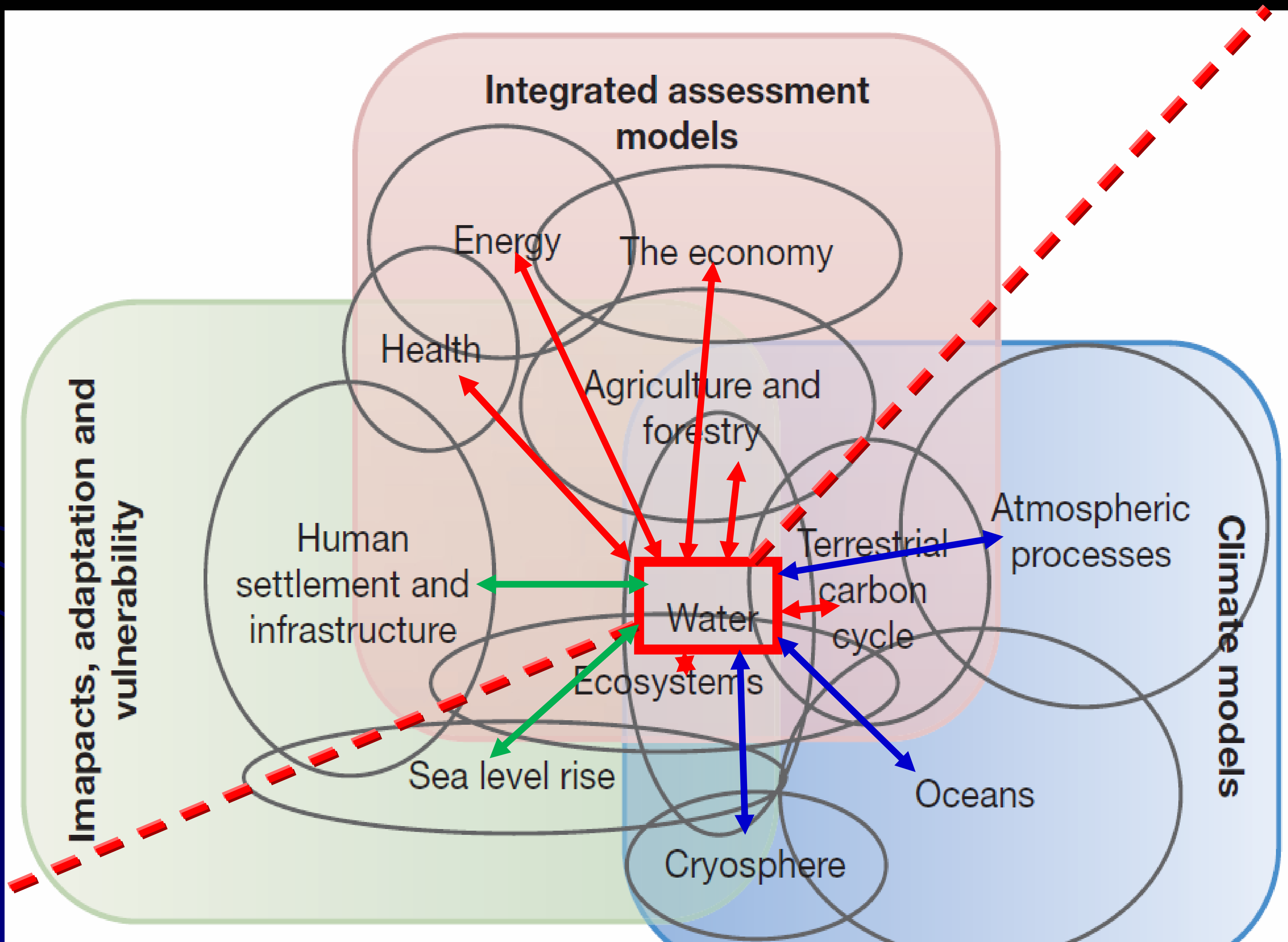
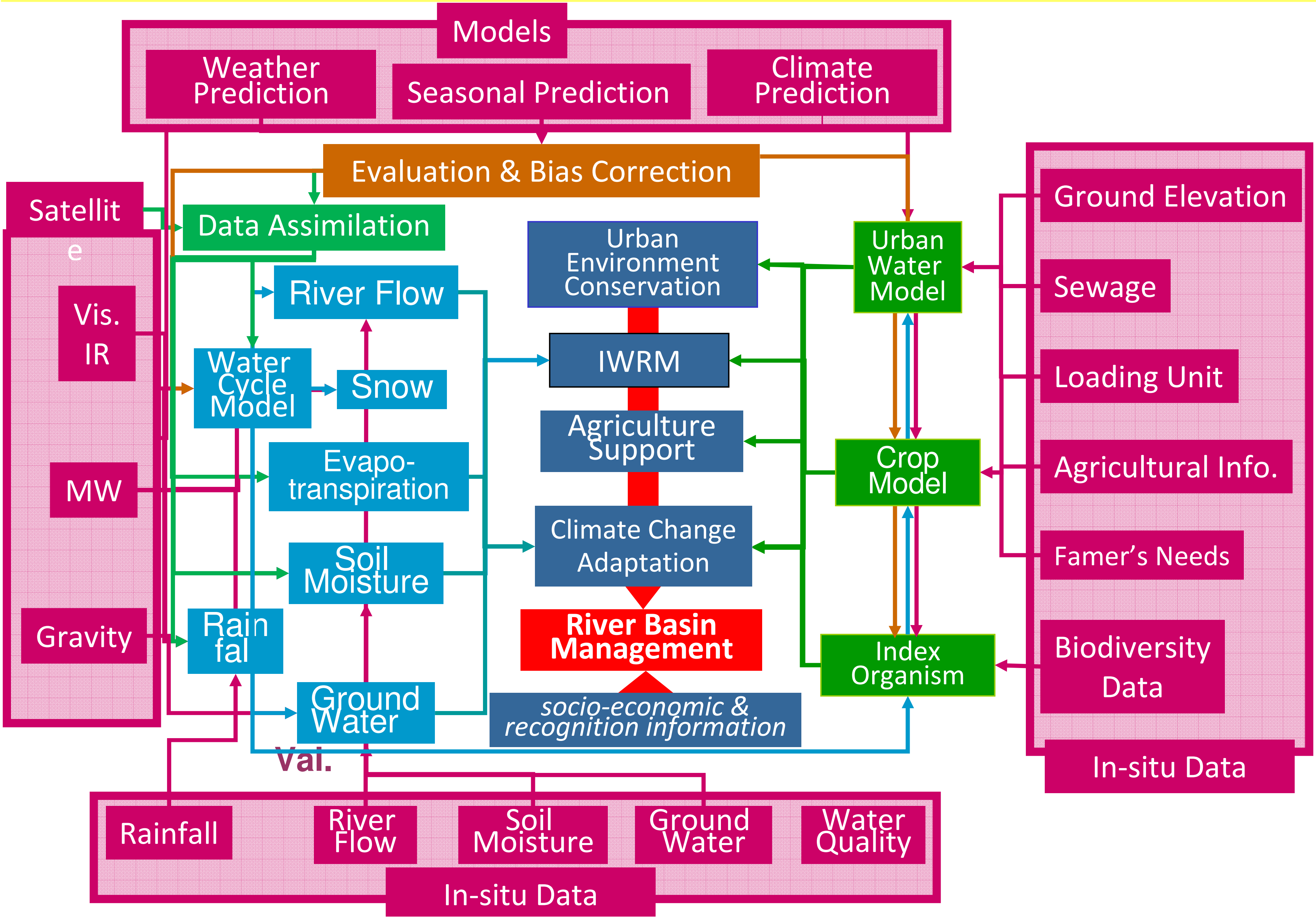
Water is a Key
bridging between climate processes and societal benefits.

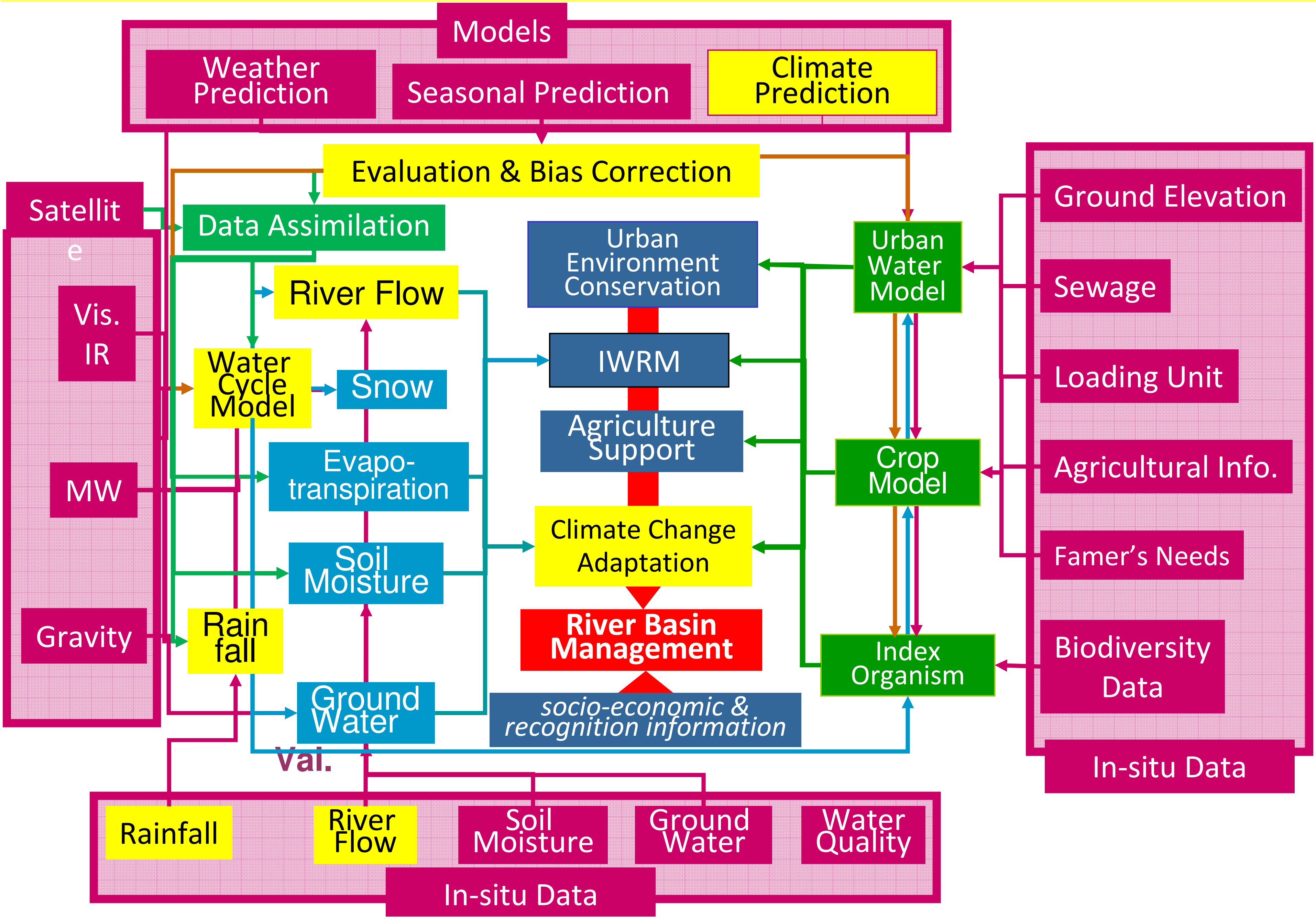


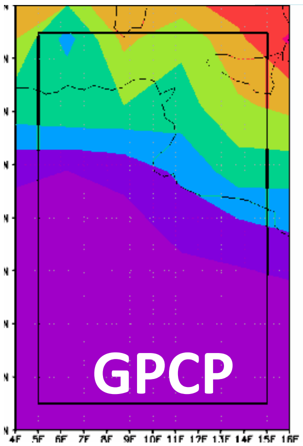
(Richard H. Moss, et al., *Nature*, 2010)

Water Cycle Integrator

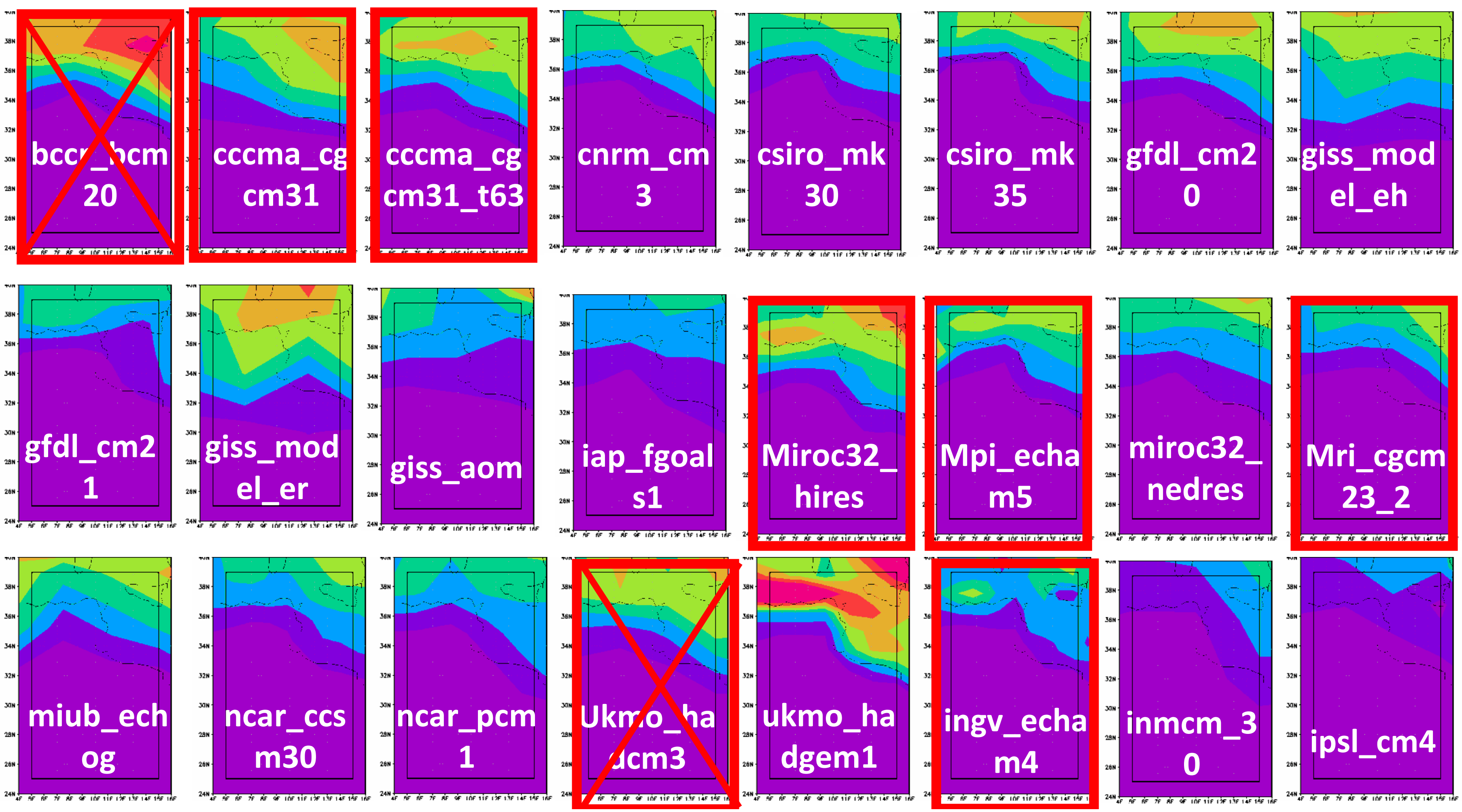


Water Cycle Integrator



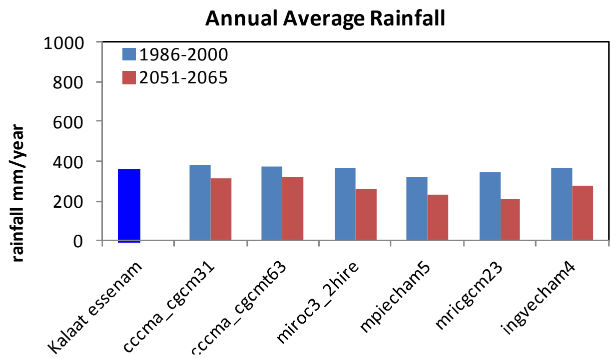


Mejerda River
Precipitation Oct – Jan (1981-2000)

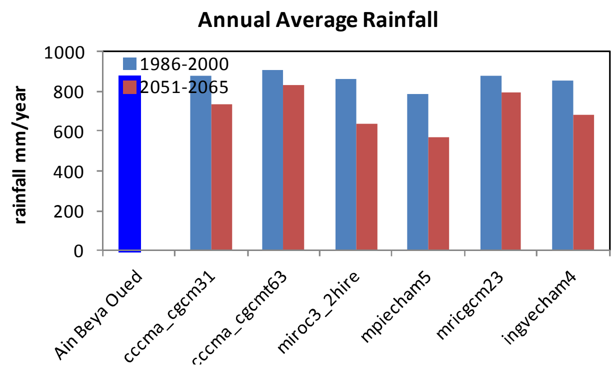


Mejerda River

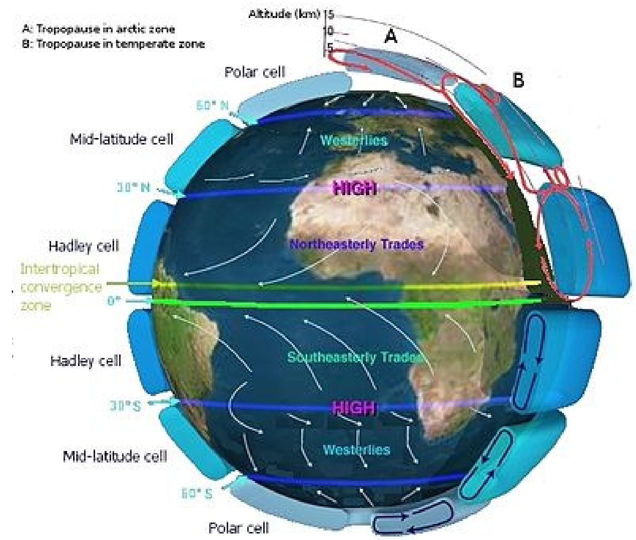
It is virtually certain that drought will become more severe.

