

# Hydrometeorology-Agriculture Droughts Monitoring and Prediction System

**Toshio Koike**

The University of Tokyo  
and

International Centre for Water Hazard and Risk Management (ICHARM)



THE UNIVERSITY OF TOKYO



# Hydrometeorology-Agriculture Droughts Prediction System

## DIAS Archives

### Hydromet Data

NASA GLDAS

JMA Reanalysis

NCDC Global Met

### Satellite

AMSR2  
MODIS

### Seasonal Forecast

GFDL  
APCC

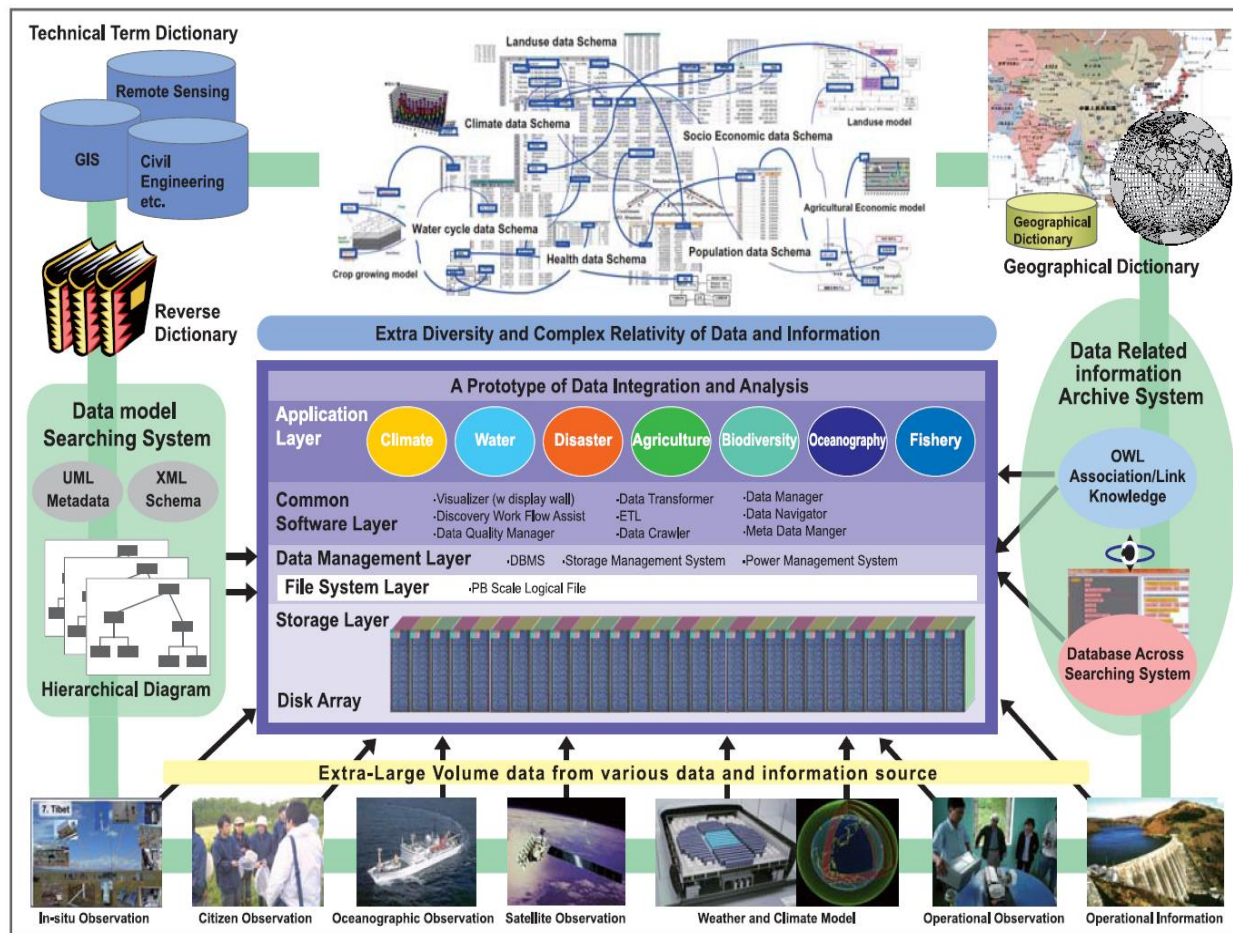
### Global CLVDAS Outputs

Optimized LDAS Parameters

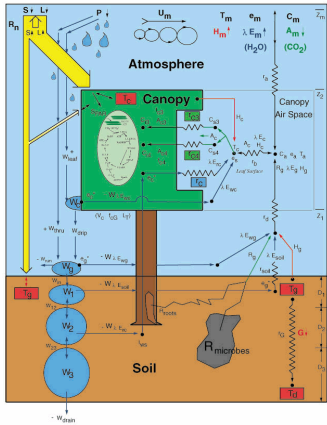
Optimized RTM Parameters

LDAS Reanalysis Statistics

To create knowledge enabling us to solve the Earth environment problems, to reduce the disaster risk, and then, to generate socio-economic benefits,



## Energy and Water flux Balance



# Hydrometeorology-Agriculture Coupled Model

Rice Production

Dynamic Vegetation

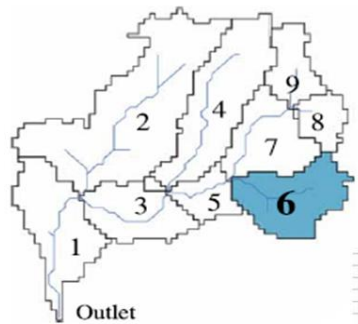
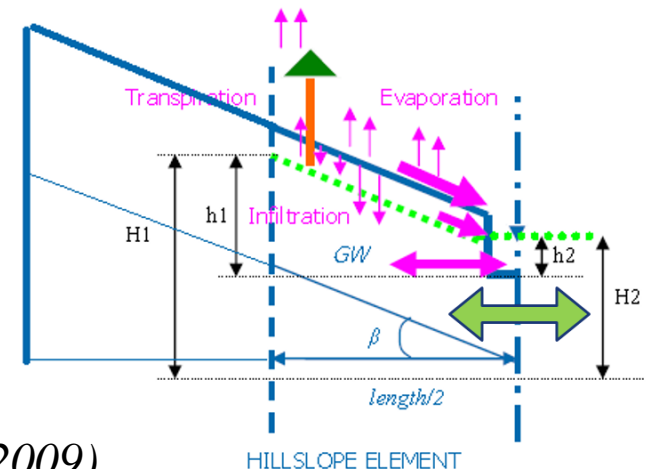
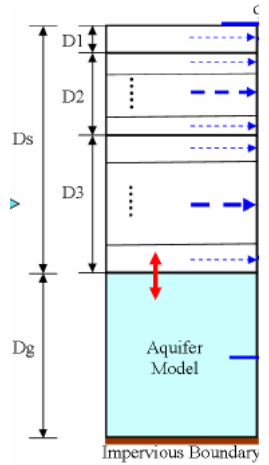
Irrigation System

Water and Energy Budget Distributed Hydrological Model (WEB-DHM)

