Ice cloud properties, an information content analysis from high spectral resolution measurements in the infrared : IASI and IASING

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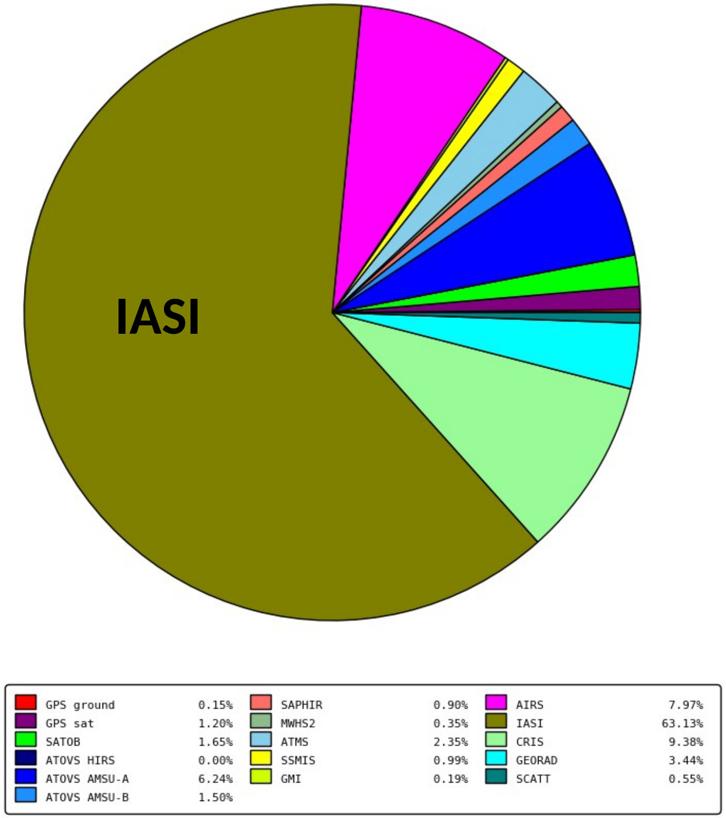
Climibio

Région Hauts-de-France

Introduction : context

→ **Weather forecast :** cloud coverage = more than **80 %** (Lavanant 2010) of satellite data remains unused

Origin of satellite measurements in ARPEGE model (MeteoFrance)



MeteoFrance

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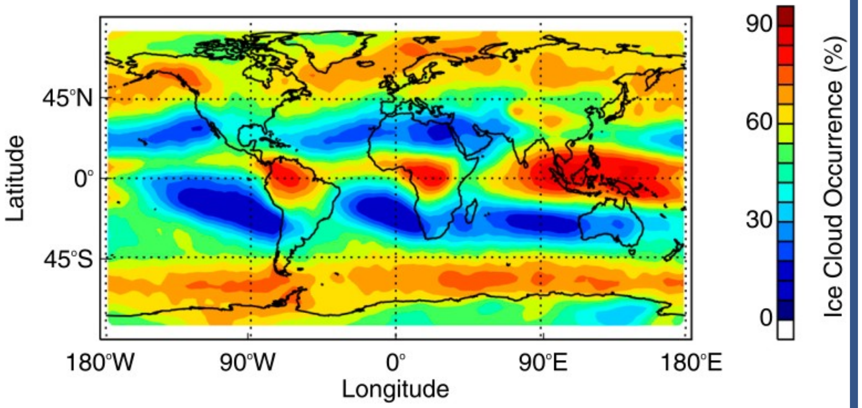
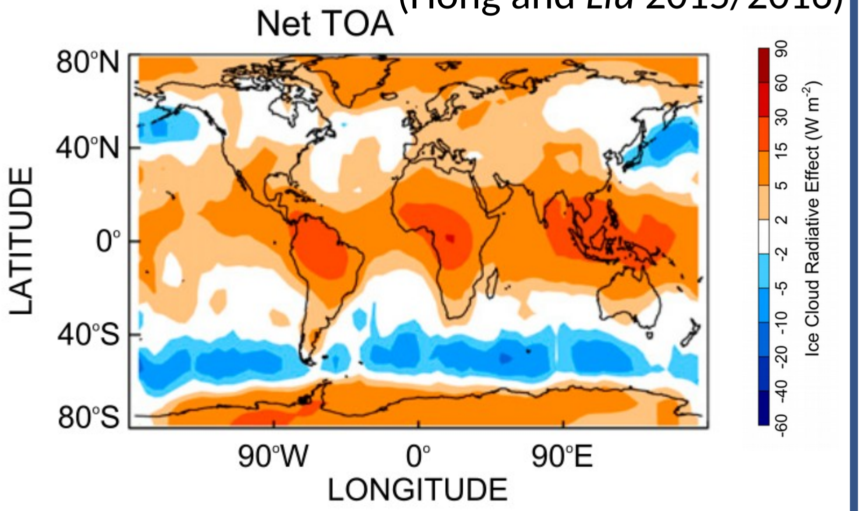
Introduction : context

→ **Weather forecast :** cloud cover **=** more than **80 %** (Lavanant 2010) of satellite data remains unused

→ **Radiative balance :** numerous thin clouds - strong radiative impact → need to test the **microphysical models in the IR with high spectral measurements**



(Hong and *Liu* 2015/2016)



