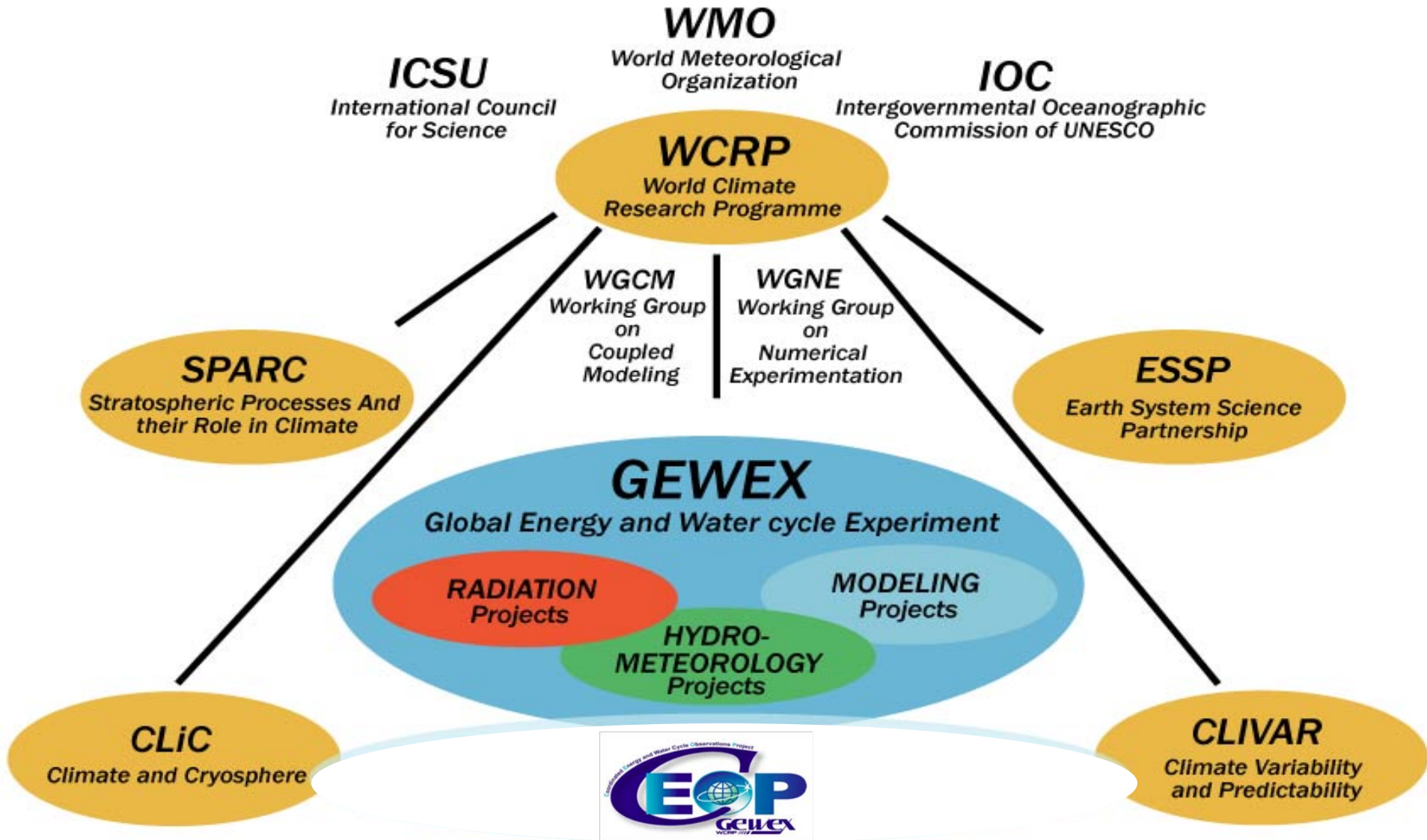


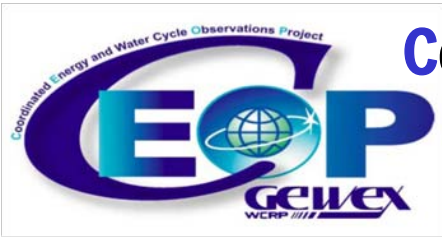
Coordinated Energy and Water Cycle Observations Project (CEOP)

**Toshio Koike
The University of Tokyo**

**GEO Alliances and Harmonization Workshop
Washington DC, USA, 11-12 November, 2009**

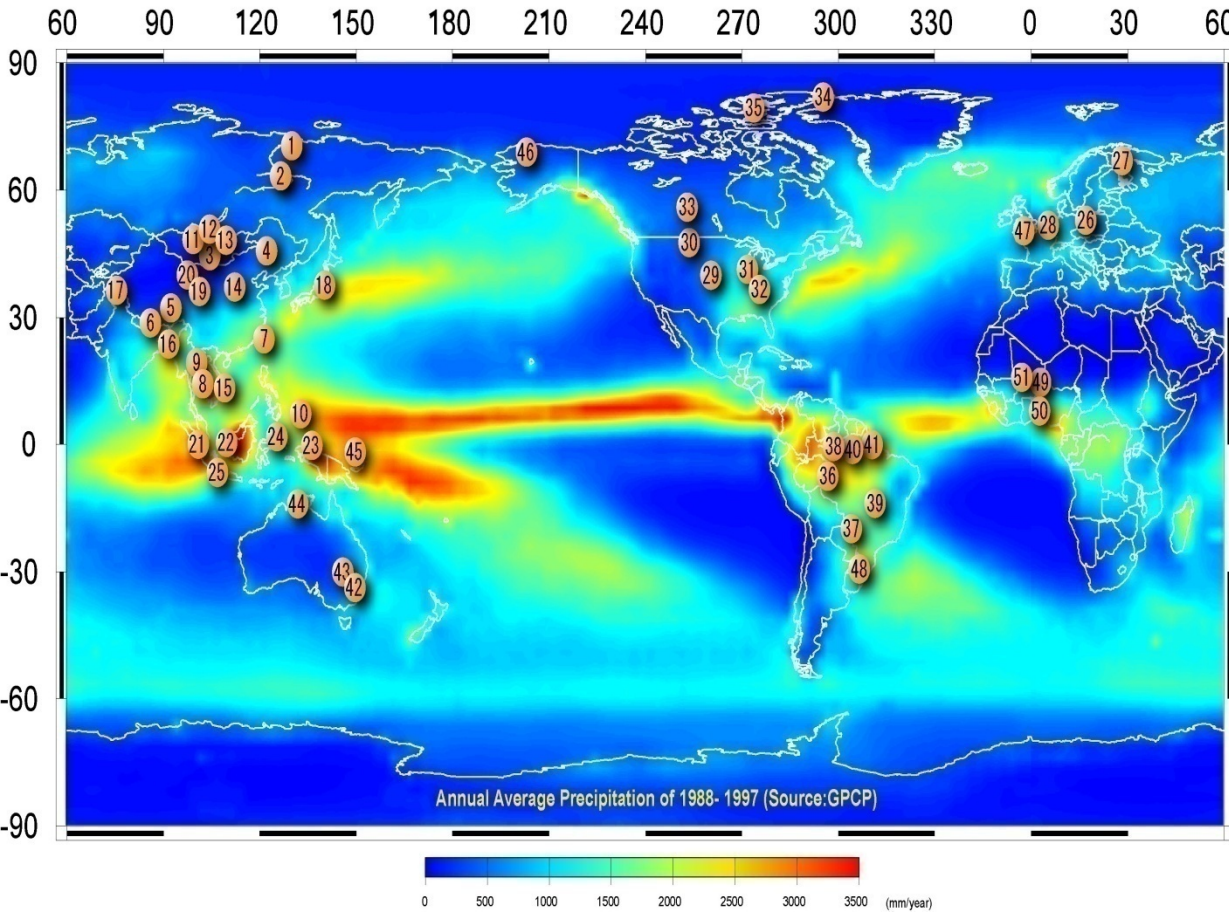
GEWEX Organization Within WCRP



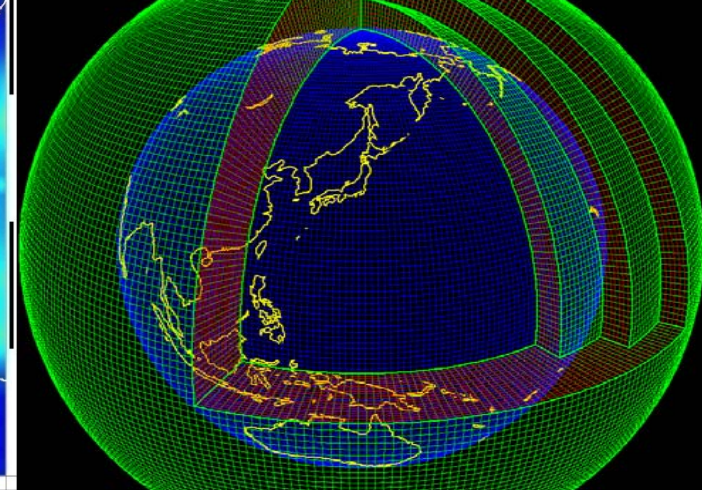


Coordinated Energy and Water Cycle Observations Project

Convergence of Observations A Prototype of the Global Water Cycle Observation System of Systems

