

## 7 Summary

The Map SOP was felt univocally as a successful enterprise. This was due to the fact that the weather during the ten weeks period showed all phenomena the scientific community wanted to study in an optimal sequence and more often than climatologically expected. This may be documented by a calendar of weather events compiled by Reinhold Steinacker:

List of MAP-relevant weather phenomena during SOP  
following the rules of evaluation for the  
„STRAW MAN SCENARIO“ (MAP Implementation Plan, p 1-9 ff.)

The following evaluation of MAP-relevant weather events has been carried out in the same manner as for the creation of the straw man scenario. It is strictly based on the information contained in the daily Berliner Wetterkarte. This has been done to provide a comparable, unbiased (as far as a subjective method allows for that) evaluation with respect to the 10 years period for the straw man. The time increments for the evaluation are 12 hours.

Table. 6.6.1: Following phenomena have been counted:

**ULF**...Upper level feature event. This has been derived from the 500 hPa analysis. Basically, the existence of a PV-streamer is being estimated if a sharpening through approaches from the West or Northwest towards France and the Western Mediterranean, eventually leading to a precursor of heavy precipitation on the Southern side of the Alps.

**FOR**...Foehn event in the Rhine valley. This has been derived from the isobaric field over the Alps. The Berliner Wetterkarte contains a high resolution analysis with a 1 hPa contour spacing. If a gradient across the Alps of a few hPa at least (lower pressure in the area of the Rhine valley) is analysed, the existence of a foehn flow is supposed.

**GAP**...Gap flow event in the Wipptal-Brenner-gap. This has been derived in a similar fashion as with the Rhine valley foehn, however looking for the pressure gradient across the Alps in the Brenner area.

**ORP**...Orographic precipitation event. For that purpose the 12 hourly precipitation amount of stations in the Lago Maggiore area and/ or the Friuli—Slovenian Alps are considered, which are listed in the Berliner Wetterkarte. The precipitation amount has to exceed 30 mm in 12 hours. If such an event is reported from the Lago Maggiore area it is indicated by an „X“ in tab. 1, irrespective of a simultaneous event in the Friuli-Slovenian area. If it only affects the latter area, it is indicated by an „E“. Note that an indication of „X“ or „E“ for the first half of the day means a heavy precipitation report at 0600 UTC, for the second half of the day at 1800 UTC.

**GWB**...Gravity wave breaking event. This is certainly the most tricky phenomenon to be derived from synoptic information solely. For that purpose a situation is being counted, where at least over part of the Alps the cross barrier wind component at crest height reaches or exceeds 30 knots, without considering the wind or temperature profile. Hence it should be seen as a very rough estimate for the existence of gravity waves and eventually wave breaking. A southerly flow leading likely to waves North of the Alps is indicated by „N“, a northerly flow, generating waves to the South of the Alps by „S“ in tab. 6.6.1.

**PVB**...Potential vorticity banner event. The evaluation has been done very similarly to the (possible) GWB events. In addition to the flow at crest height also the flow around the western edge of the Alps has been considered (Mistral).

**N**...Number of periods (continuous series of half days) with a specific MAP relevant weather event during SOP.

**NN**...Number of half days with a specific MAP relevant weather event during SOP. Note that this number divided by two is not necessarily equal to the number of calendar days on which this specific event occurred.

The statistical evaluation (tab. 6.6.2) shows that the SOP 1999 was a very good season what concerns the frequency and distribution of MAP relevant weather events. All phenomena occurred more often than on the average of the last ten years. Whereas Foehn in the Rhine valley and gap flow events which are climatologically more frequent than other MAP relevant phenomena, were 40 and 15 % respectively more frequent as could have been expected, PV-streamers, gravity waves and PV-banners occurred more than twice often during SOP as compared to the average. The high number of events with PV-banners might be in conflict with the opinion of

some participants in the field experiment. It should be noted, however, that most of the cases were accompanied by southerly flows, whereas PV banner situations with a northerly flow actually occurred slightly less frequent than on average.

