Report on Austrian Activities in Relation to

Systematic Climate Observation and Global Climate Observing Systems

according to Decisions 4/CP.5 and 5/CP.5
of the Conference of the Parties to the
United Nations Framework Convention on Climate Change

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Federal Ministry of Agriculture, Forestry,
Environment and Water Management

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This report was prepared by the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management in co-operation with the Federal Ministry of Education, Science and Culture and the Federal Ministry for Transport, Innovation and Technology.

It is based on information provided by the institutions and researchers concerned and collected by the Institute of Meteorology and Physics of the University for Agricultural Sciences, Vienna, which hosts the "Climate, Climate Change and Atmospheric Environment Research" network node of the "Austrian Network for Environmental Research".

Source of photo material: R. Böhm, W. Schöner, Sonnblickverein, ZAMG

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1 General Approach to Systematic Observation

Austria has a respectable history regarding climate and meteorological observations. The first series of measurements started in 1762 at the Benedictine monastery Kremsmünster and has been uninterrupted since then. 15 years later the second longest series started at the astronomical observatory in Vienna, and further two years later another series was begun at the former Jesuit College in Innsbruck. The number of stations began to increase at the beginning of the 19th century; in the middle of the 19th century the systematic development of a meteorological observation network was approved by the Austrian Academy of Science and promoted by the Austrian "Zentralanstalt für Meteorologie und Erdmagnetismus" (now "Zentralanstalt für Meteorologie und Geodynamik"), which nowadays – about 150 years later – still manages the network.

The current situation with respect to systematic observation can partly be seen as a consequence of the historical development. Institutions like the "Zentralanstalt für Meteorologie und Geodynamik" (ZAMG, Central Institute for Meteorology and Geodynamics) and the "Hydrographisches Zentralbüro" (Hydrographical Central Office), which were subordinate to or part of the federal administration, were funded for fulfilling among others observation tasks and have virtually included this function in their corporate identity. Academic research has early focused on some issues of systematic observation. A dense glacier monitoring network, for example, has been established in co-operation with the Alpine mountaineering club "Österreichischer Alpenverein" in the late 19th century. Universities have maintained these traditions up to now and make an important contribution to systematic observation in Austria.

Other observation activities have been established comparatively late. Systematic measurements of atmospheric constituents, i.e. air pollutants, have started in the 1980s and are now obligatory due to air quality law. They are carried out by the administration of the Federal Provinces of Austria ("Länder") and by the Federal Environment Agency Austria. For certain topics projects have been commissioned by public authorities, e.g. for monitoring of stratospheric ozone and UV radiation. Project based observation activities are also initiated by research institutions and are financed by the Austrian Science Fund and by the EU.

The institutions responsible for collecting data are also engaged in the exchange of data within the international scientific community. This is due to institutional links on the one hand, e. g. for the ZAMG, which represents Austria in the WMO and in programmes related to meteorological observation, or for the Austrian Academy of Sciences, which hosts the Austrian National Committee on the Global Change Programmes. The latter is dedicated to foster contacts with the Global Research Programmes IGBP, WCRP and IHDP, and to provide funding for contributions of Austrian scientists to the Core Projects of these programmes. On the other hand, exchange of data is usually part of scientific projects with international co-operation.

2 Atmospheric climate observing systems

It is important to note that monitoring the climate in the Alps, where the general model-based findings on climate change have limited applicability because of the complex topography, is a particular responsibility that Austria is undertaking, in co-operation with its neighbours. Austria also provides locations for monitoring where there is little influence by human activities, which is rare in Europe. With regard to climate observations, it can be stated that the longest of Austria's instrumental time series go back as far as to the 18th century and are among the longest in existence. Due to this long experience with meteorological measurements, quality- and homogeneity control of the data are highly developed and long time homogeneous datasets are available.

To meet the demands of the complex topography of Austria, a dense network for observing atmospheric climate parameters is established. More than 600 stations are measuring at least temperature and precipitation. 80 of these stations are exchanged internationally within the WWW, 10 within CLIMAT, 2 within the GSN and 1 within the GAW program (see Table 1 on the next page). Two institutions are responsible for station maintaining

Table 1: Participation in the global atmospheric observing systems

	GSN	GAW	WWW	CLIMAT
How many stations are the responsibility of the Party?	2	1	80	10
How many of those are operating now?	2	1	80	10
How many of those are operating to GCOS standards now?	2	1	80	10
How many are expected to be operating in 2005?	2	1	80	10
How many are providing data to international data centres now?	2	1	80	10

and quality control; the Central Institute for Meteorology and Geodynamics (ZAMG) and the Hydrographical Central Office (HZB). The HZB is also responsible for the river discharge measurements (765 stations) and the ground water storage (3066 stations). All WWW stations are under the direction of the Central Institute for Meteorology and Geodynamics (ZAMG).

