BOLIVAR-tool for analysis and simulation of metocean extreme events

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Metocean extreme events are caused by the combination of multivariate and multiscale processes which depend from each other in different scales (due to short-term, synoptic, annual, year-to-year variability). There is no simple method for their estimation with controllable tolerance. Thus, the extreme analysis in practice is sometimes reduced to the exploration of various methods and models in respect to decreasing the uncertainty of estimates. Therefore, a researcher needs the multifaceted computational tools which cover the various branches of extreme analysis. BOLIVAR is the multi-functional computational software for the researches and engineers who explore the extreme environmental conditions to design and build offshore structures and floating objects. It contains a set of computational modules of various methods for extreme analysis, and a set of modules for the stochastic and hydrodynamic simulation of metocean processes. In this sense BOLIVAR is a Problem Solving Environment (PSE).

The BOLIVAR is designed for extreme events analysis and contains a set of computational modules of IDM, AMS, POT, MENU, and SINTEF methods, and a set of modules for stochastic simulation of metocean processes in various scales. The BOLIVAR is the tool to simplify the resource-consuming computational experiments to explore the metocean extremes in univariate and multivariate cases. There are field ARMA models for short-term variability, spatial-temporal random pulse model for synoptic variability (storms and calms alteration), cyclostationare model of annual and year-to-year variability. The combination of above mentioned modules and data sources allows to estimate:

- omnidirectional and directional extremes (with T-years return periods);

- multivariate extremes (the set of parameters) and evaluation of their impacts to marine structures and floating objects;

- extremes of spatial-temporal fields (including the trajectory of T-years storms).

An employment of concurrent methods for extreme analysis means their comparing and provides the ensemble estimates of T-years extremes.

The BOLIVAR has an open architecture which allows to add new computational methods and models flexibly, and to use them inside the composite applications. Moreover, the BOLIVAR may be useful for educational purposes: it has the native interface and available though web-browser. This tool is successfully used for the interval extreme analysis of multivariate (wind-waves) extremes in Baltic, Barents and Caspian seas in respect to offshore design. Additionally the sensitivity analysis of storm surge floods in St. Petersburg, Russia was also performed.