Jim Hall, Anna Murgatroyd and Yakov Ben-Haim, 2024, An info-gap approach to the reliability of reservoir supplies under deeply uncertain inflows. Working paper.

Abstract The distribution of inflows into a reservoir fundamentally influences the reliability with which the reservoir can release (supply) a desired volume of water. However, future inflows to the reservoir are often deeply uncertain because of uncertainties in climatic and catchment changes, and upstream reservoir construction and/or operation. Given deep uncertainty, here we propose an info-gap approach to characterising the uncertainty in the inflow distribution as an unbounded family of nested sets of probability measures, centred upon the empirically estimated probability distribution. This uncertainty model enables us to formulate the uncertain reservoir volume and conduct an info-gap analysis of the reliability with which the reservoir can stay above a critically low storage volume whilst supplying required releases. The info-gap analysis is implemented based on inflow characteristics, storage volumes and discharge requirements at the High Aswan Dam in Egypt. We find an irrevocable trade-off between the probability of being above the critically low storage volume and the robustness to uncertainty in the inflow distribution. Reducing the required reservoir releases through demand management markedly increases robustness to moderate uncertainties in the inflow distribution, but for large uncertainties the robustness with which even this modest target release can be achieved rapidly declines.