Optimised frequency grids for infrared radiative transfer simulations in cloudy conditions

Gerrit Holl
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Luleå University of Technology
Kiruna Space Campus

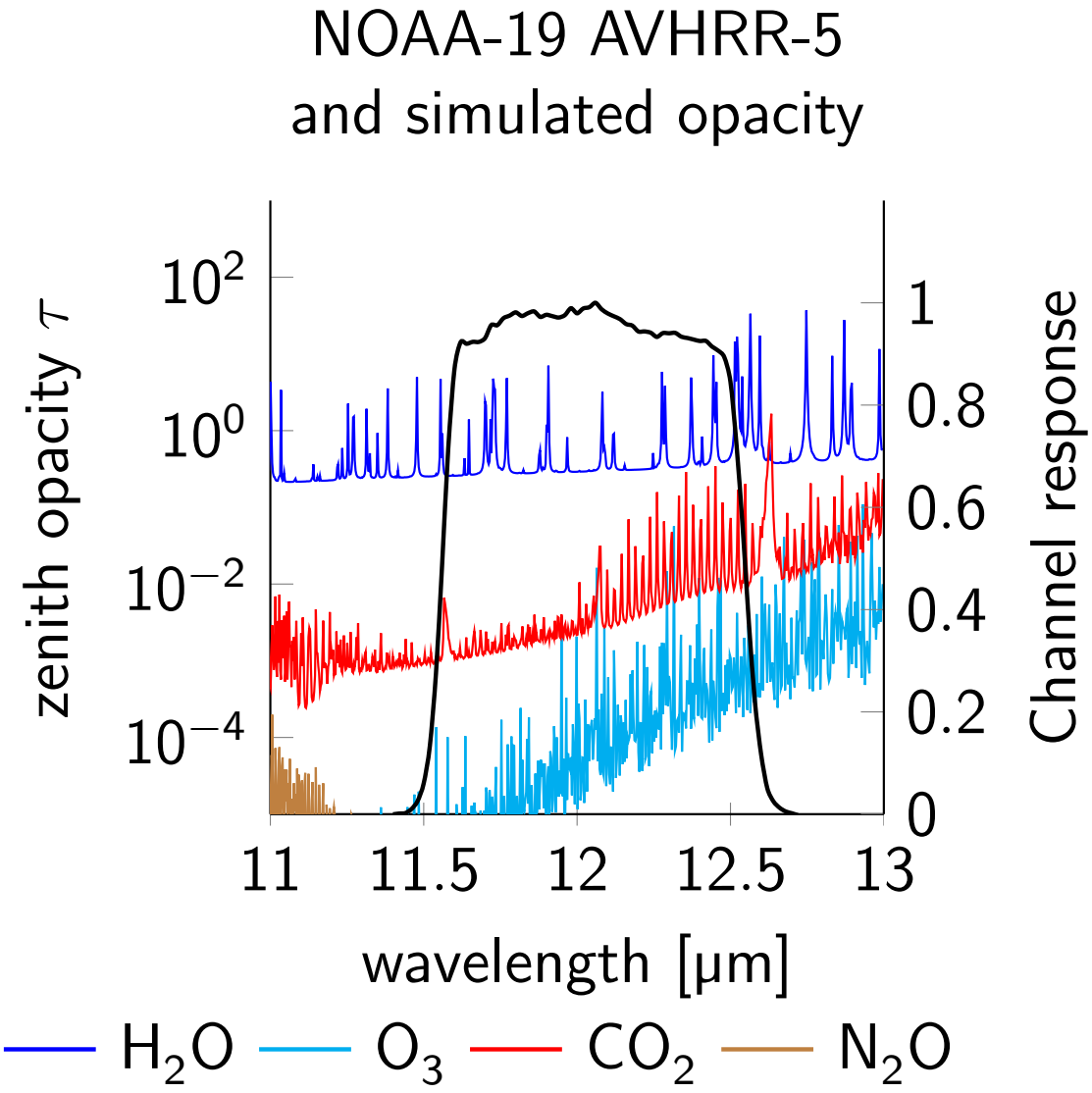
Based on: Buehler et al., 2010, JQSRT; Holl et al., JQSRT, submitted **yesterday**

gerrit.holl@ltu.se

23 March 2012

Outline

The problem



- Radiative transfer simulation for infrared channel radiance
- Many frequencies, many lines
- Time-consuming

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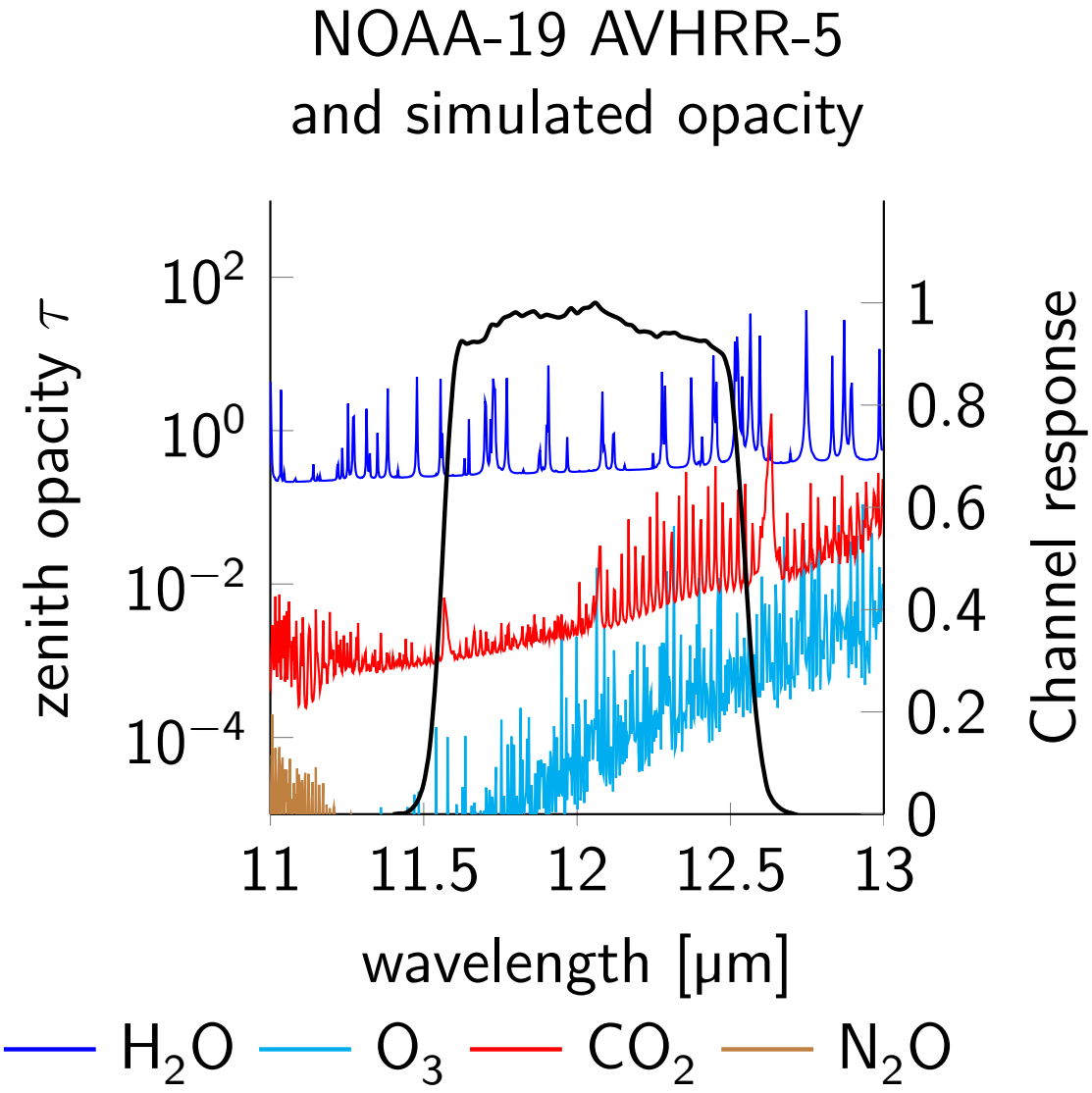

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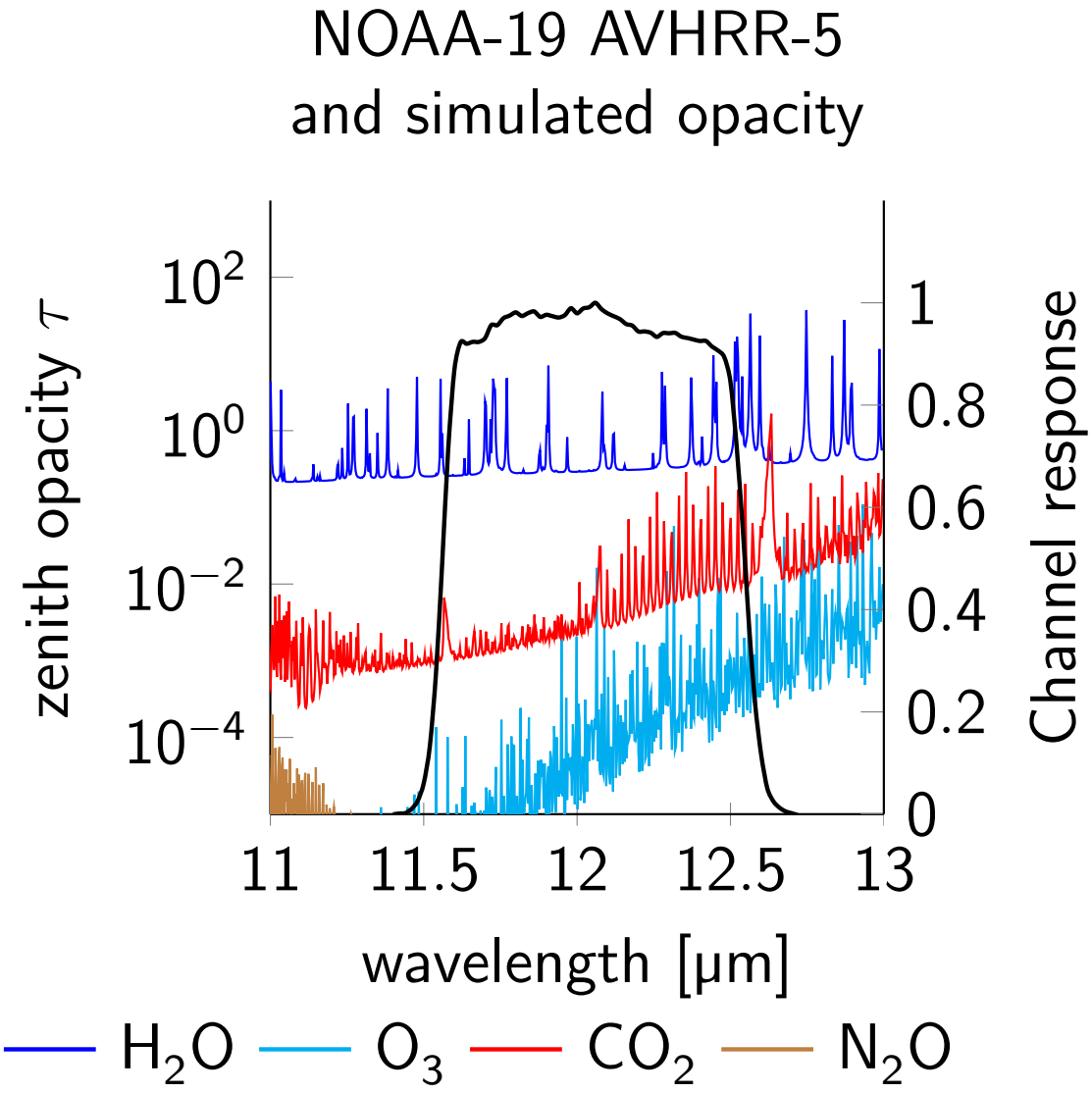

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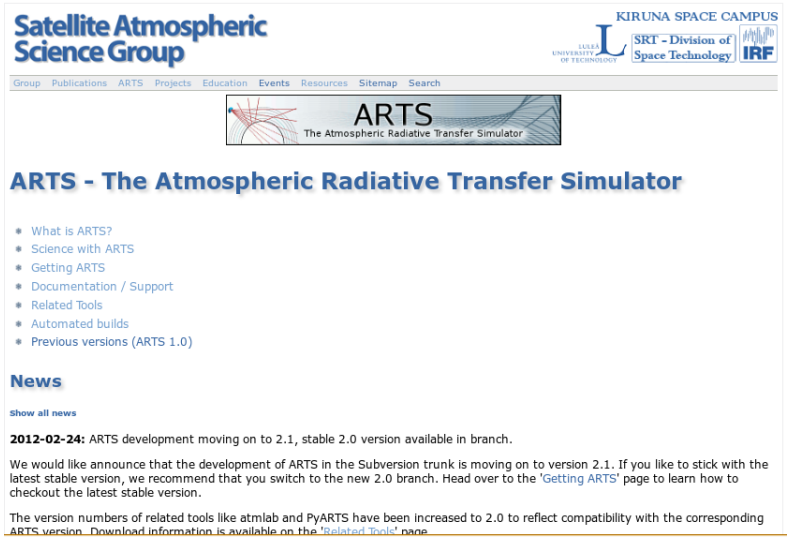

