

SPARE-ICE: synergistic IWP from passive operational sensors

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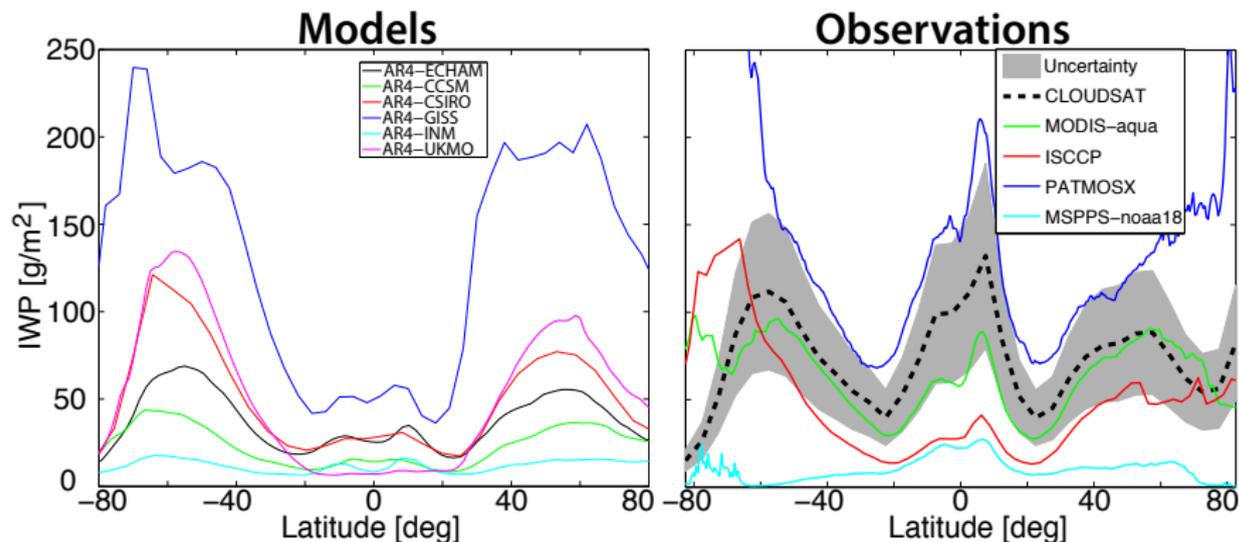
31 March 2014

Big thanks to ITWG for financing conference participation

Outline

- 1 The problem
- 2 Collocations
- 3 Retrieval
- 4 Results

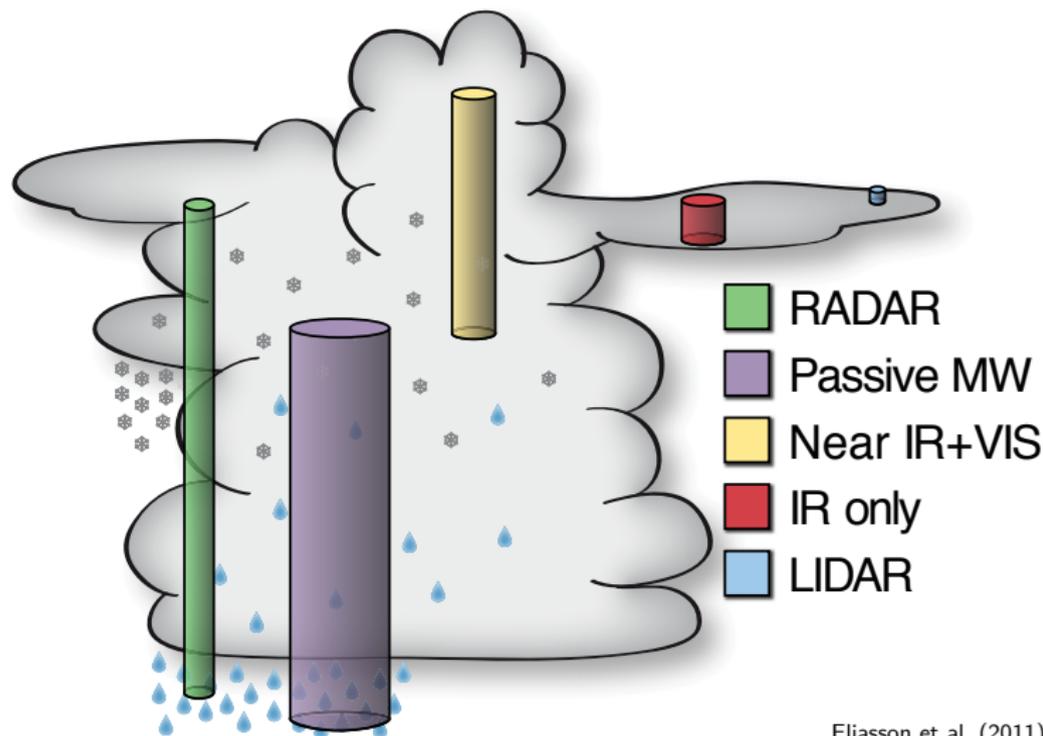
Clouds in climate models and observations



Eliasson et al. (2011)

- $\text{IWP} [\text{g/m}^2] = \int \text{IWC} [\text{g/m}^3]$. Is fundamental to the hydrological cycle and radiation budget
- Large model discrepancies, large observation discrepancies

Cloud observation technologies — sensitivities

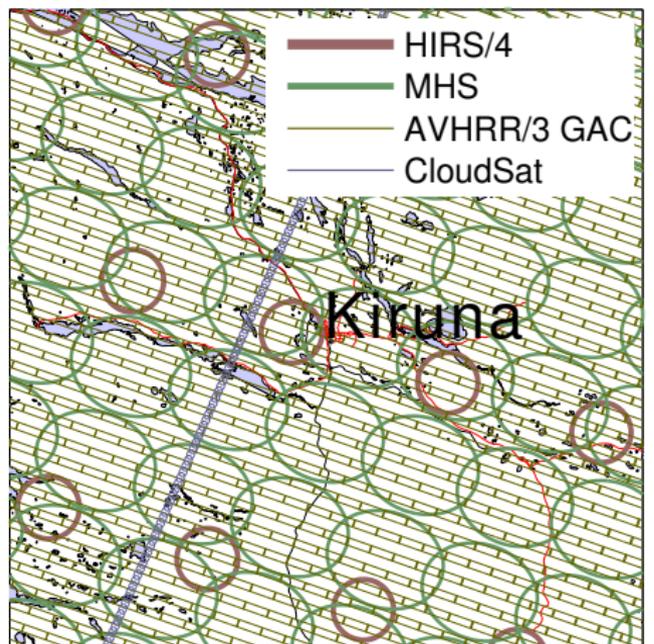


Eliasson et al. (2011)

