

3 Weather evolution, aircraft missions and typical MAP weather phenomena

3.1 Weather evolution and aircraft missions

Number of Project Days during the SOP

IOP days		with aircraft operations							
		without aircraft operations							
	Project	P1	P2	P3	P4	P5	P6	P7	P8
	07. Sep								1
	08. Sep								1
	09. Sep								1
	10. Sep								
	11. Sep								
	12. Sep								
	13. Sep								
	14. Sep								
1	15. Sep	IOP-1	1						
1	16. Sep		1						
1	17. Sep	IOP-2a	1						
1	18. Sep		1						
1	19. Sep	IOP-2b	1			1	1		
1	20. Sep		1				1		
	21. Sep								1
	22. Sep								1
	23. Sep								
1	24. Sep	IOP-3	1						
1	25. Sep		1						
1	26. Sep		1						
	27. Sep								
	28. Sep								1
	29. Sep								1
1	30. Sep	IOP-4	1						
1	01. Okt							1	1
1	02. Okt		1			1	1		
1	03. Okt	IOP-5	1			1			
1	04. Okt		1			1			
1	05. Okt								
	06. Okt								
	07. Okt								
	08. Okt								
	09. Okt								
	10. Okt								
	11. Okt								
	12. Okt								
1	13. Okt	IOP-6	1						

	14. Okt									
	15. Okt									
	16. Okt									
1	17. Okt					1	1			
1	18. Okt	IOP-7	1			1	1			
	19. Okt									
1	20. Okt		1			1	1			
1	21. Okt	IOP-8	1			1	1	1		
1	22. Okt		1			1	1			
1	23. Okt	IOP-9	1				1			
1	24. Okt		1			1	1			
1	25. Okt	IOP-10				1		1		
	26. Okt									
1	27. Okt	IOP-11	1	1						
	28. Okt									
1	29. Okt						1			
1	30. Okt	IOP-12	1			1	1			
	31. Okt									
1	01. Nov					1	1			
1	02. Nov	IOP-13		1		1	1	1		
1	03. Nov		1							
1	04. Nov	IOP-14	1							
	05. Nov									
1	06. Nov		1			1		1	1	
1	07. Nov	IOP-15	1					1	1	
1	08. Nov							1	1	
1	09. Nov									
	10. Nov									
1	11. Nov		1							
1	12. Nov	IOP-16				1				
1	13. Nov									
	14. Nov									
1	15. Nov			1						
41	# project days		25	5	0	15	13	8	4	8
	%		61%	12%	0%	37%	32%	20%	10%	20%

Figure 3.1.1: Summary of project days and flight operations during MAP SOP. The projects were:

- P1: Orographic Precipitation Mechanisms
- P2: Incident Upper Tropospheric PV Anomalies
- P3: Hydrological Measurements for Flood Forecasting
- P4: Dynamics of Gap Flow
- P5: Unstationary Aspects of Foehn in a large Valley
- P6: Three Dimensional Gravity Wave Breaking
- P7: Potential Vorticity Banners
- P8: Structure of the Planetary Boundary Layer over steep Orography

