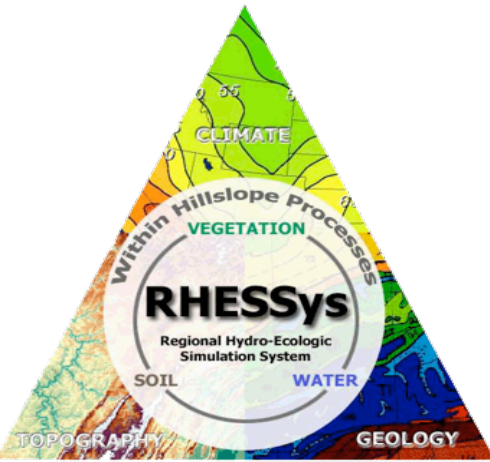


The effect of maximum plant available water (PAWmax) on transpiration across the Critical Zone Observatories

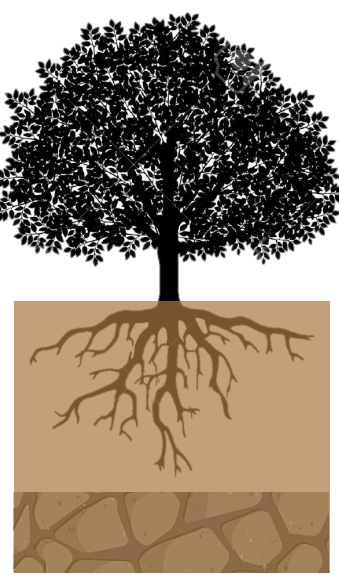


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What is PAWmax?

