

# Exploiting cloud- and precipitation-sensitive observations of microwave imagers at ECMWF

EUMETSAT Fellow Day 2026

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\*Funded by EUMETSAT under the Fellowship Programme

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# Outline

1

The importance of passive microwave observations

2

PhD works : All-sky assimilation of passive microwave sensors in the 3DENVar AROME-France system

3

All-sky assimilation of microwave imagers in the IFS system

4

Challenges

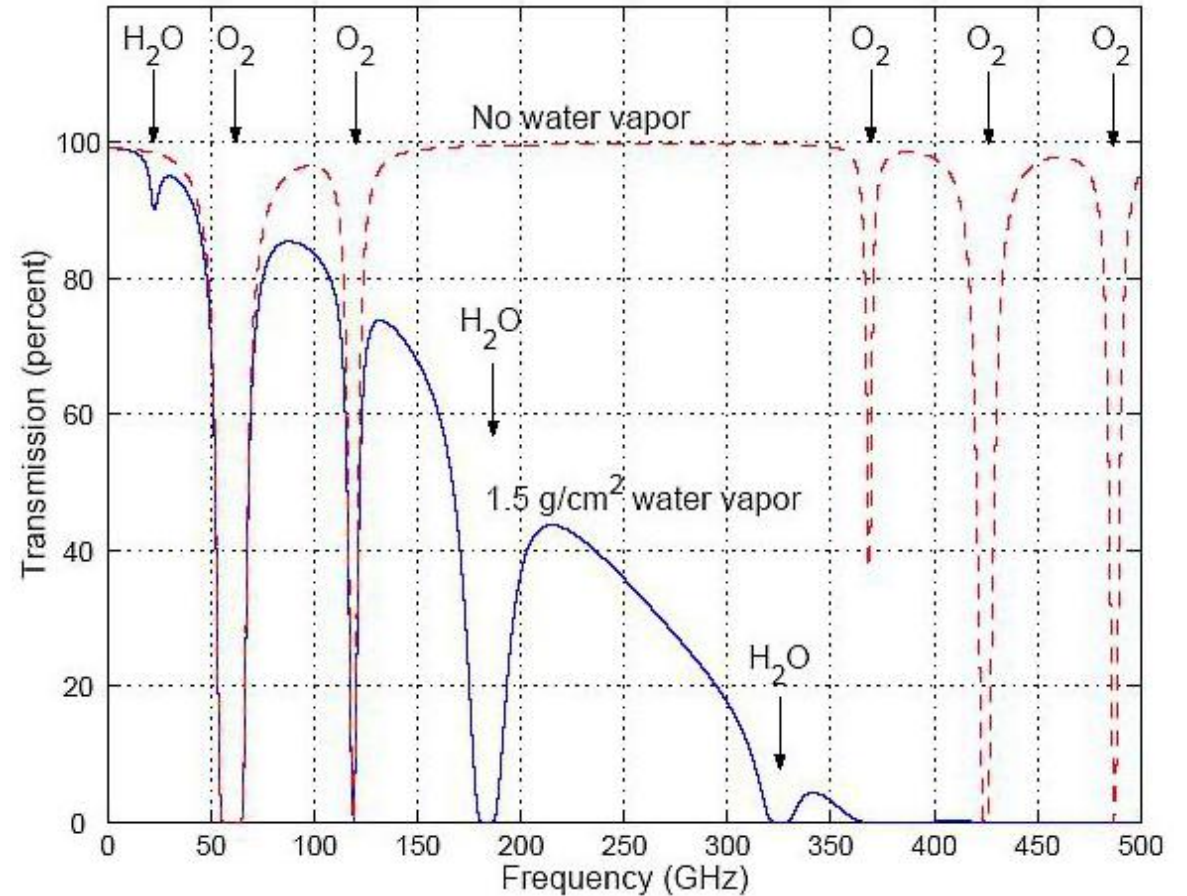
5

Plans for this year

# 1. The importance of passive microwave observations

Credit: <https://cimss.ssec.wisc.edu/>

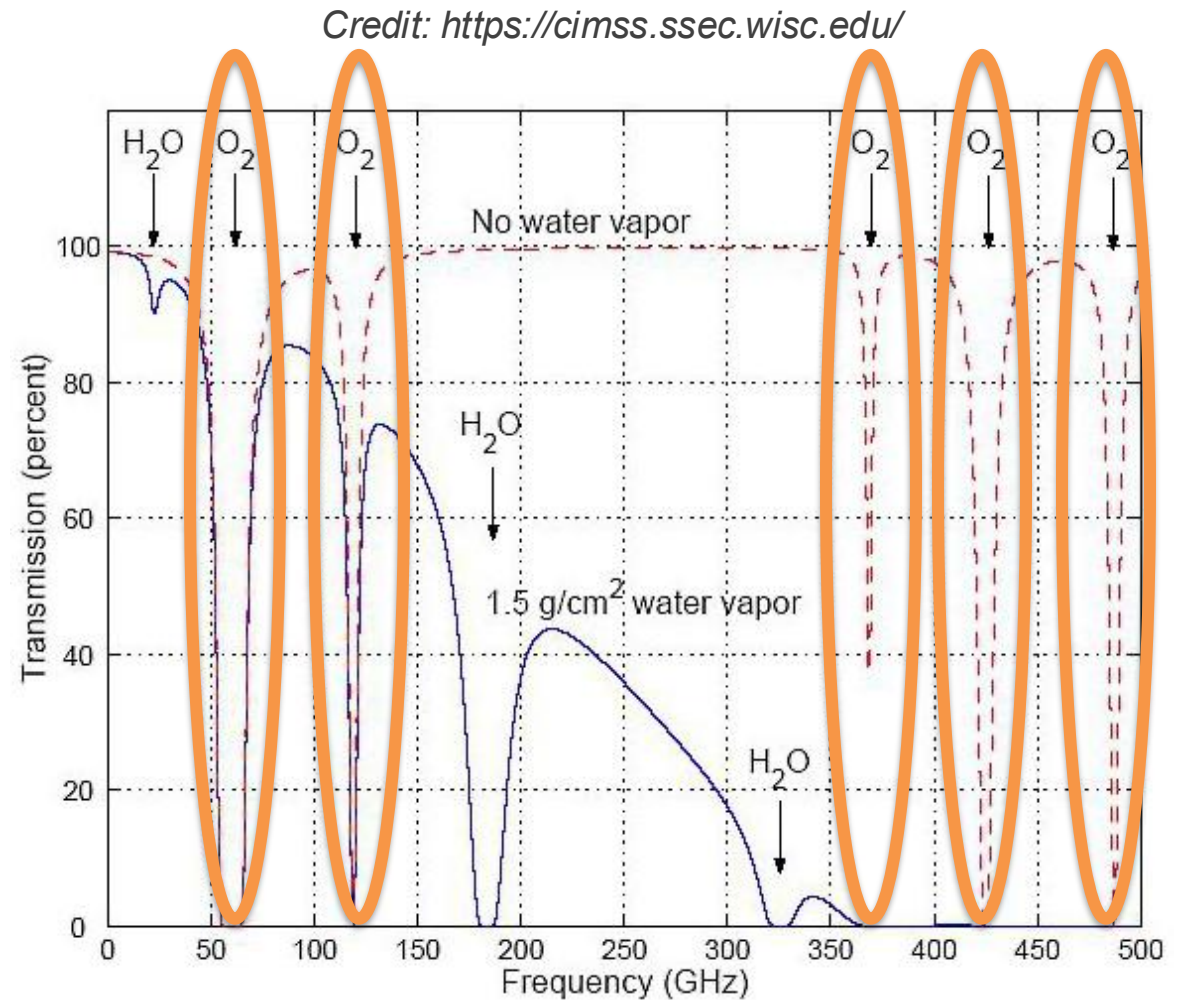
→ Information on various variables :



