

RAMSES-II

The Retrieval Algorithm for Microwave Sounders in Earth Science (II)

Mathias Schreier

(Lots of Help from Bjorn, Evan, Evan, Irina, Ruth, ...)

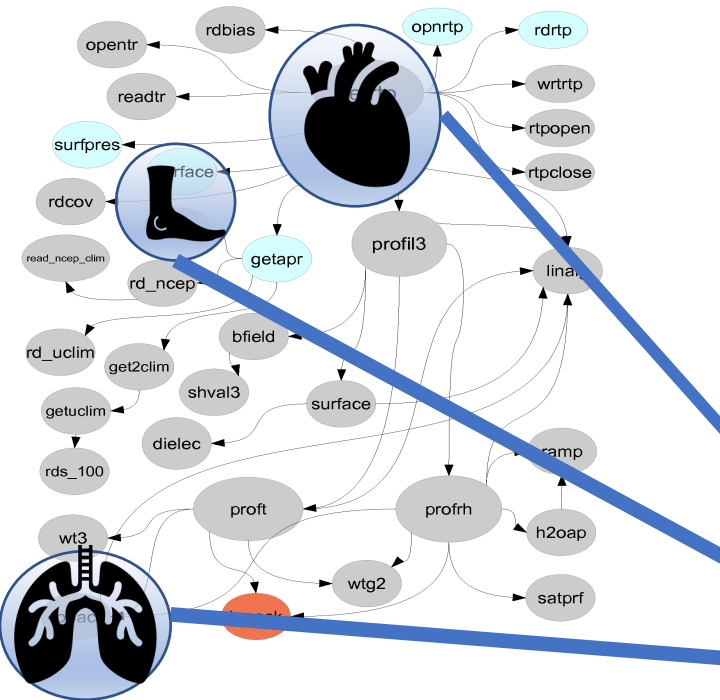
What is RAMSES-II?

- It's a microwave only retrieval
- No IR, no cloud clearing, limited magic applied
- Optimal estimation based
- At the moment, mainly focused on one instrument: ATMS
Advanced Technology Microwave Sounder on SNPP/JPSS-1
- Modular : Current system is based on MITrta, MERRA-2
- 1 footprint = 1 retrieval : one granule has 135 x 96 retrievals
- SIPS Status: Currently doing final test run

As every in Dynasty, RAMSES-II is based on some stealing

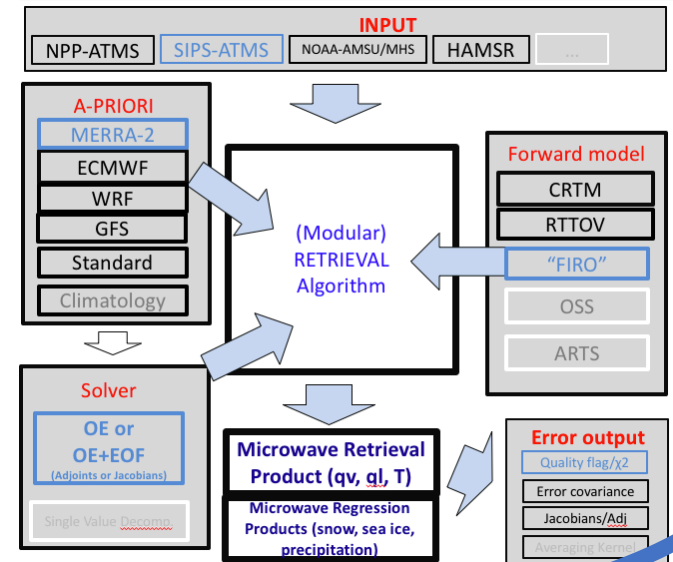
MITrta

by P. Rosenkranz and E. Fishbein



RATATOUILLE

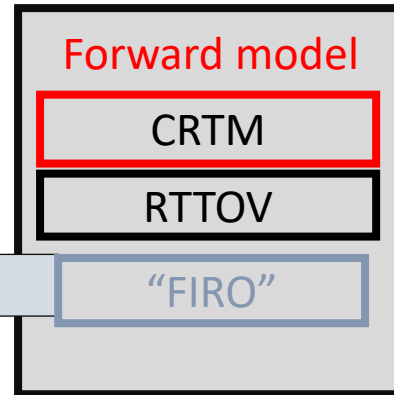
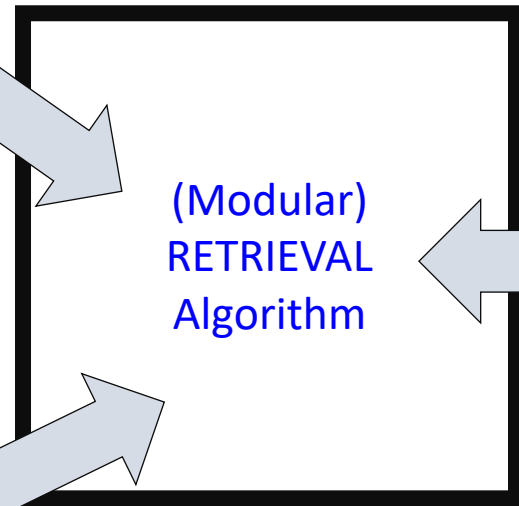
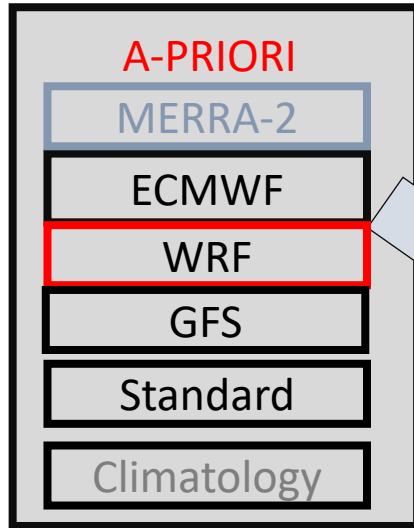
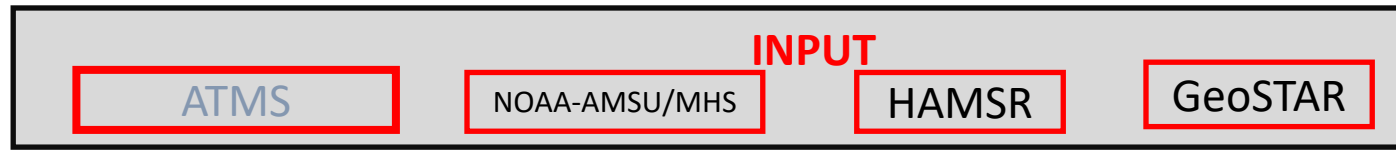
By M. Schreier and J. Steward



