THE MESOSCALE ALPINE PROGRAMME (MAP): A MULTI-FACETTED SUCCESS STORY

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Abstract: During the decade 1995-2005 the MAP initiative provided an important motor for mountain meteorology and weather research. Four years of detailed planning (phase A) led to a broad field campaign over the European Alps during autumn 1999, the MAP special observing period (SOP or phase B). During the following years a large variety of studies synthesized the data collected during the SOP and used their findings for further research (phase C). While a number of solicited presentations at the ICAM-MAP conference highlight the scientific achievements made during the conduct of MAP, it is outlined here to how the overall success of MAP may be measured and which facets were conducive to it. It is assumed that some generalities can be distilled which may provide useful guidelines for future enterprises of a similar scope.

***Keywords** - ICAM, MAP, Measures for success*

1. INTRODUCTION

Subjectively, and not fully unbiased, most people involved in MAP consider the enterprise a success. The large number of participants at ICAM-MAP-2005 and many presentations in this volume give further convincing evidence. But what really is the success of a research programme and how can it be measured? Generally, *success* is defined as *the achievement of something desired, planned, or attempted* (on-line dictionary at http://dictionary. reference.com/search?q=success). In this sense MAP was successful as plans for the SOP were laid down in a sequence of documents while the co-operation of the atmosphere, which provided many of the desired flow configurations, and of hundreds of people enabled measurements over the Alps of unprecedented spatial and temporal density as well as extent (for details cf. Bougeault et al., 2001).

As first-order measures of success we attempt to specify, *i)* to what extent the proponents of the programme succeeded to attract financial investments as necessary input for the realization of their research plans (section 2), and *ii)* how much output was generated after the SOP in the form of publications in peer-reviewed journals (section 3). Other success factors are mentioned in section 4 before conclusions are made in the final section.

2. SUCCESS MEASURED BY INPUT OF FINANCIAL INVESTMENTS

The generic pattern how an atmospheric research programme involving a field campaign usually develops through three phases was recently described by LeMone (2003) with much insight and self-critical humour. The development of MAP did not fully follow her scenario as its beautifully simple, 'first-order' acronym and the logo were available before the list of scientific objectives was finalized at a workshop at ETH in Zurich (Sept. 1994). Then, according to LeMone, reality set in as funds and instruments had to be secured. It soon became evident that Big Money from one major source would not be available, but that the participating countries had to organize their own resources as at a barbecue party in the wilderness where all guests bring salads, sauces, sausages … and drinks.

The figures in Table 1 show how this approach worked during MAP. Considerable investments were made by major funding agencies, as FWF (Austria), CNRS-INSU (France), SNF (Switzerland), and NSF (United States). Similar figures for Canada, Italy, and Slovenia are hopefully available for the final version of this paper. France and the United States made the largest overall contributions, followed by the central Alpine countries Austria and Switzerland. Remarkable are the significant contributions from international bodies (EUMETNET, EU, ECMWF). Three different kinds of support are distinguished: funds for specialized research projects (mainly for groups at universities; ~35%), financial support for large instrument platforms as aircraft and portable radars (~20%) and in-kind support through the base budgets of all the participating institutions (~45%). In a conservative fashion, the latter were estimated from average factors provided by funding managers.

One of them, a NSF program director, mentioned as key elements during the phase A of MAP the visibility of a *complete research programme*, a *strong programme office* (set up at MeteoSwiss in January 1995; regularly informing the community via the *MAP newsletter*) and the early establishment of a *first rate data centre* (starting at ETH during summer 1995; making wide use of the internet from the beginning). He concluded: *"I guess success came from good planning from both the sponsoring agencies and the scientists. MAP was an extremely well organized and well-run program. It could serve as a model for any large, atmospheric sciences program."*

Table 1. Investments made for MAP broken up by group of sponsors, project funds (for number of projects), extra investments and estimated in-kind investments from the base budgets of the participating institutions.

[1] basic contribution to run the operation centre in Innsbruck during SOP; [2] enhancement of routine measurements; [3] basic costs for radar system and two research aircraft; [4] basic costs for research aircraft and enhanced observations; [5] deployment of research aircraft; [6] USA figures where provided in US$; 1 US$ = 1 Euro is used as average conversion for the MAP period; [7] basic costs for US MAP-office and field deployments (e.g. two research aircraft, Doppler radar); [8] many national meteorological services contributed to basic infrastructure (e.g. programme office, data centre) via EUMETNET administered by MeteoSwiss; [9] ECMWF contribution to reanalysis costs in addition to EUMETMET payment.

