

# Multi-tiling for hydrology :

## New results about hillslope heterogeneities

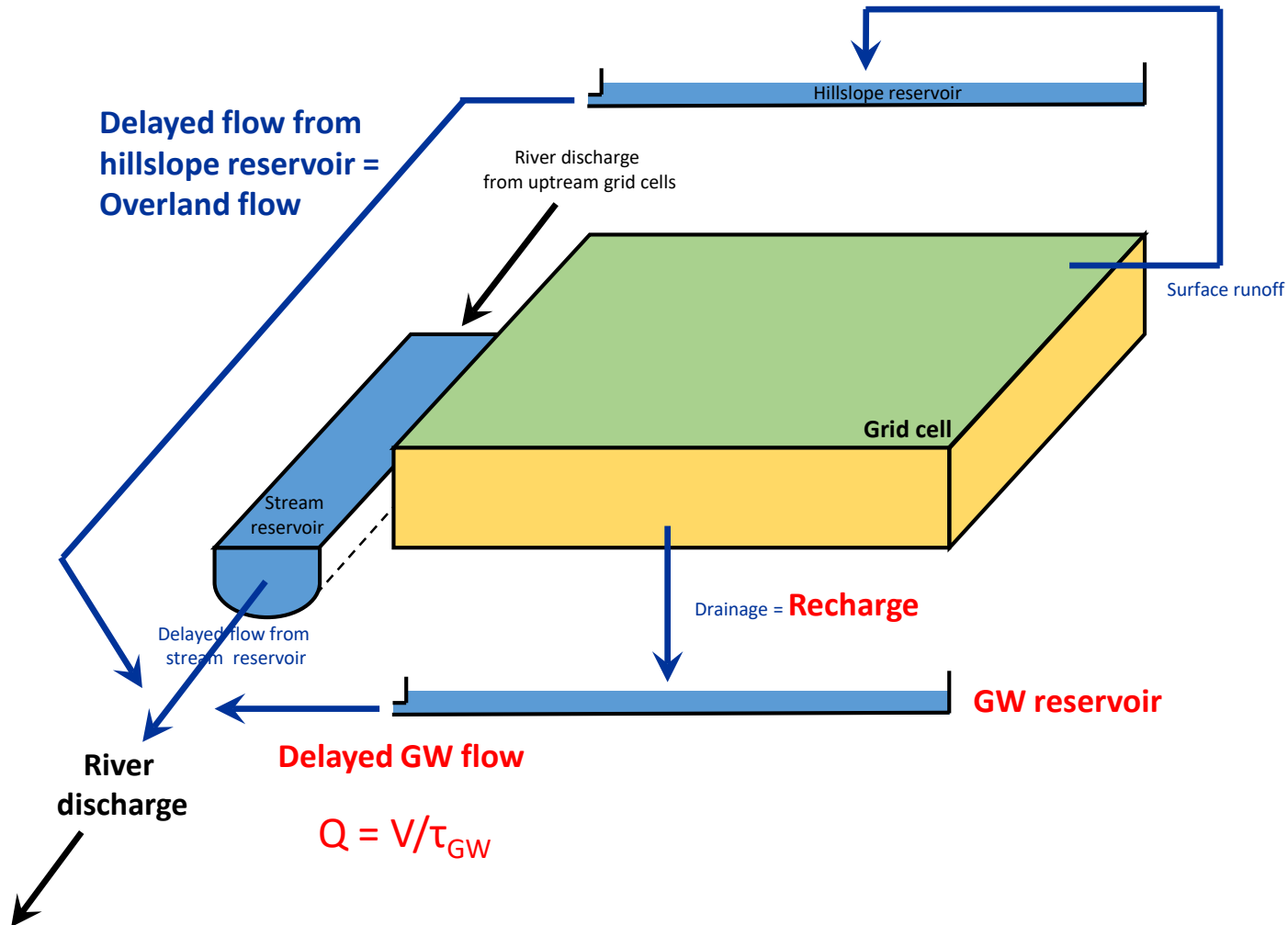
### Perspectives for a comprehensive description of waterscapes

---

Based on results of the IGEM project (ANR, with A. Jost, T. Verbeke, A. Tootchi, A. Schneider)  
And collaborations & discussion with many others