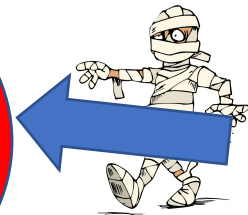
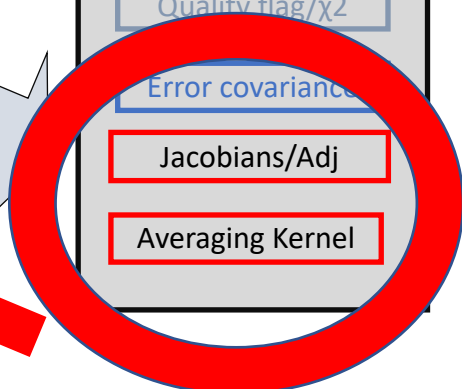
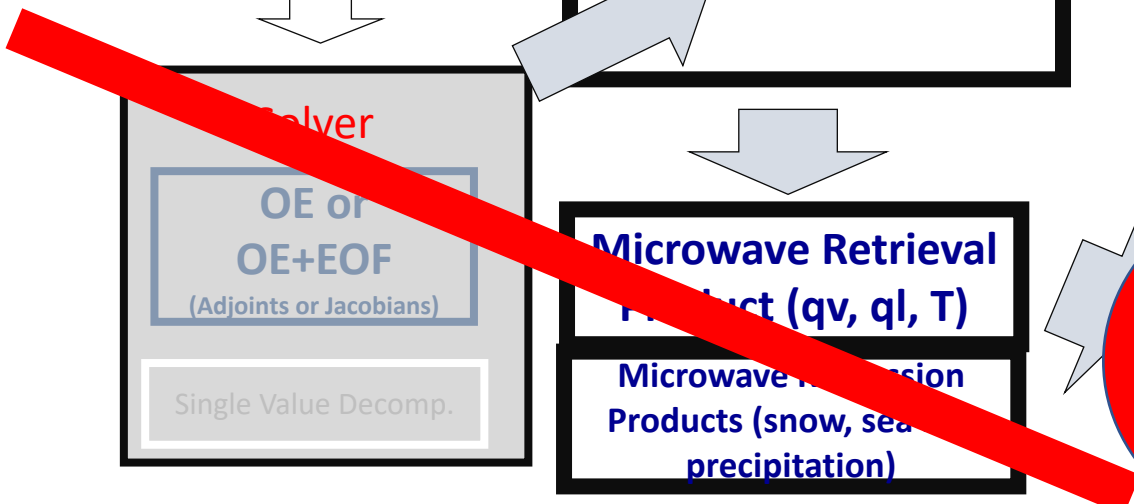
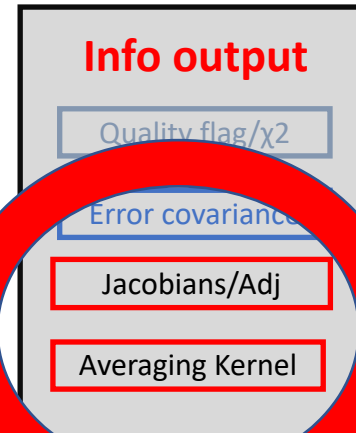
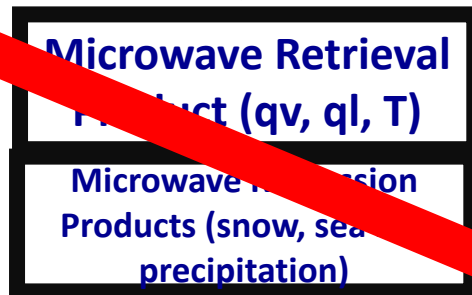
<http://clipart-library.com/clipart/dc9RB/Rdc7.htm>

RAMSES-II

RAMSES2/Ratatouille: So much more to play with ...



Scatter (slow!)
Scatter (little faster!)
Soon to Scatter!



“Microwave Utopia” :

If we include Scattering - How much information can we get from a Spaceborne Microwave Instrument?

Take a Simulation
(e.g. WRF)

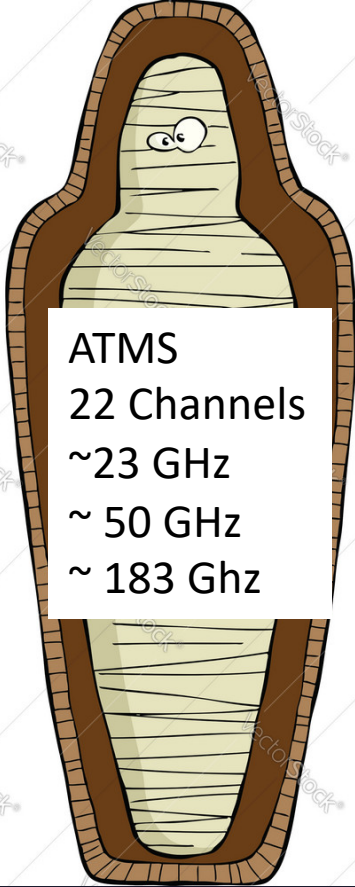
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graph TD; A[Take a Simulation (e.g. WRF)] --> B[Simulate Brightness Temperatures (e.g. using CRTM with scattering)]; B --> C[Calculate A-Kernels]; C --> D[Look at Degrees of Freedom];
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Simulate Brightness Temperatures
(e.g. using CRTM with scattering)

