Development of a neural network for groundwater recharge estimation in karst aquifers

– The future of karstic recharge management? –

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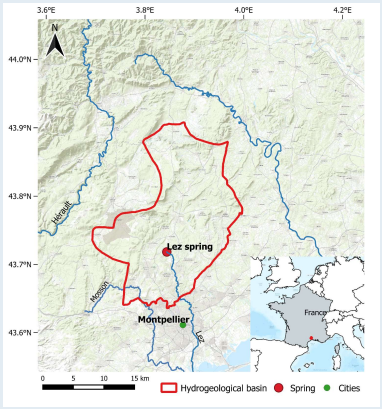
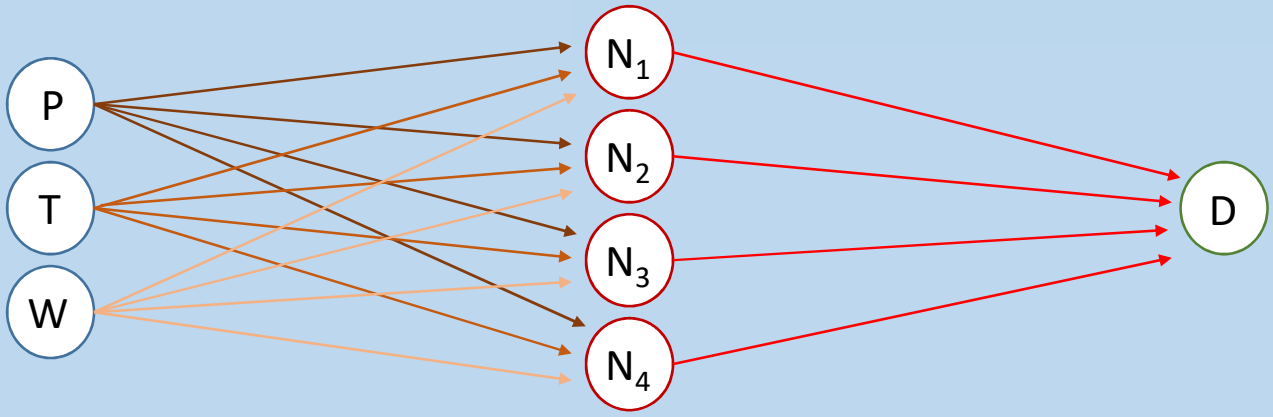
Motivation:

- Empirical and conceptual models often struggle to adequately describe the highly nonlinear recharge process
- Numerical models require a high amount of system information, which is usually not available, and are computational demanding
- Artificial neural networks (ANNs) are capable of modeling any kind of relationship
- Once trained, the computational cost of ANNs is very low → **very suited for real time modeling**

Study Area:

- South of France
- Mediterranean climate
- 709 mm/a precipitation
- Hydrogeological basin estimated at 380 km²
- Recharge area roughly 130 km²
- Supplies Montpellier with drinking water (1100 l/s pumping on average)

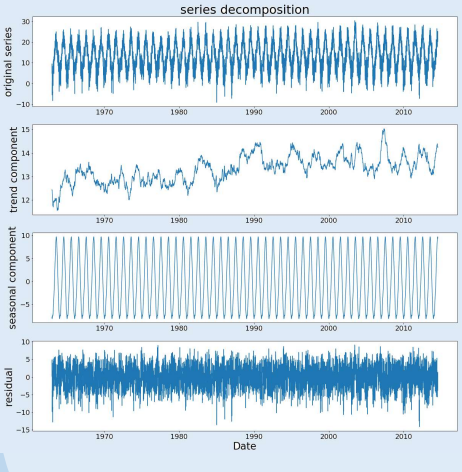




Preprocessing:

- No general rules → "**what works best**" approach

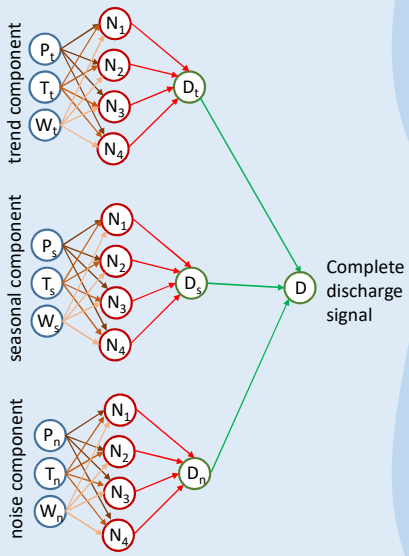
Used methods include:
- Normalizing
- Smoothing
- Input size reduction
- (Seasonal) differencing
- Series decomposition for modular approach



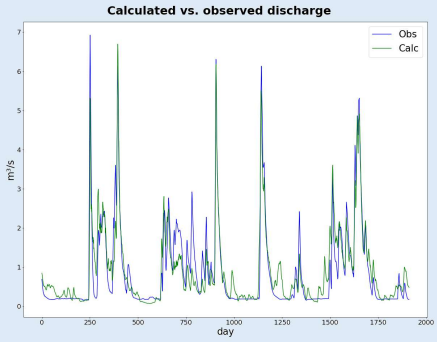
Inner workings:

- What is the best architecture?
  → wrapper feature selection approach (basically **brute forcing** many different network parameter combinations)

Modular network approach:



Results:



- So far best results if time series is smoothed
- Normalizing the inputs made the network more stable
- Interesting: well pumping seems to have a minor influence despite high pumping rates
  → might be because of correlation between temperature and pumping

Prospect:

- Decoupling of temperature and pumping
  → removing the trend and seasonality by decomposing the time series
  → removing the trend and seasonality by differencing/seasonal differencing

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