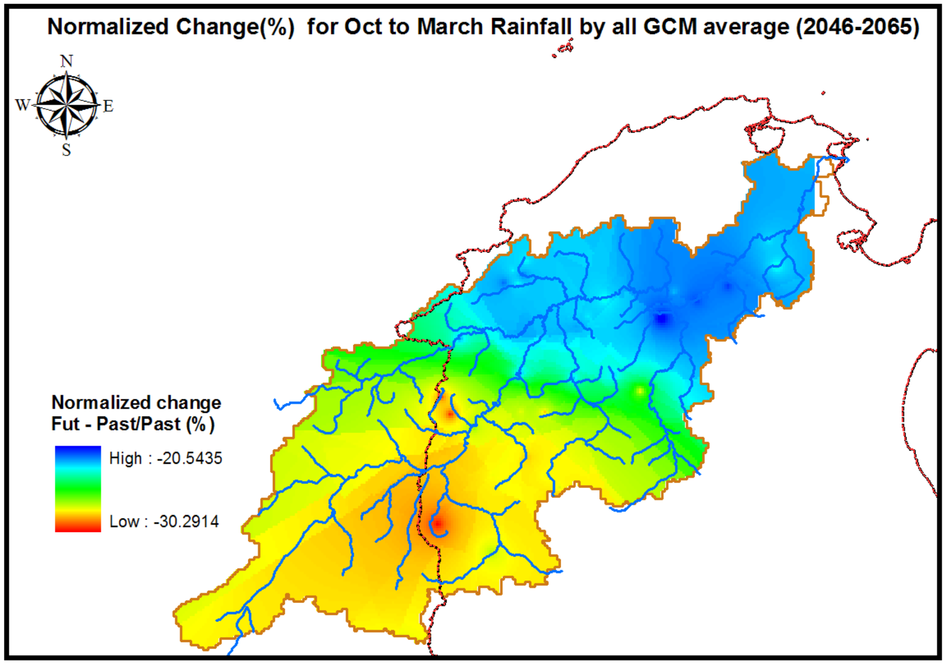


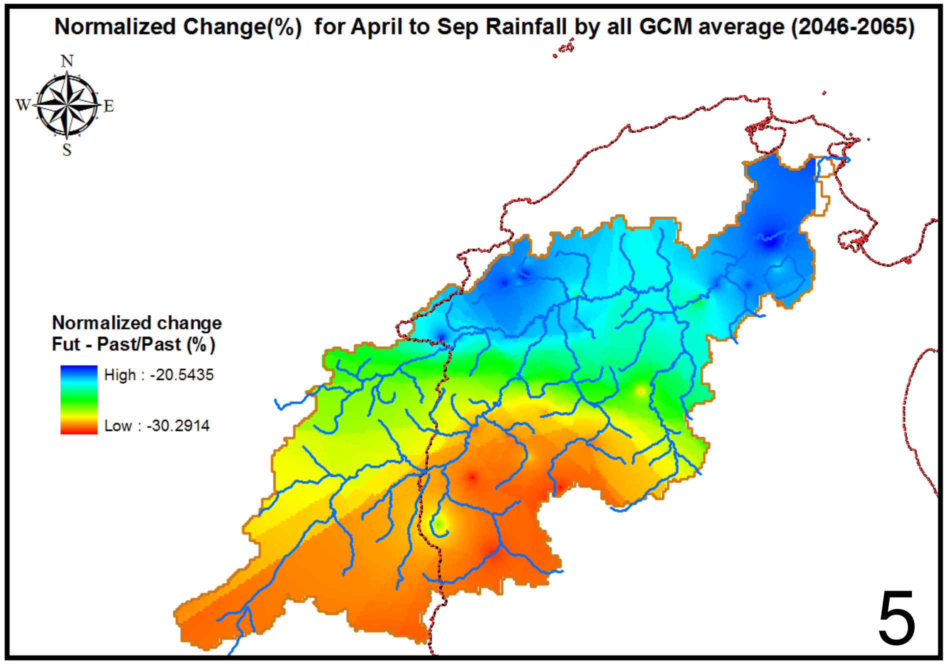
KALAAT ESSENAM



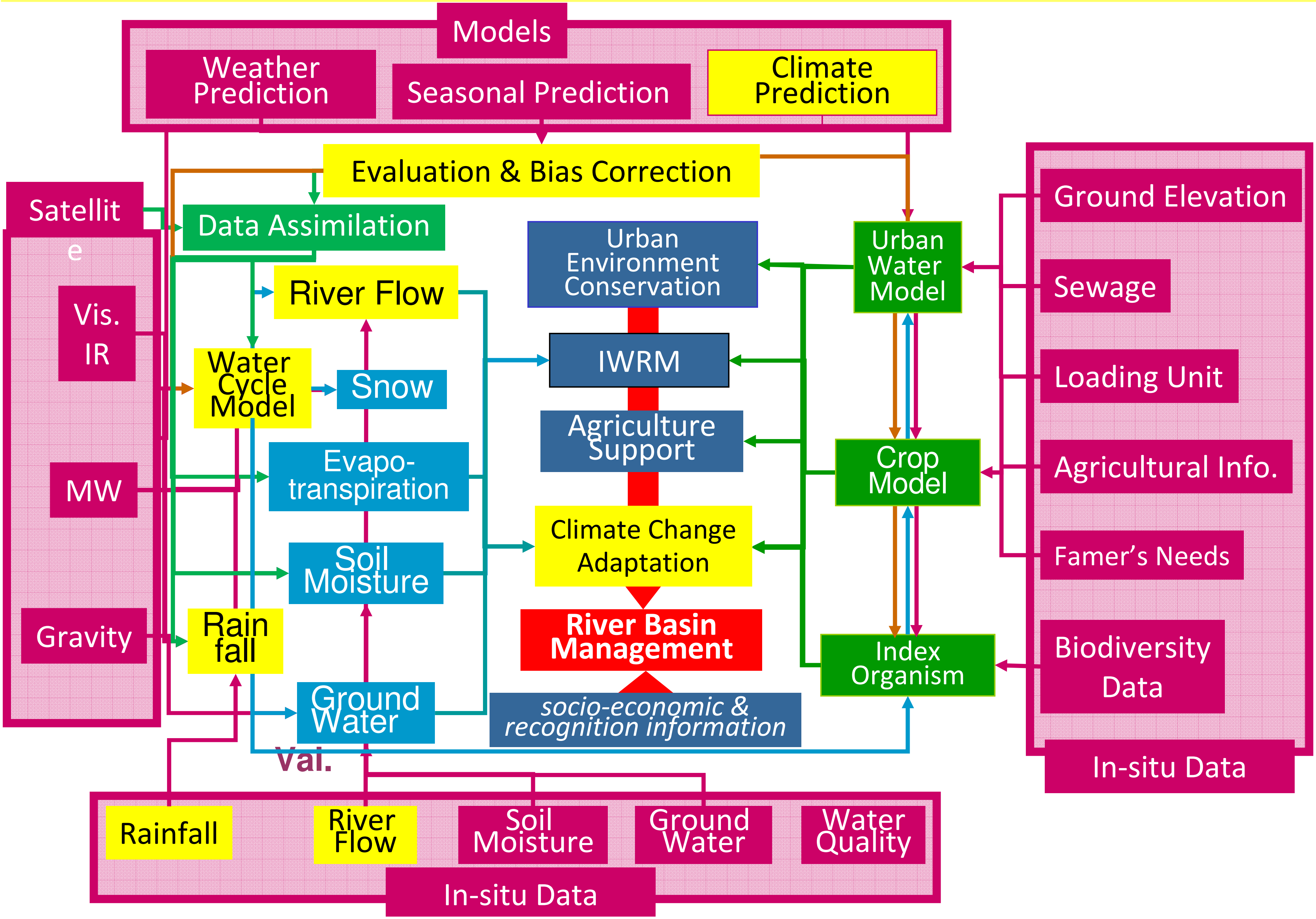
AIN BEYA OUED

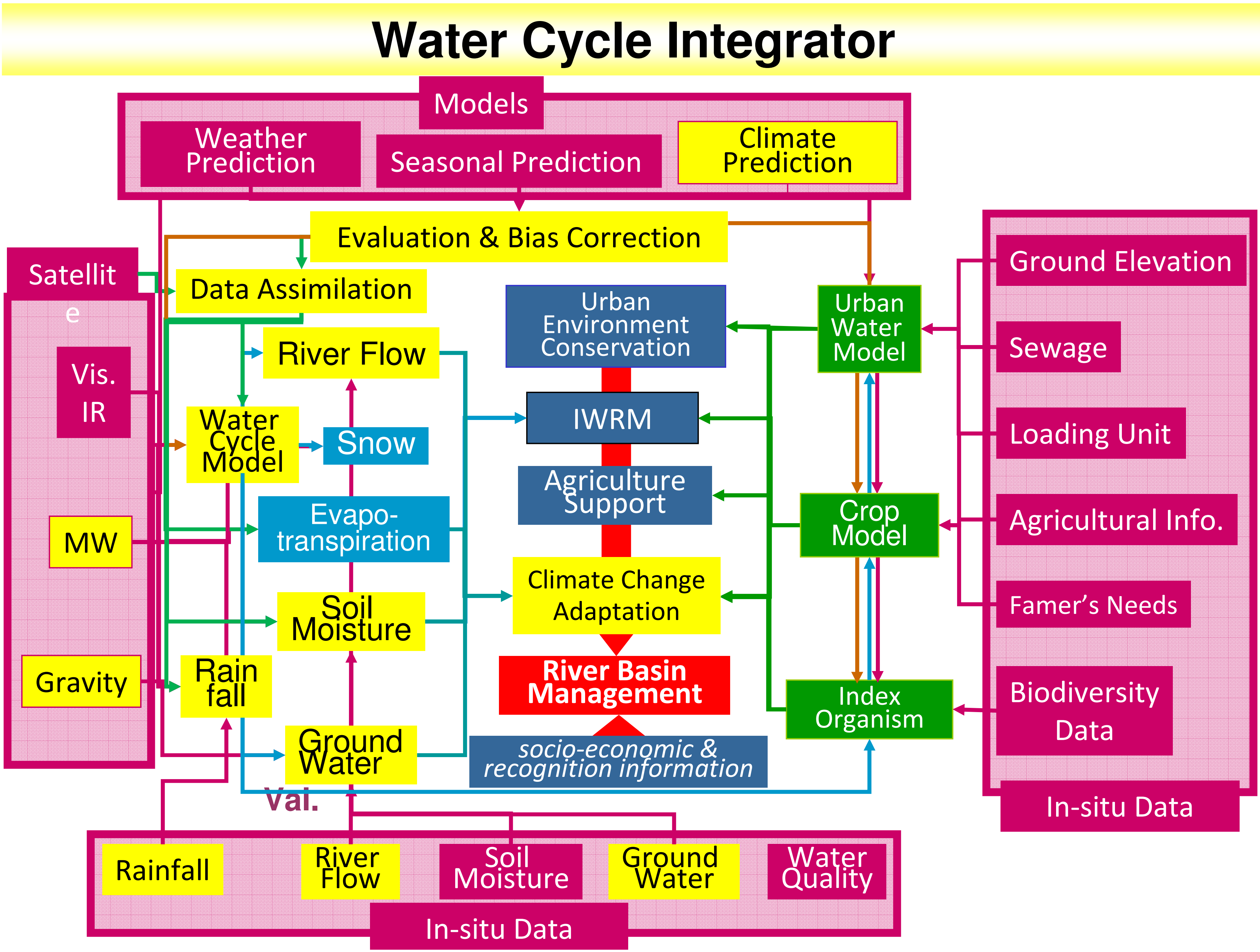




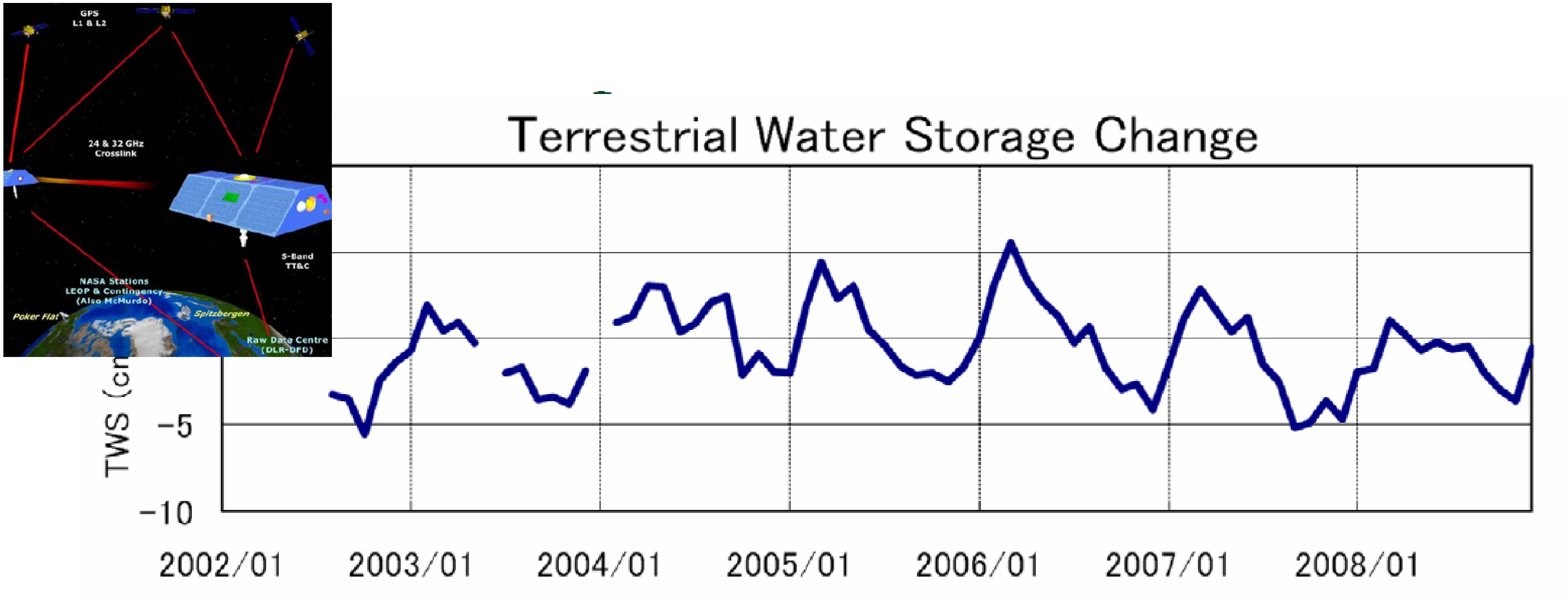


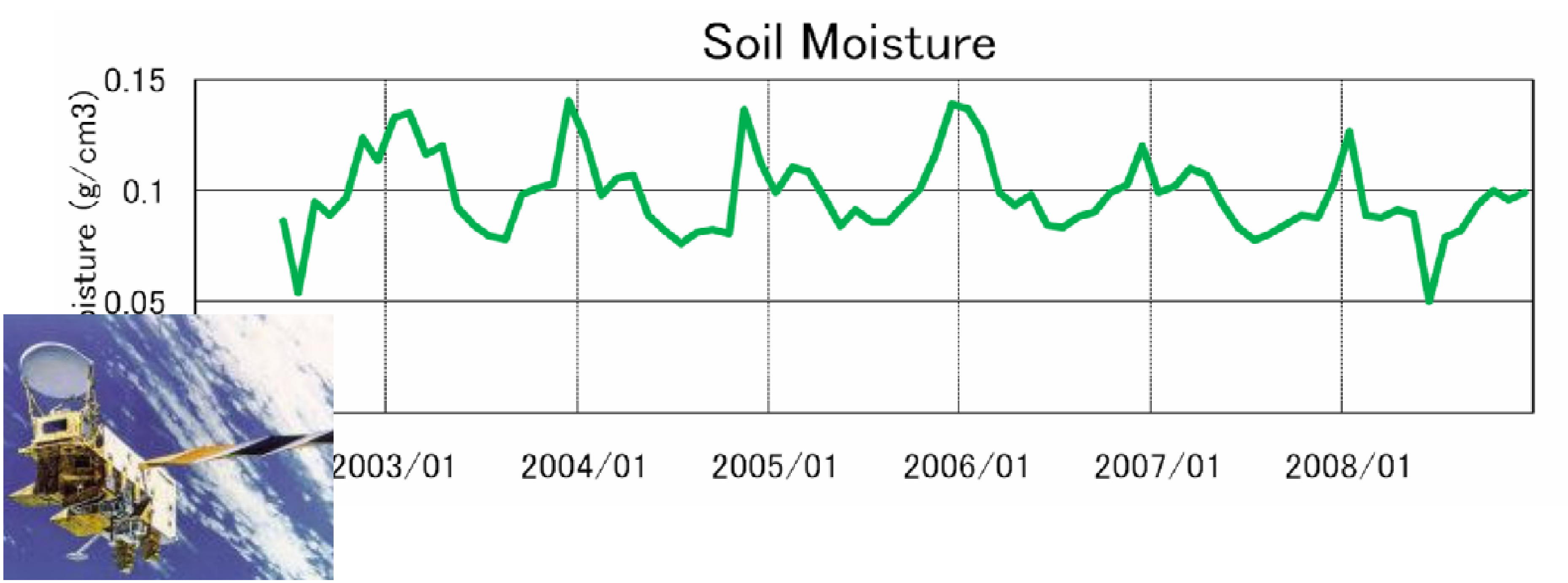
Water Cycle Integrator

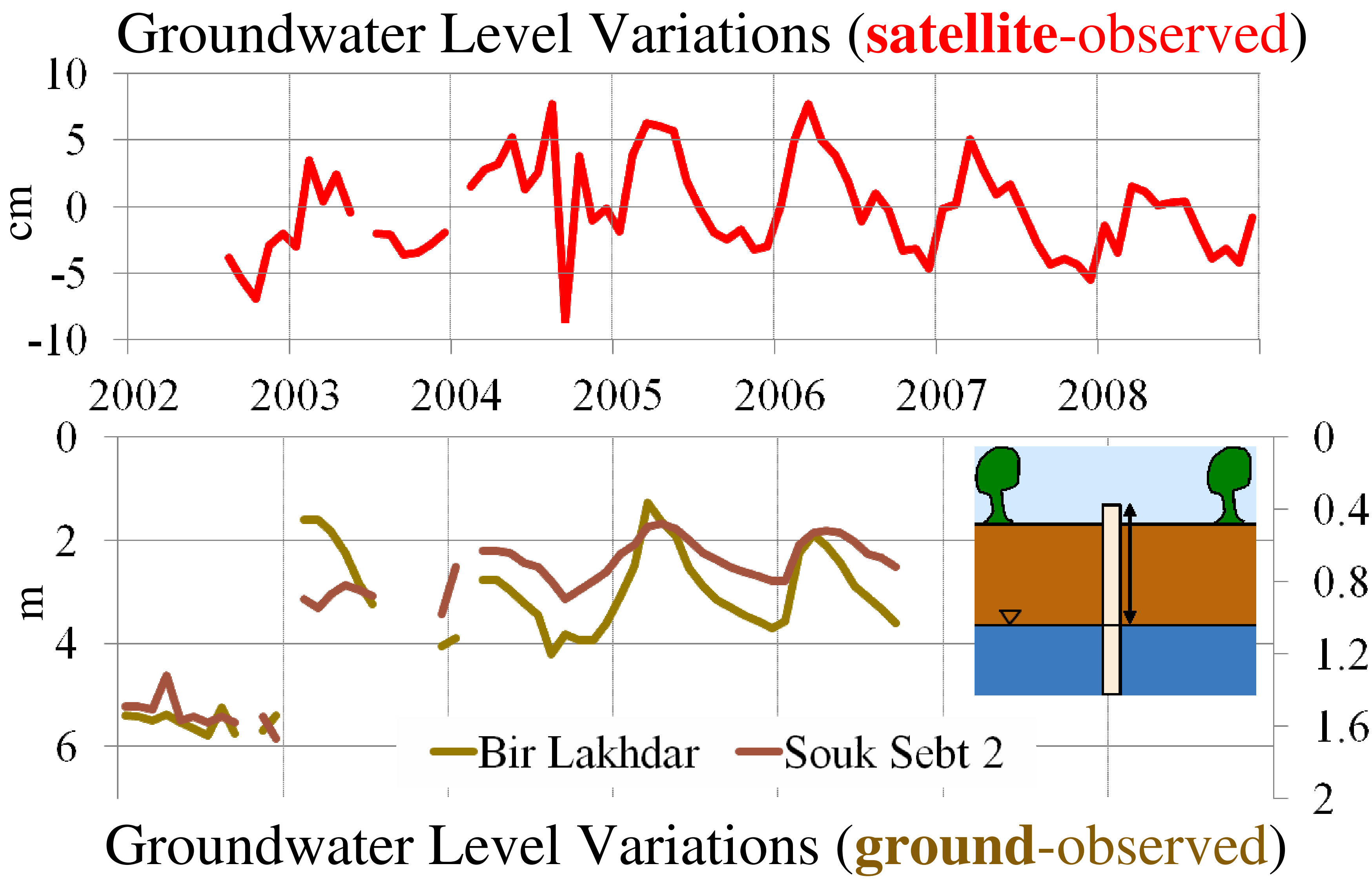




Water Cycle Integrator
Models
Weather Prediction
Seasonal Prediction
Climate Prediction
Evaluation & Bias Correction
Satellite
Data Assimilation
Vis. IR
MW
Gravity
River Flow
Water Cycle Model
Snow
Evapo-transpiration
Soil Moisture
Rain fall
Ground Water
Val.
Urban Environment Conservation
IWRM
Agriculture Support
Climate Change Adaptation
River Basin Management
socio-economic & recognition information
Urban Water Model
Crop Model
Index Organism
Ground Elevation
Sewage
Loading Unit
Agricultural Info.
Famer's Needs
Biodiversity Data
In-situ Data
Rainfall
River Flow
Soil Moisture
Ground Water
Water Quality
In-situ Data

