



Koninklijk Meteorologisch Instituut

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50 years of balloon-borne ozone profile measurements at Uccle, Belgium

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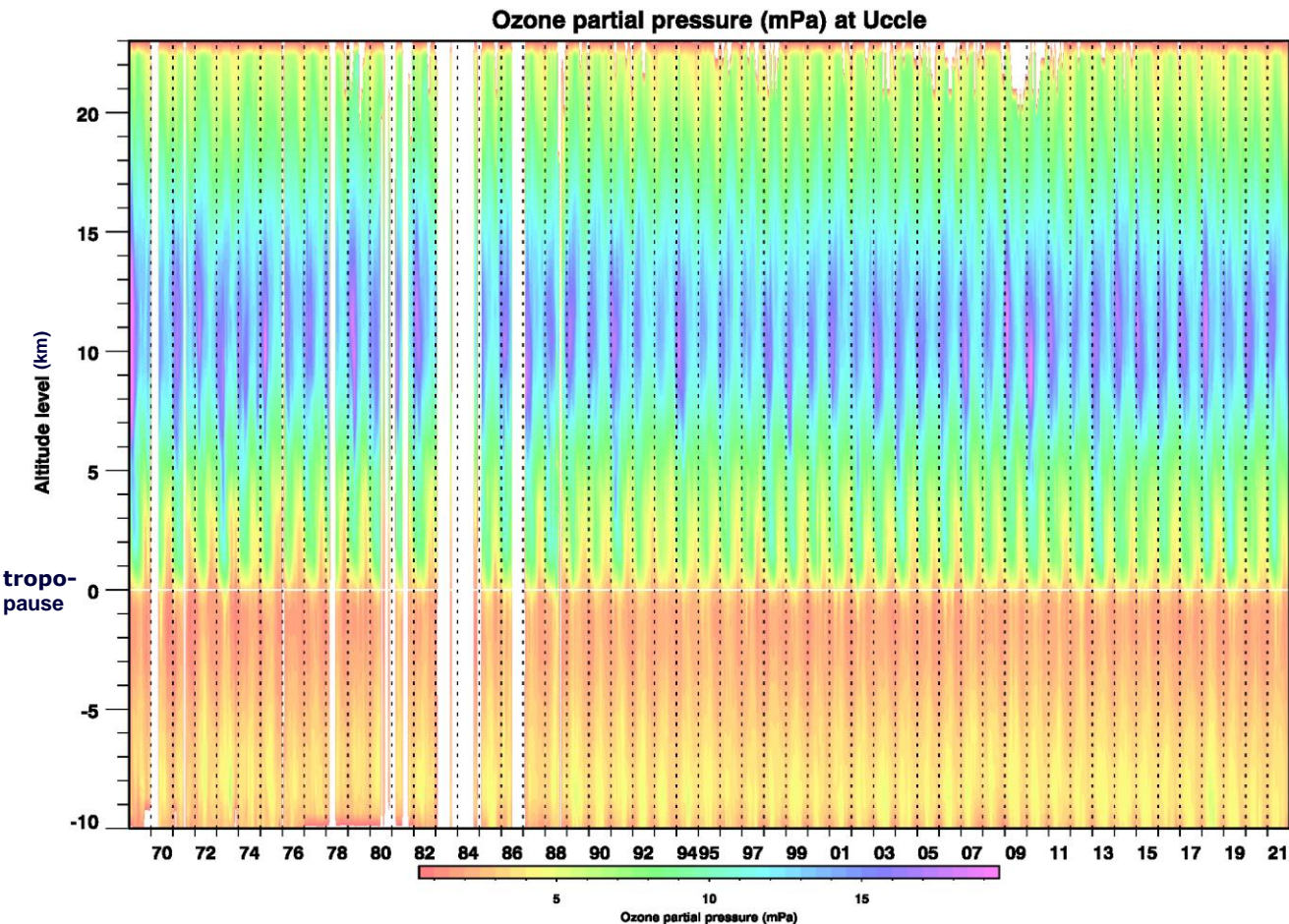
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- Uccle, a suburb south of Brussels, Belgium (50°48'N, 4°21'E; 100 m asl)
- environmental changes (SO₂) → corrected!

