

# On-going studies at EUM and future plans

IRS MAG 7<sup>th</sup> meeting,  
EUMETSAT, Darmstadt 16-17 May 2019

*Thomas August  
+ Tim Hultberg, Cédric Goukenleuque  
and external study teams (credits in the slides)*



## On-going studies

- Assimilation of IASI L2 T/q in regional model (M-F)
- Assimilation of IASI L2 T/q in global model (ECMWF)
- Instability monitoring from IASI in view of IRS (OMSZ)
- Hyperspectral sounding for severe storm forecasting (ESSL)

## Imminent

- IRS Retrievals and Applications at high Satellite Zenith Angle.

## Planned

- Assimilation of reconstructed radiances in NWP (ITT)
- Utilisation of reconstructed radiances for AC (2 ITTs)
- (FRM for validation/monitoring hyperspectral sounding)

# Assimilation of IASI L2 T/q profiles in regional NWP (Météo-France)

## External study with Météo-France, using EARS-IASI L2 products

### Objectives:

Evaluate the feasibility and impact of assimilating the IASI L2 as pseudo-sondes in a regional model

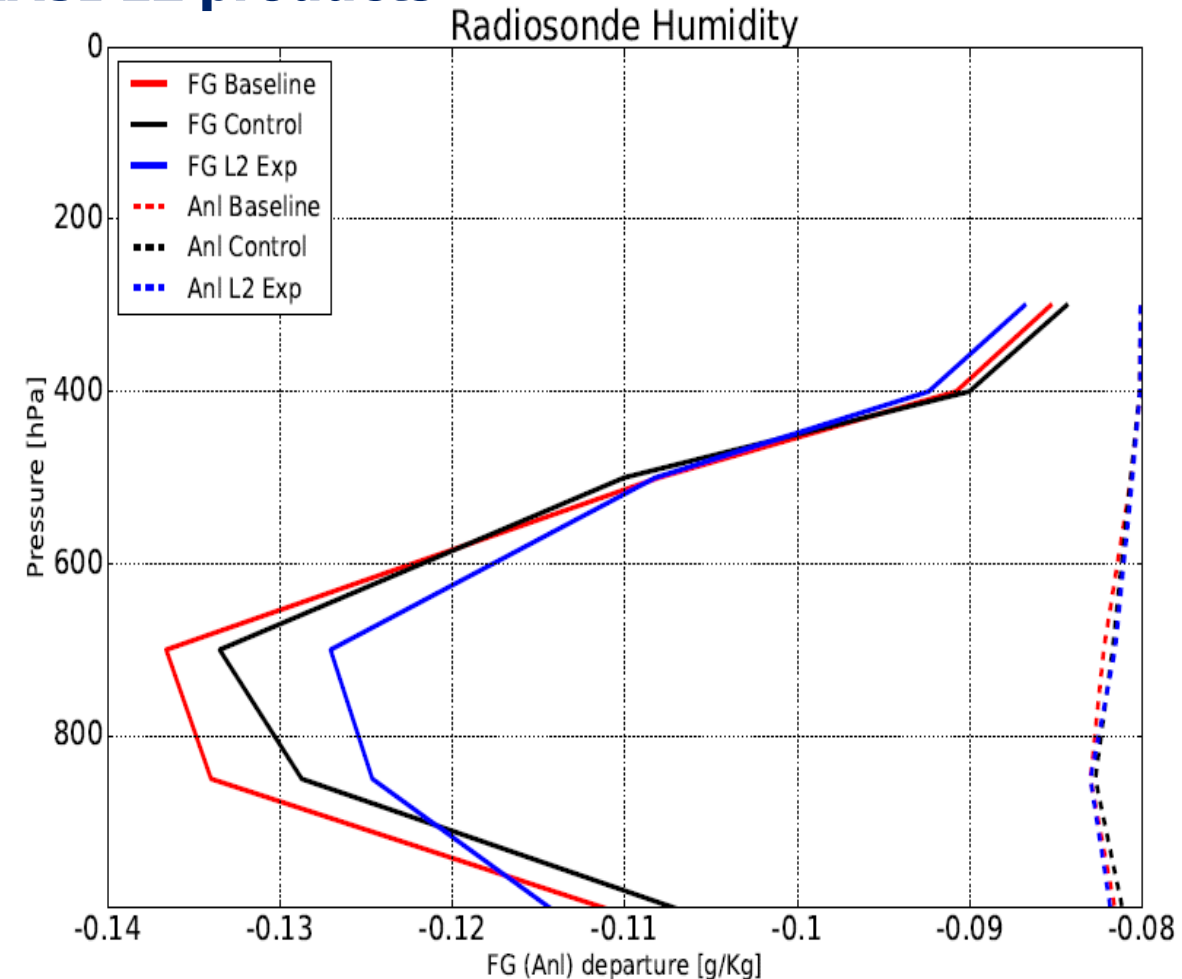
### Status at IRS MAG-6:

- ✓ IASI L2 suitable for assimilation in NWP
- ✓ First experiment: 160km ; 1-in-3 level thinning
- ✓ Positive impact on forecast biases *vs in situ* obs.
- ✓ Diagonal error (pseudo-sondes)
- ✓ Based on IASI L2 v6.3

### Since then:

- Experimented other (diag.) error characterisation
- Extended study period
- Ingested IASI L2 v6.4 (ope. since March 2018)

Credits: Bruna Silveira, Vincent Guidard, Nadia Fourrié



*"Potential benefits of assimilating Metop combined retrieval L2 products in AROME-France", EUM Conference Tallinn 2018*

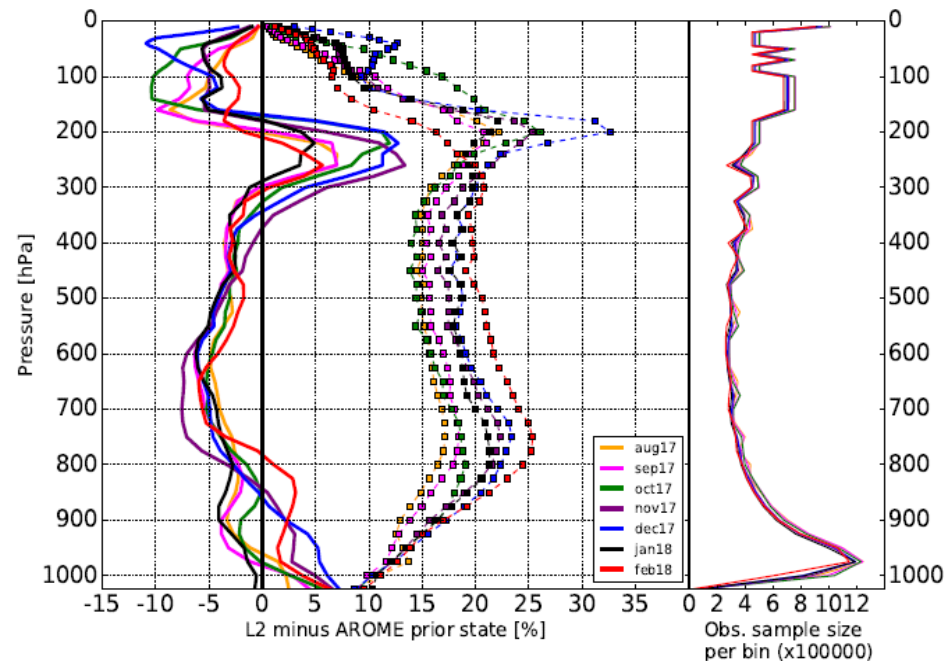
# Assimilation of IASI L2 T/q profiles in regional NWP (Météo-France)

Project: Assessment of the operational potential of assimilating IASI L2 in a regional model

