

```
for (k in 1:length(file.names)){
  basin <- read.delim(file.names[k],sep=" ",na.strings="-9999.000")
  names(basin) <- c("JJ", "DD","MM","YYYY","Qm3","P","T","PET","SM","AET","Peff")
  # basin <- basin[which(is.na(basin$Q)==FALSE),] #leave out data gaps
  basin$Date <- as.Date(paste(basin$DD,basin$MM,basin$YYYY,sep="."),format="%d.%m.%Y")
  basin$Q <- basin$Qm3*3.6*24/area$Area[k]
  thresh <- quantile(basin$Q,pVal,na.rm=TRUE)
  basin$Station <- as.numeric(gsub("sub_1.txt","",file.names[k]))

  index <- 1
  basin$Event <- NA #prepare output vectors/dataframe
  basin$EventID <- NA
  for(m in (max(lag)+1):length(basin[,1])){#assign flood event numbers to each day
    #start from max-lag+1 to allow for calculation of preconditions below
```



## DeepHydro: Petrus 2.0

Lennart Schmidt, Elona Gusho, Walter de Back

# The Elbe catchment

- Catchment: All precipitation drains into the river
- 4th largest river catchment of EU



Creative Commons



<https://commons.wikimedia.org/wiki/File:Elbe-niedrig.jpg>



[https://commons.wikimedia.org/wiki/File:Elbe\\_Einzugsgebiet.png](https://commons.wikimedia.org/wiki/File:Elbe_Einzugsgebiet.png)

# The Elbe catchment

- Strong flood events in 2002, 2006, 2013
  - Low-flow period 2003, 2005
- Need for accurate prediction of streamflow



Creative Commons

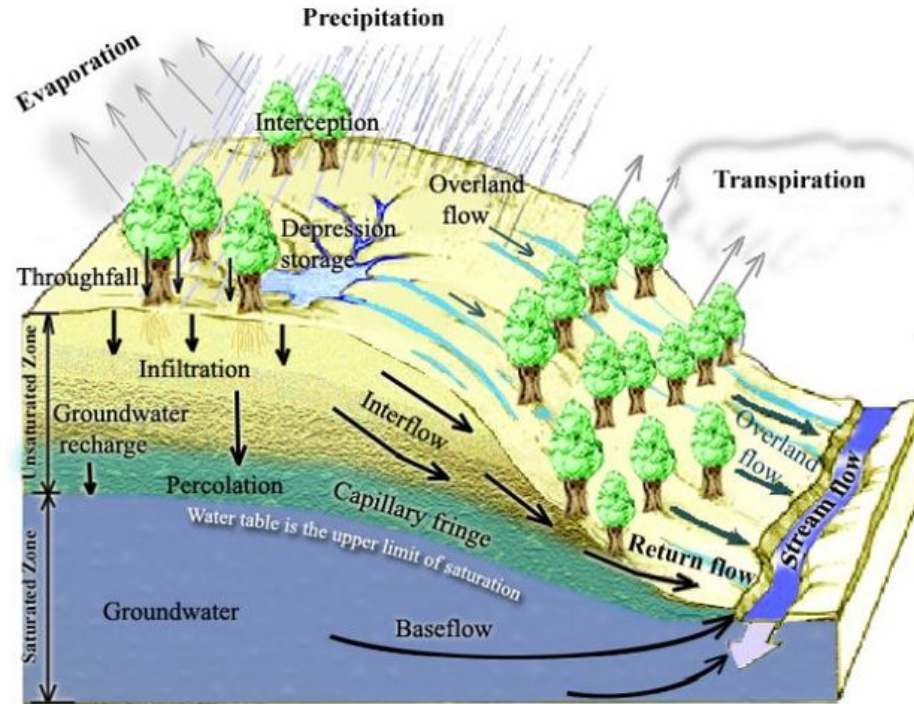


<https://commons.wikimedia.org/wiki/File:Elbe-niedrig.jpg>



# The hydrological system

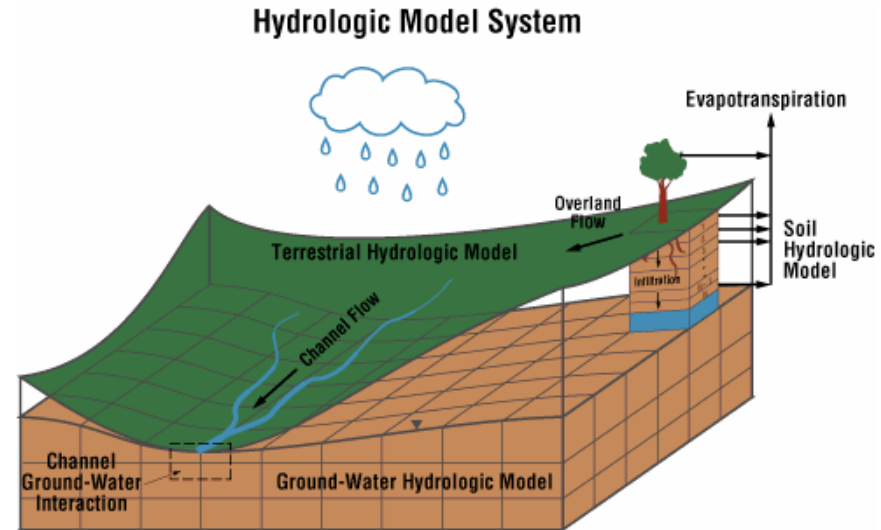
Different hillslopes react differently!