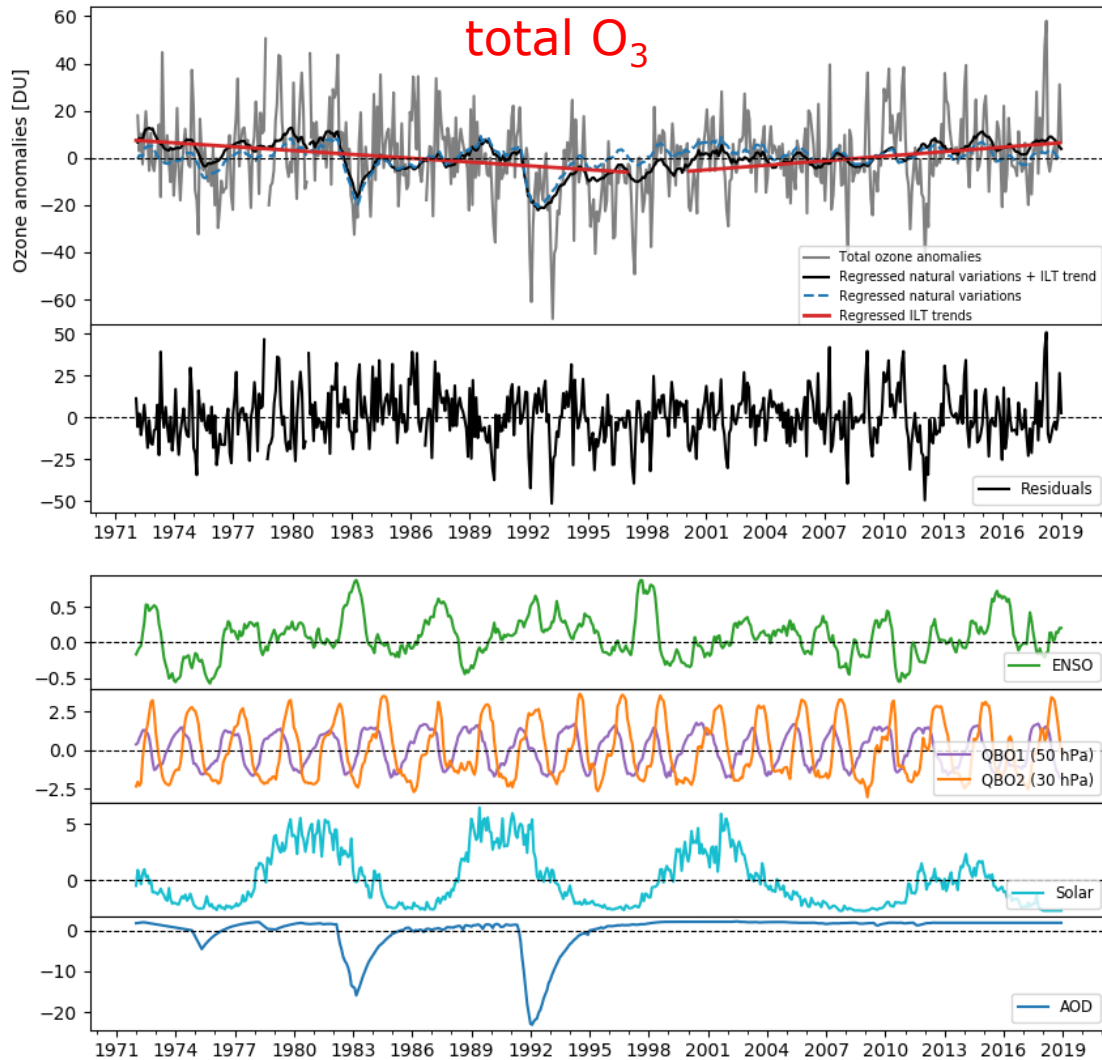


- launch frequency: 3 times a week
- started January 1969 with Brewer-Mast (B/M) sensors
- changed to Z-ECC sensors in 1997
- homogenized with **P**RESSure and **T**emperature dependent total **O**zone normalization method (**PRESTO**), based on dual soundings + pump efficiency measurements in pressure chamber