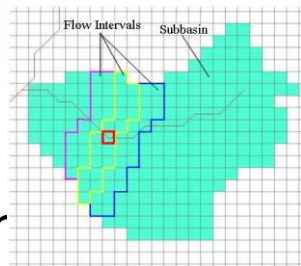
Dam Operation

Vertical Soil moisture Profile

Lateral flow, Gridded to Flow-interval

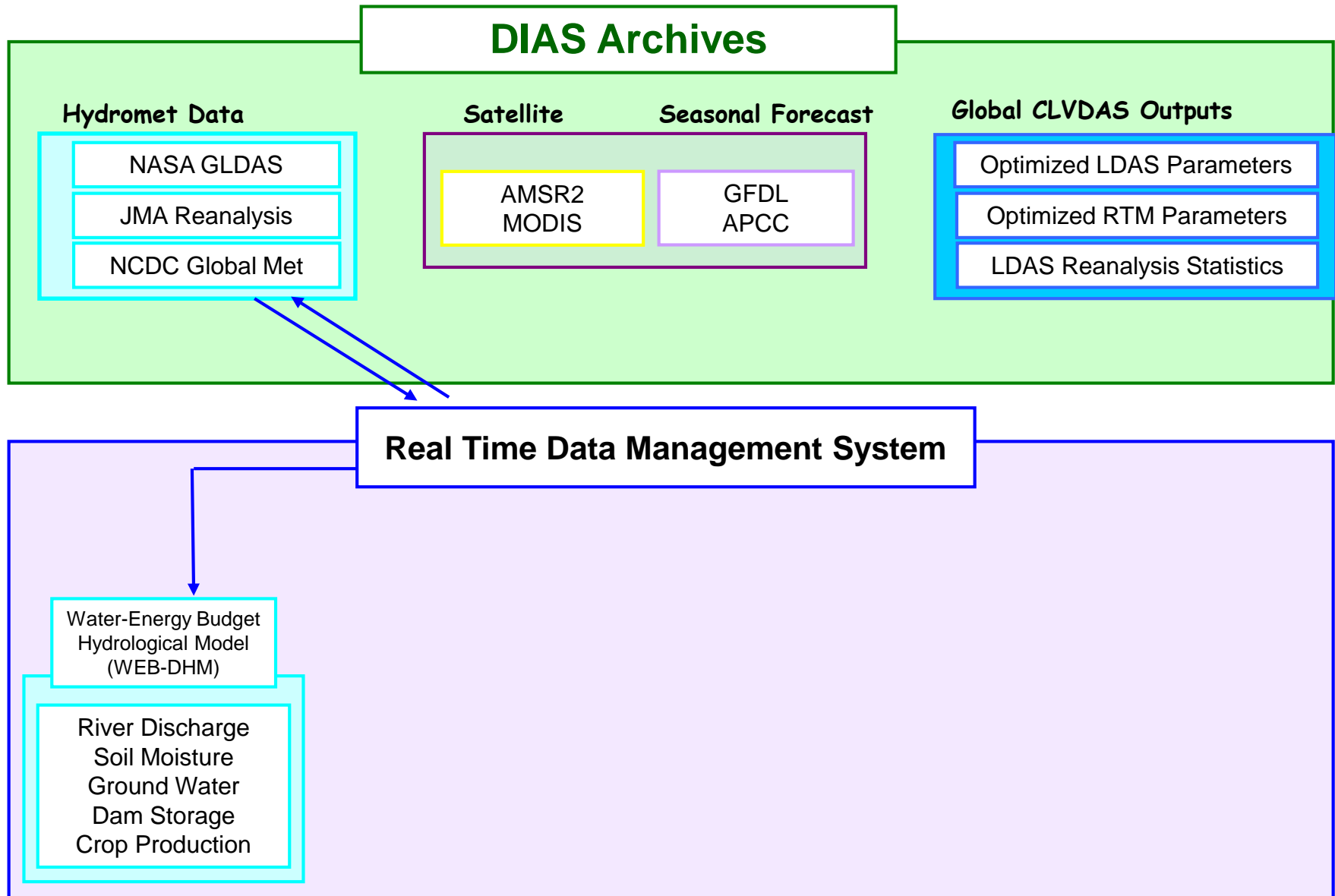


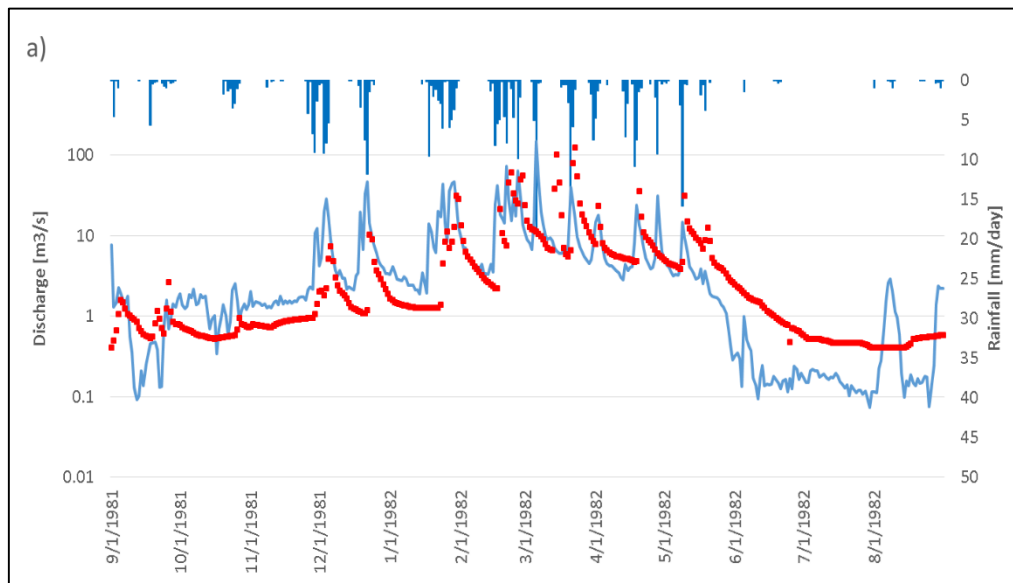
Riverflow Via Kinematic Wave Equator



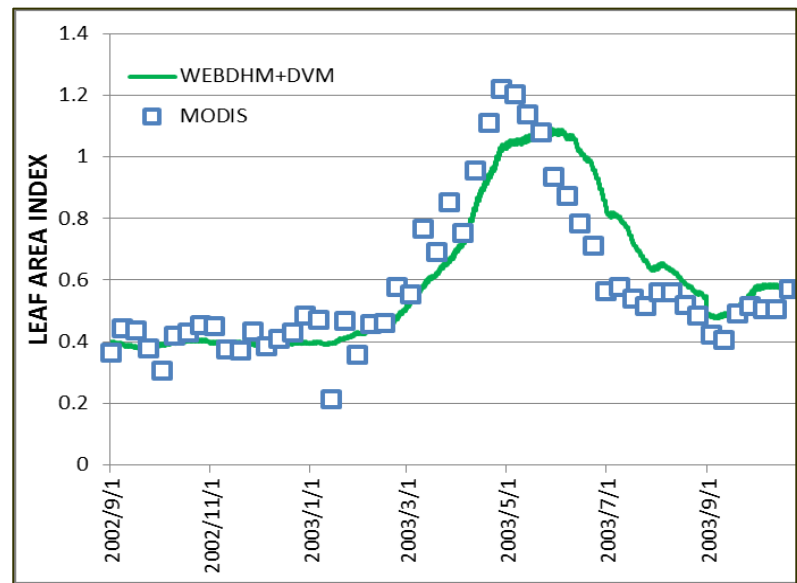
Wang, Koike, et al. JGR (2009)

# Hydrometeorology-Agriculture Droughts Prediction System

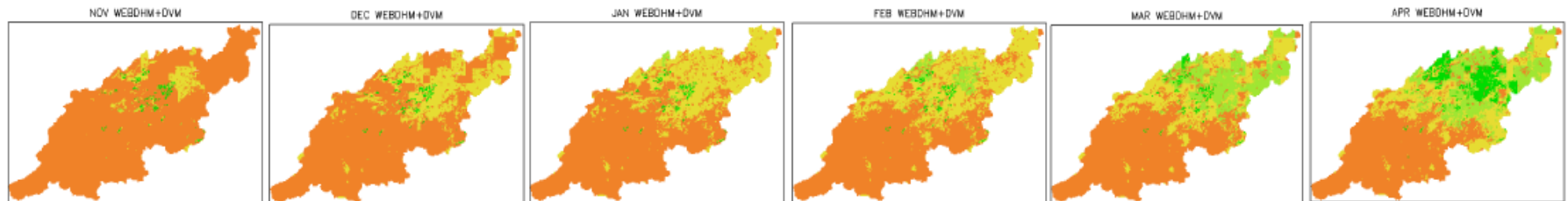




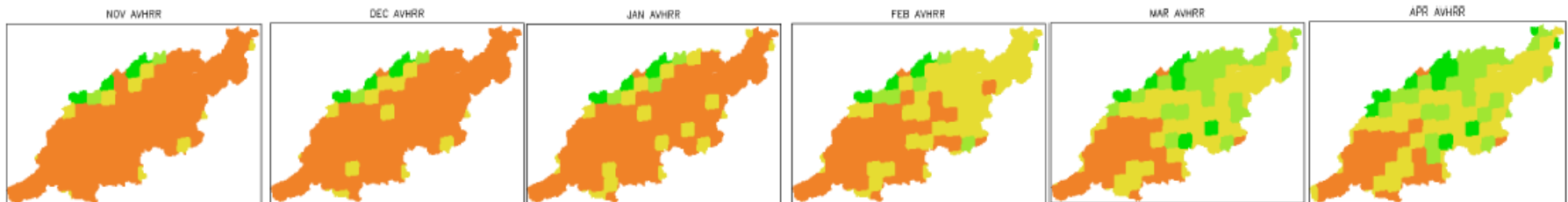
River Discharge (obs. & simulated)



LAI (obs. & simulated)