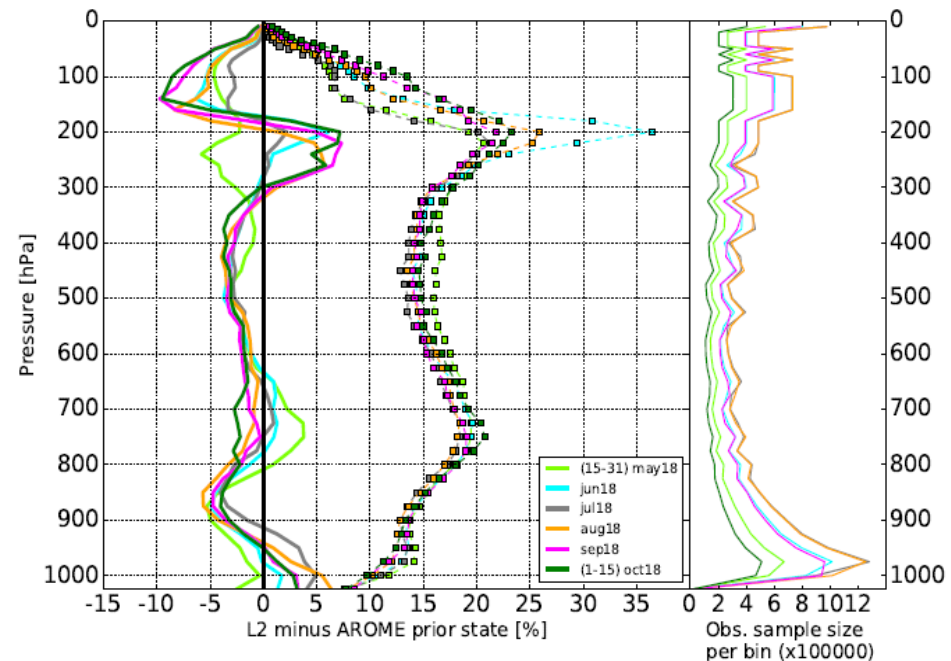
└ Evaluation of the MetOp combined retrieval L2 product v6.4

## L2 product X AROME - Monthly Variation

Relative Humidity - **V6.3**



Relative Humidity - **V6.4**



# Assimilation of IASI L2 T/q profiles in regional NWP (Météo-France)

## Experiments Period 1: January and February/2018 - Done

## Experiments Period 2: July, 15th to Sep, 15th/2017 - Done

## Experiments Period 3: May, 15th to Jul, 15th/2018 - In Progress

**Observations assimilated** : radar measurements, surface stations, buoys, ship, aircrafts, wind profilers, radiosondes, ATMS, SSMIS, GMI, SEVIRI, ASCAT and GPSSOL

Experiment	Configuration
Baseline	No IASI, AMSU-A and MHS data
Control	Baseline + IASI, AMSU-A and MHS L1 product
L2 Experiment	Baseline + L2 product



# Assimilation of IASI L2 T/q profiles in regional NWP (Météo-France)

Project: Assessment of the operational potential of assimilating IASI L2 in a regional model

└ Recap and Results of data assimilation experiments

## Case Studies

Thomas August suggested 2 case studies.

**Experiments Case Study 1:** May, 26th 2018

Hail storm in Bordeaux and Cognac

**Experiments Case Study 2:** July, 4th 2018

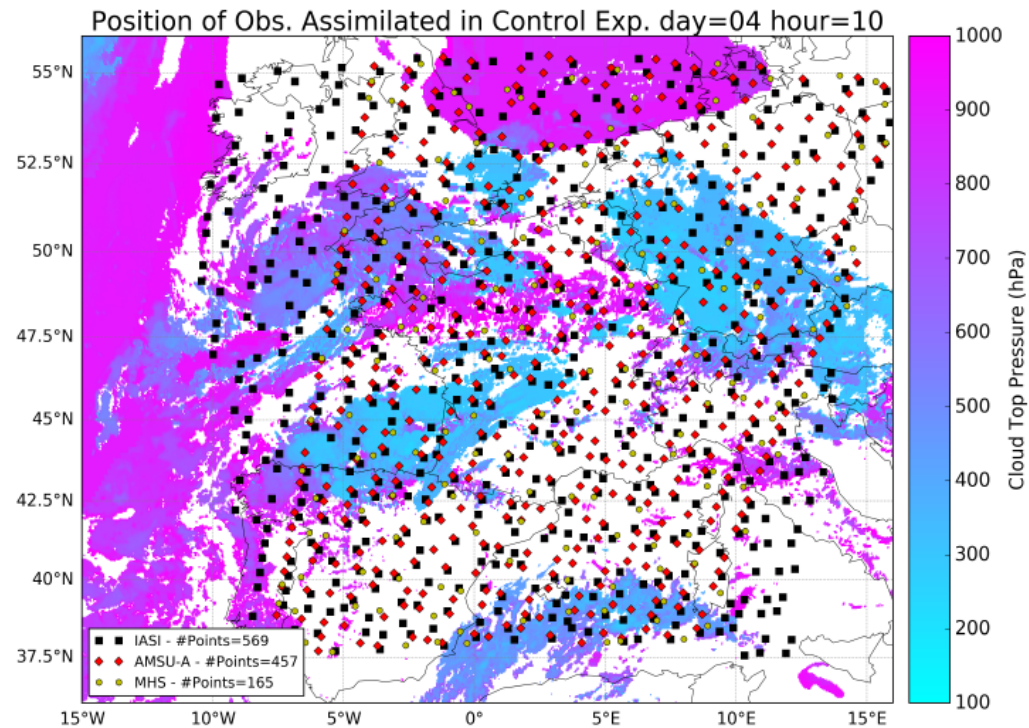
Storm in Dordogne



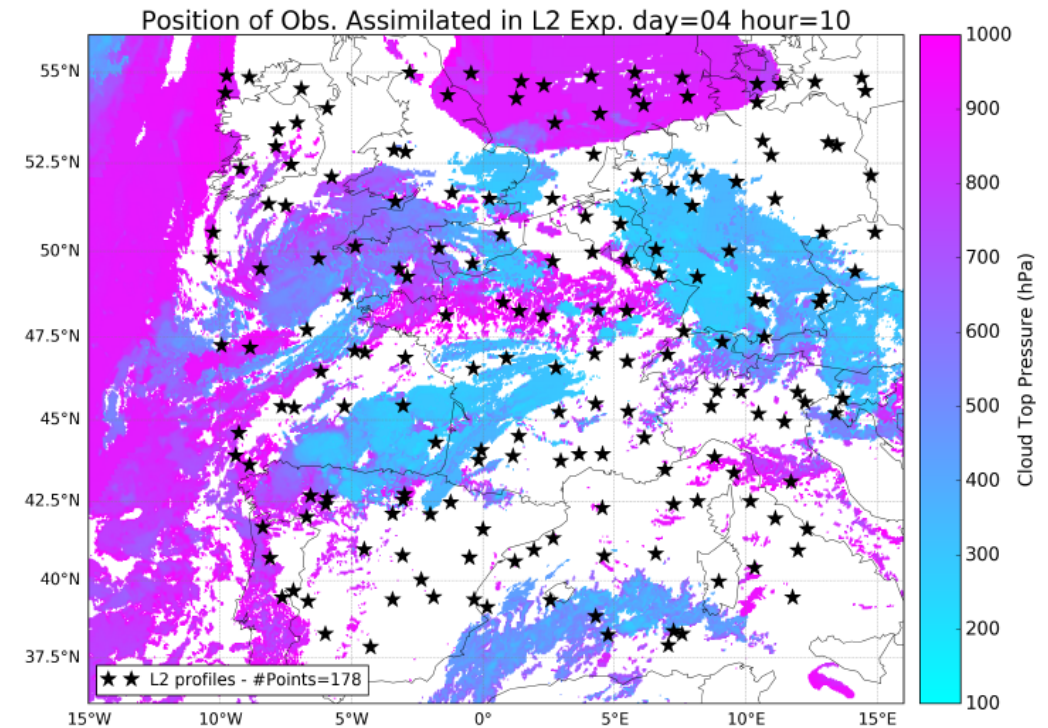
# Assimilation of IASI L2 T/q profiles in regional NWP (Météo-France)

