

**A NEW “DIET” FOR AIR-
BROADENED HALF-WIDTHS OF
WATER VAPOR IN THE
HITRAN2004 COMPILATION**

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Why do we need accurate data for air-broadened half-widths of water?

- Water is the principal absorber of longwave radiation in terrestrial atmosphere and is important for remote sensing applications
- Air-broadened half-width is one of the most important parameters in determination of molecular profiles and the largest source of uncertainty
- For accurate retrievals (in troposphere) the half-width and its temperature dependence should be known with 3-10% uncertainty depending on line intensity

Original preference order for adding air-broadened half-width data into HITRAN2004

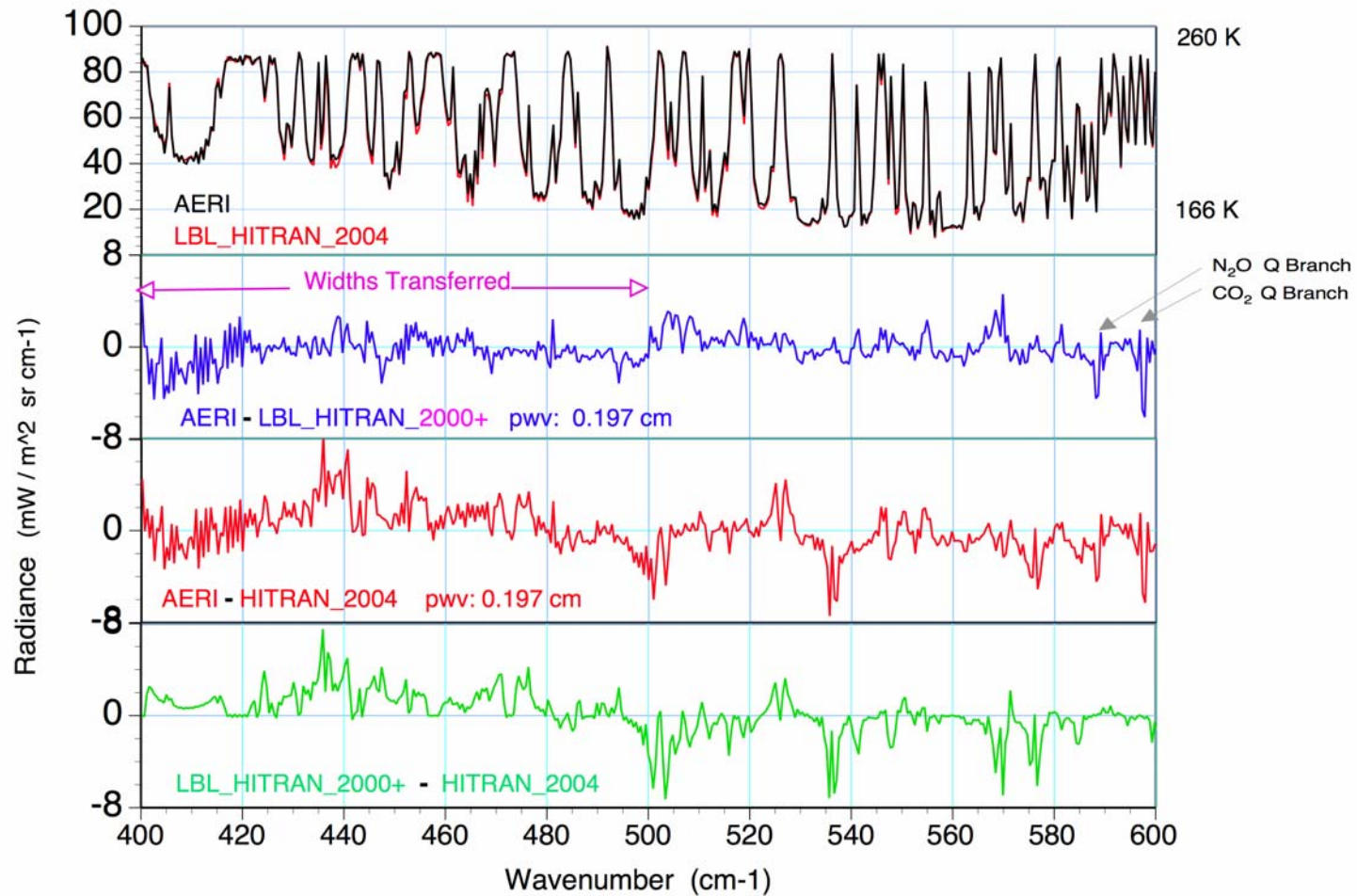
- Intercomparison database (averaging of 2-8 experimental data)
 - Database of the single measurements
 - Smoothed values from R. Toth (<http://mark4sun.jpl.nasa.gov/data/spec/H2O>)
 - Database of complex Robert-Bonamy (CRB) calculations (http://faculty.uml.edu/Robert_Gamache/)
 - Semi-empirical calculations that employ all available experimental and theoretical data
 - Default estimate
- } R. Gamache and J.-M. Hartmann, *Can. J. Chem.*, **82** (2004) 1013

