

# Relationship between Land-use, climate and the hydrologic cycle in Central Asia

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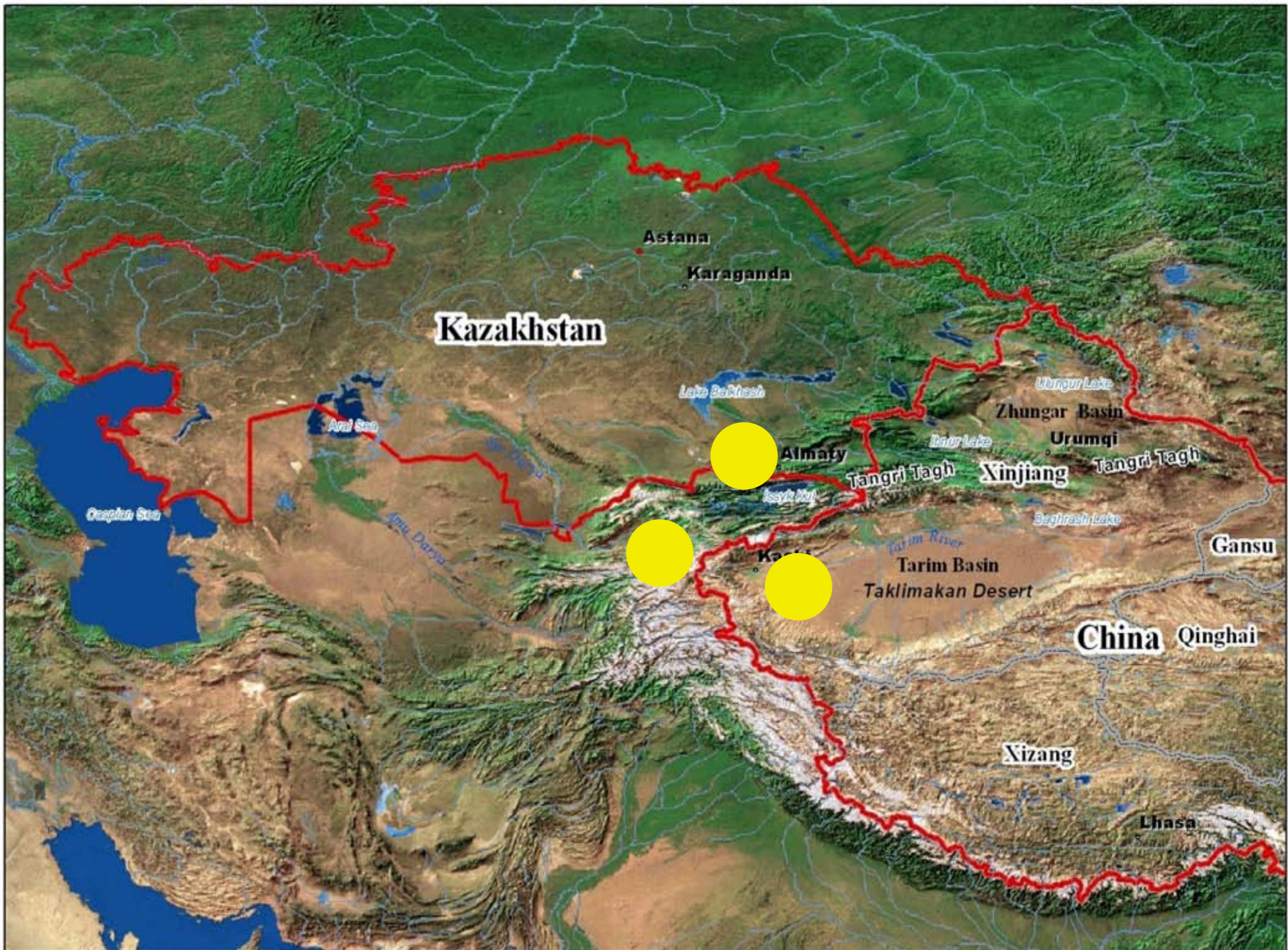
# Why Central Asia?

- Water is a vital natural resource in the region
- Mismatch between the sources and users
- Large institutional changes that affect the use of resources
- Changing land-use practices (that are unsustainable)
- Ecological systems sensitive to change
- Climate change wildcard



# A new project

- Joint between UWisc and CAS (Xinjiang Institute of Ecology and Geography)
- Focussed on 3 intensive study sites (Xinjiang, SE Kazakhstan, E Uzbekistan)
- Investigate the relationship between land-use, climate, and hydrologic cycle
- Remote sensing, hydrologic modeling, ecosystem modeling
- Apply lessons learned to a larger region