Sponsors from	Sponsors	Project funds (MEuro)	#proj.	Extra investm. (MEuro)	In-kind investm. (MEuro; estimate)	**Sum** (MEuro)
Austria	FWF, ZAMG	1.4	12	0.3 [1]	0.7	2.4
Croatia	DHMZ	0.1	1	0.1 [2]	0.1	0.3
France	CNRS, MetFran, CNES, EDF	1.3	8	2.4 [3]	8.5	12.2
Germany	DLR,DFG,DWD	0.4	4	0.4 [4]	1.0	1.8
Switzerland	SNF, MetSwiss	1.3	11		1.2	2.5
United Kingdom	MetOffice			0.3 [5]	0.7	1.0
United States [6]	NSF, NCAR	7.2	11	1.4 [7]	3.8	12.4
others (e.g. I, SI)		not yet made available.				
Nat'l Met. Servic.	EUMETNET			2.2 [8]		2.2
European bodies	EU, ECMWF	1.4	3		0.2 [9]	1.6
Sum		13.1	50	7.1	16.2	**36.4**

3. SUCCESS MEASURED BY OUTPUT OF REFEREED PUBLICATIONS

Peer reviewed publications provide the basic record of scientific achievement. LeMone (1983) found a 6-year time-lag between the GATE field phase in 1974 and the peak of publications in AMS journals in 1980. These figures were recently updated and extended to 1999 (LeMone 2003). Table 2 contains such summarizing data regarding MAP for the 5 post-SOP years 2000 to 2004. The full inventory of the so far tracked 160 publications in no less than 20 journals is given in the appendix. The selection uses as criterion that MAP is explicitly mentioned and that relevant data were used, or that techniques for subsequent SOP data processing were documented (additions and corrections to the inventory are invited to be sent to the author).

Within five years after MAP-SOP 33% more papers appeared compared to the post-GATE quinquennium (121). The peak lies at least one year earlier (as far as it can be judged by now). This may be explained by the faster publication procedure with electronic communication and a pre-established research community. Specific to MAP is the unifying rôle of special issues in established research journals [as M.A.P. **72**(2-4) for project HERA and HESS **7**(6) for project RAPHAEL during phase A of MAP, QJ **129** (588) dedicated to MAP-SOP results, and Met.Z. **13** (1-3) for results presented at ICAM-MAP-03 conference in Brig].

A systematic browsing through all the papers reveals different kinds of contributions. Early ones deal with general aspects as the Alpine-wide precipitation characteristics or new technical procedures, the bulk of middle ones discusses in depth case-studies from IOPs during MAP-SOP, while recently generalizations are attempted regarding lessons from MAP for high-resolution numerical weather prediction techniques. The lesson from GATE suggests that the impact of MAP may be long indeed and a quasi-systematic monitoring of the future MAP publications and the distillation of the eventually passed milestones is supposed to serve as an elucidating example of progress in meteorology achieved and triggered by field campaigns (cf. Volkert, 2004). It may also be useful to sample as ‘near-MAP publications’ general studies, which in all likelihood were inspired by MAP.

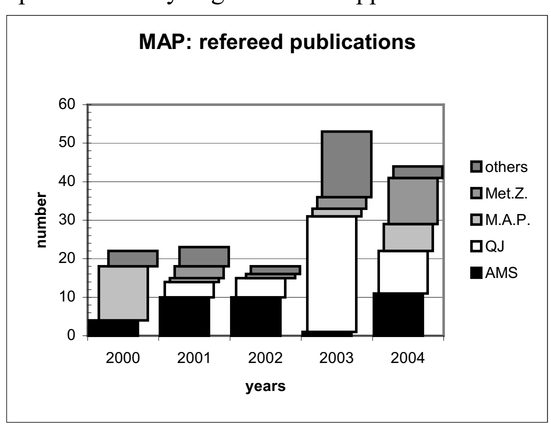
4. OTHER SUCCESS FACTORS

The input (finances) and output (papers) oriented approach only provides a simplistic picture concerning a complex inter-cultural, inter-institutional and inter-national activity such as a large research programme. Less quantifiable aspects are the desires to test new instruments in coordination with standard ones, to combine experiences from dynamic research groups in academia with those of large operational centres, to motivate young scientists to carry out studies that apparently interest many. All of these factors worked during MAP. A full collection of academic theses (PhD and master levels) with a link to MAP is in the making. Up to now these counts of MAP related theses were reported: PhD: CAN–2, CH–10, D–2, F–6, USA–1; MSc: CAN–1, CH–5.