## Position of Observation Assimilated - Case Study 2

### Control Experiment



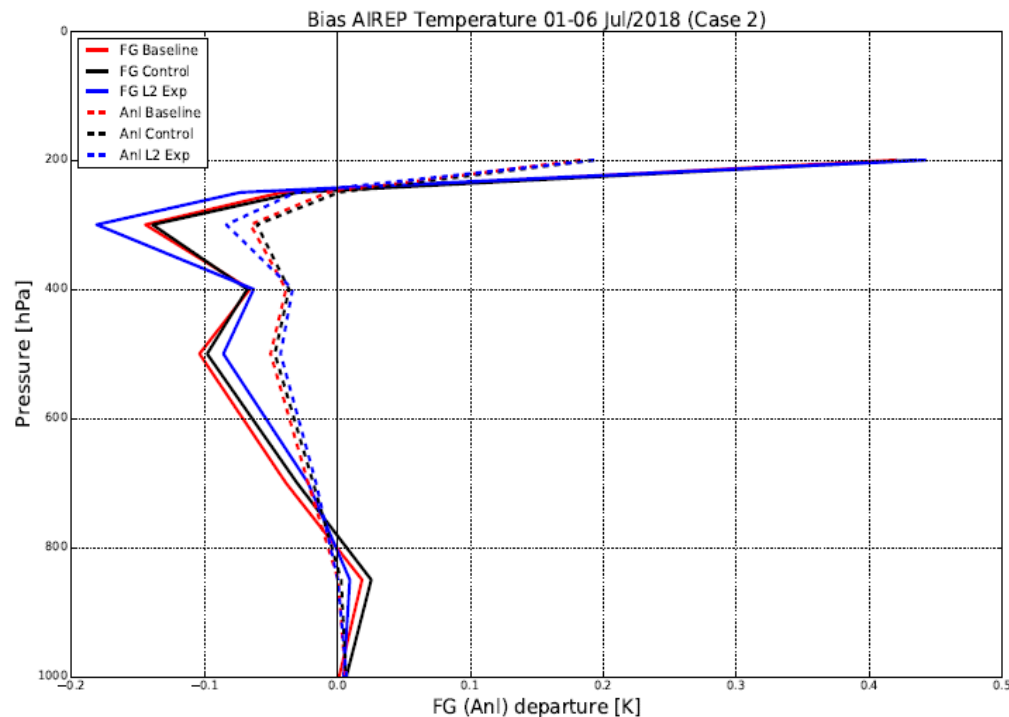
### L2 Experiment



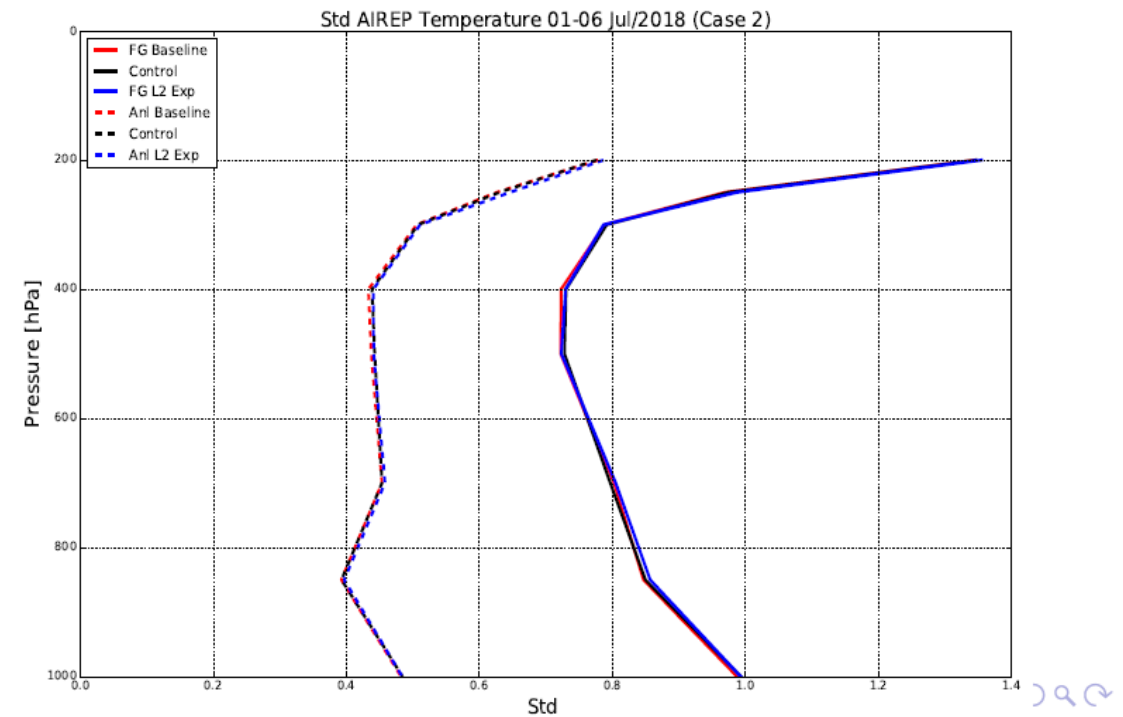
# Assimilation of IASI L2 T/q profiles in regional NWP (Météo-France)