Aim of study

- Develop new IWP retrieval that improves upon existing ones
- Investigate synergies between different techniques:
visible, near-IR, thermal IR, microwave
- Use operational sensors only
 - Provides good spatial and temporal coverage
 - Allows for time series studies
 - Will certainly continue into the future

Cloud observation technologies — collocations



Holl et al. (2010)

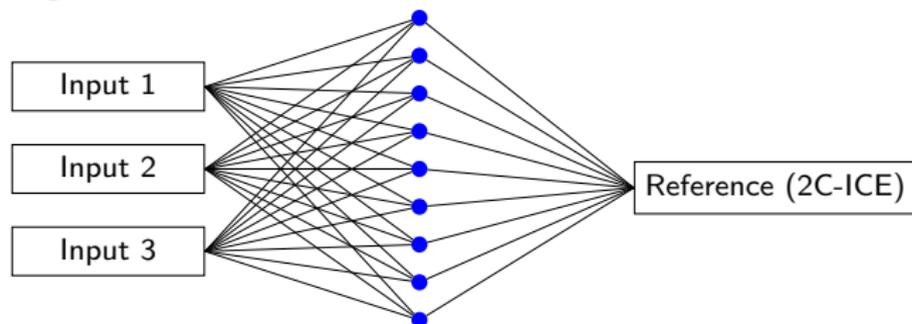
Collocations are helpful/essential for:

- Comparing existing products on a footprint-level basis (Eliasson et al., 2013).
- Studying synergistic retrievals
- Inter-calibrating sensors
- Improving passive by training with active

Neural network-based retrievals

$$\text{IWP}_{\text{NN}} = G(\mathbf{x})$$

- Divide reference dataset into training, validation, testing data.
- Training algorithm assigns weights and biases to each vertex connecting nodes.



- Use **training** data to minimise $|G(x_1, x_2, \dots, x_n) - \text{IWP}_{\text{ref}}|$
- Use **validation** data to avoid “over-fitting”
- Use **testing** data to estimate the IWP-dependent uncertainty.
- Two neural networks: one for IWP, one for cloud probability

Inputs

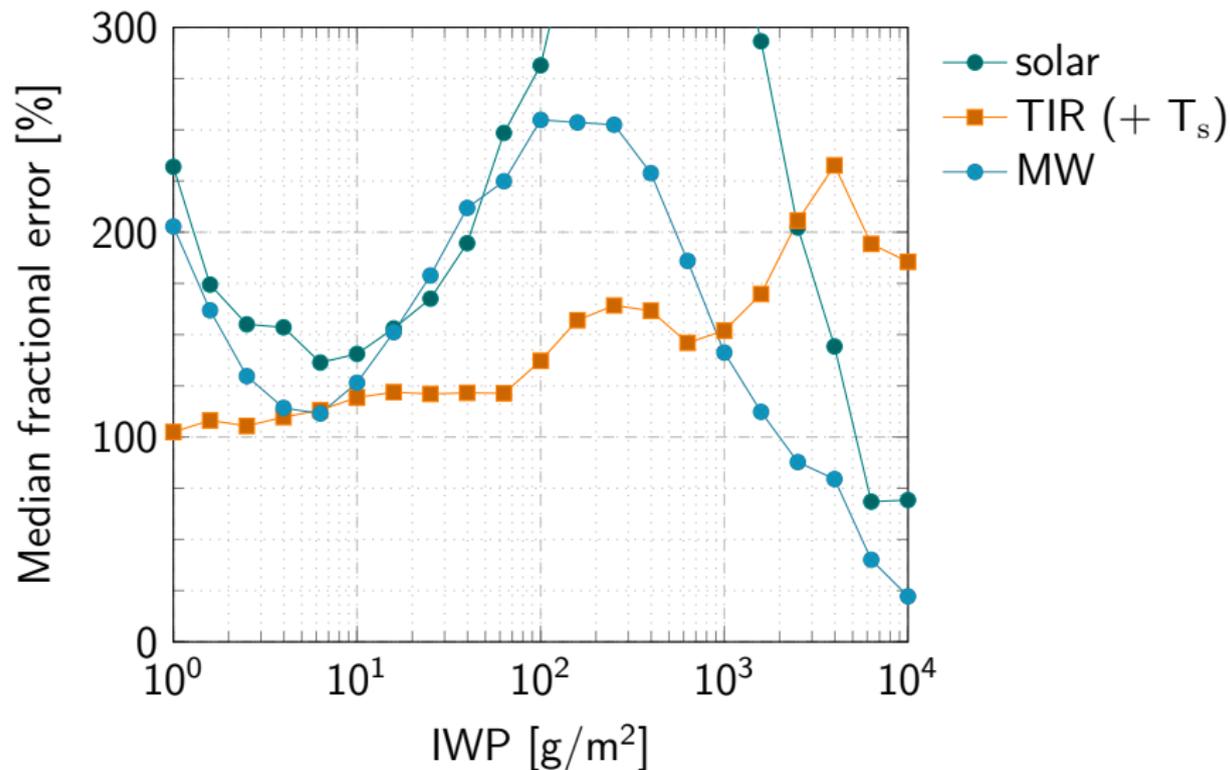
Sensor	Ch.	Spectral range
AVHRR	1	0.58–0.68 μm
AVHRR	2	0.725–1 μm
AVHRR	3b	3.55–3.93 μm
AVHRR	4	10.3–11.3 μm
AVHRR	5	11.5–12.5 μm
MHS	3	183 \pm 1 GHz
MHS	4	183 \pm 3 GHz
MHS	5	190 GHz

Also uses input from:

