Global Water Resource Assessment Project

-Validation of Global EPIC-

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1. Previous Global Water Resource Assessment
2. Model Improvement Strategy
3. Agricultural Water Use Estimation by global EPIC
4. Comparison of EPIC result and previous statistics
5. Future Issues

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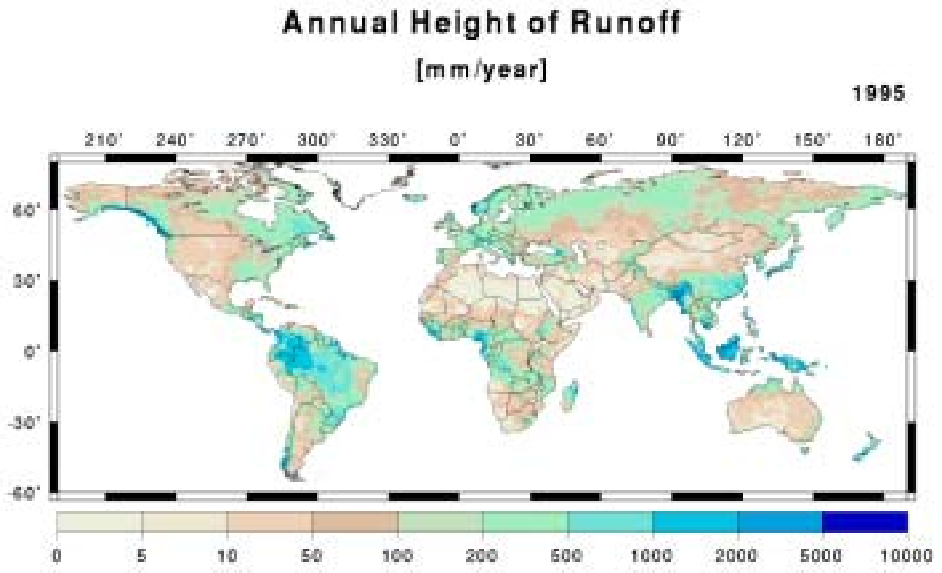
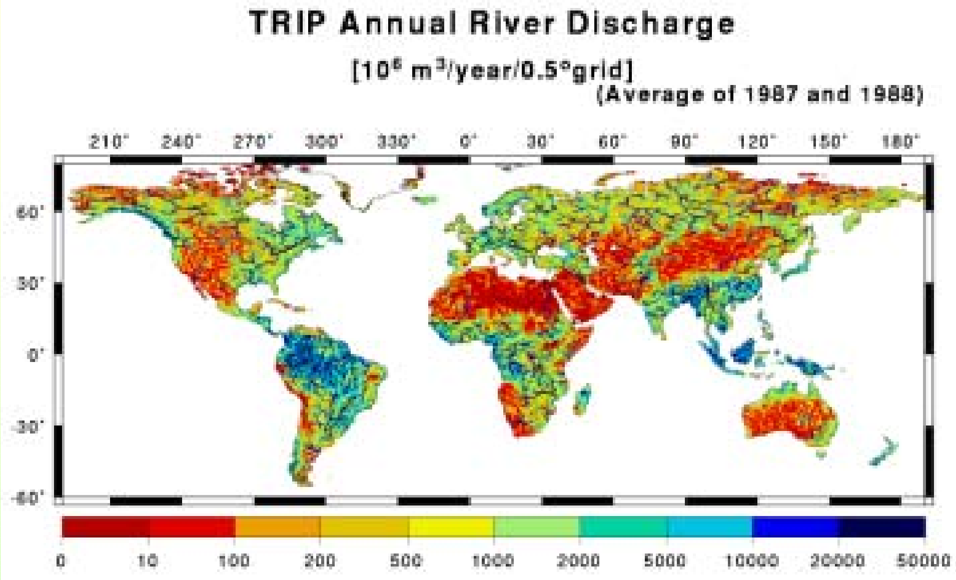
Global Water Resource Assessment (previous)

- Mainstream : <u>0.5-degree</u> grid cells.
- IHP/UNESCO
  - Shiklomanov, 2001
- Univ. of New Hampshire, USA
  - Vorosmarty et al., 2000
- Kassel Univ., Germany
  - Alcamo et al., 2000: Water Use
- Univ. of Tokyo
  - Oki et al.(2001) : Using Advanced Estimation of River Discharge

Previous Method

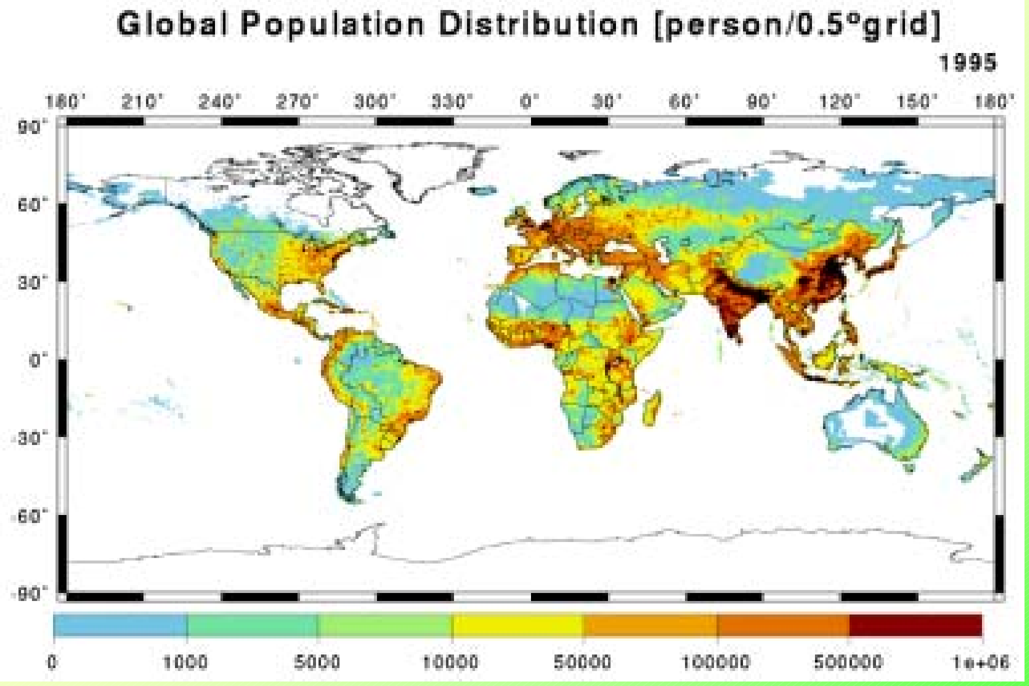
- 0.5-degree grid cells
- Water Supply
  - GSWP (Global Soil Wetness Project) Result of 'runoff' from each cells (Monthly)
  - River discharge estimation by TRIP (Total Runoff Integrating Pathways) and GSWP data