## Impact in others observations July, 1st to July, 6th 2018 AIRCRAFT Temperature

### Bias



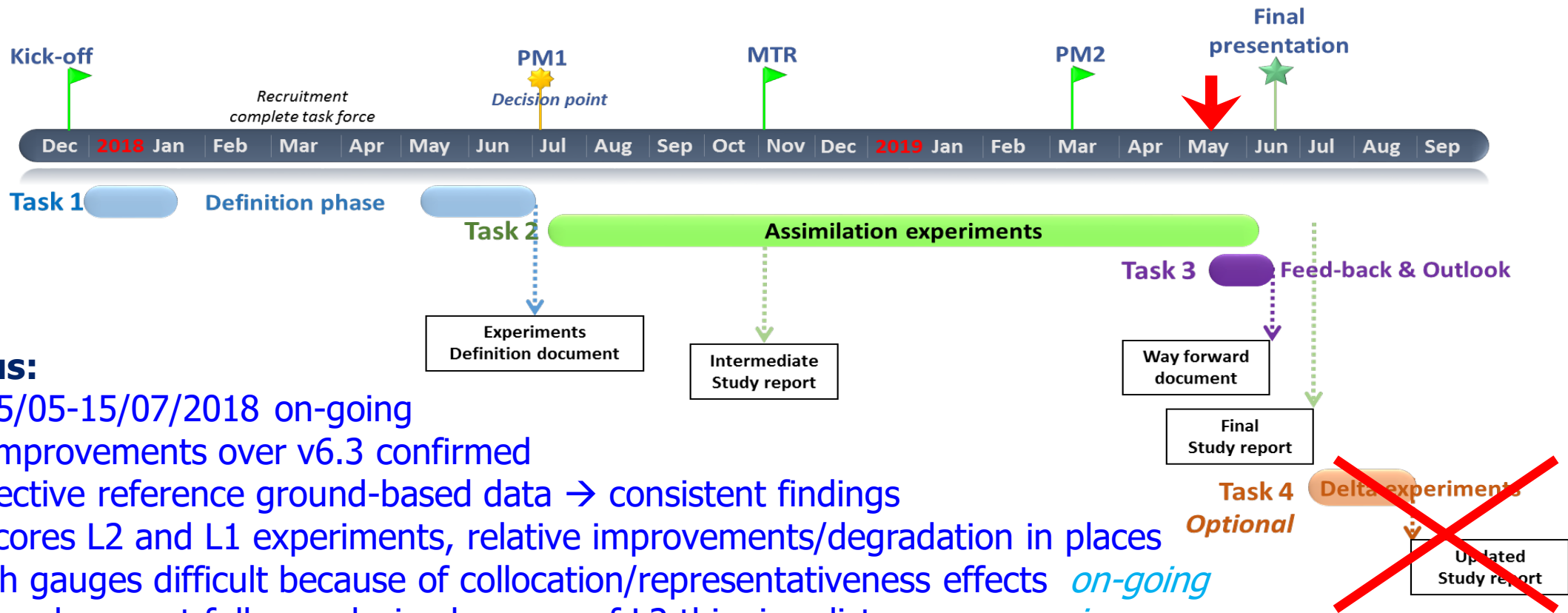
### Standard Deviation



81 / 87



# Assimilation of IASI L2 T/q profiles in regional NWP (Météo-France)



## Summary status:

- Assimilation 15/05-15/07/2018 on-going
- IASI L2 v6.4 improvements over v6.3 confirmed
- Additional objective reference ground-based data → consistent findings
- Comparable scores L2 and L1 experiments, relative improvements/degradation in places
- Evaluation with gauges difficult because of collocation/representativeness effects *on-going*
- Case studies, analyses not fully conclusive because of L2 thinning distances *on-going*
- Baseline exp. "hard to beat" given wealth of info assimilated already (ground, *in situ*, GEO...)

## Next steps:

- Complete additional experiments and analyses + Way forward document
- Final presentation 19 June 2019 – report finalised till mid-July

# Assimilation of IASI L2 T/q in global NWP model (ECMWF)

## Summary status

- ✓ Approaching end of initial study phase (July 2019)
- ✓ Assimilation framework in place, several experiments carried out
- ✓ QC (clear-sky good quality) and thinning strategy in place
- ✓ Large work to characterise L2 error structure, including covariance is essential
- ✓ Difficult to improve on Temperature, handling vertical structure of L2 T in BDL problematic in places
- ✓ Potential with L2 Humidity, some positive impact

## Outlook

- Build on initial study effort → extension of 6 month until end 2019.
- Focus on humidity and potential of assimilating some cloudy retrievals

➔ *Tony's talk*

# Instability monitoring from IASI in view of IRS (OMSZ, Hungary)

## Follow-up study IR-only - 1 year, kick-off January 2019

- Evaluate potential of IASI L2 in IR-only mode, **as proxy for IRS** and in comparison to MW+IR perfos.
  - ➔ Comparison to SEVIRI GII
  - ➔ Case studies
- Identify and study situations where FCT and L2 differ significantly ➔ routine monitoring in place
- Assess potential and practicalities of **blending ground-based and satellite L2 for instability monitoring**

*Study performed by Maria Putsay, Zsolia Kocsis, Kalman Csirmaz (OMSZ)*

## Since first study (2017-2018)

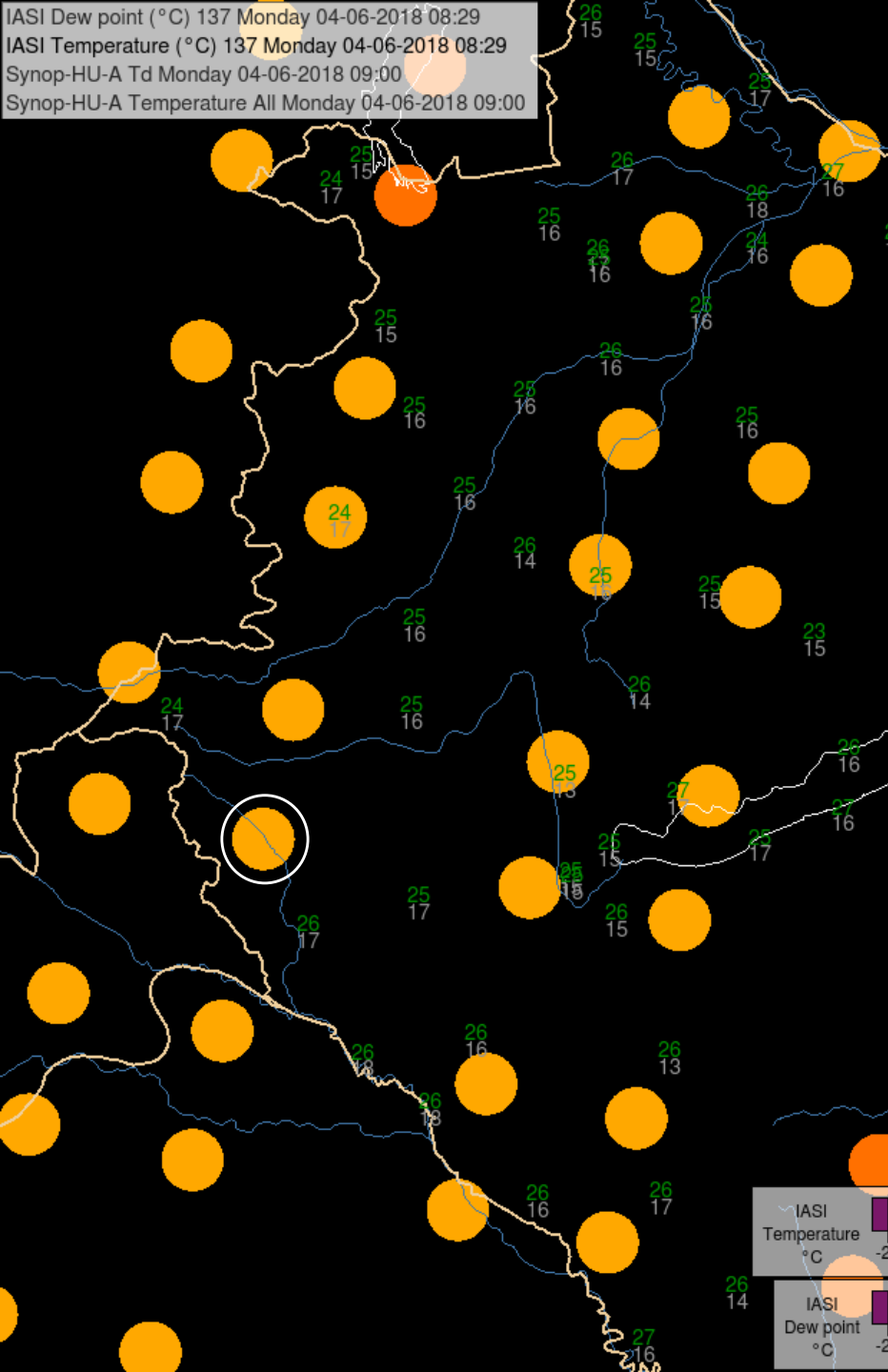
- ✓ T/q profiles routinely ingested in weather monitoring facility at OMSZ since August 2018, training of forecasters ongoing.
- ✓ Presentation at EUM User Conference 2018. *Kocsis et al., "Possible usage of IASI L2 Profiles in Nowcasting"*