As the Austrian contribution to the GAW programme, measurements from the station at the 'Hohen Sonnblick' are provided. This high altitude meteorological observatory (at 3106 metres above sea level) has been operating continuously since 1886, which is the longest continuous and homogeneous meteorological time series for high altitudes worldwide. Since the last decade additional measurement programs (e.g. Ozone, UVB, Gamma-spectroscopy) have been performed at the observatory by several research institutes. Germany, Austria and Switzerland have established the GAW-DACH co-operation with the aim of providing a combined data set of global relevance from the alpine stations Zugspitze, Hoher Sonnblick and Jungfraujoch and the observatory at Hohenpeissenberg. (Information at http://www.zamg.ac.at/, in German only)

The measurements of atmospheric constituents are the responsibility of the nine Länder governments and of the Federal Environment Agency; data are collected and published by the Federal Environment Agency. More than 120 stations are distributed all over the country and at least are measuring Ozone and SO_2.

Details about the monitoring networks can be found in Tables 3, 4, 5 and 6 on pages 5–7. For examples of projects and activities in which Austria has been particularly active and for contact details, consult Table 9 on page 10.

3 Terrestrial climate observing systems

Austria has a long tradition in glacier monitoring. About 10 % of Austria's surface area lies between 2000 and 3800 metres above sea level, part of it covered by glaciers. Since the end of the 19^{th} century, length fluctuations of approximately 100 glaciers have been observed continuously in the course of a co-operation between universities and the Alpine mountaineering club "Österreichischer Alpenverein". In addition to length measurements, mass balance measurements have been established on several glaciers for decades, using the direct glaciological method; the measurements are performed as co-operation of three universities and the ZAMG. All these data are reported internationally to the World Glacier Monitoring Service (see Table 2 on the next page).

As a result of this extensive experience in glacier monitoring, Austrian researchers are involved within the 'Glacier mass balance network in the Himalayans'. Within this IHP-UNESCO project, support to the start of a Glacier mass balance monitoring network in the Himalayans is given. The

Table 2: Participation in the global terrestrial observing systems

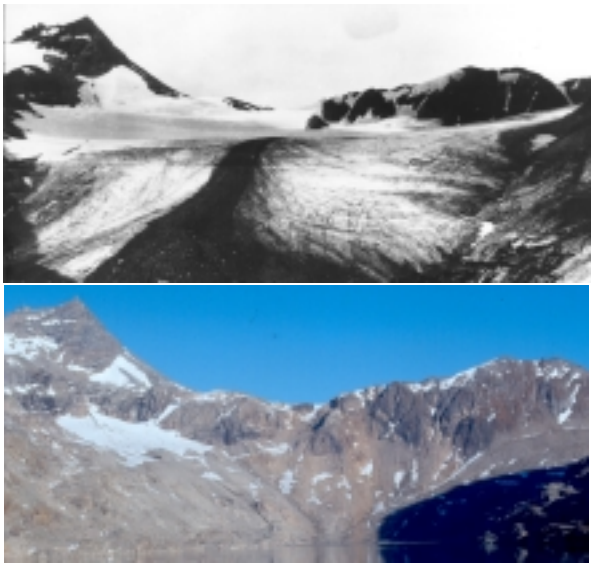
	GTN-G*	GTN-G°	TEMS	MAB
How many stations are the responsibility of the Party?	∼100	9	2	4
How many of those are operating now?	∼100	9	2	4
How many of those are operating to GCOS standards now?	∼100	9	2	4
How many are expected to be operating in 2005?	∼100	8	2	4
How many are providing data to international data centres now?	∼100	9	2	4

TEMS: Terrestrial Ecosystem Monitoring Sites
MAB: UNESCO's Programme on 'Man and the Biosphere'
GTN-G*: Glaciers Length variations
GTN-G°: Glaciers Mass balance

main objectives of this program are the promotion of sciences in developing countries and information transfer in science and technology.

The complex orography of Austria requires a high number of measurement stations to describe the water runoff. In addition to 765 stations for river discharge measurements and 3066 stations for ground water storage measurements, more than 850 stations for snow depth measurements are established. The measurements are performed by HZB, measurements of snow depth by HZB and ZAMG.

