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Models based on “out-of Kilter" algorithm

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In case of many water users along the river stretches, it is very important, in case of low flows and droughty periods to develop an optimization model for water allocation, to cover all needs under certain predefined constraints, depending of the Contingency Plan for drought management. Such a program was developed during the implementation of the WATMAN Project, in Romania (WATMAN Project, 2005-2006, USTDA) for Arges-Dambovita-Ialomita Basins water transfers. This good practice was proposed for WATER CoRe Project- Good Practice Handbook for Drought Management, (InterregIVC, 2011), to be applied for the European Regions.
Two types of simulation-optimization models based on an improved version of out-of-kilter algorithm as optimization technique have been developed and used in Romania:
• models for founding of the short-term operation of a WMS,
• models generically named SIMOPT that aim to the analysis of long-term WMS operation and have as the main results the statistical WMS functional parameters.
A real WMS is modeled by an arcs-nodes network so the real WMS operation problem becomes a problem of flows in networks. The nodes and oriented arcs as well as their characteristics such as lower and upper limits and associated costs are the direct analog of the physical and operational WMS characteristics. Arcs represent both physical and conventional elements of WMS such as river branches, channels or pipes, water user demands or other water management requirements, trenches of water reservoirs volumes, water levels in channels or rivers, nodes are junctions of at least two arcs and stand for locations of lakes or water reservoirs and/or confluences of river branches, water withdrawal or wastewater discharge points, etc. Quantitative features of water resources, water users and water reservoirs or other water works are expressed as constraints of non-violating the lower and upper limits assigned on arcs. Options of WMS functioning i.e. water retention/discharge in/from the reservoirs or diversion of water from one part of WMS to the other in order to meet water demands as well as the water user economic benefit or loss related to the degree of water demand, are the defining elements of the objective function and are conventionally expressed by the means of costs attached to the arcs.
The problem of optimizing the WMS operation is formulated like a flow in networks problem as following: to find the flow that minimize the cost in the whole network while meeting the constraints of continuity in nodes and the constraints of non-exceeding lower and upper flow limits on arcs.
Conversion of WMS in the arcs-nodes network and the adequate choice of costs and limits on arcs are steps of a unitary process and depend on the goal of the respective model.