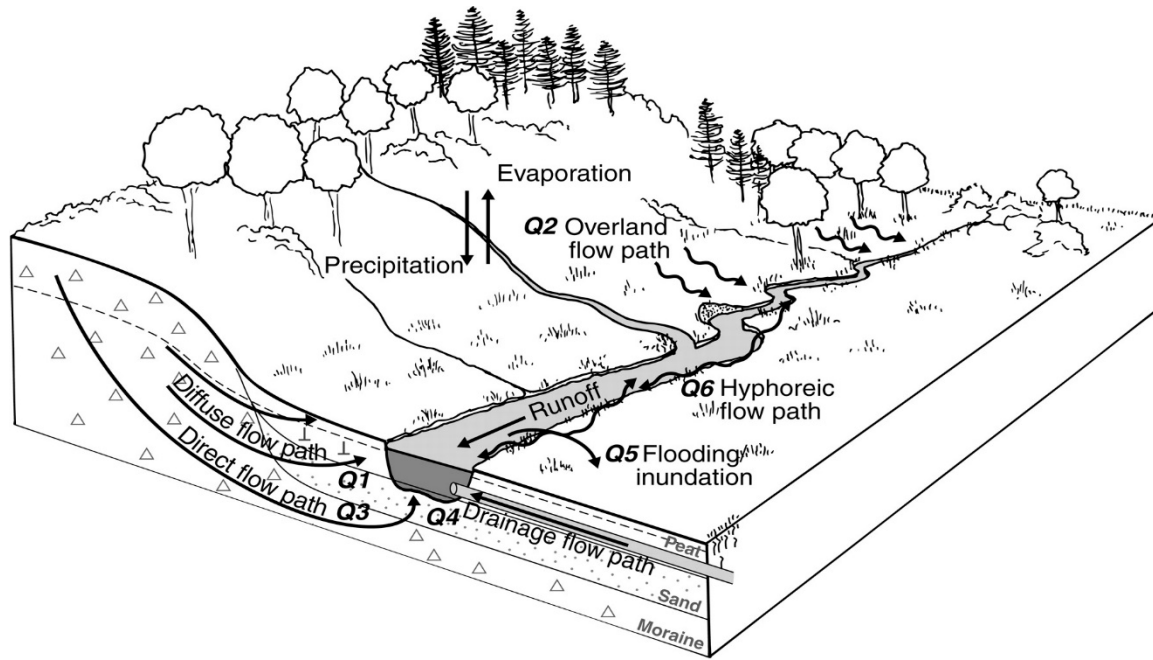


# Trunk includes very simple GW model, with no feedback on SM



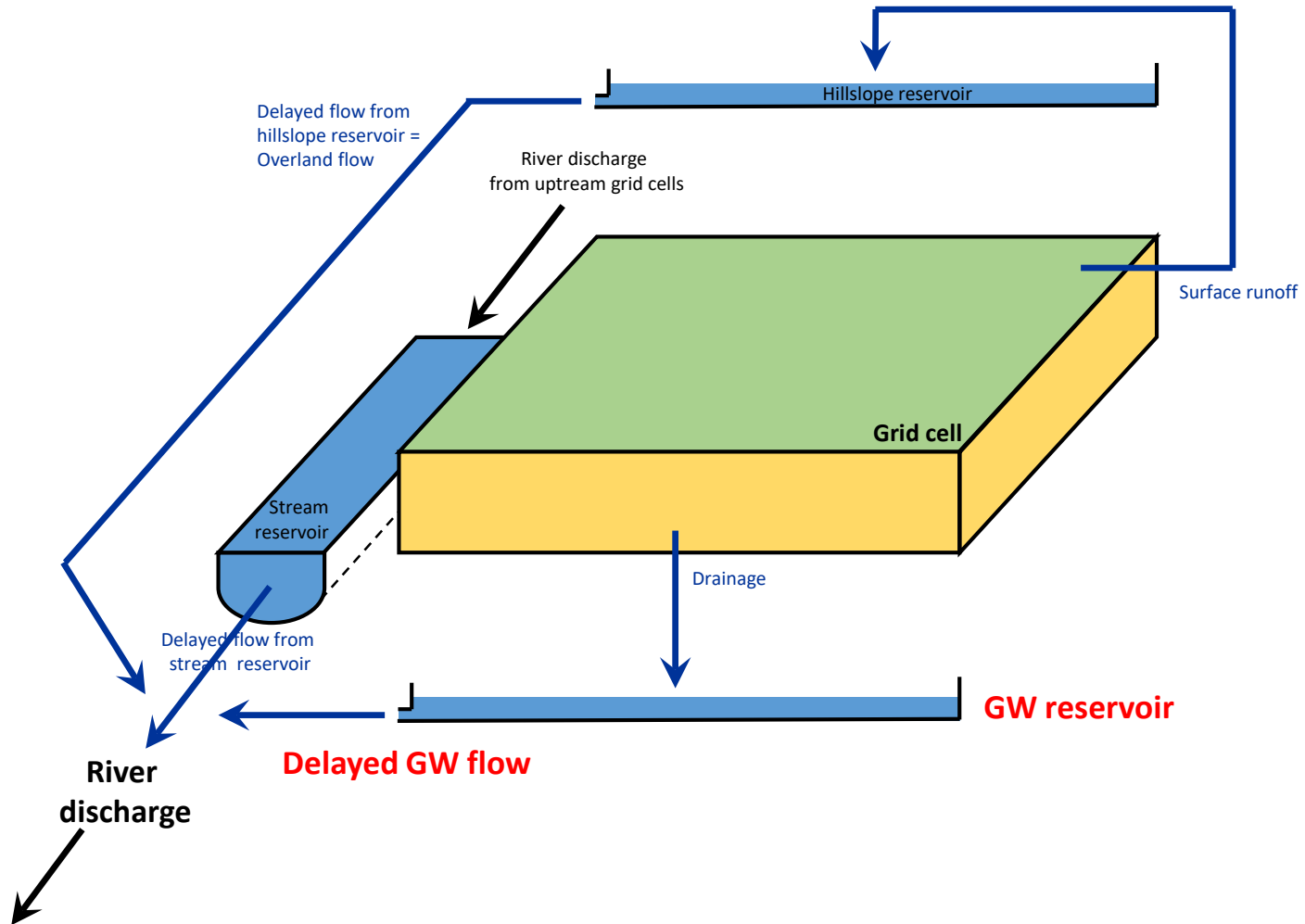
Somehow assumes flat landscapes over tens to hundreds of kms