Discrepancies

AERI_ER Validation in the Polar Window ARM NSA

Retrieved Column Water Vapor HITRAN 2000/2004 mt_ckd_1.2

J.S. Delamere and S.A. Clough; AER, June 2005

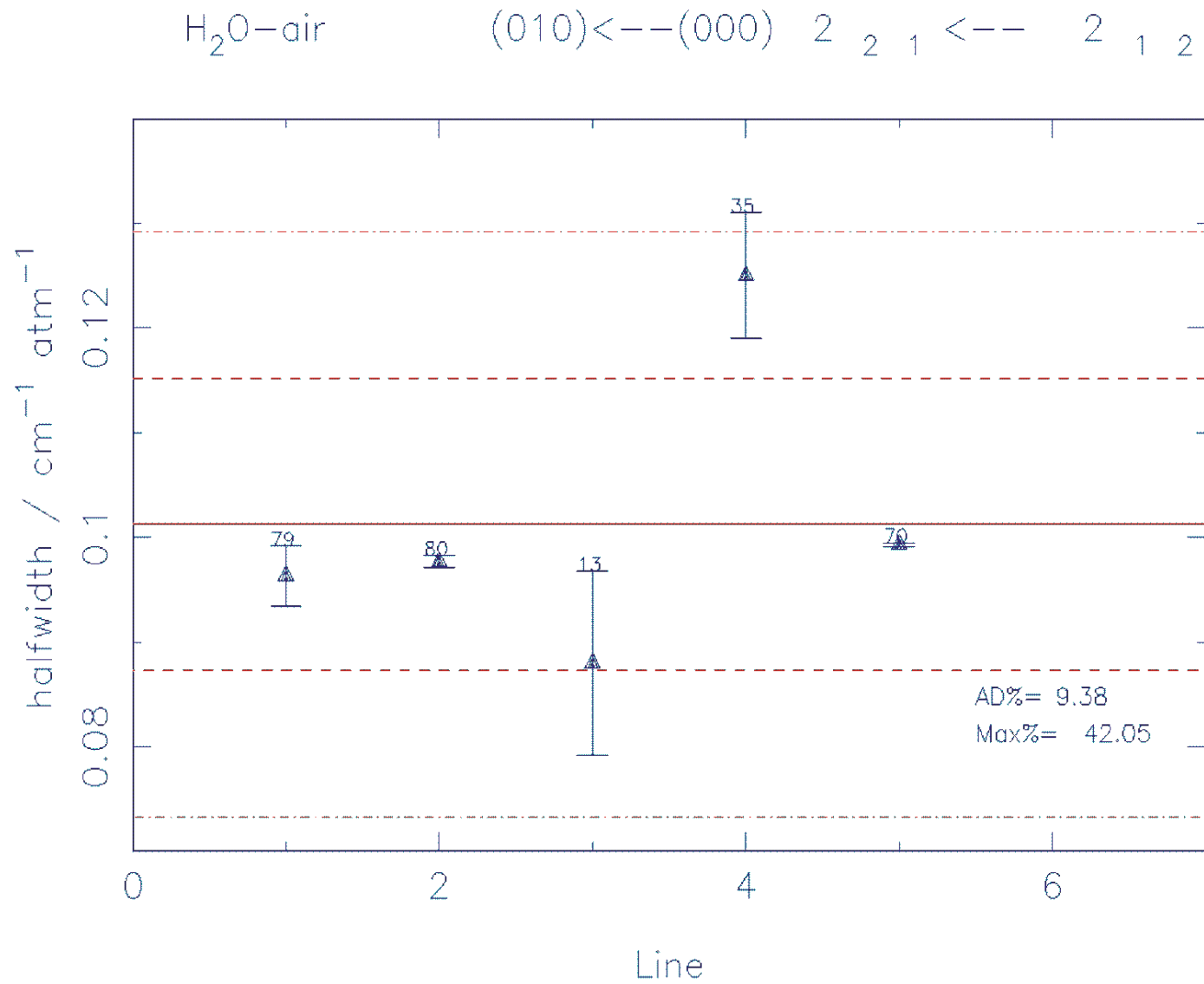


Corroborated by Masiello et al., 2005

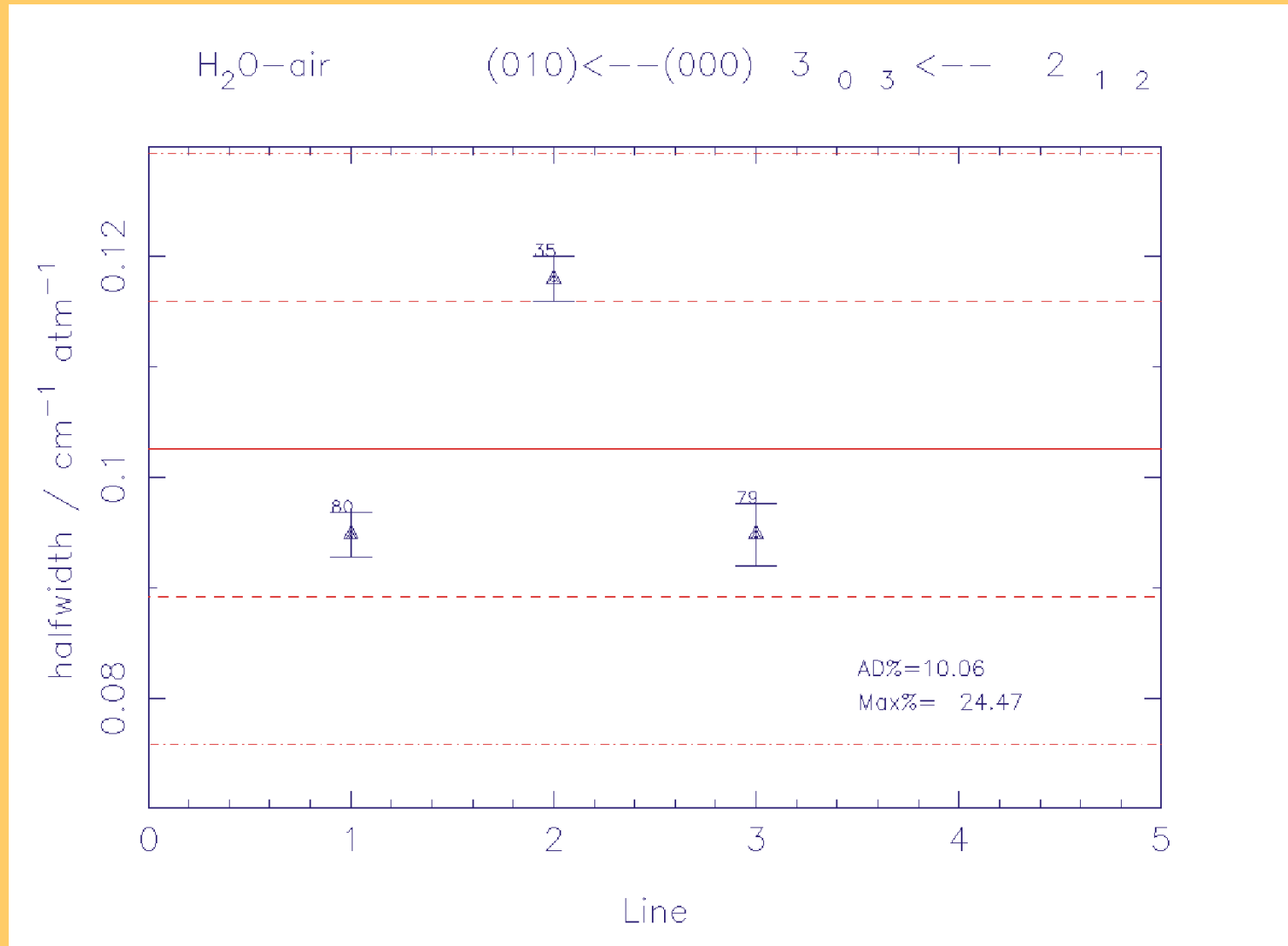
Sources of errors

- No available data is flawless
- Experiments are plagued by impurities and line overlaps, which are especially difficult for weak lines
- Smoothed values are dependant on the quality of experimental information
- CRB calculations are not perfectly applied to all types of transitions
- Semi-empirical calculations inherit uncertainties from the above sources (except smoothed values)
- Approach: Each transition have its own “metabolism” and it has own “diet”=source preference