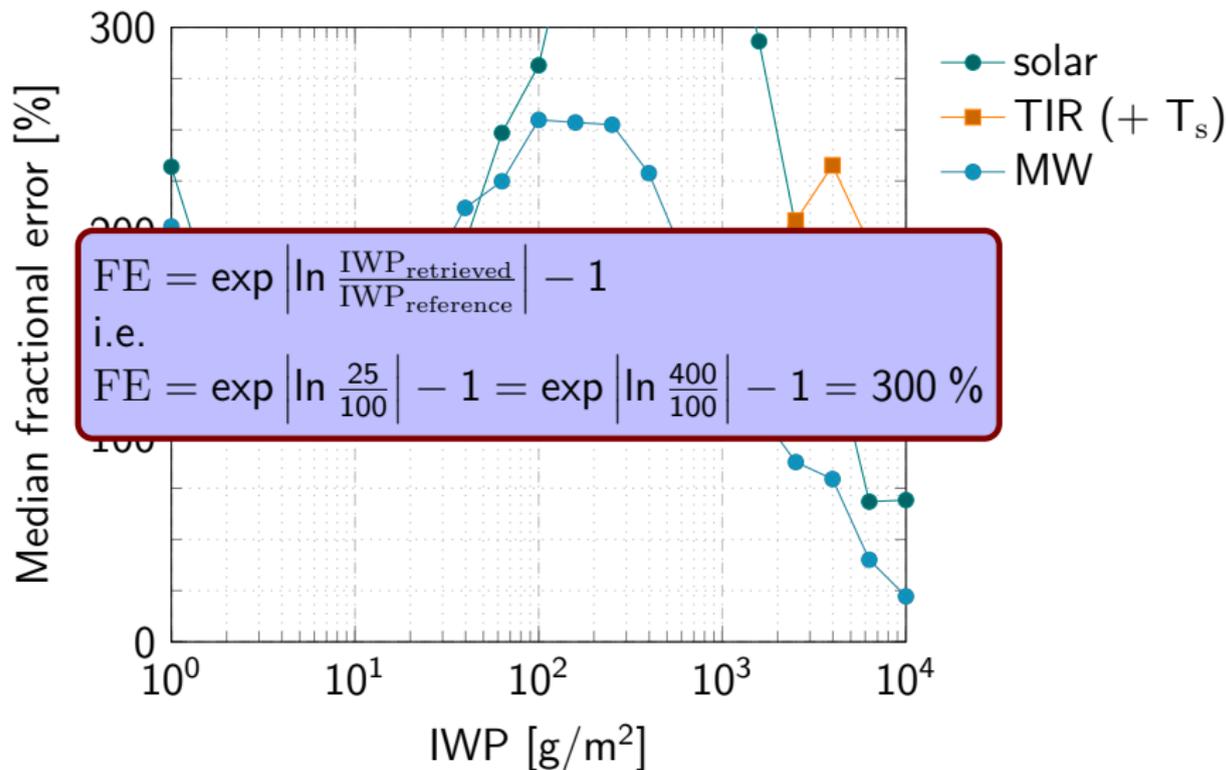
- Solar angles
- Satellite angles
- Surface elevation
- Skin temperature from CFS reanalysis (Saha et al., 2010)

Target: 2C-ICE combined radar/lidar, official CloudSat product (Deng et al., 2010). Good reasons to believe this provides the best IWP estimate we have.

