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B&P → DMB: implications for the Brewers

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Volodya Savastiouk. WMO Ozone theme meeting. Geneva. March 23-25, 2010



Outline

- Ozone calculations with the Brewer
- Differences between B&P and DMB
- Effects of the differences on Brewer calculations
- Summary
- Recommendations
- A comment on databases



Kislovodsk, Russia



Ozone calculations with Brewers

For ozone, the Brewer spectrophotometer takes readings in at 4 wavelengths that nominally are: **310.0, 313.5, 316.8, and 320.0 nm**

To account for the presence of aerosol and SO₂ a linear combination, called ratio, is calculated for the readings and the **xsecs, convolved with the slit function**

$$R6 = \sum_{\lambda=2..5} W_{\lambda} \log(I_{\lambda}) \quad \alpha = \sum_{\lambda=2..5} W_{\lambda} \alpha_{\lambda} \quad \text{the standard algorithm uses } W=(1, -0.5, -2.2, 1.7)$$

The extra-terrestrials (ETC) are calculated either by Langley method at a suitable location or by comparing to a calibrated Brewer

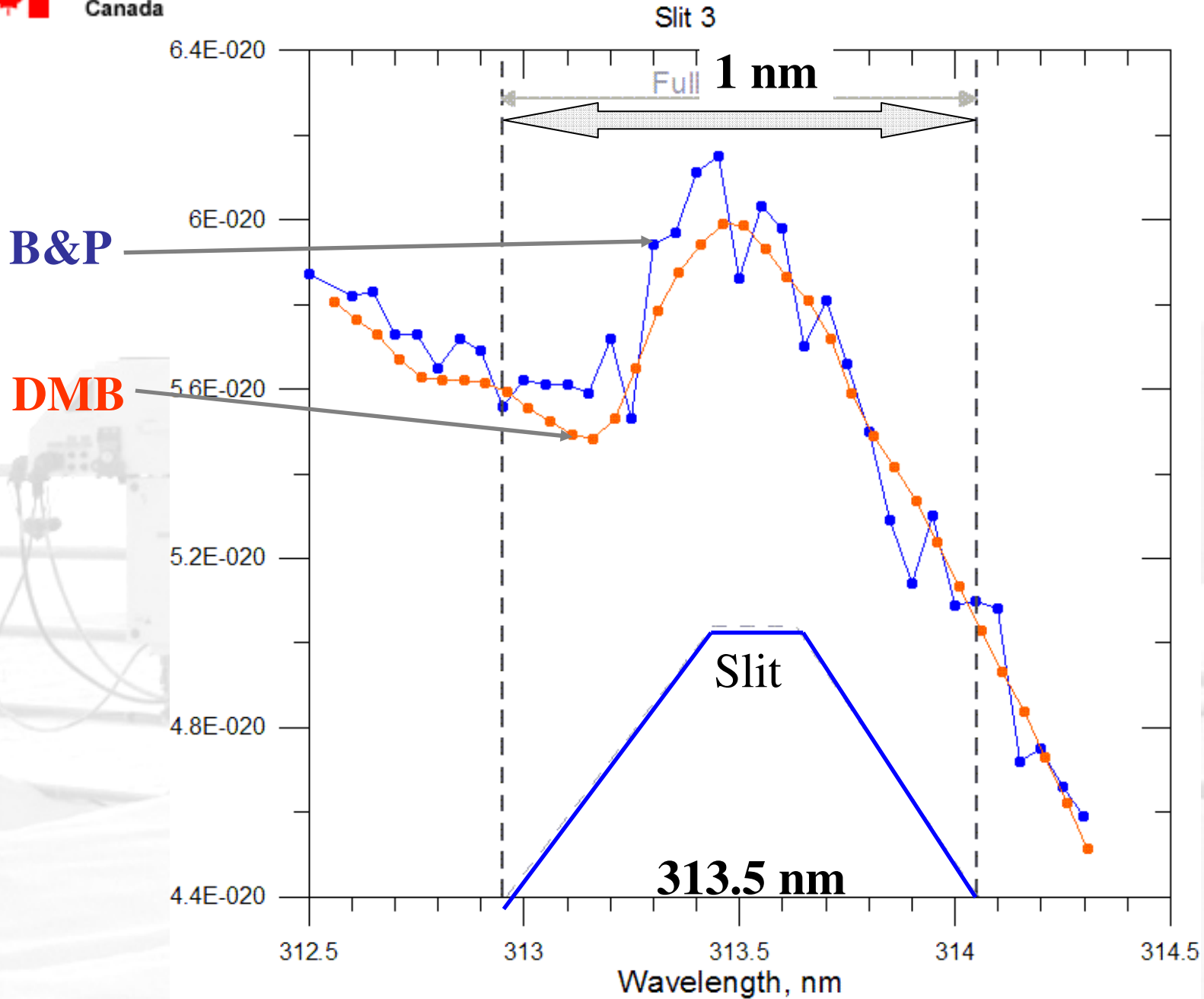
Ozone is then calculated using the extraterrestrial coefficient and the AMF:

