Identifying physio-climatic controls on watershed vulnerability to climate and land use change

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We need reliable projections of streamflow to manage freshwater resources in the future

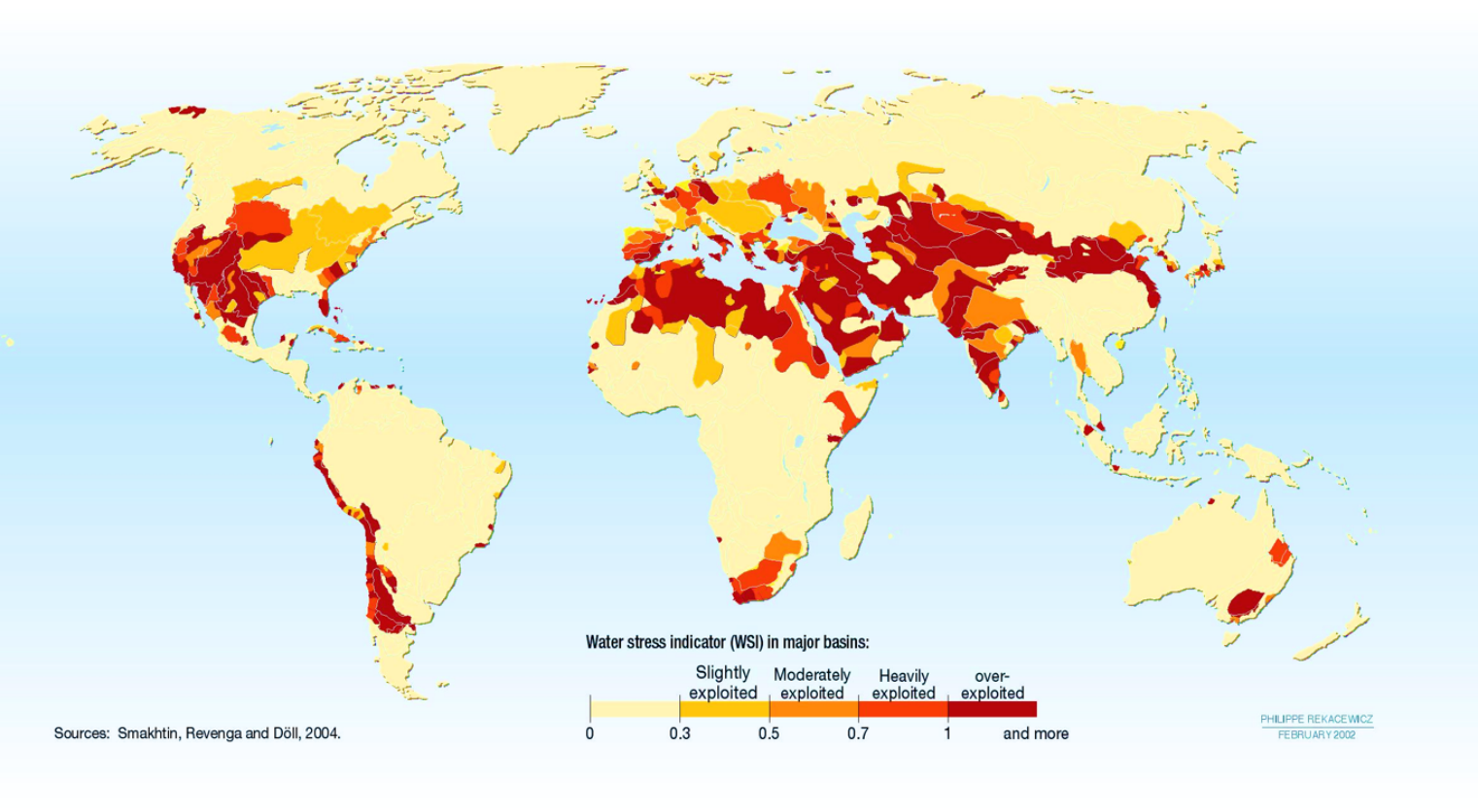
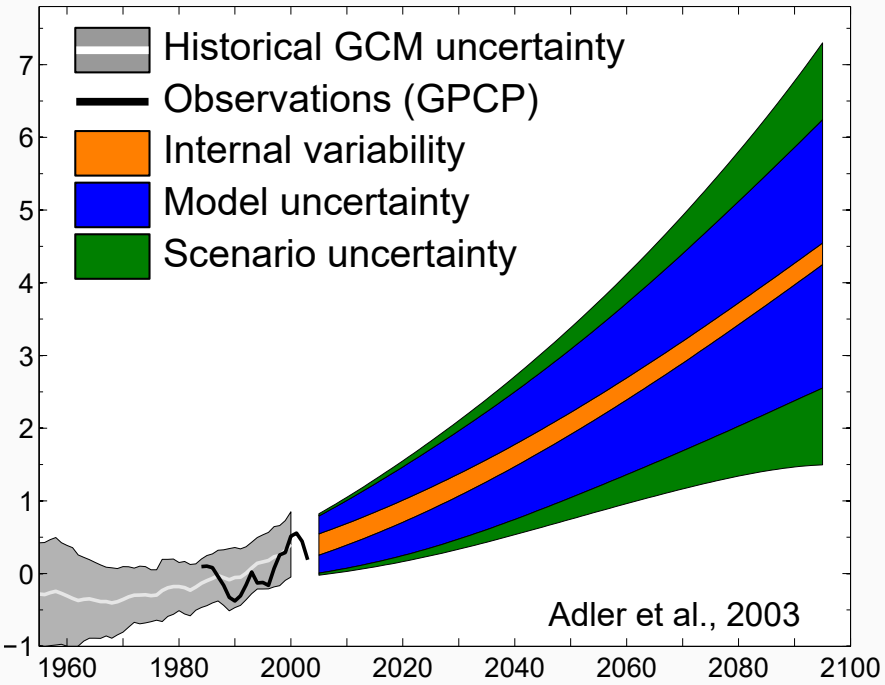