# 1. The importance of passive microwave observations

→ Information on various variables :

- Temperature

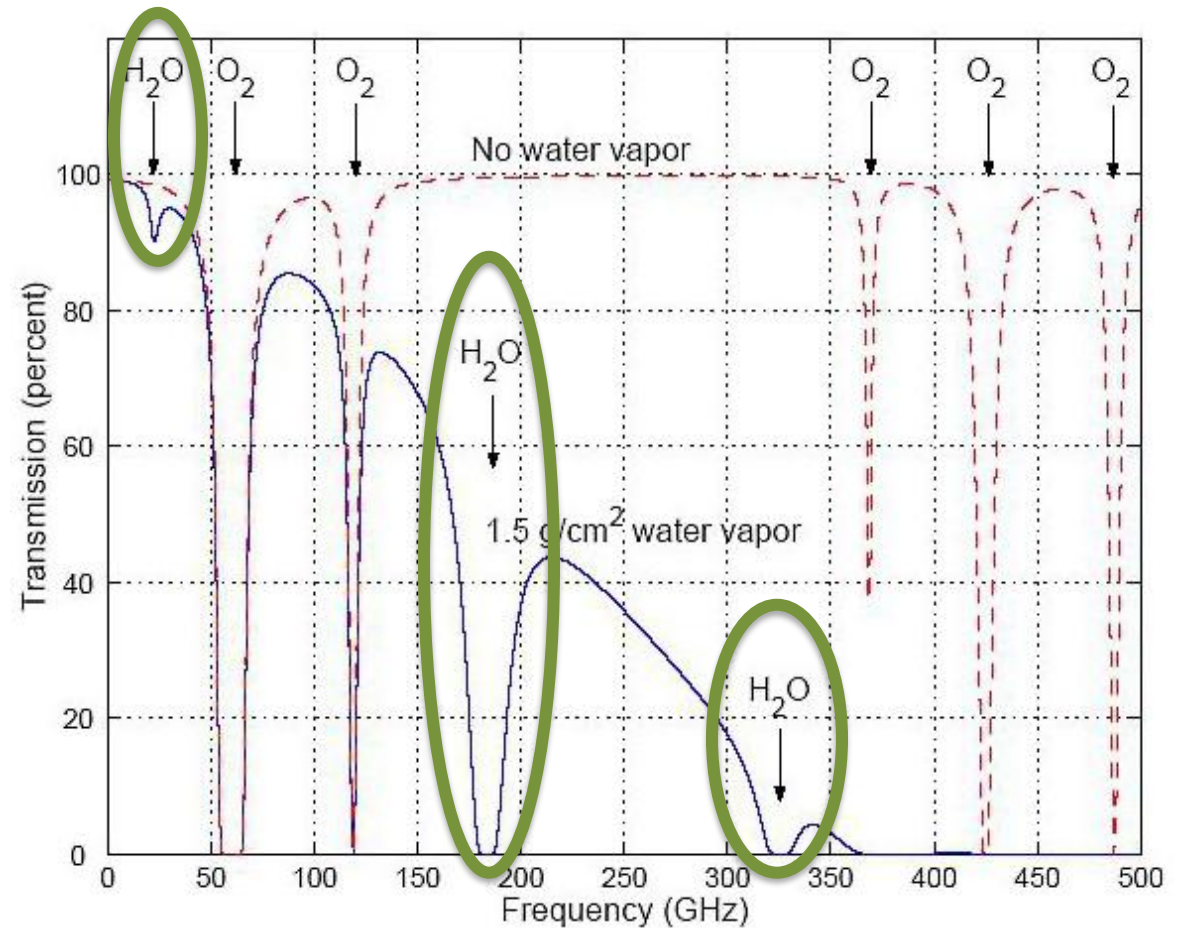


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→ Information on various variables :

- Temperature
- Humidity

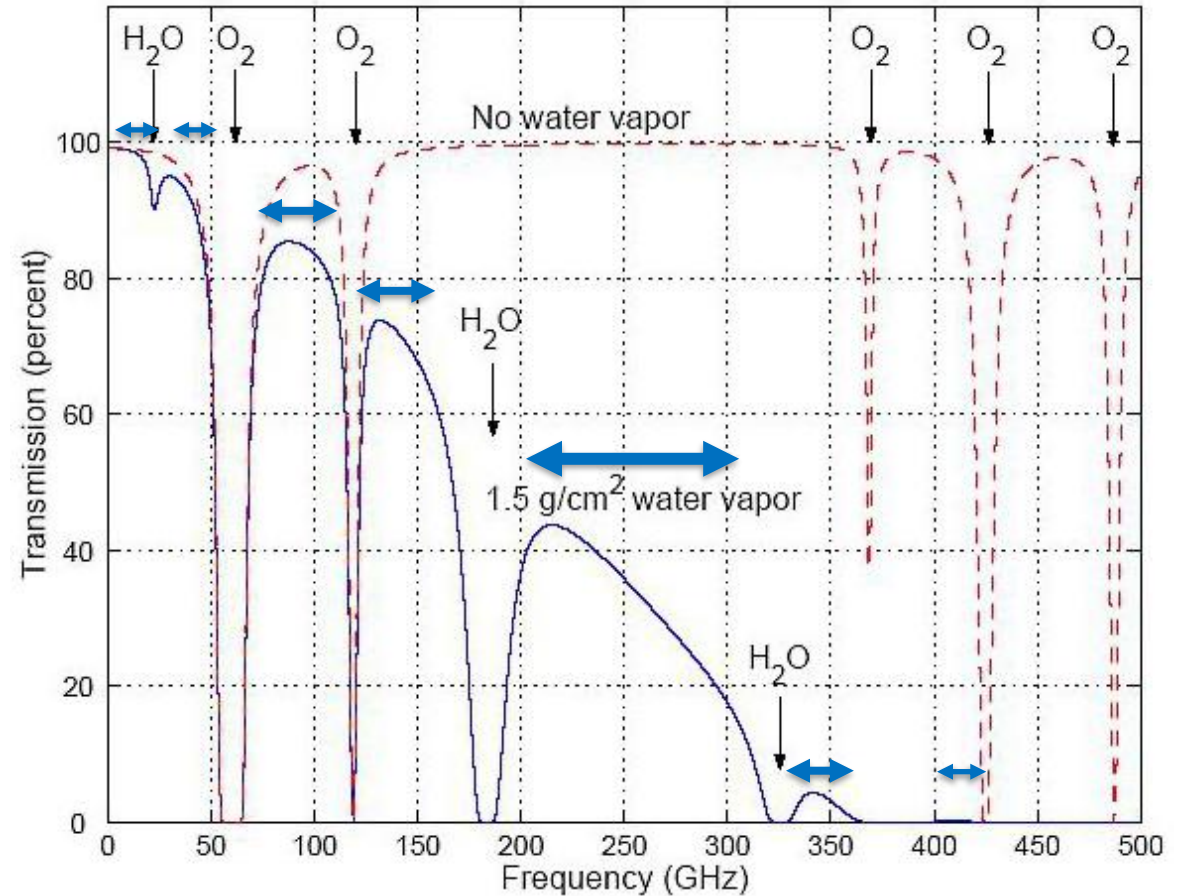


# 1. The importance of passive microwave observations

Credit: <https://cimss.ssec.wisc.edu/>

→ Information on various variables :

- Temperature
- Humidity
- Hydrometeors (rain, cloud water, snow, graupel, ice cloud water)