Particularly beneficial appears to have been the chain of large campaigns from ALPEX (1982) via PYREX (1990) towards MAP-SOP (1999) combined with an increasing number of related data and model oriented investigations. Support of the preparatory projects HERA and RAPHAEL by the European Union strengthened research links more than the size of the financial share (< 5%) warrants. The impact of convincing leadership within the MAP committees and the mission selection teams during MAP-SOP can hardly be overestimated.

Table 2. Statistics of 160 MAP-related refereed publications stratified by year of appearance (2000 to 2004) and journal groups given as numbers (left) and ‘piles of papers’ (right). Keys: AMS – American Meteorological Society Journals (BAMS, JAS, JAOT, JC, MWR, WF); QJ – Quarterly Journal of the Royal Meteorological Society; M.A.P. – Meteorology and Atmospheric Physics; Met.Z. – Meteorologische Zeitschrift; others – remaining journals. The complete inventory is given in the appendix.

Journals/ years	2000	2001	2002	2003	2004
Others	4	5	2	17	3
Met.Z.	-	3	1	3	12
M.A.P.	14	1	-	2	7
QJ	-	4	5	30	11
AMS	4	10	10	1	11
Sum	**22**	**23**	**18**	**53**	**44**



5. CONCLUSIONS

MAP was successful in securing considerable funds for the *measured response of the international atmospheric and hydrologic scientific communities* to further *adequate observation, basic understanding, and successful prediction* of weather phenomena affecting the Alpine region (*quotes* from MAP Design Proposal). The total investment is estimated to come close to 40 MEuro (including the not yet communicated shares of the 'other' countries), nearly half of which was implicitly carried by the participating institutions.

The published output is already impressive and diverse in character. European journals act as an important means to communicate these results. A series of overview papers is intended to emerge from all solicited MAP presentations given at ICAM-MAP-05. Besides constituting a condensed summary of MAP related achievements (the 'harvest basket') this may also serve as a guiding example for future atmospheric research programmes, as *e.g*. THORPEX under the auspices of the World Weather Research Programme of WMO.

In the end, it is inspired people who make initially vague plans eventually a piece of reality. May the *spirit of MAP* continue to blow through many minds and lead us on along research trails in atmospheric sciences.

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APPENDIX

Inventory of 160 refereed MAP related publications from 2000-2004 (in abbreviated format; as of 20/4/2005)

List of journals (with publisher or editing society):

AtmEnv	Atmospheric Environment, Elsevier	JC	Journal of Climate, AMS
BAMS	Bulletin of the American Meteorological Society, AMS	JGR	Journal of Geophysical Research, AGU
BLM	Boundary Layer Meteorology, Kluwer	JHyd	Journal of Hydrology, Elsevier
Geof.	Geofizika, Geophysical Institute, Zagreb	MAP	Meteorology and Atmospheric Physics, Springer
GRL	Geophysical Research Letters, AGU	MZ	Meteorologische Zeitschrift (Neue Folge), DMG
HESS	Hydrology and Earth System Sciences, EGS	MWR	Monthly Weather Review, AMS
IJCli	International Journal of Climatology, RMS	PCE	Physics and Chemistry of the Earth, Series B, Pergamon
JAM	Journal of Applied Meteorology, AMS	QJ	Quarterly Journal of the Royal Meteorological Society, RMS
JAOT	Journal of Atmospheric and Oceanic Technology, AMS	Tellus	Tellus, Series A, Swedish Geophysical Society
JAS	Journal of the Atmospheric Sciences, AMS	WF	Weather and Forecasting, AMS

List of papers (with authors, abbreviated journal, volume, and page range; sorted by year and first author):

