Abstract. A multivariate, principal-component based index has been developed to quantify the severity of droughts. Named the Aggregate Drought Index (ADI), it describes the meteorological, hydrological, and agricultural aspects of drought on a climate-divisional basis, using fluctuations in the values of five variables associated with the hydrologic cycle and available water: precipitation, evaporation, streamflow, reservoir storage, and soil moisture. Additionally, the ADI considers the snow water content of snowpack reserves. The ADI is computed as the first principal component of the observational dataset, where the principal components are determined using a correlation-based approach. Index computations are performed separately for each of the twelve months, such that the signal is not biased by the differing hydroclimatology of distinct months. The twelve series are ordered chronologically, and the basic monthly chronology is extended to produce time series of drought across several monthly time scales. Drought severities over multiple time scales are presented for three California climate divisions during the minimum period of 1975-2000. A methodology is also presented for the routine, real-time computation of current ADI values. The ADI is found to closely match the PDSI spatially and temporally, but its computational procedure is both simpler and more mathematically objective than that of the PDSI.

Despite the apparent existence of teleconnections between distant climatic precursors and Western United States hydrologic variations, and new drought indices, there remains limited use of this information to influence water management in settings like California’s Central Valley reservoir operations. This problem is related to a lack of understanding among decision-makers on how relying on climatic teleconnections and drought indices would affect operational outcomes and decision-related risk.

Using Northern California reservoir inflow and Central Valley reservoir operations as the case study setting, three research phases were performed within a decision-oriented framework. The intent was to identify and assess teleconnections that might influence California water supply planning protocols (i.e. autumn stored-water carryover targeting and winter-spring allocation of stored-water). Phase One involved identifying strong teleconnections (i.e. correlation > 99% significant) between Pacific-region climatic variability and Northern California reservoir inflow variations during seasonal to annual supply-related periods. Phase Two involved evaluating the strong teleconnections from Phase One for added information value in supporting stored-water carryover targeting and water allocation given the competing information set already supporting these decisions (i.e. climatology, snow surveys). Phase Three focused on how wet season flood control constrains the possible use of supply-related teleconnections, and involved identifying teleconnections related to seasonal flood event likelihood as a means to relax this constraint.

Results indicate a presence of strong supply-related teleconnections involving regionalized modes of mid-latitude Pacific atmospheric pressure structure variability and seasonal-to-annual Northern California reservoir inflow variations. Evaluating the use of these strong teleconnections in decision-support showed that the teleconnections related to the autumn stored-water carryover targeting process offer an added information value (i.e. teleconnections involving water-year inflow response). However, the teleconnections related to the winter-spring water allocation offer little or no added information value because of the substantial information overlap between the teleconnections and snow survey data already conditioning this decision process. Finally, the “flood event”-related teleconnection assessment showed that summer observed climatic precursors embedded in the mid-latitude Pacific atmospheric pressure structure have potential for indicating wet season (Oct-Mar) peak runoff rates. This latter result plus the existence of supply-related teleconnections related to stored-water carryover targeting indicates promise for teleconnections-based coordination of wet season flood-control and stored-water supply management strategies in California reservoir operations.