Analyzing the impact of human factors on the development of hydrological droughts using runoff reconstruction approach

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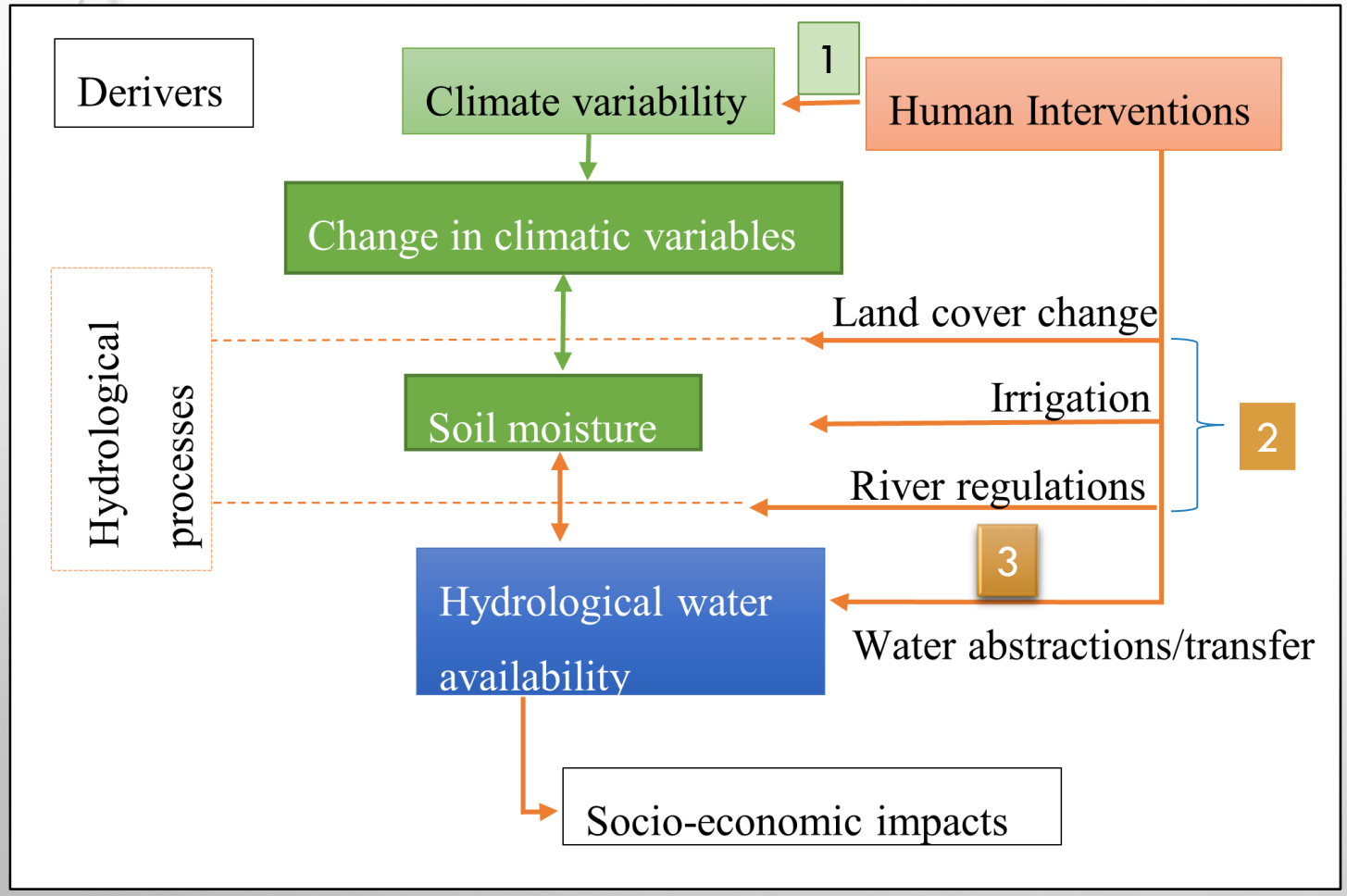
BACKGROUND AND OBJECTIVES [1/3]



Sources: modified from Van loon et al. (2016)

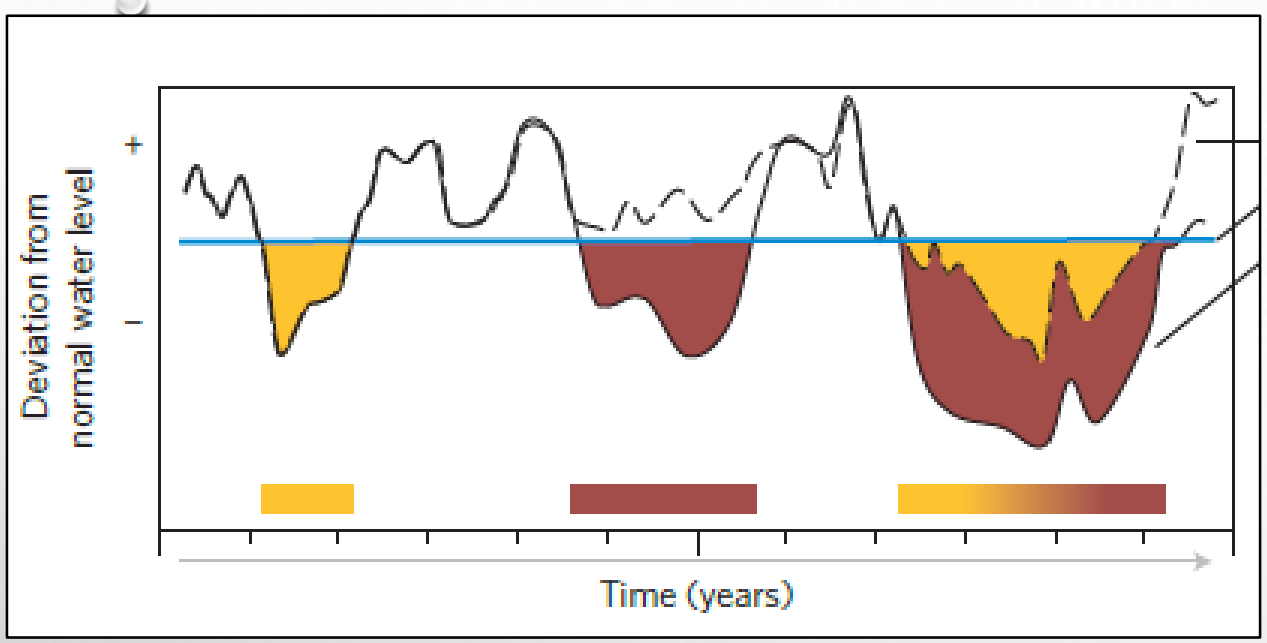
Key drivers: Climatic factors and human factors

- Normally drought perceived as natural phenomena
- It is not only natural variations, but human factors
- Human factors: direct impact or indirect impact

Which factors – climate and human factors – are key driver for the development of hydrological drought?