- Freely licensed (GPL)
- IR, sub-mm, microwave
- Polarised 1-D – 3-D
- Two independent modules for treating scattering.
- Highly flexible
- Line-by-line with optimisations
- RTTOV validated to ARTS (English et al., 2003, ITSC-13)

www.sat.ltu.se/arts

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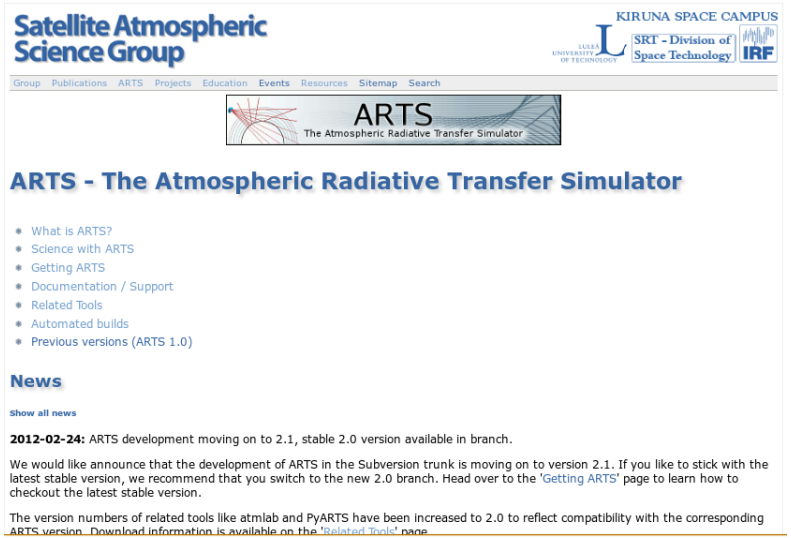

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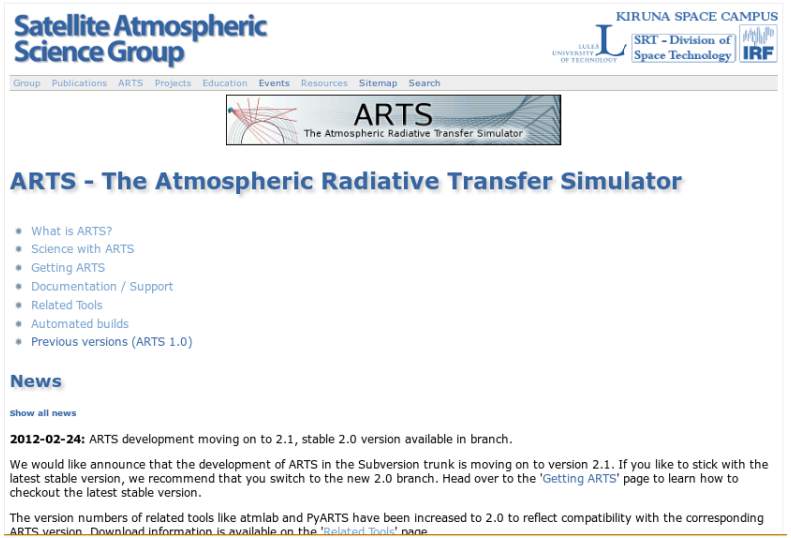

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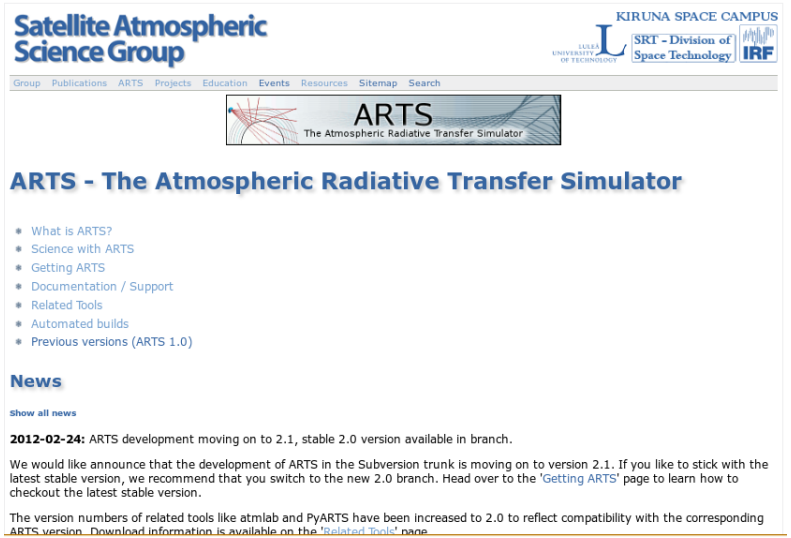

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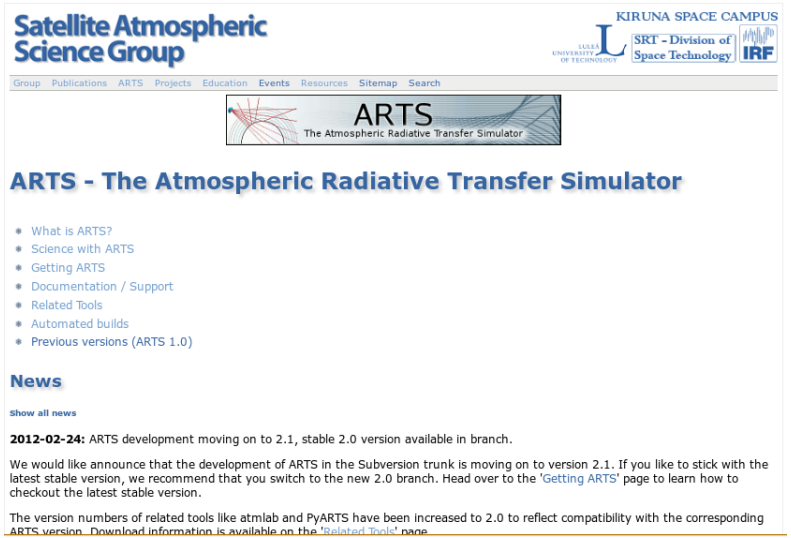

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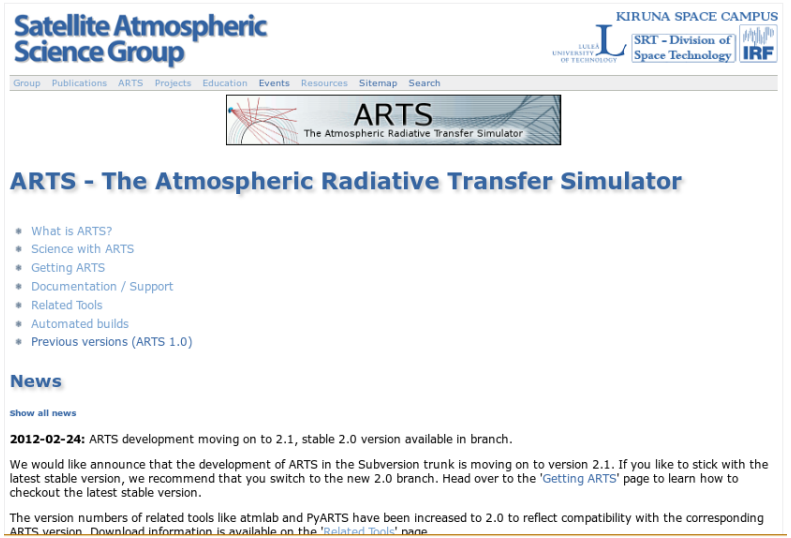

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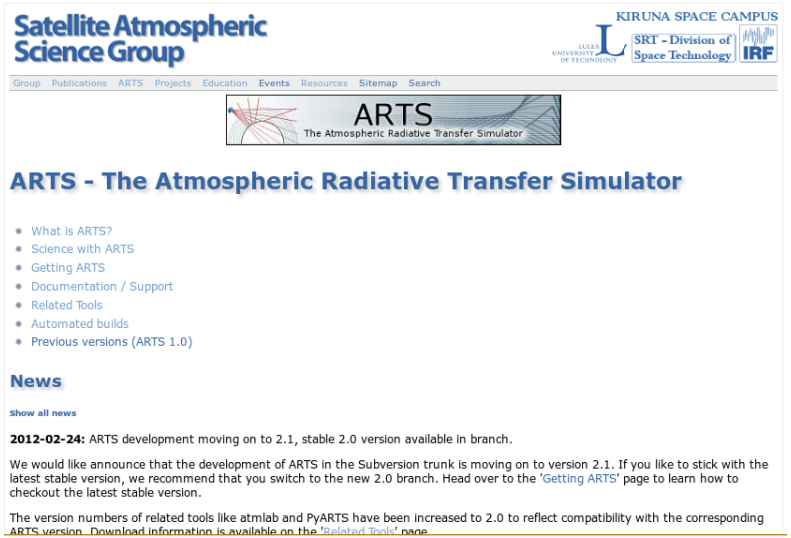

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Simulated Annealing

- Aim: find optimised frequency grid with much (factor 100 to 1000) less frequencies than full grid
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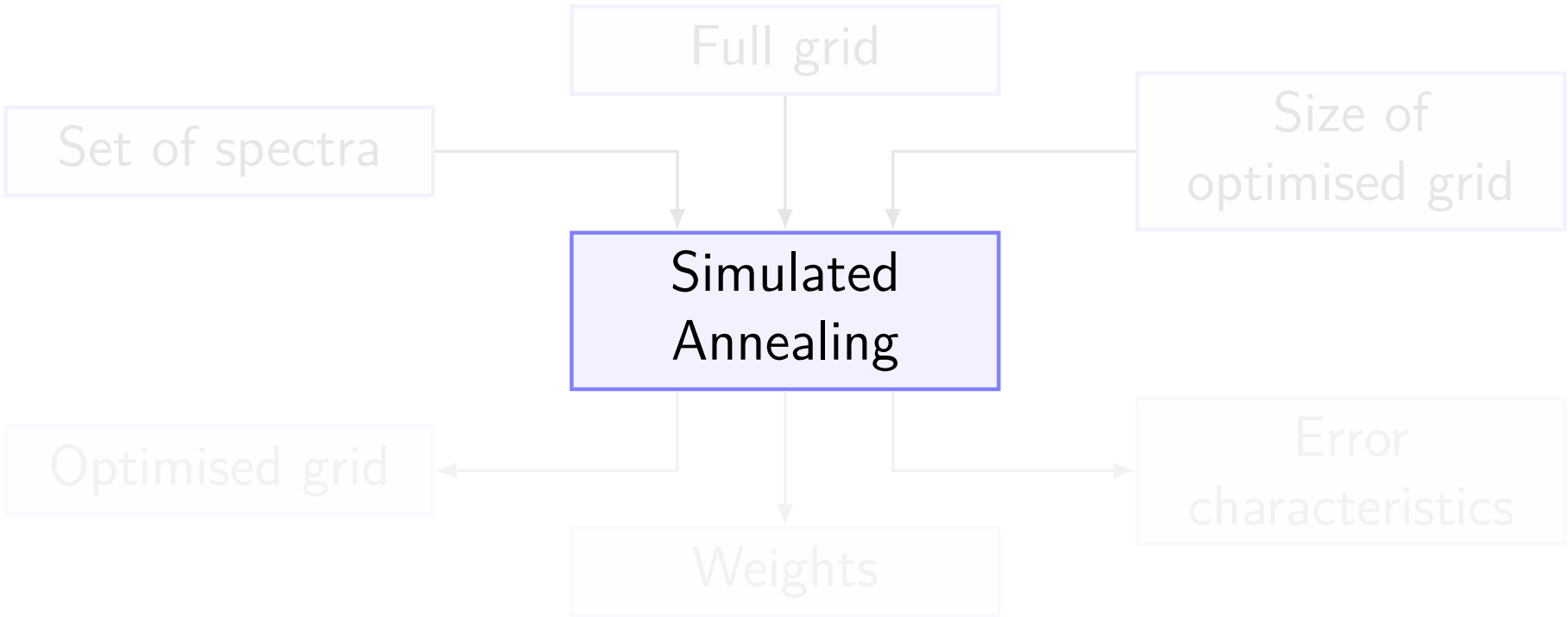