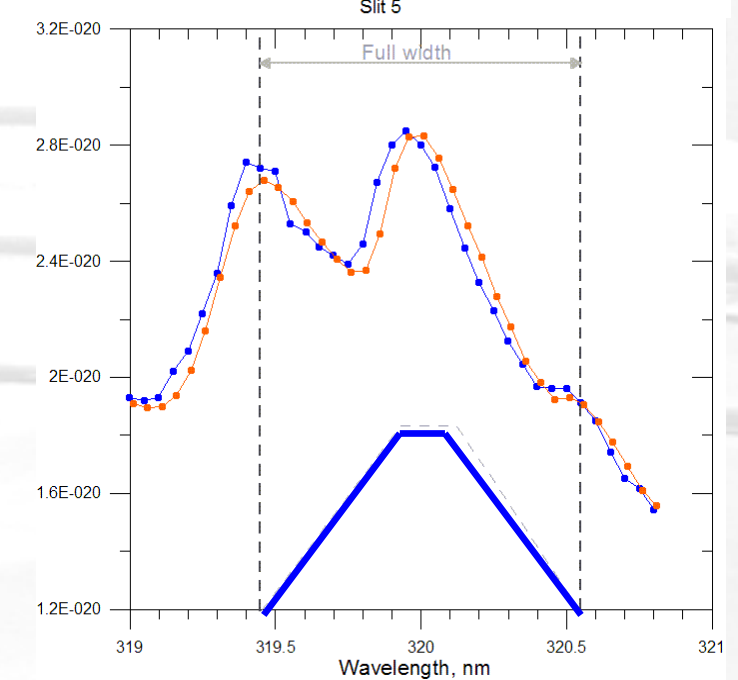
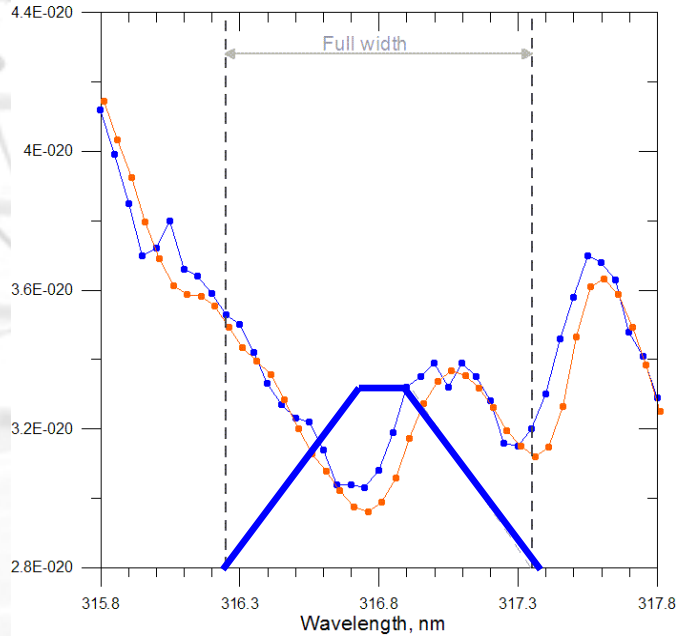
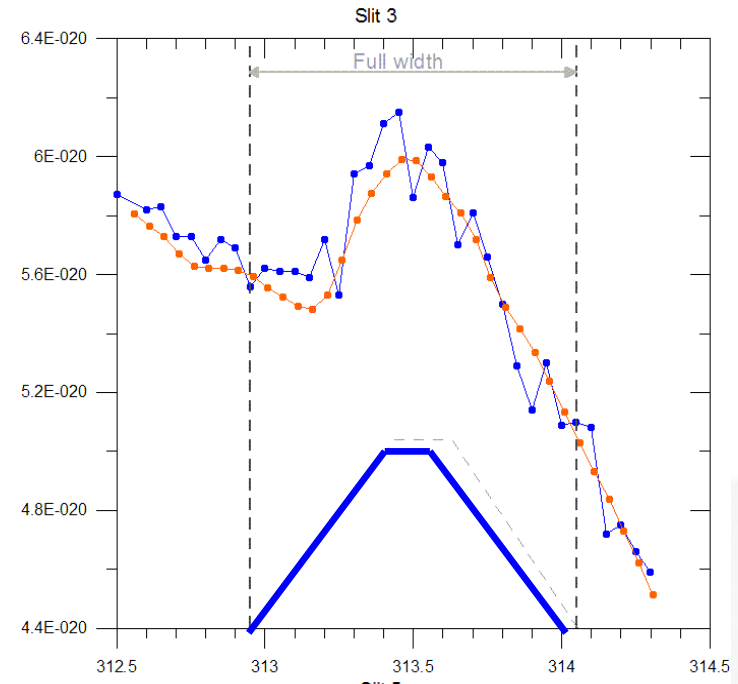