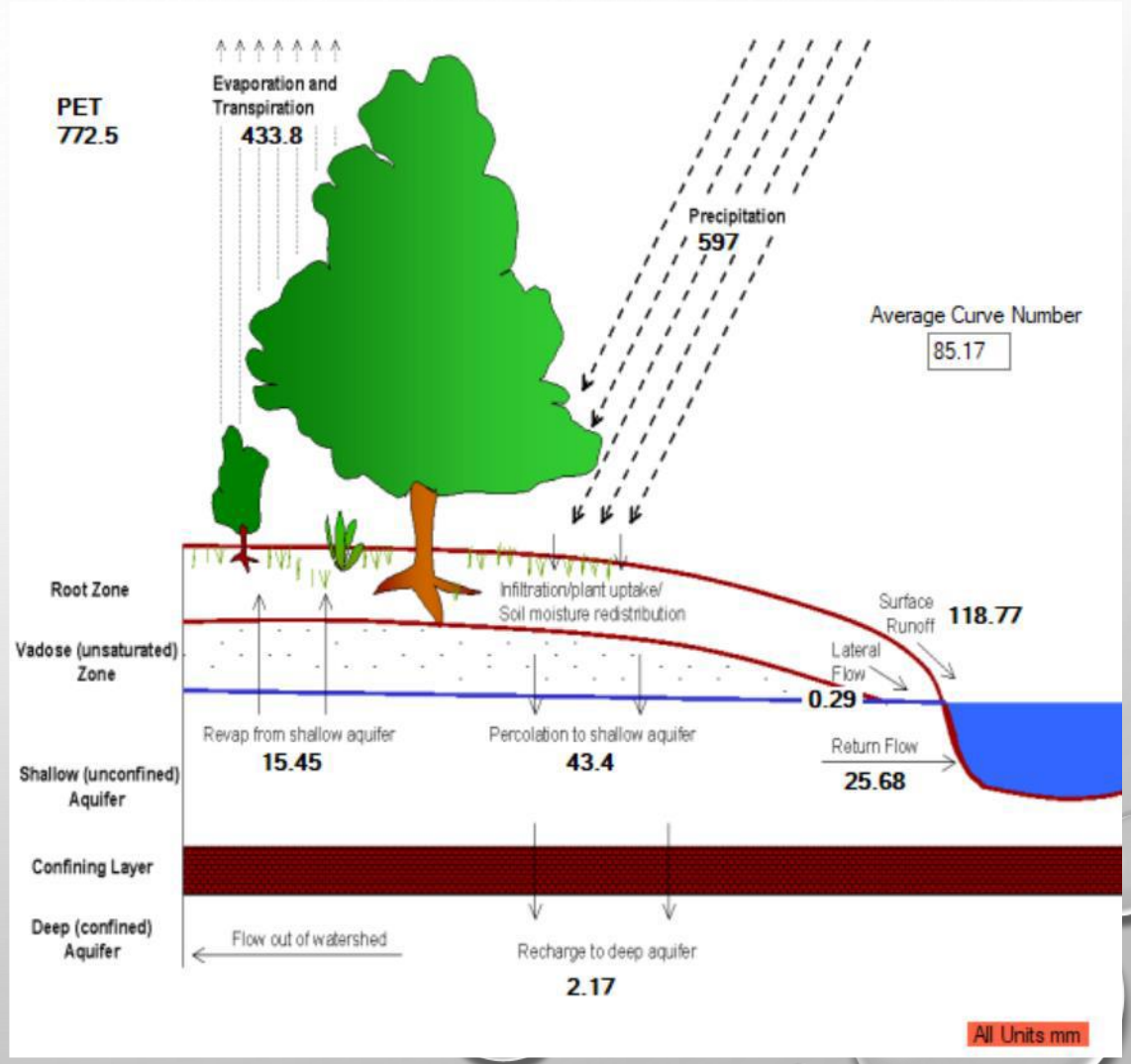
1. Runoff reconstruction method
2. Observation-based method
3. Scenario-based comparison

BACKGROUND AND OBJECTIVES [2/3]



Sources: Van loon et al. (2016)

SWAT Model structure



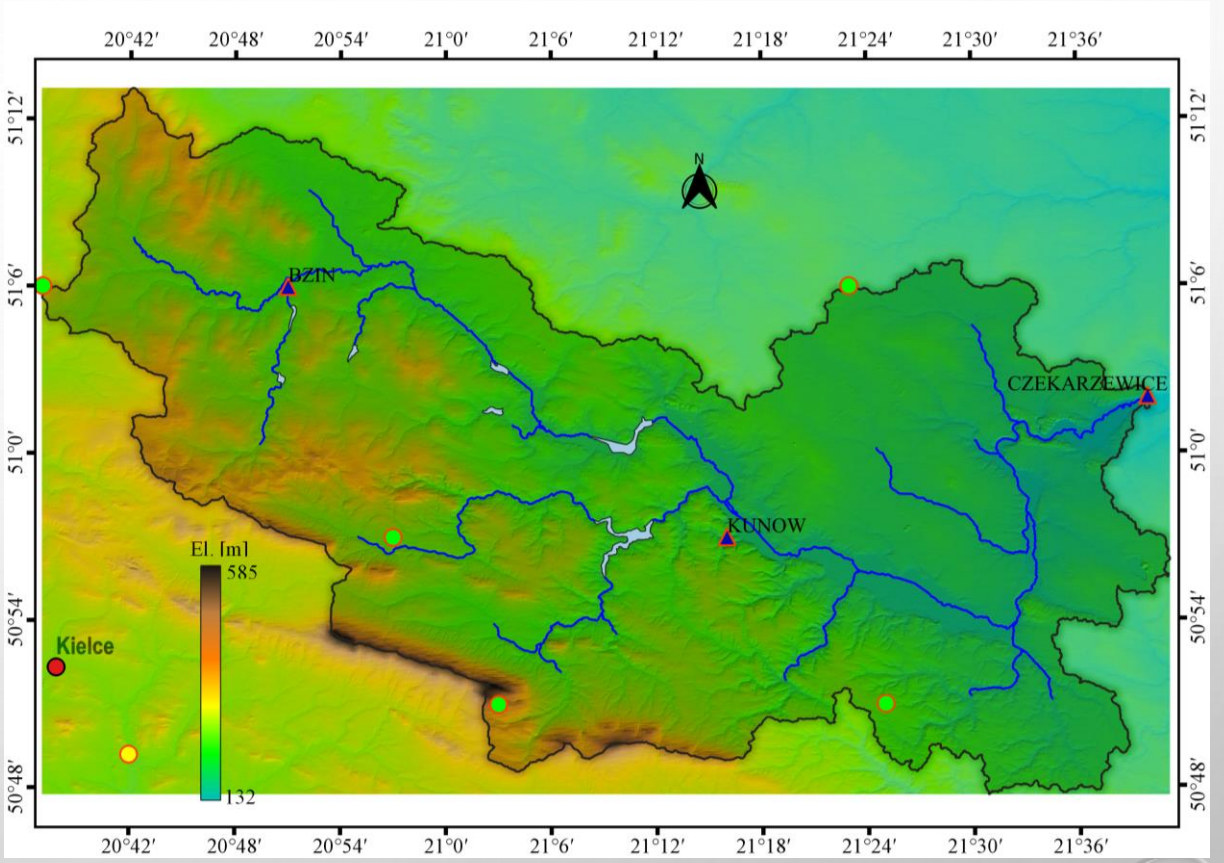
Notation:

- ✓ Horizontal blue line indicate normal conditions
- ✓ Solid black line-observation (human and climate)
- ✓ Dashed line-natural condition (climatic drivers)

BACKGROUND AND OBJECTIVES [3/2]

The aim of this study was to:

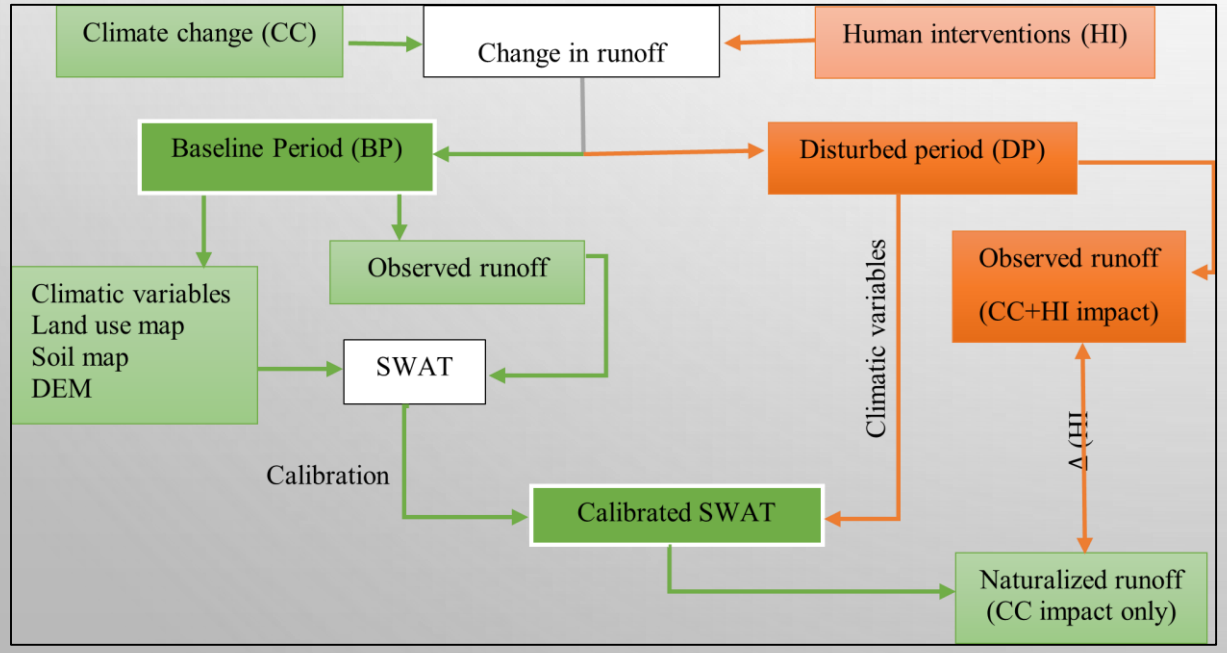
- ✓ To determine the role of human factors in the development of hydrological droughts;
- ✓ To identify the human factors that mainly contribute to the changes by analyzing the temporal and spatial changes in land cover using remote sensing data.