Sources of errors

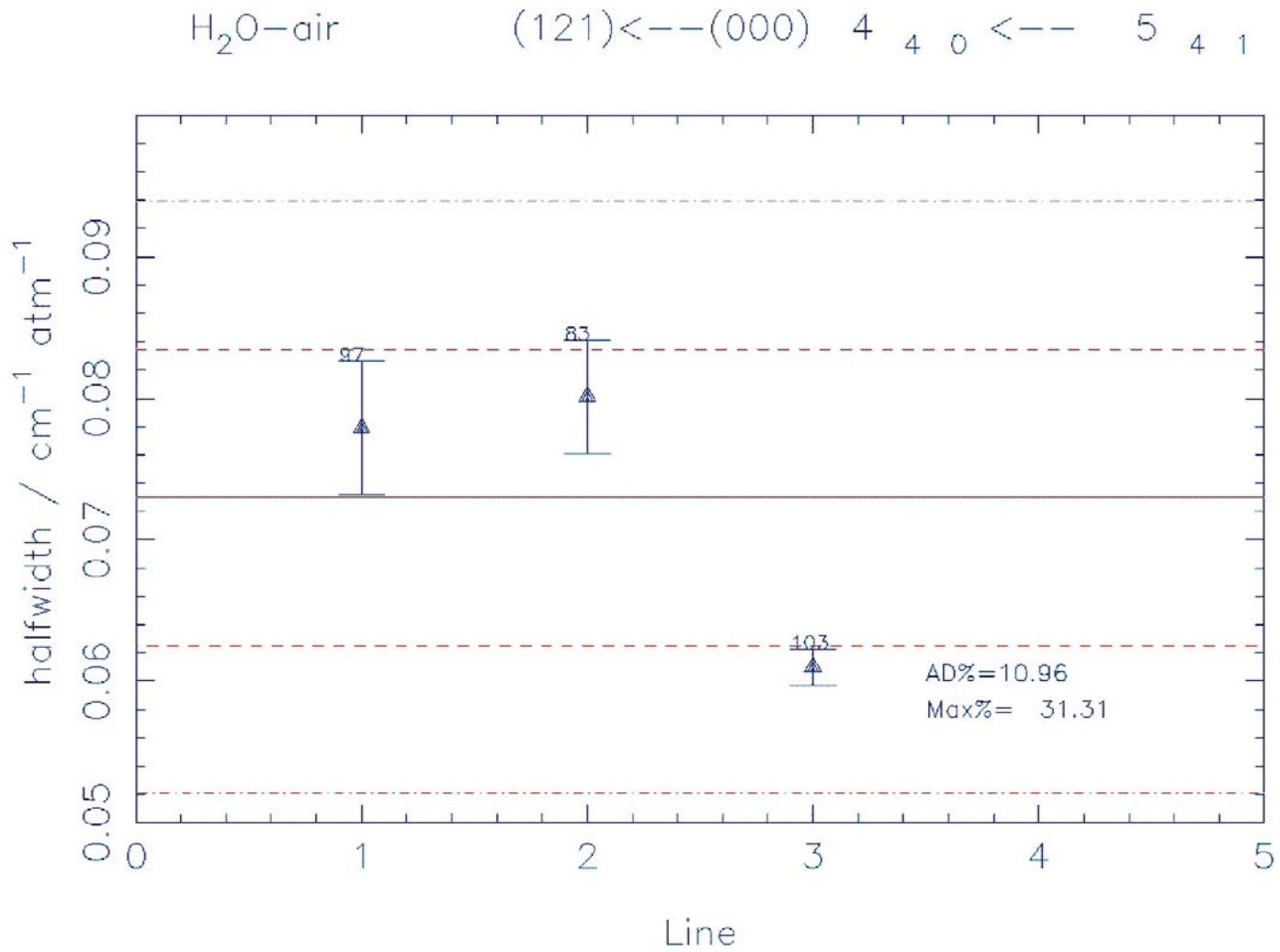


Sources of errors



Step 1: Eliminate eight references that provide consistently bad data

Intercomparison



Filtering scheme

Step 1

Eliminate measurements that are >20% off semi-empirical calculations

For intercomparison database (Step 2)