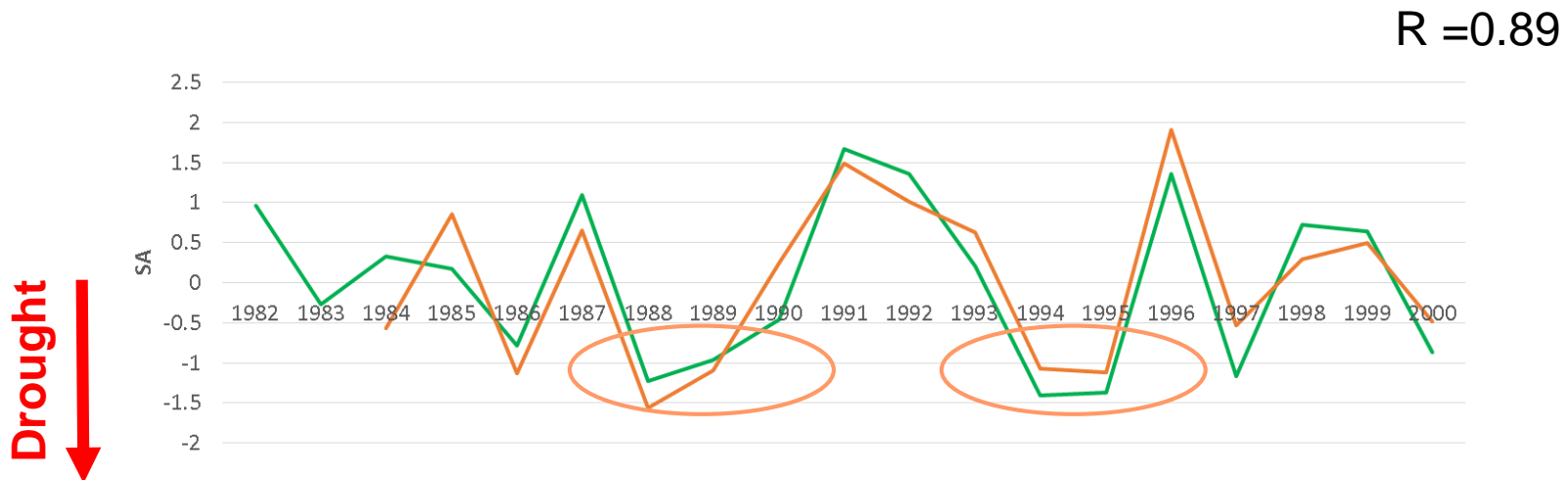
Seasonal variation of LAI by the Coupled Model (above) and MODIS (below)



# - Agricultural Drought Index -

Drought indices (SA index)

Green:simulated annual peak LAI and Orange:nationwide crop production



- The drought index calculated from the model-estimated annual peak of leaf area Index correlates well with the drought index from nationwide annual crop production.
- Severe droughts (food shortage) in 1988-1989 and 1994-1995 are reported on FAO report [FAO, 2005]

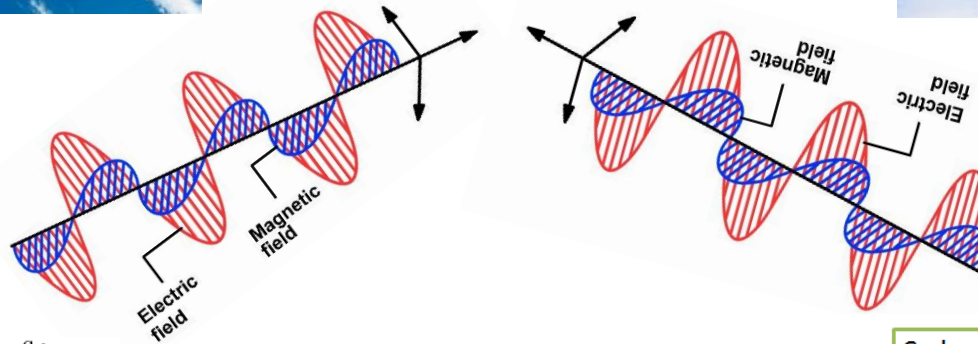


AMSR-E

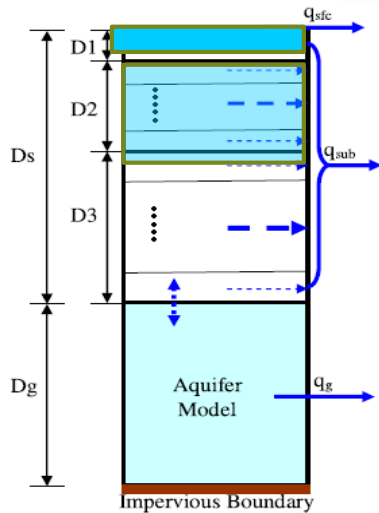
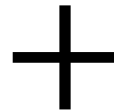