**Kazakhstan**

Astana

Karaganda

Lake Balkhash

Almaty

Ungur Lake

Zhungan Basin

Urumqi

Xinjiang

Tangri Tagh

Caspian Sea

Amal Sea

Inor Lake

Tangri Tagh

Issyk-Kul

Balkhash Lake

Gansu

Karai

Tarim Basin

Taklimakan Desert

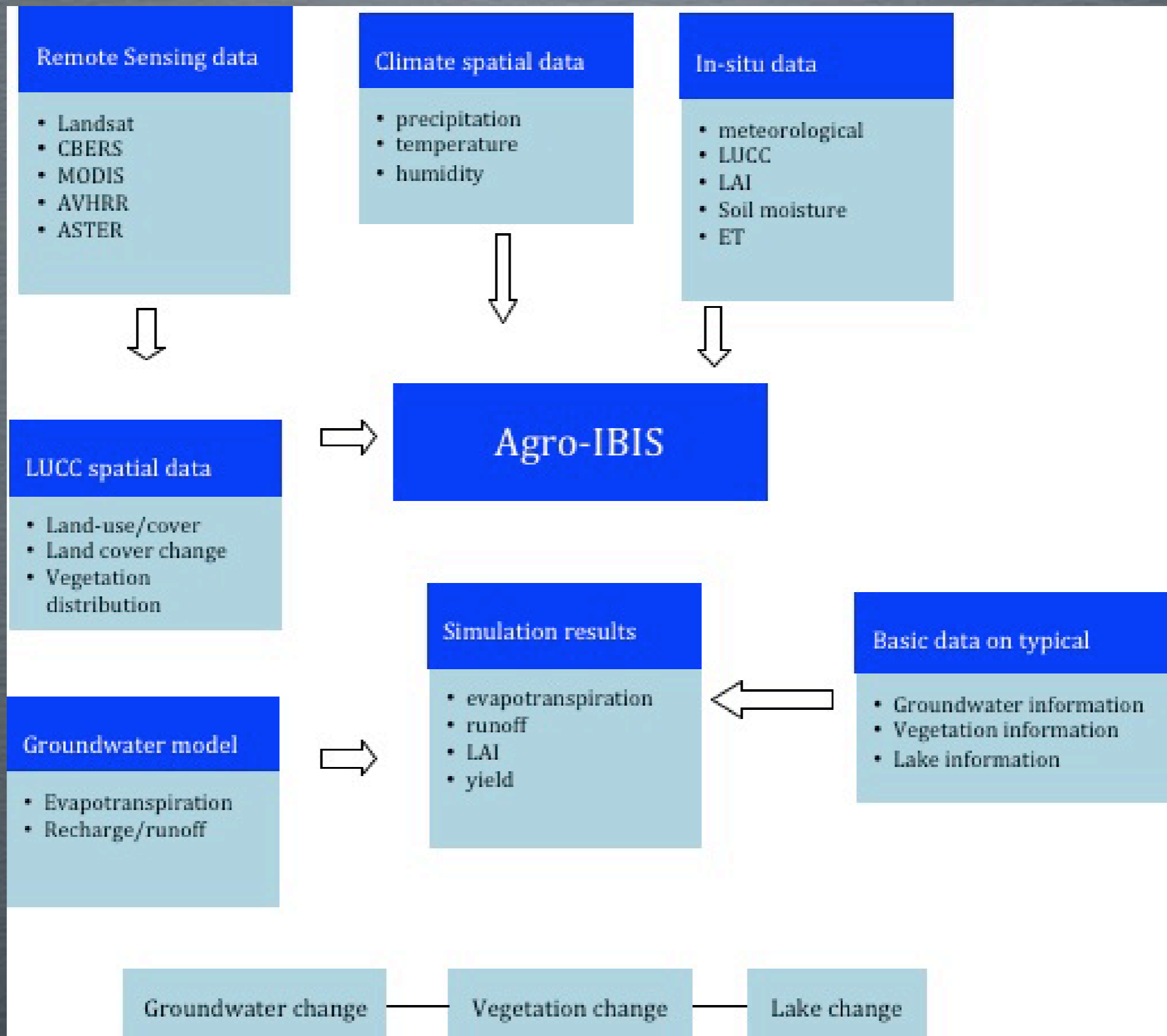
**China**

Qinghai

Xizang

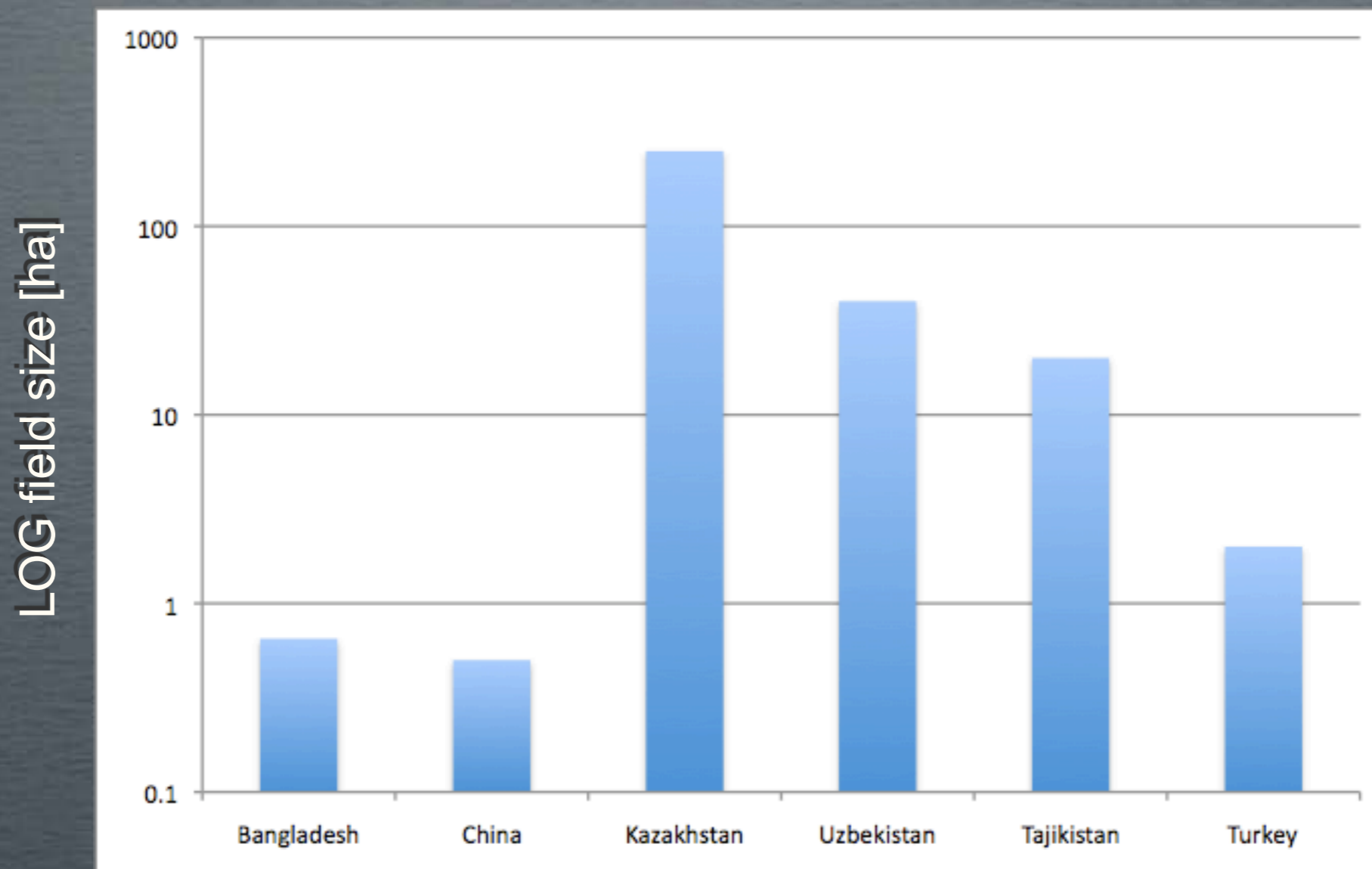
Lhasa

# Conceptual framework

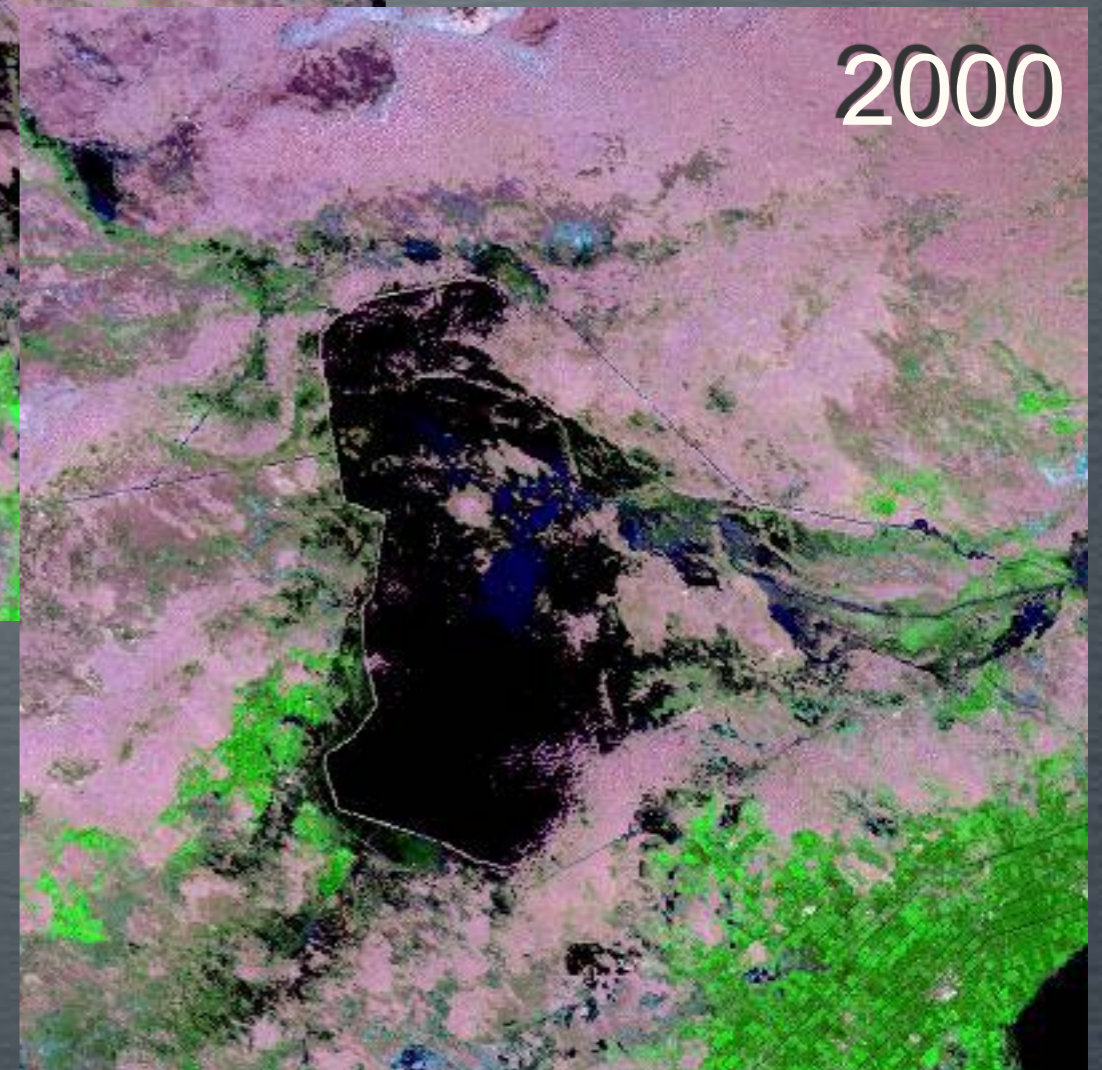
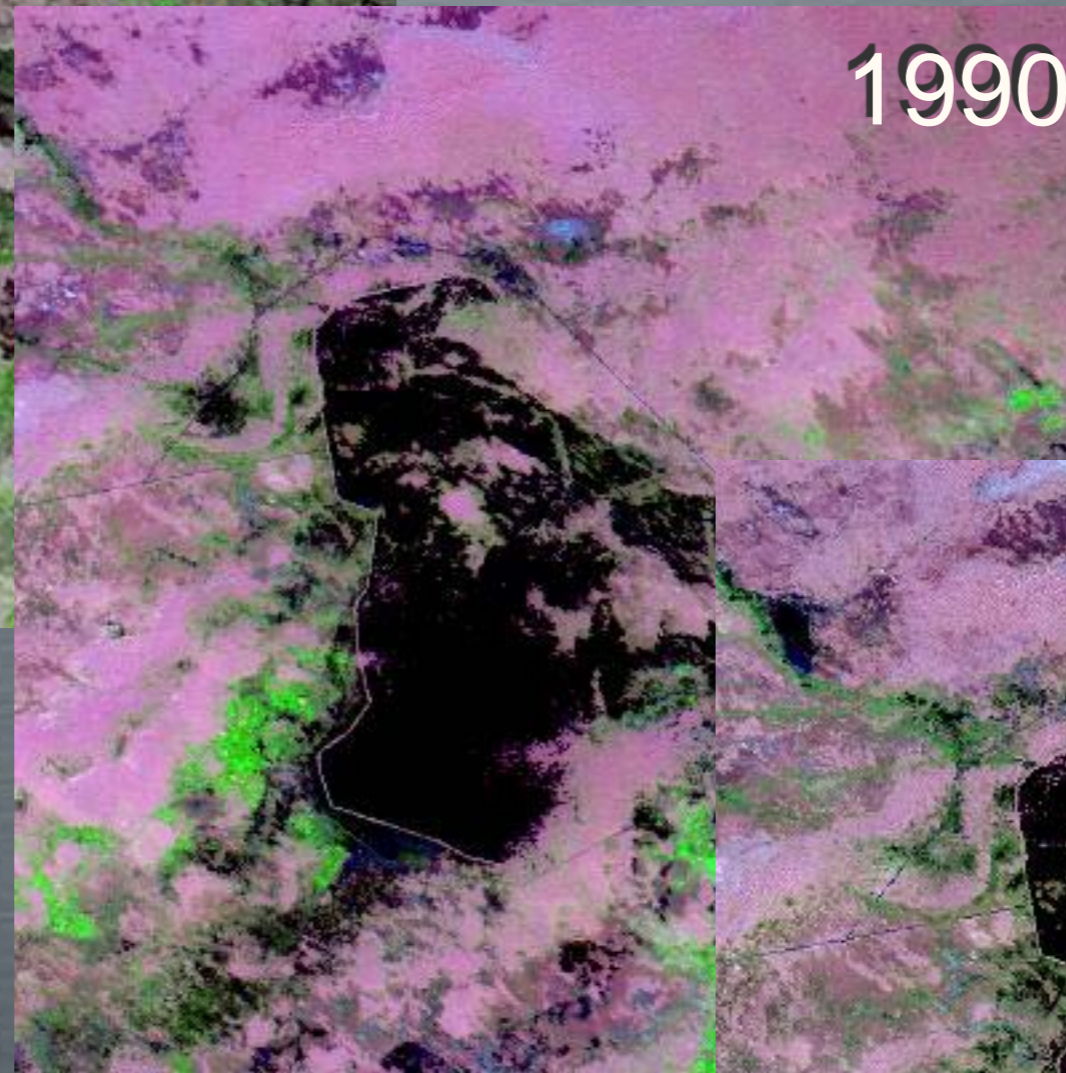
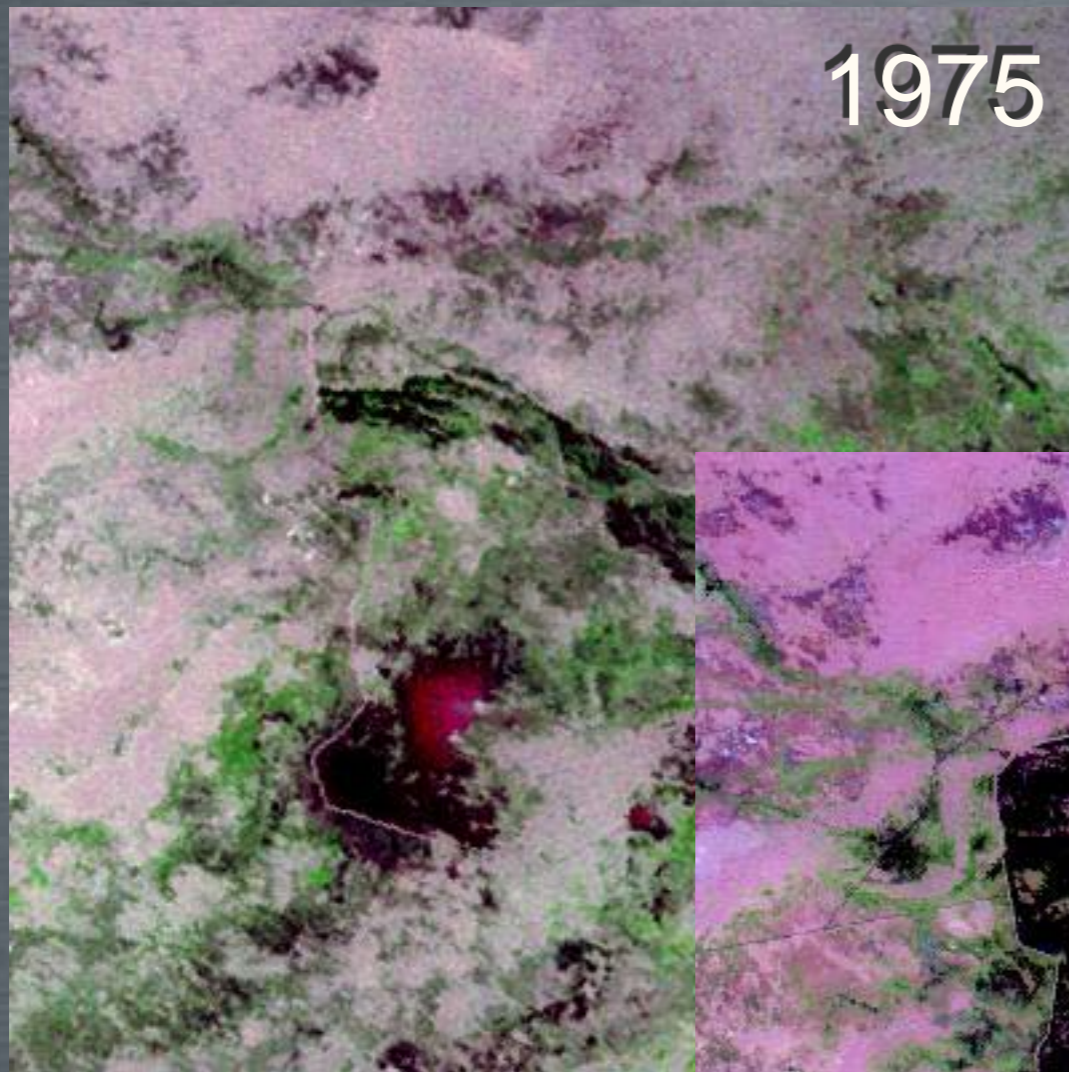