Uncertainty (U)- separation (%) between average and the farthest point

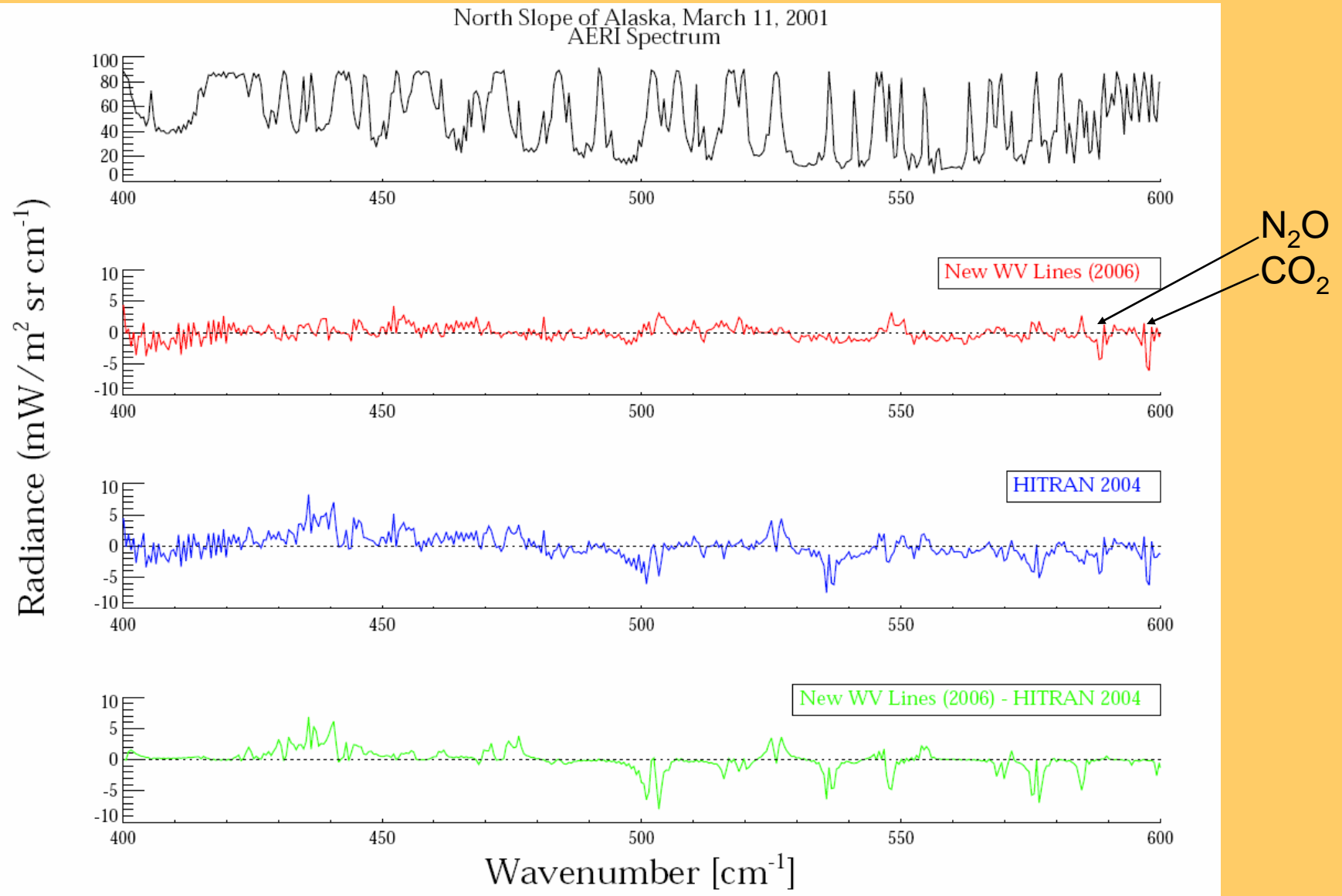
- If for J (average J between levels) <8 , $U>7\%$ then replace with CRB or semi-empirical calculations
- If for $8<J<13$, $U>10\%$ then replace with CRB or semi-empirical calculations
- If for $J>13$, $U>15\%$ then replace with CRB or semi-empirical calculations

