First periodic report for RTD-project

ALP-IMP

Multi-centennial climate variability in the Alps based on

Instrumental data, Model simulations and Proxy data

EVK-CT-2002-00148

Period covered by the report: March 1st 2003 to April 30th 2004

contents: (public part in bold)

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annex 2.1.: ALP-IMP publication list

section 4: draft T.I.P. the first draft T.I.P. will be produced in project month 21 (November 2004) – when the first workpackages are terminated

project coordination: Reinhard Böhm (ZENMG.CL)

project homepage: http://www.zamg.ac.at/ALP-IMP

SECTION 2:

EXECUTIVE PUBLISHABLE SUMMARY, RELATED TO REPORTING PERIOD 1

(MARCH 2003 TO APRIL 2004)

Contract n°	**EVK-CT-2002-00148**	Reporting period:	**2003-03 to 2004-04**
Title	**ALP-IMP: Multi-centennial climate variability in the Alps based on Instrumental data, Model simulations and Proxy data**		

Objectives:

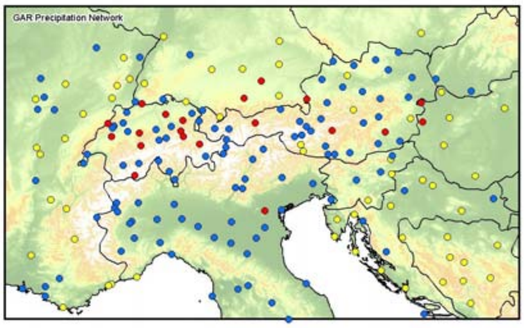
The main task of the first reporting period was the establishment of a high quality and dense database for the study region (GAR – "Greater Alpine Region", 4 to 18 deg E, 43 to 49 deg N) consisting of instrumental climate series (WP-1) and climate proxy series from tree rings (WP-2), ice cores (WP-3) and glacier variability (WP4). Two additional workpackages (WP-5 and 6) started to create the basis for future integration: WP-5 by scanning for comparable datasets and pre-process them to test their consistency with the ALP-IMP data, WP-6 by running a high-resolution regional climate model run to test the consistency of the project data with model results and to provide a better physical understanding of the project data

Scientific achievements:

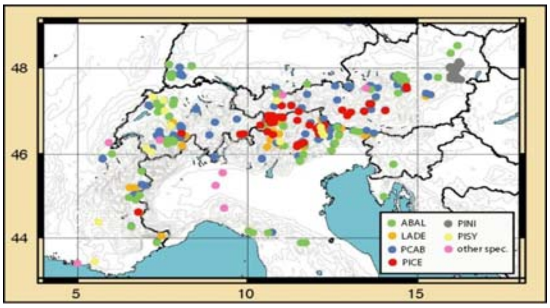
Each of the six workpackages is well on its way but not yet terminated– anyhow several results could be achieved already:

The instrumental data activity produced so far homogenised monthly climate series for 7 climate elements: Two of them (the main elements temperature and precipitation) already ready for use, the other 5 short before being finished. The instrumental datasets could considerably increase the contents and the quality of climate variability information in the study region in terms of homogeneity (several thousands of inhomogeneities and outliers detected and removed, all existing data gaps completed, the network-density strikingly increased, particularly in the early instrumental period before 1850). The following table and the map refer to the precipitation dataset and shall serve as an example for what has been don and achieved concerning instrumental data. (the colour code of the map refers to what has been done within the project: blue: pre-project data, only updated to 2003, yellow: new complete series produced within the project, red: series extended back into the early instrumental period)

HISTALP - PRECIPITATION DATASET: BREAK ANALYSIS		
update to 2003 included		
series	192	
available data (incl. closed gaps)	26250	years
available data (incl. closed gaps)	315000	months
mean length of series	136.7	years
detected breaks (total)	966	
mean homogeneous subperiod	22.7	years
square mean break	17.9	%
maximum break	238	%
mean break amplitude	23.4	%
corrected overshooting adjustments	1861	
detected real outliers	529	
closed gaps	14927	
mean gap rate (%)	4.7	%



The main duty of **the treering data activity** for the first project year was to collect, update existing, and sample new tree ring data to develop a climate sensitive multi-species network for the Greater Alpine Region (GAR). This network now contains 385 ring width (TRW) and 131 density (DEN) chronologies from 6 main species, namely *Abies alba* (ABAL), *Larix deciduas* (LADE), *Picea abies* (PCAB), *Pinus cembra* (PICE), *Pinus nigra* (PINY) and *Pinus sylvestris* (PISY).



Temporally, 106 TRW and 10 DEN chronologies extend back 300-500 year before present, 35 TRW and 1 DEN record more than 500 years, and 6 (9) records extend back more than 1000 (800) years). The latter are composite chronologies combining material from living trees and relict or historical construction wood.

All data sets will be centralized, including raw measurements of single series in Tuscon-format and the

corresponding metadata, at the institute of partner 8 on a newly created ALPIMP tree ring data bank. This database will be accessible via the ALPIMP member web page.
Strong temperature signals can be expected from the more than 200 TRW and more than 50 DEN chronologies. Several sites in dry regions will be analysed for precipitation information.

The isotopic ice core records activity is in the Alps naturally restricted to very high elevated sites ("cold glaciers"). Within ALP-IMP cores from the Monta Rosa and Mont Blanc region are used.
One of the problems to be solved at high Alpine sites is related with dating. The results of methods based on radiocarbon dating in spite of extremely low particle content and on ^{10}Be analysis now makes a well proved at least 1000 years" chronology highly feasible.
An optimising of IRMS ^{18}O analysis allows now the extraction of D-excess values for 1ml-samples – thus considerably increasing temporal resolution during the existing core re-analysis especially in the "old parts" of the cores.
Standard isotope analyses of two new Mt. Blanc cores at seasonal resolution showed recent warming and surprisingly regular strong amplitude oscillations typically longer than 3 years (upstream effects are not relevant here, so local deposition patterns are hypothesised as a first explanation).
All available cores (also the new Mt.Blanc cores) show a close to 1K warming trend of the 1990s versus the 1961-90 means
Ground penetrating radar surveys in 2003 (bedrock topography and internal reflector patterns) helped to identify an optimal drill site for the envisaged (2004) new core drilling at the low accumulation site of Colle Gnifetti.

The glacier variability data activity undertook a total revision of the WGMS-database to fulfil the requirements of ALP-IMP (expansion of the data-model, glacier reconstructions from historical and geomorphological evidenve allowed now, photos and meta-data enabled and a GIS-compatibility established).
A number of new data-sources (mass balance as well as front variations, especially in early measuring periods) have already been implemented or are still in work (front variations of Austria and Lombardia for example). Intensive data quality procedures based also on the new data were performed.

First activities of the recently started **consistency WP "observed versus observed data"** has performed first tests of the project's precipitation datasets against those of ETH-Zürich (for the Alps) and of CRU (for Europe) on a "site versus nearest gridpoint" basis in the longest common period and has studied the correlation of the leading EOFs of the GAR with the wider European precipitation variability – resulting in characterising the GAR (regarding precipitation) as a typical region of transition among four large scale regions and without (unlike temperature) an endemic GAR type.

The modelling activities of the project consistency (WP "observed versus modelled") have produced so far a 1/6 deg resolution 1958-2002 simulation with REMO for the greater part of Europe (multi-variable hourly output on 20 vertical levels). At the boundaries REMO was forced with ERA-40 reanalysis data, the wind field within the model region were constrained to the large scale ERA-40 field through a spectral nudging technique.
To support a better understanding of the isotope signals in Alpine sites a module containing the physics of stable water isotope fractionation has been built into REMO providing now a higher resolved (with the Alps visible) view on the isotope signals in precipitation over Europe

Socio-economic relevance and policy implications: will take effect by the end of the project and will be argued then

Conclusions: With a few exceptions (counterbalanced by not planned additional activities), the project is well on its way. The data activities are short before completion and the second project year will shift the focus from separated data work towards integrative analysis

Keywords: instrumental datasets, homogeneity, tree-ring datasets, isotopic ice-core records, glacier variability, Greater Alpine Region, regional modelling, isotope modelling

Publications (cumulative list)

*Peer Reviewed Articles: **see annex 2.1**. (ALP-IMP publications list, table 1)*
*Non refereed literature: **see annex 2.1.** (ALP-IMP publications list, table 2)*
*Others: (Patents, CD ROM's, videos,…) **none***
*Planning of future publications: **see annex 2.1. (**ALP-IMP publications list, table 3)*

SECTION 3:

DETAILED REPORT ORGANIZED BY WORK PACKAGES INCLUDING DATA ON INDIVIDUAL CONTRIBUTIONS FROM EACH PARTNER

RELATED TO THE REPORTING PERIOD (MARCH 2003 TO APRIL 2004)

According to the project plan (page 20 of “Description of Work” 5 Workpackages (1,2,3,4,6) are already midterm of their active period, one (5) has just started and none is already terminated.

3.1. WP-1: INSTRUMENTAL RECORDS (reported by partner 1)

Is a common activity of partners 1 and 5, supported (without costs) by a newly created network of “external project partners” mainly from weather services and other data producing services of the region (listed and regularly updated in the “who is who”-list of the project homepage). A close co-operation with two national projects in Austria (CLIVALP) and Italy (CLIMAGRI) could be established (details section 1). Lead and reporting partner is partner 1

3.1.1. Objectives

- Collect all available long-term instrumental climate data from the GAR
- Reanalysis in terms of general quality and homogeneity
- Standardized re-procession and description for further internal and external use

3.1.2. Methodology and scientific achievements related to WP-1 including contribution from partners

3.1.2.1. Definition of the ALP-IMP short list of instrumental climate elements

A first scan of the data potential in the greater alpine region (GAR, 4 to 19 deg E, 43 to 49 deg N) and discussions with the ALP-IMP partners from the proxy-communities about their needs defined the following climate elements as feasible to be included into the project’s working plan:

with full GAR-coverage, homogenisable on monthly basis: temperature, precipitation, air pressure, sunshine/cloudiness

partial GAR-coverage, homogenisable on monthly basis: vapour pressure, relative humidity

near to full GAR-coverage, high density spatial and daily temporal resolution: snow depth (the potential in terms of homogenisation has yet to be tested)

The needs from the project partners for the further progress of the project concentrated most on the two main elements temperature and precipitation. Air pressure shall be used for circulation studies and has therefore an indirect but nevertheless fundamental importance. Sunshine/cloudiness and vapour pressure/relative humidity are regarded by the proxy specialists as interesting and innovative additional agent to explain remaining uncertainties in the extraction of climate signals from tree-rings (both) or glaciers (mainly sunshine, humidity in our climate less important). For both element groups a total coverage of the GAR is not achievable (the sunshine/cloudiness group not even measured everywhere, the humidity complex in an extremely underdeveloped state concerning availability in digital form. Therefore the two element groups have been treated in a sub-region which covers most of the Eastern Alps, and will be used for the development and the test of new methods to study their influence on the ALP-IMP proxies.

Snow turned out to take the most extreme position in terms of a severe contradiction of very high application potential (snow is for a region like the Alps among the leading climate elements and therefore interesting), it has also a (yet not really well studied) influence on proxies but it is not available as a standardised monthly parameter, it is spatially highly variable and has been digitised so far only very rudimentarily. After a time of data potential scanning it was decided to start an ALP-IMP snow initiative with the objective to at least perform for the first time an Alpine wide data collecting, digitising, homogeneously processing of spatially high density daily snow data for the 20^{th} century (starting shortly before the year 1900). There is no guarantee to reach a similar quality level as for the other ALP-IMP climate elements, but the simple existence of such a new database will be a substantial progress in Alpine climatology in any case. The much higher than planned necessary working effort could be covered through a cost-neutral re-arrangement of the planned personnel (explained more in detail in section 1).

3.1.2.2. New tools for data quality improvement

An initial in depth analysis of the already existing instrumental climate datasets in the region (some national and a first EU-supported attempt from project ALPCLIM) in terms of hom-ori differences or ratios, outliers, spatial coverage and spatial density versus de-correlation distances clearly showed the great potential of a further substantial data quality increase through a complete re-analysis of the existing plus additional data to be digitised from newly discovered sources in national and sub-national archives.

Data archiving and digitising resulted in a better homogeneity in terms of spatial coverage especially in the early instrumental period and in the establishment of a GAR-wide meta-database.

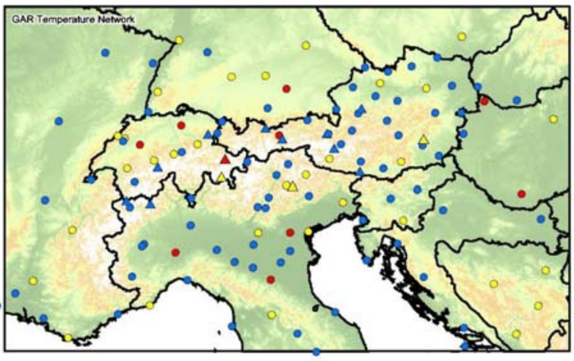
The existing programme-package for break-detection, break-elimination and gap-closing (HOCLIS) was modified in order to achieve a quicker handling (e.g. multiple break elimination in one step, partial automation of the interactive decision process,...) and also due to some scientific needs learned during the homogenising work of the past years (e.g. smoothing of the annual variation of monthly adjustments...)

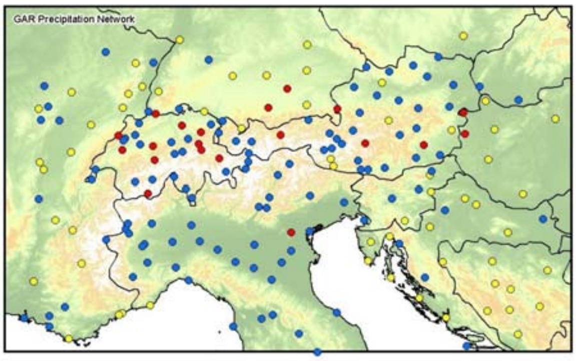
A new tool for detection and elimination of outliers was created. It is based on the MySQL-database HISTALP (taken over from project CLIVALP) where all GAR-instrumental data are kept and quickly extractable at different status (original, pre-homogenised, homogenised, relative, absolute,...) and uses a combination of a visual basic programme-modification of the ZENMG-routine real-time data-quality procedure Klimvis that allows an interactive detection and correction of outliers based on ArcView-visualised monthly field-analyses of the climate variables in HISTALP.

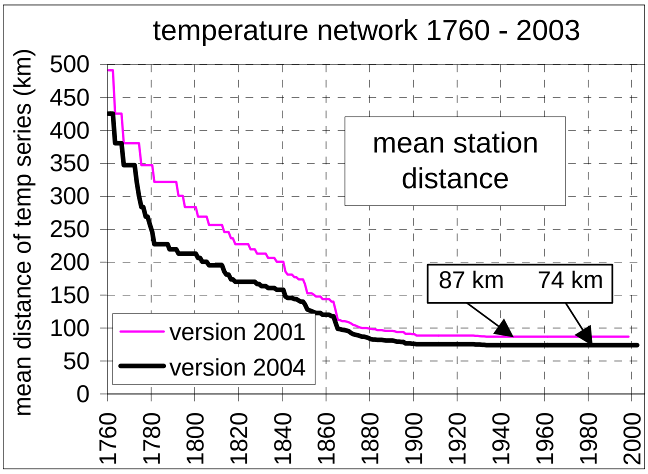
3.1.2.3. Status of the instrumental data re-analysis

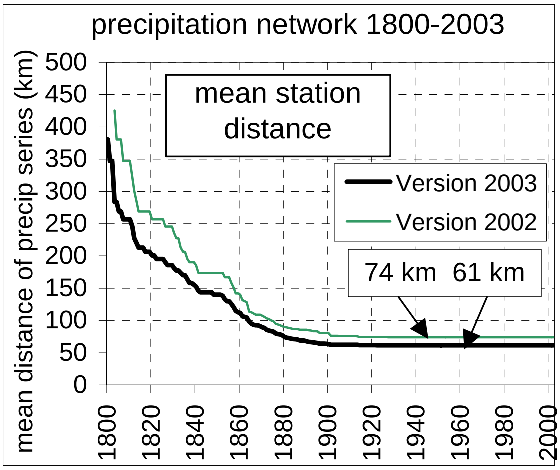
In the reporting period the re-analysis based on the described new data, metadata and programme-tools could be successfully completed and already published (confirmed submission to IJC) for precipitation. For temperature and air pressure the status is "near to final" (only outlier elimination and updating to 2003 is yet not completed. The radiative and the humidity element group only needs final updating to 2003. The mentioned precipitation publication describes exemplarily and in detail the new procedure.

The maps below show as examples the now existing instrumental GAR-networks for temperature (left) and precipitation (right). On the blue sites only updating, homogeneity and outlier re-analysis was performed within ALP-IMP, for the red sites additional early instrumental data were added and the yellow sites are completely new series added from written or digital sub-regional archives. The diagrams below show the temporal evolution of network-density of the project-datasets.









The necessity to go the described time-consuming way from original to homogenised, outlier corrected and gap-completed data is clearly underlined by the exemplary comprising basic statistic of the precipitation dataset. The table shall also serve to illustrate the expenditure of labour spent in WP-1 (e.g. some 1000 breaks, 1861 apparent and 529 real outliers had to be detected, approved and adjusted for precipitation alone).

HISTALP - PRECIPITATION DATASET: BREAK ANALYSIS		
update to 2003 included		
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available data (incl. closed gaps)	315000	months
mean length of series	136.7	years
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mean homogeneous subperiod	22.7	years
square mean break	17.9	%
maximum break	238	%
mean break amplitude	23.4	%
corrected overshooting adjustments	1861	
detected real outliers	529	
closed gaps	14927	
mean gap rate (%)	4.7	%

3.1.3. Socio-economic relevance and policy implication

The deliverables of WP-1 (instrumental climate variability data in yet unknown quality, density, length and multi-dimensionality) will support any climate impact studies in the climate sensitive region of the GAR far beyond the direct realm of ALP-IMP itself. A solid database also in the early (highly naturally forced) instrumental period allows a deeper understanding of and sets a new standard for better defined detection of oncoming anthropogenic climate effects in the region.

