Seasonal Estimation of Water Deficit for Irrigation

and Introduction of CREST project

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- What is CREST?
- Research Background
- Results and Discussion

CREST

- **C**ore **R**esearch for **E**valuational **S**cience and **T**echnology
  - 「**戦略的~~基礎~~創造研究推進事業**」 in Japanese
  - A Big Research Program under **JST** (Japan Science and Technology Corporation, **科学技術振興事業団**)
  - Assembly of Major Research Topic Currently begin paid intensive attention

Research Fields(領域) in CREST

- ・たんぱく質の構造・機能と発現メカニズム
- ・免疫難病・感染症等の先進医療技術
- ・情報社会を支える新しい高性能情報処理技術
- ・水の循環系モデリングと利用システム
- ・物理的手法を用いたナノデバイス等の創製
- ・化学・生物系の新材料等の創製
- ・生命活動のプログラム
- ・生体防御のメカニズム
- ・量子効果等の物理現象
- ・単一分子・原子レベルの反応制御
- ・極限環境状態における現象
- ・高度メディア社会の生活情報技術
- ・電子・光子等の機能制御
- ・分子複合系の構築と機能
- ・ゲノムの構造と機能
- ・脳を知る（脳の機能）
- ・脳を守る
- ・脳を創る
- ・環境低負荷型の社会システム
- ・地球変動のメカニズム
- ・内分泌かく乱物質
- ・資源循環・エネルギーミニマム型システム技術
- ・生物の発生・分化・再生
- ・植物の機能と制御

・Many programs in bio-tech, nano-tech, IT and environmental science…

Among them

“水の循環系モデリングと利用システム”

“Comprehensive IT System for understanding Real Global Water Cycle”

・Manager：Prof. Musiake

・Contains some projects

Projects under Prof. Musiake's Program(領域)

- 人間活動を考慮した世界水循環・水資源モデル
- 階層的モデリングによる広域水循環予測
- 黄河流域の水利用・管理の高持続性化
- 北東アジア植生変遷域の水循環と生物・大気圏の相互作用の解明
- 社会変動と水循環の相互作用評価モデルの構築
- 湿潤・乾燥大気境界層が降水システムに与える影響の解明と降水予測精度の向上

・Six project on atom. science, water resource, ecology, social science on water use…

Among them

“人間活動を考慮した世界水循環・水資源モデル”

“Global Water Resource Modeling with Reference to Human activities”

・Leader：Prof. Oki

・Researchers from various field

・Many PDFs, including myself

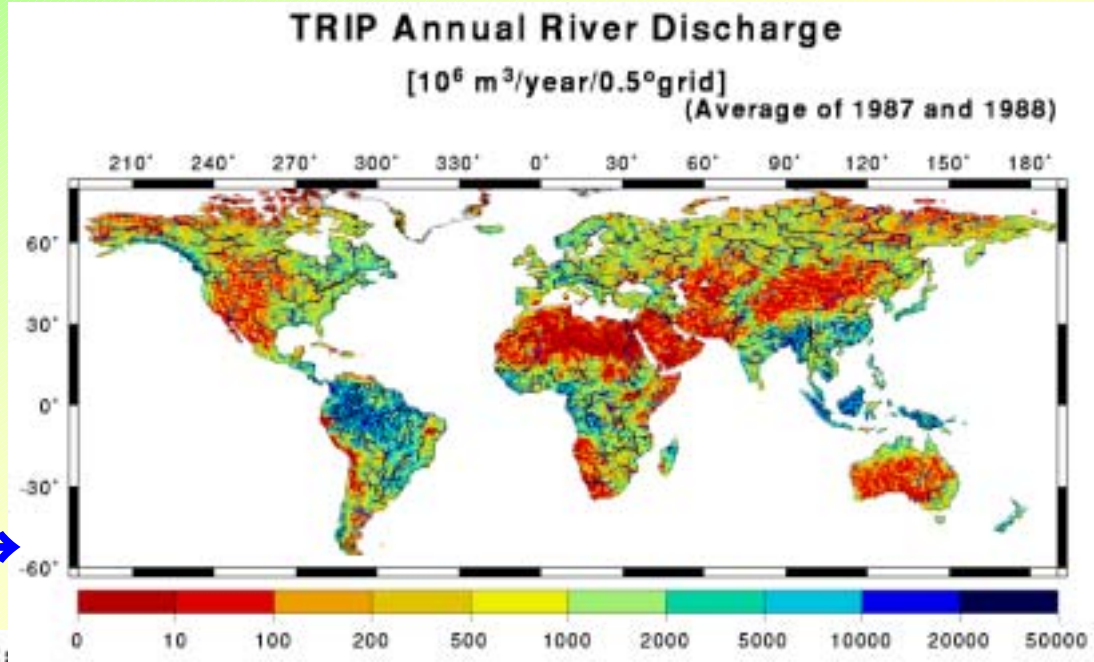
Current Global Water Resource Assessment

