Stability of ground based measurements of stratospheric ozone

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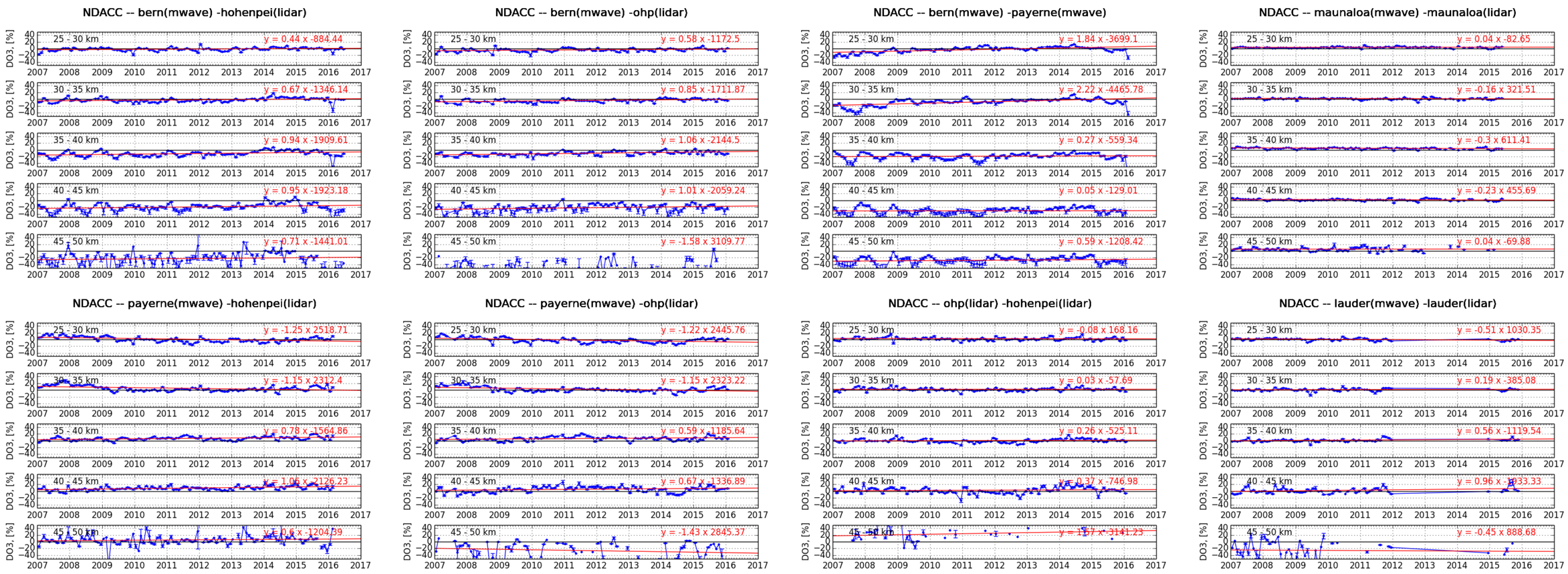
Introduction
Accurate determination of ozone trends demands long-term stability of the measurement systems. Here, the temporal stability of stratospheric ozone measurements from NDACC lidar and microwave instruments is investigated for a period of nearly 10 years. We consider differences between four closely spaced Central European stations, and differences between instruments at the same station (Hawaii, Lauder).

Summary
We find substantial time-varying differences between NDACC instruments. Sampling and geophysical variability play an important role, but instrumental changes cannot be ruled out. Generally, variability is higher in Europe, lower at Hawaii and Lauder. For good instruments, drifts and their uncertainty are determined to be less than ±5% per decade. For ozone trends at the ±1% per decade level, longer time periods are required to reduce drift uncertainties.

differences of monthly mean values



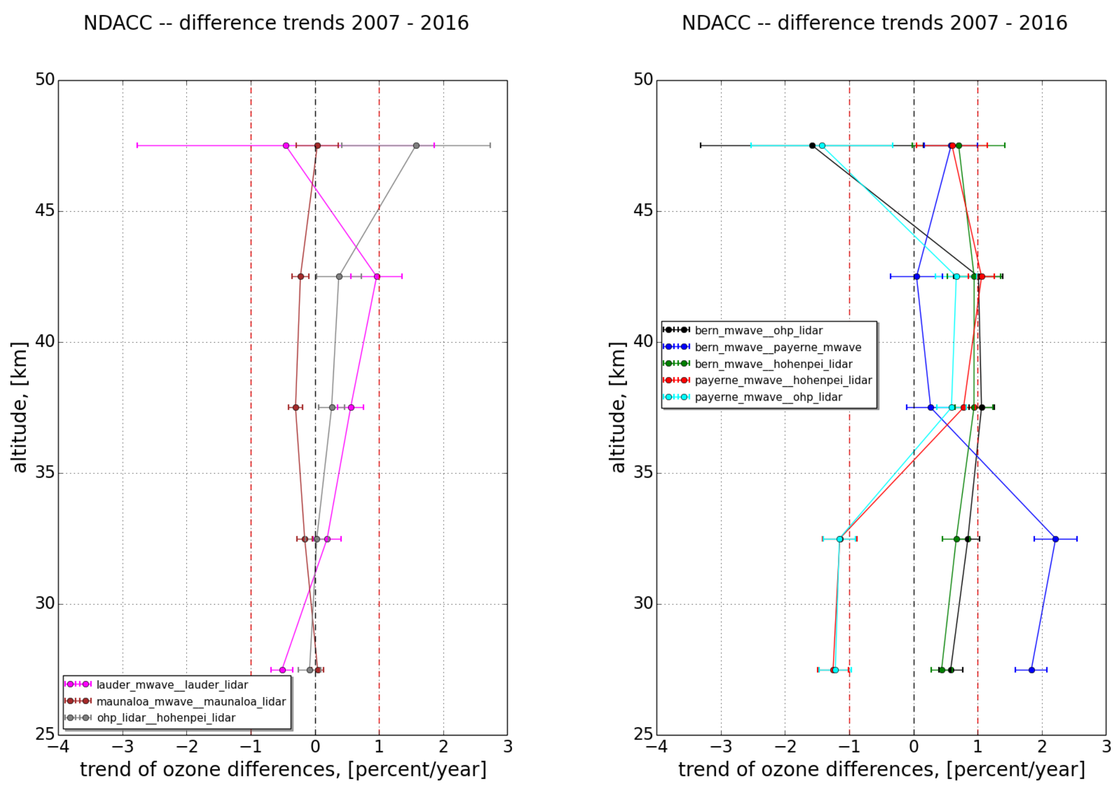
What is plotted?

