

# Revisit CH<sub>4</sub> spectroscopy test: HIT16 & ATM18

*Ralf Sussmann*

## I) Starting point (conclusions from Sussmann, AMT, 2011): **test of HITRAN 00/01 vs HIT04 & HIT08**

so first 4 viewgraphs to follow are taken from:

Sussmann, R., Forster, F., Rettinger, M, and Jones, N.: Strategy for high-accuracy-and-precision retrieval of atmospheric methane from the mid-infrared FTIR network, Atmos. Meas. Tech., 4, 1943-1964, 2011.

## II) Revisit CH<sub>4</sub> test in 2019: **test of HITRAN 00/01 vs HIT16 & ATM18**

# Revisit CH<sub>4</sub> spectroscopy test: HIT16 & ATM18

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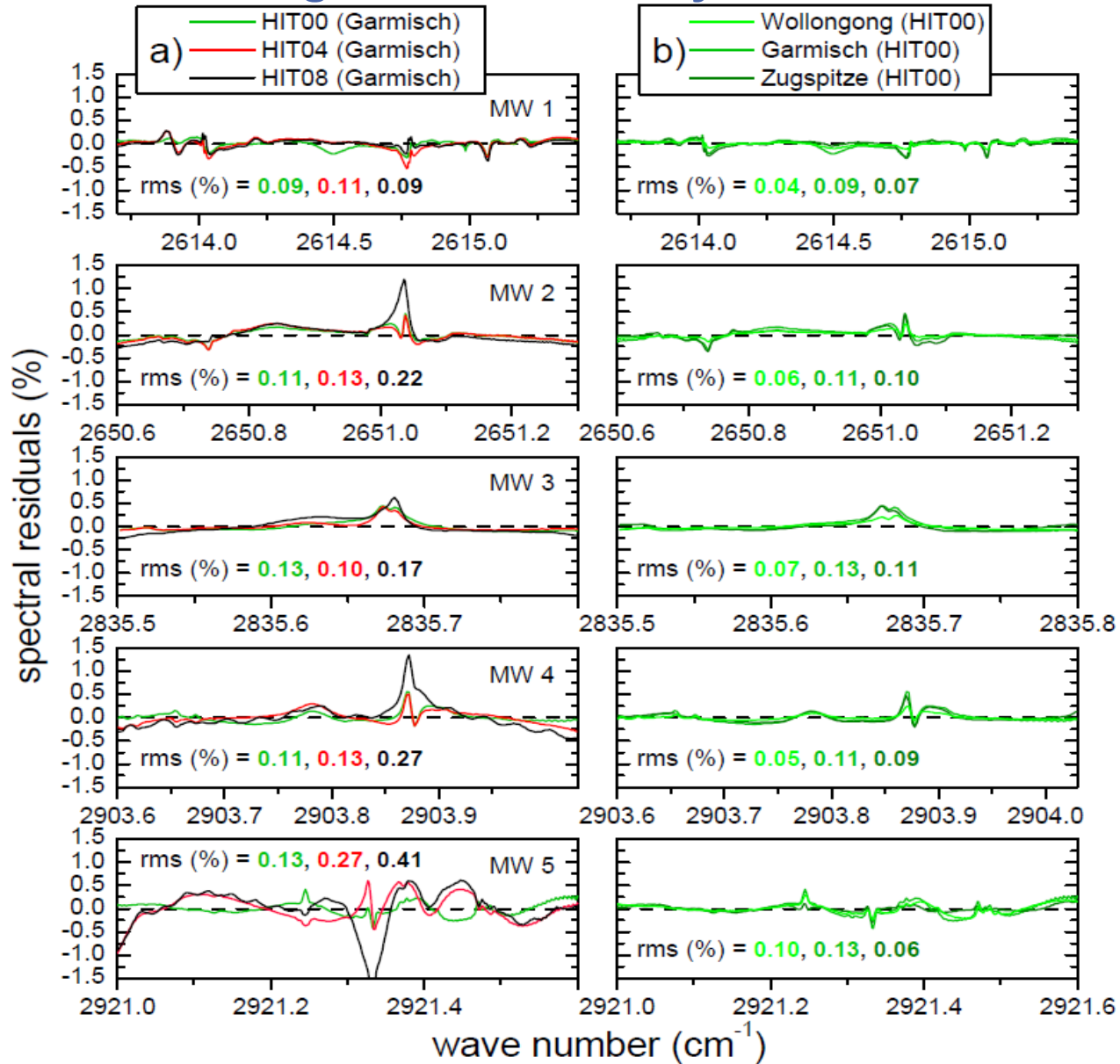
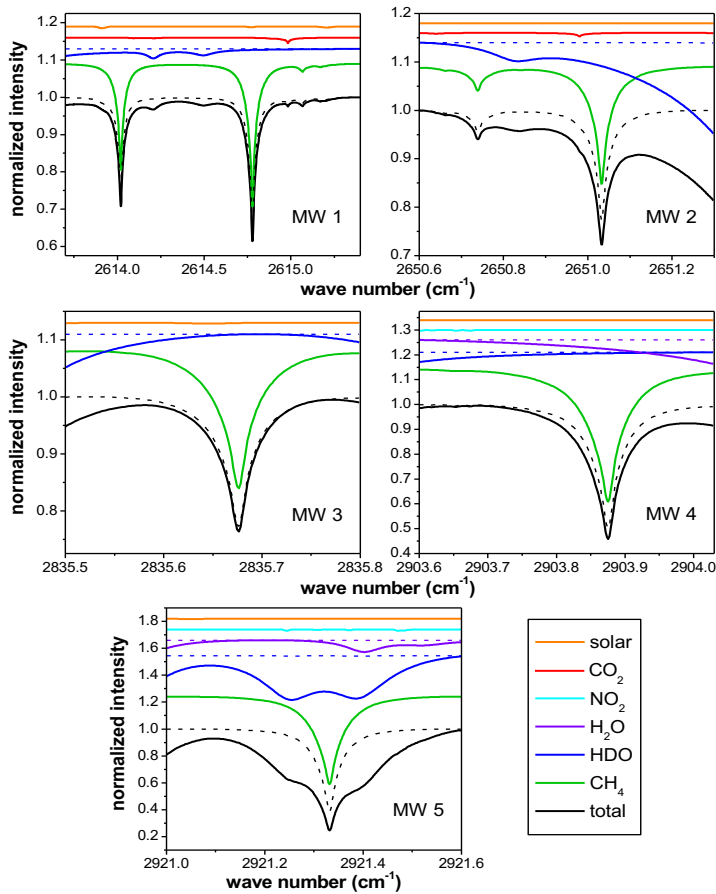
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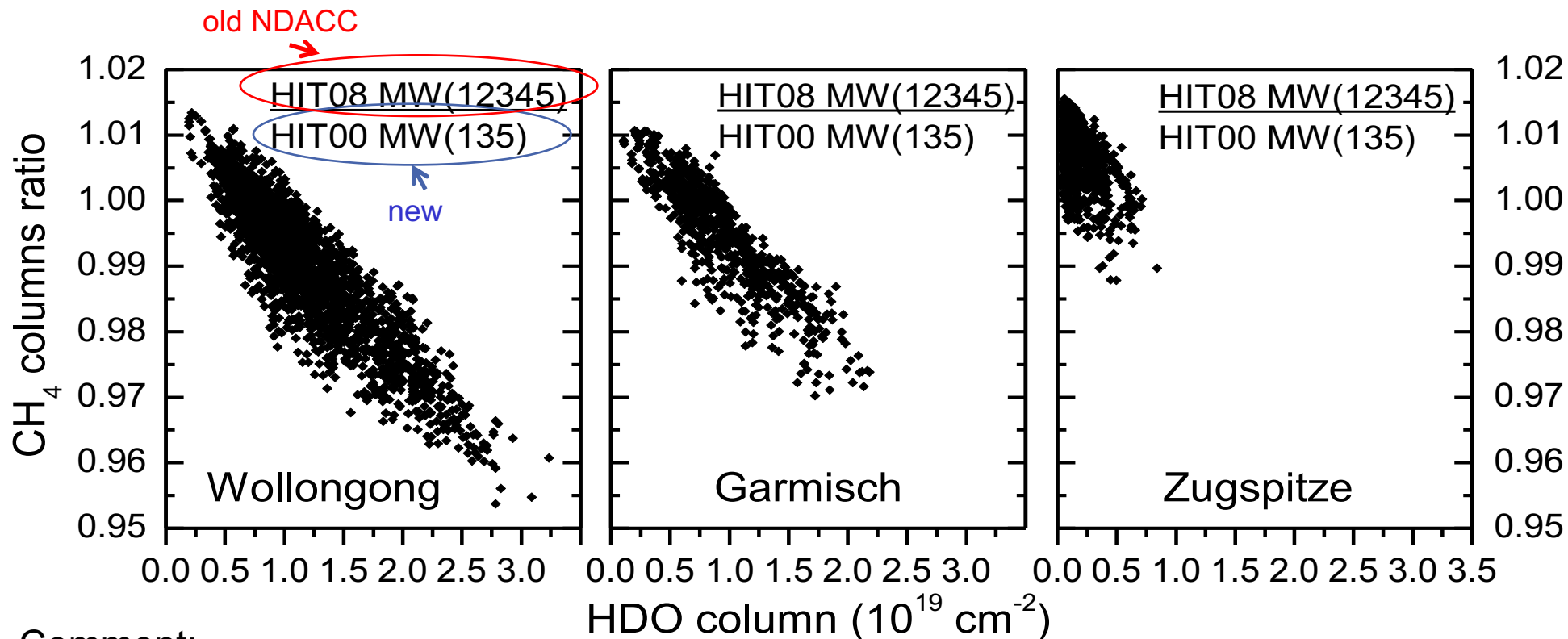
## II) Revisit CH<sub>4</sub> test in 2019: **test of HITRAN 00/01 vs HIT16 & ATM18**