Previous Method [2]

- Water Demand
  - Base1 : WRI (World Resource Institute) water- use statistics of each countries
  - Base2 : CIECIN global population data
  - Industrial and Domestic(Urban) Water Use : Re-distribute WRI country data so that values in every cells are proportional to population within that cell.



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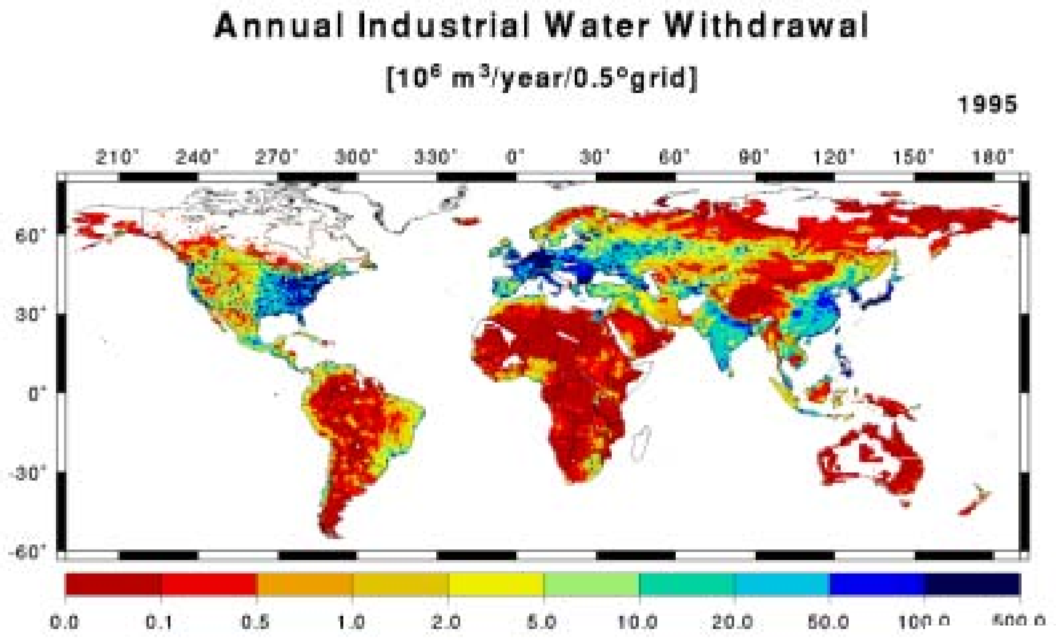
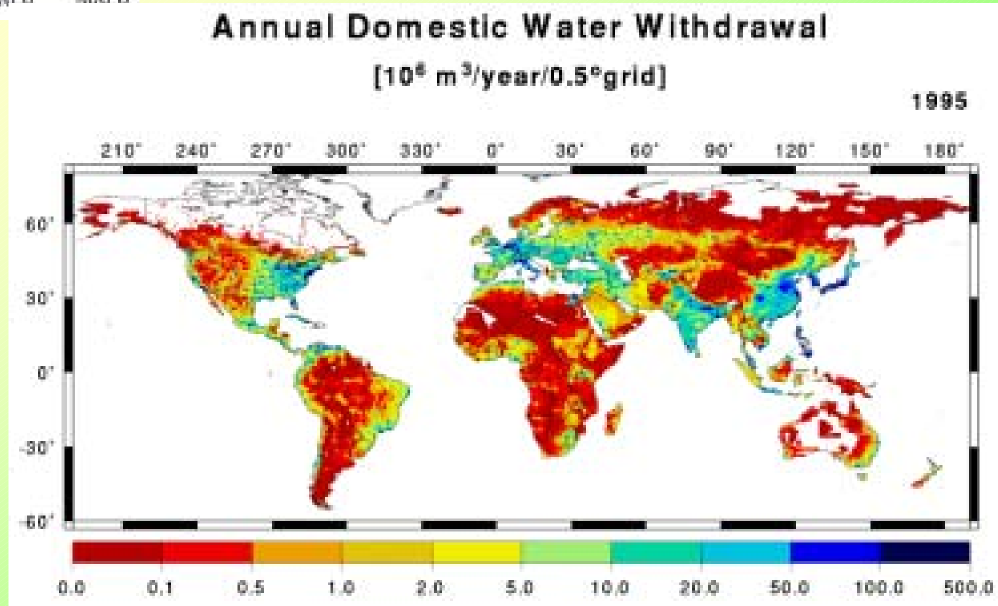