Phenological observations are performed at meteorological monitoring sites of ZAMG, as well as measurements of radiation and soil temperature. Ecosystem monitoring is based a.o. on project oriented work of research institutes, like the newly established GLORIA programme (see Table 9). There are also ecosystem monitoring activities with focus different from climate change, the results of which may be of interest for climate change research (like the Austrian monitoring site of UN/ECE's *International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems*, which is also a TEMS site).



Wurtenkees (Hohe Tauern, Austria)
in the years 1896 (top) and 2001 (bottom)

Details about the monitoring networks can be found in Table 7 on page 8 and Table 8 on page 9. For examples of projects and activities in which Austria has been particularly active, see Table 9.

In addition, Government Agencies, Universities, and other research institutions have gathered in various contexts a wealth of climate relevant data sets and statistics covering (many) decades, in areas such as wood crop statistics (forest inventory, see Table 8), humus composition, or limnology of rivers and lakes.

4 Space-based observing programmes

Austrias space-based activities are coordinated by the Austrian Space Agency (ASA)[1]. In January 1987, Austria became a full member of the European Space Agency (ESA). Since January 1994, Austria has also been a member of Europe's Meteorological Satellite Organisation EUMETSAT.

In addition to the involvement in the mandatory programme of ESA (general activities, including general studies, the technology programme and the science programme) Austria participates in the fol-

[1] http://www.asaspace.at

lowing programmes relevant to research on the climate system:

- Earth Observation Programme:
  - European Remote Sensing Satellite ERS-2
  - Earth Observation Preparatory Programme (EOPP - Extension)
  - Polar Orbit Earth Observation Missions (ENVISAT and METOP-1)
  - Meteosat Second Generation (MSG)
  - Earth Observation Envelope Programme (EOEP)
  - Earth Watch Global Monitoring for Environment and Security GMES Service Element
- Programme for the Development of Scientific Experiments (PRODEX)
- General Support Technology Programme (GSTP)

An ASA staff member represents Austria in the EUMETSAT Council, together with representatives from the Austrian Central Institute for Meteorology and Geodynamics (ZAMG). The programmes for operational meteorology include the Meteosat series of satellites, the second generation of geostationary meteorological satellites (MSG) to be launched in 2001 and the European polar orbiting meteorological satellite system EPS, now under development and in operation from 2003 onwards. Austrian industry is involved in the development of instruments for the latter two programmes. The operational application in weather forecasting and the scientific use of data provided by these satellites are under the jurisdiction of ZAMG.

ASA participates in the working group on remote sensing, under the Federal Ministry of Education, Science and Culture, which was established for information exchange and promotion of remote sensing activities in Austria. ASA acts as the National Point of Contact (NPOC) for the distribution of remote sensing satellite data in close co-operation with the Earthnet programme of ESA and the distribution entity EURIMAGE. ASA is a member of the European Association of Remote Sensing Laboratories (EARSeL) and has represented Austria in the EARSeL Council since 1989.

Additional information about all Austrian space activities can be found in the 'Austrian Report to COSPAR' (Committee on Space Research)[2]

Austria has also taken an active role within the newly approved cooperation programme between the European Commission and the European Space Agency "Global Monitoring for Environment and Security - GMES"[3]. This programme aims at meeting the needs of national and European information needs in the areas of environmental monitoring, and natural hazards by using satellite based earth observation technologies. Thus Europe wants to make an active contribution to international environment monitoring.

To underline the importance of the programme the Austrian Federal Ministry for Transport, Innovation and Technology initiates several pilot projects, which examine the use of satellite based earth observation for land use and transport planning. Besides this, Austrian Universities and private companies have already conducted a number of pilot studies using Earth observation data for land ice and forest and applications in the Kyoto framework for organisations such as the European Commission and the European Space Agency. The national coordination is done by the Federal Ministry for Transport, Innovation and Technology and the Austrian Environment Agency.

For examples of projects in which Austria has been particularly active, consult Table 9.

[2] http://www.asaspace.at/download/COSPAR2000.PDF
[3] http://gmes.jrc.it/

Table 3: Atmospheric observing systems for climate at the land surface ("Table S1"†)

	Climate parameters*	Total # stations	Appropriate for characterizing national climate?			Time series #stations/platforms (#data digitized)			Adequate quality control procedures?			Metadata avail. # stations (% digitized)	Continuity # expected operational in 2005
			Fully	Partly	No	30–50y	50–100y	>100y	Fully	Partly	No		
Stations useful for national climate monitoring	Standard[1)]	68	x			42 (42)	20 (20)	6 (6)	x			68 (100)	68
	Temperature[2)]	559	x			59 (0)	114 (0)	234 (0)	x			559 (100)	559
	Precipitation[2)]	927	x			91 (0)	185 (0)	322 (0)	x			927 (100)	927
	Potential evaporation[2)]	35	x						x			35 (100)	35
Stations reporting internationally	Standard[1)]	80				8 (8)				x			80
CLIMAT reporting stations	Standard[1)]	10					4	6	x				10
reference climate stations	Standard[1)]	2						2	x			2 (100)	2