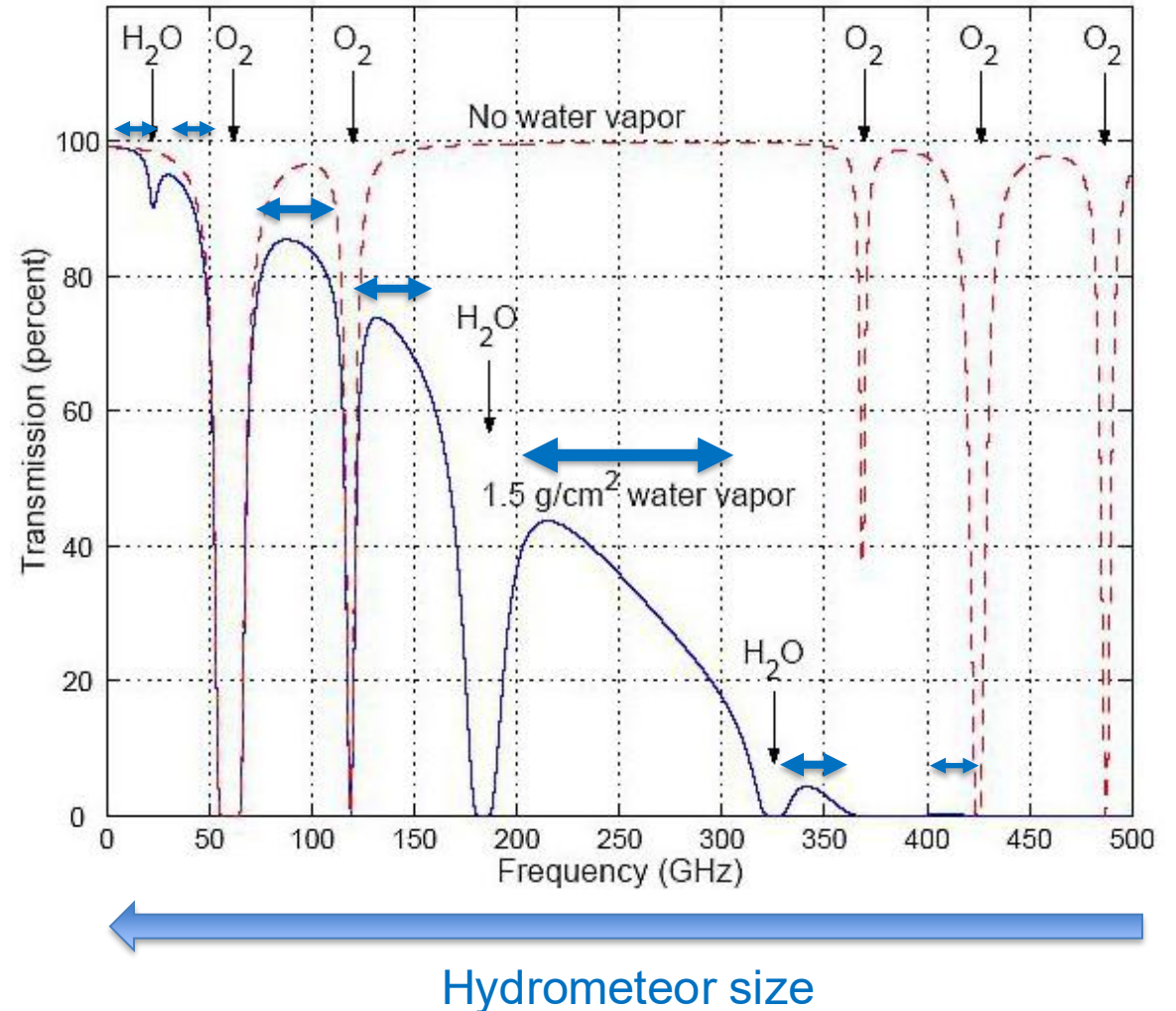


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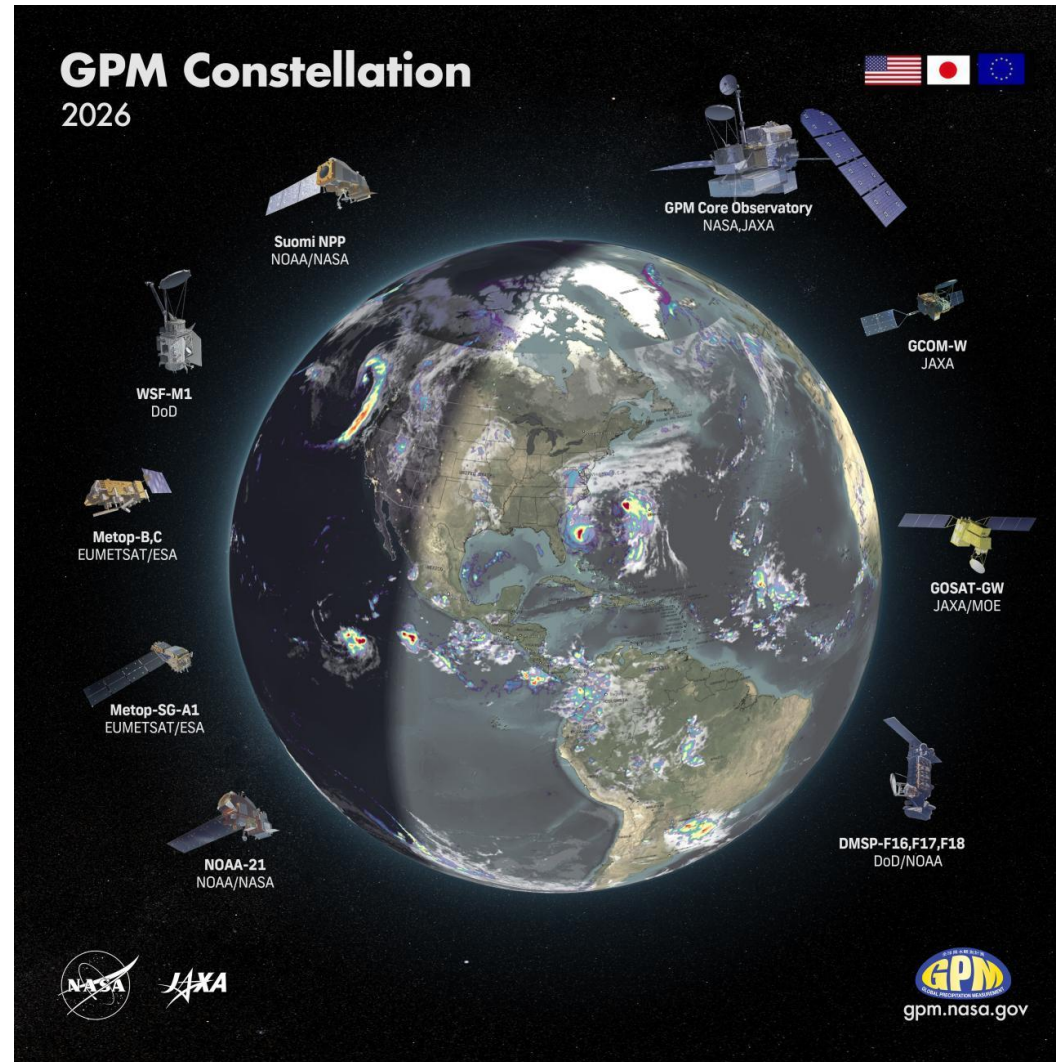
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# 1. The importance of passive microwave observations



