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Future directions of global hydrological modelling and water resources assessment Incorporating human activities

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1 Impacts of agricultural land use change on water

- Perform coupled modeling of
  - land use,
  - water use
    (irrigated and rainfed, blue and green agricultural water use, plus industrial and domestic water use), and
  - water resources

  must include economic modeling
  (compare IMPACT-WATER model, Rosegrant et al., IFPRI, LandSHIFT, Schaldach et al., CESR)
- Included or separately: assess impacts on water quality due to N, P and pesticides
  (Bouwman et al., IMAGE, RIVM, ongoing work in Frankfurt)
- Base data: global data set of monthly growing areas of 26 irrigated and rainfed crops (spatial resolution 5 min)
  (ongoing work in Frankfurt)

2 Impacts of human water use on aqueous ecosystems

Support humanity in finding balance between

"water for humans" and "water for nature"

"Human water use" includes here

- water withdrawals
- reservoirs
- canals
- other structural changes to rivers for e.g. flood protection or navigation

Requires

- introduction of these features in global models
- learning from situation in selected river basins

Alteration of river flow regimes due to withdrawals and reservoirs

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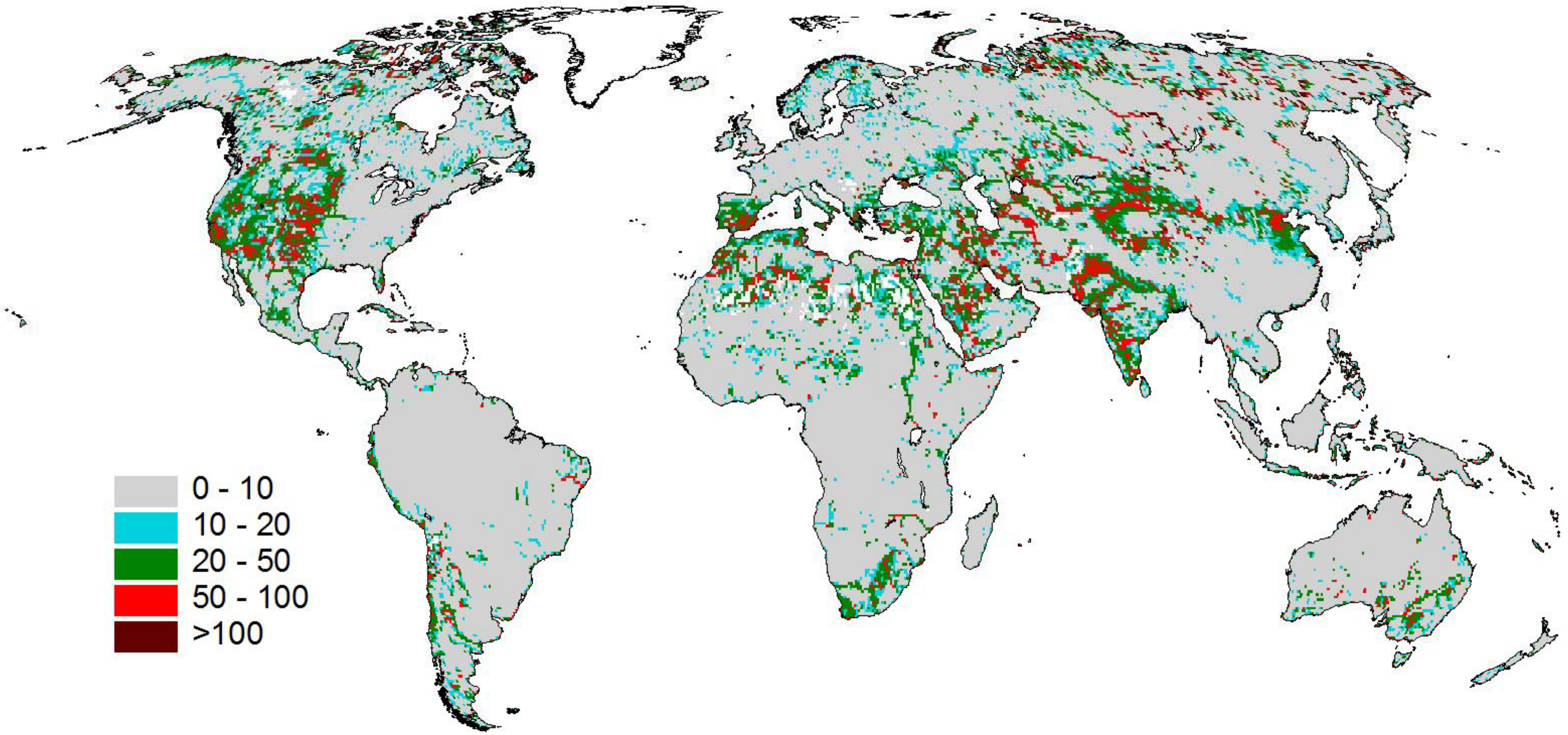
WaterGAP analysis based on "Range of Variability" approach of Richter et al. (1997)

