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Utilizing seasonal streamflow forecasts for a hydro power cascade under Mediterranean climate

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The operation of hydro power utilities is a multi-objective, multi-reservoir real-world problem. Naturally, the main purpose of hydro power facilities is the generation of carbon free energy but they also serve, amongst other purposes, as flood protection or water supply entities. Rivers, rich in hydropower potential, are being exploited by the form of cascades. There exists usually a head pond, which buffers the seasonality of the natural inflows and thus increases the energy production of the downstream power units. The cascade system deepens the complexity of the optimization problem. Furthermore, many energy markets are liberalized or going to be liberalized in the near future. This results in another degree of complexity, respectively of uncertainty: energy prices. Recently, a promising method for optimal solution of water resources management problems was introduced: Evolutionary-Multi-Objective-Direct-Policy-Search (EMODPS). EMODPS can be associated to implicit stochastic optimization methods and therefore relies on long records, or stochastic streamflow replicates capturing a wide range of possible conditions. It remains unclear whether a stochastic streamflow generator can actually cover all possible future conditions and whether it is necessary to inflate the optimization process to investigate very unlikely states – especially when the near future can be predicted to some extent. Thus, we extend the well-known EMODPS framework by an updating approach utilizing seasonal streamflow forecasts. Periodically, the reservoir policies are updated based on an ensemble of new forecasts and the actual reservoir water levels. This adaptive policy search approach is applied for a three reservoirs cascade under Mediterranean climate, where the energy market will play an important role in the future.