* Standard means, that at this stations at least the parameters temperature, humidity and precipitation are measured.
1) Responsible Institute: Central Institute for Meteorology and Geodynamics (ZAMG)
2) Responsible Institute: Hydrographic Central Office (HZB)

All stations are installed and maintained according to the WMO-recommendations. (World Meteorological Organization, 1996: Guide to meteorological instruments and methods of observation; sixth edition. WMO, Geneva.)

† Table numbers S1–S10 relate to the *Supplementary Guidance to Parties on the Preparation of Detailed National Reports on Global Climate Observing Systems* prepared at an informal meeting of national GCOS co-ordinators in August 2000.

Table 4: Available homogeneous data sets for meteorological land surface observations ("Table S2")

Data set name	Climate parameters	# Stations of grid resolution and region covered	Time period	References
ALOCLIM	Mean Temperature Min. Temperature Max. Temperature Precipitation Cloudiness Sunshine duration Relative Humidity Vapour pressure Pressure	43 Eastern Alps 20 Eastern Alps 20 Eastern Alps 37 Eastern Alps 18 Eastern Alps 15 Eastern Alps 19 Eastern Alps 21 Eastern Alps 17 Eastern Alps	1930–1998 1930–1998 1930–1998 1927–1998 1901–1998 1934–1998 1931–1998 1931–1998 1901–1998	Auer I., Böhm R. and Schöner W., 2001: Austrian Long-Term Climate – Multiple Instrumental Climate Series from Central Europe. Accepted for: *Österr. Beitr. zu Meteorologie und Geophysik*, Heft 25
ALPCLIM	Temperature Precipitation (in preparation)	1 deg. (43 – 49 deg. north; 4 – 18 deg. east) 1 deg. (43 – 49 deg. north; 4 – 18 deg. east)	1899–1998 (earliest 1760) 1899–1998 (earliest 1837	Böhm, R., Auer, I., Brunetti, M., Maugeri, M., Nanni, T. and Schöner, W., 2001: Regional Temperature Variability in the European Alps 1760–1998 from homogenized instrumental time series. Accepted for: *Int. Journal of Clim.*

Table 5: Atmospheric observing systems for climate above the surface ("Table S3")

Systems useful for national climate monitoring purposes	Total # stations or platforms	Appropriate for characterizing national climate?			Time series #stations/platforms (#data digitized)				Adequate quality control procedures?			Metadata avail. # stations (% digitized)	Continuity # expected operational in 2005
		Fully	Partly	No	5–10y	10–30y	30–50y	>50y	Fully	Partly	No		
Radiosonde stations	4	**x**			1	2	1		**x**			4	4
Stations reporting internationally	4												
CLIMAT TEMP reporting stations	1												
Profilers	3								**x**			3	3

Table 6: Atmospheric constituent observing systems for climate ("Table S5")

Constitutent	Total # stations or platforms	Appropriate for characterizing national climate?			Time series #stations/platforms (#data digitized)				Adequate quality control procedures?			Metadata avail. # stations (% digitized)	Continuity # expected operational in 2005
		Fully	Partly	No	10–20y	20–30y	30–50y	>50y	Fully	Partly	No		
Carbon dioxide	1	x							x			1 (100)	1
Ozone (surface)	120	x			43				x			120 (100)	100
Ozone (column)	1	x							x			1 (100)	1
Ozone (profile)	1		x						x			1 (100)	1
SO_2	146	x			72	26			x			146 (100)	100
SO_4 particulate	1		x			1			x			1 (100)	1
NO_3^-, NH_4^+ particulate	1		x						x			1 (100)	1

The measurements of atmospheric constituents are in the responsibility of the nine Länder governments and the Federal Environment Agency Austria; data are gathered and published by the Federal Environment Agency.