3.2 Typical MAP weather phenomena

3.2.1 P1: Orographic Precipitation Mechanisms

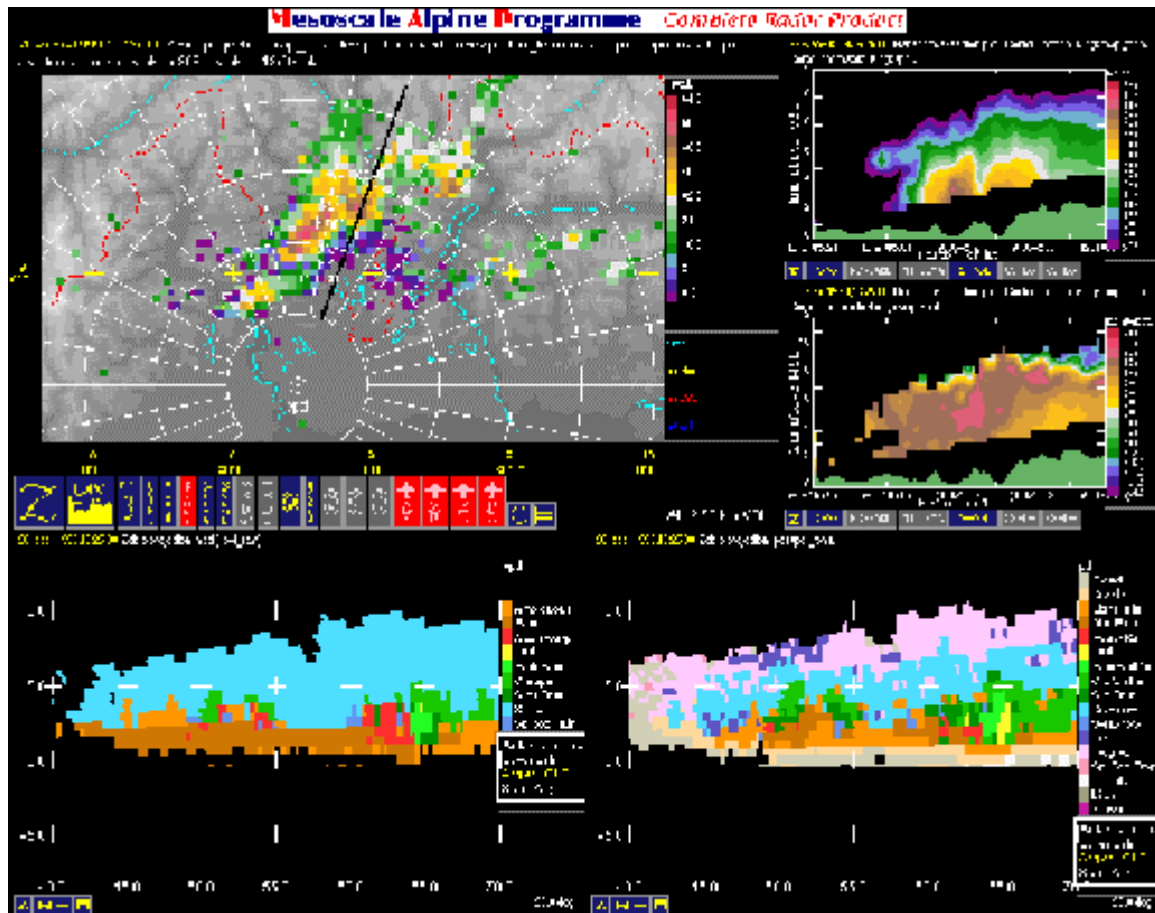


Figure 3.2.1: Reflectivity Image and microphysics of the Experimental Radar sites in the Lago Maggiore target area (26.9.1999, 16:25 LT, IOP-3).

3.2.2 P2: Incident Upper-Tropospheric PV Anomalies

300 hPa: Horizontal Wind + Absolute Vorticity [$10^{(-5)} \text{ s}^{(-1)}$]