# But landscapes are not flat...

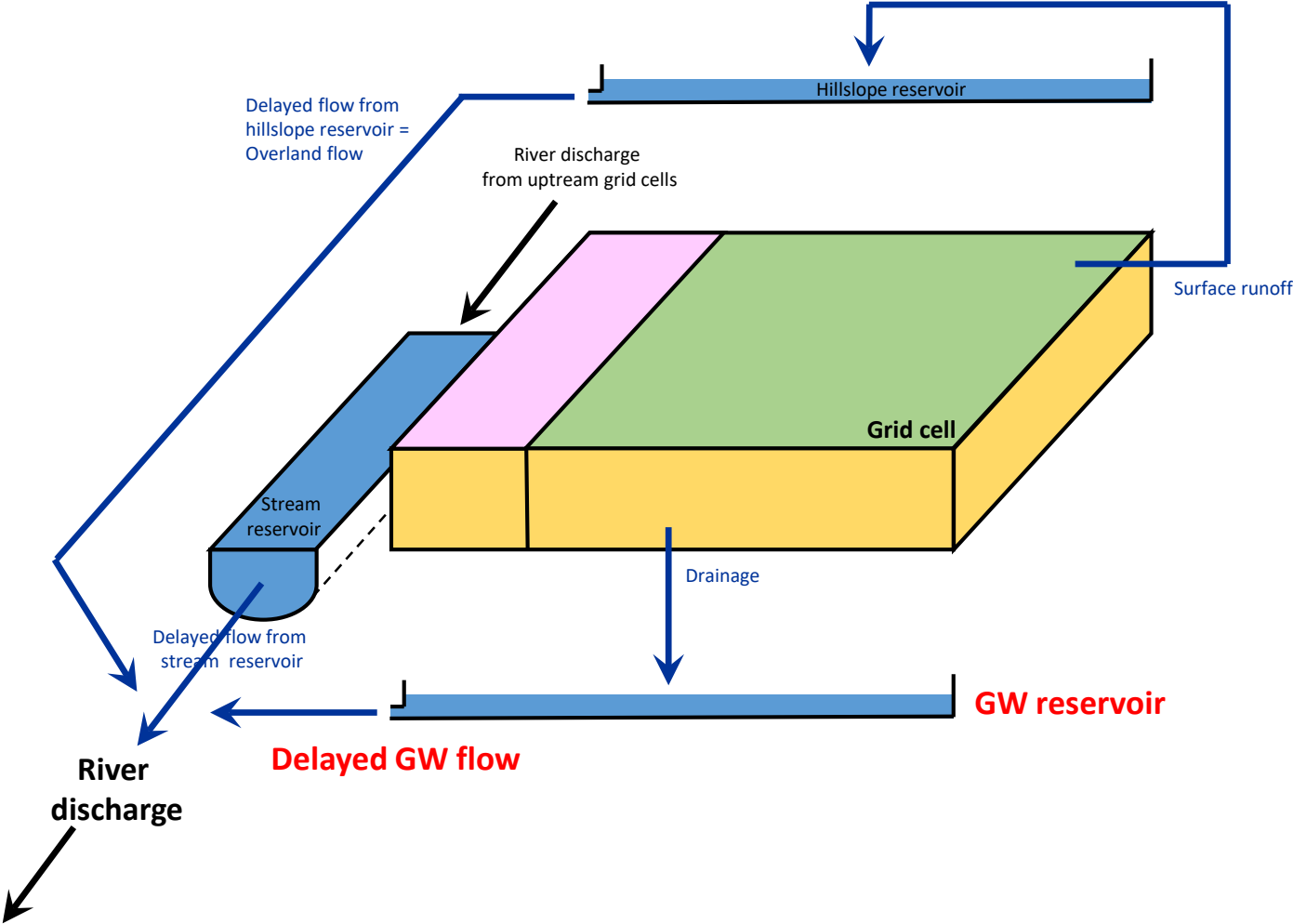


Photographs from Fan et al. 2019, WRR

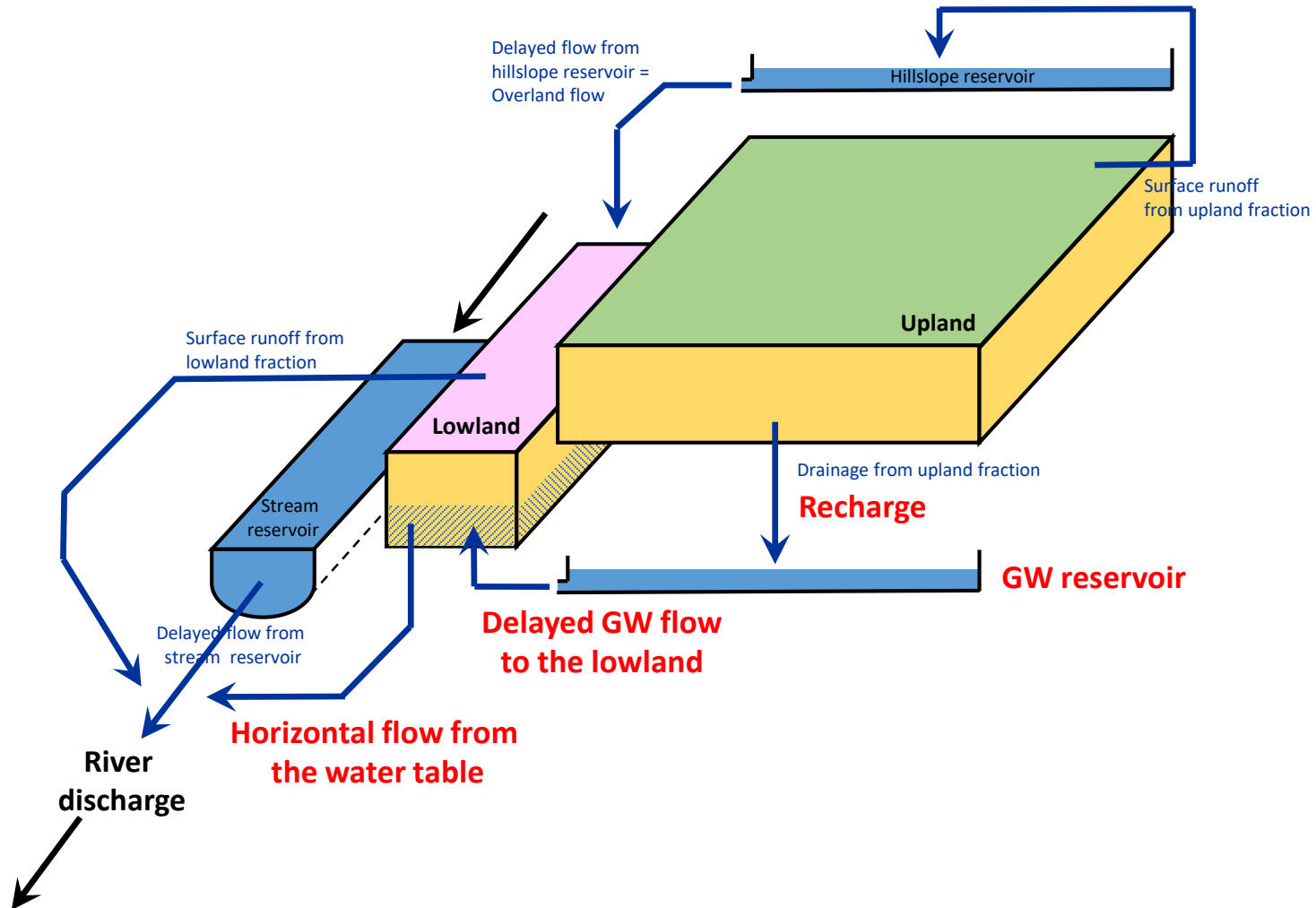
# Introduction of a lowland fraction



# Introduction of a lowland fraction