Industrial Water Use

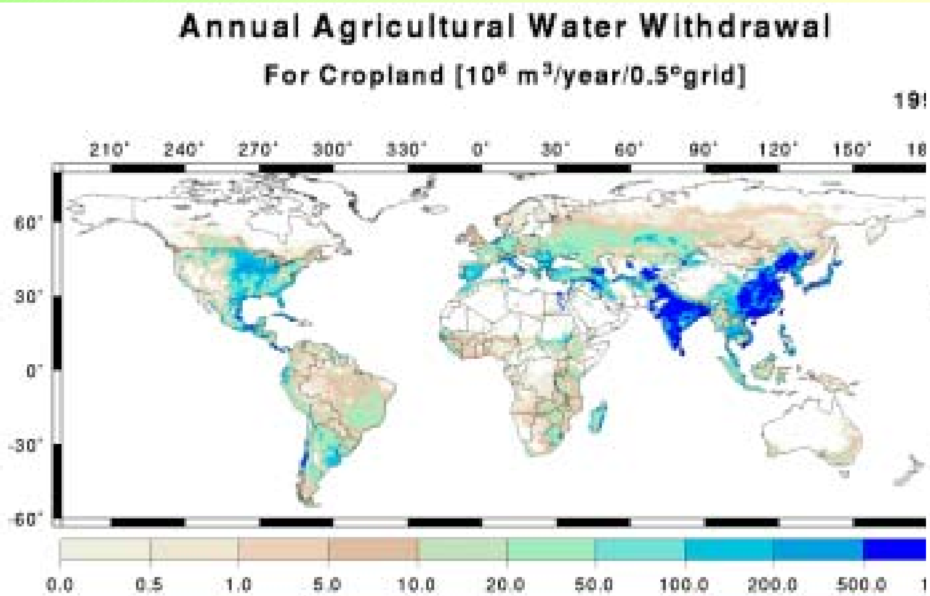
Domestic Water Use



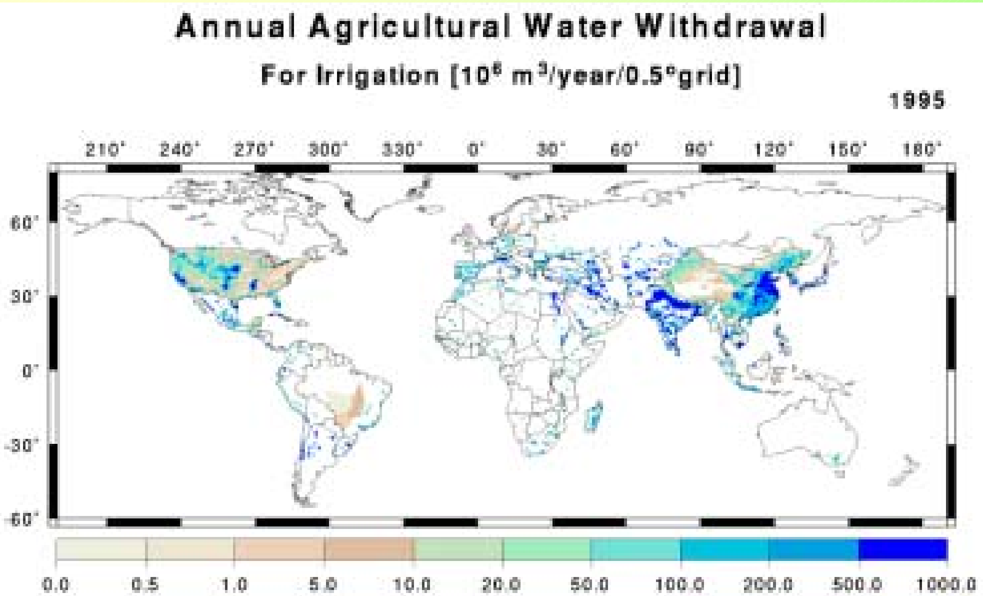
Previous Method[3]

◆Agricultural Water Use : Today's Topic

- Base: WRI country-based statistics
- How should we re-distribute this values?
  - Proportional to Grid Irrigation Area? (Kassel Univ.)
  - or to Grid Cropland Area? (WRI)



Prop. To Cropland Area



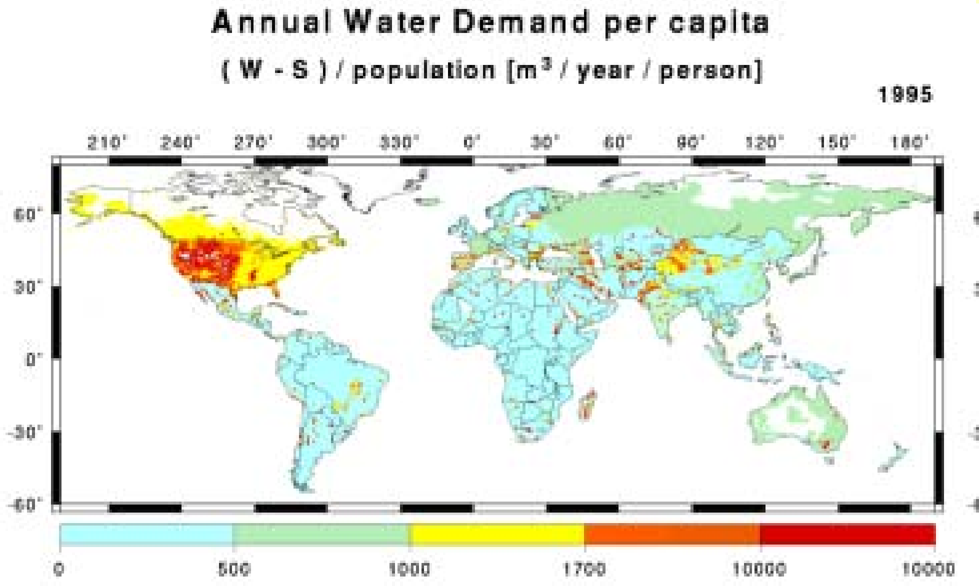
Prop. To Irrigation Area

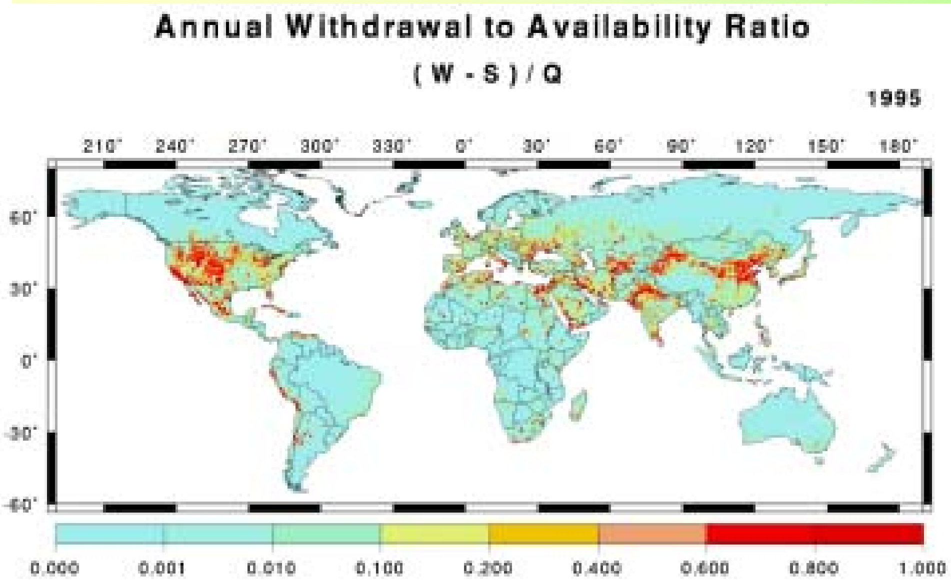
Previous Method [4]

