Shared Cost Action Projects in Area 3.3 (CEO) of the Specific Programme for Climate and Environment

HYDALP
Hydrology of Alpine and High Latitude Basins

Project Reference: ENV4-CT96-0364

Internal report RPR8
3-Monthly Progress Report 8: February 1999

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Institute: Institut für Meteorologie und Geophysik der Universität Innsbruck

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Amendment record

Amendment number	Date	Issued by	Comments
1	2nd March 1999	IMGI	First Draft
2	10th March 1999	IMGI	Final Version

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Accronyms

AVHRR	Advanced Very High Resolution Radiometer
BASAT	Test basin in the Central Alps of Austria
BASCH	Test basin in the Swiss Alps
BASSW	Test basin in Northern Sweden
BASUK	Test basin in Scotland
DBMS	Data Base Management System
DELIV	Deliverables
DEM	Digital Elevation Model
ERS	European Remote Sensing Satellite
EWSE	Europe-Wide Service Exchange
HBV	Hydrological Model of SMHI
HROI	High Resolution Optical Imaging Sensor
MM	Man Month
MROI	Medium Resolution Optical Imaging Sensor
NOAA	US National Oceanic and Atmospheric Administration
RESP	Responsible
SAR	Synthetic Aperture Radar
SIR-C/X-SAR	Shuttle Imaging Radar-C/X-SAR
SRM	Snowmelt Runoff Model
TIME	Refers to month from beginning of the project
NRT	Near real-time

1. Project summary and management issues

1.1 Summary of Work Performed

Emphasis of the work during the *project months 22 to 24* was on:

1. Preparations for data transfer and finalisation of processing flowlines for the real-time runoff forecasting activities which are planned for the 1999 snowmelt period in three HYDALP basins.

2. Near-completion of runoff simulation activities; three internal reports have been delivered, the external report on runoff simulation (RM-5) is in preparation.

3. Tests of the remote sensing snow-cover module for HBV within forecasting environment.

4. Production of time series of snow cover maps from SAR, HROI and MROI for runoff simulations and for intercomparisons of snow covered area.

5. WWW-based information activities for the public, including project description, preliminary results and compilation of preliminary demonstration material.

6. Preparing for and holding the 4th Technical Meeting.

These are tackled in detail, below.

1. *Preparations for the real-time runoff forecasts:* Real-time forecasts of daily runoff are planned for the snowmelt period 1999 in the basins BASAT, BASCH, and BASSW. The forecast periods will start in April and last for about two months. Links for real-time or near-real time recording, transmission and processing of input data for the hydrological models , including EO data, hydromet data, and numerical weather forecasts, have been established and tested. ERS SAR and NOAA-AVHRR will be the primary sources for EO input in near-real time, with Radarsat and IRS WiFS as backup or for test purposes. The time required from the ERS SAR image acquisition to the final snow cover product was 6 hours for the day-time image and 15 hours for the night-time image (with data reception at Neustrelitz, SAR processing at D-PAF, SAR –PRI image transmission via the Internet, and classification at IMGI or SCEOS). For AVHRR (with reception at Dundee) the time required from the satellite overflight to the snow cover product is only 4 hours. This is well within the requirements for real-time forecasting, because the time scale of snow cover changes in the three basins is much longer. Preparations for real-time forecasts included the expansion of the deliverables according to customer requirements in BASAT and BASCH. Regarding BASAT, the customer Verbund expressed the interest in forecasts for three further drainage basins above reservoirs in the same region as the established BASAT (Persal). Preparations for these additional forecasts are proceeding. In Switzerland the original BASCH (Rhein-Felsberg) will be replaced by the Engadin basin (BASCH-2) for the real-time activities due the involvement of a hydropower

company as potential customer (not the case in the original basin).

2. *Runoff simulations:* Model calculations of daily runoff were carried out with the two runoff models SRM and HBV for three snowmelt periods for each basin, using EO input. These model runs were essential for calibrating or tuning the model parameters for the various basins and enabled to test the model modifications and flowlines. In BASAT the runoff simulations were carried out with SRM and HBV, using ERS-SAR and Radarsat as the main EO-data source, with some Landsat TM imagery. In BASCH and in BASSW snow maps derived from AVHRR data were utilised. The runoff calculations in BASCH are based on SRM, and in BASSW on HBV. In BASUK EO-derived snow maps have not been used for runoff calculations as yet, but no forecasting activities have been planned for this basin. In BASAT simulation runs were carried out with different numbers of satellites images to study the impact of various time sequences of remote sensing input as a basis for the cost/benefit analysis. The runoff modelling activities and results are described in the internals reports RI 511, RI512, RI 513. The external report RM5 on runoff modelling is in preparation.

3. *Test of HBV using EO*: In preparation for the real-time forecasting activities, tests have been made with HBV in BASSW for three snowmelt periods to study the impact of remote sensing input on forecasts. So far these test were carried out with snow maps derived from AVHRR, both for short-range forecasts (10 days) and for long-range forecasts. The EO data are used to correct the snow cover which is estimated in the model from meteorological data. For the three test periods the EO input results in improvements of the long-range forecasts, but for the 10-day forecasts the impact of EO input is ambiguous.

4. *Snow cover products and intercomparison:* Digital snow maps of the test basins were derived from comprehensive EO data sets using the automatic and semi-automatic procedures which had been developed during the project. The snow maps were used as input for the runoff simulation activities. The sensors employed include SAR (ERS, Radarsat), HROI (Landsat-5 TM, SPOT-3 and –4 HRV), and MROI (NOAA-AVHRR, RESURS-O1). Snow maps from SAR/HROI/MROI(AVHRR) were compared in BASAT and BASCH. Systematic differences between the various sensors were found which result from the different spectral capabilities and spatial resolutions. These differences have to be taken into account if time sequences from different sensors are used. The work on EO data analysis and products is described in the internals reports DI341, DI342, DI 343, and DI 344 (in preparation).

5. *WWW activities:* Accessible through EWSE, the HydAlp WWW site at MLURI and sites at three of the partner institutes contain a range of material of interest for potential customers as well as for remote sensing experts. Information is provided on the project objectives, preliminary results, and ongoing research activities. The pages also include descriptions of the test basins and a simplified version of the SRM model with pre-calculated options for runoff simulations. The Web activities are well within the schedule, with another major step towards completion of these tasks scheduled for the final project phase, after the end of real-time forecast period.

6. *4th Technical Meeting*: The meeting was held on 8/9 February 1999 at SMHI in Norrköping. The Minutes of the 4th Technical Meeting have been prepared and are being sent out.

1.2 Problems and Risks

A review of the main achievements of the HydAlp project and of the risks was presented by the project co-ordinator at the 4th Technical Meeting on 9 February 1999. As several of the main objectives have already been achieved, in particular regarding technical work of EO data algorithm development, hydrological modelling, and preparations for real-time forecasts, the risks can be narrowed down to the few remaining important issues of the final project phase.

The real-time runoff forecasting activities will be very important for the overall success of the project. As main preparations for the real-time forecasts have been completed, the remaining risk for this activity is a failure of data links or of a satellite sensors, which may result in the loss of important input data for the runoff models. In order to reduce this risk, options for alternate data sources have been prepared. Due to the availability of several satellites and the possibility of internet access to various receiving stations, the risk for failure of NOAA-AVHRR data input is small. Regarding ERS-SAR, there are two satellites (ERS-1 and ERS-2) in orbit. In spite of the fact that both have some technical problems, the SAR and the data links are operational on both satellites. Radarsat is a further option, though it will result in a reduced data set due to cost limitation.

Another important action of the final project phase is the assessment of the services and products by the customers and the cost/benefit analysis. For this purpose it is important that products are generated in the project which are useful for the customers. The runoff forecasts are the main products for this specific task. There is a risk that these products will not be up to the customer expectations in terms of basin selection, timeliness or quality. An important step towards the customer expectations was made in the extended BASAT by enhancing the geographic coverage of the forecast to provide additional information for the management of several hydropower reservoirs. A similar initiative has been envisaged for the Swiss basin.

1.3 Project Priorities for Months 25 to 27

- *Running of real-time runoff forecasts.*

The real-time forecasts of daily runoff in BASAT, BASCH and BASSW during the snowmelt period 1999 will provide basic information for the transfer of the research and technological work, carried out within HydAlp, to the operational customer. Therefore the forecasting activities are of crucial importance for the success of the HydAlp project. In case of unexpected problems during the forecasting period, measures should be taken rapidly to overcome these problems and to minimise gaps in or deterioration of the forecast services.

- *Last preparations for the runoff-forecast activities.*

Due to the incorporation of additional drainage basins and some delays in the EO data analysis tasks, some issues still need to be solved before the beginning of the real-time forecasts. The hydrological model parameters need to be calibrated for the basins which have been selected for the forecasts in addition to the initial basins BASAT and BASCH. A solution has to be found to account for the differences of snow cover products from different sensors. The flow line for snow mapping with IRS WiFS has to be finalised.

- *Customer involvement and public dissemination related to forecasts.*

The real-time forecast offers the opportunity to address a wide range of potential customers for this type of service. These activities should be documented on the HydAlp web pages including real-time updates of the daily forecasts, and the availability of this information should be announced. These activities would be of great benefit for the project activities related to the customer assessment of services.

1.4 Project Deliverables during Project Months 25-27

The deliverables due in the next three-month period are given in the table below:

Deliv	Title	Author	Institute	Status	Shifted to	CEO-FTP
	Deliverables for March 99 and April 99 (Month 25+26)					
	None					
	Deliverables for May 99 (Month 27)					
RPR9	3-Monthly Progress Report	WP-Coord	IMGI			

Where the keys in the deliverable number are given by,

D – Database
R – Report
RM – Interim Report
I – deliverables for internal use of project consortium
S – Software

Database deliverables should be a short report on a completed database, detailing its management system, contents, and capabilities.

The dates of interest for the deliverable **review process** are given below

Deadline	Action
15th of month	Sent out for review
25th of month	Reviews returned and exchanged between reviewers

End of month	Comments integrated. Final review and approval by WP co-ordinator. For significant changes or delays, the project co-ordinator should be notified.