Introduction : context

→ Weat

than 80 %

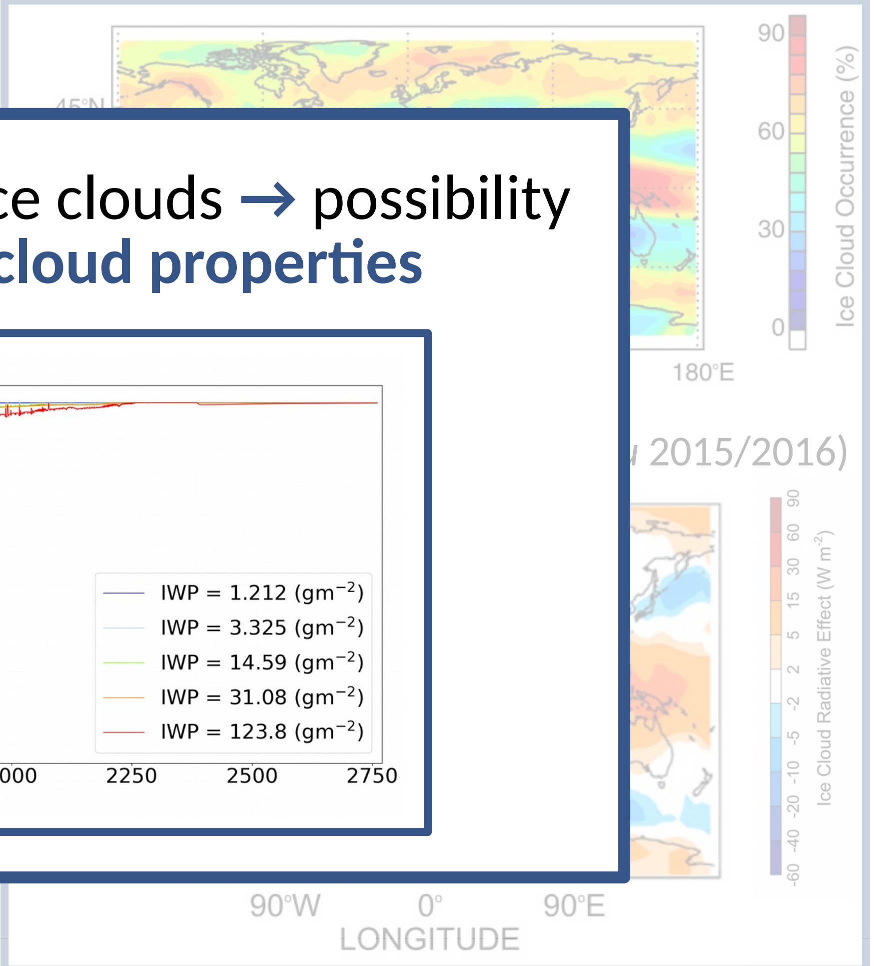
remains u

→ Radiat

50 % → IV

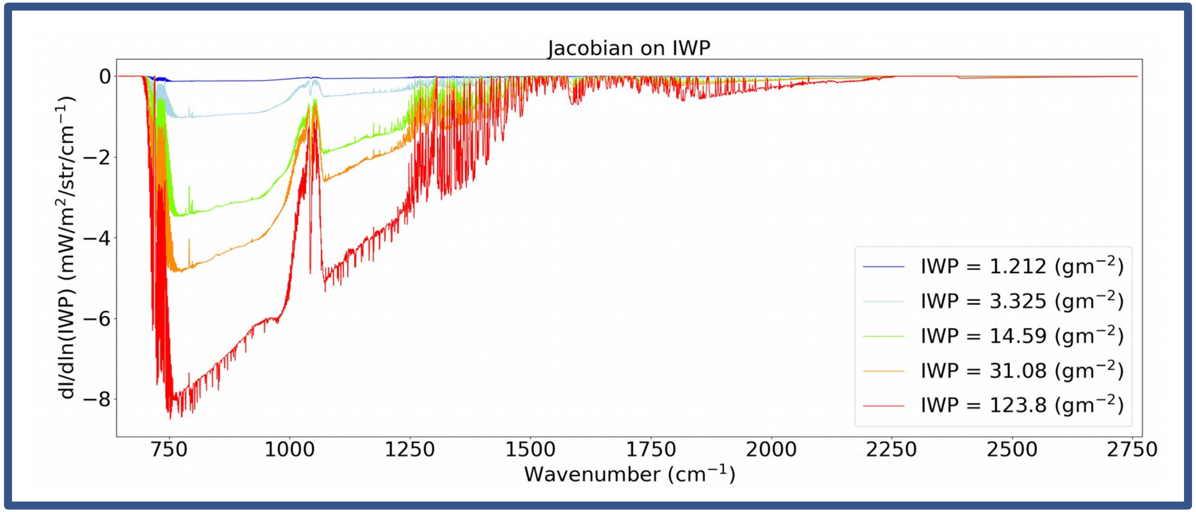
→ need t

IR with h



2015/2016)

IR is sensitive to the presence of ice clouds → possibility of **using IASI to retrieve ice cloud properties**



Introduction : objectives

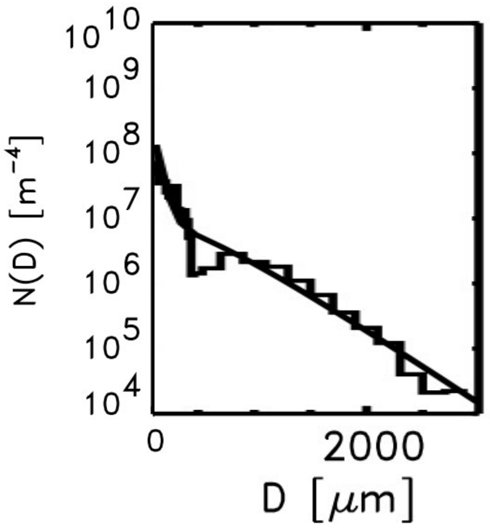
Use ice cloud contaminated IASI/IASING measurements to obtain information about :

→ Ice Water Path (**IWP**)
→ Cloud Top Height (**CTH**)
→ Cloud Geometrical Thickness (**CGT**)

Microphysical model

Field et al. (2005/2007) → **parametrization** of ice crystal **size distribution** giving only **temperature** and **IWC**

IWC
T



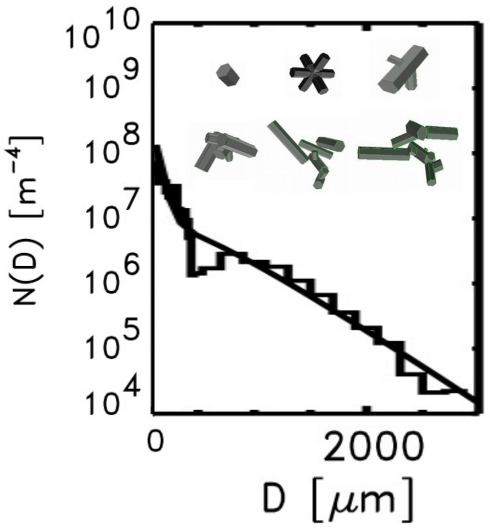
Microphysical model

Field et al. (2005/2007) → **parametrization** of ice crystal **size distribution** giving only **temperature** and **IWC**