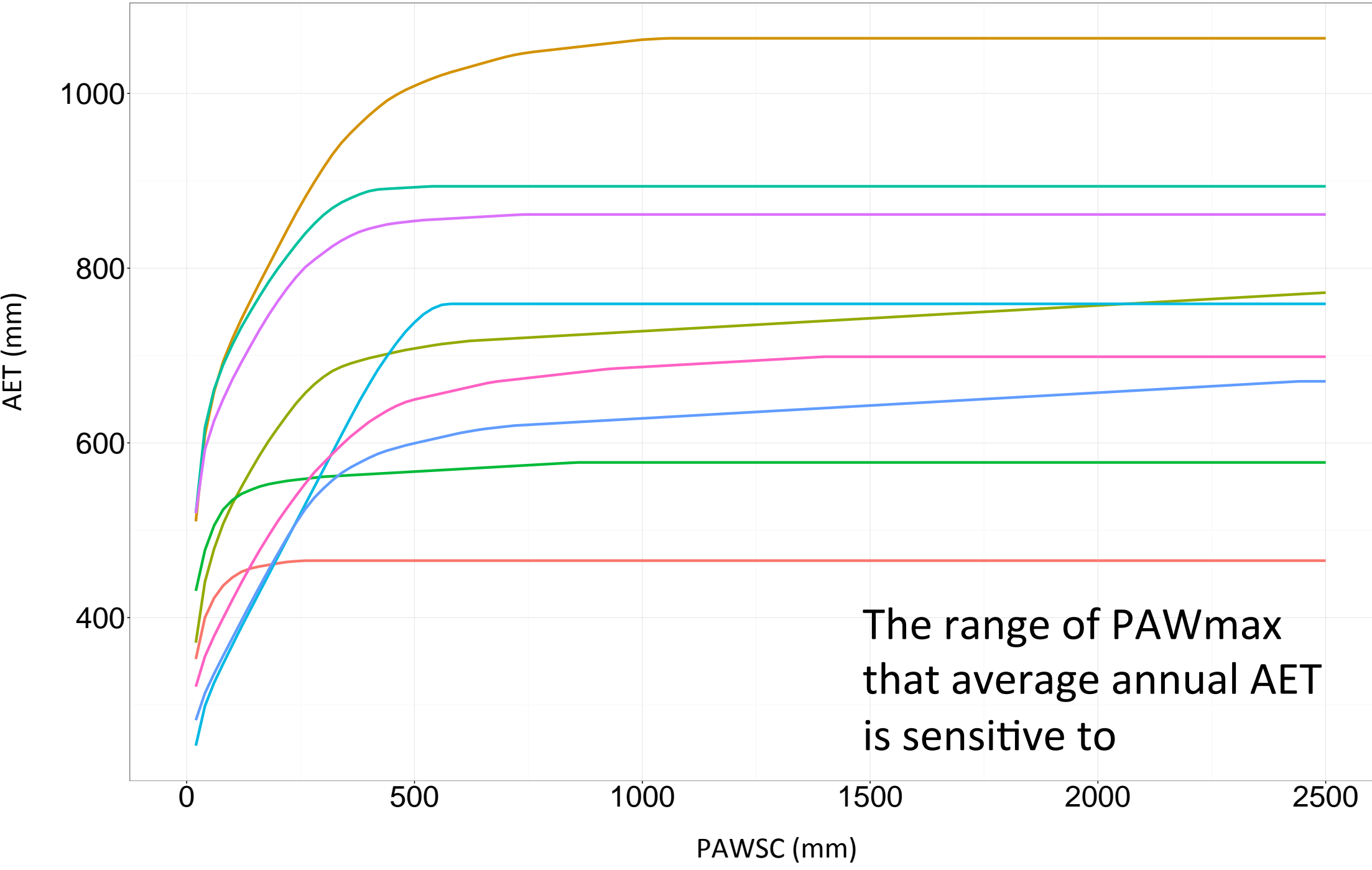
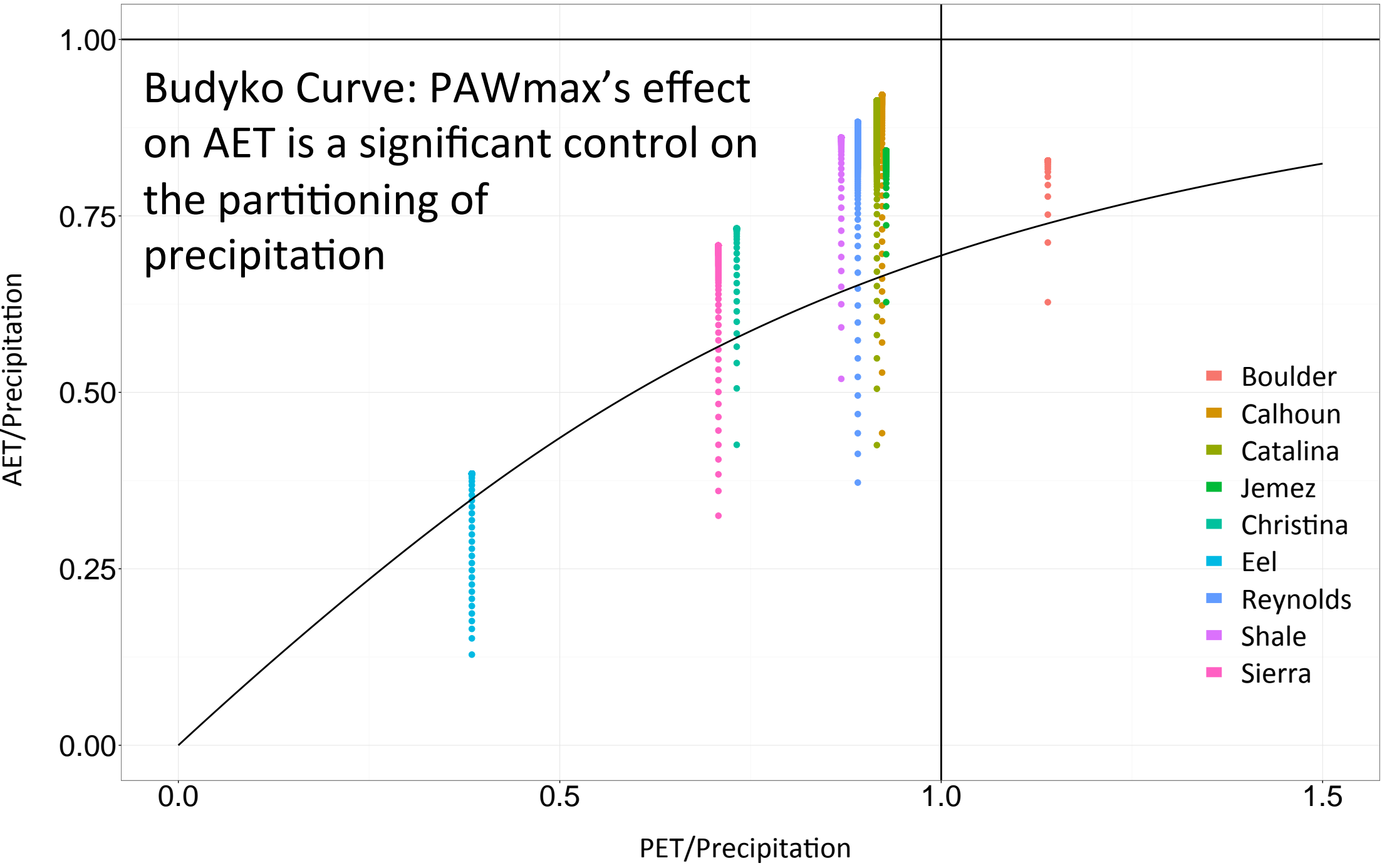
Motivation

- Plant accessible water storage capacities vary widely with soil, geology, and plant characteristics and impact the partitioning of precipitation into evaporation and runoff
- We ask: What is the storage capacity that maximizes mean annual evapotranspiration? How does this vary across CZO Sites? Why?