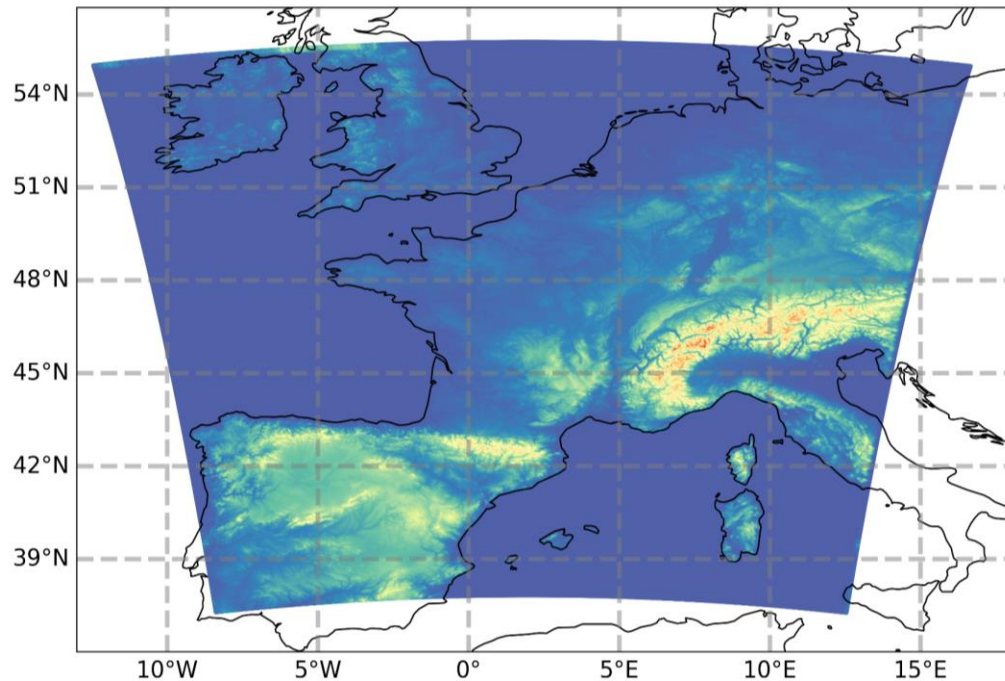
*Credit: NASA GSFC*

## 2. PhD : All-sky assimilation of passive microwave sensors in the 3DVar AROME-France system

### AROME-France

(Application of *Research to Operations at ME*scale)

Regional NWP system of Météo-France

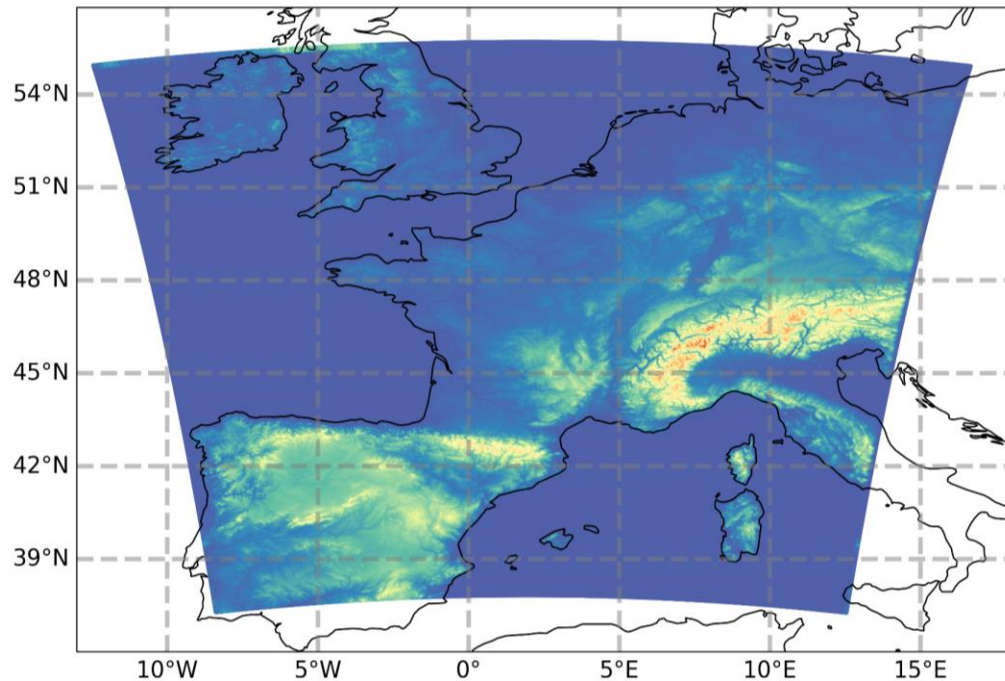


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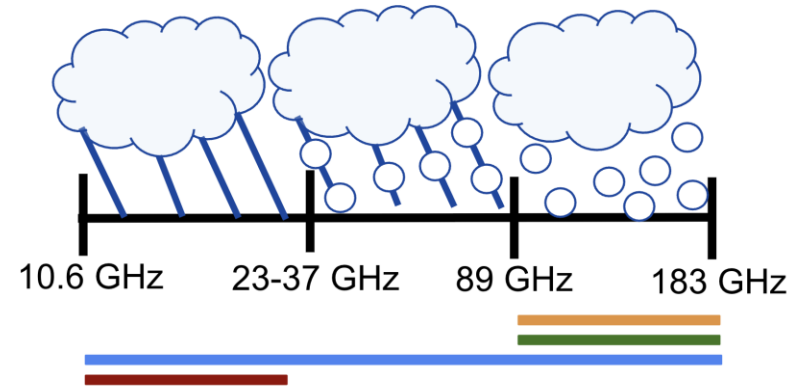
(Application of *Research to Operations* at *ME*esoscale)

Regional NWP system of Météo-France



Focus of 4 sensors (8 satellites) :