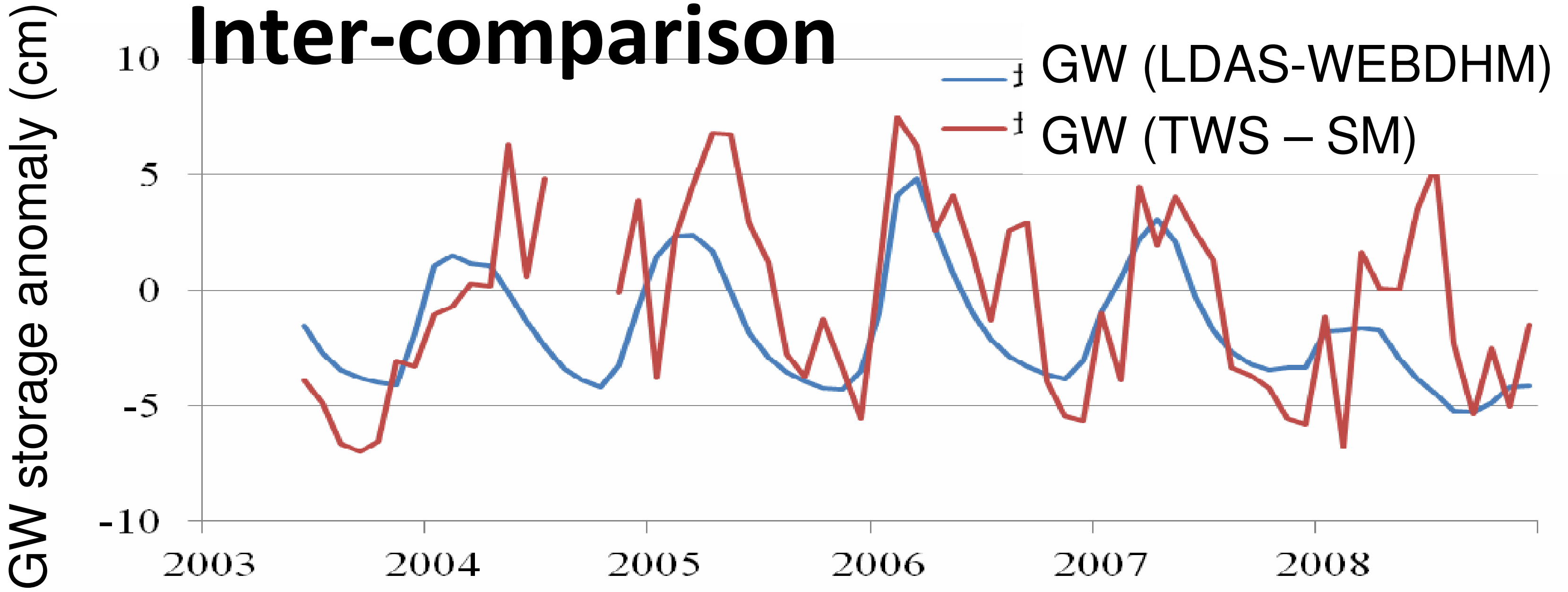

GPS
L1 & L2
24 & 32 GHz
Crosslink
S-Band
TT&C
NASA Stations
LEOP & Contingency
(Also McMurdo)
Poker Flat
Spitzbergen
Raw Data Centre
(DLR-DFD)
Terrestrial Water Storage Change
TWS
−5
−10
2002/01
2003/01
2004/01
2005/01
2006/01
2007/01
2008/01


Soil Moisture
(g/cm3)
0.15
0.1
0.05
2003/01
2004/01
2005/01
2006/01
2007/01
2008/01

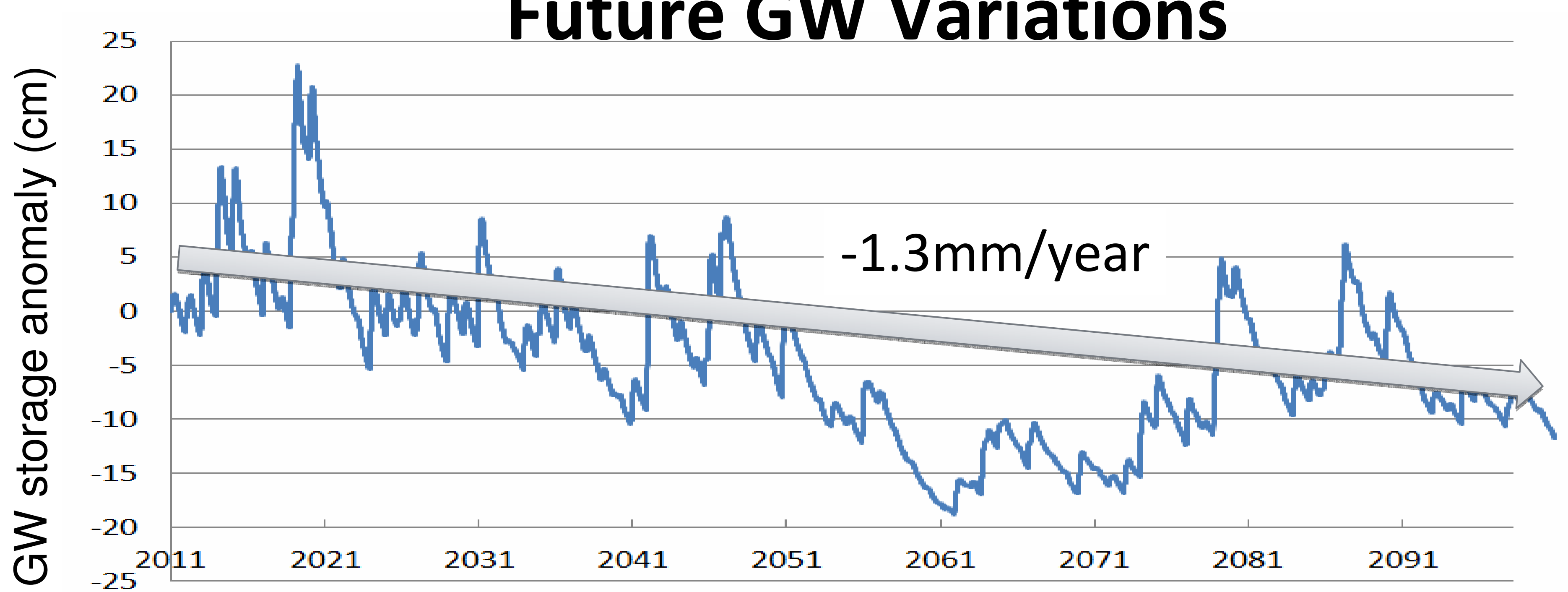


Groundwater Level Variations (satellite-observed)
10
5
0
-5
-10
cm
2002
2003
2004
2005
2006
2007
2008
0
2
4
6
m
0
0.4
0.8
1.2
1.6
2
Bir Lakhdar
Souk Sebt 2
Groundwater Level Variations (ground-observed)

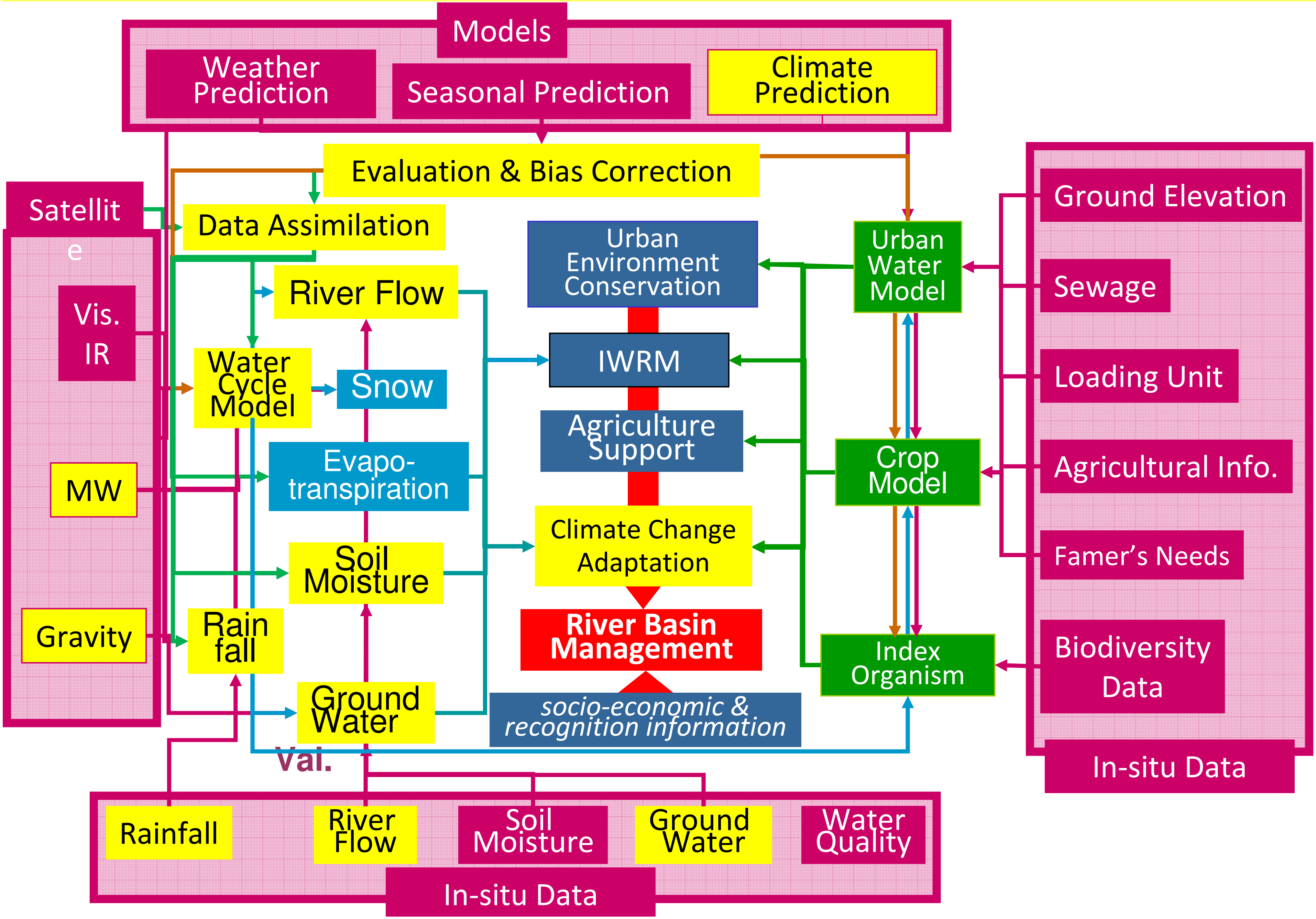
Inter-comparison



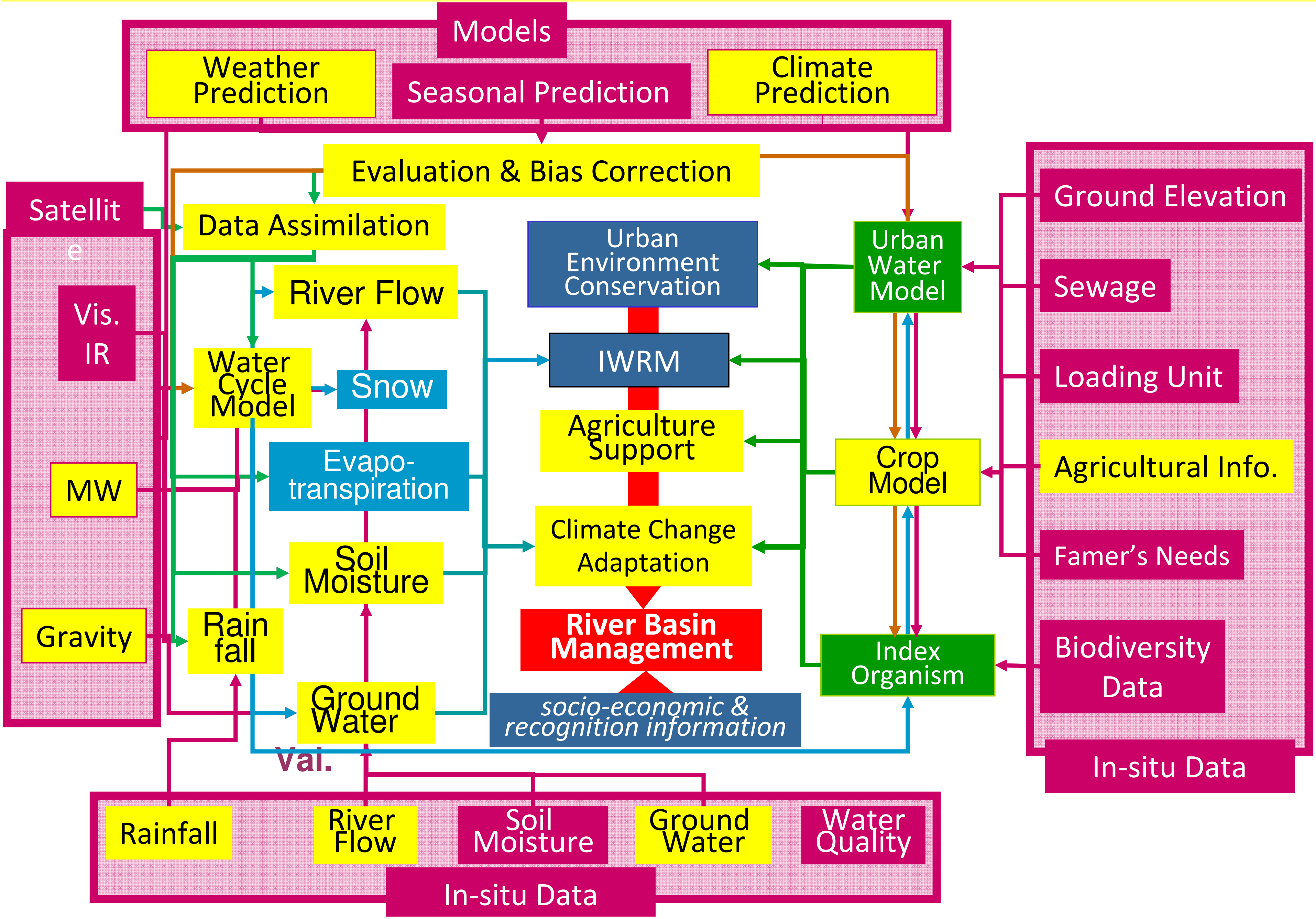
Future GW Variations



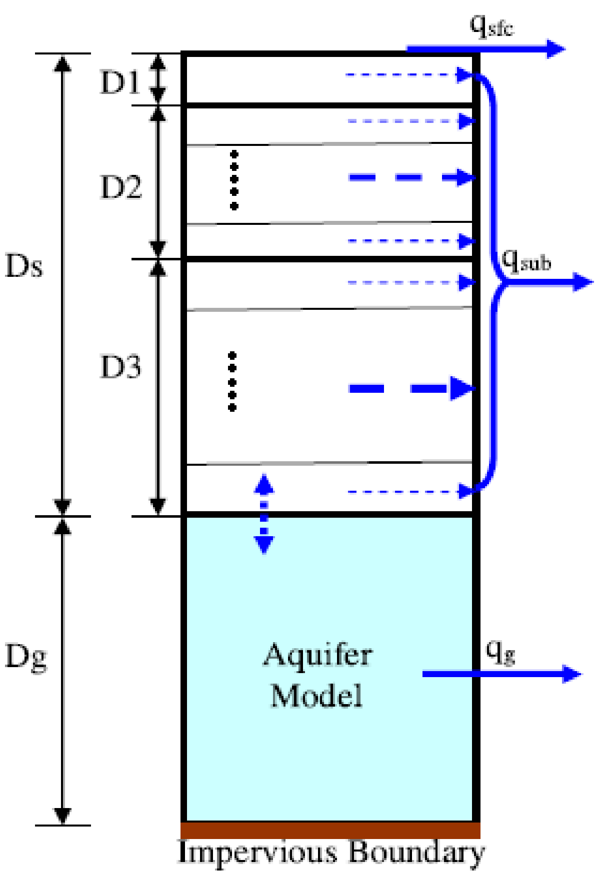
Water Cycle Integrator



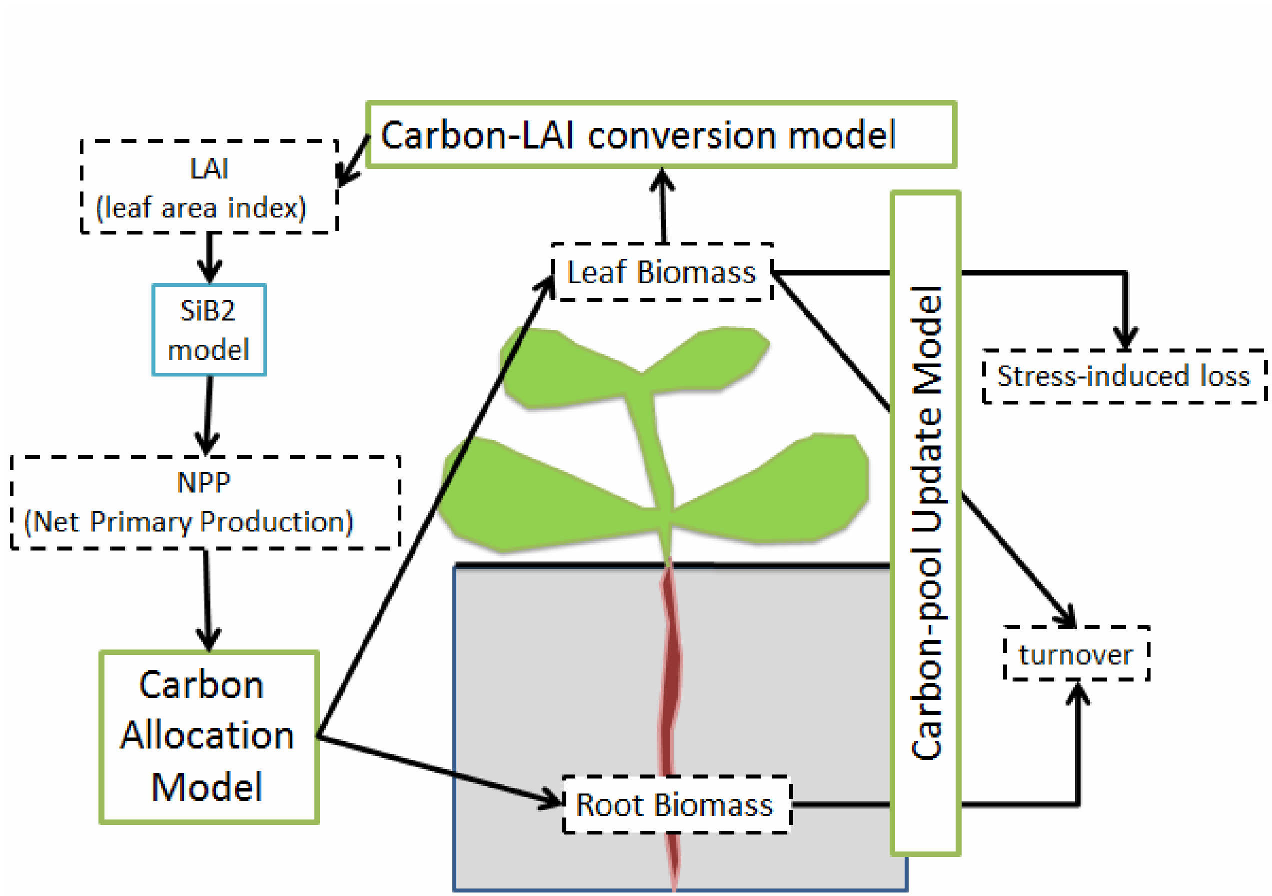
Water Cycle Integrator



Hydro-SiB

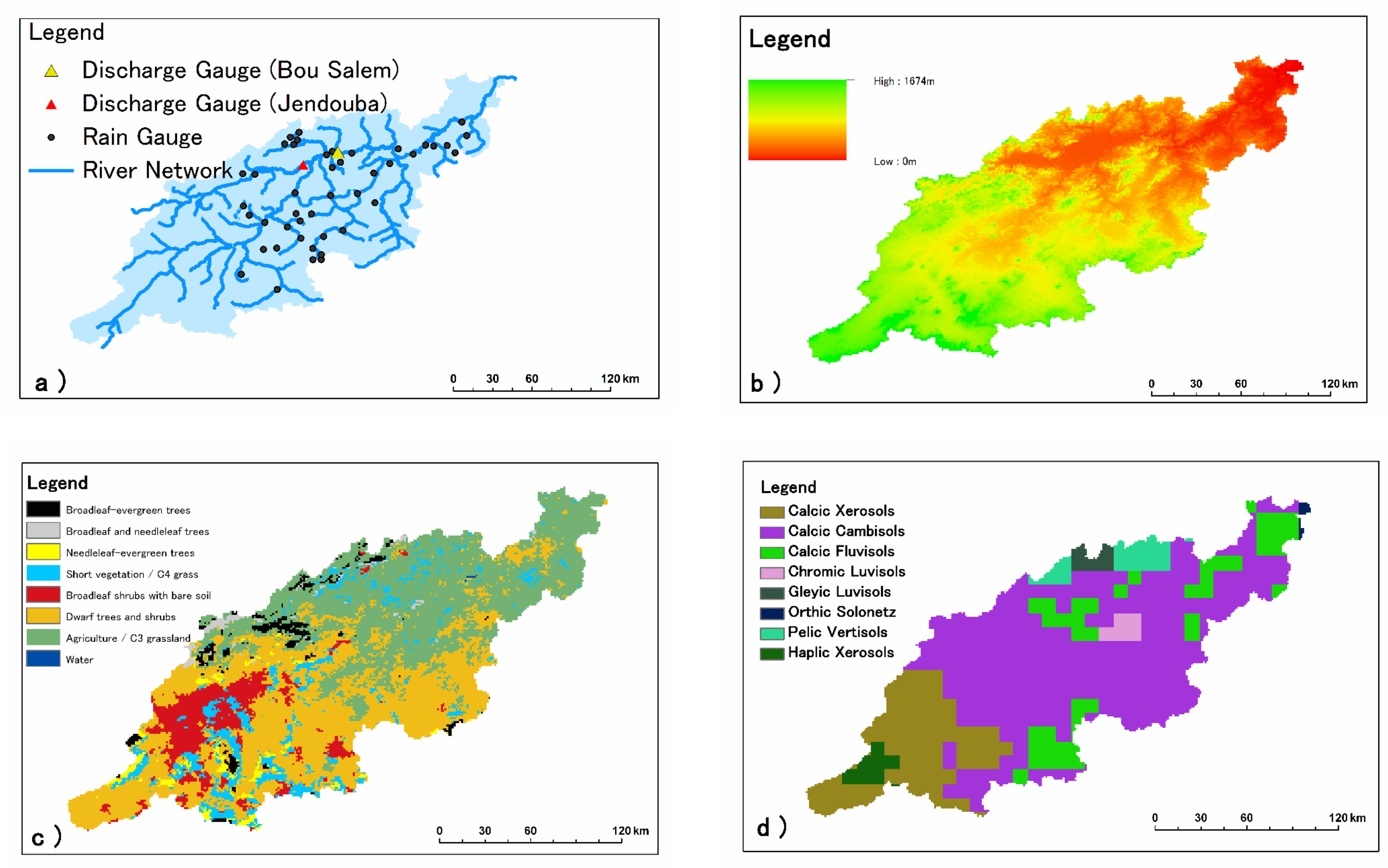


Dynamic Vegetation Model (DVM)