These deadlines are supplementary to the 20th, 24th and 27th for **monthly task reports, work package reports and work manager reports** respectively.

1.5 Draft reports

All but the final version of reports should include the word DRAFT in the footer and on the first page. The report format (see RI111) should also be followed.

Once a final version has been written, a soft copy should be sent by the author to the CEO ftp site. All previous versions should be clearly marked as such, or deleted, to avoid possible confusion. A hard copy of reports is sent to CEO by IMGI.

2. WP100: Project Management

Objective: Project management at scientific, technical, and administrative level; organising the customer community and maintaining the interaction with the customers throughout the project.

Responsible: H. Rott, IMGI

Key issues of scientific and technical management are addressed in section 1 of this report.

WP 110	Technical Co-ordination	SCEOS	Caves
WP 120	Management and Administration	IMGI	Nagler
WP 130	Communication and Interaction with End Customers	MLURI	Wright

2.1 WP 110: Technical Co-ordination

Responsible: R. Caves, SCEOS

Objectives: To define a common format for the reports, as well as quality standards and formats for graphic work (WP 111); to define standards for the software which will be developed within the project; to define data formats and/or protocols for exchange of data files between project partners (WP 112).

WP 111 and 112 are complete, and the reports RI111, RI112 are available

Tasks within WP 110

WP 111	Definition of report formats and standards	SCEOS	Caves
WP 112	Definition of software standards	IMGI	Glendinning

2.1.1 WP 111: Definition of report formats and standards

Responsible: R. Caves, SCEOS, months 1-3

This work package is complete, and available as RI111.

2.1.2 WP 112: Definition of software standards

Responsible: G. Glendinning, IMGI, month 1-6

This work package is complete, and available as RI112.

2.2 WP 120: Management and Administration

Responsible: T. Nagler, IMGI

Objectives: Planning and supervision of the project activities in general, administration of the project finances, monitoring of project progress, analysis of potential problems and risks, quality control of deliverables (by the project co-ordinator, in parallel to the WP co-ordinator and WP manager), planning and organisation of meetings.

Tasks within WP 120

WP 121	Scientific and technical management	IMGI	Nagler
WP 122	Milestones, meetings, risk analysis	IMGI	Rott

2.2.1 WP 121: Scientific and technical management, status of reports

Responsible: T. Nagler, IMGI, month 1-30

Issues and concerns related to this WP are addressed by the project co-ordinator (under Chapter 1, *Problems-Risks-Responsibilities* and *Quality Control*).

Status of deliverables from month 1 to month 24:

Deliv.	Title	Author	Institute	Status	Shifted to	CEO-FTP
	Deliverables for March 97 (Month 1)					
	Minutes of the Kick-Off Meeting	Nagler	IMGI	Mar 97		No
	Minutes of the 1st Technical Meeting	Glendinning	IMGI	Mar 97		No
	Deliverables for May 97 (Month 3)					
RI111	Definition of report formats and standards	Caves	SCEOS	20.5.97		Yes
RI132	Framework for obtaining customer requirements.	Wright et al.	SCEOS	3.6.97		Yes
RPR1	3 Monthly Progress Report – 1	Rott et al.	IMGI	May 97		Yes
	Deliverables for June 97 (Month 4)					
RI213	Req. for hydropower management	Pirker	VERB	27.8.97		**No**
RI232	Def. of Data Requirem. / Acq. Requests	Nagler	IMGI	12.8.97		Yes
RI233	Remote Sensing Data Search	Turpin	SCEOS	20.8.97		Yes
	Deliverables for August 97 (Month 5)					
RI112	Definition of software standards	Glendinning	IMGI	28.8.97		Yes
RI212	Scottish Customer Workshop	Gauld	MLURI	8.9.97		Yes
RPR2	3 Monthly Progress Report – 2	Rott et al.	IMGI	27.8.97		Yes

	Deliverables for September 97 (Month 7)					
DI221	Hydromet Data base for BASAT	Glendinning	IMGI	27Sep97		Yes
DI223	Hydromet Data base for BASSW	Johansson	SMHI	30Sep97		Yes
DI222	Hydromet Data base for BASCH	Kleindienst	UBE	Draft; Final version in RM-2		in RM2
RI110/ 225	General Flowline	Nagler et al.	IMGI	9Sep97		Yes
RI211	Assessment of Customer Needs	Wright	MLURI	----	In RM-1	---

	Deliverables for October 97 (Month 8)					
RI311	Review of methods and improvements for extraction of basin characteristics	Miller	MLURI	29Jul98		Yes
RM-1	Interim Report on Customer Requirements	Wright	MLURI	17Nov97		Yes

	Deliverables for November 97 (Month 9)					
DI224	Hydromet Data Base for BASUK	Morgan D.	MLURI	19Dec97		Yes
RI225	Data Access Module Design	Kleindienst	UBE	RI110/225	15Mar98	Yes
RI411	HBV -SRM Model Inter-comparison	Ferguson	SCEOS	4Dec97		Yes
DI422	Runoff Parameters for BASCH	Kleindienst	UBE	16Feb98	15Jan98	Yes
DI423	Runoff Parameters for BASSW	Johansson	SMHI	15Jan98	15Jan98	Yes
DI424	Runoff Parameters for BASUK	Turpin	SCEOS	11Feb98	15Jan98	Yes
RM-2	Interim Report on Project Data Base	Baumgartne	UBE	18Mar98		Yes
RPR3	3-Monthly Progress Report 3	WP-Coord	all	17Dec97		Yes

	Deliverables for December 97 (Month 10)					
RI322	Methods for Geocoding & Information Extraction	Caves	SCEOS	17Apr98		Yes
RI331	Review and improvement of methods for MROI	Voigt	UBE	2Jun98		Yes
	Minutes of 2nd Techn. Meeting	Nagler/Glen	IMGI	17Dec97		Yes
	Minutes of 1st Modellers Meeting	Turpin/Ferg	SCEOS	18Dec97		Yes

	Deliverables for January 98 (Month 11)					
DI312	Basin characteristics for BASAT	Stuefer	IMGI	26Mar98		Yes
DI313	Basin characteristics for BASCH	Voigt	UBE	09Mar98		Yes

DI315	Basin characteristics for BASSW	Turpin	SCEOS	23Apr98		Yes
RI332	Water balance and evaporation	Broadgate	MLURI	17Mar98		Yes

	Deliverables for Feb. 98 (Month 12)					
DI314	Basin characteristics for BASUK	Miller	MLURI	12Jan99		**??**
RI321	Improvement of methods for SAR & HROI	Nagler	IMGI	24Apr98		Yes
RI333	Methods for medium resolution sensors	Voigt	UBE	3Jun98		Yes
RDI421	Parameters for BASAT & Basin inter-comparison	Glendinning	IMGI	25Feb98		Yes
RM-3	Interim report on remote sensing methods	Caves	SCEOS	26Mar98		Yes
RPR4	3-monthly progress report	WP-Coord	IMGI	2Mar98		Yes

	Deliverables for May 98 (Month 15)					
	Minutes of 3rd Technical Meeting	Nagler,Glen	IMGI	21July98		Yes
RI242	Preparation and conductance of field work	Hodson	MLURI	17June98		Yes
DI243	Field work	Turpin	SCEOS	17June98		Yes
DI244	Field work	Kleindienst	UBE	Delayed	Aug98	
RI431	Review of methods for data fusion, recommendations	Caves	SCEOS	3July98		Yes
RI441	Modification of HBV for distributed input data	Johansson	SMHI	25Aug98		Yes
RPR5	3 Monthly Progress Report – Number 5	WP-Coord	All	19June98		Yes

	Deliverables for June 98 (Month 16)					
RI241	Preparation and conductance of field work	Nagler	IMGI	27Oct98		Yes

	Deliverables for July 98 (Month 17)					
RI 442	Model optimisation for Alpine basins	Glendinning	IMGI	31Aug98		Yes
RM4	Interim Report on Runoff Modelling Using Remote Sensing	Glendinning	IMGI	28Aug98		Yes

	Deliverables for August 98 (Month 18)					
RPR6	3 Monthly Progress Report – Number 6	WP-Coord	All	28Aug98		Yes

	Deliverables for November 98 (Month 21)					
RPR7	3 Monthly Progress Report – Number 7	WP-Coord	All	21Dec98		Yes

	Deliverables for February 99 (Month 24)					
RPR8	3-Monthly Progress Report	WP-Coord	IMGI	10Mar99		Yes
DI231	Search and acquisition of NOAA data	Ottersberg	UBE			Draft
DI341	Data analysis for BASAT	Nagler	IMGI		15Jan99	Draft
DI342	Data analysis for BASCH	Voigt	UBE		15Jan99	Draft
DI343	Data analysis for BASSW	Turpin	SCEOS		15Jan99	Draft
DI344	Data analysis for BASUK	Caves	SCEOS		15Jan99	
RI511	Runoff simulations for BASAT	Glendinning	IMGI		15Jan99	Draft
RI512	Runoff simulations for BASCH	Kleindienst	UBE		15Jan99	Draft
RI513	Runoff simulations for BASUK, BASSW	Turpin	SCEOS		15Jan99	Draft
RM5	Interim Report on Runoff Simulation	Turpin	SCEOS			

Where the keys in the deliverable number are given by,
D – Database I – deliverables for internal use of project consortium
R – Report S – Software RM – Interim Report

Summary of Action Items of 3rd Technical Meeting

Documents related to these action items should be delivered to the project co-ordinator, who will be responsible for distribution.