Calculate A-Kernels

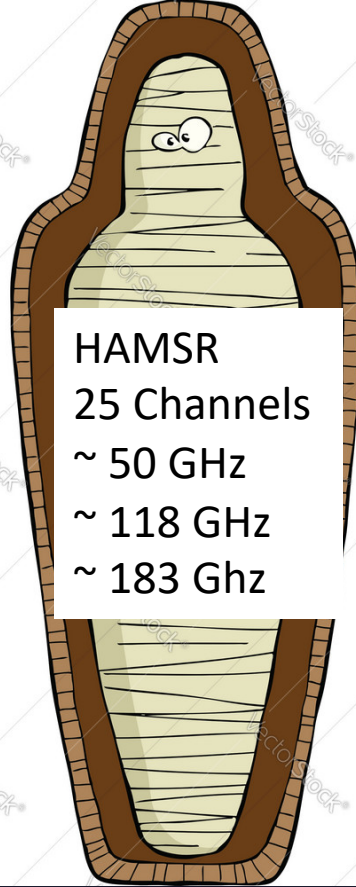
Look at Degrees of Freedom

Three Candidates for Testing



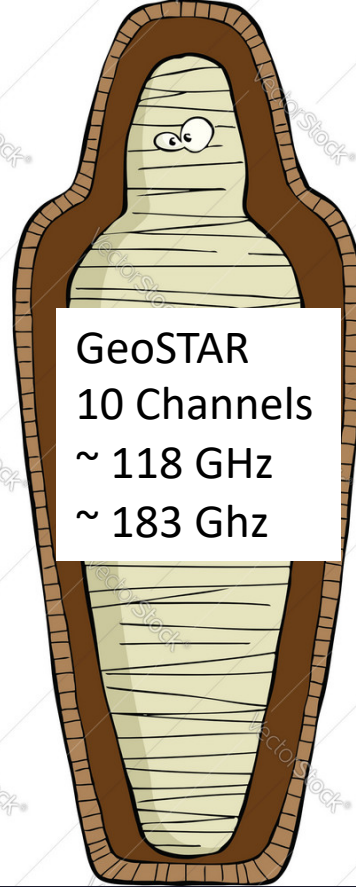
ATMS
22 Channels
~23 GHz
~ 50 GHz
~ 183 Ghz

VectorStock.com/883774



HAMSR
25 Channels
~ 50 GHz
~ 118 GHz
~ 183 Ghz

VectorStock.com/883774

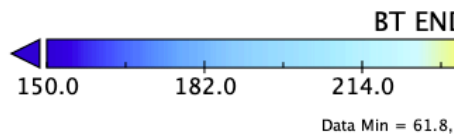
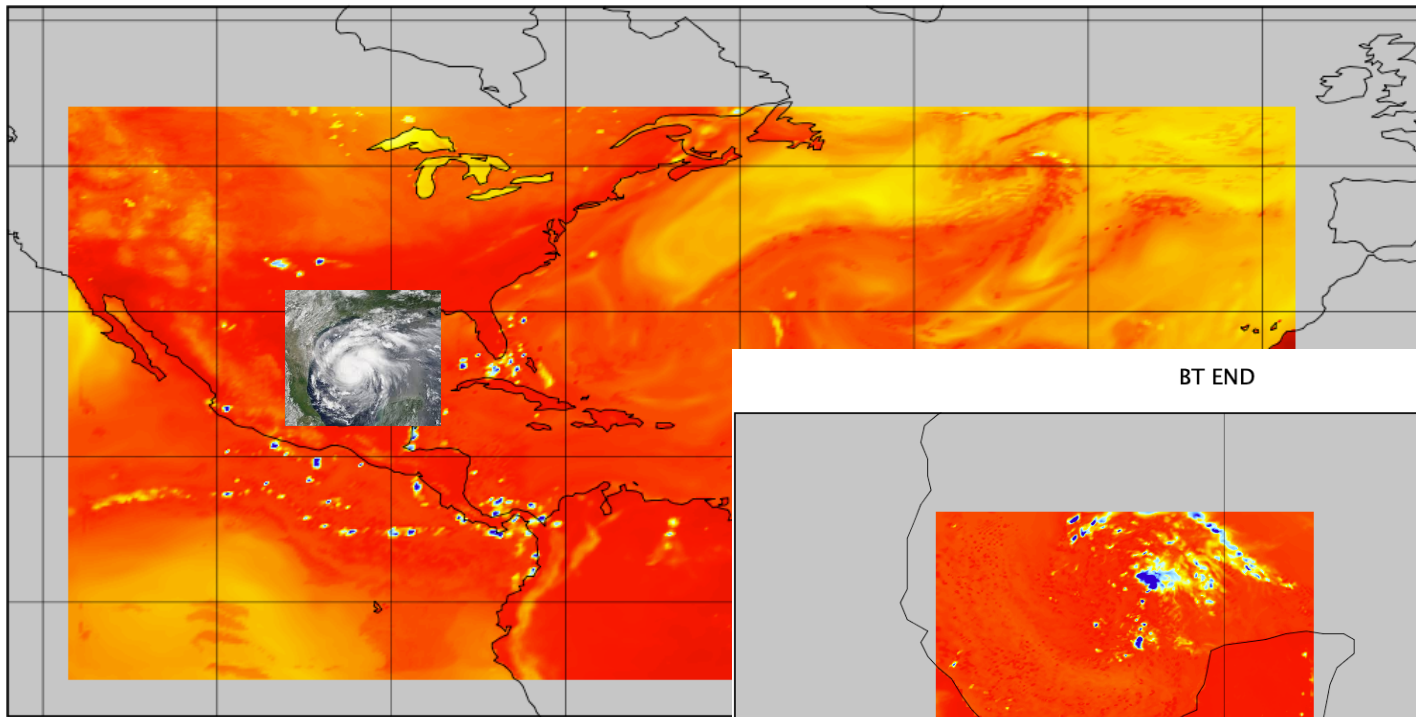


