CRYOLAND USER Dissemination WS

SPÓYRY

Snow and glacier services for geotechnical and hydropower applications

Innsbruck December 4, 2014

PÖYRY GROUP

- Global Consulting and Engineering Company
- 6000 experts in more than 50 Countries
- Operating Locally and Globally

PÖYRY'S BUSINESS SECTORS





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Strategic Advisory		Global Competence Lines		Regional Business Lines
Management Consulting		Energy	Industry	Regional Operations
Strategic advice and transaction support for selected sectors	L	- Hydropower & Renewable Energy		Broad range of services covering engineering and technical advisory
		- Thermal Power		
	L	- Transmission & Distribution		
	I	- Nuclear Energy		
	F	- Pulp & Paper		
		- Mining & Metals		
		- Chemicals & Biorefining		

PŐYRY

Pöyry's Global Competence Line Hydropower (400 experts)



Offering our services within our main sectors...



🖸 PŐYRY

Our USF

Hydropower Development



Our outstanding experience combined with international expertise guarantees professional and efficient project execution

Sectors

Pumped storage Power Plant

Reservoir Storage Schemes

Run-of-River Schemes

Small Hydropower Plants

> River Basin Development

Automation and Control

Rehabilitation and Refurbishment

BA Hydropower is offering services within the hole life cycle

Development of a Hydropower / Infrastructure project



Use of Snow and Glacier Data within Pöyry Hydropower and Pöyry Water Resources Management

Hydropower Design (Masterplans, Feasibility Studies)

Verification of hydrological data (runoff contribution of snowmelt) <u>Probably Maximum Flood Studies (Rain-on-Snow events)</u> Glaciers (Spatial extent of glaciers and GLOF potential)

Hydropower Operation

Inflow Forecasting Reservoir Optimization Studies

Water Resources Management

Flood Forecasting (Precipitation Runoff Modelling) Climate Change Impact Studies (Water Balance Modelling)



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User Validation – Case Study: Reservoir Impounding Turkey





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Tasks of Pöyry in Reinstatement Project

• Concept and Design of the reinstatement works





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- Emergency Action Plan for impoundment phase



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- Support of Client in developing an impoundment strategy



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- Emergency Action Plan for impoundment phase
- Support of Client in developing an impoundment strategy
- Support of Client in monitoring the impoundment process
 - Monitoring of technical structures
 - Monitoring of hydrological conditions



Start of Impounding on Dec 27th 2012





On Dec 27th, 2012:

- Snow cover in the basin: ~ 50%
- Short and medium range Weather forecast: dry and cold
- Decision was made to start impounding





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Normal Operation Level reached on Jan 16th 2012





On Jan 16th, 2012:

• Snow coverage in the basin: > **50%**













Monitoring of hydrological conditions during impoundment phase

- Pilot system for Inflow forecasting in place
- Based on conceptual hydrological modell
- Very weak data base (almost no precip observations)
- Outputs of pilot system highly uncertain
- End of March the model showed still a significant snowpack
- High temperatures (with some rainfall) forecasted for the next days
- Model simulated a snowmelt-induced flood peak (~ 1 year flood)
- Check with Cryoland FSC Pan-European FSC: < 10% snow cover
- Model obviously wrong
- => No alert!



Monitoring of hydrological conditions during impoundment phase





- Pöyry is currently developing a hydropower decision support system (Pöyry Hydro DSS)
- Comprised of
 - hydrological model
 - water allocation & reservoir operation model
 - GUI & hydrological data base (incl. Regional Climate Change data)
- Web based application
- System was originally developed for Zambezi Basin as a system for water resources planning considering different climate change (simulation tool)
 - Long Term Flow Projections
- System is now being extended to a real-time inflow forecasting system for
 - Seasonal Inflow&Generation Forecasts
 - Short-Term Inflow&Generation Forecasts
- System is also being transferred to other basins (SE-Asia, Europe)

IPCC Climate Change Projections



Long Term Flow Projection

User



Long Term Flow Projection













Universities

Other Stakeholders



Universities

Other Stakeholders



• Integration of Cryoland Productions in Hydro DSS could be highly interesting as

• Qualitative Information for model evaluation and hydrological monitoring

- Snow Extent (FSC, 10-day FSC cloudfree very useful)

=> very little effort required for automatic download and integration

• Quantitative Information for updating the model states

- Snow Extent (FSC, Uncertainty estimation very useful)
- SWE for large basins

Pöyry Conclusions on Cryoland Products

- Useful products for different services in hydropower consulting & engineering
- Glacier data relevant for hydropower design in remote areas
- Snow data are relevant for design, construction and operation phase
- Pöyry is currently developing software tools for its hydropower clients and could easily integrate cryoland products, which would create an added value to the users
- Continuation of cryoland services would be highly appreciated !!!







Probable Maximum Flood Studies (considering snowmelt)

PMF required for spillway design

Design value with strong impact on costs

Rain-on-snow events can be crucial for PMF

It is important to know the maximum extent of snow cover during flood season (e.g. snow cover at beginning of monsun s.)

Input for PMF simulations









2005-01-23

2005-03-08





2005-04-11

2005-05-20



Applications in Pakistan, Turkey, West Balkan



Glacier extent and GLOF Potential

Important for estimation of glacial melt contribution to summer runoff

Discrimination between Glacier Ice and Snow Fields

Debris covered glaciers ?

GLOF potential very important for dam design and dam safety

Information on glacier extent and retreat for water resources and climate change impact studies in many regions of the world



Palas Valley and Spat Gah Catchment, NWFP Pakistan



Inflow and Flood Forecasting using conceptual hydrolog. Models

Snow models are an essential component of inflow and flood forecasting systems

Snow information important for

- Model Calibration and
- Model Updating





State variables to be updated:

- •Spatial extent (and distribution) of snow cover
- •Snow water equivalent
- •Liquid snow water equivalent



User Requirements

Hydropower Design and Climate Change Studies (Historical data)

- Series and statistics of regional extent of **snow cover** (series > 10 years)
- Interpolation of snow extent for areas which are partly cloud covered ??
- Latest status of **glacier extent** (end of ablation period)
- Recent changes in glacier extent (since the 1980ies)

Spatial resolution: - appropriate for catchment sizes between 100 and 10000 km² (> 10.000 km² for climate change applications)

Data Format: Flexible. Expert Users with Desktop GIS

Regions: C and SE Europe, Turkey, Caucasus, Karakorum, Himalaya



User Requirements

Hydropower Operation and Control (DSS), Flood Forecasting (near real time)

- Snow water equivalent (dry and wet)
- Snow cover extent
- (Snow Albedo)

Spatial resolution: - appropriate for catchment sizes between 100 and 10000 km²

- Delivery time: < 1 day for Flood Forecasting and short term Inflow Forecasting Weekly for seasonal Inflow Forecasting
- Data Format: Data Transfer via API ?
- Regions: SE Europe, West Balkan, Turkey, Caucasus,