Figure 1: Global extent of water scarce regions in the last decade. (UNEP, 2008)

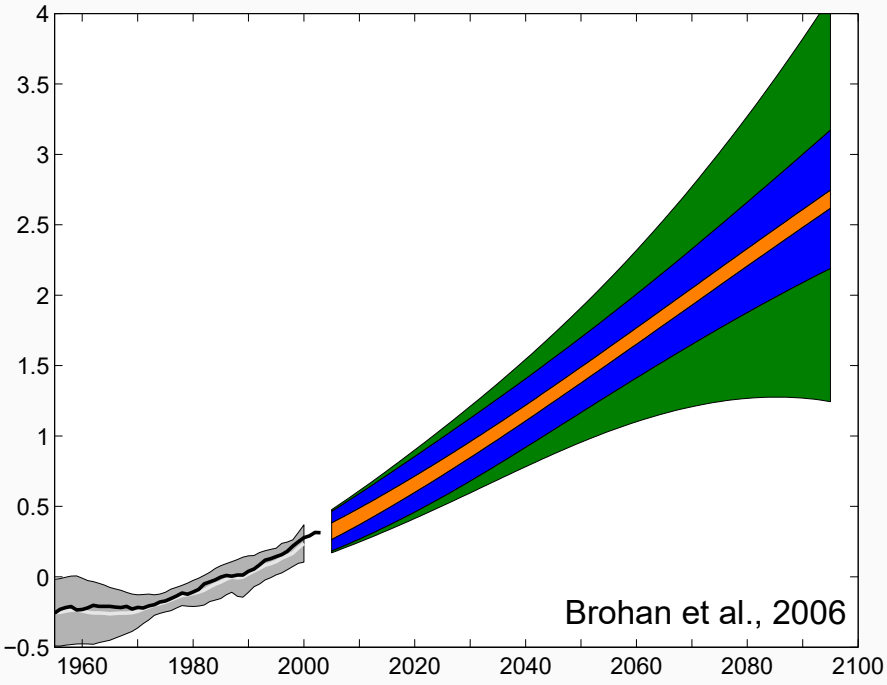
However, obtaining future projections are challenging!

Changing climate will lead to significant and uncertain changes in future

Projected change in global mean precipitation [%]