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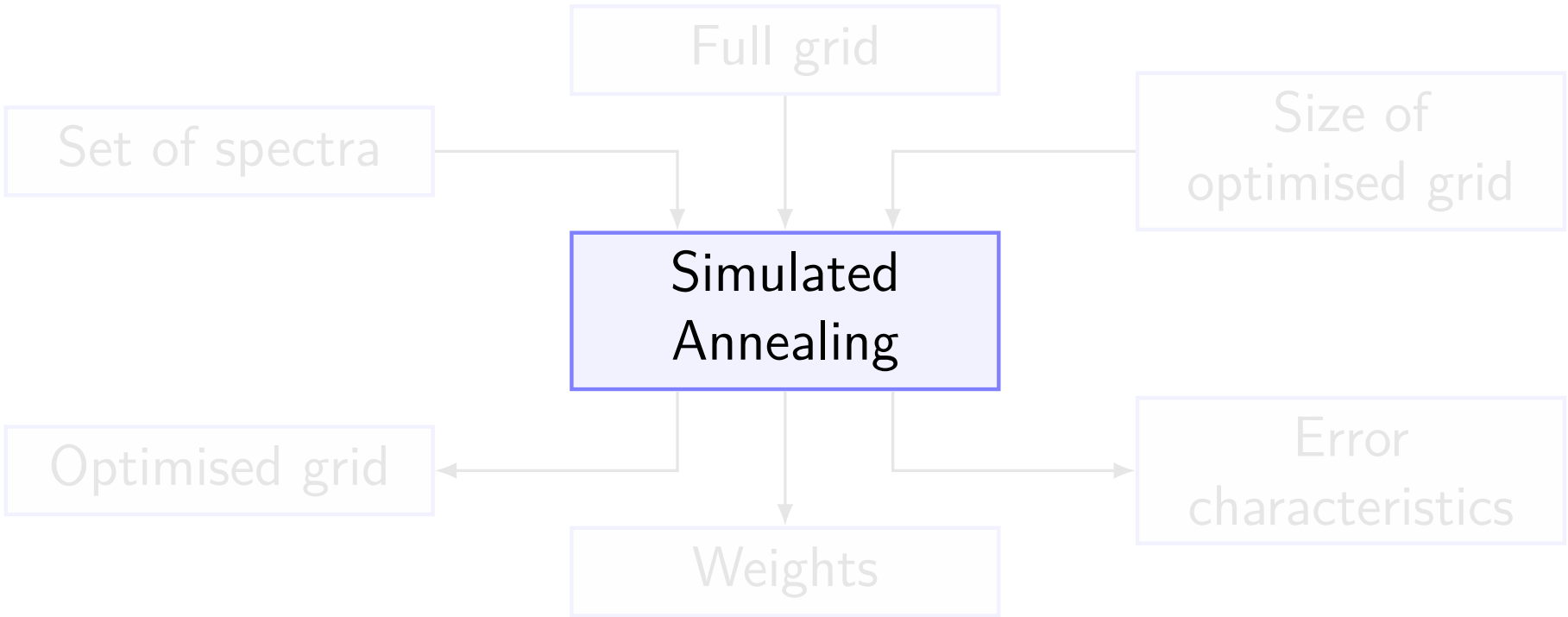

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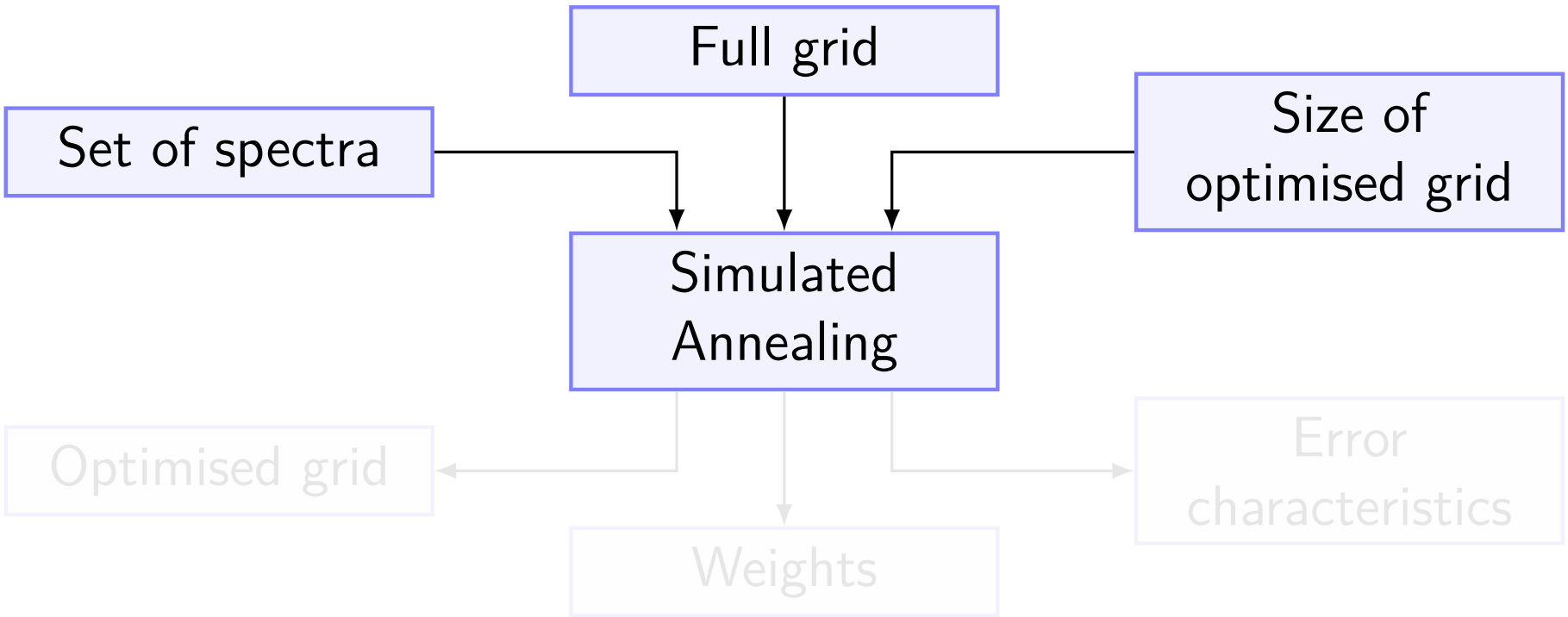

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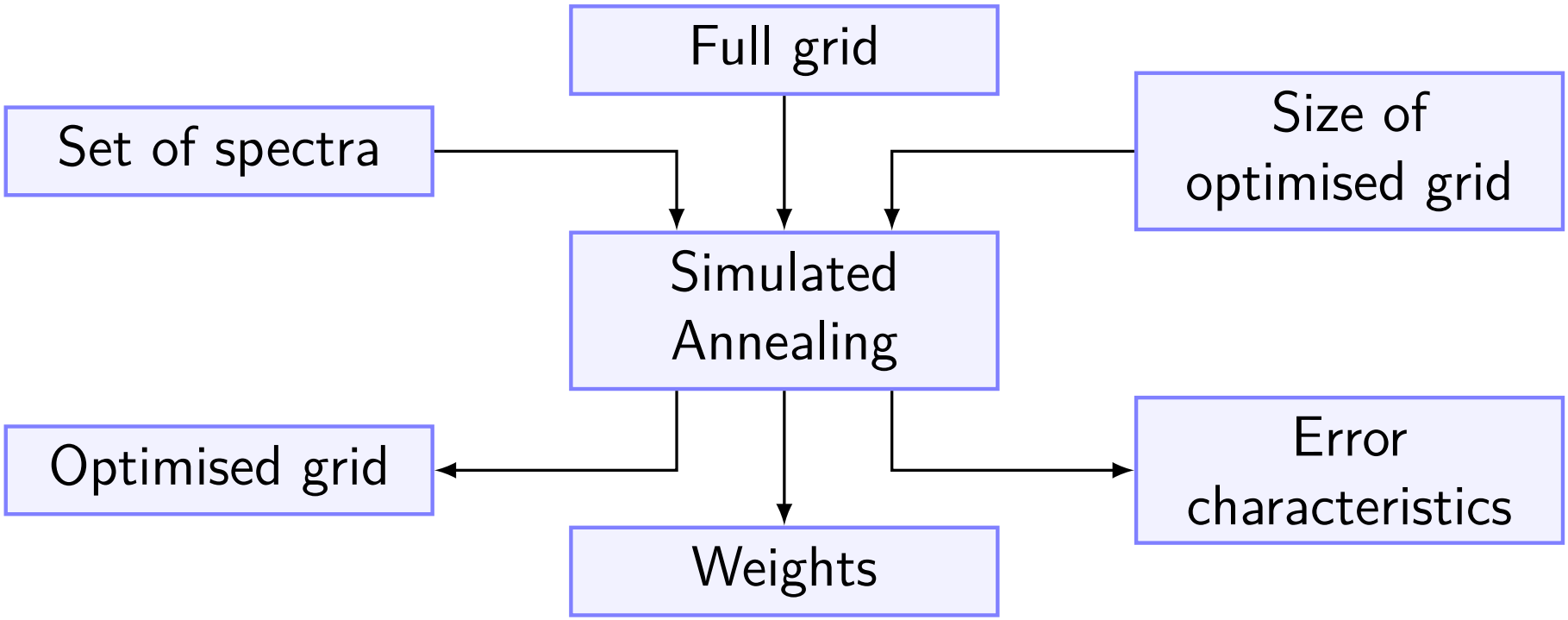
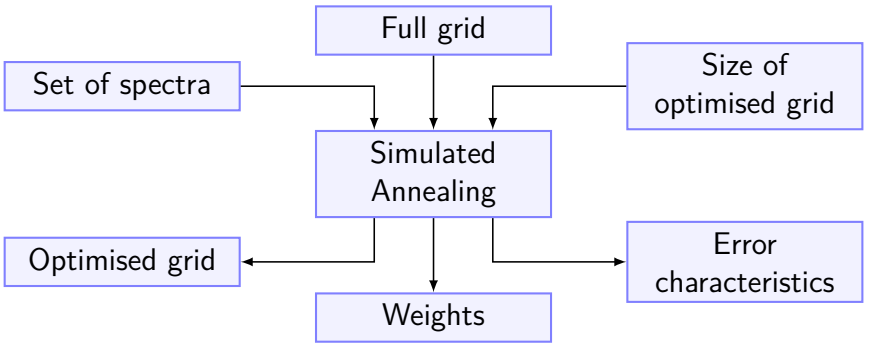
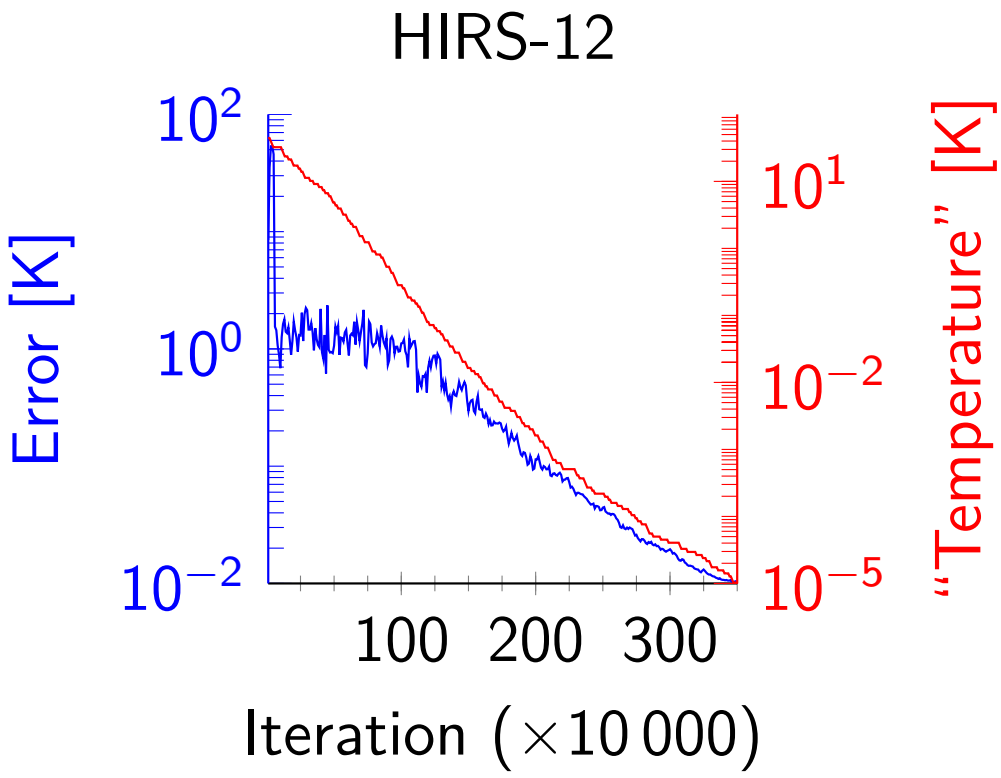