GeoSTAR
10 Channels
~ 118 GHz
~ 183 Ghz

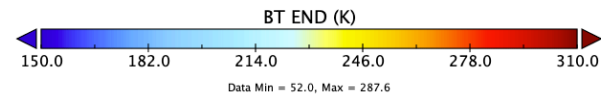
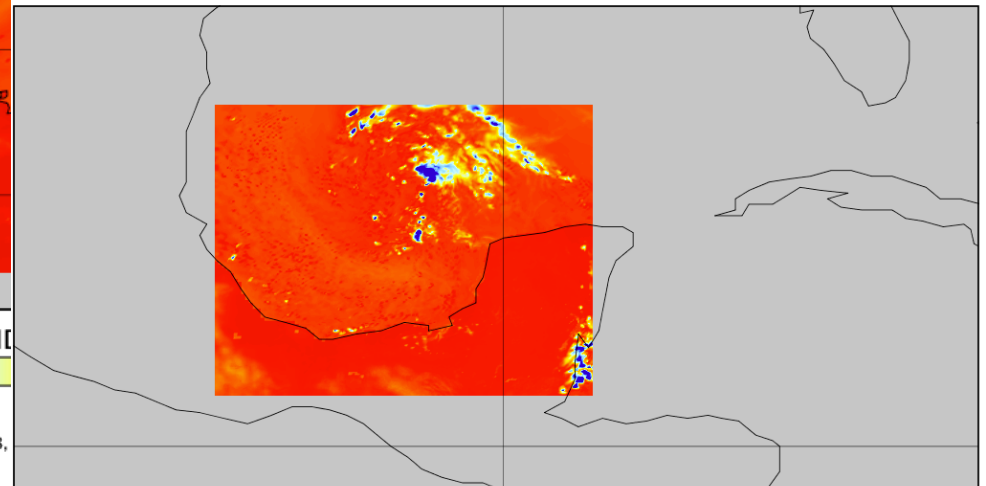
VectorStock.com/883774

WRF Simulation of Hurricane Harvey (2017-08-23) – 25 km

BT END

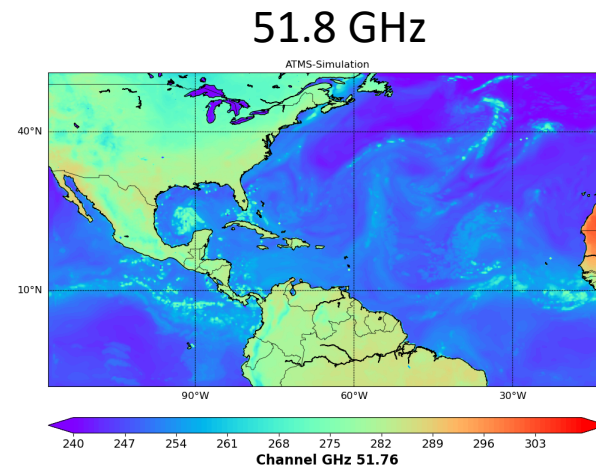
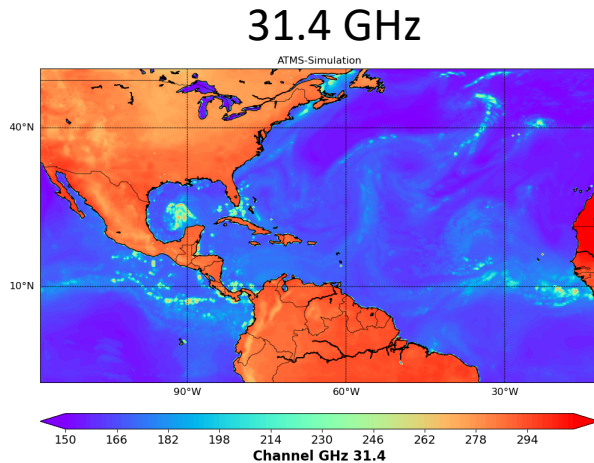
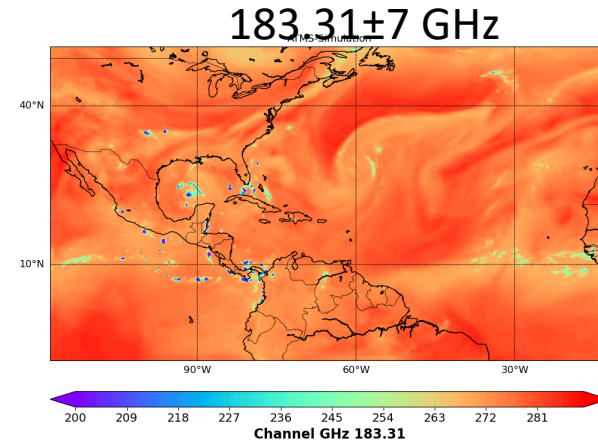


BT END

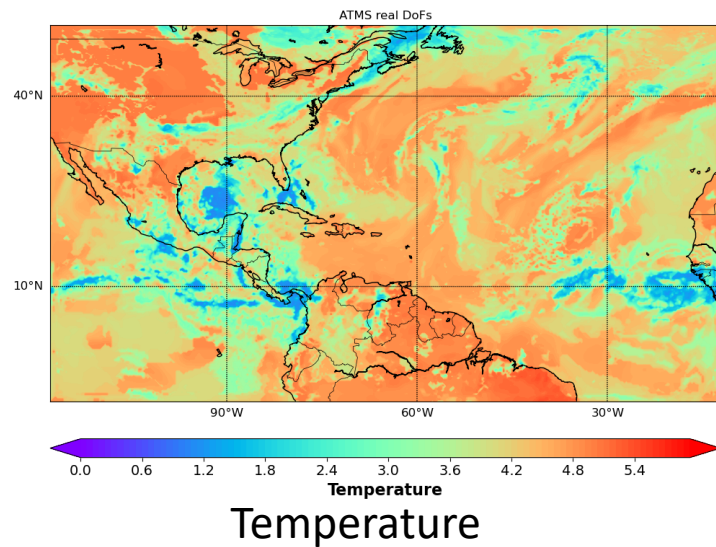


Brightness Temperature for “Geo”-ATMS (scattering on)