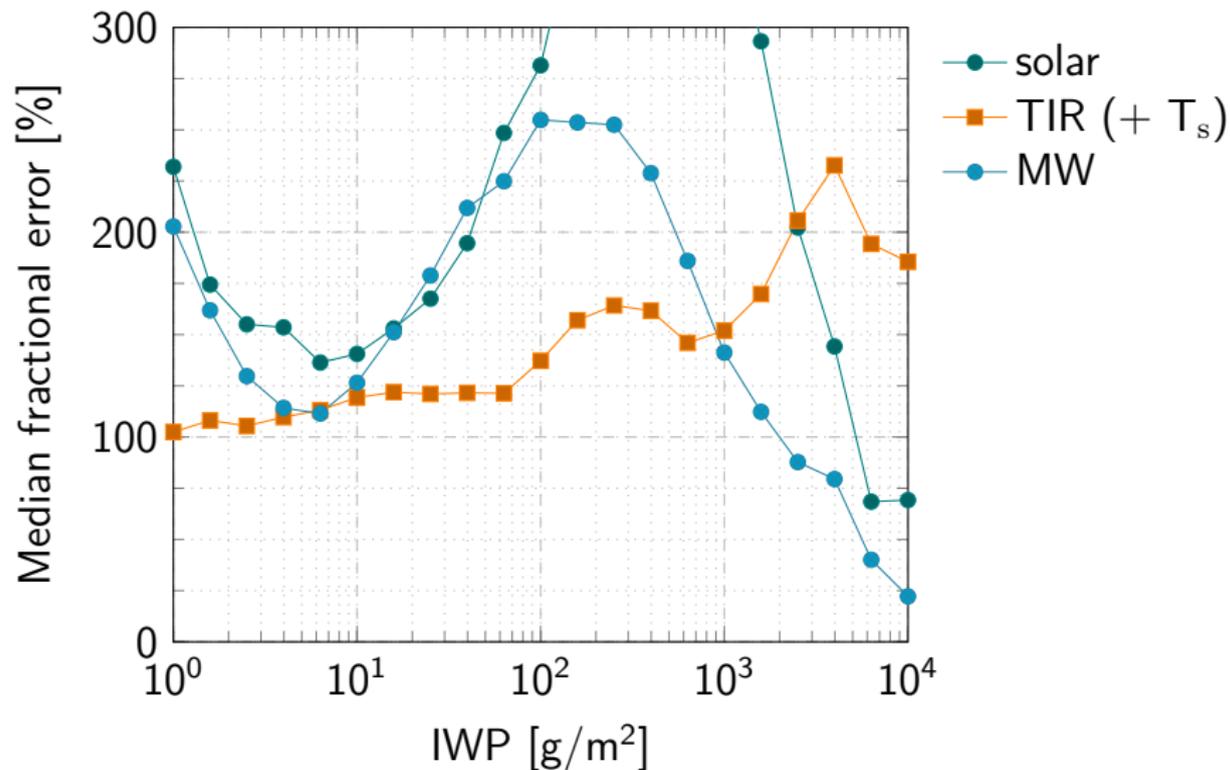
Performance for IWP neural net



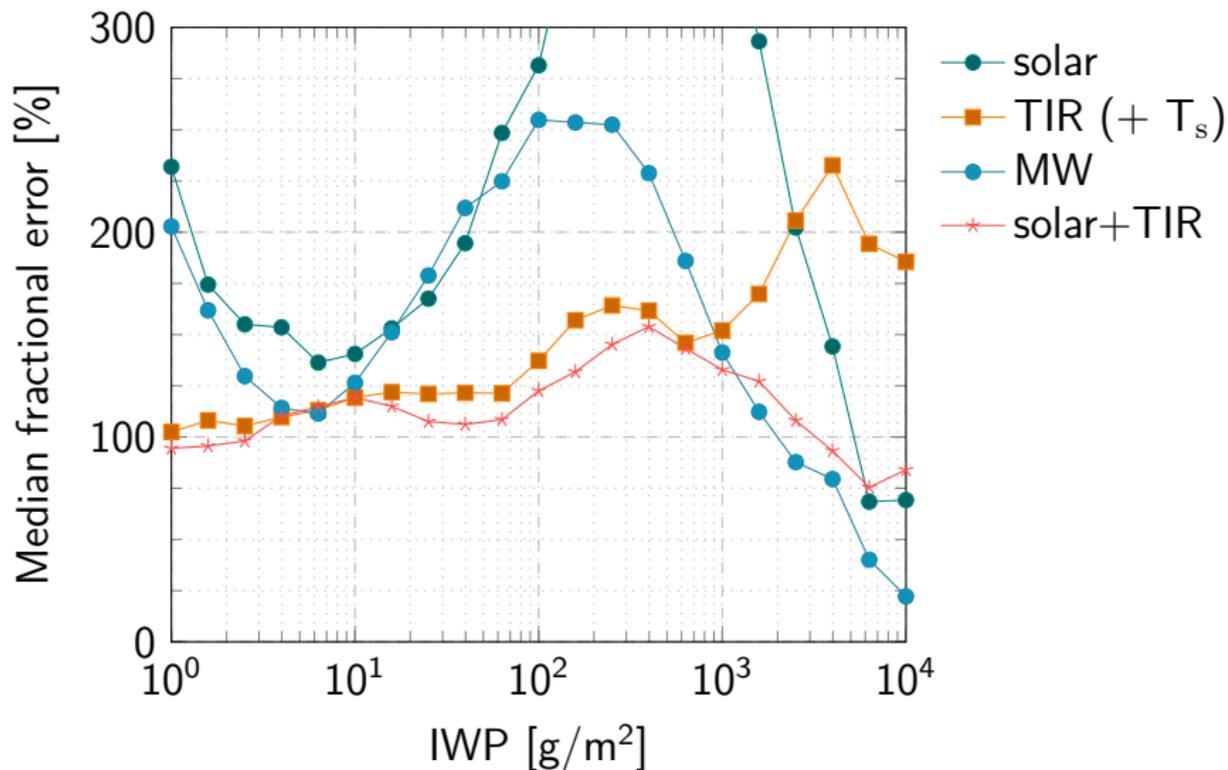
Performance for IWP neural net



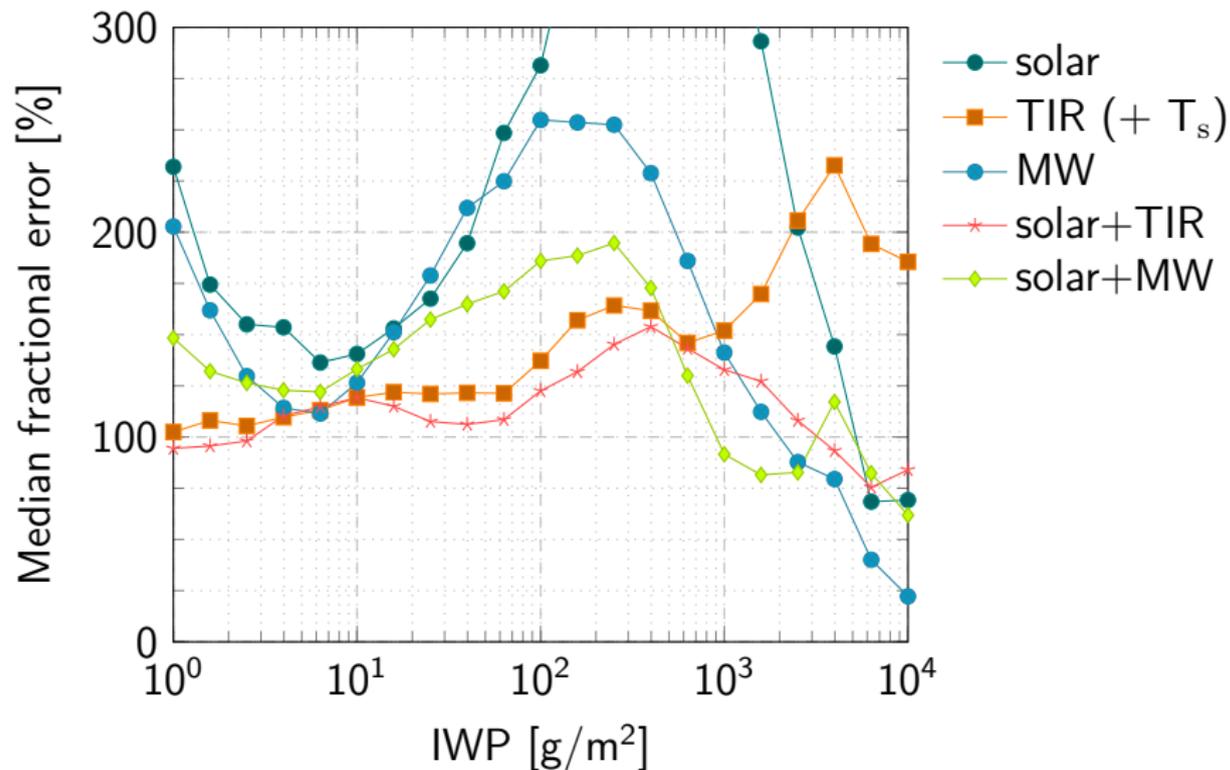
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