**MHS**, **MWHS-2**, **GMI** and **AMSR2**

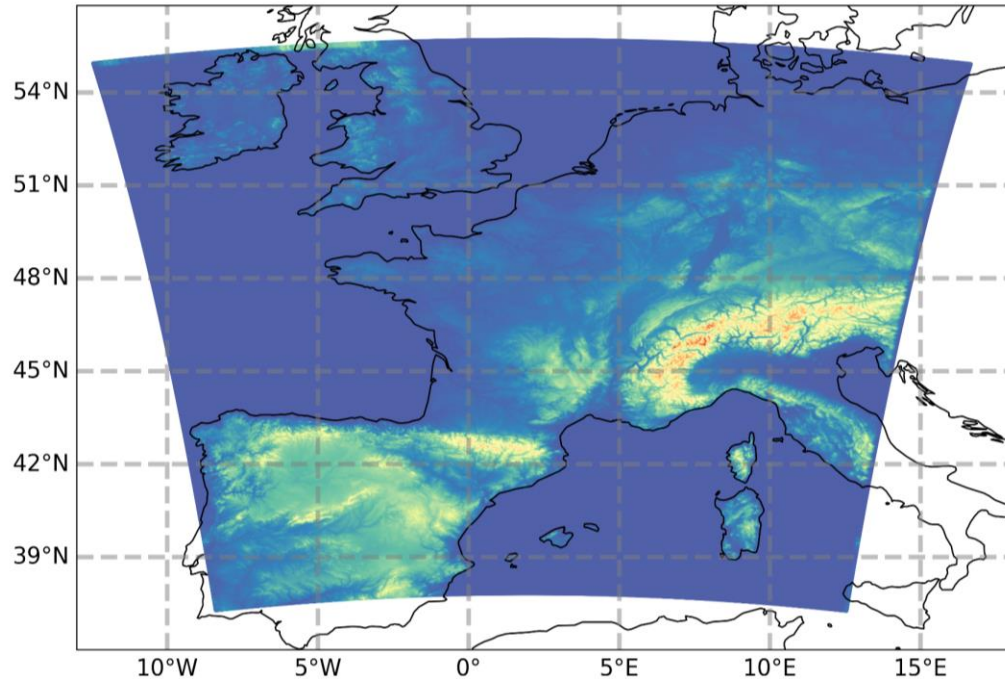


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## AROME-France

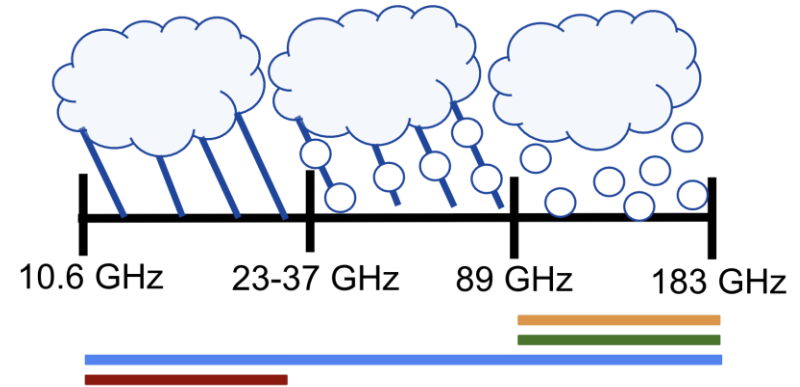
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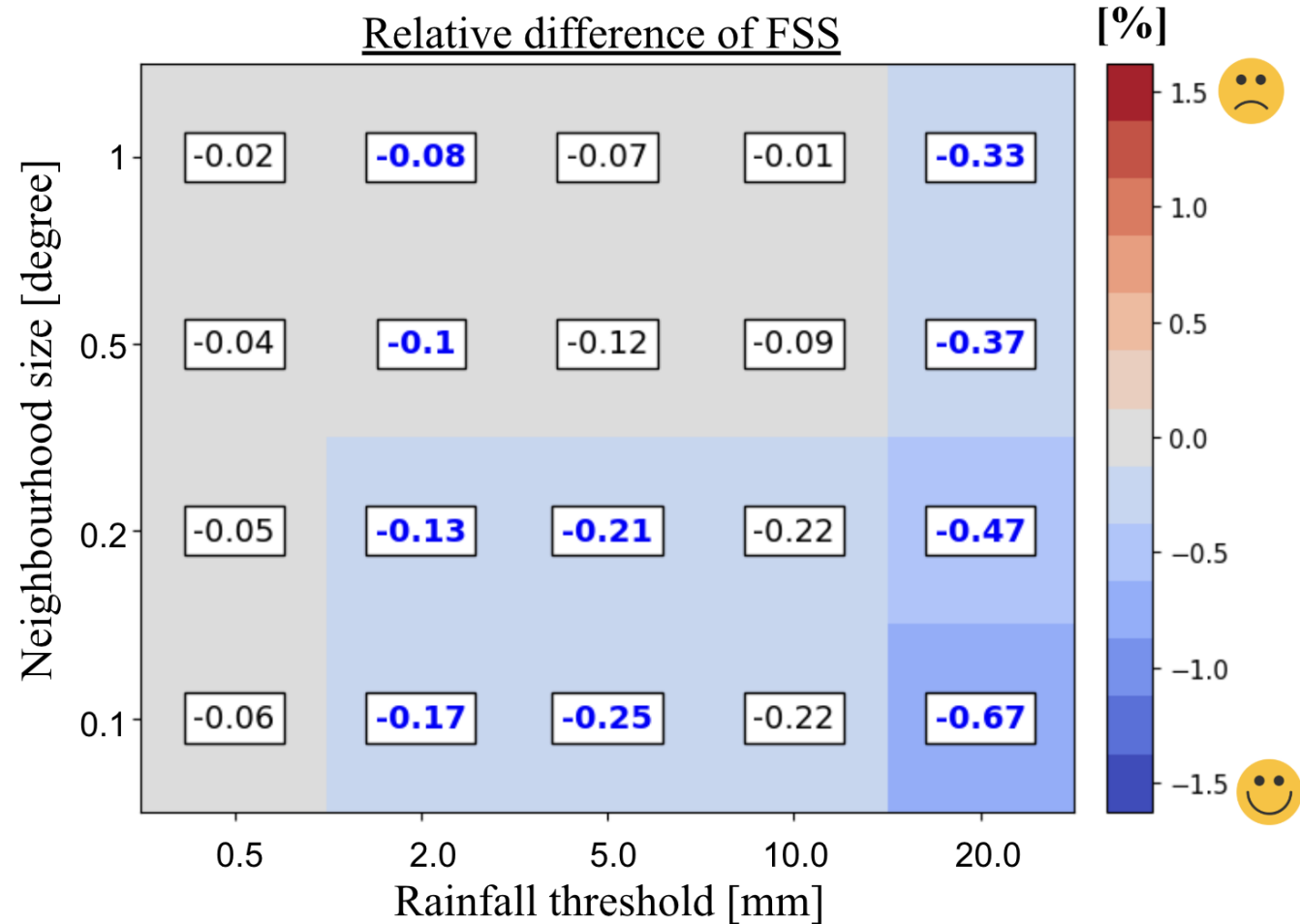
### Configuration

- Data assimilation system : 3DEnVar
- Control variables : T, Q, U, V, Sp + 5 hydrometeors (Rain, Cloud Liquid Water, Snow, Graupel, Ice Cloud Water)
- Radiative transfer model : RTTOV-SCATT v12
- Observation error models varying according to a cloud predictor.

PhD works based on : Bauer et al. (2010), Geer et al. (2010), Geer et al. (2011)  
Geer et al. (2014), Brousseau et al. (2025), Destouches et al. (2020)  
Destouches et al. (2023), Combarous et al. (2024), Martet et al. (2025)

## 2. PhD : All-sky assimilation of passive microwave sensors in the 3D-EnVar AROME-France system

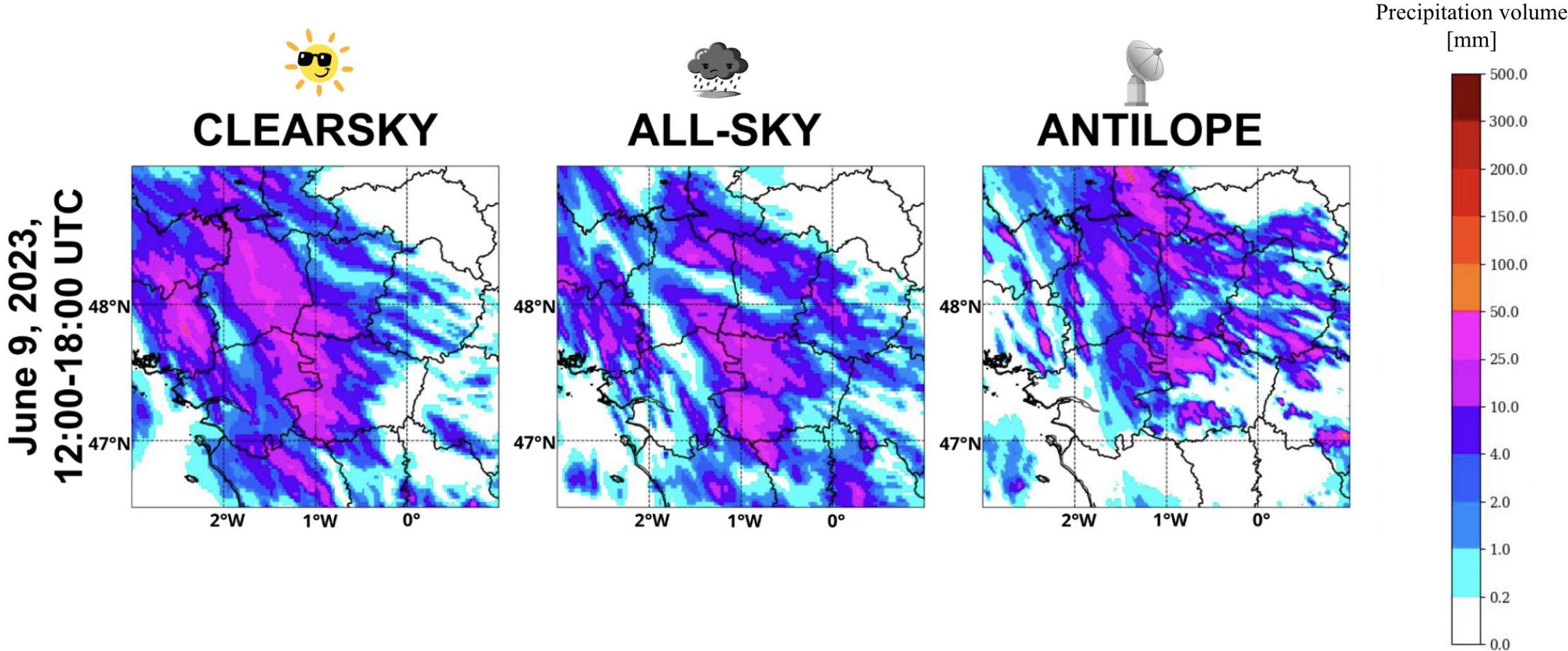
Impact on the rainfall 1-hour forecasts, 18 Oct.- 30 Nov. 2023