Moreover the WP-1 deliverables will provide a considerably increased basis for climate sensitive planning activities in the region – the new snow dataset and it's value for winter tourism, one of the leading economic sectors in the Alps is evident and may serve as an example for the wide field of potential applications of socio-economic relevance. The political dimension of well defined and high quality climate variability data is given by the reduction of uncertainties which allows a better proved arguing in the recent climate change discussion.

3.1.4. Discussion and conclusion

The so far executed part of WP-1 fully approved it's necessity to set a solid instrumental database for the project. The applied methods turned out to be scientifically clean, quickly to handle and well usable – they significantly improved the basis for further ongoing within the project during the integrative consistency- and analysis- workpackages.

3.1.5. Plan and objectives for the next period

WP-1 will be active as planned (based on the new time schedule after the project prolongation) until project month 20. In the 6 remaining months the WP-1 internal work will be finalised in time. Only the snow-initiative (which goes far beyond to what was initially planned in ALP-IMP) will be continued also after closing WP-1. From the two consistency-workpackages (5 and 7) an increasing input should allow to further detect, understand and eliminate still remaining inconsistencies, but the overwhelming quantum of errors and non climatic noise will be eliminated by the end of WP-1

3.2 WP-2: TREE-RING RECORDS (reported by partner 8)

WP 2 is a common activity of partners 2, 8, 9 and 10, with partner 8 as the lead and reporting partner. During the first project year a close cooperation with two Italian groups (University of Padua and University of Ancona, see section 1 and the project home page) has been established. WP2 has already exchanged data with these new collaborators and joint analyses are planned.

Objectives

- Assemble best possible 'optimum' set of existing and new tree-ring data for the Greater Alpine Region (GAR) with a focus on identified key regions and tree-growth variables
- Screen, quality control, and reprocess raw measurement data to form standardized multi-century to millennial site and regional chronologies for different species, using recently developed/improved statistical techniques
- Undertake systematic detailed identification of climate signals in the chronology data, with emphasis on quantifying time-dependent changes

3.2.1 Methodology and scientific achievements related to WP-2 including contribution from partners

3.2.1.1 The GAR tree ring network

The main duty of WP 2 for the first project year was to collect, update existing, and sample new tree ring data to develop a climate sensitive multi-species network for the Greater Alpine Region (GAR). This network now contains 385 ring width (TRW) and 131 density (DEN) chronologies from 6 main species, namely *Abies alba* (ABAL), *Larix deciduas* (LADE), *Picea abies* (PCAB), *Pinus cembra* (PICE), *Pinus nigra* (PINY) and *Pinus sylvestris* (PISY). (sources: WP partners and Elling, Fritts, Huesken, Neuwirth, Rolland, Schweingruber, Serre, Tessier, Urbinati & Carrer) (fig. 1). 208 TRW and 53 DEN chronologies are situated above 1500 m asl, 177 TRW and 78 DEN chronologies are situated below 1500 m asl. This first altitudinal threshold was chosen according to the grouping of the instrumental measurements of WP 1, and as a threshold for sites approaching tree-line. We expect, especially for TRW, strongest temperature response from those tree-line sites.

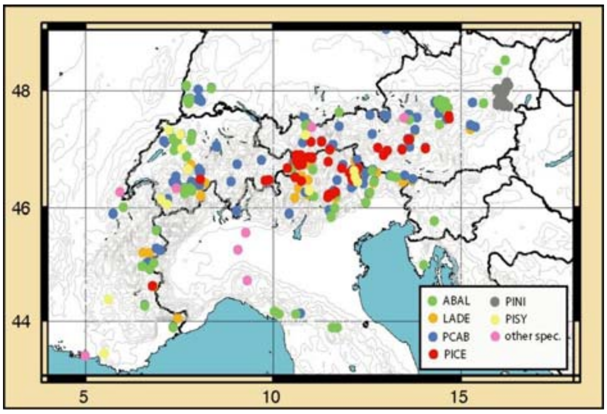


fig. 1: The GAR tree ring network,

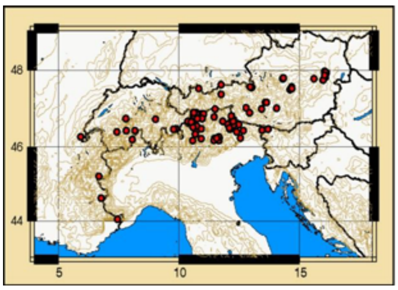


fig.2a: 300-500 year GAR network

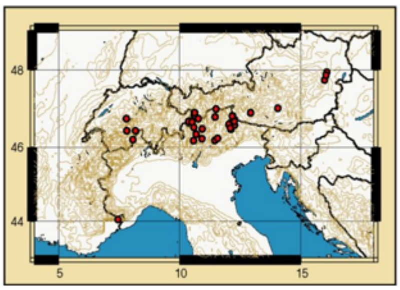


fig.2b: >500 year GAR network

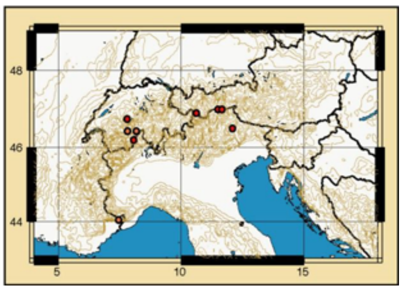


fig.2c: >800 (>1000) year GAR netw.

Temporally, 106 TRW and 10 DEN chronologies extend back 300-500 year before present, 35 TRW and 1 DEN record more than 500 years, and 6 (9) records extend back more than 1000

(800) years (fig. 2). The latter are composite chronologies combining material from living trees and relict or historical construction wood.

All data sets will be centralized, including raw measurements of single series in Tuscon-format and the corresponding metadata, at the institute of partner 8 on a newly created ALPIMP tree ring data bank. This database will be accessible via the ALPIMP member web page.

3.2.1.2 Network analyses

Screening, quality control and reprocessing raw measurement data to form standardized site and regional chronologies is ongoing on different spatial and temporal levels of the network.

A first analysis of 53 TRW and 30 DEN sites, selected based on criteria such as elevation above 1500 m asl, sample replication, segment length, cross correlation calculations (program COFECHA), and data availability has been undertaken. This network includes 4 species: ABAL, LADE, PCAB and PICE. Standardisation tests determined that adjusting the variance of the single series with power transformation (dendro program ARSTAN) followed by calculating the residuals from 300-year splines is a suitable method to handle these data. With this detrending, most of the low frequency temperature related variation from series is preserved whilst biological induced age trends are eliminated. The density records are of a more homoscedastic nature and possess more linear age trends. Therefore they were standardised by calculating residuals from linear fittings.

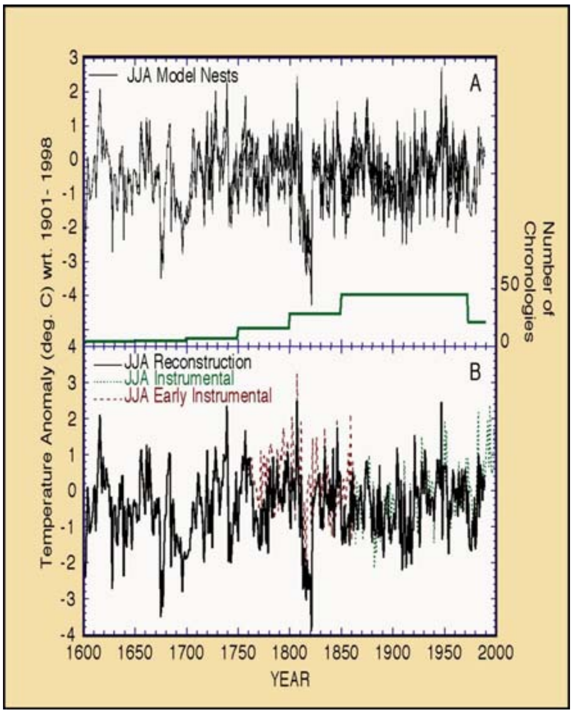


fig. 3A: models based on principial component analyses; **3B**: temperature reconstruction from 53 high elevation sites (Frank et al., in prep)

Inter-site and inter-species correlations of the resulting local and regional chronologies show highly significant spatial and temporal similarities for both tree ring parameters. Species based climate-tree-relationships were investigated using homogenised monthly and seasonal temperature and precipitation data provided by WP 1. The results highlight temperature as the main growth forcing factor for all investigated species and sites. Whilst the TRWs respond primarily to summer temperatures (June to August), the season of DEN responses spans essentially the whole vegetation period (April to September). Precipitation has relatively minimal influence on the selected sites.

Based on principal component analyses several models for temperature reconstruction were developed and calibrated and verified over two independent periods. For additional verification a low elevation temperature gridpoint was used.

Fig. 3 shows the models and resulting temperature reconstruction back to 1600 AD, compared with instrumental data. Warmer periods are detected around 1620, in the mid 1700s and around 1800. Cool periods occur in the mid 1600s, around 1700, and most striking in the early 1800s. Tree rings reconstruct this period to be cooler than instrumental measurements indicate. Such discrepancies between tree rings and meteorological data in the early instrumental period (more for DEN than for TRW). will be investigated in more detail during the next project period.

Network analyses of precipitation sensitive sites are at the very beginning and presently focus on sites in eastern Austria.

3.2.1.3 millennium long chronologies

Significant progress has been made in the construction of >1000 year long composite chronologies out of living trees, building based, and relict material. In Austria sampling of sub-fossil material from two alpine lakes (Schwarzensee, Riesachsee), and from Hallstadt took place. This has resulted in 8 new chronologies, which should provide higher replication and the extension of the existing ones (max. length 1483 years) back in time. The Tyrolian PCAB, LADE and PICE chronologies (max. length 1352 years) will be updated with material from very high elevation trees (2000-2300 m asl) growing at both sites of the central alpine range and historical wood. A 1032 year long PICE chronology of the north eastern Italian Alps is finished and has been provided by the Italian collaborators. In the central Alps of Switzerland (Valais) a 1318 year long LADE chronology was established using living trees and historical timber wood (own samplings and existing archaeological dendro data from Schmidthalter and Seifert).

Most of the commonly used methods to eliminate biological long-term trends also remove the low frequency climatic signal in long tree ring records. Power transformation and 300-year splines, for example, remove multi-centennial variations in the data sets from the Valais. With adequate sample depth and ecological considerations, the size and structure of the millennium long composite tree ring width records provides the potential for novel age-related standardisation methods to be applied. Such age related standardization methods are the only way to retain climatic related variation from annual to multi-centennial scales, and avoid the “segment length curse” (Cook et al. 1997) inherent to conventional tree-ring data. In particular we have been using a newly developed method know as “Regional Curve Standardisation” (RCS) to develop chronologies. By splitting the data sets in several sub-groups based on certain criteria (e.g., living vs. relict material, geographic region, age-class, or based on pith-offset information), we are evaluating the robustness of the climatic signals within these data.

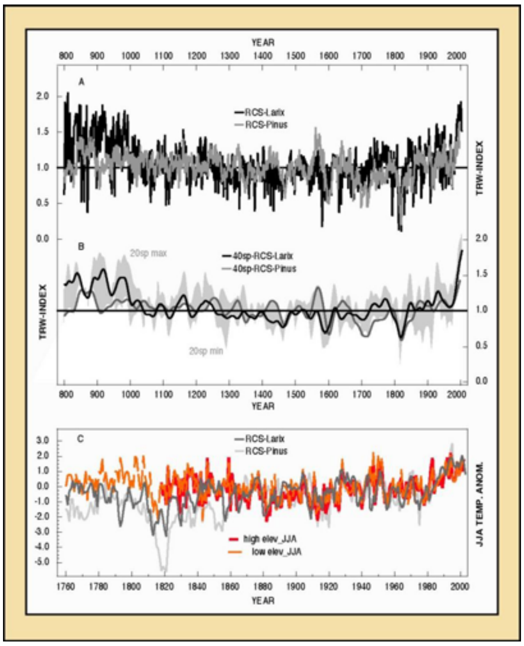


fig. 4: comparison of 2 millenium long RCS chronologies from Switzerland (LADE) and Austria (PICE) (Büntgen et al., in prep)

Fig. 4 compares two RCS records from the GAR network: one from Switzerland (LADE) and one from Austria (PICE). Both RCS chronologies show strong similarities from interannual (fig. 4A) to multi-decadal and centennial variations (fig. 4B). These independent records both display the Medieval Warm Period (MWP), Little Ice Age and recent warmth that seems to exceed that during the MWP. However, discrepancies between these records, such as during the MWP, need further investigation.

The calculation of climate-tree relationships for both records using temperature data from WP 1 (fig. 4C) points again to the dominant influence of JJA-temperatures on tree growth, as seen in the network analysis. Interestingly there is a notable divergence between the tree-ring reconstructions and the early instrumental data.

These results are promising for further studies on long-term climate trends, including all long data sets of GAR.

3.2.2 Socio-economic relevance and policy implication

According to the deliverables, WP 2 will provide at least 120 climate sensitive TRW and 40 density chronologies for the last 300-500 years and 4 climate sensitive subfossil and building based chronologies for the last 1500 years. These records and their explained local and regional climatic sensitivity will allow detailed interpretation of climate before, at the transition to, and during unprecedentedly intense anthropogenic activity. These data will hence be useful to quantify anthropogenic impact in the highly sensitive Greater Alpine Region. The millennial length tree-ring data will also contribute to the scarce proxy data currently available, needed, together with instrumental measurements, to assess recent changes and quantify natural (e.g., solar and volcanic) vs. anthropogenic (e.g., CO_2 and manmade aerosols) forcing in a long-term context. Moreover, the data sets will help enable quantifying long-term spatial and temporal changes of GAR biomass. This will yield information to aid in future valuation of forest resources, and can provide data to help shape, and/or assess compliance with, policies seeking regulate the flux and sequestration of carbon.

3.2.3 Discussion and conclusion

During this period, the cooperation between the WP partners has led to the development of a GAR tree ring network with a dense spatial and extensive temporal resolution. Additional sampling recently completed and underway is targeting areas where data will most directly complement the existing data. Initial investigations from selected high elevation sites, have yielded detailed local and wider regional temperature reconstructions on annual to multi-decadal time scales. Effort has focused on the development and analyses of millennial length chronologies, with sufficient sample replication for the application of age-related standardization techniques to be applied, so that multi-centennial scale variations can be preserved and reconstructed. Investigations on precipitation changes are more challenging because of the more spatially heterogeneous nature of precipitation, and additionally, a lower tree sensitivity to this parameter. Future efforts will focus on more local levels for reconstructing precipitation, and explore the possibility of reconstructing drought metrics, such as the Palmer Drought Severity Index (PDSI), on a large-scale, as tree response to drought is likely stronger than that for precipitation alone in the GAR.

3.2.4. Plan and objectives for the next period

WP 2 will be active as planned. Future activities might include studies of supra-long chronologies, drought reconstructions of precipitation sensitive sites, analyses of extreme years, investigations on the early instrumental period and their homogenization in comparison to proxy data, and more detailed local analyses on different altitudinal gradients. Moreover, combined studies on millennium scales will be formed.

3.3 WP-3: ISOTOPE ICE CORE RECORDS (reported by partner 4)

The WP comprises a common activity of partners 1, 3, 4, 6 and 7. This includes as well external co-operation with the Universities of Berne (field work) and Vienna (AMS), the LGGE-CRNS (sample sharing ,field work), the ETH-Zürich AMS facility and the German Polar Research Institute–AWI (GPR, field work). In charge of WP-3 lead and reporting is partner 4

3.3.1 Objectives

- to retrieve first multi-centennial isotope profiles in the Mt. Blanc in addition to the Monte Rosa region
- to interlink all Alpine long term isotope records by appropriate ice core chronologies
- to identify periods of abrupt changes and long-term trends in isotope summer precipitation signature, representative for high elevation Alpine areas
- to provide recent and long term isotope records ready for use in WP6 and WP9

3.3.2 Methodology and scientific achievements related to WP-3 including contribution from partners

Methodology :

The isotope ratios ($\delta^{18}O$) or.δD) of the ice core matrix provide the prime climate proxy parameter as mainly controlled by the precipitation history of moist air masses and thus eventually reflecting the local temperature variability. The secondary quantity Deuterium-excess thought to be primarily depending on the climate situation at the water vapour source region serves supplementary as proxy for long-term circulation changes.

Selected target regions for these investigations are the Monte Rosa and Mt. Blanc summit range (4500 m asl and 4250m asl, respectively), which are the most suitable for this purpose . The needed extension of the spatial and temporal coverage of the existing Alpine isotope records to enhance and to confirm their significance are accomplished by analysing three specifically selected new ice cores: one from Monte Rosa (Colle Gnifetti) to be drilled in a (known) flat bed rock area with extremely low accumulation rates, and two existing ones from the Mt. Blanc region (Col du Dome), one of them located at a dome position..

In order to obtain isotope time series from the new ALP-IMP cores going back in time as far as possible at adequate precision the whole suite of modern dating techniques are applied as: radioactive, chemical and volcanic horizons (also used for synchronisation), chemistry-based annual layer counting at cm depth resolution, ^{210}Pb-chronologies, CH_4 cross-linked to well dated Greenland cores ,radiocarbon dating and ^{10}Be-excursions during sun spot minima.