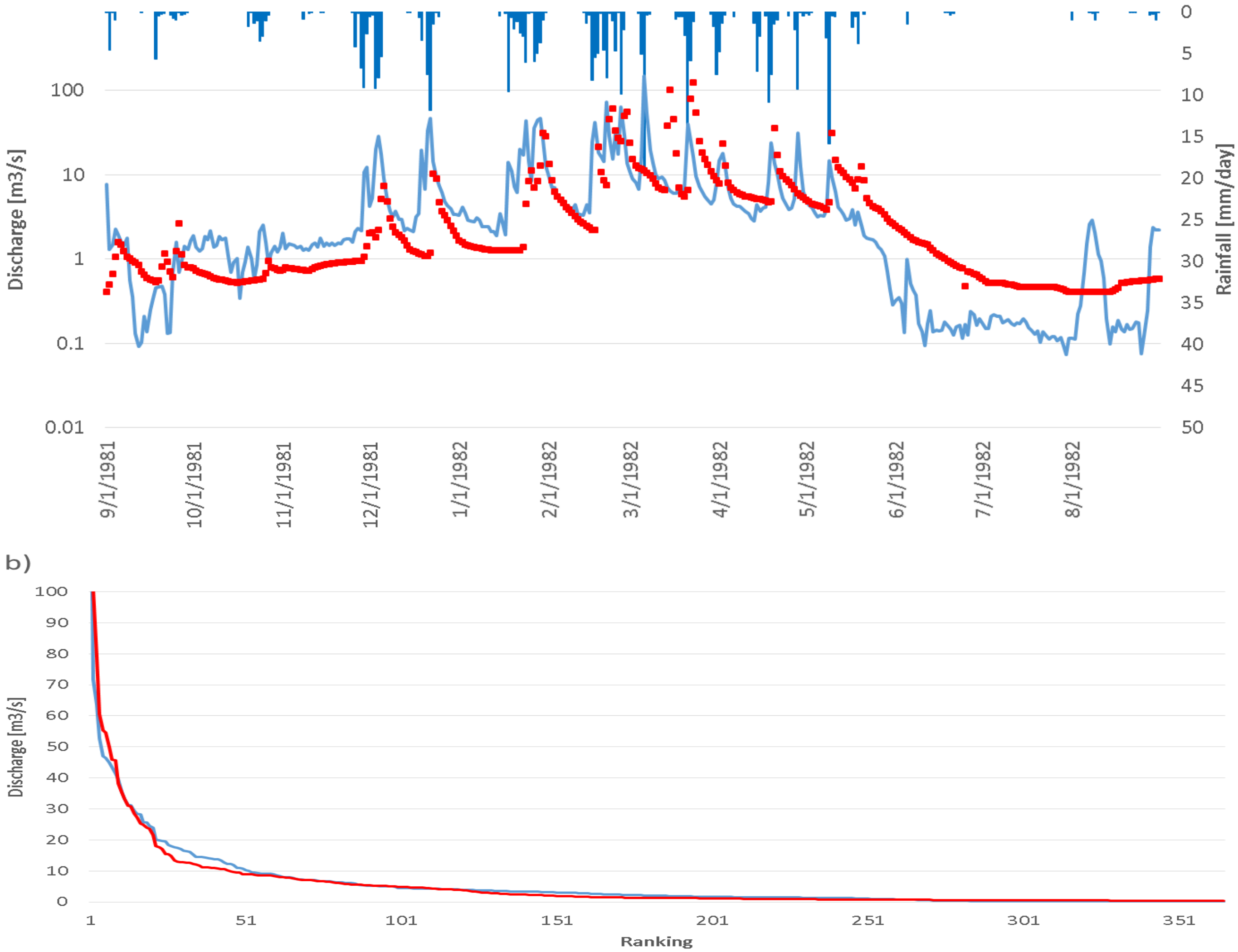
1. Carbon Allocation Model allocates net primary production to leaf and root carbon pool.
2. Carbon-pool Update Model calculates carbon loss as normal turnover and drought stress loss.
3. Carbon-LAI conversion model calculates leaf area index, which is needed to run land surface model at next time step.

Eco-hydrologicalal Model for Identification of Droughts



Medjerda River Basin. a) Discharge gauge, rain gauge, and river networks from DEM. b) Topography delineated by DEM. c) Land-use type. d) Soil type.

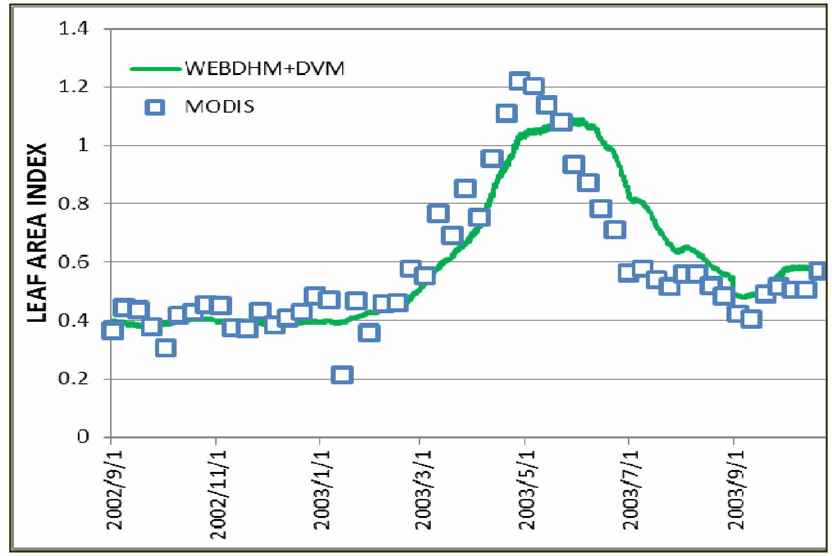
Eco-hydrologicalal Model for Identification of Droughts

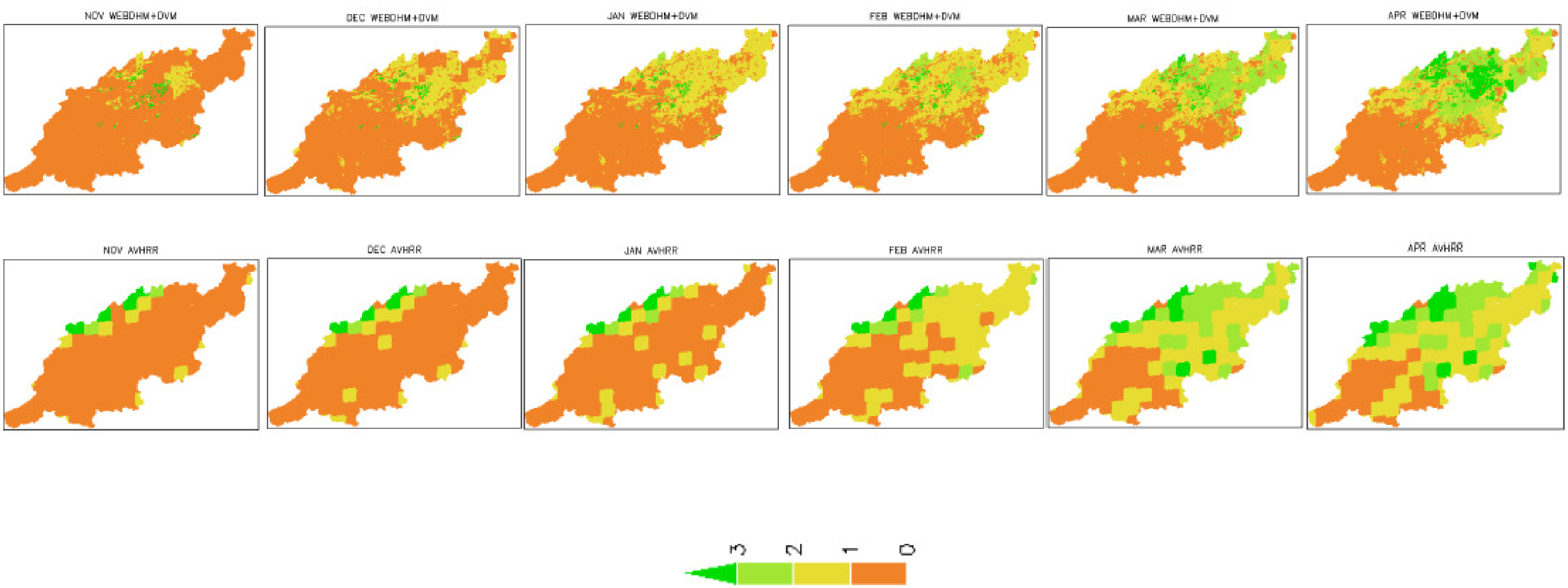


a) Simulated (blue line) and observed (red dots) daily river discharge, and
b) Flow duration curve of simulated (blue) and observed (red) daily river discharge at Jendouba from September 1981 to August 1982

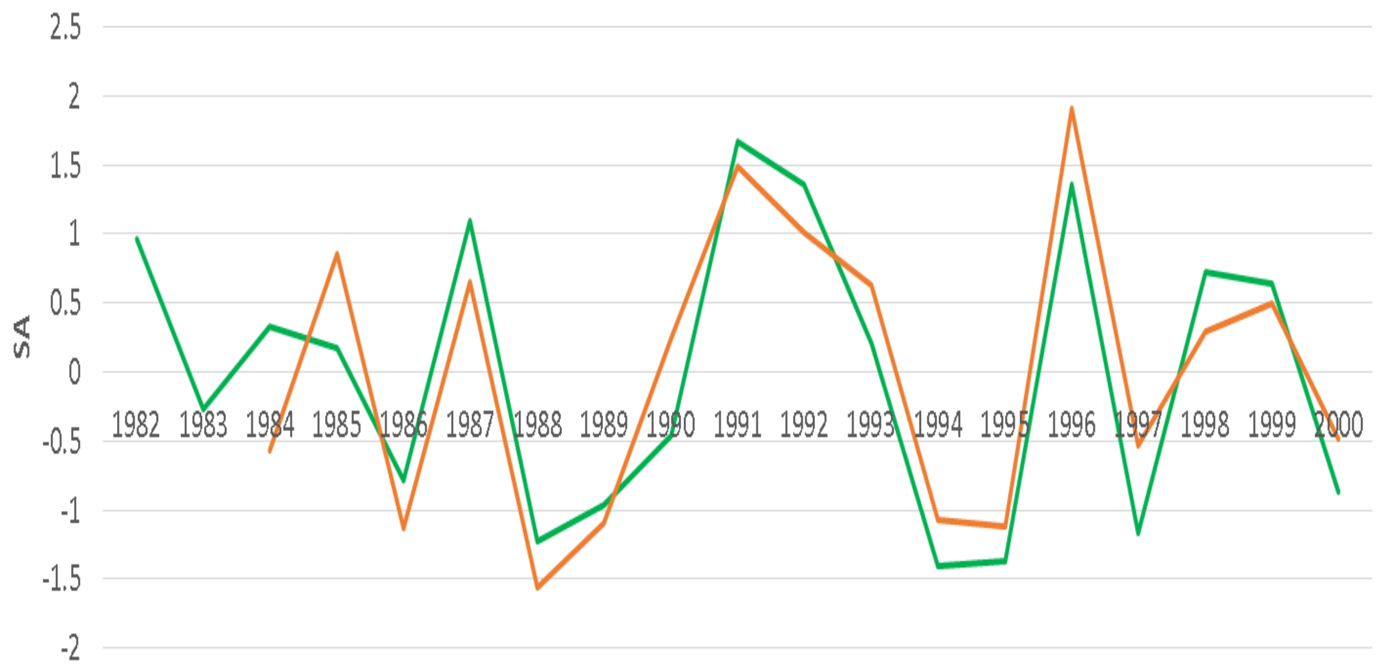
Eco-hydrologicalal Model for Identification of Droughts

LAI: Simulated *vs.* MODIS



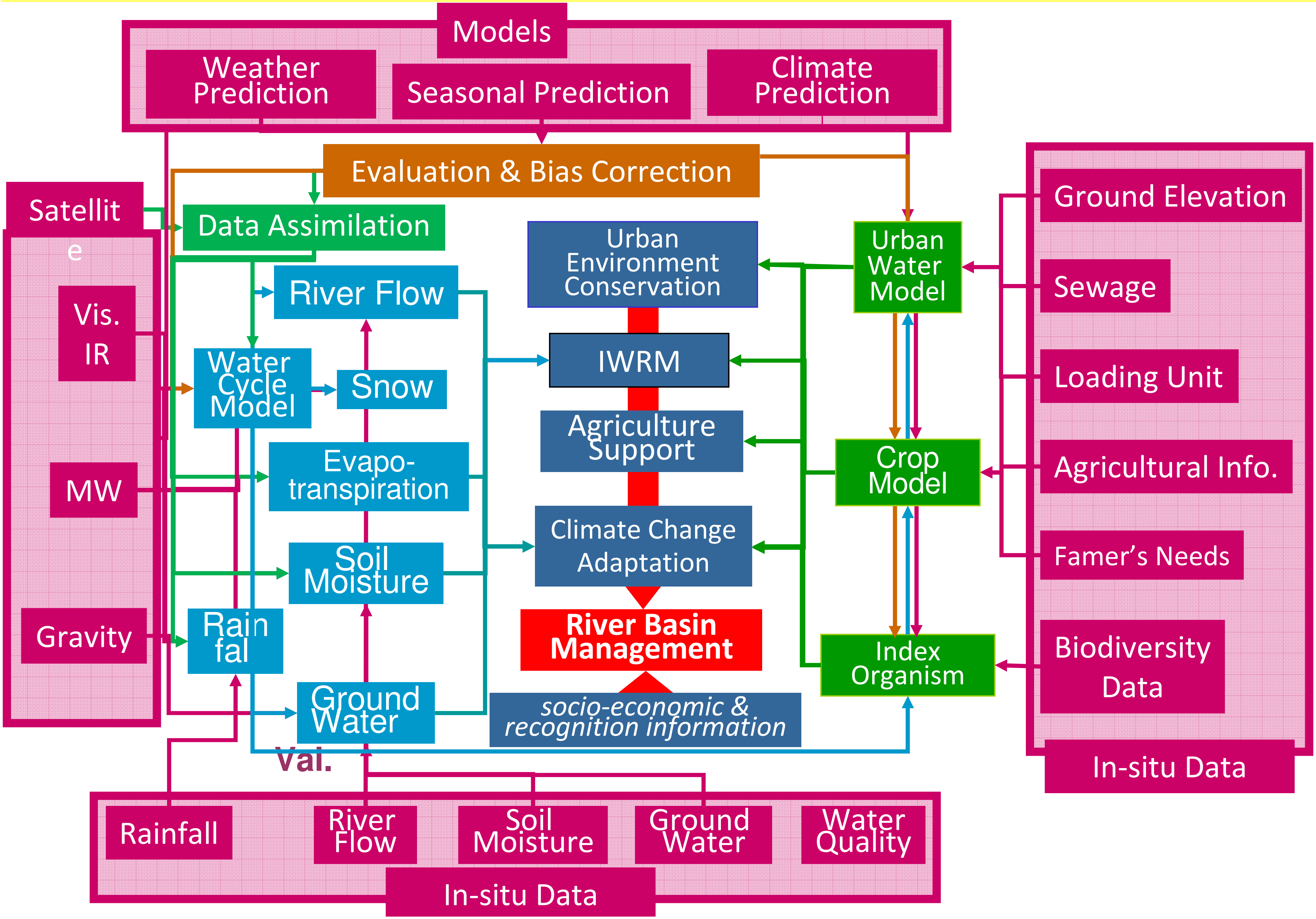


Eco-hydrologicalal Model for Identification of Droughts

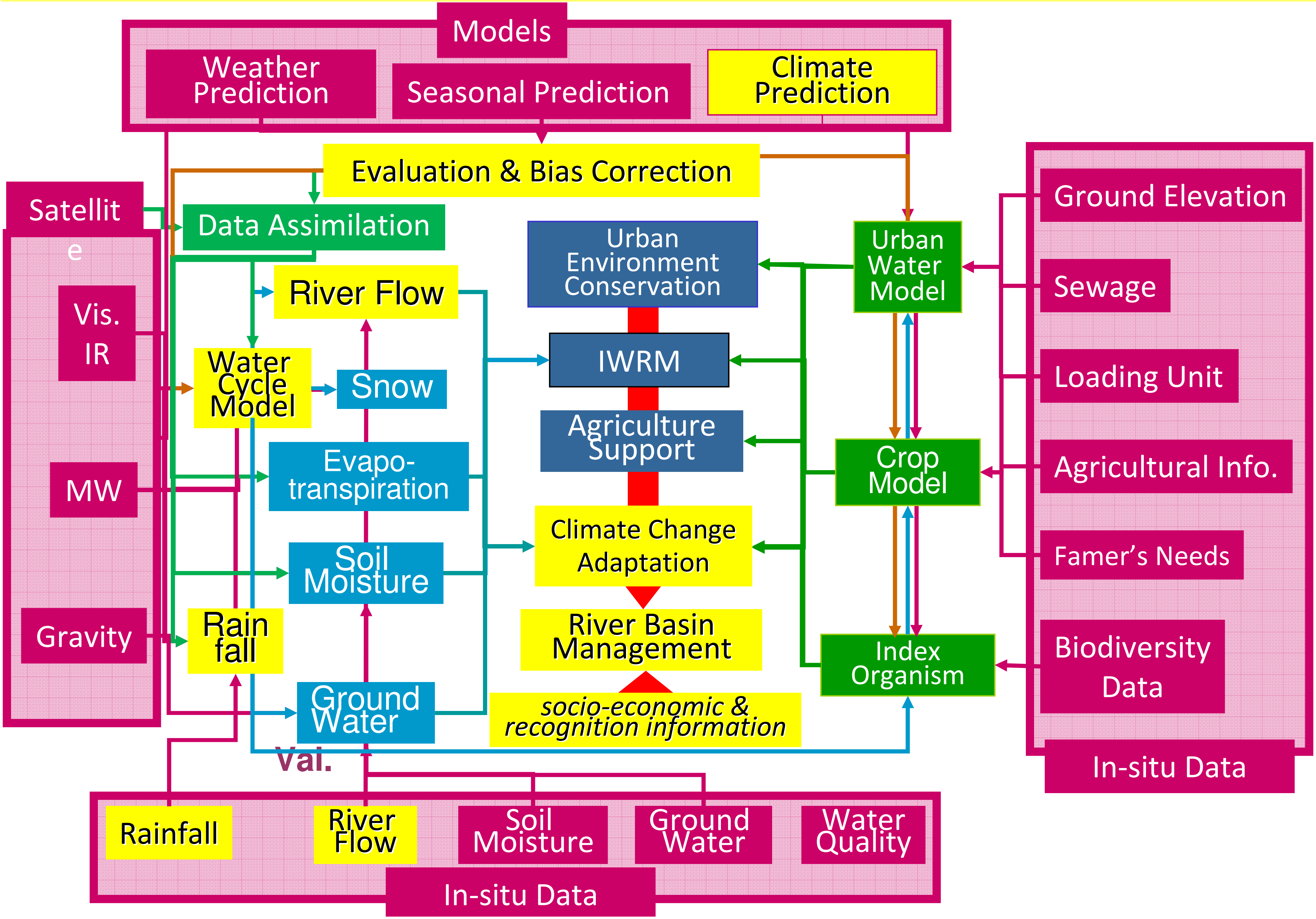


Standardized anomaly (SA) index for estimated annual maximum leaf area index (green line) from WEBDHM+DVM and observed annual crop production in Tunisia (orange line).