- Estimation of Water Stress Distribution
- Symbols
  - R: Runoff from each cell
  - Q: River discharge
  - W: Total water demand(Indus.+Agri.+Domes.)
  - S: Freshwater production by desalinization
  - C: Population

(cont'd)

- Criteria
  - Water demand per capita: W/C
  - Withdrawal-to-Availability ratio: (W-S)/Q
    - >0.4 : severe water stress
    - <0.1 : safe





W/C

(W-S)/Q

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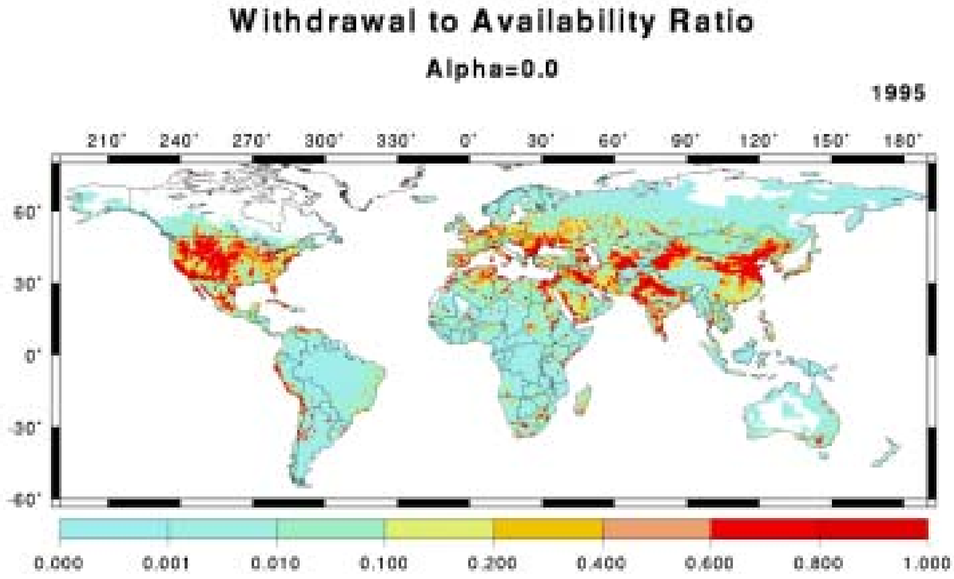
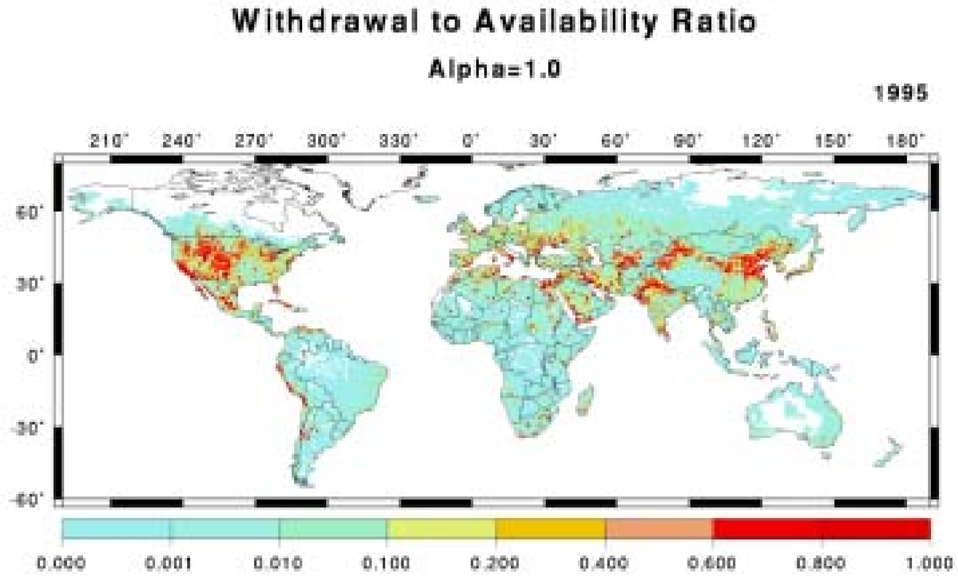
- What is 'available water'?
  - Not whole amount of Q can be used.
    - Used (and lost) or polluted in upstream region
  - Introduction of Alpha-index
    - Available water = R + $\alpha\ \Sigma D$
      - ΣD: Sum of river water from upstream cells