# Coupled Data Assimilation

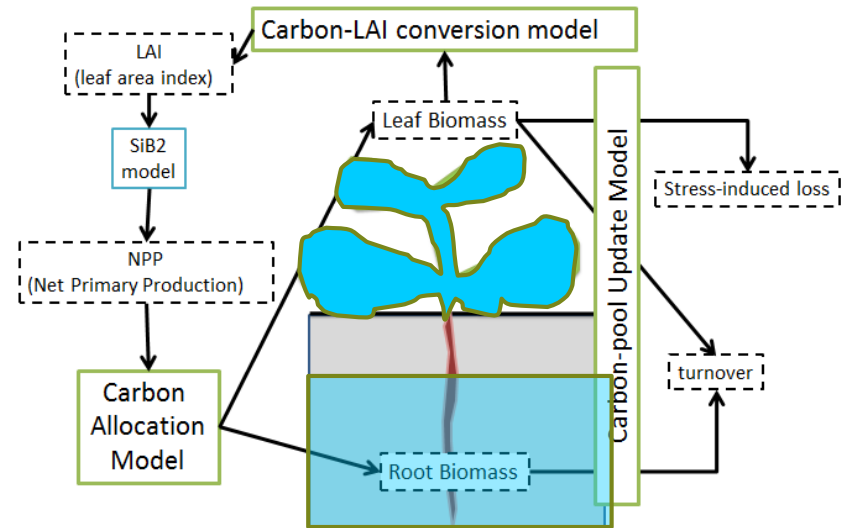
AMSR2



Electronic-Magnetic Wave



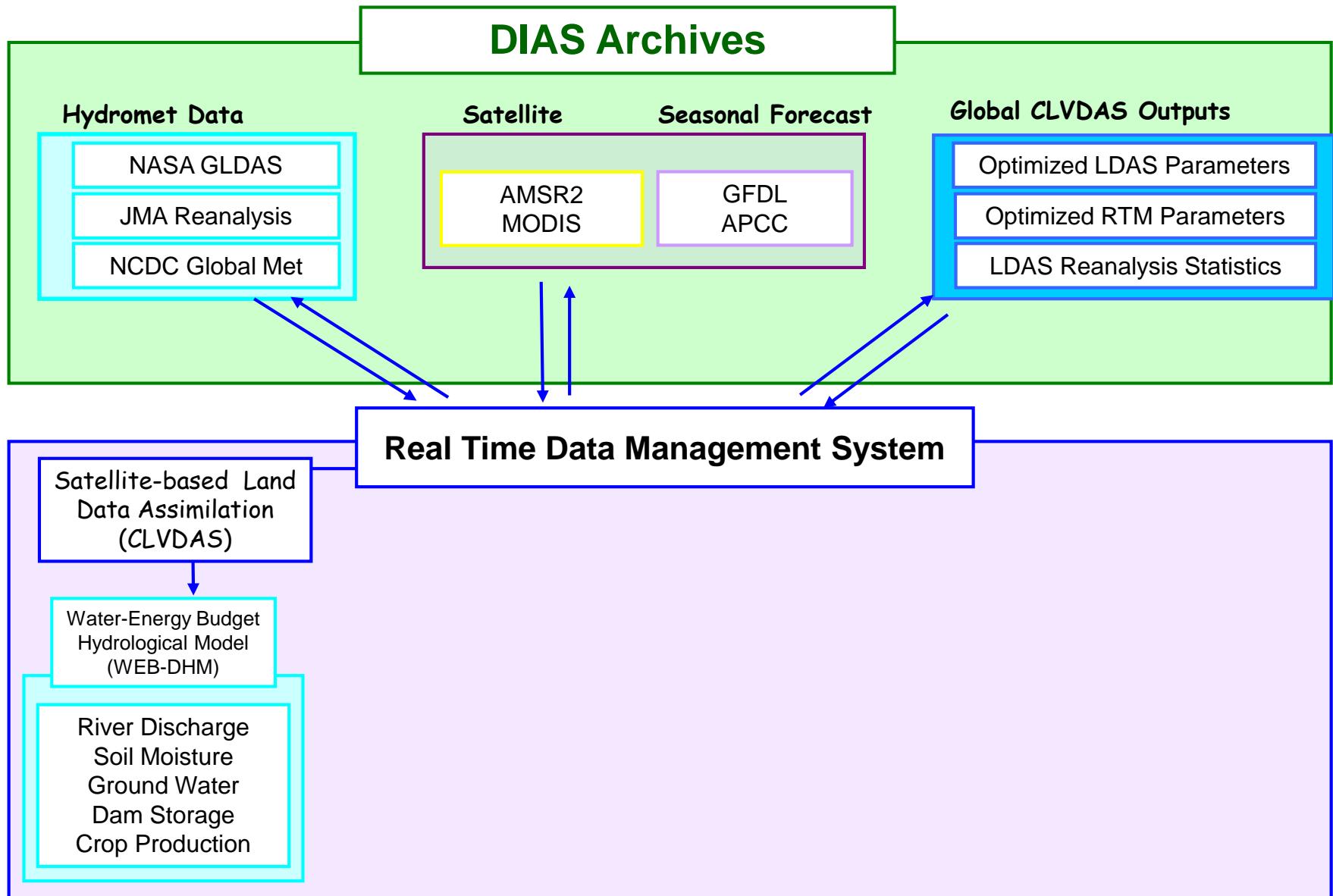
Land surface model



Dynamic Vegetation Model

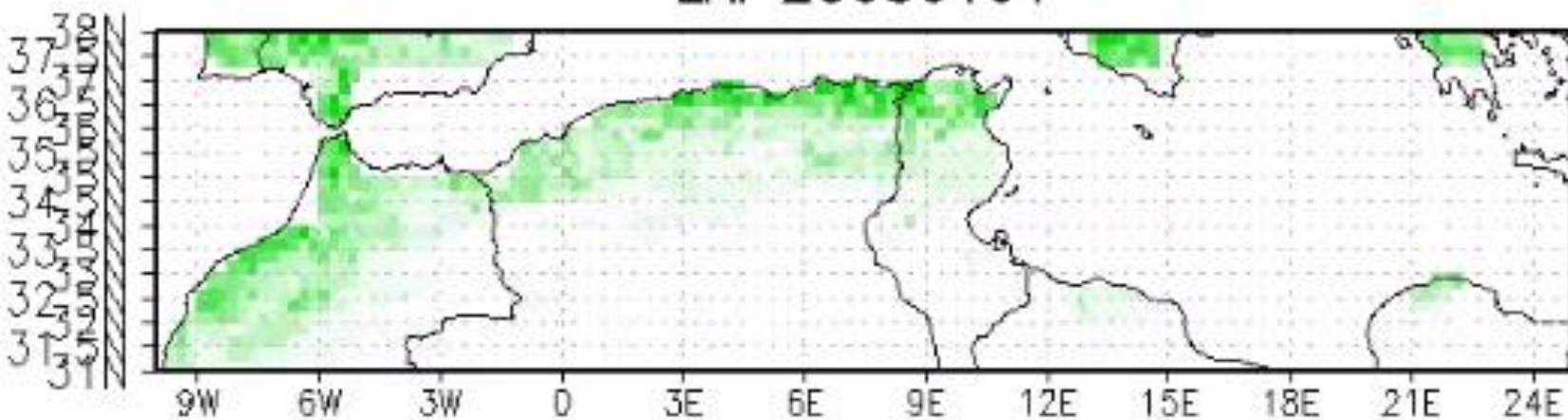


# Hydrometeorology-Agriculture Droughts Prediction System



movie

LAI 20030101

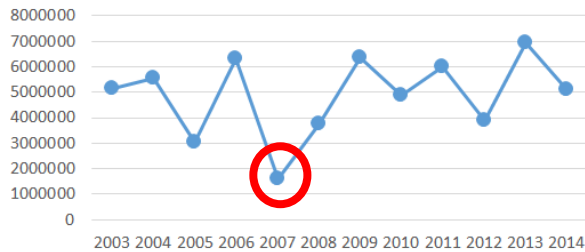


# Drought analysis

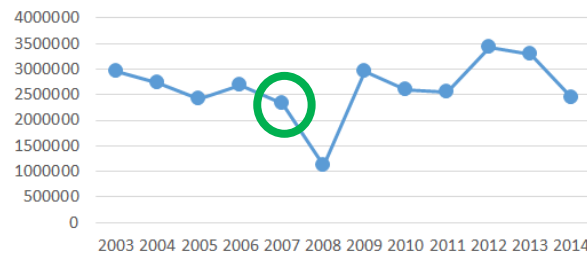
## Wheat production

### 2007 Morocco Drought

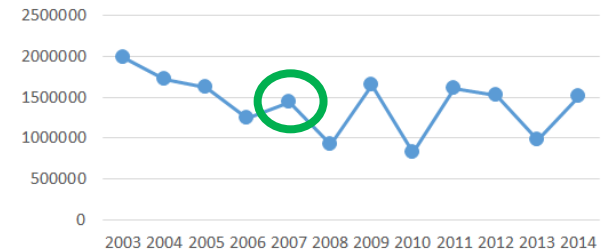
Morocco



Algeria

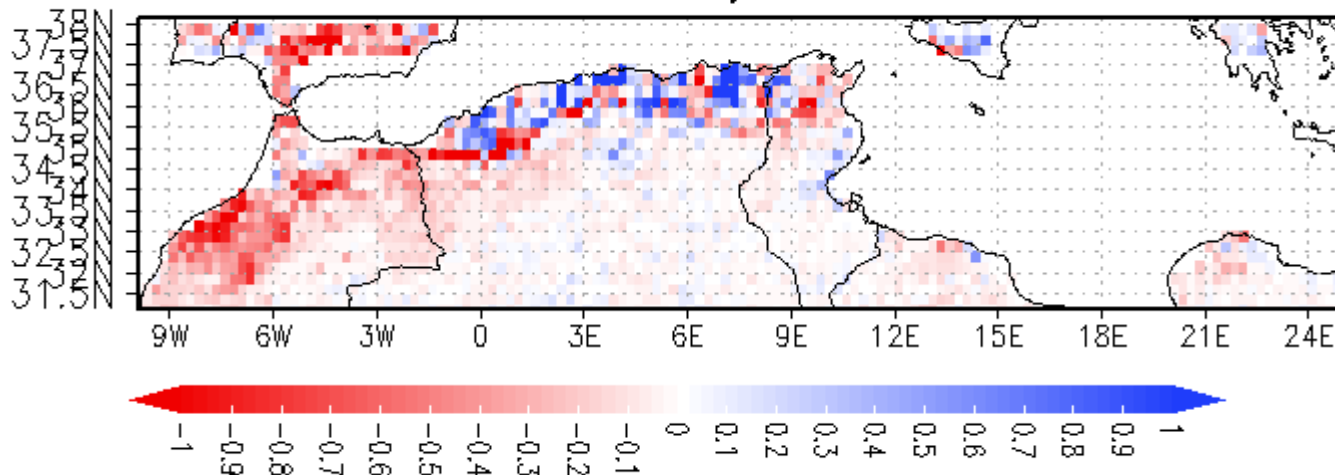


Tunisia



## LAI anomaly from CLVDAS

LAI anomaly 20070401



# Drought analysis

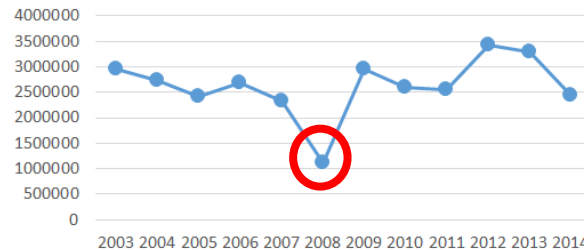
## Wheat production

### 2008 Morocco, Algeria, & Tunisia Drought

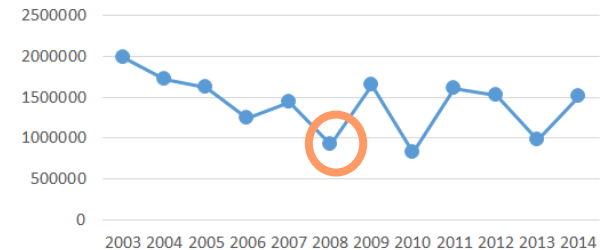
