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FROM THE PHYSICS OF THE SMALL TO LARGE BASIN SYNTHESIS

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In spite of all the scientific and technological efforts exerted in the past decades towards data collection, analysis and modeling of hydroclimatic processes, there is still a large amplitude of uncertainties in the prediction of the so-called leading precursors of climate such as temperature and precipitation, let alone the prediction of the resultant runoff. The most recent analysis of the Intergovernmental Panel on Climate Change (IPCC) indicates a series of possible effects greenhouse warming might have on the supply of water and the hydrological balance, based on predictions of climate change from GCMs. The results suggest that a 1.5 to 4.5°C rise in global mean temperature would increase global mean precipitation about 3 to 15% with very divergent results according to different scenarios. Translating such precipitation predictions into annual runoff has become an upbeat task. For example, prediction of annual runoff with different models for northern South America shows considerable discrepancies varying from 93.3% increase to 49.1% decrease of regional runoff.

Even though the introduction of remote sensing techniques was heralded as decisive, their contribution towards understanding climate dynamics and their ground effects is still minimal. Satellite data for example have been accumulated and interpreted at least in the past three decades but still not much seems to have been achieved in terms of predicting climate change and/or climate modifications, necessary for adapting water resources management strategies.

Couldn't it be the case to 'study' the 'artificial' planet (or part of the planet) through physical models instead of the study of the planet from satellite data being considered as a laboratory by itself? Alternatively, it could be a scaling laboratory comprising part of the atmosphere. Is this approach more expensive than the satellites or is it much more uncertain? I do not know. The Japanese have always been on this path and, among other things, they have, for example, developed a complex simulation installation for atmospheric processes and their resultant ground effects under different weather scenarios from physical models to real world installations and thereby creating many exciting scientific facilities in Tokyo. Is it only a question of money or is it a promising road?

Hasn't the time come to think about something else, perhaps, or to go back to Nature through nature's own system construction of the river network? The law of conservation of mass and energy is well observed within the system boundaries of the river network. It is well known that the river network itself is a definite product of climatic, soil, and hydraulic processes and changes in the triggering processes can therefore be monitored through the basin response at different time scales. The river basin has a unique property of having a very stable structure in time (skeleton) which does not lend itself to instantaneous changes and hence can monitor the changes in the mass and energy balance within its system.

Recourse to Hydraulics can therefore 'explain' many things! The discharge of a river at a section (and hence the volume of water passing during at a given time interval: month, year, multiyear) is an integration (in both physical and mathematical senses) of a series of processes occurring in the channel network and therefore emerges as the resultant synthesis of all! I therefore think that a big project on large basins with or without atmospheric 'boundary' but rather with land boundary could better 'explain' a series of questions connected to the climate and/or climate changes. This could lead to a necessary synthesis which can be derived from hydraulics of large basins (eg. Amazon River, Mississippi, Danube, etc.). A special discussion on the Mediterranean basin can also be initiated and formulated, within a global framework. The alternative road could be from the 'physics' of the small to arrive at deriving information at a larger scale but presently much has been left at the level of the 'small'.

Such projects could go a long way towards monitoring climatic processes and modifications and also climate changes through actual measurements of discharges at controlled sections (basin response) which could lead to a continuous verification of the relations between surface and ground water responses to precipitation modifications from the basin water balance. This approach could lead to the quantitative monitoring of the effects of the ongoing frequency/magnitude modifications of precipitation and the consequent necessity for adapting water management strategies to them.