No	***Partner***	***Action Item***	***Date***	***Status***
1.	IMGI UBE	Availability of updated versions of EO Tools	31Oct98	✓
2.	UBE SMHI	Hydrological Models, tested: SRM, HBV	31Oct98	✓
3.	IMGI SCEOS UBE	EO Real Time data links for forecast period 1999: 1) Selection of sensors 2) Agreement of EO data links	31Oct98	✓
4.	IMGI SCEOS UBE SMHI	Test of 1) hydromet data links 2) EO Data links 3) near real time EO data analysis	31Jan99	✓
5.	IMGI SCEOS UBE SMHI	Definition of Forecast period and basin details	30Sept98	✓
6.	IMGI SCEOS SMHI UBE	Runoff Simulations - Information for each basin: 1) Basins /Sub-basin 2) Simulation periods 3) EO Sensors /data-sets to be used 4) Hydrological Model used 5) Inter-comparison of Runoff simulations with/without EO	15Jul98	✓

7.	SCEOS	EO: comparison of SCA from different sensors within WP340; responsible R. Caves	31Oct98	ongoing
8.	IMGI SCEOS UBE	Send Information on areal interpolation of precipitation to Kleindienst (WP510)	30Sep98	✓
9.	UBE	Summary on Areal interpolation of precipitation; (resp. H. Kleindienst)	15Oct98	delayed
10	MLURI	Flowline for WWW demonstrator; (resp. R. Dunham)	15Jan99	✓
11	UBE SMHI	Conversion routines for HYDALP Format into SRM: Resp. H. Kleindienst HYDALP Format into HBV: Resp. B. Johansson	30Sep98	✓
12	MLURI	Guidelines on cost-effectiveness (resp. G. Wright)	30Sep98	draft
13	SCEOS	Send out information sheet for EO methods (resp. R. Caves)	31Oct98	✓

2.2.2 WP 122: Milestones, meetings, risk analysis

Responsible: H. Rott, IMGI, month 1-30;

See Chapter 1.

2.3 WP 130: Communication and Interaction with End Customers

Responsible: G. Wright, MLURI

Objectives: To organise the customers (including project partners and new customers) for the purpose of obtaining specifications of their requirements for hydrological modelling and forecasting, for the assessment of project activities throughout the project, and for assessment of project results.

Tasks within WP 130

WP 131	Organisation of customer community and meetings	MLURI	Dunham
WP 132	Dissemination of framework standards for customer requirements	MLURI	Wright

2.3.1 WP 131: Organisation of customer community and meetings

Responsible: Gauld, MLURI, month 1-30

Discussions with the Scottish Customer Focus Group (SCFG) are continuing. It is planned to have a final SCFG meeting in August to demonstrate the results of HydAlp, and obtain information on customers' perception of cost effectiveness. This will build on the successful meeting of the SCFG which was held in the autumn of

1997.

In addition customers will also be informed when the demonstrator (WP622) has reached a level of refinement where customer feedback on the contents and presentation will be possible.

2.3.2 WP 132: Dissemination of framework standards for customer requirements

This work package is now complete.

3. WP 200: Assessment of customer needs and data base compilation

Objective: Definition of customer needs, preparation (including acquisition) of hydrological, meteorological and remote sensing data, data base compilation, design of an access module

Responsible: Michael Baumgartner / Hannes Kleindienst, UBE

Work packages within WP 200

WP 210	Specification of customer needs	MLURI	Wright
WP 220	Hydrological and Meteorol. database compilation	UBE	Kleindienst
WP 230	Remote sensing data base	IMGI	Glendinning
WP 240	Field experiments	IMGI	Nagler

WP 201: WP supervision and quality control

Responsible: H. Kleindienst, UBE, months 1-24

The receiving station at UBE is still not operational. Contingency plans exist for data acquisition from other sources.

3.1 WP 220: Hydrological and meteorological data base compilation

Responsible: H. Kleindienst, UBE

This work package includes the compilation of hydrological and meteorological data into database as well as the design of a common data access module.

Tasks within WP 220

WP 221-224	Hydrological / meteorological database	All	
WP 225	Data Access Module	UBE	Kleindienst

3.1.1 WP 224: Hydromet Database for BASUK

Responsible: Morgan-Davis, MLURI, months 2-9.

The Report DI224 is complete.

3.1.2 WP225: Access Module Design

Responsible: H. Kleindienst, UBE

This task is complete, and described in report RI110/225.

3.2 WP 230: Remote sensing data base

Responsible: G. Glendinning, IMGI

The only task active within this work package is WP231, described below.

3.2.1 WP231: Search and acquisition of NOAA data

Responsible: Ottersberg: UBE, months 1-24

UBE satellite receiving station is still under revision. A final report is in progress, which will list the images successfully acquired.

3.2.2 WP242/243 - Preparation and conductance of Field Work – BASUK

Responsible: Bell, MLURI, months 1-3, 13-15

The Report DI242/243 is delivered.

4. WP 300: Remote sensing methods and analysis

Responsible: Shaun Quegan, SCEOS, months 1-24

Objective: This work package has the following objectives:

- To review available methods for remote sensing data analysis, to identify needs for improvements regarding the application in hydrological models, and to implement the methodological improvements.
- To extract hydrological relevant information from the remote sensing data to be used as input for hydrological modelling and forecasting.

Optical sensors are to be used for mapping areal extent of snow cover, surface albedo, and land surface types, while SAR is to be used for mapping the extent of melting snow cover. Possibilities for estimating evapotranspiration will also be investigated. The work is broken down into four sub-work packages:

WP 310	**Extraction of Basin Characteristics**.	MLURI	Miller
WP 320	**Remote Sensing Methods for High Resolution Sensors**.	IMGI	Nagler
WP 330	**Remote Sensing Methods for Medium Resolution Sensors**.	UBE	Voigt
WP 340	**Earth Observation Data Analysis.**	SCEOS	Caves

WP 300 Status

WP 300 is almost complete. The only active work package during the report period was WP 340. Deliverables from which have either already been reviewed or are being prepared for review. The only report outstanding from earlier WPs (DI314) has now been delivered.

The overal status of EO data analysis methods was reviewed at the 4th Technical Meeting and is reported on in the minutes from that meeting.

Work on EO data analysis is still ongoing. This primarily involves continuing preparations for near real time forecasting and intercomparisons of snow covered area derived from different EO sensors.

Tasks within WP 300

WP 301	WP supervision and quality control	SCEOS	Caves
WP 302	Interim Report 3 on Remote Sensing Methods	SCEOS	Caves

4.1.1 WP 301: WP supervision and quality control

Responsible: Ron Caves, SCEOS, months 1-24

Status: ongoing.

4.1.2 WP 302: Interim Report 3 on Remote Sensing Methods

Responsible: Ron Caves, SCEOS, months 11-12

Status: RM3 delivered.

4.2 WP 310: Extraction of Basin Characteristics

Responsible: D. Miller, MLURI, months 1-12

Objectives: To extract the physiographic characteristics of each test basin.

Tasks within WP 310

WP 311	Review of methods and improvements	MLURI	Miller
WP 312	Data analysis for basin BASAT Stueffer	IMGI	
WP 313	Data analysis for basin BASCH Baumgartner	UBE	
WP 314	Data analysis for basin BASUK	MLURI	Miller
WP 315	Data analysis for basin BASSW	SCEOS	Turpin

WP 310 Status

The WP is now complete.

4.2.1 WP 311: Review of methods and improvements

Responsible: David Miller, MLURI, months 1-8

Status: RI311 delivered.

4.2.2 WP 312: Data analysis BASAT

Responsible: Martin Stuefer, IMGI, months 4-11

Status: DI312 delivered.

4.2.3 WP 313: Data analysis BASCH

Responsible: Michael Baumgartner, UBE, months 4-11

Status: DI313 delivered.

4.2.4 WP 314: Data analysis BASUK

Responsible: David Miller, MLURI, months 5-12

Status: DI314 delivered.

4.2.5 WP 315: Data analysis BASSW

Responsible: Owen Turpin, SCEOS, months 4-11

Status: DI315 delivered.

4.3 WP 320: Remote Sensing Methods for High Resolution Sensors

Responsible: Thomas Nagler, IMGI

Objectives: To assess the available methods for the extraction of information from high resolution optical and radar imaging sensors for mapping extent and properties of the snow pack and for estimation of evapotranspiration, to identify deficiencies, and to implement modifications regarding their use in hydrological models.

Tasks within WP 320

WP 321	Improvement of methods for SAR & HROI	IMGI	Nagler
WP 322	Methods for geocoding and information extraction	SCEOS	Caves

Status of WP 320

The WP is now complete.

4.3.1 WP 321: Improvement of methods for SAR & HROI

Responsible: T. Nagler, IMGI, months 2-12

Status: RI321 delivered.

4.3.2 WP 322: Methods for geocoding and information extraction

R. Caves, SCEOS, months 2-10

Status: RI322 delivered.

4.4 WP 330: Remote Sensing Methods for Medium Resolution Sensors

Responsible: S Voigt, UBE, months 2-12

Objectives: To review, improve and document semi-automatic and automatic procedures for estimating albedo and generating snow cover maps from NOAA

AVHRR data, including geocoding issues.

Tasks within WP 330

WP 331	Review & improvement of methods for MROI	UBE	Voigt
WP 332	Water balance and evapotranspiration	MLURI	Miller
WP 333	Documentation of methods	UBE	Voigt

Status of WP 330

The WP is now complete. All reports were delivered by mid 1999. Open questions and further refinements of methods are dealt with in WP340.

4.4.1 WP 331: Review and improvement of methods for MROI

Responsible: Stefan Voigt, UBE, months 2-10

Status: RI331 delivered.

4.4.2 WP 332: Water balance and evapotranspiration

Responsible: Miller, MLURI, months 8-11

Status: RI332 delivered.

4.4.3 WP 333: Documentation of methods

Responsible: Stefan Voigt, UBE, months 9-12

Status: RI333 delivered.

4.5 WP 340: EO data analysis

Responsible: R Caves, SCEOS, months 12-24

Objectives: To analyse time sequences of EO data of the four test basins to obtain areally distributed information as input for the hydrological simulations and forecasts, to test the EO analysis methods and to refine the methods for future operational use.

Tasks within WP 340

WP 341	Data analysis for BASAT	IMGI	Nagler
WP 342	Data analysis for BASCH	UBE	Voigt
WP 343	Data analysis for BASSW	SCEOS	Turpin
WP 344	Data analysis for BASUK	SCEOS	Caves

Status of WP 340

WP 340 is almost complete. The DI341, DI342 and DI343 reports have been reviewed and final versions are being completed. DI344 are currently being prepared.