Baran et Labonnote (2007) → ice crystal **optical properties** from a 6 shape ensemble model

IWC
T

→



→

optical properties

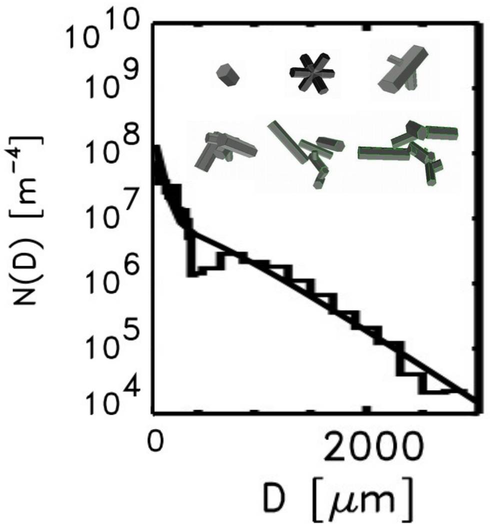
Microphysical model

Field et al. (2005/2007) → **parametrization** of ice crystal **size distribution** giving only **temperature** and **IWC**

Baran et Labonnote (2007) → ice crystal **optical properties** from a 6 shape ensemble model

Vidot et al. (2015) → parametrization for **RTTOV**

IWC
T



optical properties

Methods

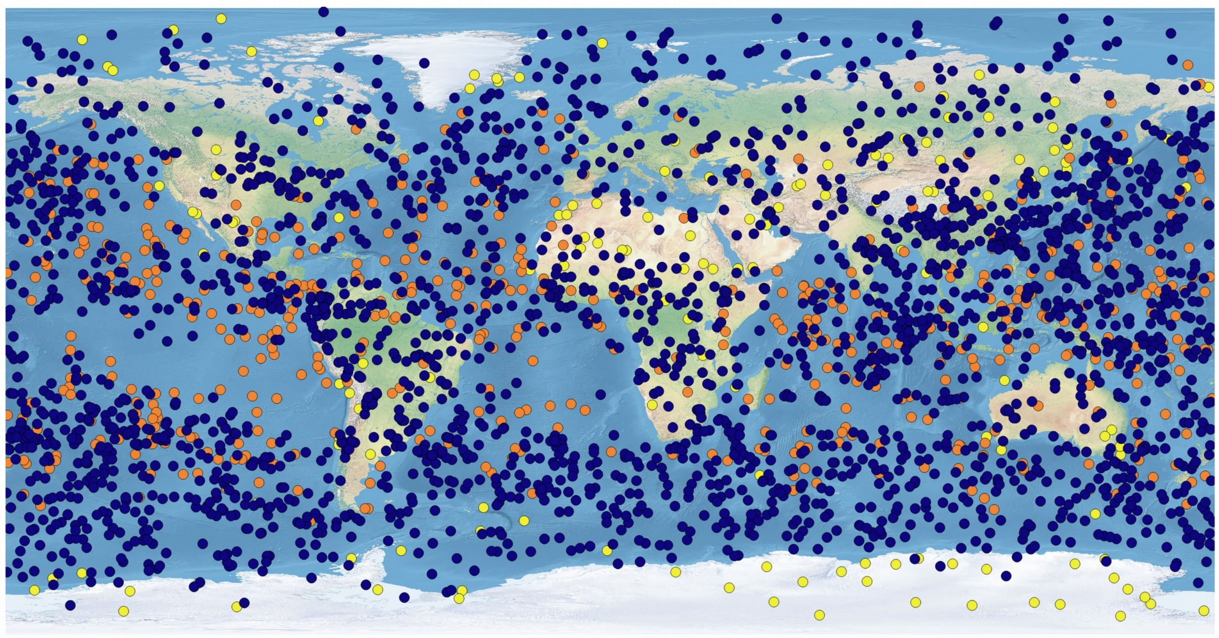
→ **Forward model :** RTTOV (fast radiative transfer code)

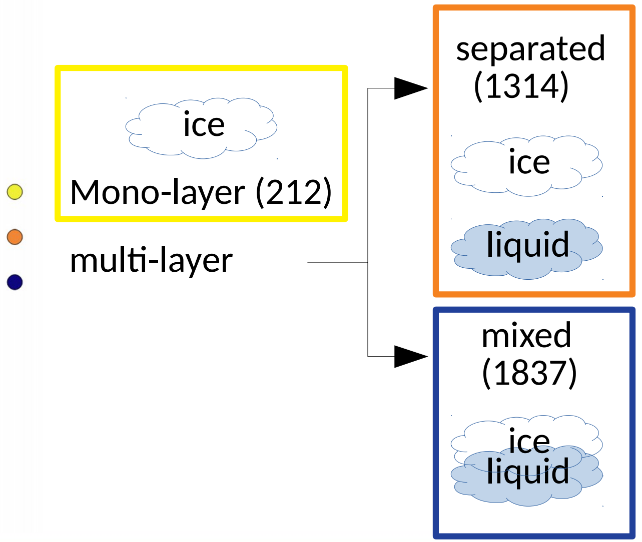
→ **Optimal estimate** as inverse method (Rodgers 2000)

→ **Information content** and **channel selection** from information theory (Shannon 1949)

Methods

→ **ECMWF profiles database :** representative profiles of normal conditions, variability and extreme conditions of the atmosphere over a year (Eresmaa and McNally 2014)