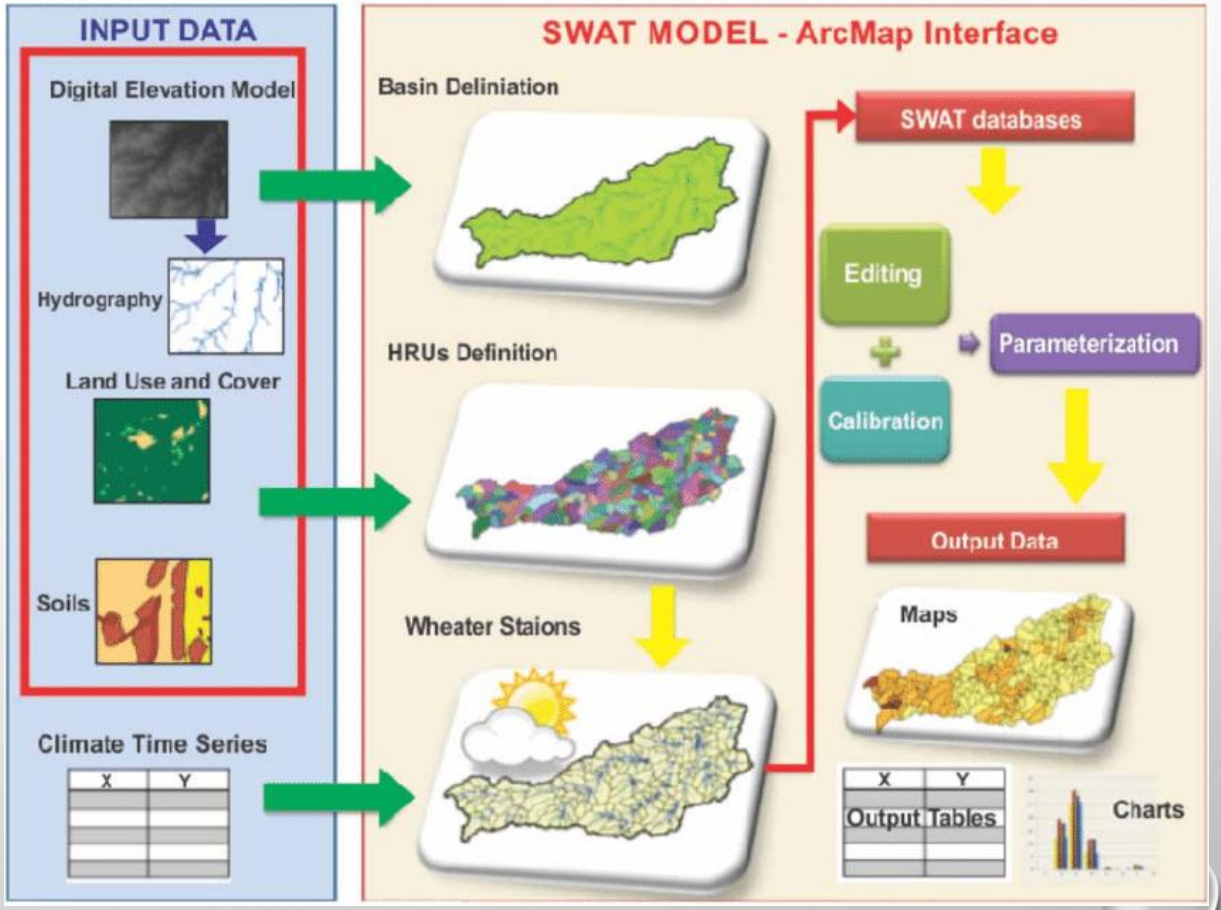


IMPACT ASSESSMENT METHODS [1/2]

Naturalized runoff reconstruction method

- Methods for change point detection in runoff-Pettitt test
- Calibrate and validate the model in baseline period (BP)
- Keep all optimized and other inputs constant
- Reconstructing naturalized runoff during DP



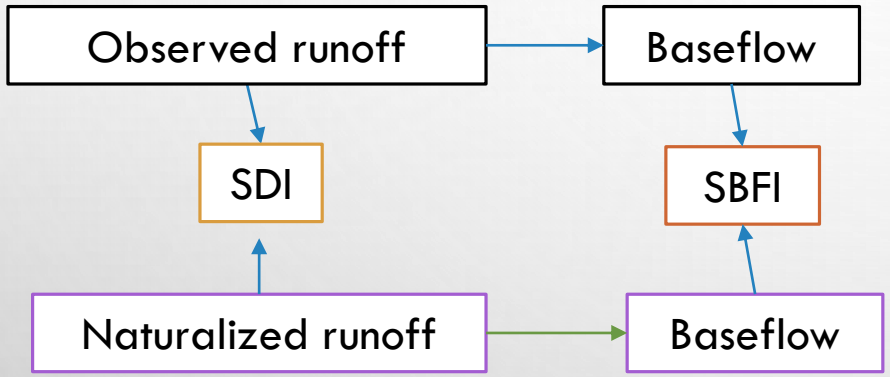


Source: Da Silva et al. (2018)

IMPACT ASSESSMENT METHODS [2/2]

✓ The baseflow filtering algorithm developed by Wittenberg (1999)

- Streamflow Drought Index (SDI)
- Standardized Baseflow Index (SBFI)