One annealing run





- Derivation using clear-sky dataset with 42 profiles (Garand et al., 2001)
- Annealing took 15 hours on workstation for one channel
- Applied to HIRS and AVHRR

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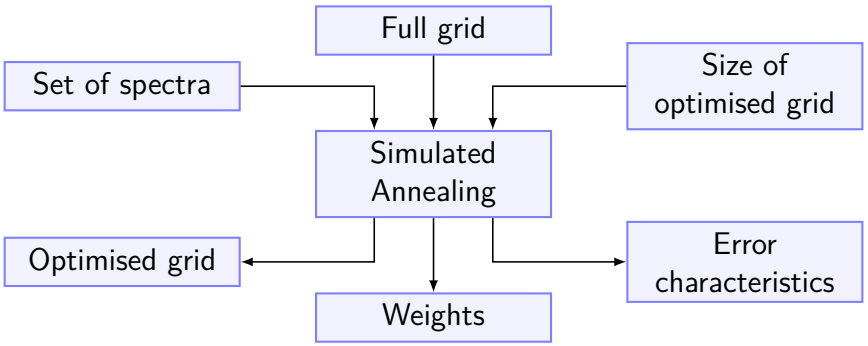

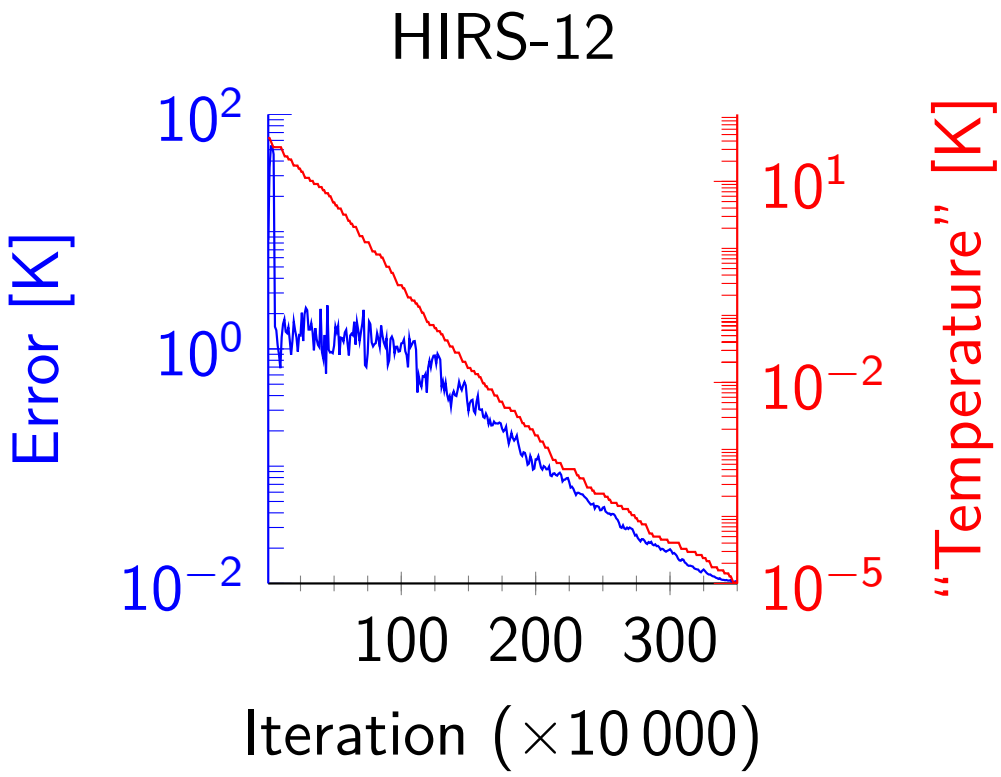

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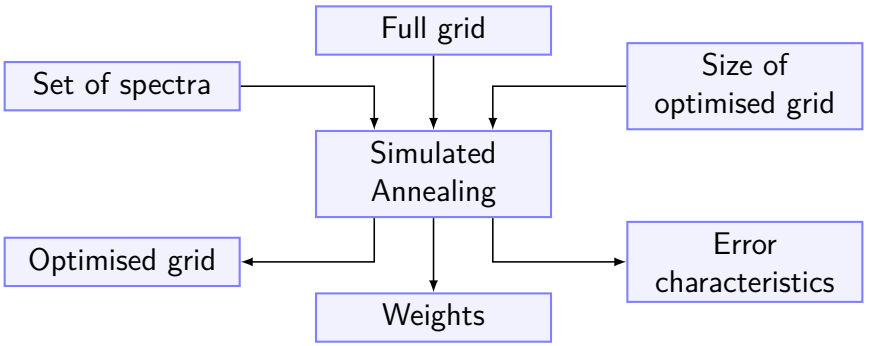

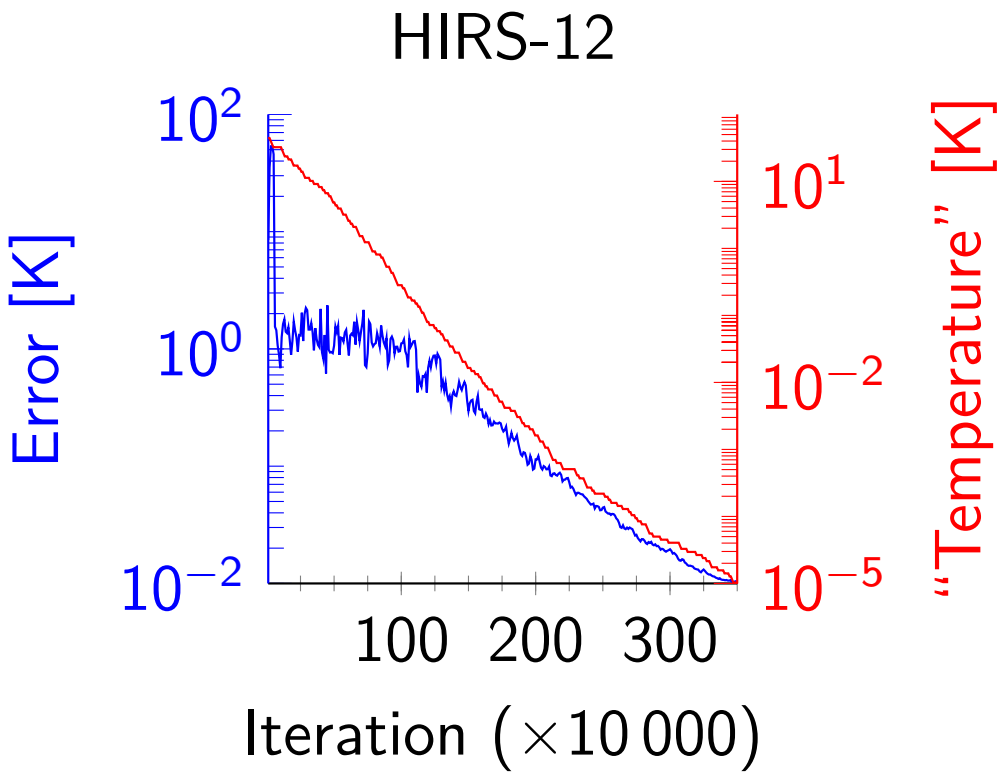

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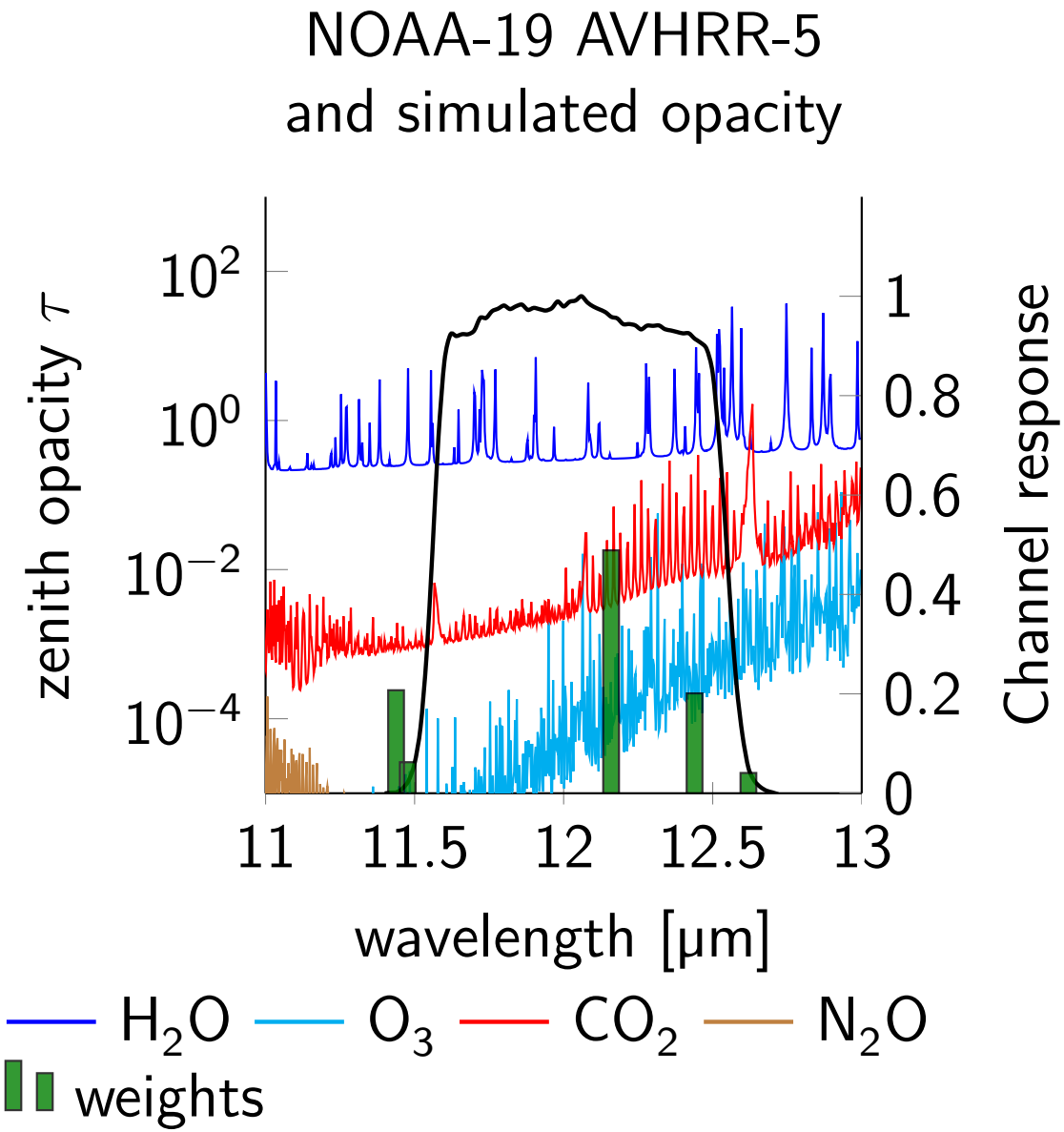
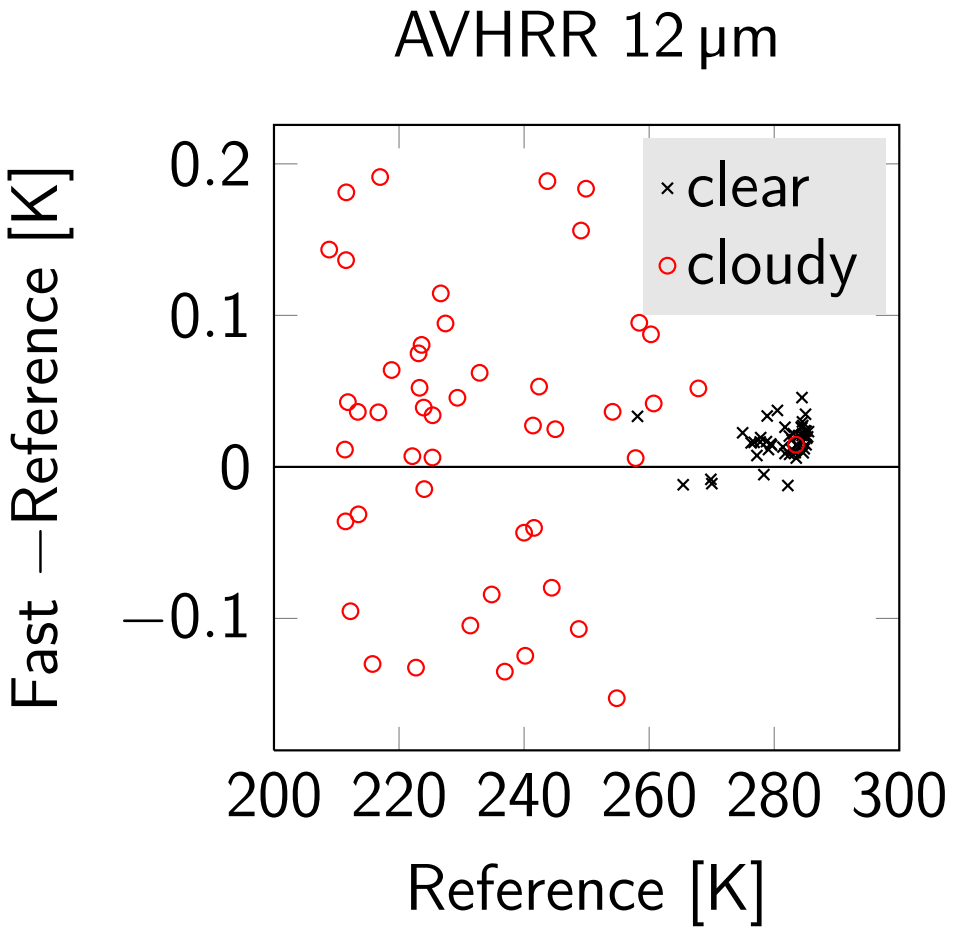