Sun 12

Based on: 1999 November 05 12 UTC +48 h

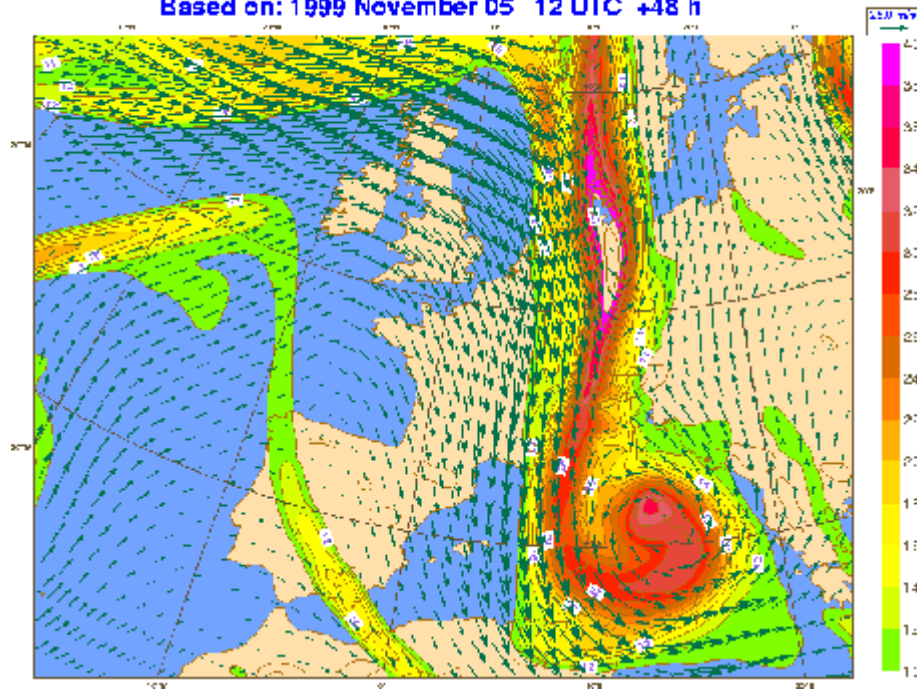


Figure 3.2.2: ECMWF forecast of absolute vorticity (colored patches) and horizontal wind (vectors) in 300 hPa for 7.11.1999, 12 UTC (IOP-15). The elongated band of absolute vorticity indicates clearly the strong PV anomaly. It was investigated with the German DLR Falcon aircraft.

3.2.3 P3: Hydrological Measurements for Flood Forecasting



Figure 3.2.3: 26.9.1999 (IOP-3), Lodrino waterfall (Ticino). Hydrological response to accumulated rain. The mountain sides have very little soil covering the rocky substrate, and the water cascades down the mountainsides in huge waterfalls into the Ticino River. Maximum daily precipitation sums during MAP-SOP reached 400 mm locally. (Courtesy Scott Richardson, Univ. of Oklahoma)