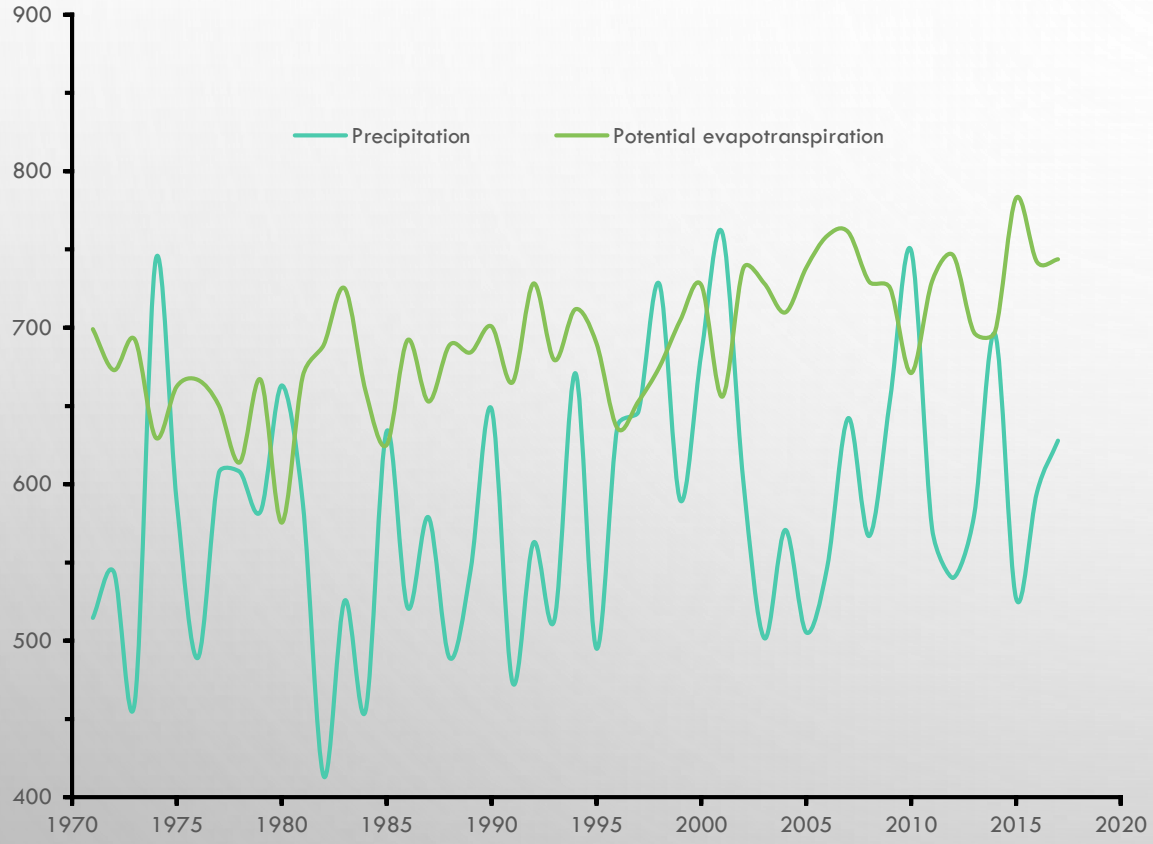


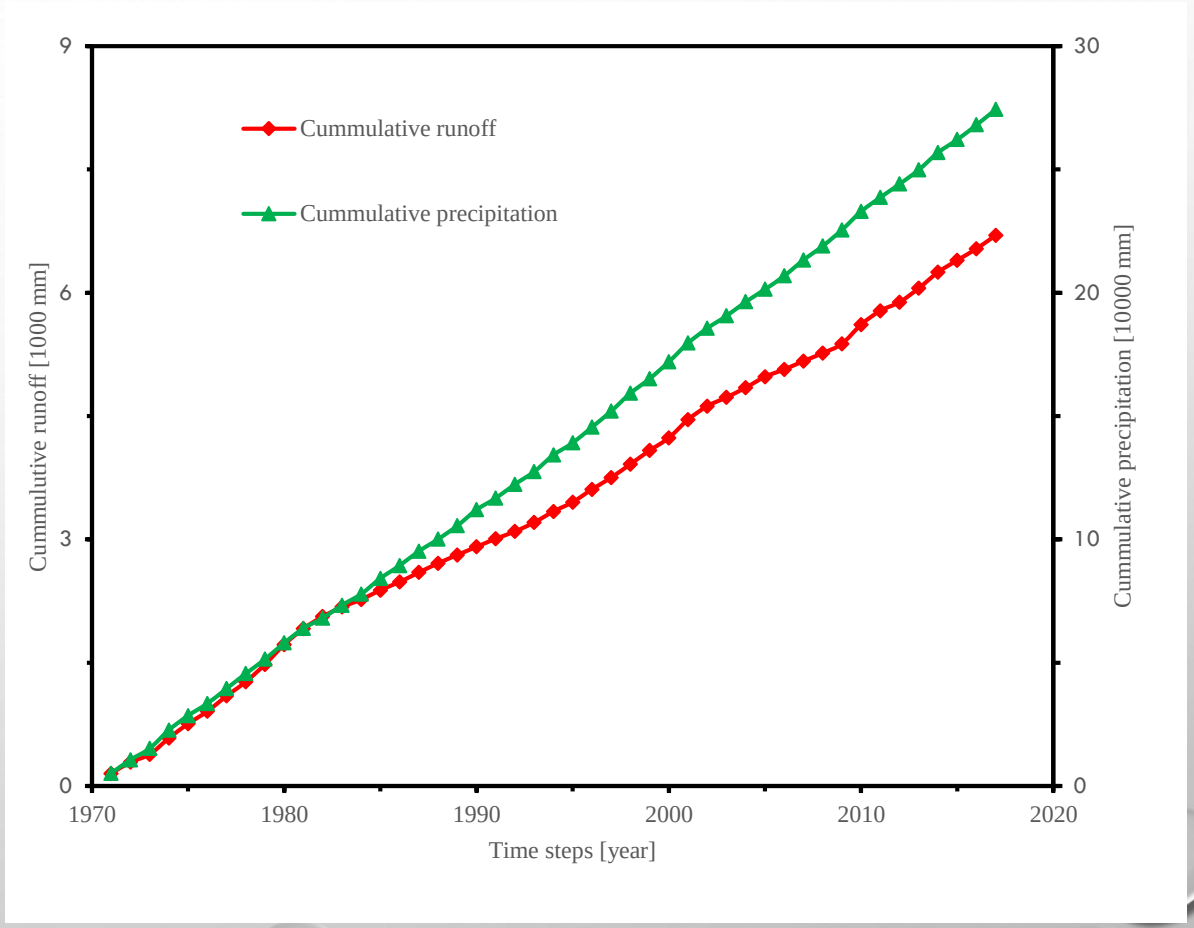
There are three approaches to assessing hydrological drought using standardized indices

1. The traditional method
2. The time-varying method
3. The parameter transplantation method

✓ Human factors impact on the evolution of hydrological drought is investigated by comparing the different drought characteristics estimated with the parameter transplantation method.

CHANGE POINT DETECTION RESULTS [1/4]