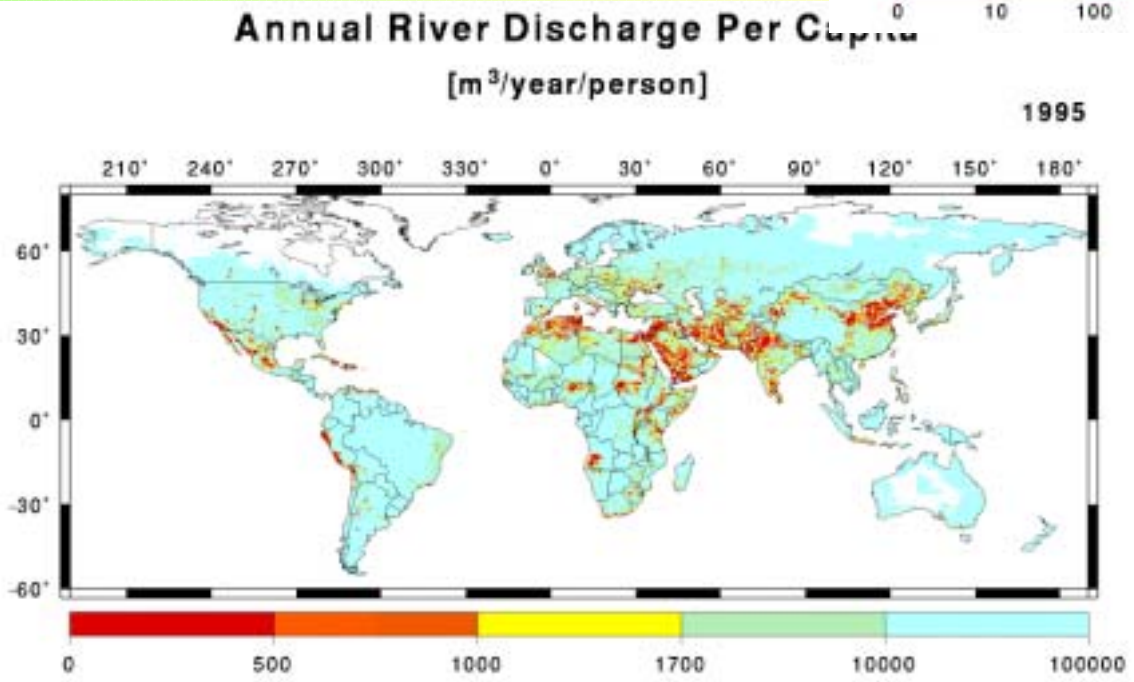
- Done by 0.5deg x 0.5deg grid , Annual Value
- Water Supply: our original method
  - Climate Data + Hydrological Simulation
  - "natural" river flow
- Water Demand: two ways
  - Simple Method (conventional , “ver.1”)
    - National Statistics + Population Grid +Agriculture Grid Data
  - Process-based Modeling (recent job by Dr.Tan, “ver.2a”)
    - Using EPIC for agriculture water use
- Both estimations are done independently
  - As the first step

Water Supply

- How much water can be potentially used?

River Discharge Blue=wet→



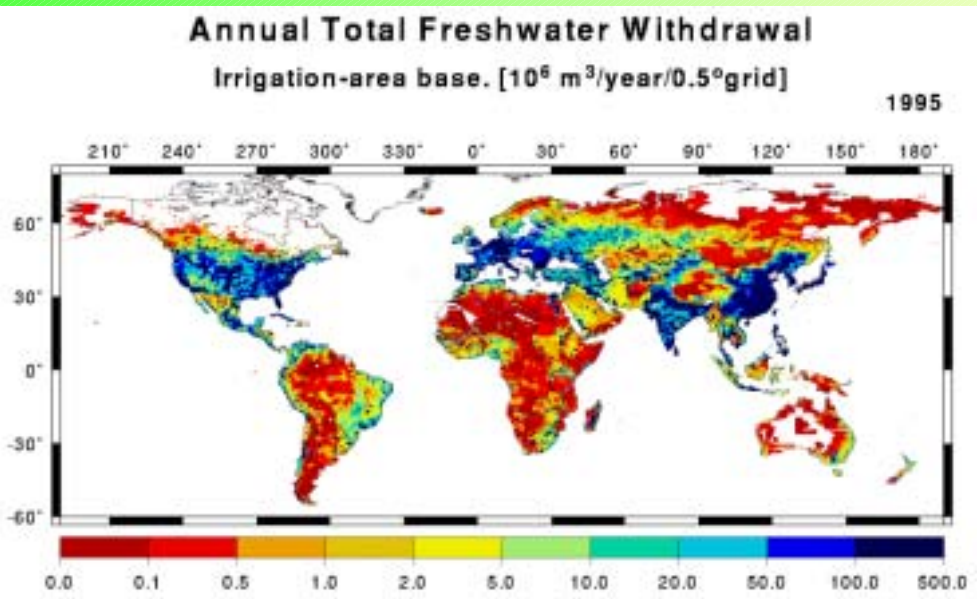


←River Disc. per capita

Red=poor in water

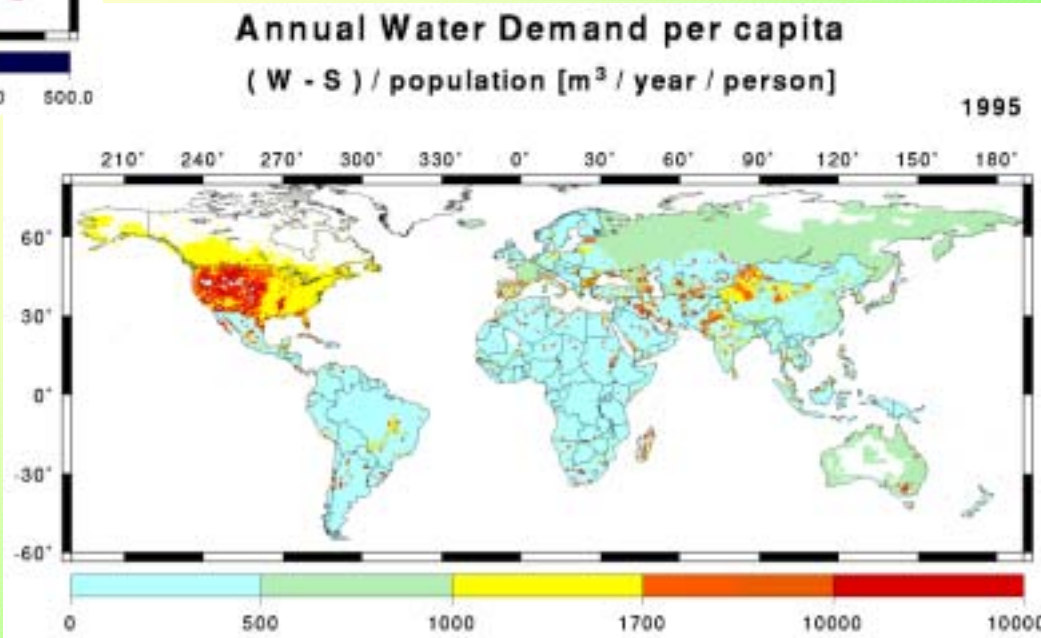
Water Demand – ver.1

- How much water is necessary for human society?