The number of IOPs during the SOP 1999 was 17. This corresponds to exactly the maximum number which would have been possible during the previous ten MAP seasons. The last equally “good” MAP year is dating back as far as 1993. Hence we can state that the 1999 SOP season offered us an outstanding good year which happens only about every fifth year. This is also confirmed by the fact that we were able to use nearly all of our generous resources, e. g. flight hours or radiosondes, basically for the research we anticipated. Instead of a mean number of 40 days without any of MAP relevant events, this year we had only 36 “quiet” days in the total of 70 which means that 34 days were “event” days. The quiet days were concentrated around the mid term of SOP with a continuous period of 13 such days, good for some early scientific evaluations, excursions or simply recovering. Fortunately the two mayor “blocks” of events during end of September/ early October and end of October/ beginning of November were divided by this calm period, otherwise the SOP would have been quite exhausting. Such Indian summer periods are very typical during the MAP season.

10 days<sup>1</sup> with only one of MAP relevant weather events, 13 with two and 1 with three phenomena at the same time occurred. Particularly the 10 days with four or even more events synchronously – three times more often as on the average - show that the competition between the scientific teams with different interests was quite hard. Finally it is interesting to state that the decision to shift the MAP field phase from 1998 – as it was planned initially - to 1999 was a lucky one. One year earlier we would have had only the chance of collecting data for little more than half of the events as compared to 1999.

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<sup>1</sup> Note that the number of „days“ actually means number of half day periods divided by two and is not necessarily equal to the number of calendar days.

	S E P T E M B E R																															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
ULF																			X X			X X									X	
1 FOR														X X		X	X X X	X				X X	X					X		X X		
9 GAP														X X					X X	X X		X X X								X X		
9 ORF																X			X X	X						X X		X				
9 GWB																			N N N N											N N		
PVB																			N N N N											N N		
IOP														X X X		X X X	X X	X X						X X	X X	X X				X X		
	O C T O B E R																															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
ULF			X X																		X X				X X							
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9 GAP		X	X X																X	X X	X X	X X	X X	X X	X				X X X			
9 ORF			X X	X E	X															X			X	X X	X X	E						
9 GWB			N N N		S														N N N	N N N	N N N	N N N										
PVB			N N N		S														N N N	N N N	N N N	N N N										
IOP	X	X X	X X	X X	X									X X			X X X				X X	X X	X	X X	X X	X	X X	X	X X	X X		
	N O V E M B E R																															
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ULF			X X			X X																								8	15	
1 FOR	X X	X X		X X	X X						X X	X X																		13	45	
9 GAP	X X	X X		X X	X X	X						X X	X X																	10	40	
9 ORF			X X		X E																									9	23	
9 GWB					N	S S	S S																							8	25	
PVB					N	S S	S S																							8	25	
IOP	X	X X		X X	X X	X X	X X	X X	X X			X	X X	X		X X														17	69	

Table 6.6.1: Calendar of MAP-relevant weather phenomena during SOP 1999

DAYS WITH	10-YR-MEAN (1989-1998)	MINIMUM (1989-1998)	MAXIMUM (1989-1998)	SOP-1999	% OF 10-YR-MEAN
PV-streamers	3.3	1.0	9.0	7.5	227
Foehn in Rhine Valley	16.4	9.5	28.0	23.0	140
Gap flow in Wipp Valley	17.4	8.0	28.5	20.0	115
Heavy precipitation S-Alps 7.2	2.0	20.5	11.5	160	
Gravity Waves	5.6	1.0	10.5	12.5	223
PV-banners	5.4	1.0	10.5	12.5	223
PV-banners South of Alps	2.6	0.0	6.5	2.5	96

Possible IOPs (Periods)	10.9	7	17	17	156
without MAP-event	40.1	25	52	36	90
max. period without event	14.1	6	24	13	92
with 1 or more events	29.9	18	45	34	114
with 2 or more events	19.0	8	30	24	126
with 3 or more events	5.9	2	13	11	186
with 4 or more events	3.5	1	9	10	294

Table 6.6.2: Statistics on MAP related weather events

Finally a statement of Dr. James D. McFadden, the NOAA Facilities Manager for Map shall be quoted out of a letter to the Director of the Zentralanstalt für Meteorologie und Geodynamik. He writes:

“...I can attest to the fact that MAP was the most well organized and superbly executed field programme in which I have participated...”