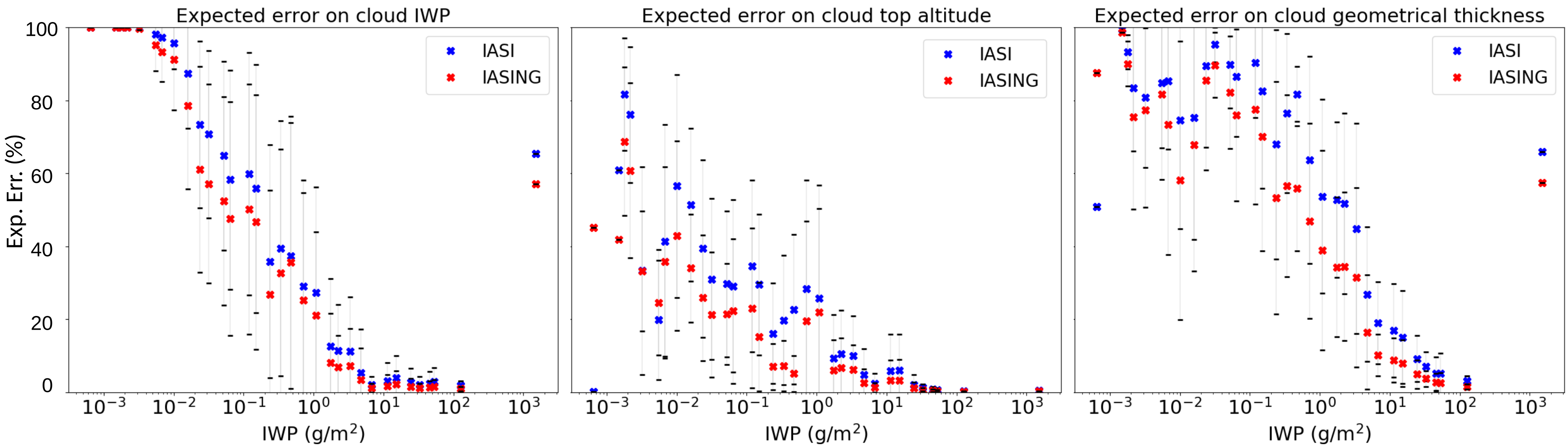




Information content analysis

→ Mono-layer case

ice



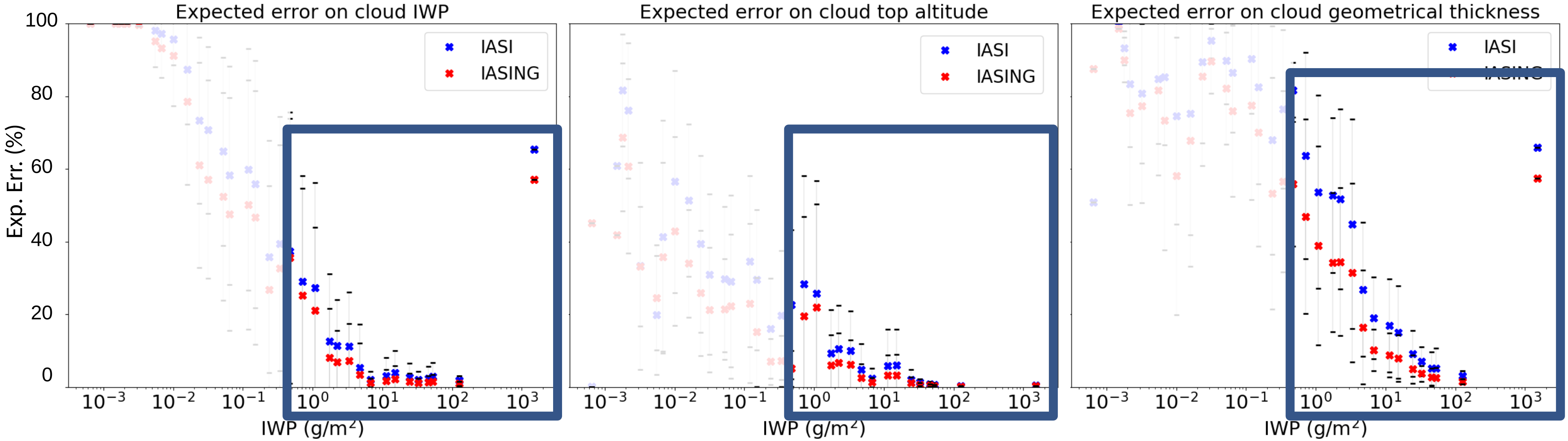
IWP (g/m^2) **CTH (km)** **CGT (km)**

Information content analysis

→ Mono-layer case

ice

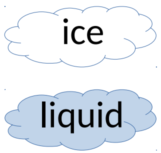
IWP > 1 g/m²

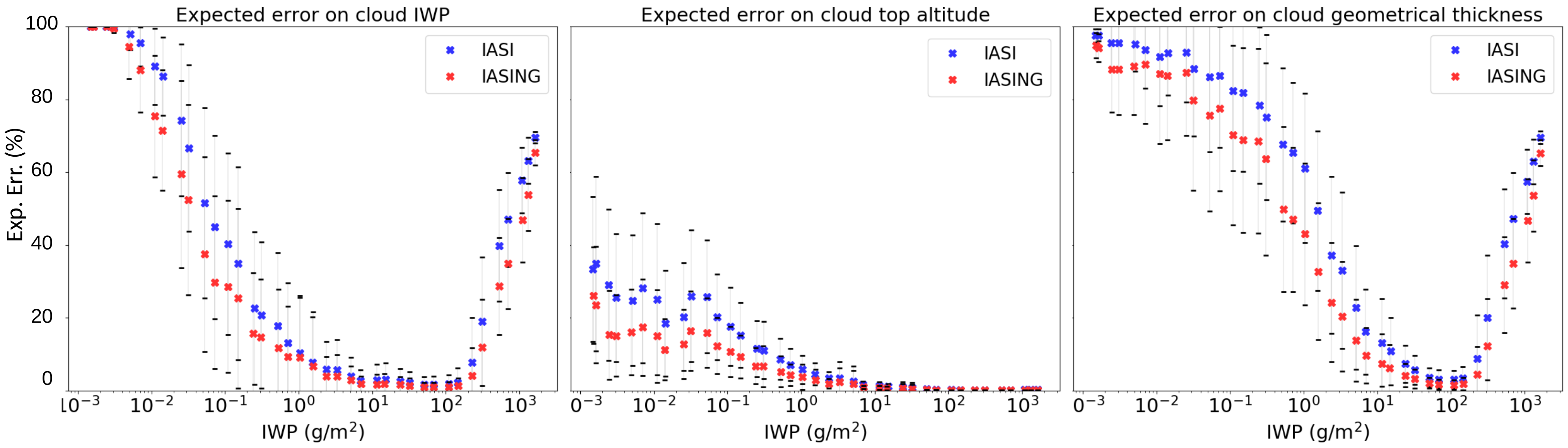


IWP (g/m²) CTH (km) CGT (km)