# Field sizes

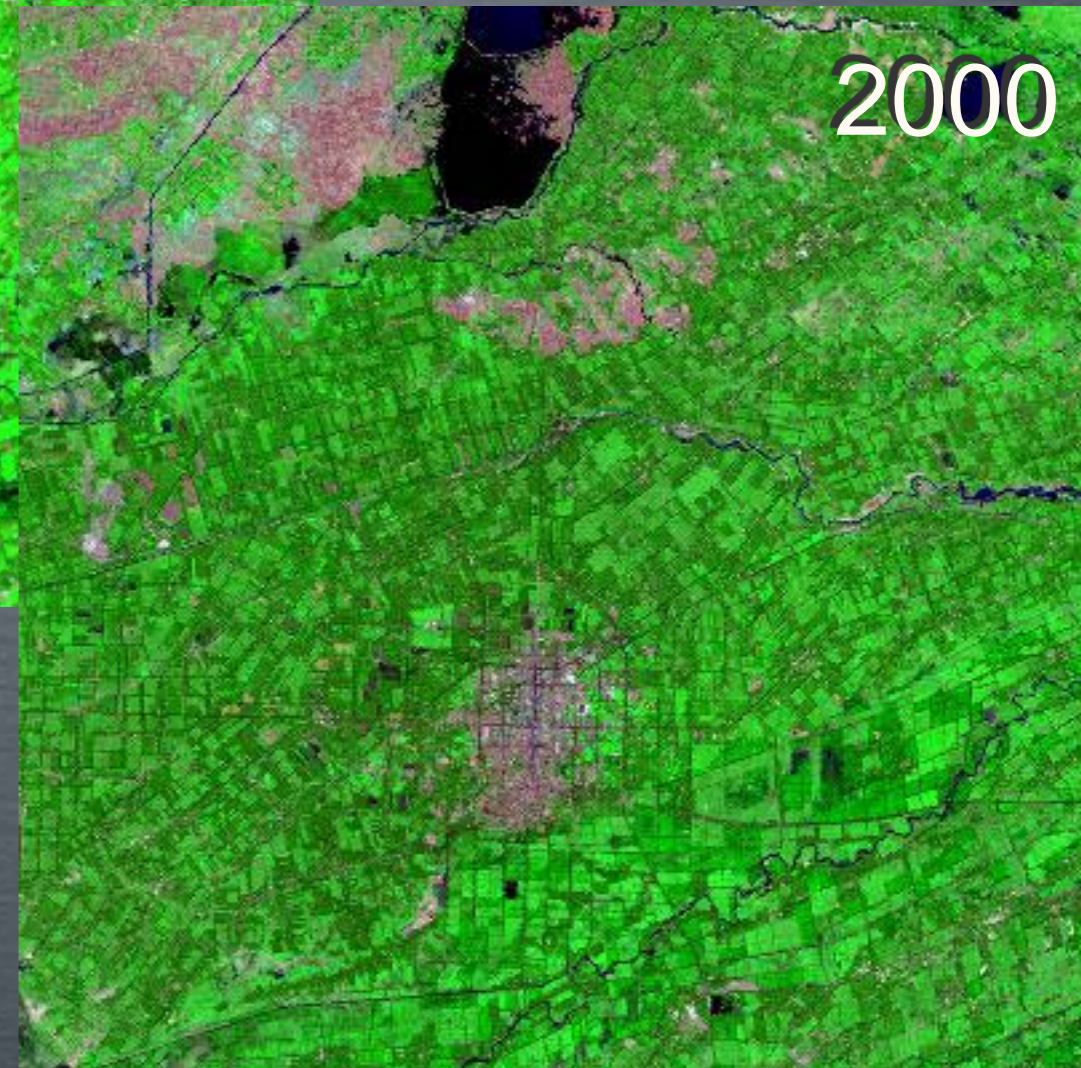
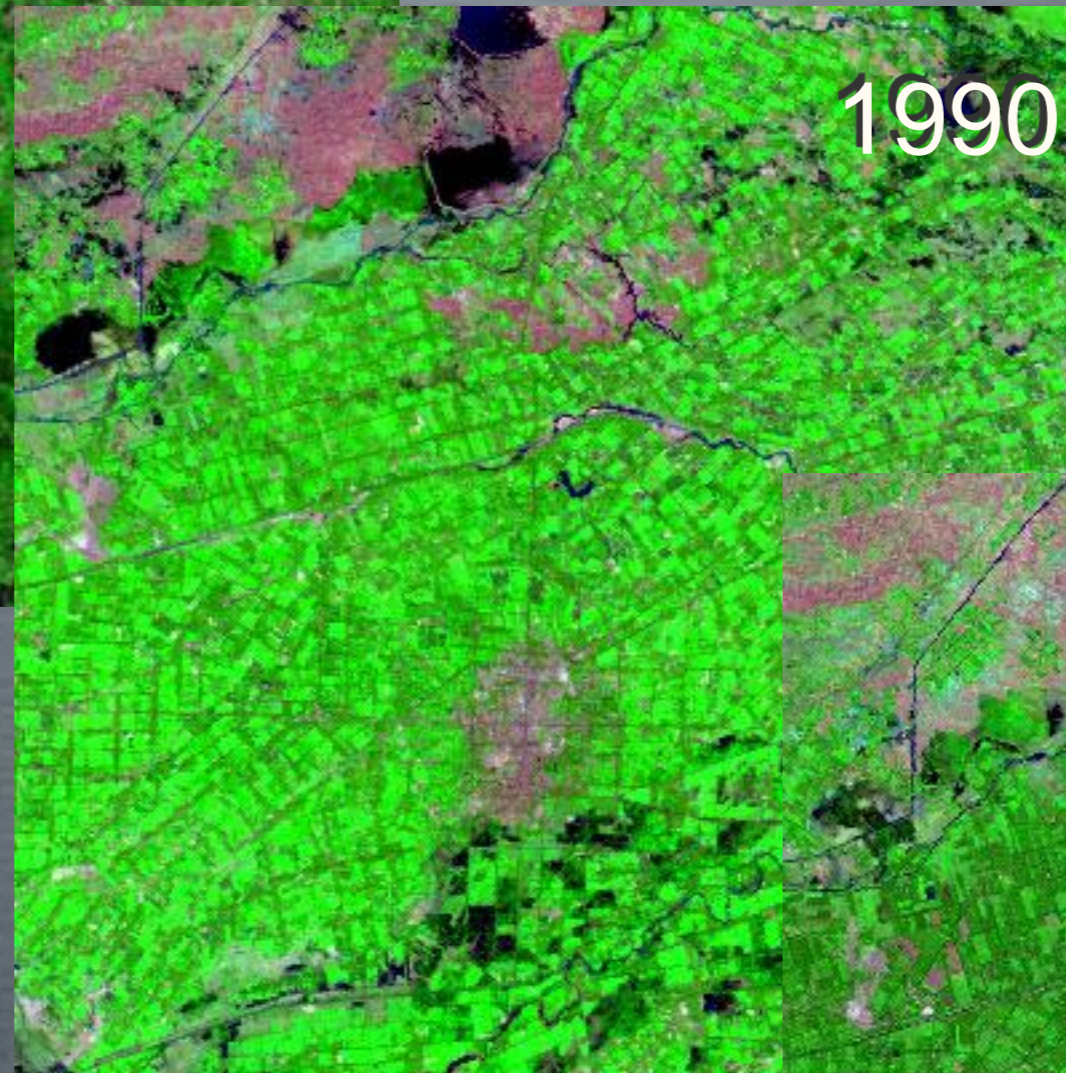
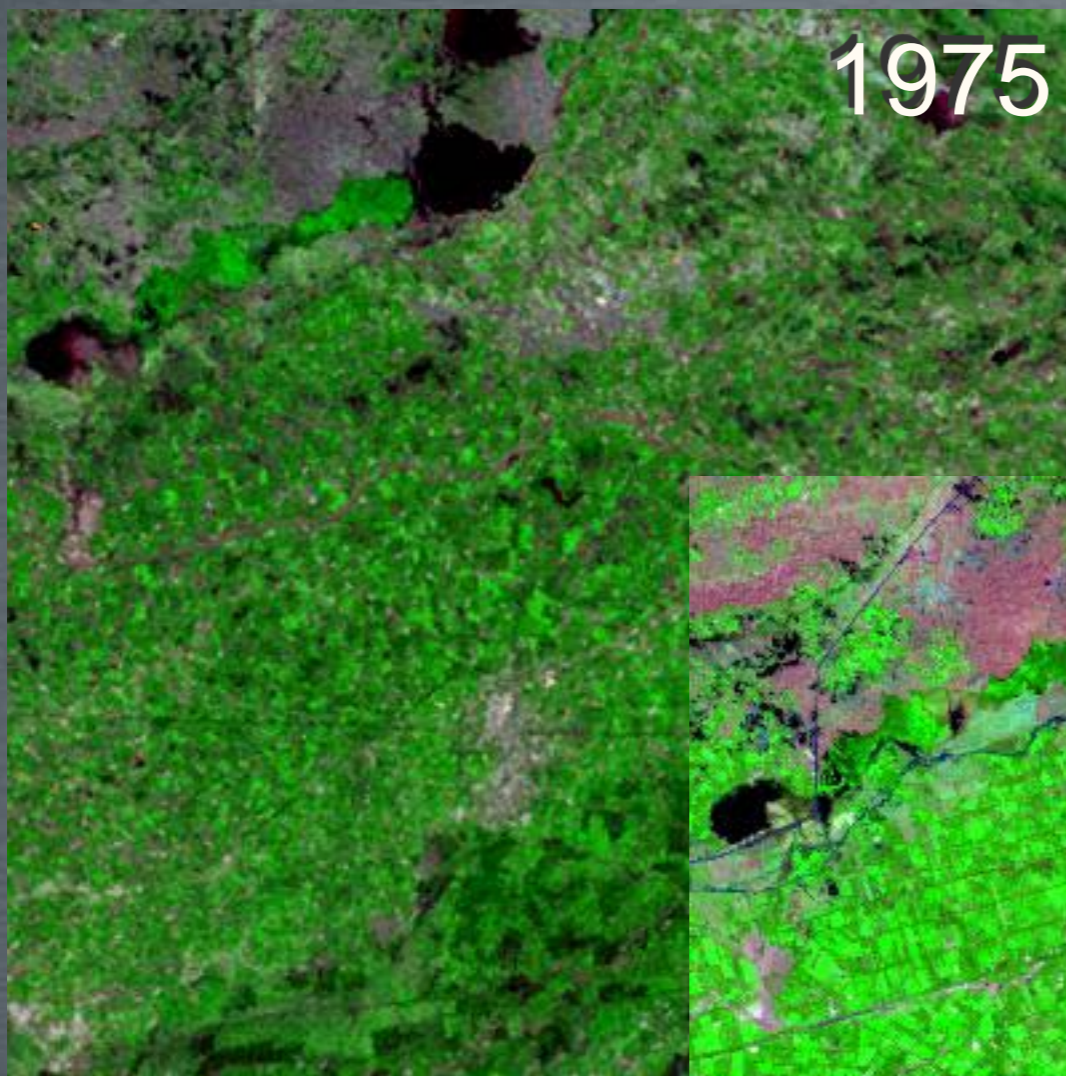
- Average field size in the region determines remote sensing of crops and irrigation status