Optimised vs. full grid

Clearsky or cloudy



- Derived clear-sky
- Testing for clear and cloudy (cloudy with ARTS-MC)
- Using ECMWF-based dataset (Chevallier et al., 2006)
- Only small bias
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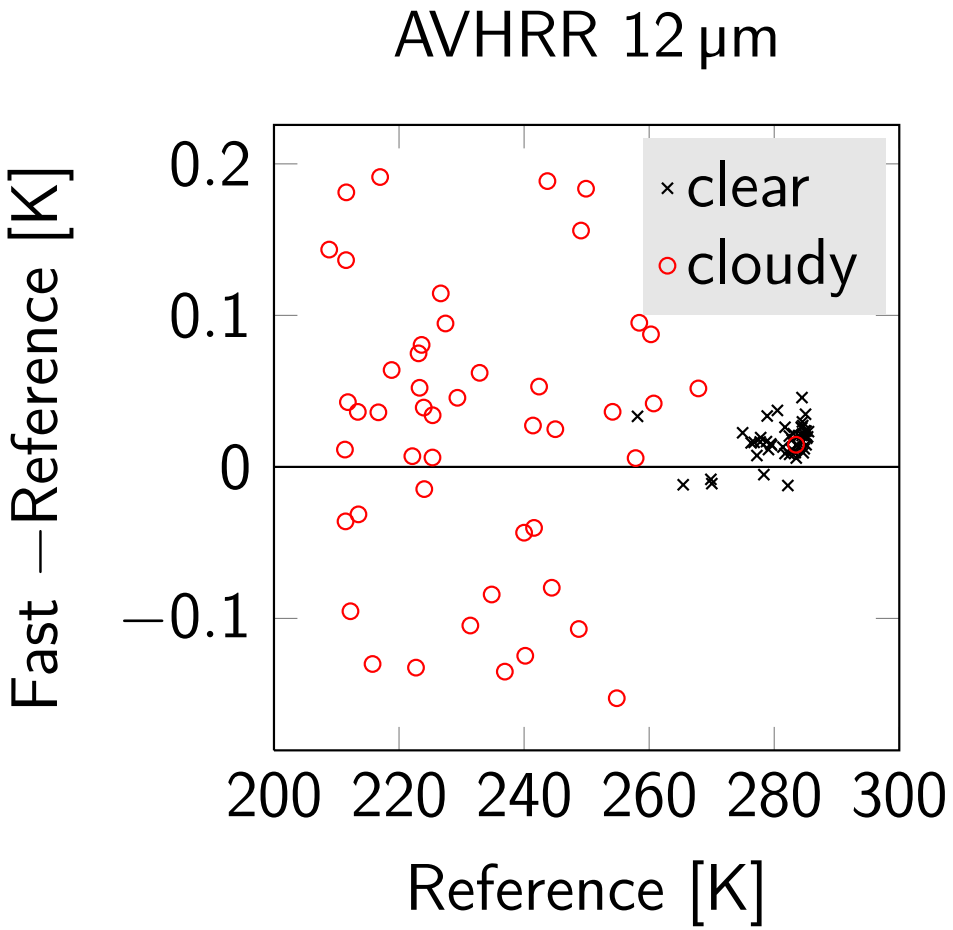

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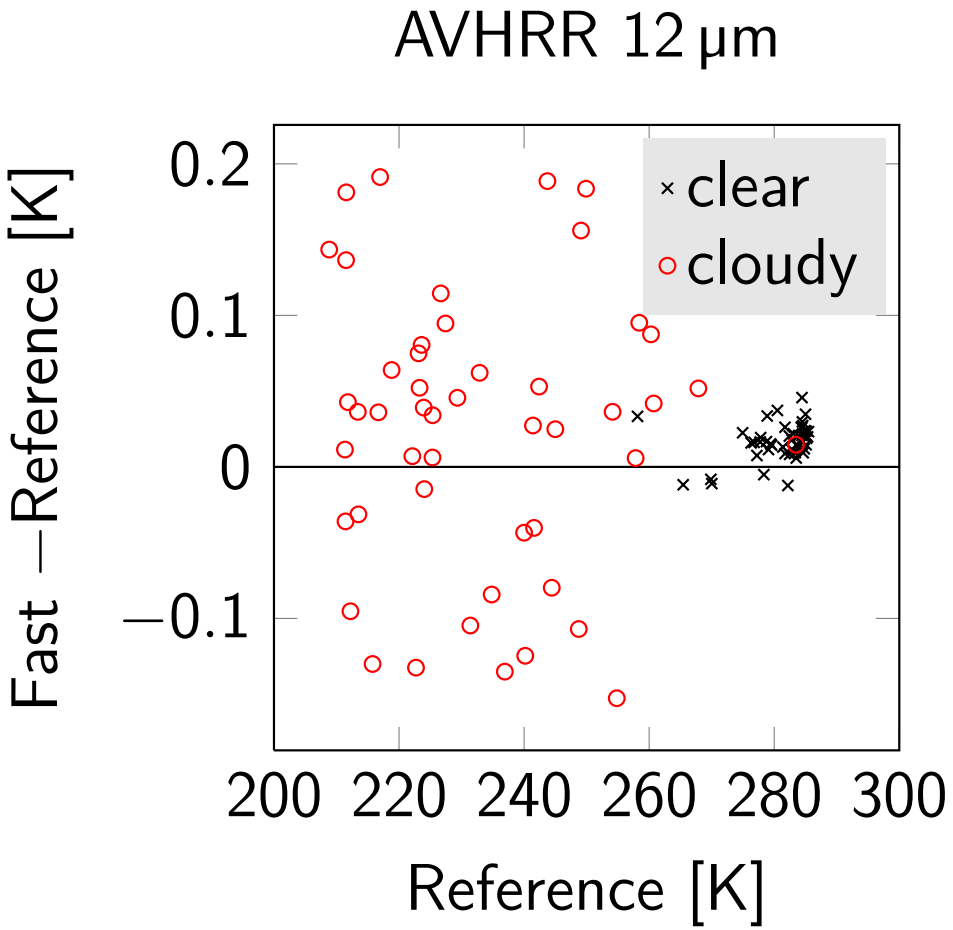

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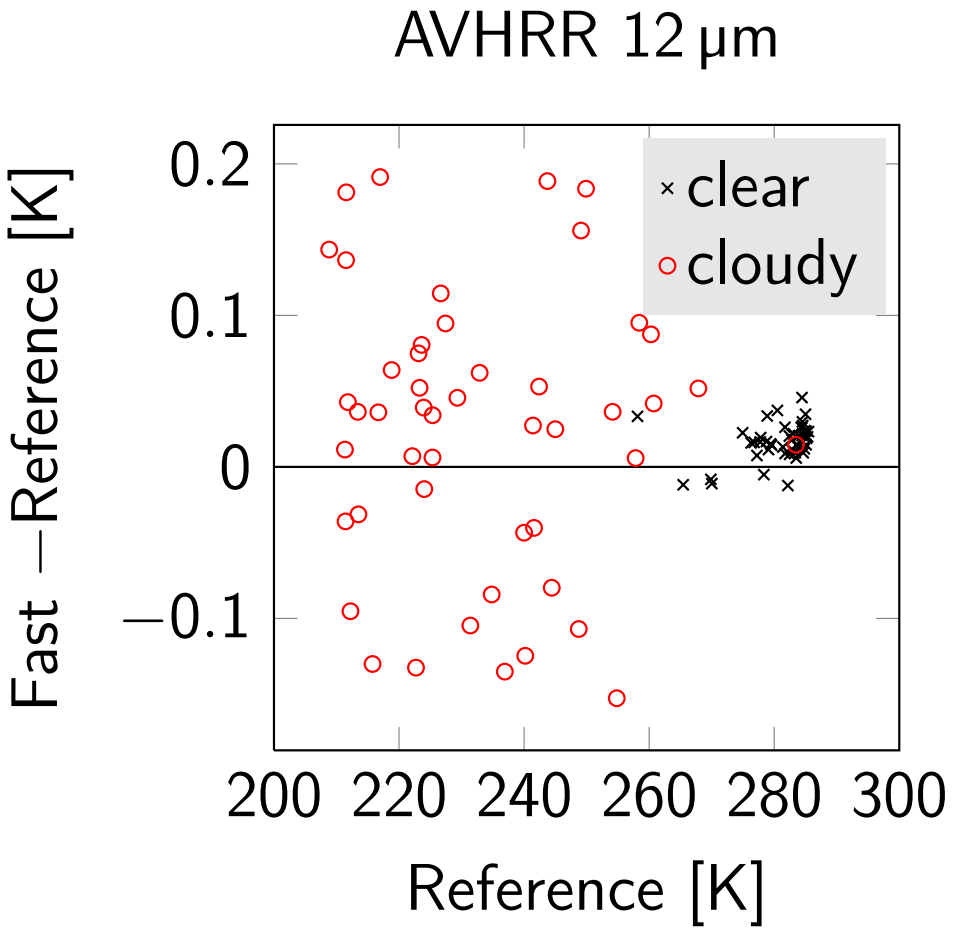

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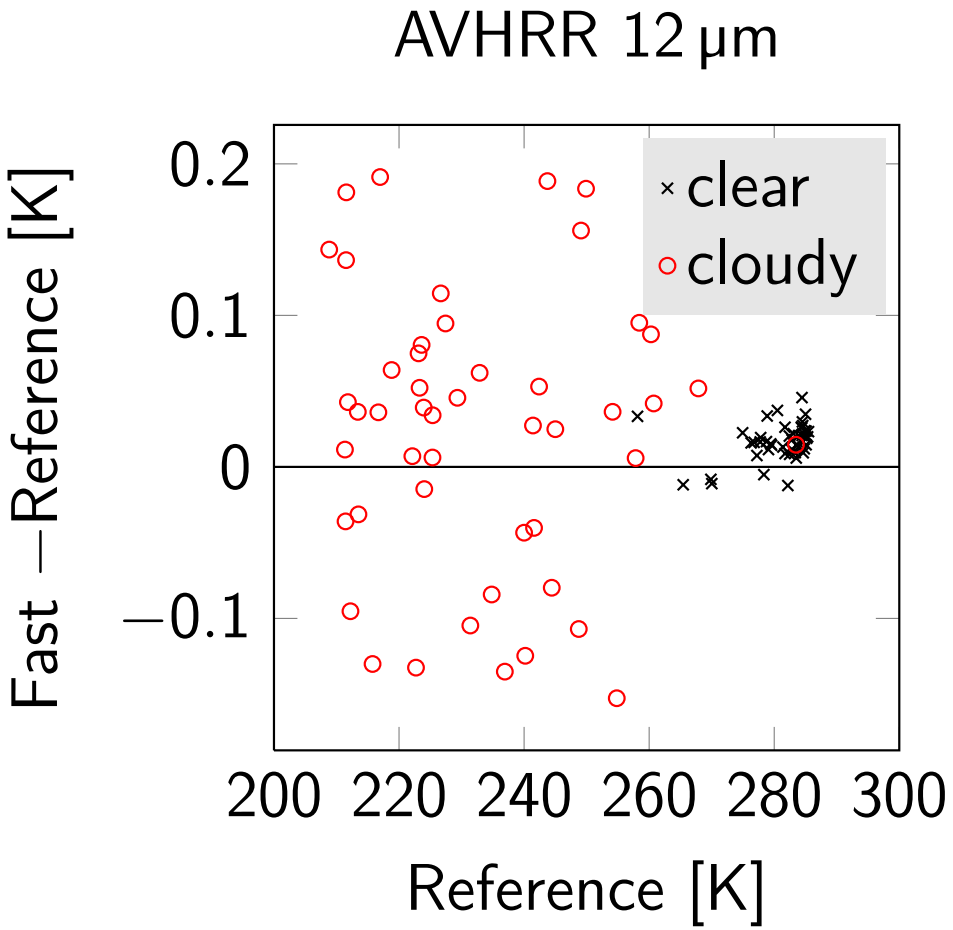

