End of project popular science description - EOForChina

Introduction

EOForChina focused on the exploitation of the latest generation of satellite earth observation (EO) missions for hydrological modelling and forecasting, and water resources management. The project focused specifically on satellite radar and laser altimetry to measure water surface elevation in rivers, lakes and reservoirs and its variation in space and time. EOForChina combined satellite altimetry and other satellite EO datasets (surface water extent from spectral and synthetic aperture radar imagery, GRACE total water storage change, microwave soil moisture, actual evapotranspiration from multispectral and thermal imagery) with hydrologic and hydraulic models operating over a range of scales, to improve predictions of inland water cycle processes and forecasts of flows and water levels in river systems. The project demonstrated mapping and modelling workflows for selected Chinese river basins spanning a wide range of geographic, physiographic and climatic conditions, i.e. the Songhua River, the Hai River, the Han River, the Changjiang River, the Yellow River, the Lancang River and the Nu River. The methods and workflows developed in the project are transferable to other river basins around the world.

Results

EOForChina developed new data products derived from satellite EO for inland waters in China:

- A national-scale satellite radar altimetry database including the Sentinel-3 and CryoSat-2 missions.
- A national-scale, monthly, 10m spatial resolution surface water extent dataset based on spectral and SAR imagery.
- Regional-scale datasets for selected river basins including GRACE total water storage grids, Icesat-2 land and water elevation, soil moisture, solar induced fluorescence and actual evapotranspiration.

EOForChina developed new hydrologic and hydraulic modelling and model calibration workflows for large and poorly instrumented river basins that can be informed with data products derived from satellite EO:

- A hydrologic modelling workflow that assimilates soil moisture and GRACE total water storage change data into the DHI global hydrologic model.
- A hydraulic inversion workflow that estimates river hydraulic parameters from satellite observations of water surface elevation and river width.
- A hydraulic modelling workflow exploiting the high-resolution elevation data products from IceSat-2 for river modelling
- A drought risk mapping workflow based on GRACE total water storage change and solar induced fluorescence data.

EOForChina developed operational modelling and forecasting systems that are being informed with satellite EO datasets:

- An operational flood forecasting system for the Changjiang river basin run by DHI China
- The DHI global hydrological model, run operationally by DHI for China and other parts of the world.

Conclusions

EOForChina has demonstrated the potential of satellite earth observation for hydrologic forecasting and modeling in China. Datasets and modelling workflows are available for uptake by operational agencies and end users (e.g. river basin commissions). While in-situ hydrometric data is still classified and proprietary in China, satellite EO data is free, open, and accessible for everyone. This is particularly important in transboundary river basins, such as the Mekong/Lancang, where growing conflicts over water resources allocation impede the exchange of data and information. Datasets and modelling workflows have been integrated into DHI's commercial service portfolio. Workflows and approaches are transferable to other regions of the world and are well suited for integration with global-scale operational modelling and forecasting systems such as the DHI global hydrologic model. Three PhD students and 2 postdoctoral researchers were trained in EOForChina and have now advanced in the academic system in China and beyond due to the rich and high-impact scientific output resulting from their work in the project.

Recommendations

Integration of satellite EO data streams with operational hydrologic/hydraulic modelling and forecasting tools has large potential and EOForChina recommends its implementation

- In global-scale inland water modelling and forecasting systems, such as the DHI global hydrological model
- In operational river basin scale forecasting systems operated by the Chinese river basin commissions and their subcontractors (e.g. the Changjiang system run by DHI China)
- In poorly instrumented and/or transboundary river basins, where in-situ datasets are scarce and/or inaccessible due to political reasons (e.g. Lancang/Mekong River, Nu River).

More research and development work is required to support the integration of satellite EO data streams and operational hydrologic modelling and forecasting. The EOForChina consortium has long-term interests in this field and will pursue this agenda in the future, potentially under the upcoming EU-China climate and biodiversity flagship mechanism in Horizon Europe.