For single measurements database (Step 3)

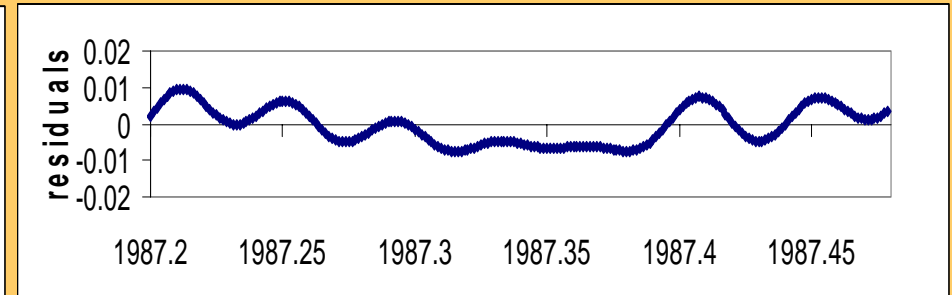
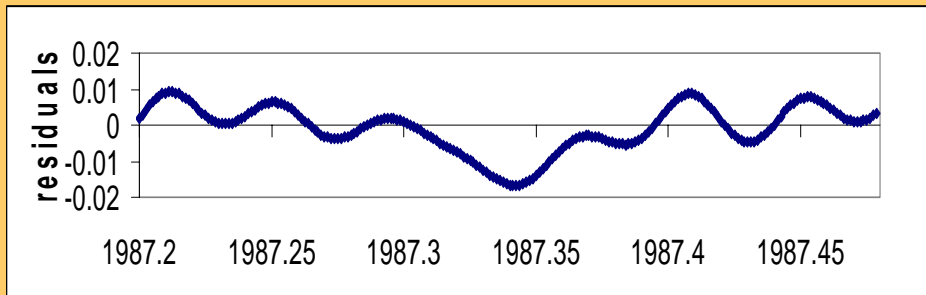