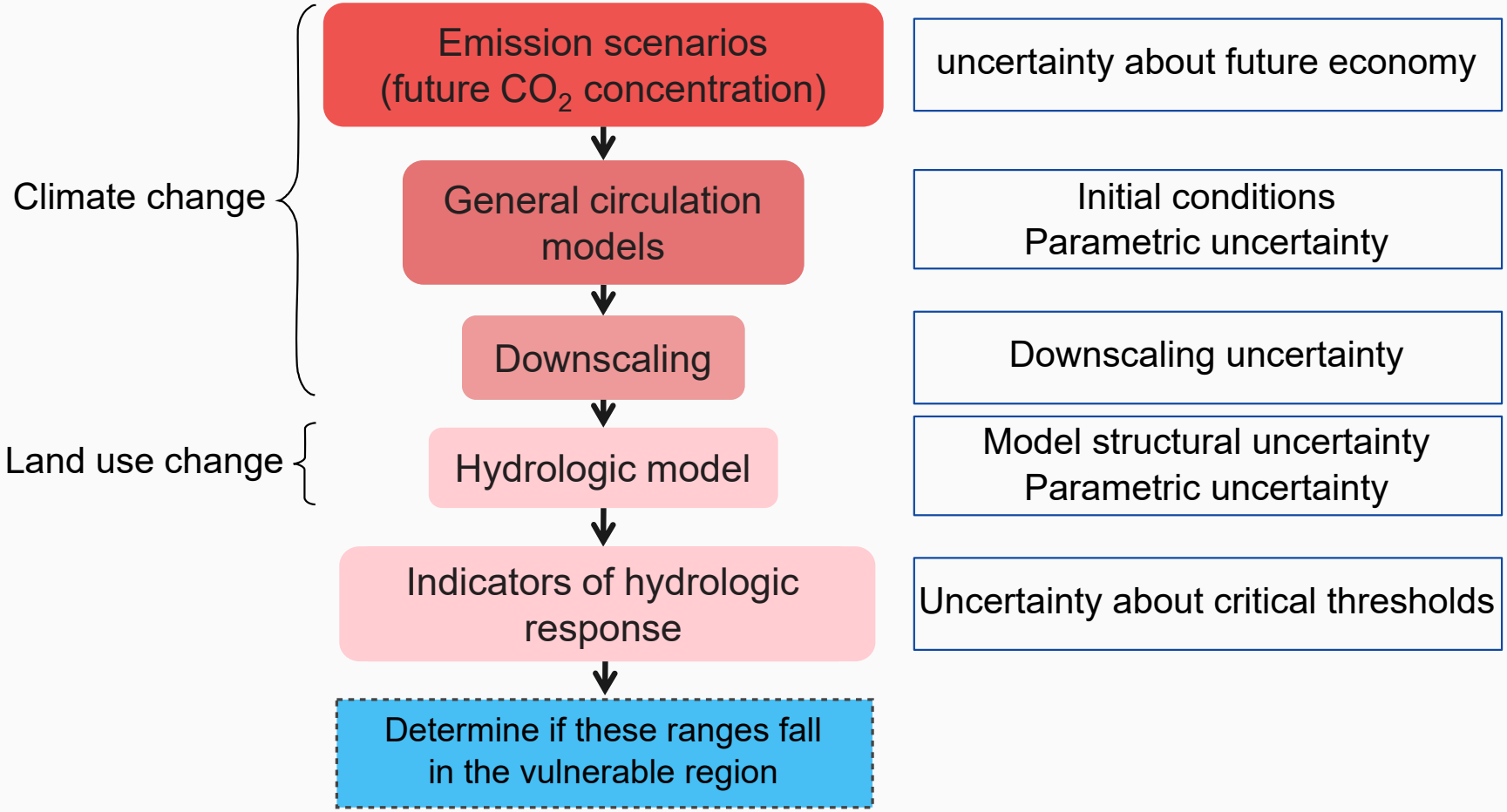
Projected change in global mean temperature [K]



Decadal mean projections for the 21$^{\text{st}}$ century (the total uncertainty in CMIP-3 global mean)

Hawkins and Sutton [2011]

Uncertainties are present in all the steps of obtaining a hydrologic projection



Thus we need a way to provide useful information to stakeholders in the presence of large uncertainties.

We provide an alternative approach to identify vulnerability to climate change which is independent of future projections of climate and land use change