Information content analysis

→ Multi-layer case : separated

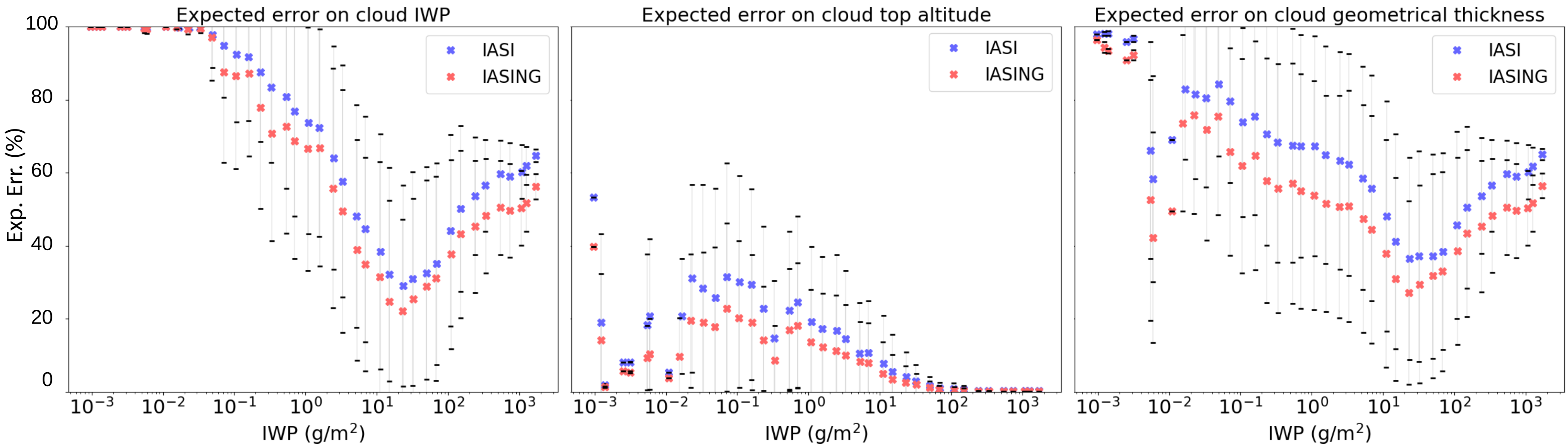




IWP (g/m²) **CTH (km)** **CGT (km)**

Information content analysis

→ Multi-layer case : mixed



IWP (g/m²) **CTH (km)** **CGT (km)**

Channel selection

→ **Information content analysis** with all the IASI and IASING channels
→ **calculation cost too important**

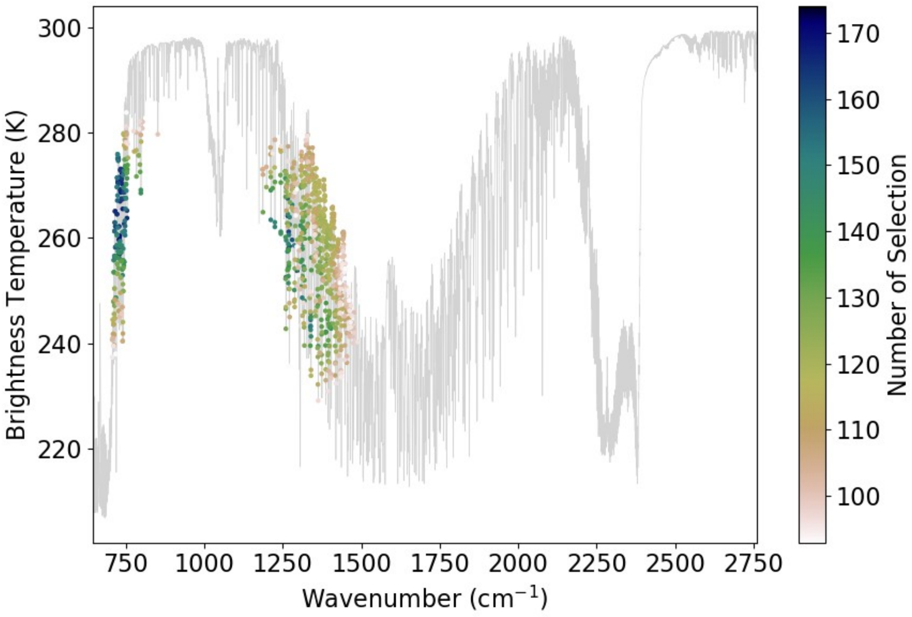
→ Channel selection to remove reduntant information

Channel selection

→ IASI

Mono-layer case

ice



Non-retrieved parameters errors :

- gas profiles concentration (H2O, O3) → 10 %
- temperature profile → 1K
- emissivity → 5 %
- surface temperature → 1K

