Linkages between mid-latitude Pacific ocean/atmosphere climatic conditions and seasonal/annual Northern California streamflow

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Abstract. This research is the first part of a framework to assess risk and uncertainty of using remote-climate-based streamflow forecasts in surface water reservoir operations. The research presented here focuses on how to best utilize remote ocean/atmospheric data to improve seasonal-to annual-streamflow forecasts in Northern California basins. Three basins were used in this study (i.e. watersheds tributary to Lake Shasta, Lake Oroville, and Folsom Lake). It was hypothesized that interannual streamflow variability could be linked to mid-latitude Pacific Region ocean/atmospheric variability. Monthly remote climate indicators obtained found from using principal component analyses on sea surface temperature (SST) and atmospheric geopotential height (GPH) data fields. Annual correlations between indicators and basin streamflow were computed while allowing three parameters to vary: the indicator averaging period, the basin streamflow accumulation period (BSAP), and the lag between the two periods. Best indicators were identified as those having similarly strong association (i.e. correlation > 0.5) with streamflow in each basin for a given BSAP. For the Oct-Sep BSAP, the indicator with the strongest correlation was the mean JAS 4th principal component (PC) of the mid-latitude Pacific region 700mb GPH field. For the Jan-Sep BSAP, the same indicator was selected, except using JASOND averaging period. For the Feb-Sep BSAP, the indicator with the strongest correlation was the mean DJ 4th PC of the mid-latitude Pacific SST field. For the Mar-Sep BSAP and Apr-Sep BSAP, the same indicator was selected, except using the DJF averaging period. Additionally for the Mar-Sep and Apr-Sep BSAP, another indicator with a strong correlation was the mean ASONDJ 5th PC of mid-latitude Pacific region 700mb GPH field. The nature of these indicators and their link to Northern California streamflow variability was further investigated using composite analyses of the SST and GPH data fields and correlation analyses with Feb-May snow survey data collected in the study basins. This research framework continues with the inclusion of these indicators into the existing probabilistic seasonal streamflow forecasting framework used by State/Federal agencies to manage California reservoir operations. Historical operations analyses will then be conducted to explore the risk and uncertainty of using this climate information from various water-distributor and user perspectives.