CEOP Data Management – Satellite Data Session

1. Introduction

Kevin expressed concern about the diversity of projects and the coordination of observing and modelling activities. CEOP addressed these issues by putting more emphasis on the cross cutting activities.

2. General comments

2.1. Coordination of RHPs by defining a few key priorities, for example, MAC.
2.2. CEOP unique contribution to GEWEX
a defined set of specific tasks, or unique technological elements : effective data management and archiving, model inter-comparison with satellite measurements and in-situ data, development of high resolution data sets.
2.3 Through well coordination of RHPs, to obtain a deeper understanding of the key processes of the water cycle in collaboration with GMPP and GRP.
2.4. Global/regional water and energy budgets based on NWP analyses and satellite data and its validation and process studies coupled with the in-situ data in cooperation with RHPs.
2.5. Reporting skill.

GEWEX SSG Rapporteur's Comments on CEOP

3. Specific comments on outstanding issues

3.1. What is the focus of the satellite data?

3.2. AMMA's position in CEOP

3.3. CEOP land surface data assimilation – Landflux, GLASS

3.4. HAP's linkage with the RHPs, GRP, GWSP.

3.5. HAP targets: seasonal forecasting + Extremes or a separate Extremes initiative

3.6. Global water and energy budgets based on regional detail.

3.7. Ocean-atmosphere data.

3.8 Climate prediction of specific hydroclimate phenomena in a synergetic manner by CEOP.

3.9. The transferability modelling project in collaboration with RHPs.

3.10. Aerosols - Monsoonal circulations in collaboration among some RHPs3.11. CEOP-GMPP collaboration for the validation of extremes in models.

3.12. Creation and archiving of high resolution gridded precipitation products.

CEOP Objective #1:

GEWEX Objective #1

Produce consistent research quality data sets complete with error descriptions of the Earth's energy budget and water cycle and their variability and trends on interannual to decadal time scales, for use in climate system analysis and model development and evaluation.

Specific Technical Issues

1. Developing an integrated hydroclimate data set that can be used to answer the CEOP main scientific questions.
2. Developing the capability to handle and disseminate a large amount of data from diverse sources
3. Analyzing and comparing with model simulations this diverse data to understand the underlying mechanisms and model deficiencies.

2011-2012: DELIVERABLE: A “state-of-the-art” suite of global energy and water cycle products complete with error bars for closing the global water and energy budgets for the period 1980 to 2010.

CEOP Objective #2:

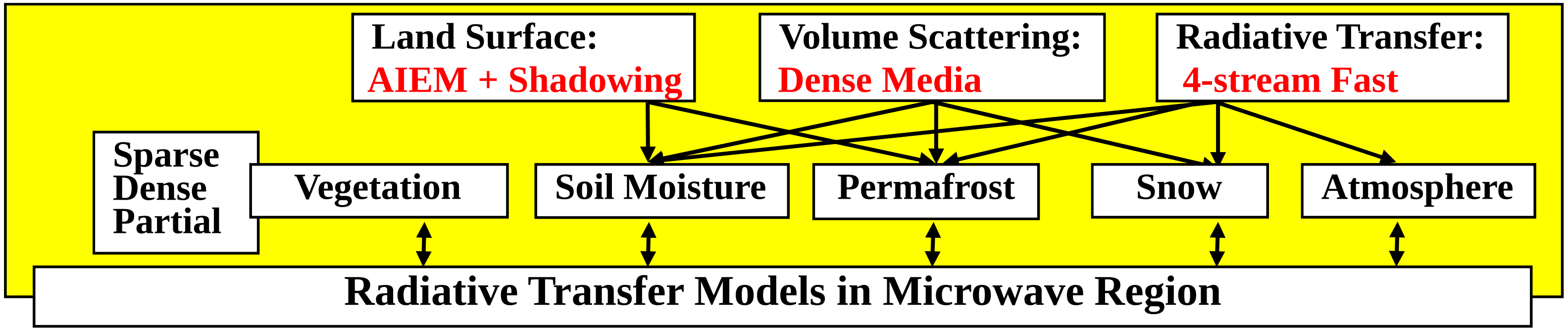
GEWEX Objective #2

Enhance the understanding of and quantify how energy and water cycle processes contribute to climate feedbacks.

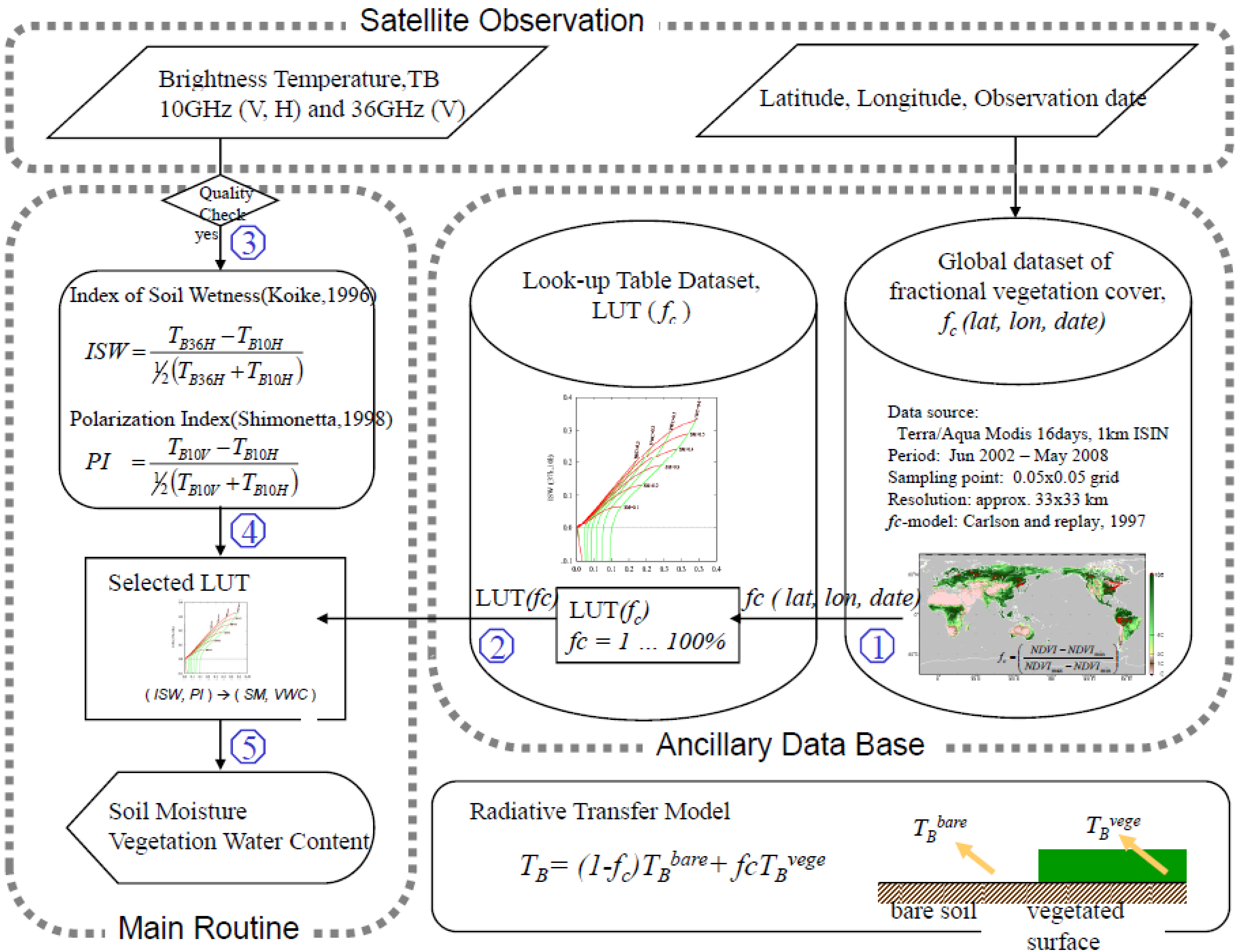
Associated Science Questions

i. What are the average hydroclimate conditions over various regions and seasons?
ii. How does water and energy flow into and through individual regions as well as being redistributed within these regions by local mechanisms?
iii. How do extremes occur and what is their role in the hydroclimate?
iv. How do aerosols affect the hydroclimate?
v. Does knowledge of water isotopes help us to understand the water cycle?

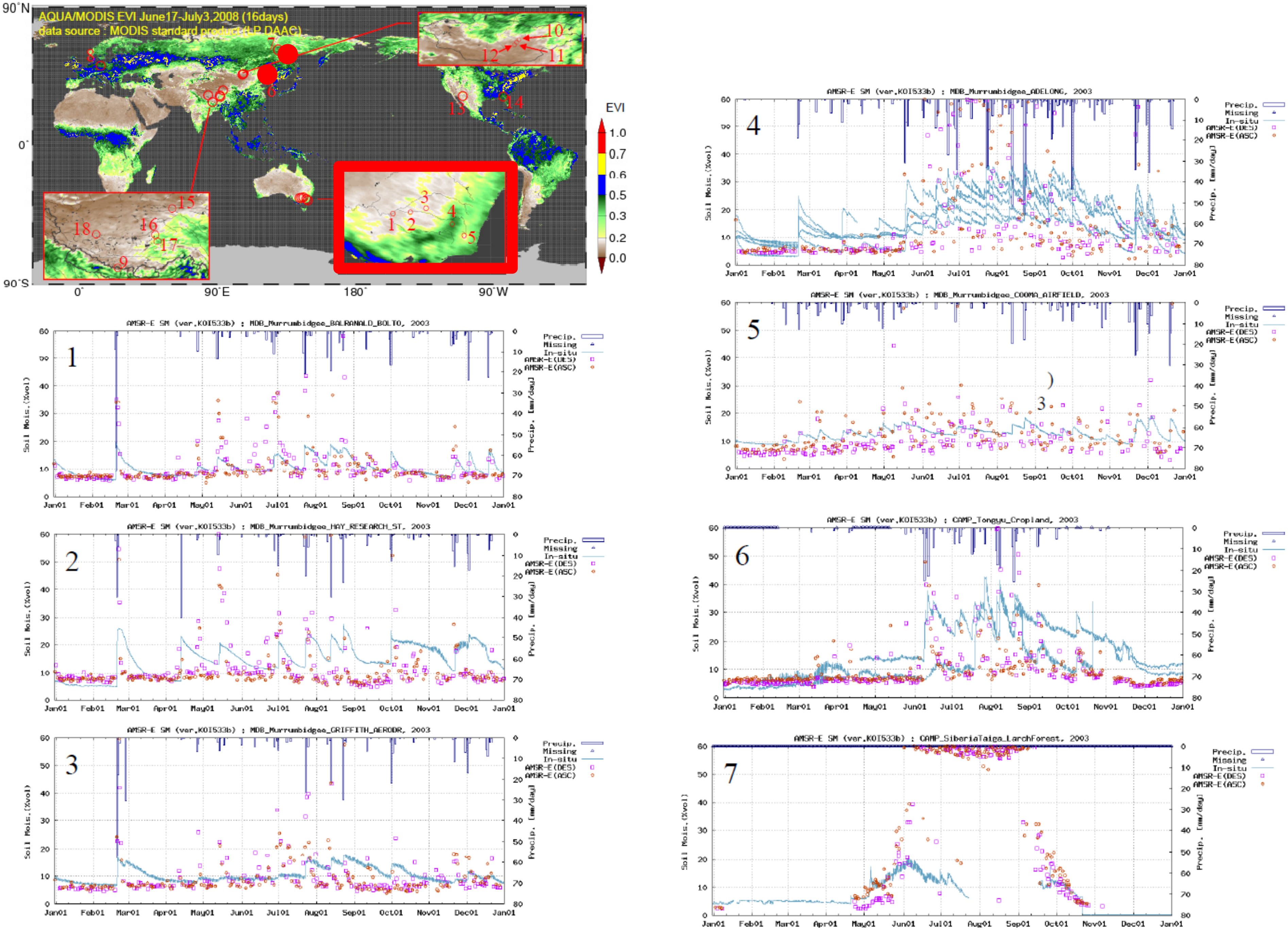
Understanding the contributions of water and their highly coupled non-linear interactions in regulating feedbacks to the climate system.

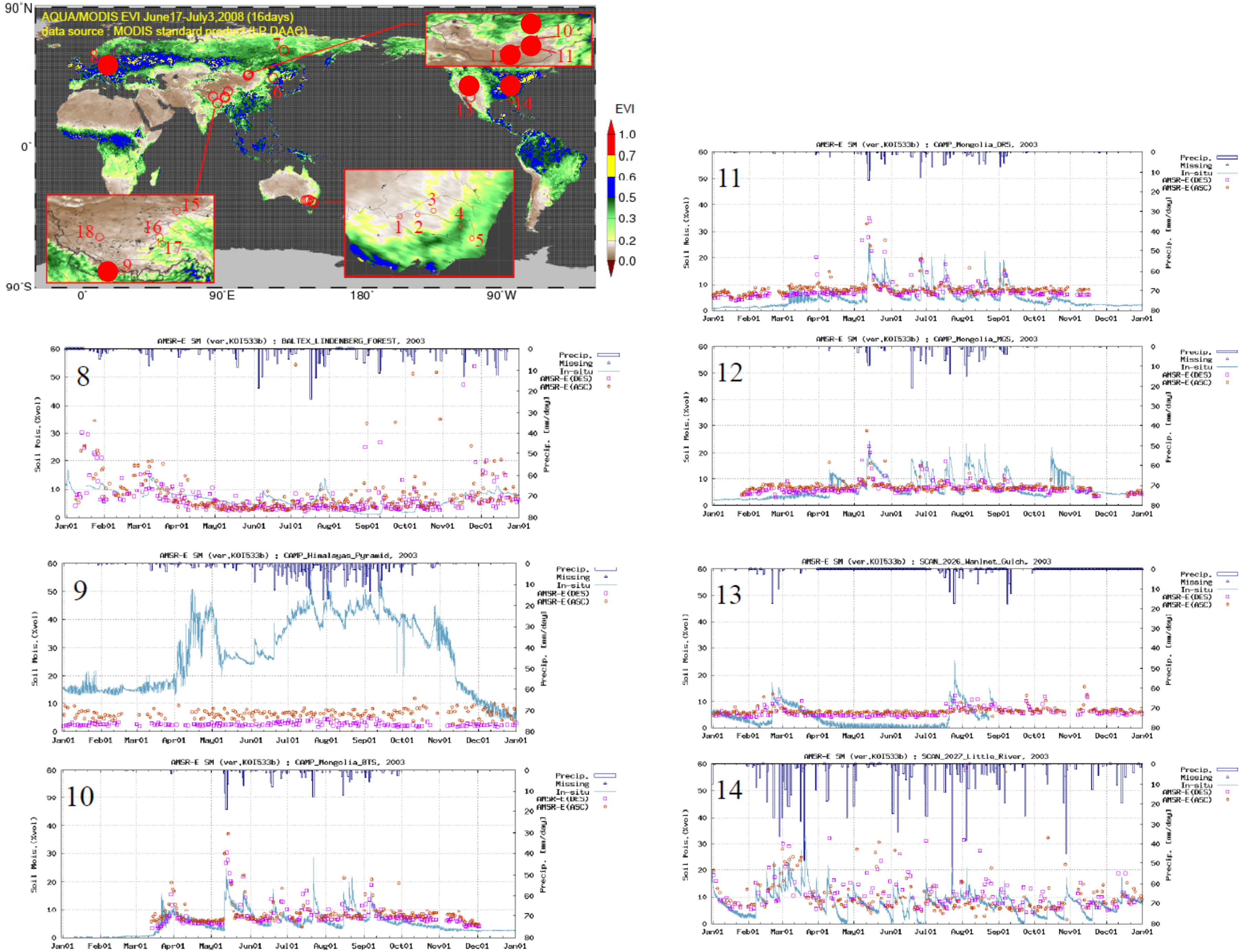

Land Surface:
AIEM + Shadowing
Volume Scattering:
Dense Media
Radiative Transfer:
4-stream Fast
Sparse
Dense
Partial
Vegetation
Soil Moisture
Permafrost
Snow
Atmosphere
Radiative Transfer Models in Microwave Region


18.7/23.8/36.5/89GHz
6.9/10.7/18.7GHz

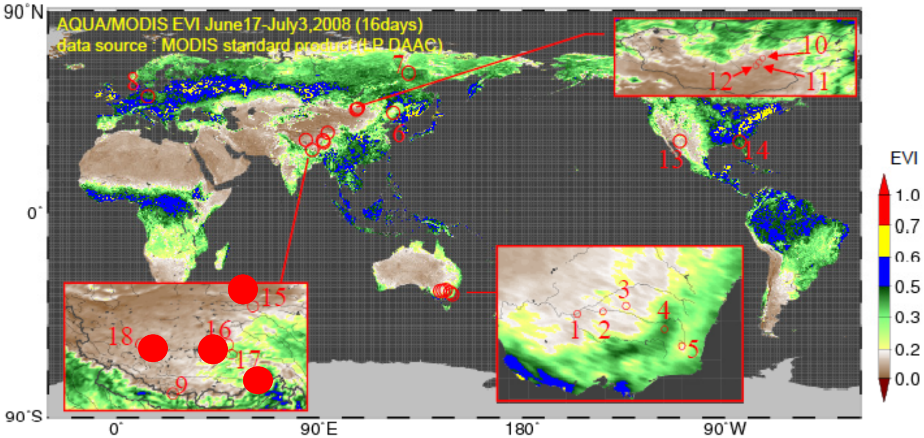


Satellite Observation
Brightness Temperature,TB
10GHz (V, H) and 36GHz (V)
Latitude, Longitude, Observation date
Quality Check
yes
3
Index of Soil Wetness(Koike,1996)
$ISW = \frac{T_{B36H} - T_{B10H}}{\frac{1}{2}(T_{B36H} + T_{B10H})}$
Polarization Index(Shimonetta,1998)
$PI = \frac{T_{B10V} - T_{B10H}}{\frac{1}{2}(T_{B10V} + T_{B10H})}$
4
Selected LUT
(ISW, PI) → (SM, VWC)
5
Soil Moisture
Vegetation Water Content
Main Routine
Look-up Table Dataset,
LUT (f_c)
Global dataset of
fractional vegetation cover,
f_c (lat, lon, date)
Data source:
Terra/Aqua Modis 16days, 1km ISIN
Period: Jun 2002 – May 2008
Sampling point: 0.05x0.05 grid
Resolution: approx. 33x33 km
fc-model: Carlson and replay, 1997
LUT(fc)
LUT(f_c)
fc = 1 … 100%
fc (lat, lon, date)
2
1
$f_c = \left(\frac{NDVI - NDVI_{min}}{NDVI_{max} - NDVI_{min}}\right)$
Ancillary Data Base
Radiative Transfer Model
$T_B = (1-f_c)T_B^{bare} + fcT_B^{vege}$
T_B^{bare}
T_B^{vege}
bare soil
vegetated surface