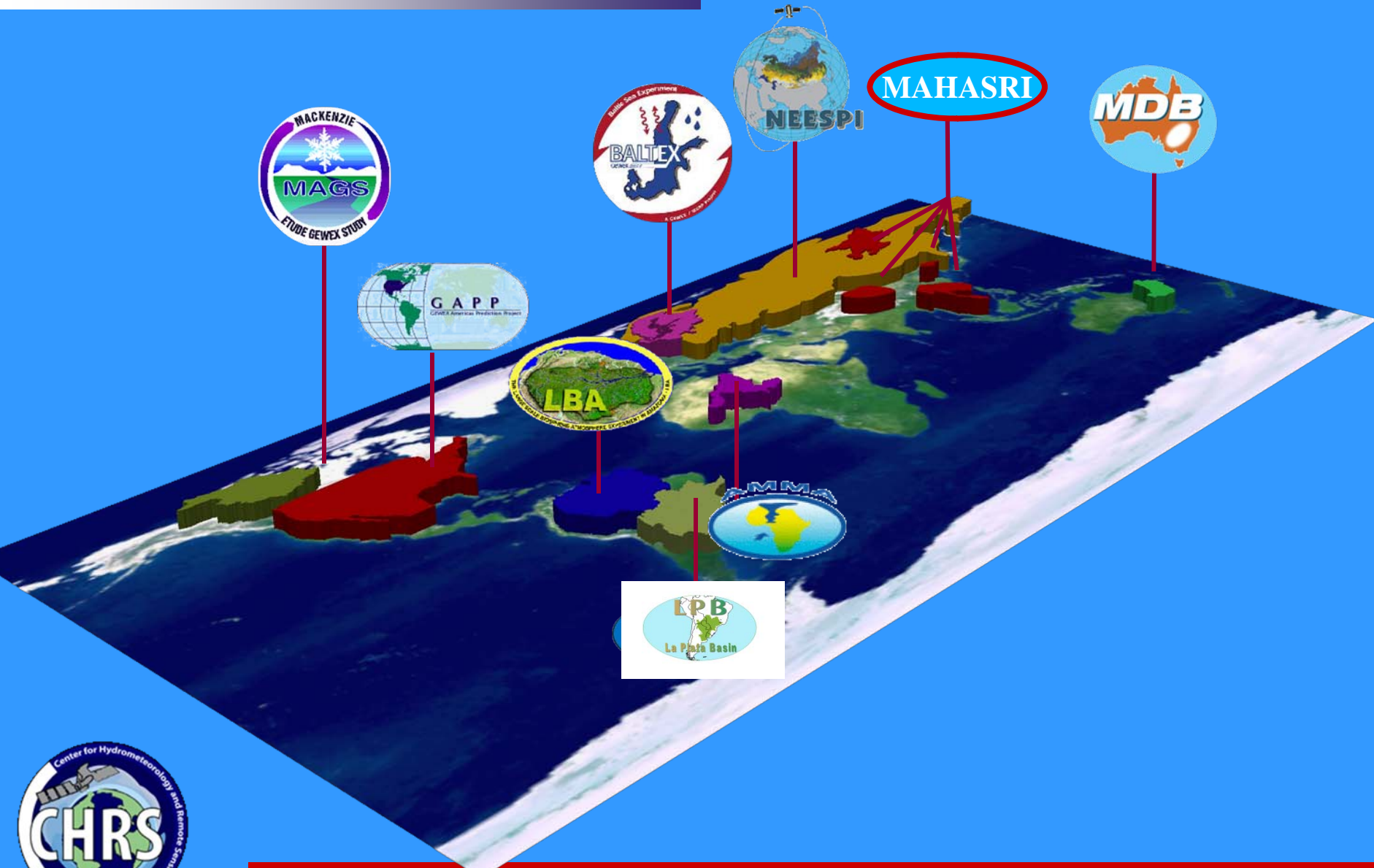


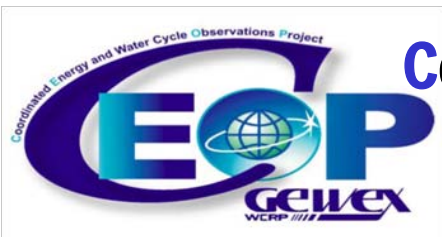
12 NWP+DA Centers



13 NWP+DA Centers

GEWEX Regional Hydroclimate Projects (RHPs)

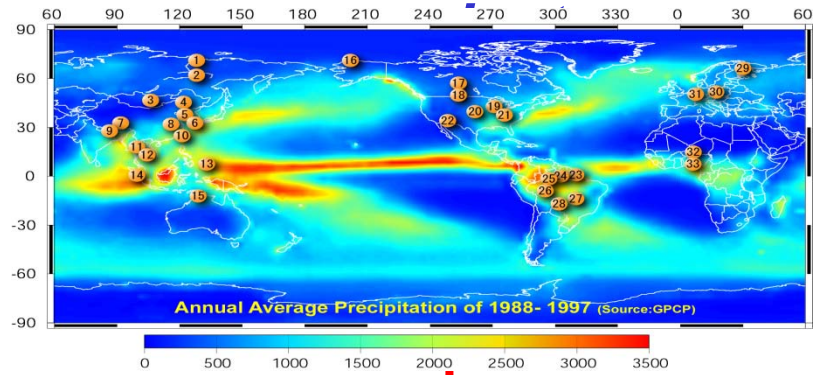
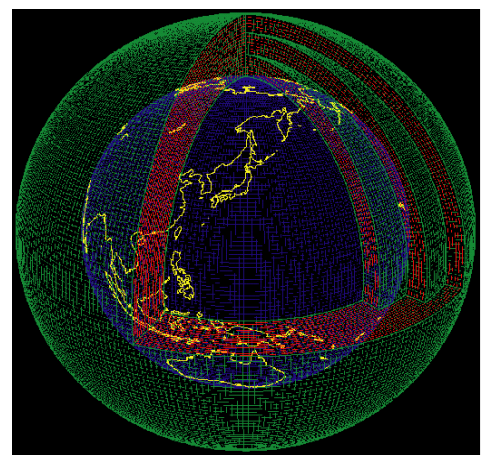




Coordinated Energy and Water Cycle Observations Project

Interoperability Arrangement

A well organized collecting, processing, storing, and disseminating shared data, metadata and



Model Output Data Archiving Center at the World Data Center for Climate, Max-Planck Institute for Meteorology of Germany

In-Situ Data Archiving Center at NCAR (National Center for Atmospheric Research) of USA

Data Integrating/Archiving Center at University of Tokyo and JAXA of Japan



Metadata design for integrating CEOP satellite imagery, reference site data and simulation result data

Version 1.0

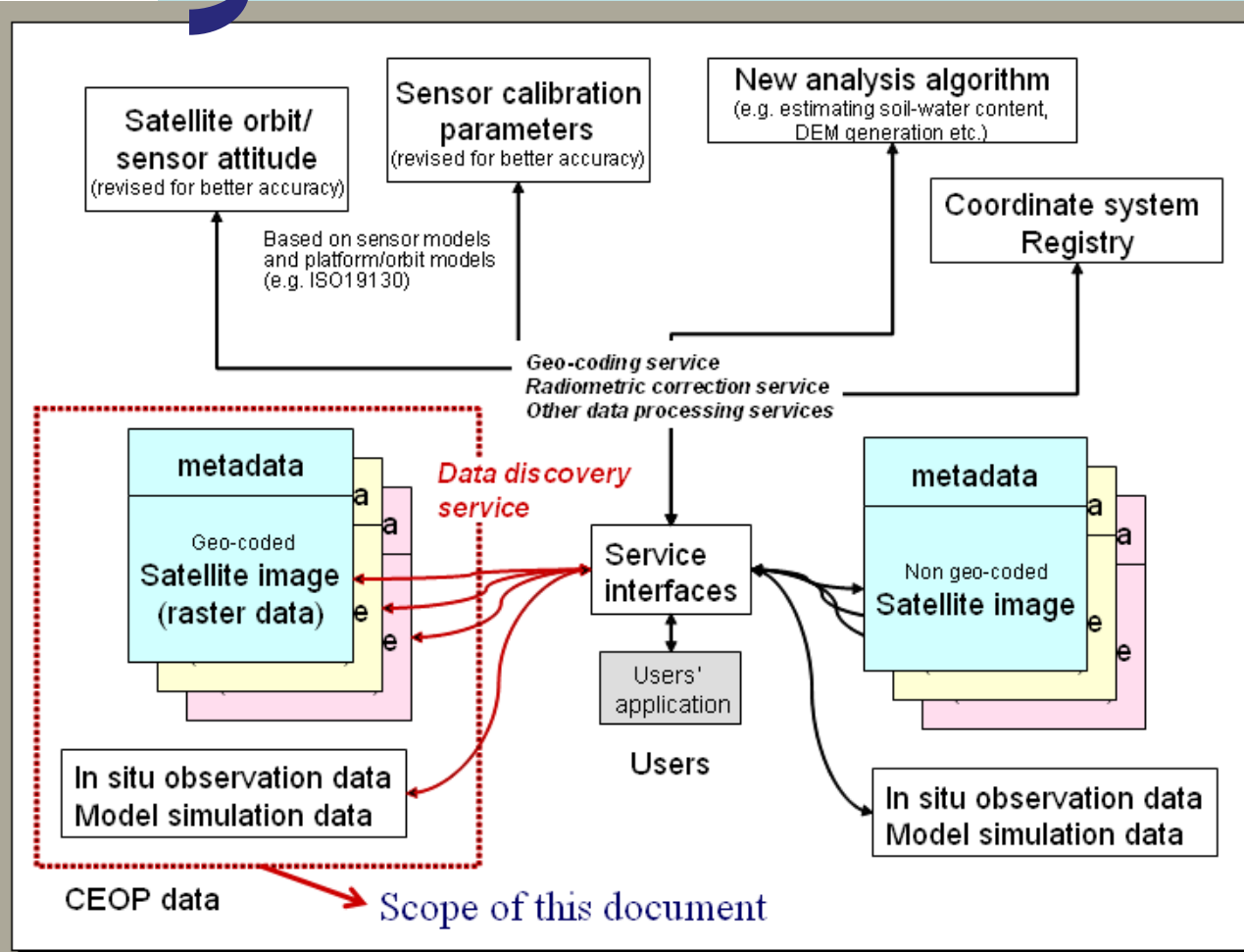
Shibasaki Group
For "Koike global water informatics" project

October 30, 2004

Center for Spatial Information Science
The University of Tokyo
4-6-1 Komaba, Meguro-ku, Tokyo 153-8505, Japan
Tel: +81-3-5452-6412
Fax: +81-3-5452-6414
<http://shiba.is.u-tokyo.ac.jp>

CEOP Metadata Design Meeting

University of Tokyo, 1-2 November 2004



- **Based on ISO 19115 Metadata Standards**
- **Design for Finding and Integrating data**

CEOP data → Scope of this document

REFERENCE SITE GATEWAY

CEOP Reference Site Data Sets - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://data.eol.ucar.edu/master_list/?project=CEOP/EOP-3/4


Most Visited mozilla.org mozillaZine mozdev.org CNN.com NOAA Staff Directory Colorado Weather People Search

CEOP Reference Site Data Sets .be - Google Search

For other ancillary data sets please click here.

The CEOP data formats are described in the [CEOP Reference Site Data Set Procedures Report](#)

To jump to a particular RHP click on the appropriate logo:



RHP	Reference Site Name	Data Set	Oct 2002 Dec 2003	2004	2005	2006	2007	2008
BALTEX	Cabauw	SFC		X (24 Jun 2009) NEW				
		TWR		X (24 Jun 2009) NEW				
		STM		X (21 Oct 2008)				
		FLX		X (21 Oct 2008)				
		Soundings (Raw)		X (22 Oct 2008)				
	Lindenberg	SFC				X (24 Jun 2009) NEW		
		TWR				X (24 Jun 2009) NEW		
		STM				X (24 Jun 2009) NEW		
		FLX				X (24 Jun 2009) NEW		
		Soundings (Raw)			X (18 Jan 2008)			
	Norunda	SFC	X (29 Jun 2006)					
		TWR						
		STM						
		FLX						
		Soundings (Raw)						
Sodankylä	SFC		X (18 Apr 2006)					
	TWR		X (25 Jul 2006)					
	STM		X (24 Jul 2006)					
	FLX		X (25 Jul 2006)					
	Soundings (Raw)		X (02 Aug 2006)					

CEOP SFC Data Status and Quality

The colors represent the CEOP Data Quality Flags (see [definitions](#)) as follows: green=G, yellow=D, red=B, black=I, gray=U. Note that the time period covered varies from station to station. If a station does not measure any FLX parameters it is not included in this table.

For the Soil Temperature and Moisture Data Status and Quality summary click [here](#).

For the Meteorological Tower Data Status and Quality summary click [here](#).

For the Flux Data Status and Quality summary click [here](#).