# I) Sussmann et al. (2011): MW 's and averaged residuals for year 2007



- i. HITRAN 2000 is the spectroscopy compilation with the overall smallest residuals.
- ii. The HITRAN 2004 release kept the methane line parameters in our micro windows unchanged relative to HITRAN 2000. However, HITRAN 2004 contains additional residuals due to line parameter errors for HDO in MW 4 (left hand side) and MW 5 (left hand side) as well as errors due to H<sub>2</sub>O parameters (MW 4, right hand side, MW 5 mid to right hand side). This can be verified by comparing the residuals to the contribution plots (Fig. 1).
- iii. HITRAN 2008 shows similar problems as HITRAN 2004 for the non-methane line parameters. Additionally, the residuals due to methane have increased with HITRAN 2008. In particular, a huge error in the line strength of the 2921.33 cm<sup>-1</sup> methane line was introduced.

# I) Sussmann et al. (2011): Suggested compromise: drop MW's 2 & 4 and use HIT00/01



## Comment:

- the H<sub>2</sub>O-CH<sub>4</sub>-interference problem is serious for medium humidity and wet sites like Garmisch and Wollongong
- the interference problem is negligible for dry sites like Zugspitze, Izana, or Jungfrauoch, so spectroscopy doesn't matter much for these sites

- HITRAN 2000/01 is the currently best available spectroscopy for our 5 MW 's:

MW1 2613.70–2615.40 cm<sup>-1</sup>

MW2 2650.60–2651.30 cm<sup>-1</sup>

MW3 2835.50–2835.80 cm<sup>-1</sup>

MW4 2903.60–2904.03 cm<sup>-1</sup>

MW5 2921.00–2921.60 cm<sup>-1</sup>

- We need better HDO and CH<sub>4</sub> line parameters for MW2 and MW4.

Based on that we could include these two MW 's to CH<sub>4</sub> profile retrievals. This would significantly enhance information content as a pre-requisite to separate trop. and strat. CH<sub>4</sub> from ground-based mid-IR FTIR spectrometry.

### Reference

Sussmann, R., Forster, F., Rettinger, M, and Jones, N.: Strategy for high-accuracy-and-precision retrieval of atmospheric methane from the mid-infrared FTIR network, Atmos. Meas. Tech., 4, 1943-1964, 2011.