The approach to derive net “atmospheric” signals is built on sorting out glacier flow effects at the two non-dome positions and on constraining the characteristic seasonal representativeness by up stream samplings of sub-seasonally resolved isotopes and chemistry profiles. This attempt is backed up through precipitation sampling for isotope analyses at high elevation sites (including Alpine isotope data in precipitation from existing net-works outside ALP-IMP). Straightforward statistical analysis (correlation to large scale atmospheric parameters, downscaling techniques) will enable us to de-convolute the ΔT - $\Delta\delta$ relationship and the influence of atmospheric circulation as input for WP-6.

Scientific Achievements:

a) First attempts to constrain the ice core chronology on the centennial time scale via deploying the cosmogenic radioisotopes ^{14}C and ^{10} Be revealed that:

- even the extremely low particulate organic carbon content of Alpine ice cores (down to 100-ppb)may be radiocarbon dated ,though at samples typically in excess of 500ml (Drosg et al.2003).

- even ^{10}Be analyses taken at multi-decadal time resolution clearly reflect the distinct solar minima of the LIA period, although solar changes are less sensitively seen via ^{10}Be at mid-latitudes.

It is feasible therefore to achieve a realistic and independently confirmed ice core chronology within ALP-IMP over ,at least last 1000 years.

b) In order to cope with rapid annual thinning recognized to largely exceed the expected rate at an existing deep Colle Gnifetti and at the Dome du Gouter core, IRMS ^{18}O analyses were optimised to run samples of around 1ml only ,at a precision allowing to obtain still useful D-excess values. In this context re-analyses of both isotope species made at a factor of five higher depth resolution (i.e. 2cm over 28 m) in the above Colle Gnifetti core yield roughly a bi-annual time resolution around the 1000 AD horizon ,which considerably adds to the assessment of isotope excursions in the older part of the core.

c) Standard isotope analyses focusing on two new Mt.Blanc cores at seasonal resolution (wrt surface firn) showed surprising regular variations in the summit core(total depth analysed by 85% already).Their amplitudes are quite large and comparable to the seasonal cycle (clearly seen in the near slope core),but typically covering more than tree years. Since up-stream effects are not relevant here it appears that regular mass balance changes at the ice dome may control multi-year excursions of the isotope signals in the summit core.

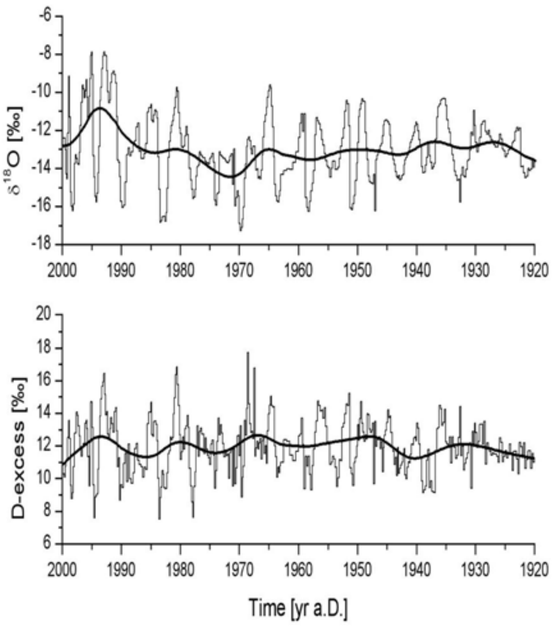


Fig: 3.1 High resolution isotope variability in the Dome du Gouter summit core (Mt. Blanc) indicating a recent warming tendency and distinct multi-annual cycles(likely driven by the local deposition pattern) . Note that the core chronology ,is still tentative

d) Comparative evaluation of the new Mt.Blanc isotope profiles in the recent (i.e. dated) core section with existing profiles points to a consistent recent warming trend in the isotope temperature at all cores and both drilling areas. Based on the empirical ALPCLIM calibration this effect is close to 1°C if the 2000-1990 period is contrasted with the 1960-1990 one. However, within the 2000-1990 intervals. no conclusive trends can be retrieved (being either not significant or opposed in sign). This indicates again that a strong impact of the various glaciological regimes on individual .,short term core signals should be considered in the interpretation of Alpine isotope signals (mainly glacio-meteorological noise introduced by the systematic ,large differences between precipitation and net snow accumulation rate).

e) Reconnaissance of the minimal accumulation area at Colle Gnifetti by ground penetrating radar surveys did already allow to narrow the future drilling target area (as selected wrt bedrock topography and internal reflector patterns) as to mostly avoid disordered layering and rapid thinning in the millennium scale section It is thus envisaged to get a dedicated long term record core clearly connected to the near by ALPCLIM core array and their common bergschrund source region.

3.3.3 Socio-economic relevance and policy implication

Climate proxies derived from high altitude cold glaciers of the Alps (ice cores and related glacier data variability)may provide specific means to assess the climate variability in Central Europe in an unique supplement of commonly deployed paleo-climate information archives of the European realm. The dedicated exploration of this source otherwise available in polar regions or sub-tropical mountains only constitutes an innovative challenge within the European climate research community.

3.3.4 Discussion and conclusion

Major progress achieved within WP- 3 comprises: the establishment of precise ^{18}O-analysis of 1ml sized water samples enabling high resolution D-Excess profiling , the first exploration of ^{10}Be and ^{14}C in the dating context exhibiting clear changes associated with solar activity , the five times depth resolution improvement at one deep Monte Rosa core showing yet undiscovered high frequency changes and most important the integration of isotope profiles from two further Mt.Blanc cores into the existing data set. First evaluation of these new data clearly show that the extraction of climatically relevant isotope signals from Alpine ice cores can only be established if based on a variety of cores associated with different glacio-meteorological regimes. This basically confirms the appropriateness of the WP-3 conceptual design .

3.3.5 Plan and objectives for the next period

a) Systematic up-stream effects ,as identified to be a key obstacle obtaining meaningful long term records of isotope changes at Colle Gnifetti will be investigated during 2004 summer campaigns in the relevant flow regimes through:

-high resolution tracking of internal isochrones by ground penetrating radar profiles through existing and envisaged drill positions and

-accordingly drilling of shallow firn cores and associated ^{18}O &D analyses

b) Definite fixation of the potential ,new drilling position at the Colle Gnifetti low accumulation area followed by down drilling to bedrock

c) Final ^{18}O &D analyses of existing core material including the new shallow firn cores ,the basal ice layer of all three Col du Dome cores as well as summer precipitation obtained from Mt.Blanc and Monte Rosa summit regions

d) Compilation of an Alpine related isotope data sets in excess of the GNIP data base as to form a starting base for respective model comparison

e) Establishment of first chronologies for Slope and Summit ice cores at Col du Dome

f) Improvement and precision assessment of existing long term chronologies of Colle Gnifetti ice cores among others by ^{10}Be and ^{14}C dating techniques

3.4. WP-4: GLACIER RECORDS (reported by partner 5)

WP-4 is carried out by partner 5 with minor support of partners 1 and 10

3.4.1 Objectives

3.4.1.1 WP 4 aims

- dense and long term set of glacier variability data within Greater Alpine Region (GAR)
- uniform structure in terms of data quality
- glacier as an integrated proxy for air temperature, precipitation, radiation, snow cover, atmospheric circulation and its representativity for GAR
- climate impact study on glaciers (use of glaciers as key indicator of climate change)

3.4.1.2 WP 4 deliverables & milestones

Month 13: A quality checked dataset of glacier variability within GAR (mass balance, front position changes, area changes, volume changes, historical/geomorphological evidences)

Month 16: Representativity of glacier variability data within GAR

Month 18: Complete GAR glacier dataset plus description ready for use on the project homepage and for transfer to the existing dataset of World Glacier Monitoring Service (WGMS) and World Data Center-A for Glaciology

3.4.2 Methodology and scientific achievements of 1st reporting Period

3.4.2.1 General remarks

In the first project year we focused on the build-up, control and correction of an Alpine glacier dataset and the development of an adequate data model to store the information in a relational database. The data was converted into a format that allows analysis with a Geographical Information System (GIS). The GAR dataset consists of glacier point information (i.e. geographical coordinates) with attributes on mass balance, front variations, area and volume changes, etc. In addition glacier polygon inventories from Switzerland serve as pilot study.

In addition, two-dimensional (2D) glacier information from Switzerland was compiled for the years 1850, 1973 and 1998/9 in a GIS-based format (Arc/Info polygon coverage) and compared against the revised Swiss glacier inventory from Maisch et al. (2000). Thereby, one major problem has become clear: the separation of glaciers through time causes considerable difficulties in data handling. Although such changes can be handled by introduction of a 'parent glacier', the starting point for this glacier has to be defined. Moreover, former Alpine glacier inventories were not compiled with respect to GIS-based data processing and include, for example, 'glacier groups' as one glacier. As both issues are important when glacier change is used as a proxy for climate change, this topic must be more intensely discussed among the ALP-IMP community.

3.4.2.2 Field work

In 2003 stake readings reported in Machguth (2003) were continued at Upper Grindelwald and Oberaar glacier to extend this dataset for a comparison with results from distributed mass balance modelling in a later project step.

3.4.2.3 Dataset

The database of WGMS serves as primary database. Thereby, the ALP-IMP project benefits from an already capacious database and an existing framework that ensures the continuation of data management and maintenance. The former dataset is being expanded with glacier data from various other sources:

- World Data Center-A for Glaciology (mirror-site of WGMS)
- Compilation of mass balance data from DYURGEROV, M. (2002): *Glacier mass balance and regime: Data of measurements and analysis*. INSTAAR Occasional Paper No. 55, ed. MEIER, M. and ARMSTRONG, R., Bolder, CO: Institute of Arctic and Alpine Research, University of Colorado
- Mass balance data obtained after a call for data for the Glacier Mass Balance Bulletin No. 7 (2000-2001)
- Front variation data from DISCHL, M. (1999): *Weltweite Gletscherlängenänderungen seit 1894*. Diploma thesis, Geography Department, University of Zurich.
- Fluctuation data provided after a call for data for the Fluctuations of Glaciers No. 8 (1995-2000).
- Glacier reconstruction data obtained from historical and geomorphological evidences in various published papers and by a call for data
- Italian front variation and mass balance data from external project partners (in progress)
- Fluctuation data from the new Austrian glacier database (in progress)

The additional dataset was also used to control the existing data. Detected differences and errors were marked and whenever possible corrected with the help of the National data providers. A special effort is about to be done to control and correct glacier coordinates for the analysis and visualization in GIS.

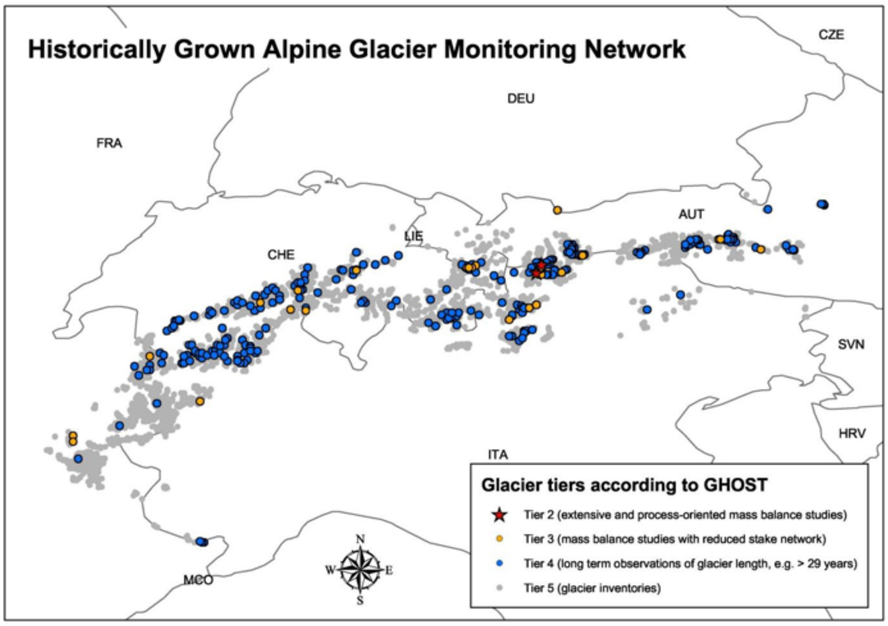


Figure: Historically grown Alpine glacier monitoring network. Tier 2 to 5 refer to the Global Hierarchical Observing Strategy (GHOST) as applied by the Global Terrestrial Network for Glaciers (GTN-G) within the Global Climate Observing System (GCOS).

The collection of glacier reconstruction data from historical and geomophological evidences from the literature helped to design the data model for the storage of reconstructed fluctuations data. However, the contacts with the most important data holders within GAR were not very successful so far. Longer time periods for analysis, lack of established networks (as it exists for glacier fluctuation measurements) and the fear of loosing control on the interpretation of the reconstruction data are some of the reasons, why only a few complete reconstruction series could be loaded into the database.

For the same reasons (among others) the digitized Swiss glacier inventories from 1850 and 1973 have not been made available to the public yet. However, for individual requests and smaller regions they are provided to other scientists. The new satellite derived Swiss glacier inventory (SGI 2000) is already part of the new NSIDC database for the USGS-led project GLIMS (Global Land Ice Measurements from Space). Due to snow cover and cast shadows it is not fully complete at the moment. The 2D glacier polygons will be available through a web-based ArcIMS application and have been converted to geographical coordinates (WGS84). Glacier polygons from 1973 and 1850 are projected in the 'Swiss reference system' (oblique Mercator) using metric units. A possible future combination with the WGI / FOG database has to account for this. In particular the position of glacier labels will be a problem to be solved.

3.4.2.4 Database revision

After a total revision the database of WGMS is able to fulfil the requirements of ALP-IMP and the fast changing database context (data providers, data users, information technology and WGMS itself). The data model was revised and expanded, storage of glacier reconstructions, photos and meta information was enabled, a database lineage established and data are now GIS-compatible. Thus, data analysis with GIS-based evaluation tools is now possible.

Besides the revision of WGMS's database we support the ongoing build-up of the new Austrian glacier database and the development of a Lombardian glacier inventory. For storage and data handling of 2D (and 3D) glacier information, a data base model has been developed at NSIDC. The model uses shape files (public domain format) for glacier outlines and stores additional attribute data together with the label point, similar to the revised WGMS database (see http://www.glims.org/MapsAndDocs/datatransfer/data_transfer_specification.html). The integration of both data bases in the future is recommended.

3.4.2.5 Public data access

Conceptual work for data access and a pilot study from Leutwyler (in prep.) about the potential and requirements for an online database interface are in progress.

*3.4.2.*6 Glacier variability analysis

Glacier variability analysis just started – fist results were presented at the EGU 1. General Assembly by Hoelzle et al. (2004).

3.4.3 Socio-economic relevance and policy implication

Glaciers are recognized as high-confidence climate indicators and as a valuable element of early detection strategies in view of possible man induced climate change by several international assessments such as the periodical reports of the Intergovernmental Panel on Climate Change (IPCC). Past and present glacier fluctuations do indeed provide important information on ranges of natural variability and rates of change with respect to long-term energy fluxes at the earth's surface. The spectacular loss in length, area and volume of mountain glaciers during the 20th century is a major reflection of the fact that rapid secular change in the energy balance of the earth's surface is taking place at a global scale. However, glacier change not only has implications on the water cycle at global scale (e.g. sea level rise). Increased impacts are expected on economic aspects (e.g. tourism, energy production, water irrigation) and on natural hazards (e.g. glacier lake outbursts) on a regional to local scale. These impacts show the strong socio-economic relevance of the glaciers especially on the local and regional scale within GAR.

3.4.4 Discussion and conclusion for the first period

A quality checked dataset of glacier variability within GAR has been established. It contains nearly all available glacier fluctuation series within GAR. The integration in the revised database of WGMS ensures data storage at international standards. However, this is not a one-time job but requires ongoing database maintenance and management.

The data model has been expanded to store reconstructed glacier data from historical and geomorphological evidences. However, the compilation of all important reconstructed series within GAR will be difficult. At least contacts to the leading scientists in that field has been established.

Glacier representativity studies are in progress: Alpine glacier variability will be analysed with respect to volume, area, length, response time, climate sensitivity and others.

Information about available data and exemplary fluctuation series will be published on the project homepage. For particular data requests, WGMS will help to get the appropriate data.

3.4.5 Plan and objectives for the next period

The next steps are:

- Completion of database revision
- Completion of data glacier coordinate control and correction
- Integration of front variation data from Italian glaciers
- Integration of fluctuation data from the new Austrian glacier database
- Representativity study of glacier variability
- Integration of the historically grown Alpine glacier network into Global Terrestrial Network on Glaciers (GTN-G) of the Global Climate Observing System (GCOS) according to the Global Hierarchical Observing Strategy (GHOST)
- Publication of the data on the project homepage
- Reassessment of the length measurements in Switzerland and development of related GIS-based tools.
- Investigate climate proxy interaction of glacier variability by means of the ALP-IMP instrumental datasets

3.5. WP-5: CONSISTENCY OBSERVED VS. OBSERVED DATA (reported by partner 2)

Workpackage 5 is a common activity of partners 1, 2 and 5. Leading partner is partner 2.

