Streamflow Disaggregation for Regulated and Unregulated Waterways

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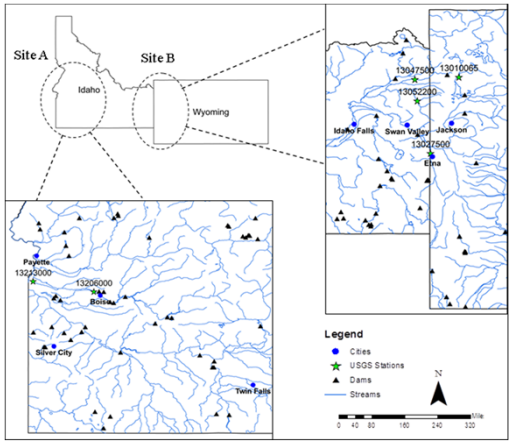
ABSTRACT

This paper describes a simple, site specific, data driven, flexible and adaptive methodology to disaggregate daily streamflows from monthly streamflows. The effectiveness of this method has been demonstrated through its application at both regulated and unregulated rivers located in the states of Idaho and Wyoming. Only streamflow acts as decision variables in this method. For monthly streamflow that needs disaggregation at the target station (TS), selection of monthly streamflow from historical records at the source station (SS) is based on minimum error criteria which is calculated with respect to three-months time window for seasonal flow volume. Flow indexes based on historical data at the 'SS' are applied to monthly streamflow at the 'TS' while performing disaggregation. For both regulated and unregulated monthly streamflows, this method preserves mass balance and statistical characteristics by developing synthesized daily sequences statistically similar to historical daily sequences. This model as a test model is proposed for a single site, which can be applied at any regions and by any organizations that are looking for less intensive and less time consuming method of streamflow disaggregation from monthly to daily scale. The availability of finer scale (daily or shorter) hydrologic data can be utilized by water engineers in water resources management including reservoir operation, water quality and ecological modeling.

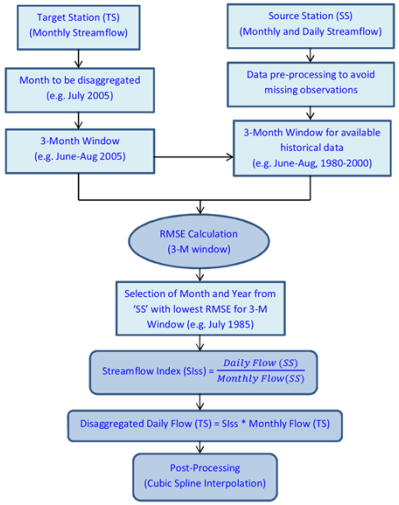
METHODOLOGY

STUDY AREA



Site A: Regulated Boise River
Site B: Unregulated Upper Snake and Salt River

DISAGGREGATION PROCESS (FLOWCHART / EXAMPLE)

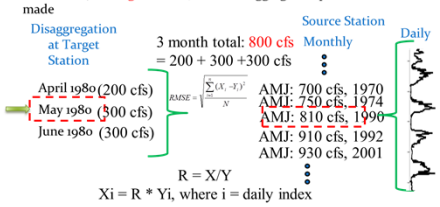


Assumptions

- Source Station (Monthly/Daily Time Series)
- Target Station (Monthly Time Series)
- If Missing data, gap filling techniques to construct complete data set w/o missing.

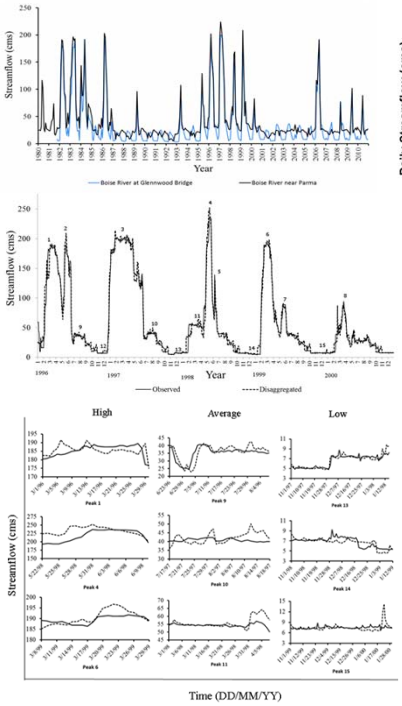
Example

Find a 3 month window (3-month total streamflow) at Source station, the closest to the 3 month window (3-month total streamflow) at Target station, where disaggregation processes is made