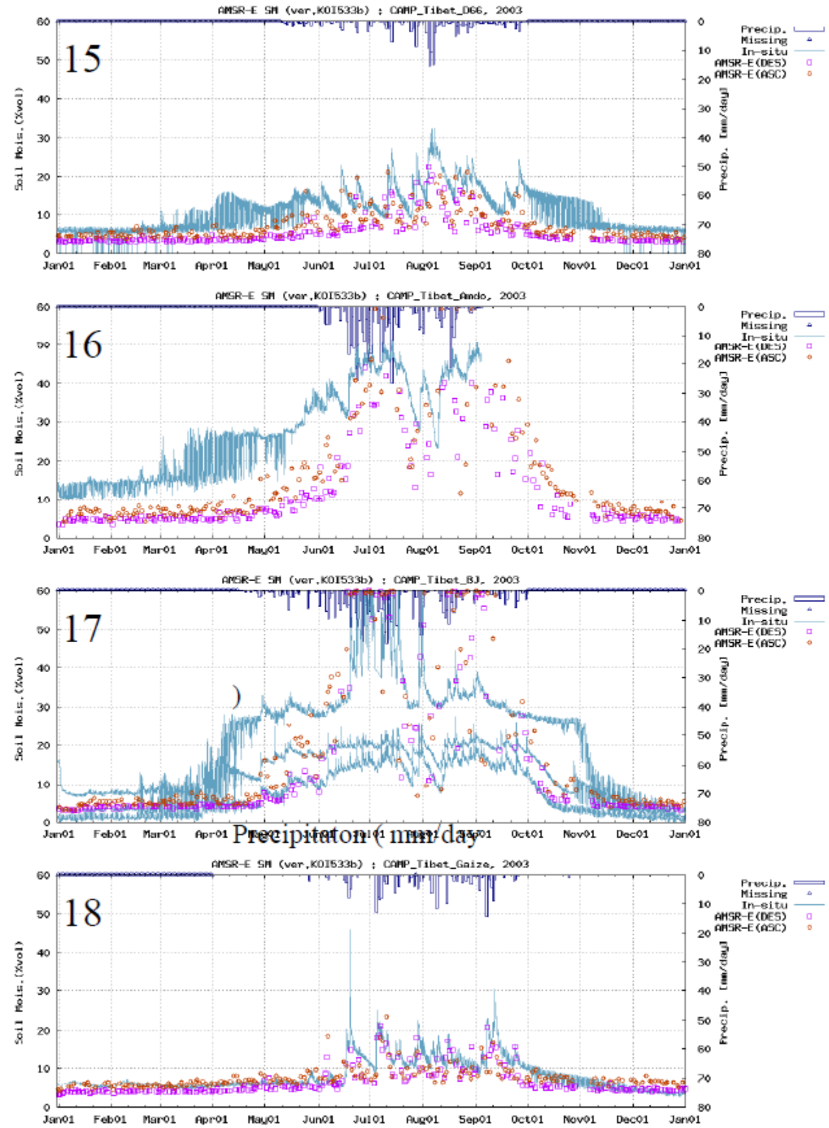

AQUA/MODIS EVI June17-July3,2008 (16days)
data source : MODIS standard product (LP DAAC)
90°N
0°
90°S
0°
90°E
180°
90°W
EVI
1.0
0.7
0.6
0.5
0.3
0.2
0.0
AMSR-E SM (ver.KOI533b) : MDB_Murrumbidgee_BALRANALD_BOLTO, 2003
AMSR-E SM (ver.KOI533b) : MDB_Murrumbidgee_HAY_RESEARCH_ST, 2003
AMSR-E SM (ver.KOI533b) : MDB_Murrumbidgee_GRIFFITH_AERODR, 2003
AMSR-E SM (ver.KOI533b) : MDB_Murrumbidgee_ADELONG, 2003
AMSR-E SM (ver.KOI533b) : MDB_Murrumbidgee_COOMA_AIRFIELD, 2003
AMSR-E SM (ver.KOI533b) : CAMP_Tongyu_Cropland, 2003
AMSR-E SM (ver.KOI533b) : CAMP_SiberiaTaiga_LarchForest, 2003
Soil Mois. (%vol)
Precip. [mm/day]
Precip.
Missing
In-situ
AMSR-E(DES)
AMSR-E(ASC)
Jan01 Feb01 Mar01 Apr01 May01 Jun01 Jul01 Aug01 Sep01 Oct01 Nov01 Dec01 Jan01



AQUA/MODIS EVI June17-July3,2008 (16days)
data source : MODIS standard product (LP DAAC)
90°N
0°
90°S
0°
90°E
180°
90°W
EVI
1.0
0.7
0.6
0.5
0.3
0.2
0.0
AMSR-E SM (ver.KOI533b) : CAMP_Mongolia_DRS, 2003
AMSR-E SM (ver.KOI533b) : BALTEX_LINDENBERG_FOREST, 2003
AMSR-E SM (ver.KOI533b) : CAMP_Mongolia_MGS, 2003
AMSR-E SM (ver.KOI533b) : CAMP_Himalayas_Pyramid, 2003
AMSR-E SM (ver.KOI533b) : SCAN_2026_Walnut_Gulch, 2003
AMSR-E SM (ver.KOI533b) : CAMP_Mongolia_BTS, 2003
AMSR-E SM (ver.KOI533b) : SCAN_2027_Little_River, 2003
Soil Mois.(%vol)
Precip. [mm/day]
Precip.
Missing
In-situ
AMSR-E(DES)
AMSR-E(ASC)
Jan01
Feb01
Mar01
Apr01
May01
Jun01
Jul01
Aug01
Sep01
Oct01
Nov01
Dec01
Jan01

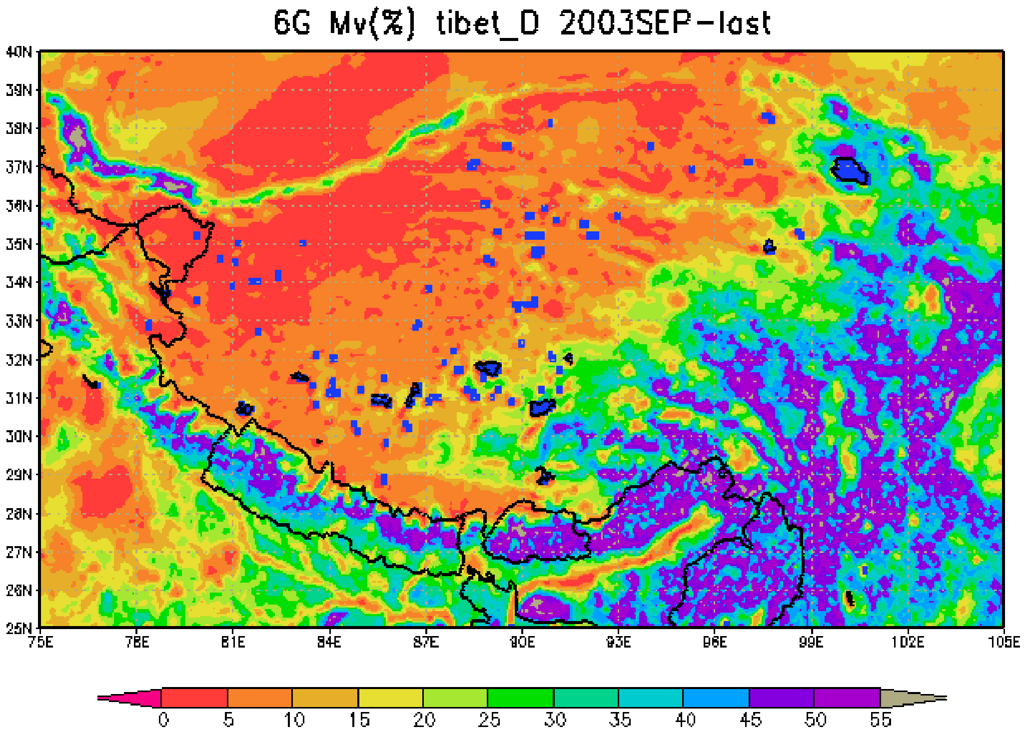


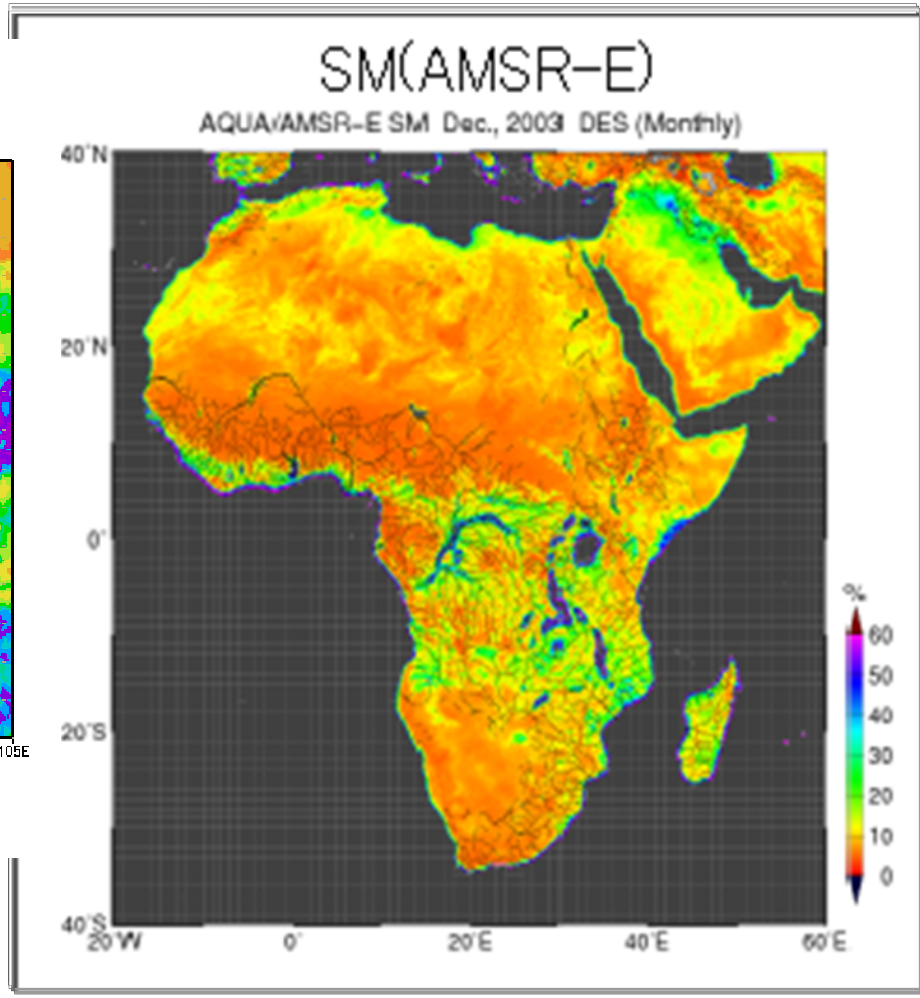
No.	Project	Site Name	Probe depth
1	CEOP	MDB Murrumbidgee BALRANALD BOLTO	4cm
2	CEOP	MDB Murrumbidgee HAY RESEARCH ST	4cm
3	CEOP	MDB Murrumbidgee GRIFFITH AERODR	4cm
4	CEOP	MDB Murrumbidgee ADELONG	4cm
5	CEOP	MDB Murrumbidgee COOMA AIRFIELD	4cm
6	CEOP	CAMP Tongyu Cropland	5cm
7	CEOP	CAMP SiberiaTaiga LarchForest	10cm
8	CEOP	BALTEX LINDENBERG FOREST	10cm
9	CEOP	CAMP Himalayas Pyramid	5cm
10	CEOP	CAMP Mongolia BTS	3cm
11	CEOP	CAMP Mongolia DRS	3cm
12	CEOP	CAMP Mongolia MGS	3cm
13	SCAN	SCAN 2026 Wanlnet Gulch	5cm
14	SCAN	SCAN 2027 Little River	5cm
15	CEOP	CAMP Tibet D66	4cm
16	CEOP	CAMP Tibet Amdo	4cm
17	CEOP	CAMP Tibet BJ	4cm
18	CEOP	CAMP Tibet Gaize	3cm