(W-S)/Q, alpha=0.0



alpha=1.0

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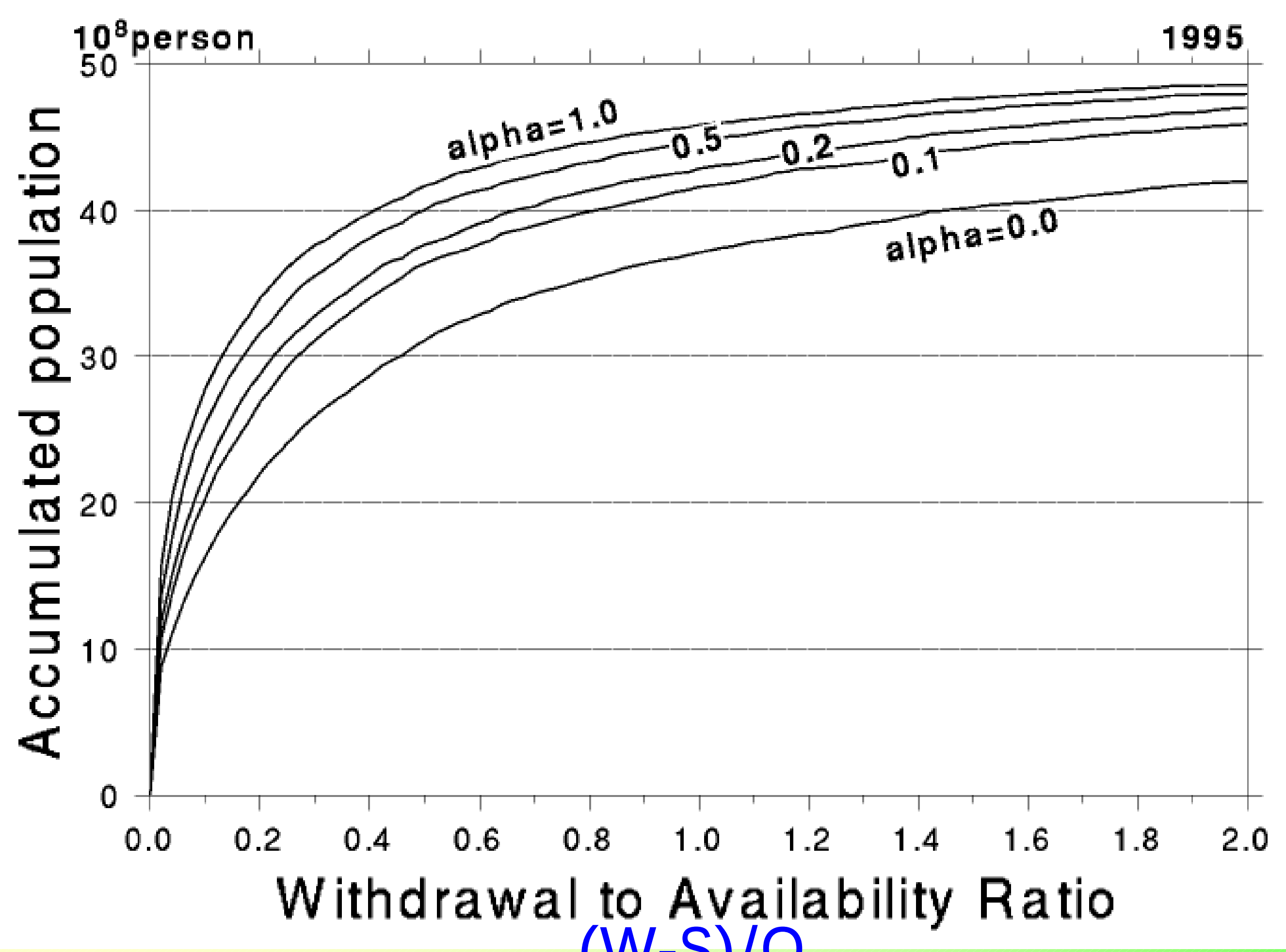
- Sensitivity of alpha-index to water stress estimation



(W-S)/Q

Change in population under water stress according to change in alpha

Model Strategy

- Current : 'nearly static' model
  - ---or merely 'calculation'
  - Severe problem in future projection
    - Scenario-dependent
    - What if no data and/or projection available?
    - Unrealistic assumption

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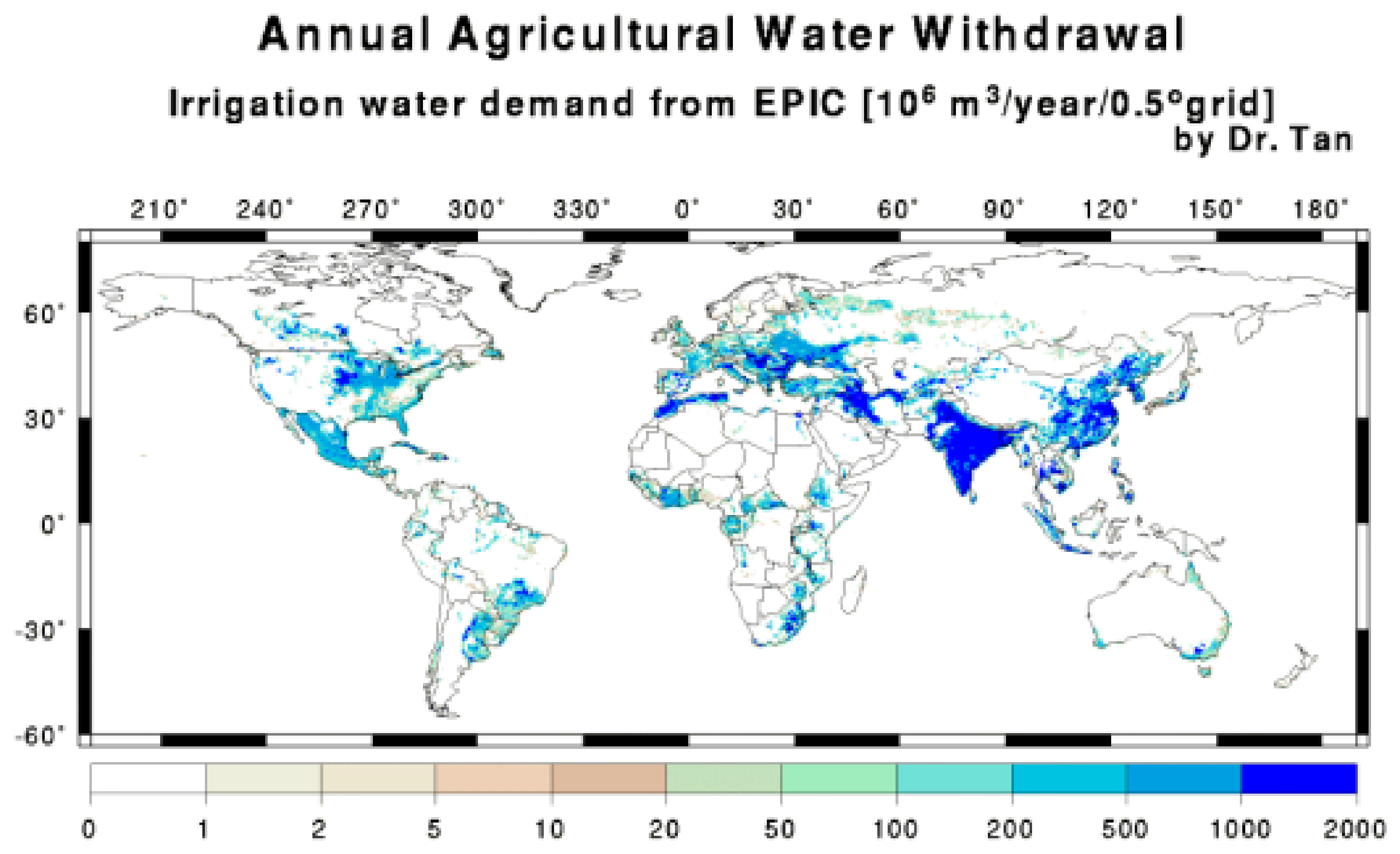
- To 'dynamic' model with as less external variables as possible
  - Sub-models
    - Climate change / River flow
    - Agriculture model
    - Industrial water use model
    - Urbanization model
    - Environmental water demand estimation
  - Linkage of all models
    - To be one of the goals of CREST project