Change in seasonal regime

Average absolute difference between 1961-1990 **mean monthly river discharge** under natural and anthropogenically altered conditions, in %



Alteration of river flow regimes due to withdrawals and reservoirs

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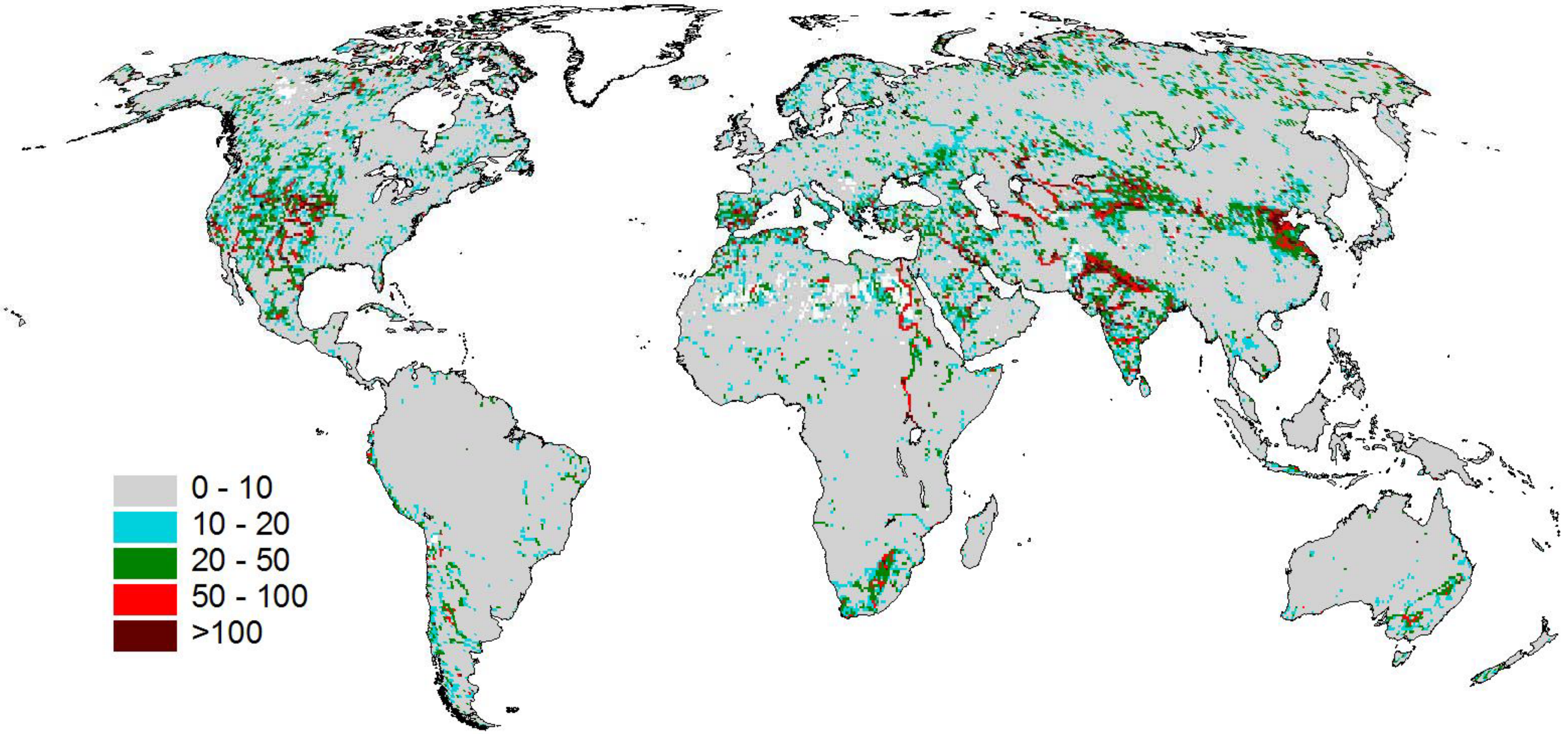
Change in interannual variability of seasonal regime