Seasonal Variation of the Soil Moisture

Tibetan Plateau / Africa

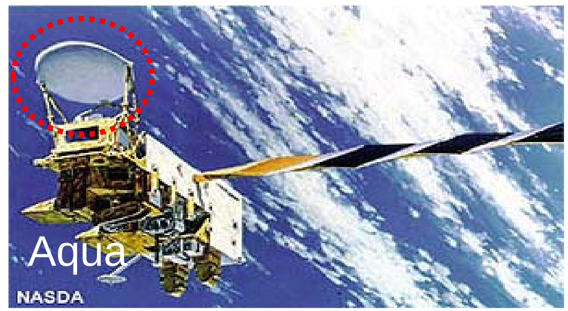


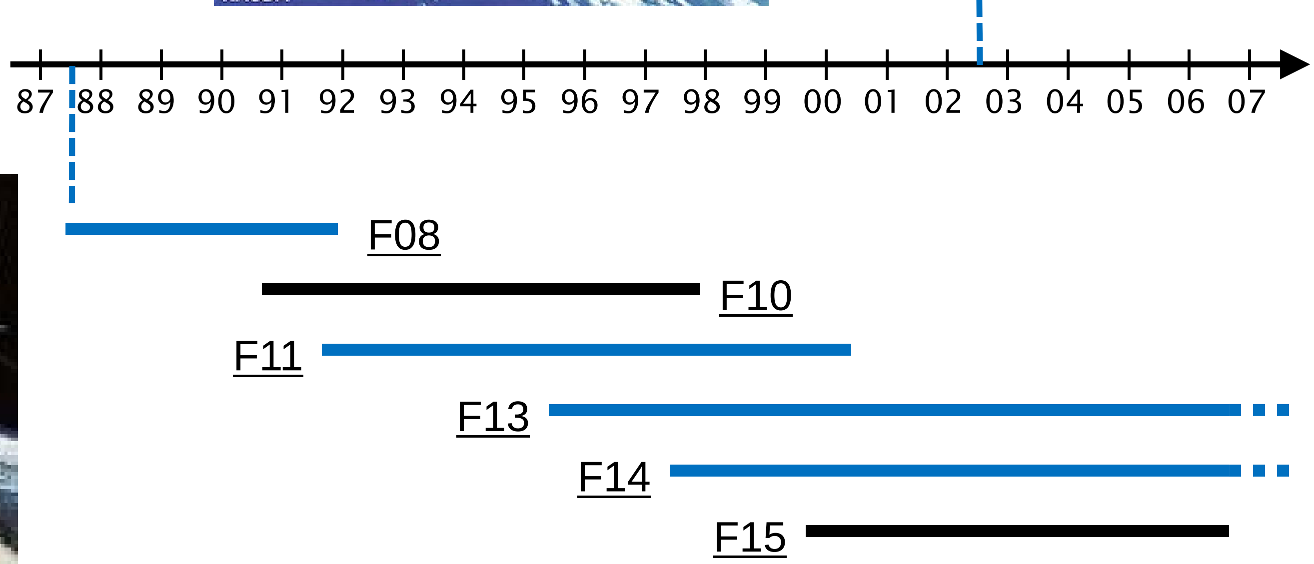


Satellite Data Application to Climate Change

AMSR-E on AQUA

6.925, 10.65, 18.7, 23.8, 36.5, (50.3), (52.8) and 89.0 GHz



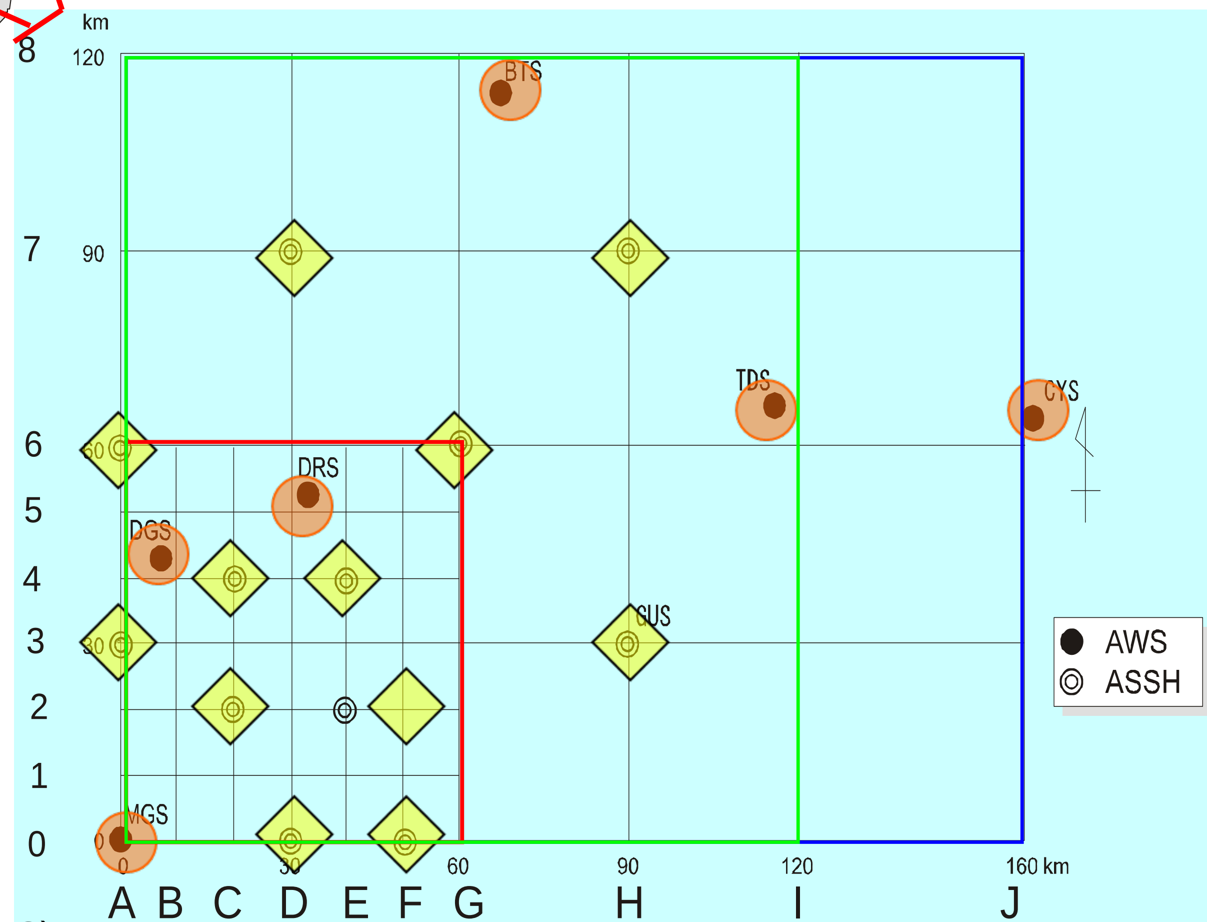


SSM/I on DMSP

19.35, 22.235, 37.0 and 85.5 GHz

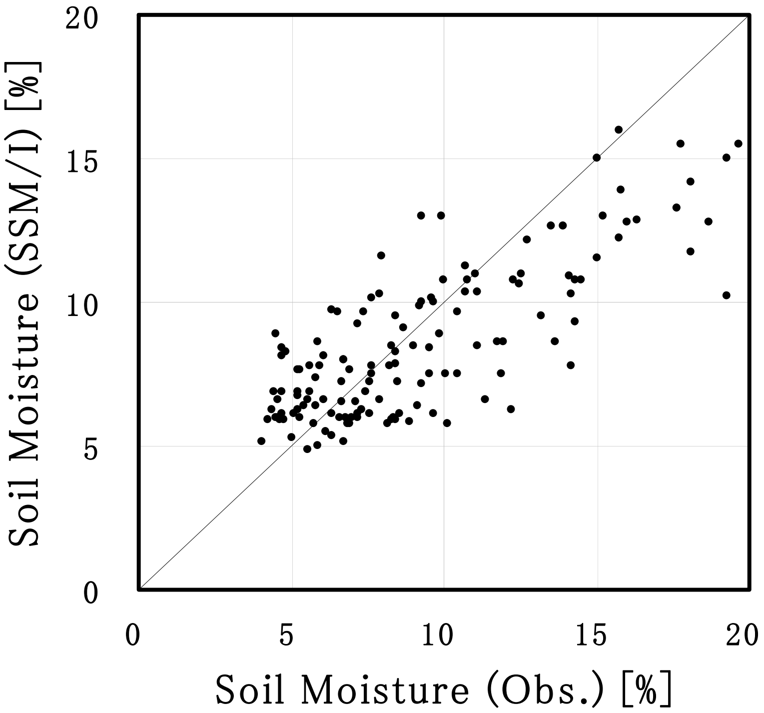
CEOP Reference Site in Mongolia

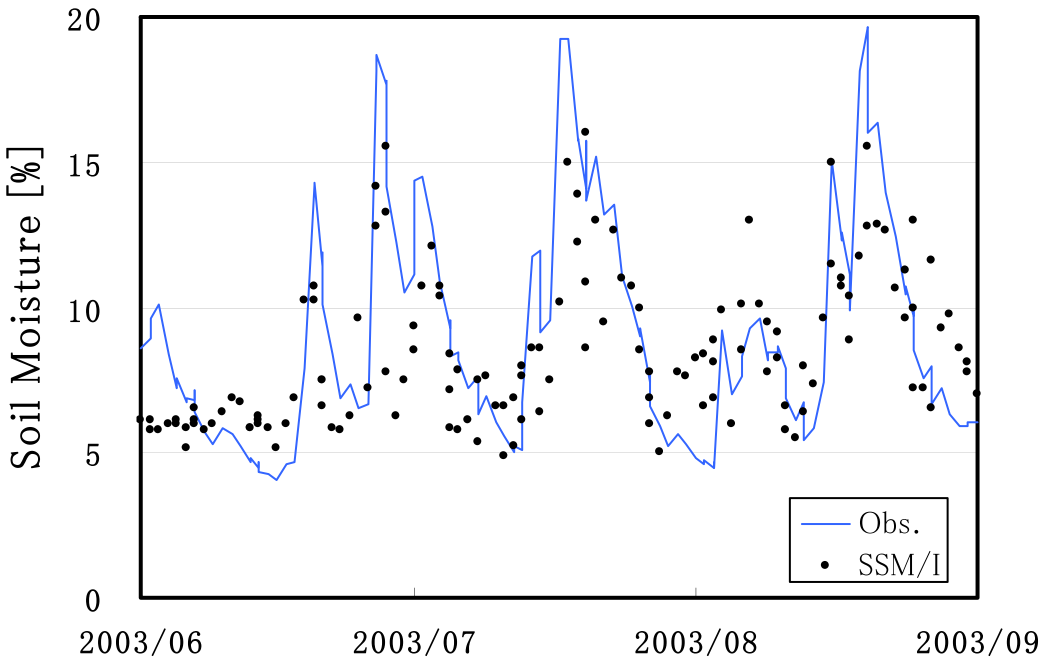
(Automatic Station for Soil Hydrology, ASSH)



(Automatic Weather Station, AWS)

SSM/I Soil Moisture Algorithm Tuning by the CEOP Reference Site Data and AMSR-E



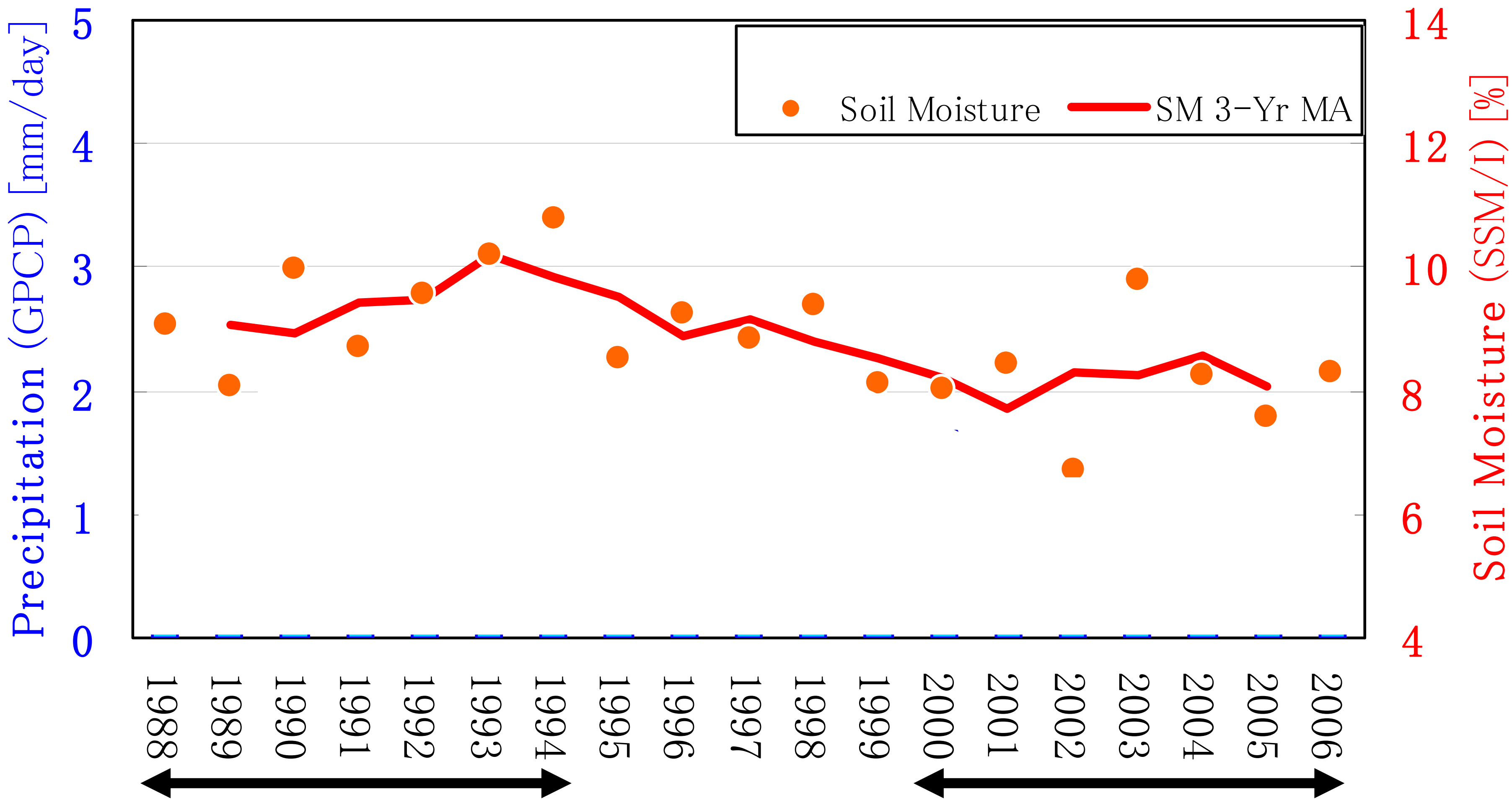


Mean Absolute Error : 2.00 [%]

RMS Error : 2.55 [%]

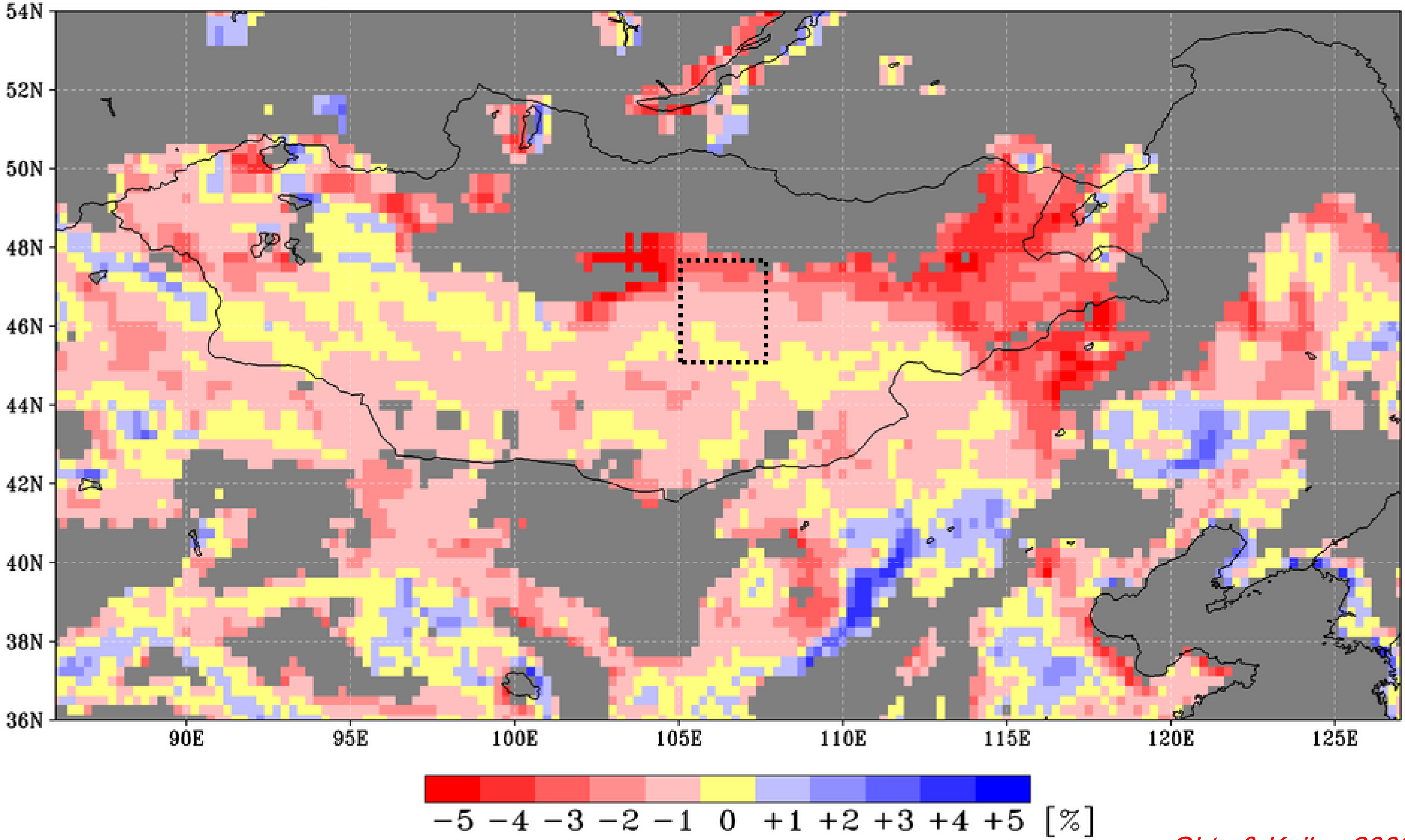
Ohta & Koike, 2008

Long Term Application of 2.5 x 2.5 Degrees Area including Validation Sites (JJA Average)

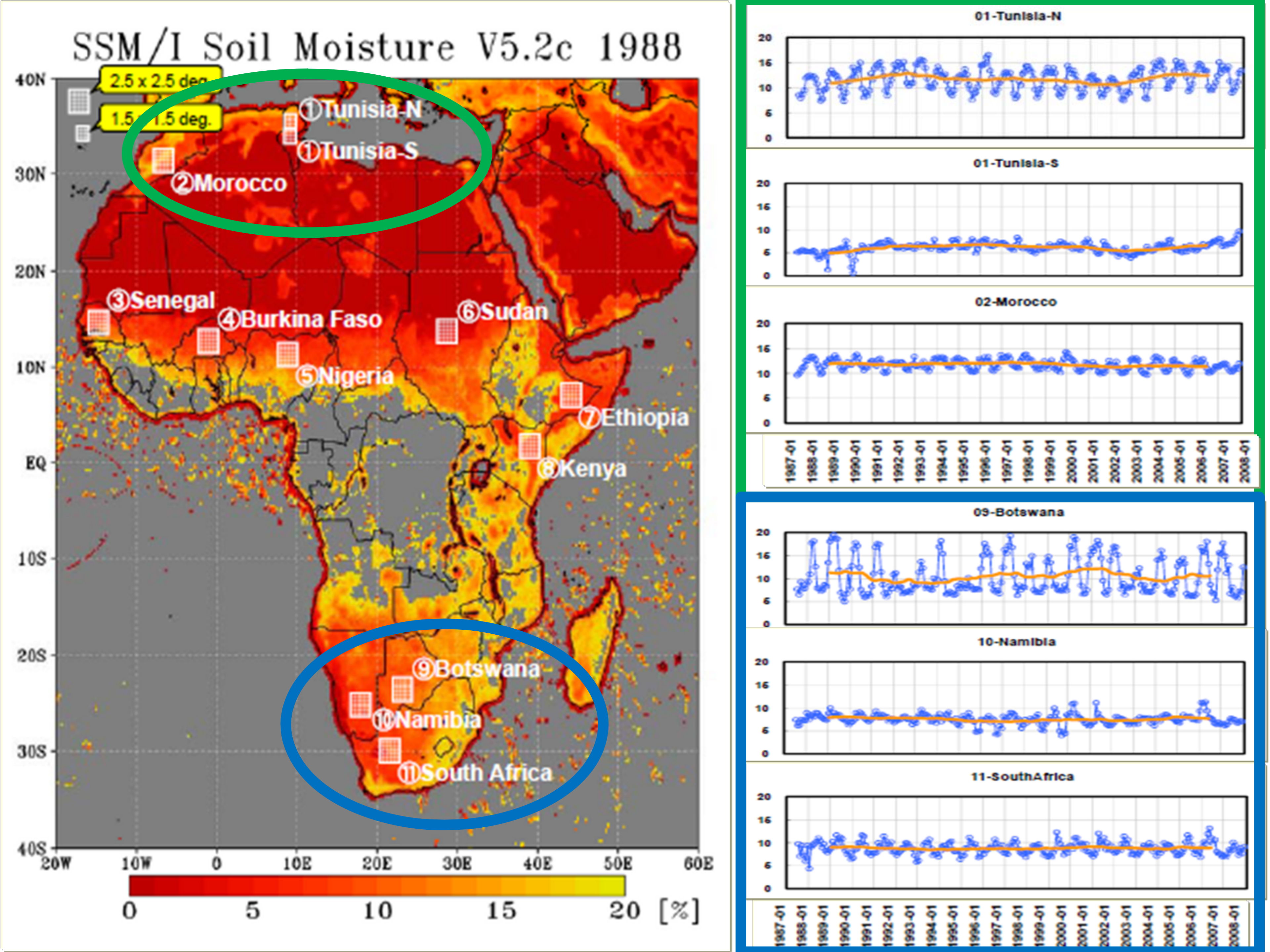


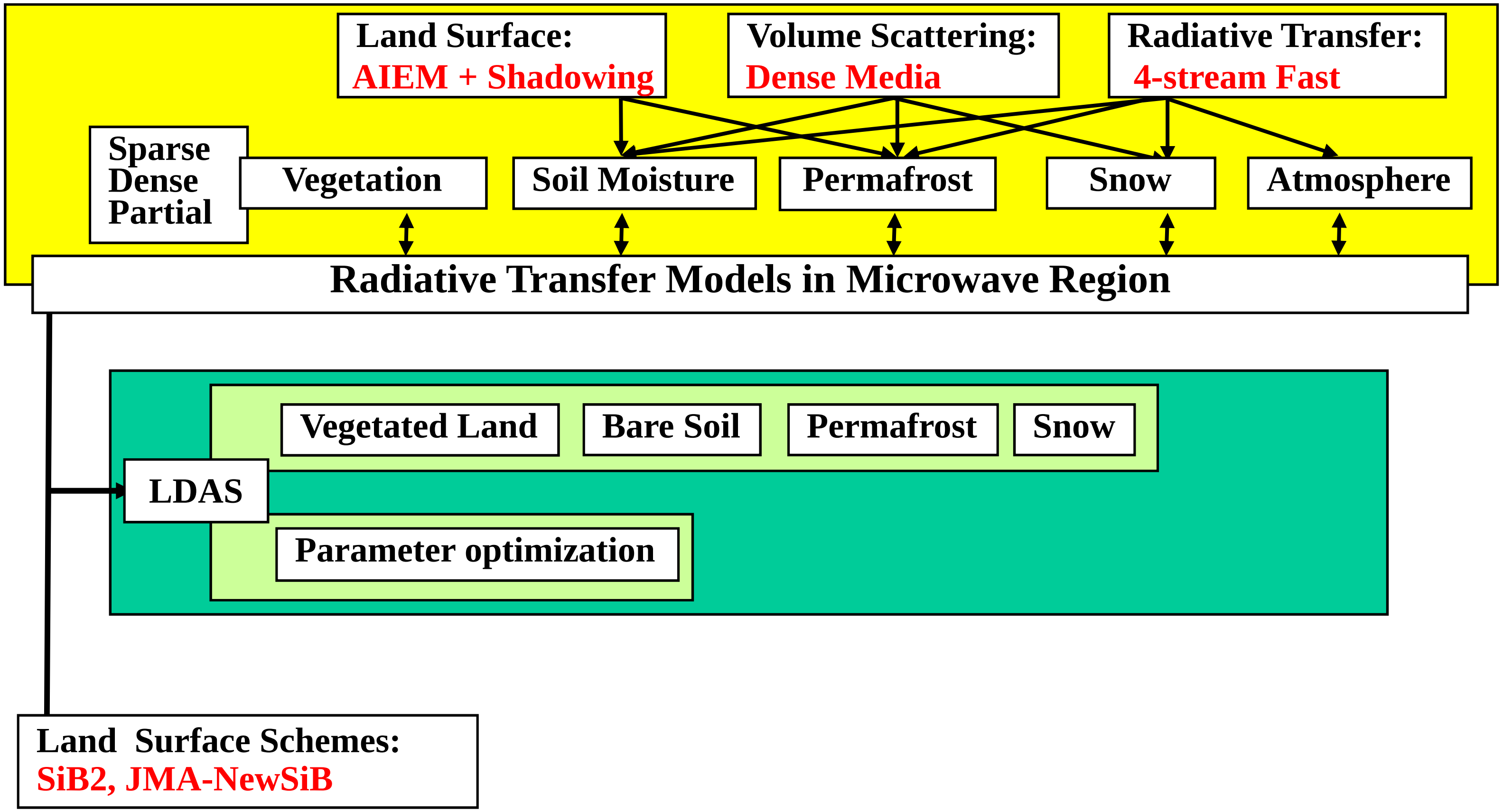
Ohta & Koike, 2008

Interannual Variation Trend of Soil Moisture in Mongolia(JJA, 1988-2006)