Water Cycle Integrator



Water Cycle Integrator



1. End Poverty

1d. Build resilience and reduce deaths from natural disaster by x%

Disaster Prevention Investment

Flood simulation

1. Develop of flood models to reproduce actual flood damage.

2. Demonstrate counter measure effects for reducing damage.

3. Translate flood model outputs into economic model inputs

Economic simulation

4. Develop economic models to reproduce actual economic parameters.

5. Simulate effect of the counter measures on economy and society with several senarios.

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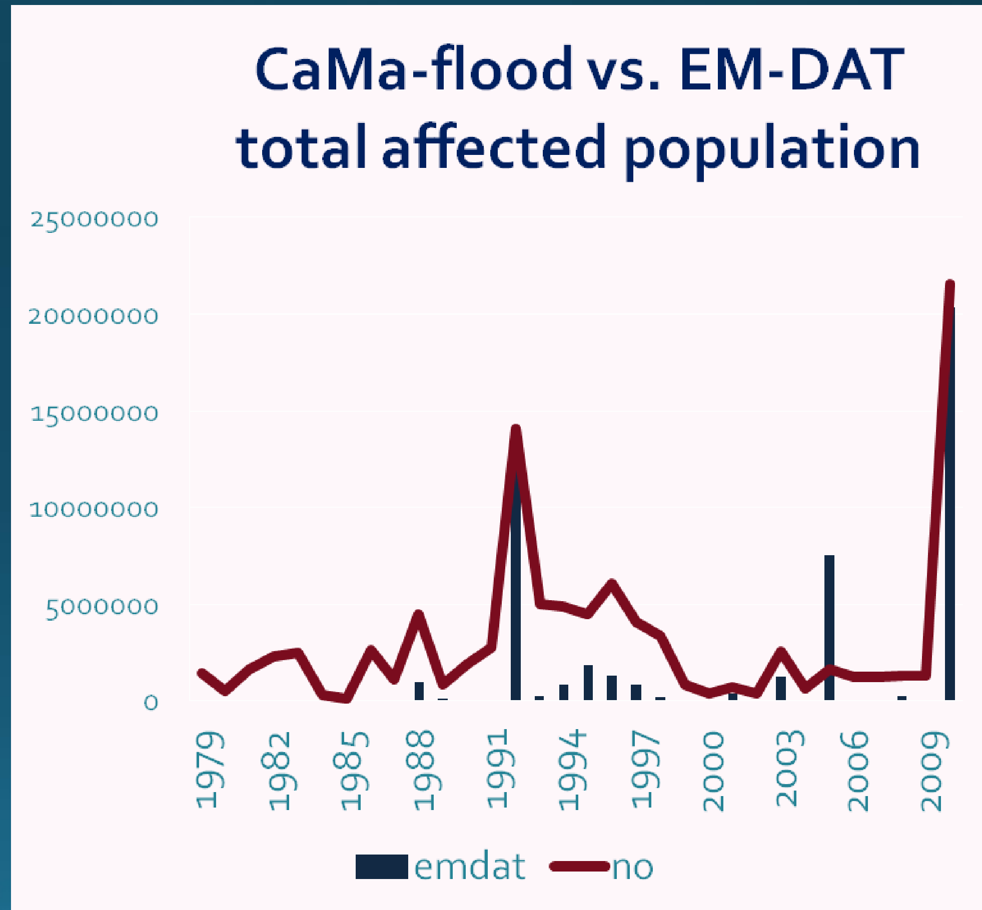
Result of Confirmation
: CaMa-flood has reproducibility against EM-DAT on affected population

Assuming that the place flooded deeper than 5.0m is affected,

CaMa-flood has some reproducibility compared to EM-DAT



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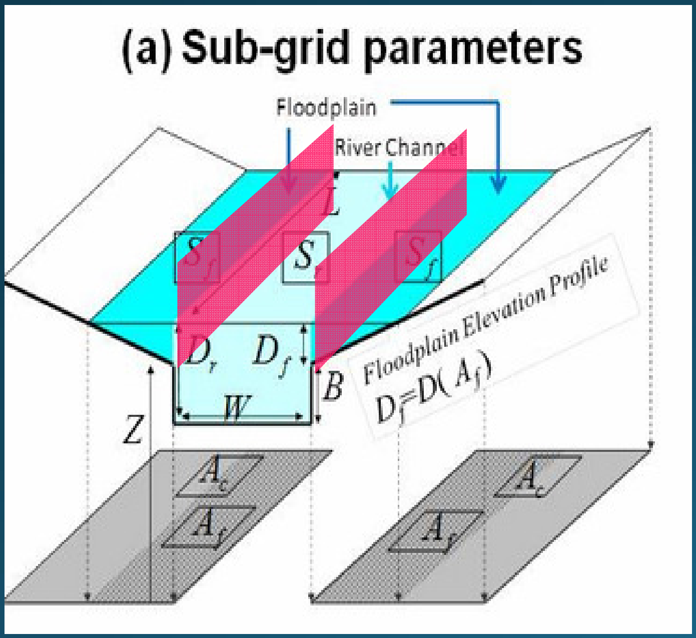
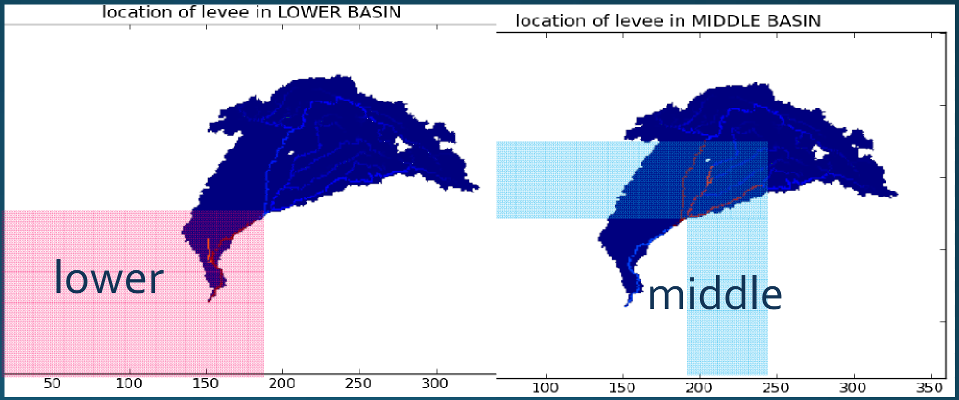
2. Establish the levee as disaster prevention and calculate the effect on damage reduction

Establishing **LEVEE** as **Disaster Prevention** in CaMa-flood and measure the effect of the levees on the **damage reduction**





Building levee in **mainstream** of LOWER(LW) and MIDDLE(MD) basin

D. Yamazasi, 2012, Physically-based Modelling of Large-scale Floodingin Continental-scale Rivers of the World

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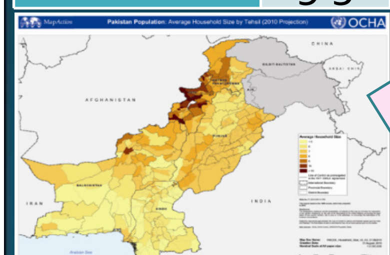
Example of parameter calculation ~ ψ: Physical damage rate ~

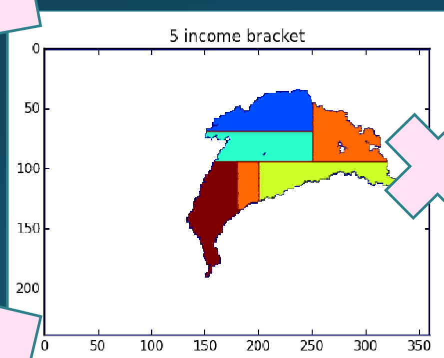
What percentage of Physical Asset were damaged for each 5 income brackets??

Family size data

Income Bracket	Family Size
1st ,poorest	8.78
2nd , poor	7.97
3rd , middle	7.32
4th , rich	6.45
5th , richest	5.36



Family size distribution



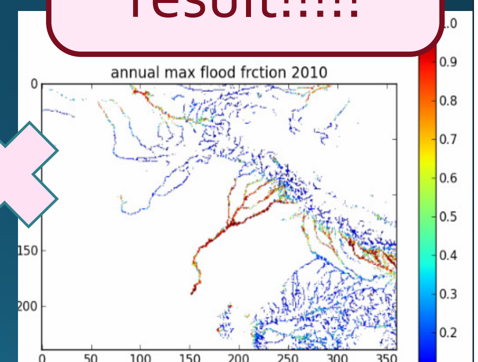
Income bracket map

Physical Assets distribution

Income Bracket	Physical asset
1st ,poorest	84$
2nd , poor	151$
3rd , middle	181$
4th , rich	197$
5th , richest	313$

Physical assets amount for 5 brackets

CaMa-flood result!!!!!



Percentage of inundated area

1. End Poverty

1d. Build resilience and reduce deaths from natural disaster by x%

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Economic simulation

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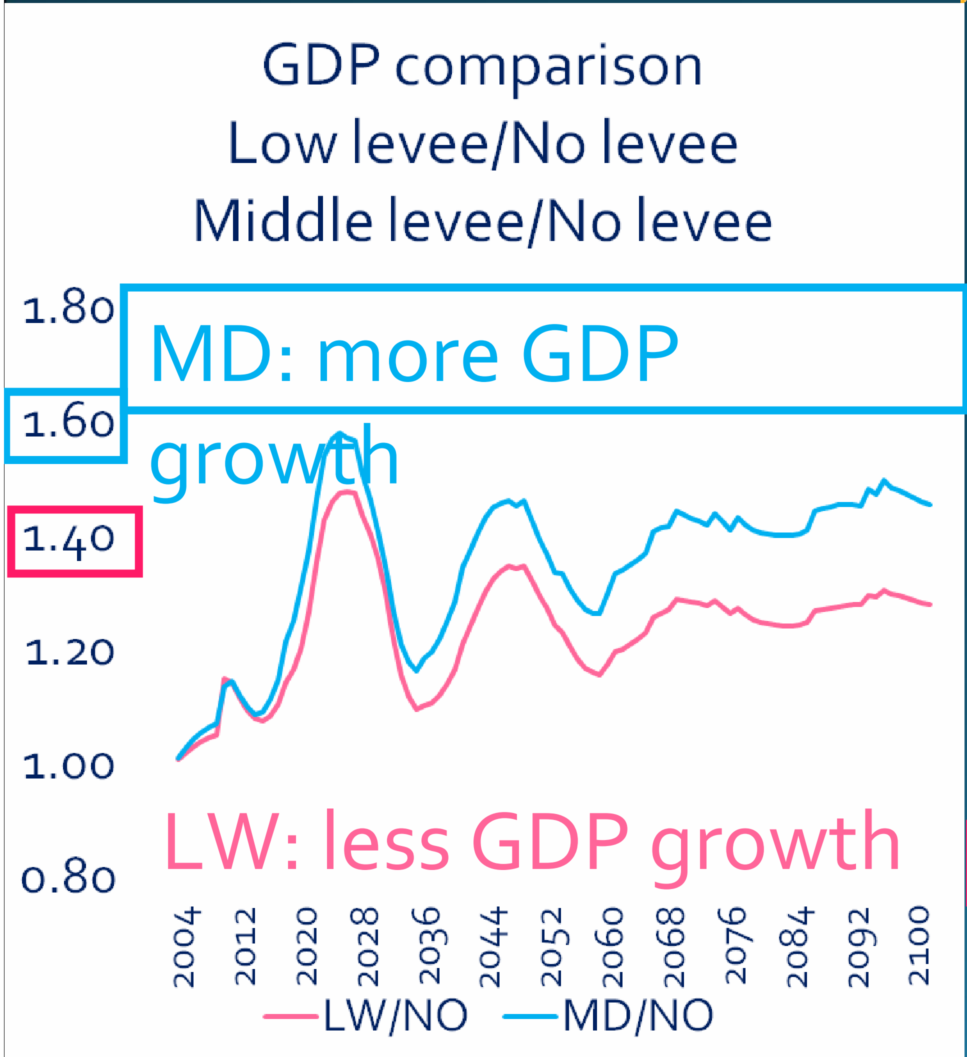
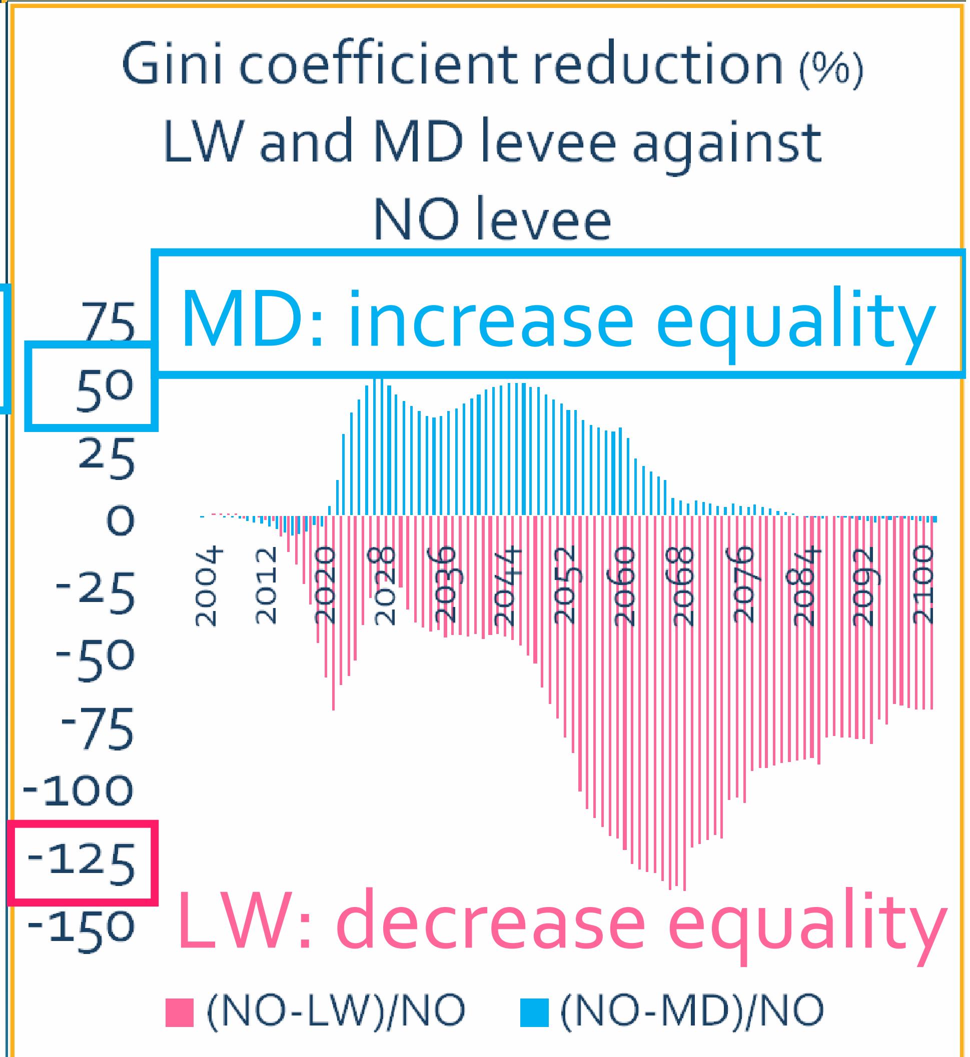
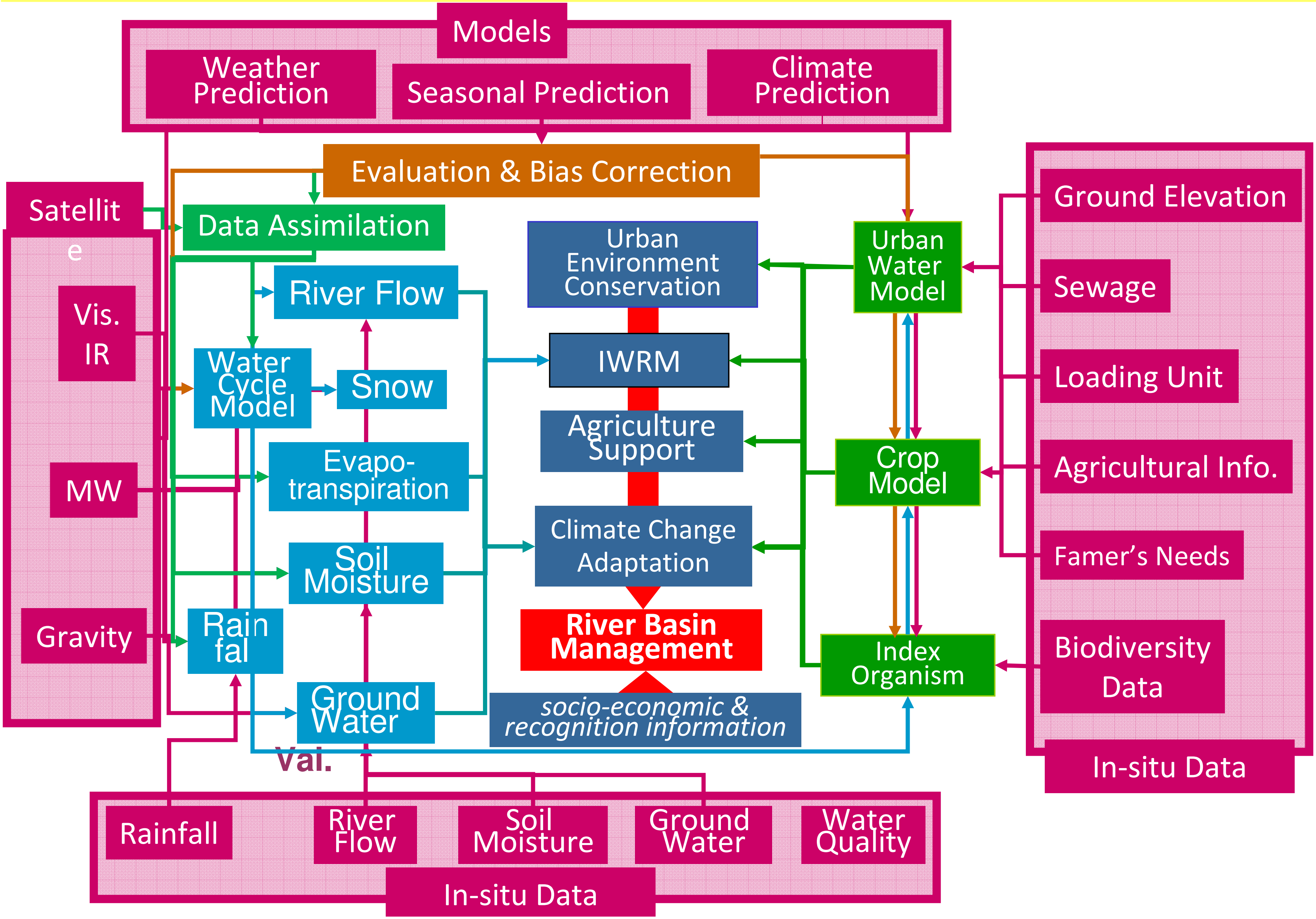
Results are different between LW levee and MD levee