RHP	Reference Site	Station	Station Pressure	Air Temp	Dew Point	Relative Humidity	Specific Humidity	Wind Speed	Wind Dir	U Wind	V Wind	Precip	Snow Depth	In Short	Out Short	In Long	Out Long	Net Rad	Skin Temp	In P AR	Out P AR
BALTEX	Cabauw	Cabauw											None							None	None
BALTEX	Lindenberg	Falkenberg																			
BALTEX	Lindenberg	Forest						None	None	None	None		None							None	None
BALTEX	Norunda	Norunda										None	None						None		
BALTEX	Sodankyla	Observatory Site A														None	None	None	None	None	None
RHP	Reference Site	Station	Station Pressure	Air Temp	Dew Point	Relative Humidity	Specific Humidity	Wind Speed	Wind Dir	U Wind	V Wind	Precip	Snow Depth	In Short	Out Short	In Long	Out Long	Net Rad	Skin Temp	In P AR	Out P AR
CIC (MAGS)	BERMS		No data available yet.																		
RHP	Reference Site	Station	Station Pressure	Air Temp	Dew Point	Relative Humidity	Specific Humidity	Wind Speed	Wind Dir	U Wind	V Wind	Precip	Snow Depth	In Short	Out Short	In Long	Out Long	Net Rad	Skin Temp	In P AR	Out P AR
CPFA (GAPP)	Bondville	Bondville											None								
CPFA (GAPP)	Ft. Peck	Ft. Peck											None								
CPFA (GAPP)	Mt. Bigelow	Mt. Bigelow	No data available yet.																		
CPFA (GAPP)	Oak Ridge	Oak Ridge											None								
RHP	Reference Site	Station	Station Pressure	Air Temp	Dew Point	Relative Humidity	Specific Humidity	Wind Speed	Wind Dir	U Wind	V Wind	Precip	Snow Depth	In Short	Out Short	In Long	Out Long	Net Rad	Skin Temp	In P AR	Out P AR
CPFA (GAPP)	SGP (ARM)	C1 Lamont	None	None	None	None	None	None	None	None	None	None	None							None	None
CPFA (GAPP)	SGP (ARM)	E1 Lamed											None						None	None	None
CPFA (GAPP)	SGP (ARM)	E2 Hillsboro	None	None	None	None	None	None	None	None	None	None	None						None	None	None
CPFA (GAPP)	SGP (ARM)	E3 Le Roy											None						None	None	None
CPFA (GAPP)	SGP (ARM)	E4 Plevna											None						None	None	None
CPFA (GAPP)	SGP (ARM)	E5 Halstead											None						None	None	None
CPFA (GAPP)	SGP (ARM)	E6 Towanda											None						None	None	None
CPFA (GAPP)	SGP (ARM)	E7 Bk Falls											None						None	None	None



MODEL & DATA

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CEOP Phase II

The structure of the model output

For CEOP Phase II WDC-Climate proposes a more homogeneous [pdf](#) data structure for gridded data and MOLTS. The WMO-GRIB format is used for the gridded data. MOLTS can be stored in NetCDF-CF format as an [example header](#) of JMA data shows. Find a set of example NetCDF files (Also JMA) here: [\(tar\) example](#). The tarball contains 4 NetCDF files for one day with the 12:00 file containing 72 forecast steps. The [pdf](#) Stationlist list of the station names with proposals for changes.

MOLTS

The Information of the MOLTS (Model Output Location TimeSeries) is available as a [pdf](#) map and as a [pdf](#) list as well.

Data Sets included into the CERA Database

Center	MOLTS Data	GRID DATA
JMA	1-JAN-2007 - 30-JUN-2008	1-JAN-2007 - 30-JUN-2008

Data size

Currently the data base contains **618.6 GByte** of data.

latest update: 2008-08-20 15:37



Dataset Description

■ Three Scales

- 250km rectangular covering each Reference Sites,
- Monsoon Regional
- Global Area

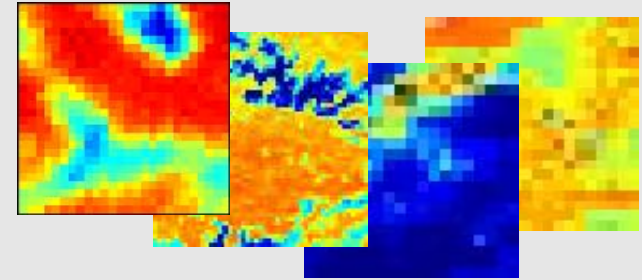
■ Product Levels

- **Level-1b:** Radiance product with full resolution at reference sites.
- **Level-2:** Geophysical product at the same resolution at reference sites and monsoon regions.
- **Level-3:** Statistical geophysical product in space and/or time at reference sites, monsoon regions and global. (example: Monthly mean rain rate at reference sites, etc.)

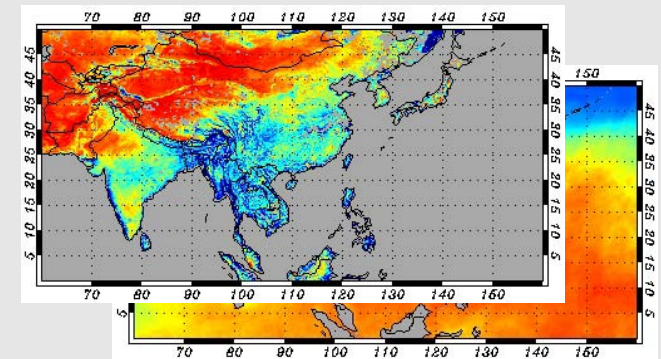
■ Metadata

- Consist of an image element and a metadata part element that is compliant with the ISO-19115 metadata standard.