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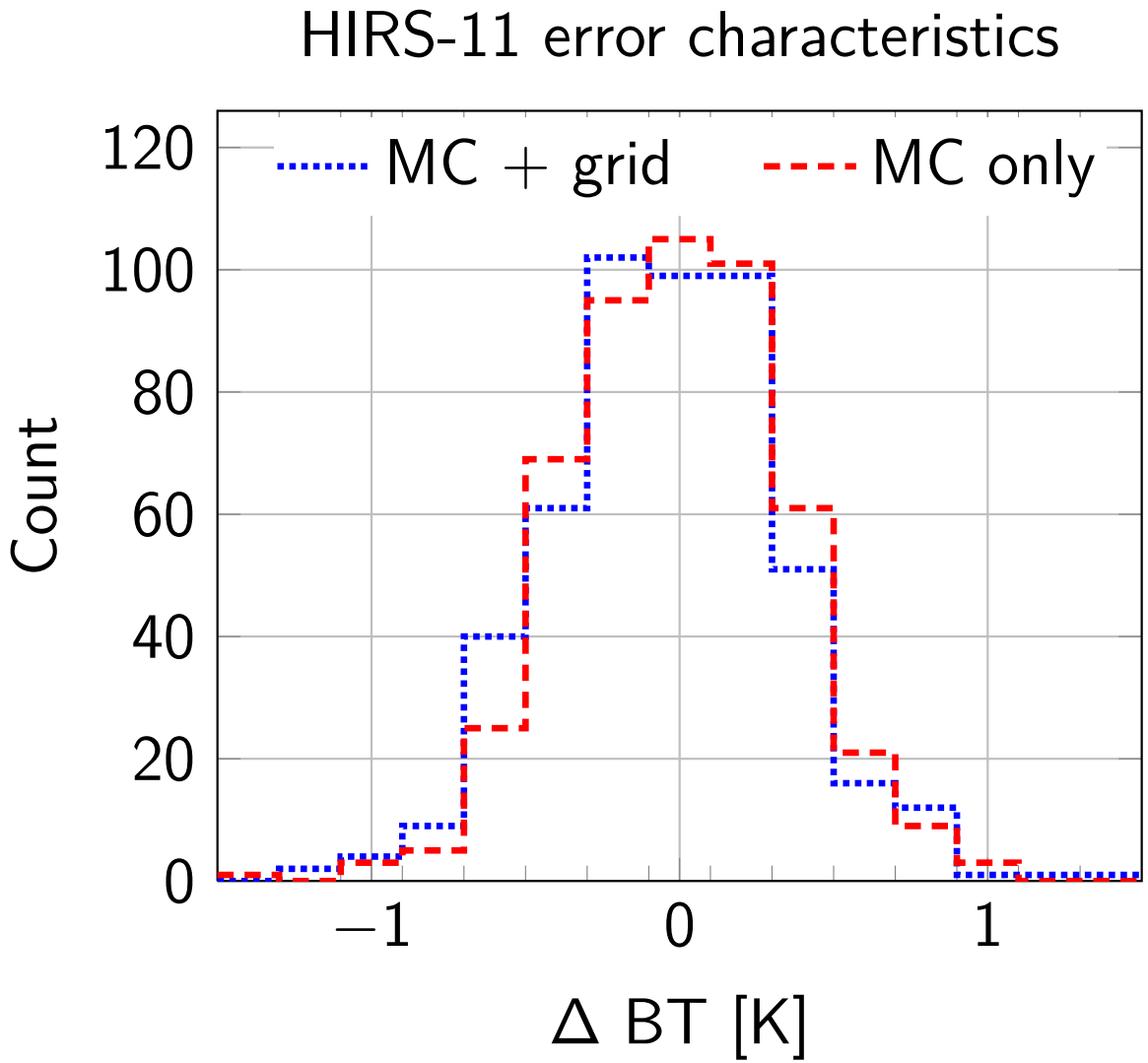

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- Bias small (less than 0.03 K)
- Optimised grid represents full grid for cloudy

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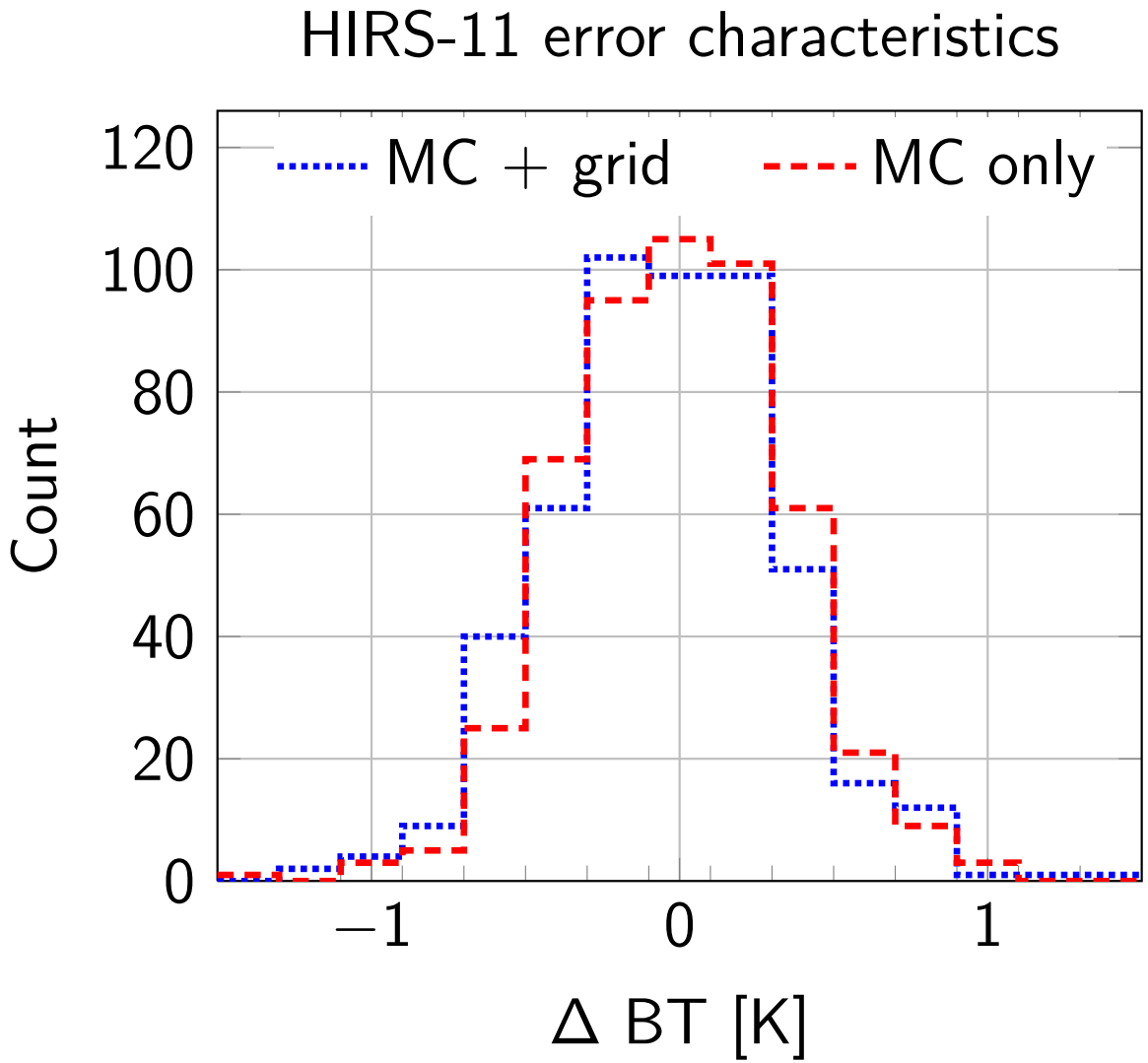

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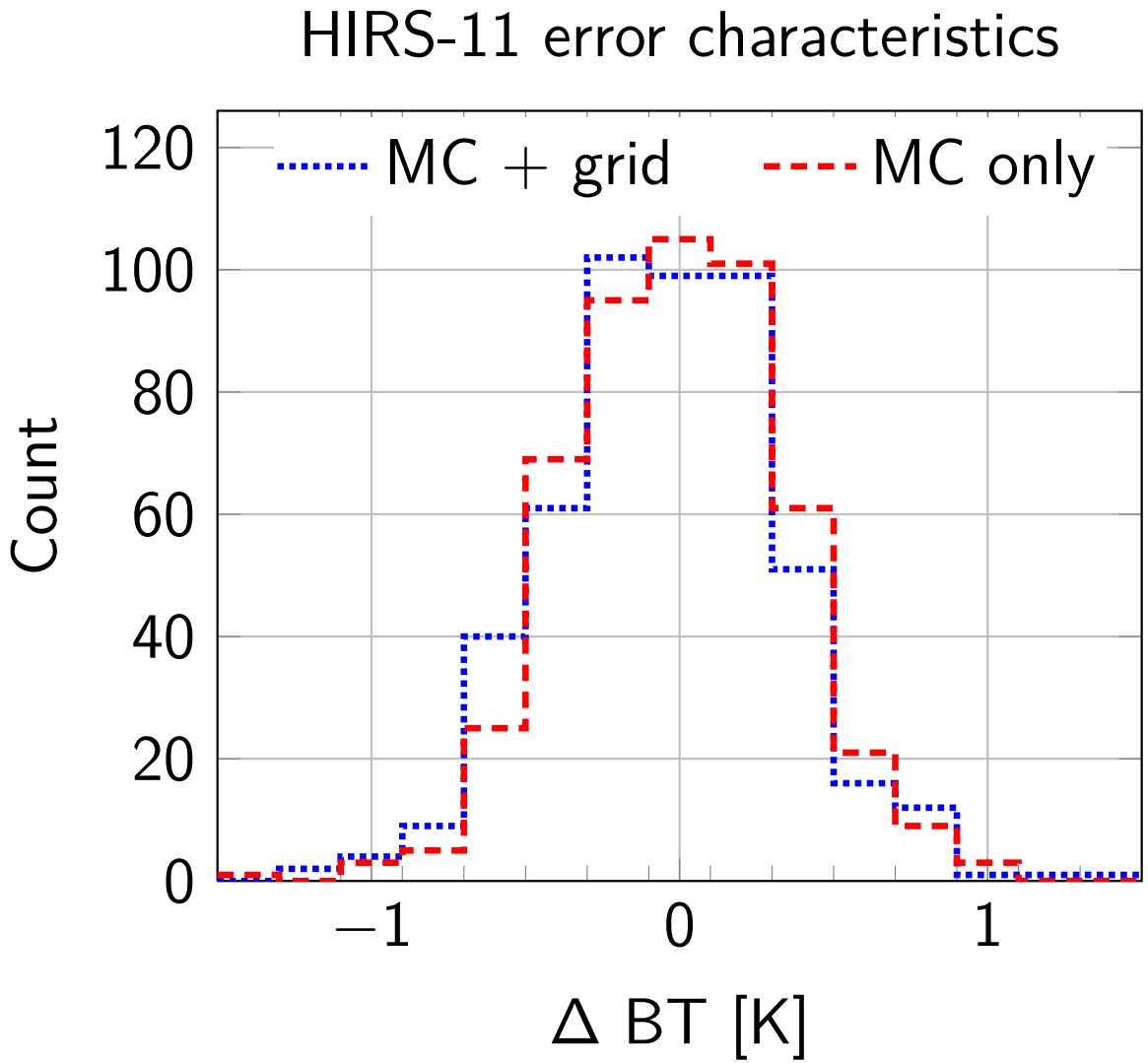

