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How accounting for transient catchment hydrology in the design of river engineering works ?

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Current engineering practice of hydrologic design is based on hazard estimates that are carried out under the steady state conjecture, i.e. stationarity. This occurs for both assessing averages and second order statistics, and predicting low frequency quantiles. Conversely, routing of hydrologic input variables via known boundary conditions of the systems, i.e. the hydrological basin, can produce non stationary behavior of derived variates, i.e. those required for design. Abrupt changes in the drainage basin can lead to unexpected and profound changes in the magnitude of design events, sometimes providing design loads higher than those expected for a stationary system. Modified connectivity between the constantly developing human mobility network, the drainage system, and the dendritic river topology may result in tremendously modified signature of the climate on hydrologic response. Anthropic footprint on soil use may lead to hugely increased hydrological feedback and floods therein. Transient effects of forest fires in arid or semiarid areas decrease vegetation dampening on runoff production and soil stability, with a dramatic fallout when heavy storms occur within the post event recovery time window. Sudden pulses of fine and coarse sediment occurring in the forest fire's wake, and in connection with rapid mass movements, such as landslides or avalanches in alpine areas, may decrease the effectiveness of engineering works even for unchanged hydrologic loads. New paradigms are necessary to provide enhanced design strategies of river engineering works. These should entail the heavily non linear effects of pulse events with transient effect in time on hydro-morphological dynamics of rivers and increased risk therein, particularly for those works aimed to bear extreme loads, i.e. coping with very high return periods. Major instances deal with dams, power plants, and all those schemes that are very sensitive because of potential consequences of hydrologic catastrophes. Here, examples are given of structures, works and events with transient effect in time affecting the expected hydrological risk, and some strategies sketched to deal with such issues henceforward.