Comparison of Brewer total ozone measurements using different ozone absorption cross sections with selected satellite measurements

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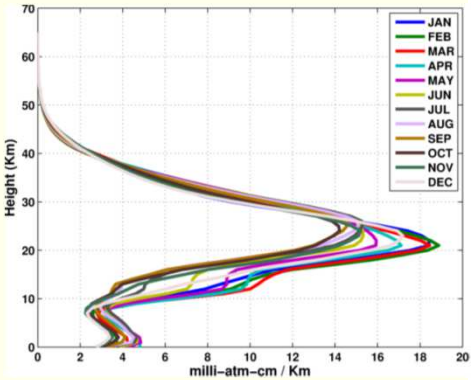
Motivation

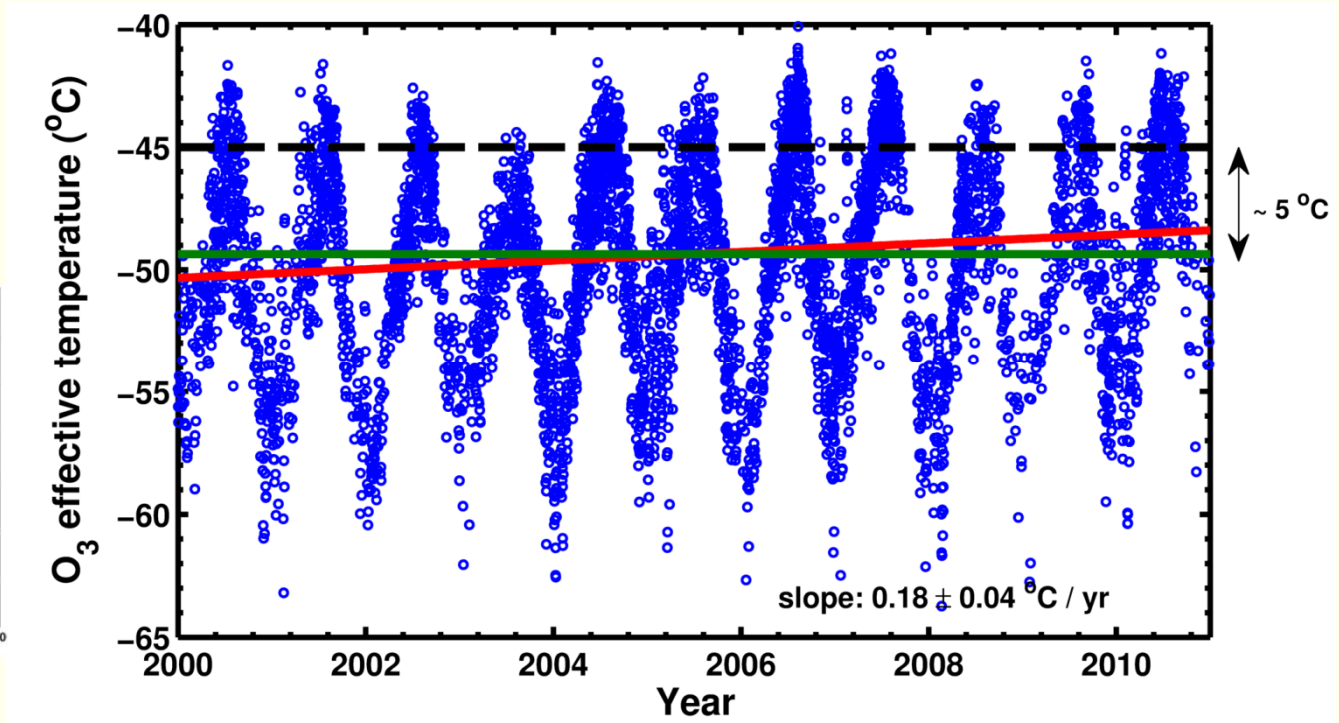
- Temperature dependence of O_3 cross-sections is not accounted in Brewer retrieval algorithm
- Actual air temperature at different layers is different from the assumed -45°C (228 K)
- Corrections on retrieved total ozone are possible using radiosonde data and climatological ozone profiles
- Assessing the effects of differences in T-dependence of available O_3 cross sections is challenging

Ozone effective temperature at Thessaloniki

$$T_{eff} = \frac{\int_{0\ \mathrm{Km}}^{30\ \mathrm{Km}} T(z)\cdot O_3(z)dz}{\int_{0\ \mathrm{Km}}^{30\ \mathrm{Km}} O_3(z)dz}$$

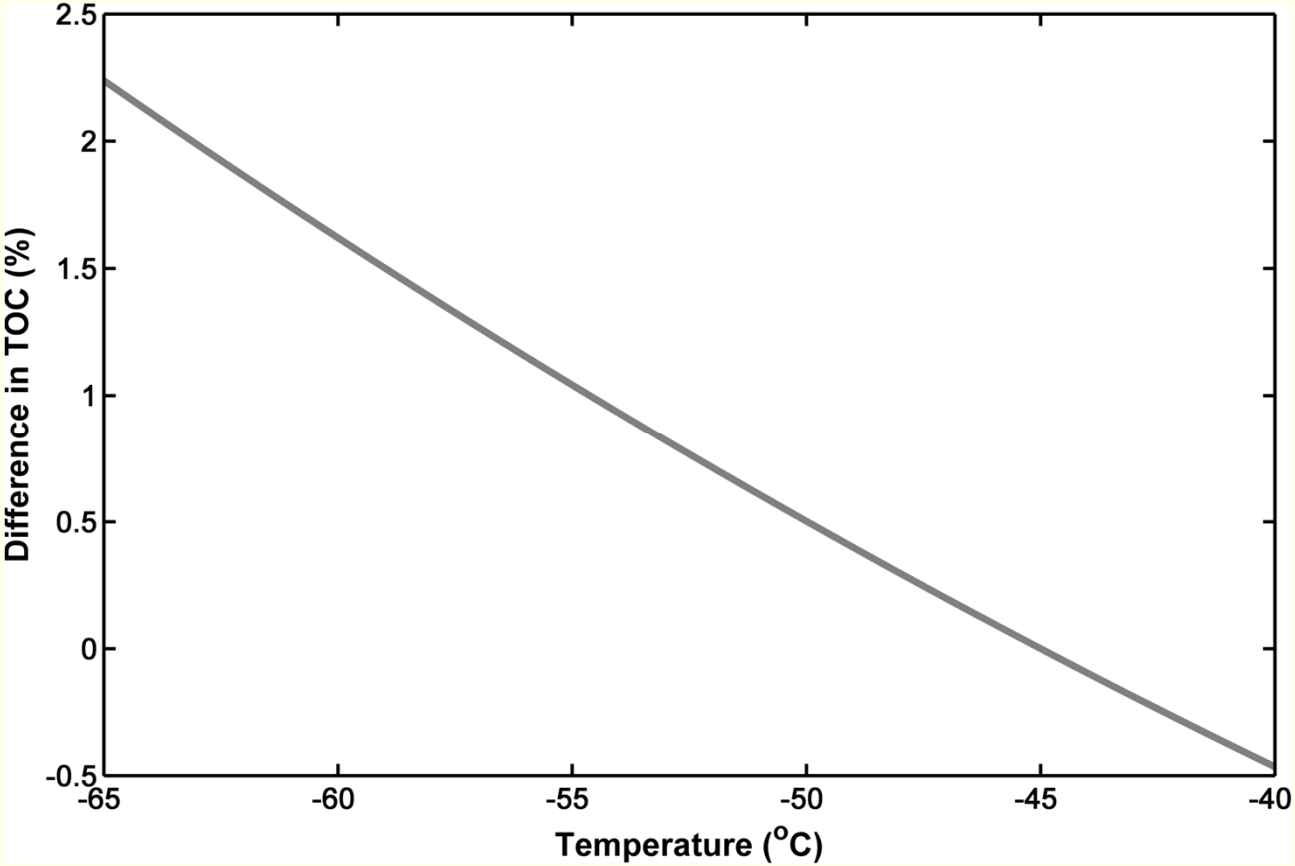


LLM O_3 climatology



- Mean effective temperature: -49.7 °C (vs -45°C)
- Annual variation (peak-to-peak): ~20°C