←Total Demand

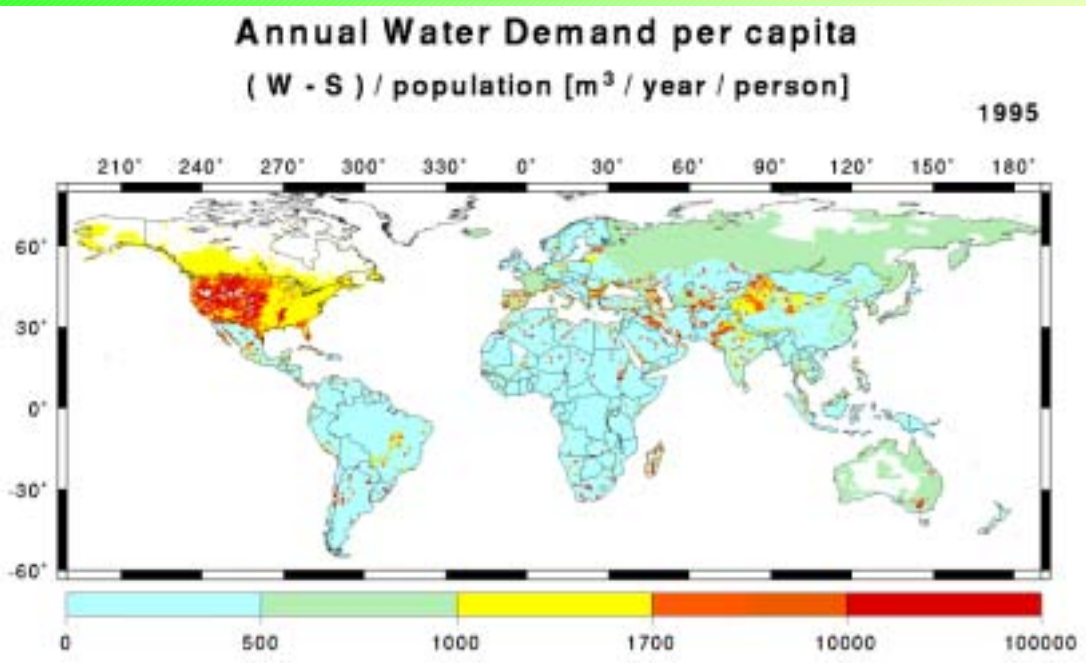
Blue=much water needed



Water Demand per capita→

Red=much water needed

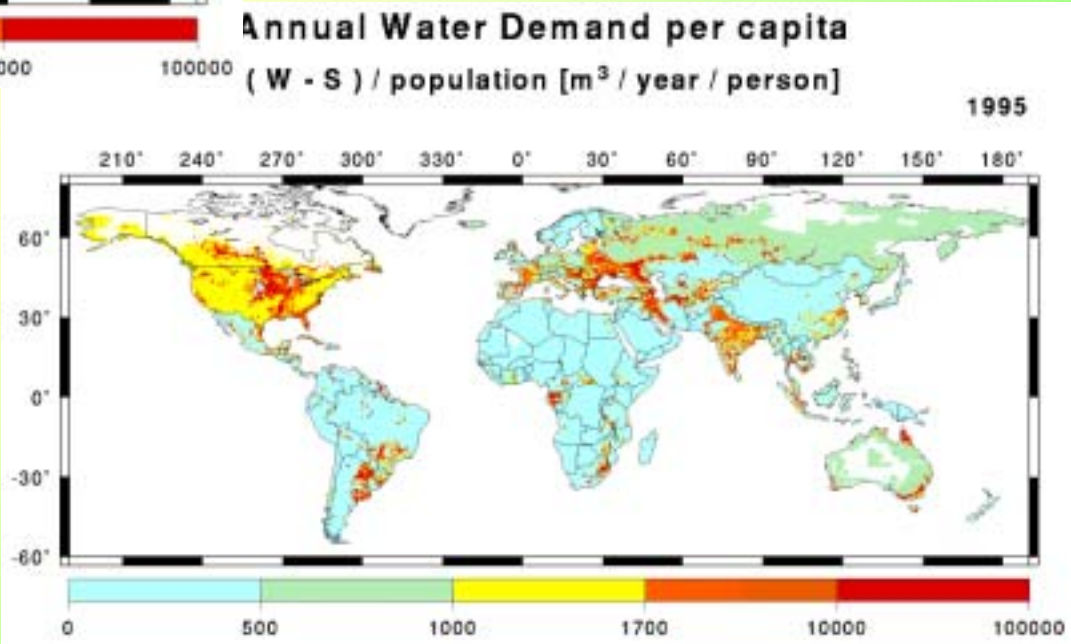
Water Demand in two ways



Demand per capita

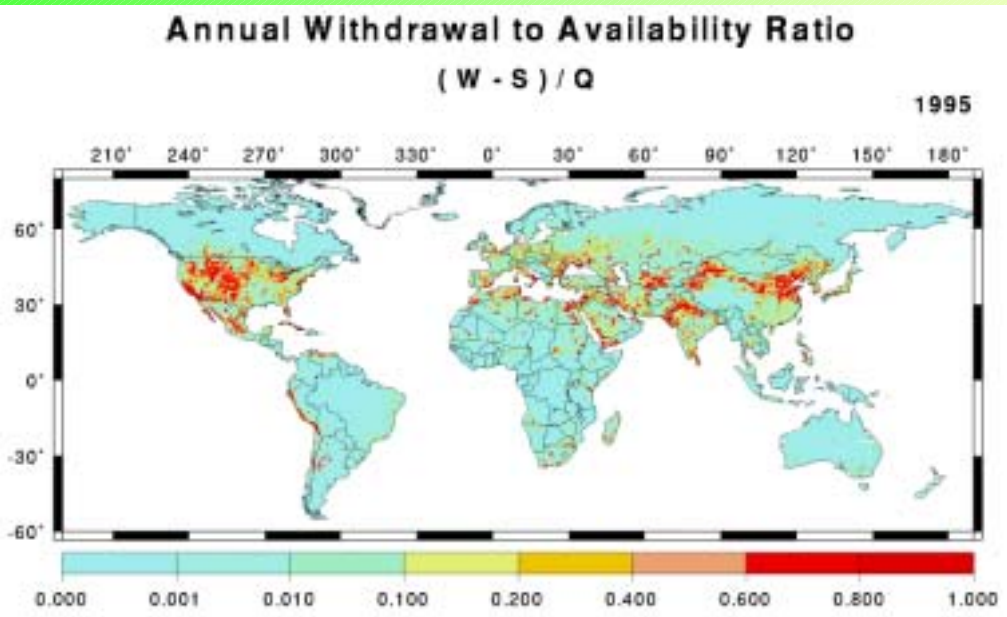
←Simple method (ver.1)