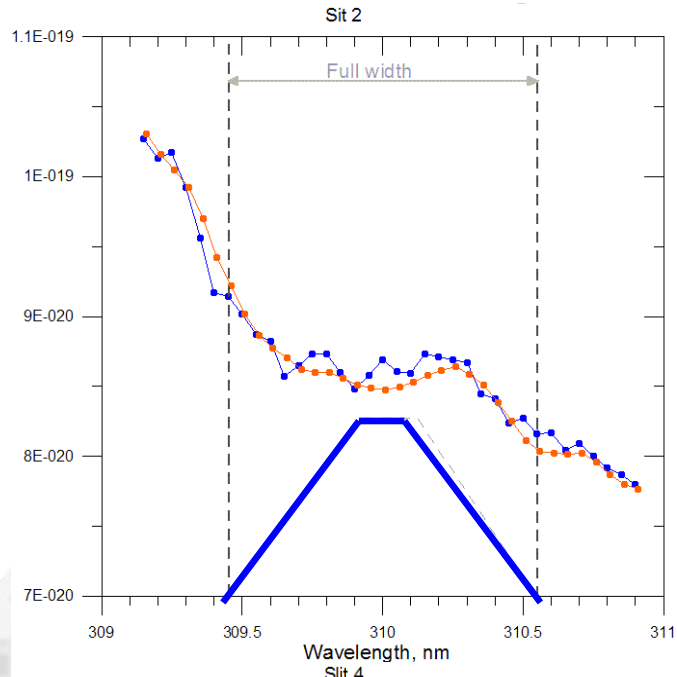
$$X_{o_3} = \frac{R6 - ETC}{\alpha \mu}$$