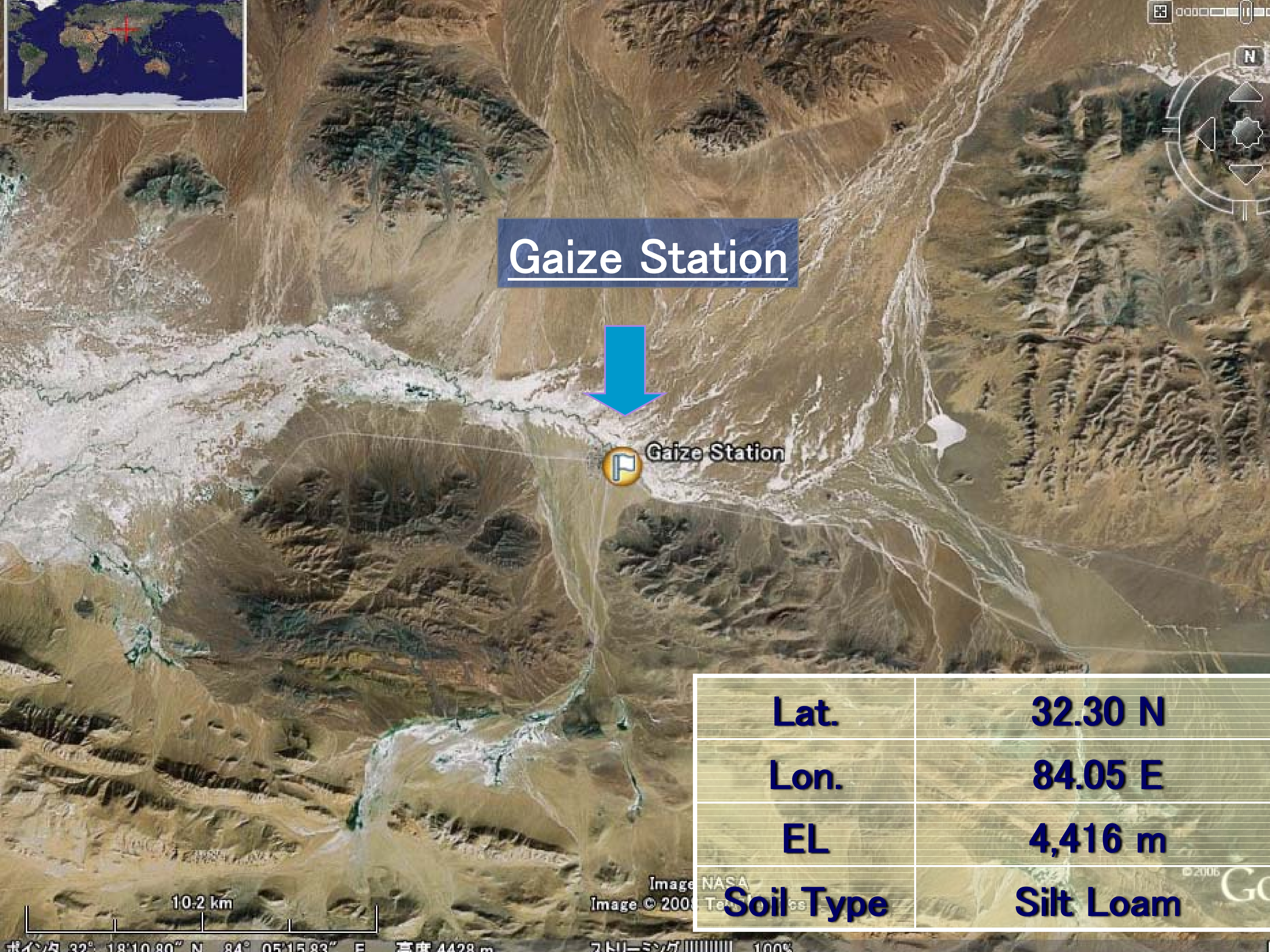
Ohta & Koike, 2008


SSM/I Soil Moisture V5.2c 1988
2.5 x 2.5 deg.
1.5 x 1.5 deg.
①Tunisia-N
①Tunisia-S
②Morocco
③Senegal
④Burkina Faso
⑤Nigeria
⑥Sudan
⑦Ethiopia
⑧Kenya
⑨Botswana
⑩Namibia
⑪South Africa
40N 30N 20N 10N EQ 10S 20S 30S 40S
20W 10W 0 10E 20E 30E 40E 50E 60E
0 5 10 15 20 [%]
01-Tunisia-N
01-Tunisia-S
02-Morocco
09-Botswana
10-Namibia
11-SouthAfrica
0 5 10 15 20
1987-01 1988-01 1989-01 1990-01 1991-01 1992-01 1993-01 1994-01 1995-01 1996-01 1997-01 1998-01 1999-01 2000-01 2001-01 2002-01 2003-01 2004-01 2005-01 2006-01 2007-01 2008-01



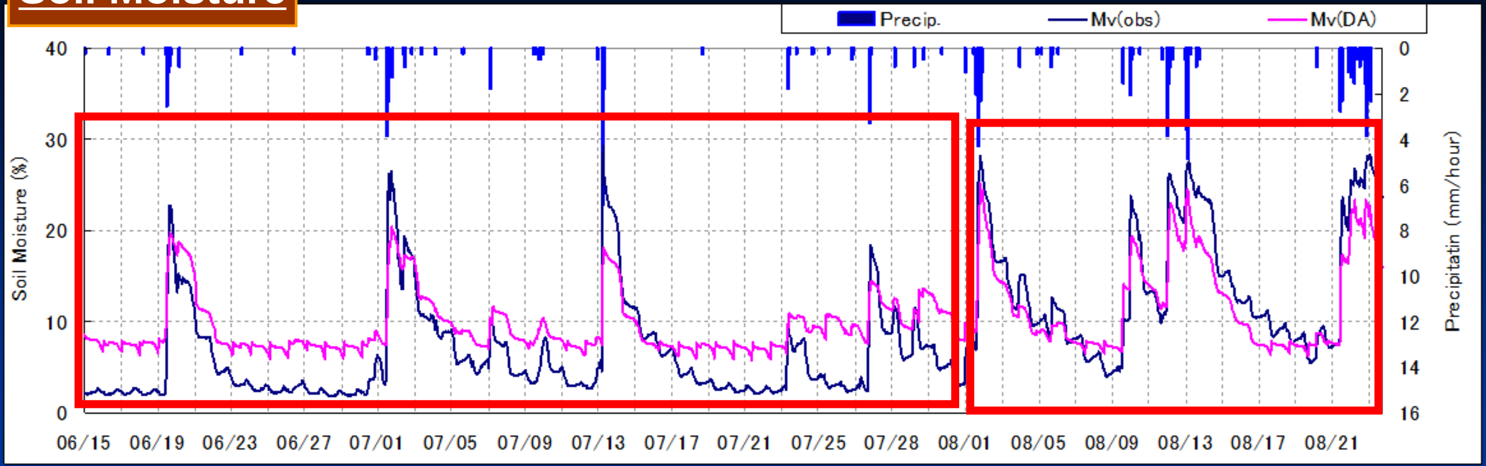
Land Surface:
AIEM + Shadowing
Volume Scattering:
Dense Media
Radiative Transfer:
4-stream Fast
Sparse
Dense
Partial
Vegetation
Soil Moisture
Permafrost
Snow
Atmosphere
Radiative Transfer Models in Microwave Region
Vegetated Land
Bare Soil
Permafrost
Snow
LDAS
Parameter optimization
Land Surface Schemes:
SiB2, JMA-NewSiB

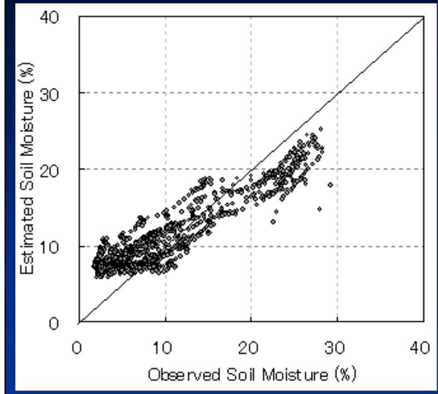
Gaize Station



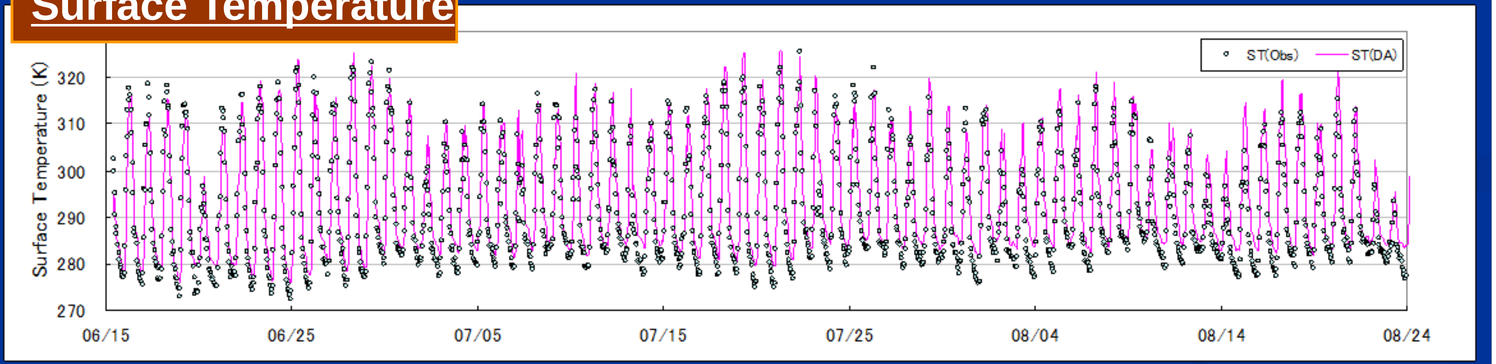
Lat.	32.30 N
Lon.	84.05 E
EL	4,416 m
Soil Type	Silt Loam

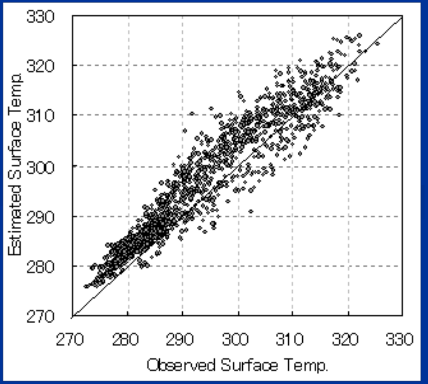
Soil Moisture





Surface Temperature

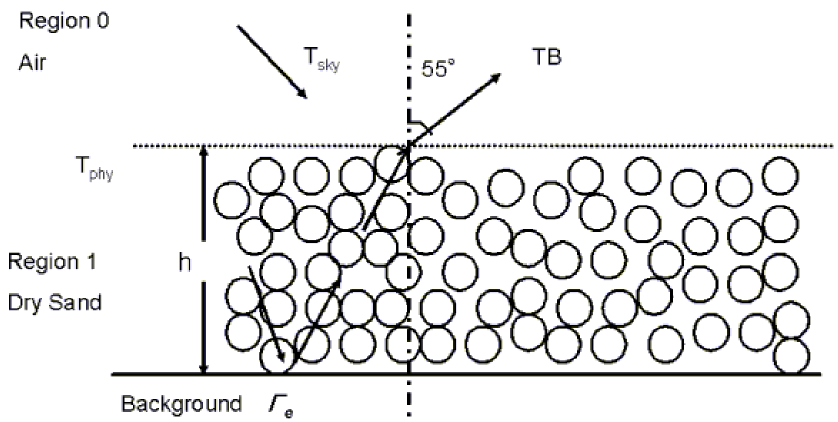


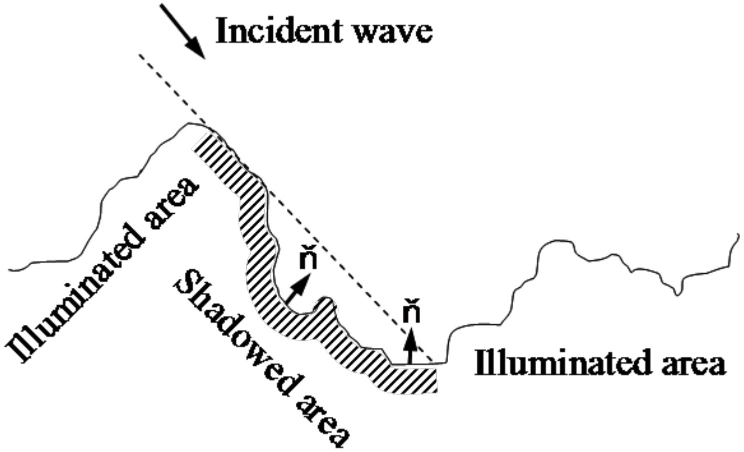


Good agreement under wet condition

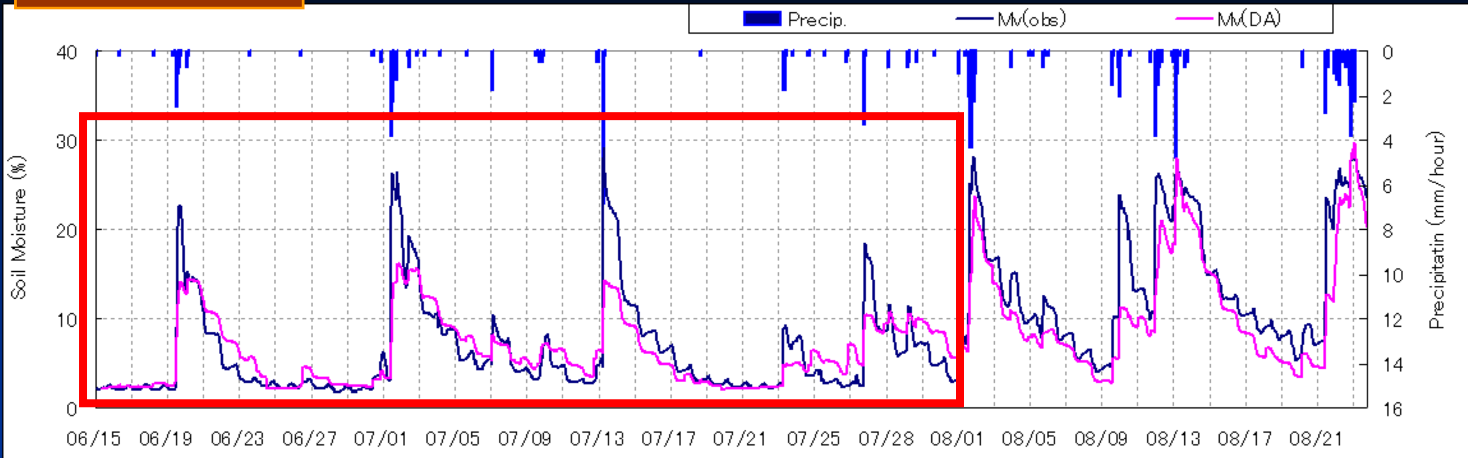
Gap under dry condition

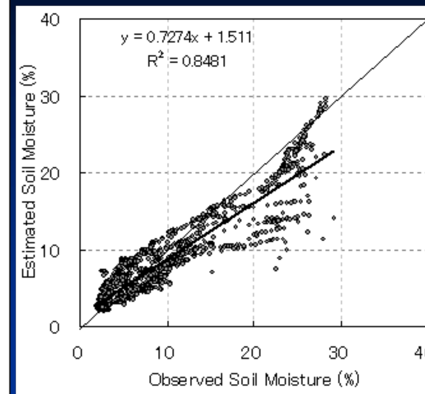
GBHM Experiments



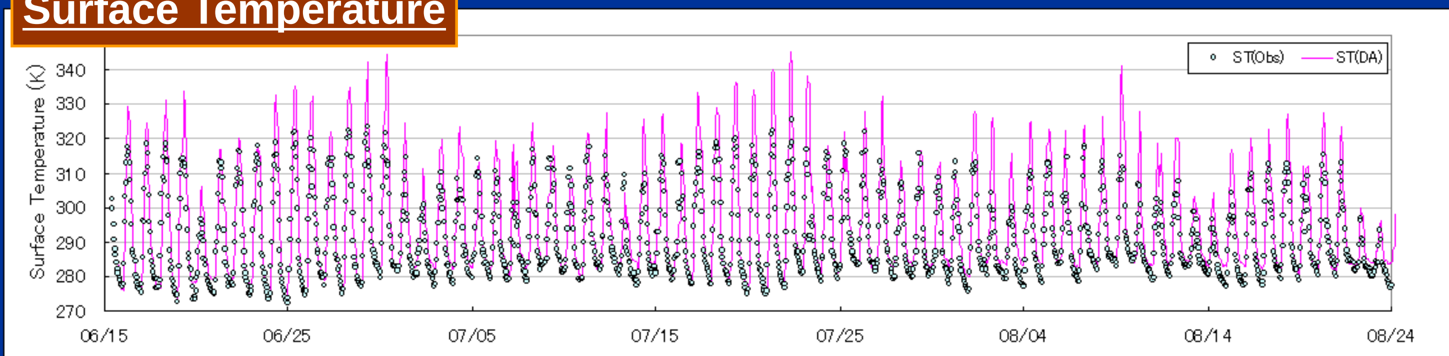


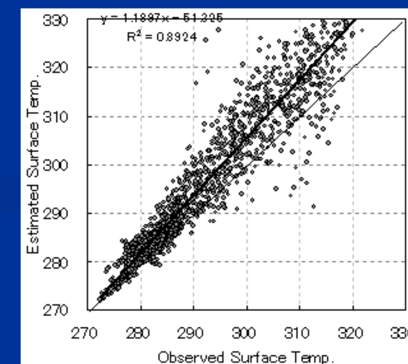
Soil moisture





Surface Temperature

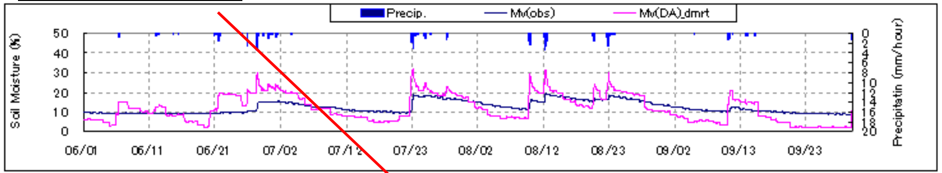




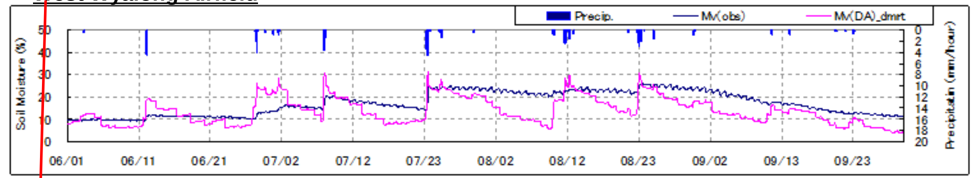
LDASUT with DMRT.