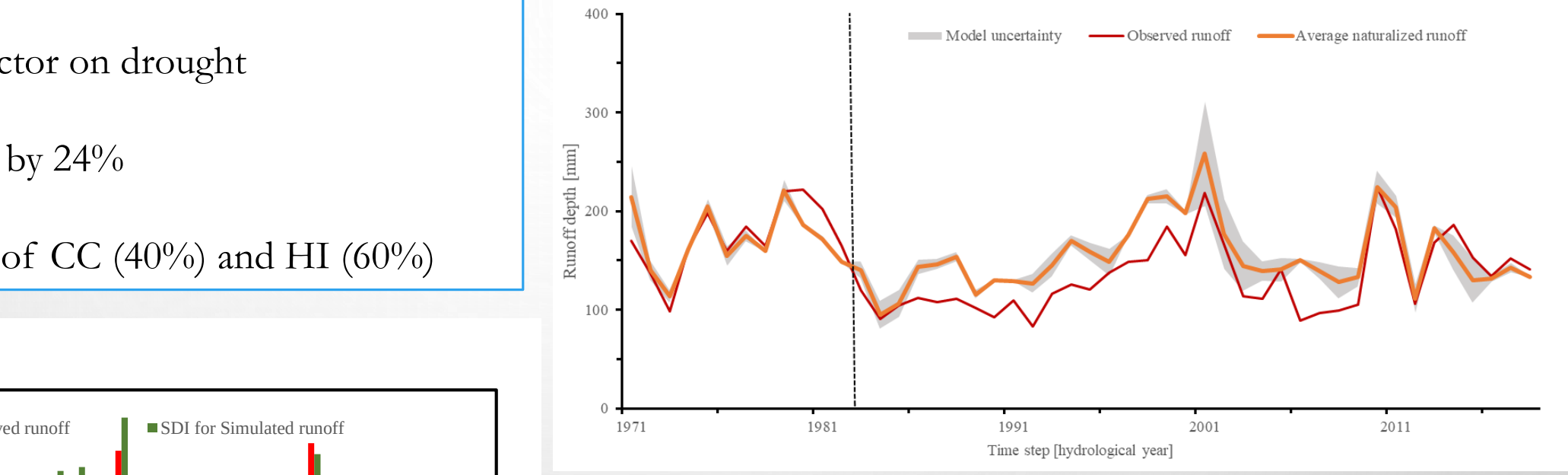


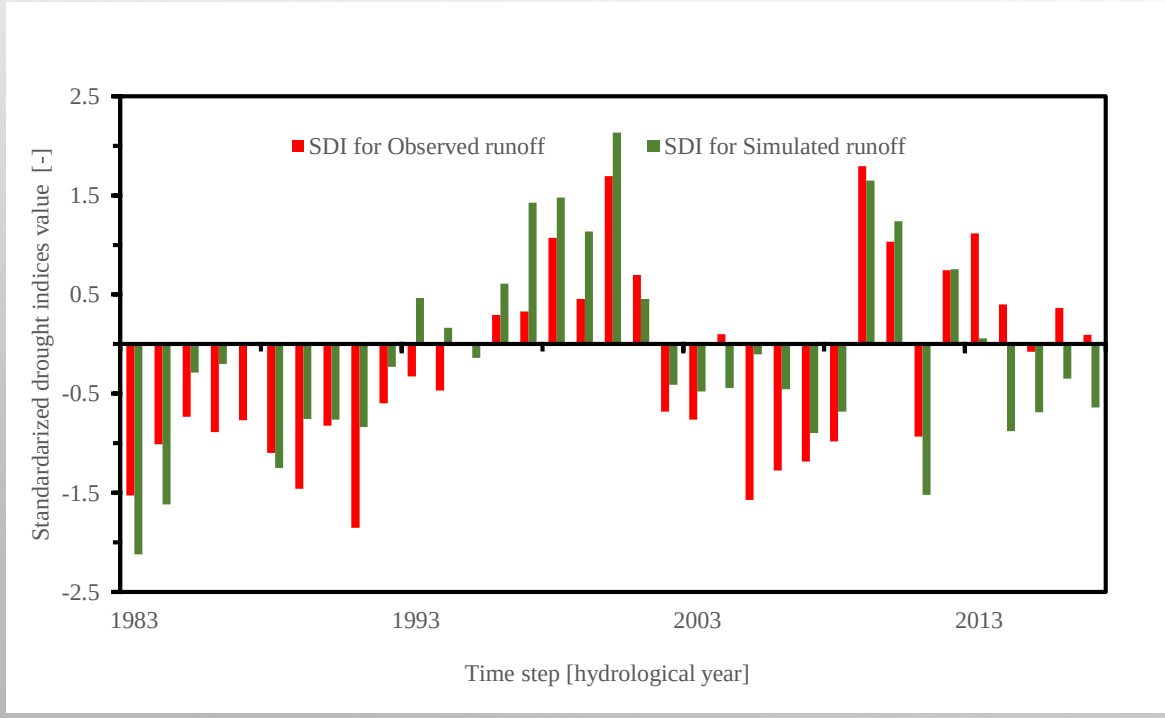


IMPACT OF HUMAN FACTORS ON HD [2/4]

Impact of human factor on drought

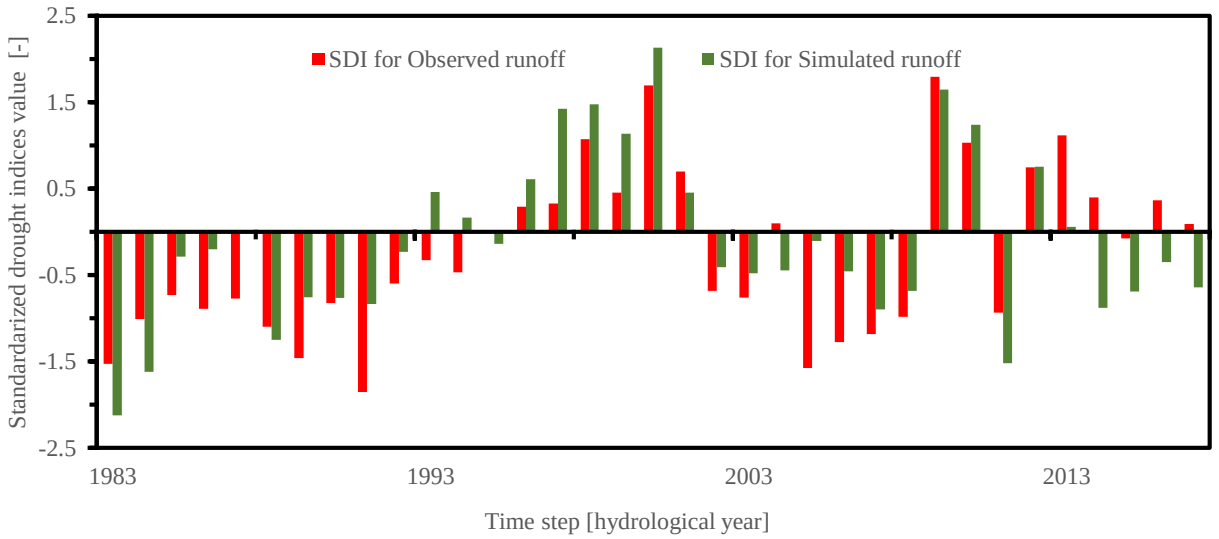
- Runoff decreases by 24%
- The contribution of CC (40%) and HI (60%)