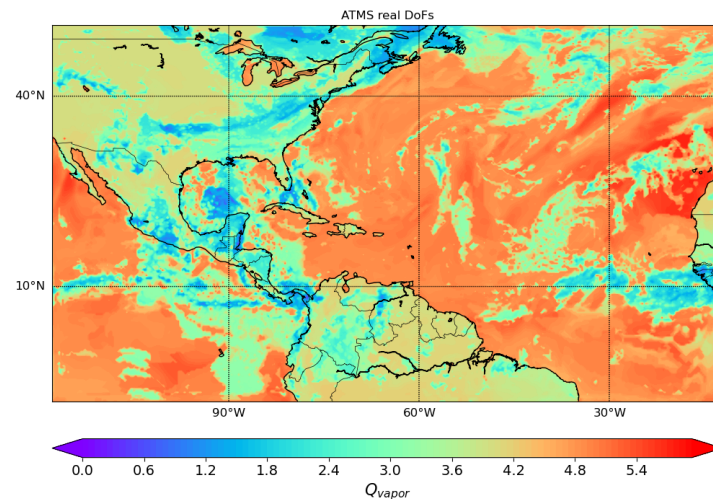
22 channels:
9 between 23.8-55 GHz
6 channels ~ 57 GHz (O₂)
2 between 88-165 GHz (surface)
5 channels ~ 183 GHz (H₂O)



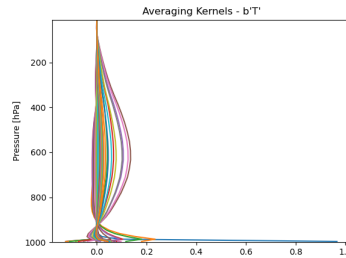
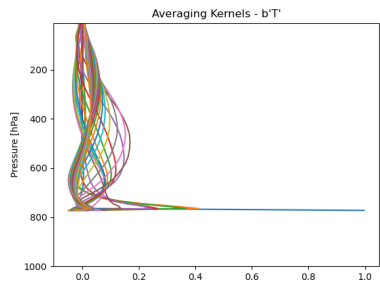
Averaging Kernels - Degrees of freedom for Geo-ATMS



Water vapor

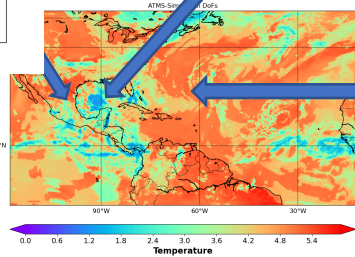
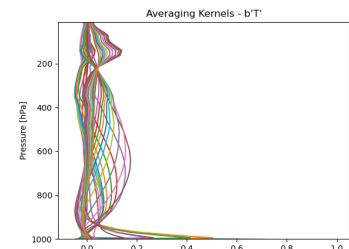
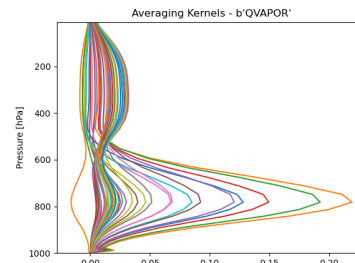
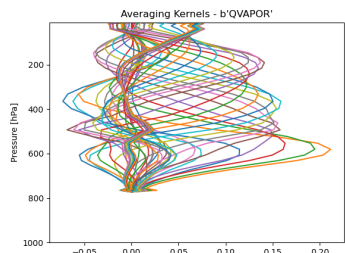


Averaging Kernels - Degrees of freedom (scattering on)

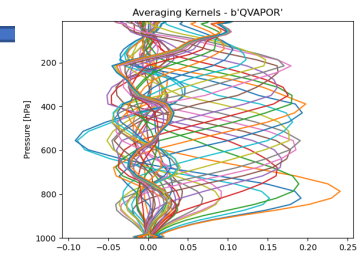


Good place

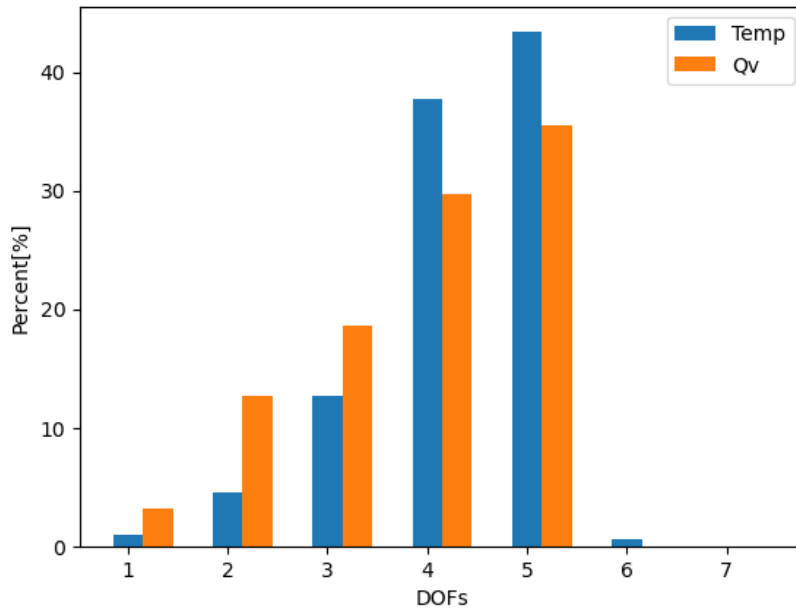
Strong precip



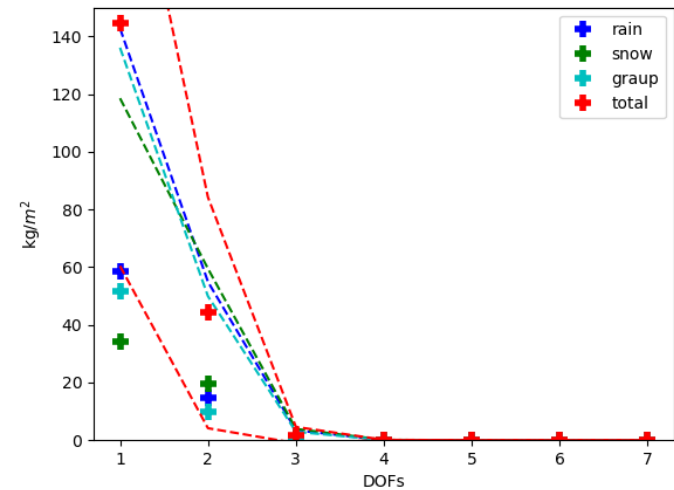
Surface elevation



Degrees of freedom for ATMS (scattering on)



