seen as an input to deeper analysis – To be used with other products

      2) More intensive use of NWP data for a 2nd major step of CI developments

- RDT: wish of the users to focus on the convective cores of mature systems in the RDT cells, rather than the coldest part of it, but early growing stages appreciated, and sometimes full depiction of the cloud system

      => Investigate more detailed Cloud Top features detection (CDOP4)

      => Delineate contour(s) of active core(s) rather than cold top thanks to other data sources (MTG-LI or GOES-GLM 2D products, CRR, microphysical properties, etc.)
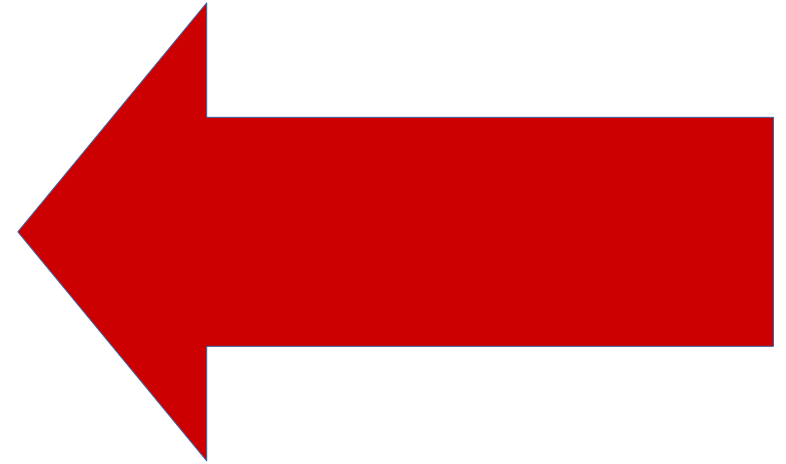
Other products

   - very interesting RGBs, complementary to convection products

   - 2D OT products appreciated. Interesting comparison with RDT cells and RDT-OTD.

Plan

1) Outcome of CDOP3

2) CDOP4 plans

CWG meeting May 2022

Human ressources

MFT in CDOP4 will be

- In Toulouse, part of Nowcasting Department

- Composed of 3 people up to 30/6/2023 : Jean-Marc Moisselin (LM), Frédéric Autonès, Michael Claudon.

- Frédéric will retire on 30/6/2023: many thanks for his contribution!!

- For CDOP4, and in addition to permanent staff members, Météo-France will recruit several person.months of non-permanent staff

- 14 p.m for VSA planned

WP 1411 (management)

WP 2040 (GEO-I NGI1 MTG Day 1)

WP 2240 (GEO-I NGI2 MTG Day 2)

WP 2240 (GEO-I NGI3)

WP 3340 (GEO-S Convection Sudies)

WP 4330 User Support and maintenance

WP 5300 User Training

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Functionalities planed (1/2)

- To take benefit of the last MTG datatest and the commissioning phase

- MTG/LI: a key point for improving convection products
    - CI: tuning, validation
    - RDT: tuning, validation, operation mode, attributes (e.g. LJ for cells over Africa)
    - Especially for the southern part of the disk where there is a lack of ground truth

- To take benefit of all other NWCSAF products:
    - Continuous development/improvement (all GEO)
    - New functionality as the cumiliform/stratiform distinction (MFL)
    - Upcoming of ASII-ICE (ZAMG)
    - Upcoming of lightning products (NMA)
    - Upcoming of sSHAI (AEMET)

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Functionalities planed (2/2)

- To improve existing behaviour of CI and RDT and adapt to MTG characteristics:
    - Use of rapid-scan (CI, RDT)
    - Higher spatial resolution (CI, RDT).
    - Probability assessment (CI)
    - Test of new IA technics (CI – decision tree, RDT – discrimination process)
    - Note: short-lived and high resolution sub-phenomena like overshooting top inside RDT cells to be improve

- To develop new functionalities
    - Analysis of MTG/IRS benefit for convection products
    - iSHAI (or sSHAI) as input of CI (no convection if no instability detected in previous hour)
    - CI as input of RDT
    - MBR attribute in RDT
    - Cloud top dynamic U/V-Ring attribute in RDT
    - CI under cirrus

CWG meeting May 2022

CDOP4 objectives in term of status

- GEO-RDT-CW: to keep the status operational

- GEO-CI: to upgrade from pre-operational to operational

Thanks for your attention !