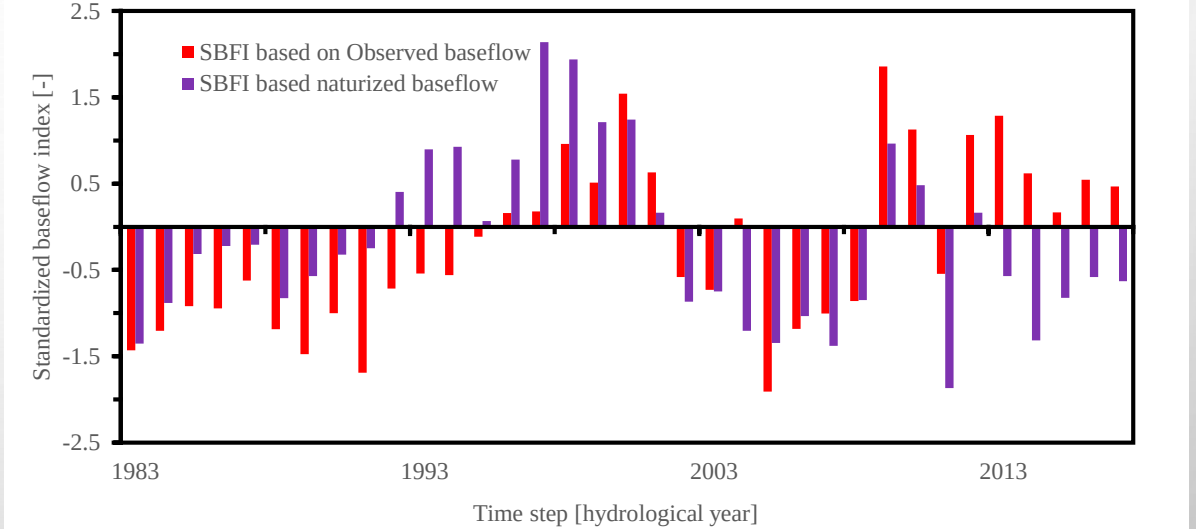




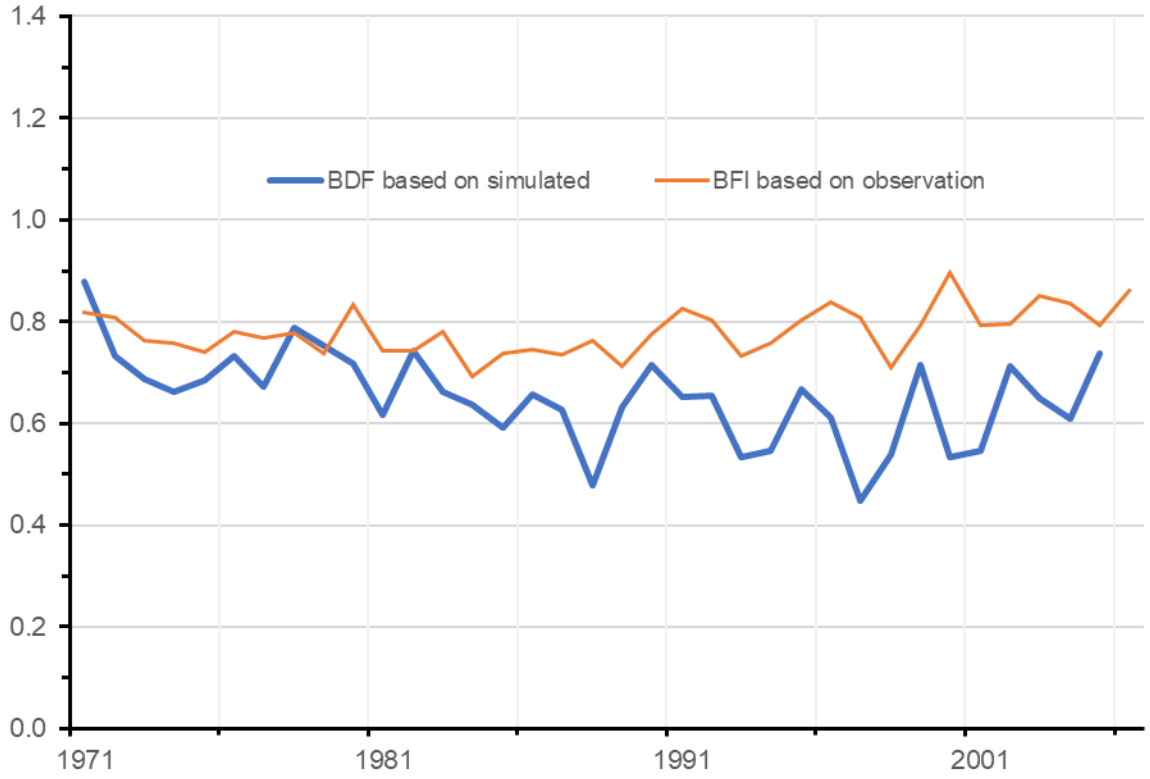
- The gap between naturalized and observed runoff during indicates the existence of human interventions: 1980s-2000s.

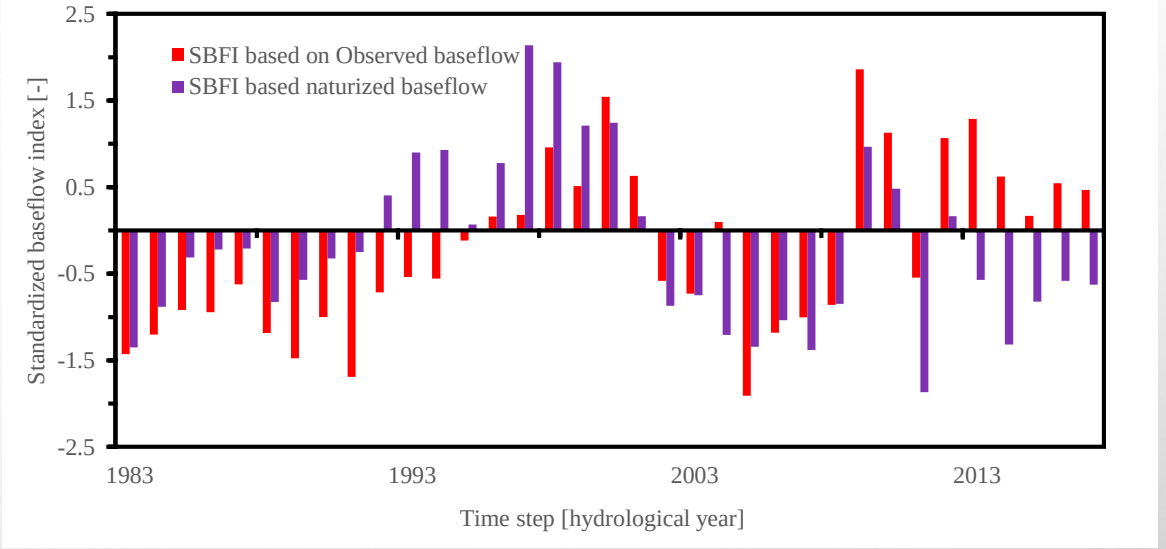
CONTRIBUTION OF CC AND HI RESULTS [3/4]





IMPACT OF HUMAN FACTORS ON HD [4/3]