# Changes in landscape



# Changes in landscape



# Fine-scale surface features



# Landsat vs. CBERS

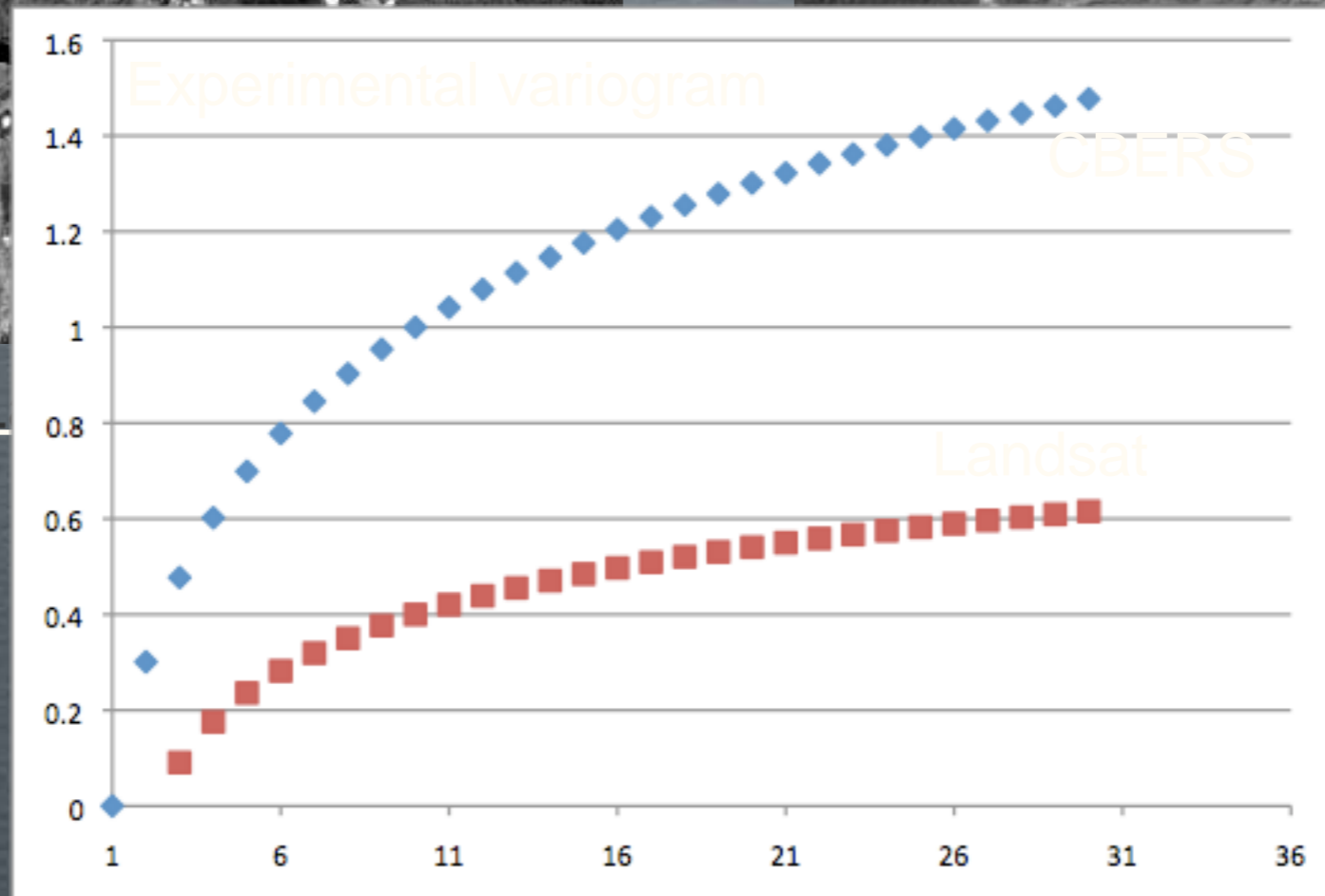
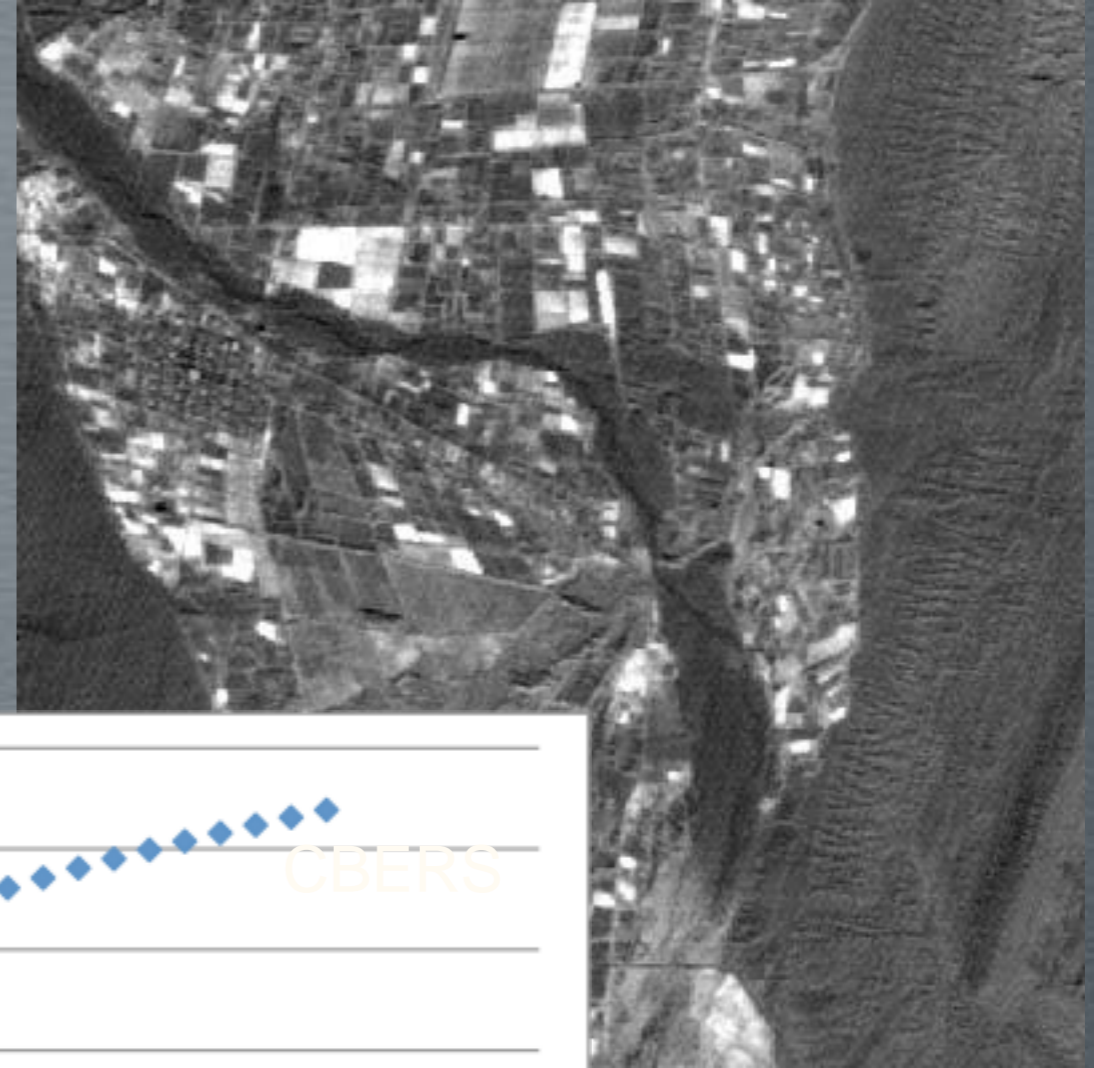
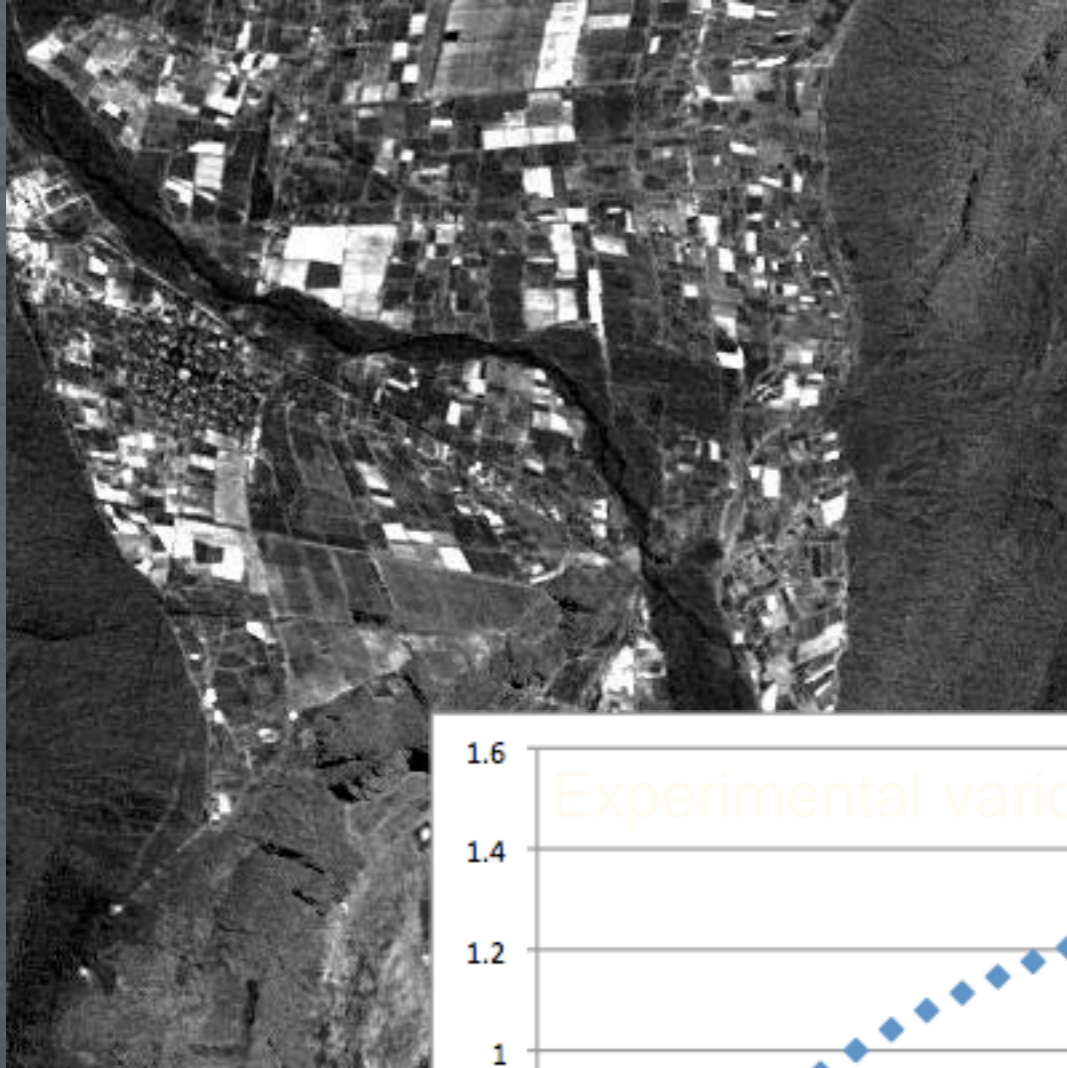