## Excerpts from an early case study

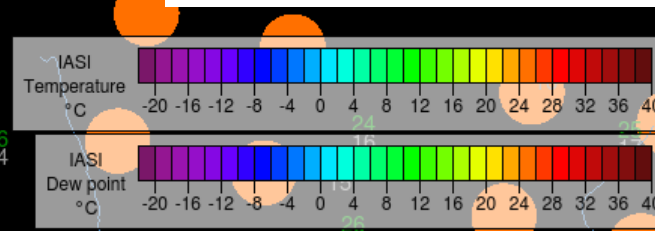
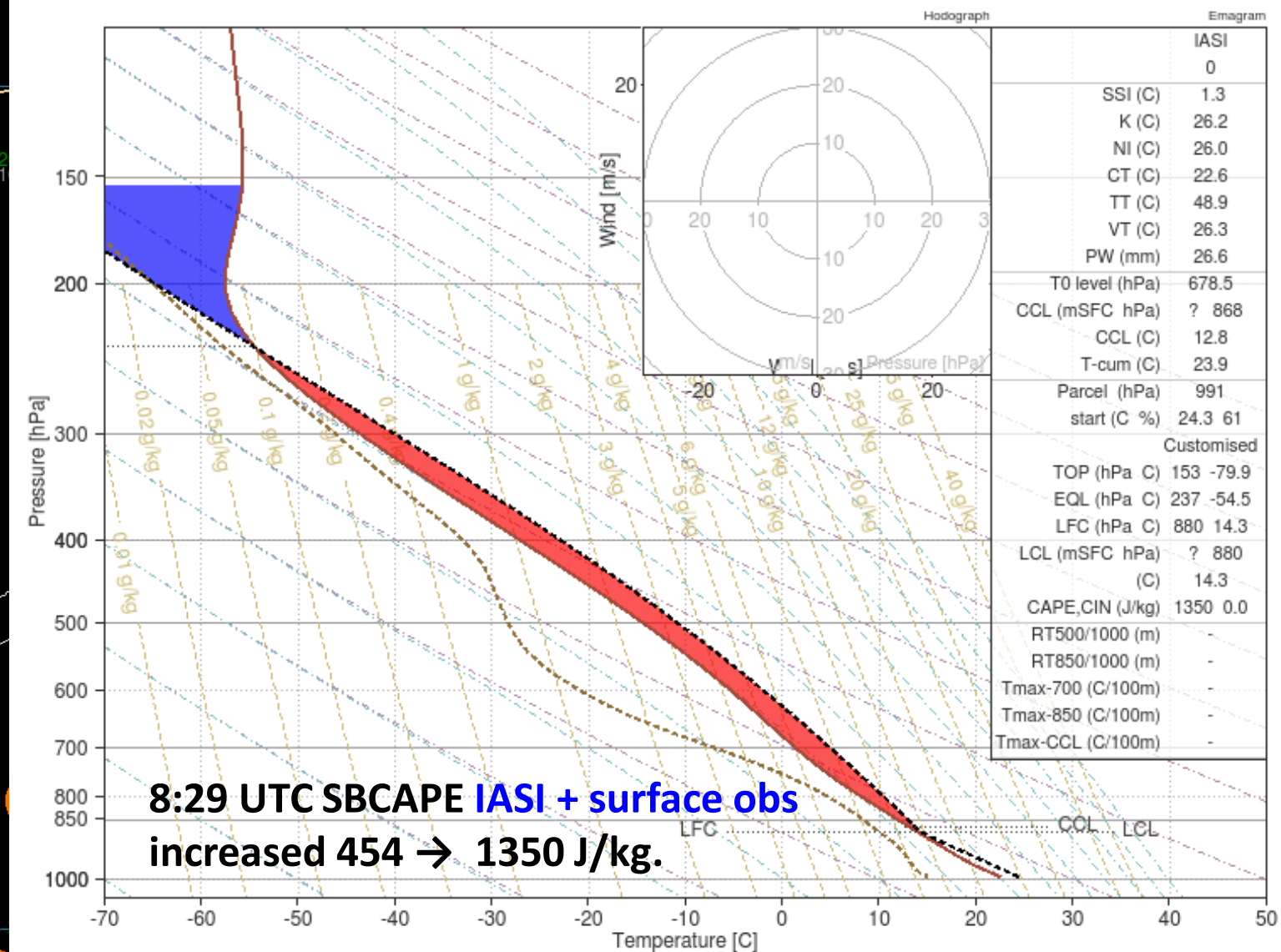
- Deep convective thunderstorm
- Slovenian border
- 4 June 2018 at 10 UTC
  
- IASI overpasses 08:29 and 09:11
- ECMWF forecasts 8 and 9 UTC
- Blending IASI L2 (and NWP FCT) with ground-based to evaluate SBCAPE



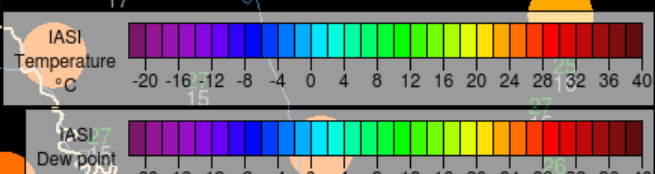
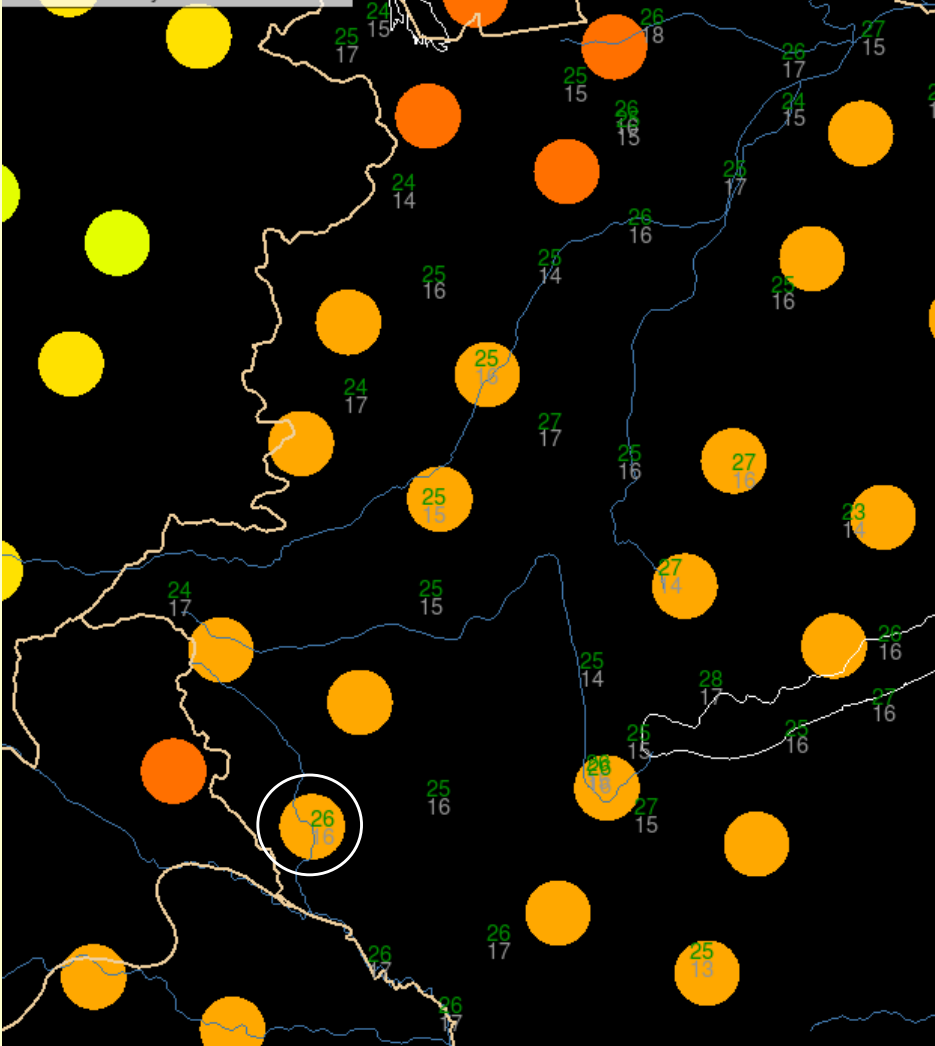
IASI Dew point (°C) 137 Monday 04-06-2018 08:29  
IASI Temperature (°C) 137 Monday 04-06-2018 08:29  
Synop-HU-A Td Monday 04-06-2018 09:00  
Synop-HU-A Temperature All Monday 04-06-2018 09:00