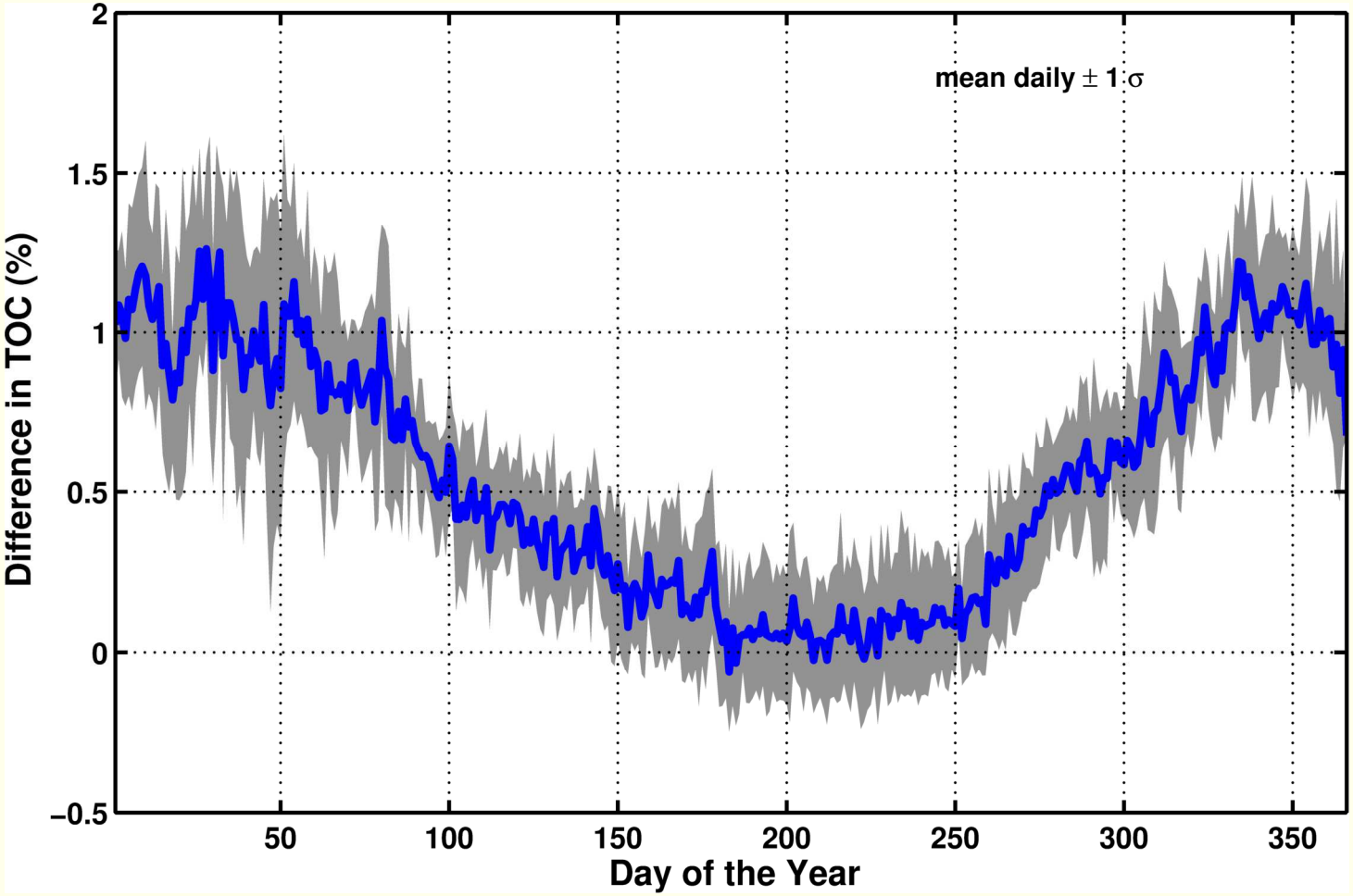
Effect of T-dependence of (BP) O_3 xs on TOC



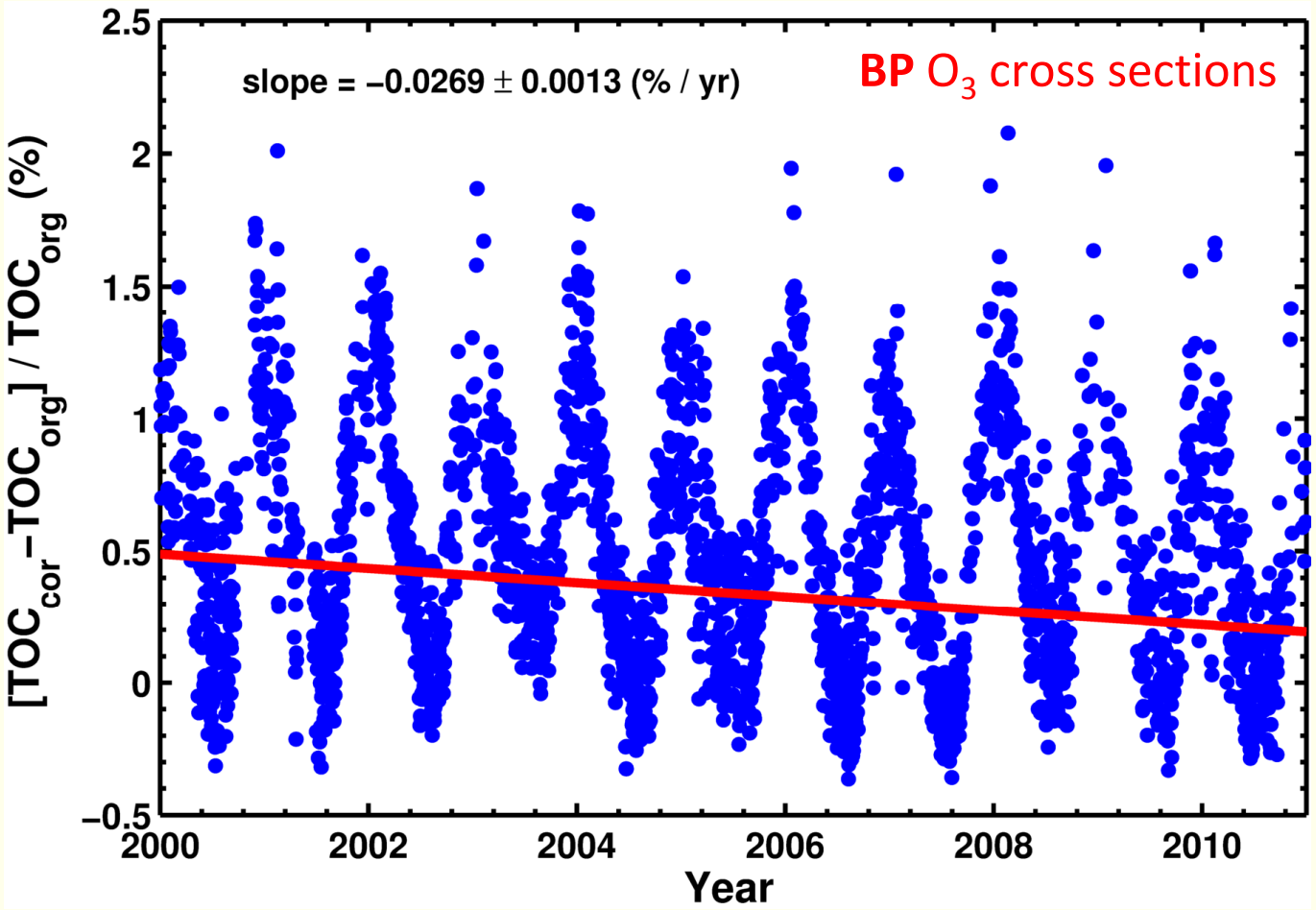
$$\Delta_{TOC}(\%) = \frac{\Delta\alpha(-45°) - \Delta\alpha(T_{eff})}{\Delta\alpha(T_{eff})} \times 100$$