Process-based agriculture model, EPIC→ (ver.2a)



Water Stress

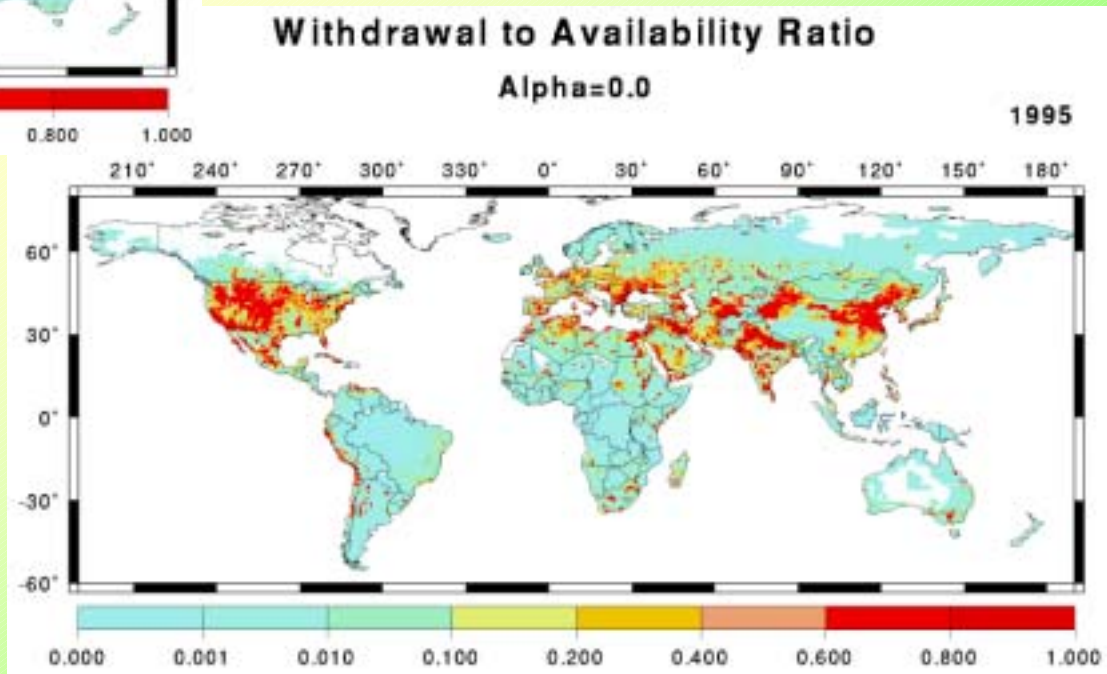
- Necessary water / Available water (base: ver. 1 demand)



Red = more risky

←Scenario 1

All river water can be used



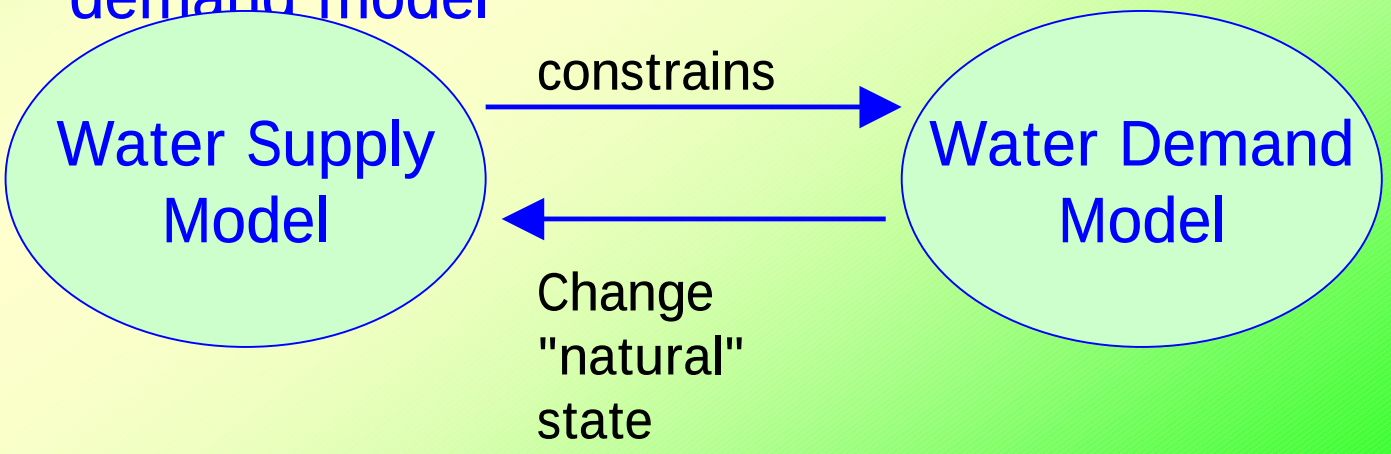
Scenario 2→

No water from upstream can be used

Unexamined issues

- For future
  - Higher temporal resolution
    - Data limitation : discussion based on annual value have been common
    - What-if estimated by monthly?
  - Process-based modeling of demand
    - Partly done for agriculture
  - Interactive modeling between supply model and demand model

Today's Topic



Evolution of modeling

~Oct. 2001

(already in paper)

Water Supply Estimate

(independent)