The link for near real time (NRT) transfer of ERS SAR data has been arranged with ESA. DLR/D-PAF are responsible for practical arrangements. The link has been successfully tested for both BASAT and BASSW. Data orders have been placed for the forecast periods in both basins. Processing of AVHRR data from the Dundee receiving station has also been successfully tested in NRT.

Further preparations are required prior to NRT forecasting in parts of the extended BASAT and BASCH II. This includes the analysis of EO data to derive SCA maps from previous years.

Work is still ongoing on intercomparisons of snow covered area derived from different EO sensors. Guidelines on how to conduct comparisons were recently circulated by the WP co-ordinator. The following tests were proposed:

- Comparisons of SCA by basin, sub-basin and elevation zone.
- Time series plots, by sensor, once again by basin, sub-basin and elevation zone.
- Regression plots of SCA derived from pairs of sensors.
- Image comparisons - to identify any systematic differences and physical causes.
- Confusion matrices.
- Mixed pixel analysis of MROI data.
- Relation of observed and modelled depletion curves (HBV only).

This work is to be reported upon by mid-April unless NRT preparations prevents this (see below).

The Project Coordinator has pointed out that in terms of the overall aims of the project, preparations for NRT forecasting must be given priority over intercomparisons, especially in BASAT and BASCH where considerable preparations are still required. Work on intercomparisons should initially focus on issues which have direct impact on forecasts. This work needs to be completed before the forecast period begins in BASAT (15th April) and BASCH at the end of March.

4.5.1 WP 341: Data analysis for BASAT

Responsible: Thomas Nagler, IMGI, months 12-24

The final report DI341 has been completed. It includes a description of recent improvements of the SWSM software package, and lists the EO data analysed from SAR (ERS-2, Radarsat), HROI (Landsat-5 TM, SPOT HRV), and MROI (NOAA AVHRR). Preparations for the near real time analyses are described. The NRT test of ERS-2 SAR data was successful. First results of the intercomparison of snow maps from different sensors are shown. Additional work is planned on this topic (see

Minutes of the 4th Technical Meeting).

4.5.2 WP 342: Data analysis for BASCH

Responsible: Stefan Voigt, UBE, months 12-24

During the last three months work focused on the following topics:

- Analysis of an AVHRR time series for 1992.
- Improvements of the MROI flow lines.
- Further development and implementation of an MROI post-classification method for AVHRR SCA maps.

All three points are reported on in DI342 which is currently under revision. DI342 will be sent out to the project partners in the following weeks.

Talks with the Swedish Space Cooperation on 11 of February 1999 made clear that it will not be possible to apply RESURS-O1 data for the NRT phase of the project. RESURS-O1/4 data will not be available before summer 1999. IRS WiFS data will be used instead.

The main issues that require some work in the months to come are given in the following list:

- Setting up the IRS data flow and processing
  - Establish and test of real-time data flow of IRS data via EUROMAP.
  - Test of processing, mainly interactive processing, only minimal automation possible.
  - Dry runs for the product generation.
- Validation of the developed post-classification procedure
  - Introduction of artificial clouds of varying size and distribution to cloud free SCA maps.
  - Quality check of the post-classification results.
- Inter-comparison of EO data (AVHRR/RESURS/IRS/TM/SAR) by applying the methods agreed on at the technical meeting at Norrkoping.
- Sub-pixel analysis
  - Simple linear unmixing.
  - Verification of “new” SCA (see above).

4.5.3 WP 343: Data analysis for BASSW

Responsible: Owen Turpin, SCEOS, months 12-24

Sequences of snow cover maps have been derived from AVHRR, Landsat TM and SAR data for the 1992, 1996 and 1998 (not TM) melt seasons and have been supplied to SMHI for use in verifying and updating HBV simulations. The DI343 draft report has been delivered.

The SAR and AVHRR links for near real time forecasting were tested on 3 February. The ERS SAR images was acquired at 20:24 (ascending pass). After overnight data reception and processing at D-PAF the image was transferred to SCEOS the next morning. A geocoded and classified image was available by 11:00 which is fourteen and a half hours after data acquisition and well within the near real time forecasting requirement. Processing of descending pass images should be quicker as they are acquired mid-morning.

With the AVHRR test a geocoded and classified image was available within two and a half hours of data acquisition. Cloud cover and the low sun angle in the AVHRR image prevented accurate geocoding and classification. A further test of AVHRR NRT processing is planned for April when the sun-angle is higher.

Initial intercomparisons of snow maps derived from different sensors indicate that AVHRR overestimates snow covered area detected by TM while SAR underestimates it. Ongoing work is investigating whether it is possible to reduce SCA variations between sensors by either altering classification thresholds or through the use of correction factors.

4.5.4 WP 344: Data analysis for BASUK

Responsible: Ron Caves, SCEOS, months 12-24

No further EO data analysis has been conducted for BASUK since RPR7. This is due to a number of reasons:

- Priority on analysing EO data of BASSW to allow HBV modification for use of EO data to proceed.
- Preparations for NRT processing in BASSW. BASUK will not be used for forecasting.
- The lack of suitable EO datasets of BASUK from good snow years.

The paper on the results of BASUK fieldwork presented at the 2nd International Workshop on Retrieval of bio and geo-physical parameters from SAR data for land applications (Caves et al 1998b) is being prepared for submission to IEEE Trans GRS.

The DI344 report on this WP is currently being prepared.

5. WP 400: Hydrological Modelling

Responsible: SCEOS, months 1-17

Objectives:

- To review existing modelling methodologies and identify possible areas of improvement.
- To modify existing models to make optimum use of remotely sensed and ground information for calculating daily runoff using as input *in situ* measurements of hydrological and meteorological variables, information derived from remote sensing data, and - in the case of runoff forecasts - also meteorological forecasts. The work will rely on the runoff models HBV and SRM.

The work is broken down into the following sub-work packages

WP 410	Intercomparison of the SRM and HBV runoff models	SCEOS	Turpin
WP 420	Compilation of runoff parameters	IMGI	Glendinning
WP 430	Methods for remote sensing and hydro-meteorological data fusion	SCEOS	Clark
WP 440	Hydrological model modification.	SMHI	Johansson

All of these work packages are now complete. The individual sub-WP reports and the summary report on hydrological modelling (RM4) have been delivered.

6. WP 500: Model Validation and Application

Responsible: H. Rott, IMGI

Objectives:

- To apply the runoff models for simulations and for forecasts of runoff in the four test basins, to optimise the model parameters, and to determine the accuracy of the simulations and forecasts.
- To assess the improvements due to the use of remote sensing
- To determine the cost-effectiveness of the use of remote sensing data for hydrological modelling and forecasting.

This work package is directed towards runoff calculations as the final application of work carried out in WPs 200, 300 and 400. The calculations are to be carried out in simulation mode, as used for planning tasks in hydrology, and in forecasting mode, as applied for hydropower or irrigation management. The gain in accuracy from remote sensing data will be determined based on these calculations. The cost-benefit of the remote sensing data will be assessed in co-operation with the customers.

Work packages within WP 500

WP510	Runoff Simulations / Water Balance	UBE	Kleindienst
WP520	Runoff Forecasts	SMHI	Johansson
WP530	Customer Assessment of Services	MLURI	Wright

6.1 WP 510: Runoff Simulations / Water Balance

Responsible: H. Kleindienst, UBE

The main objective of this work package is to gain experience with the two hydrological models SRM and HBV, to test the model modifications to make further model improvements if necessary, and to define a parameter set which can be used for forecasts within WP 520.

Tasks within WP 510

WP 511	Runoff simulations for BASAT	IMGI	Glendinning
WP 512	Runoff simulations for BASCH	UBE	Kleindienst
WP 513	Runoff simulations for BASUK, BASSW	SCEOS	Turpin
WP 514	Interim Report 5 on Runoff Simulations	SCEOS	Turpin

6.1.1 WP511 Runoff Simulations for BASAT

Responsible Graham Glendinning IMGI, months 12-24

The SRM and HBV models have both been run in the Austrian basin. The simulation periods, basins and snow cover data used are given below. A fuller description, including model parameters and the results may be found in RI511.

The SRM model has been run for the hydrological years 1995-96, 1996-97 and 1997-98 with snow cover information from a total of 21 images. The HBV model required calibration over a longer period, and was thus run from 1985-1998. The years 1995-96, 1996-97 and 1997-98 were used for validation, as in SRM.

Discussion with the Austrian customers, Verbund, has concentrated the runoff modelling to watersheds supplying reservoirs and generating stations. The simulations described here cover theTuxbach basin, to runoff gauge Persal, and the Schlegeis basin. The upper part of the Tuxbach basin is taken as being part of Schlegeis in hydrological terms, as water is abstracted to the Schlegeis reservoir from the Tuxbach Überleitung.

The meterorological stations, weightings and precipitation gradients are given in RI511 and RM5.

The EO data used in SRM involved 2 Landsat TM images from 1996, 7 images from 1997 and 13 images from 1998. The ERS SAR data require ascending and descending passes for elimination of layover regions. For more complete temporal coverage, ascending and descending passes were used individually. SCA in layover regions was assumed the same as areas at the same elevation. Not all of the available data were used in simulations, due to recent snowfall, non-complete coverage, or non-dry reference imagery. The temporal interpolation method used between images for SRM is the accumulated melt depth method.

A full description of model runs is given in RI511 and RM5. The model performance with decreasingly frequent snow cover information is given here. SRM was run for the Tuxbach basin, including the upper regions and abstractions. It may be concluded that a denser temporal coverage of snow cover (beyond 5 images) does not improve the simulations for BASAT. If less imagery is used, the choice of images and of interpolation procedure becomes important. Using the AMD method in the Tuxbach basin, only four images are required to reproduce the accuracy gained using all of the imagery. These four images should include one at the beginning of April, just before the main melt, two during the main melt period and one later on, in August for example. More images may be required if the snowmelt season is longer or reveals more complex temporal behaviour.

The HBV model was calibrated from 1985-95 and run from 1995-1998. The remote sensing imagery was used to update the model for the Tuxbach basin at the end of winter and to validate the model's snow depletion. The introduction of SCA data resulted in the recalibration of the basin. The results of this are described within RI511 and RM5.