# Introduction of a lowland fraction



# Lowland fraction prescribed from global wetland map

**RFW**

**Regularly flooded wetland**

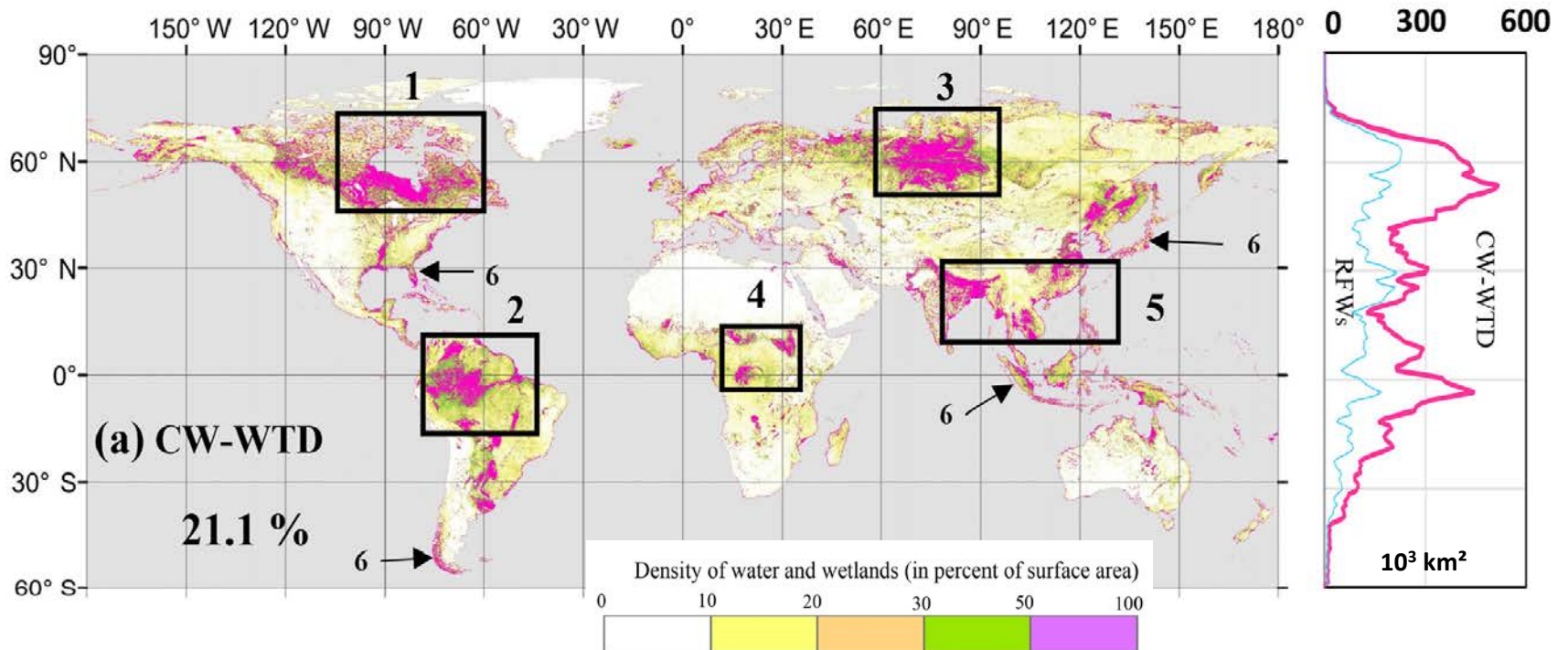
GIEMS-D15 + JRC surface water  
+ ESA CCI wetland class