Effect of O_3 xs T-dependence on TOC at Thessaloniki

BP O_3 cross sections

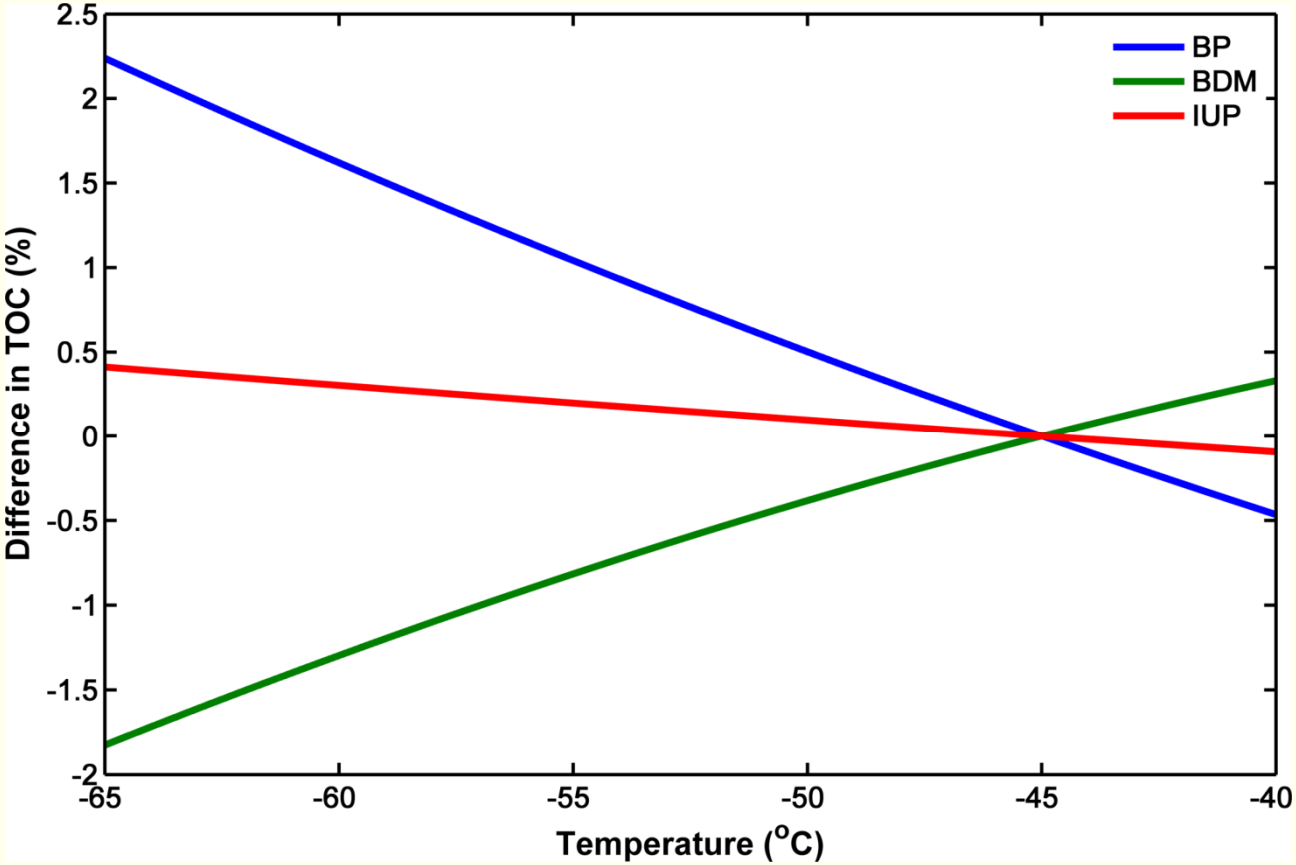


Effect of O_3 xs T-dependence on TOC at Thessaloniki

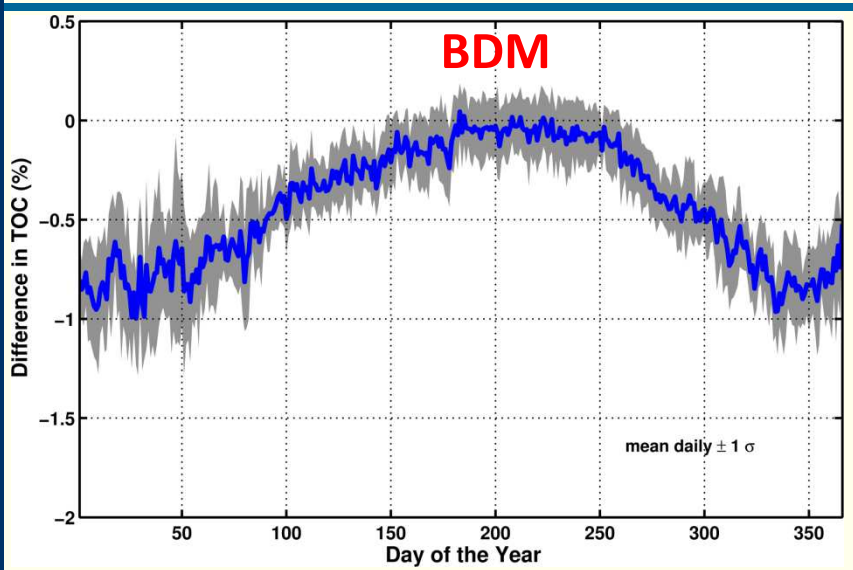


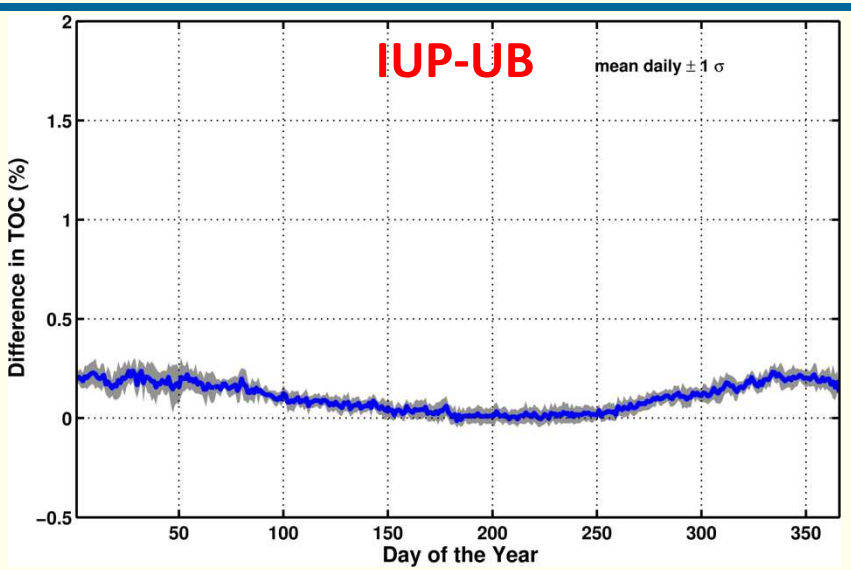
Trend change:
-0.3% per dec

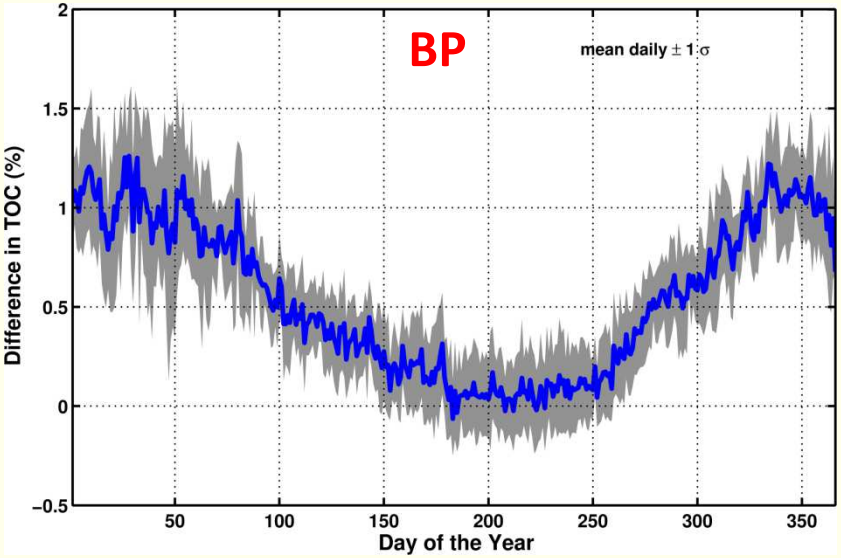
Temperature effect on TOC in different O_3 xs