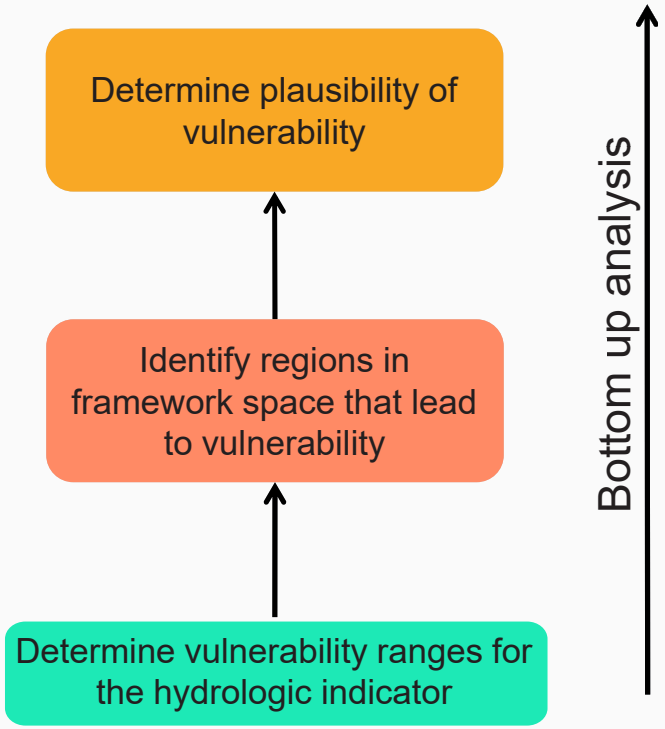


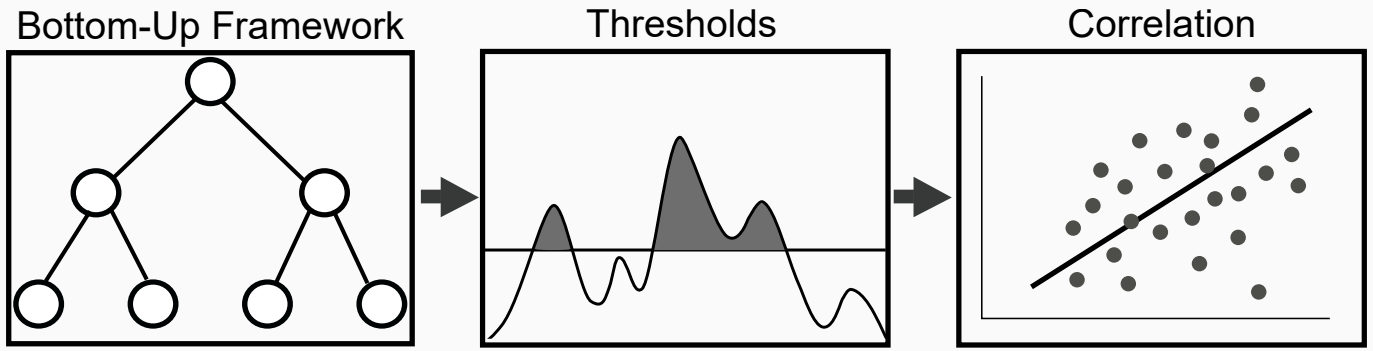
Figure 2: Bottom up: A vulnerability based approach

Our vulnerability based approach is useful for decision makers and water policy makers.

Singh et al. [2014]

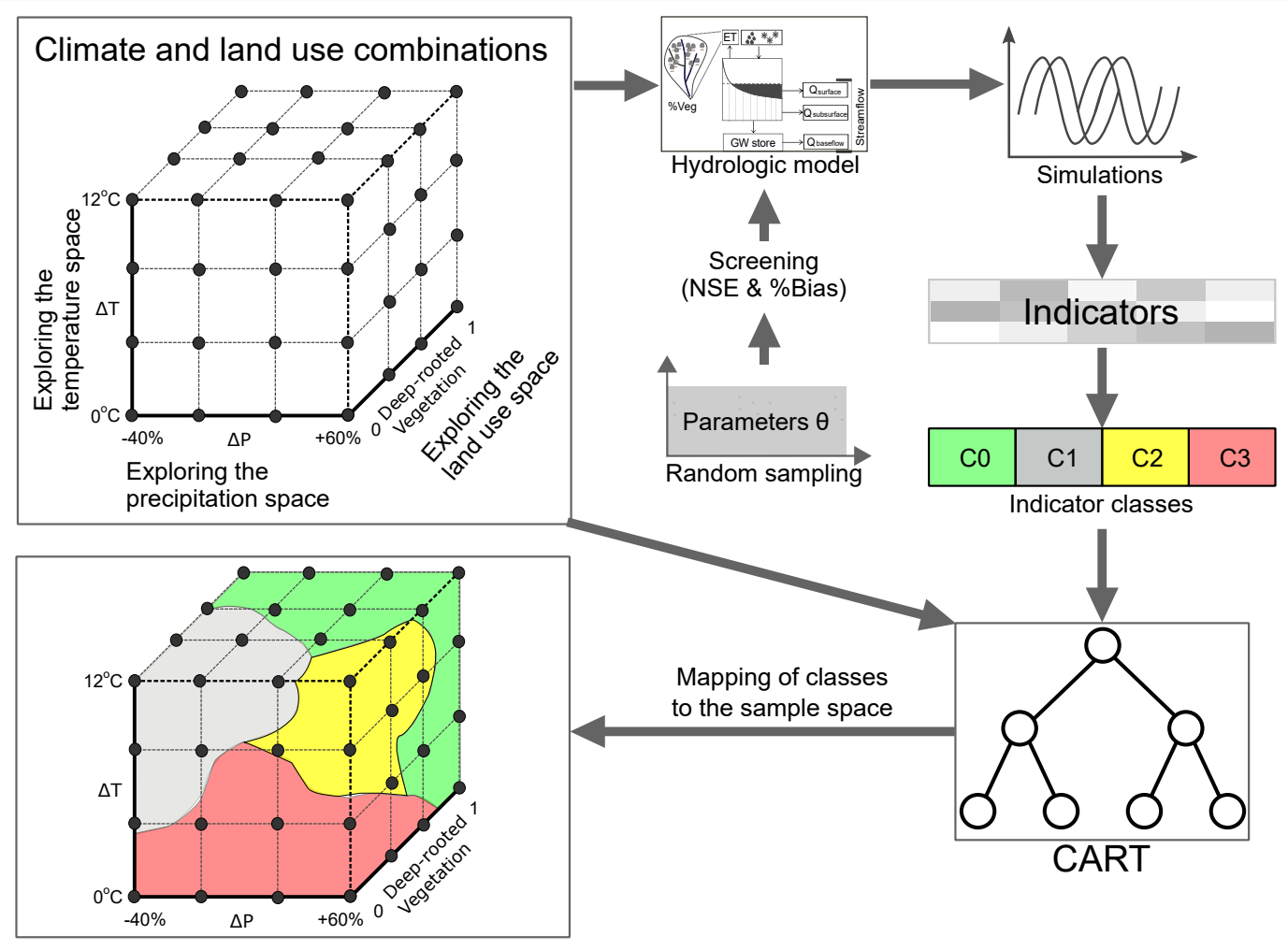
We develop a framework which combines strength of bottom-up approach and comparative hydrology