3.2.4 P4: Dynamics of Gap Flow

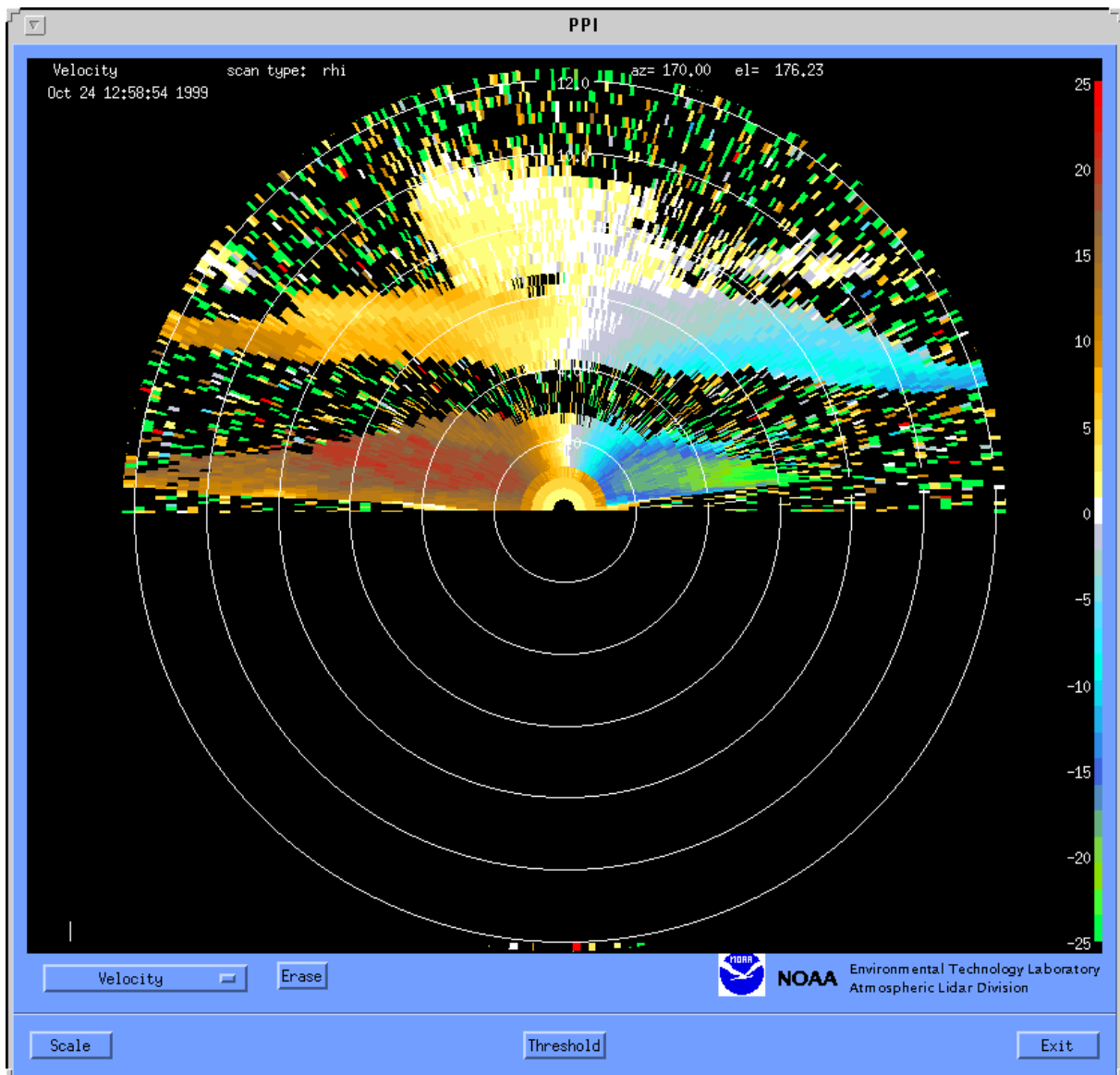


Figure 3.2.4: Vertical Cross-section through the Wipptal: RHI Image of 24.10.1999, 12:59 LT (IOP 10) of the NOAA LIDAR located at Gedeir (Wipptal). Green colors indicate radial particle velocities towards the LIDAR, red colors indicate velocities away from the LIDAR. One can see the significant Foehn flow from right (S) to left (N) along the Wipptal up to 4 km. The signal in upper levels derives from cirrus clouds. (Courtesy Robert Banta and Lisa Darby)

