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Inter-annual and seasonal variability of flows: A Mexican rivers classification towards climate-smart environmental flows

Sergio Salinas-Rodríguez

Delft University of Technology, Civil Engineering & Geosciences Faculty, Water Management, Delft, Netherlands (s.a.salinasrodriguez@tudelft.nl)

The study of flow-ecology and flow alteration-ecological response relationships in environmental water science is key in environmental flow assessments (EFA). Nowadays, the more advanced hydrologic-based methods in EFA focus on building those relationships for the inter-annual and seasonal flow regime variability components. In Mexico, the most detailed hydrological method is set by a norm, applicable nation-wide, in which the natural frequency of occurrence is used to integrate these variability components to the environmental flow proposals. However, to date it hasn't been investigated the magnitude of the hydrological contributions of wet, average, dry and very dry conditions from the flow variability components and if is it differentiated on rivers and streams by climatic-influence or their geographic location. The primary goal of this work is to fill this gap.

Forty-one streams were selected based on three criteria: available information to fulfill hydrological requirements, their variability and geographic representation. First, the hydrological requirements were flow records at daily scale for at least 20 consecutive years (36 with gauging stations and 5 from rainfall-runoff models). Second, the nature of current: ephemeral (19), intermittent (7) or perennial (15). Third, their geographical location in two separate subselections: a) with regard the Tropic of Cancer to cover the incidence of climatic extreme events such droughts (northern = 13) and floods (southern = 28); and b) according to exorreic (Atlantic or Pacific [13 and 21, respectively]) or endorreic (7) drainage. The inter-annual and seasonal (dry and wet) variability of wet, average, dry and very dry conditions were obtained in the form of discharge volume (m3/sec) and their relative contribution to the maximum historical of the full set of flow records.

Preliminary results of inter-annual and seasonal variability show that there is a greater contribution in wet condition for ephemeral streams followed by intermittent and perennial while the contribution of average, dry and very dry conditions is inverted, all in general with the same proportions. The streams located with regard the Tropic of Cancer show the same pattern of contributions (northern is greater than southern in wet condition but inverted in average, dry and very dry conditions). Finally, although drainage zones classification presents also this same pattern (endorreic larger than exorreic in wet condition but reversed for the rest), streams that drain to the Pacific Ocean have almost the same magnitude of contribution in all conditions than the median from all streams. Furthermore, the streams that drain to the Atlantic and Pacific Oceans have practically the same level of contribution in average and dry conditions for the inter-annual and wet season variability, and average for the inter-annual.

These results suggest that the nature of current appears to be the most comprehensive classification that better reflects climatic-influence. Future research will focus on (1) conducting a variance hypothesis test; (2) if there is a meaningful variance, what does this contribution means in terms of ecological and biological processes?; and (3) assessing whether the frequency of occurrence of dry or wet conditions are increasing or decreasing.