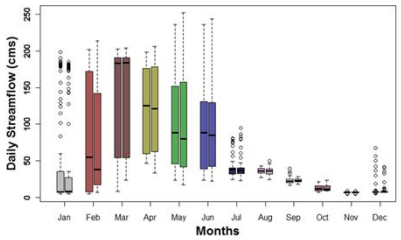


RESULTS AND CONCLUSIONS

REGULATED RIVER



OBS VS DISAGG DAILY STREAMFLOW

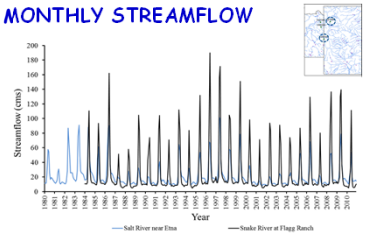


➢ **Result 1:** Root Mean Sq. Error (RMSE: 8.35 cms), Bias (0.02%), Corr. Coefficient (r: 0.99), Nash SutCliffe Efficiency (NSCE: 0.98)

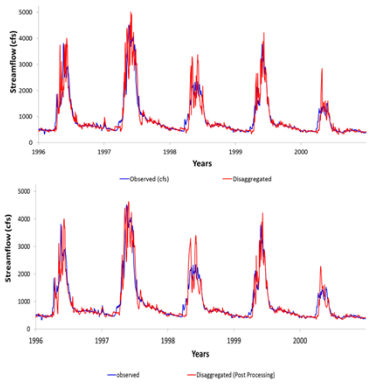
➢ **Result 2:** Observed and disaggregated streamflow volume matches quite well (Ratio varies from 0.94 to 1.00).

UNREGULATED RIVER (CASE 1)

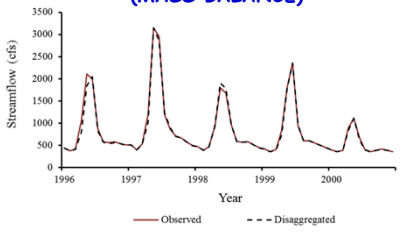
MONTHLY STREAMFLOW



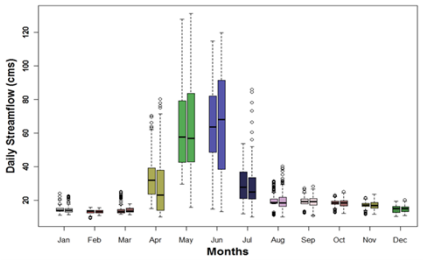
DISAGGREGATED DAILY STREAMFLOW (BEFORE/AFTER POSTPROCESSING)



MONTHLY STREAMFLOW (MASS BALANCE)

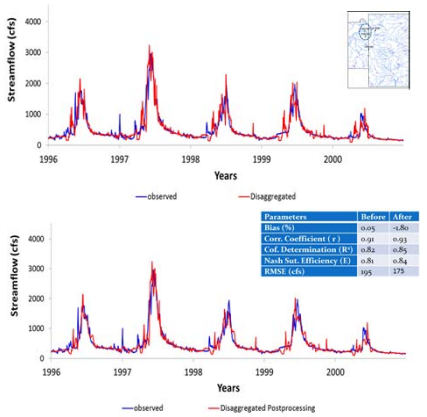


OBS/DISAGG DAILY STREAMFLOW



➢ **Result 3:** RMSE: 9.03 cms, Bias: -1.83%, r: 0.92, NSCE: 0.83. Similar hydrologic responses throughout the study period, except some abnormal peaks identified during the periods of April-June windows in 1998, for example.

UNREGULATED RIVER (CASE 2)



CONCLUSION: Simple statistical method to disaggregate streamflow from monthly to daily time scale. Sreamflow magnitudes as well as hydrograph response are well captured at most regions of the study period for all cases. Perhaps flexible, adaptable to any regions/ organization, and easily implementable in user-friendly computational environment.

FUTURE WORK: Enhancement of this tool, which can be easily applied with less computational burden in user-friendly software architecture based on cross-relationship between hydrologic variability and weather forcing (precipitation and temperature) as inputs.

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