User should defined vulnerability: One can defined vulnerability as "streamflow reduced by >50% in the watershed"



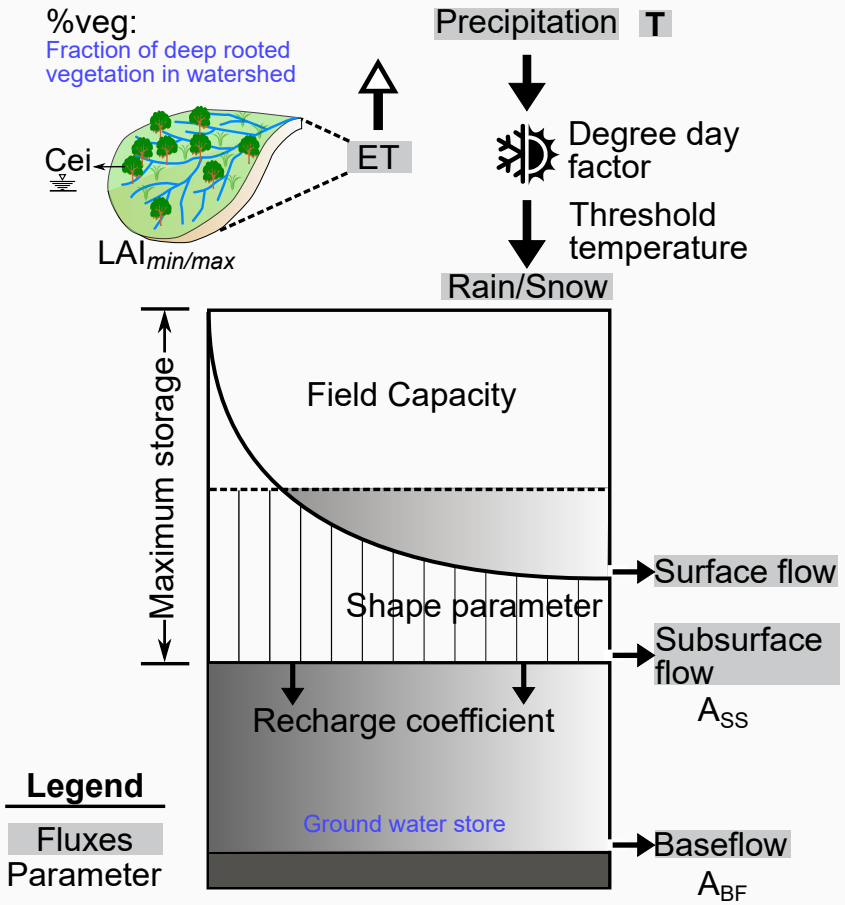
The framework provides a quantitative measurement (critical thresholds) of watershed vulnerability to climate and land use change.