Water Demand Estimate

Current

Water Supply Model

constrains →

Water Demand Model

Future

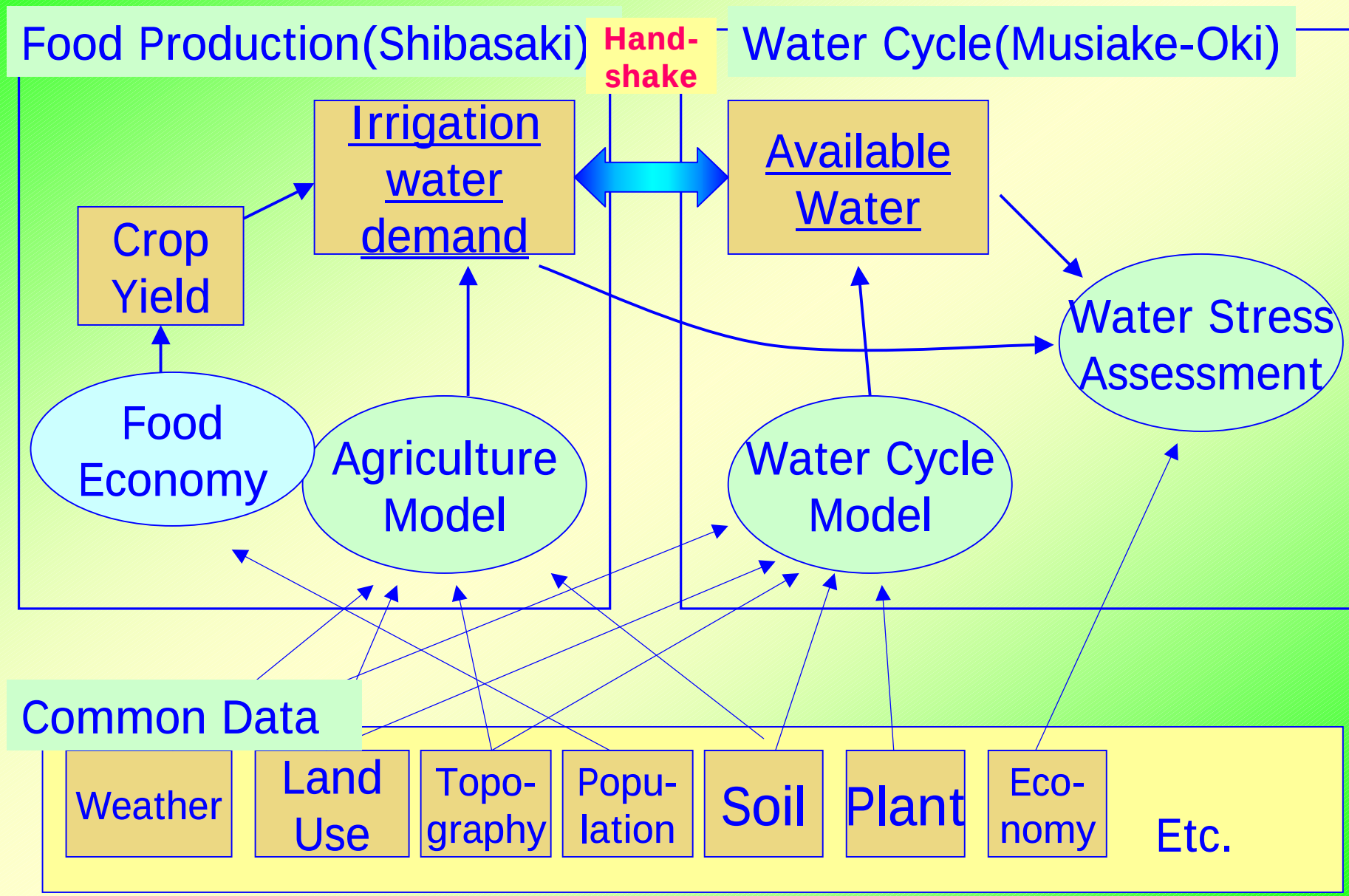
Water Supply Model

constrains →

← Change "natural" state

Water Demand Model

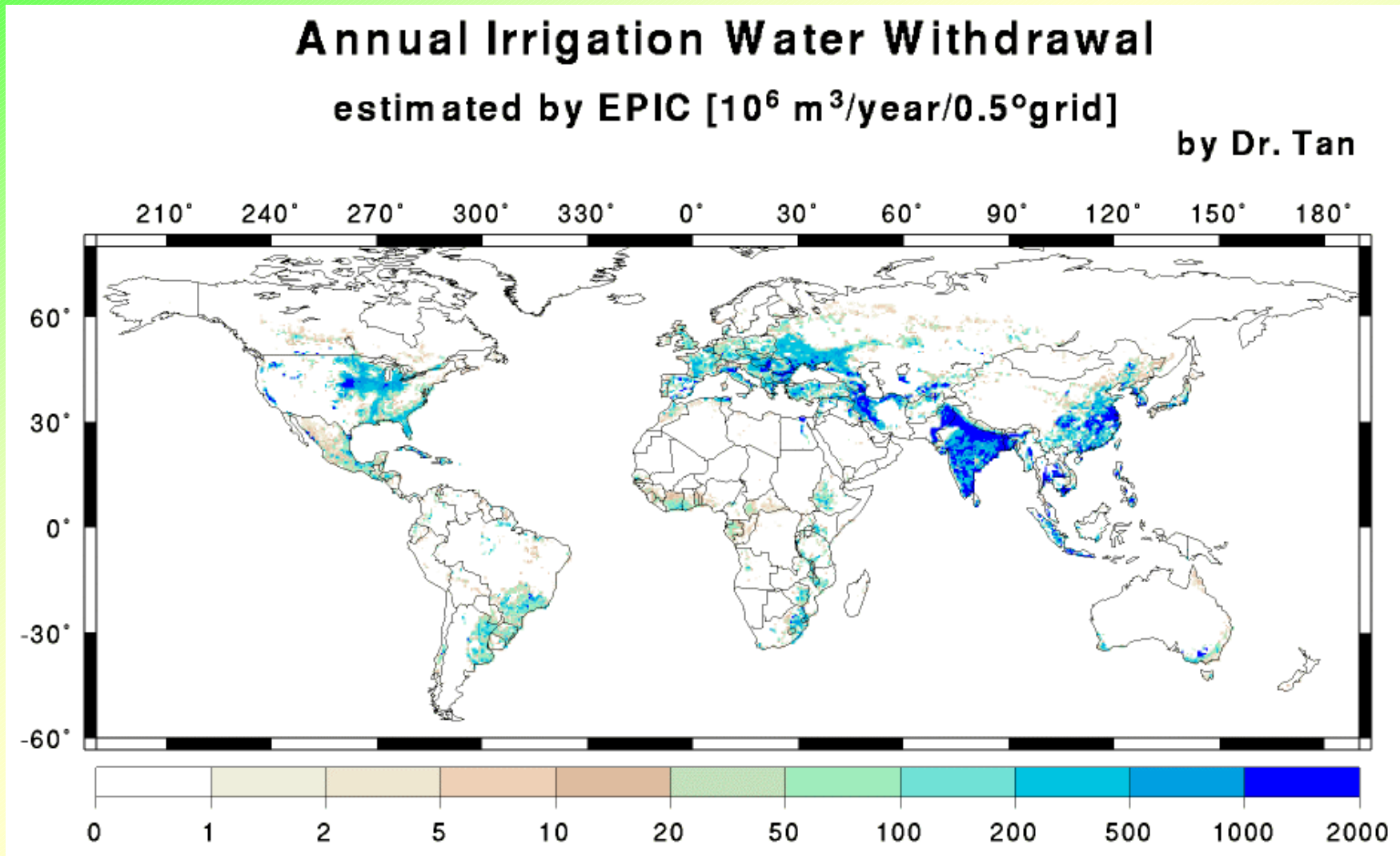
Model connection : schematic chart



Water Stress Assessment in monthly temporal scale

- Why monthly?
  - Water should exists at the right time
    - Annual value assessment :
      may fail to detect
      seasonal water deficit