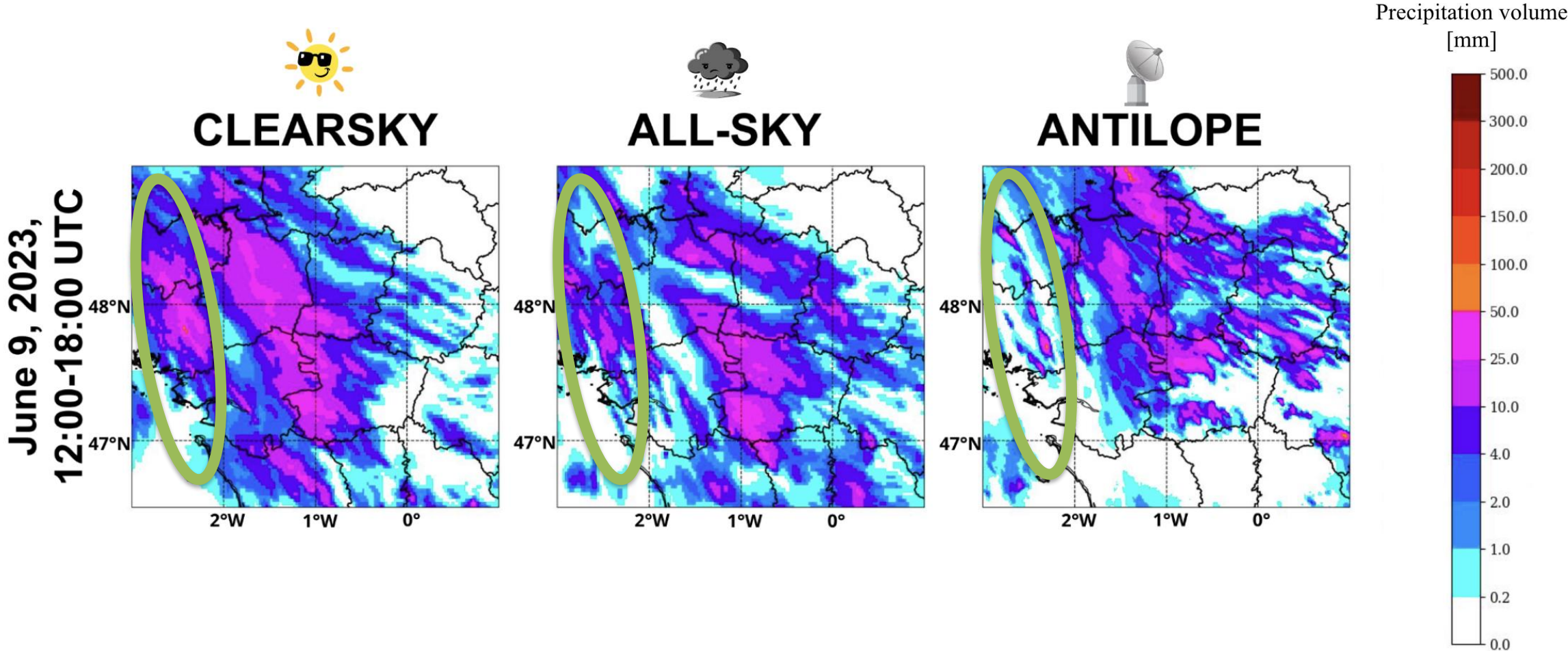
Chardon--Legrand et al. 2025

\*Bold numbers indicate 95% significant results

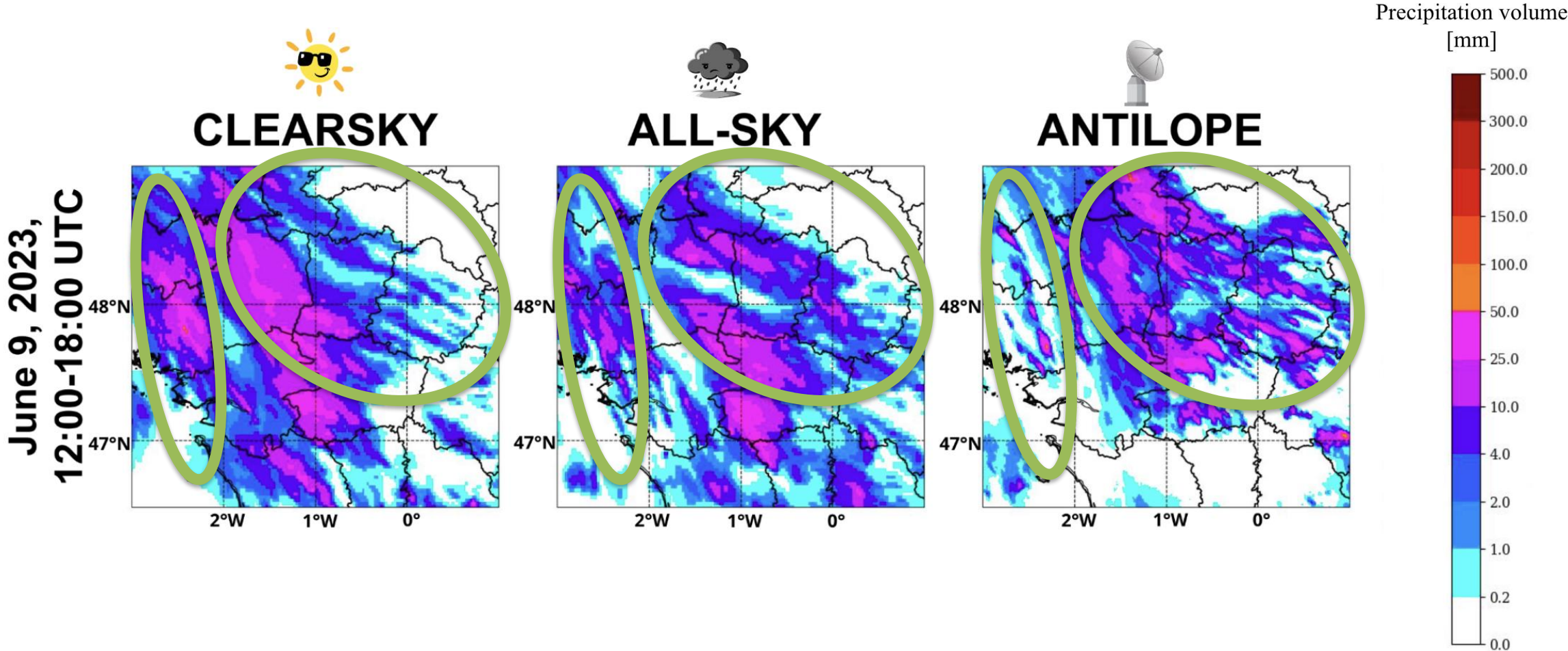
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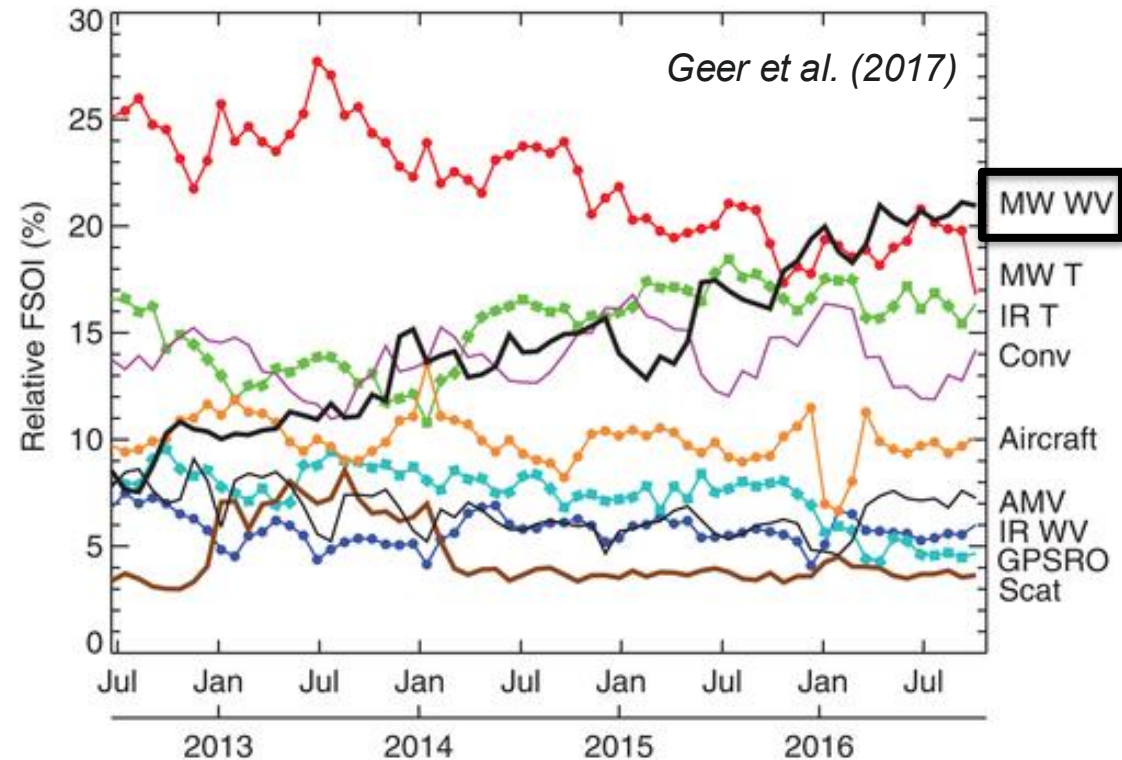


### 3. All-sky assimilation of microwave imagers in the IFS system

**March 2009** : 1<sup>st</sup> operational all-sky assimilation of microwave imager observations in IFS.  
→ SSM/I and AMSR-E (Bauer et al., 2010 ; Geer et al., 2010)