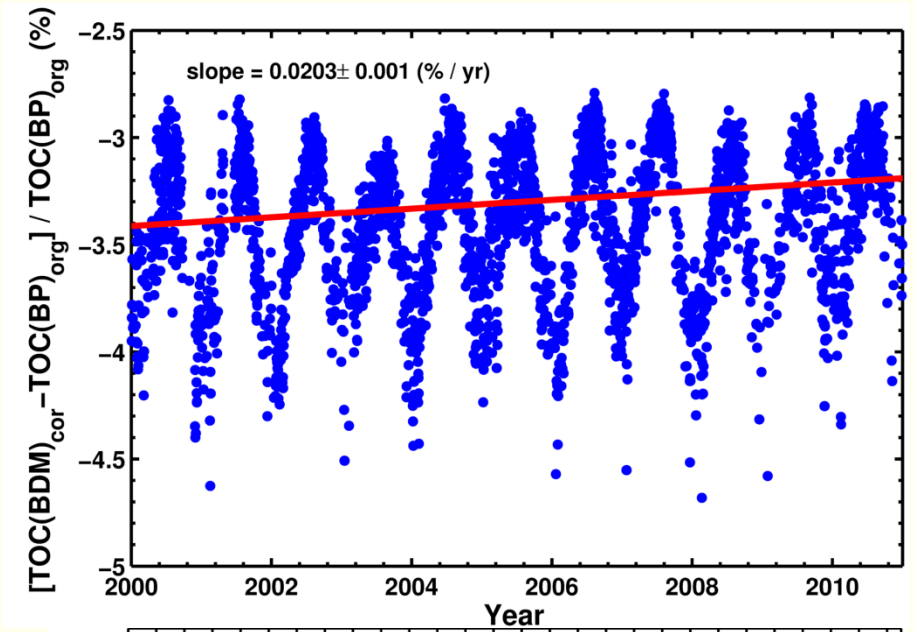
Temperature effect of O_3 xs on TOC

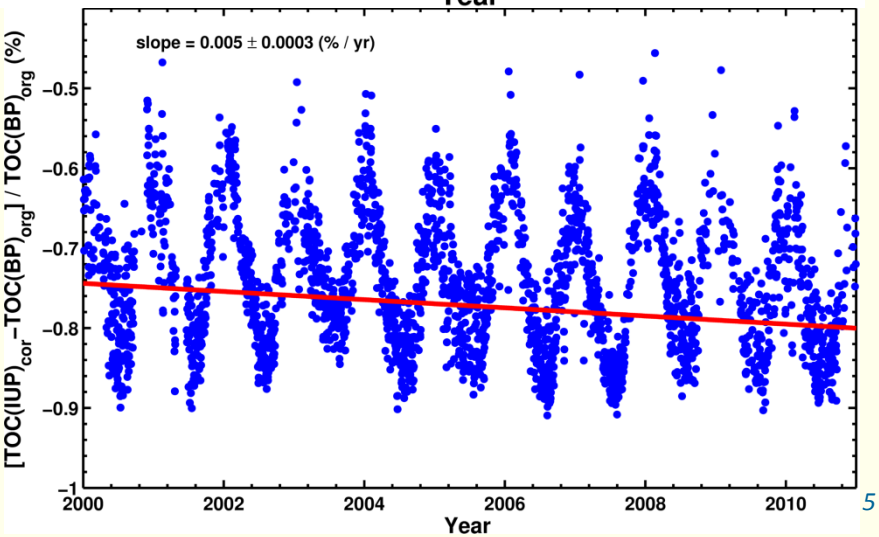






Effect of replacing BP in TOC at Thessaloniki



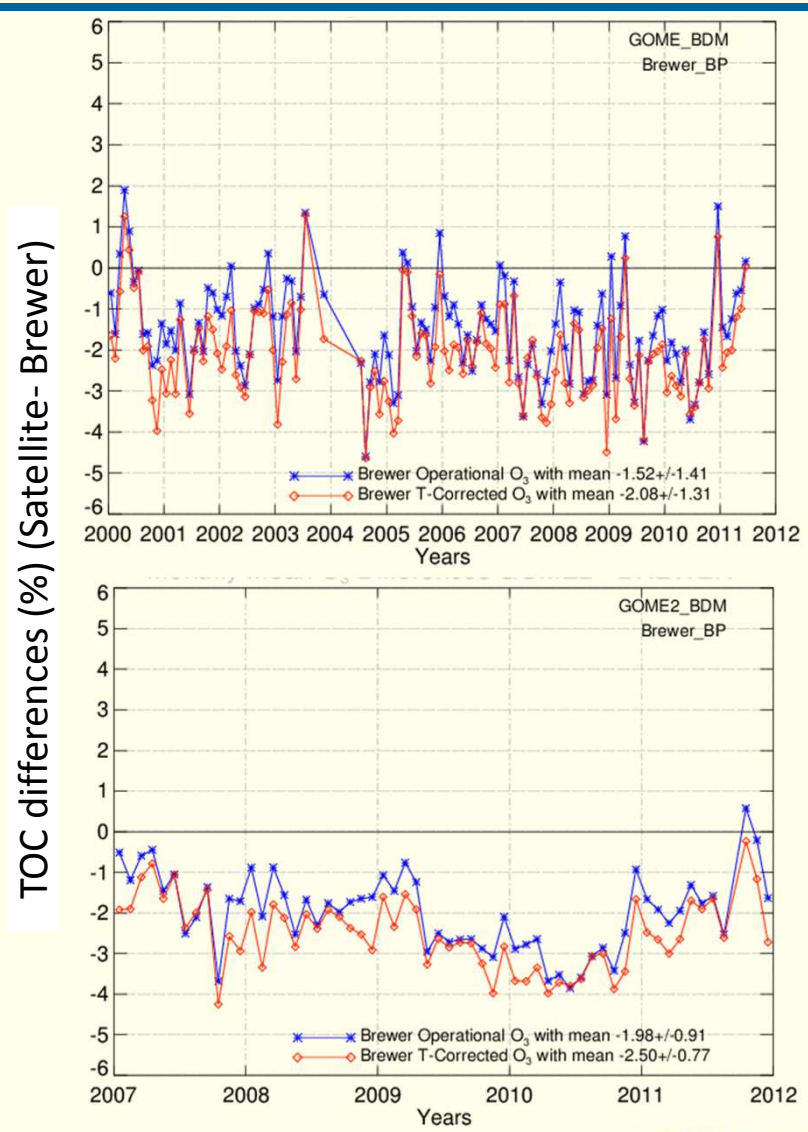


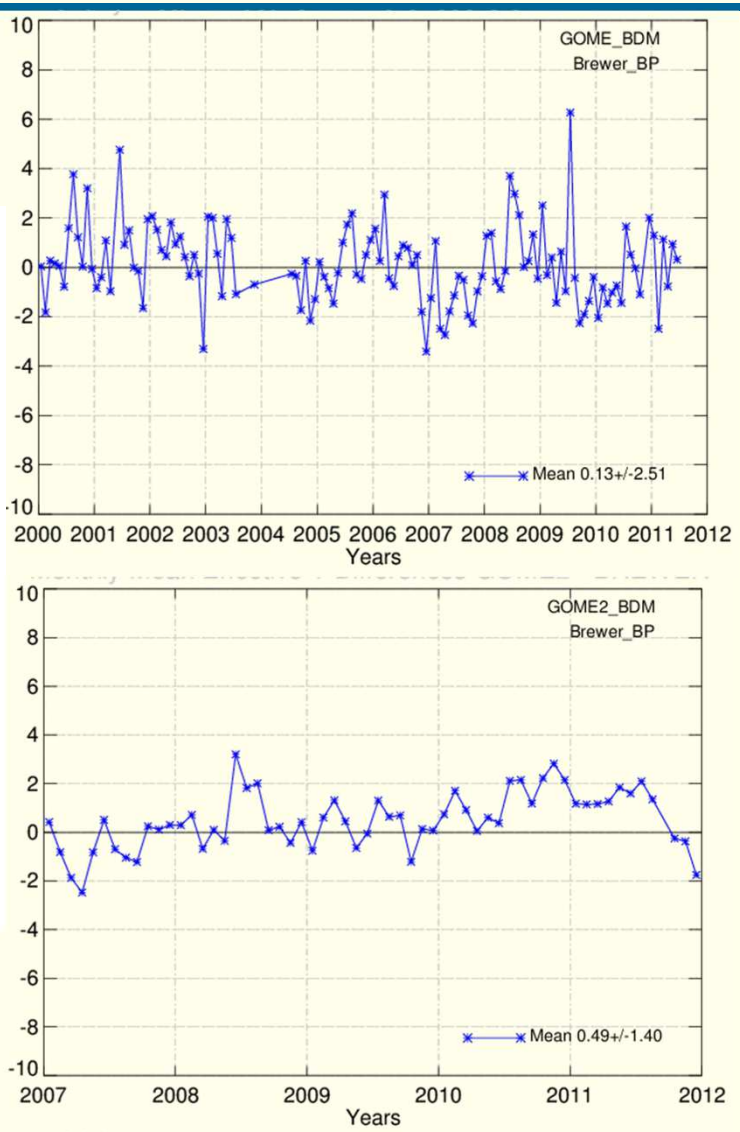
BDM: 3-4% reduction in TOC
+0.2% change in trend