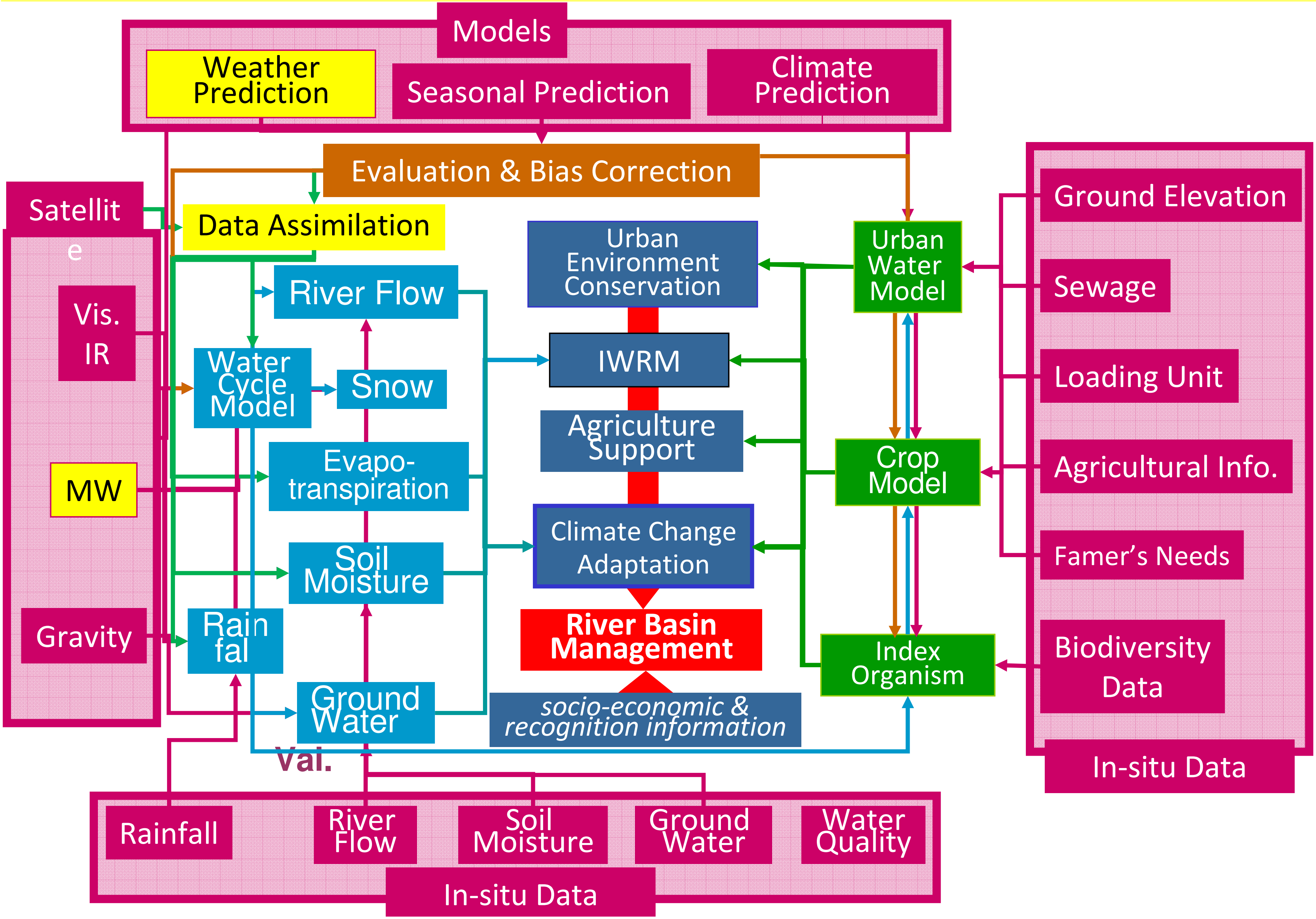


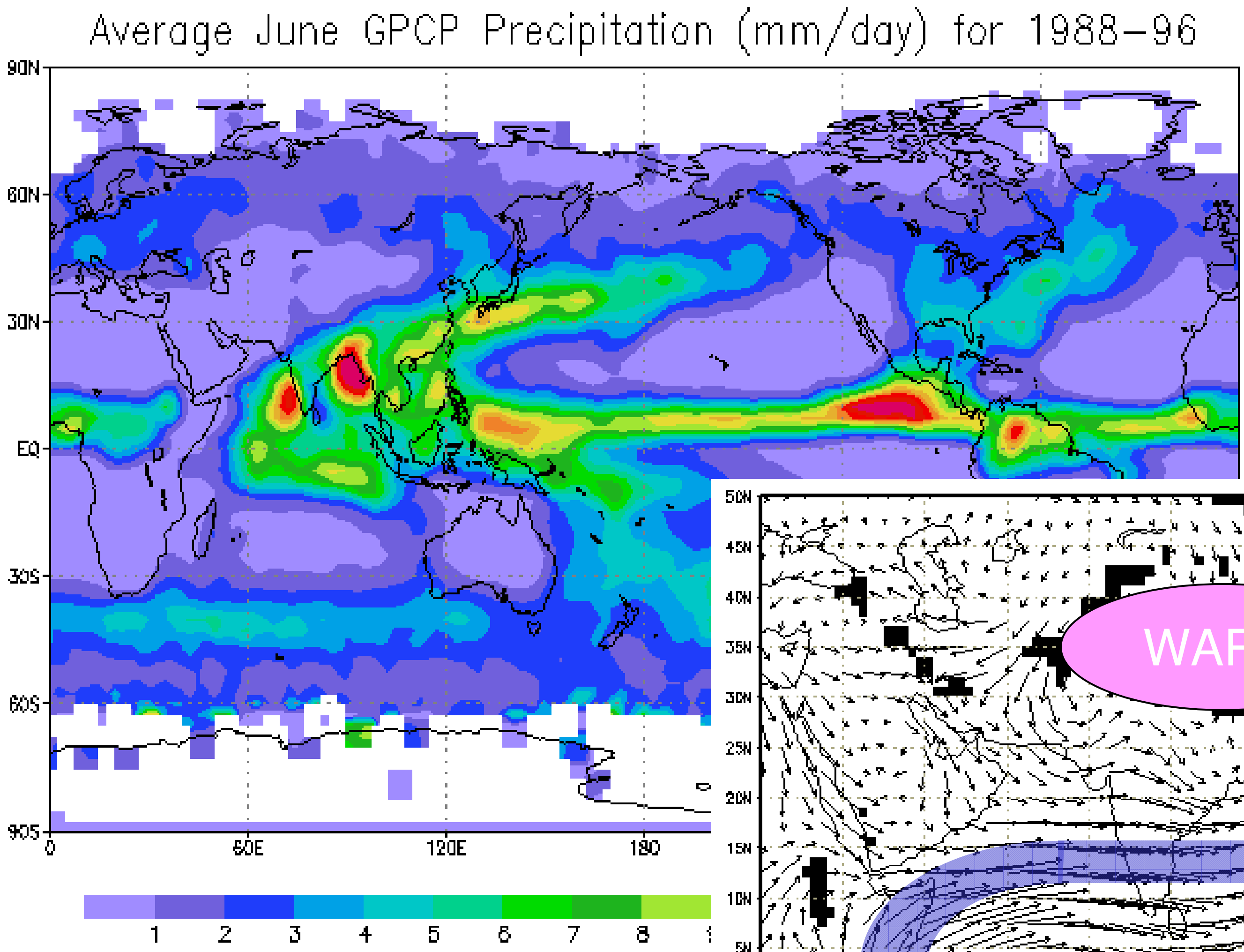


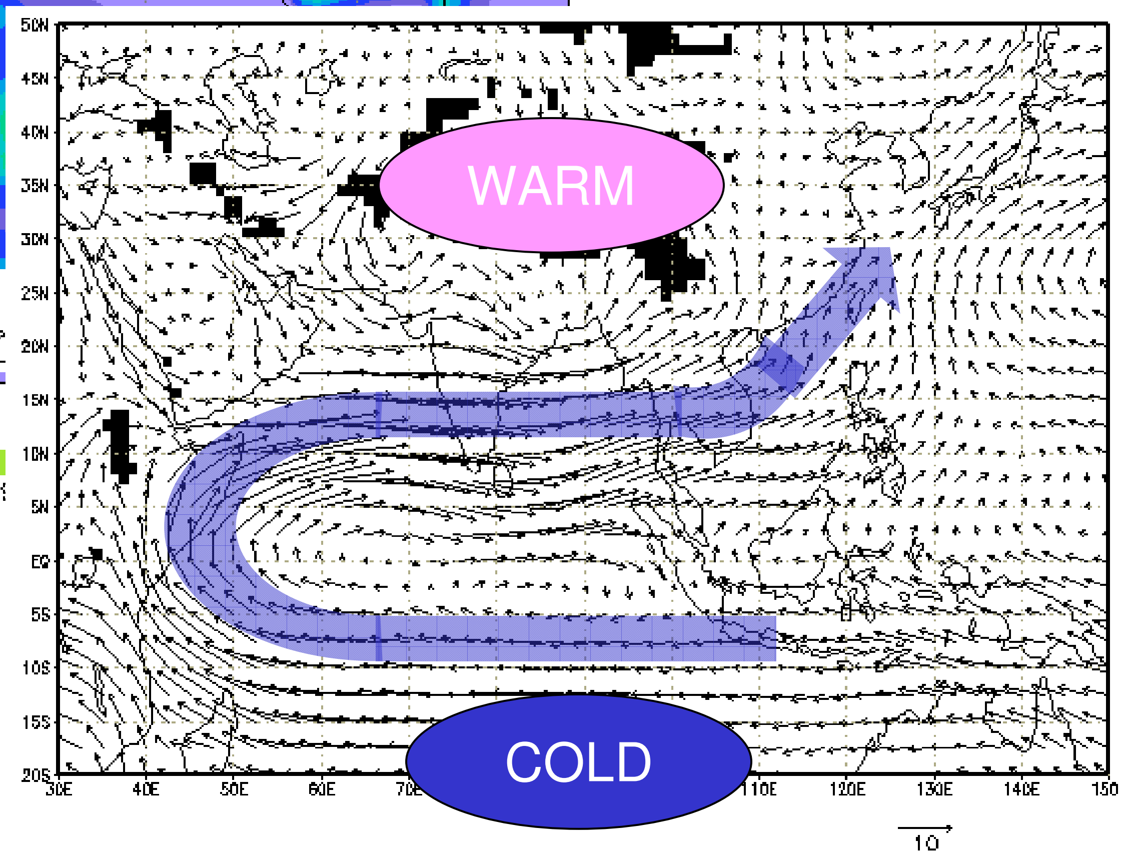
Water Cycle Integrator

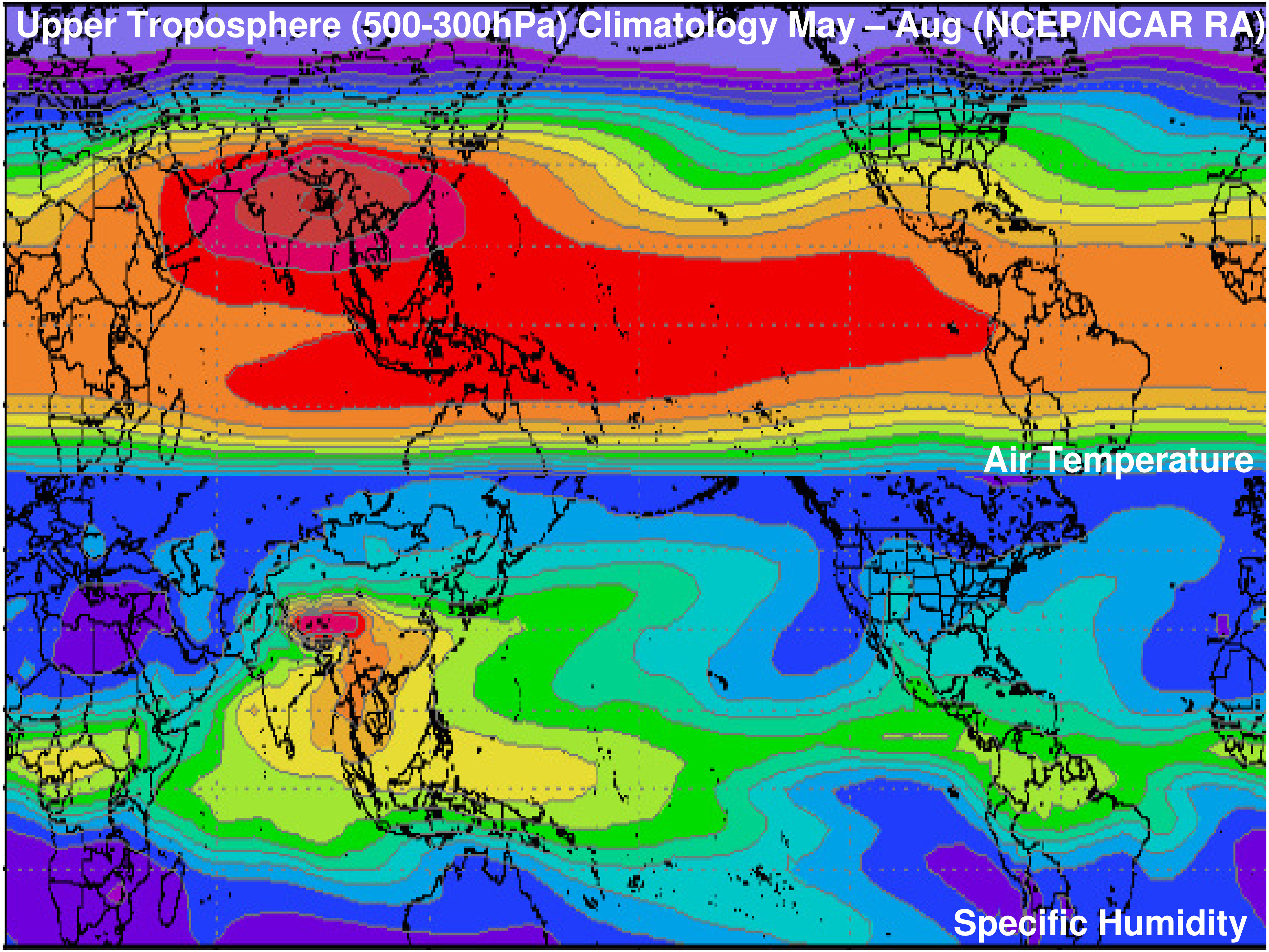


Water Cycle Integrator

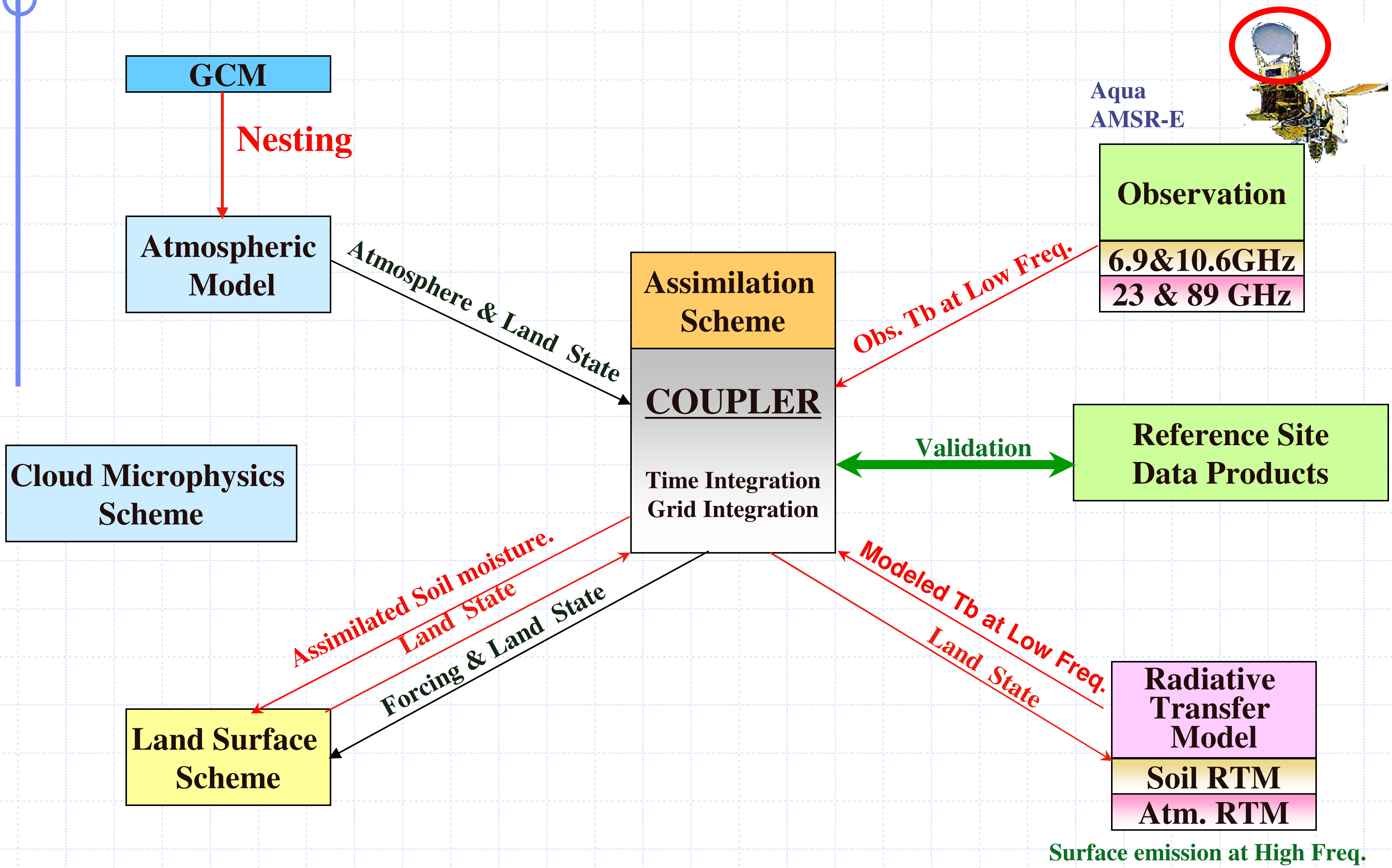


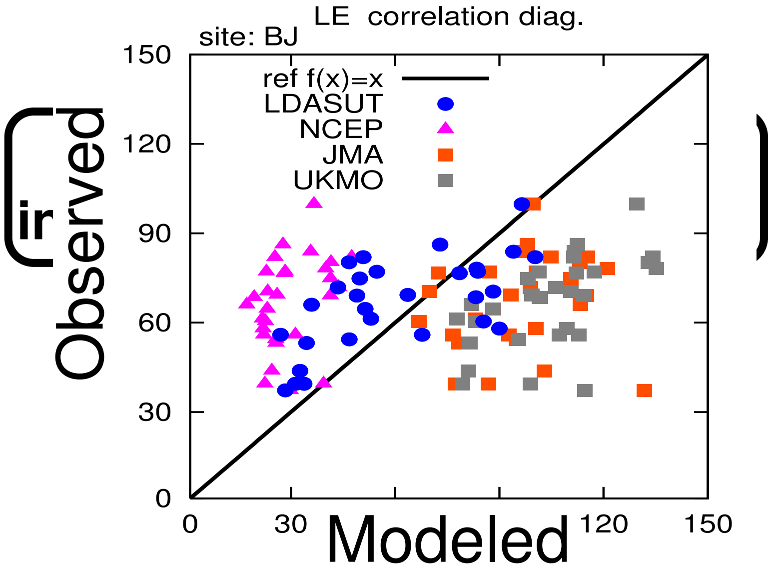

Average June GPCP Precipitation (mm/day) for 1988-96
90N
60N
30N
EQ
30S
60S
90S
0
60E
120E
180
1
2
3
4
5
6
7
8


WARM
COLD
50N
45N
40N
35N
30N
25N
20N
15N
10N
5N
EQ
5S
10S
15S
20S
30E
40E
50E
60E
110E
120E
130E
140E
150
10

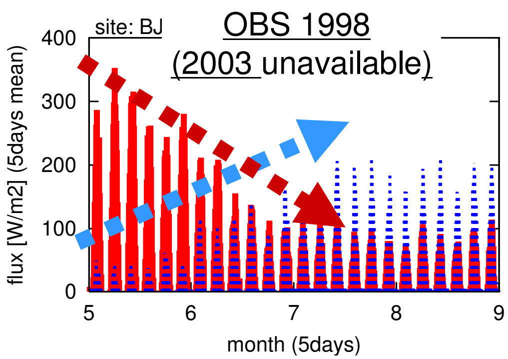

Upper Troposphere (500-300hPa) Climatology May – Aug (NCEP/NCAR RA)
Air Temperature
Specific Humidity

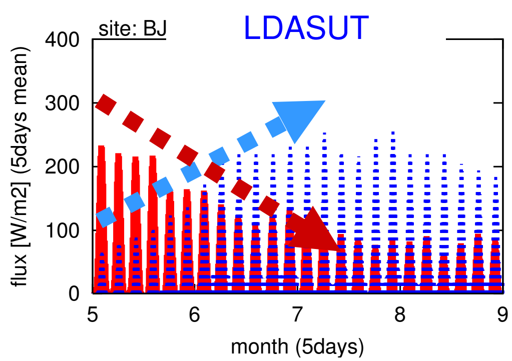
Data Integration by LDAS-COUPLER



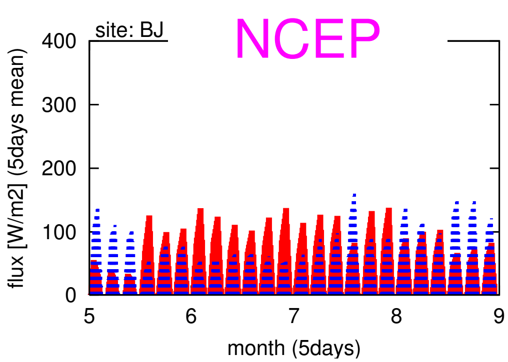


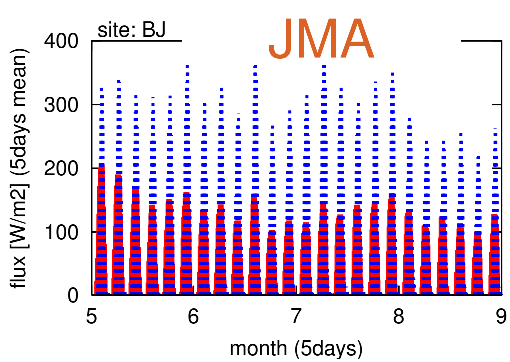
	H RMSE [W/㎡]	LE RMSE [W/㎡]
NCEP	40.2	68.4
JMA	32.3	79.8
UKMO	35.3	80.1