Landsat 7



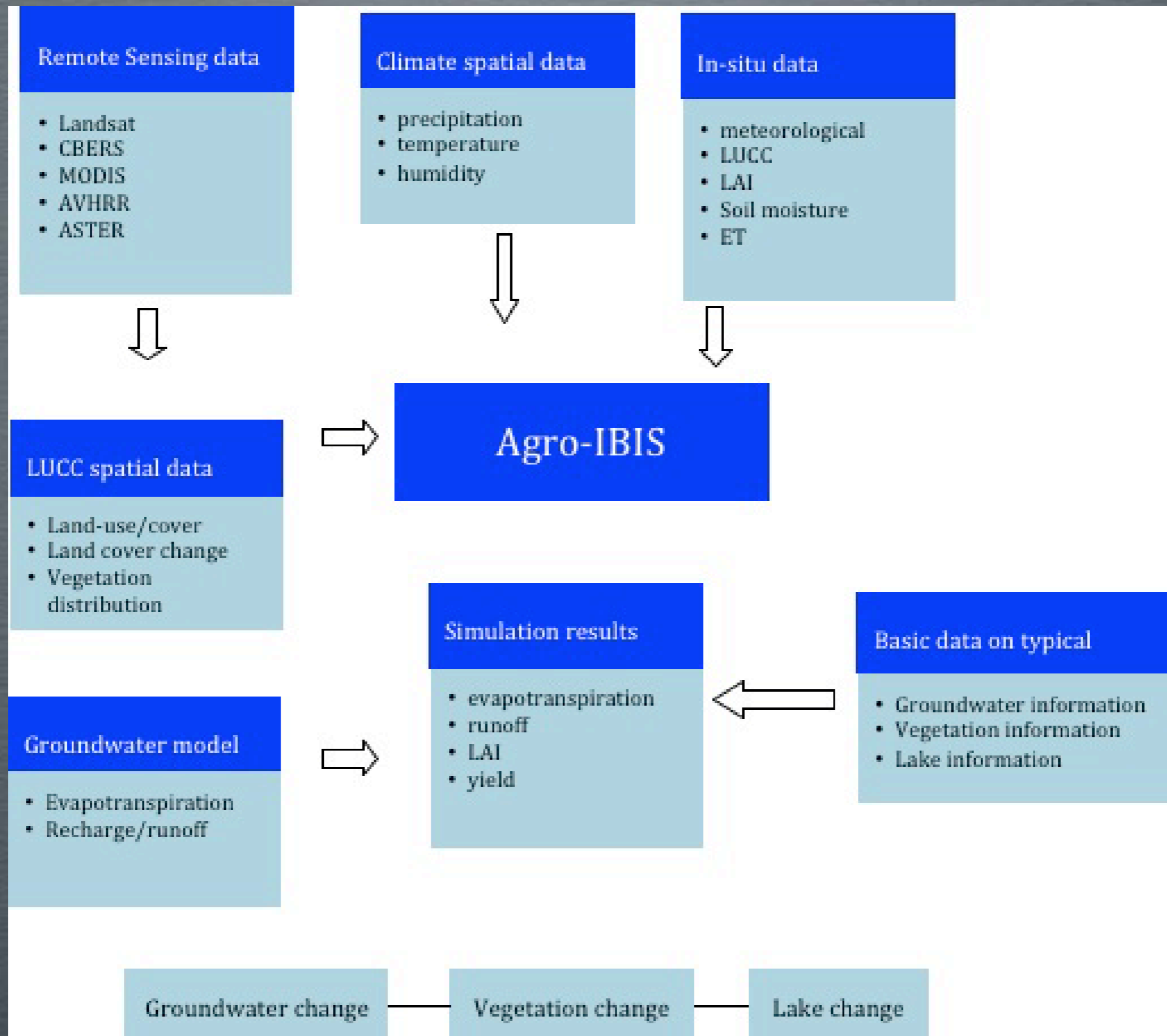
CBERS CCD

# Landsat vs. CBERS

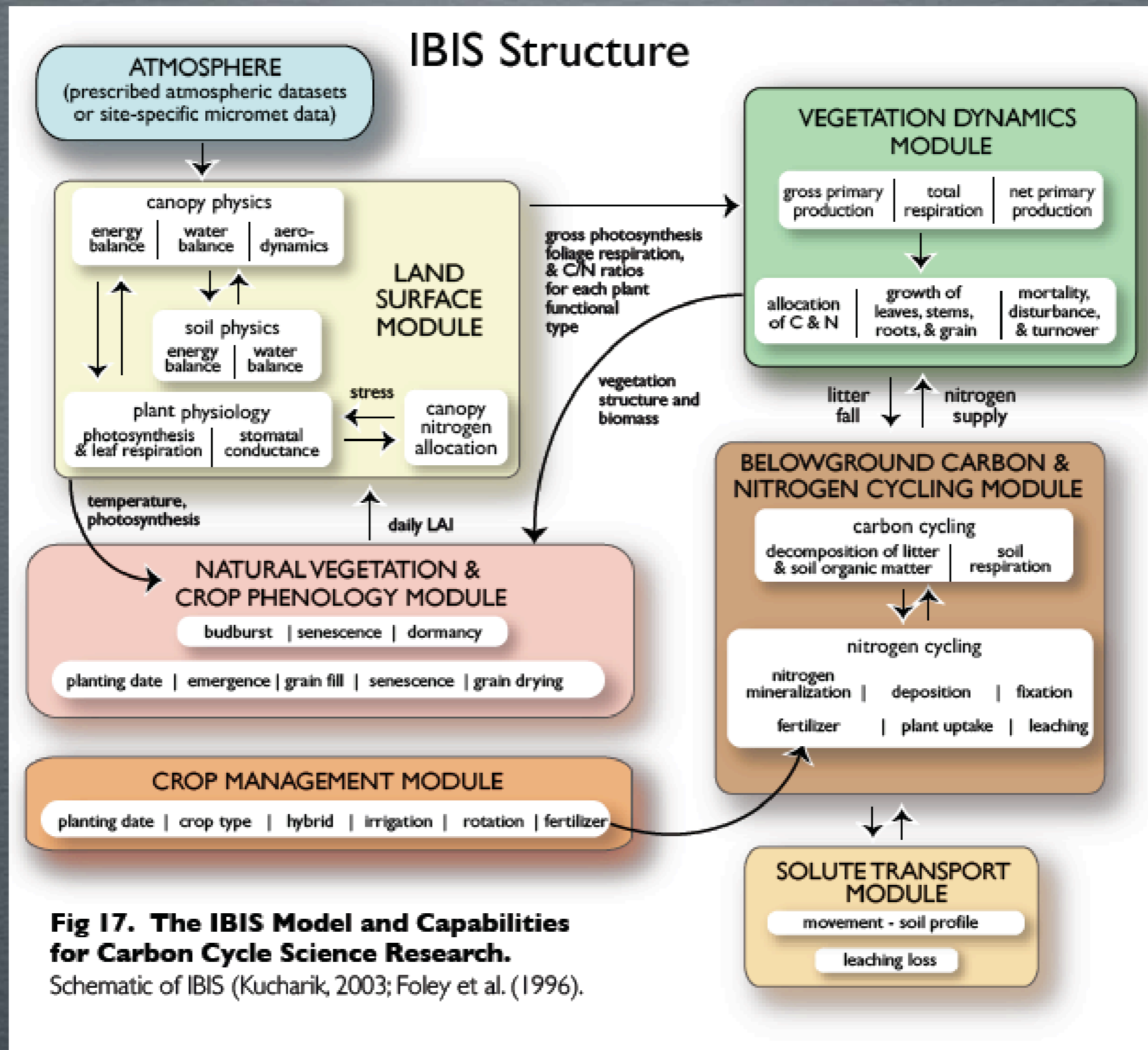


CCD

# Conceptual framework

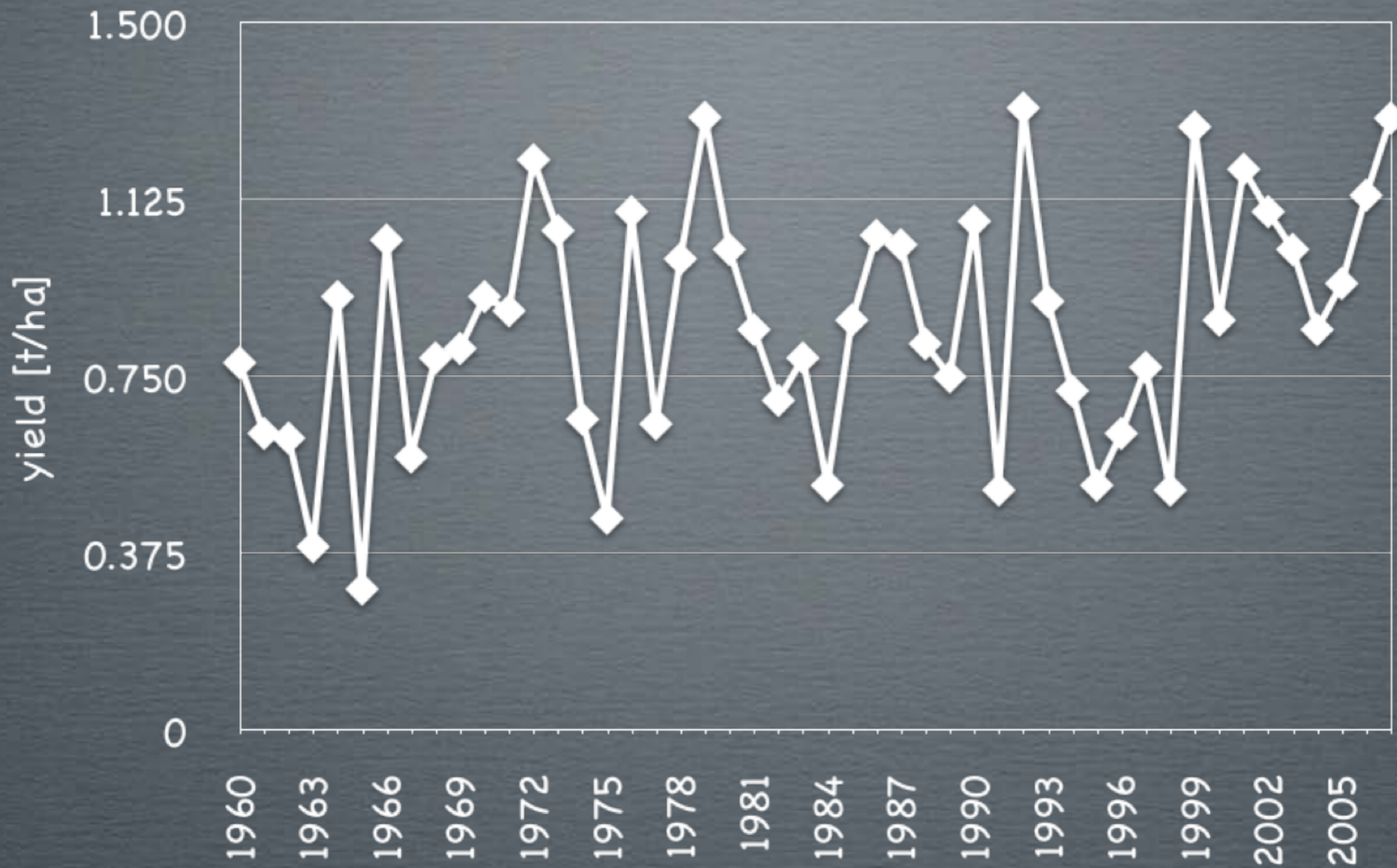


# Agro-IBIS Land Surface Model

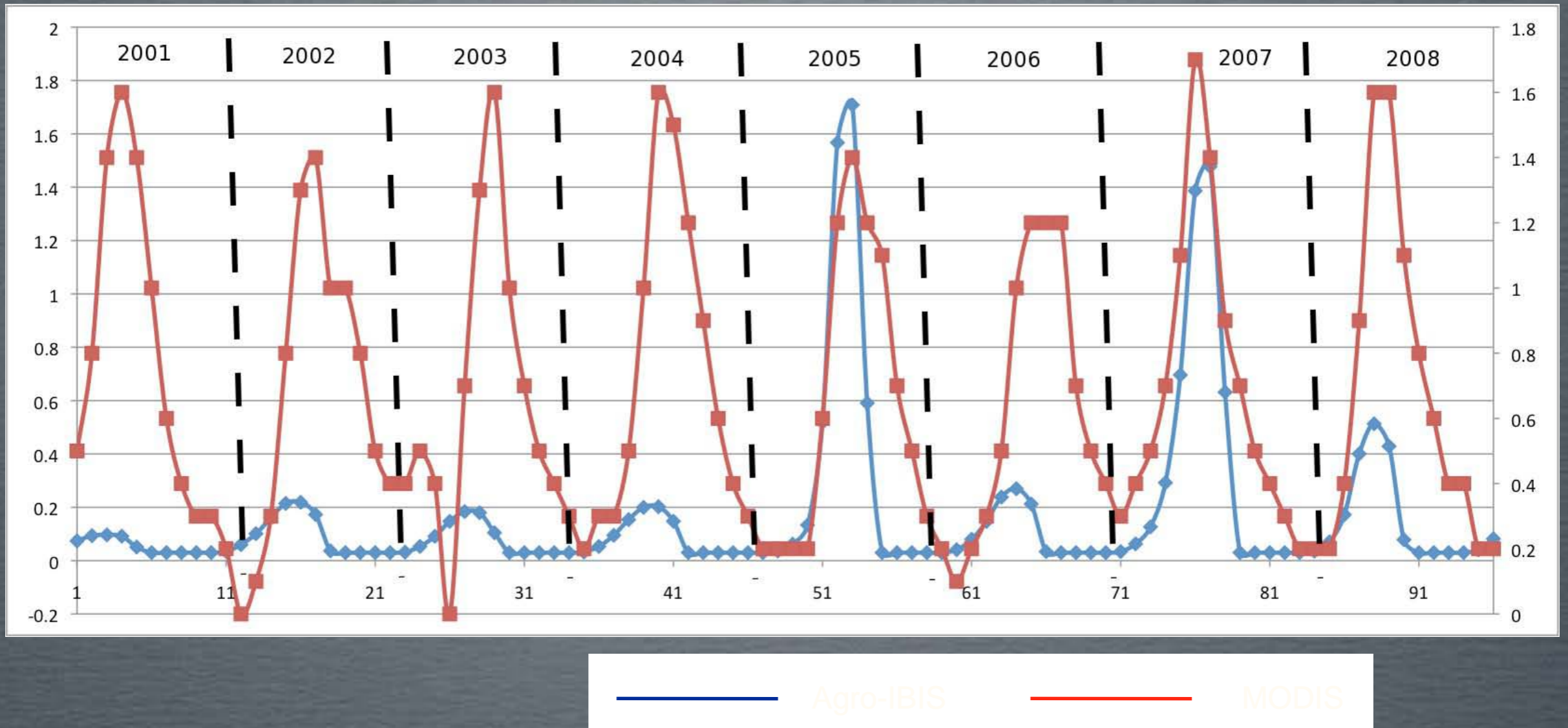


**Fig 17. The IBIS Model and Capabilities for Carbon Cycle Science Research.**  
Schematic of IBIS (Kucharik, 2003; Foley et al. (1996).