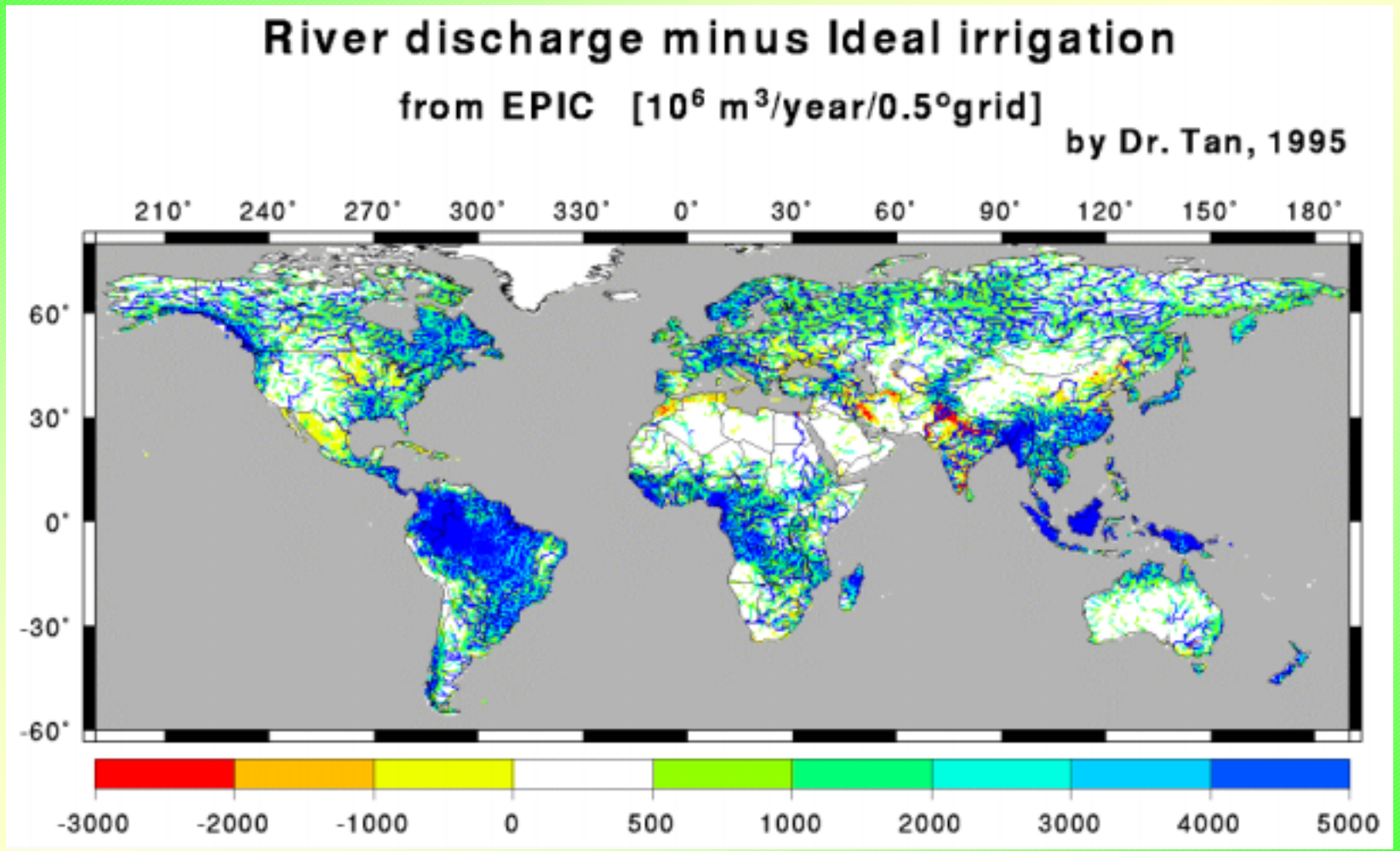
Irrigation water demand by Model(EPIC)



Estimated Annual Total Irrigation Demand

Irrigation water deficit

RiverDischarge – Irrigation : Red = water deficit

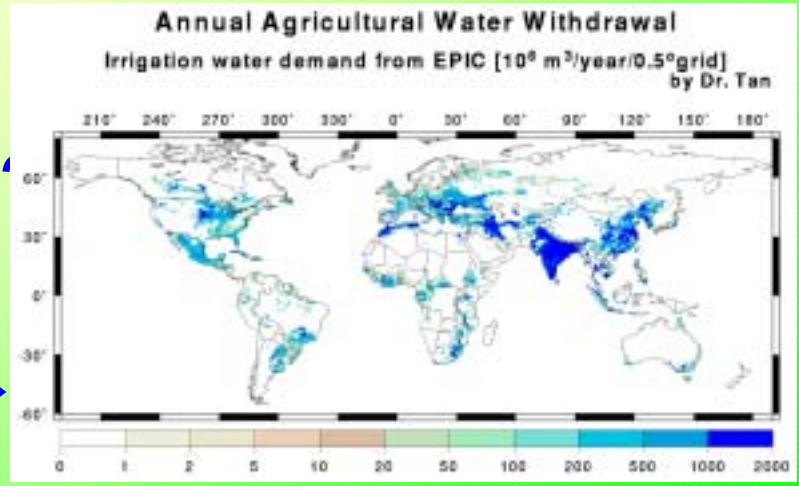


Irrigation demand by EPIC

- There are two estimates
  - "**Maximum**" irrigation use
    - Potential irrigation use without water resource constrains
  - "**Real**" irrigation use
    - Constrained by available water amount