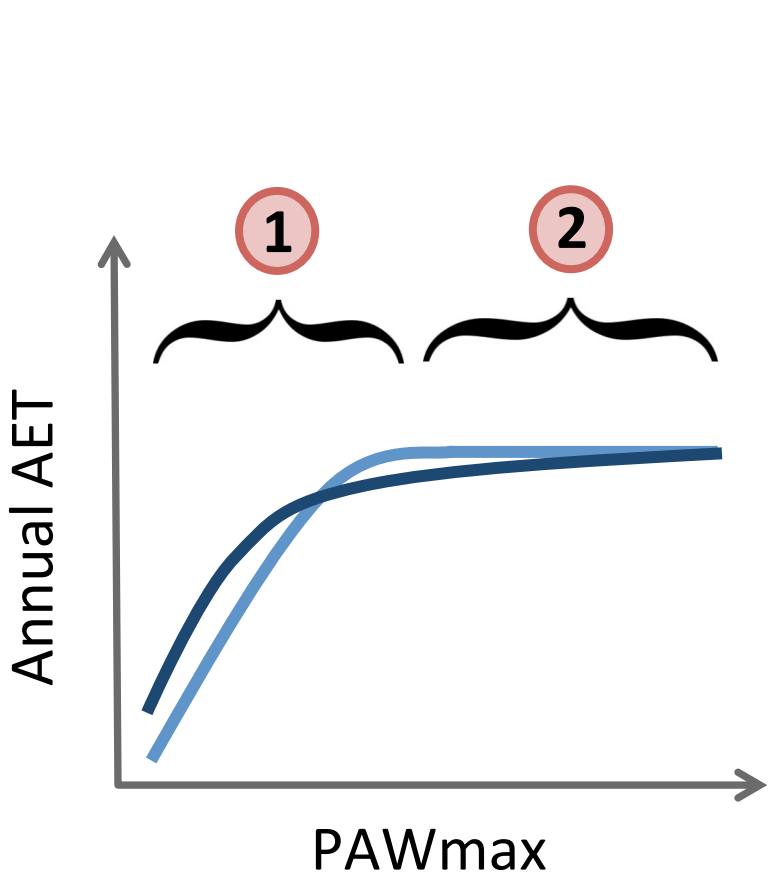


The maximum plant available water (PAWmax) if defined by:

- The difference between field capacity and permanent wilting point integrated over the rooting area

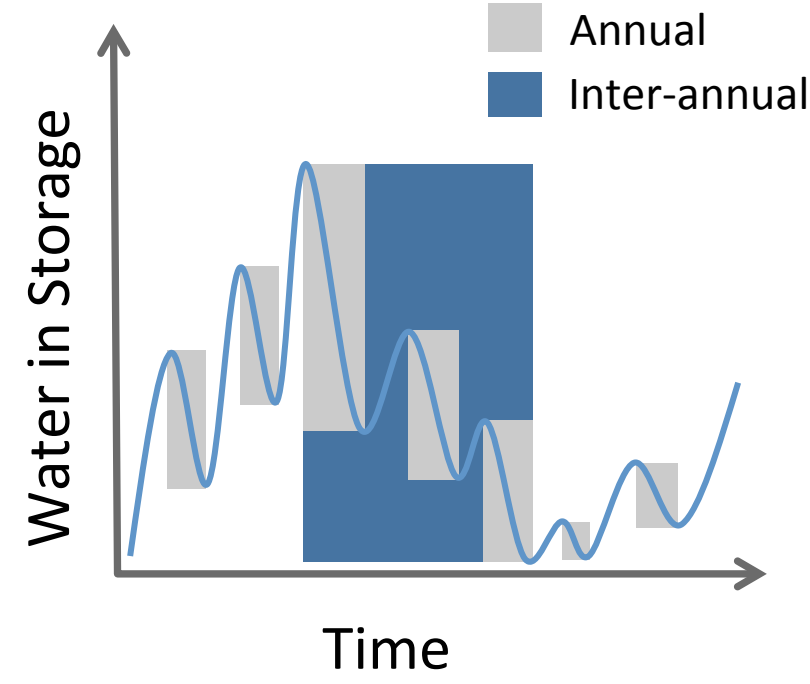


Time scales of PAWmax



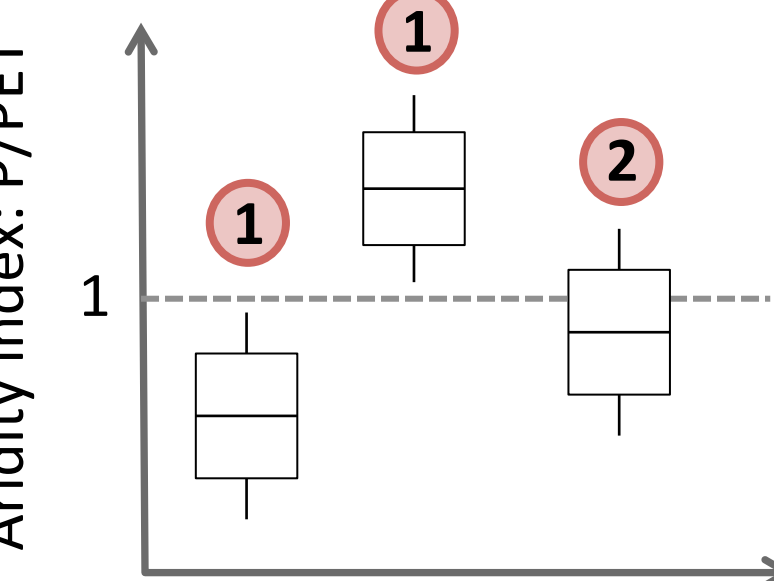
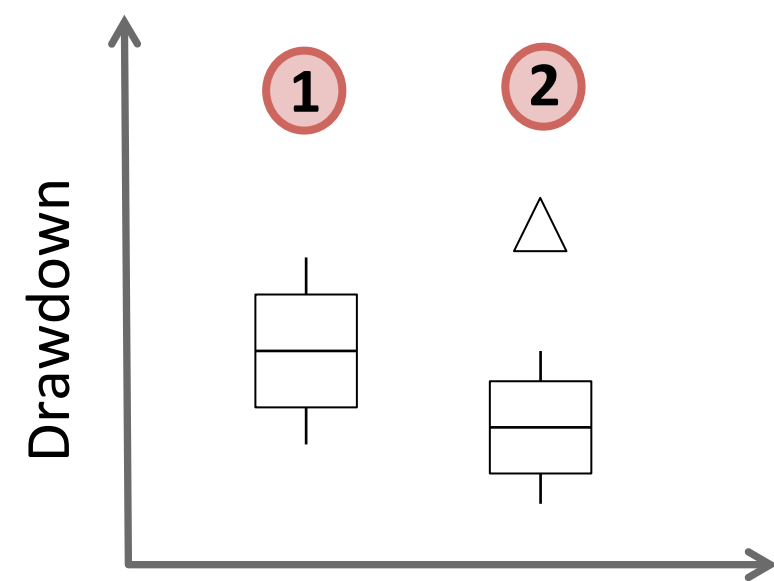
Range of sensitivity to PAWmax defined by:

- AETsen1: All sites have a high sensitivity of average annual AET to PAWmax
 - Due to range of annual drawdown of storage
- AETsen2: Not all sites have a low sensitivity of average annual AET at large PAWmax
 - Due to inter-annual drawdown of storage



Defining drawdown:

- Drawdown is calculated as the largest peak to trough difference for a given time period whether that be annual or inter-annual time scales



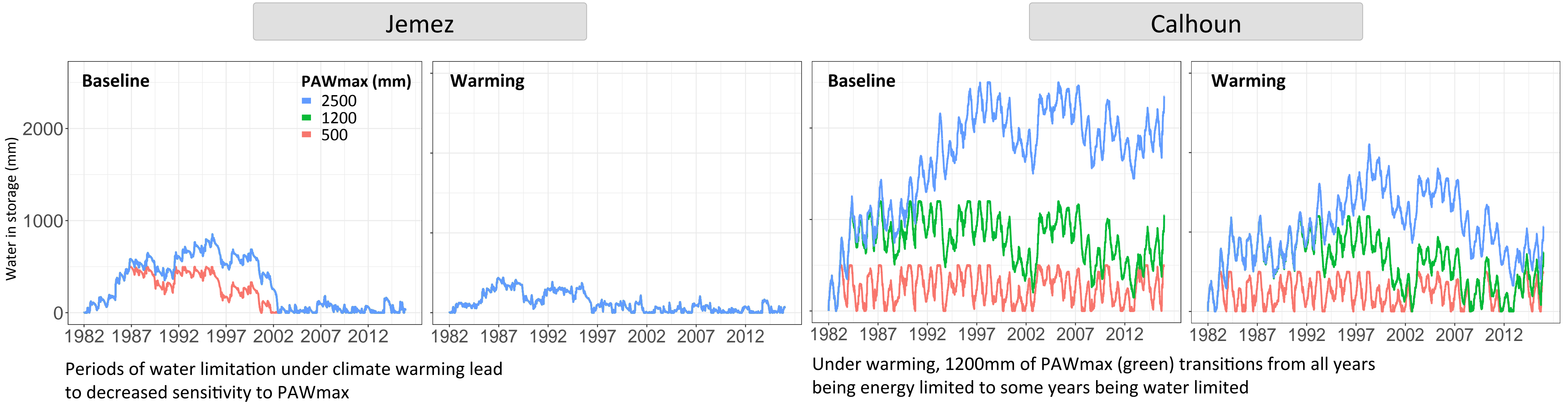
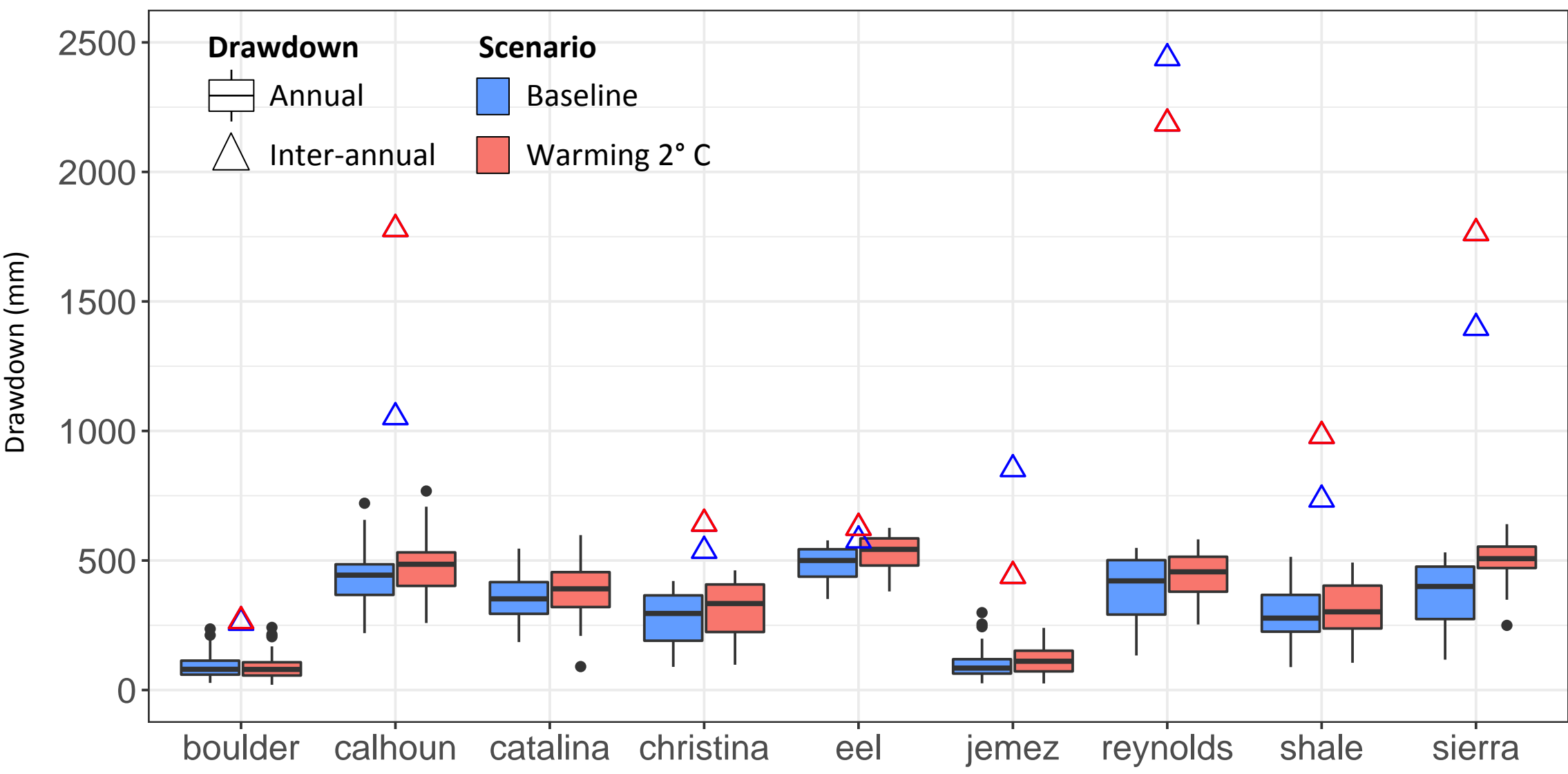
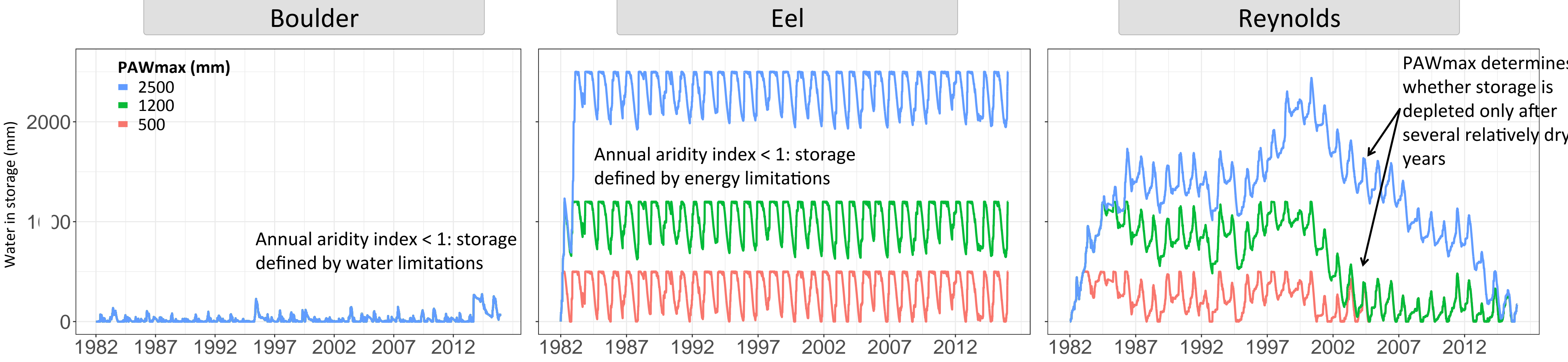
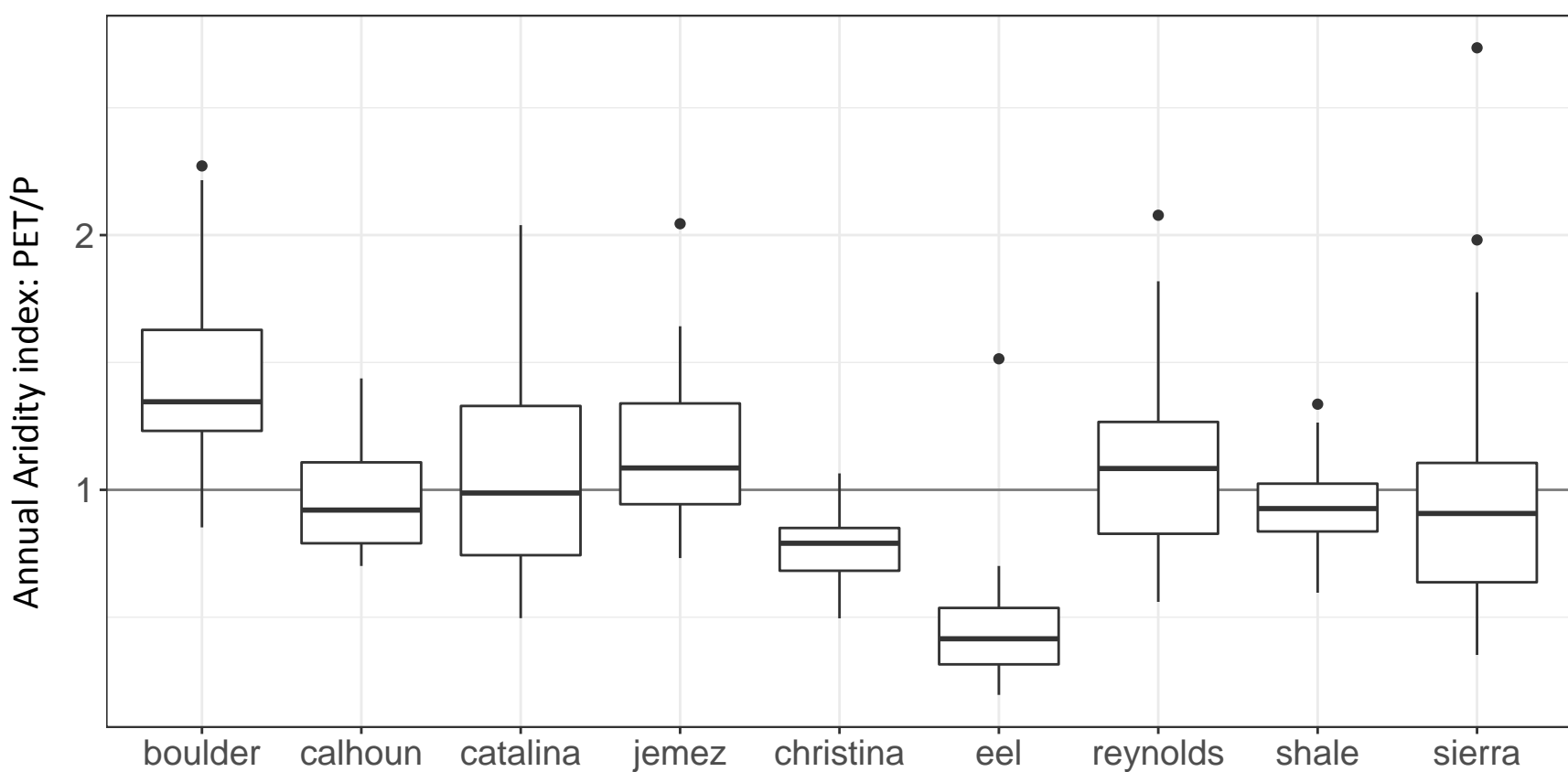
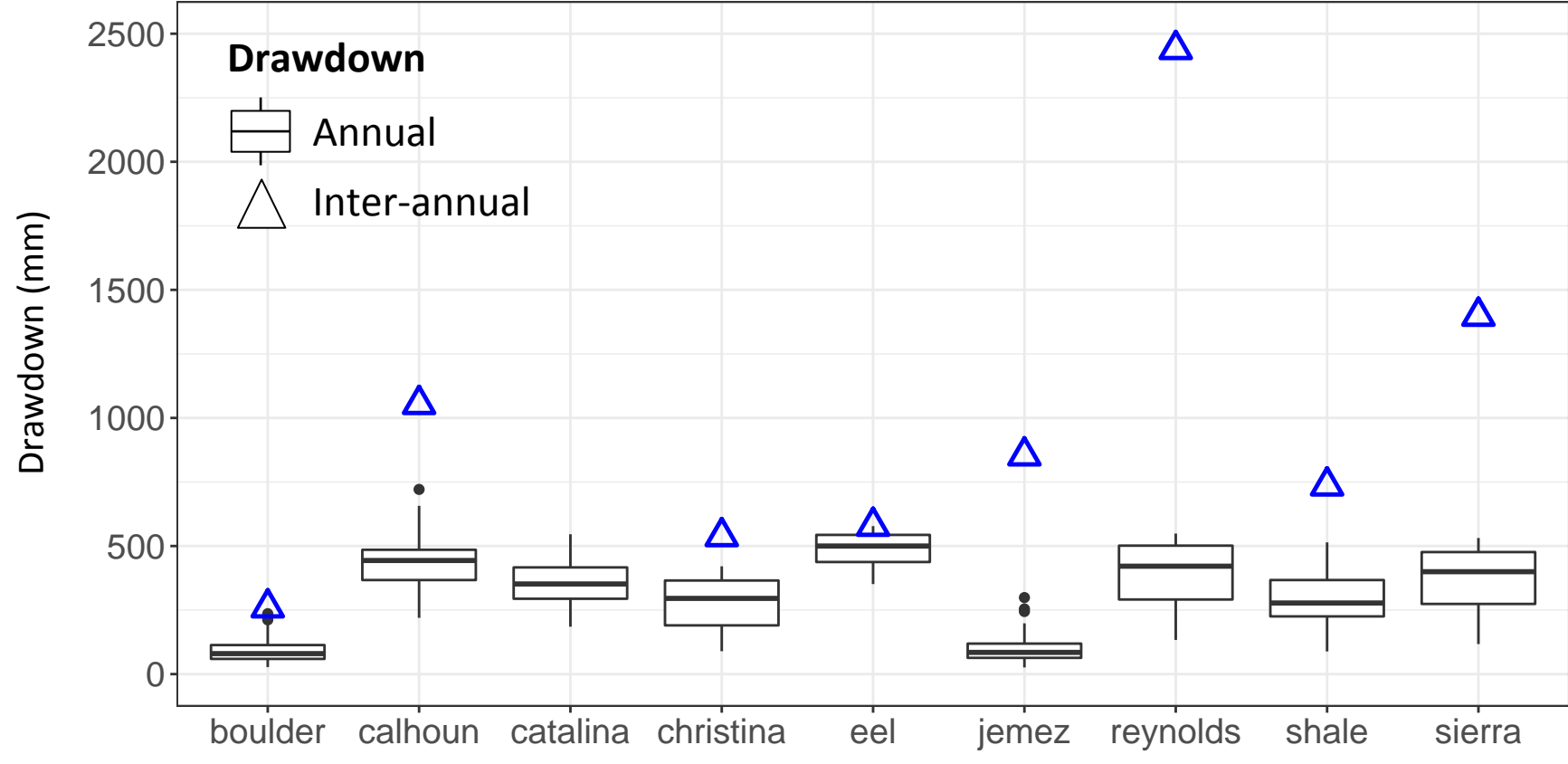
Ranges of drawdown:

- All sites have a range of annual drawdowns as indicated by the box and whisker
- Some sites have a drawdowns that are outside the range of annual drawdown, (indicated by the triangle). The larger drawdowns occur during multi-year drought (inter-annual drawdown)

Sites with inter-annual drawdown:

- For sites with an annual aridity index that is consistent greater or less than 1, inter-annual drawdown is with the range of annual drawdowns
- For sites that include years with aridity indices greater and less than one, the inter-annual drawdown can exceed annual drawdown

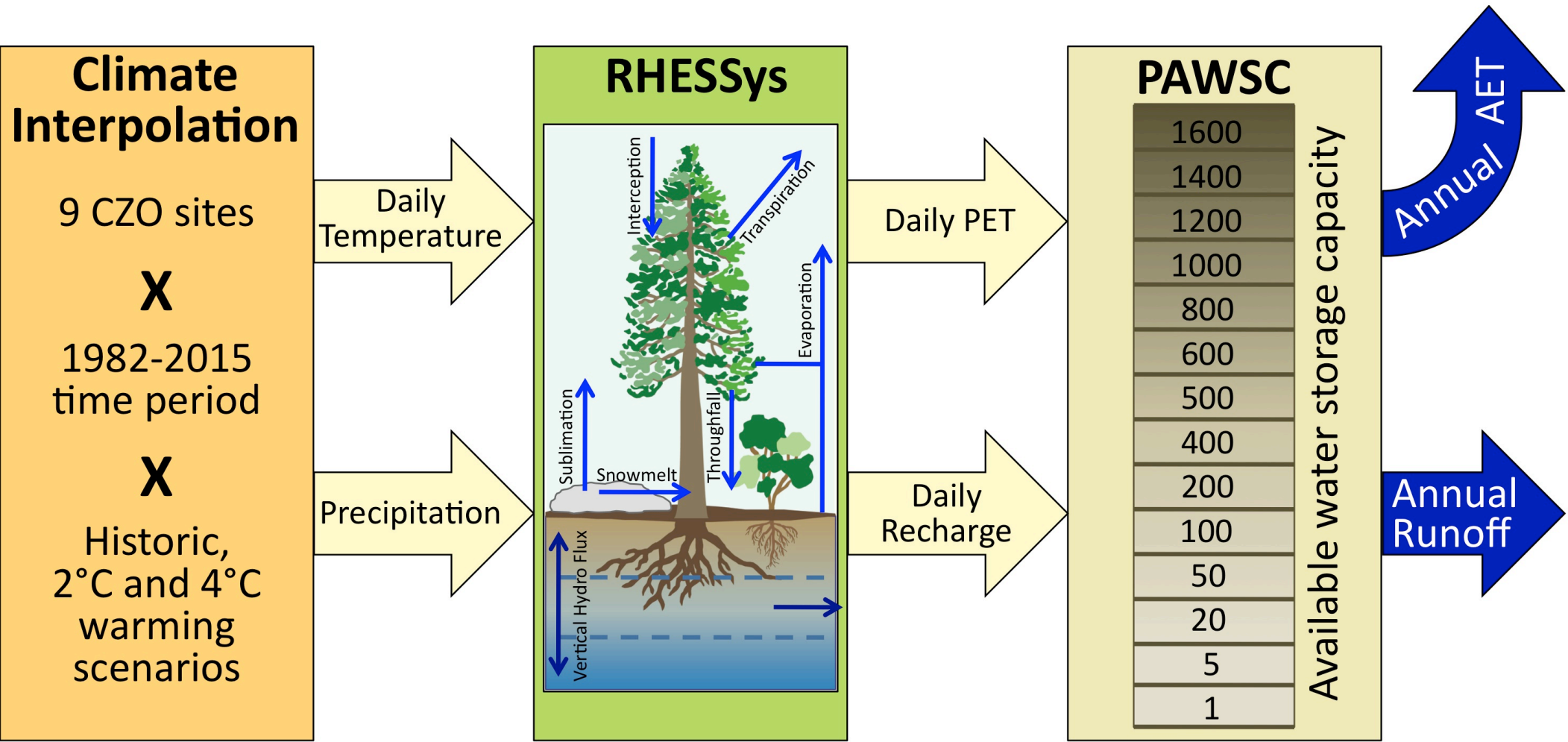
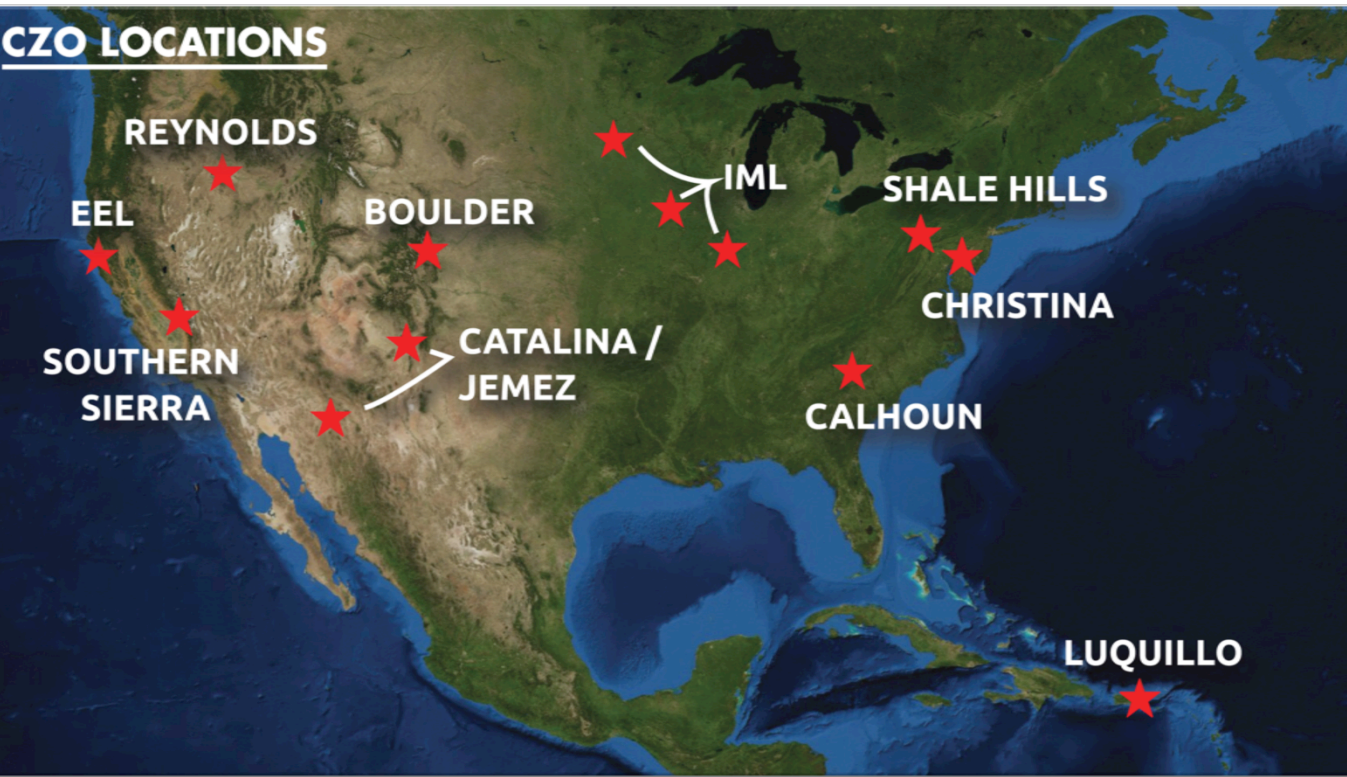
Results



Climate Warming

- As the climate warms demands for water (PET) increases, which leads to increased drawdowns but only in time periods that are energy limited
- Drawdown may decreases in periods that are water limited (if less filling occurs in pre-drying period). This occurs at inter-annual time scale in Jemez and Reynolds
- Depending on PAWmax, sites can transition from energy to water limited with warming

Methods



Conclusions

- Daily, seasonal, and inter-annual patterns in recharge and energy drivers combine to define drawdown of plant available water, which defines the depth of PAWmax necessary to maximize AET; this range of PAWmax is often far beyond what has been found in other studies
- A PAWmax in the range of AETsen1, which is the range of annual drawdown, is important in defining how water limited a site will be on an annual time scale
- A PAWmax in the rage of AETsen2, which is a drawdown larger than the range of annual drawdown, is import in defining periods of inter-annual drought
- These values of drawdown, and respective range of PAWmax that AET is sensitive to, is defined based upon past climates only and may not reflect how watersheds will respond to increased water demands under climate change, and therefore empirical measurements of PAWmax is integral in predicting vegetation reaction to climate change

Acknowledgements:

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