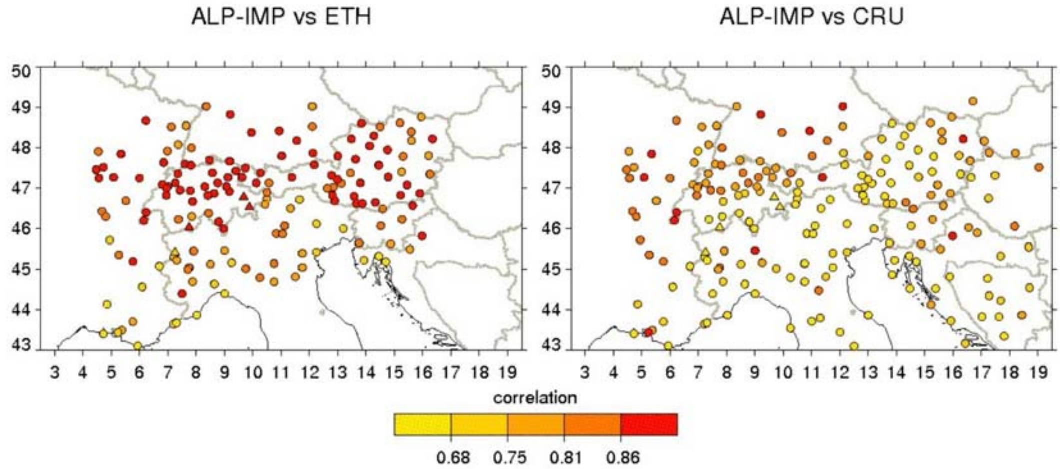
3.5.1. Objectives

- Inter-comparisons between variables within the GAR
- Comparison of principal variables for the GAR with their counterparts in gridded hemispheric variables

Although work for WP-5 was scheduled to take part in the 2nd year of the project (months 13–24), a preliminary evaluation of the ALP-IMP-constructed datasets for temperature and precipitation fields, at meteorological station locations, was considered to be useful. Moreover, the results of that evaluation would assist in the development of advanced versions of these datasets, i.e. time series on a regular geographical grid. As a first step, the efforts during the previous months were primarily focused on the precipitation field.

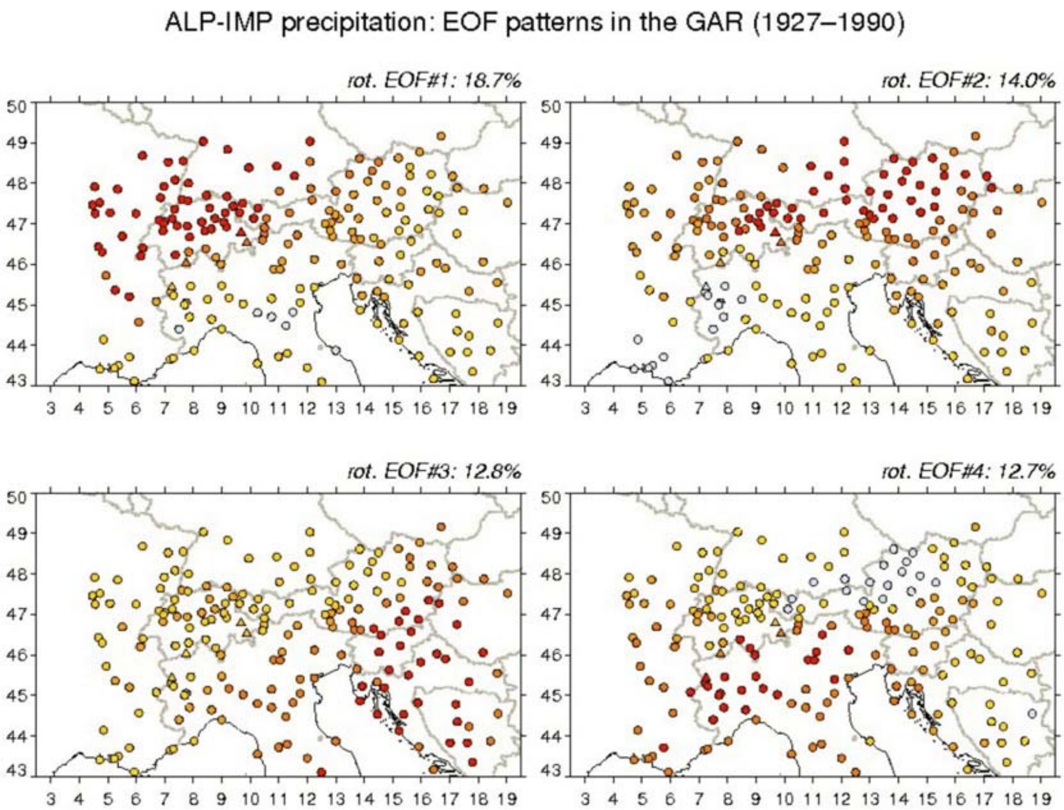
3.5.2. Alpine precipitation datasets intercomparison

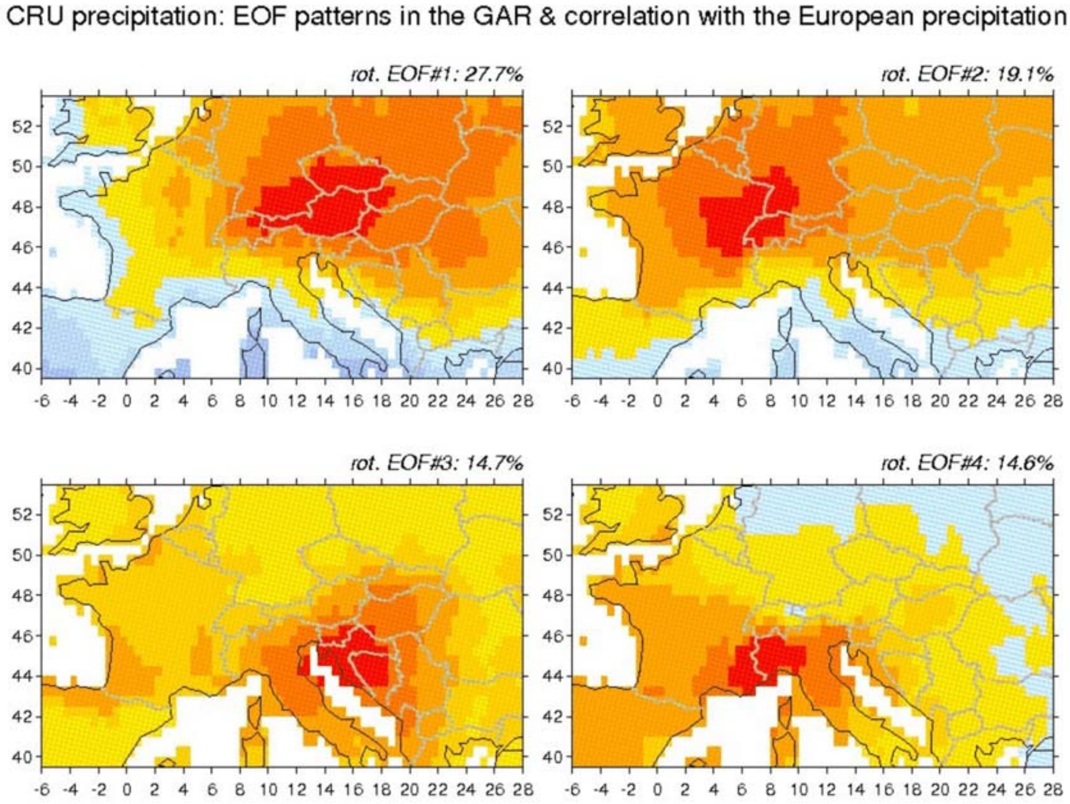
The newly developed ALP-IMP precipitation dataset (WP-1) was compared with two independent datasets of gridded precipitation: ETH [*Schmidli et al.*, 2001; 2002] and CRU TS 2.02 [*Mitchell et al.*, 2003]. The dataset intercomparison was confined to the 20th Century and mainly to the 1927–1990 common period. A series of statistical tests were carried out to examine various aspects of the precipitation field: the climatology (long-term mean of monthly totals), the variability of the anomaly field (i.e. the original field minus the climatological one; see the following figure), and long-term trends. The precipitation field as provided by the ALP-IMP dataset appeared to compare well with the field from the two other datasets, being closer to the field of the ETH dataset than that of CRU. However, certain discrepancies were found to exist. For instance, pronounced differences of the annual cycle were detected at some station sites. Moreover, sporadic deviations were found in the February and October time series, whereas largest, on average, deviations were observed in summer months. The discrepancies between the ALP-IMP and CRU fields were rather large over the Central Alps. The overall differences can be attributed to the different networks of stations used for constructing the gridded datasets together with the particular characteristics of the individual interpolation techniques applied. In any case, the unprecedented station density of the ALP-IMP dataset and its long-term span (bask to early 19th Century, for individual stations) make it suitable for studying the Alpine meso-scale precipitation variability and its associated impacts during the last two centuries.



3.5.3. Mesoscale precipitation patterns of the GAR in relation to the wider European precipitation variability

The representativeness of the GAR precipitation patterns in the wider European context was examined using Empirical Orthogonal Function (EOF) analysis. The first four principal empirical patterns (in 'rotated' form) of precipitation field, derived from the analysis of either the ALP-IMP or the CRU dataset, showed a roughly geographical partitioning into the NW, NE, SE, SW sectors of the GAR. Although these patterns represent a year-round average, which varies from season to season, their geographically limited correlation in the European area illustrated their regional character. Similar analysis carried out at a hemispheric-scale frame showed no special connection with the wider precipitation field.





3.5.4. Plan and objectives for the next period

The WP-5 will be continued with the analysis of temperature and other climatic variables of the GAR. Detailed inter-comparisons with hemispheric-scale fields, at seasonal resolution, are expected to shed more light on any potential association of GAR climatic variability with the global-scale variability.

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3.6. WP-6: CONSISTENCY OBSERVED VS. SIMULATED DATA reported by partners 3 and 7

This workpackage is a common activity of partners 3, 4, 5, and 7, additionally supported by partner 1. The lead and reporting partner is partner 3. Information exchange and coordination among the partners have been established.

3.6.1. Objectives

- Perform a high-resolution (approx. 17 km) simulation for the greater Alpine region (GAR) with a regional atmospheric model for the last few decades.
- Identify regions, variables, and periods where the simulation and the observations agree and where they do not, and analyze reasons for inconsistencies.
- Identify water vapor sources for the Alps and their influence on water isotopes.
- De-convolute the isotope signal in a part affected by local climate parameters and in a part affected by large-scale circulation and varying vapor sources.

3.6.2. Methodology and scientific achievements related to WP-6 including contribution from partners

3.6.2.1. High-resolution simulation for the last decades

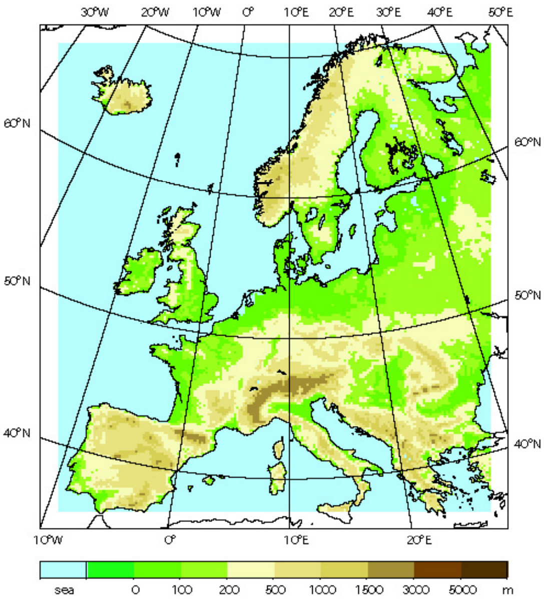
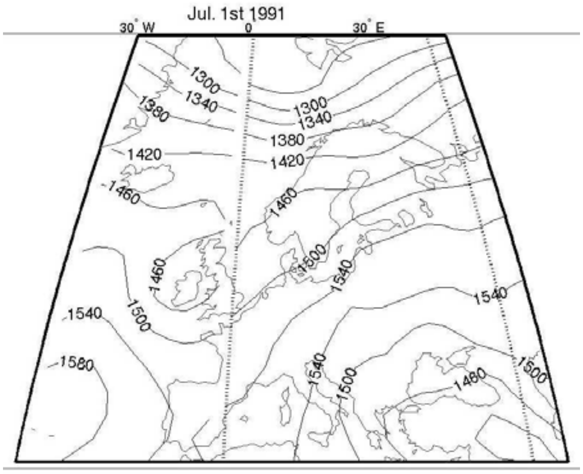
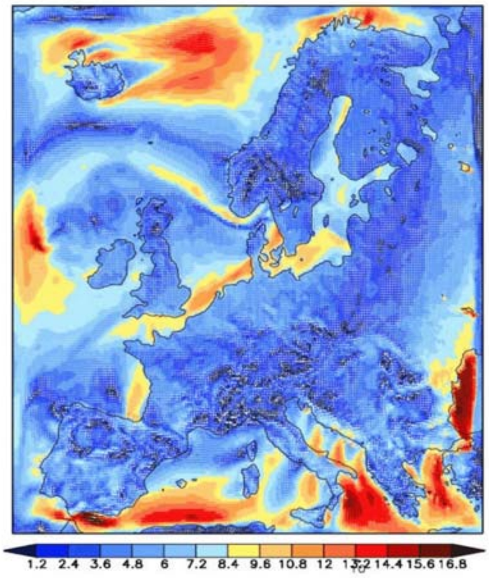


Figure 1: Model domain and topography of the REMO model used for the ALP-IMP simulationwith 1/6 deg resolution.

At GKSS (partner 3) a simulation with the REMO regional model (Jacob and Podzun 1997) for the period 1958 to 2002 has been completed. The model domain covers most of Europe (Figure 1). The simulation provides multi-variable hourly output with a horizontal resolution of about 17 km (1/6 deg on a rotated grid) on 20 vertical levels. An example for wind speeds on an arbitrary day (31 July 2002) is shown in Figure 2. While the wind speeds were low over the Alps on this day, strong orographic effects are simulated for instance in the lee of the Dalmatian Mountains or of Iceland. This simulation will later be used for the analysis of topographic effects and mesoscale circulation patterns over the GAR, and as a basis for climate reconstructions (WP-7). At the boundaries REMO is forced with meteorological variables taken from the ERA40 reanalysis, which was released in 2003 and has a spatial resolution of about 1.1 deg. In addition, the large-scale wind fields within the REMO domain are constrained by means of a spectral nudging technique (Von Storch et al. 2000) to be in agreement with the large-scale ERA40 wind fields. The spectral nudging approach was chosen because various atmospheric states within the model domain can be consistent with a given set of values prescribed at the lateral boundaries. While in simulations for future climates it may be acceptable to randomly select any of these possibilities, simulations for the past should be kept close to the known large-scale state.

Figure 2: Large-scale meteorological situation on 31 July 2001 taken from the ERA40 reanalysis and associated wind speeds simulated with the REMO model with 1/6 deg resolution.





When the ALP-IMP proposal was written, we expected that only the NCEP/NCAR reanalysis would be available to provide the large-scale forcing over several decades for the planned regional simulation. The situation was different when the ALP-IMP simulation was started, because the new ERA40 reanalysis, which has been produced by the European Centre for Medium Range Weather Forecasting (ECMWF), had become available. The ERA40 reanalysis has a resolution of about 1.2 degrees, which is approximately twice as fine as the NCEP/NCAR reanalysis. It can be expected that the ERA40 is more realistic than the NCEP/NCAR reanalysis and therefore it was used to force the regional model.

The change from the NCEP/NCAR to the ERA40 reanalysis led to two changes from the original planning. If the NCEP/NCAR reanalysis had been used, the ratio of the spatial resolution of the reanalysis and the 1/6 deg regional model would have been so large that a double nesting approach, with an additional ½ deg regional simulation would have been needed. With the use of the higher resolution ERA40 reanalysis the ½ deg simulation is not required anymore. The two reanalyses differ also in the period that they cover. ERA40 is available for 1958-2002, while NCEP/NCAR covers 1948-2003. The first WP6 deliverable (6/1) in the proposal, in month 4, is a ½ deg run with REMO from 1948-1957 in order to extend an already existing ½ deg run for 1958-2000. Due to the change to the ERA40 reanalysis the ½ simulation for 1948-1957 has not been done. The slight disadvantage of the shorter than planned simulation period can be expected to be outweighed by the anticipated better quality of the ERA40 reanalysis.

The second WP6 deliverable (6/2), which is the 1/6 deg REMO simulation for the complete reanalysis period, should be completed by the end of May 2004. The simulation was completed in April 2004 and thus delivered in time. The primary post-processing, which is needed before the output can be analysed, is underway and will need a few more months to be finished due to limitations in computing speed.

3.6.2.2. Isotope modelling (subrep. by partner 7 – in close connection also with WP-3)

At CEA/LSCE (partner 7) the physics of fractionation of the stable water isotopes has been built into REMO in order to allow a direct evaluation of the model on a longer ”paleo” time scale in the Greater Alpine Region (GAR). The direct evaluation will be achieved by comparing simulated isotope records with observed water isotope records available from many different archives. Specifically the primary modelling targets are long-term isotope records from high Alpine glaciers, in particular from ice cores taken on the Col du Dôme (Mont Blanc) and on the Colle Gnifetti (Monte Rosa) both analysed within the ALP-IMP project.

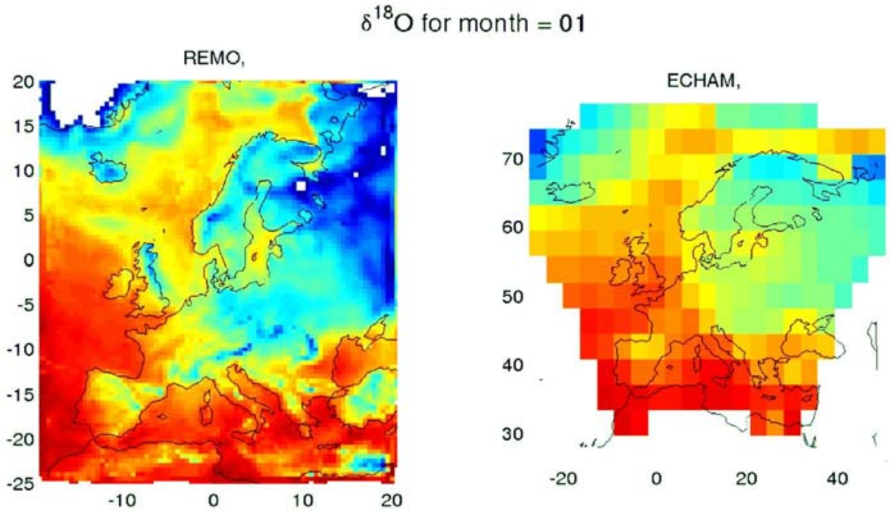


Figure 3: Comparison of the simulated water isotope signals in precipitation, $\delta^{18}O_p$, between the global model ECHAM and the regional model REMO for January, 1995 and the regional model REMO for January, 1995. REMO was forced at it’s boundaries by the ECHAM output for the same model year.