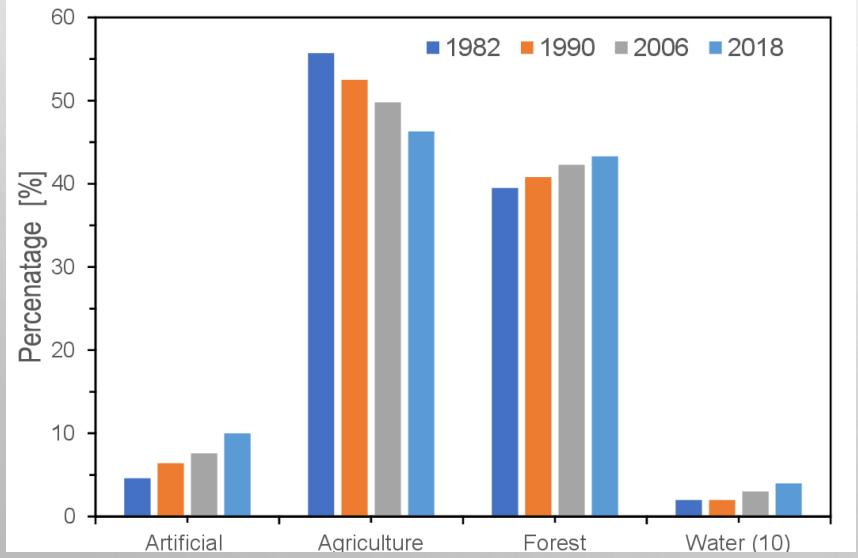


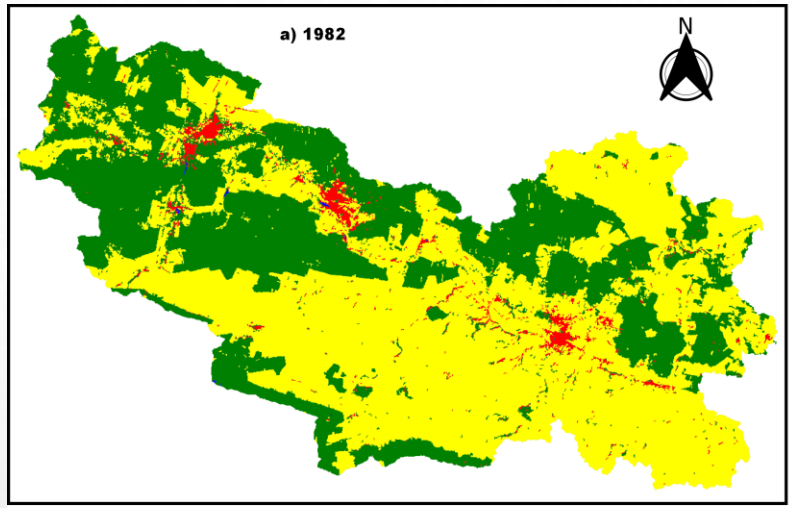


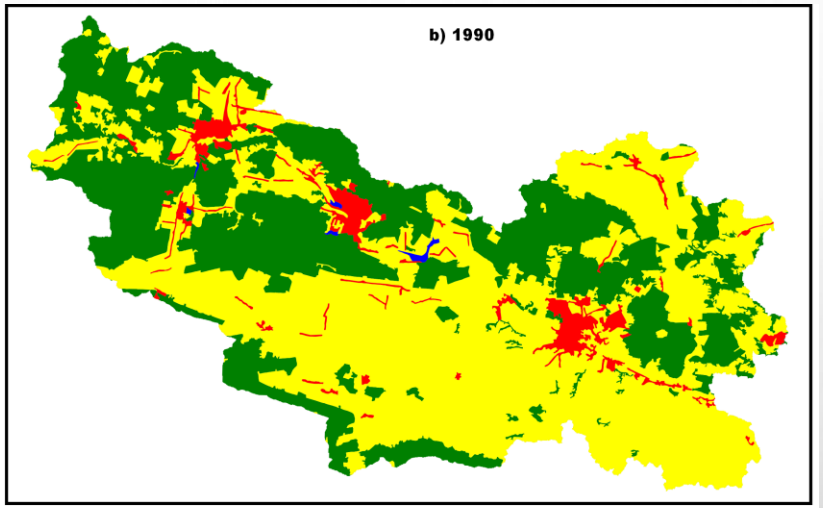
LAND COVER CHANGE RESULTS [1/1]

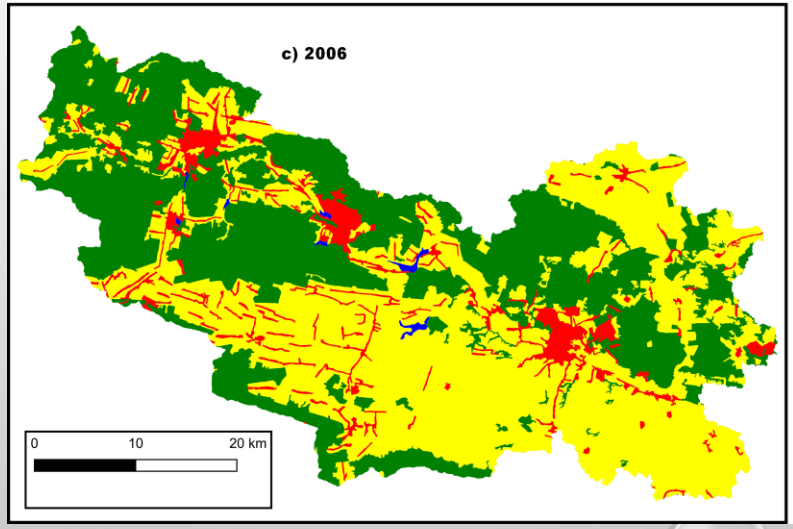
Spatial and temporal change in LULC

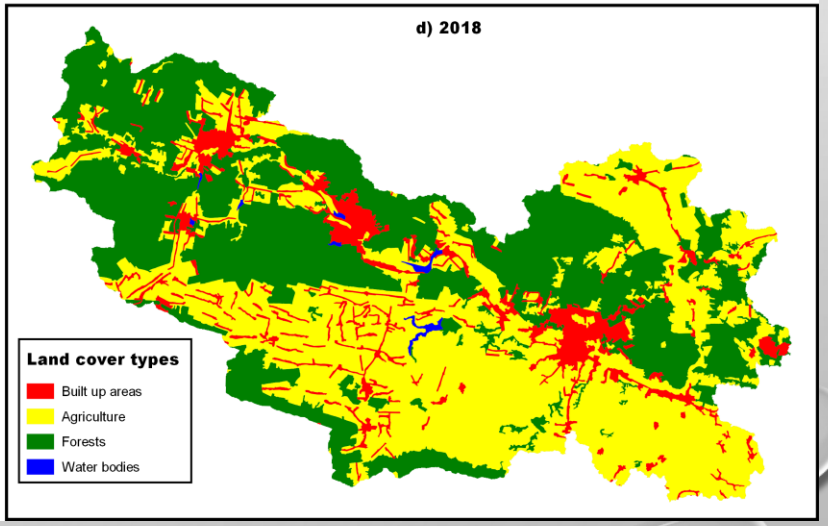
- Spatial variations
- Temporal variations: Agriculture land decreased while water, artificial, and forest increased.











CONCLUSIONS [1/1]

- The significant change in runoff in the watershed began in the early 1980s.
- Human factors have dominated the decrease in runoff over the watershed.
- Indirect effects of human interventions on hydrological drought characteristics
- From 2010 the naturalized runoff closely matched the observed runoff suggesting increased groundwater recharge and higher baseflow and/or a systematic reservoir release of excess water during the dry season