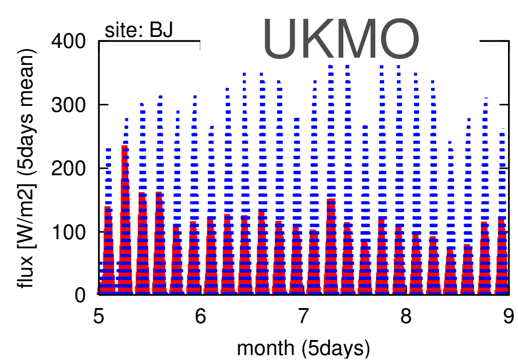




riation
ember)
Sensible (H) —
Latent(LE) —

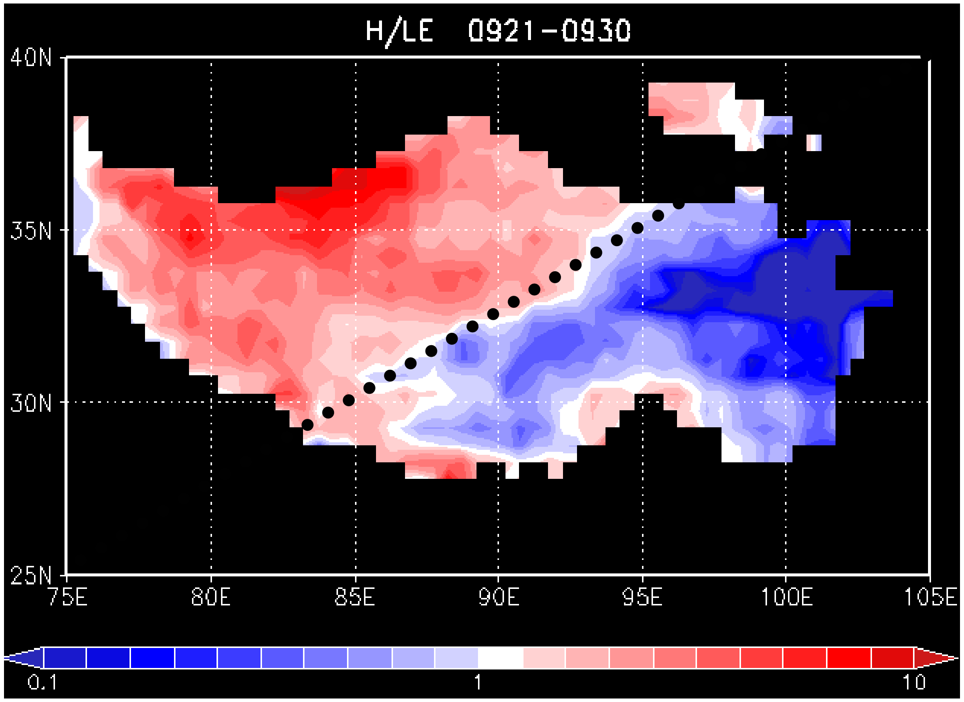




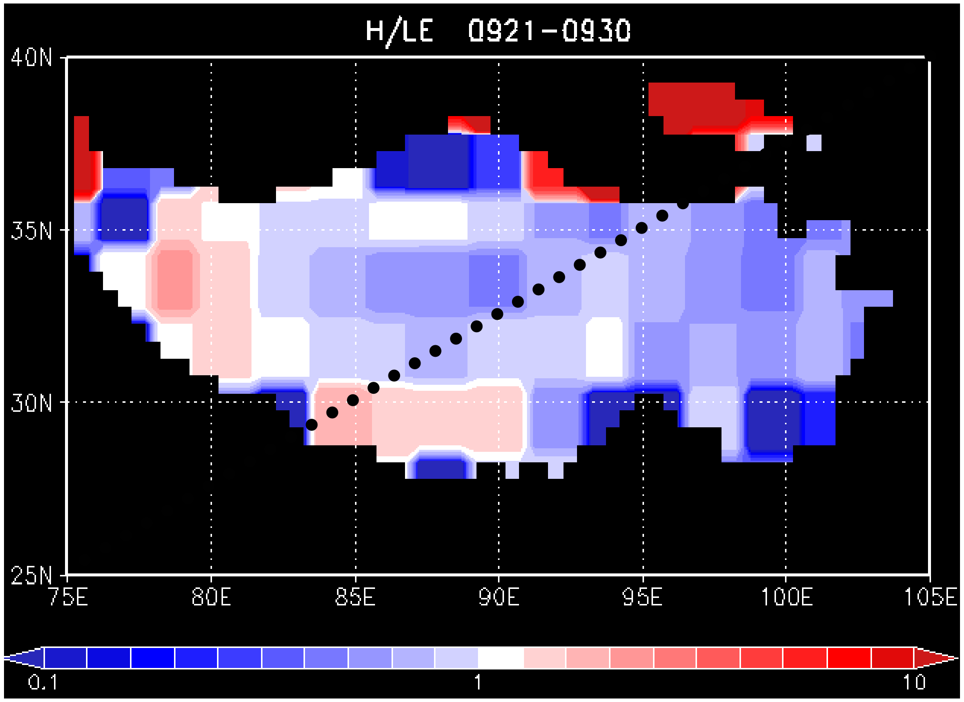


Seasonality of distributed Bowen Ratio: Sensible Heat Flux/Latent Heat Flux

LDASUT



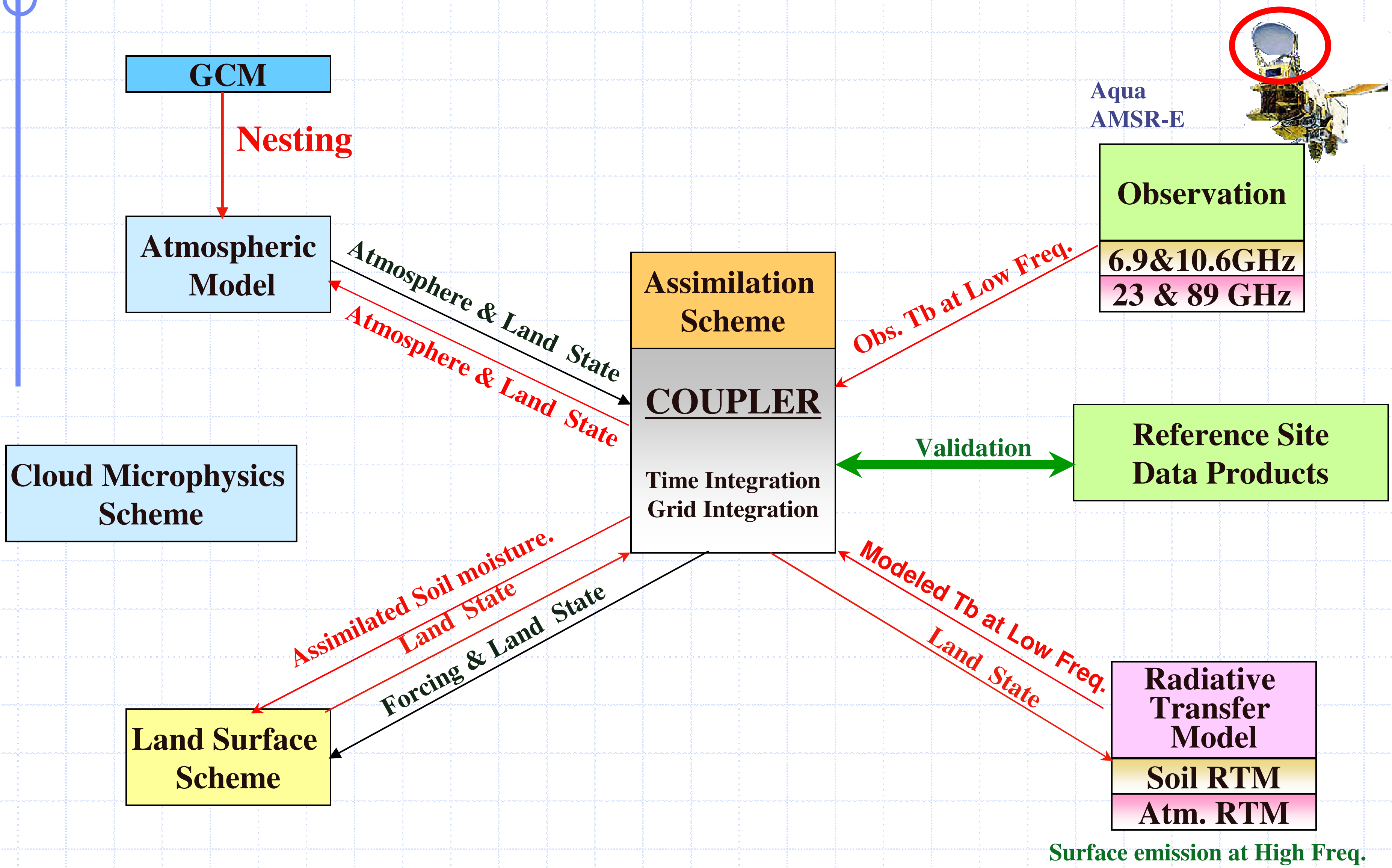
NCEP



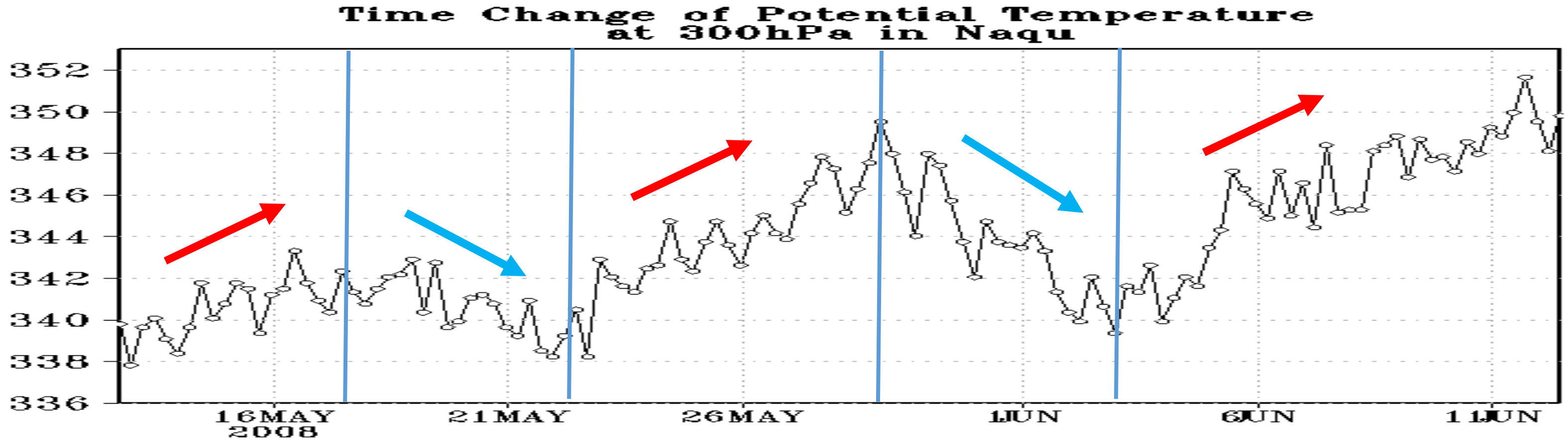
LDAS Seasonality: May~Mid June, H > lE; Mid June~Aug; lE>H

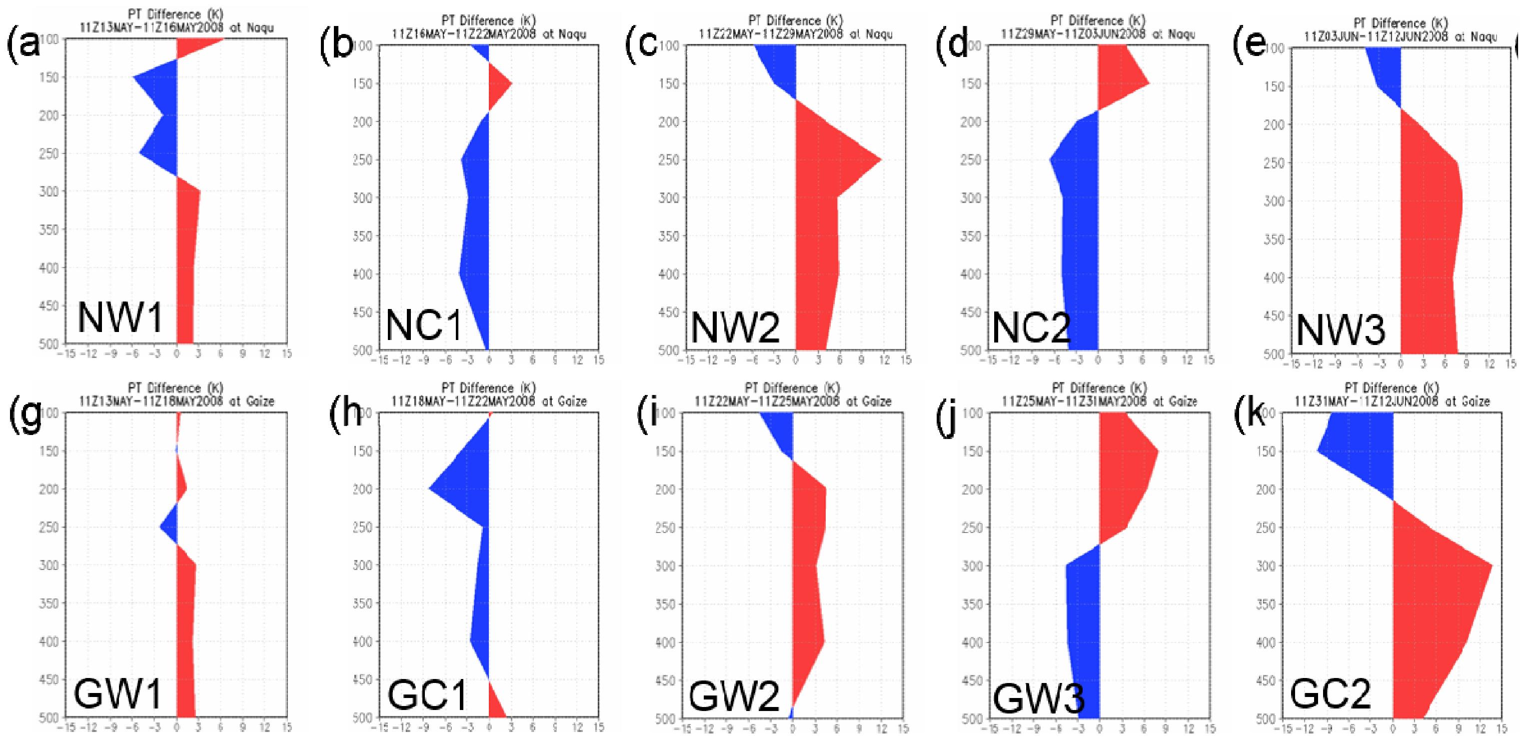
LDAS Regionality: H is dominant in N.W. TP, lE is dominant in S.E. TP

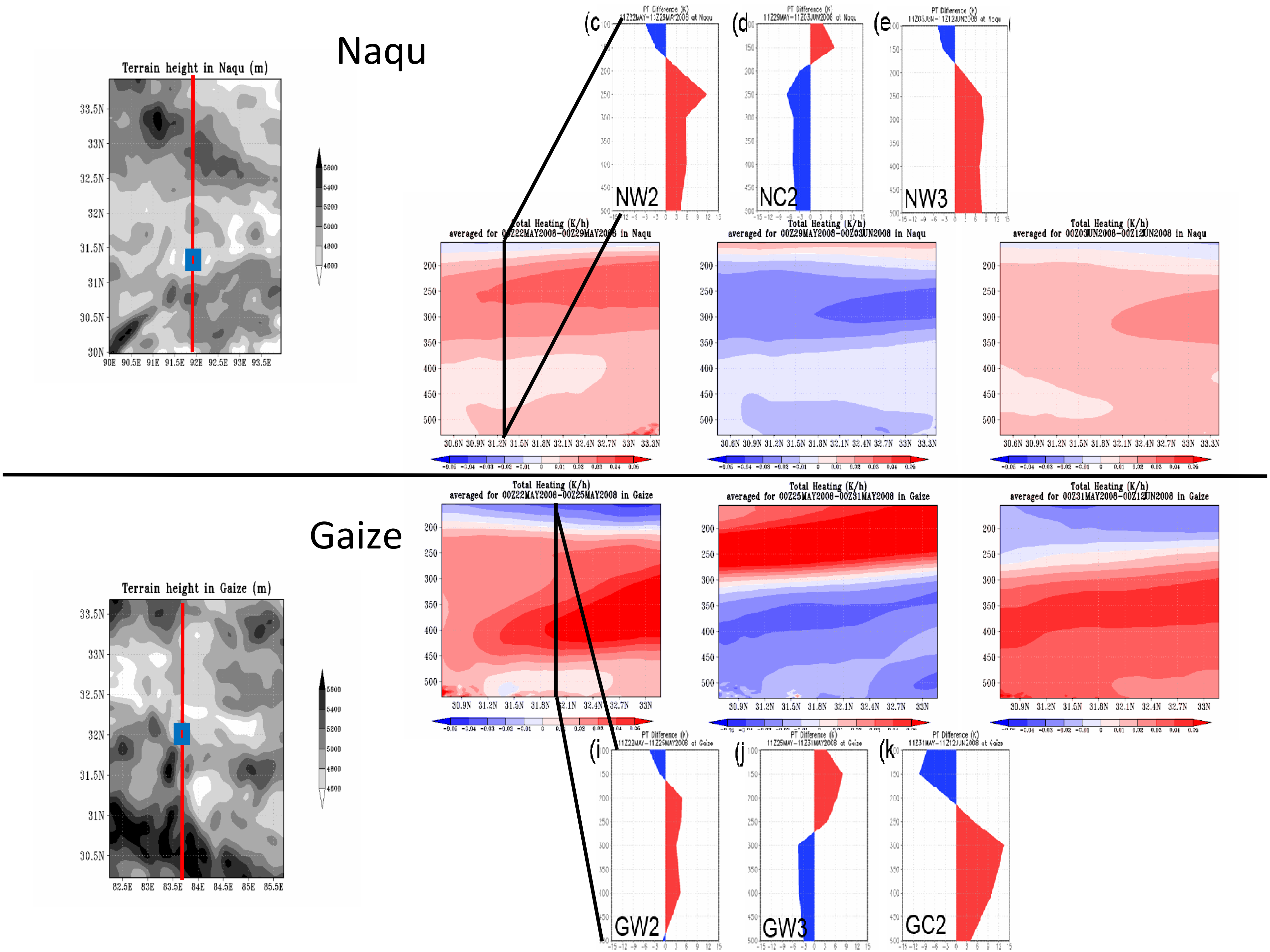
Data Integration by LDAS-COUPLER



JICA-Tibet Intensive Radio Sonde Observation May 13 to June 11 at Naqu and Gaize

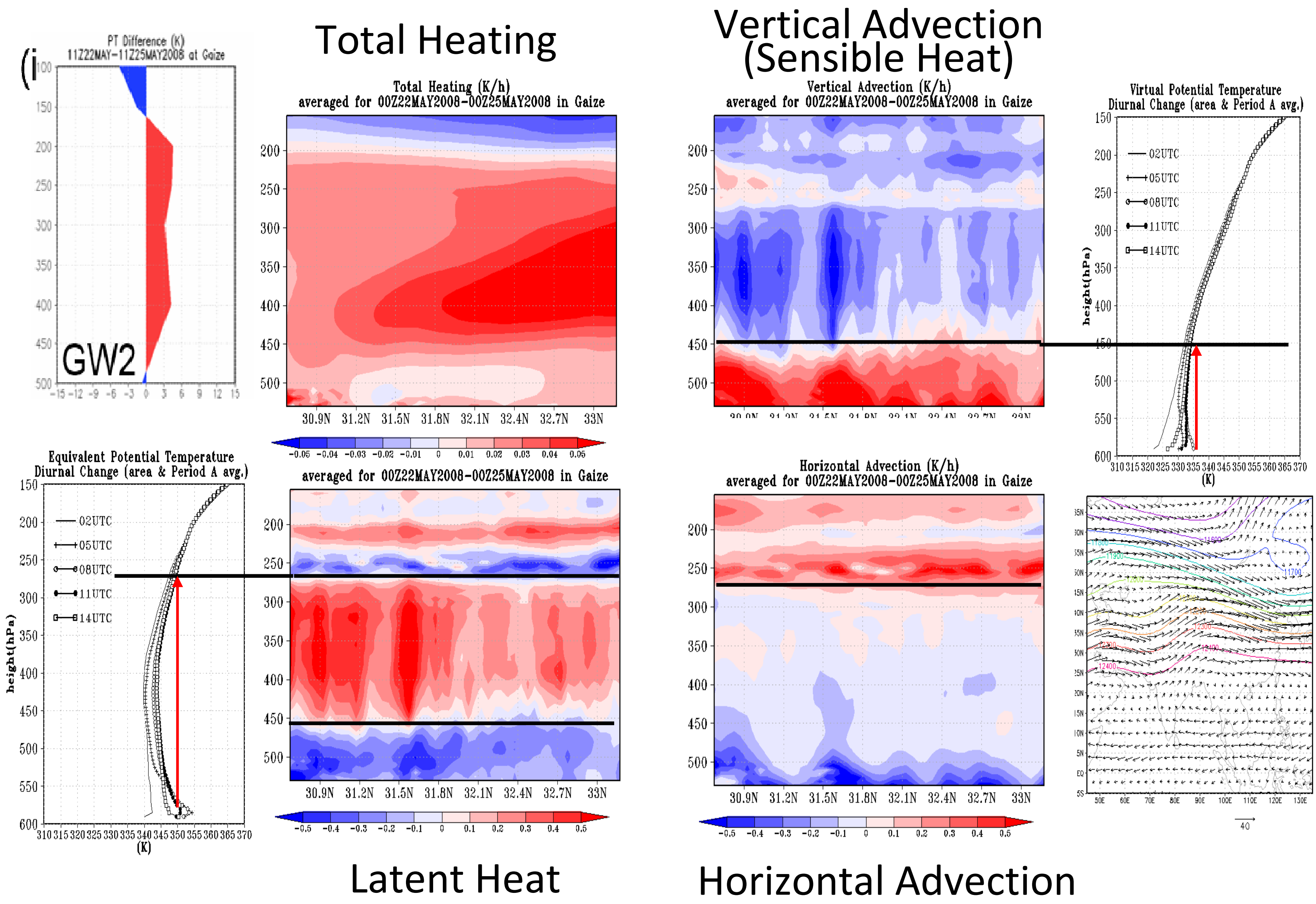




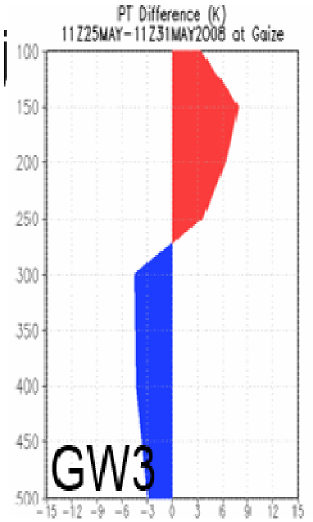


Naqu
Terrain height in Naqu (m)
(c
(d
(e
NW2
NC2
NW3
Total Heating (K/h)
averaged for 00Z22MAY2008-00Z29MAY2008 in Naqu
averaged for 00Z29MAY2008-00Z03JUN2008 in Naqu
Gaize
Terrain height in Gaize (m)
Total Heating (K/h)
averaged for 00Z22MAY2008-00Z25MAY2008 in Gaize
averaged for 00Z25MAY2008-00Z31MAY2008 in Gaize
(i
(j
(k
GW2
GW3
GC2