We implement the bottom-up approach using exploratory modelling framework



Deshmukh and Singh [2016]

We use a spatial lumped model to simulate runoff which account land-use as fraction of deep rooted vegetation in the watershed

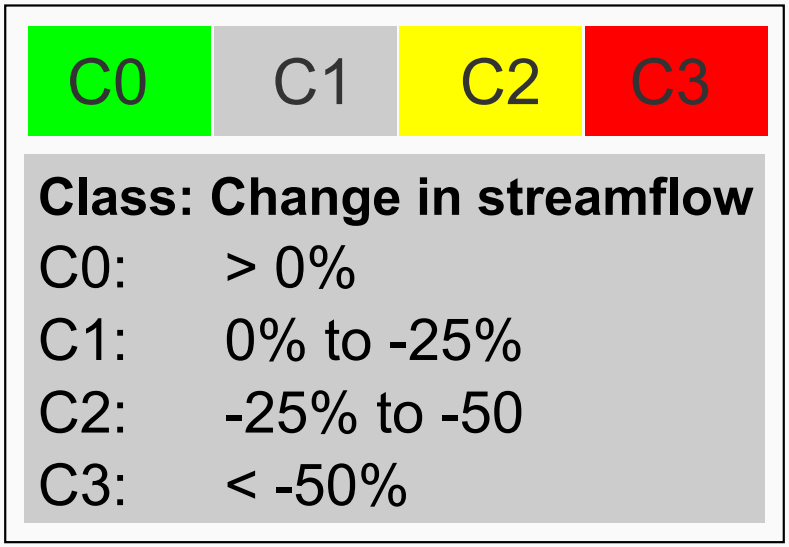


Simulated runoff used to calculate indicator of vulnerability (i.e. mean annual runoff).

Singh et al. [2014]

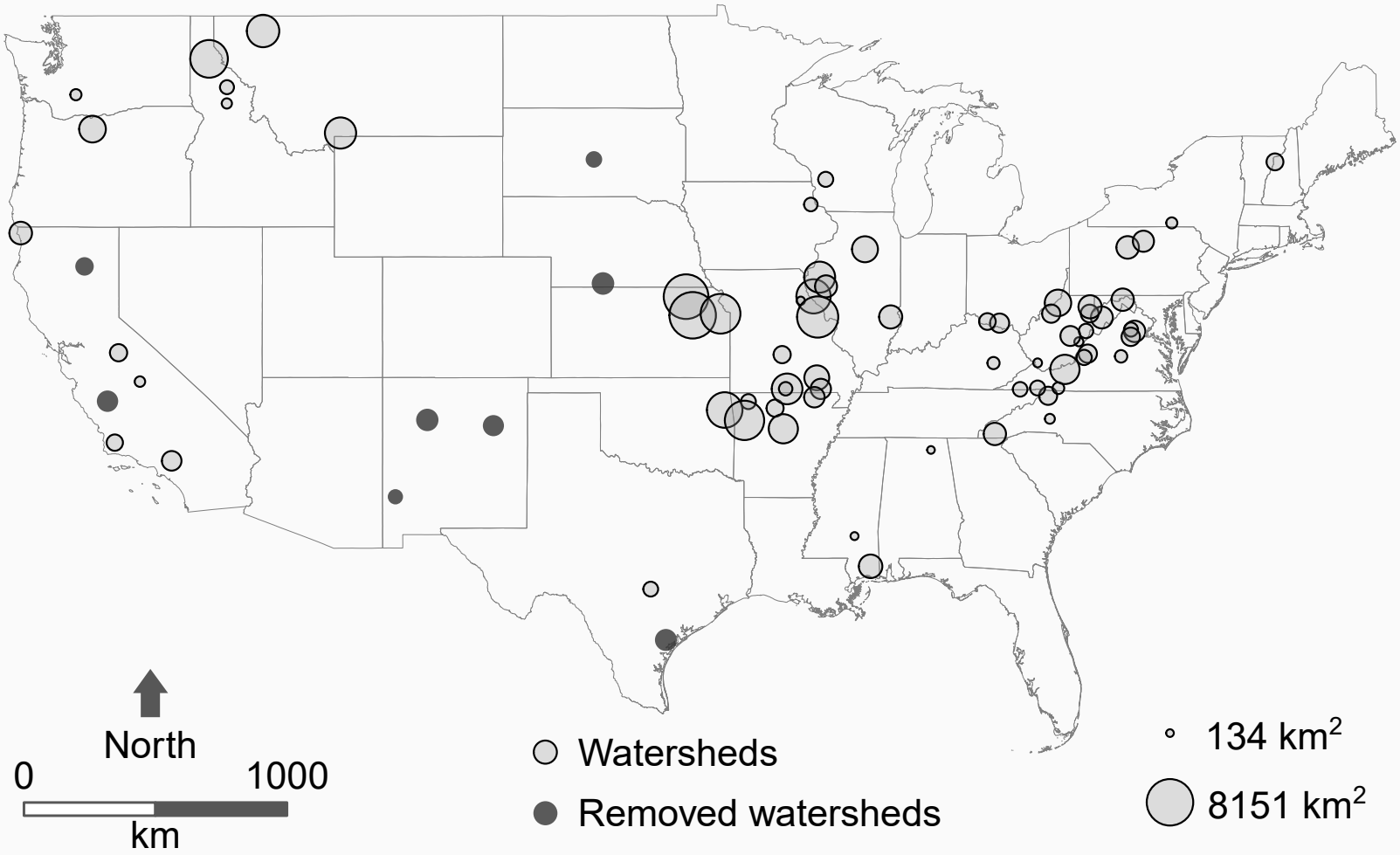
We classify an indicators based on class definitions