IUP-UB: 0.5-0.9% reduction in TOC
-0.05% change in trend

Satellite vs Brewer TOC – current situation

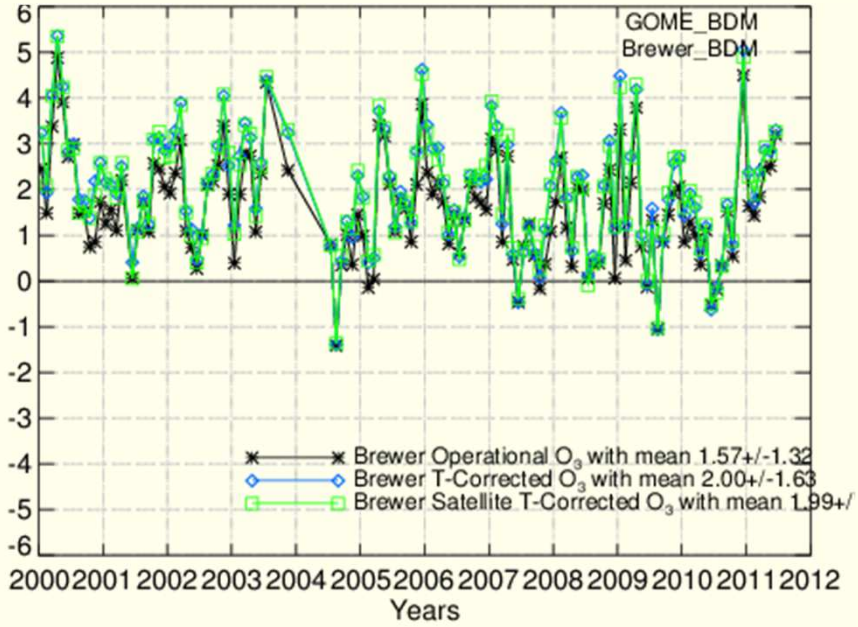
DIFFERENT O_3 cross sections



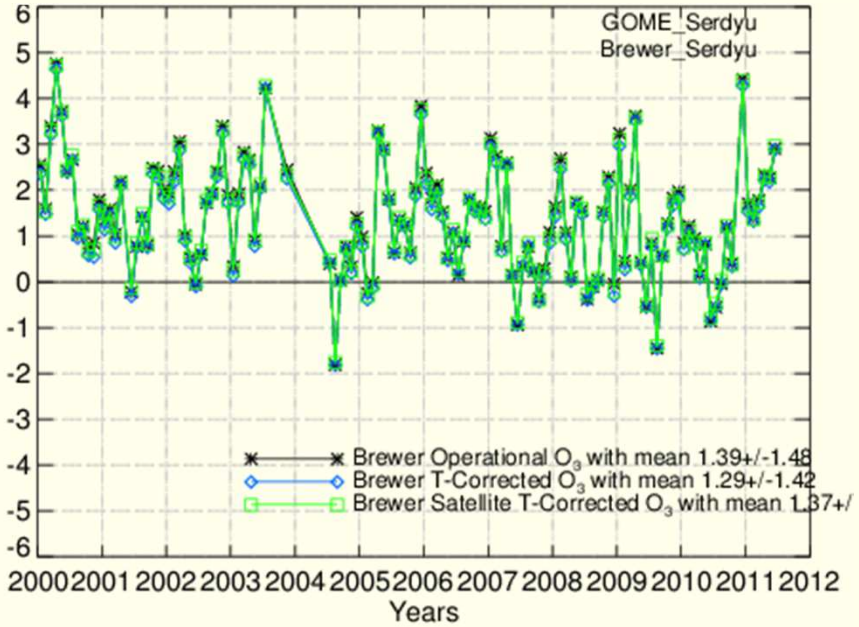


TOC differences (%) (GOME- Brewer)
SAME O_3 cross sections

BDM