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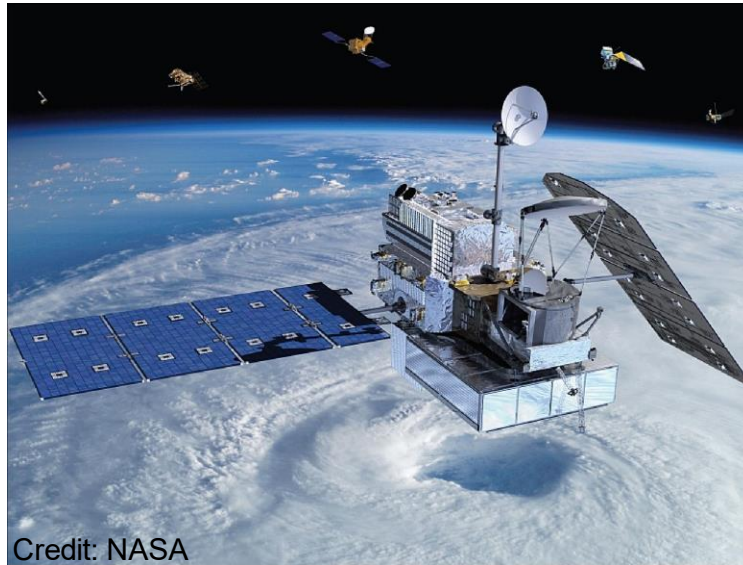


cloud and precipitation-sensitive  
microwave observations  
(sounders + imagers)

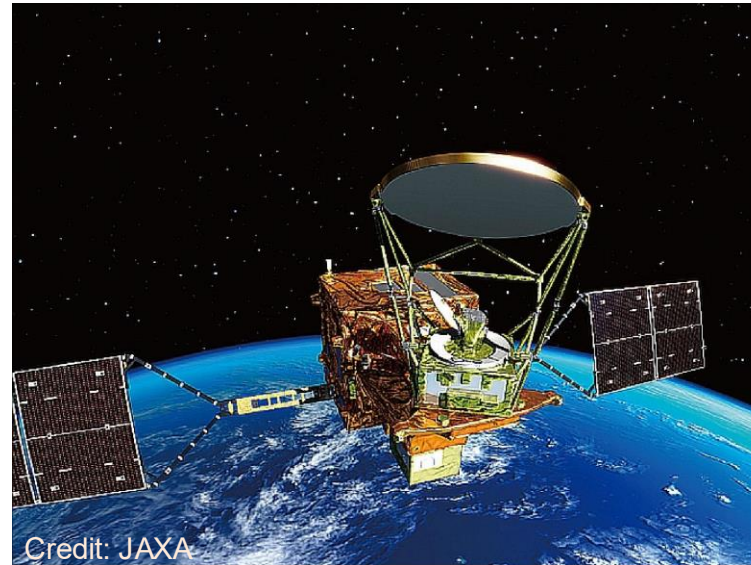
Forecast Sensitivity to Observation Impact (FSOI) in the ECMWF operational system from June 2012 to October 2016, averaged in 25 day bins, normalized so total impact is 100%.