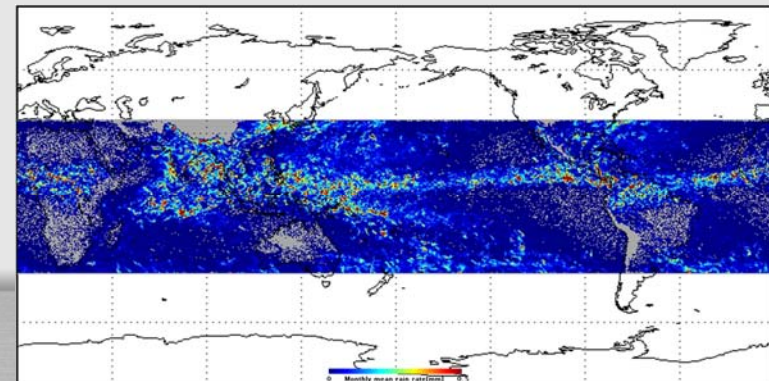
Reference Sites



Monsoon Regional

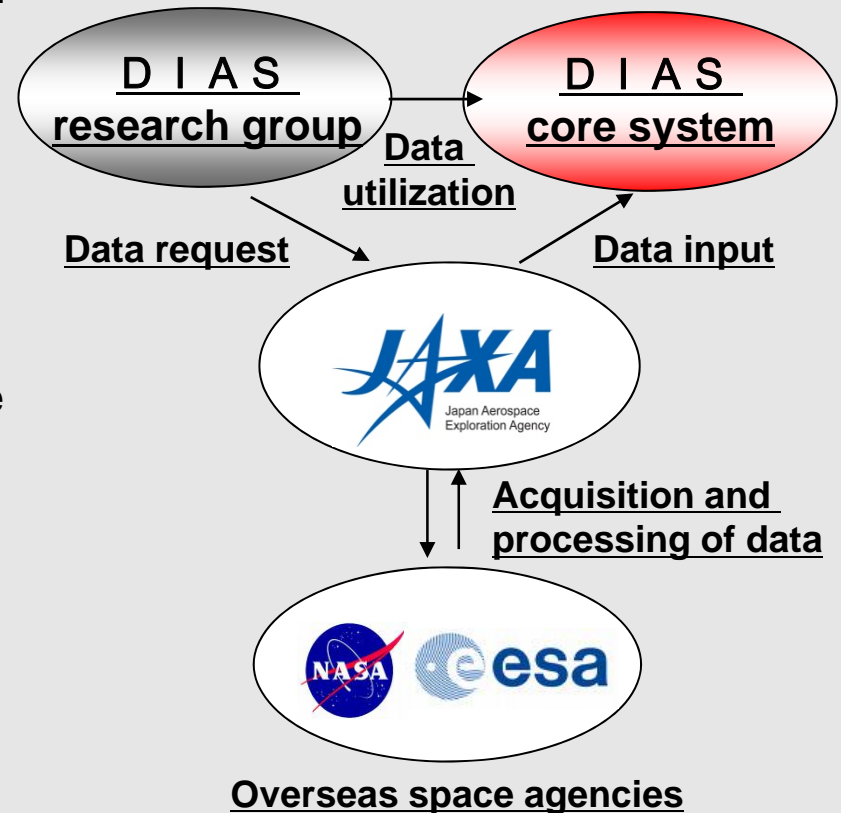


Global Area

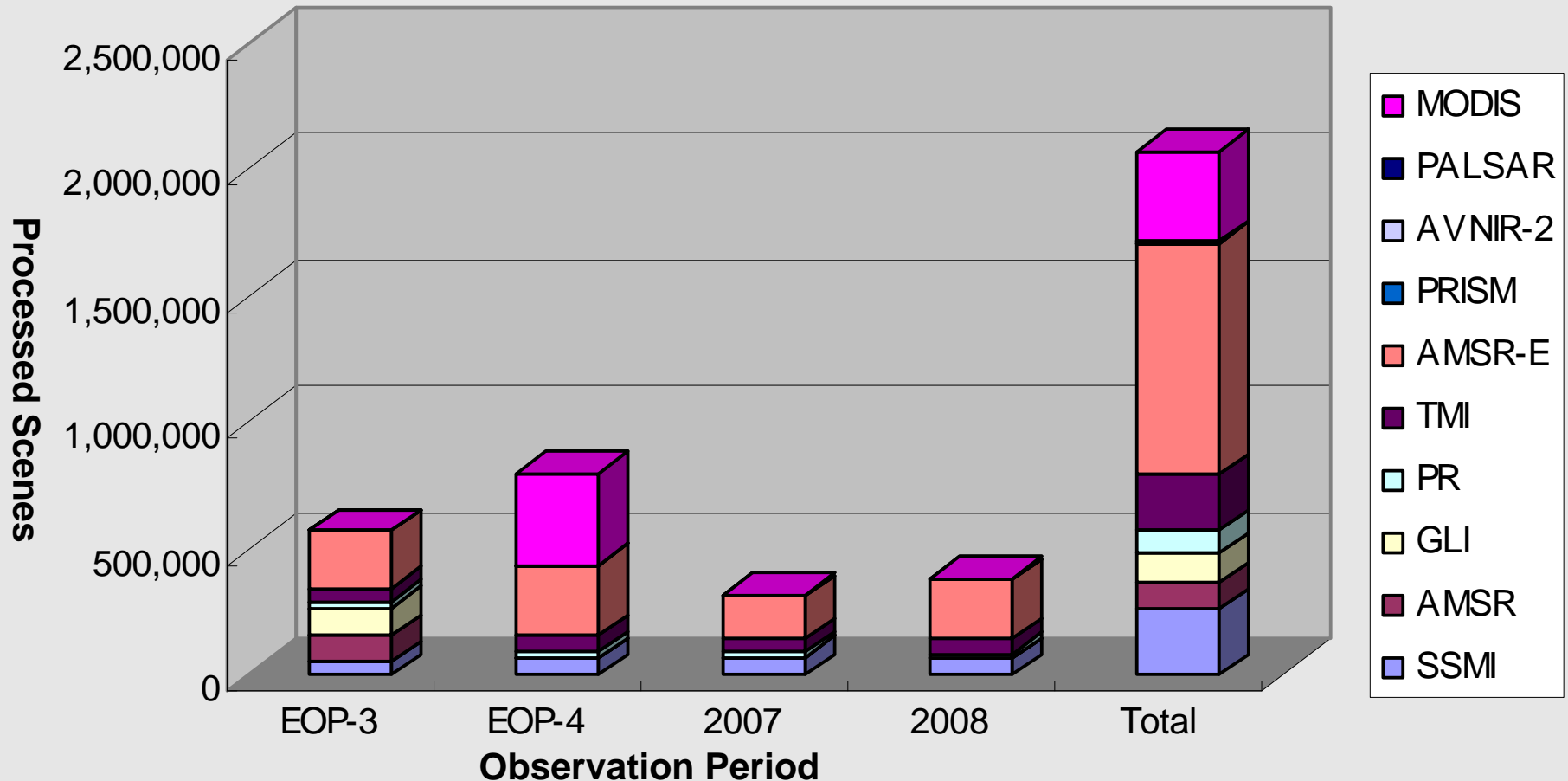


International Cooperation

- Moderate Resolution Imaging Spectroradiometer (**MODIS**) and Atmospheric Infrared Sounder (**AIRS**) datasets were added in 2008.
- **NASA MODIS Team** produces subsets of MODIS data, while JAXA reformats and resamples the subsets, and prepares corresponding metadata.
- In 2008, **Terra/MODIS datasets of EOP-4** were produced with selected products in three scales as same as the other CEOP satellite datasets.
- **NASA AIRS Team** produces AIRS datasets for CEOP
- Both AIRS and MODIS datasets are archived in the **CEOP centralized database (DIAS core system)** located in the University of Tokyo, the same as the other CEOP datasets.



Number of Processed Scenes



EOP-3: 2002/10/1 – 2003/9/30
 EOP-4: 2003/10/1 – 2004/12/31

Total 2,078,411

GCMD
Global Change Master Directory

a directory of Earth science data and services



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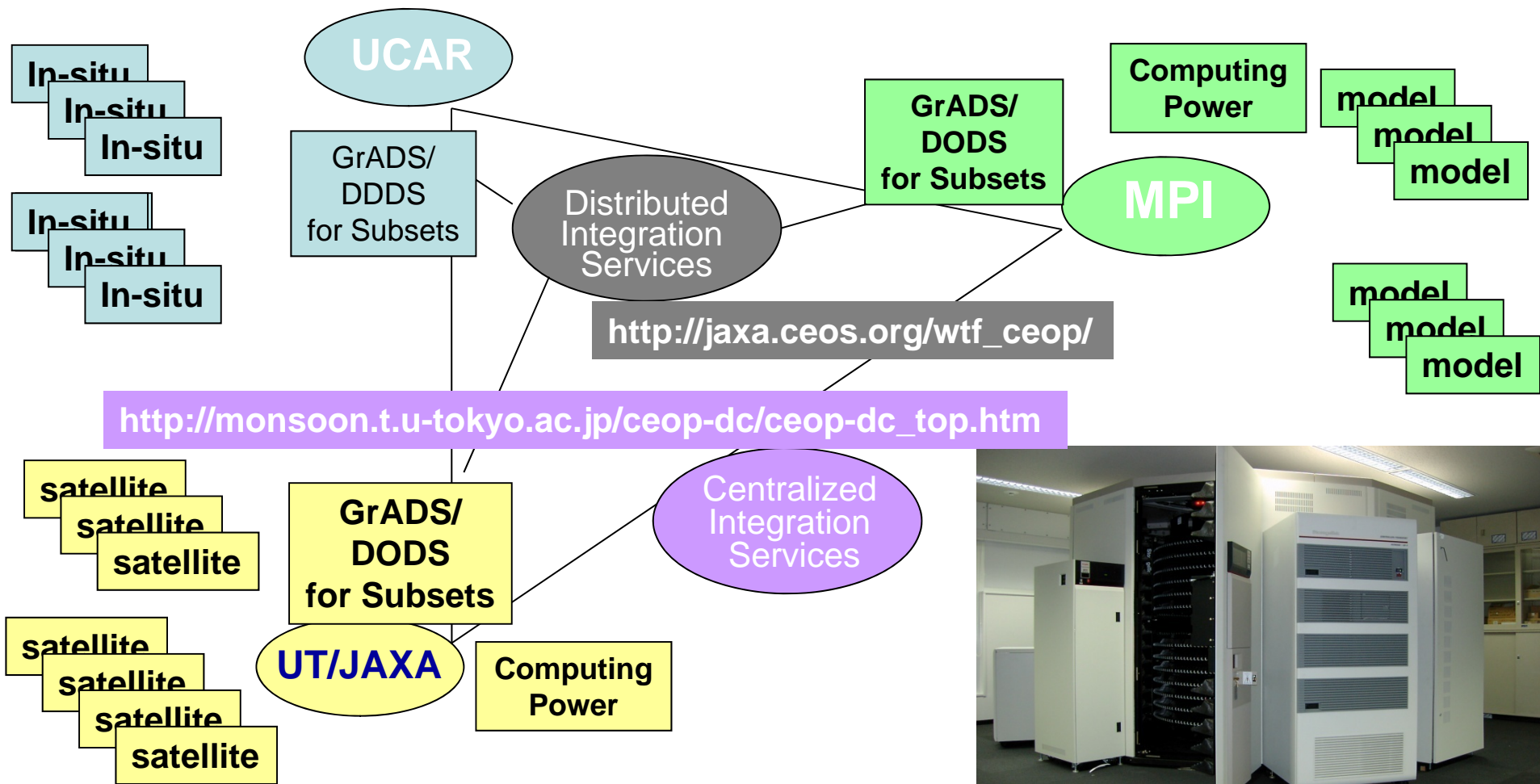
[Data Centers](#) - [Locations](#) - [Instruments](#) - [Projects](#) - [Platforms/Sources](#)