Morocco



Algeria

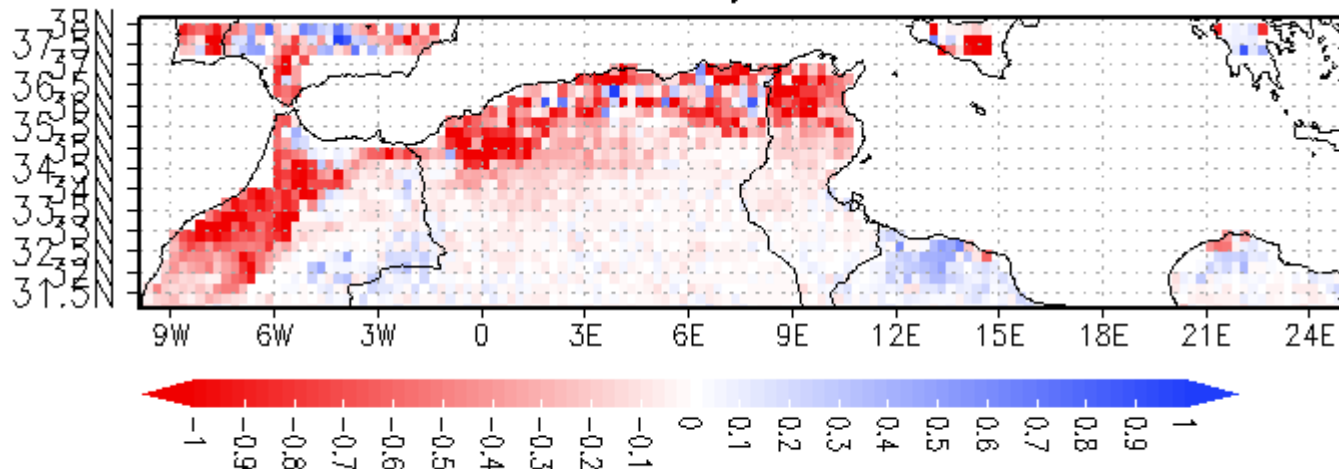


Tunisia



## LAI anomaly from CLVDAS

LAI anomaly 20080401

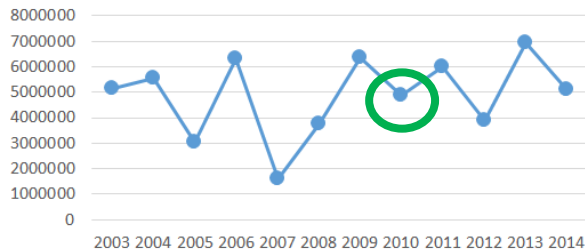


# Drought analysis

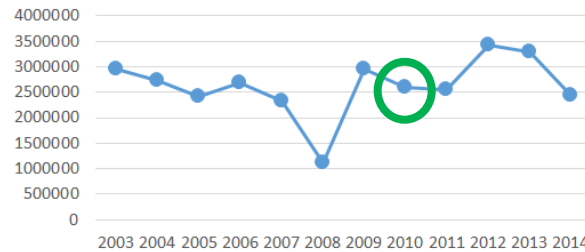
## Wheat production

### 2010 Tunisia Drought

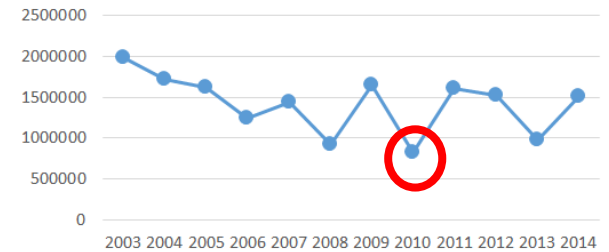
Morocco



Algeria

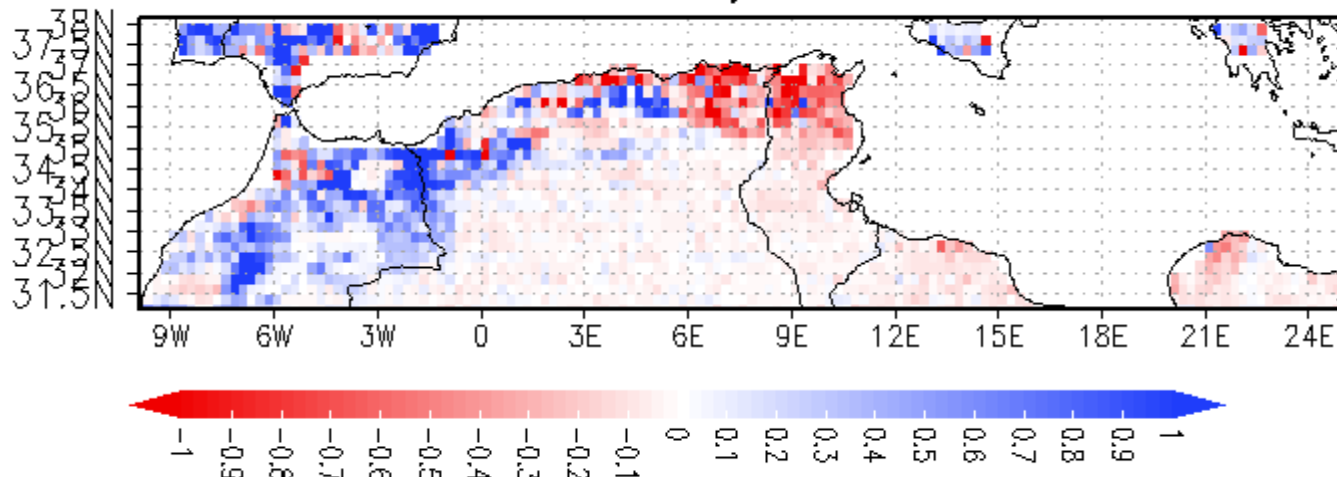


Tunisia

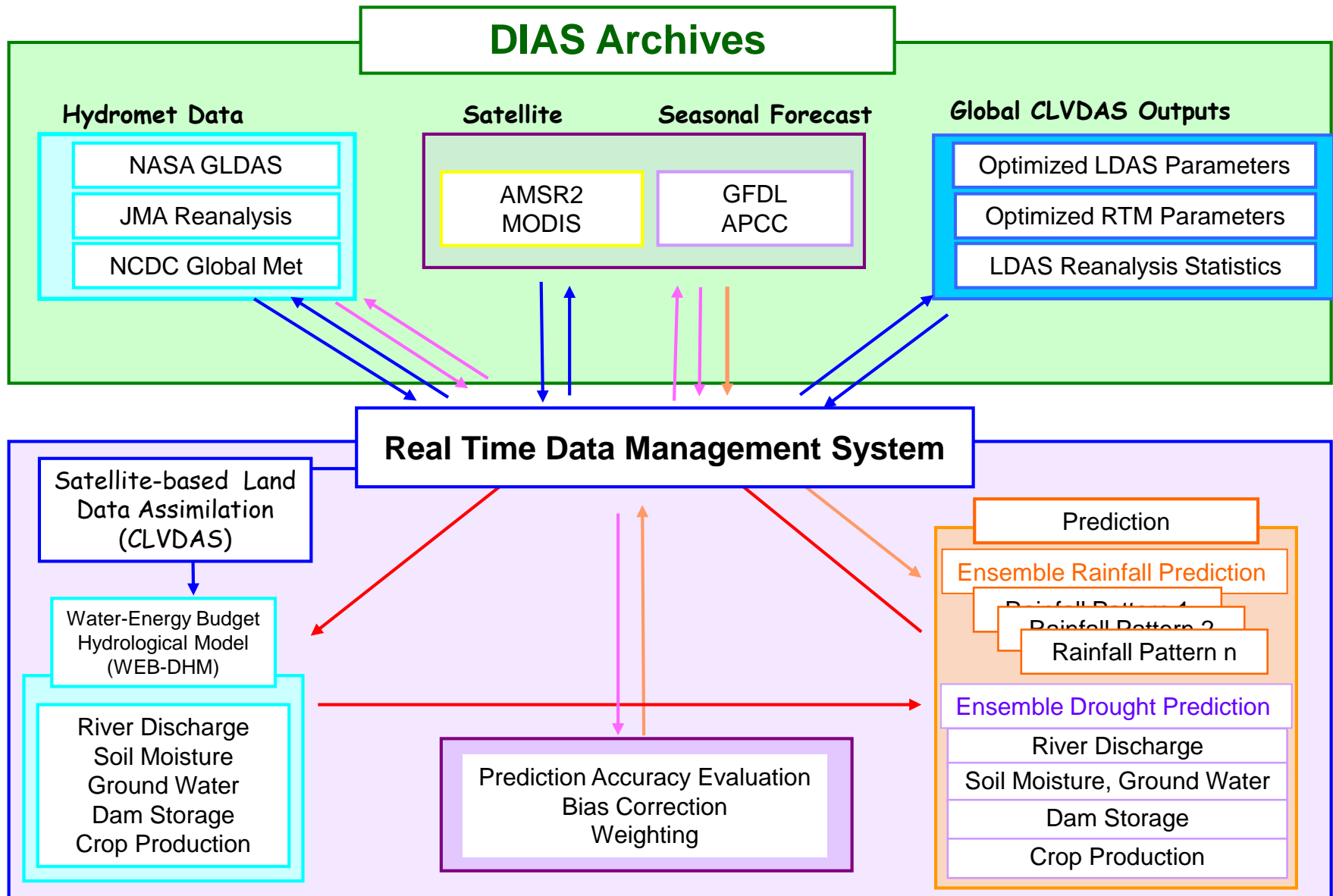


## LAI anomaly from CLVDAS

LAI anomaly 20100401



# Hydrometeorology-Agriculture Droughts Prediction System

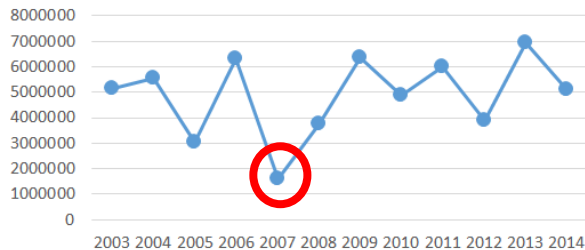


# Drought analysis

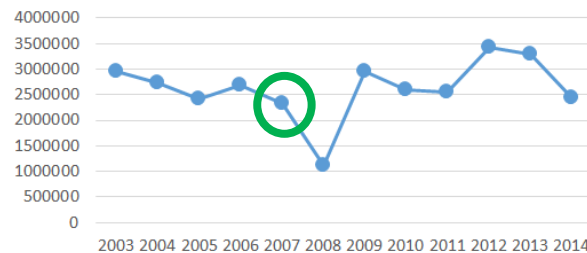
## Wheat production

### 2007 Morocco Drought

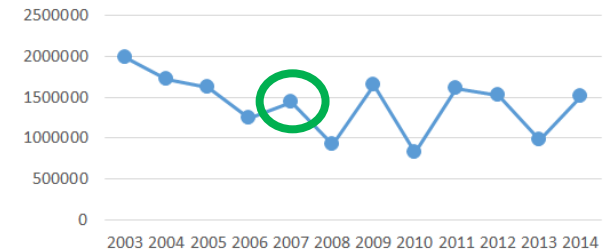
Morocco



