First steps of a new methodology for integrating ground-based ozone profile data

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Introduction

A new methodology is developed for integrating complementary ground-based data sources to provide consistent ozone vertical distribution time series as well as tropospheric and stratospheric ozone partial columns. Primary results are presented for the Alpine station of the Network for the Detection of Atmospheric Composition Changes (NDACC).

The first step of this study is to evaluate the validity domain of ozone profile data by using error assessment and vertical resolution. We started our work for the Alpine station with Lidar DIAL data at OHP (44°N, 6°E), Microwave data at Bern (47°N, 7°E) and FTIR data at the Jungfrauchjoch station (47°N, 8°E).

Data description

	LIDAR (1985-2012)	Microwave (94-2012)	FTIR (1989-2012)
Altitude	10-45 km	13-76 km	3.7 -93.4 km
Resolution	1 – 4.5 km	10 - 15 km	7 – 15 km
Precision	2 – 10 %	5%	4.2%

1. Methodology

Two case scenarios have been studied in order to estimate the bias between each profile at each altitude:

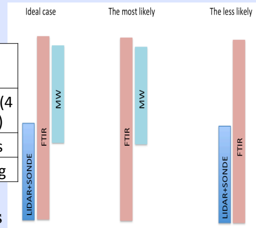
- Degradation of the LIDAR profile resolution: data smoothed by using the averaging kernel of the FTIR.
  $x_s = x_a + A(x_h - x_a)$
  O_3 sonde climatology profiles at OHP have been used to complete the lidar profile from the ground.
- Comparison without smoothing any data

Construction of the database:

Depending on the occurrence of the measurements

	Occurence	Temporal resolution
LIDAR	Clear sky	Every evening (4 hours (night))
Microwave	Every day	Every 2 hours
FTIR	1 -2 per day	Every morning

3 scenarios



2. Data base sampling: Year 2009

A primary work has been done on available data in 2009

Number of measurements

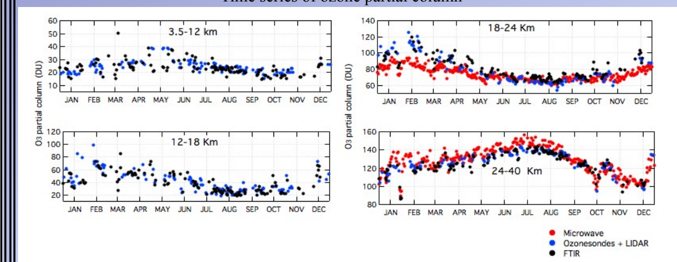
LIDAR	Microwave	FTIR
105	320	124

Number of coincident profiles

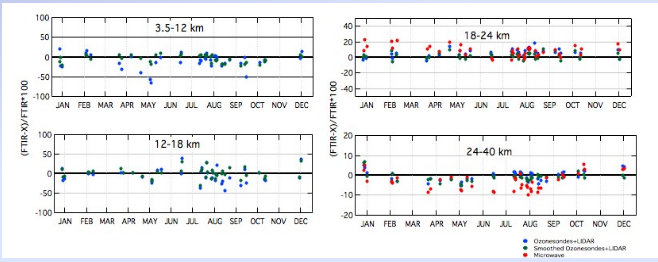
Ideal case	The most likely	The less likely
40	112	99

2.1. Partial column comparisons

Time series of ozone partial column



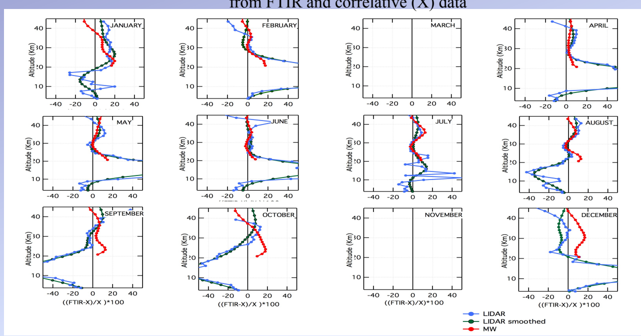
Relative discrepancies of ozone partial column coincident measurements between FTIR data and the other instruments for ideal case



- Peak to Peak amplitude of the ozone seasonal cycle well captured by all measurements.
- Largest discrepancy between the FTIR, the Microwave and the LIDAR during the winter period in each layer.
- Maximum bias below 21 km due to the lower resolution of the FTIR
- Similar bias ratio between FTIR_LIDAR and FTIR _Microwave above 18 km, smaller discrepancies observed (less than 20%)

2.2. Profiles comparisons

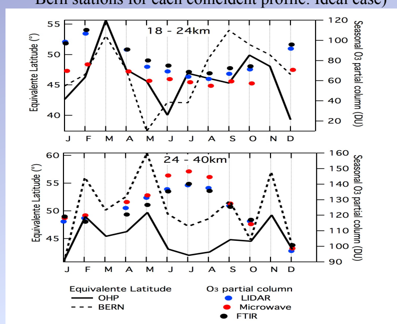
Monthly average relative difference between the O_3 vertical profiles from FTIR and correlative (X) data



- From April to May: Lidar and Microwave show similar bias with FTIR from 25 to 35 km with values less than 5%.
- Below 25 km, positive (from September to June) and negative (from (August to October) biases (more than 70 %) observed between LIDAR and FTIR profiles.

2.3. Air Mass criteria: Equivalent latitude

Seasonal variations of ozone partial columns and the Equivalent latitude (computed at OHP and Bern stations for each coincident profile: Ideal case)



- From 18 to 24 km: Microwave seasonal variation smaller than the others due to the lack of point below 20km (maximum biais in winter 10 DU) Similar variation of the Equivalente latitude at the two stations
- From 24 to 40 km: Equivalent latitude at Bern bigger than at OHP (>10 °) but with similar variations (max in Winter and min in Summer). Partial column seasonal variation similar an amplitude of 45 DU

3. Conclusions

- These primary comparisons make an idea of the extent of the possible bias between the different types of measures.
- Good agreement on O_3 Seasonal variation at the three stations.
- Further investigations are needed regarding other criteria to explain biases between O_3 profile at OHP and at Jungfrauchjoch.