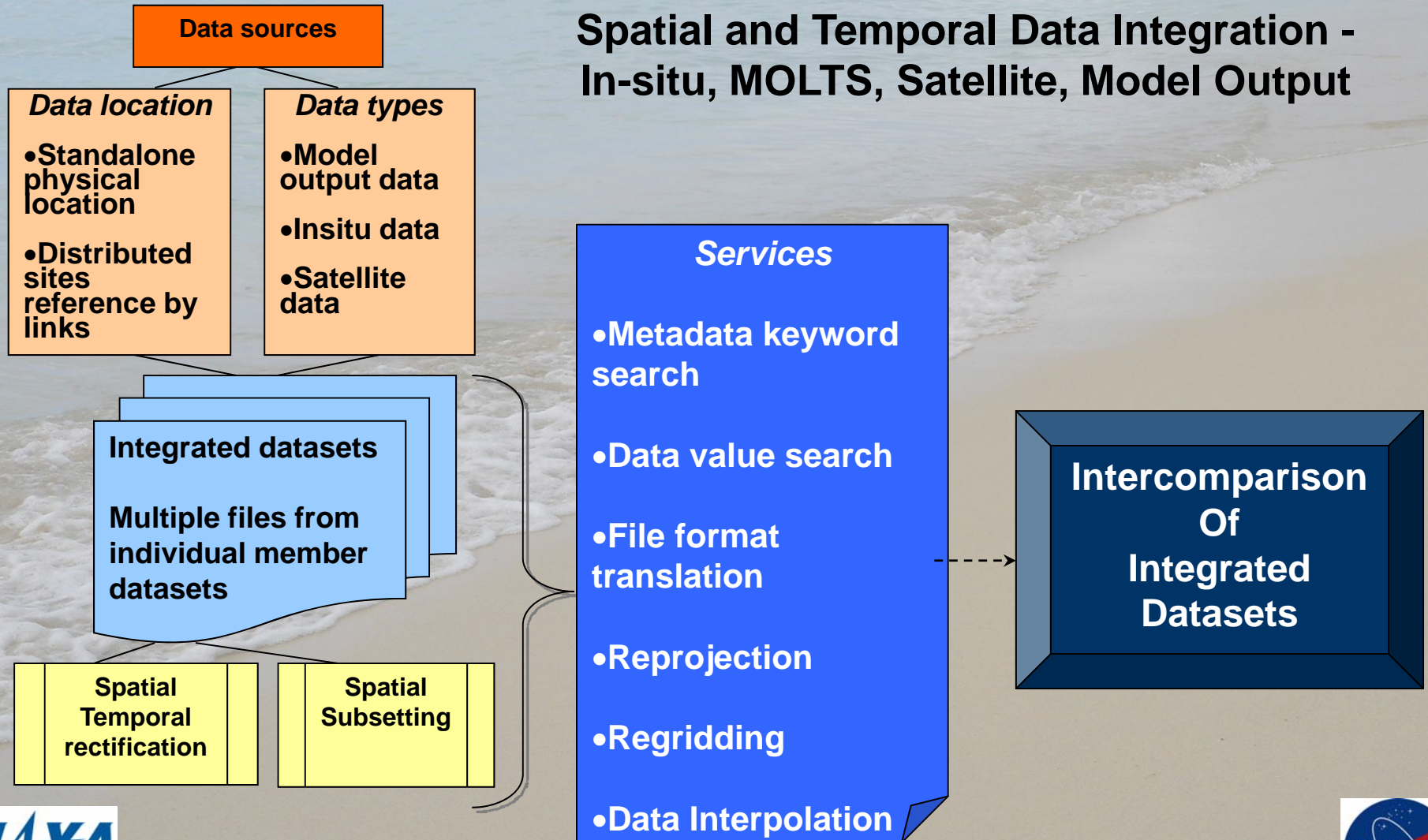
Coordinated Enhanced Observing Period

Data Management

Distributed- and Centralized- Data Integration Functions



Distributed Data Integration Services



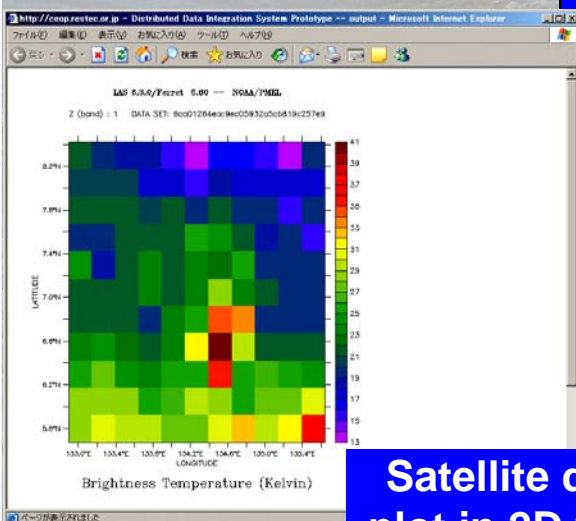
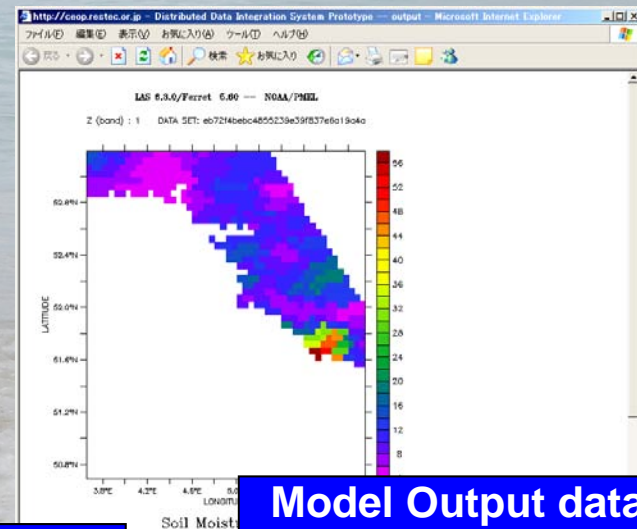
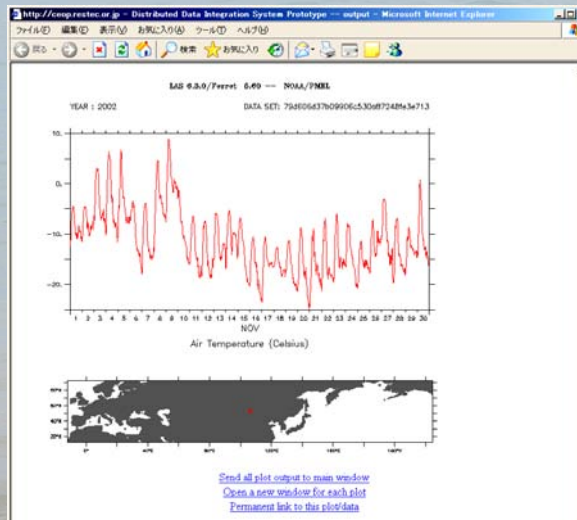
Spatial and Temporal Data Integration - In-situ, MOLTS, Satellite, Model Output

JAXA Prototype: Phase 1 Status

http://jaxa.ceos.org/wtf_ceop/

Tutorial DVD

Top Page

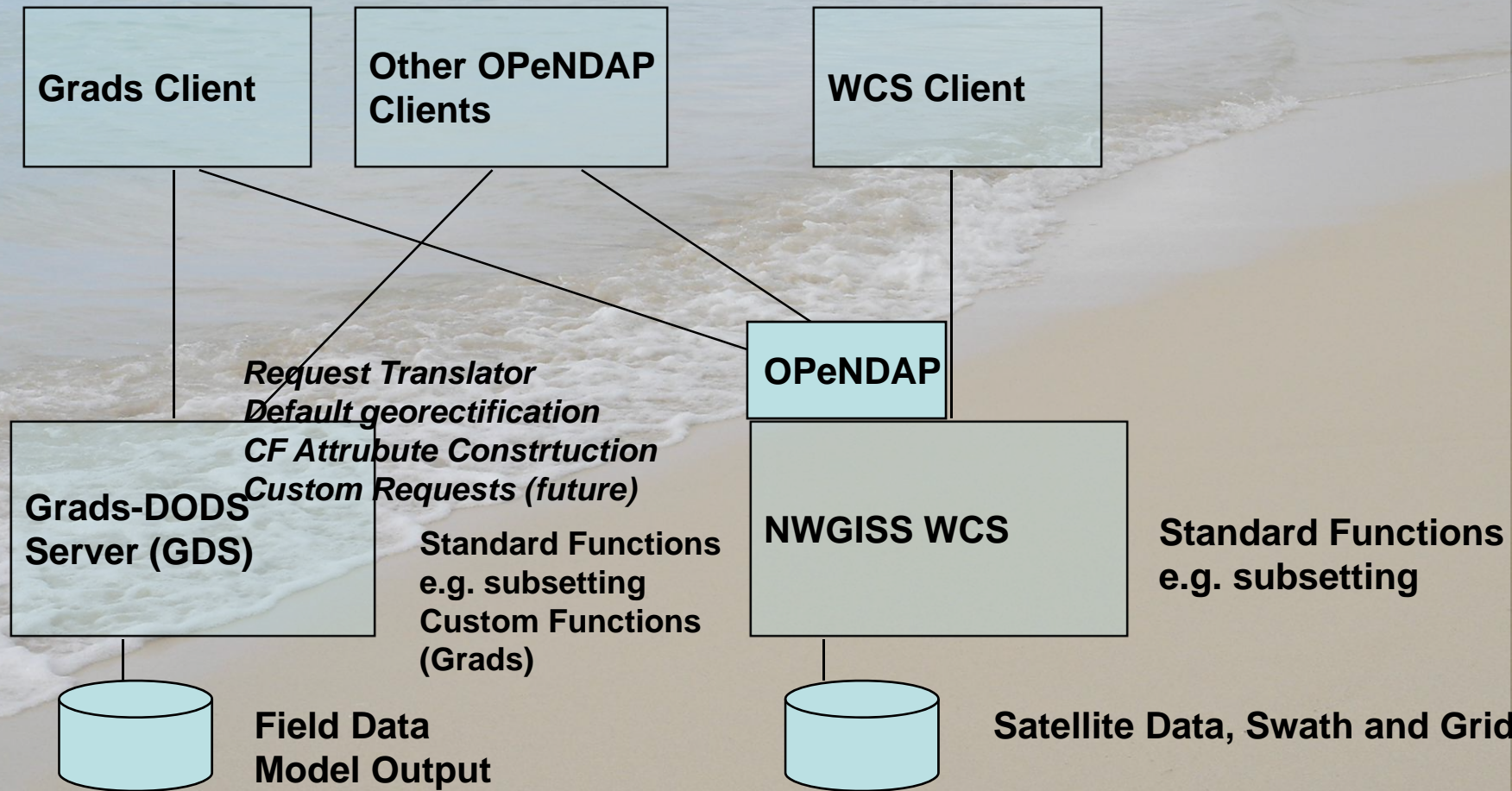


LASoutput.nc:flag		LASoutput.nc:Soil_Moisture	
	1		1
1	G	1	6.18
2	G	2	6.28
3	G	3	6.41
4	G	4	6.56
5	G	5	6.61
6	G	6	6.67
7	G	7	6.71
8	G	8	6.7
9	G	9	6.7
10	G	10	6.74
11	G	11	6.75
12	G	12	6.7
13	G	13	6.67
14	G	14	6.6

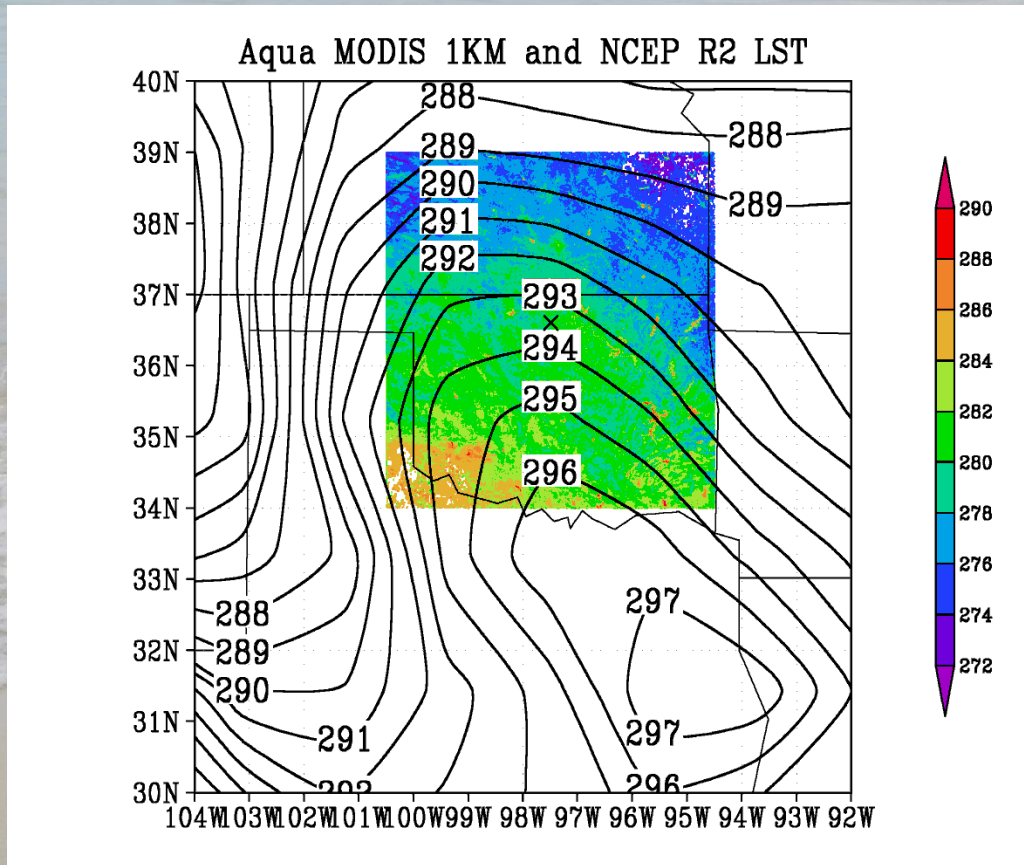
In-situ data in NetCDF format with QC flags

QC flags Observed Data

NASA Prototype: Satellite Data Server



Integration of Satellite and Model Data

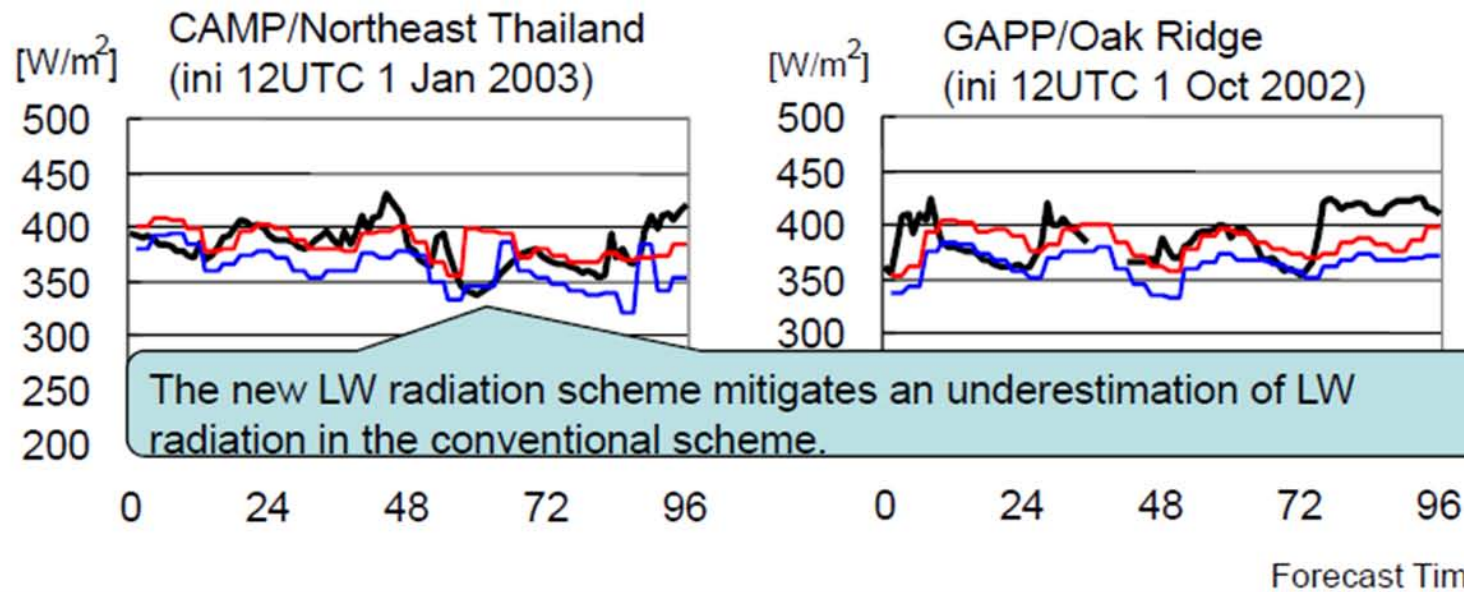
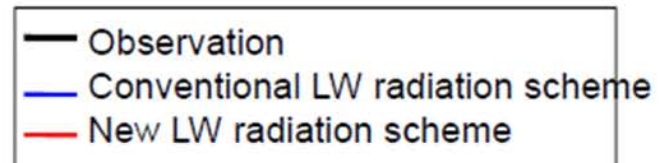