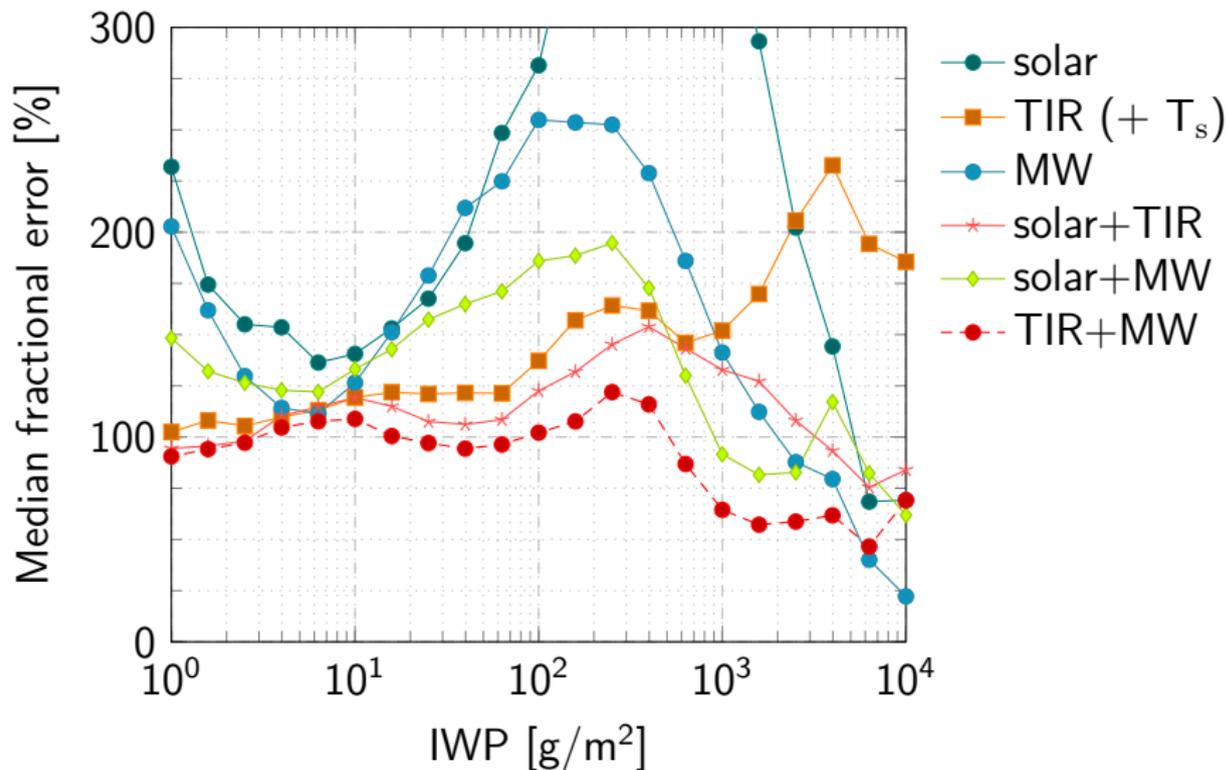
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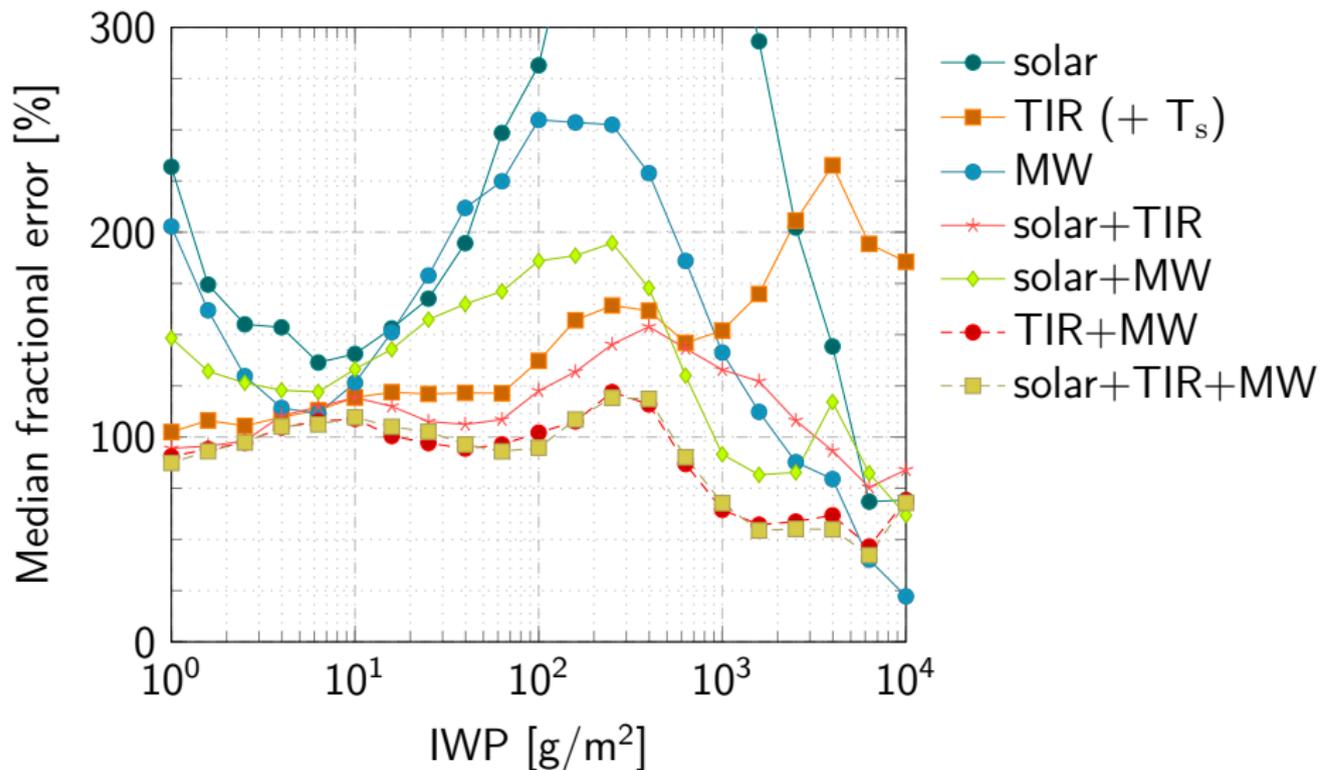
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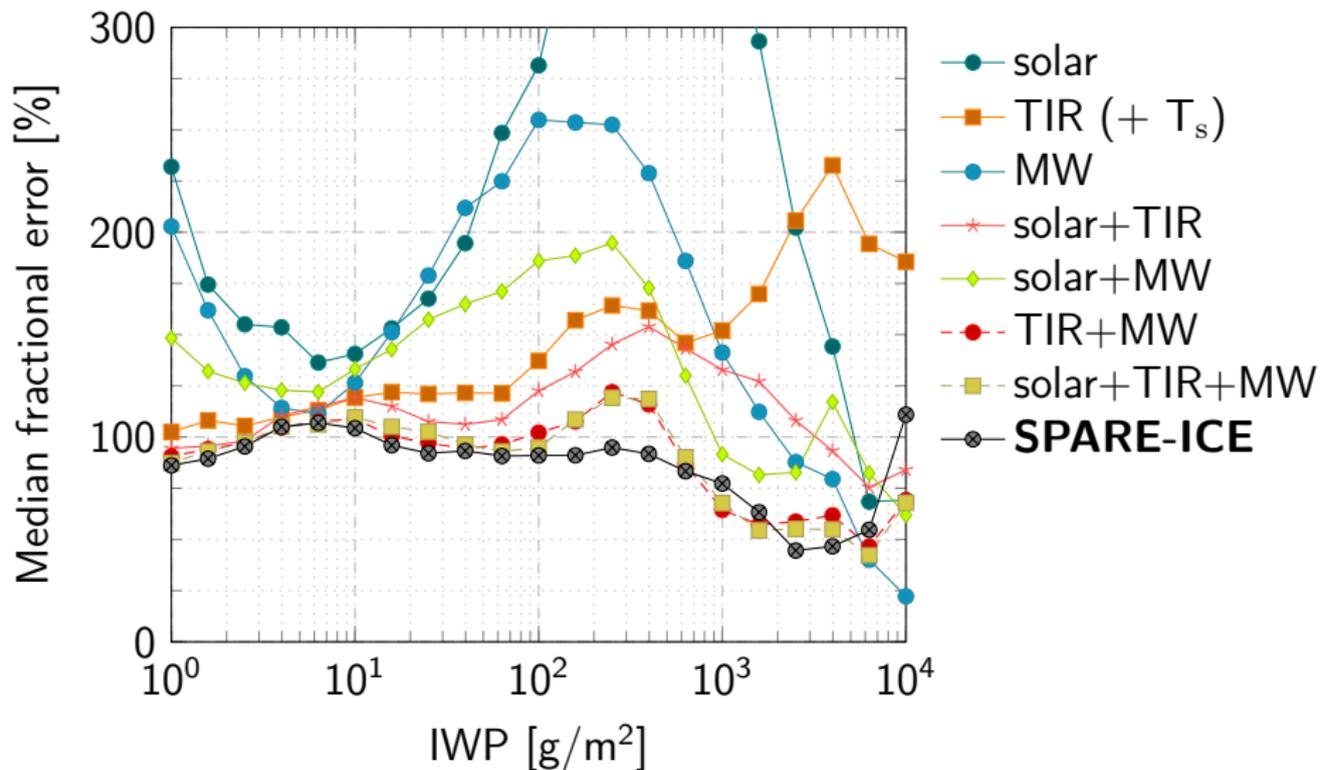