The first WP6 deliverable related to this activity is a one year simulation with 0.5° resolution with a REMO version that includes the isotope fractionation module (deliverable 6/4), due in July 2004. The model is now equipped with water isotope diagnostics, and first simulations have been performed using the meteorological and water isotope forcing at the mesoscale model’s boundaries that were computed by the global general circulation model ECHAM4 (see Figure 3 for a comparison of simulated water isotope fields between the general circulation model ECHAM and the regional model REMO (Sturm et al., 2004)). The 12 month simulation corresponds to the period 1995 only in a very loose sense. The global model was forced with observed sea surface temperatures which hardly constrain atmospheric circulation. This approach therefore does not allow a detailed comparison with, for example, isotope observations of the corresponding time period. In fact, it was a major outcome of the first phase of our contribution to the ALP-IMP project to demonstrate that a direct forcing with re-analysis data (ERA40) is not possible since the REMO model needs isotope fluxes consistent with energy and moisture fluxes at its boundary. To achieve such a consistent forcing *and* a simulation which corresponds as close as possible to a concrete period we have to nudge the global model (ECHAM) first towards the historic atmospheric states as given by the ERA40 reanalysis, and then use it’s output for the boundary conditions of the REMO model. These additional computations were not foreseen in the original proposal. Since the REMO isotope modelling contribution to ALP-IMP is slightly ahead of the original timetable, we think that the additional work of a multi-decadal nudged simulation with the ECHAM4 model will not change considerably the original working plan.

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3.6.3. Socio-economic relevance and policy implication

The ERA40 driven high-resolution simulation for Europe performed within ALP-IMP provides a four-dimensional, multi-variable meteorological dataset for the period 1958-2002 of unprecedented resolution. This simulation can substantially improve our understanding of the links between large-scale atmospheric states and regional weather and climate, in particular over areas where the regional weather can not be fully captured by the instrumental network, either due to a sparsity of observation sites, for instance over the sea or remote areas, or due to the complexity of the terrain, as is the case for parts of the Alpine region. A better understanding of the link between large and regional scales can improve our estimates for the past climate derived from local records, and thus help to discern natural climate variability from anthropogenic effects. It has also a potential for improving regional scenarios for future climate change. The fact that the model simulates not only meteorological variables, but also water isotope fractionation makes it also particularly suited for improving estimates of the past climate from isotope records from icecores.

3.6.4. Discussion and conclusions

The considerable technical challenges associated with conducting a regional simulation that goes to the limit of what is feasible on the current supercomputer at the German Climate Computation Centre (DKRZ), and with implementing an water isotope fractionation module in the REMO model have been successfully mastered. The technical details of the workplan were quickly adapted to take advantage of the release of the ERA40 reanalysis. The unexpected difficulties with respect to the sensitivity of the isotope fractionation simulation to the constraints at the boundaries of the model domain were systematically analysed and a feasible approach to provide realistic isotope boundary values has been suggested and is being implemented.

3.1.5. Plan and objectives for the next period

WP6 will be active as planned (based on the new time schedule after the project prolongation) until project month 26. In the 12 remaining months the WP6 work will focus on testing the consistency between the regional simulation and observations both with respect to meteorological variables and to isotope fractions. Particular emphasis will be given to understanding how the meteorological situation affects the water isotope signals. In the second project phase the model output will be used in WP7 to describe topographic effects as well as to reconstruct the climate in the GAR from long instrumental records.

ANNEX 1.1. Minutes of ALP-IMP kickoff meeting

ALP-IMP KICK-OFF MEETING, VIENNA, MAY 5TH TO MAY 6TH 2003

Participants:

Partner 1, ZAMG: I.Auer, R.Böhm, S.Debit, A.Orlik, H.Scheifinger, W.Schöner, M.Ungersböck
Partner 2, UEA: P.Jones, K.Briffa
Partner 3, GKSS: M.Widmann
Partner 4, UHEI-IUP: D.Wagenbach, M.Pettinger
Partner 5, CNR-ISAC: M.Brunetti, M.Maugeri, T.Nanni
Partner 6, UNIZH: W.Haeberli, M.Hoelzle, F.Paul, M.Zemp
Partner 7, LSCE: G. Hoffmann
Partner 8, WSL: J.Esper, K.Treydte
Partner 9, UAS: M.Grabner, S.Leal
Partner 10, UIBK-IHR: K.Nicolussi

External participant: Giancarlo Rossi, Venice, IT

The meeting took place at two different institutes:

1) a public session at the Agricultural University (BOKU) of Vienna
   http://www.boku.ac.at
2) the “private” workshop for the project partners only at the ZAMG-building
   http://www.zamg.ac.at

Monday, May 5th

9am to 1pm: **PUBLIC SESSION AT BOKU**
(25 project partners plus apprx. 60 participants) :

09.00 to 9.10: (Helga Kromp-Kolb, AustroClim Initiative): Opening address

09.10 to 09.30: Reinhard Böhm (ZAMG, Vienna): General project overview

followed by 6 overview presentations of the pre-project state of the art in the fields of the main project topics (20 minutes each):

09.30 to 09.50: Keith Briffa and Phil Jones (CRU-UEA, Norwich, UK):
Global climate and its reconstruction for the past 1000 years

09.50 to 10.10: Ingeborg Auer (ZAMG, Vienna):
The instrumental period in the greater alpine region

10.10 to 10.30: Martin Widmann and Julie Jones (GKSS, Geesthacht, DE):
Regional climate modelling in complicated terrain

10.30 to 11.00: Coffee break

11.00 to 11.20: Kurt Nicolussi (Uni Innsbruck):
Tree-rings as climate proxies in the Alps

11.20 to 11.40: Dietmar Wagenbach (Uni. Heidelberg, DE) and Georg Hoffmann (LSCE-CEA, Saclay) Alpine ice cores as climate proxies

11.40 to 12.00: Wilfried Haeberli (Uni.-Zürich, CH):
Alpine glaciers as a climate proxy and as a prominent climate impact

12.00 to 13.00: Discussion

The event was visited by natural scientists from the climate impact community mainly. Most of the reactions were positive, only a few colleagues would have preferred to hear about project results already. The general public could be addressed by a broadcasting in ORF-1 and by a contribution at the ORF-science homepage

Short versions of the lectures will be put into the public domain of the project homepage:
Request to Inge Auer, Keith Briffa, Phil Jones, Martin Widmann, Kurt Nicolussi, Dietmar Wagenbach, Georg Hoffmann, Wilfried Haeberli:
these authors are requested to send a 2 to 3 pages version plus 2 to 5 figures to Vienna within the next 2 weeks! Please contact us if this deadline is too short, we can also try to produce the summaries ourselves, but we would highly prefer Your versions

Monday, May 5th 3pm to 6pm:

1ST WORKSHOP SESSION – PLENUM AT ZAMG

General administrative topics:

Information of the partners about:

1) the coordinator's **receipt of the first tranche of CEC-money** at April 1st 2003 (€ 553.112) which was immediately passed on to the contractors at April 8th according to the needs given by the project contract (at ZAMGS cost).
Note for H.Brelen (CEC):
Bank transfer costs are still incredibly high – thus the system of using the co-ordinator institute as a distributing station causes unnecessary additional costs that should be thought over for the future
Request to all partners:
Please check at Your administrations about the receipt of the money at Your institutes
Request to H.Brelen:
Partner 3 (GKSS) shares the costs of one person employed for the project (Beate Müller, post-doc, modelling specialist) with CEC. Due to administrative reasons GKSS would strongly prefer to pay their part of the money for that right at the start of the project, and use the CEC-money later. Is it a problem for CEC, that (unlike to what was written in the money statement of the contract) GKSS does not use any personnel -money in the cost statement for the first project year?
For further explications please contact: Martin Widmann, GKSS, TEL.: +49 4152 87-1835, or the project coordinator, TEL.: +43 1 36026 2203

2) the official start of the project at March 1st 2003

Request to H.Brelen: Most of the partners complained that the written version of the contract reached them not earlier than in April 2003 (dated at CEC with 21/03/03, arrived at Vienna some days later, immediately passed on by us to the partners). So for most of their administrations the process of employing personnel could not be started earlier. This resulted in a realistic actual project start at May 1st, not at the unrealistic March 1st that is mentioned in the contract. Could You please comment on that? We would like to hear Your opinion about a possible postponement of:
a) the annual cost statements
b) the annual project reports

3) the envisaged internal and external project information policy:

day to day bi-lateral routine contacts via **e-mail or telephone**

useful information, requests, data distribution and description, draft-reports and publications, grey literature … etc. to all or many project partners preferably to be distributed via the **internal part of the project homepage**
(password-saved, described later)

PU-products of the project (ref. "dissemination level" in "deliverable list", page 22 of "description of work" preferably be put in the **public domain of the project homepage.** At least there should be a reference or a link in the homepage about any PU-products at other homepages or in printed publications.

Establishing the project steering group (SG)

The partners agreed to adopt without alterations the proposal in ANNEX I of the contract:
The SG consists of: The project coordinator (R. Böhm), the 3 worktask leaders (I.Auer, M.Widmann, P.Jones) and the three proxy-WP leaders (J.Esper, D.Wagenbach, M.Hoelzle)

The question of collaboration with external groups

The plenum agreed to offer external groups on demand a collaboration with the project. Any collaboration should be based on a two-way exchange of knowledge, data etc. A first example is Giancarlo Rossi, a Hydrologist and Glaciologist, who was an external participant of the kick-off meeting. He is supposed to provide the project with some Italian instrumental series and with Italian glacier data.
The integration of further external groups will be discussed on occasion within the steering group. Especially groups from the lake-sediment and from the documentary community positive enlargement would be positive enlargements.

Update of project address-list

A number of new co-workers (project employees and external co-workers) have to be included into the address-list of the project. Some of them were already participating at the workshop and were introduced to and welcomed by the already existing ALP-IMP core team:

Helfried Scheifinger (ZAMG)
Alexander Orlik (ZAMG)
Markus Pettinger (IUP-UHEI)
Frank Paul (UNIZH)
Michael Zemp (UNIZH)
Kerstin Treydte (WSL)
Sofia Leal (UAS)
Thomas Pichler (UIBK-IHR)

The updated address-list will be present in the internal part of the project homepage

Annual project workshops

The plenum agreed to the necessity to hold the annual workshops at least one month before the deadline for the annual project reports. Therefore the next workshop should be either in January 2004 (project month 11 referring to the start date March 1st 2003) or in March 2004 (if CEC allows a shift of two months due to the unrealistic March 1st starting date that was already mentioned before).

In their mail from May 12th the UNIZH-group invited to host the 2nd annual workshop in Switzerland.

P. Jones suggested to try to (at least once) convene a session on Alpine climatology at the annual EGS-meetings, preferably after 2 project years. This would be a good occasion to discuss the progress and the first results at one of the leading conferences in Europe – it would advertise the project and would still allow to include alterations for the last project year based on suggestions and hints from external experts.
I. Auer suggested to try the same at the next bi-annual ICAM (Intern. Conf. On Alpine Meteorology) which will be held 2005 in Croatia. The ICAMs are smaller conferences, but concentrated on the Alps and have a more than 50 years tradition.

Discussion about open problems, necessary alterations, etc. concerning the realisation of the working plan with special regard to project year 1

The plenum discussed before all any necessary changes and/or adjustments of the working plan arising from the 1 years delay in time from the official information about the positive evaluation (25th March 2002) to the receipt of the final contract (21st March 2003). In general the changes of the state of the art have not been that severe to have pre-solved considerable parts of the project objectives. The project's main goals are still worth to be worked on.

Some problems arise from the transformation of the time-axis from "project-months" to real calendar time. Some of the field work fall now into unrealistic winter months and have to be shifted.
Request to the field work groups:
Please inform us about Your new time schedules for fieldwork

Some of the improvements of the state of the art allow highly positive changes (as for instance a better basis for the high resolution regional modelling through the launching of the ERA-40 re-analysis database).

Definition of the working-groups for the separate sessions of May 6th am

5 working groups were established:
3 for the three proxies, one for instrumental climate and one for climate modelling. The following section contains their reports.

Tuesday, May 6th am

WORKING GROUP SESSIONS AT ZAMG

1) **Instrumental Working group**

Participants:
Michele Brunetti, Maurizio Maugeri, Teresa Nanni (CNR-ISAC)
Phil Jones (CRU)
Inge Auer, Alexander Orlik, Markus Ungersböck (ZAMG)

A) Data:
Elements for the whole Alpine Area
For these climate elements a spatial coverage of the entire study region is envisaged

Mean temperature:
Additional Italian temperature series (raw data) will be provided by CNR-ISAC, homogenisation in Vienna. For existing Italian series an update to 2001 can be provided soon, update to 2002 could last until autumn.

Precipitation:
Due to the absence of Michele questions about outliers should be sent in the form of printed maps to Italy. For the joint paper (see B topics to be studied) also raw data are needed.→ Raw data into databank.

Sunshine duration:
only short series for Italy. → useful for a comparison with cloudiness

Cloud cover:
Italian cloud cover data should be available within 6 months. Warning of Phil: cloudiness data are sometimes very suspect.
For France no cloudiness data are available!

For neither of the 2 climate elements (sunshine, cloudiness) a complete spatial coverage seems to be possible, therefore, a **combined sunshine/cloudiness** study must serve to derive the missing series for the gap-regions (as already foreseen in the working plan)

Air pressure:
Digitisation phase in Italy.
Problem: reduction to sea-level of monthly pressure data. Helpful will be the ADVICE data set, which will be sent by Phil Jones, updated as long as possible. Also monthly gridded sea level pressure (5°/10°) since 1780 from ADVICE will be helpful. Before that time only maps of January and July constructed by Lamb are available – (no information how it had been done.)

Elements for representative (selected) regions:

These elements up to now are existing for the Eastern Alps in homogenised form. Additional series should be available for regions South and West/North West of the Alps.

MDR:
For MDR mean daily maximum and minimum temperature data are needed.
In Italy MDR is increasing, no change in Austria, in other regions decrease.
Italian series start 1856, but have to be updated for the last 6 years.
Co-authors of Paper Weber et al. should be contacted for additional data.

Snow:
No snow data for Italy are available at the moment.
Request to CNR-ISAC and to the glacier working group:
Snow is a typical "Alpine" climate element and it should be seriously tried to be adequately studied by the project
Therefore:
Please **CNR, Rossi and the glaciological working group** check carefully once more the availability of snow data for Italy (possible data recovering by digitising from archives of regional entities, from glaciological groups…?)
For France, Switzerland and Germany **the glaciological group** should do so
For Austria, **ZAMG** has already started a "snow initiative", and **ZAMG** will also contact the rest of the smaller and not so "Alpine" ALP-IMP countries.

Vapour Pressure:
From Italy 1 or 2 series will be available.

Relative Humidity:
No additional series to the already existing

B) Topics to be studied for the next time:

- paper of precipitation data set (data, metadata, homogenisation,)
- analyses of precipitation data set
- sensitivity studies (e.g. change of frost days due to higher temperatures etc…)
- Temperature increase derived from air pressure without direct temperature measurements (paper of Tuomi for stations in N-America).
- Alpine MDR

C) Future plans:

The 4th Seminar for Homogenisation and Quality Control in Climatological Databases in Budapest, 6-10 October 2003 is strongly recommended for ALP-IMP partners dealing with homogeneity and data

quality topics. It is a bi-annual WMO-sponsored workshop organised by the Hungarian Met. Service. Further information from szalai.s@met.hu
A project internal working meeting of the data working group is envisaged to handle open questions and exchange knowledge, practical procedures, etc. concerning data availability, homogenising and meta data. Also interested members of non instrumental groups are welcome for information (this refers to a request for information about homogeneity topics from Jan Esper during the workshop).

Inge Auer, 07.05.2003

2) Modelling working group

Participants:
M. Widmann (GKSS),
G. Hoffmann (LSCE)
H. Scheifinger (ZAMG)

Planned work

When the ALP-IMP proposal was written, we expected that only the NCEP/NCAR reanalysis would be available to provide the large-scale forcing over several decades for the planned simulation with a high resolution regional model. The situation is now different, because the new ERA40 reanalysis, which has been produced by the European Centre for Medium Range Weather Forecasting (ECMWF) and covers the period 1958-2002, will be made available for EU researchers within the next few weeks. The ERA40 reanalysis has a resolution of about 1.2 degrees, which is approximately twice as fine as the NCEP/NCAR reanalysis. It can be expected that the ERA40 is more realistic than the NCEP/NCAR reanalysis and therefore we will use the former to force the regional model.

The first modelling milestone, in month 4, is a run with the REMO regional model with 0.5 degree resolution forced by the NCEP/NCAR reanalysis for the period 1948-1957 in order to extend the already existing run for 1958-2000. Due to the change to the ERA40 reanalysis, which starts in 1958, we do not intend anymore to do a simulation for 1948-1957. The slight disadvantage of the shorter than planned simulation period can be expected to be outweighed by the anticipated better quality of the ERA40 reanalysis.

In contrast to the NCEP/NCAR reanalysis, the resolution of the ERA40 reanalysis is high enough to directly force the planned regional model run with 1/6 degree resolution. A double nesting strategy with the intermediate step of a 0.5 degree REMO simulation, as formulated in the proposal, is not needed anymore and therefore the planned simulations will deviate in this respect from the proposal. For comparison a 0.5 degree resolution run will still be produced, but not used to force the 1/6 degree run.