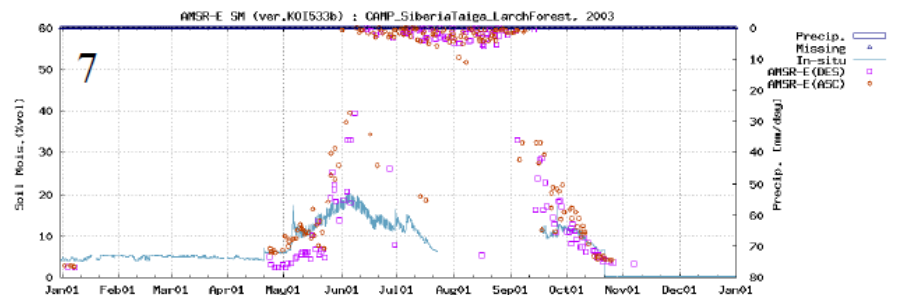
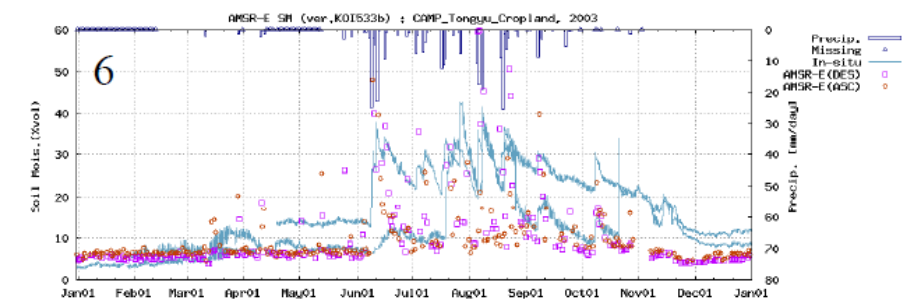
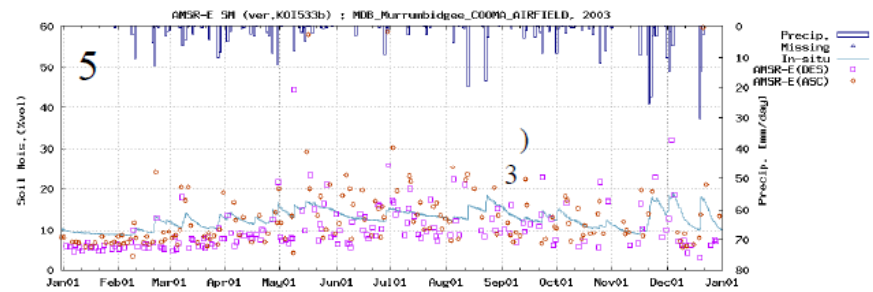
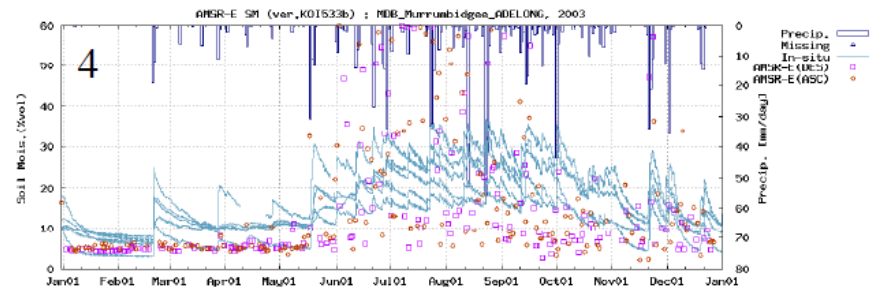
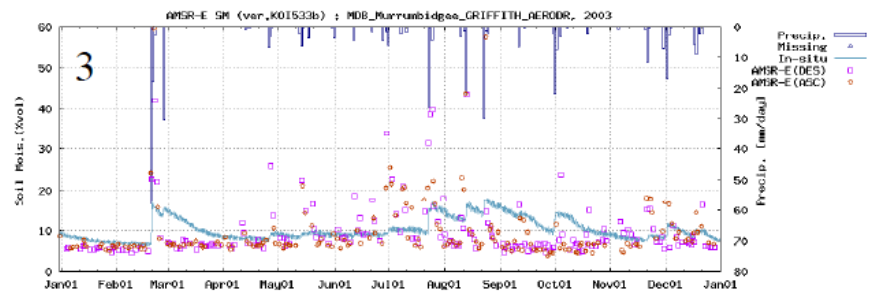
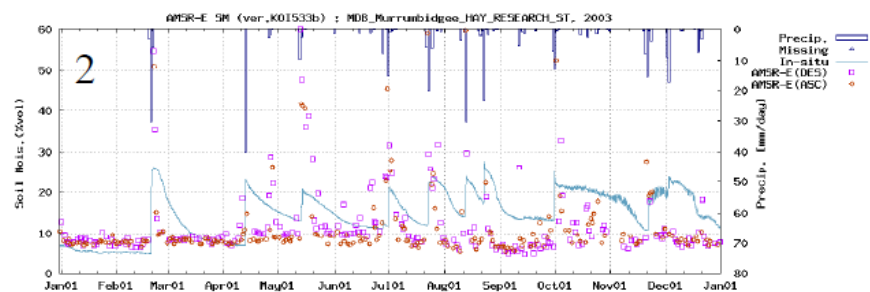
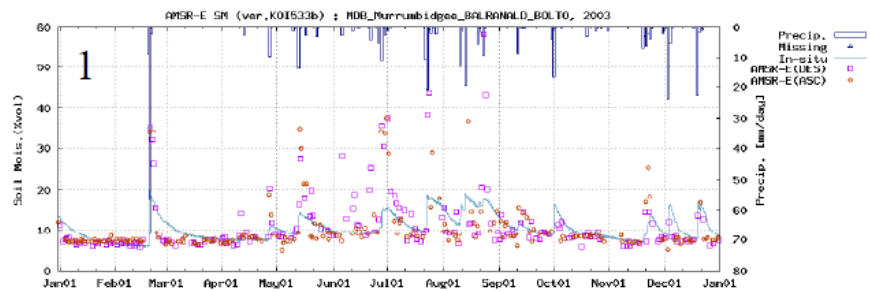
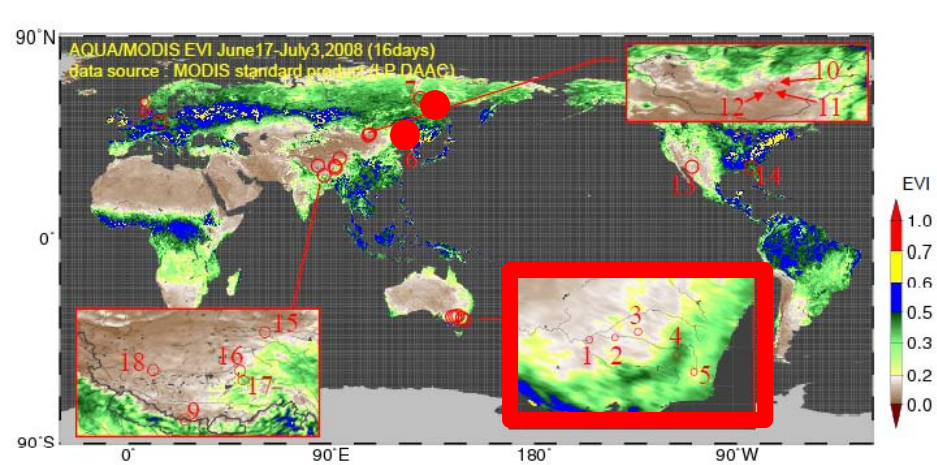
Improvement of a long-wave radiation scheme

(put into operation in Dec 2004)

CEOP dataset can evaluate not only a land surface scheme but also the other physical processes.