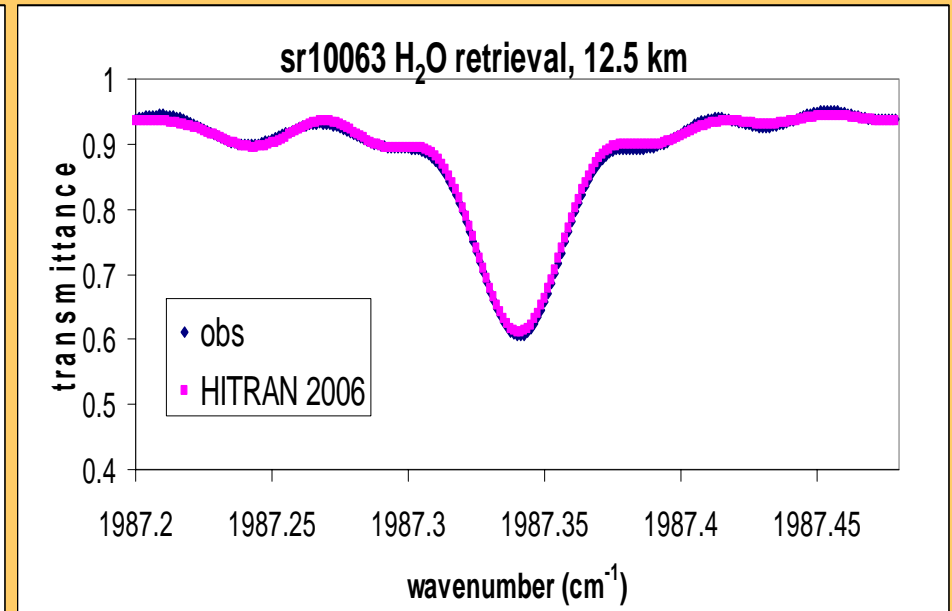
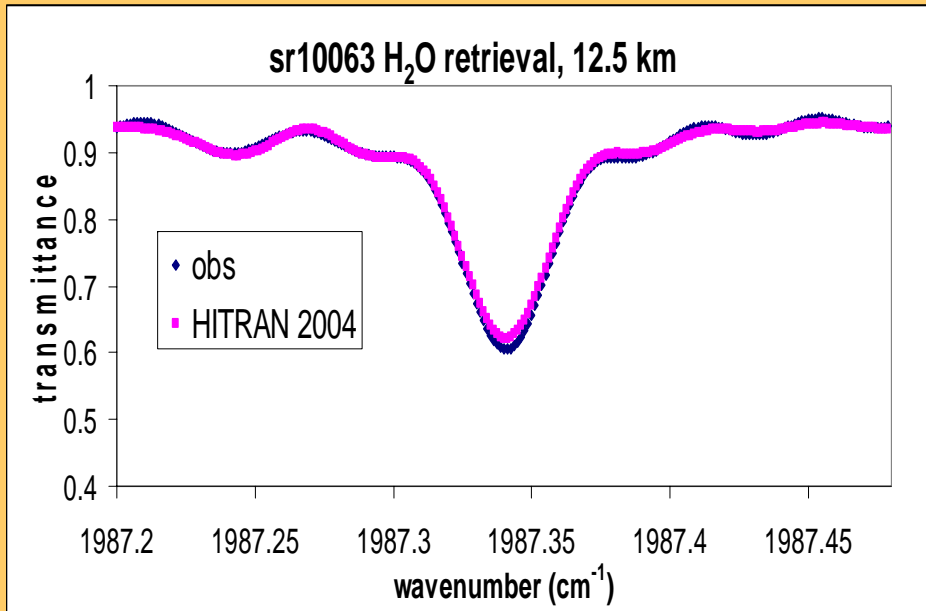
Uncertainty (U)- is reported experimental uncertainty (%)