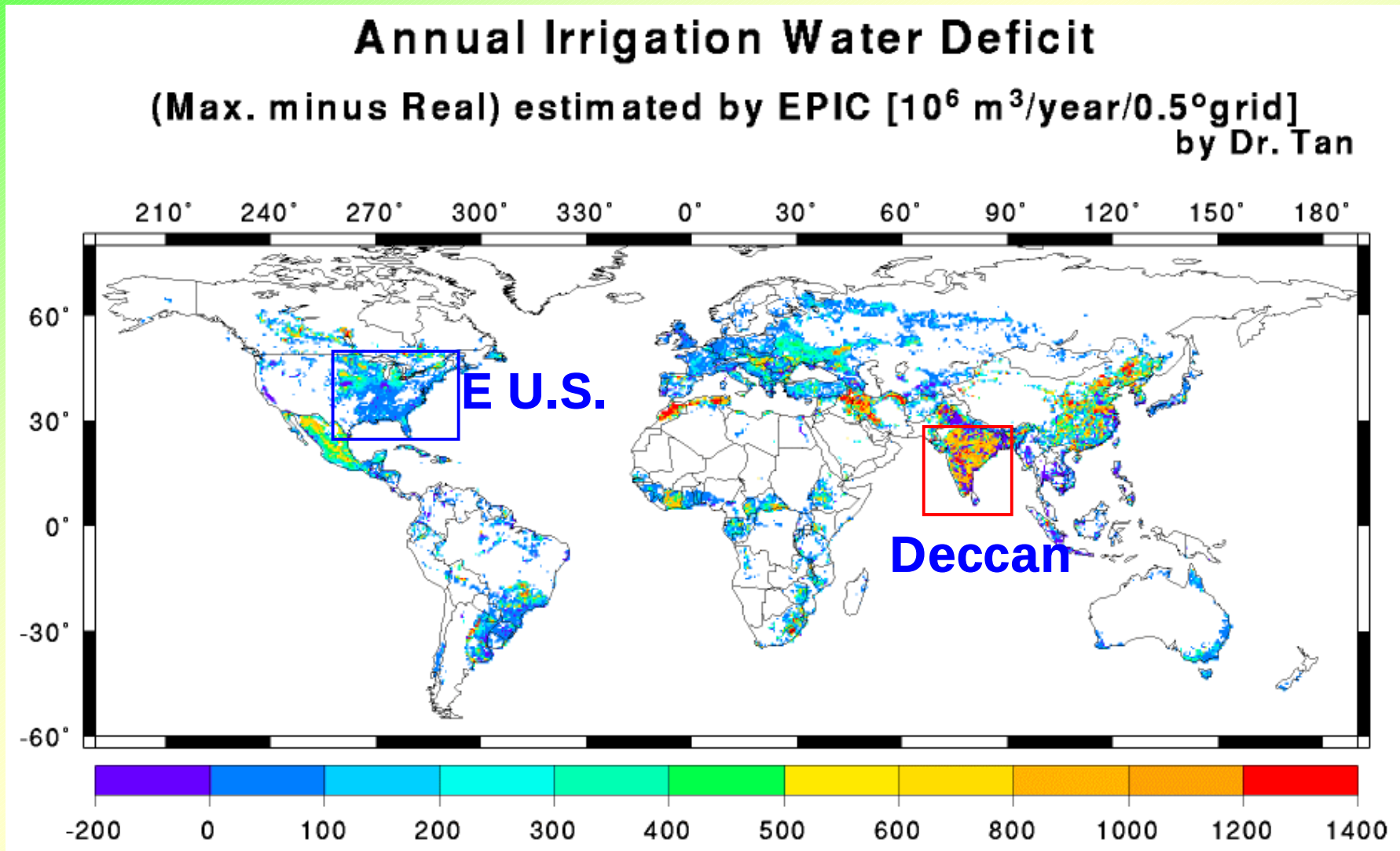
- How they are different?
- Constraints:When, where?

Maximum irrigation demand→



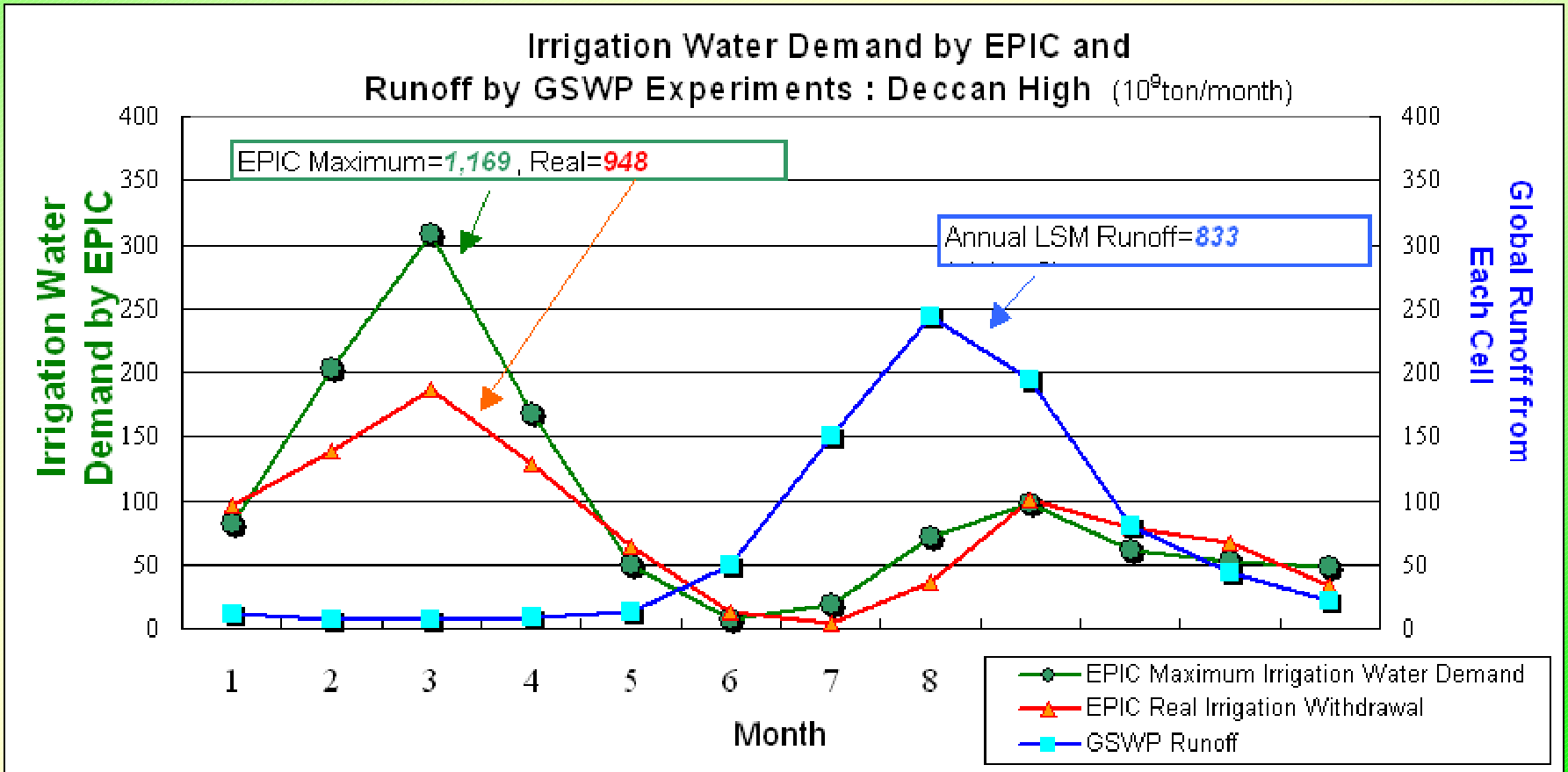
Irrigation demand by EPIC (2)

