

Overview of boundary layer soundings within project ROM during MAP IOPs

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Introduction

Within the activities of FORM, ZAMG conducted the Rhine valley ozone study ROM in the area south of Lake Constance. The vertical structure and the temporal evolution of the planetary boundary layer (PBL) and the ozone concentrations during Foehn episodes were observed by using a tethersonde system carrying up to three meteorological and up to two ozone sondes simultaneously (Piringer et al., this volume), a sonde mounted on the Pfaender cable car, a sodar as well as an ultrasonic anemometer (Baumann et al., this volume) and one conventional ground-based meteorological station. The objectives of ROM as well as the instruments used are described in detail by Piringer et al. (2000). This paper gives first a brief overview about the experimental set-up and then compares the boundary layer soundings conducted with the high-speed multi-sonde tethered balloon (TMT) system launched at Fussach and the sonde mounted on the Pfaender cable car at Bregenz.

Overview of experimental set-up

Measured parameters are summarised in Table 1, and the operating parameters of the different systems are given in Table 2. The tethersonde system and the cable car sonde were in operation on selected South Foehn days, whereas the other instruments recorded continuously throughout the SOP.

Table 1: Measured parameters (shaded): temperature T, relative humidity h, air pressure p, wind direction dd, wind speed ff, global radiation gl, ozone O₃.

Site	instrument	T	h	p	dd	ff	gl	O ₃	remarks
Fussach	Met. station								
	tethered balloon								pressure used for height calculation
Pfänder	cable car sonde								pressure used for height calculation
Lustenau	sodar								echo intensity, PBL parameters
	ultrasonic anemometer								sensible heat flux, velocity fluctuations, PBL parameters

Table 2: Selected operating parameters of the different systems

Parameter	TMT system	Cable car sonde	Sodar	USA
Frequency	403 MHz	-	2 kHz	
Average	-	-	30 min.	10 min.
Vertical range	500 m	550 m	~ 700 m	-
Range resolution	< 10 m	~ 10 m	50 m	-

Results

24 October 1999 was the last of a series of Foehn days within MAP IOPs 8 - 10 caused by a prevailing south-westerly airflow in 500 hPa over the Alps. The forecast surface pressure pattern over the Rhine valley promised strong Foehn in the course of the day for at least six hours and a possible breakthrough even in the area just south of Lake Constance. The tethersonde and cable car sonde measurements shown in Fig. 1 were taken shortly before this Foehn breakthrough to the ground.

The comparison between averaged tethersonde and cable car sonde vertical profiles gives information on spatial differences of the measured boundary layer parameters (Fig. 1). During the averaging interval (half hour for the tethersonde, one hour for the cable car sonde), the moist cool ground-based layer of a little more than 100 m thickness with relatively weak easterly winds was still present. Both systems show an increase in ozone and temperature and a decrease in relative humidity within this layer. In the Foehn layer above, there is a good co-incidence in ozone and temperature observations of the two systems, but the tethersonde humidity drops down to less than 20 %, whereas the cable car sonde measures 40 %, on average. This can be explained by the fact that the cable car along the Pfaender mountain slope is somewhat shielded from the strongest part of the Foehn flow, whereas the tethersonde is launched well within this flow.

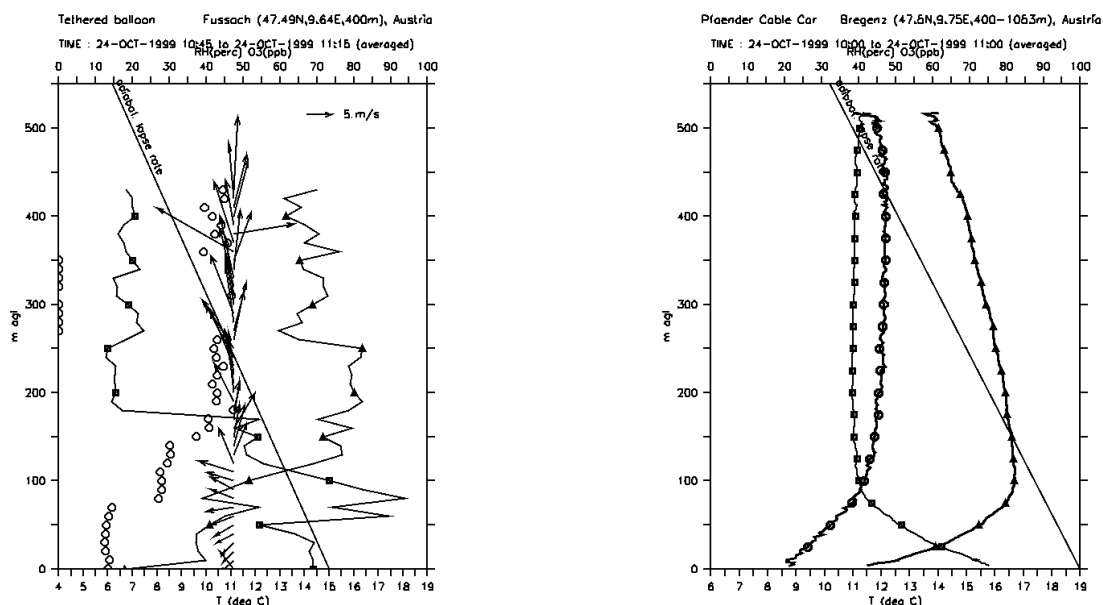


Figure 1: Temperature (triangles), humidity (squares), ozone (circles) and wind vectors left: tethersonde system at Fussach; right: Pfaender cable car sonde

References

- Baumann, K., M. Piringer, U. Pechinger, 2000: Continuous PBL measurements of the project ROM during the MAP SOP: sodar and ultrasonic data (this volume).
- Piringer, M., K. Baumann, U. Pechinger, S. Vogt, 2000: Objectives and first results of the Rhine valley ozone study within MAP. submitted to Meteorologische Zeitschrift.

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