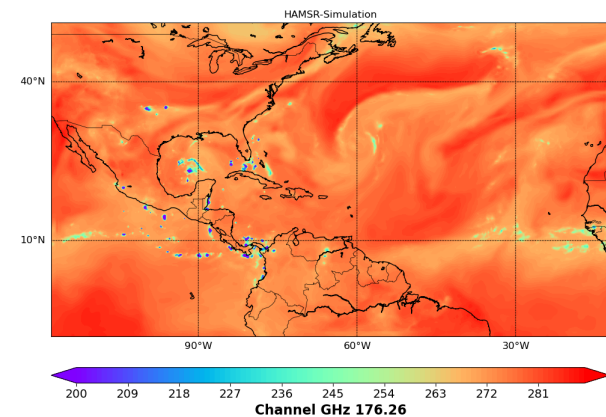
Connection of
total precip and
DOFs
(Temperature)



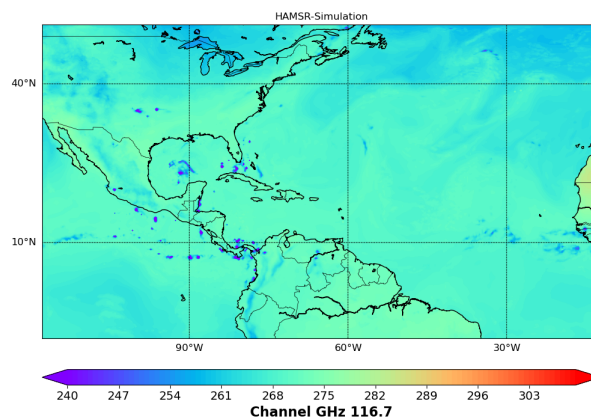
Brightness Temperature for “HAMSR in Space” (scattering on)

25 channels
8 channels ~ 52 GHz (O_2)
10 channels ~ 118 GHz (O_2)
7 channels ~ 183 GHz (H_2O)

