FLOW FORECAST
Supporting Hydropower Operations
Hydropower operators have to constantly adapt to the current inflow conditions. We support our clients in their daily operations with short-term and seasonal inflow forecasting systems. This helps our clients to increase energy generation outputs, ensure flood safety at all times and improve annual maintenance planning.

FROM WEATHER FORECAST TO FLOW FORECASTS

Weather forecasts are freely available in all parts of the world. We have specialized in converting precipitation and air temperature forecasts into site specific flow forecasts by application of detailed hydrological models. Flow forecasts are automatically updated every day based on the latest weather forecast. The hydrological models allow to account for the highly non-linear rainfall-runoff transformation, especially in river basins with varying topographical and climatological characteristics. Rainfall induced runoff enters the river network, where flow routing and flood attenuation in floodplains are key processes for accurate inflow forecasts at hydropower plants.

SATELLITE DATA OPENS NEW ERA FOR HYDROLOGICAL MODELLING

As many of our clients’ projects are located in remote, data sparse regions, we have developed a suite of tools to merge the available information from station data, gridded hydro-meteorological fields and satellite-based rainfall measurements. We use these data streams to thoroughly calibrate and test the hydrological model simulations before operational application.

In the last years the advent of satellite-based rainfall products have opened new possibilities for setting up flow forecasting systems with reduced costs especially in countries where there is no existing dense rainfall station network. The satellite data serve as a near real-time source for updating the soil moisture and flood routing simulations in our operational flow forecasting systems, thereby enhancing the accuracy of the flow forecasts.

SEASONAL INFLOW FORECASTS

Standard weather forecasts have a range of a few days, after which the skill and accuracy of the forecast diminishes rapidly. Especially in large river basins, seasonal forecasts with hydrological models can extend the skill in the flow forecast to a few weeks or even months due to the added memory in system states such as soil moisture and flow routing processes. This means – depending on the basin – we can provide skillful inflow forecasts based on hydrological models with a lead time of up to several months.

Such seasonal flow forecasts are crucial for efficient planning of water resources management, as they provide the required information to address the typical questions of “How fast shall I draw down the reservoir during the next dry season?”, “When shall I start to refill the reservoir?”, “What electricity generation can I expect in the next few months?”.

OPTIMIZATION OF HYDROPOWER RESERVOIR OPERATION

Related to inflow forecasting is the question of how to optimize reservoir operation given the latest inflow forecasts and consideration of plant specific settings such as turbine characteristics, turbine availability due to maintenance, reservoir storage capacity, seasonal reservoir water level rule curves, spillway outflow capacity, and tailwater rating curves.

TAILOR-MADE SOFTWARE FOR OUR CLIENTS

The best modelling tools are useless if they are not easy-to-use in the daily work. Therefore, our software engineers provide flow forecasting systems specifically tailored to the needs of our clients. Thereby we ensure that existing operational planning procedures are also reflected in the software. We also develop manual or automatic interfaces to make use of existing data already measured by our clients in their daily work. Thus, there is no need that the client adapts to the new flow forecasting software, but rather we adapt the software to our clients.

CAPACITY BUILDING

In addition to easy-to-use flow forecasting systems we also provide capacity building programs to enhance the knowledge in hydrological data processing, interpretation of flow forecasts, dealing with hydrological uncertainty, planning of reservoir operation and electricity generation forecasting. Capacity building can be a short 1-2 day course or a series of workshops over the course of a year.

In addition to capacity building we offer operational support services, which extend beyond the usual software maintenance contracts. Our in-depth knowledge in hydrology and water resources management allows us to support in decision making for optimal hydropower reservoir operation and forecasting of hydropower electricity generation.
The Zambezi River is of vital importance for energy generation in southern Africa. Kariba and Cahora Bassa are two major hydropower plants and are strongly affected by annual variations in inflow. The sheer size of the basin and scarcity of rainfall stations make it extremely difficult to provide inflow forecasts. In a pilot study Pöyry set up an inflow forecasting system solely based on satellite rainfall data and numerical weather forecasts. A rainfall-runoff model was used to simulate runoff generation, floodplain losses and routing to downstream hydropower plants.

The hydropower plants at the Drin River are the main source for electricity generation in Albania. Heavy rainfall and floods from local tributaries are a serious concern in the safe operation of the reservoir cascade. Pöyry developed an online Operational Support System to support the daily operational planning of the Albanian hydropower operator. The system uses rainfall station data and numerical weather forecasts to issue inflow forecasts and flood warnings from lateral, high mountain tributaries.

Kainji and Jebba hydropower plants at the Niger River are critical for the electricity supply in Nigeria. Pöyry supports the hydropower operations with short-term and seasonal flow forecasts. Satellite rainfall and weather forecast data are used with a hydrological model to simulate reservoir inflows. Due to the long flow times in the basin the inflow forecasts have high skill with a lead-time of several months. This enables optimal, seasonal planning of reservoir operation thereby increasing energy generation and streamlining turbine maintenance work.

Floods are a major risk for construction work in the river channel at any new-built hydropower plant. Pöyry helped to mitigate this risk by setting-up a flood warning system for the construction phase of the Nam Theun 1 hydropower plant in Laos. Pöyry built several gauges in the remote areas of the upstream basin, using satellite data transmission. The data are merged with weather forecasts to simulate flow conditions at the construction site with several days lead time, allowing early warnings and evacuation of the construction site before flood events.

Integration of intermittent renewable energy sources such as wind with traditional hydropower generation is a challenge for Austrian energy utilities. Pöyry set-up a flow forecasting system for several hydropower plants at the Erlauf River in Austria. Ensemble weather forecasts are used to issue a range of possible inflow over the next 48 hours in a high temporal resolution of 15 min time-steps. The forecasts help the energy utility to guarantee grid stability from their wind and hydropower plants. Flood forecasts by the system are provided to the provincial government.

Gabčíkovo hydropower plant in Slovakia is located at the Danube River, one of the major rivers in central Europe. The hydropower operator uses an inflow forecasting system, which combines flow gauge data, a hydrological model and hydrodynamic flow routing. The flow forecasts help to maximize energy generation and ensure safe operations during floods. Pöyry is supporting the hydropower operator with maintenance work of the forecasting system, thereby guaranteeing that the system is available at all times.
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