Algeria

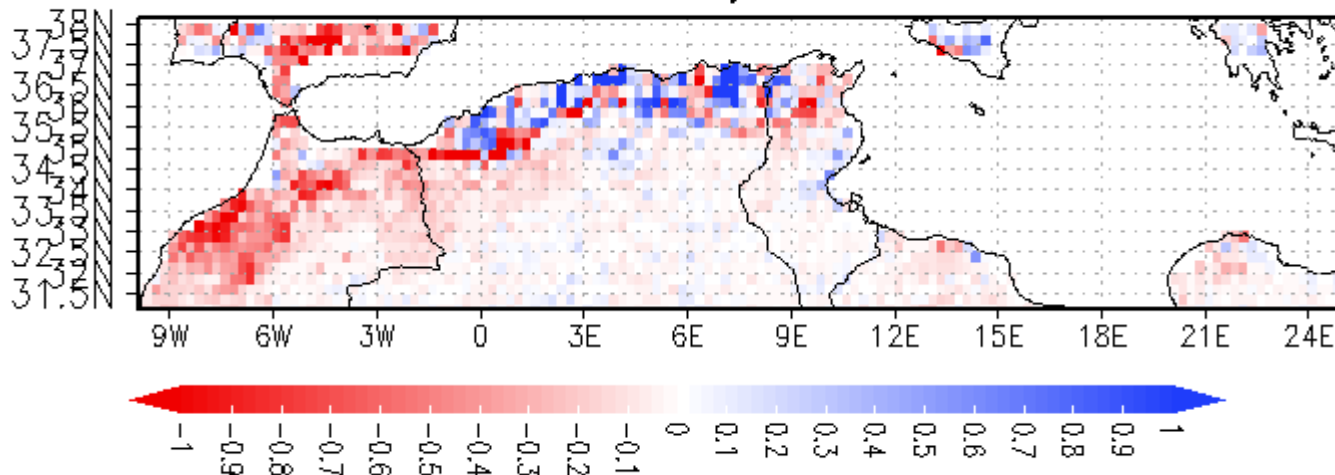


Tunisia



## LAI anomaly from CLVDAS

LAI anomaly 20070401





# Drought Early Warning System based on Satellite Land Data Assimilation

From 20070101 To 20070331 = 90days, 90frames

200701

200801

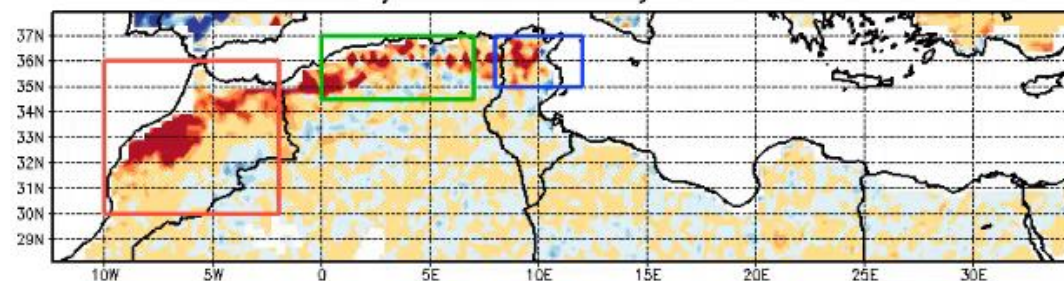
200802

200803

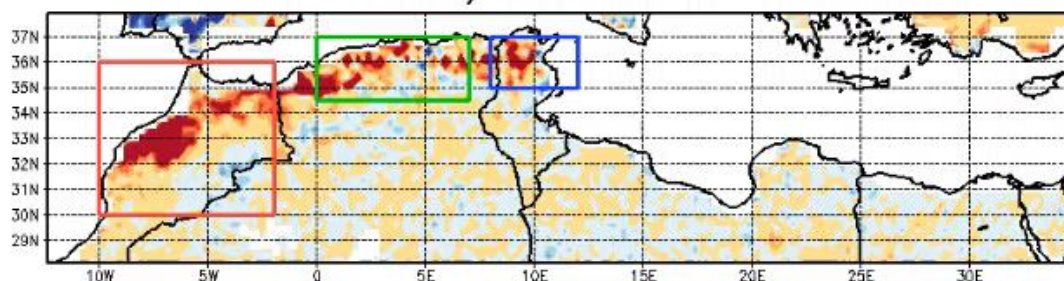
Loop: ☒ Int.: 100 (ms) #: 1 /90

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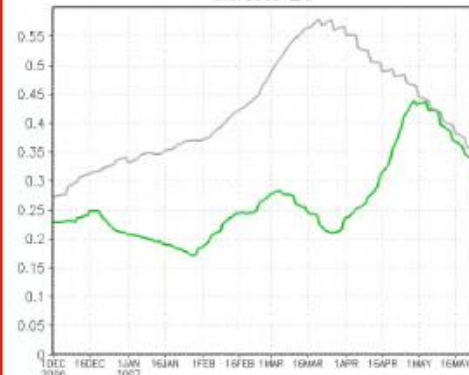
Reanalysis LAI anomaly 20070101



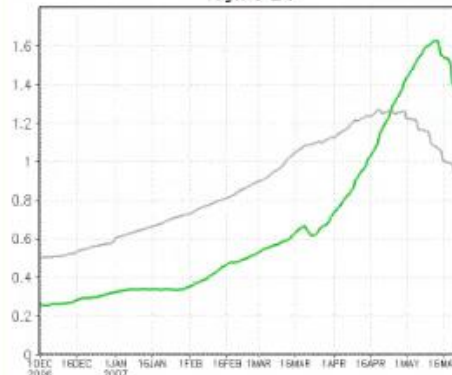
Forecast LAI anomaly ave 20070101 from 200701



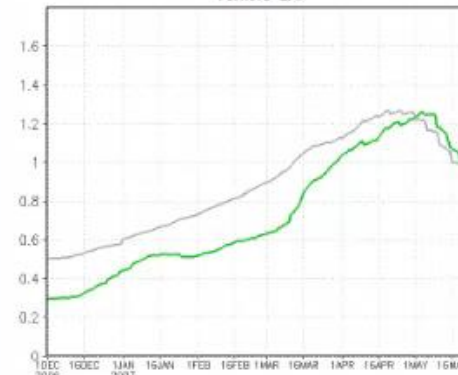
Morocco LAI



Algeria LAI



Tunisia LAI

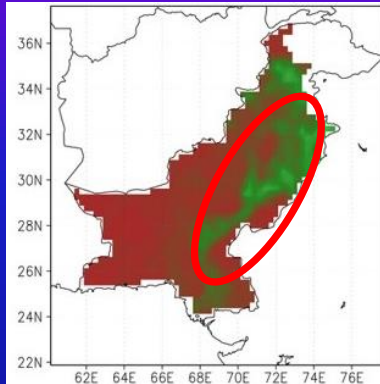
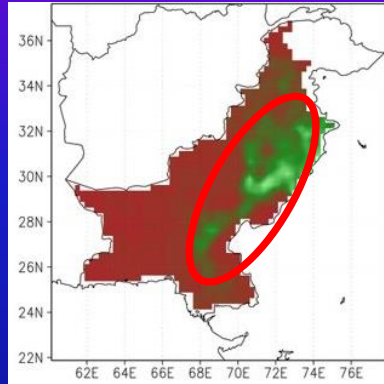