**GDW**

**Ground-water driven wetland**

Fan et al. 2013

15 arc-sec  
resolution

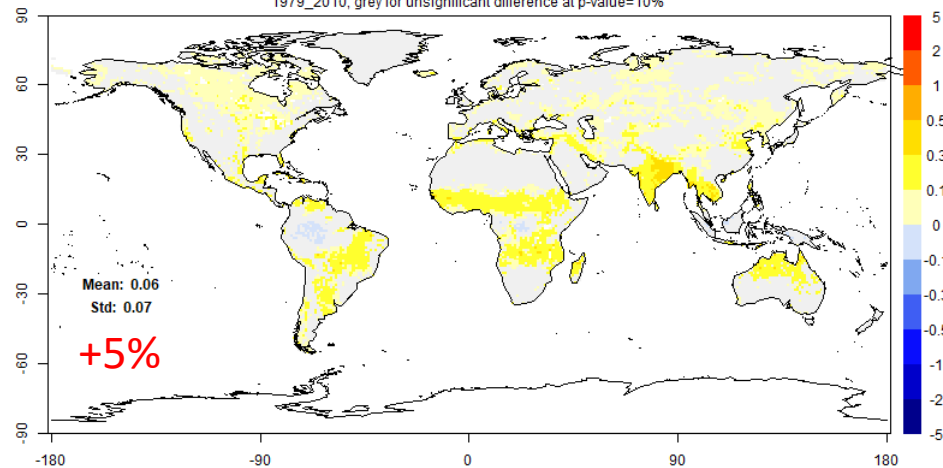


# Land surface water budget

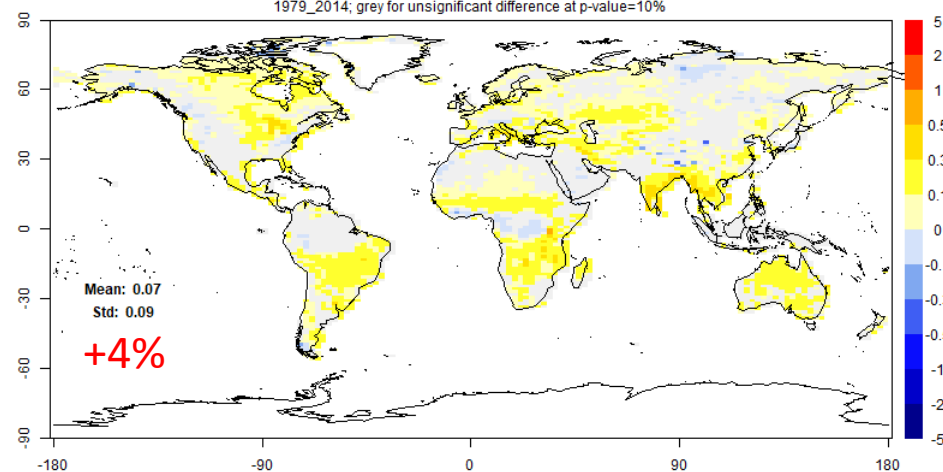
**Off-line**

**Coupled**

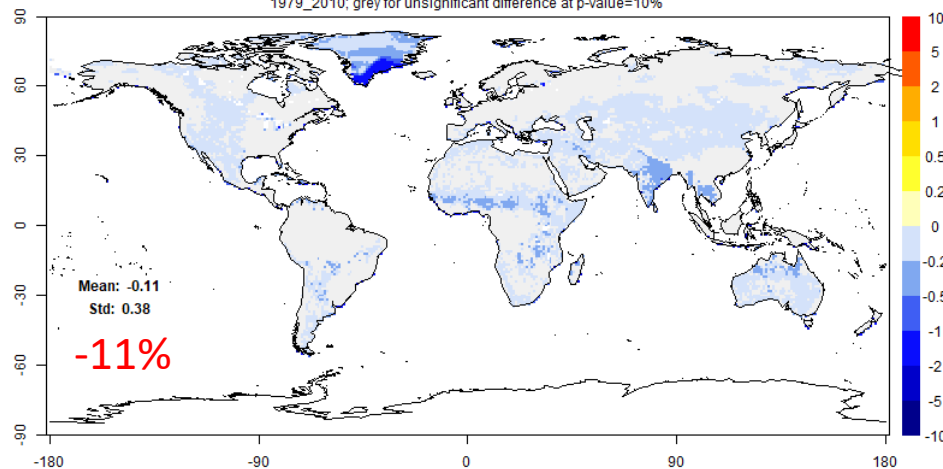
Year PGF GWF - REF, ET (mm/d)  
1979\_2010; grey for insignificant difference at p-value=10%