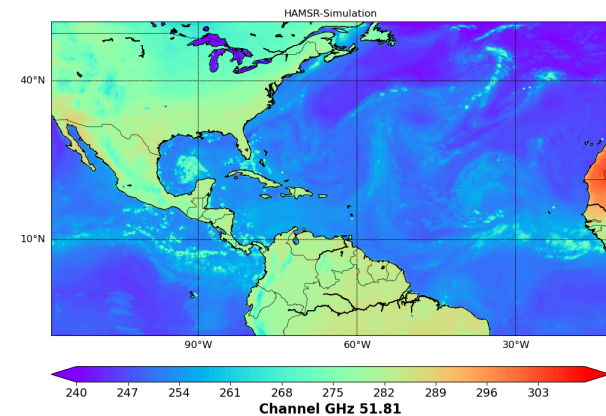
183.31-7 GHz



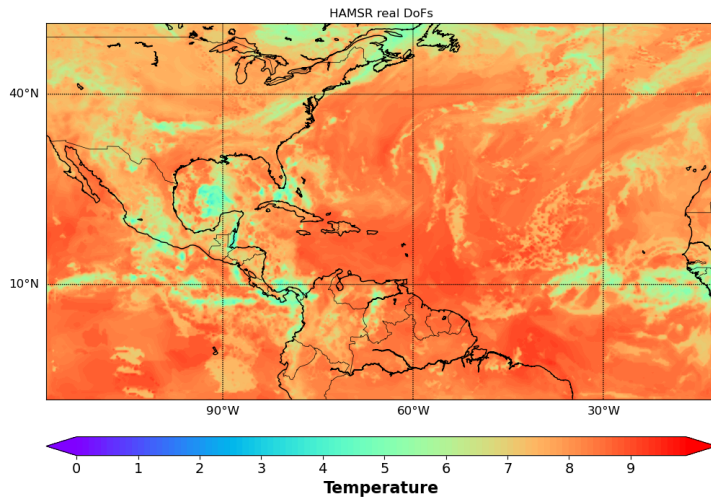
118.7-2 GHz



51.61 GHz

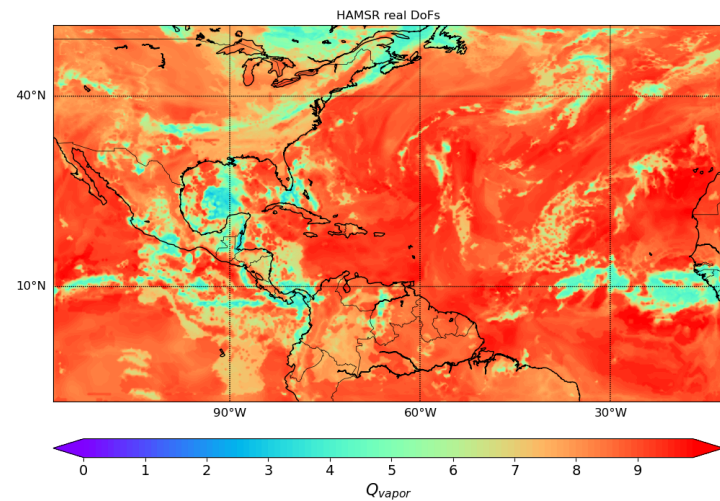


Averaging Kernels - Degrees of freedom for Space-HAMSr

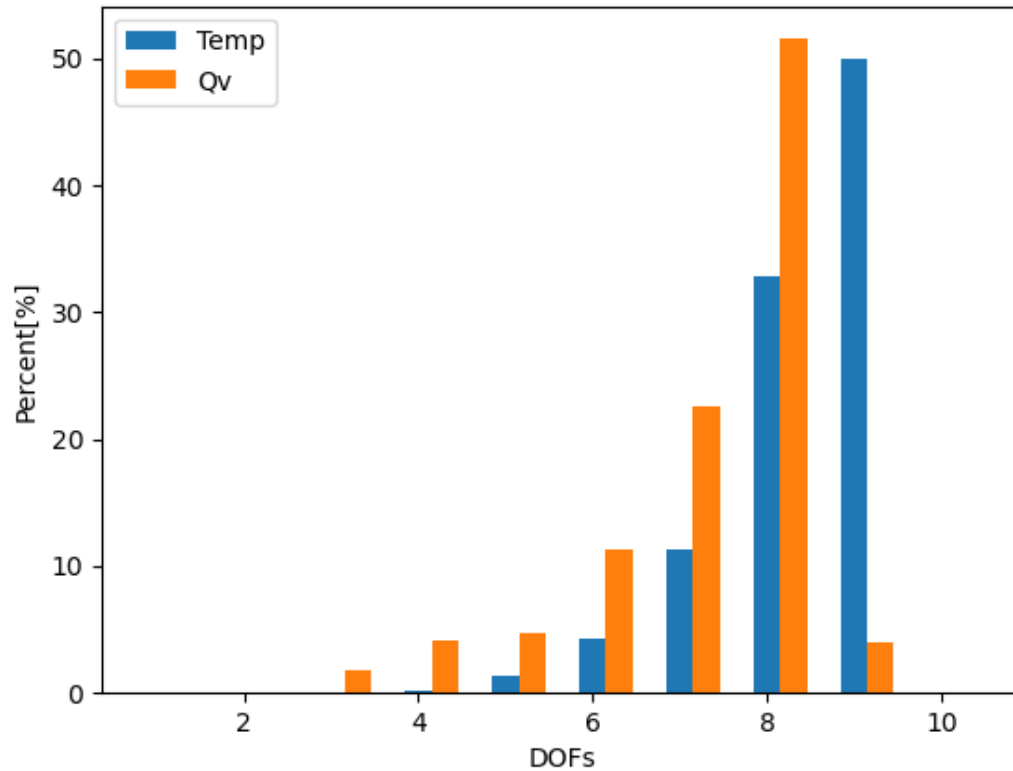


Temperature

Water vapor

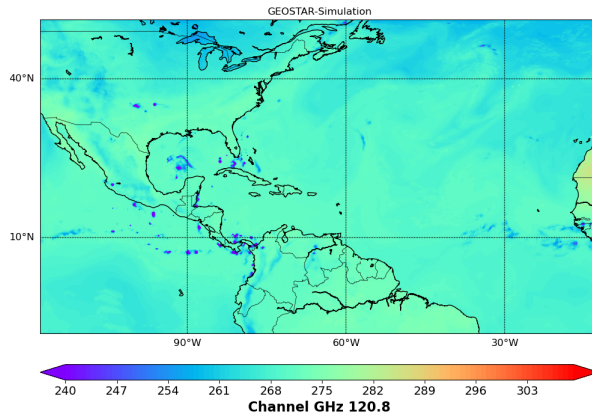


Degrees of freedom for Space-HAMSR (scattering on)

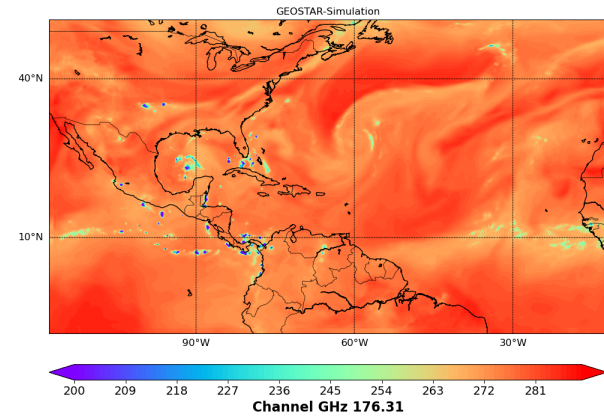


Brightness Temperature for GeoSTAR (scattering on)

10 channels
6 channels ~ 118 GHz (O_2)
1 at 166 GHz
3 channels ~ 183 GHz (H_2O)