[DOI Full Challenge](#): Evaluating Temporal and Spatial Scale Issues with Hydrologic Models in the Black Hills, South Dakota (2013)

# Traditional physical modeling

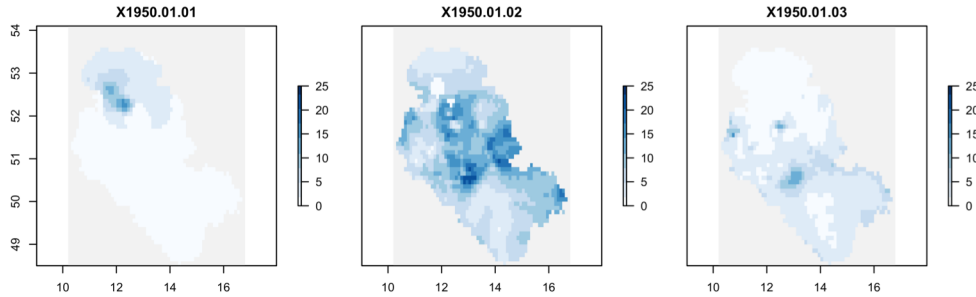
- Grid volumes = mini storages
  - Information missing
  - Costly assumptions+parametrization
- Deep Learning: Identify spatial units



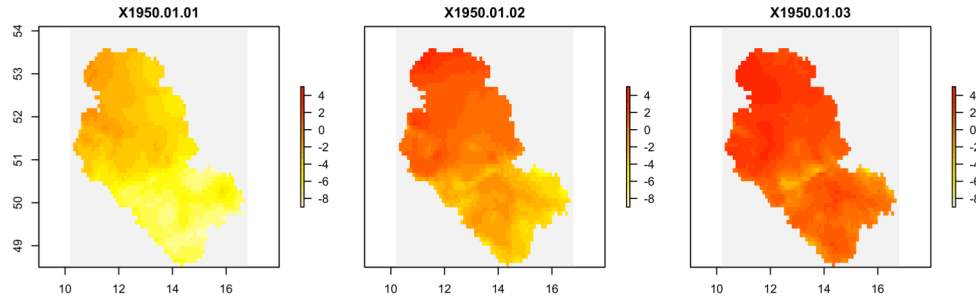
<http://www.essc.psu.edu/hms/hms/>

# Data

## Precipitation



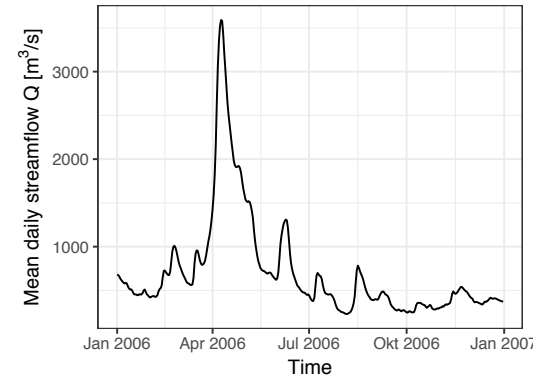
## Air temperature



Input

CNN-LSTM

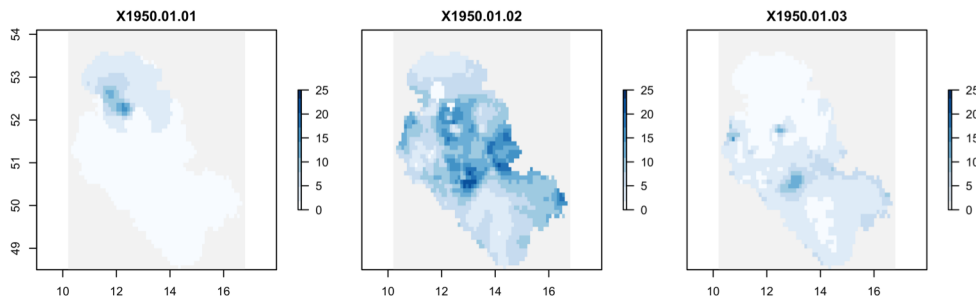
- Patterns
- Time-lags



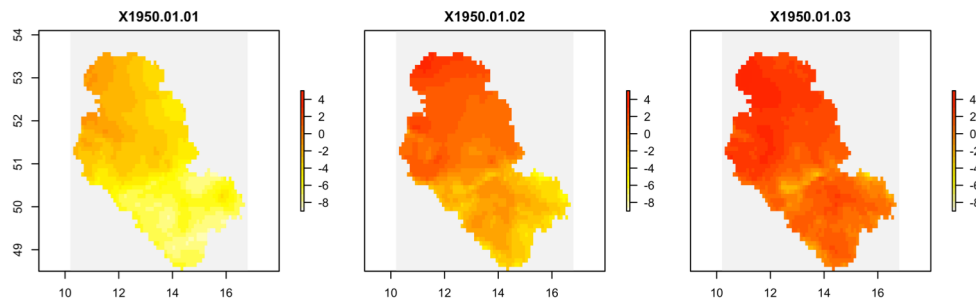
Target

# Data

## Precipitation



## Air temperature



Input

- Daily mean values
  - 1950 – 2016
- Input:**
- Precipitation + Temperature
  - Dimensions: 56 x 66 x 24472

- Target:**
- Dimensions: 1 x 24472

# Our goals

---

- Evaluate Performance of Deep Learning
- Evaluate gain in accuracy by including spatial information
- Gain knowledge:
  - Quantify the “Elbe`s memory“
  - Saliency maps: Identify flood-inducing patterns in precipitation + temperature
- Learn a lot
- Networking



**Thanks for your attention!**

---