At the ALP-IMP kick-off meeting in Vienna there was a consensus that it is desirable to link the modelling efforts of GKSS and LSCE as closely as possible. Therefore it will be investigated whether it is possible to merge the REMO version used by GKSS, which includes the spectral nudging, with the REMO version used by LSCE, which includes the calculation of the isotopic composition of precipitation. If merging is possible with a reasonable effort, GKSS will use the merged version to do the runs for the whole period 1958-2002.

Request to other project groups:
Other project groups are asked to send their special demands from the modelling groups sa soon as possible. It is much less time consuming for the modellers to include them right at the start of the model run than to do so later

Financial issues to be clarified for GKSS (see also the respective request to H.Brelen):

Does the EU allow that we spend the 50% percent of the finances contributed by the EU at any time during the three year project period, rather than one third of it each year?

Do the GKSS contribution and the EU contribution need to be 12 month (full position) per year, or is it ok to have less than 12 month allocated to the project on one year and more on another year? – assuming the milestones are met.

GKSS would prefer to have only specified that by the end of the project we have to show that we contributed 36 person months to the project.

Martin Widmann, May 17th 2003

3) Tree-ring working group

Participants:
J.Esper, K.Treydte (WSL)
K.Nikolussi (UIBK-IHR)
M.Grabner, S.Leal (UAS)

a) milestones: changing of dates

The new dates are:

Month 6 : completion of survey of existing/available tree-ring data
Month 18 : fieldwork to update network
Month 24 : laboratory processing of new material completed;
completion of selection and statistical reprocessing of tree-ring data
Month 27 : site and regional chronology construction completed;
Analysis of chronology uncertainty and climate sensitivity completed

b) work on first milestone

We first intend to inventory existing tree ring data by providing lists of available data by the end of July 2003. The WSL will send a proposal for the template to the WP partners next week.

The list should include two data sets:
(a) material from living trees only
(b) composite chronologies including living and dead material

and information about:
(a) Maximum length of chronology
(b) Number of trees
(c) Mean segment length
(d) Lon./Lat.
(e) Elevation
(f) Aspect, if possible
(g) Expected sensitivity (precipitation, temperature)
(h) Species
(i) Available parameters
(j) Source
(k) Existing data, data in progress, where do people want to sample.

A map including locations, species, and maximum chronology length information will be sent by each partner together with the completed list.

Every partner is additionally encouraged to contact other people for existing data, data in progress or planned measurements. To close the gaps of chronologies in the Italian Alps, Kurt will get in touch with Carlo Urbinati and discuss the issue of joining the club on a more intensive level. There should be a data security statement in the project, e.g. saying the data is only for use within Alp-Imp or between the four tree ring labs joining Alp-Imp. When asking for data we are allowed to offer the ZAMG products like homogenized instrumental records.

When centralizing the tree ring records, we intend to use (a) Tucson format and (b) tree mean curves.

Based on this list, the network update will start focusing on temperature and precipitation sensitive sites and long records. To organize these next steps the tree ring group will meet at the WSL in late summer 2003.

May, 13th, Kerstin Treydte

4) Ice core working group

Participants:
D.Wagenbach, M.Pettinger (IUP-UHEI)
G.Hoffmann (LSCE)
Plus contacts with glacier group and modeling group

- IUP-Heidelberg is involved in sample collection, isotope data analyses and evaluation and will arrange a one day meeting with LSCE-Paris (being in charge with isotope modelling) in Heidelberg. Here, details on extra ice core data needs and on a dedicated schedule for interactive modelling activities on isotope patterns will be fixed. When the implementation of the isotope fractionation models into the REMO (regional model) programme is finished, the impact of key weather situations (uplift of air masses, precipitation amount, large scale circulation patterns) on the isotope signature of ice cores may be evaluated.
  In this context the installation of a quasi-continuous water-vapour collection device on Sonnblick observatory has been discussed.
- Potential new ice core drillings on Colle Gnifetti are foreseen during September '03 the earliest (in view of stable weather conditions and low air temperature needed). In advance, site selection campaigns based on GPR (ground penetrating radar) surveys are mandatory within the envisaged low accumulation area. Such activities are only viable in close collaboration between Univ.-Zürich and IUP possibly assisted by the Geophysics Section of AWI-Bremerhaven. A short planning meeting of respective field activities is scheduled for early June in Zürich.

Note for H. Brelen:
It was noticed also by the ice core group, that the extensively delayed starting date may have a mayor impact on the high alpine field work schedule (activities virtually excluded during high summer and high winter month)

Request to the other project groups
Please contact Dietmar Wagenbach for a more detailed description and a deeper understanding of your data and results and a possible merging with ice core data and results

May 15th, Dietmar Wagenbach

5) Glacier variability working group

Participants:
Michael Zemp, Frank Paul, Wilfried Haeberli, Martin Hoelzle (all UNIZH)
Wolfgang Schöner (ZAMG),
Gian-Carlo Rossi (ext.)

The WP4-working group met at the Kickoff Meeting of the ALP-IMP Project in Vienna at 6th May

2003. The first 18 months of the project were mainly discussed in the group. First discussion point was about the data availability, then it was followed by discussions on data collection, data selection, data quality and data analysis. Gian-Carlo Rossi will act in the project as an external project partner.

a) Data availability
Many of the data, concerning mass balances, length changes, areal changes and volume changes, are
available in the database of the World Glacier Monitoring Service (WGMS). Some of the data, mainly length change data, were digitized from the old reports of the International Commission of Glaciers and
will be loaded now into the WGMS-database. In addition, an extended literature search will deliver some time series, which are not available in the database until now. Old and long-term series will be extended by historical/geomorphological information.
Coordinator's remark:
Please make sure that You really get as much as possible long-term length change data, which may be well hidden in personal archives of the measuring institutes and/or single persons. Our common intention is to go strongly behind spatial patterns – so an as dense as possible web of measuring points is our "conditio sine qua non". I do not think there are problems to have the mass balance data well organised, but I hope we can also fully rely on a great number of single glacier length changes series as well.

b) Data quality and check
Then, the data will be distributed to G. Rossi for Italy, W. Schöner for Austria, C. Vincent for France and M. Hoelzle for Switzerland. Each country will test the data from the WGMS against their own database and will produce a high quality dataset. This dataset will than again incorporated in the existing WGMS-database. A WEB-site on the basis of a GIS will be developed to simplify the user access and to allow better analysis of the existing data.

c) Data selection and analysis
The data will be selected after several quality and representativity considerations, which have to be determined soon.
After this selection process, the data is ready for analysis. Here are some perspectives for this analysis:
- glacier variability within the Greater Alpine Region (GAR), based on the evaluation of the new ALP-IMP climate data set
- determination of mass balance from glacier length changes
- long-term runs of energy balance models to calculate mass balance
- relationship between glacier and tree ring proxies as well as ice core proxies
- potential of glaciers as proxy for temperature, precipitation, radiation, etc.
- comparison of modelled and/or measured mass balances with ice core or tree ring data to go back as far as possible.
- evaluation of possible impacts of climate change on glaciers from GIS-based modelling

May 12th, Martin Hoelzle

Tuesday, May 6th pm

CONCLUDING PLENUM SESSION AT ZAMG

1) presentation of the project homepage

M. Ungersböck presented the state of his work at the project homepage. The near to final version (not yet in the net) has a freely accessible public part and a password secured internal project member part. It will continuously become updated according to the progress of the project

The public part:
- describes the project objectives, the working plan, the project partners
- contains a project related reference list

- will give short and generally understandable summaries of project results
- will describe the content and the access to project deliverables
- will hint to project related workshops, conferences etc.
- will hopefully serve to make the general public and also interested scientist from other climate related fields of research aware of the project.

Thus it will serve as an information of the general public about the use of public money for our project

The internal part:
is password secured and shall serve as:

- the internal discussion forum for not yet ready to be publicly presented results
- an internal discussion forum for problems, new ideas, proposals for necessary or beneficial changes of initial project ideas…
- a "to do list" according to the schedule for deliverables and milestones
- a "to do list" for administrative topics
- an internal data exchange platform for smaller datasets (plus descriptions for the use) to be freely exchangeable within the project group
- a forum for the announcement of where to get and how to use larger data products (e.g. model runs)
- plus several internal info sites as for example address-list, partner descriptions, and so on…

the homepage will be in the net by the end of May under:

http://www.zamg.ac.at ???

The homepage will be technically managed by Markus Ungersböck. Any contributions from the project partners for the homepage please to be sent to to Inge Auer or to Reinhard Böhm. It will be placed in the site according to Your demands.

2) General open end discussion, bilateral talks etc. and departure of the participants

We are glad that, in spite of the traffic troubles due to a strike in the Vienna region before noon, it seems that all participants could leave the city without severe troubles. The organisers thank them for their useful and interesting contributions and want to stress once more to use this document as a basis for a successful initial project period.

ANNEX 1.2. Minutes of ALP-IMP 2nd annual meeting

ALP-IMP 2nd GENERAL ANNUAL MEETING, ZÜRICH, MARCH 22ND TO 23RD

Participants:

Partner 1, ZAMG: Ingeborg Auer, Reinhard Böhm, Alexander Orlik, Wolfgang Schöner, Markus Ungersböck
Partner 2, UEA: Phil Jones, Keith Briffa, Dimitrios Efthimiadis
Partner 3, GKSS: Martin Widmann
Partner 4, UHEI-IUP: Dietmar Wagenbach, Markus Pettinger
Partner 5, CNR-ISAC: Maurizio Maugeri, Teresa Nanni Michele Brunetti, Fabio Monti, Fabio Dalan
Partner 6, UNIZH: Wilfried Haeberli, Martin Hoelzle, Frank Paul, Michael Zemp
Partner 7, LSCE: Georg Hoffmann
Partner 8, WSL: Jan Esper, Kerstin Treydte
Partner 9, UAS: Michael Grabner, Sofia Leal
Partner 10, UIBK-IHR: Kurt Nicolussi
European Commission, DG RTD/1.2, Bruxelles: Hans Brelen
External participant: Giancarlo Rossi, Venice, IT

The meeting took place at the University Zürich-Irchel

Monday, 22.03.2004:

09.30 – 13.00: 1st Plenum session

Welcome addresses and introductory words:

Wilfried Haeberli (Welcome address on the part of the hosting institute (GIUZ): used some statistical data of the World Glacier Monitoring Service from 1850 to the extreme summer 2003 and some results of future climate projections about the Alpine Glaciers in 2025 and 2100 to illustrate the values of a better understanding of climate variability in the Alps.
file: WS2-pres-Haeberli

Reinhard Böhm Coordinator's report (ZAMG): presented the workshop programme, gave a short summary of the main topics of the working plan of the 1st project year and mentioned shortly the leading administrative topics (project prolongation and the resulting new deadlines for deliverables and milestones, needs for the annual report, the conditions for the inclusion of external project collaborators). He stressed that now, after the first project year (which was mainly dedicated to data collecting and processing and first analyses within the different data-groups) it will be increasingly necessary to accrete and collaborate among the groups. As one means the project homepage shall be used. Finally he expressed the hope that the administrative topics should be as less time consuming as possible and that the workshop should concentrate mainly on science itself.

Hans Brelen Welcome address on the part of EU-RTD: introduced himself as the responsible contact person in the European Commission's Research Directorate General and stressed that his function as a workshop participant is not a controlling one (for this the written reports will be used) but one to get acquainted with the project-partners, with the first results and not at least to help with open questions in administrative terms. He also mentioned the upcoming European Paleoclimate Conference, 6-9th July 2004 in Utrecht and invited to join it. (*www.ucgeo.nl*)

The remaining time of the morning session was devoted to short

Activity reports of the partners

Partner 1, ZENMG.CL:

Instrumental data (WP-1): Stronger than expected concentration on the two main elements temperature and precipitation (ready for use in station mode) due to successful data archaeology, the use of a new method for data adjustment and an intensive correction of outliers (R. Böhm reported in detail in the afternoon session). Cooperation with Austrian project CLIVALP in the field of other climate elements (air pressure, sunshine, cloudiness) and concerning analysis in the instrumental period (I. Auer and M. Ungersböck reported in detail in the afternoon session). The start of an alpine wide "snow data initiative" which goes beyond what was planned due to the importance of that element for the Alpine region and due to the necessity to rely for that element on daily data and on high network density (W. Schöner reported in detail in the Tuesday morning session and initiated and discussed the topic in the snow and ice working group sub-session).

It has to be specifically appreciated that the creation of the instrumental database was only possible due to the voluntary cooperation of a number of persons from national and regional weather services and other measuring network maintaining institutes. They have been incorporated into the project as "external project partners" – their names, addresses, institutes can bee seen on the "who is who" – list of the project homepage.

Glacier records (WP-4): Fieldwork to maintain and support glaciological mass-balancing of three central alpine glaciers. Data archaeology concerning East-Alpine length-, geodetic- and mass balance data which are not yet included in the database of WGMS (compare sub-session report 4). Respective contact activities with glaciological research institutes in France, Germany, Italy and Austria at the 8th Alpine Glaciology meeting in February 2004 in Innsbruck.

Partner 2, UEANG.SES.SE.CR:

Instrumental records (WP-1): Processing of the so far existing project datasets and the two leading supra-national datasets of the study region (CRU, ETH-Zurich) for inter-comparison.

Intercomparison of Alpine Precipitation Datasets" (WP-5): In particular, the recently constructed ALP-IMP precipitation dataset from various multinational station and networks across the GAR, were compared, in terms of inter-annual variability long-term trends, with two other annual datasets of gridded precipitation field (from Climatic Research Unit and the Eidgenössische Technische Hochschule, Zürich). (D. Efthimiadis reported in detail in the afternoon session)

Synthesis – 200y GAR internal (WP-7): As a feasibility study for WP-7 (which in fact starts later) a first regionalisation of the GAR-precipitation dataset based on rotated EOFs was performed and was compared and discussed with the parallel attempts of partner 5.

Tree ring records (WP-2): Leading role (K. Briffa) in the integration of global datasets and in analysis and reconstruction planning of the proxy-domain (see also sub-session report of the tree-ring group).

Partner 3, GKSS.IC:

Consistency obs. vs. simulated (WP-6): The first contribution of the GKSS group to ALP-IMP is a numerical simulation with the REMO regional model that includes the Greater Alpine Region from 1958 to the present with multi-variable hourly output and a horizontal resolution of about 17 km on 20 vertical levels **(WP-6, deliverable 6/2**) This simulation will later be used for the analysis of topographic effects and mesoscale circulation patterns, and as a basis for climate reconstructions **(WP-7**). The model domain is the whole of Europe. At the boundaries REMO is forced with weather variables taken from the ERA40 reanalysis, which was released in 2003 and has a spatial resolution of about 1.1 deg. In addition the large-scale wind fields within the REMO domain are constrained by means of a spectral nudging technique to be in agreement with the large-scale ERA40 wind fields.

According to the milestone planning, the REMO simulation should be completed by the end of May 2004. At the end of March 2004 it covers the period 1958-1995, the primary postprocessing is underway and will need a few more months to be finished due to limitations in computing speed. Thus the corresponding milestone will be met.

M. Widmann reported in detail in the afternoon session.

Partner 4, UHEI.IU:

Isotope ice core records (WP-3): Last year IUP activities

I. Analyses of stable isotope ratios $\delta^{18}O$, δD in Alpine ice cores

1) Monte Rosa KCS core: Sub – sampling at 2 – 6 cm depth resolution to compensate rapid annual layer thinning. 650 $\delta^{18}O$ and 1400 δD analyses over 27 m have been done (18 m to be completed)
2) Mt. Blanc area: Processing and isotope analyses of two Mt. Blanc cores drilled to bedrock. At the Vallot slope core (CDF) 300 $\delta^{18}O$ and 300 δD analyses over 22 m have been done (68 m to be completed) and at the Dôme du Goûter summit core (CDG) 500 $\delta^{18}O$ and 700 δD analyses over 32 m (6 m to be completed).

II. Field activities

1) Search for an optimal drill site at Monte Rosa (Colle Gnifetti)
   Ground penetrating radar (GPR) campaign by UNIZH (Zürich), as based on previous data of the ALPCLIM core array
2) Establishment of two high Alpine sites for precipitation sampling
   Refuge Cosmique, 3610 m asl.: Mont Blanc Region, March – Sept. sampling
   Capanna Margherita, 4555 m asl.: Monte Rosa, June – early Sept. sampling

III. Supplementary laboratory activities

- Ice core dating via bomb – tritium horizon at CDF core
- 15 ^{10}Be pilot analyses of KCS core (Monte Rosa) to identify well known minima of solar activity
- Development of radio – carbon dating of POC and DOC
- Establishment of $\delta^{18}O$ analyses on small ice core samples

IV. Contrast to deliverables and milestones schedules

a) Relevant milestones

- Recovering an ideal ice core at Colle Gnifetti (Monte Rosa) down to bedrock
- 15th month: assessment of isotope sensitivity versus seasonal and glacier flow forcing

b) Relevant deliverables

- 18th month: Continuous $\delta^{18}O$ and D-excess profiles at two Mt. Blanc ice cores down to bedrock
- 18th month: Continuous $\delta^{18}O$ and D-excess profiles at one Monte Rosa ice cores down to bedrock

⇒ **Deficits and major changes**

- Drilling to bedrock at Colle Gnifetti postponed to spring – fall 2004
- Lack of coherence between experimental and modelling based activities

Near future IUP activities

- Define drill place at Colle Gnifetti based on GPR – results
- Establish recent Mt. Blanc core chronologies via seasonal ion stratigraphy (in collaboration with LGGE)
- Complete isotope analyses of KCS and CDG ice cores
- Recover shallow ice cores for up-stream corrections
- Organize deep drilling activities
- Constrain millenia ice core chronology at Colle Gnifetti

D. Wagenbach reported in detail in the afternoon session

Partner 5, CNR.ISAC:

Instrumental records (WP-1): Close cooperation with partner 1 in WP-1 in regard to data archaeology, quality checking, homogenisation for the Italian and former Italian parts of the GAR. Integration of Italian project CLIMAGRI mainly concerning data, later also concerning analyses. The Italian situation is different from that of other countries due to the non-existence of a central national weather service in charge also of climate data. Therefore partner 5 has to compensate this deficit by retrospectively taking over the work of a national weather service in the fields of the establishment of a national climate database. After a sub-workshop with partner 1 (planned for June 2004) the work on all instrumental climate project data will be terminated as scheduled. (For the specific situation concerning snow compare the respective report of partner 1.