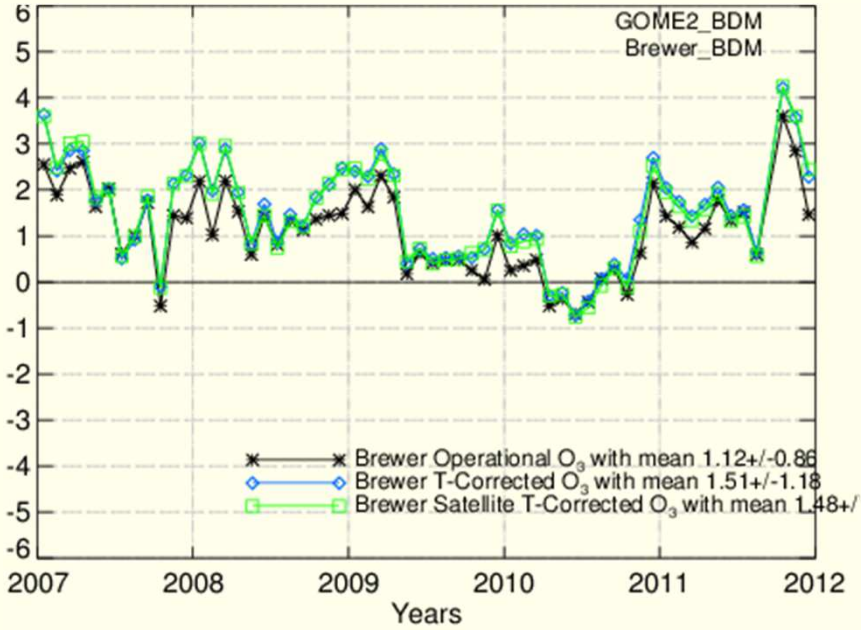


IUP-UB



TOC differences (%) (GOME2- Brewer)
SAME O_3 cross sections

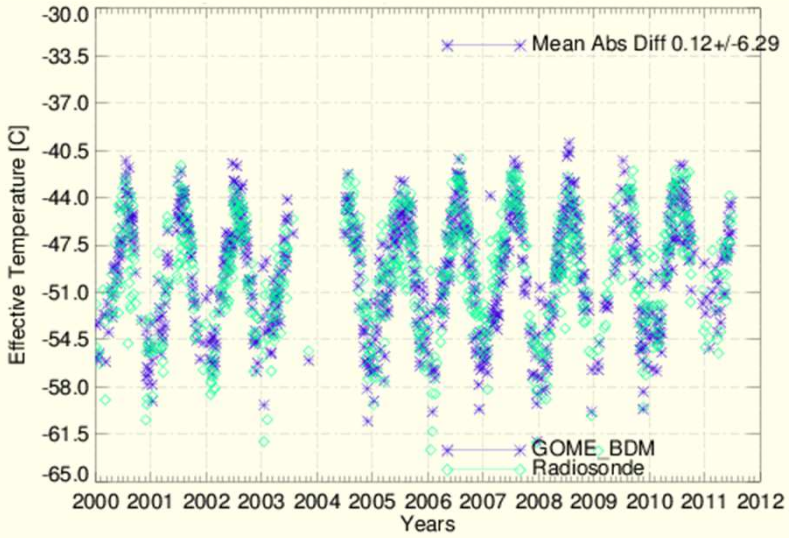
BDM

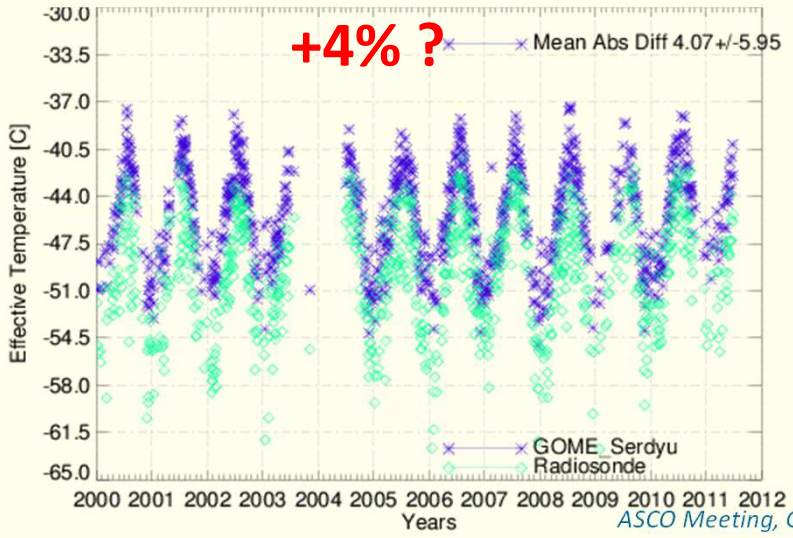


IUP-UB

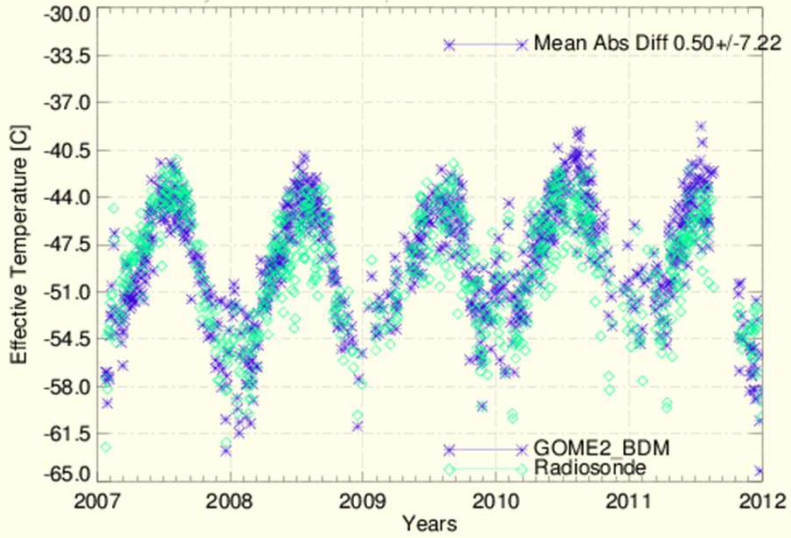
Effective temperature (Satellite vs Measured)