LDASUT(DMRT) application result (2003/06 – 2003/09)

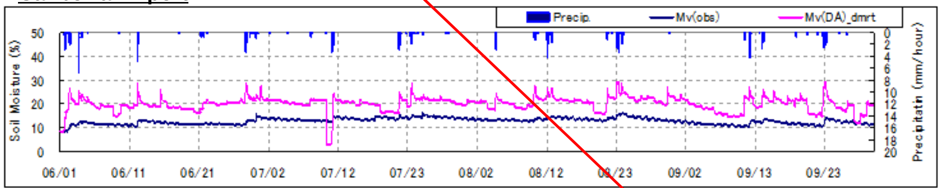
Balranald-Bolton Park



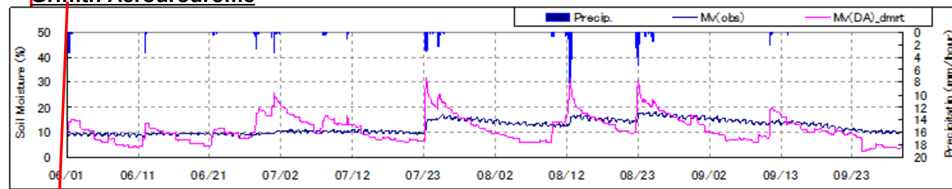
West Wyalong Airfield



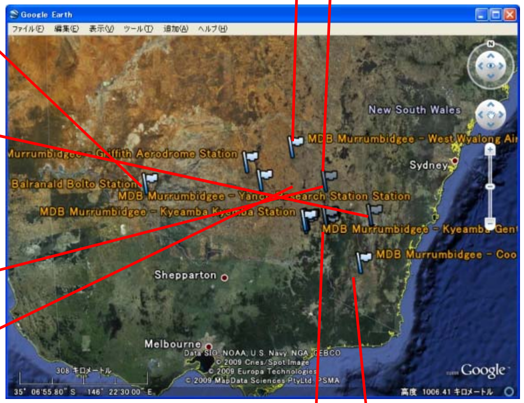
Canberra Airport



Griffith Aerodrodrome

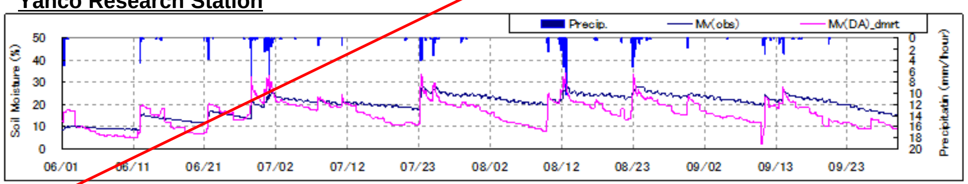


Station name	MBE	RMSE	NSEE
Balranald-Bolton Park	-0.50	4.92	0.39
Canberra Airport	7.22	7.69	0.59
Yanco Research Station	-4.04	5.82	0.28
Cootamundra Aerodrome	3.84	5.60	0.39

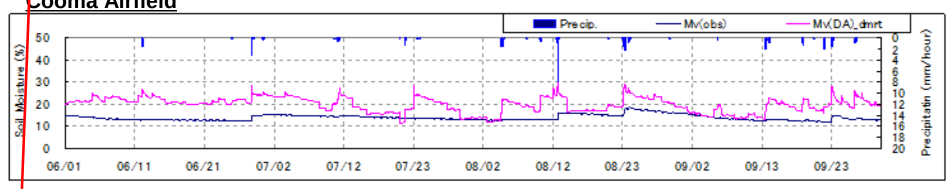


Station name	MBE	RMSE	NSEE
West Wyalong Airfield	-3.45	5.99	0.33
Griffith Aerodrodrome	-0.78	4.69	0.38
Cooma Airfield	5.89	6.77	0.49
Kyeamba - Gentle Slope	-5.55	8.43	0.32

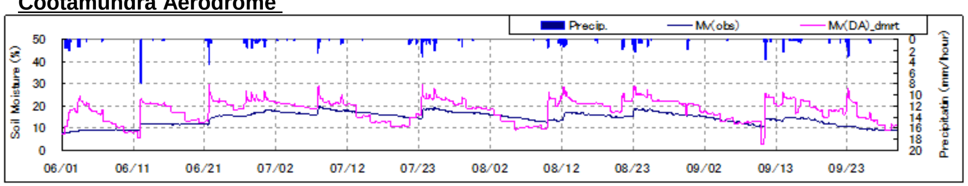
Yanco Research Station



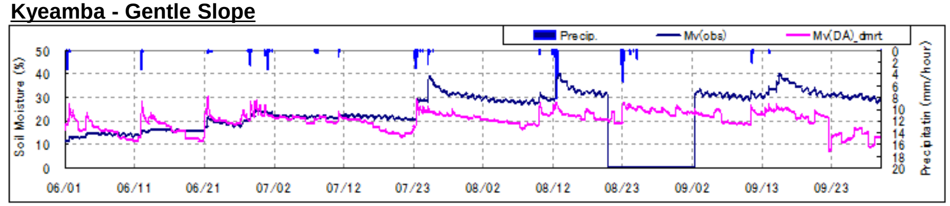
Cooma Airfield



Cootamundra Aerodrome



Kyeamba - Gentle Slope



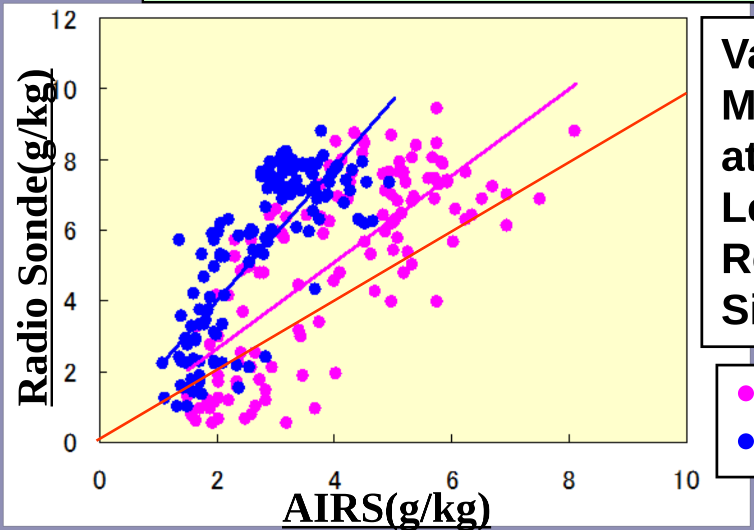
CEOP Data Management – Satellite Data Session

NASA contributions (MODIS Team Provided Chart)
JAXA contributions (K. Umezawa)
ESA contributions (E.-A. Herland)

MODIS Status for CEOP--8/19/2009

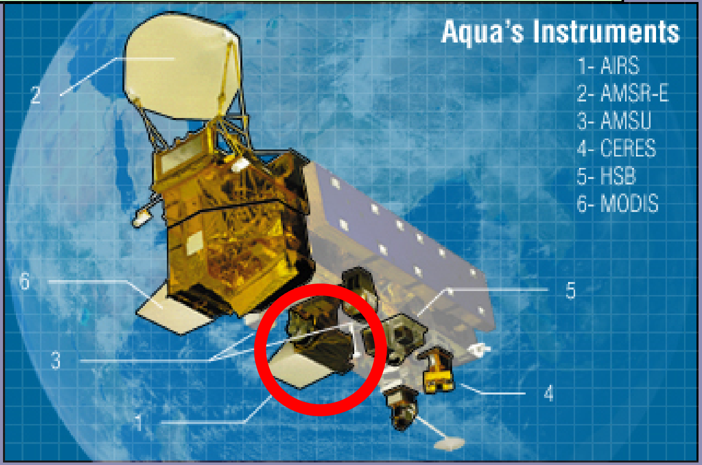
- MODAPS completed Terra MODIS data production for period EOP-4 (2003/10/1 - 2004/12/31) and loaded the 5.4 TB data to a ftp server that is large enough to stage both EOP-3 and EOP-4 Terra MODIS data.
- JAXA downloaded 80% of the Terra MODIS EOP-4 data, and processed about 60% of the Terra MODIS EOP-4 data.
- MODAPS just started Terra MODIS data production for period EOP-3 (2002/10/1 - 2003/9/30), and expects a production rate of approximately 7x.
- MODAPS will have capacity to generate Aqua MODIS products for CEOP if it's desired.

AIRS 3D Water Vapor Product

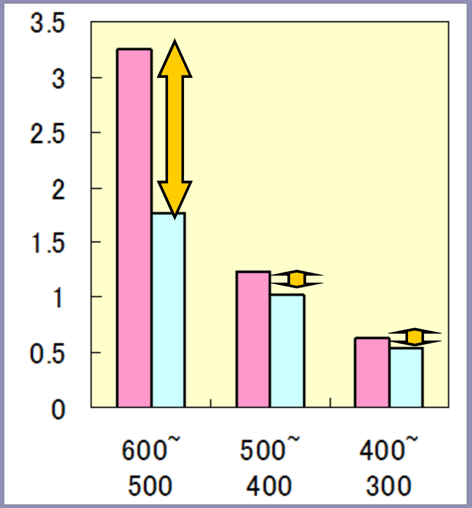


Validation of Mixing Ratio at 600-500hPa Level, Tibet Reference Site, 2004)

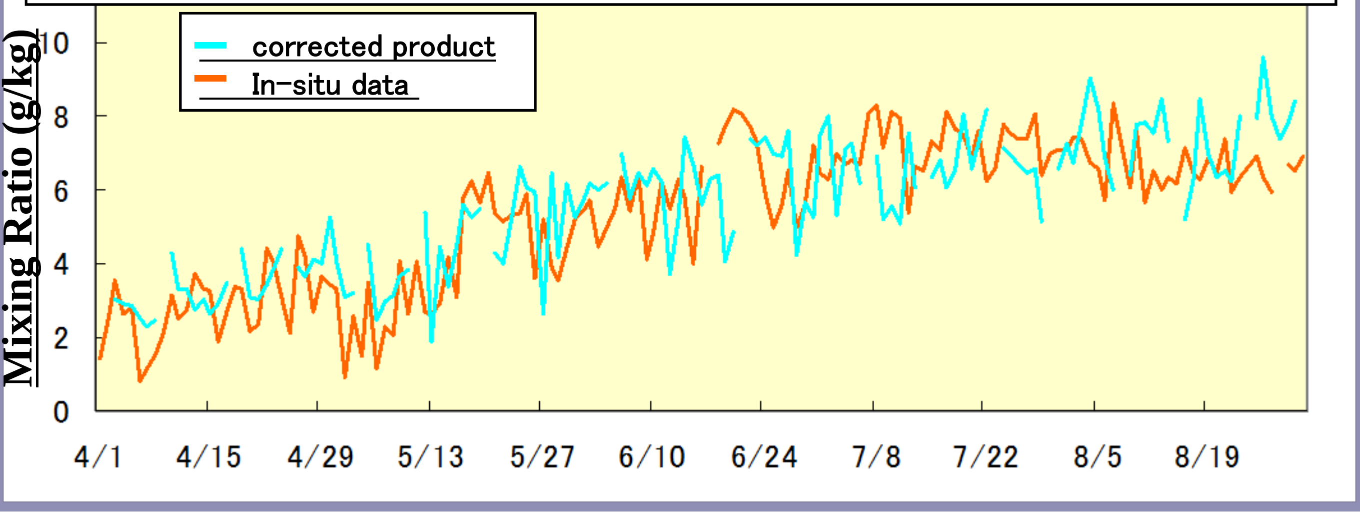
daytime
nighttime



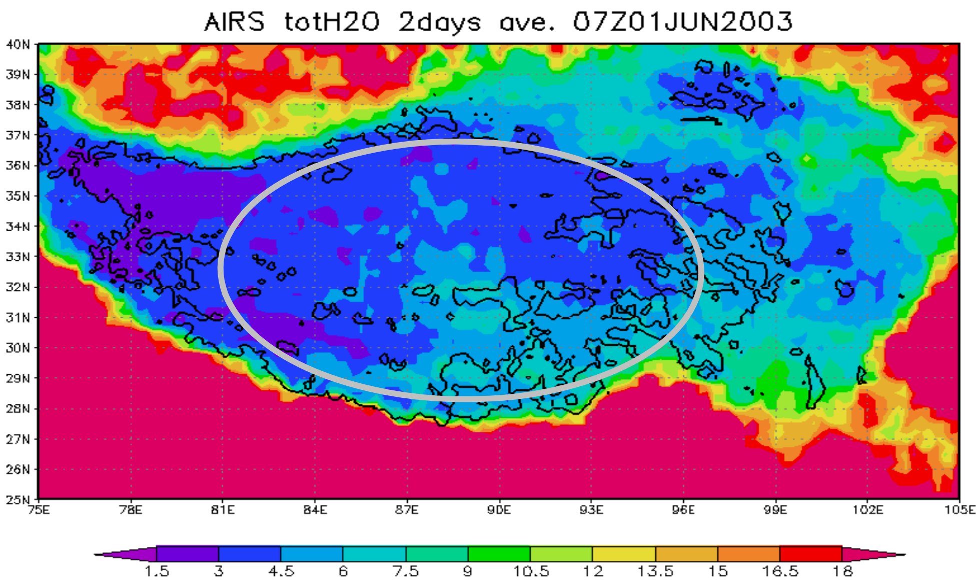
Comparison of the Mixing Ratio

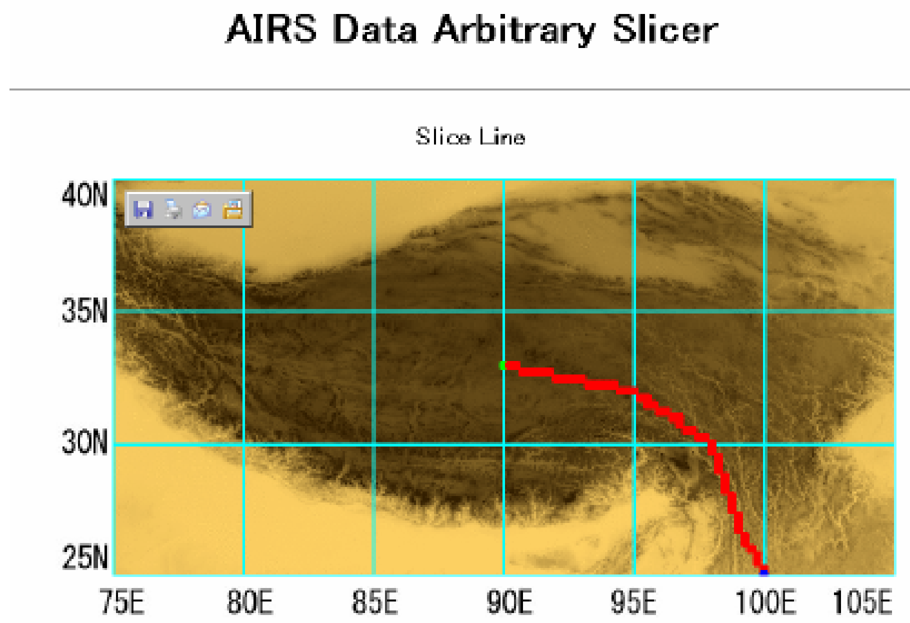


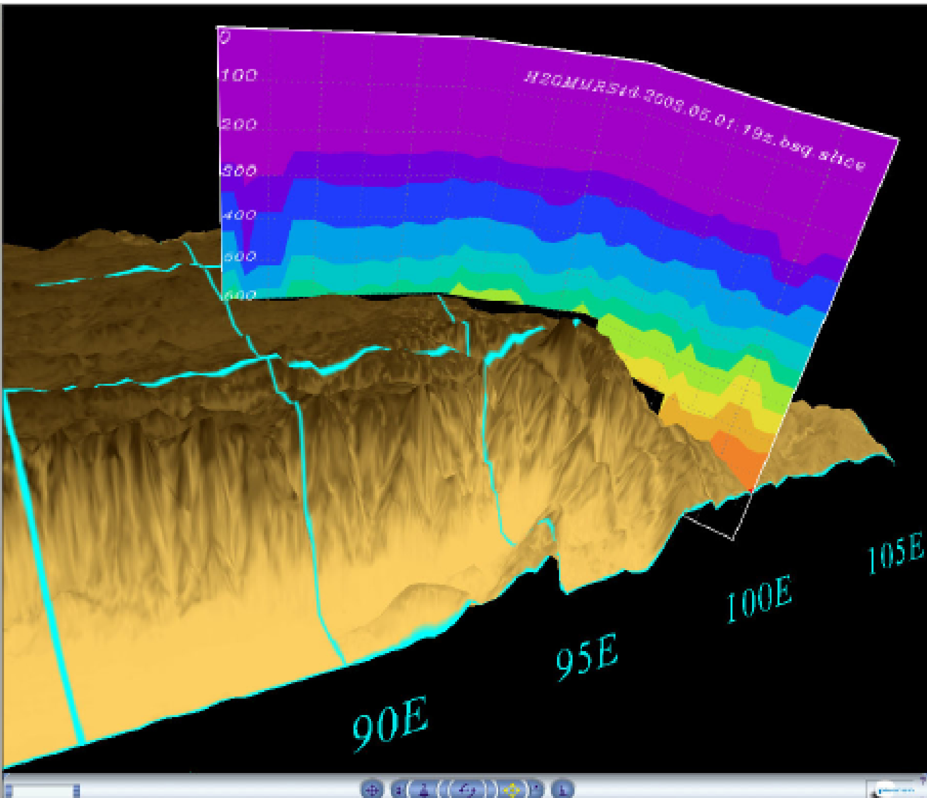
Time Series of Corrected AIRS Water Vapor Product
Lhasa 600～500hPaLevel, Daytime, 2004