## II) Revisit CH4 test in 2019: Leading question and answer

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So leading question is:

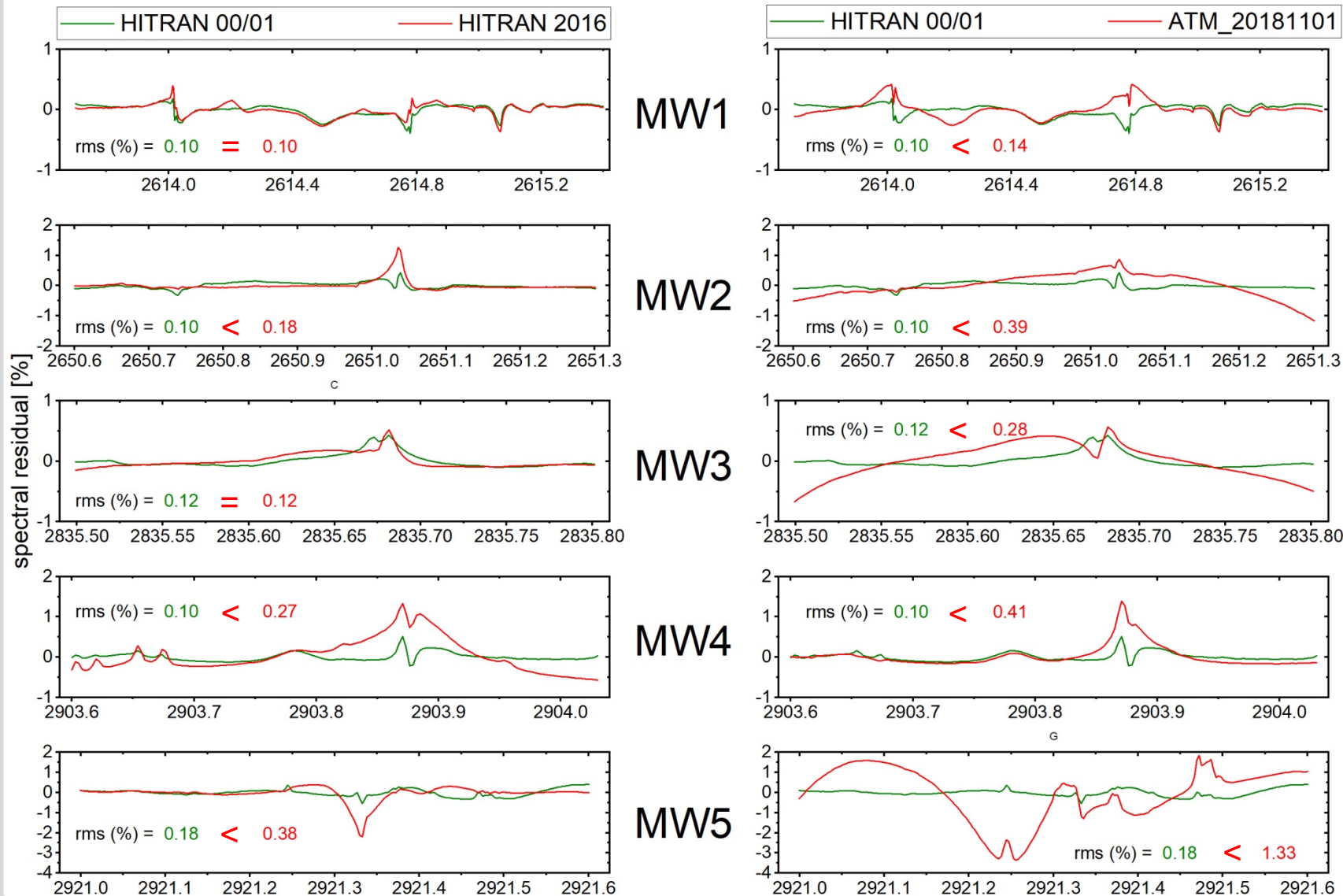
- Does HIT16 or ATM18 give smaller HDO and CH4 residuals than HIT00/01?
- In particular for MW2 and MW4 ?

Answer is:

- **No, HIT16 and ATM18 residuals are worse than HIT00/01.**

Prove for that is given on the next viewgraph ⇒

# II) Revisit CH4 test in 2019: Averaged residuals for 2007 for Garmisch



Averaged residuals from fitting  $\approx 800$  spectra from 2007



## II) Revisit CH4 test in 2019: Conclusions

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- **HIT16 and ATM18 give significantly worse averaged residuals than HIT00/01.**
- For medium to high humidity sites like Garmisch we should not use HIT16 or ATM18 but stick to HIT00/01
- For medium to high humidity sites it is still recommended to use only MW1, MW3, and MW5, i.e. NOT MW2 or MW4
- Only for very dry sites like Zugspitze, Jungfrauoch, or Izana the choice of spectroscopy and MW 's is less critical