Average absolute difference between **coefficient of variation** of 1961-1990 monthly river discharge under natural and anthropogenically altered conditions, in %



3 Impacts of climate change

- Many …
- Combined impact of atmospheric chage and sea level rise on groundwater and surface water resources, and flooding, in coastal areas

4 Role of groundwater for water resources issues

- Groundwater recharge
- Groundwater table
- Groundwater withdrawals
- Use and state of fossil groundwater
- Groundwater flows (e.g. directly to ocean)

GW recharge – effect of tuning
(WaterGAP Version 2.1f with GPCC corr. precip.

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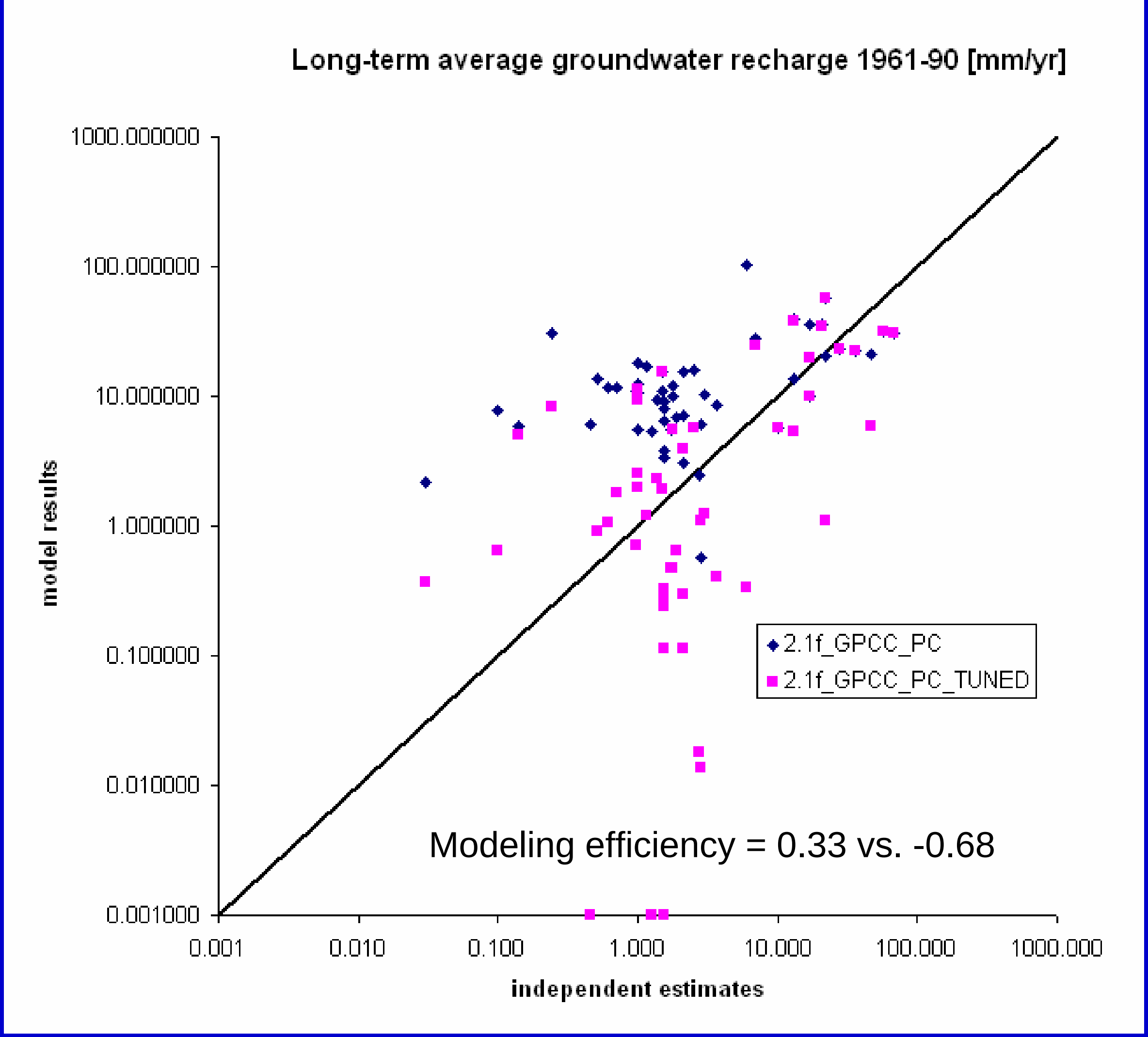
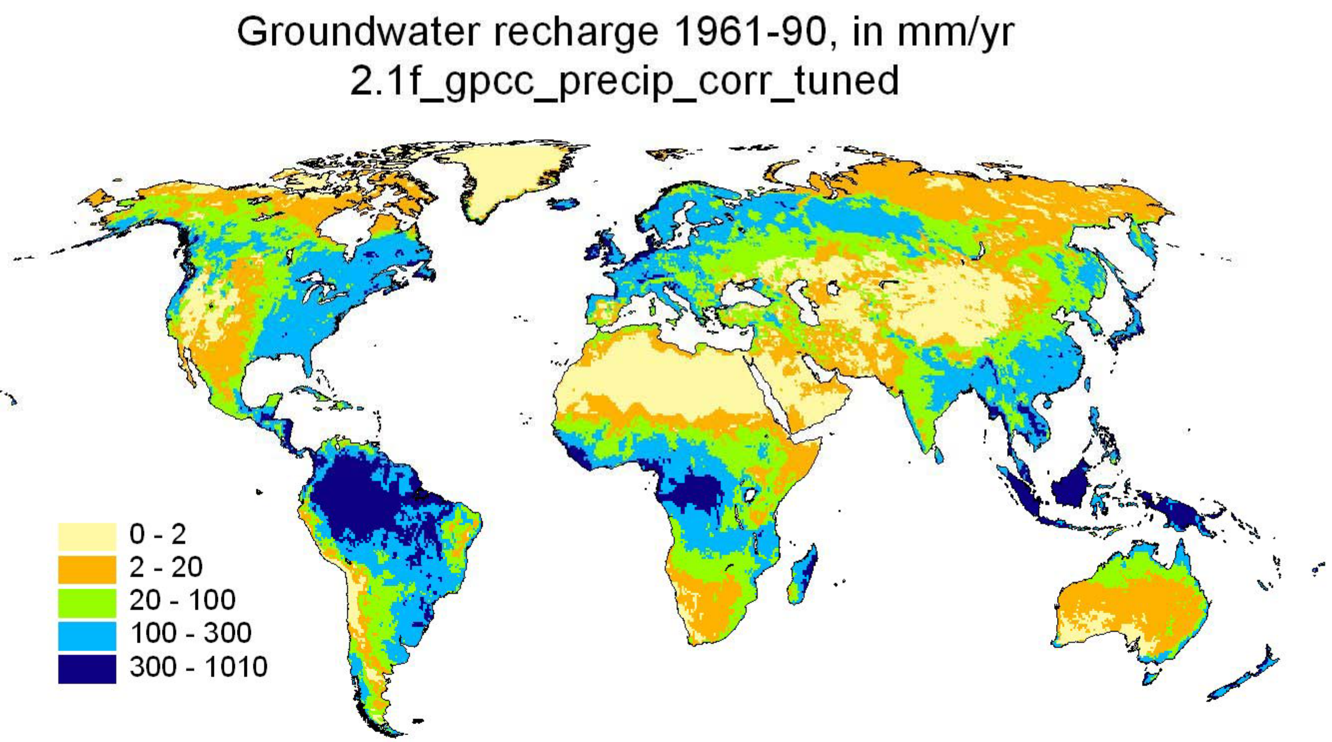