Downward LW radiation at surface



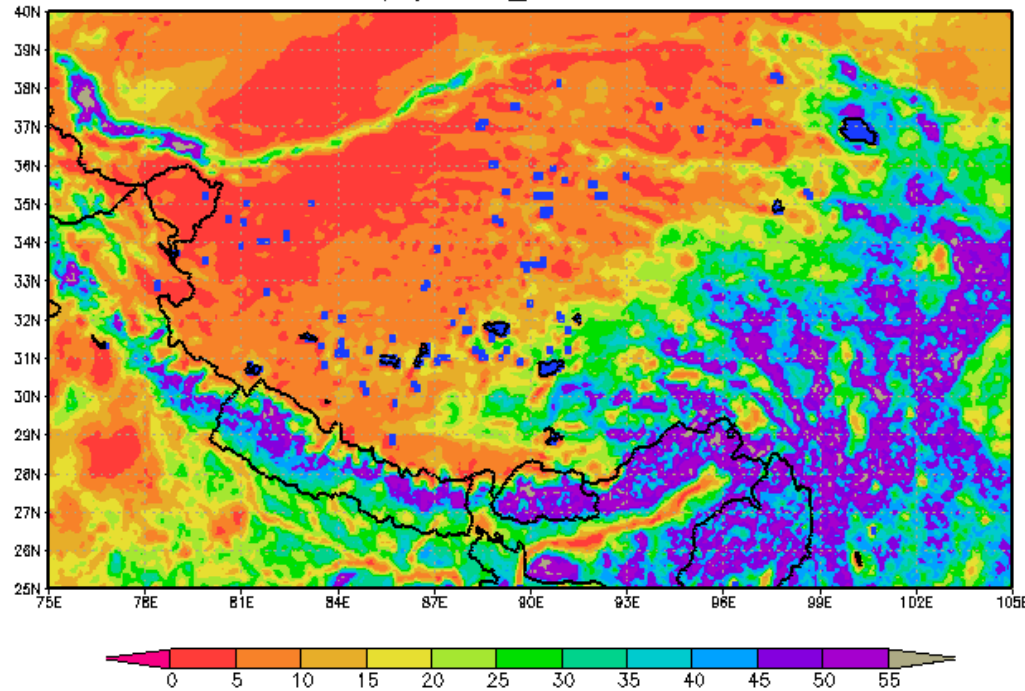


Seasonal Variation of the Soil Moisture

Tibetan Plateau

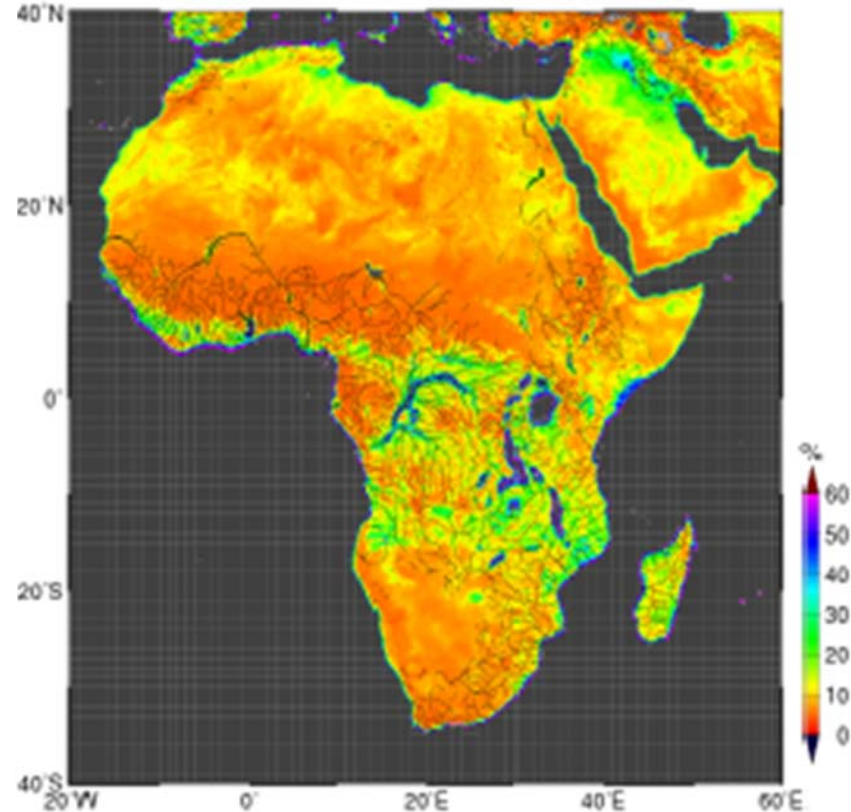
Africa

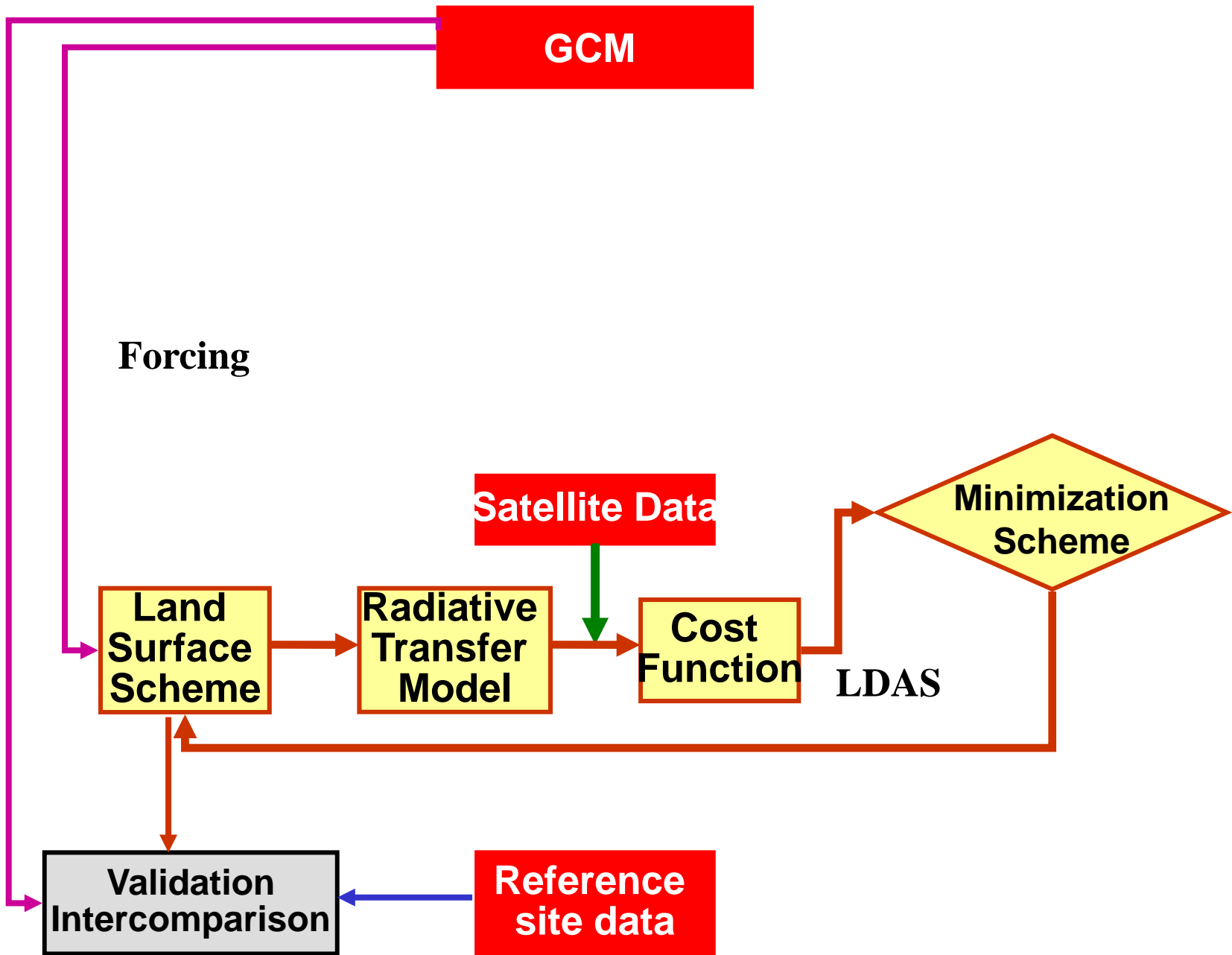
6G Mv(%) tibet_D 2003SEP-last



SM(AMSR-E)

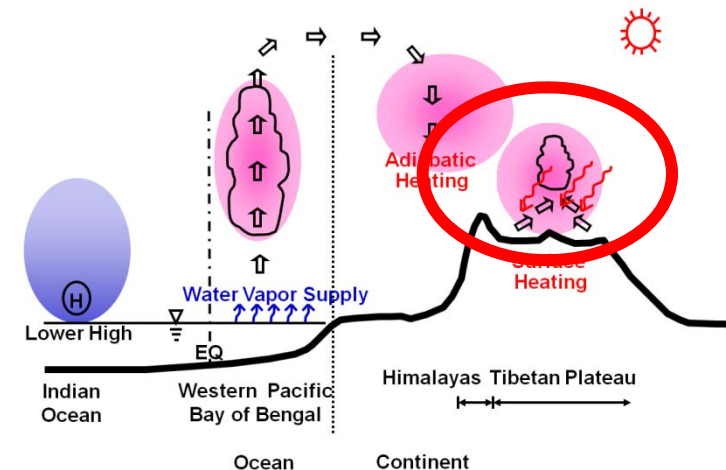
AQUA/AMSR-E SMI Dec., 2003 DES (Monthly)





Input Data → High Applicability in Any Region

- LDAS-UT grid size: 0.5 degree
- Forcing
 - GPCP precipitation: 1 degree
 - ISCCP radiation: 2.5 degree
 - NCEP reanalysis: 1.5 degree
- Leaf area index: MODIS
- Microwave Tb: AMSR-E

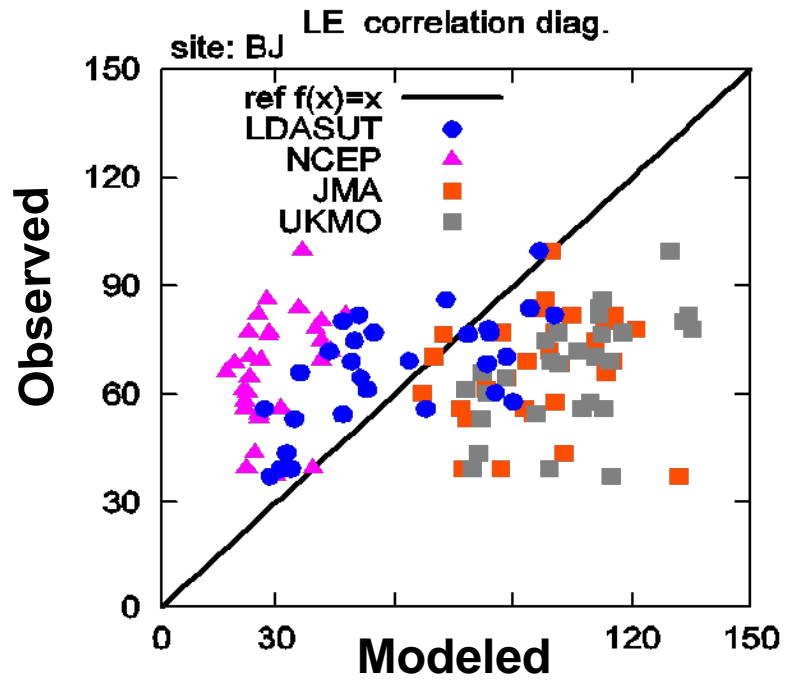
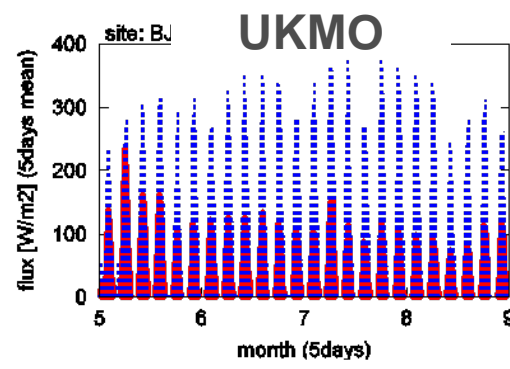
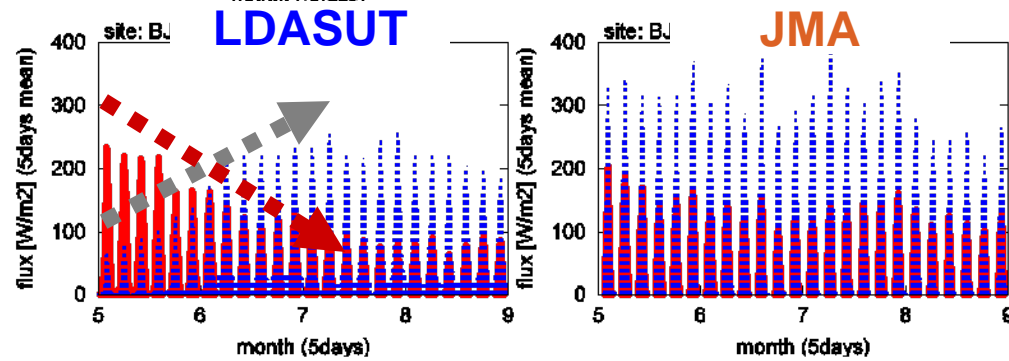
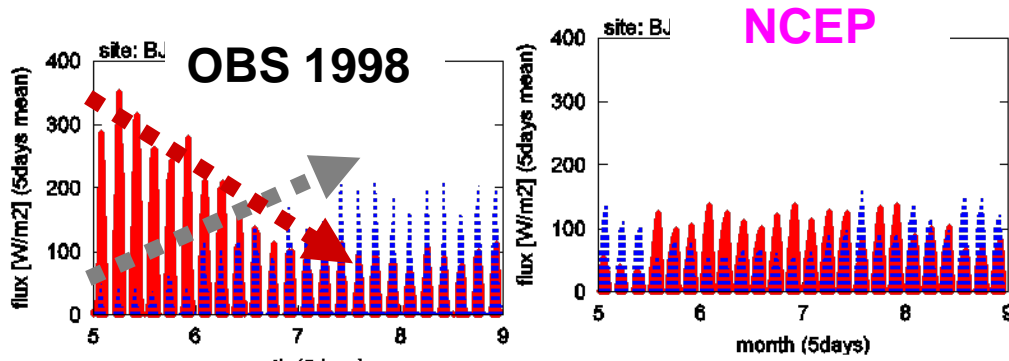