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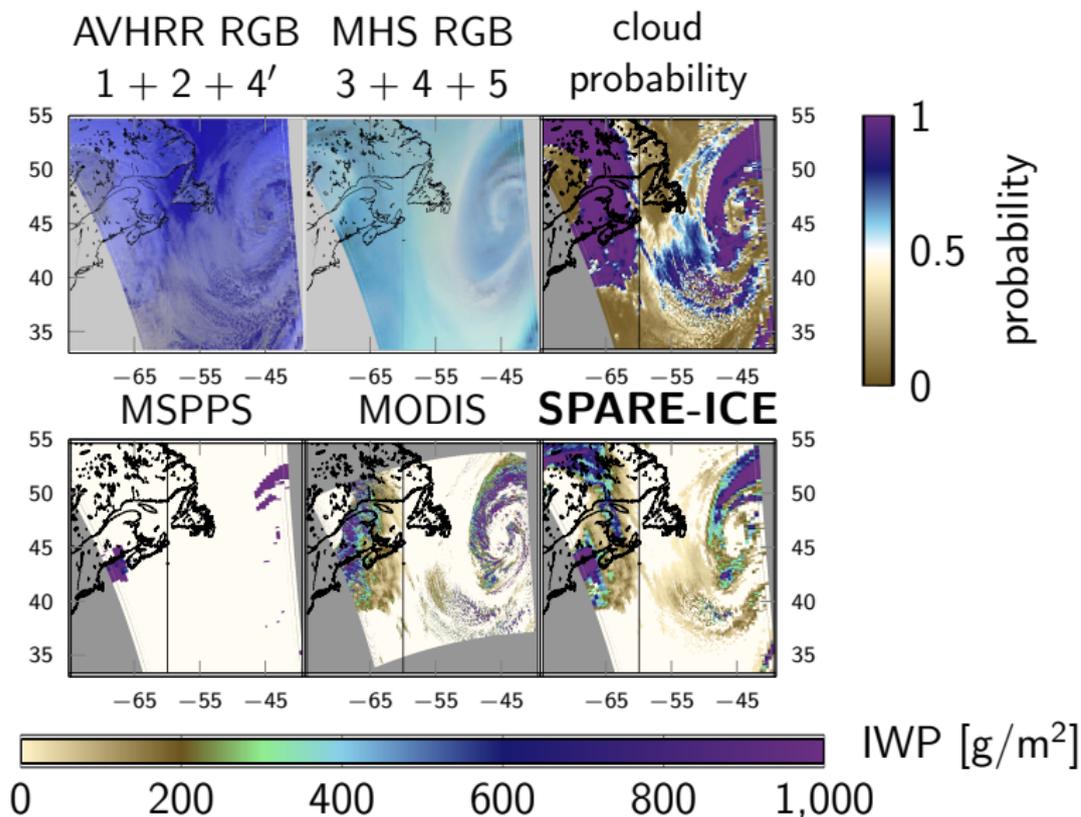
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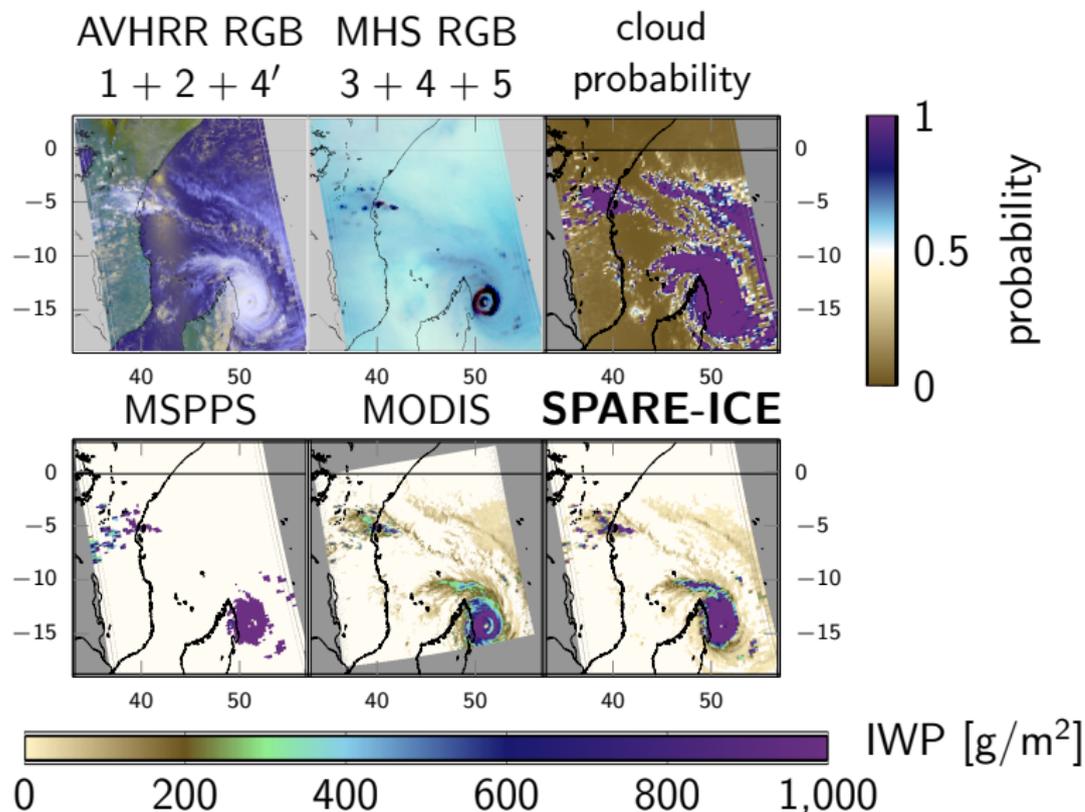
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Swath examples