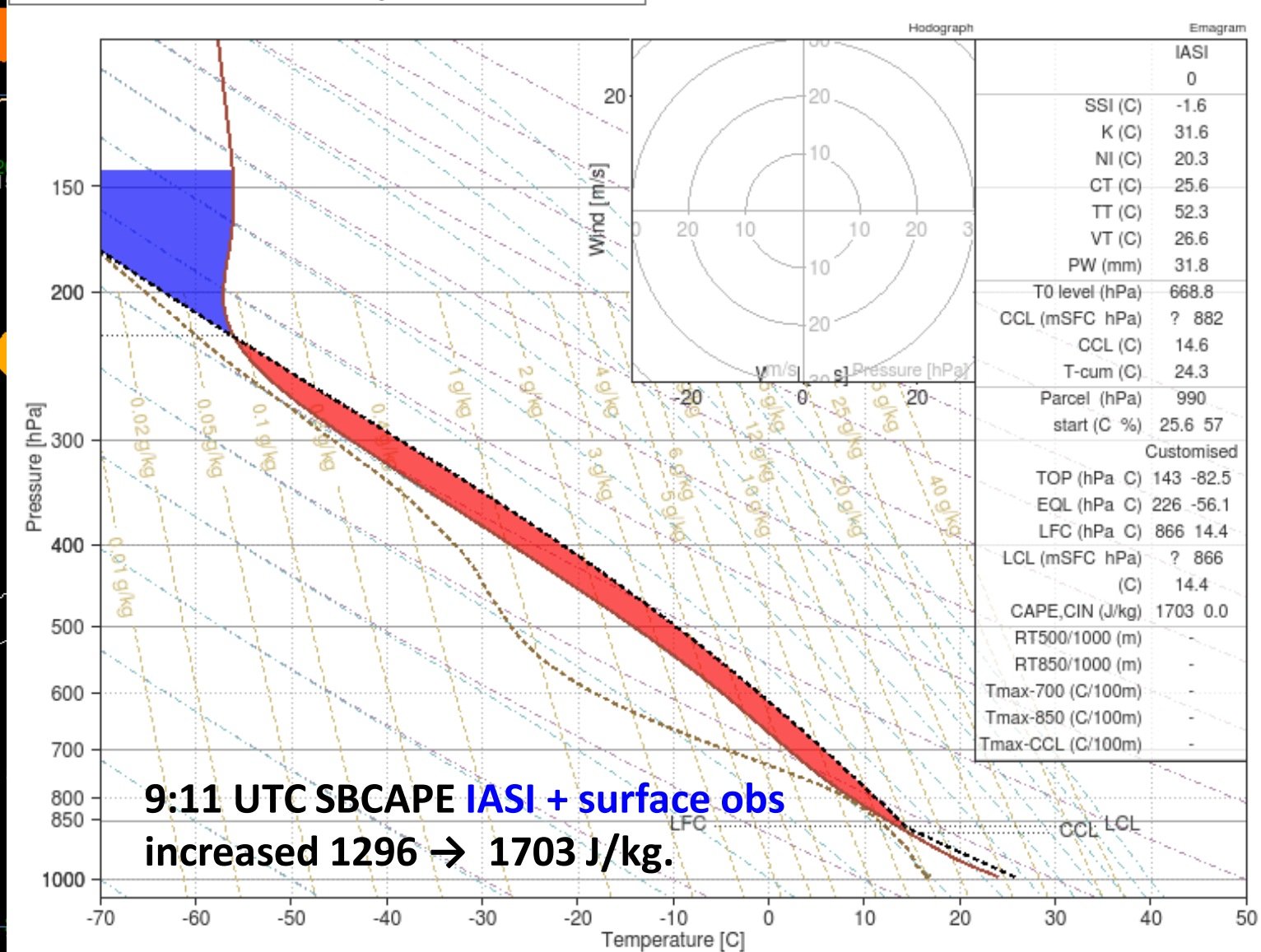
IASI-GRID Fi: 46.73 La: 16.51 Monday 04-06-2018 08:29



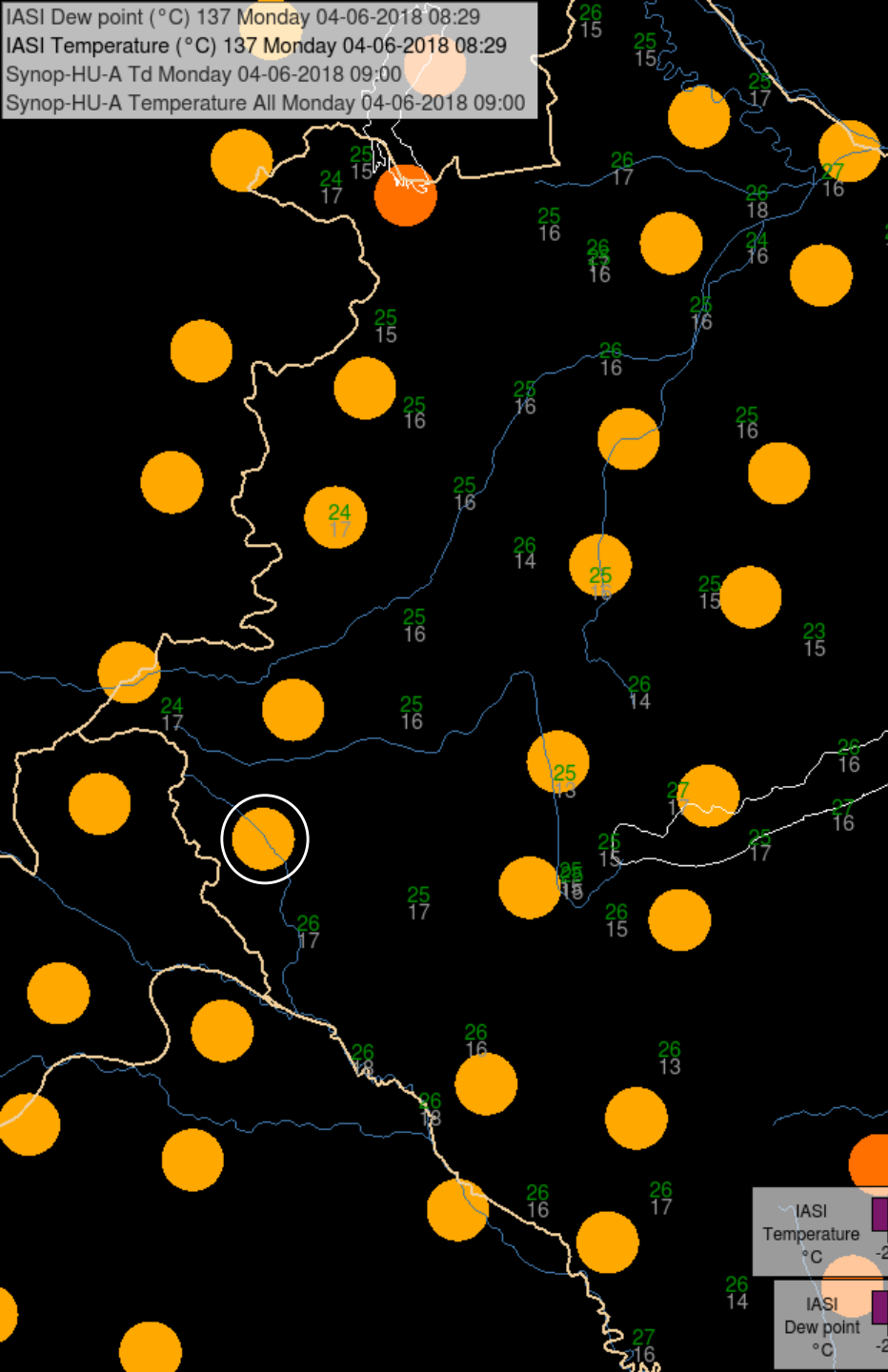
37 Monday 04-06-2018 09:11  
137 Monday 04-06-2018 09:11  
Monday 04-06-2018 09:10  
Monday 04-06-2018 09:10