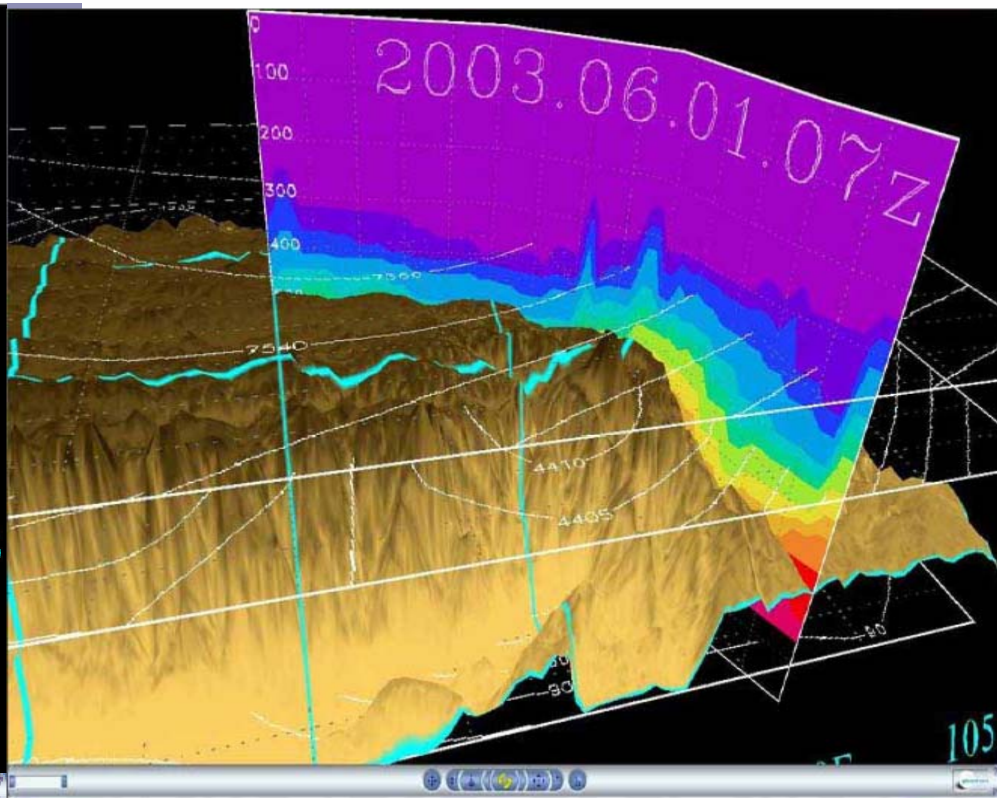


Nomoto & Koike, 2006

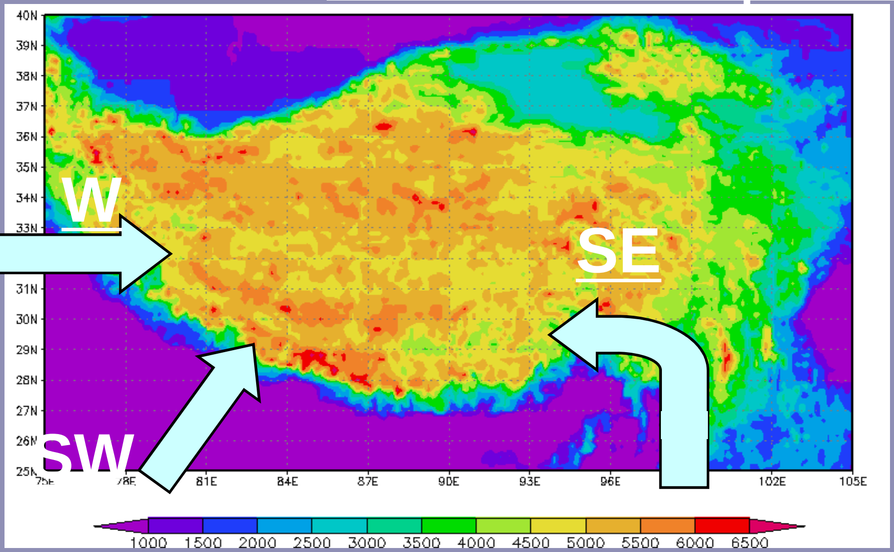

AIRS totH2O 2days ave. 07Z01JUN2003
40N
39N
38N
37N
36N
35N
34N
33N
32N
31N
30N
29N
28N
27N
26N
25N
75E
78E
81E
84E
87E
90E
93E
96E
99E
102E
105E
1.5 3 4.5 6 7.5 9 10.5 12 13.5 15 16.5 18

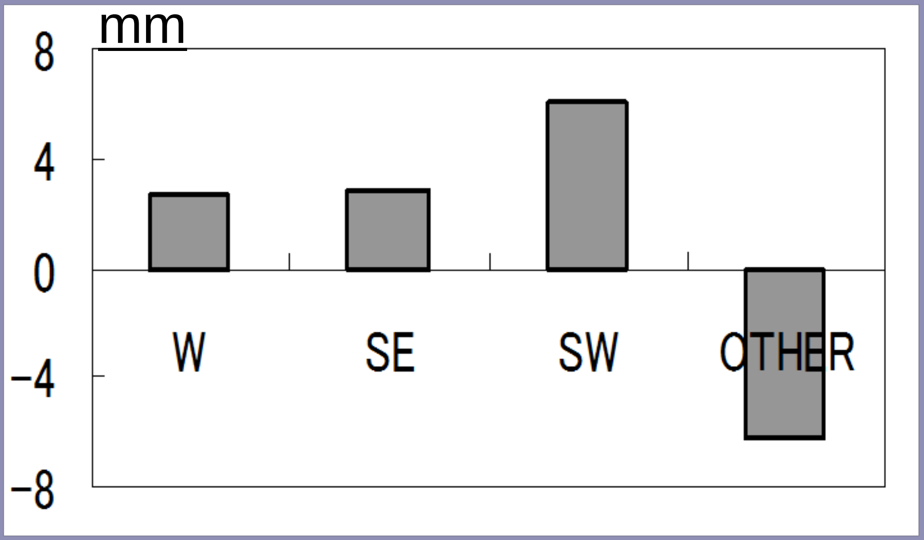

AIRS Data Arbitrary Slicer
Slice Line
40N
35N
30N
25N
75E
80E
85E
90E
95E
100E
105E

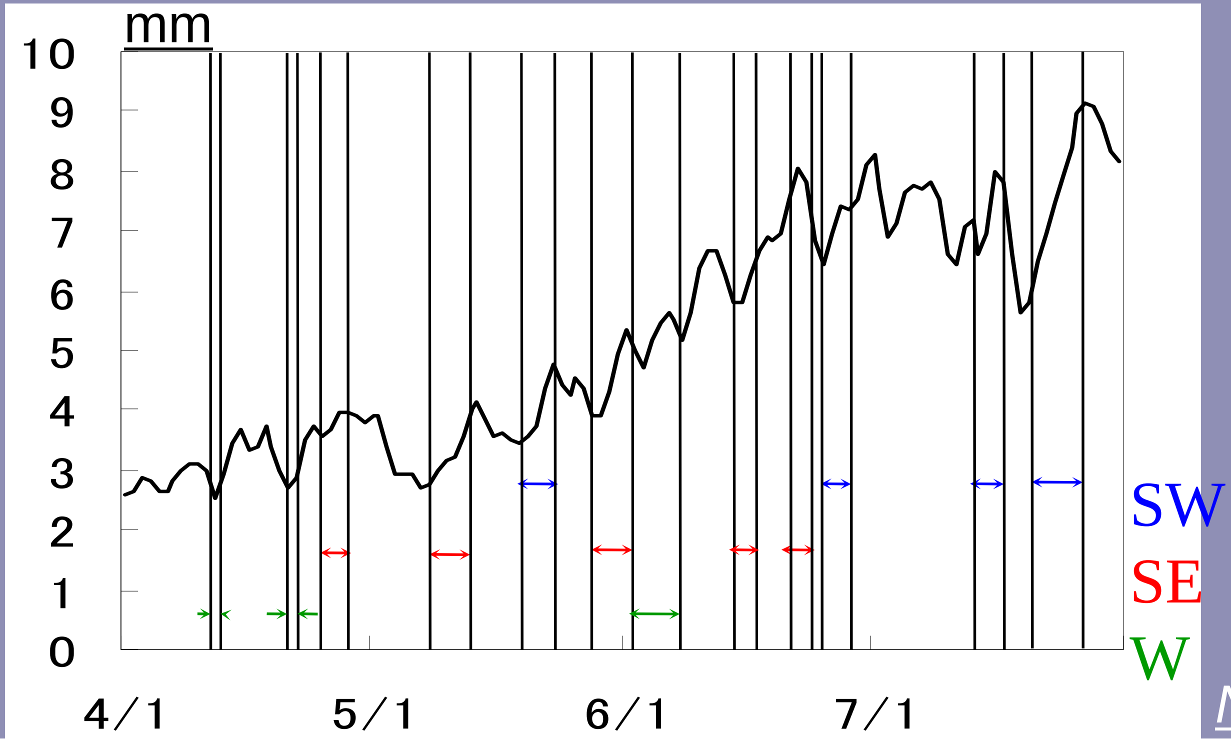

100
200
300
400
500
600
90E
95E
100E
105E


2003.06.01.07Z
100
200
300
400

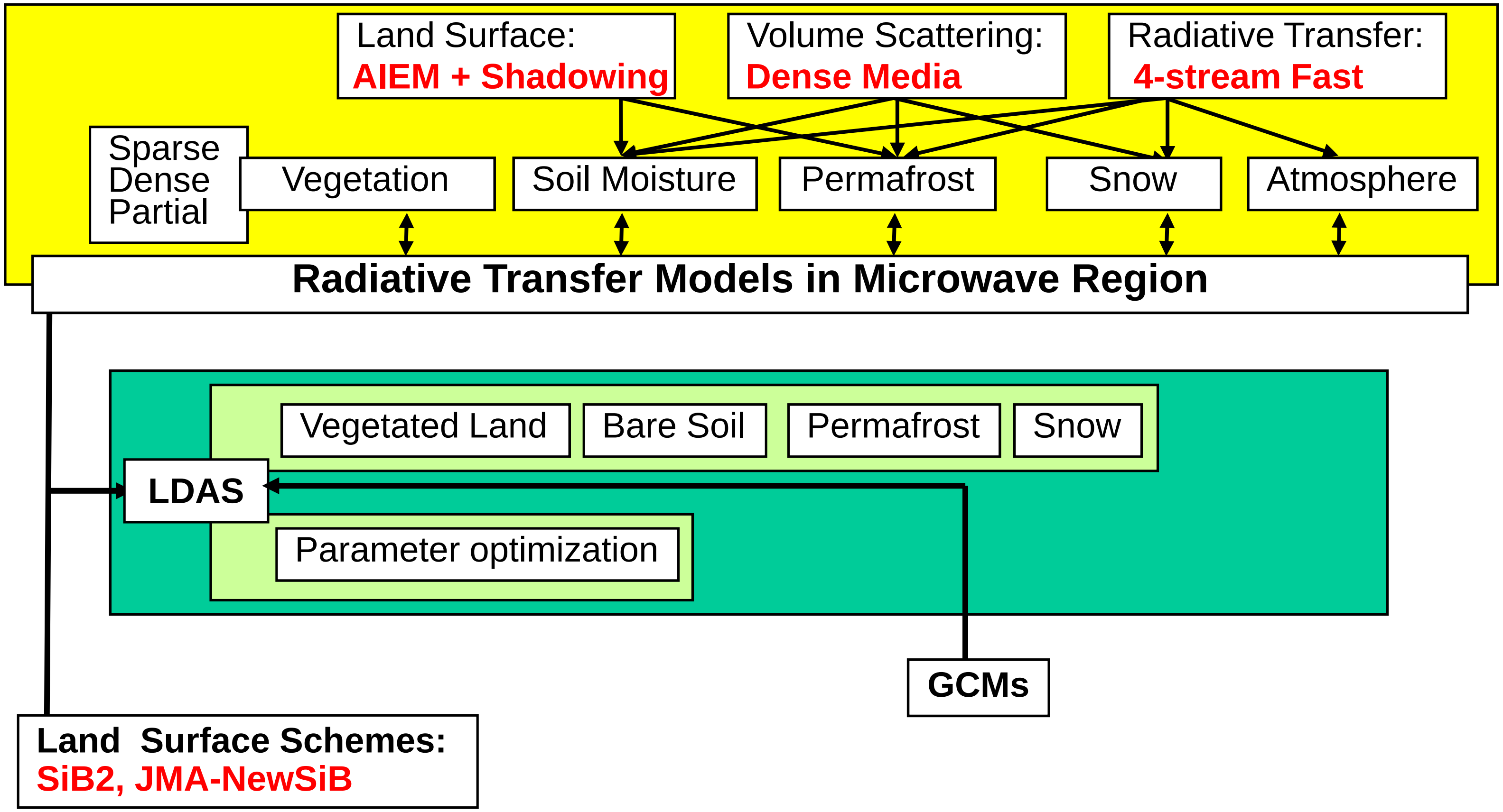
Increase of Water Vapor in the Atmosphere over the Tibetan Plateau



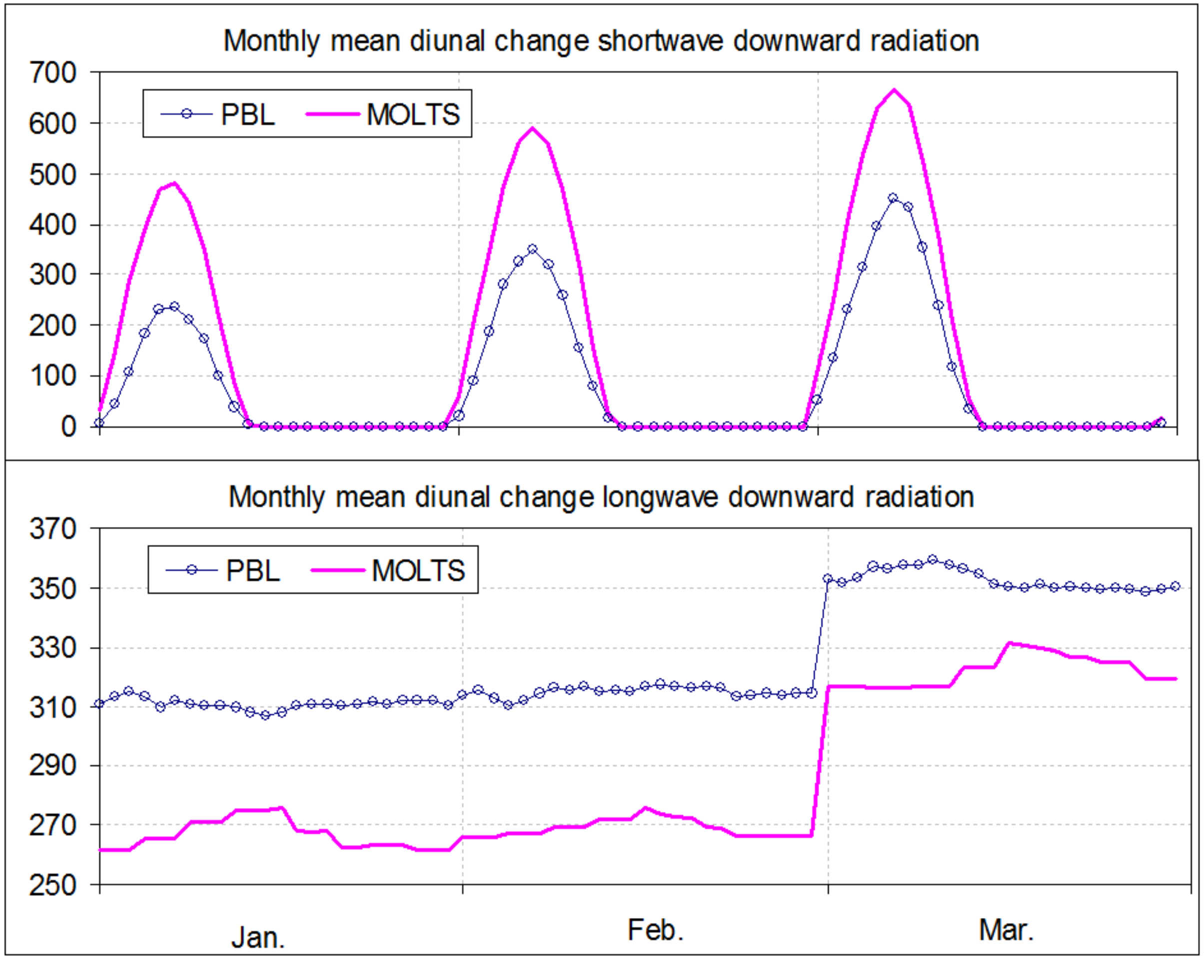




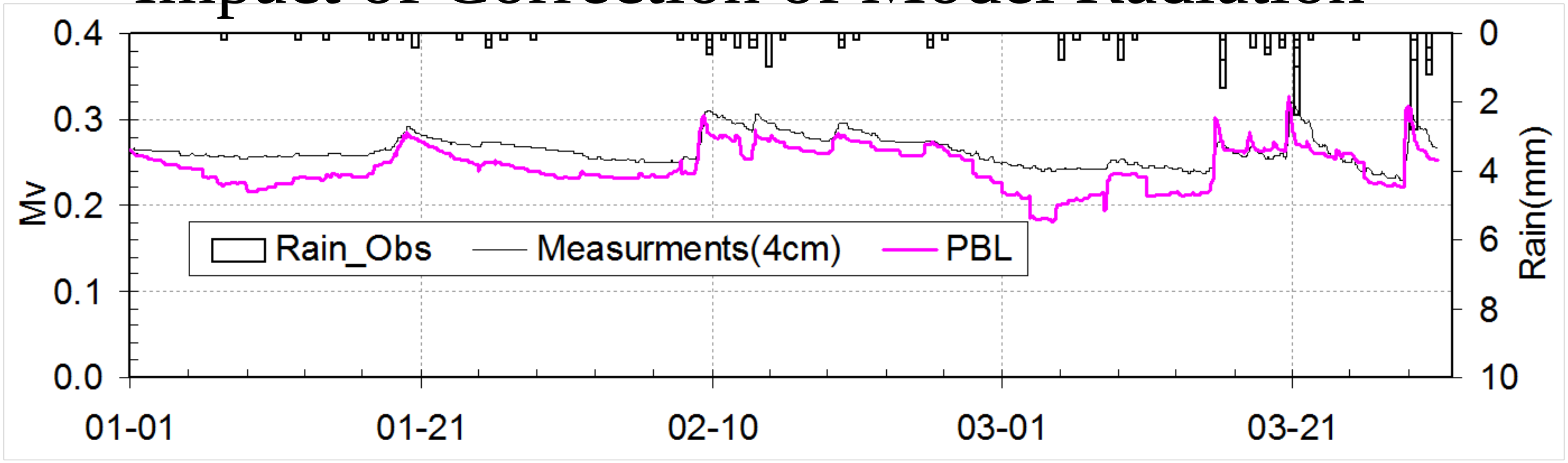
Nomoto & Koike,2006

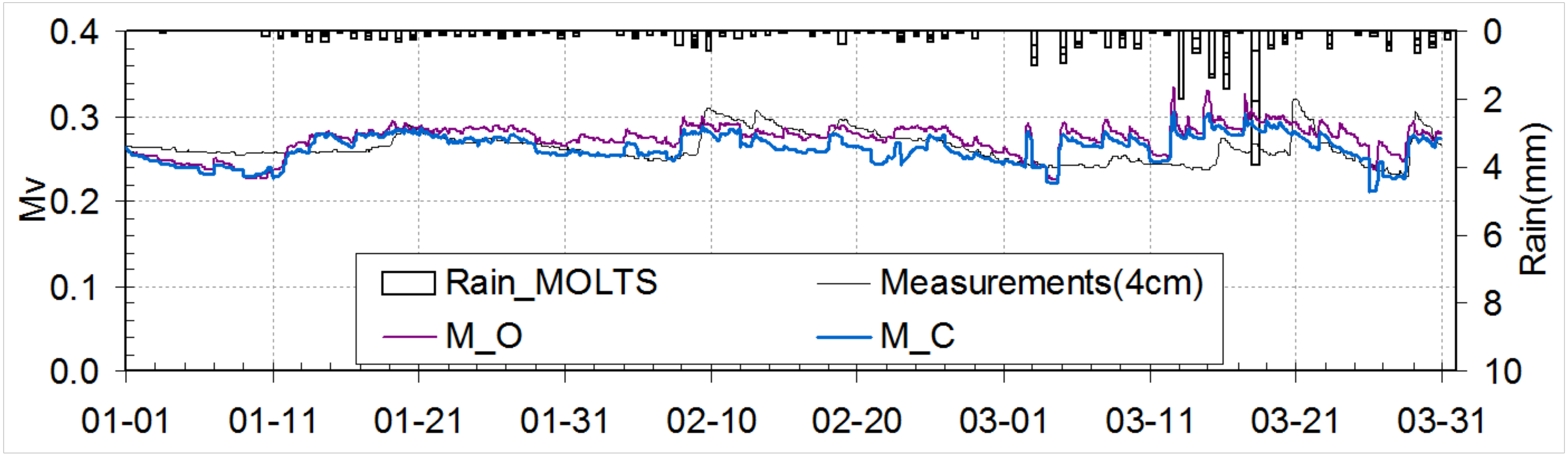

Land Surface:
AIEM + Shadowing
Volume Scattering:
Dense Media
Radiative Transfer:
4-stream Fast
Sparse
Dense
Partial
Vegetation
Soil Moisture
Permafrost
Snow
Atmosphere
Radiative Transfer Models in Microwave Region
Vegetated Land
Bare Soil
Permafrost
Snow
LDAS
Parameter optimization
GCMs
Land Surface Schemes:
SiB2, JMA-NewSiB