Table 7: Terrestrial observing systems for climate ("Table S9")

Systems useful for national climate monitoring purposes	Total # stations or platforms	Appropriate for characterizing national climate?			Time series #stations/platforms (#data digitized)			Adequate quality control procedures?			Metadata avail. # stations (% digitized)	Continuity # expected operational in 2005
		Fully	Partly	No	30–50y	50–100y	>100y	Fully	Partly	No		
River discharge [2] (streamflow gauges)	765	x			129 (0)	176 (0)	93 (0)	x			765 (100)	765
Ground water storage (e.g. boreholes) [2]	3066	x			841 (0)	187 (0)	4 (0)	x			3066 (100)	3066
Snow [1][2] snow depth	874	x			77 (4)	180 (2)	317 (0)	x			874 (80)	874
Glaciers [3] lenght variations	∼100	x					All	x			All (100)	∼100
Glaciers [3] mass balance	9		x		1			x			9 (100)	8
Permafrost [3] ground temperature	4		x						4		4 (100)	4
Radiation [1] global radiation	80	x				1 (1)			x		80 (50)	80
Soil [1] soil temperature	100		x			1 (1)			x		100 (50)	100

Measurements performed by the [1] Central Institute for Meteorology and Geodynamics, the [2] Hydrographic Central Office and [3] several universities.

Table 8: Ecological observing systems for climate ("Table S10")

Systems useful for national climate monitoring purposes	Total # stations / platforms	Appropriate for characterizing national climate?			Time series #stations/platforms (#data digitized)				Adequate quality control procedures?			Metadata avail. # stations (% digitized)	Continuity # expected operational in 2005
		Fully	Partly	No	30–50y	50–100y	100–300y	>300y	Fully	Partly	No		
Phenological [1]	90		x		90					x		0	80
Biomass change [2] [3]													
Vegetation type [3]	4		x									4	4
Land cover [3]													
Land use change [3]													
PaleoClimate (dendrochronology)	5		x				1	4	x			1 (100)	5

[1] Measurements performed by the Central Institute for Meteorology and Geodynamics
[2] Biomass change for Austrian forests as a whole is monitored in the course of the Austrian Forest Inventory in multiyear intervals
[3] Austria participates in TEMS (3 sites) and the MAB biosphere reserves network (5 sites) as well as in the GLORIA project (4 sites, see Table 3); the sites, however, have individual research focuses and are difficult to classify according to the given categories. GLORIA stations are mentioned – exemplary only – under "Vegetation Type" for that reason.

Table 9: Examples of projects with respect to data collection, monitoring and systematic observation

Examples of projects and activities	Objectives
Actinic Flux Determination from Measurements of Irradiance (ADMIRA) ✉ Mario Blumthaler; Mario.Blumthaler@uibk.ac.at	The overall objective of the project is to develop tools whereby existing and future spectral UV irradiance data measured on a horizontal surface may be converted into spectral actinic fluxes, which can be applied to any UV-driven photo reaction
Austrian Glacier Inventory 1999 ✉ Michael Kuhn; Michael.Kuhn@uibk.ac.at	30 years after the first complete inventory, Austrian glaciers were resurveyed in the years 1997 – 99. Digital elevation models and orthophotographs are being produced form aerial photographs. The changes form 1969 to 99 will be related to climatic conditions.
Austrian Long-term Climate (ALOCLIM) ✉ Ingeborg Auer; Ingeborg.Auer@zamg.ac.at	The *Climate Fluctuations Task Force* at the Austrian Central Institute for Meteorology and Geodynamics is conducting time series analyses of Austria's climate stations. Thus far, approximately 50 homogeneous series each have been elaborated on and analyzed for temperature, precipitation and snow. For 15 Locations, 9 different parameters (e.g. sunshine duration; vapour pressure) are actually available. In cooperation with other European countries, this homogeneous dataset was expanded throughout the whole Alps.
Austrian Network for Isotopes in Precipitation (ANIP) ✉ Wolfgang Papesch; wolfgang.papesch@arcs.ac.at	The aim of the Austrian Network for Isotopes in Precipitation (ANIP) is to provide input data for hydrological and hydrogeological investigations and to serve as a data-base for climatological changes and trends in sensitive Alpine areas. 71 stations are presently sampled all over Austria with some preference given to the Karst areas North and South of the Alpine mountain range. The network is jointly run by the Austrian Research Centers Seibersdorf and the Austrian Environment Agency. The precipitation is collected on a daily basis in ombrometers (500 cm2) and mixed to monthly samples at stations ranging from 120 to 2250 m in altitude.
Austrian Project on Health Effects of Particulates (AUPHEP) ✉ Clean Air Commission, Austrian Academy of Sciences Helger Hauck; helger.hauck@univie.ac.at	Within this interdisciplinary and multiinstitutional Project an extensive Aerosol monitoring and analysis program at four different sites in Austria is conducted
Climate reconstruction for the eastern part of Austria using tree rings. ✉ Rupert Wimmer; wimmer@mail.boku.ac.at	Tree rings are used to reconstruct the climatic variability over the past 500 years. Several tree species growing in the eastern part of Austria are intensively investigated. In addition, cores are taken from old buildings and construction sites to extend the chronologies.