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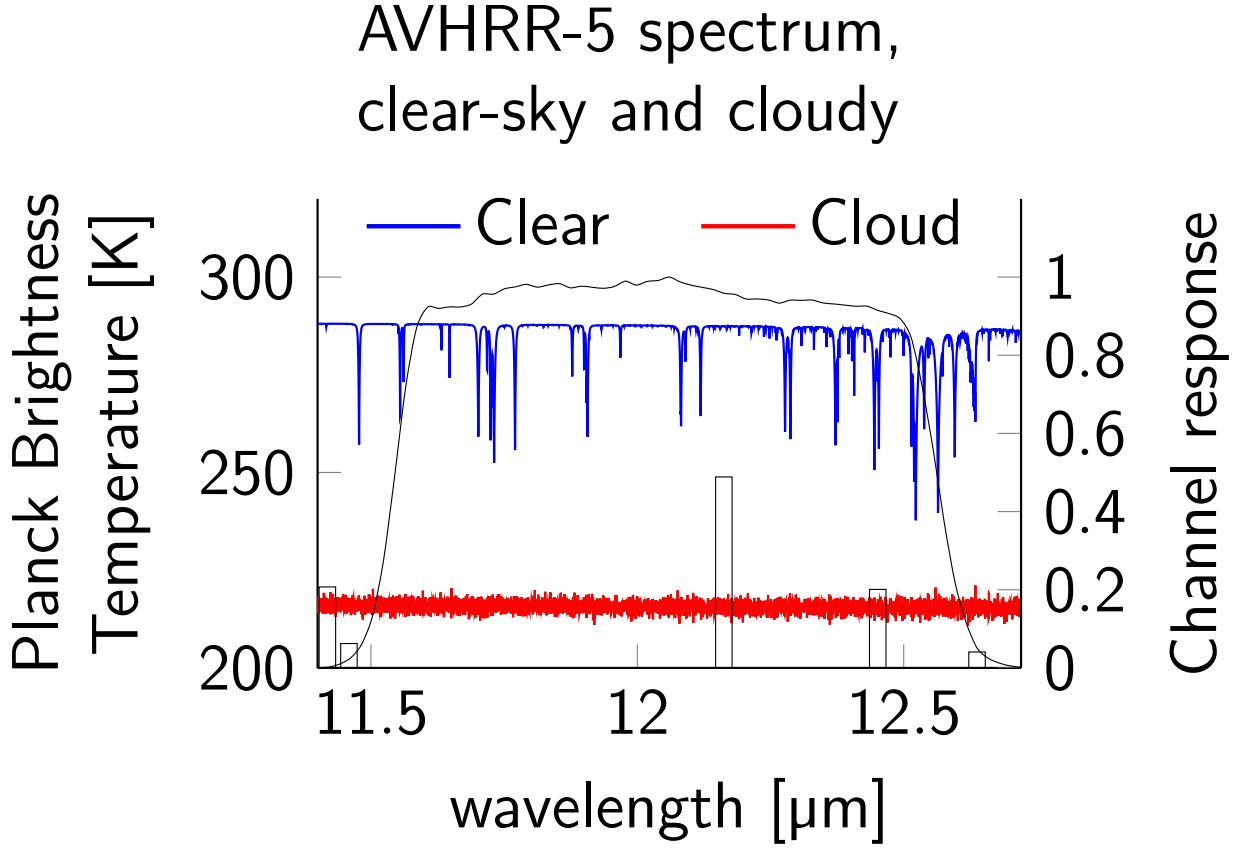

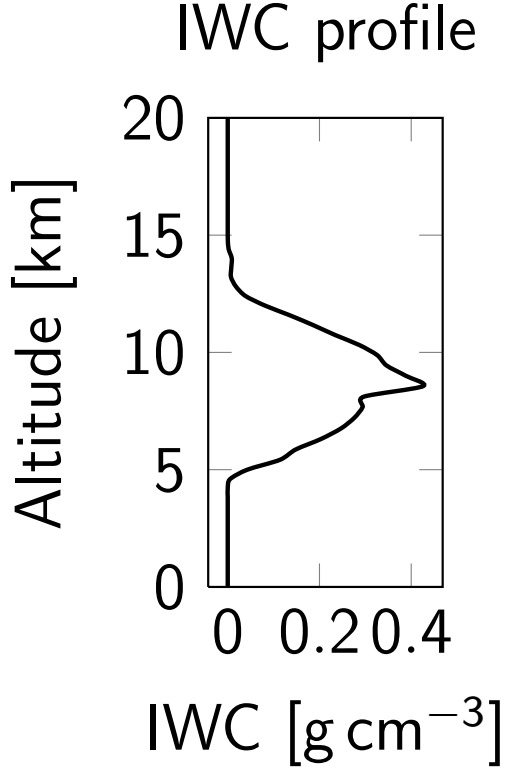

- Gas optical properties spectrally strongly varying
- Cloud optical properties spectrally quite flat
- Cloud "hides" clear-sky

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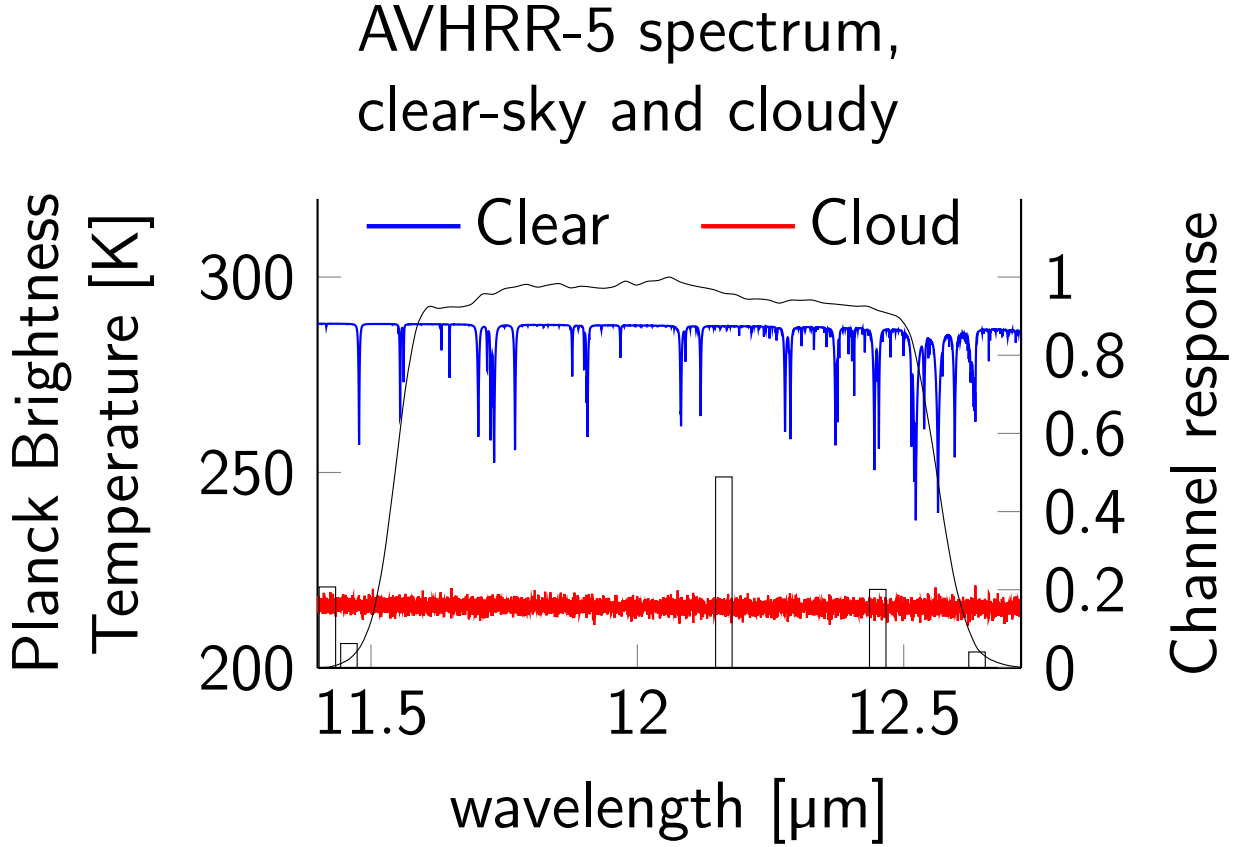

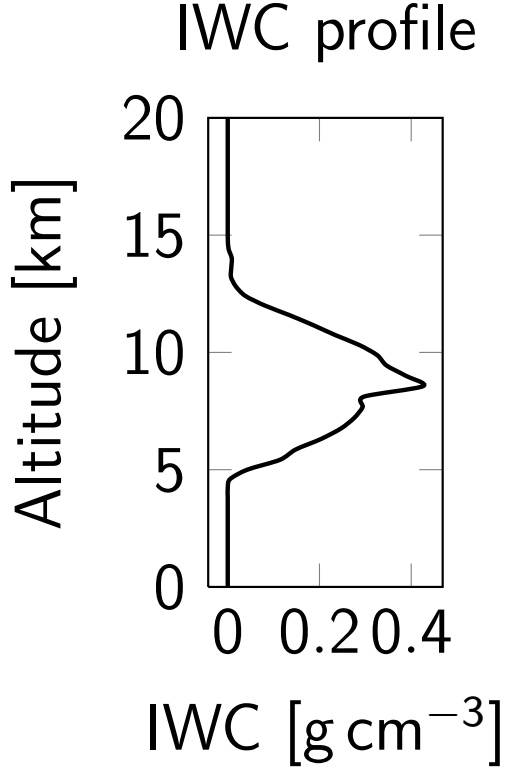

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AVHRR-5 spectrum,
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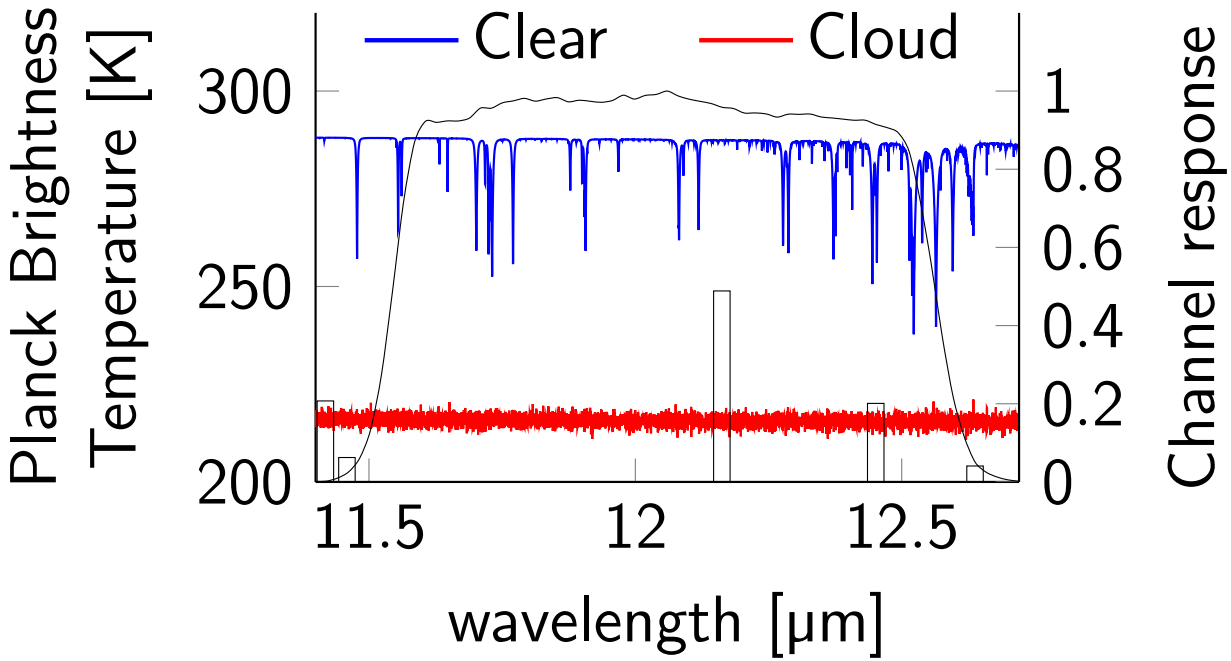

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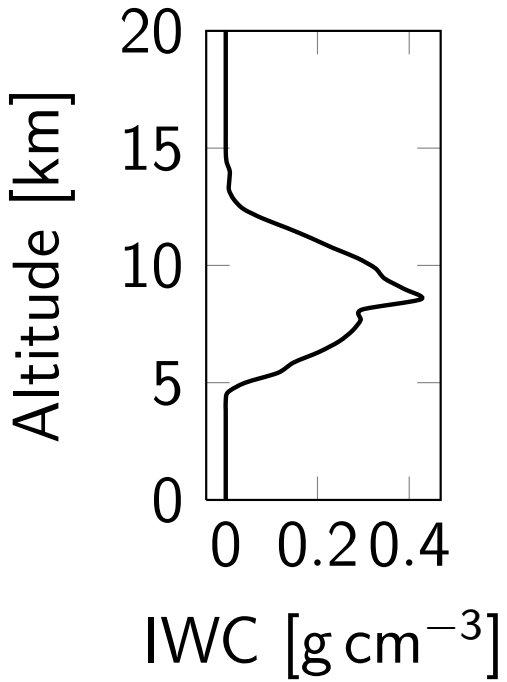