"Maximum" minus "Real" : Red=water deficits in some season



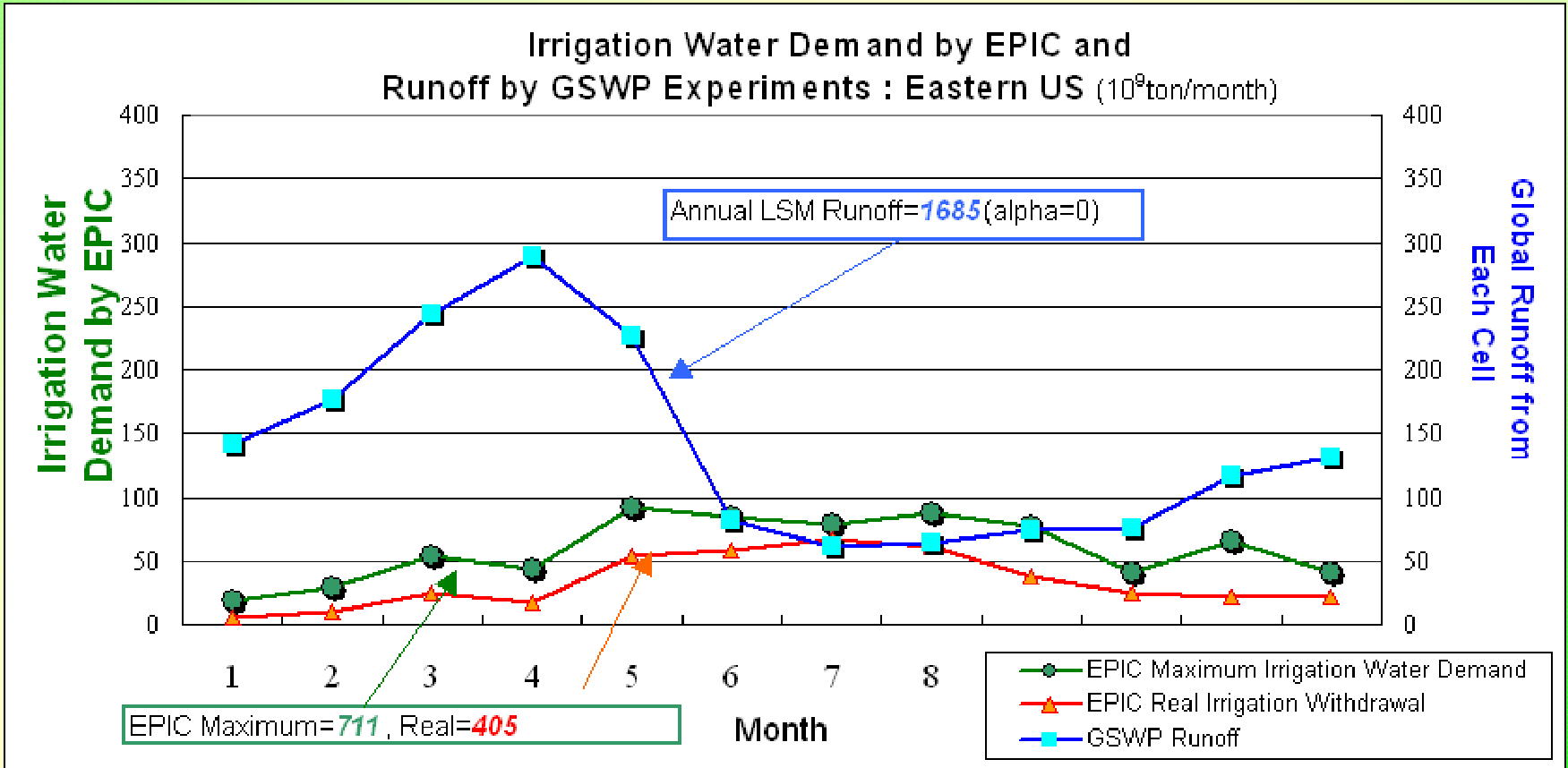
Deccan High

- Spring Water Use is strictly limited
- Irrigation > in-situ Available water
  - Contribution of river flow?
  - Modeling Error? Future Issue!



Eastern US

- Constant limitation
- But summer water shortage may damage agriculture (soybean and wheat) there
  - →Also effects Japanese economy!



Concluding Remarks

- Process Model allows us to investigate high temporal resolution feature of water resource
- Like spatial high-resolution analysis done in last year, temporal high-resolution assessment may give us a new point of view on global water resource
- However, interactive modeling is necessary especially for Asia
- All datasets and results have been already published : http://hydro.iis.u-tokyo.ac.jp/GW/