# Kazakhstan spring wheat yields

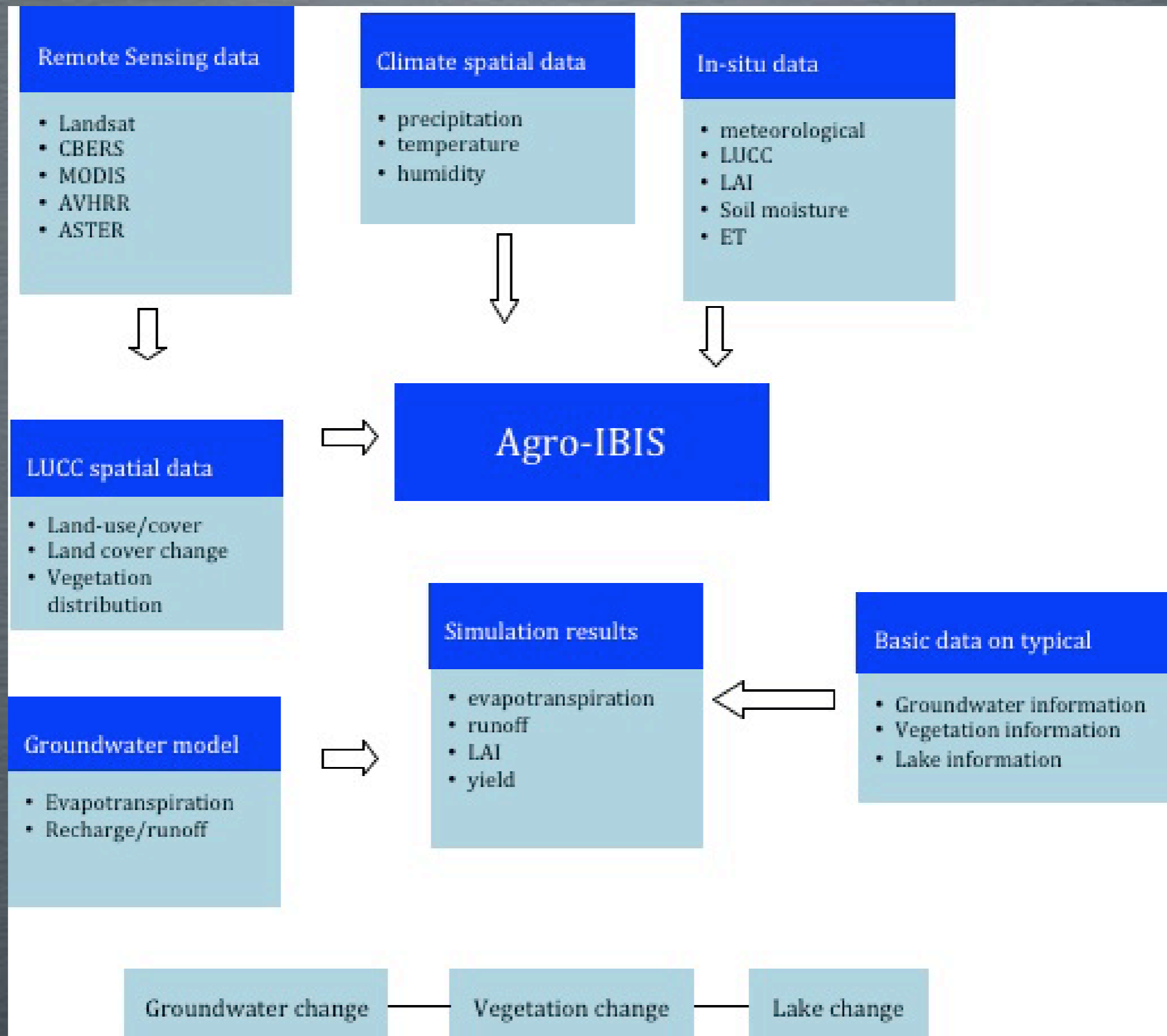


# Predicted vs. observed (MODIS) LAI



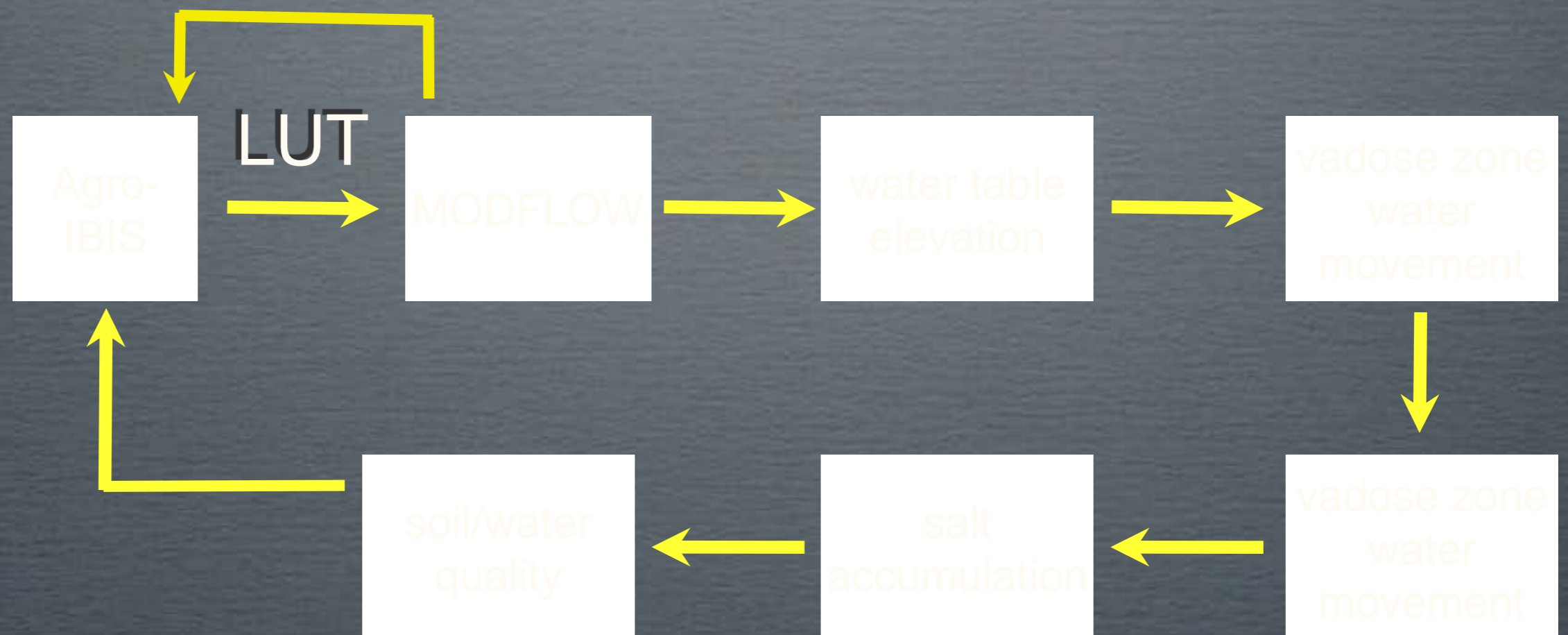
Agro-IBIS simulations show failed crop starts in certain years but for those years for which we can simulate crops there is a strong correspondence between modeled and observed LAI