Estimation by EPIC

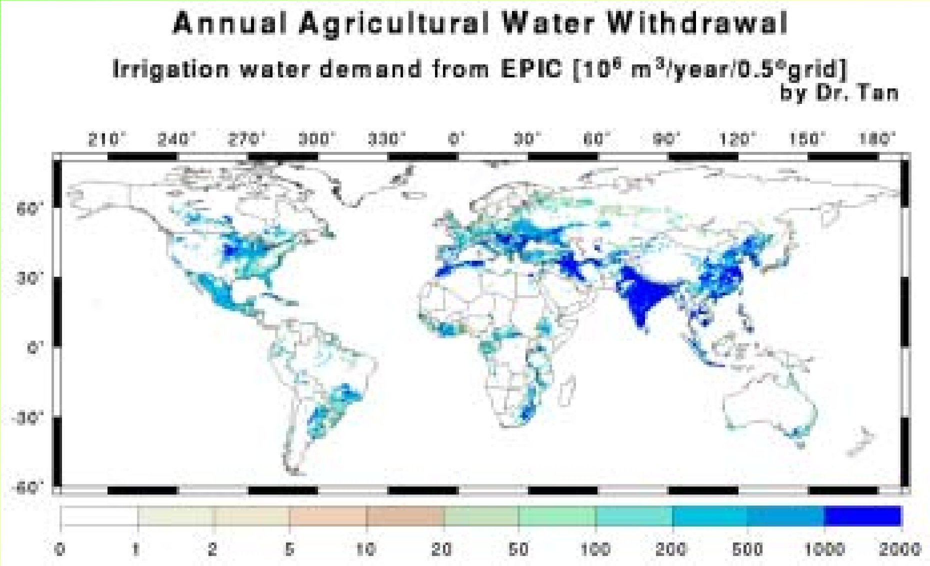
- Result：Monthly 0.1-degree grid estimation of maximum irrigation water demand