Impact of Model Errors in Radiation

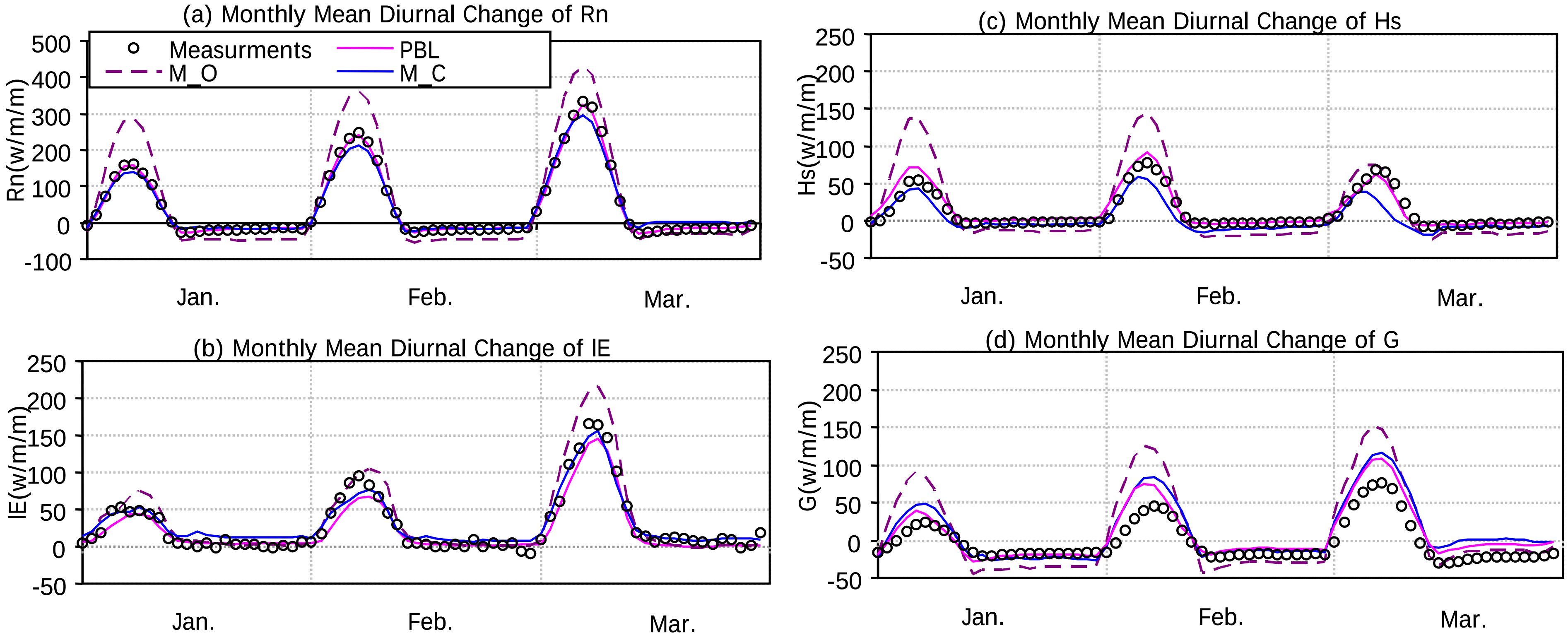


Impact of Correction of Model Radiation

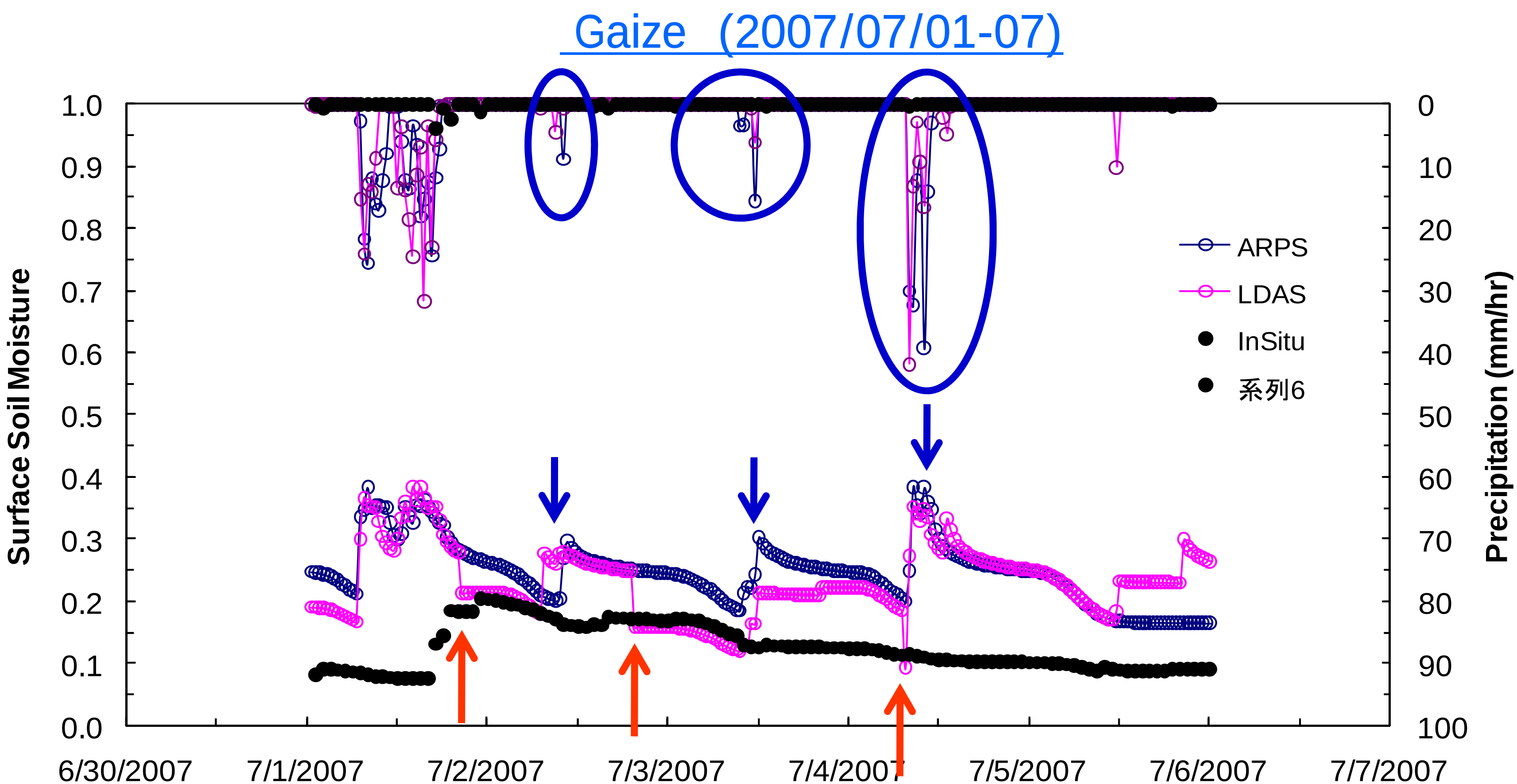


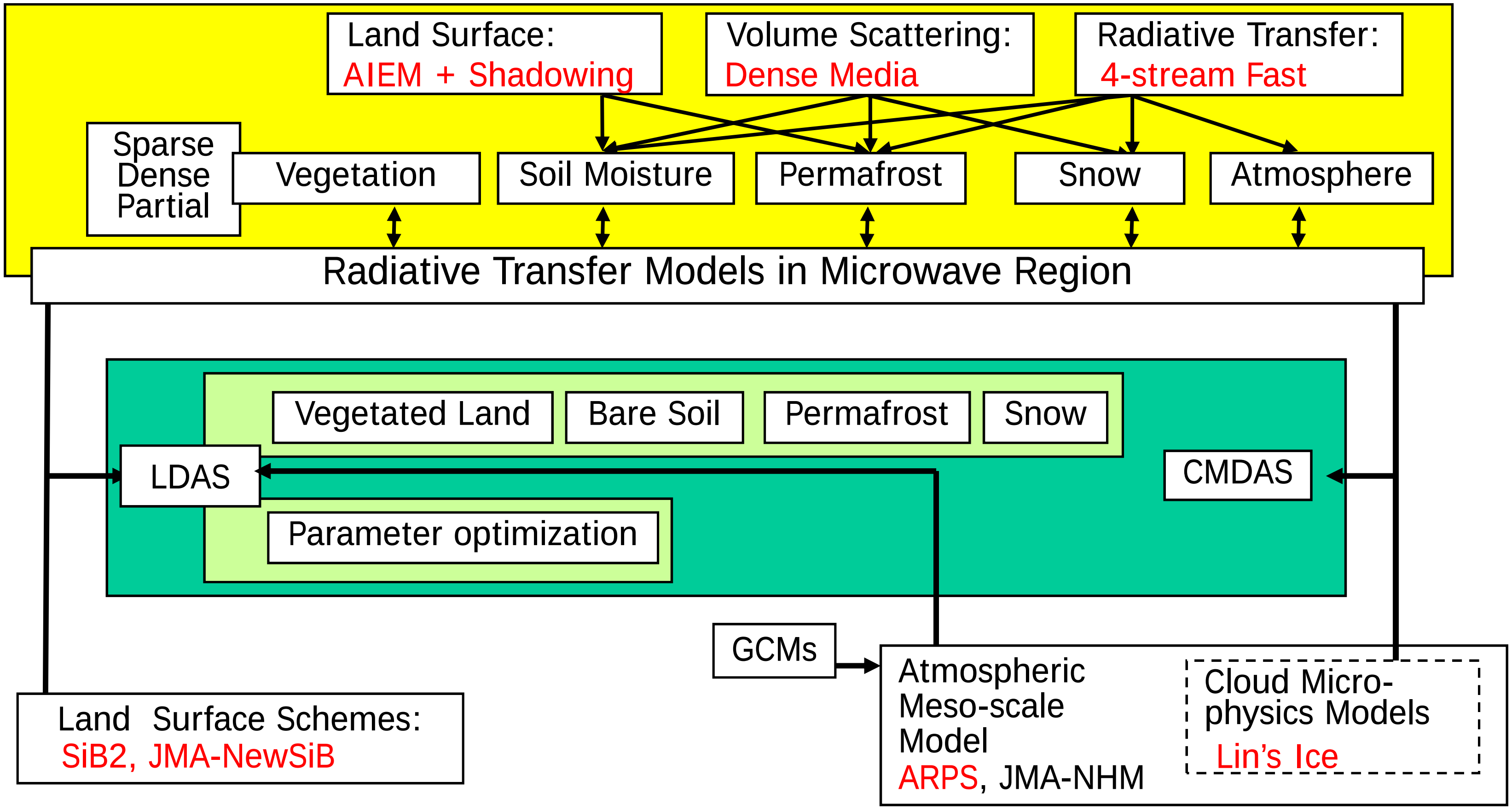


Impact of Correction of Model Radiation



Applications & verifications




Land Surface:
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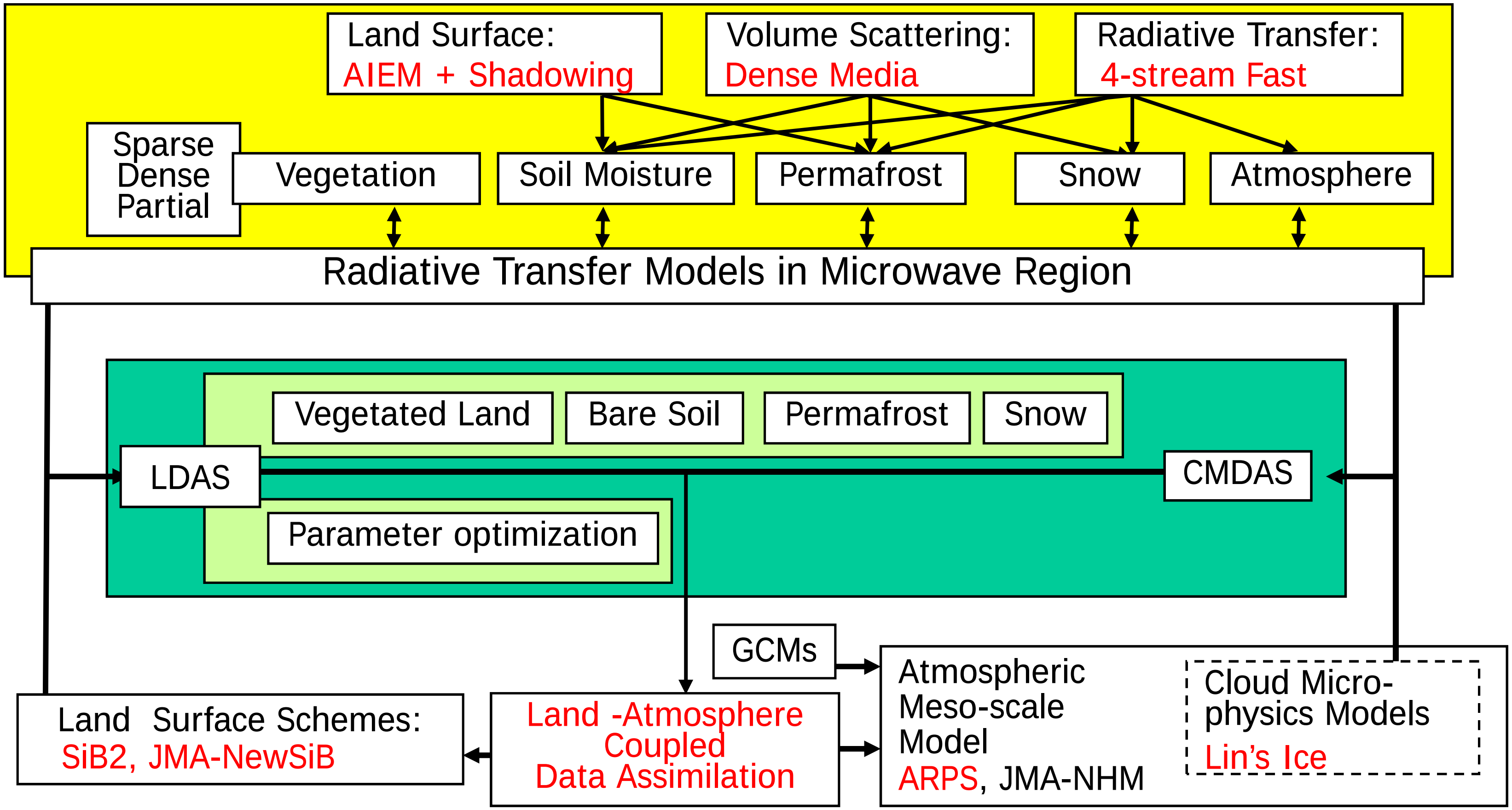
Model
ARPS, JMA-NHM
Cloud Micro-
physics Models
Lin's Ice
Land Surface Schemes:
SiB2, JMA-NewSiB


Land Surface:
AIEM + Shadowing
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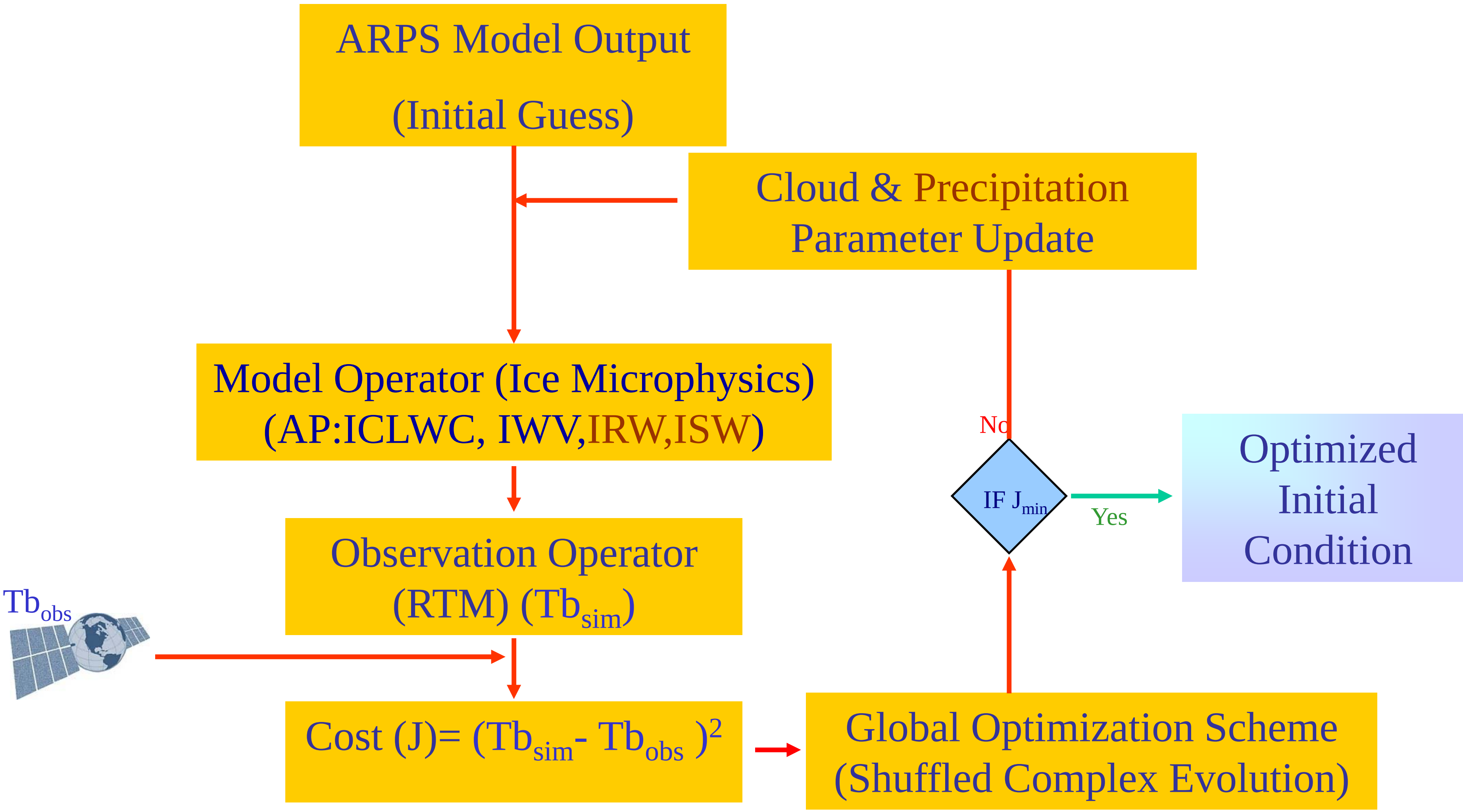
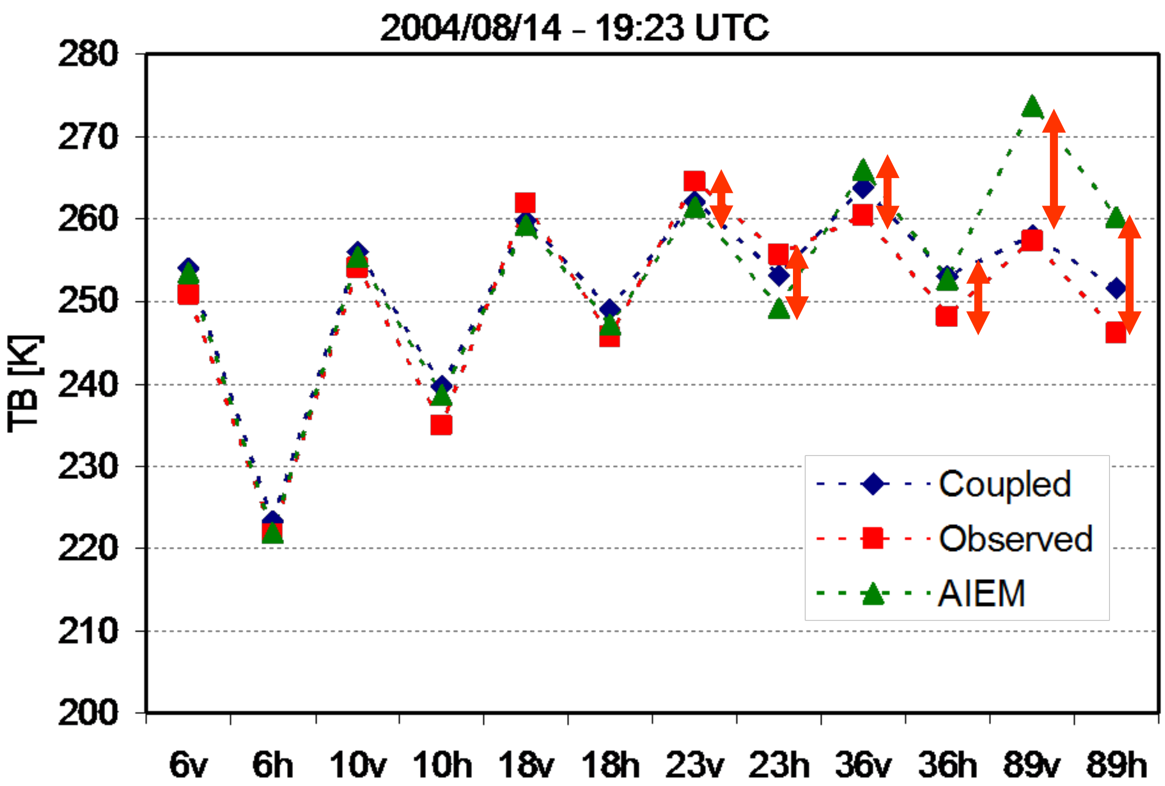
Land -Atmosphere
Coupled
Data Assimilation