Same procedure

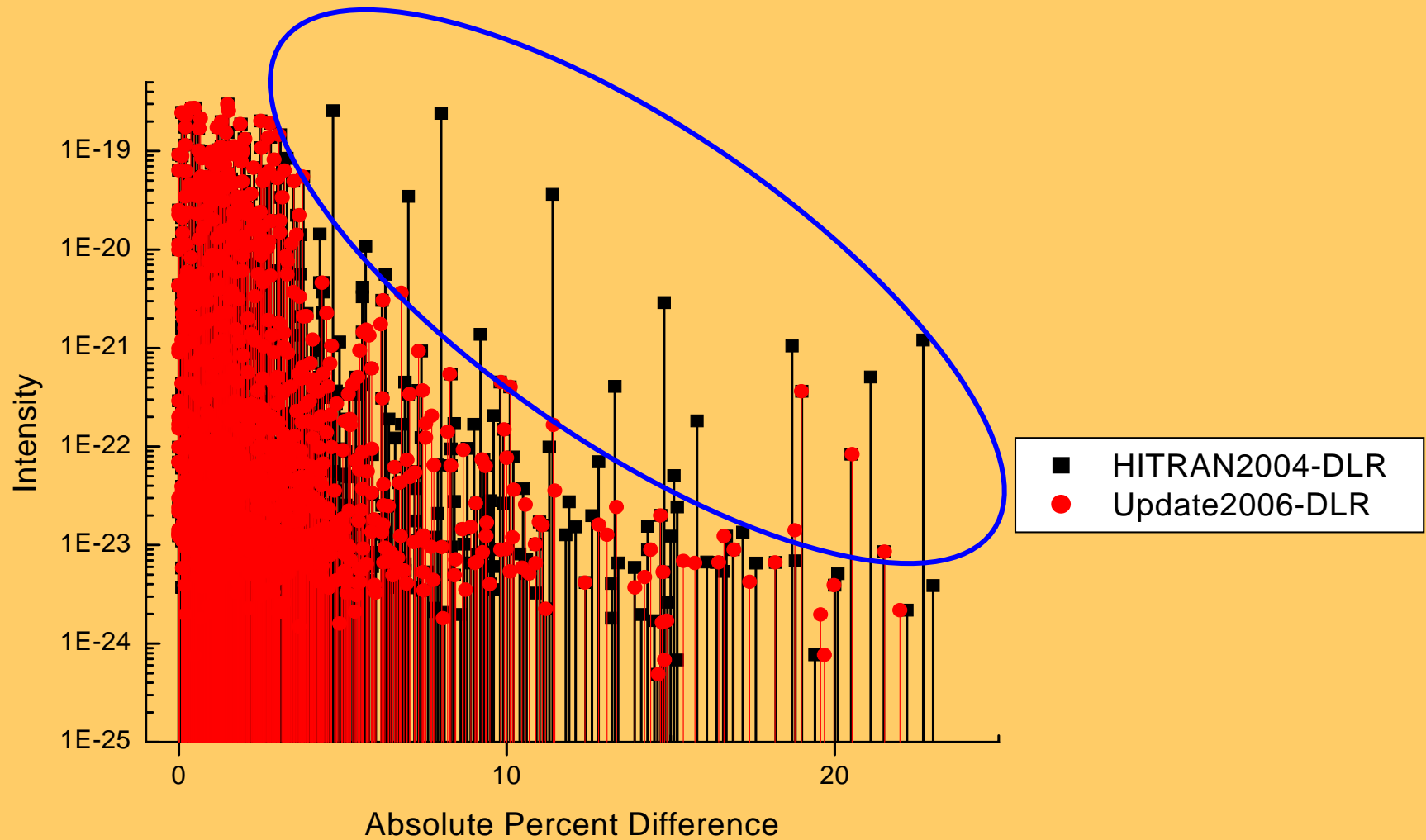
Validation (AER)



Validation (ACE)



Comparison (DLR)



Conclusions and potential improvements

- Air-broadened half-widths were improved significantly as can be seen from application to the spectra of lower troposphere
- The measurements at the higher altitudes (11-12 km) have not shown significant improvement which affirms the small importance of air-broadened half-widths in these retrievals
- We have found the new data from DLR to be superior to any previous experiments in that region and we are planning to include this data into HITRAN
- More (THOROUGH) experiments are desirable
- Refinement of the CRB calculations, or development of more accurate calculations is a promising alternative
- Update semi-empirical calculations once significant bulk of new data becomes available

Acknowledgements

- M. Shephard, J. Delamere, S. A. Clough
(Atmospheric and Environmental Research (AER), Inc.)
 - C. Boone and P. Bernath
(University of Waterloo, ACE)
 - K. Jucks
(Harvard-Smithsonian Center for Astrophysics)
 - NASA