Table 9: continued

Examples of projects and activities	Objectives
Data quality monitoring of the Alpine observing system (DAQUAMAP) ✉ Inga Groehn; inga.groehn@univie.ac.at	GTS data of the Alpine region are evaluated on a regular basis with respect to gross errors and biases. It is based on a 4D variational approach, developed at our Department. Parameters checked are: sea level pressure, (potential) Temperature, humidity (equivalent potential temperature) and wind. This project was initiated within the framework of MAP.
Development and calibration of a sea-ice - climate - glacier model in Northern Iceland ✉ Johann Stötter; hans.stoetter@uibk.ac.at W^3 http://geowww.uibk.ac.at/island	The aim of the research project is the development and calibration of a model describing the relationships between sea-ice, temperature and precipitation conditions and glacier extents in Northern Iceland for the period since the mid-19th century, when continuous and homogeneous meteorological records in Iceland start. As an additional result, a GIS-based glacier inventory following the standard of the UNESCO World Glacier Inventory is established for Northern Iceland.
Enhanced resolution analysis of the Alpine atmosphere (VERA) ✉ Reinhold Steinacker; reinhold.steinacker@univie.ac.at	Real time enhanced resolution (i.e. resolving structures beyond the scale resolved by data solely) analyses of the Alpine atmosphere have been carried out for two years. The enhanced resolution is created by a down-scaling algorithm using a variational method. The three one-hourly fields are collected and used to create a long-term time series of mesoscale fields over the Alps. Several new mesoscale features have been uncovered by this method, e.g. the Vienna vortex. Several fields, e.g. pressure, pressure tendency, temperature, humidity, wind, precipitation, cloud cover, cumulus condensation level and level of snow fall are available.
Environmental and Climatic Records from high Elevation Glaciers (ALPCLIM) ✉ Reinhard Boehm; Reinhard.Boehm@zamg.ac.at	Within these EC sponsored project ice core analyses from the high alpine locations Monte Rosa and Mont Blanc are compared with a homogeneous long-term dataset covering the whole Alps. Though it is possible to calibrate the reconstructed climate variability from the ice core analyses with observed data. It is also possible to define the spatial representativity of the ice core data.
European database for Ultraviolet Radiation Climatology and Evaluation (EDUCE) ✉ Mario Blumthaler; Mario.Blumthaler@uibk.ac.at W^3 http://www.muk.uni-hannover.de/EDUCE	The principal objectives are to establish a UV climatology for Europe in combination with investigations into potential long-term changes in the UV radiation environment, to continue the collection and storage of UV radiation and ancillary data in the European UV database, providing a comprehensive database of measurements, together with the software tools needed for efficient search and retrieval of data, to control and assess the quality of the data in the database and to develop, test and implement radiative transfer models, which are the primary tools in both the study of the UV environment and the quality assurance of the measurements.

Table 9: continued

Examples of projects and activities	Objectives
Glacier mass balance network in the Himalayans ✉ Georg Kaser; georg.kaser@uibk.ac.at	The UNESCO – HKH (Hindukush-Karakorum-Himalaya)-FRIEND group has asked the International Commission on Snow and Ice (ICSI) to help in building up a glacier mass balance network in the Himalayans, to organise a respective training course and to write a manual on glacier mass balance studies. Work on the design of the network and on the manual is in progress. The training course is planned for 2002.
Glacier monitoring, Glacier mass balance, long-term modelling of glacier-climate relations and chemical analyses of winter snow ✉ Gernot Patzelt; Gernot.Patzelt@uibk.ac.at Michael Kuhn; Michael.Kuhn@uibk.ac.at Heinz Slupetzky; Heinz.Slupetzky@sbg.ac.at Wolfgang Schöner; Wolfgang.Schoener@zamg.ac.at	A dense glacier monitoring network in cooperation with the 'Österreichischen Alpenverein' has been observing the glacier front variation of ∼100 glaciers since the end of the 19^{th} century. At nine glaciers, mass balance measurements using the direct glaciological method have been established. All these data are reported to the 'World Glacier Monitoring Service'. Additional winter snow cover studies involving chemical analyses of snow have been conducted on the Wurtenkees in the Sonnblick region since 1983. Together with mass balance measurements, profiles of various anions, cations, OH and pH values as well as conductivity profiles are measured each year in May (at the maximum of winter accumulation).
Global Land Ice Measurements from Space (GLIMS) ✉ Helmut Rott; Helmut.Rott@uibk.ac.at	GLIMS is an international project to survey the majority of the world's glaciers, ice caps, and ice sheet margins with the accuracy and precision needed to assess recent changes and trends in glacial environments. The primary data source is the ASTER instrument aboard the EOS Terra spacecraft. The data are analysed at regional centers. We are responsible for GLIMS activities at the Eastern Antarctic Peninsula and for the Austrian glaciers.
Global Land Surface Hydrology from Spaceborne Scatterometers ✉ Wolfgang Wagner; ww@ipf.tuwien.ac.at	The primary aim of this activity is to produce a global soil moisture data base for the years 1992-2000 from scatterometer measurements of the European Remote Sensing Satellites ERS-1 and ERS-2. National and international projects to demonstrate the use of these data in climate modeling and agricultural drought assessment in developing countries have been carried out. European (EUMETSAT) and American operational scatterometer programmes provide the basis for a long-term continuation of this activity.