### 3. All-sky assimilation of microwave imagers in the IFS system

#### Imagers currently assimilated in IFS



GMI onboard GPM Core Observatory satellite



AMSR2 onboard GCOM-W satellite



SSMIS onboard DMSP-F18 and DMSP-F17

## 4. Challenges

Evaluation and exploitation of new EUMETSAT products and imagers :  
AMSR3, WSFM MWI, EPS-SG MWI, ICI

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ICI  
submillimetre frequencies,  
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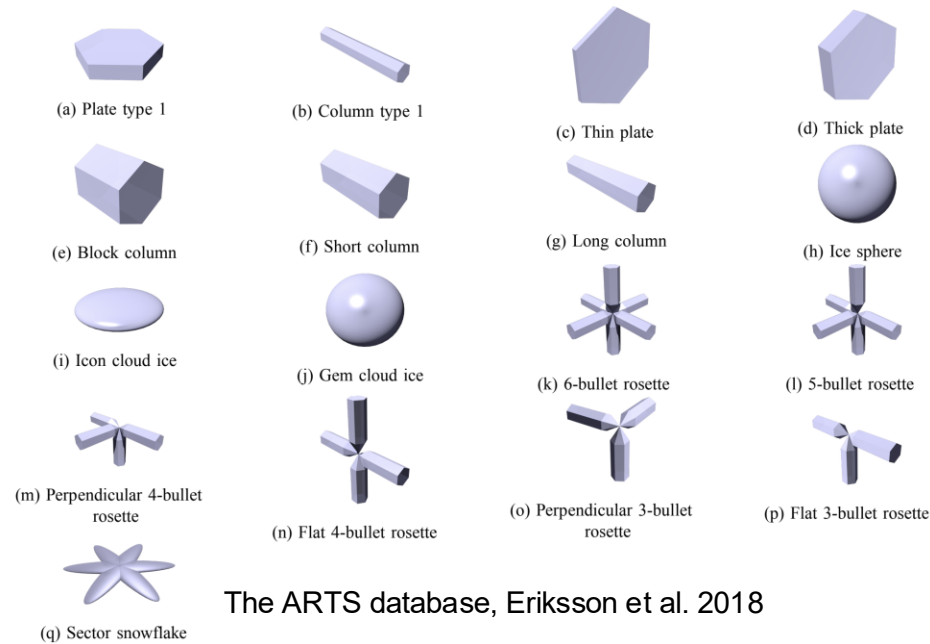
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Improving the radiative transfer model RTTOV-SCATT.



The ARTS database, Eriksson et al. 2018

## 4. Challenges

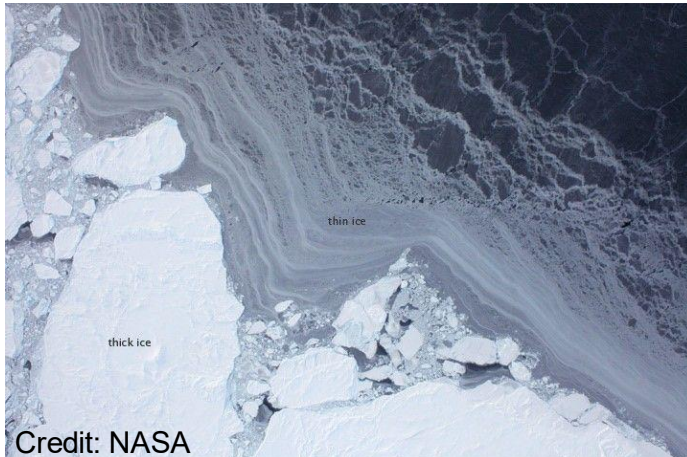
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All-sky assimilation over complex areas  
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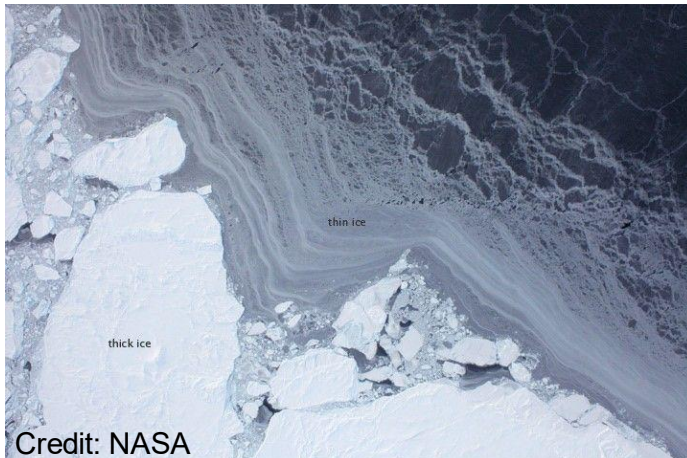


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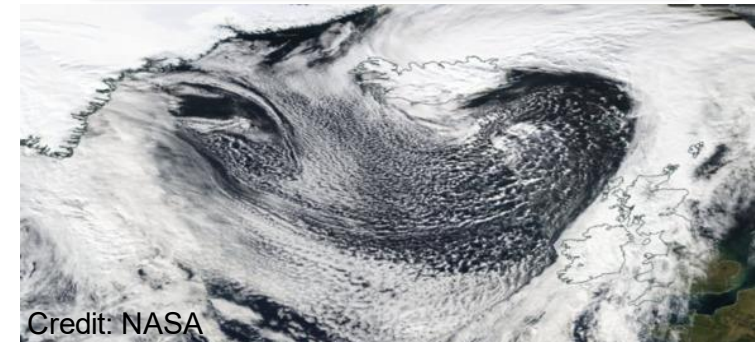
All-sky assimilation over complex areas  
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Assimilation of 37h and 89h GHz channels.  
→ Might help to have a better representation of cloud water.



Credit: NASA

Cold air outbreaks

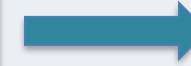


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# 4. Challenges

## Enhancing the exploitation of imagers for NWP models

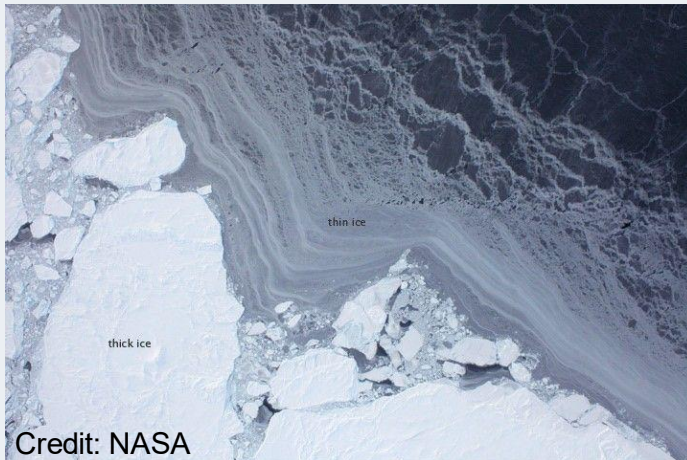
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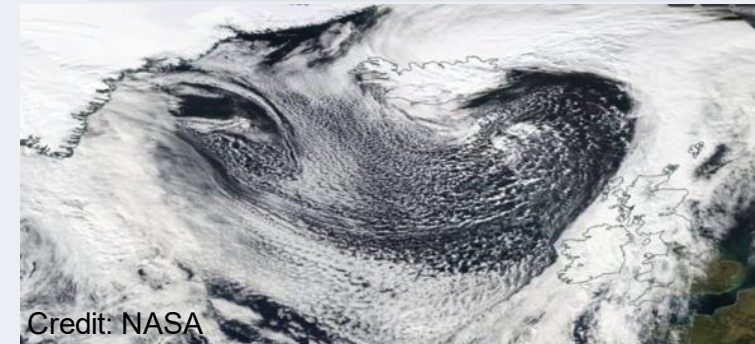
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Cold air outbreaks



## 5. Plans for this year

1

Evaluation of AMSR3 and impact study of its assimilation within the IFS.<sup>1</sup>

2

Preparation of the assimilation of EPS-SG MWI and WSFM MWI within the IFS by using AMSR3.

3

Assimilation of 37h and 89h GHz polarization channels.<sup>2</sup>

<sup>1</sup> Based on a prior study of David Duncan.

<sup>2</sup> Based on the prior study of Tracy Scanlon et al, 2023.