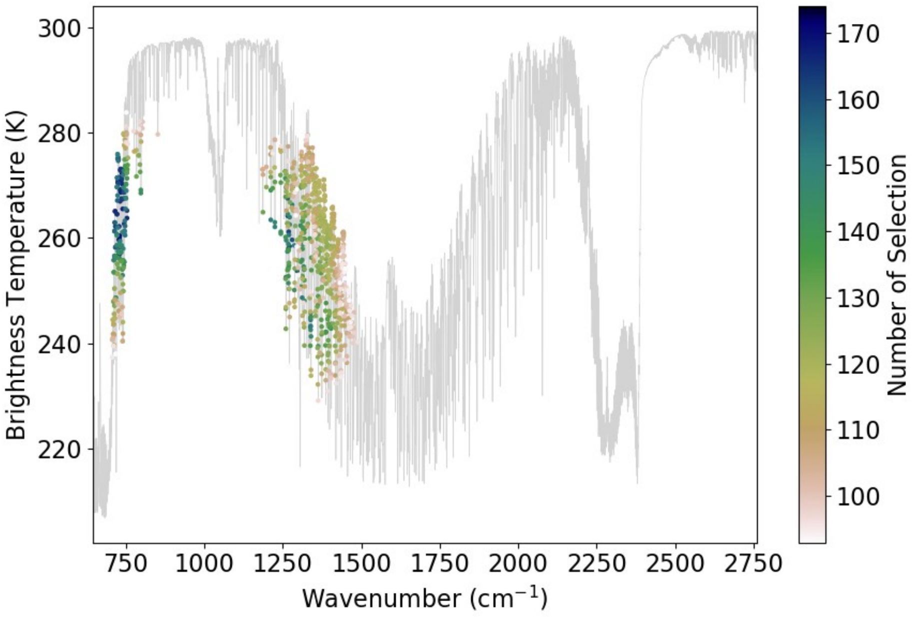
→ 905 selected channels

Channel selection

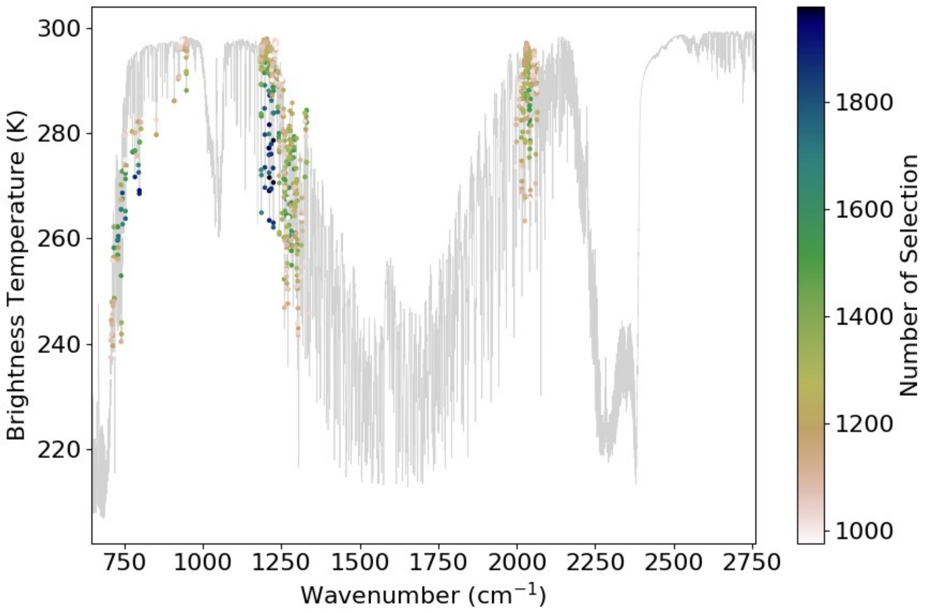
→ **IASI**

→ similar regions for **IASING**

Mono-layer case (ice)



Multi-layer case : separated (ice, liquid)



→ **905 / 872 selected channels**

Ice cloud properties retrieval

Retrieval algorithm test on IASI and IASING synthetic measurements generated from the profile database :

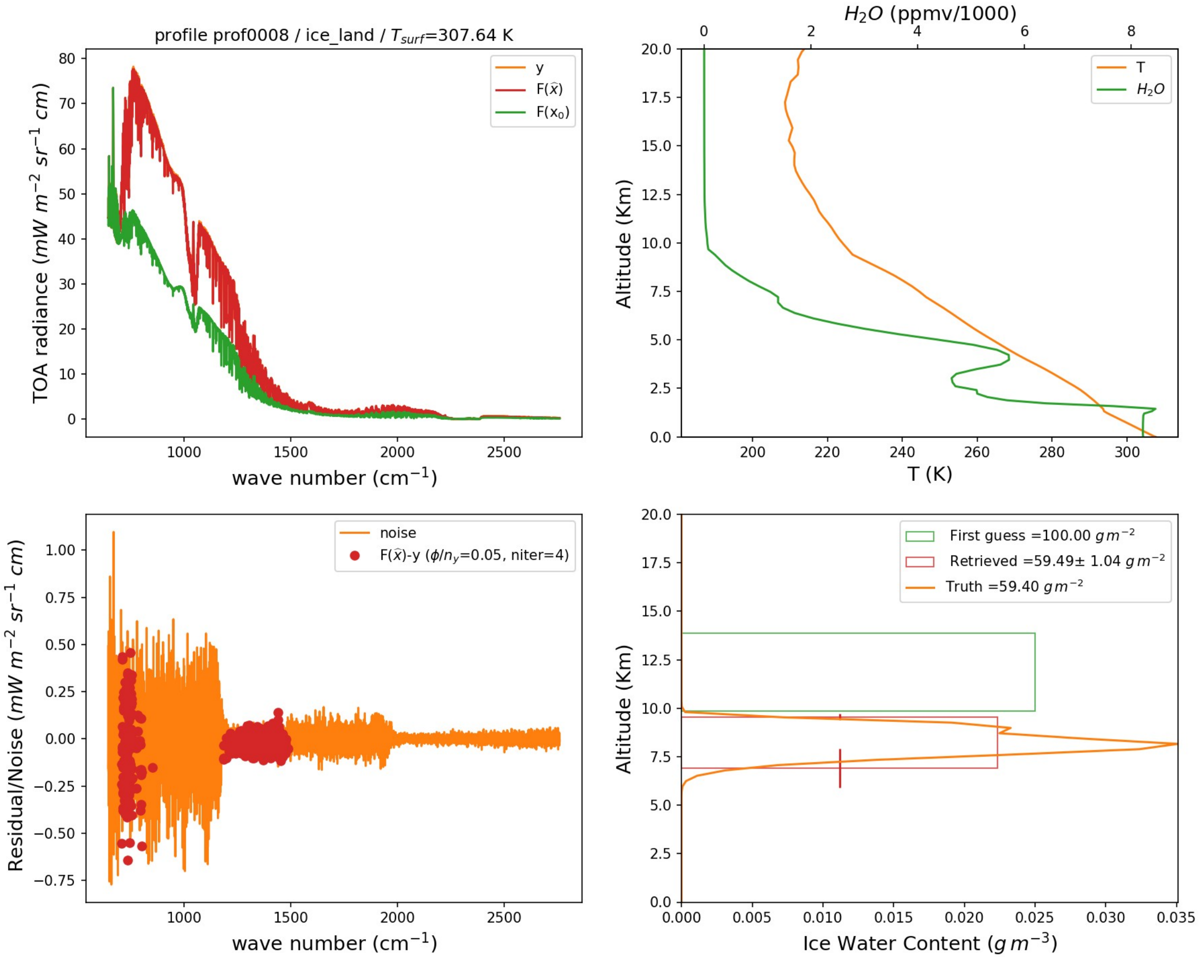
→ synthetic radiances calculation with radiometric noise added following a gaussian distribution