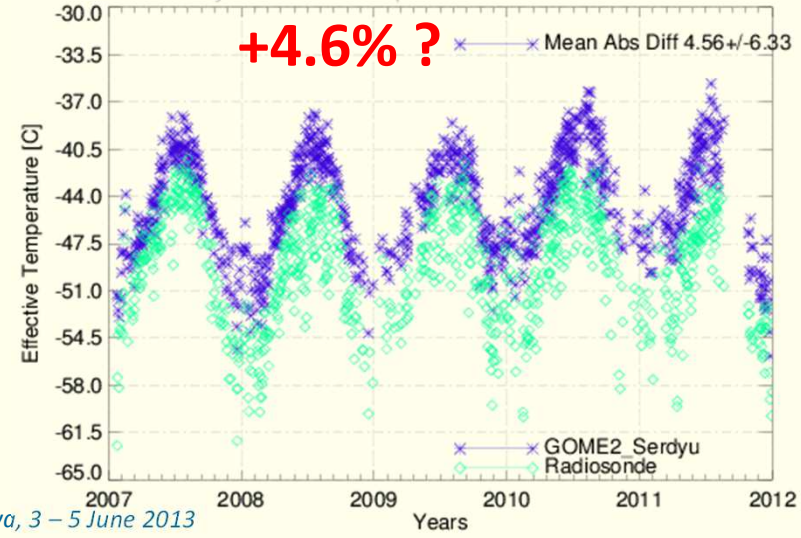
GOME





GOME-2

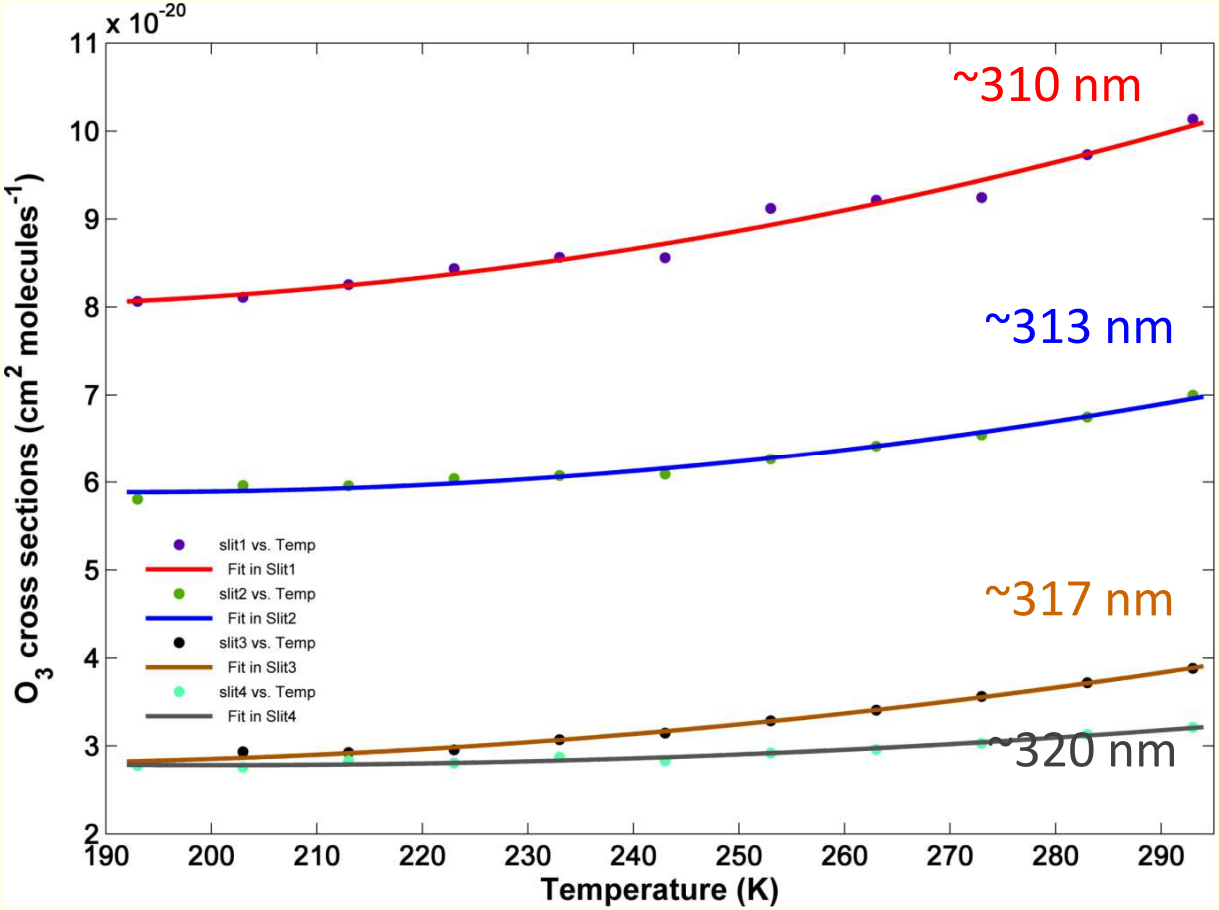




BDM

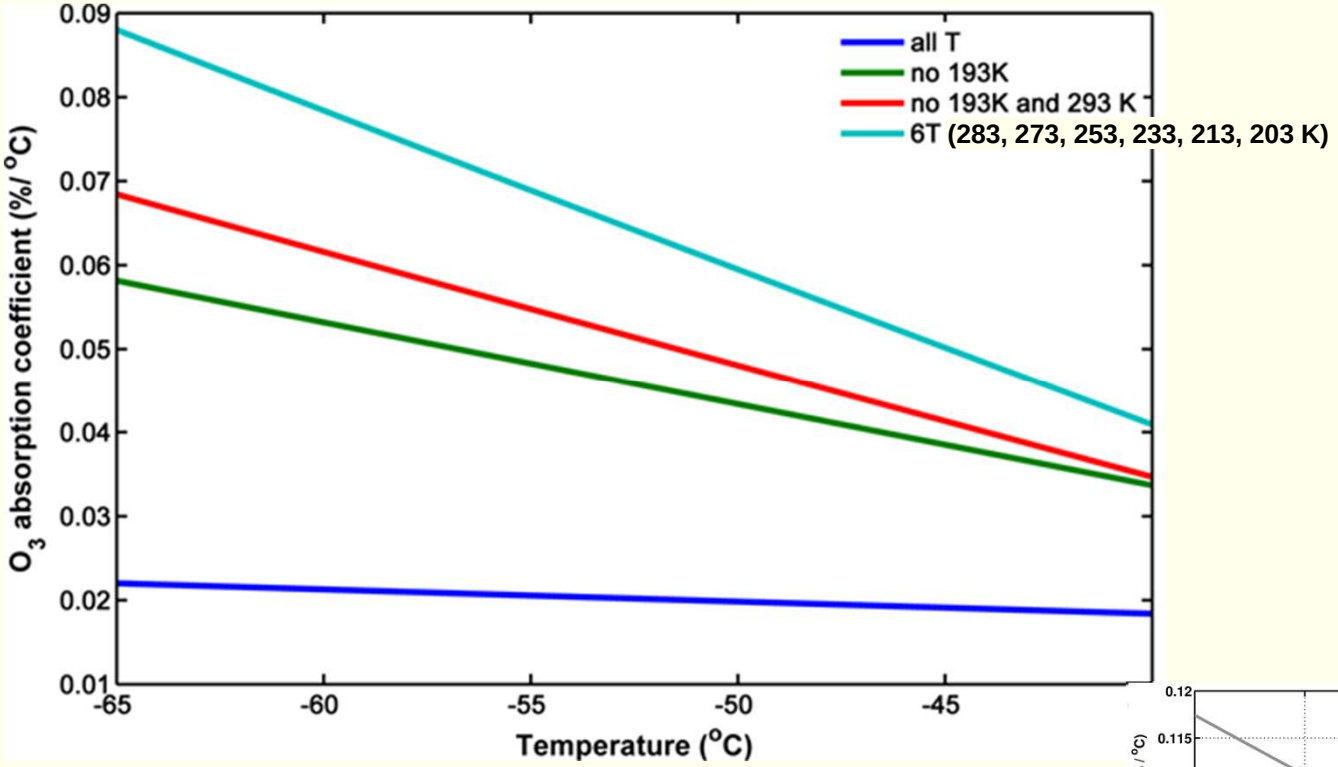
IUP-UB

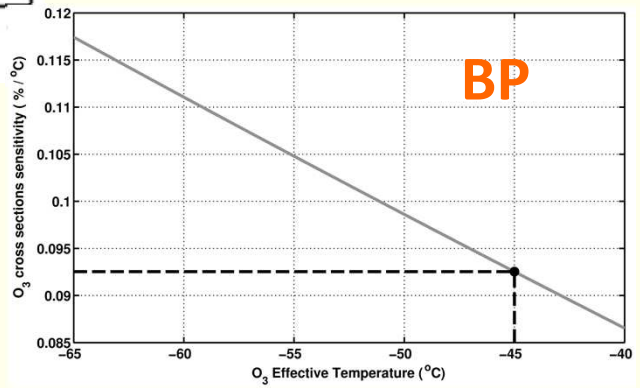
IUP-UB – Quadratic Temperature parameterization