6.1.2 WP512 – Runoff Simulations for BASCH

Responsible H. Kleindienst UBE, months 12-24

In addition to the Rhein-Felsberg basin (BASCH), the Inn basin down to the stream gauge Scouls-Tarasp or Martina (at the Swiss-Austrian border) has been defined as second Swiss testbasin (BASCH-2) for the HYDALP project. This is due to the fact that the Engadiner Kraftwerke AG are controlling all reservoirs within this basin and can thus provide a complete dataset of stream flow corrections. They are also interested in the outcome of the HYDALP project and might contribute as Swiss customer within the customer focus group. This, however, has to be discussed with the Engadinger Kraftwerke AG first.

For BASCH, only SRM has been applied. It has been run for the ablation periods 1984, 1993 and 1996. For the latter period, an extended number of NOAA-AVHRR based snow maps were available (25 maps between November 1995 and October 1996). As a first test, the number of SCA datasets has been reduced. Other than for BASAT, significant differences occur, when leaving out a larger number of snow maps.

Methods have been derived to easier define some of the SRM parameters. The rainfall contribution parameter (RCA) is computed based on the temperature history of the last 20 days, the runoff coefficients are defined applying a minimum and maximum value, calculating the actual coefficients based on an estimation of potential evapotranspiration. More details of these procedures are described in RI512.

6.1.3 WP513 – Runoff Simulations for BASUK and BASSW

Responsible O. Turpin SCEOS, months 12-24

BASSW

Recent BASSW simulations have been aimed at investigating model sensitivity, and verifying and updating modelled snow cover. The effect of forest area on runoff was investigated to determine the accuracy required for forest classification from EO data. Conversion of all forest below 800 m to field, and all field below 800 m to forest resulted in R^2 change of less than 1 %. This indicates that HBV simulations of BASSW are not sensitive to land cover classification errors.

Several parameters that affect snow cover are set at fixed values before HBV is calibrated. These include the precipitation gradient (pcalt) and its upper limit (pcaltl), the temperature lapse rate, the number of snow classes within an elevation zone and the snowpack distribution within an elevation zone (sfdistfi). The station weights used for estimation of areal precipitation and temperature also affect the distribution of snow. The sensitivity of the model to these parameters was investigated at both SMHI and SCEOS. At SMHI HBV was re-calibrated with two different values for pcalt, three different values for sfdistfi and two different estimates of subbasin precipitation and temperature (subjective weighting and an optimal interpolation method). The modelled SCA results differ from the EO derived SCA but are within the range of SCA shown by the different sensors. More careful evaluation on how to select these model parameters is needed. When measured against AVHRR data the best modelled SCA results for all four sub-basins were obtained when optimal interpolation of precipitation and temperature was employed. Optimal interpolation of meteorological data was therefore used in the preliminary updating tests. At SCEOS adjustments were made to pcalt and pcaltl and verified using TM snow maps for the 1992 melt season. By decreasing pcalt and increasing pcaltl less snow accumulation was simulated at lower elevations and more at higher elevations providing better agreement with the TM SCA than the default parameter settings without significantly affecting the R^2 fit.

The HBV updating method described in RI441 was used to update simulated snow cover in an attempt to improve HBV runoff fits. The snow cover estimates from the three sensors differ considerably. In these tests no effort was made to adjust the EO SCA estimates to a common standard. As the model could not be made to fit all sensors at the same time only one data source was used for updating. AVHRR was selected since there are more images available for this sensor over the three melt seasons then for the other sensors. In 1992 HBV overestimated spring flood runoff (April to July, inclusive), in 1996 there was a very slight underestimation and in 1998 a clear underestimation. Updating of snow cover on days that AVHRR data were available led to an increased volume error towards the end of the 1992 melt season, similar results to those without updating in 1996 and considerable improvement in 1998 (Table 1).

Table 1. Effect of updating HBV simulated SCA using AVHRR data for 1992, 1996 and 1998.

	1992	1996	1998
Default R^2	0.89	0.93	0.87
Updated R^2	0.85	0.93	0.92
% Change	**-4.5**	**0.0**	**+5.7**

BASUK

No further hydrological simulations have been performed for BASUK since RPR7.

EO data (SAR, MROI and HROI) have been acquired for two melt seasons (1997 and 1998). This data will be used to verify and update HBV snowpack predictions generated. Image processing priority is presently being given to BASSW, though.

6.1.4 WP514 – Interim Report 5 on Runoff Simulations

Responsible O. Turpin SCEOS, months 23-24

This report is currently being prepared.

6.2 WP 520: Runoff Forecasts

Responsible: B. Johannson, SMHI

The main objective of this work package is to determine the usefulness of the models for short-term runoff forecasts and to assess the accuracy of the forecasts. A further prime aim is to determine the gain in accuracy for runoff forecasts brought by remote sensing input.

Tasks within WP 520

WP 521	Runoff forecasts for BASSW	SMHI	Johannson
WP 522	Runoff forecasts for BASAT and summary for all basins	IMGI	Glendinning
WP 523	Runoff forecasts for BASCH	UBE	Kleindienst
WP 524	Interim Report 6 on Runoff Forecasts	IMGI	Glendinning

6.2.1 WP521 Runoff forecasts for BASSW

Responsible B. Johannson SMHI, months 21-30

With remote sensing data from three seasons, preliminary tests have been made to improve HBV model forecasts for BASSW by updating the simulated snow cover. (The method was described in RI441.) For the seasons 1992, 1996 and 1998 data from three sensors were available, NOAA-AVHRR, Landsat TM and ERS-SAR. The snow cover estimates from the three sensors differed considerably (Figure 1). In the preliminary tests, no effort was made to adjust the remote sensing data to one common standard. As the model could not be made to fit all sensors at the same time, only one was used for the updating procedure. NOAA-AVHRR was selected as the one with most images available.

Several model parameters affecting the snow cover are set at a fixed value before calibrating the HBV model. Examples of such parameters are the elevation correction for precipitation (pcalt) and temperature and the snow fall distribution factor which divide each elevation zone into classes with different snow accumulation (sfdistfi). Also the selection of station weights for estimation of areal precipitation and temperature affects the snow distribution. To illustrate the model sensitivity to these parameters, the model was calibrated with two different values of the elevation correction for precipitation, three different values for the snow fall distribution factor and two different estimates of subbasin precipitation and temperature (subjective weighting and optimal interpolation). The results with respect to snow cover are summarised in Figure 1. Straight lines are drawn between dates with remote sensing data. HBV model values are given for the same dates as AVHRR and Landsat TM images. The model results differ, but are often within the limits of the data from the satellite sensors. More careful evaluation on how to select these model parameters is needed, but the alternative were optimal interpolation was used to estimate areal precipitation and temperature seemed to give the best snow distribution between catchments in relation to the AVHRR data. It was therefore used in the preliminary tests reported here.

Two types of forecasts are carried out in the Swedish basin:

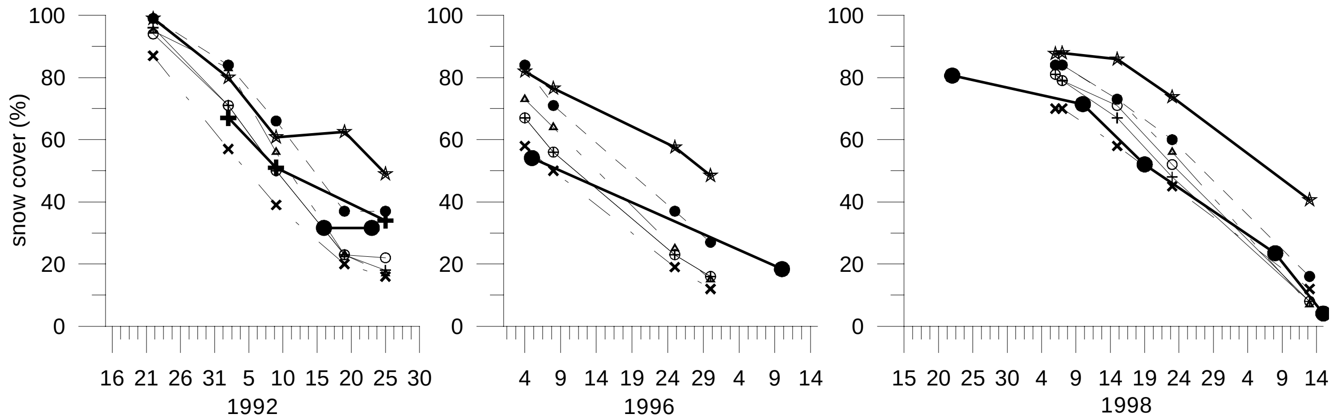
– The long range forecast which has the purpose to aid in long-term reservoir planning for hydropower production

– The short range forecast which is of main interest towards the end of the snow melt season, when the reservoirs are filled and there is a risk for flooding.

The forecast is made for reservoir inflow, and the actual peak flow value is not of such importance as the inflow volume over a defined period. Traditionally the HBV model has been updated before a snow melt forecast by comparing observed and simulated runoff. If runoff is underestimated, a temperature correction is added to increase the melt rate and vice versa. This procedure is obviously based on the assumption that the total snow cover is simulated correctly, only the timing is wrong. If the disagreement between observed and simulated runoff is caused by an error in the total snow cover, there is risk of gradually moving the volume error towards the end of the melt season. With the availability of remote sensing data comes the possibility of correcting for an error in the total estimated snow cover.

For the melt seasons 1992, 1996 and 1998 forecasts were carried out, using observed precipitation and temperature for the forecasted period, which is a way to test the accuracy of the runoff model. The forecasts were made on the dates with available RS data, for a 10-day period and until the last of July (the end of the snow melt season). The forecasts were made without any updating, with updating against observed runoff, and with a combined updating against observed runoff and RS snow cover. The results are summarised in Figure 2, presenting the runoff volume error over the forecasted period. For the long range forecast there was a general improvement in the accuracy with the RS data. For the 10-day forecasts the results were mixed, with an improvement on most occasions, but with quite a large deterioration on two occasions in 1996. The results need to be further analysed, and forecasts of different lengths must be tested.