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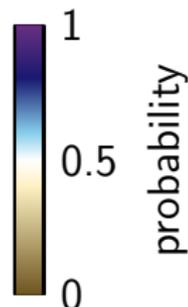
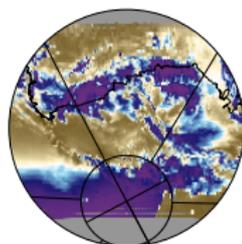
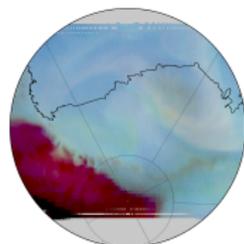
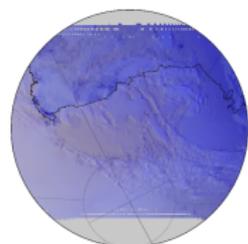


Swath examples

AVHRR RGB
1 + 2 + 4'

MHS RGB
3 + 4 + 5

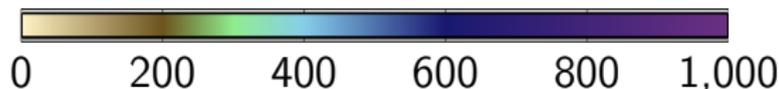
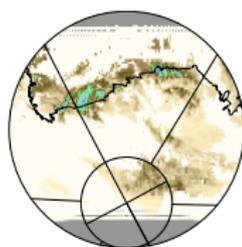
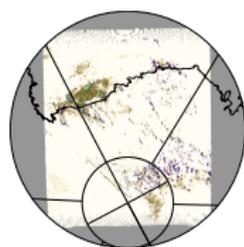
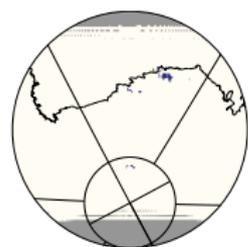
cloud
probability



MSPPS

MODIS

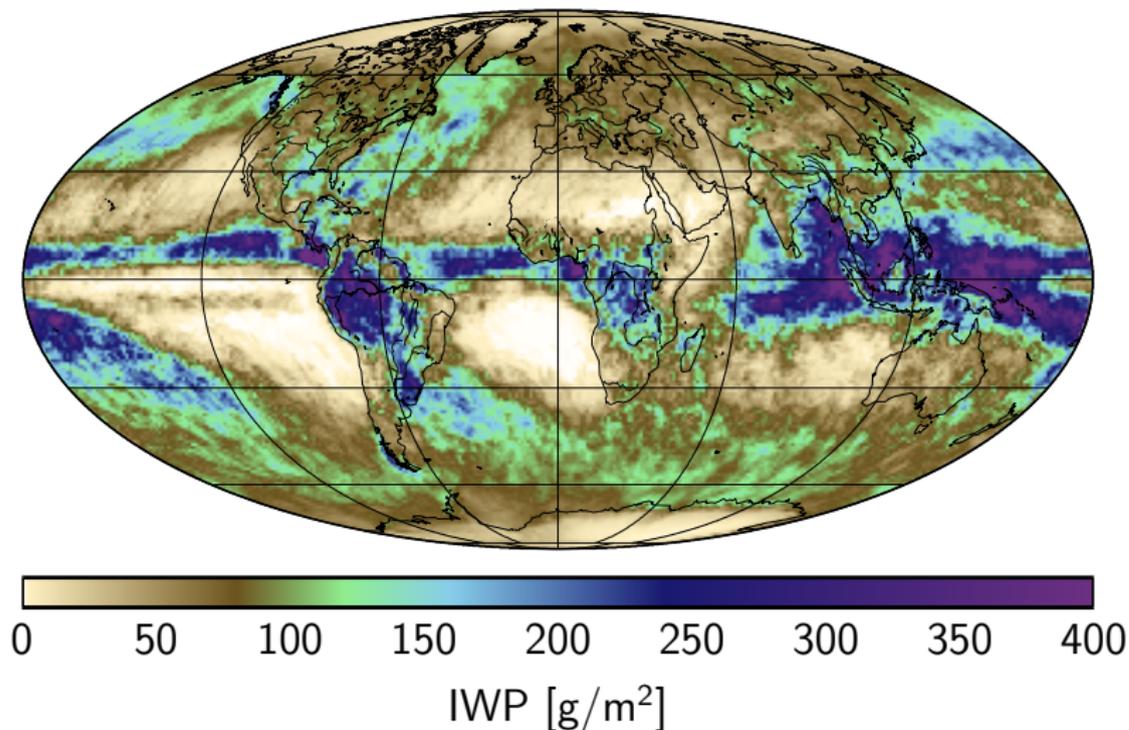
SPARE-ICE



IWP [g/m²]