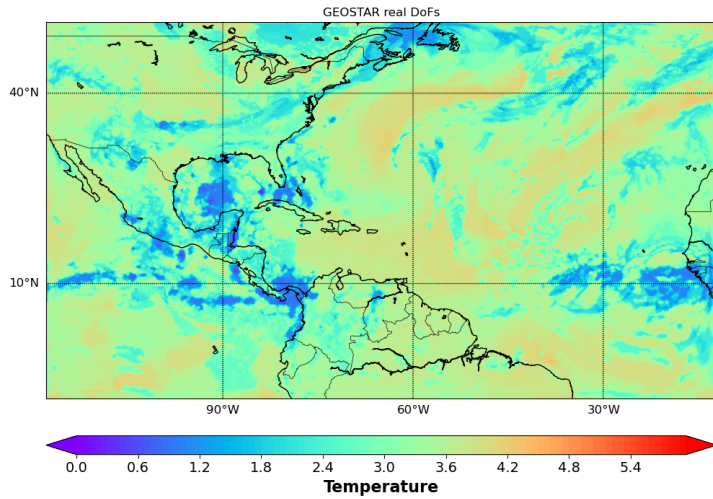


118.7+2



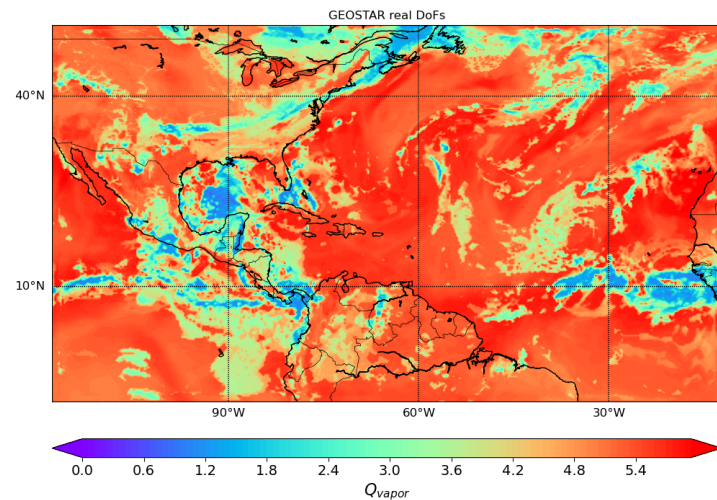
183.31-7

Averaging Kernels - Degrees of freedom for GeoSTAR

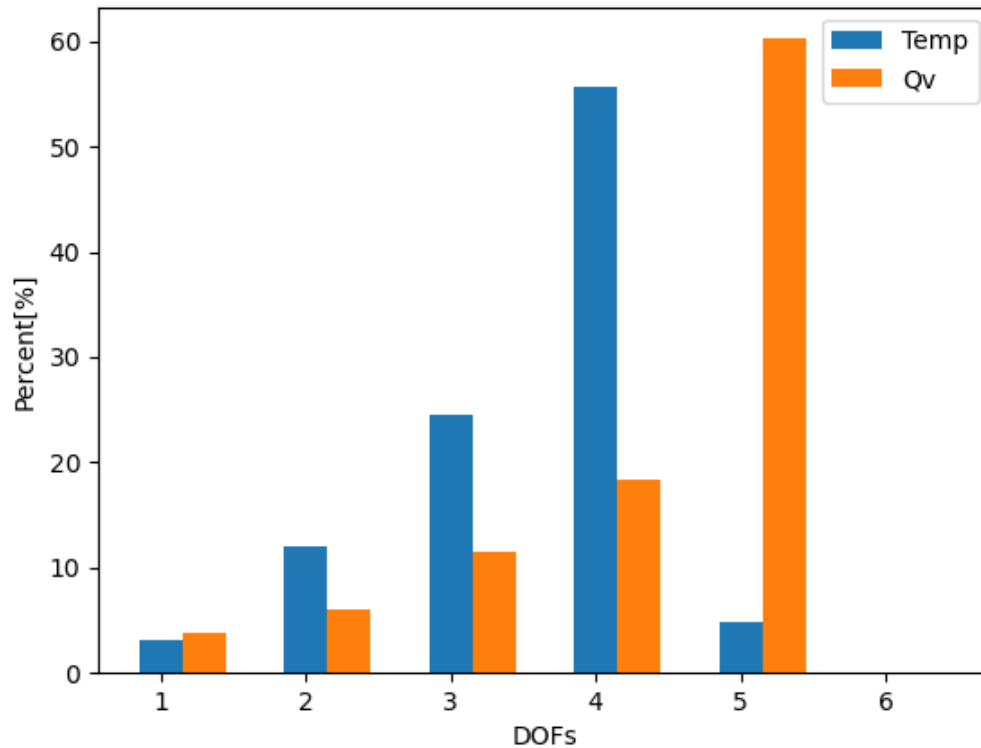


Temperature

Water vapor

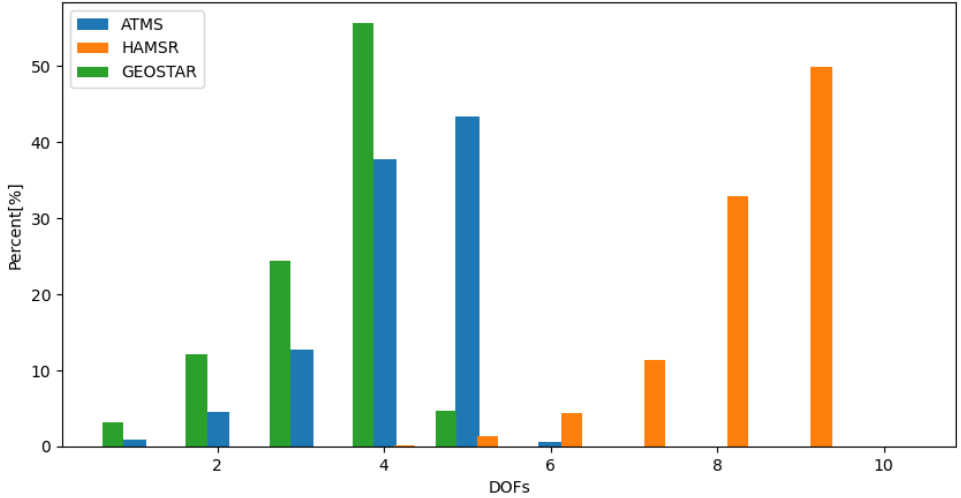


Degrees of freedom for GeoSTAR (scattering on)

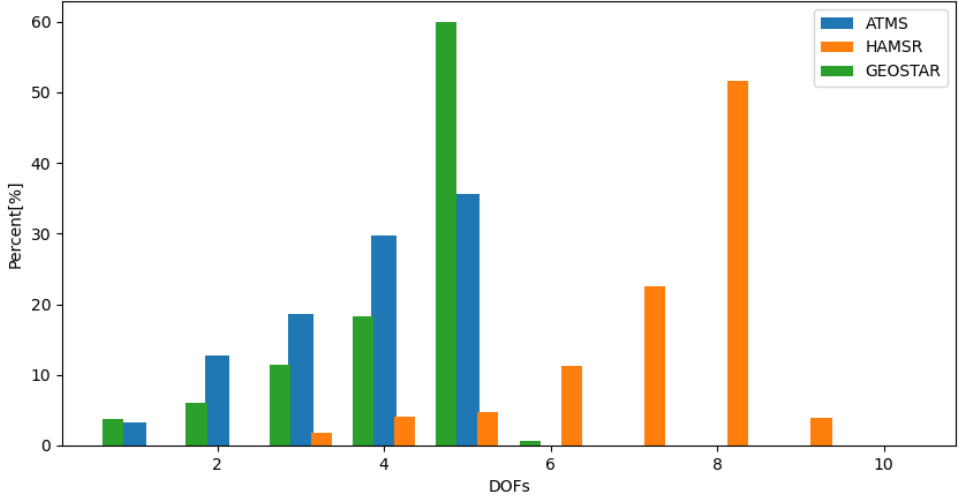


Comparison

Temperature



Water vapor



Conclusion

- There is a lot of potential information in MW
- Even with precipitation, there is still some information of T and Q_v
- Adding scattering is therefore helpful:
 - can help to narrow it down in the region of precipitation
- The key:
 - Smart selection of channels
 - Reduction of noise
- Regarding Temperature:
 - 118 GHz is a good replacement for 54GHz
 - But : if you have both, you get much more info
- Regarding Water Vapor:
 - The more channels around 183 GHz, the merrier