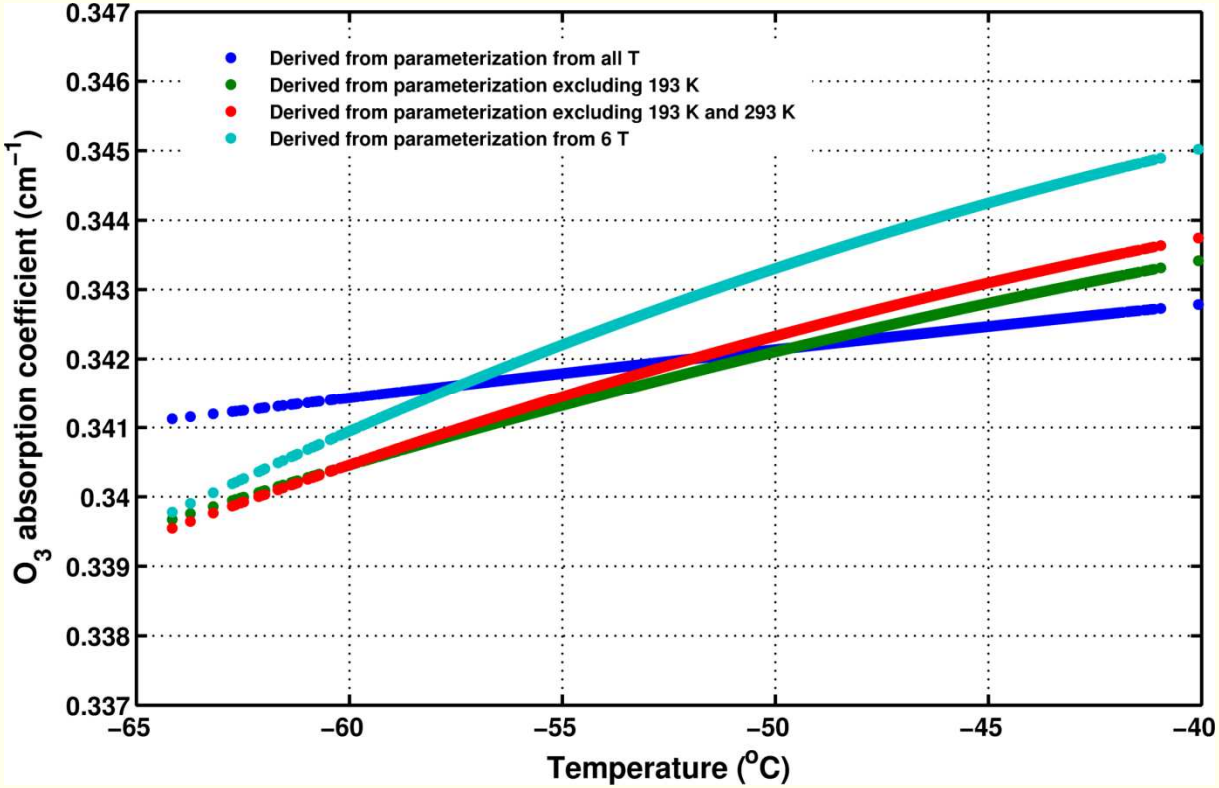
Are all temperatures needed for O_3 retrieval?

UIB – Temperature parameterizations

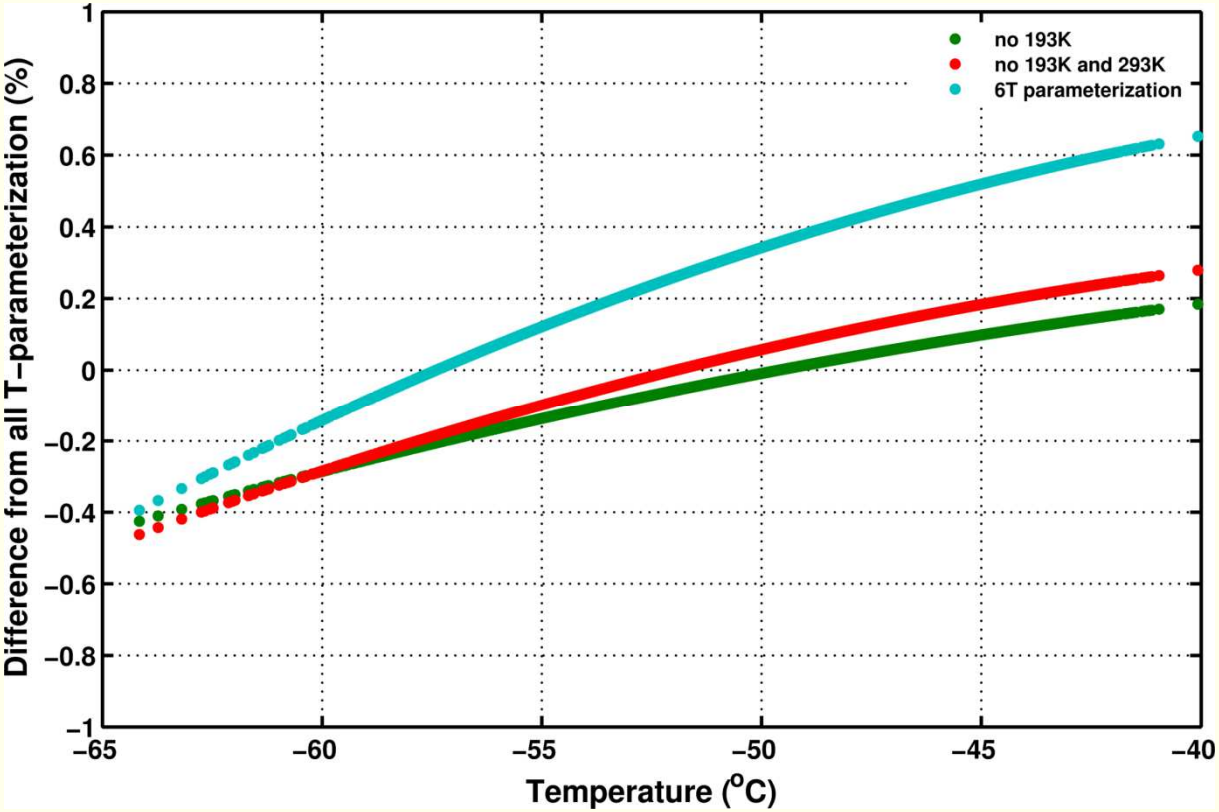




Effect of T-parameterizations on O_3 abs. coeff.



Deviations in the O_3 abs. coeff. derived from different parameterizations



Winter-summer differences of up to 1% in TOC depending on parameterization chosen

Summary

- Accounting for the effective temperature of the ozone absorption affects the annual cycle of TOC and its trend; the magnitude and sign depend on O_3 Xsections used
- Estimated effect on the TOC at Thessaloniki (2000-2011):

Cross sections	Offset Summer	Offset Winter	Change in trend (%/dec)
BP T-corrected	-0.3	+1.5	-0.3
BDM	-2.8	-4.2	+0.2
IUP-UB	-0.9	-0.5	+0.05

- IUP-UB Xsections improve the agreement between Brewer and satellite TOC (best results for GOME2)
  **the derived from satellite T_{eff} is larger by 4-5°C
- Need for reconsidering the temperature parameterizations of IUP-UB cross sections?

Thanks!