The reason we are here is the part where the ozone cross-sections are convolved with the slit functions.

$$a_{\lambda_i} = \frac{\int_{-slitwidth}^{slitwidth} crossO3(\lambda) slitF(\lambda - \lambda_i) d\lambda}{\int_{-slitwidth}^{slitwidth} slitF(\lambda - \lambda_i) d\lambda}$$







So we know that B&P are different from DMB.

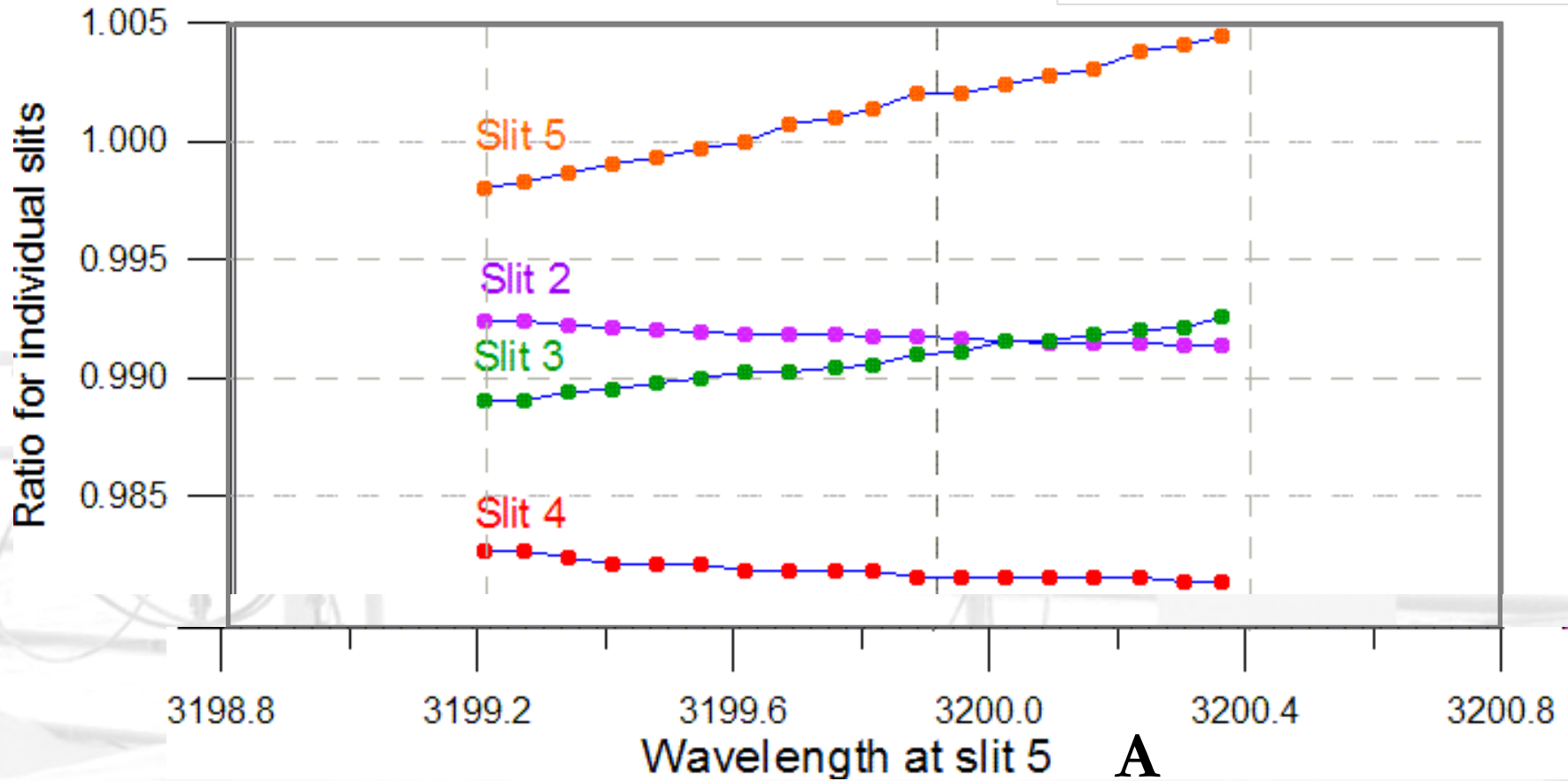
Also, there are slight variations in the operating wavelengths and slit functions between Brewers. Fortunately, we know what they are quite accurately.

It turns out that the variations in the slit functions are not enough to affect the effective absorption coefficient (the convolved value), but the variations in the wavelengths are important.



$$a_{\lambda_i} = \frac{\int_{-slitwidth}^{slitwidth} crossO3(\lambda) slitF(\lambda - \lambda_i) d\lambda}{\int_{-slitwidth}^{slitwidth} slitF(\lambda - \lambda_i) d\lambda}$$