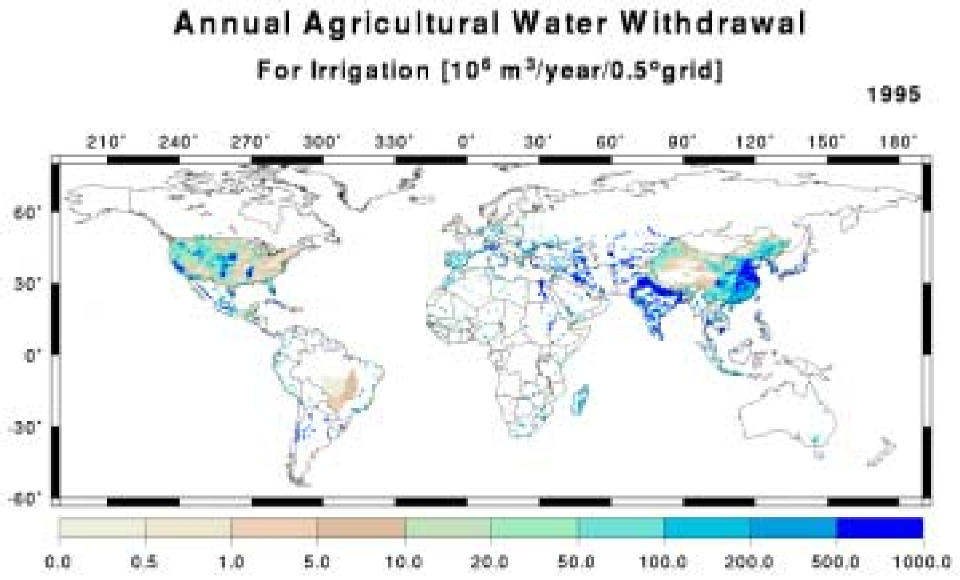


Annual Total

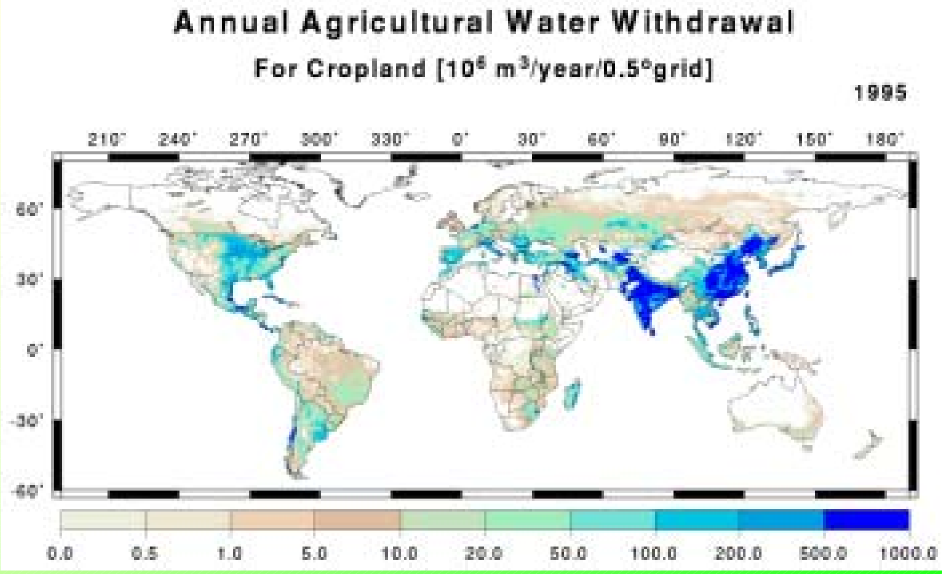
Estimation by EPIC

EPIC





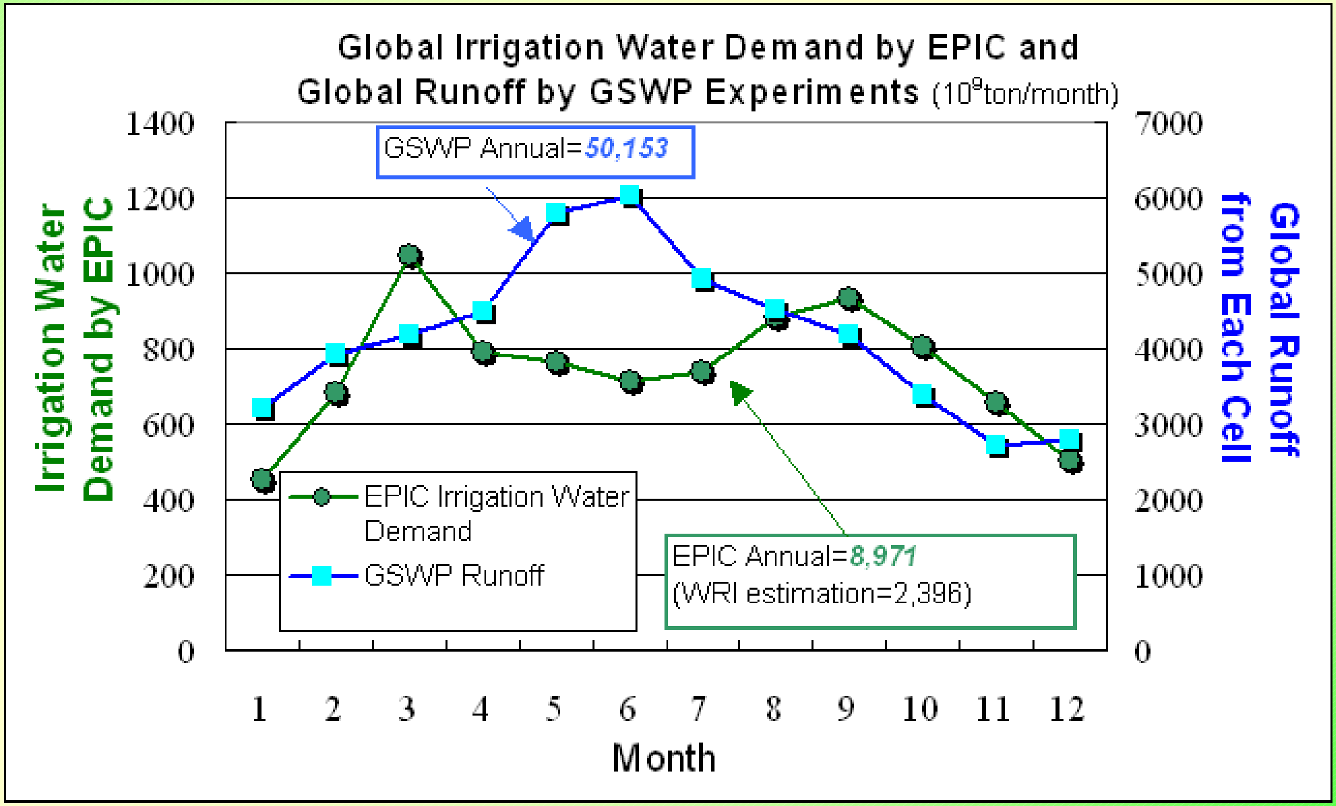
WRI (irrigation)



WRI (cropland)

Comparison

- Annual Total Agri. Water Demand
  - EPIC: 8,971*$10^9 m^3$
    - Two peaks in March and September
  - WRI+Kassel Irrigation:2,396 *$10^9 m^3$