# Agricultural-Drought Monitoring in Panjab

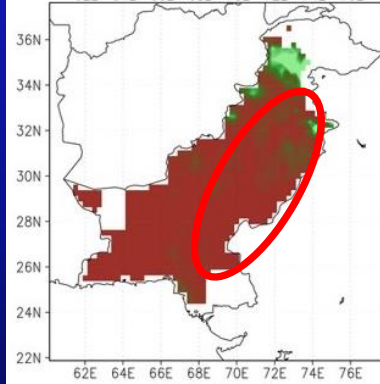
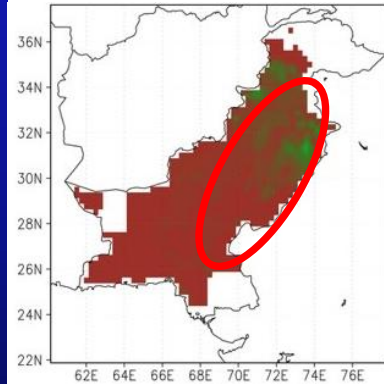
Winter, 2007

Summer, 2007

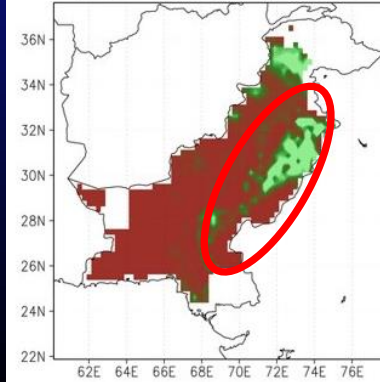
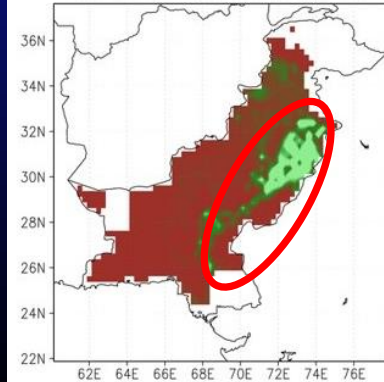
Satellite



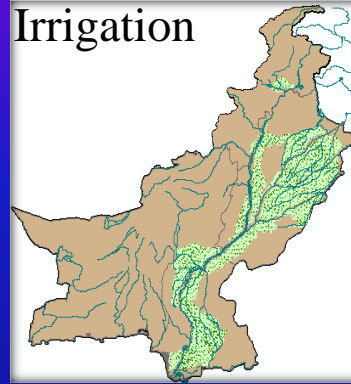
Preliminary



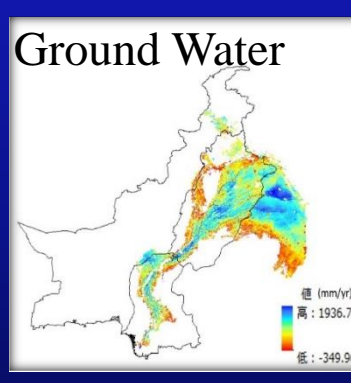
Improved



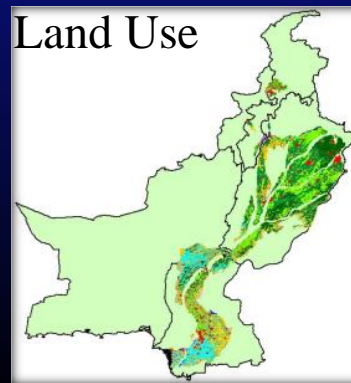
Irrigation



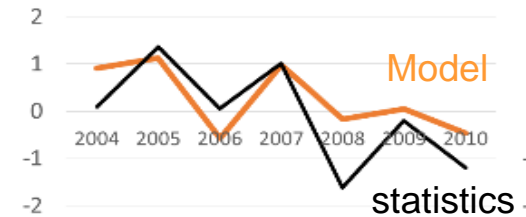
Ground Water



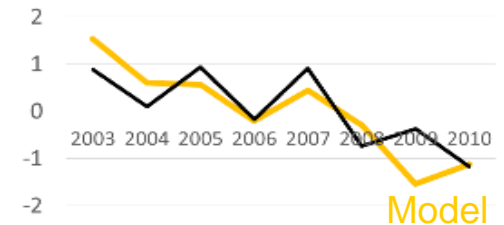
Land Use



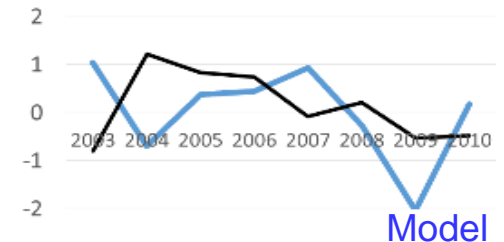
Punjab Wheat



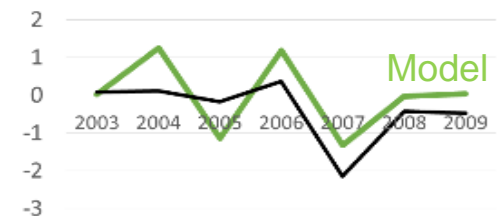
Punjab Rice



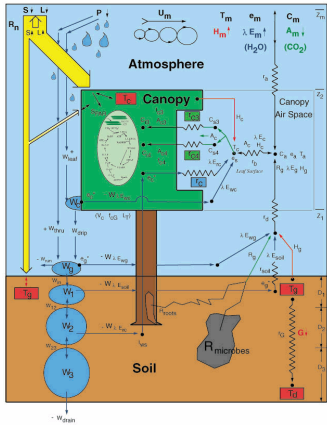
Punjab Cotton



ROP Sugarcane



## Energy and Water flux Balance



# Hydrometeorology-Agriculture Coupled Model

Rice Production

Dynamic Vegetation

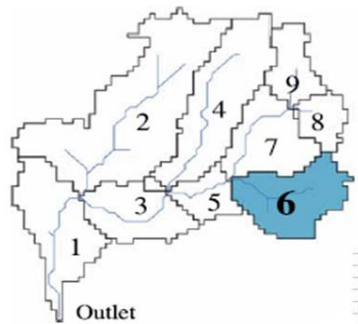
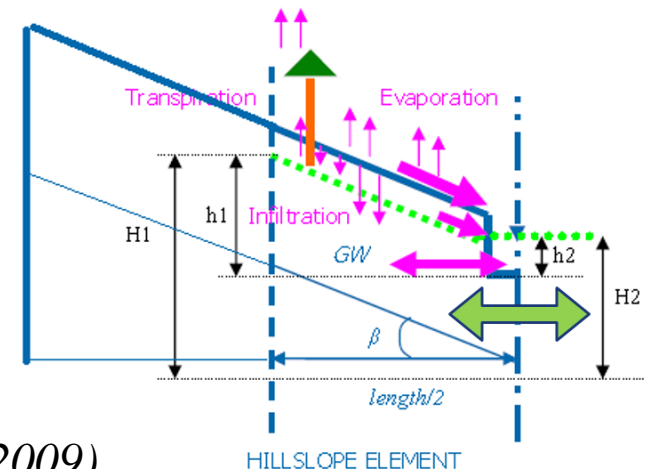
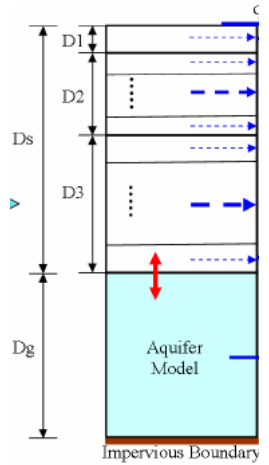
Irrigation System

Dam Operation

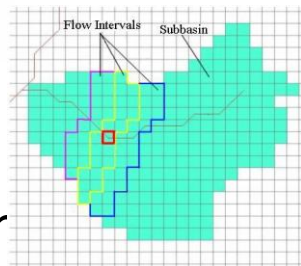
Water and Energy Budget Distributed Hydrological Model (WEB-DHM)