Table 9: continued

Examples of projects and activities	Objectives
Global Observation Research Initiative in Alpine Environments (GLORIA) ✉ Georg Grabherr; grab@pflaphy.pph.univie.ac.at gloriaeurope.oecologie@univie.ac.at W^3 http://www.gloria.ac.at	The aim of GLORIA is to establish an effective long-term observation network for detecting the effects of climate change on mountain biota on a global scale. The Multi-Summit approach – GLORIA's basic strategy – will provide such a feasible method. This method is designed to compare biodiversity patterns along the fundamental climatic gradients, vertically as well as horizontally. *GLORIA-EUROPE* started on the 1^{st} of January 2001. The observation network consists of 18 target regions, each with 4 summits as reference units. On each site, the basic sampling design of *GLORIA* – the *Multi-Summit approach* – will be applied. Based on these data, impact scenarios will be developed. The project is designed as a contribution to international efforts for an ecological global change observing system (e.g. of the *EEA*, of *GTOS* and *IGBP*) and to implement the *GLORIA* network on a global scale.
Holocene timberline tree-ring chronology for the central Eastern Alps ✉ Kurt Nicolussi; Kurt.Nicolussi@uibk.ac.at	Subfossil logs from timberline sites of the central Eastern Alps are used to establish a calendar dated mulit-millenial tree-ring width chronology. This chronology is the base for the absolute dating of climatically relevant events in the Alps such as glacier advances, snow avalanches and tree-line fluctuations. The tree-ring series are also used to reconstruct summer temperature fluctuations.
Hydrological Atlas of Austria (HAÖ) ✉ Josef Fürst; fuerst@edv2.boku.ac.at Hartwig Dobesch; dobesch@zamg.ac.at H.P. Nachtnebel; nacht@edv2.boku.ac.at W^3 http://iwhw.boku.ac.at	The Hydrological Atlas of Austria (HAÖ) will present the hydrology of Austria in a uniform, consistent format to a broader public. The primary format of presentation is the thematic map, which is complemented by tables, texts and diagrams. The Atlas is conceived both as a collection of approximately 50-70 printed maps and in a digital, GIS based version with a set of interactive functions. The chapters on Precipitation, Evapotranspiration, Snow and glaciers, Rivers and lakes, Groundwater and Water balance will contain thematic maps of relevance for the national climate report.
Ice/climate interactions in Patagonia and at the Antarctic Peninsula. ✉ Helmut Rott; Helmut.Rott@uibk.ac.at	This is a cooperative project with the Argentinean Antarctic Institute, going on since 1994. Climate data and glaciological observations are collected at the Eastern Antarctic Peninsula and at the Southern Patagonian Ice field to study the sensitivity of glaciers and ice shelves to climate change. Drastic ice retreat has been observed in part of this region, which can be attributed to pronounced atmospheric warming during the last few decades.
International data exchange as part of the WWW (World Weather Watch) of the WMO. ✉ Wolfgang Lipa; Wolfgang.Lipa@zamg.ac.at	Observational data and other products are made available to meet the needs of the WWW Program of the WMO.