# Conceptual framework



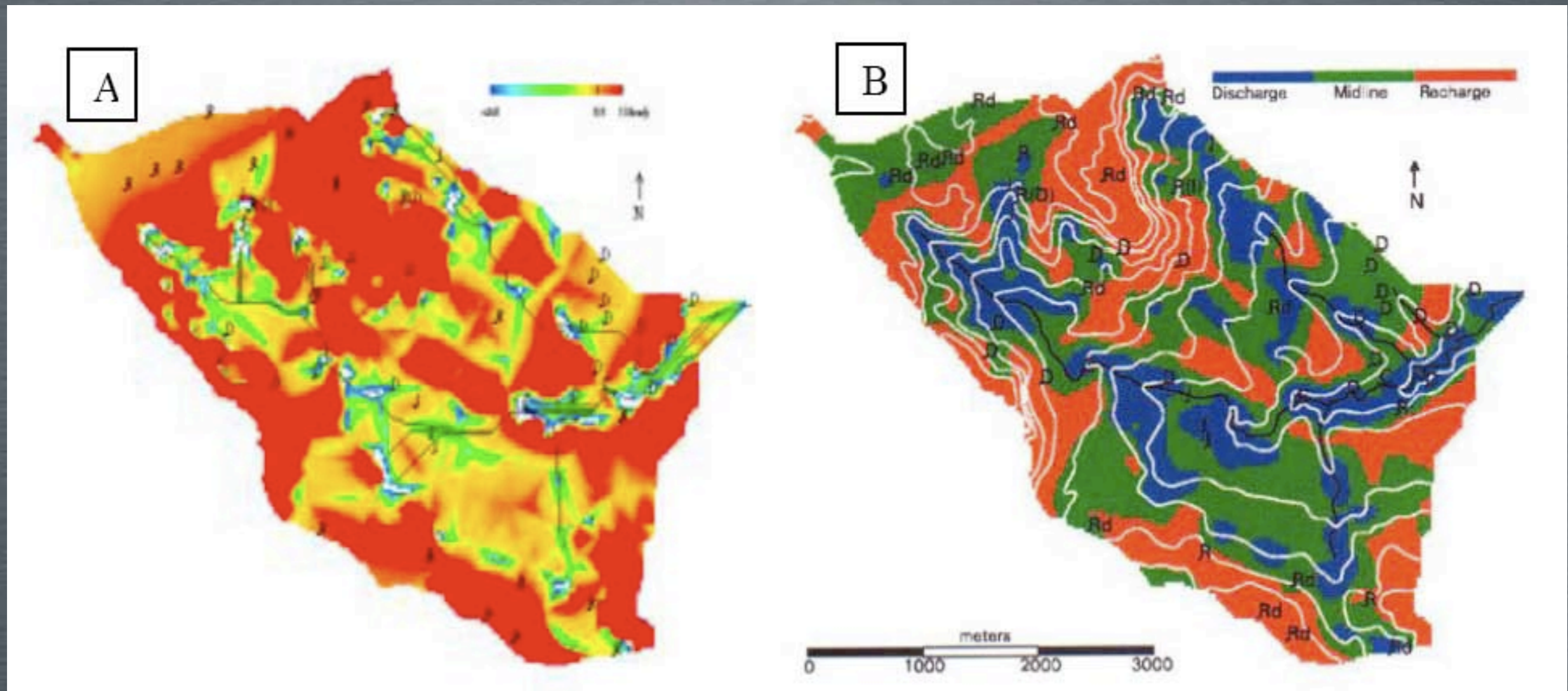
# AgroIBIS - Groundwater linkage

- Crop yields
- Hydrologic fluxes
- Agricultural runoff (nitrate)



# Prediction of recharge/discharge

An Example from Canadian Prairie

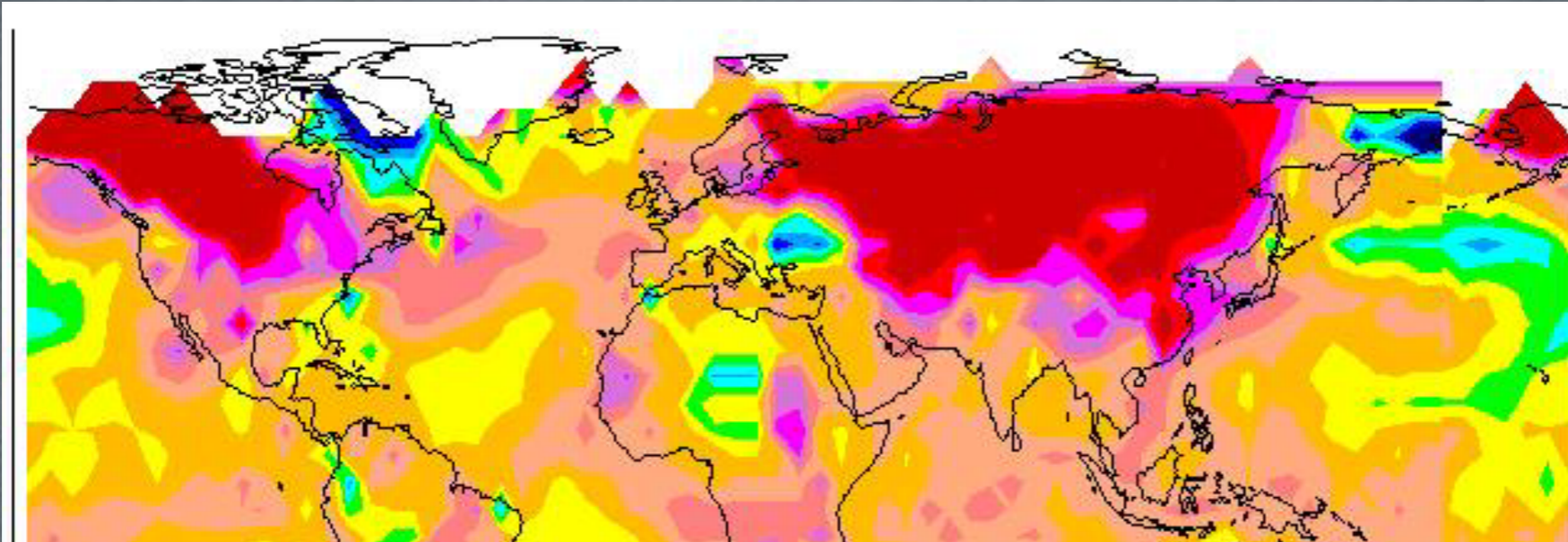


AgroIBIS-MODFLOW predicted recharge (**RED**) and discharge (**BLUE**) zones  
discharge zones are also locations susceptible to salt accumulation  
it is also possible to calibrate the model with **ASTER LST** observations

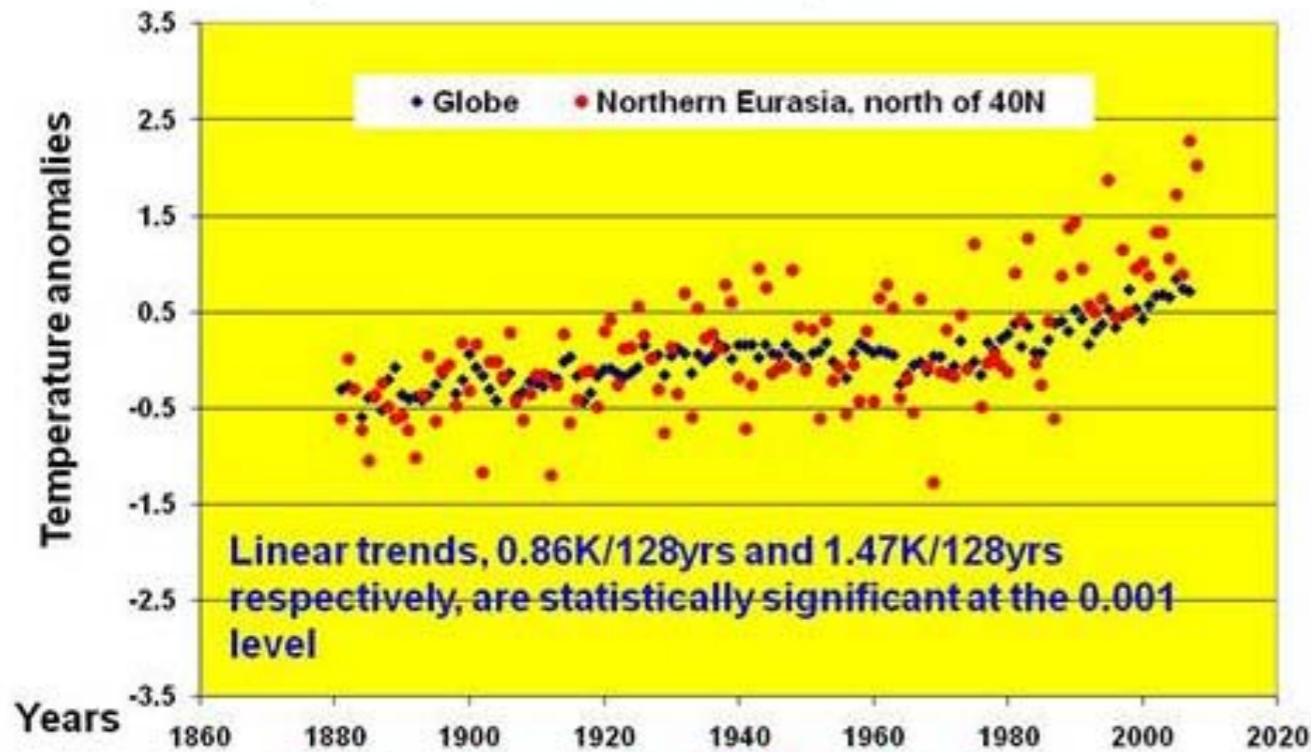
# Climate change wildcard

- The region is expected to experience dramatic changes in climate
- Directly linked to water resources (e.g. glacier retreat, decreased surface flow, decreased lake levels, increased ET)
- What is the role of these changes on crop productivity, rate of water depletion, salt accumulation and so on?
- Answer some of these questions with our modeling framework

# Climate change wildcard

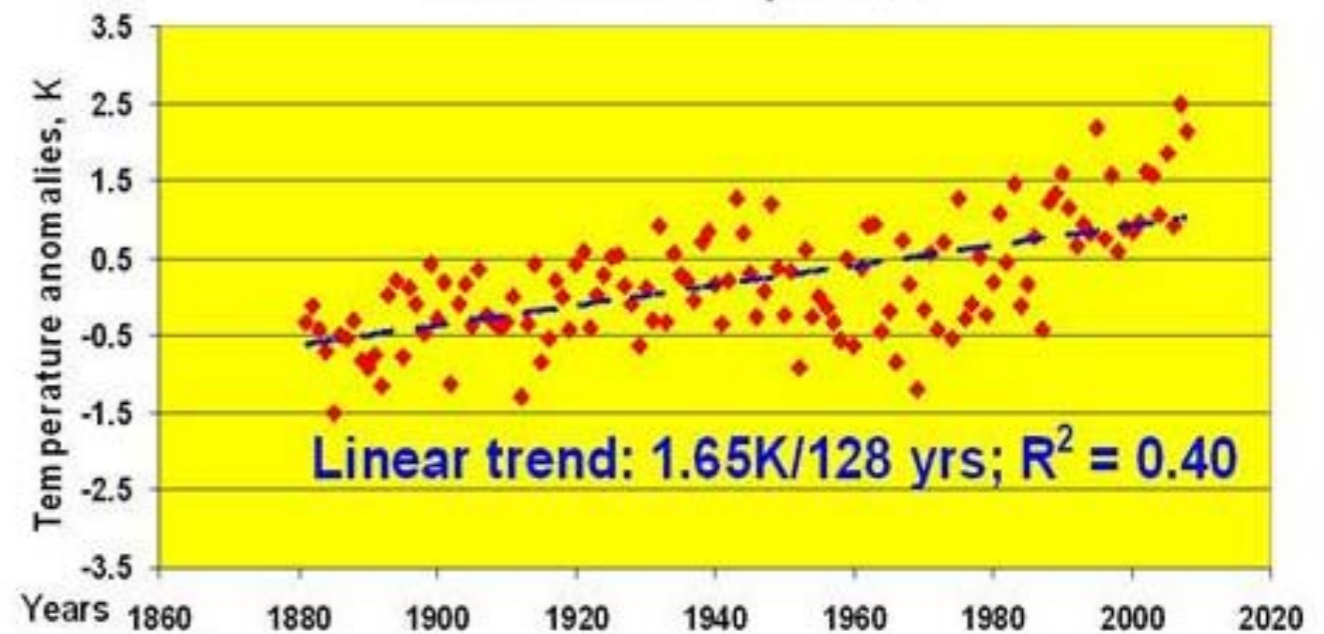


Global (latitudinal zone from 60°S to 90°N) and Northern Eurasia (north of 40° N) surface air temperature anomalies, 1881-2008