- Differences between monthly mean data from two instruments/stations. Period is 2007 to 2016. Ozone number density averaged over 5 km layers.
- Red lines give fitted linear trends.
- Separate plots (below) give fit-results for *trend* (=slope) and *bias* (value of the line for June 2011).

What can we see?

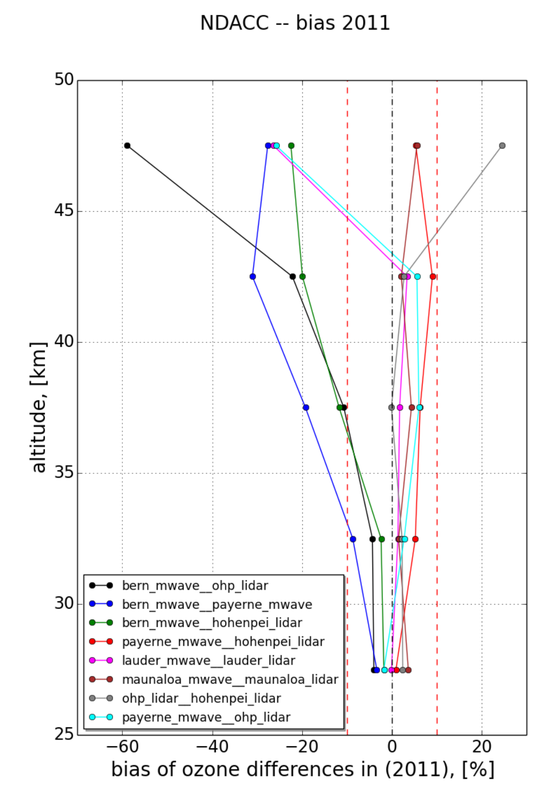
- Substantial and time-varying differences between microwaves at Bern and Payerne and lidars at Hohenpeissenberg and Haute Provence (left 4 to 6 panels).
- Slightly better agreement between the two lidars at Hohenpeissenberg and Haute Provence (3rd column, bottom).
- Smaller variability, better agreement at Hawaii and Lauder (rightmost column).

trends/drifts



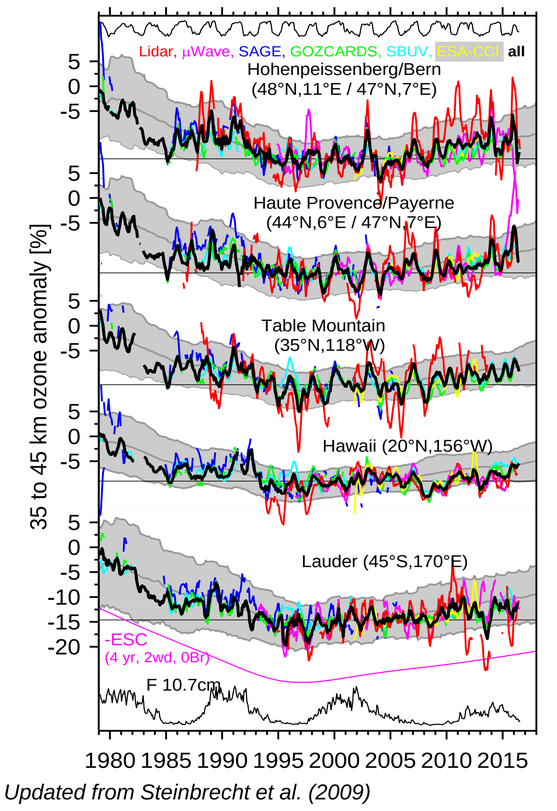
Left panel: The smallest drifts, less than 5% per decade are seen between the two lidars at Hohenpeissenberg and Haute Provence, and between lidar and microwave at Mauna Loa, Hawaii. Uncertainties in these drifts are less than 5% per decade (2σ), **Right panel:** The microwaves at Bern and Payerne show substantial drifts (>±5% per decade) against the two lidars at Haute Provence and Hohenpeissenberg. No significant drift between the two microwaves in the 35 to 50 km region.

bias in 2011



- No bias between the two European lidars.
- Payerne, Hawaii and Lauder microwaves 0 to 10% higher than lidars.
- Bern microwave 5 to 40% low.
- larger differences above 45 km.

anomaly time series at 40 km



Updated from Steinbrecht et al. (2009)

- Substantial variability, especially at Northern latitudes and for station data.
- Temporal bias for certain instruments.
- Overall agreement, quite good between satellite zonal means.
- Observations within model-corridor.

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