3.2.5 P5: Unstationary Aspects of Föhn in a Large Valley

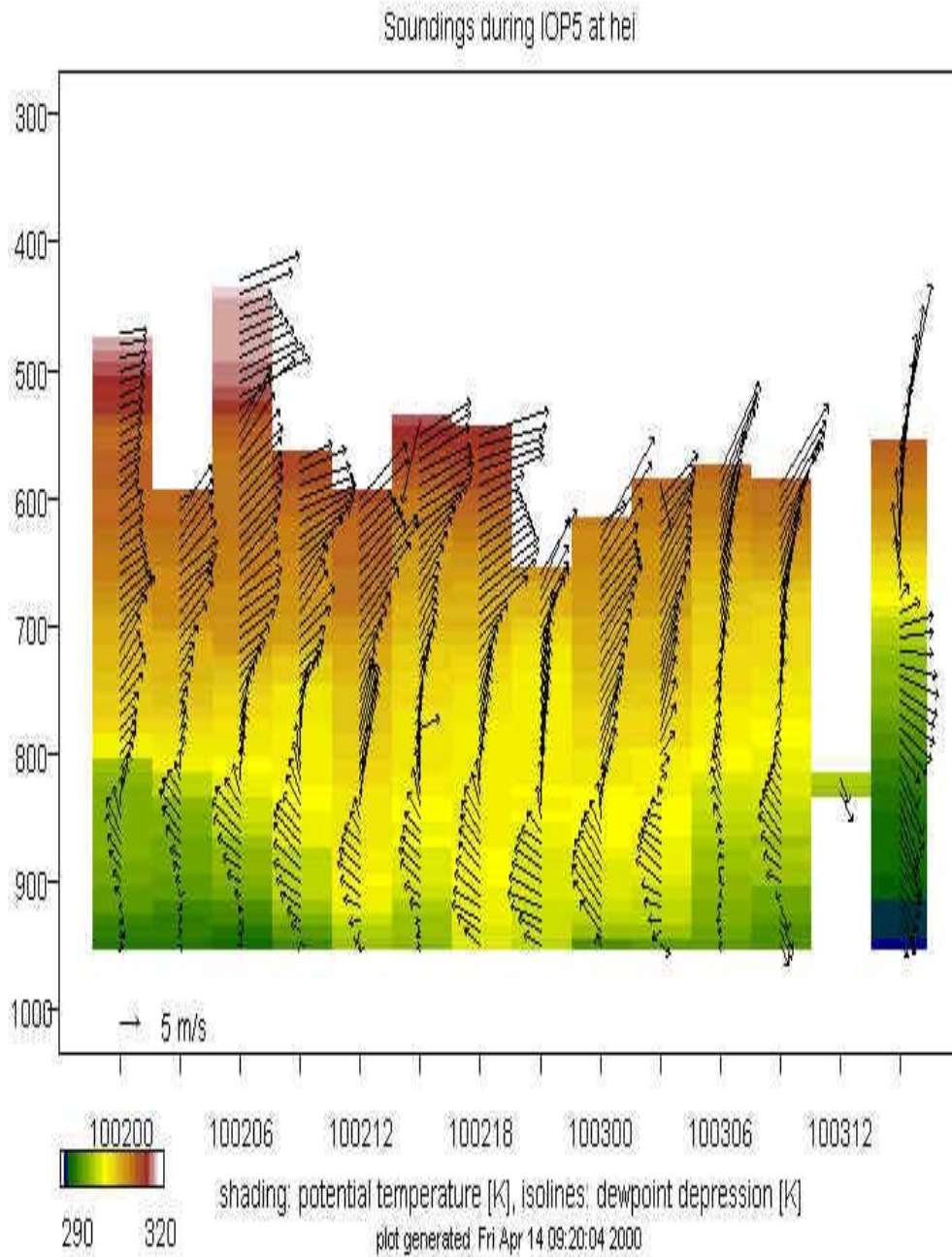


Figure 3.2.5 Time height cross section based on three-hourly soundings at Heiligkreuz in the Rhine valley. It is clearly evident how the Southeasterly foehn flow within the valley is channelled and nearly perpendicular to the upper level Southwesterly flow. The foehn air touches the ground only during a short interval around Oct. 2, 1800 UTC. (Courtesy Christian Haerberli)