Synthesis – 200y GAR internal (WP-7): The 192 precipitation series of the HISTALP dataset were clustered into homogeneous precipitation areas by means of a principal component analysis (PCA). The technique was applied to the correlation matrix R calculated from the monthly anomalies (in order to avoid the dominance of the annual cycle) for the sub-sample 1927-2000 (for which all 192 series are available).

M. Brunetti reported in detail in the afternoon session

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Partner 6, UZUR.DG:

Glacier records (WP-4): In WP-4 lies the focal point of the UZUR.GD-involvement in ALP-IMP. Partner 6 maintains the World Glacier Monitoring Service (WGMS) and one of its main tasks in WP-4 is to integrate the WGMS-data into the project. A number of topics could be successfully completed, some are still going on, for some future topics not yet on schedule there are clearer plans now based on the experience gained during the first project year:

past WP-4 activities:

- WGMS database new design
- WGMS mass balance data update and check
- WGMS length change data update and check
- Building of GIS-based evaluation tools
- Geomorphological evidences
- Stake readings (Oberer Grindelwald glacier, Oberaar glacier)
- Development of mass balance model

Ongoing WP-4 activities:

- Loading of glacier data into database for the GAR
- Coordinate check
- Further development of mass balance model
- Representativity of glacier variability
- Integration of historically grown alpine glacier network into GTN-G (GHOST)
- Finishing of GIS-based Swiss inventory

Isotope ice core records (WP-3): As support for UHEI.IU radar measurements at Colle Gnifetti were performed

M. Zemp and F. Paul reported in detail in the Tuesday-morning session

Partner 7, CEA.LSCE:

Isotope ice core records (WP-3): The main contributions of partner are in the field of a better understanding of the isotopes-climate relations and dependencies. Thus a close cooperation with partners 3 and 5 has been established.

The REMO regional climate model *[Jacob et al*., 1995] is intensively used in climate change impact studies on a regional scale. Here, within the ALPIMP project we built the physics of fractionation of the stable water isotopes into REMO in order to allow a direct evaluation of the model on a longer "paleo" time scale in the Greater Alpine Region (GAR). We achieve such a direct evaluation by comparing simulated isotope records with observed water isotope records available from many different archives. Specifically our primary modelling targets are long-term isotope records from high Alpine glaciers, in particular from ice cores taken on the Col du Dôme (Mont Blanc) and on the Colle Gnifetti (Monte Rosa) both analysed within the ALPIMP project. A major delivery of our contribution to the ALPIMP project is a high-resolution simulation of the climate of the second half of the 20 th century (1955-2000) with the REMO model. REMO will be forced at its model boundary by re-analysis data from the ECMWF. The model is now equipped with water isotope diagnostics (see Figure 1 for a comparison of simulated water isotope fields between the general circulation model ECHAM and the regional model REMO, *[Sturm et al*., 2004]) and is ready for the "20 th century simulation". However, for such a simulation the regional model does not only need observed wind fields, energy and moisture fluxes as boundary forcing, but also realistic water isotope fluxes. Since such fluxes are not observed in a next step we will compute the needed isotopic forcing by means of the global model ECHAM.

Jacob, D., M.Claussen, D.Majewski, R.Podzun, and B.Rockel, REMO - a model for climate research and weather forecasts, in *Research Activities in Atmospheric and Oceanic Modelling*, 1995.
Sturm, K., B. Langmann, G. Hoffmann, and W. Stichler, Water isotopes in precipitation over Europe: regional atmospheric modelling versus station measurements, *Hydrological Processes*, 2004.

G. Hoffmann reported in detail in the Tuesday-morning session

Partner 8, SFIF.RGD:

Tree ring records (WP-2): Partner 8 leads WP-2, the deliverables of WP 2 are:

- To establish new GAR tree-ring networks of 120 ring-width and 40 ring-density chronologies extending back 300-500 years, and 4 subfossil and building-based chronologies extending back 1500 years
- To describe the local and wider-regional climate sensitivity of the tree-ring data

The first two milestones are:

- Month 6: completion of survey of existing/available tree-ring data
- Month 18: field work to update network

Current state of activities:

385 ring-width and 131 ring-density chronologies from 6 main species (*abies alba, larix decidua, picea abies, pinus cembra, pinus nigra and pinus sylvestris*) have been collected during the last year. They cover the whole alpine range and an elevational gradient from 50 m a.s.l. up to 2300 m a.s.l. The extension of the network to the Eastern Italian Alps is related to the contact with Carlo Urbinati (Uni Ancona) and Marco Carrer (Uni Padua) as new ALPIMP collaborators. 106 records reach back 500 years and 6 composite chronologies (subfsossil and building-based) will reach back more than 1000 years. Work on these long records (quality control, extending the replication and time window) is currently underway. All of these data sets will be centralized at the WSL.

53 ring-width and 30 density chronologies from high elevation sites (>1500 m a.s.l.) were used to develop a high elevation network for temperature reconstruction (June to August and May to September), which is stable over space and time and provides detailed information about the alpine temperature history back to 1600 AD (David Frank).

A 1300-year composite chronology based on recent and historic wood (Larix decidua) from the Wallis/Switzerland is nearly finished, using own material and archaeological tree ring data from Swiss archeologists (M. Schmidthalter and M. Seifert). It will lead to detailed knowledge about long-term temperature trends of the alpine area (Ulf Büntgen).

The planned density measurements to update some selected sites are slightly delayed due to technical problems at the subcontractors institute in Krasnoyarsk/Russia. These problems have recently been solved. But at the same time, we are currently conducting density measurements on the 1300-year Larix chronology at the WSL. This project was not proposed, but has been undertaken as a project of opportunity and anticipated valuable outcome. This record will be the first millennium-long high elevation alpine density series and will provide new aspects on the temperature history within ALPIMP.

Altogether we are on a reasonable time schedule, and do not foresee any difficulties in reaching the deliverables.

K. Treydte reported in detail in the afternoon session (see also tree-ring sub-session report and tree-ring interim meeting report)

Partner 9, OBW.BO:

Tree ring records (WP-2): Concerning the tree-ring data-workpackage partner 9 is responsible for the Eastern Alps east of Tyrol. The main topic of the first year was to take new dendro samples and to reorganise and check the old, available dendro data.

*) Almost all tree-ring series of the 82 old sites were checked. A database of meta-data and the tree-ring files itself was established.

*) New sampling took place in south-east Austria in high elevation (Wurtenkees, Mauterndorf, Paal, Malta and Mörtschach) resulting in 14 new chronologies. These sites were chosen to close regional gaps and to study the influence of precipitation on the growth of the trees in high elevation. The measurements of these sites are finished, and most of the synchronization is done.

*) Sampling of sub-fossile samples took place at two alpine lakes (Schwarzensee, Riesachsee) and in Hallstatt, resulting in 8 new chronologies. Sampling in the lakes was successfully done by the Austrian military. Unfortunately – against all expectations - not very long lived trees were found. The measurements are finished, dating of the samples just started. In Hallstatt we started to set up another long chronology, with the main sampling in August 2004.

*) Also four “dry sites” closed to Vienna (Weinviertel – one of the driest regions in Austria, to reconstruct precipitation) were sampled. These samples are not processed yet. We still try to find dry sites with old trees.

M. Grabner combined the activity report and the first results report into one presentation
file: WS2-pres-Grabner.ppt
file: WS2-pres-Grabner-app.AVI

Partner 10, IHF:

Tree ring records (WP-2): Concerning the tree-ring data-workpackage partner 10 is responsible for the Eastern Alps west of Salzburg.

This work can be divided in two main fields:

1. sampling and analysis of new tree-ring material: samples from 8 sites of the middle part of the eastern Alps have been analysed to up-date and improve existing tree-ring chronologies and to establish a new chronology for low elevations.

2. re-processing of existing tree-ring data: a major and time-consuming part of the work of the Innsbruck group is the re-processing of existing tree-ring data to bring these data into a common format and to check data quality.

With a part of the existing tree-ring data, climatic analyses have started in co-operation with the SFIF.RGD tree-ring group. The goal is the establishment of a summer-temperature reconstruction by using tree-ring material from high elevation sites for the Alp-IMP time-frame.

K. Nicolussi combined the activity report and the first results report into one presentation
file: WS2-pres-Grabner.ppt

Monday, 22.03.2004
14.00 – 17.00: 2nd Plenum session

Tuesday, 23.03.2004
09.00 – 10.00: 2nd Plenum session, continued

Extended reports on first results:

Although the first project year mainly dealt with data-collection, -processing, -quality checking, there have been already some first studies on the new data. They were presented in more extended presentations of 25 to 25 minutes during the Monday-afternoon and Tuesday-morning. Most of them can be found as ppt-files on the ALP-IMP ftp-server. The following presentations were given (included in the list are also combined activited-first results reports that were already given during the Monday-morning session)

Reinhard Böhm et al.**:** The new (updated and re-analysed) instrumental temperature and precipitation datasets – from ori to hom and some first results
file: WS2-pres-Boehm.ppt

Ingeborg Auer et al.: Frost frequency and mean temperature – a non linear relation
file: WS2-pres-Auer.ppt

Markus Ungersböck et al.**:** The new CLIVALP-air pressure dataset – from ori to hom and some first results
file: WS2-pres-Ungersboeck.ppt

Martin Widmann et al.: High resolution numerical modelling
file: WS2-pres-Widmann.ppt

Michele Brunetti et al.: ALP-IMP project: The precipitation dataset – pricipal component analysis
file: WS2-pres-Brunetti.ppt

Dimitrios Efthimiadis et al.: Alpine Precipitation Datasets Intercomparison
file: WS2-pres-Efthimiadis.doc

Kerstin Treydte et al: The GAR tree-ring network
file: WS2-pres-Treydte.ppt

Dietmar Wagenbach: Ice core presentation

Michael Zemp and Frank Paul et al.: WP-4, Glacier proxies – First results
file : WS2-Paul.ppt

Georg Hoffmann: Isotope modelling
file: WS2-pres-Hoffmann.ppt

Wolfgang Schöner et al.: Initiative for long term series of snow cover in the Alps and examples of expected results
file: WS2-pres-Schoener.ppt

Tuesday, 23.03.2004

10.30 – 12.30: Non plenary sub-sessions

After a short discussion about the necessity of sub-sessions it was decided to keep them on schedule. Some of the partner-institutes spread their participants into different sub-sessions and some work-packages were combined into joined sub-sessions. This resulted into the following 4 groups:

Sub-session 1: WP-1, WP-5, WP-6 (instrumental data and analysis topics supported by the modelling expert from GKSS and with guests from WP-3 and WP-4)

Sub-session 2: WP-2 (tree-ring topics)

Sub-session 3: WP-3 (ice core topics)

Sub-session 4: WP-4 (glacier topics)

The following sub-session reports are supplemented by a report about a sub-group meeting of the WP-2 group (tree-rings) who had already an interim meeting at the institute of partner in October 2003 at Birmensdorf (CH)

Report of sub-session 1

Participants: Phil Jones, Dimitrios Efthimiadis, Martin Widmann, Markus Pettinger, Maurizio Maugeri, Teresa Nanni, Michele Brunetti, Fabio Dalan, Ingeborg Auer, Reinhard Böhm, Markus Ungersböck, Alexander Orlik

Main topics of discussion:

- Cooperation with external project partners
- The needs and methods to develop the instrumental datasets from station-mode to grid-mode
- Planning of the next publications
- further topics for studies and publications

Cooperation with external project partners

There was general agreement with the formal integration of the group of instrumental data providers (see activity report of partner 1) into the project. They get the password to the member area of the homepage and should be acknowledged in oncoming papers dealing with the instrumental part of the project database. Their use of any project data for any publications during the next 2 years is allowed under the condition to first inform the project's steering group and then to mention the project in the paper. Studies on topics of the project's working plan without any project partner included will not be authorised, such with project partners included are welcome.

The inclusion of potential external institutes for studies based on the project database (e.g. the two Swiss climate variability groups at ETH and Uni-Bern has to be approved by the project's steering group.

station-mode – grid-mode

Main point of discussion was the further planning of the need and the methodology for constructing gridded versions of the instrumental precipitation and temperature datasets. For both parameters ZEMG.CL will soon provide a gridded version of the monthly relative fields in 1-1 deg resolution (precipitation in percent of a long-term normal, temperature as subtractive deviations from a long-term normal). These fields refer to grid-points and are calculated according to the method described in the 2001 Böhm et al publication in IJC. The calculation of other relative gridded fields with other methods would be welcome and could serve for methodology comparisons (grid-points vs. grid-boxes, weighted or non-weighted averaging, grid-distance. All in all there should not be any real problems concerning the relative fields.

The discussion then changed to the possibility to construct not only relative but also absolute fields. Here the complicated topography of the Alps comes into play. Much higher spatial resolution is needed, topography in any case produces sub-scale effects compared to any thinkable network density. On the other hand most users – primarily also the project partners from the proxy-groups – have a need for absolute data.

The necessary preconditions are high resolution digital climatologies for the GAR. For precipitation the ETH-Zürich MAP-precipitation climatology would be a good basis to work with, for temperature such a basis exists only for some countries on national level (Austria, Slovenia, Croatia, Bavaria). CRU is going to apply a method already existing at the institute to create such an alpine wide monthly mean temperature climatology. As a first step the Austrian 400-station dataset will be used and compared with the already existing ÖKLIM mean monthly 1961-90 high-resolution temperature climatologies.

Further on a method similar to the ETH-Zurich method for reconstructing high resolution absolute fields based on the more homogeneous (in terms of spatial homogeneity and of the elimination of non climatic breaks), denser and longer project data shall be applied.

next publications (next months)

After the already submitted (IJC) paper explicitly describing the creation of the precipitation dataset two further precipitation papers are planned for the near future:

- one paper dealing with gridding, intercomparison with other datasets (regional and global), spatial representation... (CRU as lead-institute, ZENMG maybe ETH as co's)
- one dealing with the analysis of the precipitation variability patterns in the GAR (trends, sub-regional differences, special periods, exceptionally wet or dry months or seasons, seasonal effects...) (CNR-ISAC as lead-institute, CRU and ZENMG as co's)

further topics for studies and publications (2nd project year)

In close cooperation with the national projects CLIMAGRI and CLIVALP some topics for studies and papers within the second project year were discussed and

- 1 combined temperature-precipitation analysis also in respect to circulation influences
  starting with the Auer-Böhm combined temp-precip paper (Auer, I. and R.Böhm (1994): Combined Temperature-Precipitation Variations in Austria During the Instrumental Period. Theoret. and Appl. Climat. 1994, pp. 1-14), focusing on GAR-climate – NAO correlation and its fluctuations (oscilations) in time
  evt. deriving a new GAR-focussed index
  evt. highlighting also some connections to glaciers and tree-rings (in regard to the inversion problem: multiple climate (temp and precip) –> glaciers –> temperature or precipitation (similar for tree-rings?)
- 1 (or more) temperature paper (s):
  description of the re-analysed dataset (what's new compared to the ZAMG-CNR-UNIMIL- 2001 temperature paper),
  overall description of long-term features (special attention to the early period with much new data)
  special periods at decadal scale (the summer warm spell near 1800 (was it too warm for the advanced glaciers???), the abrupt cooling of the 1810s, the early 19th century glacier advances and first strong glacier retreat period after 1850 are they explainable by temperature alone??? What do tree rings tell us in the early instrumental period?), the maritime phase of the 1910s (warm winters plus cool summers, glacier advances, tree-rings?), he phase shifting of the (GAR) first maximum near 1950 versus the global maximum near 1940, the Scandinavian near 1930
  extreme events at annual to sub-annual scale (Summer 2003, year 1829, and other extreme seasons or years, their spatial extension, plus cross-connections to impacts and/or proxy information from the glacier and tree-ring community....)
  vertical features (trends of zero deg-line, trends of TSI (thermal stability index), measured and modelled (air pressure method) AACTs (Alpine air-column temperatures)

Report of the WP-2 interim meeting in October 2003

October 07, 2003 at the WSL

Participants:

Keith Briffa (UEA), Kurt Nicolussi (UIBK-IHR), Sofia Leal (BOKU),

Jan Esper, Kerstin Treydte, David Frank, Ulf Büntgen (all WSL)

The aims of the meeting have been:

- to consolidate a list of existing tree ring data at all institutes (and ITRDB), concerning living trees and composite records
- to discuss gaps and needs obvious from this list
- to make decisions about the next steps to meet the deliverables

Tree ring list:

The main product of the meeting is a consolidated list of available tree ring data of the Greater Alpine Region (GAR). Currently the **list with living material** contains 318 data sets to establish well replicated chronologies: 148 from the WSL, 70 from the BOKU, 31 from the UIBK/IHR and 40 from the International Tree Ring Data Bank (ITRDB). However, because of some gaps concerning coordinates and elevation, the number of useful site data sets might be about 280. About 90 of them include density measurements. The main species are *Abies alba, Larix deciduas, Picea abies, Pinus cembra, Pinus nigra, Pinus sylvestris* and *Pinus mugo*. Only few data sets including *Fagus sylvatica* and *Quercus robur* are available.