→ non-retrieved parameter errors

→ *pdf* maximum → minimisation with Levenberg-Marquardt

Ice cloud properties retrieval

IASI



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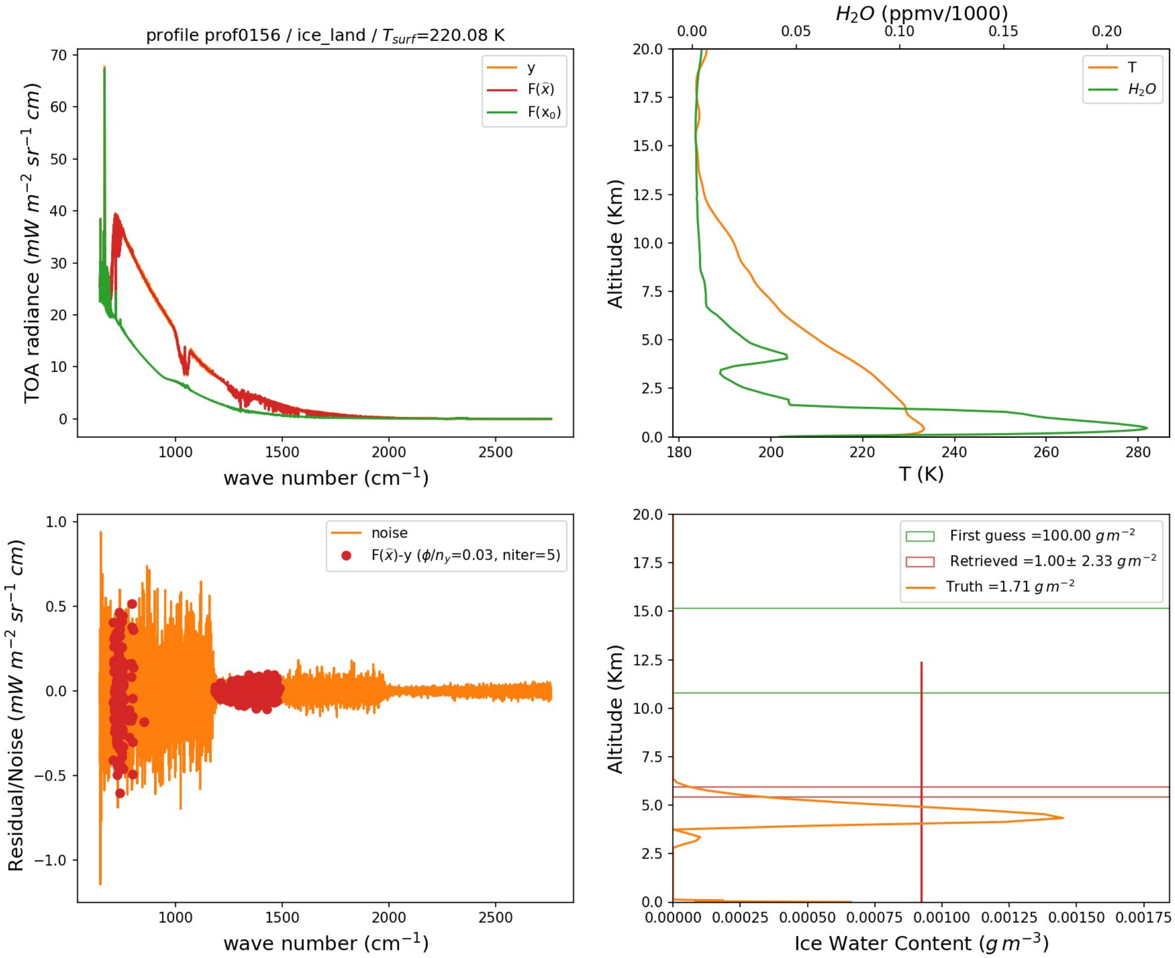
Ice cloud properties retrieval

IASI



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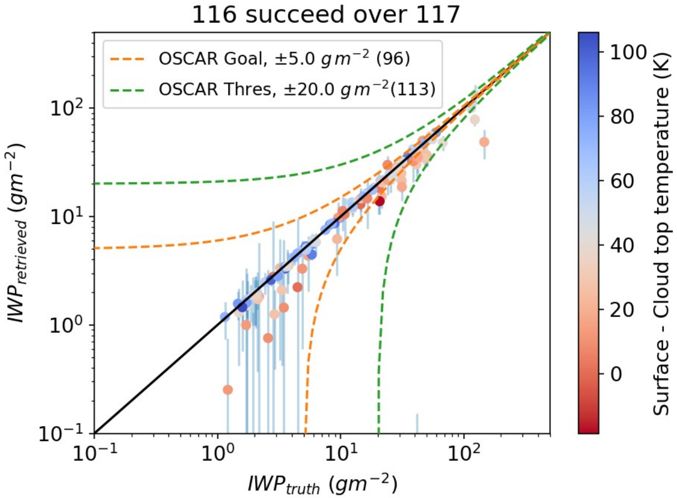
Ice cloud properties retrieval