Table 9: continued

Examples of projects and activities	Objectives
Long term homogenisation of Central European Radiosonde data (CALRAD): ✉ Reinhold Steinacker; reinhold.steinacker@univie.ac.at	Within this project the long-term time series of the Central European Radiosonde data are homogenised and interpolated to a regular grid. The method applied is a variational 4D procedure, developed at our Department. It will be used to objectively determine the Eastern Alpine Flow pattern classification. Furthermore an intercomparison with data of Mountain stations (e.g. Hoher Sonnblick) will be carried out.
Mapping of Carbon Reservoirs in Forests as Input to Post-Kyoto Monitoring ✉ Christian Hoffmann; hoffmann@geoville.com	The project was carried out by GeoVille as a prime contractor under a contract of the European Space Agency. The project was investigating the role that data from the future ESA-MERIS (Medium-Resolution Imaging Spectrometer) sensor, and high optical spatial resolution sensors can play for mapping forests with regard to their potential role in carbon (C) sequestration and carbon dioxide (CO_2) emission mitigation.
Measurements of solar UVA and UVB irradiance in high mountains ✉ Mario Blumthaler; Mario.Blumthaler@uibk.ac.at	Within this a long-term project since 1980 variability and trend of solar UV irradiance have been observed as a consequence of short- and long-term variations of atmospheric ozone and of the other atmospheric parameters at the High Alpine Research Station Jungfraujoch (3576 m a.s.l., Switzerland).
Monitoring of total ozone and spectral UV radiation at Sonnblick ✉ Stana Simic; Stana.Simic@boku.ac.at	The total ozone column is continuously monitored using a Brewer Spectrometer at the Hoher Sonnblick (3,105 m), Austria, and profiles are made whenever the weather allows. The values are markedly below the 30-year average as measured in Arosa, Switzerland. Interdiurnal variability and larger deviations from monthly averages are subject to meteorological analyses.
Participation in the Global Atmospheric Watch (GAW) Program of the WMO ✉ August Kaiser; August.Kaiser@zamg.ac.at	A GAW station is being established based on four mountain observatories, one being the Hoher Sonnblick (3,105 m) in Austria. For this purpose, a *Sonnblick Task Force* has been set up consisting of representatives from various governmental agencies and university institutions. Part of the necessary measurements are already being carried out; cooperation with Switzerland and Germany has been initiated ('GAW Station: The Alps').

Table 9: continued

Examples of projects and activities	Objectives
Spectral UV radiation in the area of Vienna and integral UV measurement at Sonnblick ✉ Stana Simic; Stana.Simic@boku.ac.at	A UV broadband sensor (Bentham) is established at the Hoher Sonnblick (3,105 m), Austria, a second one is set up near Vienna, both operating in a continuous mode. Beside monitoring aspects important for man and vegetation, the data collected serve also as a basis for scientific research. Solar UV-A and UV-B irradiance and total irradiance have been measured annually since 1981 in 1-2 measuring periods of eight weeks each at the high mountain research station Jungfraujoch (3,575 m above sea level; Switzerland) to examine the influence of various atmospheric parameters including the total ozone content. For comparison, measurements were carried out at Innsbruck and Hafelekar (577 and 2,300 m above sea level, respectively), both stations being within a horizontal distance of 5.8 km.
Radiative Transfer in the UV: Influence of aerosols and cloudiness ✉ Erich Putz; erich.putz@uni-graz.at W^3 http://www.kfunigraz.ac.at/igamwww/rap/	The aim of this project is the construction of a partly automatic station for measuring UV-radiation and significant parameters influencing radiative transfer (Ozone and NO2-content, aerosol-optical characteristics) at an alpine station. By a systematic comparison of measured and modeled radiation data the quantification of the influence of individual physical processes is performed, special interest is taken in cloudiness.
The Austrian digitised climate atlas (OEKLIM) ✉ Ingeborg Auer; Ingeborg.Auer@zamg.ac.at	OEKLIM is a detailed multimedia illustration of the Austrian climate (1961 – 1990) on CD-Rom. It is the basis of a broad spectra of applications as climate impacts, planning or education. It contains climate maps and diagrams, descriptions with text and additional illustrations with pictures and video clips.
UV monitoring in Austria ✉ Mario Blumthaler; Mario.Blumthaler@uibk.ac.at W^3 http://www.uibk.ac.at/projects/uv-index/	9 UVB-Detectors are distributed all over Austria. The data are collected daily, and a map of the maximal UV irradiance in Austria of the previous day is published in the internet, together with daily courses at the stations for the last 30 days and with an archive of the maps.
Verification of ERA-40data with Austrian climate stations ✉ Michael Hantel; michael.hantel@univie.ac.at	The forthcoming ERA-40 dataset (a 40-year four-dimensional analysis of the atmosphere, performed by ECMWF) will be extensively used for climate research. We check this data set against a homogenized time series of Austrian climate stations in order to detect possible inhomogeneities in the ERA-40-dataset due to changes in the observing system.