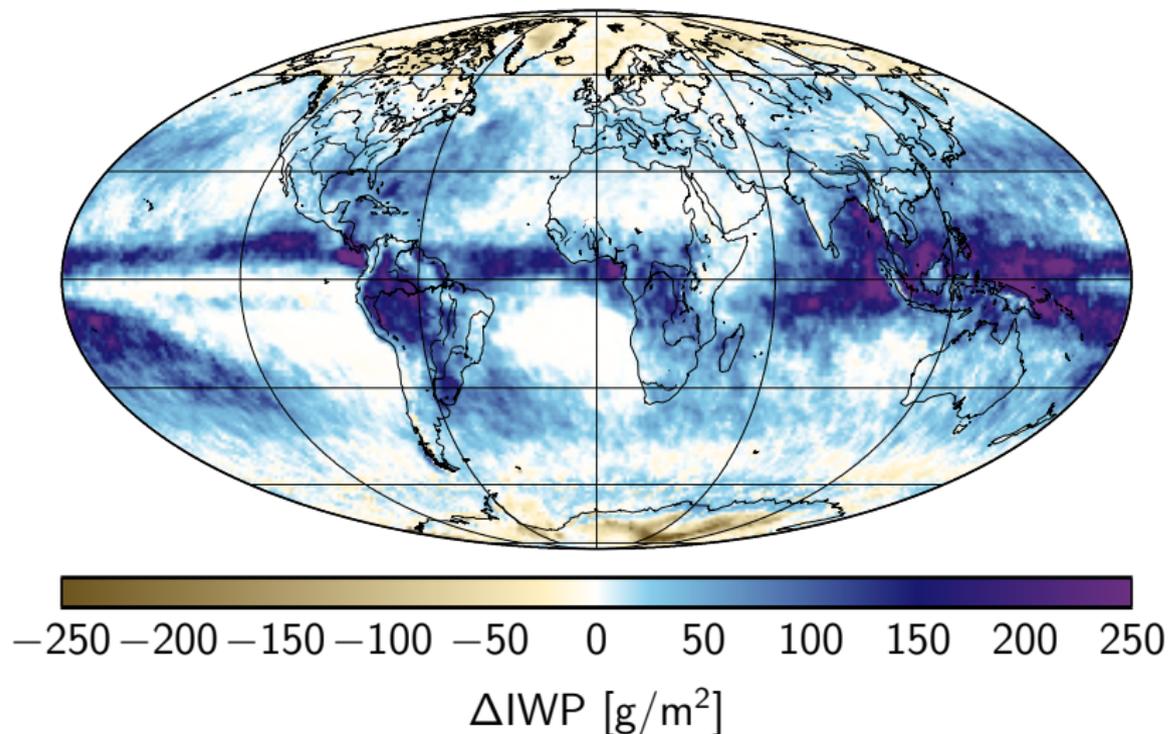
Gridded mean SPARE-ICE

SPARE-ICE gridded mean IWP, 2007



Gridded mean delta

Difference SPARE-ICE - MODIS Aqua IWP, 2007



Outlook

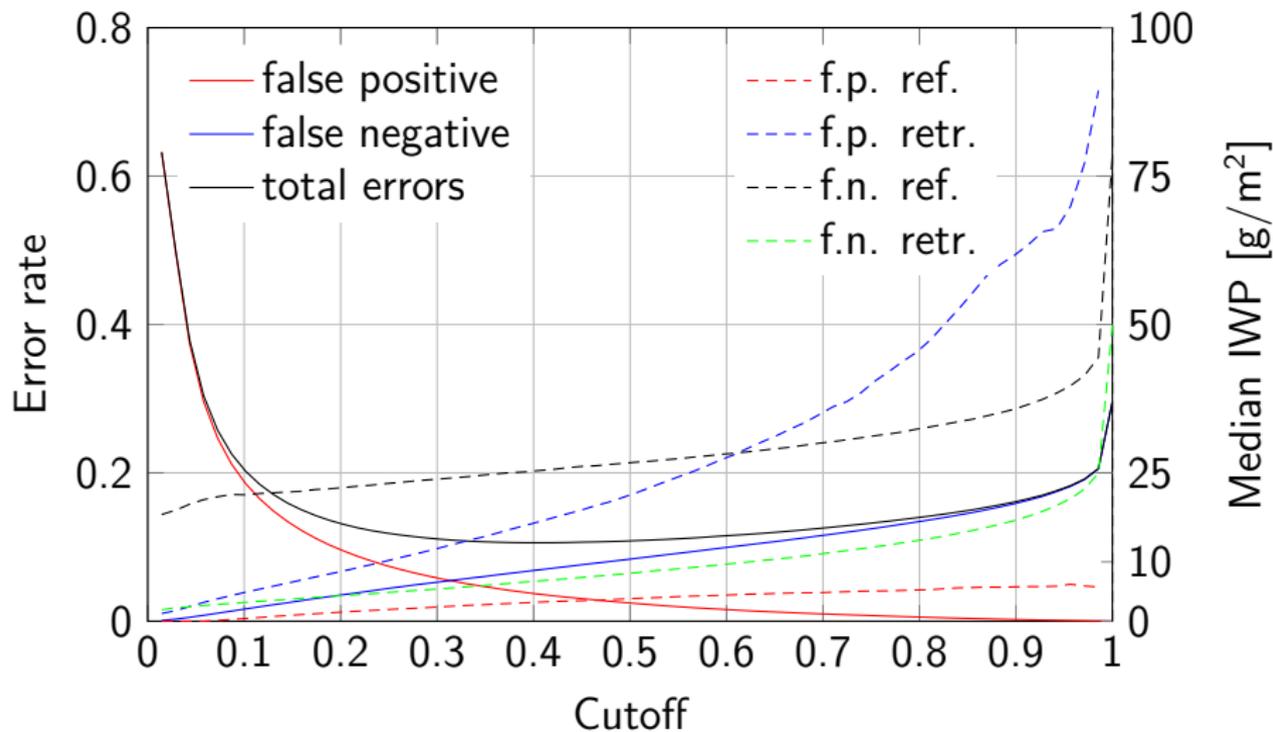
- Paper published (Holl et al., 2014)
- Extend dataset for longer time periods and other satellites
- Do a more formal information content analysis
- Contact authors for data access

감사합니다!

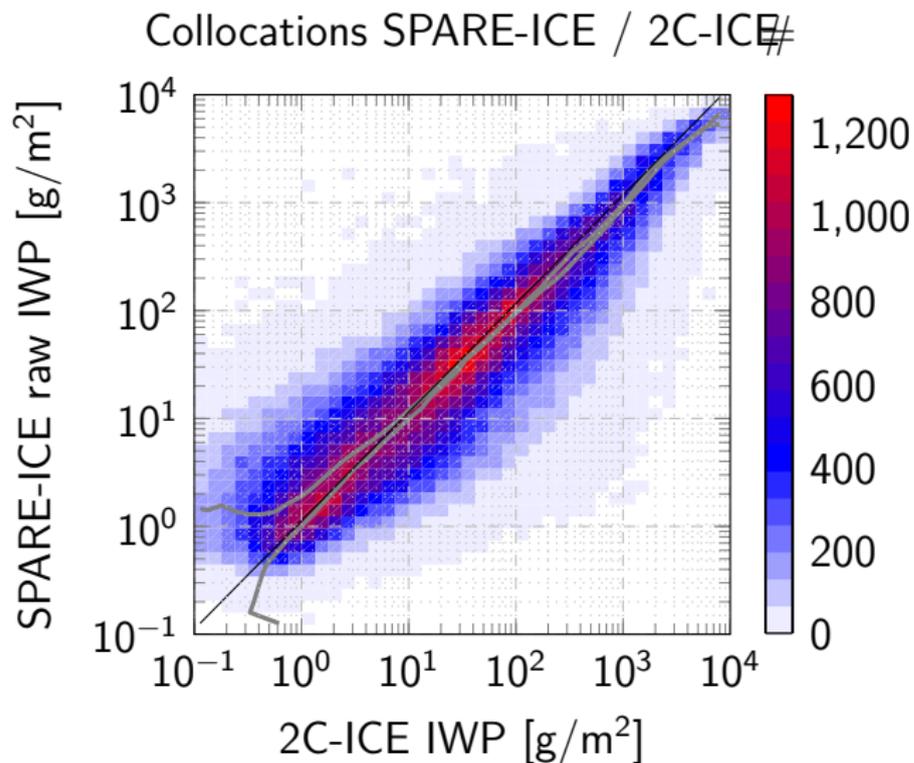
(gamsahamnida!)

- All my co-authors and other friends near and far
- Funding from Swedish Research Council
- Conference support from ITWG

Performance for cloud filter neural net, SPARE-ICE

Cloud filter test (threshold at 10 g m^{-2})

Systematic error



Bibliography

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