Indicator mean annual runoff (for water availability in the stream) classified into 4 classes.



We use a classification method, CART to identify the combinations of climate and parameters which leads to a specific class.

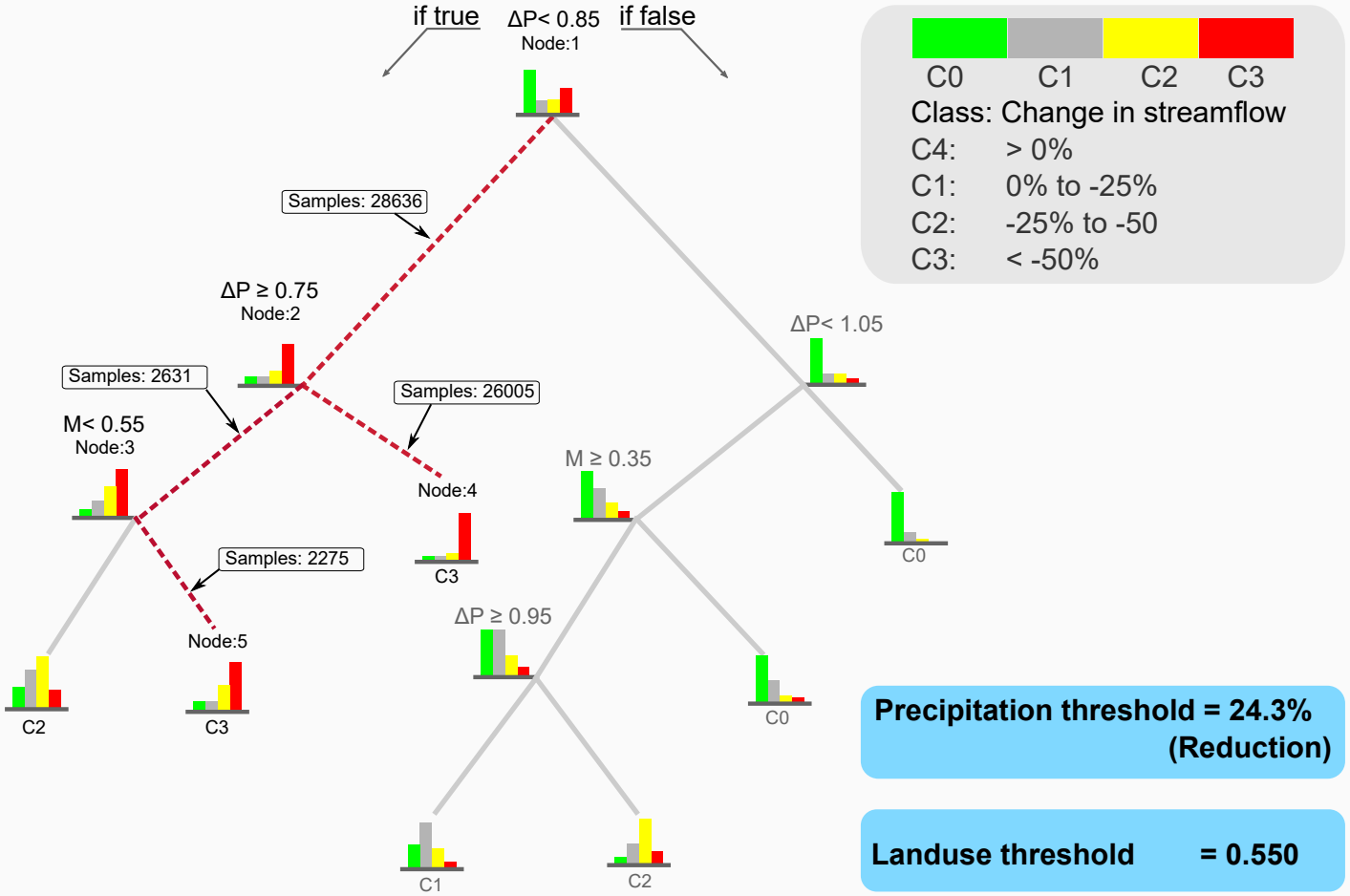
We select 77 United states watersheds for this study



We remove 8 watersheds based on model performance criteria and low runoff ratio.