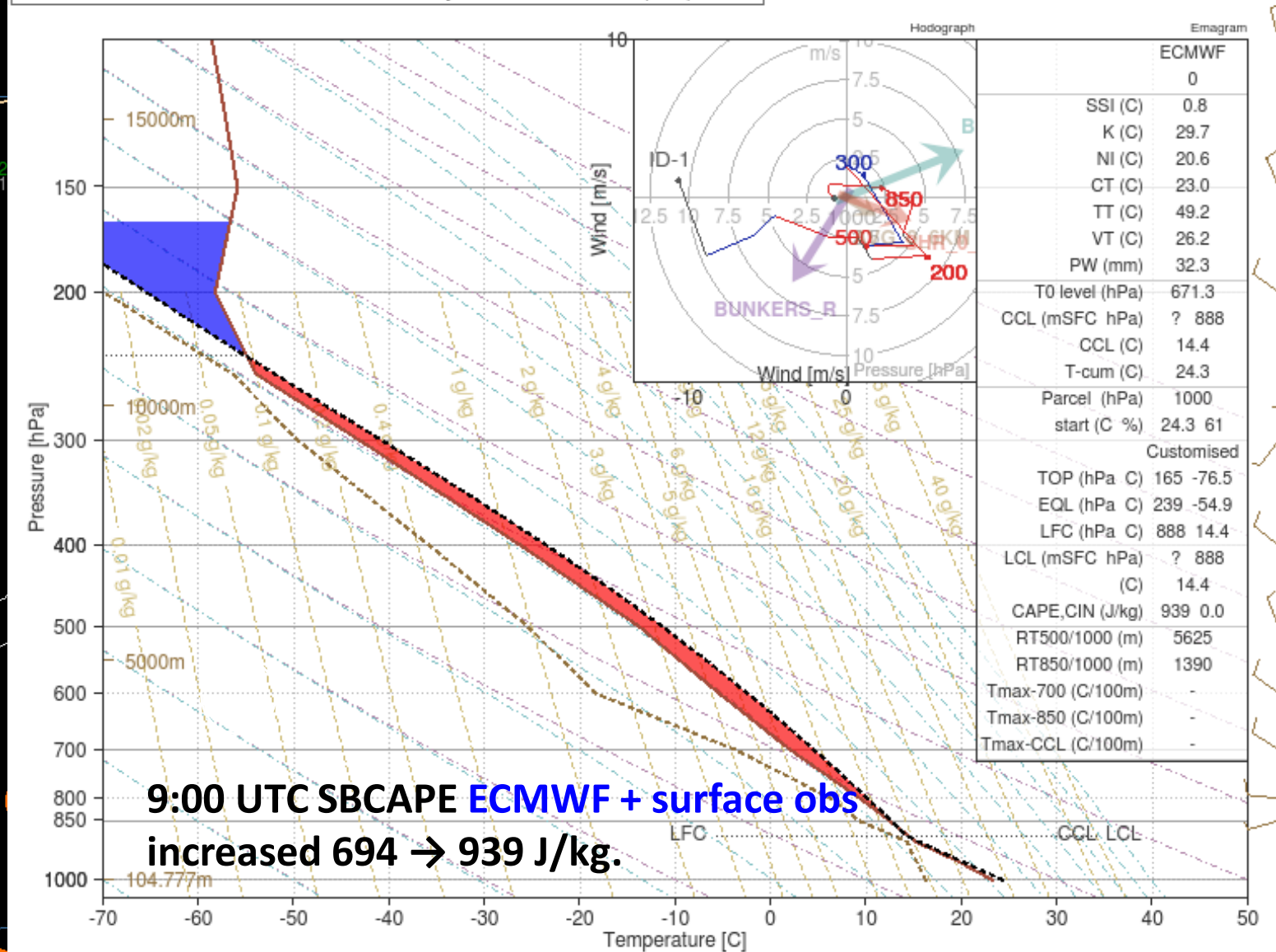
IASI-GRID Fi: 46.60 La: 16.56 Monday 04-06-2018 09:11



IASI Dew point (°C) 137 Monday 04-06-2018 08:29  
IASI Temperature (°C) 137 Monday 04-06-2018 08:29  
Synop-HU-A Td Monday 04-06-2018 09:00  
Synop-HU-A Temperature All Monday 04-06-2018 09:00



ECMWF-H-GRID Fi: 46.74 La: 16.50 Monday 04-06-2018 09:00 (+9h) .....



**IASI lapse rate higher in this case,  
yielding larger CAPE.**



# ESSL – Raise user awareness, organise tests and collect feed-back

**European Severe Storm Laboratory (ESSL)** is a non-profit association established in 2006 with the mission to perform and support research in severe weather forecasting in Europe, coordinating test beds, experiments and workshops with European forecasting offices. ESSL membership includes a number of EUMETSAT NMHSs (e.g. DWD, KNMI, MetOffice, FMI, etc.) as well as ECMWF.

The **objectives** of the procurement in view of MTG-IRS are:

- to **raise awareness and train European forecasters** with products derived from EUMETSAT hyperspectral Infrared sensors for the prediction of severe storm.
- to **collect feed-back from European users to evaluate and consolidate the requirements** on hyperspectral products and associated services for short-term severe weather forecasting.
- to **constitute a catalogue of relevant cases**, to serve as test bed for algorithms experiments, case studies and feed into products and services developments.
- to **perform detailed case studies** by ESSL experts from the above catalogue with existing L2 products.





# Hyperspectral sounding for severe storm forecasting (ESSL)

## One-year study:

- ✓ **Kicked-off January 2019**
- **Test beds: 3-7 and 24-28 June and 1-5 July 2019 + 15-19 July 2019 (experts week)**