Litnok + Laitaure



Sitojaure

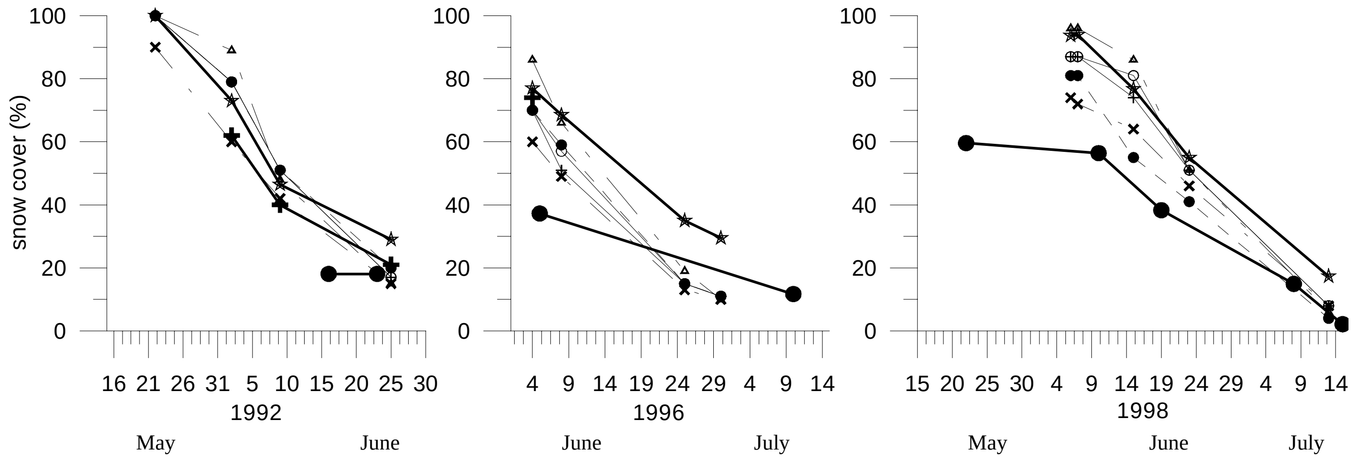


Figure 1a: Snow cover for BASSW sub-catchments, estimated from remote sensing data (AVHRR, Landsat TM, ERS-SAR) and from HBV simulations with different sets of model parameters

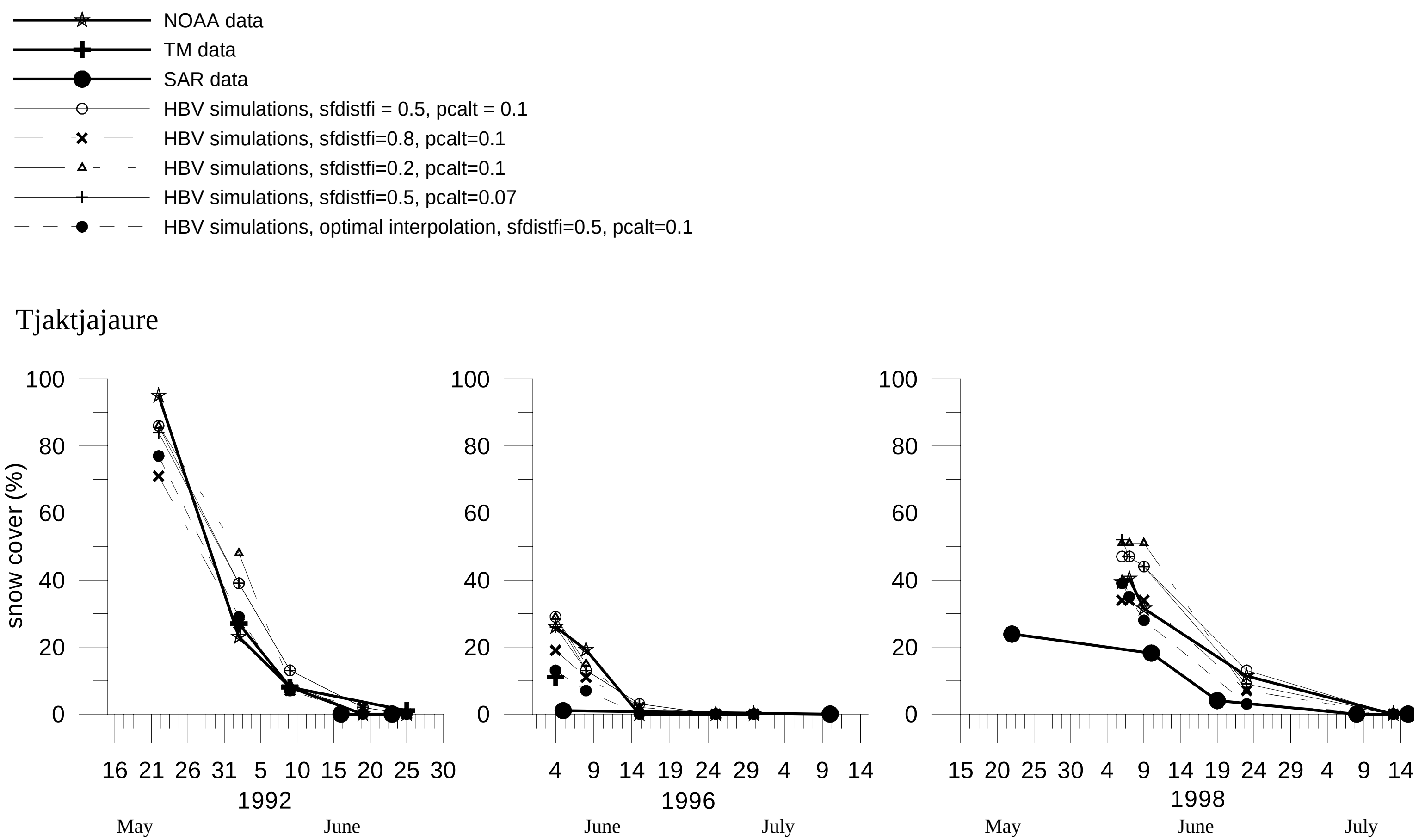


Figure 1b Snow cover for BASSW sub-catchments, estimated from remote sensing data (AVHRR, Landsat TM, ERS-SAR) and from HBV simulations with different sets of model parameters

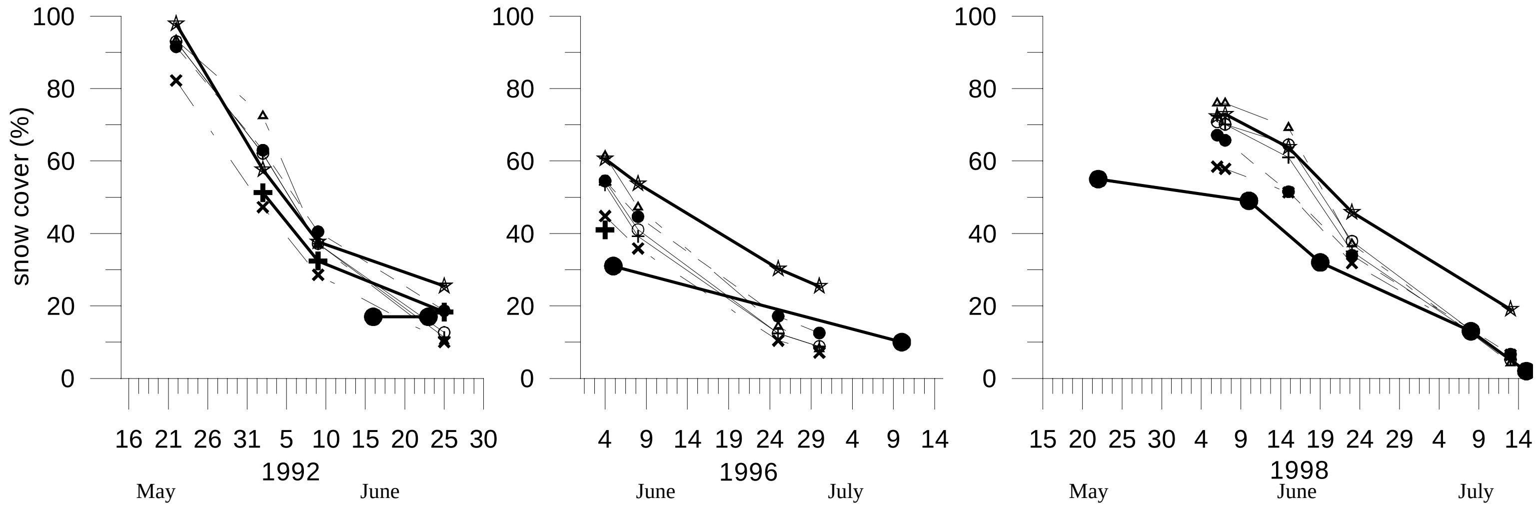


Figure1c Snow cover for whole of BASSW estimated from remote sensing data (AVHRR, Landsat TM, ERS-SAR) and from HBV simulations with different sets of model parameters