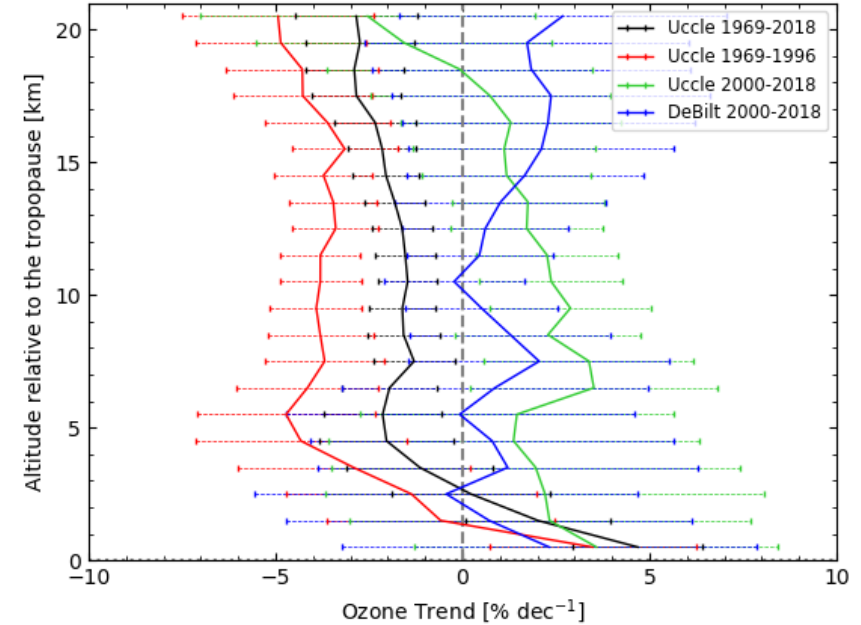


Trends: total ozone & stratosphere

LOTUS MLR trend model

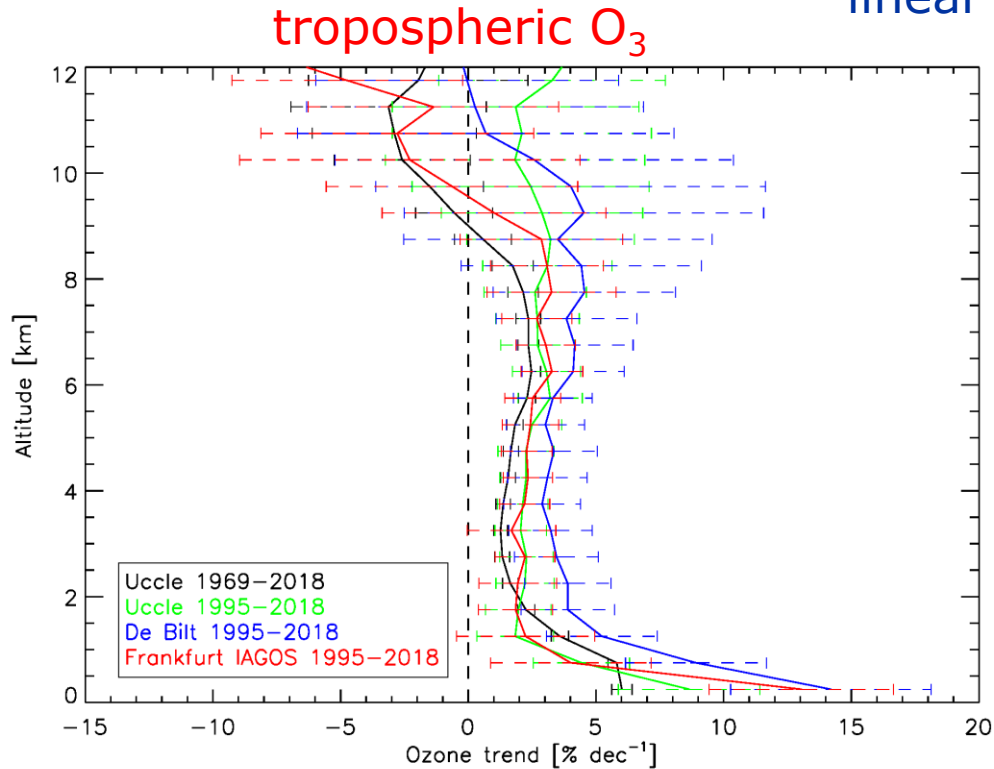


stratospheric O₃

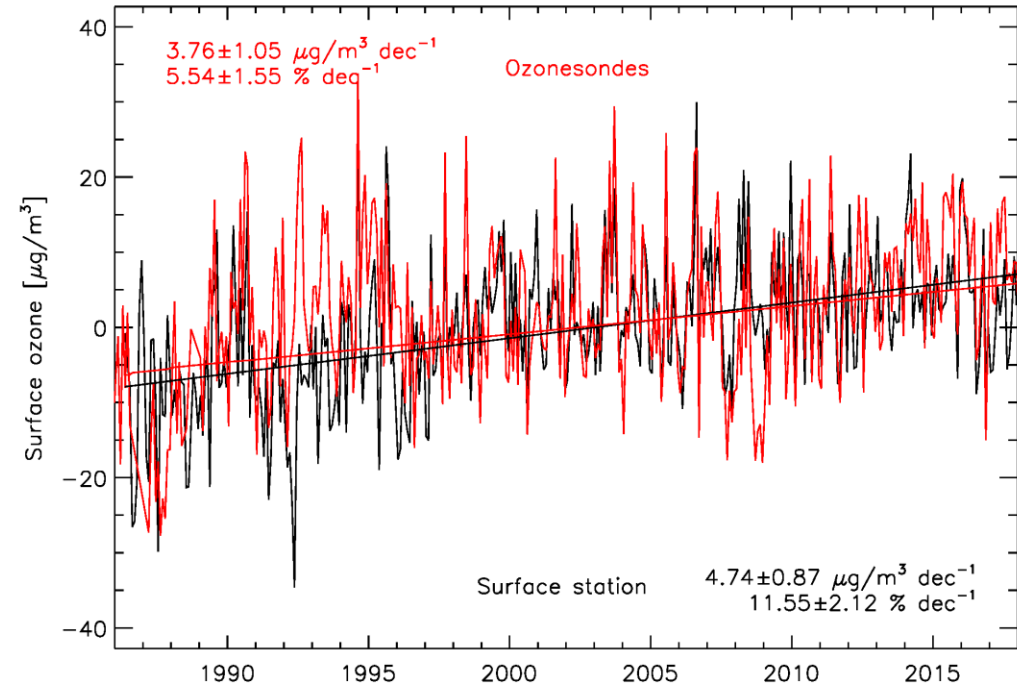


- **total O₃** from Dobson#40+Brewer#16+Brewer#178
pre-1997: -1.6%/dec , post-2000: +1.9%/dec
 - full recovery?!
- **stratospheric O₃**: pre-1997: -4%/dec , post-2000: +1 to +3%/dec
 - no full recovery
 - higher post-2000 recovery than nearby (175 km) De Bilt (The Netherlands), except at higher altitudes.