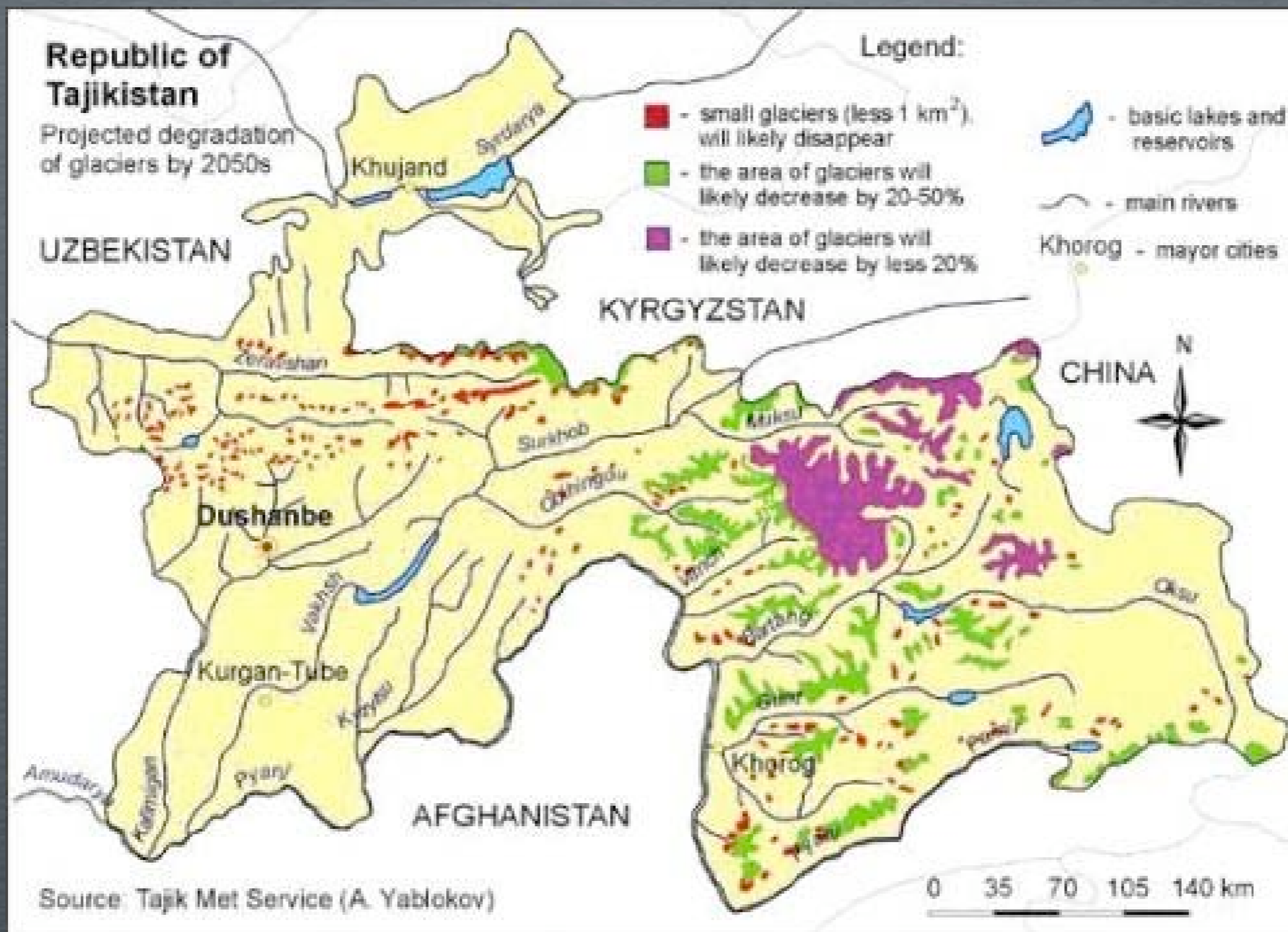
(Archive of Lugina et al. 2007 updated).

Northern Asia, north of 40°N. 1881-2008. Surface air temperature anomalies from the 1951-1975 reference period



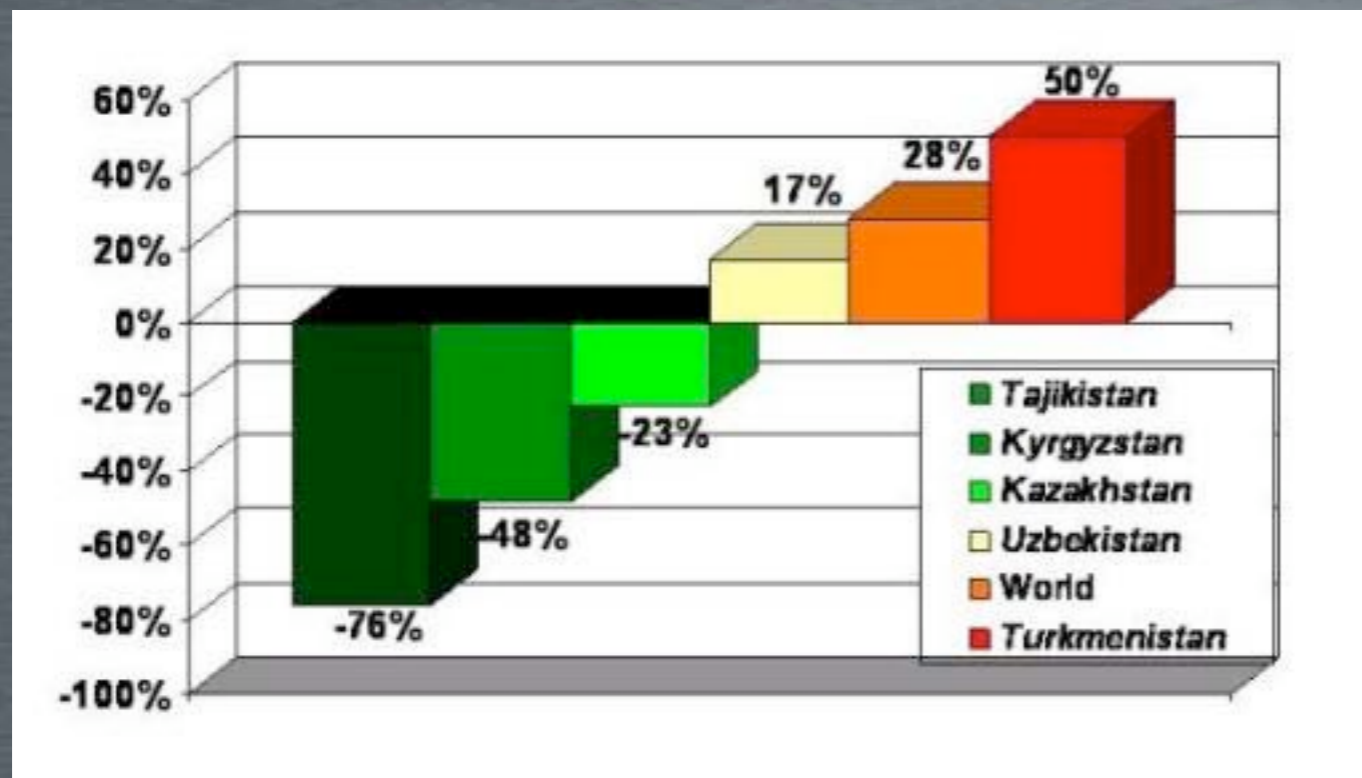
During the past twenty years, all anomalies were above 0.5K and eight of them were above 1.5K. Year 2007 showed a record anomaly of 2.5K.

# Projected changes in glacier volumes in Tajikistan (2050)

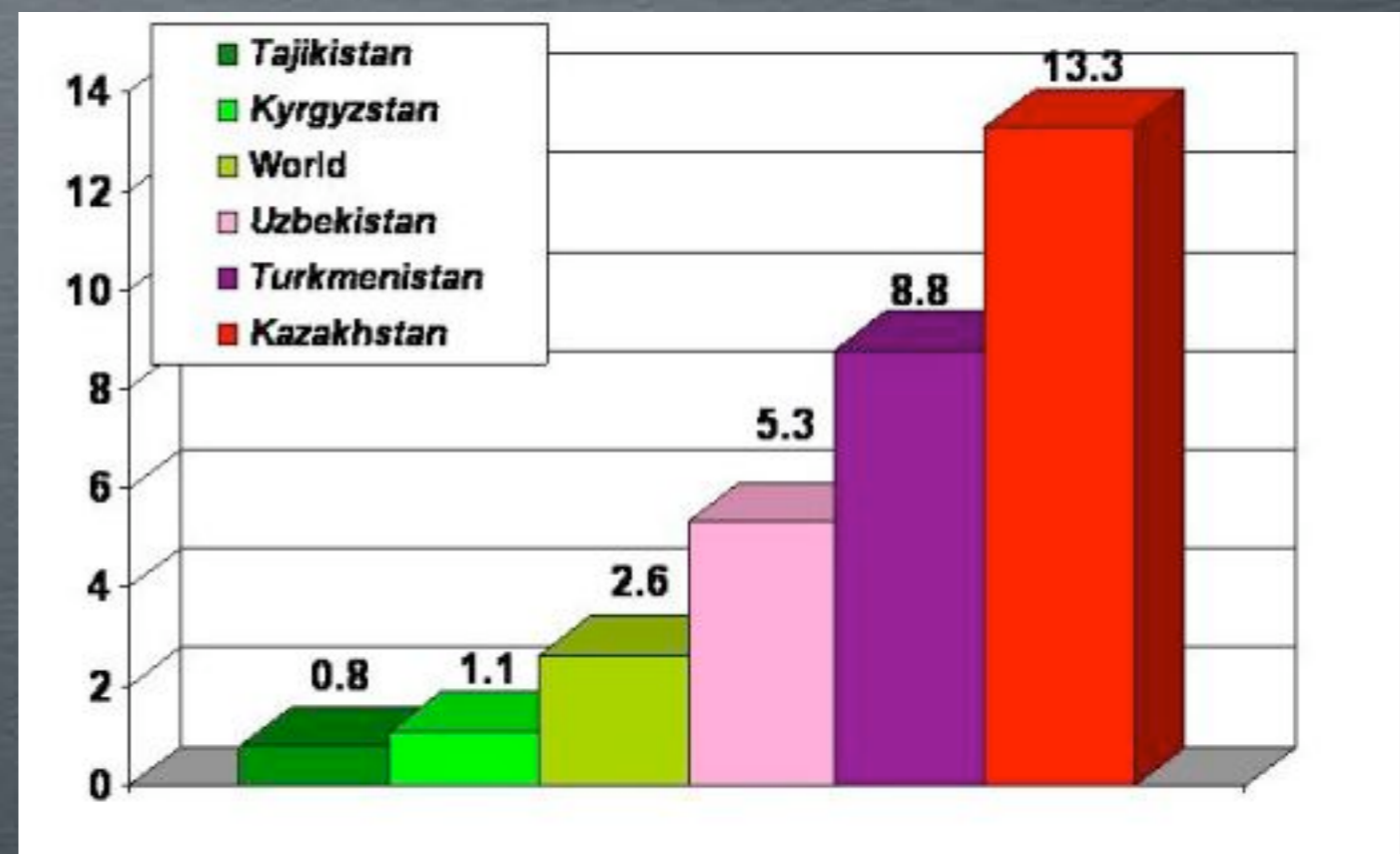


# Different emitters

Changes in annual GHG emissions in Central Asia (1990-2004)



Per-capita greenhouse gas emissions in Central Asia (tons)





Thank you

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