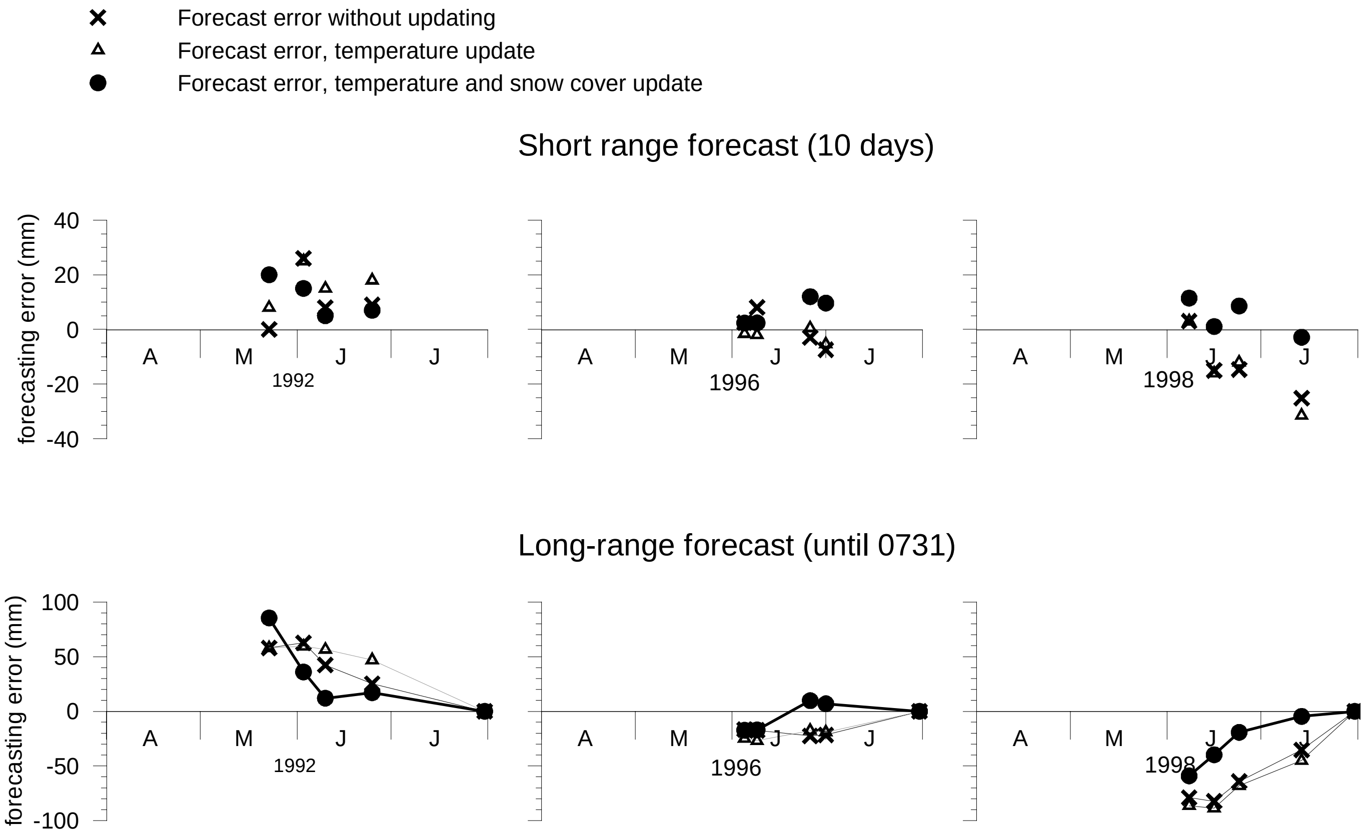


Figure 2: Spring flood forecast errors with the HBV model for BASSW. The errors represent the total volume error from the date of the forecast (marked by a symbol) to the end of the forecasting period.

6.2.1 WP522 Runoff forecasts for BASAT and summary for all basins

Responsible G. Glendinning, months 21-30

A meeting held with Verbund was held in December regarding data sources for forecasts. This meeting resulted in the reappraisal of subbasins. According to customer needs, the modelling of reservoirs was to be the focus of forecasting. For this purpose, TKW agreed to supply the additional automated meteorological and hydrological data (see Table 2) and to set up the data link to Persal runoff gauge.

These data links are now extant and the hyrdomet data are being downloaded daily. Perl scripts exist for adding data to the database. These can be modified now the exact nature of the transfer is known. The daily hydromet data are stored using a crontab script.

The other data sources necessary for the forecasts (NRT remote sensing input, numerical weather forecasts) are also operational. The data flow paths are shown in Figure 3.

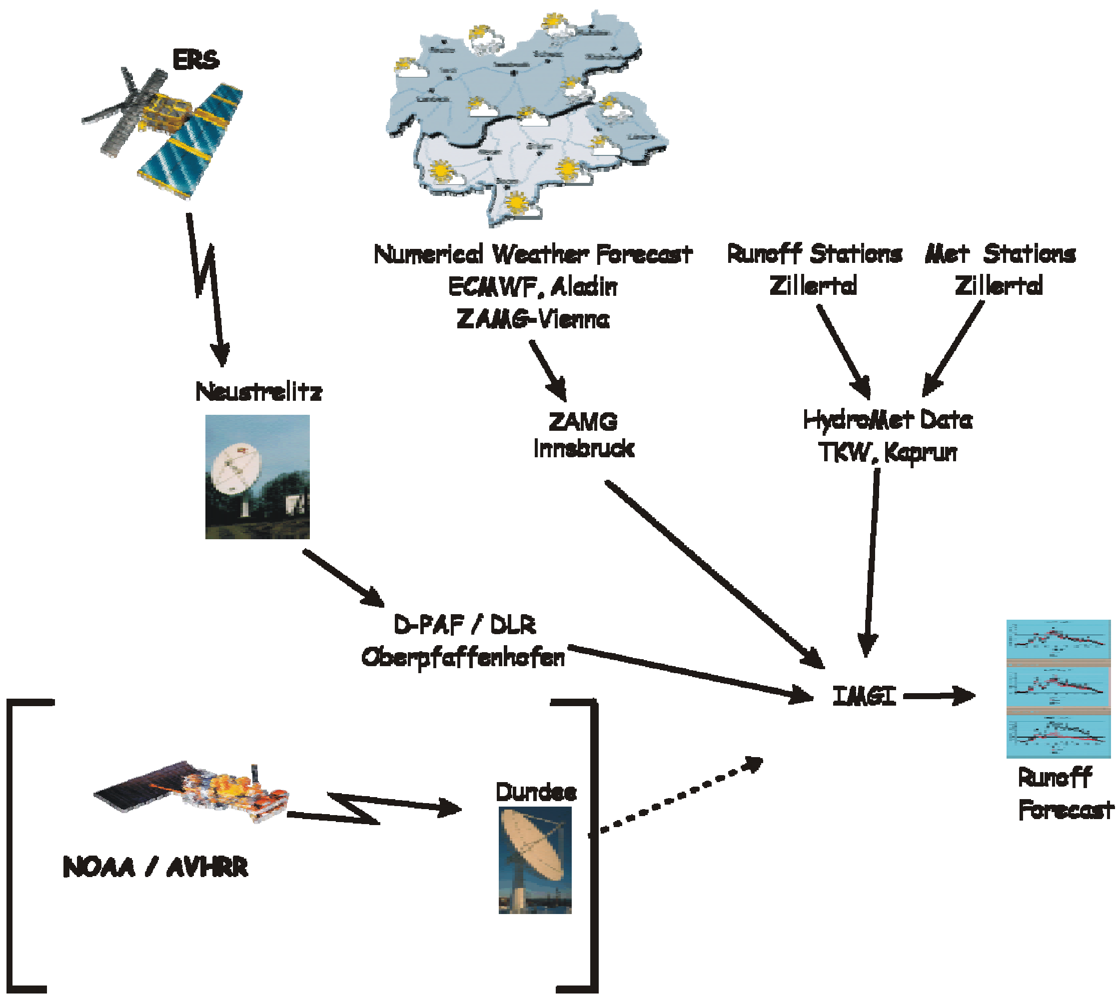


Figure 3: Data flow for forecasts in BASAT

Table 2: NRT hydromet inputs

Station	Parameters	Timing
Plattkopf	T, P	daily, 09:00
Schlegeis	T, P	daily, 09:00
Mayrhofen	T, P	daily, 09:00
Stillup	T, P	daily, 09:00
Durlassboden	T, P	daily, 09:00
Gerlos	T, P	daily, 09:00
Persal	Q	daily, 09:00
Schlegeis	Q	daily, 09:00
Stillup	Q	daily, 09:00
Zillergruendl	Q	daily, 09:00

For between-basin comparisons, a number of forecast performance criteria were decided upon at the workshop after the 4th Technical Meeting.

A nomenclature was devised for the forecast parameters and the statistical tools for measuring the quality of the forecasts were defined. These are described in the minutes of the 4th Technical Meeting

6.2.2 WP523 Runoff forecasts for BASCH

Responsible H. Kleindienst UBE, months 21-30

Hourly meteorological data as well as weather forecast data have been received during the last three months. A short overview of the received data shows that the data files of the observed meteorological data are partly incomplete or missing. This brings up the question of how to deal with data gaps when calculating daily values of precipitation and temperature out of hourly values. Several approaches are possible:

(1) As soon as one hourly value for one station is missing, declare the days value as missing

(2) Try to interpolate the missing hourly values based on the available data for the specific station.

(3) In addition to (2) use nearby stations to improve the interpolation.

(4) Estimate the daily values based on only a few hourly values, as it is done with the non-automised stations, for which the Mannheimer Stunden are applied (7am, 1pm, 7pm).

Possibility (1) is certainly the simplest approach, however, with most days marked as missing. Option (2) can lead to problems, if the extreme values are missing (e.g. early afternoon temperatures). An interpolation can be imrpoved if a function (e.g. a sine curve) is fit into the available data points. The third possibility is probably the most accurate. The last option is difficult, because it requires a coefficient which is not only different for each station, but depends also on the time of year. No specific way of calculating the daily values has been defined. Discussions with the Swiss

Meteorological Institute are ongoing concerning this problem.

Little advance has been made concerning the automatic processing of the meteorological data. The final procedure for managing and processing the real time data will be defined and implemented by mid March.

The Swiss Meteorological Institute has been contacted concerning the availability of ECMWF forecast data. The data should be free for research purposes, so only the data links need to be established.

6.3 WP 530:Customer assessment of services

Responsible: G. Wright, MLURI

The main objectives of this work package are

- The on-going assessment of the model developments during the life of the project including elaboration of directives for modifications.
- Appraisal of the runoff model for operational applications in hydrology and water management.
- To assess the cost-effectiveness of the use of remote sensing data

Tasks within WP 530

WP 531	Evaluation of user assessment & Interim Report 7	MLURI	Wright
WP 532	Assessment for hydropower management	VERB	Pirker

WP531 has been started early, to instigate the costing procedure within HYDALP. This now requires input from the modelling laboratories.

6.3.1 WP531 – Evaluation of user assessment and Interim Report 7

Responsible G. Wright, MLURI, months 28-31

A draft preliminary report has been received.

6.3.2 WP532 – Assessment for hydropower management

Responsible O. Pirker, VERB, months 29, 30

Package not yet active.