CMDAS Framework

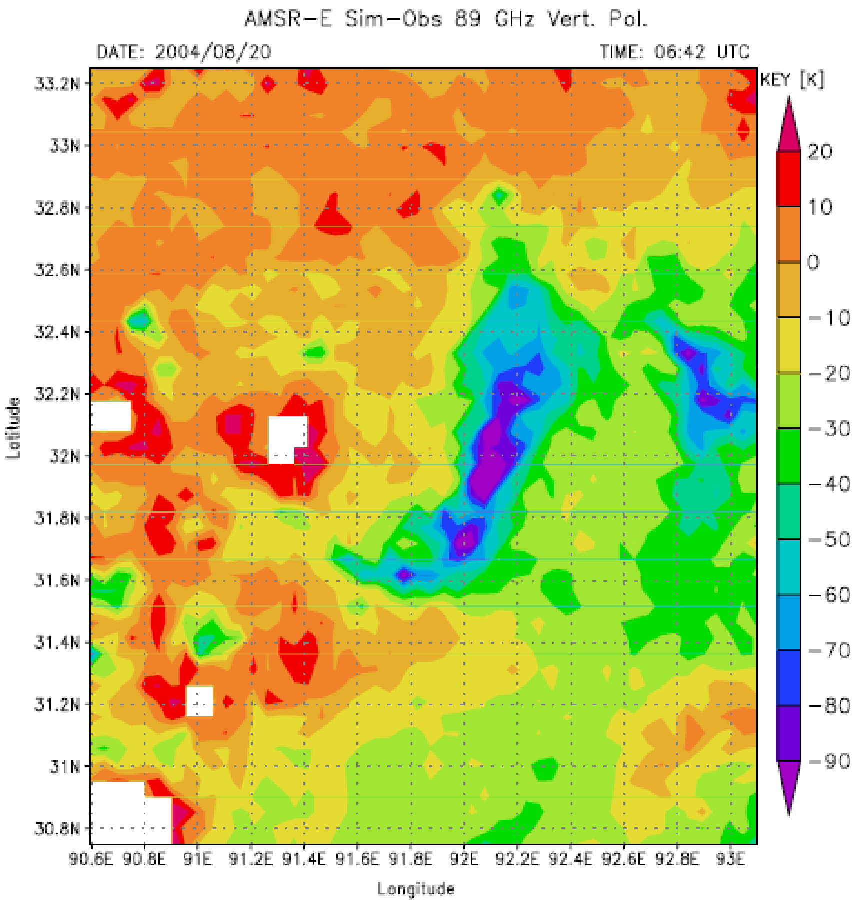


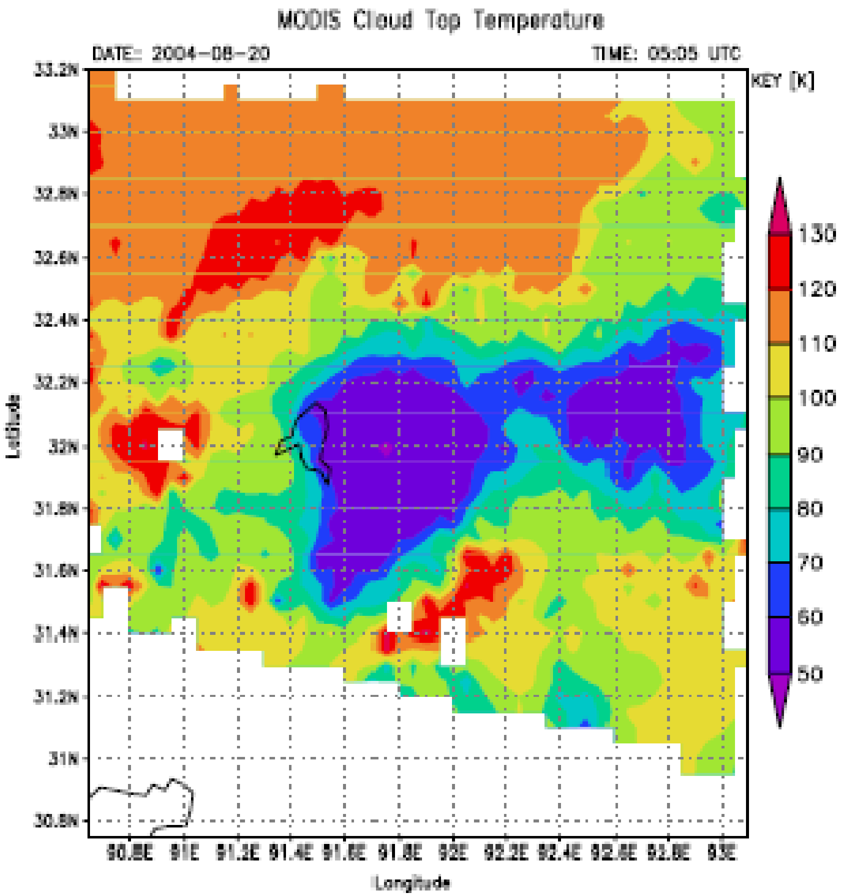
Coupled Soil Atmosphere RTM



By coupling AIEM with atmosphere RTM we get better agreement. For wetter cases AIEM is sufficient.

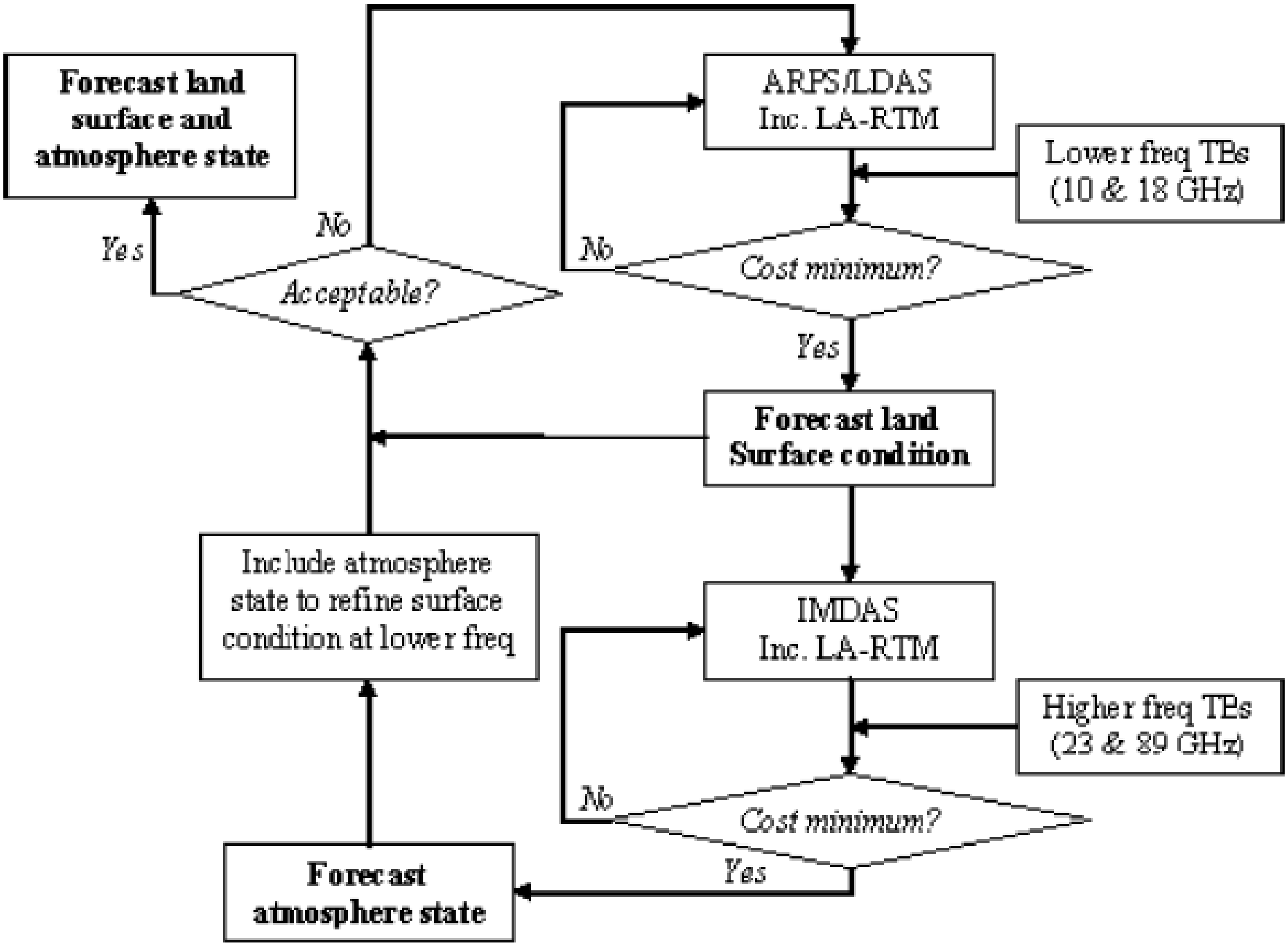
Effect of Atmosphere



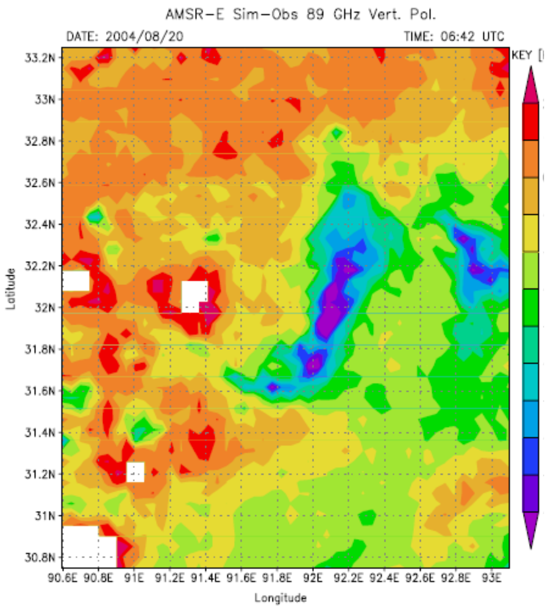


Atmospheric effect derived from AMSR-E vs. MODIS Cloud Top Temperature

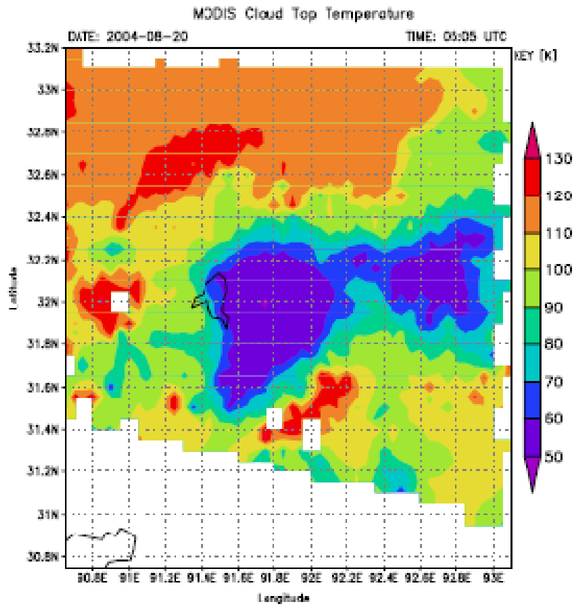
Atmosphere-Land Coupled Data Assimilation System



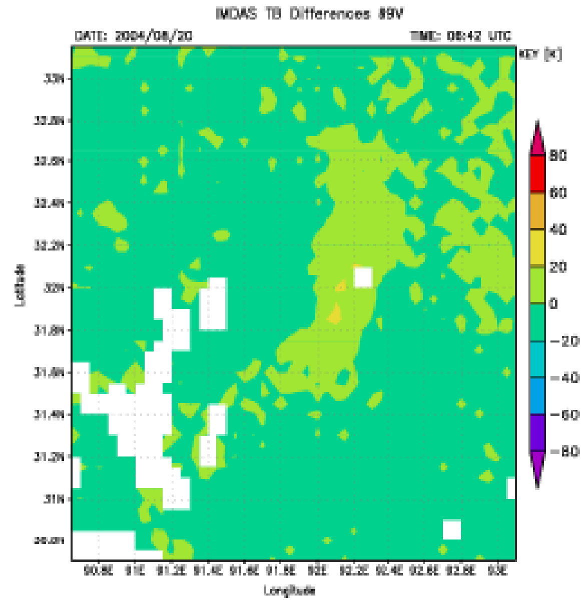
Tb Error



LDAS only



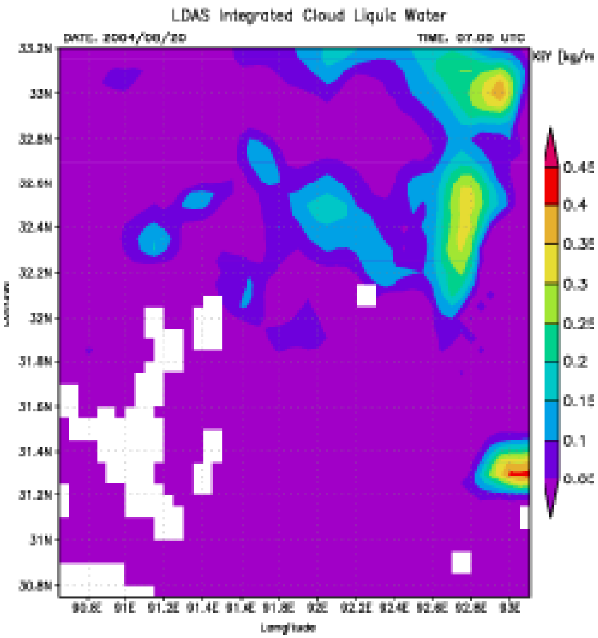
MODIS/IR



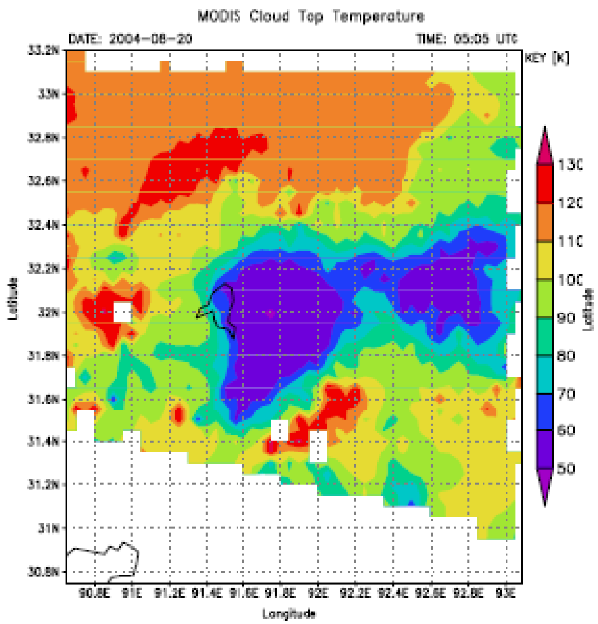
A-L Coupled DAS

Atmospheric effect derived
from AMSR-E vs. MODIS Cloud Top Temperature

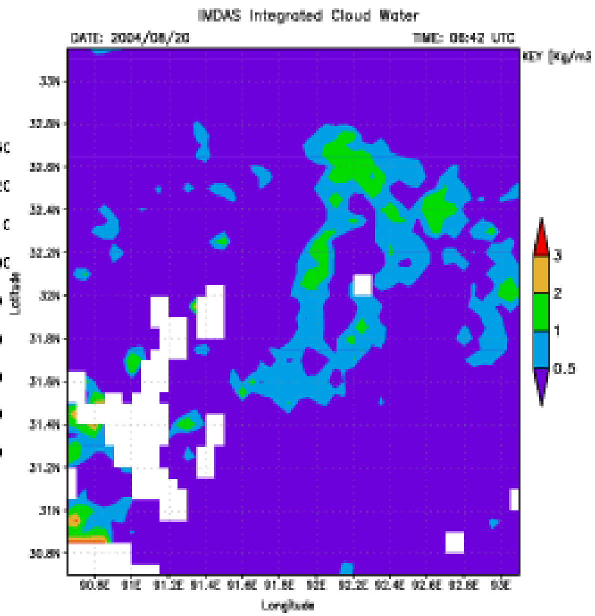
Integrated Cloud Liquid Water



LDAS only



MODIS/IR



A-L Coupled DAS

Atmospheric effect derived
from AMSR-E vs. MODIS Cloud Top Temperature