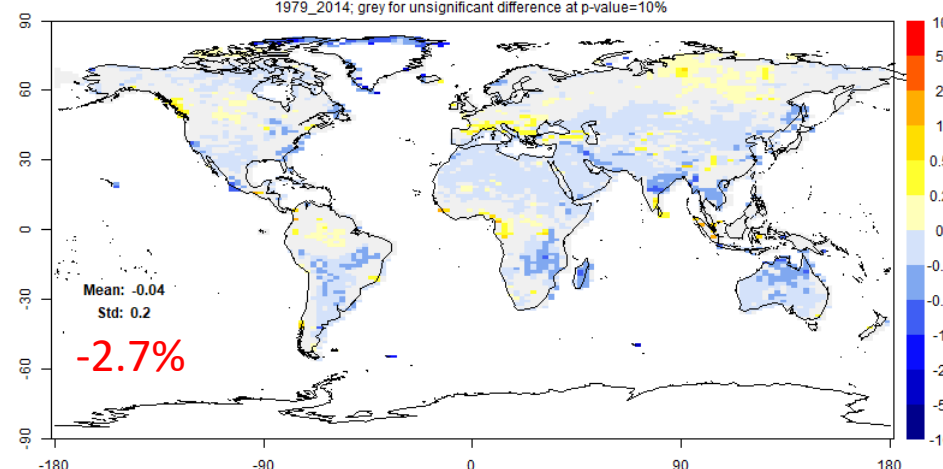
Year AMIP GWF - REF, ET (mm/d)  
1979\_2014; grey for insignificant difference at p-value=10%



Year PGF GWF - REF, Total runoff (mm/d)  
1979\_2010; grey for insignificant difference at p-value=10%



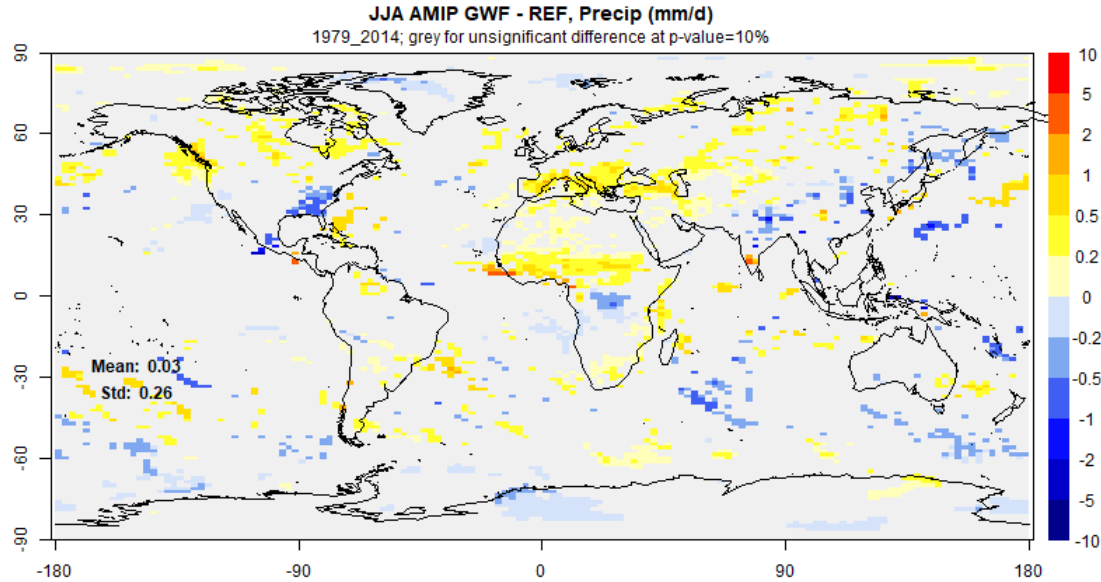
Year AMIP GWF - REF, Total runoff (mm/d)  
1979\_2014; grey for insignificant difference at p-value=10%