3.2.6 P6: Three-Dimensional Gravity Wave Breaking

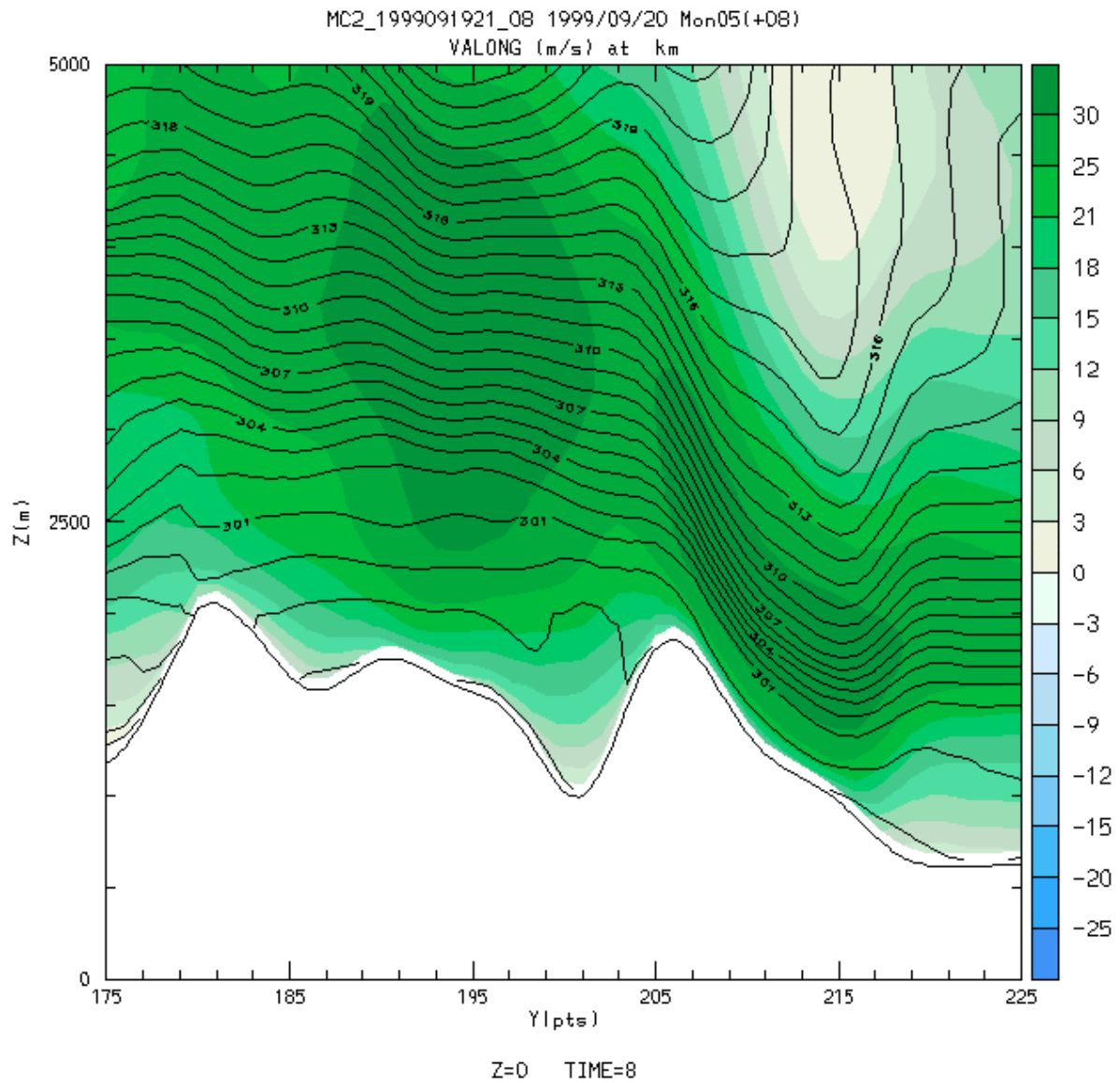


Figure 3.2.6: MC2 Cross-section of potential temperature (solid lines) and along-wind component along the Wipptal for 20.9.1999, 05 UTC (IOP-2). Breaking gravity waves can be seen in the upper right corner. This P6 case was investigated by the NCAR Electra aircraft.