The **composite list** (existing living and dead material) currently contains three 1000 to 1500 year long chronologies (PCAB, LADE, PICE) from the UIBK/IHR and one 3474 year long chronology (LADE, PCAB, ABAL) from the BOKU. All of them are Austrian sites based on tree ring width measurements.
The attached map shows the spatial distribution of the sites and age-classed chronology lengths.

Further progress:

A temperature reconstruction utilizing a Western Alpine high elevation network of 52 ring width and 32 density sites is analyzed (WSL). The network demonstrates the strong spatial similarity in tree response to summer and vegetation period temperature variation over wide alpine regions. It adresses the suitability of the chosen sites for temperature reconstructions.

Furthermore the construction of a millennia-scale *Larix decidua* chronology from living trees and archeological timbers in the Lötschental (Valais, Swiss Alps) is in progress (WSL). This analysis will enable an extension back to 1300 years.
Besides at each institute measurements of living material (new and updates) from several network relevant sites are in progress.

<u>Gaps and needs</u>

The main gap is the still low spatial density of sites in northern Italy. Here we need to collect more data sets.
Most of the existing density records end in the 1970's and 80's. Here an update of 5 to 10 relevant sites would be useful (depending on the workload when measuring the densities from the new long Lötschental series).
Presently the millennia-long chronologies are only based on tree ring widths. Density measurements from at least one of the long records will be performed.
The data sets containing raw measurements on single series have to be centralized.

Decisions

The forthcoming sampling procedures for the updating and extending of the GAR-network have been decided between the institutes. Furthermore each group will choose the most important sites for updating density measurements. This updating will concentrate on PCAB and LADE being the most important species.

A millennia-long density record will be established from the Lötschental – chronology. This will be the first long chronology of *Larix decidua* samples. Depending on the workload this will reduce the number of updated density chronologies from living material.
The data sets with raw measurements of single series in Tuscon-format and the correspondent meta-data sets are going to be centralized at the WSL. A Data-CD available for the dendro group within ALPIMP will be prepared.

The data exchange of the millennia-long composite chronologies will be discussed again in spring 2004.

<u>Report of Sub Session 2</u>

Participants: Keith Briffa, Kurt Nicolussi, Sofia Leal, Michael Grabner, Jan Esper, Kerstin Treydte

Upcoming activities:
We agreed to send lists of current analyses and papers to the dendro-partners within Alp-Imp.

This should include a schedule of the summer season activities. If possible this information should circulate before the end of April 2004.
Another meeting of the group, perhaps towards the end of the growing season 2004, will be held in Austria. If possible, Carlo Urbinati and Marco Carrer should join this meeting.

Data:
Kerstin and Jan will check the possibility to centralize tree-ring data in Birmensdorf. In the case that this turns out to be problematic, the GAR tree-ring data will be centralized in Norwich. There will be a password-protected platform to be used by Alp-Imp partners including Carlo Urbinati and Marco Carrer. The database might include different categories of data. More information on this issue will be distributed by Kerstin Treydte within the next 3-4 weeks.
Analyses:
Currently there are several analyses carried out by the partners. These will be reported by the end of April (see above) and released to Reinhard Boehm. Future activities might include studies on supra-long chronologies (Michael, Kurt), PDSI reconstructions (Keith), extreme years (Dave, all), early instrumental data (?), and local more detailed analyses (all). We discussed the need for comprehensive papers perhaps focusing the last 1000 years and including solely tree-ring data and perhaps a multi-proxy comparison. Reconstructions and papers should be send to the Alp-Imp website.

Jan Esper, Kerstin Treydte
(Birmensdorf, March 25, 2004)

Report of Sub Session 3

Participants: Dietmar Wagenbach, Wilfried Haeberli, Martin Hoelzle

High Elevation Sites:
Mont Blanc:

- Radar Measurements will be carried out at the top of Mont Blanc in May or June, depending on weather conditions together with the French group from Grenoble (S. Preunkert, C. Vincent).

Monte Rosa:

- There is an open 100 m borehole from the PSI-group at the Colle Gnifetti site, where temperarature measurements will be carried out in May or June, depending on weather conditions.
- Two new boreholes are planned at the Colle Gnifetti based on the radar measurements, which were performed last summer.

Low Elevation Sites:
Vadret da Rims:

- Ice core taken from the small glacieret will be analysed at Heidelberg

Corvatsch:

- New ice cores will be taken from the ice crest at Corvatsch and analysed in Heidelberg

Report of Sub Session 4

A) Integration of Italian front variation data
Participants: Giancarlo Rossi, Adrian Stolz, Michael Zemp

The Zurich group received front variation data from about 700 Italian glaciers from Giancarlo Rossi. In the weeks before the 2nd ALP-IMP Meeting this was controlled and converted into a WGMS-compatible format for the integration into WGMS's database. In this sub session we discussed the workflow, semantic and data conversion problems and the treatment of separating glaciers. In the next weeks coordinates have to be controlled and corrected, the new data will be uploaded into the database and the final version will be sent as Access file to Giancarlo Rossi. Further on mass balance data from Giancarlo Rossi will be checked with existing mass balance data – however, here we expect to have most of the data.

B) WGMS: Database revision and data model
Participants: Frank Paul, Wolfgang Schöner, Michael Zemp

The revision of the WGMS's database is about to be completed. The new Austrian glacier database will be based on the revised data model from WGMS. In this sub session we went through the whole data model and discussed new features, specific problems and concepts (e.g. development of coordinates from sexadecimal to decimal numbers; angular vs projected front variation). Decisions made:

- An expansion of WGMS's database to store reconstructed mass balance data will be considered.
- Wolfgang will provide the Zurich group with a comparison of angular vs projected front variations from Austrian glaciers.

The new Austrian glacier database should be completed within the next two or tree months and will then be integrated into WGMS's database.

Tuesday, 23.03.2004

14.00 – 16.00: Concluding plenum session

After short reports of the sub-session discussions (included above) some items of general interest were discussed:

Annual report:

Dietmar Wagenbach pointed to the changes in reporting from 4th to 5th framework programme (e.g. the structure has been changed from structured by partner-reports to structured by workpackage reports)

Hans Brelen underlined that and strongly advised to use the respective documents downloadable from the CORDIS homepage.

Some partners not so familiar with the structure of the homepage asked the project-coordination to specifically select the necessary documents, forms and guidelines. (remark: this has been done by e-mail of Sophie Debit from April 1st – no April-fooling!)

Reinhard Böhm mentioned to refer to the (changed) first reporting period March 2003 to April 2004, and to send the necessary material to the coordinator soon after May 1st. (remark: as there were already some not-understandings and some mis-understandings, we will soon (1st week of May) contact the respective WP-leaders and spread some additional information if necessary - please use also these minutes, there may be some useful information for the annual report)

Some remaining scientific remarks

Markus Pettinger raised the topic of "temperature on precipitation days". This topic was first touched during the previous project ALPCLIM, but not really and completely implemented into the study of isotope-information in ice cores versus climate variability. Inge Auer will discuss this with partner UHEI in the future.

Reinhard Böhm stressed the necessity for the 2nd project year to successfully handle the transition from a more specific single database oriented proceeding (which was the scope of the 1st project year) to a more and more integrative way of proceeding for the remaining part of the project. Hans Brelen supported this opinion. He also described his positive impression about the workshop and his hope for a successful and interesting continuation.

To make this growing together easier Dietmar Wagenbach asked to make some instrumental and some proxy series already now available for other groups to get acquainted with them. Also if they are not regarded as "final" or "definitely quality tested" they should serve only "to play around with them". It could well be that during this process some at first view strange ideas could be raised from non specialists which could initiate interesting new aspects. (remark from ZENMG: the instrumental datasets of precipitation and of temperature are already available in "station-mode" via the project homepage. Precipitation can be regarded as final version, temperature is still subject of final quality testing – especially in regard to single outliers there may be some remaining changes to come up in the next time).

Next general annual meeting

The Italian partner 5-group announced their offer to organise the next annual workshop in spring 2005 in Bologna. This proposal was thankfully adopted.

ANNEX 2.1. to ALP-IMP first progress report

ALP-IMP cumulative publication list (status : June 2004)

PEER REVIEWED ARTICLES				
Authors	**Date**	**Title**	***Journal***	**Reference**
Aguilar E, Auer I, Brunet M, Peterson TC, Wieringa J	Dec. 2003	Guidlines on Climate Metadata and Homogenization	*WMO-TD* **1186** *WCDMP* **53**	51 pages
Auer I, Böhm R, Jurkovic A, orlik A, Potzmann R, Schöner W, Ungersböck M, Brunetti M, Nanni T, Maugeri M, Briffa K, Jones P, Efthymiadis D, Mestre O, Moisselin JM, Begert M, Brazdil R, Bochnicek O, Cegnar T, Gajic-Capka M, Zaninovic K, Majstorovic Z, Szalai S, Szentimrey T	accepted June 2004	A new instrumental precipitation dataset in the greater alpine region for the period 1800-2002	*International Journal of Climatology*	no pagecount available yet
Maugeri M, Brunetti M, Monti F, Nanni T	2004	Sea-level pressure variability in the Po-plain (1765-2000) from homogenized daily secular records	*International Journal of Climatology* **24**	437-455

NON REFEREED ARTICLES

Authors/Editors	Date	Title	Event	Reference	Type*
Böhm R, Auer I, Ungersböck M, Schöner W, Huhle C, Nanni T, Brunetti M, Maugeri M, Mercalli L, Gajic-Capka M et al.	May 2003	Mesoscale patterns of long-term precipitation variability in the greater alpine region	ICAM-03: International Conference on Alpine Meteorology	Binder P, Richner H, Schär Ch (eds): ICAM-03 Extended Abstracts, *Publications of MeteoSwiss* **66** 555	abstract (of an oral presentation)
Böhm R.,Auer I, Schöner W, Ungersböck M, Huhle C, Nanni T, Brunetti M, Maugeri M, Mercalli L, Gajic-Capka M, Zaninovic K, Szalai S, Szentimrey T, Cegnar T, Bochnicek O, Begert M, Mestre O, Moisselin JM, Müller-Westermeier G, Majstorovic Z	Sep. 2003	Der Alpine Niederschlagsdipol – ein dominierendes Schwankungsmuster der Klimavariabilität in den Scales 100 km – 100 Jahre *(The alpine precipitation dipole - a dominant climate variability pattern at the scales of 100 km - 100 years)*	6. Deutsche Klimatagung - Klimavariabilität, 22.9. - 25.9.2003, Potsdam (DE) *(6th German climate conference - climate variability)*	Negendank FW, Ristedt H (eds), 2003: *Terra Nostra* **2003/6**, 61-65	proceedings with extended abstracts (of an oral presentation)
Auer I, Böhm R, Scheifinger H, Ungersböck M, Orlik A, Jurkovic A	approved in Dec. 2003	Metadata and their role in homogenising	Fourth Seminar for Homogenization and Quality Control in Climatological Databases, 6.-10.10.2003, Budapest (HU)	Szalai S, Szentimrey T (eds.), 2004: Proceedings of the 4th Seminar for... *WMO-WCDMP*	proceedings with extended abstracts (of an oral presentation)
Scheifinger H, Böhm R, Auer I	Sep. 2003	Räumliche Dekorrelation von Klimazeitreihen unterschiedlicher zeitlicher Auflösung und ihre Bedeutung für ihre Homogenisierbarkeit und die Repräsentativität von Ergebnissen *(Spatial de-correlation of climate time series of different time-resolution and it's relevance for homogenization and spatial representation of results)*	6. Deutsche Klimatagung - Klimavariabilität, 22.9. - 25.9.2003, Potsdam (DE) *(6th German climate conference - climate variability)*	Negendank FW, Ristedt H (eds), 2003: *Terra Nostra* **2003/6**, 375-379	proceedings with extended abstracts (of a poster)
Roswitha Drosg, Walter Kutschera, Martin Schock, Peter Steier, Dietmar Wagenbach, Eva Maria Wild	Sep. 2003	Radiocarbon determination of particulate organic carbon in glacier ice	18th International Radiocarbon Conference in Wellington, New Zealand, 1-5 September 2003	Proceedings of the 18th International Radiocarbon Conference (in Press)	abstract (of an oral presentation)

NON REFEREED ARTICLES (continued)

Böhm R	Apr. 2004	Systematische Rekonstruktion von zweieinhalb Jahrhunderten instrumentellem Klima in der größeren Alpenregion – ein Statusbericht (*Systematic reconstruction of two and a half centuries of instrumental climate in the greater alpine region - a status report*)	54. Deutscher Geographentag, Bern (CH) 28.9.2003 bis 4.10.2003 *(54th German Geographer's Day)*	Gamerith, W., Messerli, P., Meusburger, P., Wanner, H. (Hrsg.) (2004): Alpenwelt – Gebirgswelten. Inseln, Brücken, Grenzen. Tagungsbericht und wissenschaftliche Abhandlungen, 121-131	extended proceedings with invited contributions (of an oral presentation)
Böhm R, Auer I, Jurkovic A, Orlik A, Potzmann R, Schöner W, Ungersböck M, Brunetti M, Maugeri M, Nanni T, Jones P, Briffe K, Efthimiadis D	Apr. 2004	Die neuen ALP-IMP - CLIVALP Klimadatensätze - Neuerungen, Datenqualität unsd erste Ergebnisse *(The new ALP-IMP - CLIVALP datasets - news, data quality and first results)*	8. Österreichischer Klimatag, 19. und 20.Apr. 2004, Wien (AT) (8th Austrian Climate Day)	http://oegm.boku.ac.at/Veranstaltungen/klimatag08.html	Abstracts and ppt-files of presentations
Paul, F., Kääb, A., Maisch, M., Kellenberger, T. W. and Haeberli, W.	2003	Das neue Schweizer Gletscherinventar: Anwendungen in der Gebirgskartographie. (*The new Swiss glacier inventory: Applications in mountain catography*)	*Kartographische Nachrichten,* **5**	212-217.	
Haeberli, W., Paul, F., Gruber, S., Hoelzle, M., Kääb, A., Machguth, H., Noetzli, J., Rothenbühler, C.	2004	Effects of the extreme summer 2003 onglaciers and permafrost in the Alps - first impressions and estimations.	EGU 1st General Assembly, Nice, 25-30 April 2004	*Geophysical Research Abstracts* , **6,** 2004, CD-ROM (ISSN: 1029-7006)	abstract (of an oral presentation)
Hoelzle, M., Zemp, M., Frauenfelder, R. and Haeberli, W.	2004	Integration of alpine glacier monitoring into the GTN-G network of the global climate observing system (GCOS) by applying the global hierarchical observing strategy (GHOST). A discussion report.	EGU 1st General Assembly, Nice, 25-30 April 2004	*Geophysical Research Abstracts* , **6,** 2004, CD-ROM (ISSN: 1029-7006)	abstract (of an oral presentation)
Zemp, M. and Hoelzle, M.	2004	Revision and expansion of World Glacier Monitoring Service's database	EGU 1st General Assembly, Nice, 25-30 April 2004	*Geophysical Research Abstracts* , **6,** 2004, CD-ROM	abstract (of an oral presentation)
Machguth, H.; Paul, F.;Hoelzle, M. and Haeberli, W.	2004	Calculating distributed glacier mass balance over entire mountain groups.	EGU 1st General Assembly, Nice, 25-30 April 2004	*Geophysical Research Abstracts* , **6,** 2004, CD-ROM (ISSN: 1029-7006)	abstract (of an oral presentation)
Paul, F.; Machguth, H.; Hoelzle, M.; Salzmann, N. and Haeberli, W.	2004	Application of a distributed glacier mass balance model to the western part of the Swiss Alps	EGU 1st General Assembly, Nice, 25-30 April 2004	*Geophysical Research Abstracts* , **6,** 2004, CD-ROM (ISSN: 1029-7006)	abstract (of an oral presentation)

PLANNING OF NEAR FUTURE PUBLICATIONS

type	date	authors from partners (lead partner bold)	contents
peer reviewed journal	2004	**2**, 1, 5	GAR-precipitation: gridding methods testing, intercomparison with other datasets (regional and global), spatial representation
peer reviewed journal	2004	**5,** 2, 1	GAR-precipitation: analysis of the precipitation variability patterns in the GAR (trends, sub-regional differences, special periods, exceptionally wet or dry months or seasons, seasonal effects...)
peer reviewed journal (most probably more than one papers)	2nd project year	1, 2, 5 (plus optional proxy partners?)	description of the re-analysed dataset (what's new compared to the ZAMG-CNR-UNIMIL- 2001 temperature paper), overall description of long-term features (special attention to the early period with much new data), special periods at decadal scale (the summer warm spell near 1800 (was it too warm for the advanced glaciers???), the abrupt cooling of the 1810s, the early 19th century glacier advances and first strong glacier retreat period after 1850 are they explainable by temperature alone??? What do tree rings tell us in the early instrumental period?), the maritime phase of the 1910s (warm winters plus cool summers, glacier advances, tree-rings?), he phase shifting of the (GAR) first maximum near 1950 versus the global maximum near 1940, the Scandinavian near 1930, extreme events at annual to sub-annual scale (Summer 2003, year 1829, and other extreme seasons or years, their spatial extension, plus cross-connections to impacts and/or proxy information from the glacier and tree-ring community….) vertical features (trends of zero deg-line, trends of TSI (thermal stability index), measured and modelled (air pressure method) AACTs (Alpine air-column temperatures)
peer reviewed journal	2nd project year	1, 2, plus optional 3, 5)	1 combined temperature-precipitation analysis also in respect to circulation influences focusing on GAR-climate – NAO correlation and its fluctuations (oscilations) in time - possibly applying a new GAR-focussed circulation index - highlighting also some connections to glaciers and tree-rings (in regard to the inversion problem: multiple climate (temp and precip) –> glaciers –> temperature or precipitation (similar for tree-rings?)