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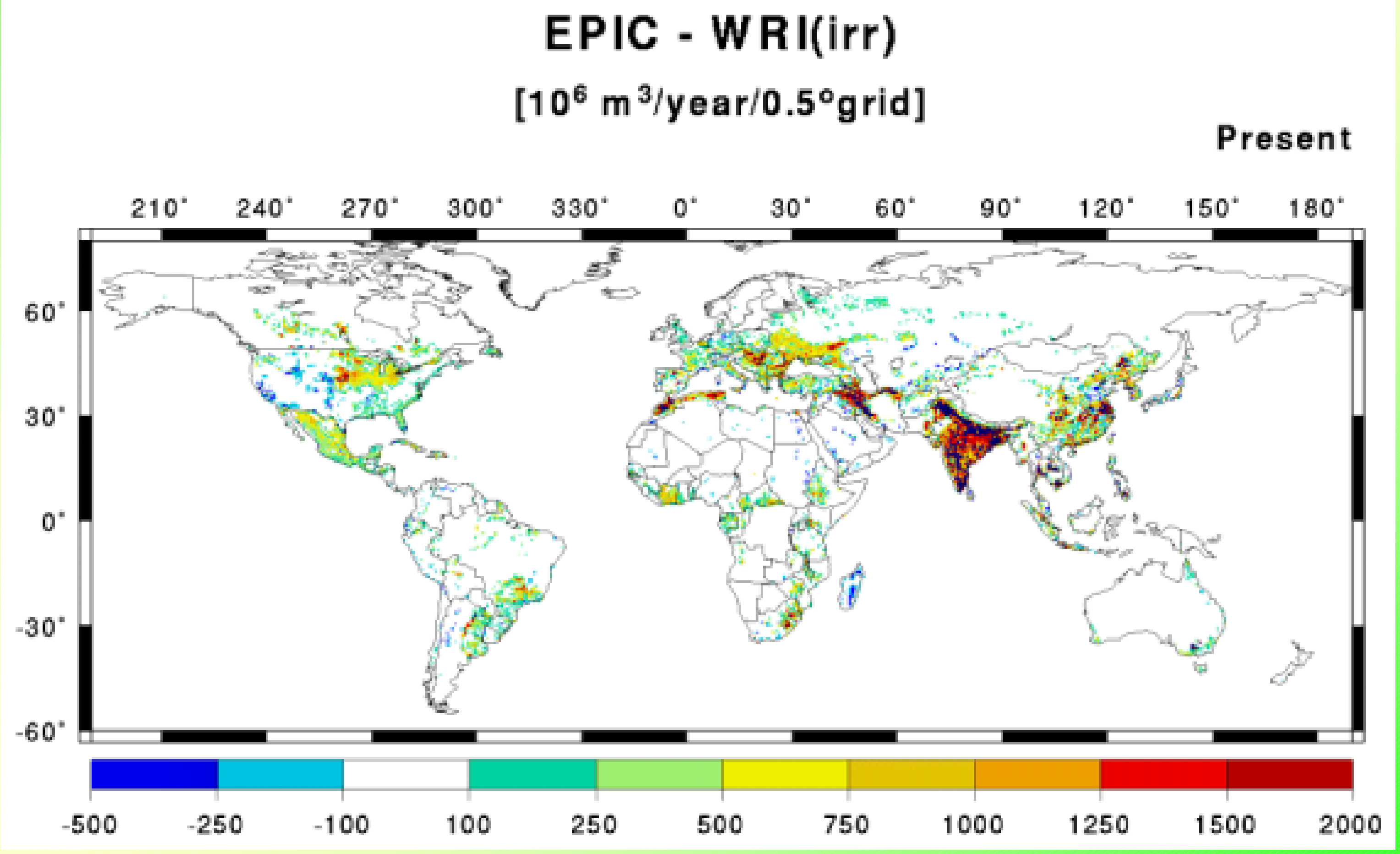
- EPIC result – WRI statistics
  - EPIC is larger : India
  - EPIC is smaller : USA



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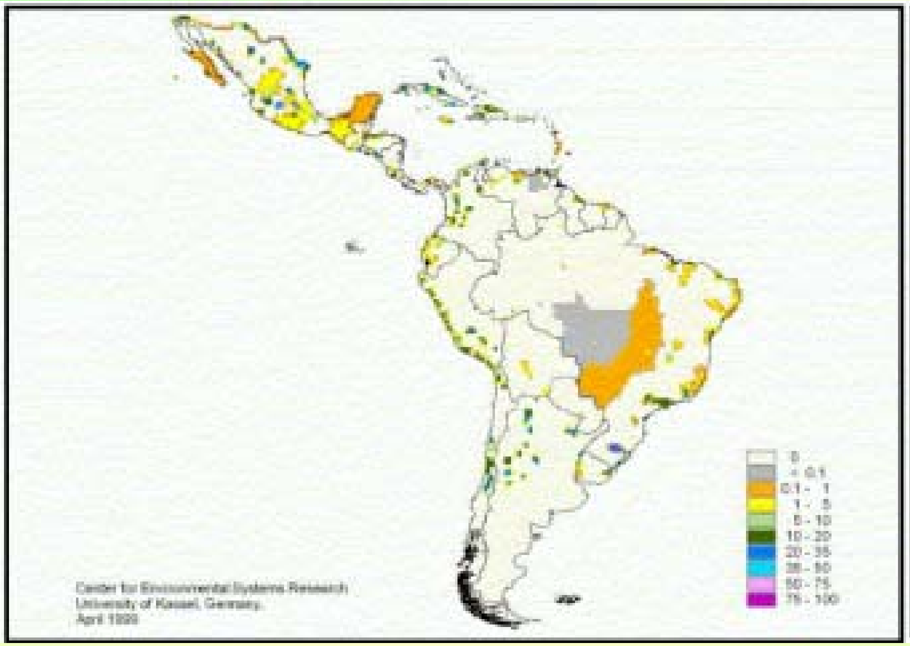
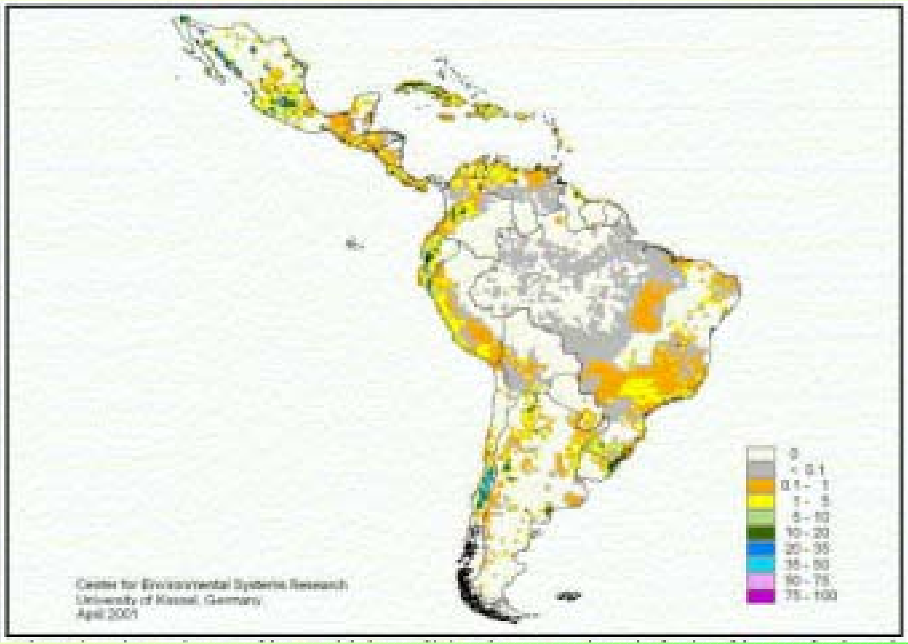
- New irrigation area dataset by Kassel Univ. is available





Old (currently used) New

Future Issues

- Use of common dataset to drive each submodels
  - Climate, soil type, vegetation, river network, crop type etc.
  - Needs: Common data archive and uniform (standard) data format
- Determination of interface of each model
- Definition of 'available water'