3.2.7 P7: Potential Vorticity Banners

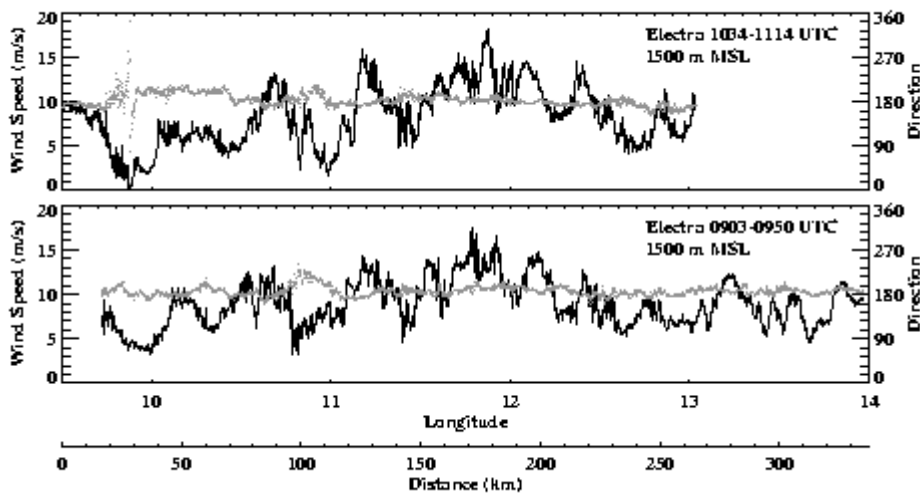


Figure 3.2.7: Horizontal Wind profiles measured by the Electra flying crossflow at 1500m MSL over the Po valley during northerly winds. The two legs show a considerable coherence which indicates the existence of rather steady shear zones with corresponding high vorticity values. (Courtesy Luisa Bogar Nance, NOAA)

3.2.8 P8: Structure of the Planetary Boundary Layer over Steep Orography

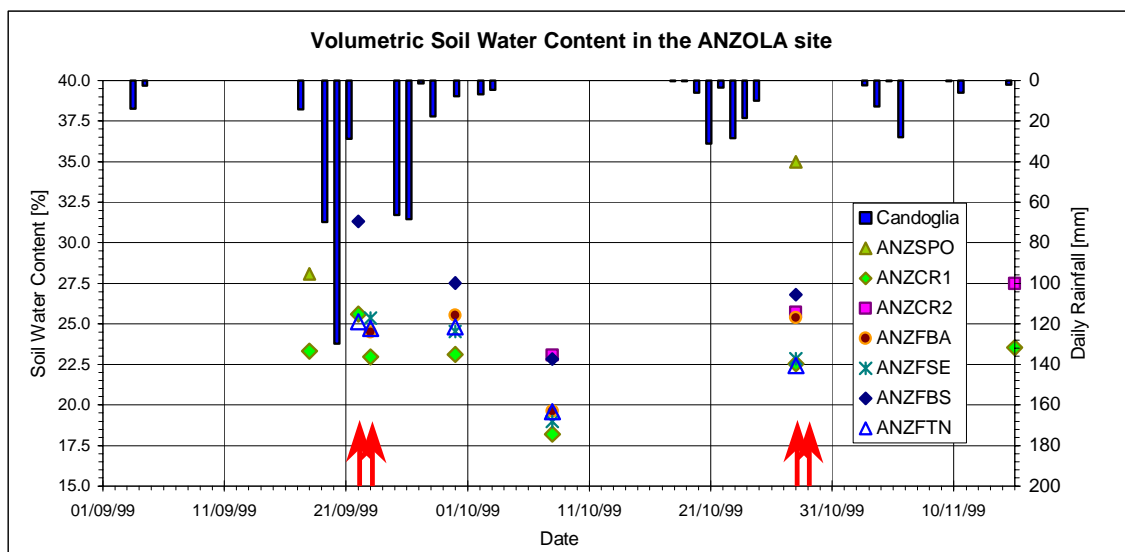


Figure 3.2.8- TDR soil moisture measurements at Anzola. Arrows indicate the dates of the four CNR-IROE helicopter flights. (Courtesy Roberto Ranzi, University of Brescia)