## Status:

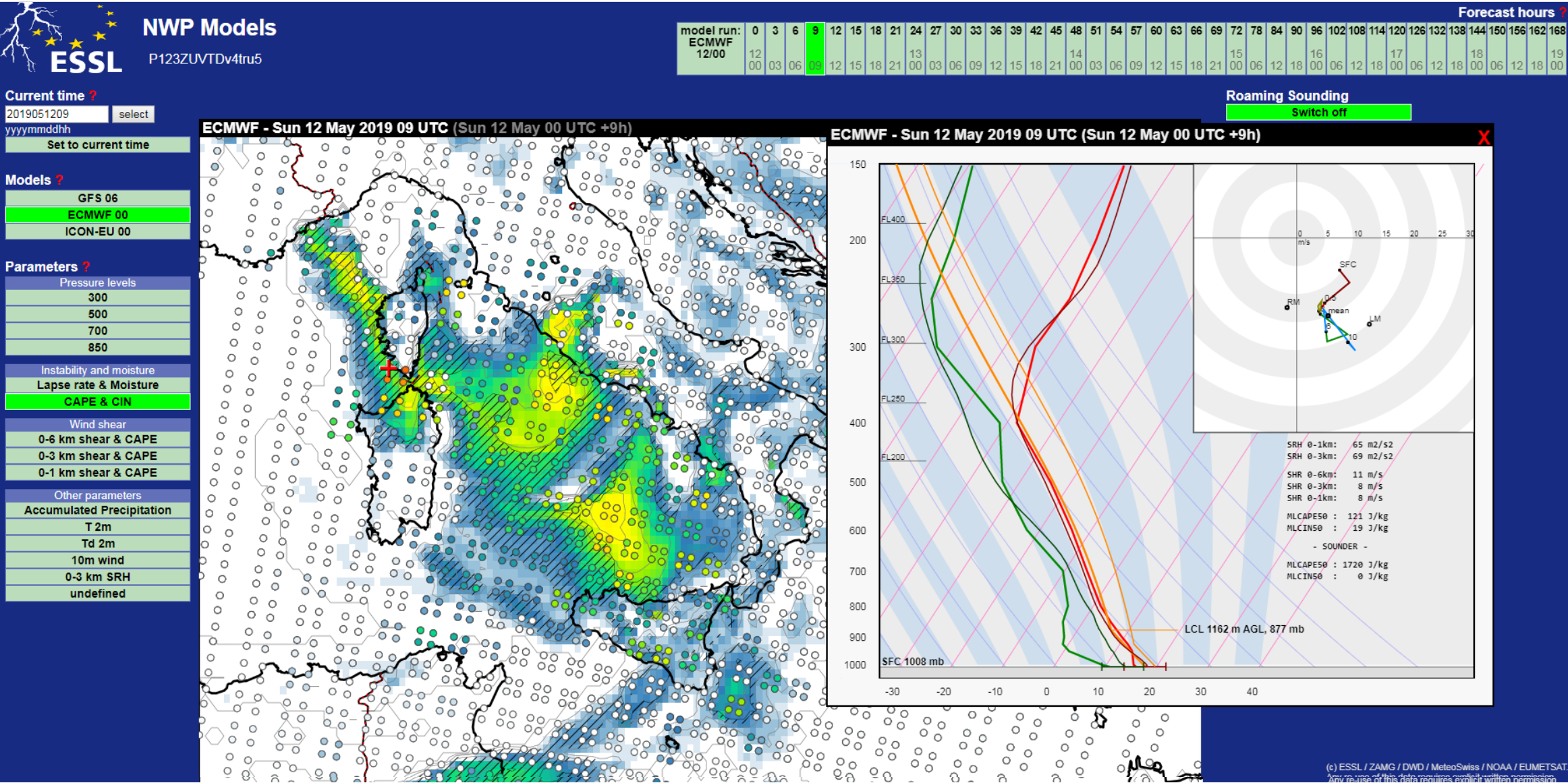
- ✓ **A couple of weather cases of interest identified already (01 and 10 August 2017)**
- **Adding Cognac and Dordogne events (26 May and 4 July 2018)**
- ✓ **Weather monitoring facility adapted to IASI L2 → routinely ingested from EARS-IASI service**
- ✓ **Defined sets of convective parameters to be displayed and presented in test bed**
  - **Lapse rate quantities**
  - **Integrated WV layers**
  - **Surface- and Mixed-layer CAPE and CIN (convective inhibition), ...**

## Next steps:

- **Test beds: presentation of the satellite products, feed-back from forecasters (Summer)**
- **Catalogue of situations of interest (severe weather, signal expected at IASI overpass time, NWP models divergent information...)**
- **Investigations by ESSL experts on selected cases**

*Study team: Pieter Groenemeijer, Tomas Pucik, Alois Holzer*

# Hyperspectral sounding for severe storm forecasting (ESSL)



# Outline

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## Imminent

- IRS Retrievals and Applications at high Satellite Zenith Angle.

## Planned

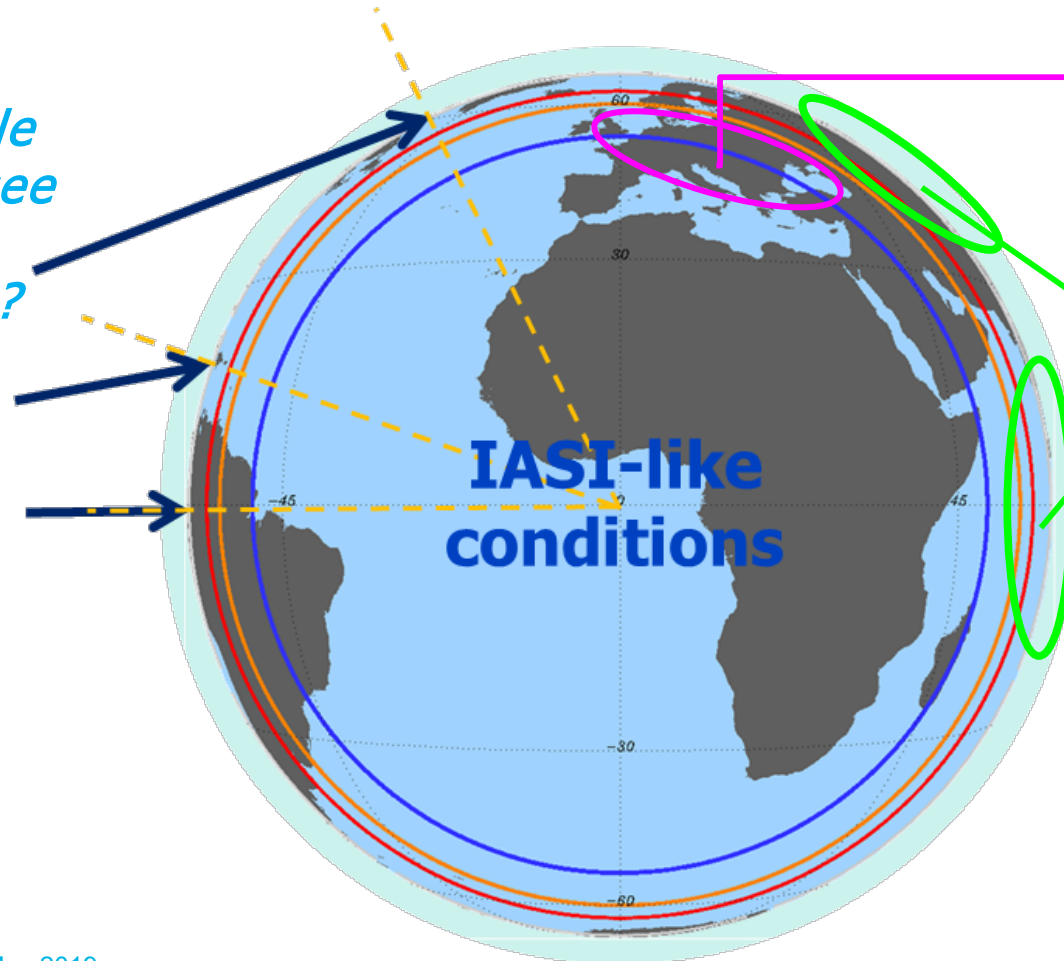
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# Upcoming study: IRS Retrievals and Applications at high Satellite Zenith Angle

- Vertical sensitivity, resolution and sounding precision varies with viewing angle
  - ➔ Quantify with representative set of atmospheric states
  - ✓ Contract awarded, kick-off to follow shortly

## *Surface emissivity:*

- Up to which zenith angle does it matter (do we see the surface)?
- Angular model needed?



*Viewing angle limit to derive useful tropospheric information for instability monitoring?*

## *Quasi-limb sounding:*

- Process studies  $O_3$ ,  $H_2O$  in UTLS?
- New applications at high angles?
- Specific algorithms needed?



# Planned studies

PC compression = baseline for IRS L1b NRT dissemination

Assimilation of reconstructed radiances in NWP (ITT)

Utilisation of reconstructed radiances for AC (2 ITTs)

- ➔ Fostering PC product uptake – User readiness
- ➔ Compile set of rare AC signal
- ➔ Study practical aspects of compression/utilisation (e.g. hybrid eigenvectors, core basis update, retrieval algorithms applicability...)

HSIR atmospheric products validation and monitoring

FRM for validation/monitoring hyperspectral sounding – e.g. GRUAN, campaign

- ➔ Short-term for IASI, preparatory to IRS Cal/Val and monitoring design

# Summary

**On-going:** First set of studies, part of dialog with Users to consolidate requirements and study assimilation of L2

- ✓ Some positive signs and limitations of L2 profiles used in NWP models
- ✓ Narrowing sets of (instability) parameters to be generated, to be presented to and studied with forecasters

**Upcoming:** Applications, limitations and potential at high viewing angles

**Planned:** User readiness and applications with reconstructed radiances

*Thank you for your attention!*  
*Questions?*