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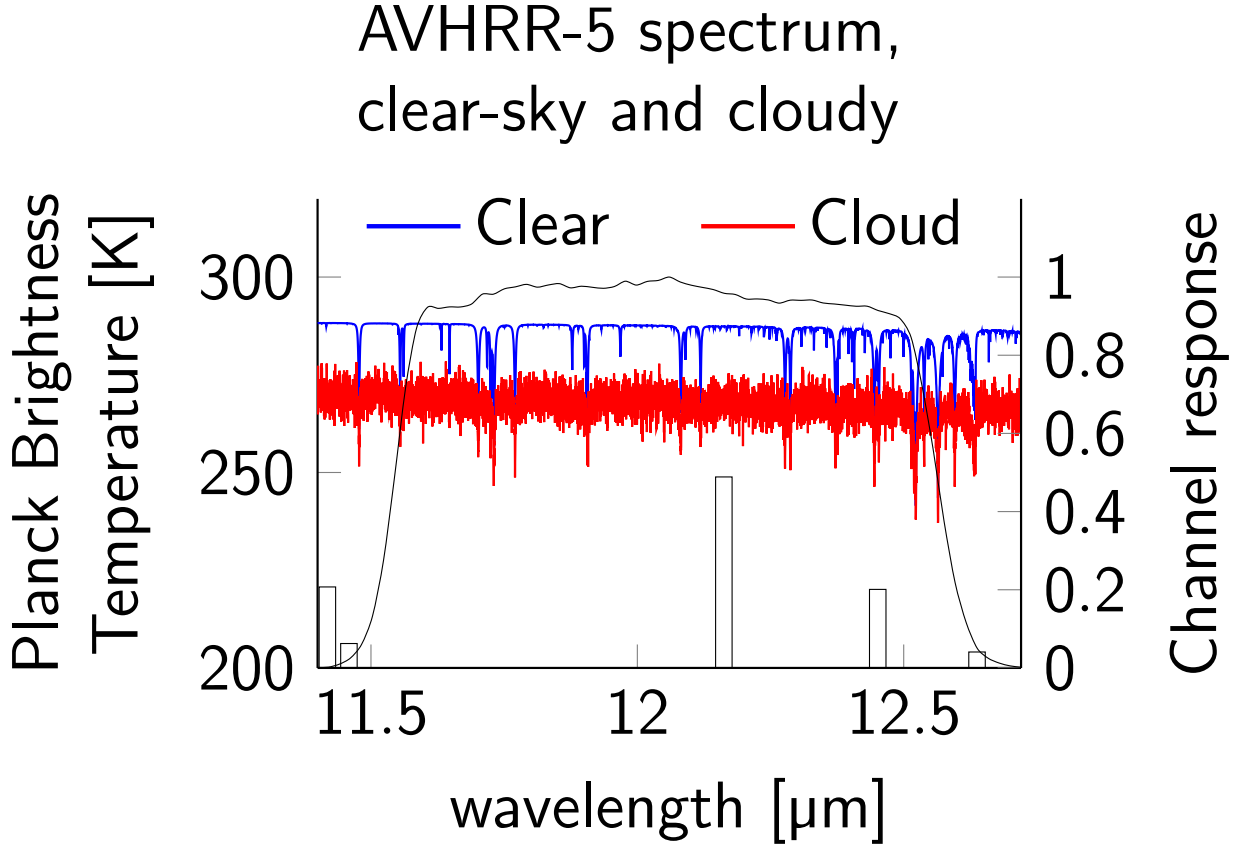

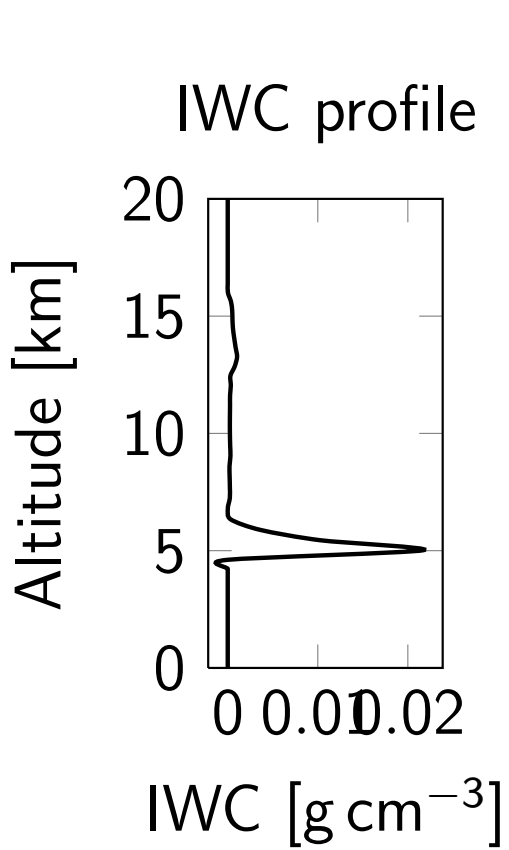

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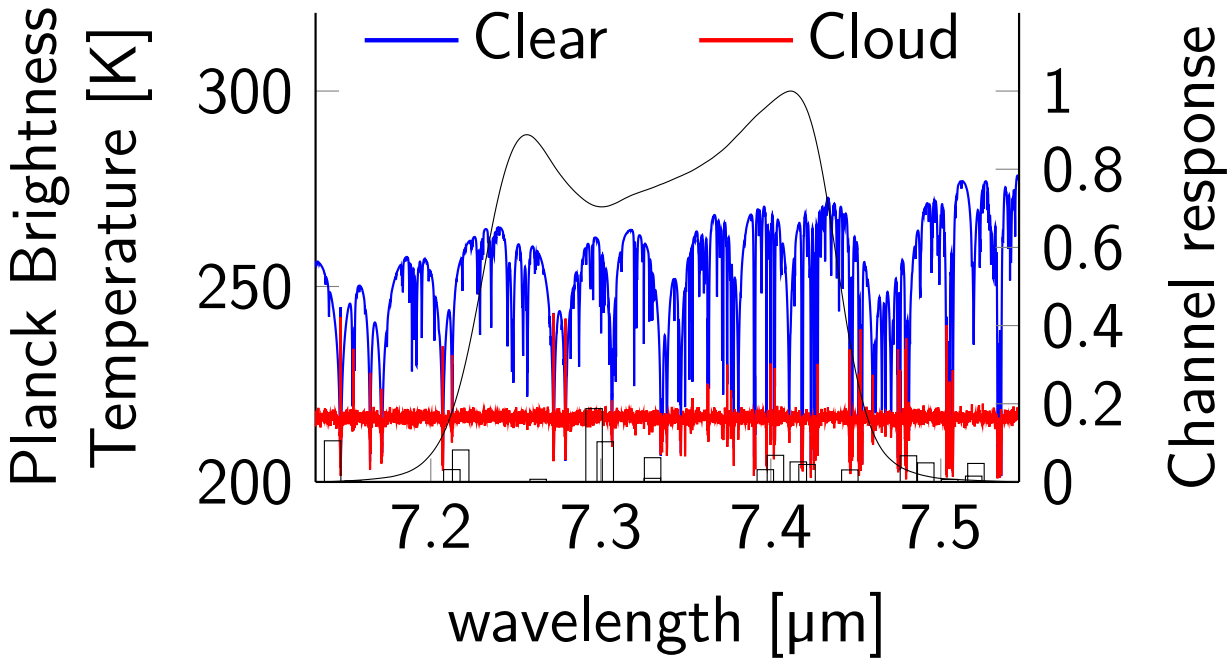

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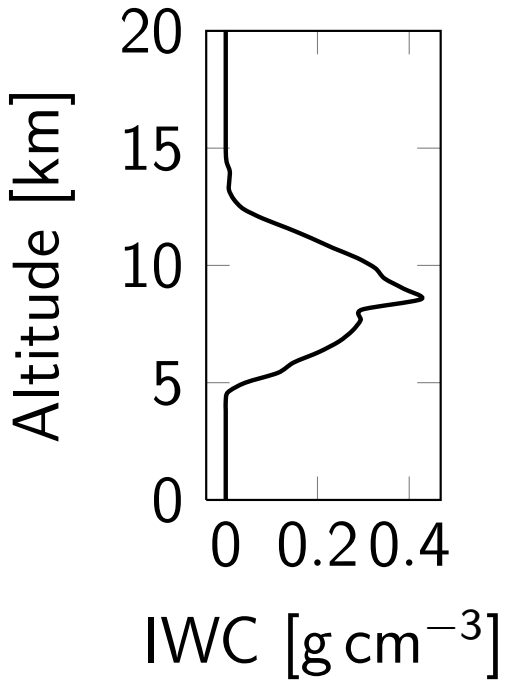

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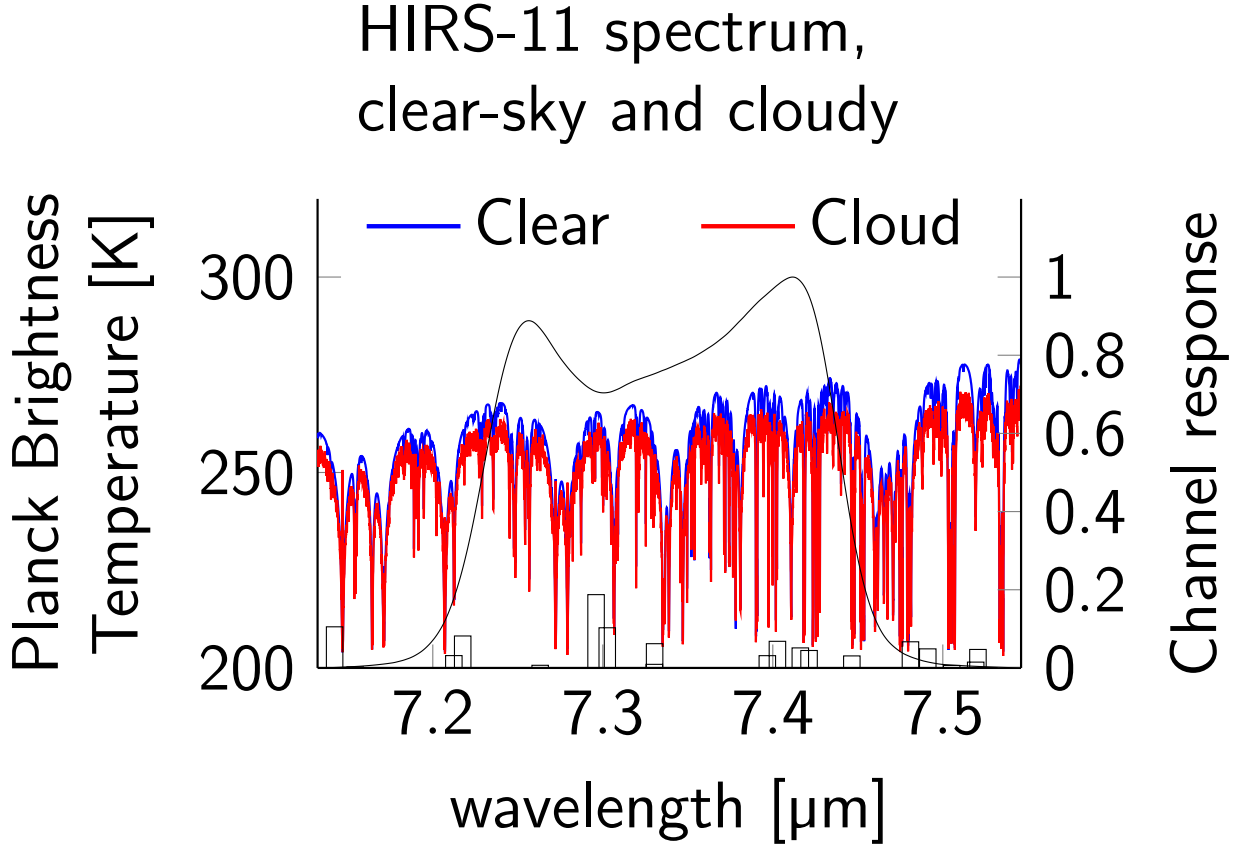

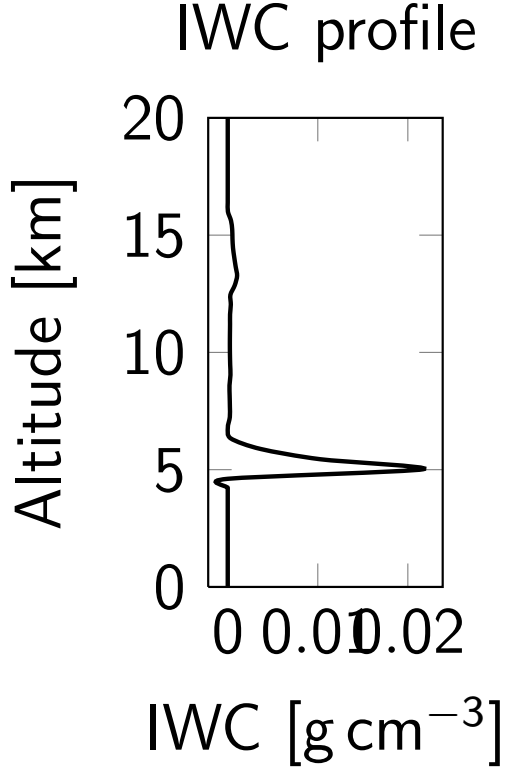

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Thanks

Thank you for your attention.
Questions?

Bibliography I

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Bibliography II

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