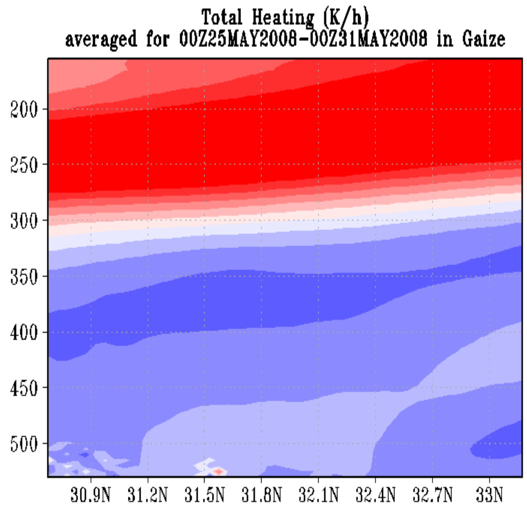
Warming Phase in Pre-monsoon Season



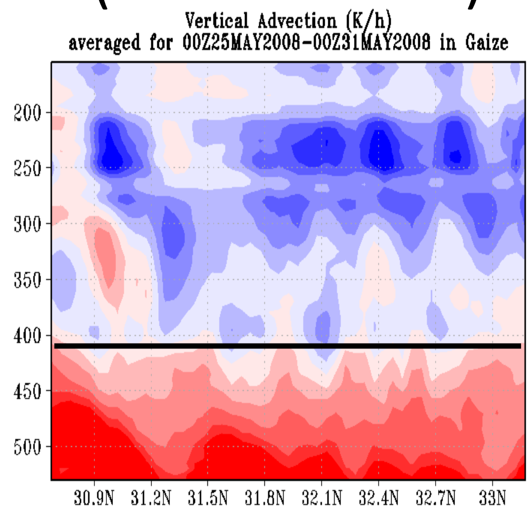
Warming Phase in Pre-monsoon Season

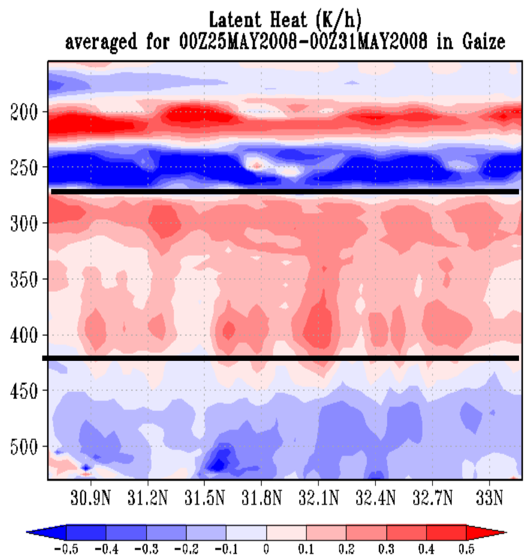


Total Heating

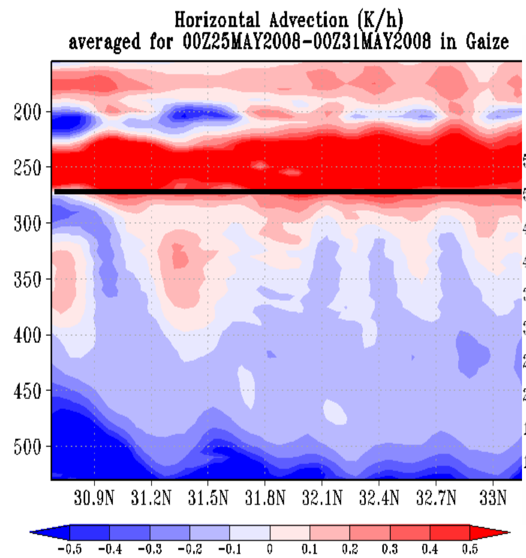


Vertical Advection
(Sensible Heat)

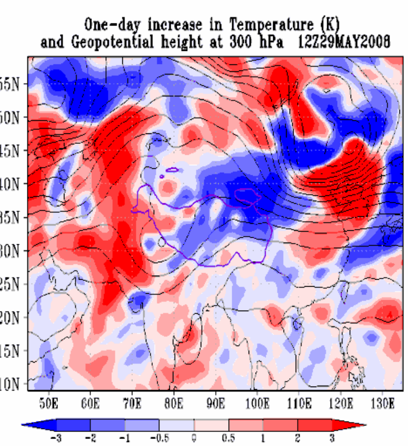




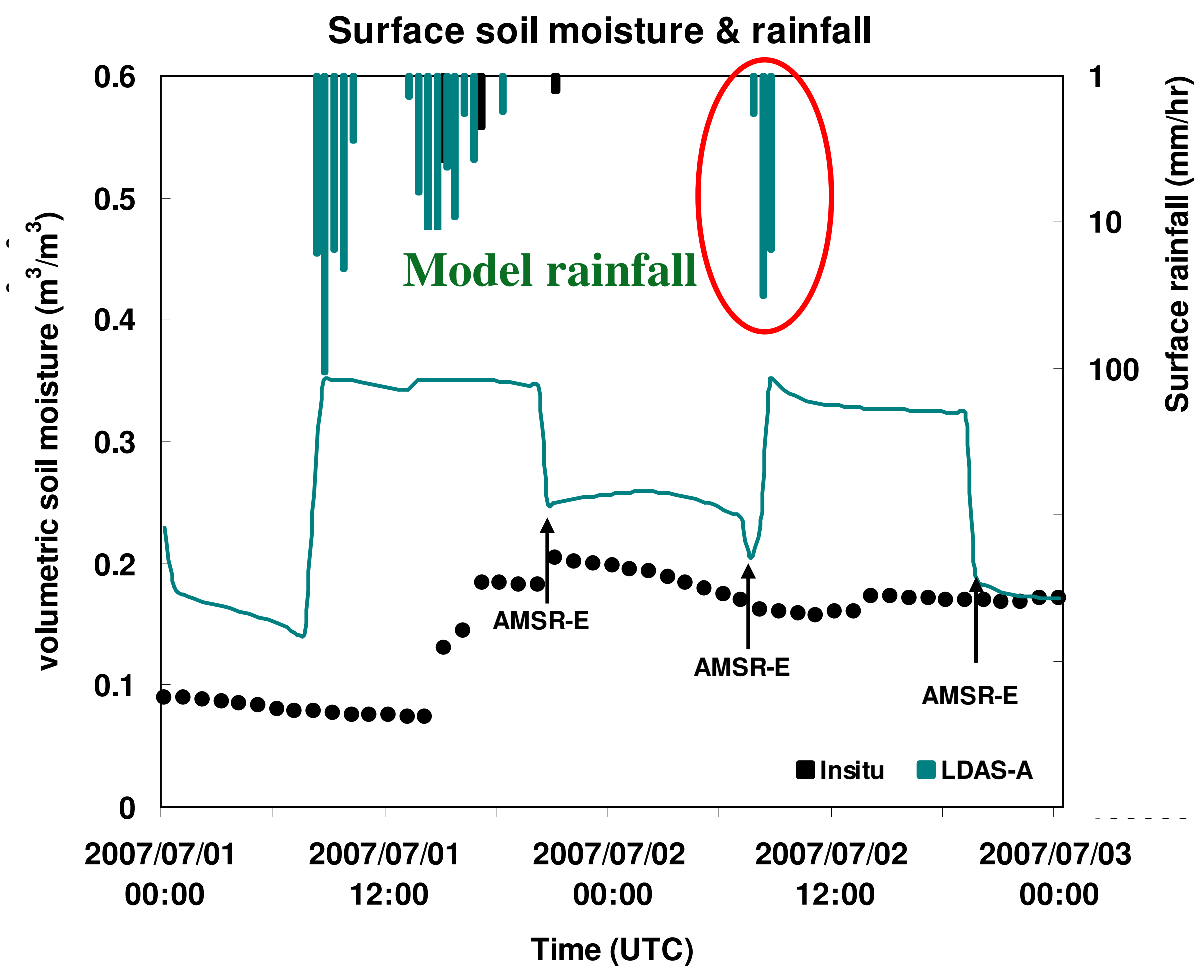
Latent Heat



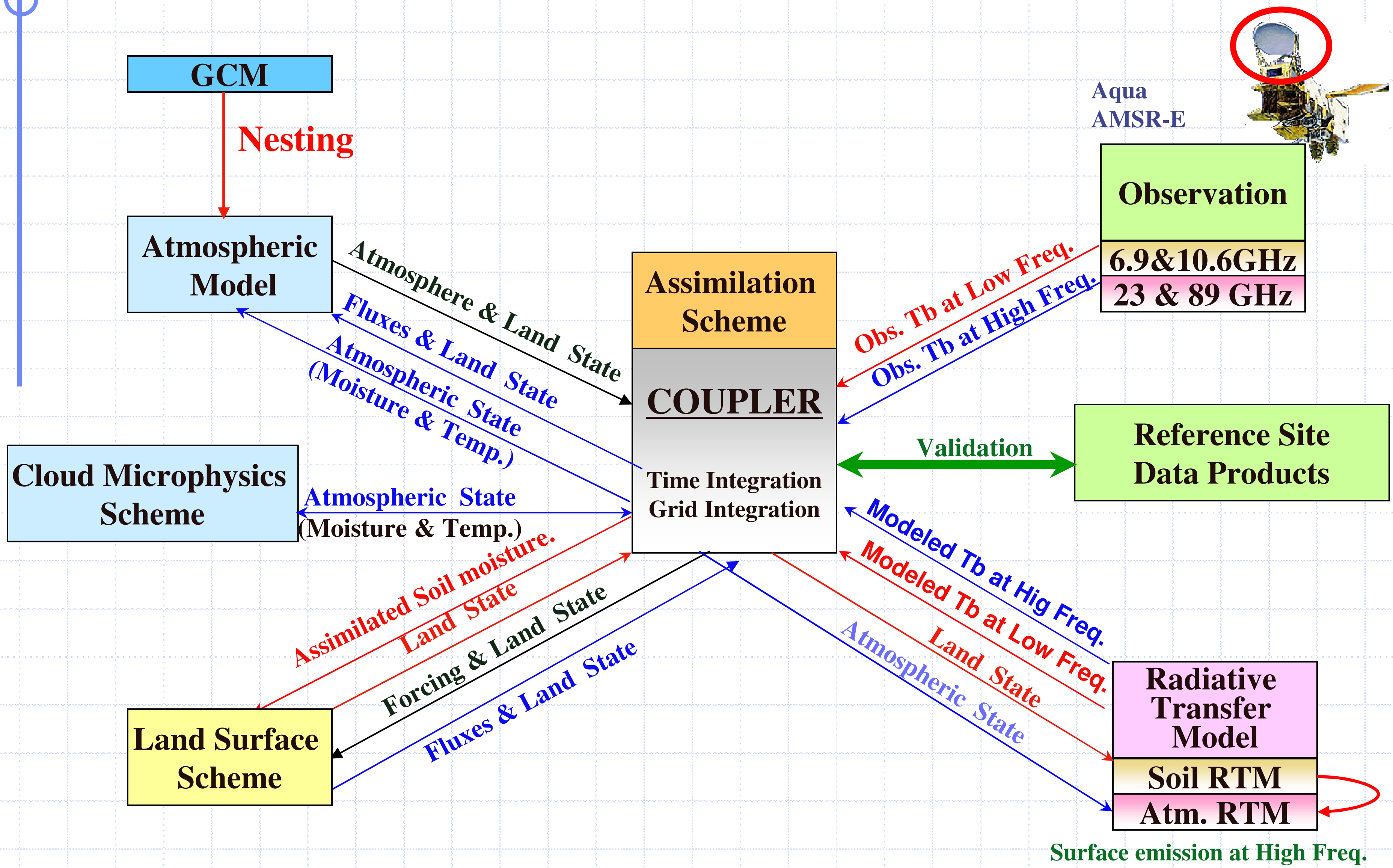
Horizontal Advection

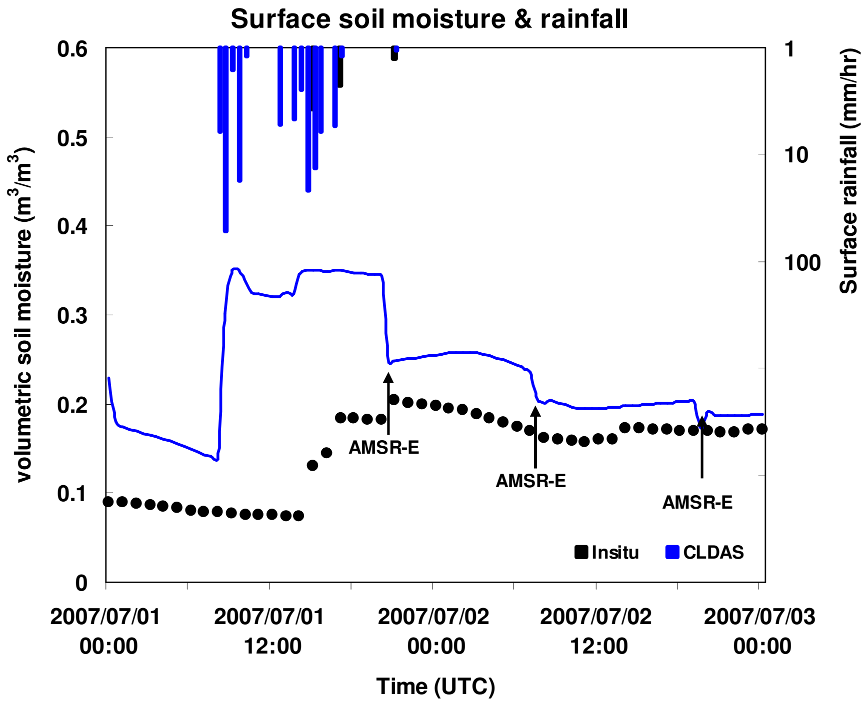


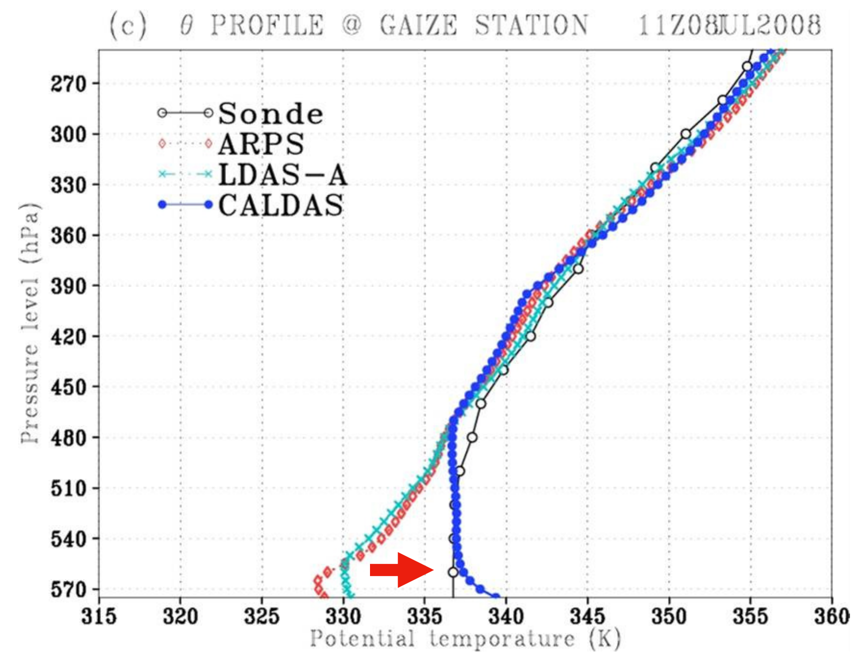
Impacts of Errors in Model Rainfall on the Soil Moisture

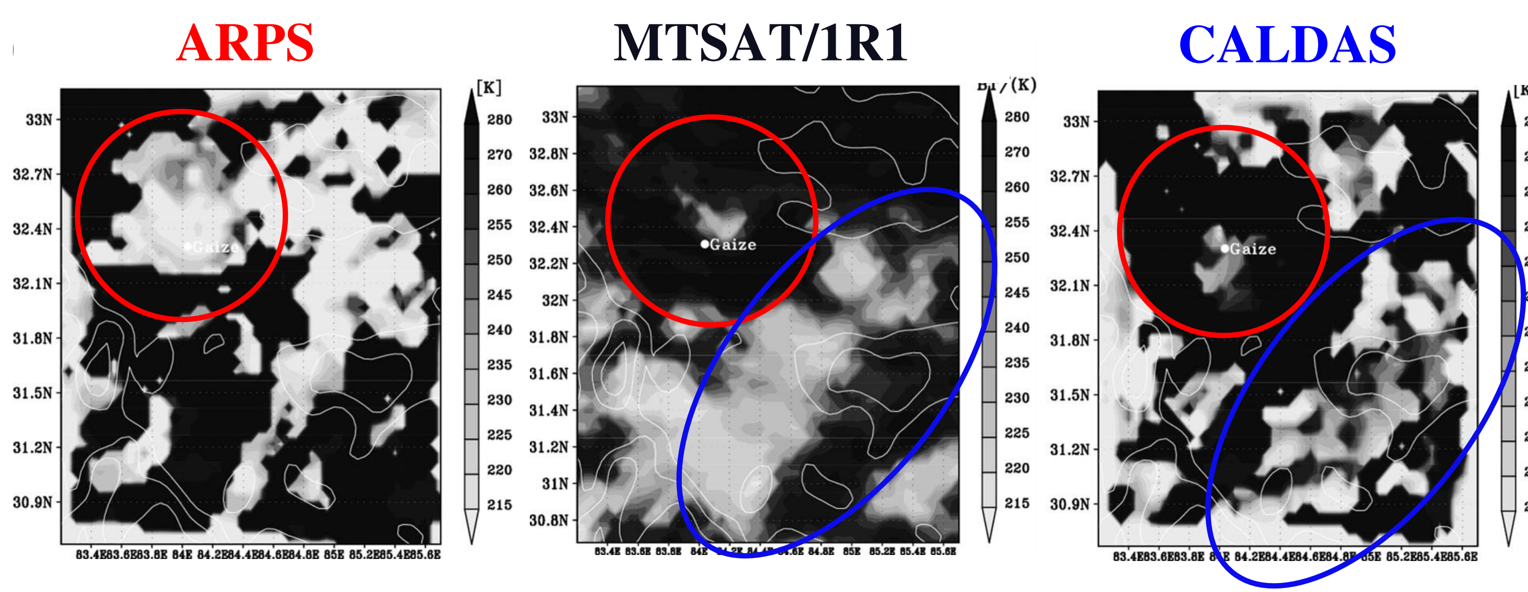


Coupled A-L DAS (CALDAS)-COUPLER









0900 UTC 08th July 2008

Water Cycle Integrator