Vertical Soil moisture Profile

Lateral flow, Gridded to Flow-interval

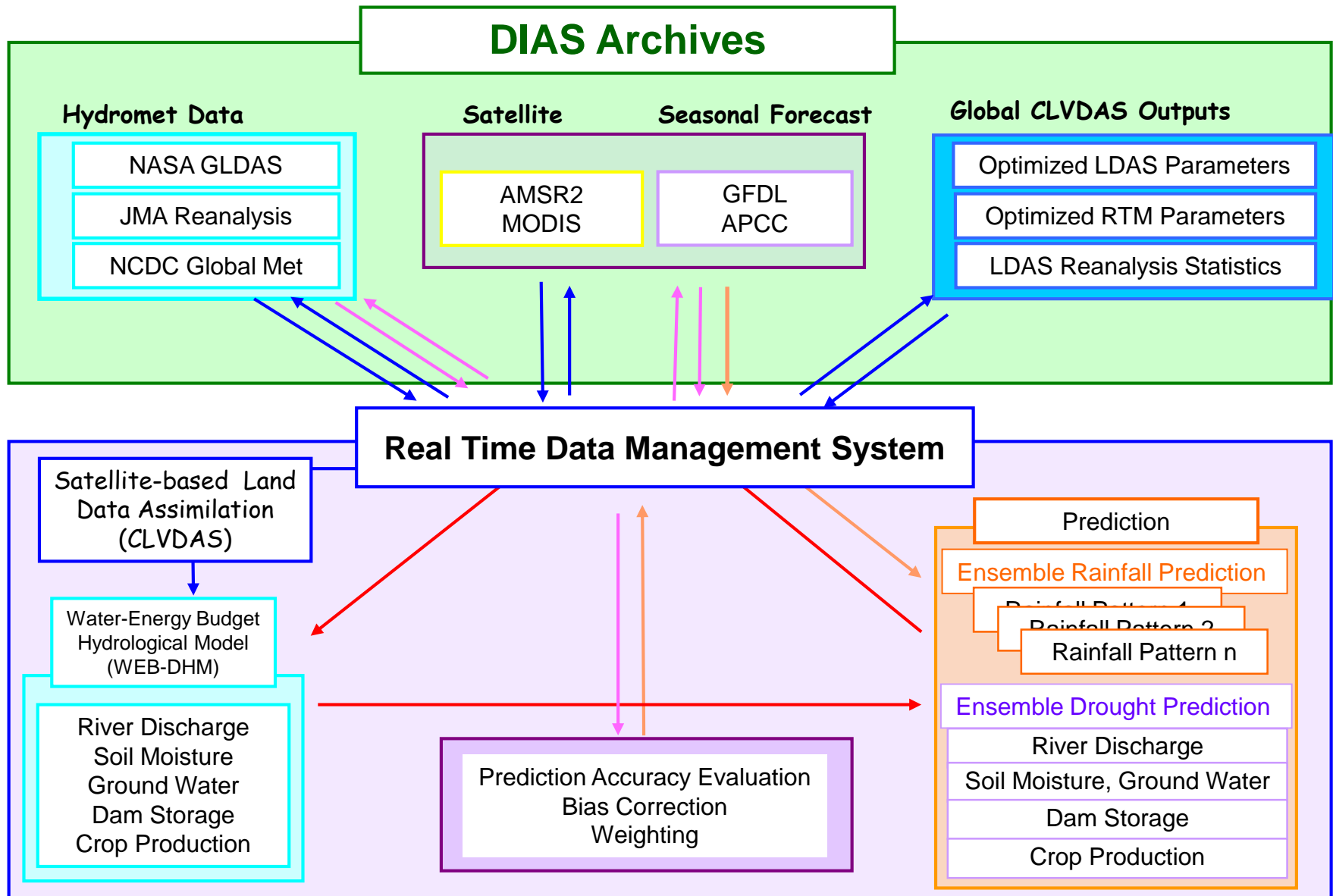


Riverflow Via Kinematic Wave Equator



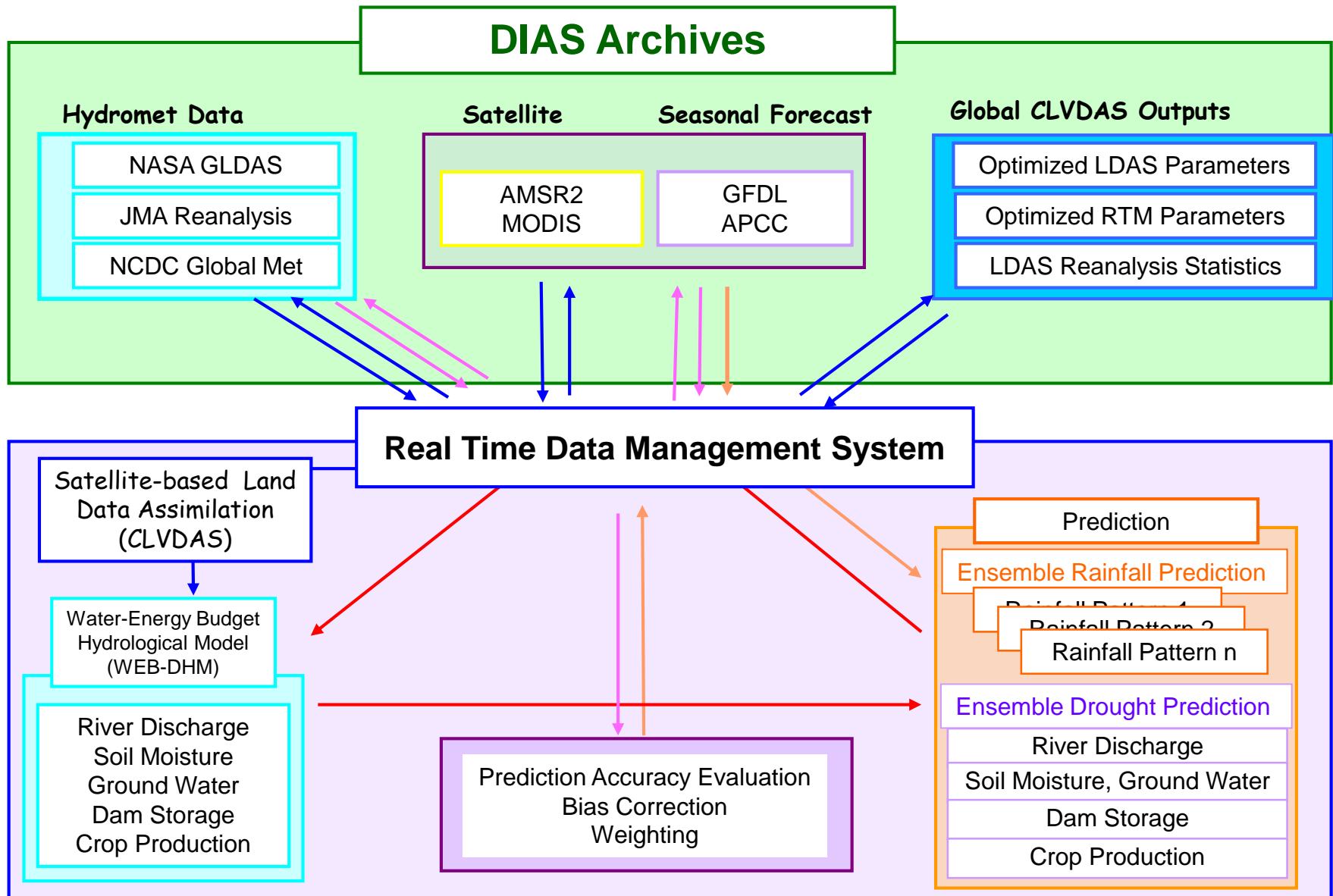
Wang, Koike, et al. JGR (2009)

# Hydrometeorology-Agriculture Droughts Prediction System





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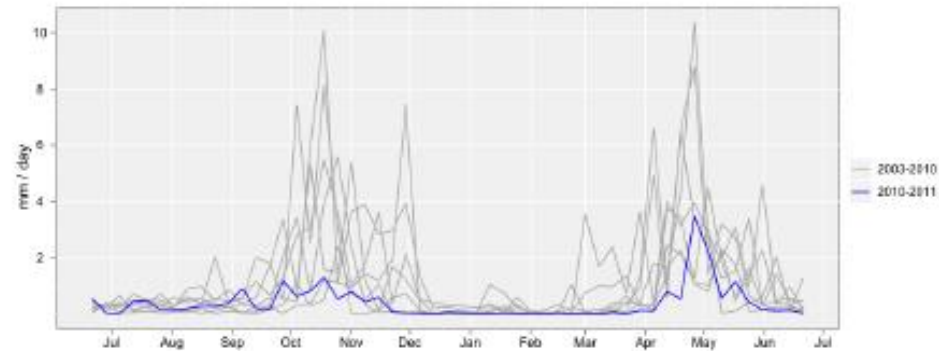
4 August 2011

### HIGHLIGHTS

- 12.4 million people are in urgent need of assistance in Djibouti, Ethiopia, Kenya and Somalia.
- Neighbouring countries – South Sudan, Sudan, and Uganda – all require support to ensure the crisis in the Horn of Africa does not spill over their borders.
- FAO funding gap as of 4 August 2011: USD 111.8 million.

### PRIORITY AGRICULTURAL CHALLENGES

- protecting livestock assets by preventing livestock disease outbreaks to ensure the continued functioning of vital livestock export markets.
- enabling farmers to plant during the coming rainy season to ensure the availability of food in the next season.
- increasing households' access to food through cash-for-work that has a longer-term benefit in terms of rehabilitating vital agricultural infrastructure.



Satellite Land Data Assimilation  
: 30days, 60frames



From: Interval

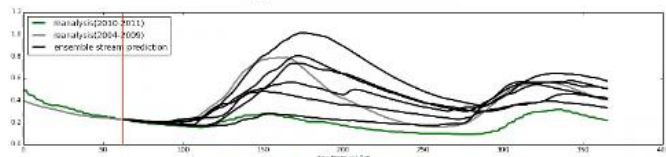
201009 201011 201101 201103 201105

1 Day 3 Days 5 Days 7 Days 10 Days

Loop: Int: 300 (ms) #1 /60

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Reanalysis + 2003-2008 ensemble



Reanalysis + m1-m12 ensemble

