Successful Integration of EO-Based Observations and Machine Learning in Spring Peak Flow Forecasting

Summary

Earth Observation based Snow Water Equivalent (SWE) data, together with machine learning techniques and hydrological forecasting modelling provided useful leadtime in predicting spring snowmelt driven reservoir inflow volume and peak timing for hydropower production optimization in Northern Finland.

Sponsor	Project	Solution provider	User
The e-shape project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 82085	e-shape	blocked URL	KI

Taxonomy

- Inland water
- Topography
- Alternative energy

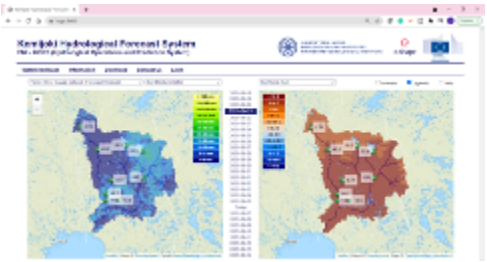
User profile

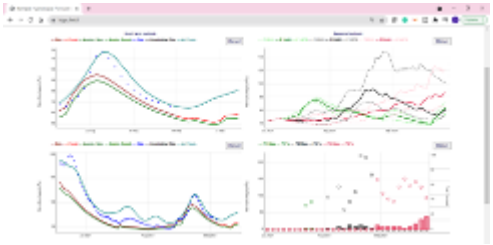
Kemijoki Oy is the most important producer of hydropower and regulating power in Finland. We own 20 hydropower plants, 16 of which are located at the Kemijoki watercourse area, two at River Lieksanjoki and two at River Kymijoki. In addition, we regulate the reservoirs in Lokka and Porttipahta as well as Lake Kemijärvi and Lake Olkkajärvi. Our most important goal is to produce hydropower for our stakeholders reliably and cost-effectively. We operate as an expert and commissioner organization of hydropower production and are developers of hydropower expertise. We acquire most of our operations from service providers. Thanks to our agile, partnership-based operating model, we can produce hydroelectricity cost-efficiently and adapt to changing conditions.

KEMIJOKI

Service description

The Finnish Meteorological Institute (FMI) provides detailed information to support in more efficient hydropower operations through reduction of hydrological model uncertainties arising from incomplete information on snowpack states over large areas through increasing observation resolution and through data ingestion to the FMI HOPS model with both probability based and non-probabilistic frameworks. This service aims in reduction of spring snowmelt driven flood risks through more reliable hydrological nowcasts and forecasts. It is increasing forecast end-users' situational awareness and understanding of uncertainties and consequently providing a basis for optimization of hydropower operations. The outcome aims to bridge the gap between forecast providers and forecast end users by seeking solutions to remove barriers for information dissemination, application, and utilization.





Customer experience

The data presented in the webservice is used for hydropower production optimization and assessment of modelling and monitoring uncertainties and as such has been seen as useful auxiliary information. Since FMI is not at this stage legally able to provide direct guidance on operational activities, the pilot is considered as an auxiliary service for new technologies and methods for forecast production and for combining relevant data from multiple sources into a single web service. Combining and displaying data from different sources, is seen as very significant in assessing forecasting uncertainties. Also, new promising methods for streamflow forecasting such as the operational usage of machine learning techniques has been added to the service during 2021.

Need

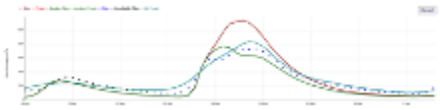
- Decreasing the vulnerability of energy companies to variations in meteorological and hydrological conditions through improved seasonal forecast products is the main expected impact of the project.
- End-user tailored products on hydrological conditions will be disseminated to the key end user; Kemijoki Oy.

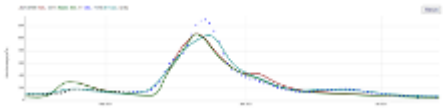
Challenges

- Currently modelling and forecasting of snowmelt timing and melt rate uncertainties stem from uncertainties in model forcing data. The lack of widely available and reliable forcing data restricts wide spread application of more complex models, particularly in operational stream flow prediction systems. EO based snow state ingestion and communication with end users will be used to address these limitations.
- The methodology for determining snow conditions using coarse resolution EO data (for hydropower optimization) is already available. The main objective is to derive higher resolution and higher quality products, to improve timeliness and information content.
- Providing accurate snow cover information from satellite observations and forecast products requires well-coordinated collaboration between the developers and the end users. All information needs to be disseminated in plain language, with special focus on communicating uncertainties to ensure that no information is "lost in translation".

Results

- Successful assimilation of EO-based SWE data in improving spring snowmelt driven runoff peak timing and volume forecasts.
- Successful communication of uncertainties relating to long term seasonal ensemble forecasting.
- Successful implementation of machine learning based new streamflow forecasting methods.
- Successful integration of hydrometeorological data from multiple independent sources.
- Useful overall reduction of official forecast uncertainties through auxiliary information dissemination.





References

Learn more about the service: https://hops.fmi.fi/

Learn more about e-shape: www.e-shape.eu

A question? Contact the Helpdesk: https://helpdesk.e-shape.eu