linear regression trend



surface O₃

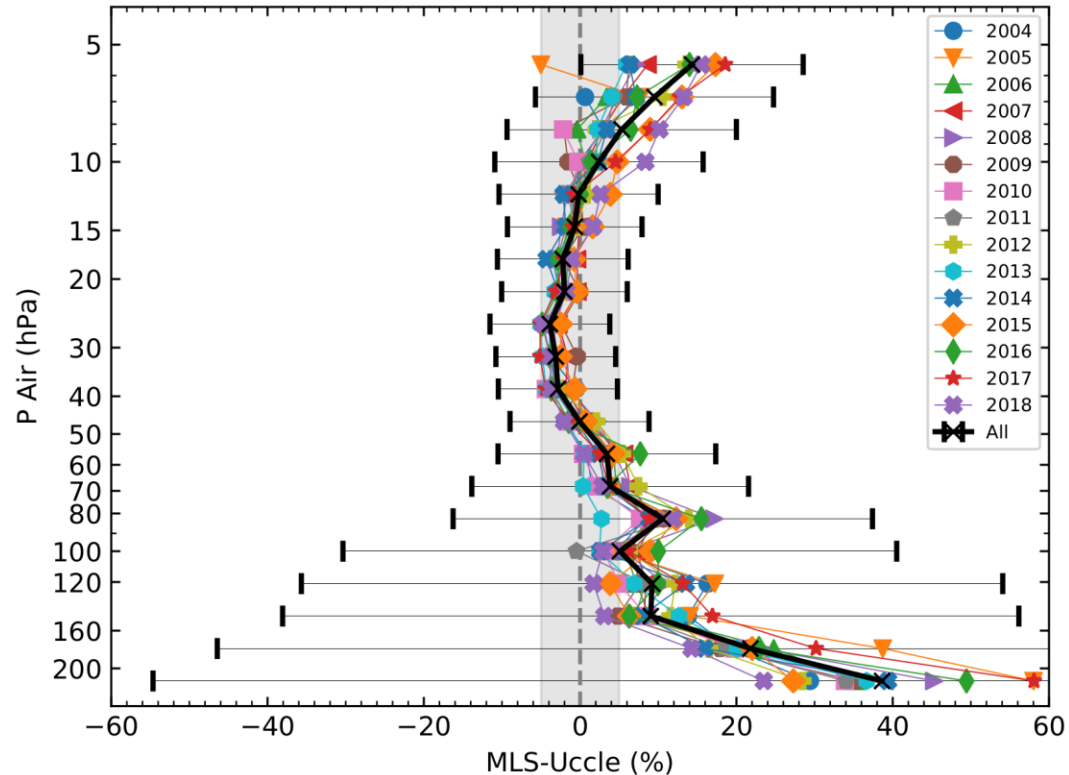


- **tropospheric O₃**: post-1995: +2.5%/dec (Uccle + IAGOS @ Frankfurt), +3.5%/dec for De Bilt
- very similar trends @ 3 locations!
- acceleration of Uccle trend? post-1969: +2%/dec

- **surface O₃**: higher trends at surface than in troposphere: post 1987: +5.5%/dec O3S, +11.5%/dec surface station
- mean surface ozone concentrations increase, but reduction in ozone peak concentrations!

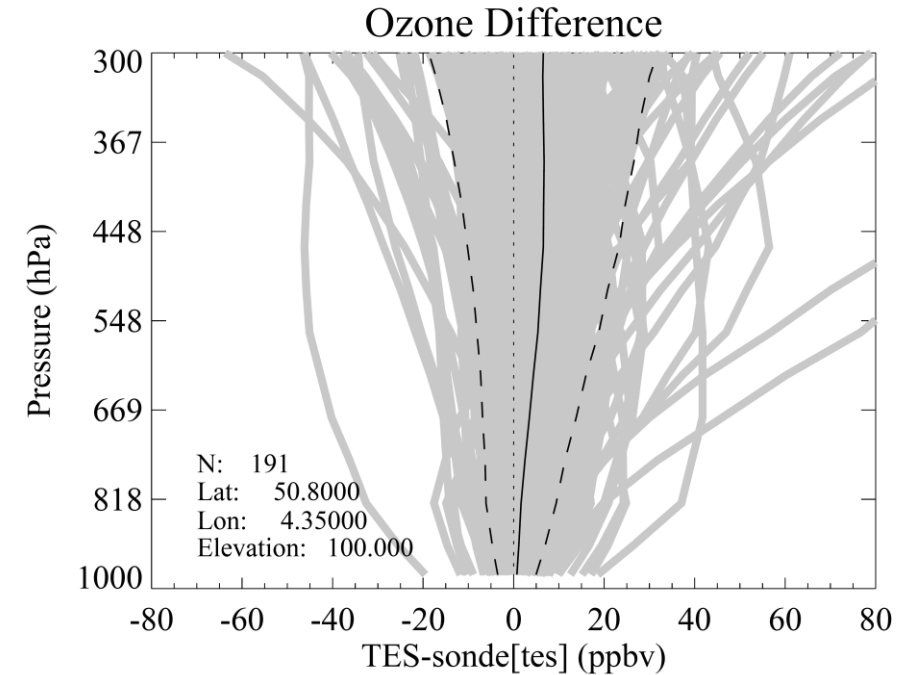
Validation of satellite retrievals

Stratosphere: Aura-MLS



- within $\pm 5\%$ between 10 and 70 hPa
- mean annual relative differences are very consistent over the different years \rightarrow no drift between MLS and Uccle O3S

Troposphere: Aura-TES



- positive bias of TES in troposphere ($>500\text{hPa}$: ~ 3 ppbv, $<500\text{hPa}$: ~ 8 ppbv)
- no temporal trend in the data pairs differences

After taking into account **instrumental artefacts** the long-term (since 1969), high-frequency data set of ozone profiles at Uccle is suitable for

- **trend analysis:** *since mid-1990s increase at all levels (surface, tropo, strato, overall)*
- **validation** of ozone profiles from satellites and aircraft: *very good quality of ozonesonde dataset!*
- studies of particular events (e.g. tropopause folds)

More examples are in an ACP publication →

The data are stored at WOUDC (Uccle is WMO station 53) and NDACC and are also available from the authors.

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Atmos. Chem. Phys., 21, 12385–12411, 2021
<https://doi.org/10.5194/acp-21-12385-2021>
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Fifty years of balloon-borne ozone profile measurements at Uccle, Belgium: a short history, the scientific relevance, and the achievements in understanding the vertical ozone distribution

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Received: 16 July 2020 – Discussion started: 2 December 2020

Revised: 31 May 2021 – Accepted: 2 June 2021 – Published: 18 August 2021

<https://doi.org/10.5194/acp-21-12385-2021>