→ Mono-layer case

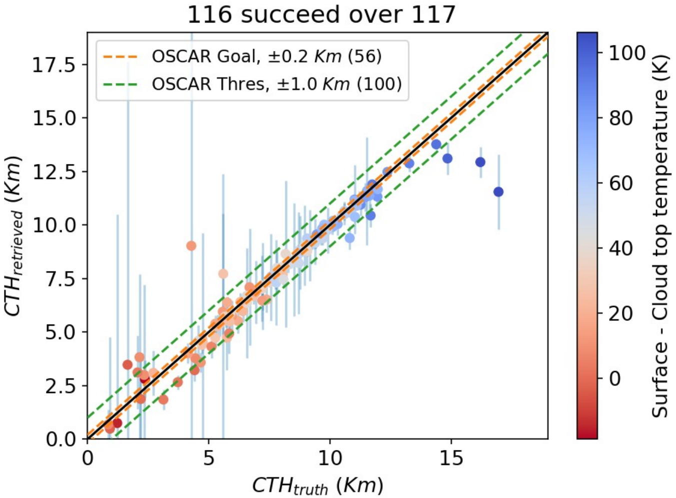
ice

IWP > 1 g/m²

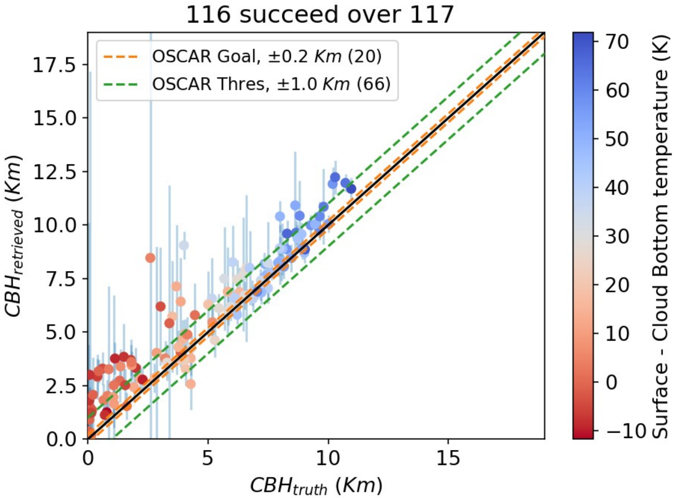
IASI



IWP



CTH



CBH

OSCAR Goal = objectives from WMO

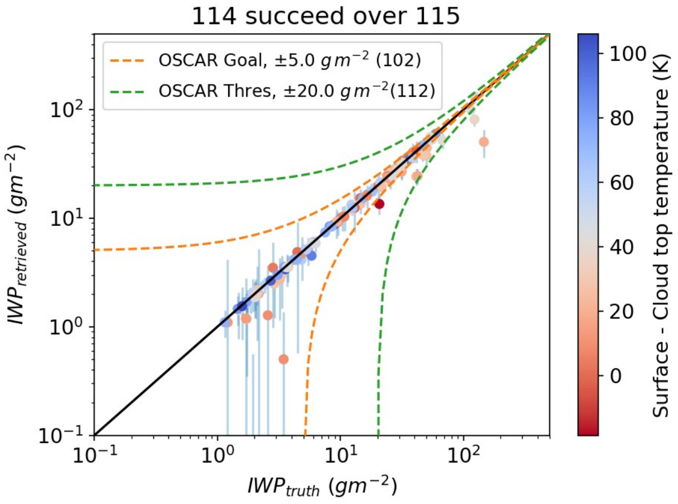
Cloud Bottom Height = **CTH - CGT**

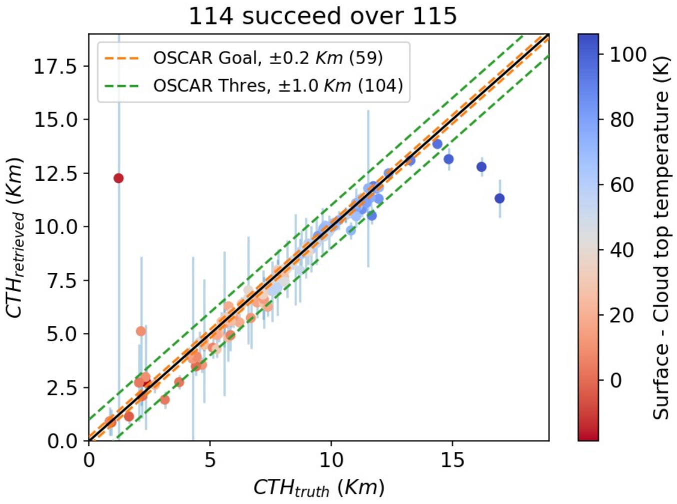
Ice cloud properties retrieval

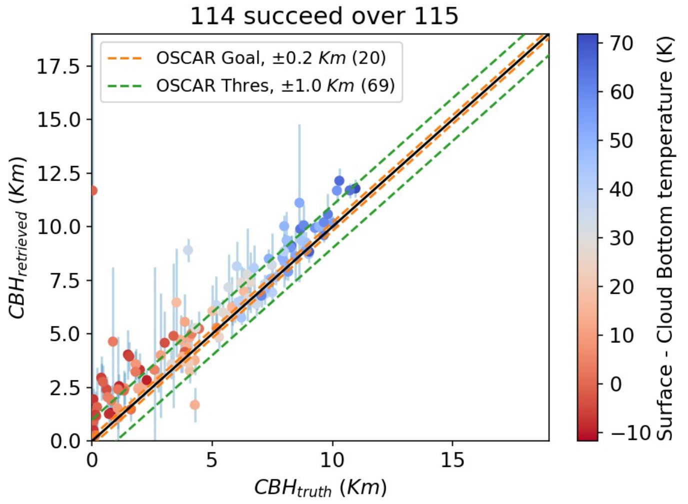
→ Mono-layer case

IWP > 1 g/m²

IASING







IWP **CTH** **CBH**

OSCAR Goal = objectives from WMO

Cloud Bottom Height = **CTH - CGT**

Conclusion and outlooks

→ high spectral resolution measurements such as **IASI/IASI-NG** can potentially be used to retrieve ice cloud properties with a **channel selection** to decrease calculation time

→ **Outlooks :**

- retrieval on real **IASI measurements**
- **water vapour** retrieval in the presence of clouds

Thank you for your attention