2000:
..Buzzi & Foschini, MAP **72**, 131-146
..Cacciamani et al, MAP **72**, 147-159
..Chong & Cosma, JAOT 17, 1556-1565
..Chong et al., BAMS **81**, 2953-2962
05 Doyle et al., MWR **128**, 901-914
..Fantini & Davolio, MAP **72**, 261-270
..Fehlmann & Quadri, MAP **72**, 223-231
..Ferretti et al., Tellus **52**, 161-179
..Georgis et al., MAP **72**, 185-202
10 Germann & Joss, PCE **25**, 903-908
..Hagen et al., MAP **72**, 87-100
..Hofinger et al., MAP **72**, 175-184
..Keil & Volkert, MAP **72**, 161-173
..Mladek et al., MAP **72**, 111-129
15 Pellarin et al., PCE **25**, 953-957
..Peristeri et al., MAP **72**, 251-260
..Petitdidier et al., PCE **25**, 1195-1199
..Scheidereit & Schär, MAP **72**, 233-250
..Stein et. al, MAP **72**, 203-221
20 Steinacker et al., MAP **72**, 101-110
..Steinacker et al, MWR **128**, 2303-2316
..Volkert, MAP **72**, 73-85

2001:
..Baumann et al., Atm.Env. 35, 6379-6390
..Bougeault et al., BAMS **82**, 433-462
..Caccia et al, MZ **10**, 469-478
..Chong & Bousquet, MAP **78**, 133-139
05 Drobinski etal., BLM **98**, 475-495
..Drobinski etal., BLM **99**, 277-296
..Frei & Schär, JC **14**, 1568-1584.
..Furger et al., JOAT **18**, 1975-1988
..Germann & Joss, JAM **40**, 1042-1059
10 Houze et al., QJ **127**, 2537-2558
..James&Houze, JAOT **18**, 1674-1683
..Marsigli et al., QJ **127**, 2095-2115
..Menziani etal., PCE **26**, 431-436
..Miglietta & Buzzi, Tellus **53**, 481-499
15 Molteni et al., QJ **127**, 2069-2094
..Piringer et al., MZ **10**, 445-455
..Reitebuch et al., JAOT **18**, 1331-1344
..Rotunno& Ferretti, JAS **58**, 1732-1749
..Ruffieux & Stübi, MZ **10**, 489-495
20 Schmidli et al., JC **14**, 3289-3306.
..Sprenger & Schär, QJ **127**, 161-187
..Tabary&Scialom, JAOT **18**,1293-1314
..Tabary et al, JAOT **18**, 875-882

2002:
..Benoit et al., BAMS **83**, 85-109
..Cosma et al, QJ **128**, 75-92
..Doyle, MWR **130**, 3087-3099
..Doyle et al, QJ **128**, 2175-2184
05 Flamant et al., QJ **128**, 1173-1210
..Germann & Joss, JAM **41**, 542-557.
..Germann & Zawadzki, MWR **130**, 2859-2873
..Gheusi & Stein, QJ **128**, 337-360
..Jasper et al., JHyd **267**, 40-52
10 Mayr et al., JAOT **19**, 1545-1556
..Pradier et al., MWR **130**, 2533-2553
..Rubel et al., MZ **11**, 367-370
..Schär et al., MWR **130**, 2459-2480
..Schmidli et al., IJCli **22**,1049-1074
15 Smith RB et al., JAS **59**, 2073-2092
..Tabary & Petitdidier, JAOT **19**, 875-887
..Vignal et al., JAM **39**, 1715-1726
..Zängl, QJ **128**, 927-949