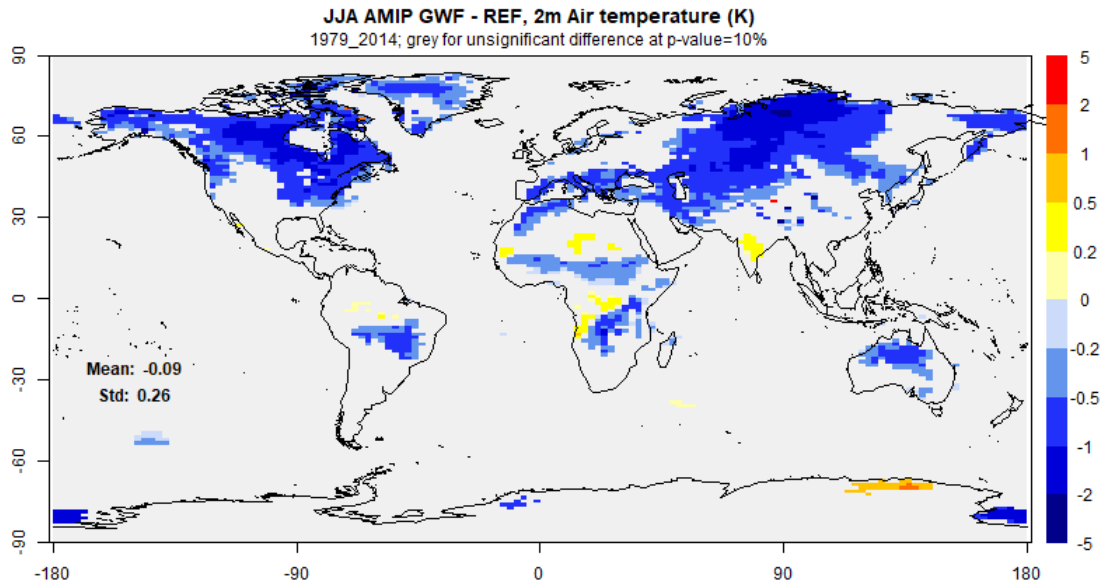


# Simulated climate

NH summer  
JJA



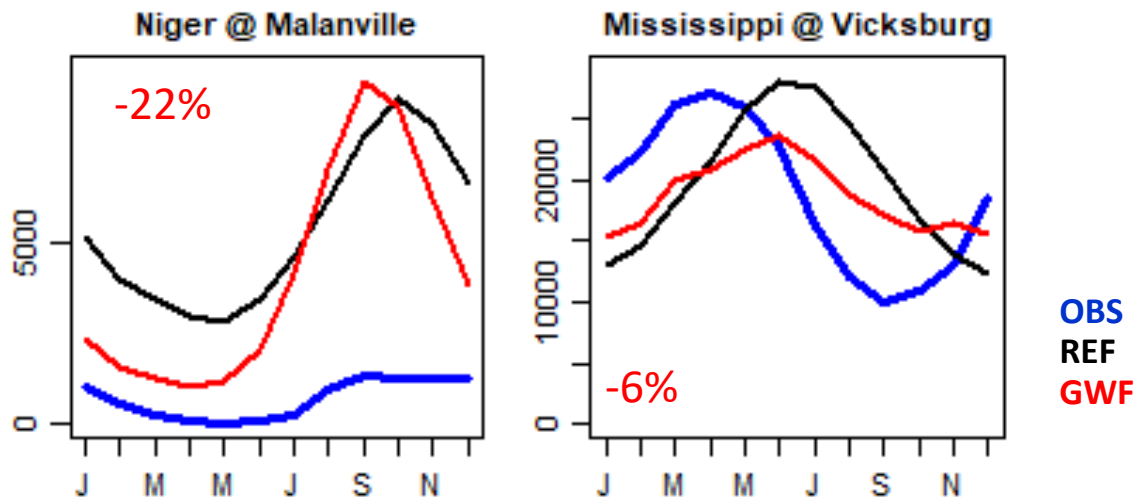
Precip  
 $\Delta_{\text{glob}} = +0.7 \%$   
 $\Delta_{\text{land}} = +1.3 \%$