Deshmukh and Singh [2016]

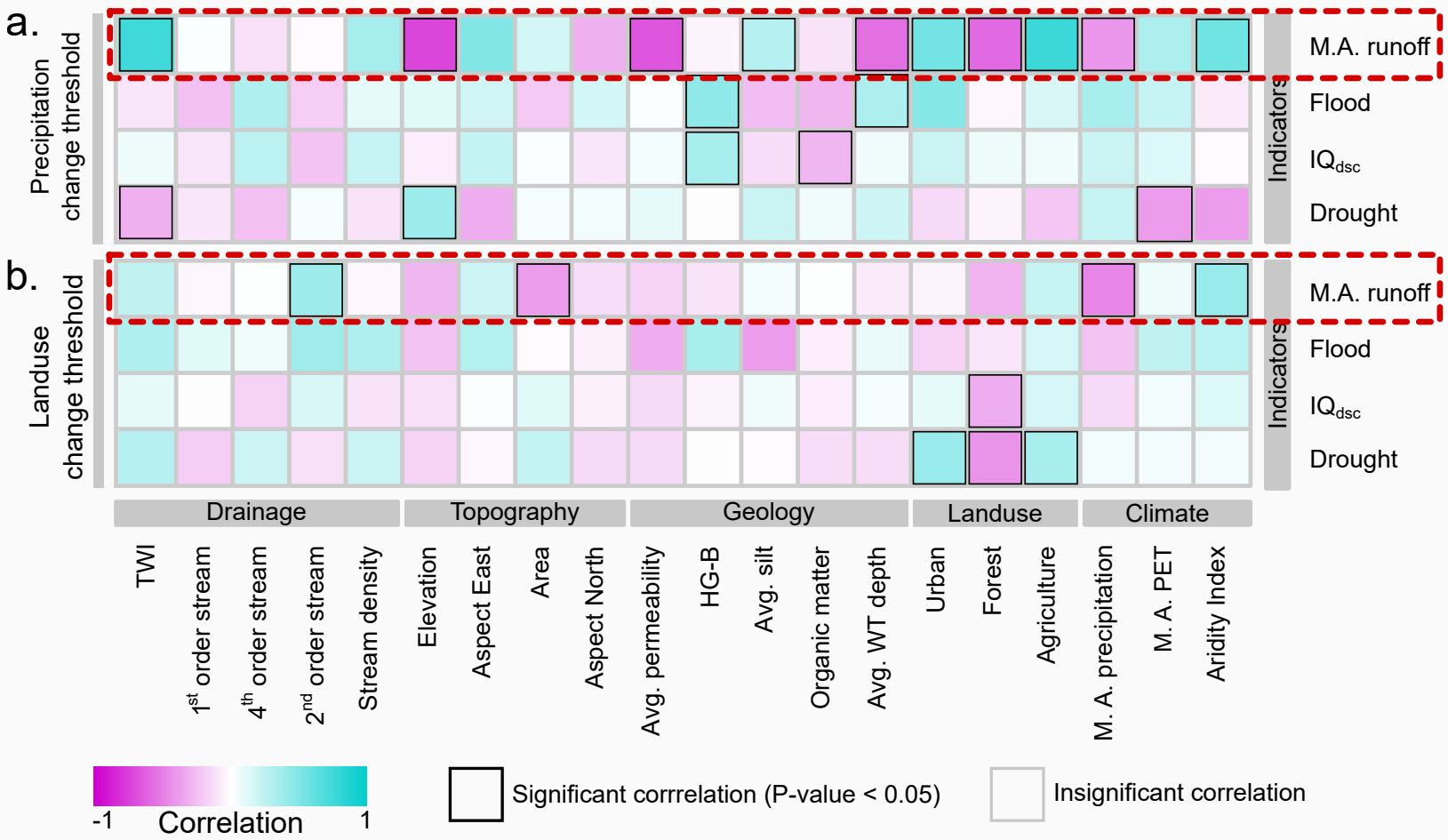
We use CART to relate climate, land use and parameters samples into vulnerability classes



Critical thresholds are computed by weighted averaging of thresholds for all watersheds (for precipitation and land use change)

Deshmukh and Singh [2016]

We identity relationship between critical threshold and watershed physio-climatic characteristics



The correlation explain generalized relationship of watershed physio climatic characteristic with watershed vulnerability.

Deshmukh and Singh [2016]

Thank you
Questions?

References

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