2003:
..Ahrens, MZ **12**, 245-255
..Asencio et al., QJ **129**, 565-586
..Bacchi & Ranzi, HESS **7**, 785-798
..Bencetić et al., Geof. **20**, 23-61
05 Benoit et al., HESS **7**, 877-889
..Bolliger et al., MZ **12**, 73-80
..Bousquet & Smull, QJ **129**, 391-409
..Bousquet&Smull, JAM **42**, 1497-1513
..Buzzi et al., QJ **129**, 1795-1818
10 Corazza et al., MAP **83**, 131-143
..Dabas et al., GRL **30**, 1049, 21, 1-4
..Doyle & Smith, QJ **129**, 799-823
..Drobinski et al., QJ **129**, 729-753
..Durran et al., QJ **129**, 693-713
15 Ferretti et al., QJ **129**, 587-607
..Frei et al., JGR **108**, ACL 9, 1-19
..Frioud et al., AtmEnv **37**, 17855-1797
..Georgis et al., QJ **129**, 495-522
..Gheusi & Stein, QJ **129**, 1819-1840
20 Grossi & Falappi, HESS **7**, 920-936
..Hagen & Yuter, QJ **129**, 477-493
..Hoinka et al., QJ **129**, 609-632
..Ivančan-Picek et al., MZ **12**, 103-112
..Jasper&Kaufmann, QJ **129**, 673-692
25 Jaubert & Stein, QJ **129**, 755-776
..Jiang, Tellus **55**, 301-316
..Jiang et al., QJ **129**, 857-875
..Kaufmann et al., HESS **7**, 812-832
..Liniger & Davies, QJ **129**, 633-651
30 Lothon et al, QJ **129**, 2171-2193
..Matzinger et al., QJ **129**, 877-895
..Medina & Houze, QJ **129**, 345-371
..Menziani et al., HESS **7**, 890-902
..Montaldo et al., HESS **7**, 848-861
35 Pullen et al., JGR **108**, 3320, 18,1-20
..Ranzi et al., QJ **129**, 653-672
..Reitebuch et al., QJ **129**, 715-727
..Richard et al., QJ **129**, 543-563
..Richard et al., HESS **7**, 799-811
40 Rotunno & Ferretti, QJ **129**, 373-390
..Ross & Vosper, QJ **129**, 97-115
..Schär et al., QJ **129**, 825-855
..Seity et al., QJ **129**, 523-542
..Smith RB, JHyd **282**, 2-9
45 Smith RB et al. QJ **129**, 433-454
..Smith S &Broad, QJ **129**, 2195-2216
..Soula et al., JGR **108**, ACL 10, 1-17
..Steiner et al., QJ **129**, 411-431
..van Gorsel etal., BLM **109**, 311-329
50 Volkert et al., QJ **129**, 777-797
..Yuter & Houze, QJ **129**, 455-476
..Zängl, MAP **83**, 237-261
..Zappa & Gurtz, HESS **7**, 903-919

2004:
..Baumann & Piringer,MAP **85**,125-139
..Baumann & Groehn, MZ **13**, 131-142
..Beck & Ahrens, MZ **13**, 55-62
..Beffrey et al., QJ **130**, 541-560
05 Beffrey et al., MZ **13**, 77-82
..Belušić & Klaić, Tellus **56**, 296-307
..Bolliger et al, MAP **87**, 219-234
..Buzzi et al., MZ **13**, 91-97
..Chiao et al., MWR **132**, 2184-2203
10 Davolio & Buzzi, WF **19**, 855-871
..Flamant et al., QJ **130**, 1275-1303
..Friedrich & Caumont, JAOT **21**, 717-729
..Frioud et al., MZ **13**, 175-181
..Gheusi & Davies, QJ **130**, 2125-2152
15 Gohm & Mayr, QJ **130**, 449-480
..Gohm et al., MWR **132**, 78-102
..Grubišić, QJ **130**, 2571-2603
..Häberli et al., MZ **13**, 109-121
..Hoinka&Zängl, MWR **132**, 1860-1867
20 Ivatek & Tudor, MZ **13**,99-108
..Jiang & Doyle, JAS **61**, 2249-2266
..Keil & Cardinali, QJ **130**, 2827-2849
..Kirshbaum&Durran, JAS **61**, 682-698
..Lascaux et al., MZ **13**, 49-54
25 Mayr et al., MAP **86**, 99-119
..Miglietta & Buzzi, QJ **130**, 1749-1770
..Pradier et al, MAP **87**, 197-218
..Rakovec et al., MZ **13**, 83-90
..Rotach et al., BAMS **85**, 1367-1384
30 Smith S, QJ **130**, 1305-1325
..Soula et al., JGR **109**, D02101, 1-13
..Stein, QJ **130**, 481-502
..Vogt & Jaubert, MZ **13**, 165-174
..Vrhovec et al., MAP **86**, 15-29
35 Vrhovec et al, MZ **13**, 201-208
..Walser & Schär, JHyd **288**, 57-73
..Walser et al., MWR **132**, 560-577
..Weigel&Rotach, QJ **130**, 2605-2627
..Weissmann et al., MWR **132**, 2684-2697
40 Žagar et al., MAP **85**, 187-204
..Zängl et al., MWR **132**, 368-389
..Zängl et al., MZ **13**, 69-76
..Zängl et al., MAP **86**, 213-243
..Zängl, QJ **130**, 1857-1875