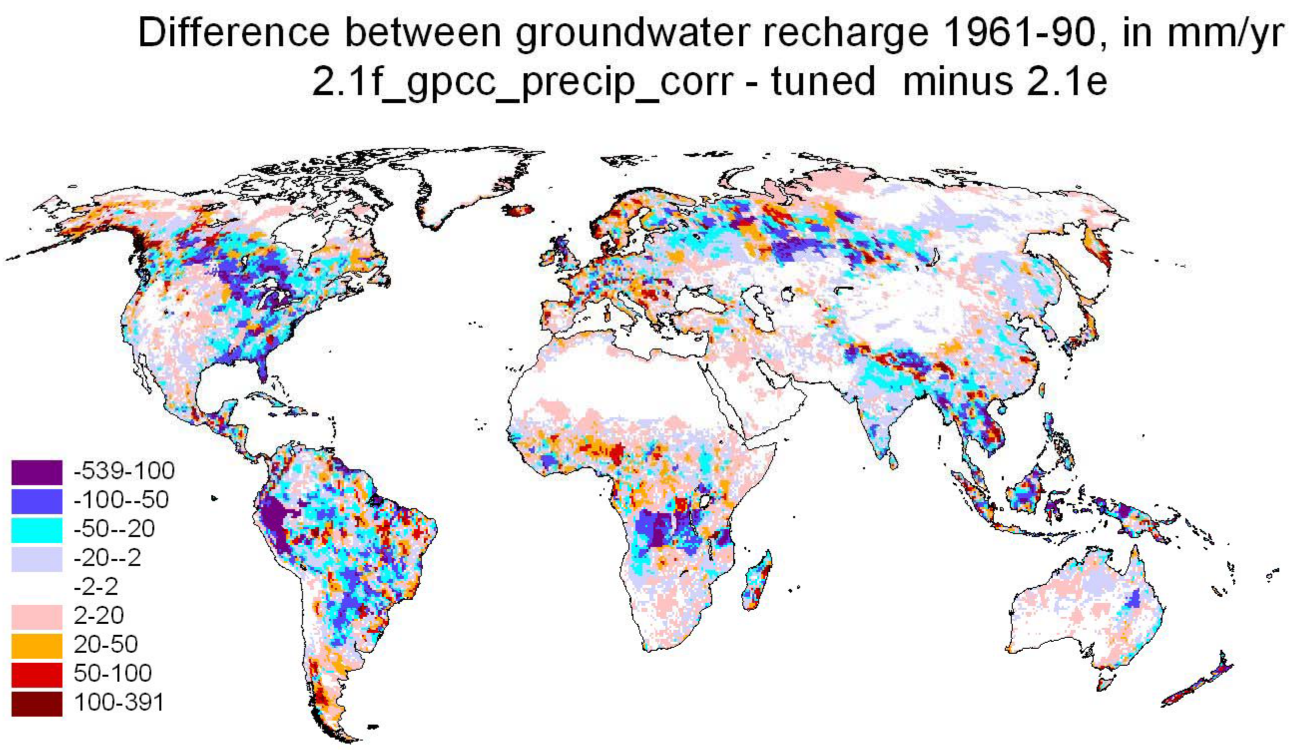


Global map of long-term average 1961-90 groundwater recharge



Difference to old (2.1e) version



5 Pollution hot spots

Develop global map of pollution hot spots including

- pesticides
- heavy metals
- arsenic
- fluoride
- organic waste
- …

Assess risk/urgency

6 Improved indicators of water scarcity

Based on case studies and improved global-scale hydrological modeling, e.g.

- water scarcity for ecosystems
  (due to human encroachment on water for aqueous ecosystem)
  vs.
  water scarcity for humans
- Indicators including green and blue water use and availability
- agricultural and hydrological drought risk

7 Methods to show impacts of global developm. on basin-scale

Make global-scale developments more relevant for water and land management on the river basin scale or in urban areas e.g. by

- downscaling of climate change results
- downscaling of other water-relevant global-scale driving forces to derive local scenarios of water resources, use and quality
- improving indicators that address consumers instead of water and land managers (like “water footprint “ approach of Arjen Hoekstra)

8 Develop new data products / promote improved data collection

E.g.

- Water use data (like in USA)
- Reservoirs (location, geometry and management)
- Water quality

References

- http://www.geo.uni-frankfurt.de/ipg/ag/dl/publikationen/index.html

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