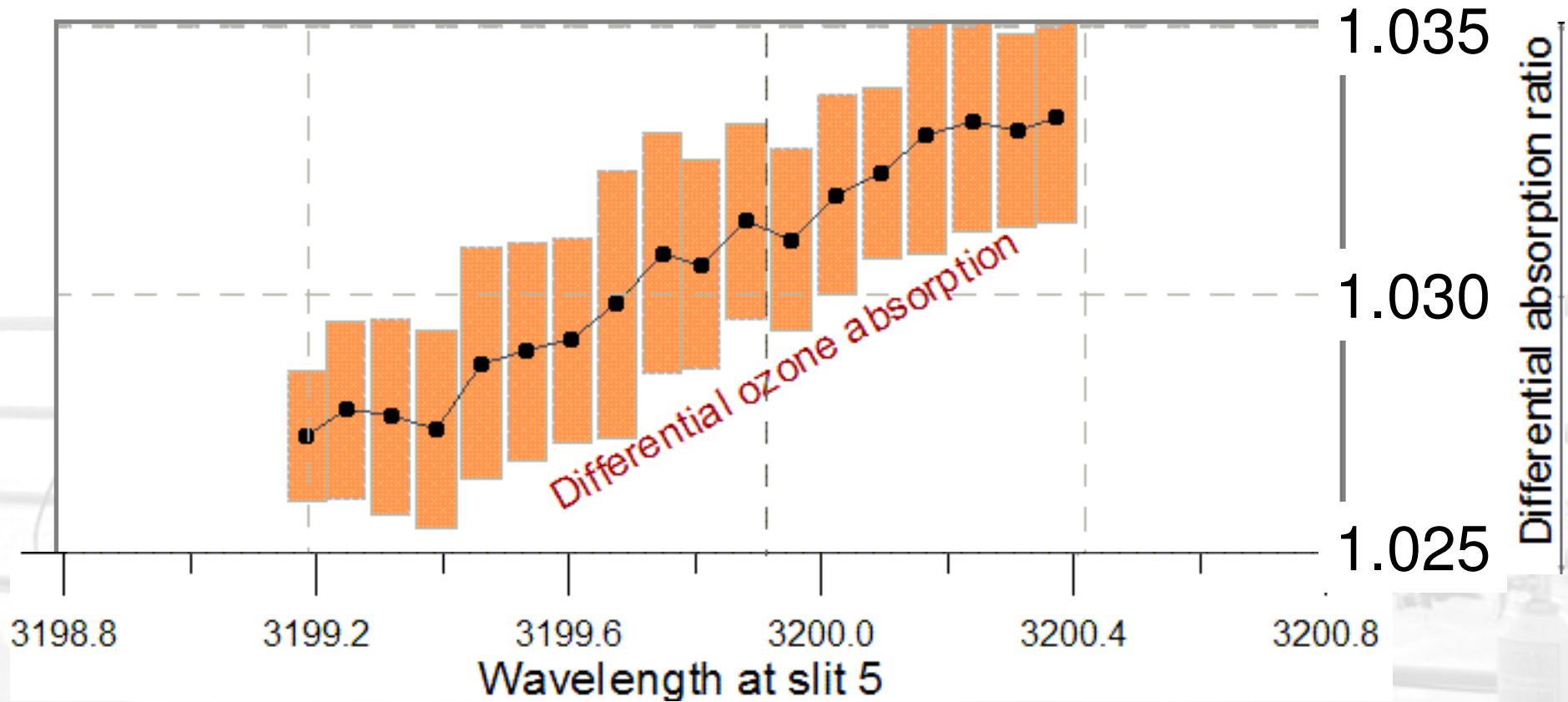
Ratio Brion/Bass





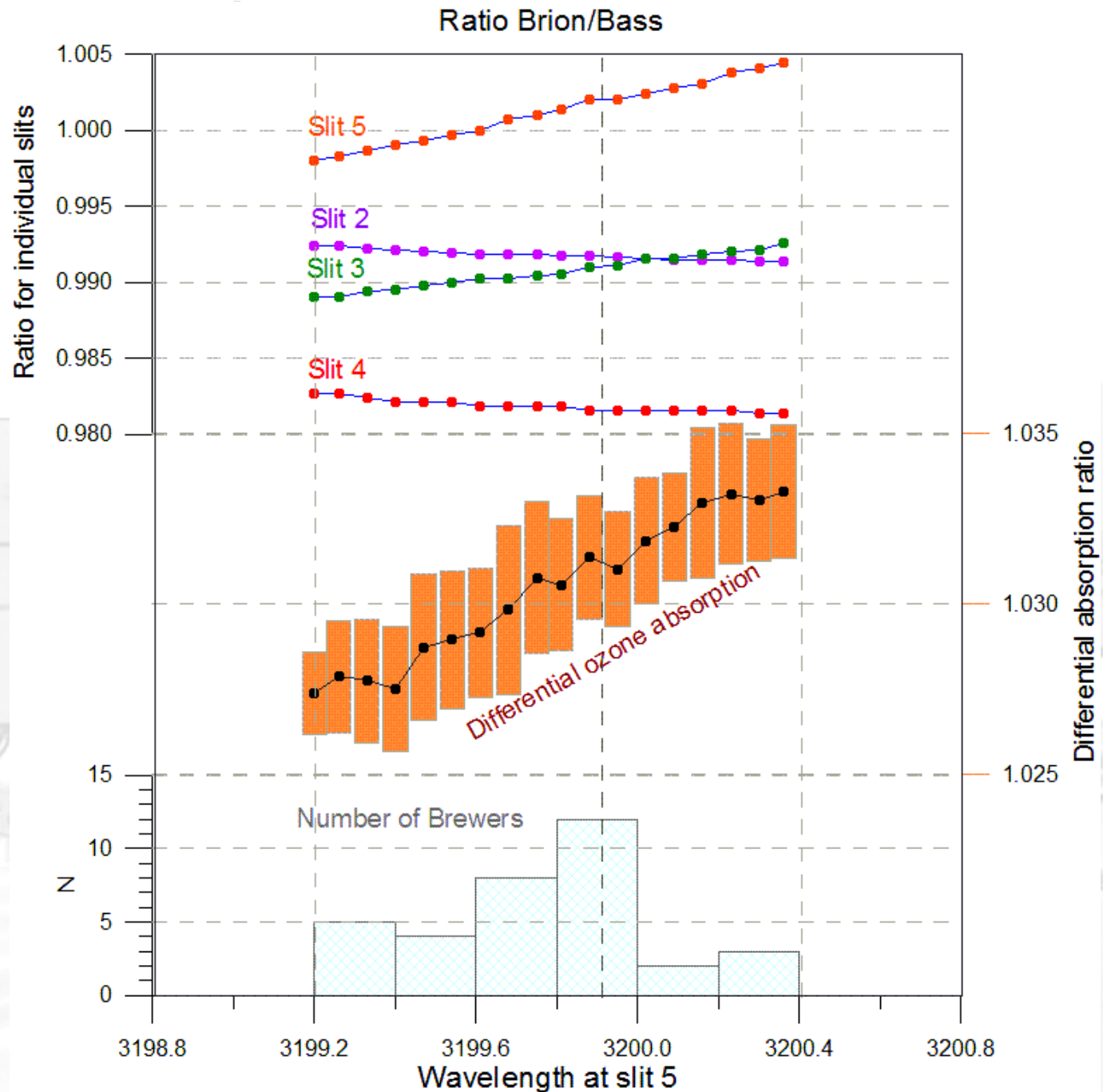
$$\alpha = \sum_{\lambda=2..5} W_{\lambda} \alpha_{\lambda}$$

Ratio Brion/Bass





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Effect on the ETC from the intercomparisons.

Both ETC and the differential absorption from the reference Brewer are used to calculate ETC, and thus ozone, for the other Brewer

Mean AMF during calibration

Change in absorption for reference and new Brewer

Ozone

Ozone “true”

$$\frac{X_{new}}{X} = 1 - \frac{\overline{X\mu}}{X\mu} \left(1 - \frac{\gamma^{ref}}{\gamma^{new}}\right)$$

$\approx 2\%$



Summary

- DMB ozone cross-sections provide advantages over B&P in consistency and resolution
- Average effect on total ozone from the Brewers is a factor of **0.970 +/- 0.005**
- There can be a significant effect on the ETC from the cross-section change when calibration is done by intercomparison. The effect can be as much as 2% in ozone (AMF dependent)
- Also: Important advantage of DMB is in the consistency of the temperature dependence



Recommendations

- Switch to DMB ozone cross-sections
- Reprocess intercomparison data to correct for possible effects on ETC
 - *This can be easier than it sounds if you use databases*
- Data Centres need to be **ready to track the changes before** the new cross-sections are put to use



Thank you!