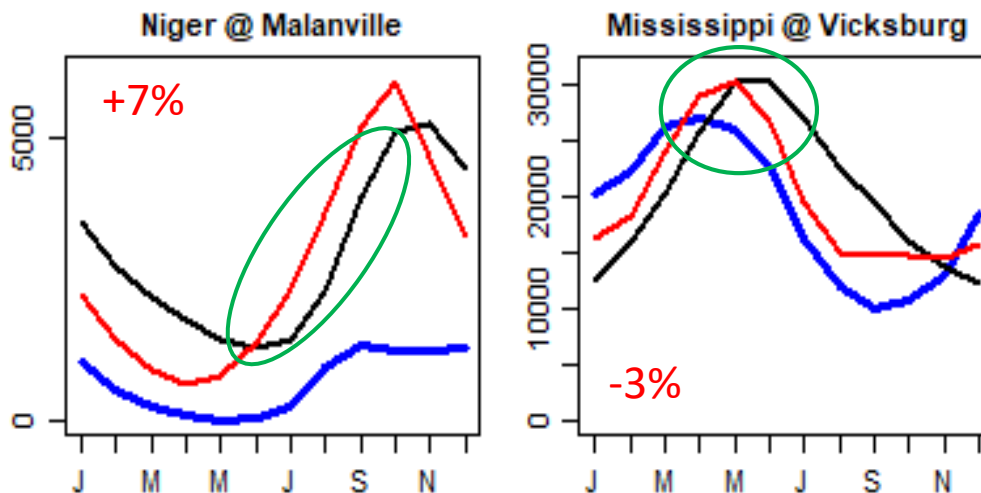
T2m  
 $\Delta_{\text{glob}} = -0.09 \text{ C}$   
 $\Delta_{\text{land}} = -0.27 \text{ C}$

# River discharge in basins with strong LA coupling

Off-line

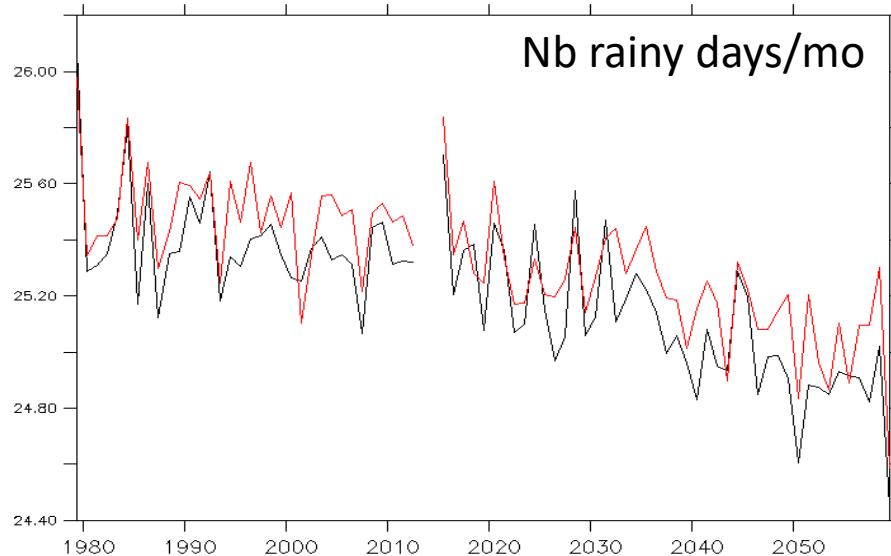
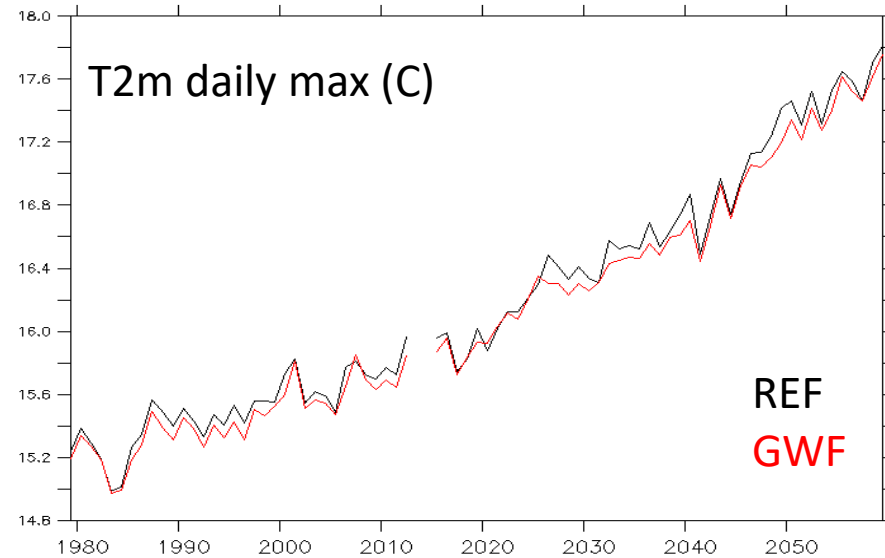


Coupled



Positive P-ET feedback

# A glimpse to the future...



- **SSP585**, not yet analyzed till 2100
- Global means, yearly time series
- **GW mitigates some global warming manifestations:**
  - Increase of extreme temperatures
  - Increase of dry days

# Many shortcomings

- **Simulations with ORCHIDEE2.0** → no nitrogen, no CAN, etc.
- **Many options switched off for simplicity**
  - Soil freezing
  - Floodplains and swamps
  - Irrigation
- **Need for parameter exploration / optimisation, but...**
- **Potential interactions with many developments**
  - Multi-tile energy budget
  - High-resolution routing
  - New floodplains (Ronny), wetland processes (methane, peats, etc.)
  - Lakes, reservoirs, water use
  - PFT composition, vegetation density, rooting depths



# Merci de votre attention