7. WP 600: Contributions to CEO Enabling Services / EWSE

Responsible: D. Miller, MLURI

WP 610	Implementation of Software and Documentation at CEO Services	SCEOS	Caves
WP 620	Demonstration Packages	MLURI	Dunham

WP600 became active in late 1998.

Aspects of the work in each task were discussed at the 4th Technical Meeting, held at SMHI in early February 1999, certain targets were revised and objectives set for the collation of materials for the production of Demonstrator packages.

Three participants have active World Wide Web (WWW) sites describing aspects of the HydAlp project and a fourth has an information page (addresses are listed at the end of this Section), in addition to the CEO project page. These pages, which are all linked, provide a range of materials for the dissemination of the project objectives and also provide some preliminary results. They may be considered as a single, if loosely linked, structure through which details about HydAlp can be accessed.

During the last three month period, the role of the Demonstration packages from WP600 in communicating the objectives and products of HydAlp to external customers (*e.g.* the Scottish Customer Focus Group) has been developed, thus linking activities in WP130, WP210, WP530 and WP600.

Future work

Over the coming three month period efforts will be directed in 5 areas.

1. Responding to feedback from CEO on the expectations and requirements of WP600 to provide Demonstrations for ESWE at CEO.

2. Producing a proforma for each Participant for summarizing data, processing and modelling flowlines, such that these details be presented in WWW compatible formats.

3. Developing a common presentation format for the HydAlp sites, at the top level (this is also dependent upon the outcome of item 1 above).

4. Designing a ‘Demonstrator’ facility for the HydAlp models.

5. Revised metadata on BASCH-2.

7.1 WP610 Implementation of Software and documentation at CEO services

7.1.1 WP611 Software systems and documentation

Responsible R. Caves, SCEOS, months 22-31

Documentation of the software system is proceeding at SCEOS, although it is felt that since live models will not be available from the WWW site that the 8 man months allocated to this aspect of the project will not be needed and can be allocated to other work packages. Revised objectives can be found in the minutes of the 3rd and 4th Technical Meetings.

7.1.2 WP612 Remote sensing component

Responsible T. Nagler, IMGI, months 22-31

Sar wet snow mapping documentation is in progress and a draft version is available on the IMGI WWW site.

7.2 WP620 Demonstration packages

7.2.1 WP621 Compilation of data sets for basins

Responsible T. Nagler, IMGI, months 25-32

The HydAlp WWW site at IMGI currently provides detailed information on the Austrian Basins. The site includes a clickable basin map, general descriptions, photographs, a hydro-power page and pages for meteorological and hydrological stations (in progress). In the next few months, this will be extended to include the other basins. The WWW site at MLURI contains equivalent information for BASUK (as described under WP622).

7.2.2 WP622 WWW demonstration and documentation

Responsible R. Dunham, MLURI, months 25-32

Project dissemination

The WWW site at MLURI has continued to be regularly updated during the last three months.

The site contains a publicly available demonstration page, which has provided a testing ground for ideas which will be used in the final demonstration package. Users, not only from HydAlp countries, but also from the United States, Germany, Greece, Spain, Belgium, Norway and France have accessed the publicly available demonstration.

A “Publications” page has been added and provides information on work that has been published by the HydAlp team. Currently 16 publications are listed, but this number will increase throughout the duration of the project. Where possible abstracts or complete papers are available in electronic form and may be accessed by site users, although copyright issues may have to be addressed for some publications.

Within the password protected pages, information about the minutes of the 4th Technical Meeting have been added.

Administration and public pages

Currently, the majority of the development work remains password protected within the Administration pages of the MLURI WWW site. A timetable has yet to be developed and agreed on the transfer of materials from the private to the public pages. This will await progress in the development of the Demonstration facilities and clarification of the requirements of CEO.

However, the basin descriptions outlined above are all available for public access.

Development of a WWW based demonstration of the models

A draft flowline for the WWW demonstrator was presented at the 4th Technical Meeting in Norrköping. The overall layout was accepted, although aspects such as the level of detail required, will depend on whom CEO views as being the target audience. Currently a draft HTML version of the demonstrator has been produced for discussion purposes. This is shown in Figure 4.

This demonstration is currently not publicly available. The URL for the demonstration is http://bamboo.mluri.sari.ac.uk/hydalp/private/hyddemo/index.html. It is planned that this demonstration will include information about the models (HBV and SRM) used within the project, and will include links to the model homepages, although full programs of the models will not be available.

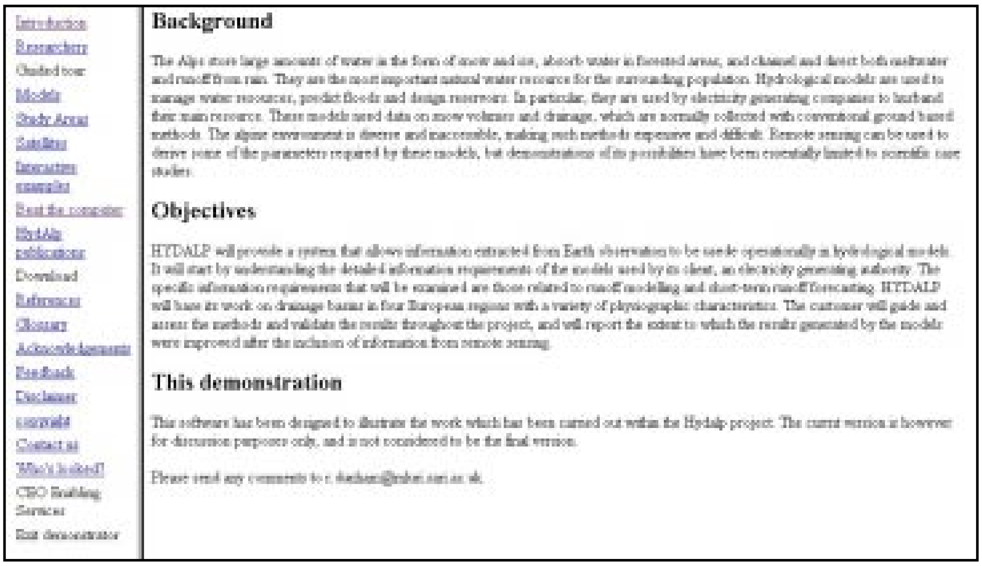


Figure 4. The draft HydAlp demonstrator. Currently the menu consists of text, since this is convenient to adjust in response to feedback. Ultimately "buttons" will be used instead.

A section on the test basins is also included and it is envisaged that this will include pre-calculated examples of model runs based on varying quantities of EO data. This will allow demonstration users to assess the value of using EO data with respect to their activities, whether that is hydropower generation, flood protection or something else.

The section on satellites will provide information on the satellites, which provide data for use within HydAlp, including examples of the EO data that are available. This offers the opportunity to develop an extensive educational resource.

Interactive examples will it is envisaged include a simplified version of the models, which will allow users to see the effect of manipulating various input parameters on the model results. It is hoped that the SRM-like model previously created can be developed for this purpose.

A section entitled "Beat the Computer" has already been produced and includes data for BASUK. Three options are available whereby the user can estimate the river discharge either one day of up to ten days ahead, and the user's estimates are compared with the HydAlp calculations and the observed runoff to allow an informal assessment of "guessed" as opposed to "modelled" results. It is envisaged that this section will be expanded to include examples from at least one other basin, although an agreement on the provision of data has yet to be reached.

Other sections within the demonstrator will include a list of participants, publications and references, as well as a method for allowing users to provide feedback.

Although the demonstration has not yet been rigorously tested or validated it has continued to stimulate discussion during meetings with HydAlp participants and with members of the Scottish Customer Focus Group.

HydAlp WWW addresses:

CEO	http://www.ceo.org/HydAlp.html
MLURI	http://bamboo.mluri.sari.ac.uk/HydAlp/
IMGI	http://www.dude.uibk.ac.at/Projects/HydAlp/
UBE	http://www.saturn.uibe.ch/remsen/project/HydAlp/
SMHI	http://www.smhi.se/sgn0106/if/hydrologi/runoff.htm

8. Action Items - 4th Technical Meeting

Documents related to these action items should be delivered to the project co-ordinator, who will be responsible for distribution.

No	Partner	Action	Deadline	Status
1.	UBE	Check for Near Real Time delivery of WiFS and Resurs	28Feb99	
2.	IMGI SCEOS UBE	Statistics of cloudfree AVHRR images (from literature) responsible by SCEOS (R. Caves)	15Mar99	✓
3.	SCEOS	Notes on SCA Intercomparison: what to do, which issues?	28Feb99	
4.	UBE	Decide on basin and period for NRT forecast (Engadin, BASCH); responsible: H. Kleindienst	28Feb99	
5.	IMGI	Check for online availability of runoff gauge of Inn near Swiss border.	20Feb99	✓
6.	IMGI	Check for DEM covering Engadin at IMGI	20Feb99	✓
7.	MLURI	Send out list of requirements for cost benefit analysis to all partners. responsible D. Miller	10Mar99	
8.	ALL	List of requirements for cost-benefit analysis (see Item7); back from HydAlp partners to MLURI	15Jun99	
9.	IMGI	Role definition of CEO Enabling Services (EWSE) responsible H. Rott (result: no standard document format) Contact P. Churchill (CEO), L. Lepan (DGXII) for setting up WWW site regarding WU1/2; responsible H. Rott (result: Just link @ CEO)	28Feb99	✓
10	SCEOS / SMHI	Select snow cover product for real-time forecasts in BASSW (AVHRR, SAR or both)	15 Mar99	
11	SCEOS	Ordering ERS acquisitions for NRT period for BASSW, BASAT; responsible R. Caves	20Feb99	✓
12	SCEOS IMGI	EC guidelines for final report; Publication of final report; responsible: S. Quegan, H. Rott	15Apr99	
13	SCEOS IMGI	contact ESA to publish a paper on real time runoff forecasting using ERS in Earth Observation Quarterly (EOQ) or ESA Bulletin: S. Quegan, H. Rott (confirmed by J. Lichtenegger ESRIN)	15Feb99	✓
14	ALL	Send a list of recent papers and conference presentations to IMGI for updating the publication list	15Mar99	