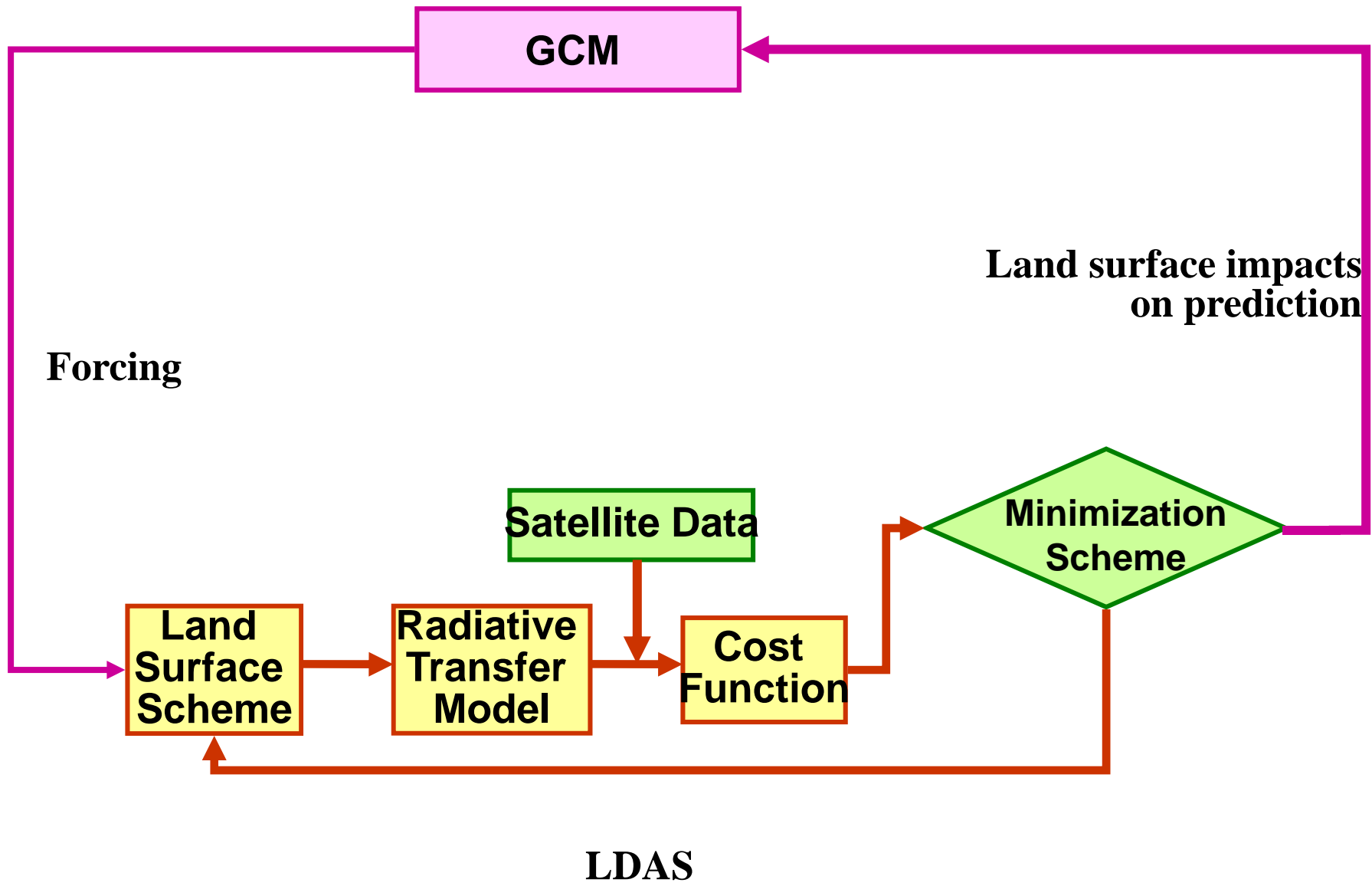
LDASUT- GCMs

LE daily-mean (June)

Seasonal variation **Sensible (H)** -
(May - September) **Latent(LE)** -

	H RMSE [W/m ²]	LE RMSE [W/m ²]
LDASUT	32.0	42.5
NCEP	40.2	68.4
JMA	32.3	79.8
UKMO	35.3	80.1



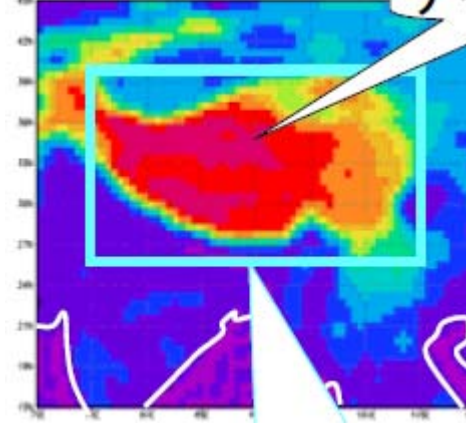


Impacts of the Tibet surface initial conditions on the GCM prediction of the **surface parameters** (UT-JMA Cooperative Research)

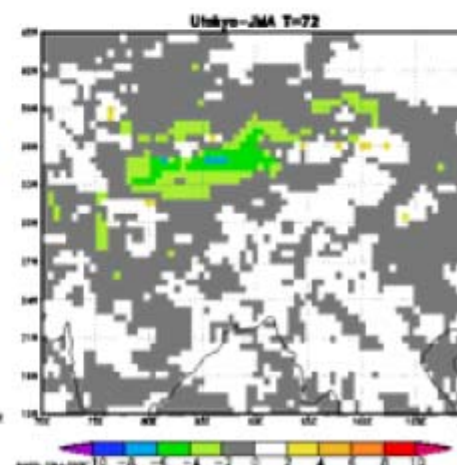
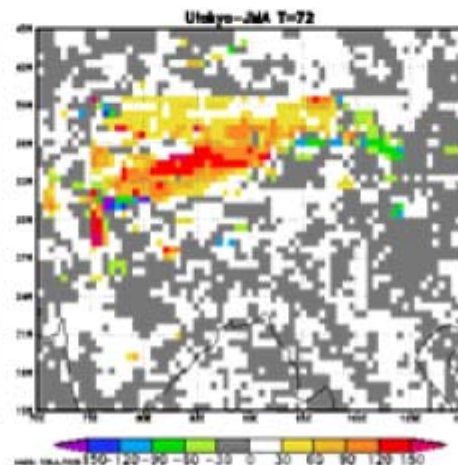
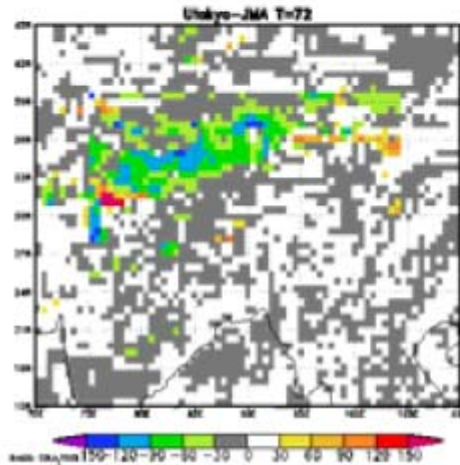
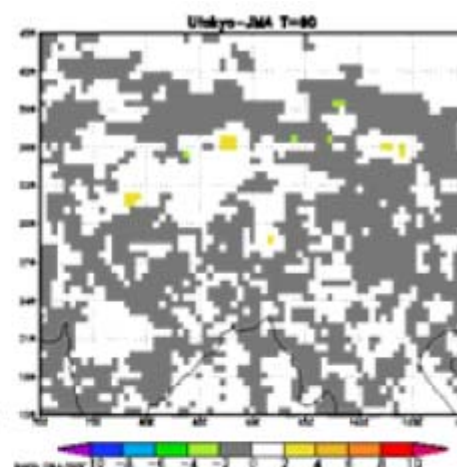
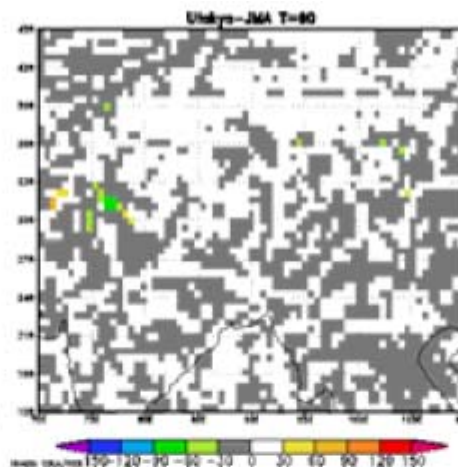
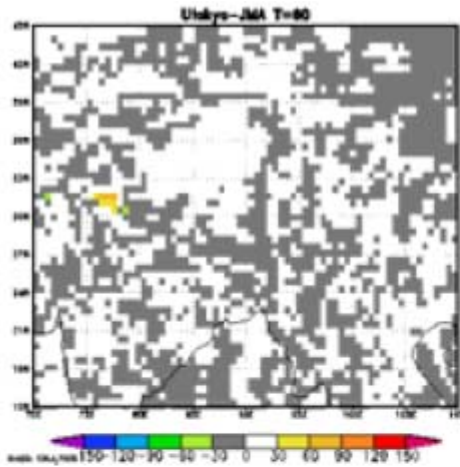
**sensible
heat flux**

**latent
heat flux**

**surface
temperature**



Use the assimilation product as the initial condition



Nighttime

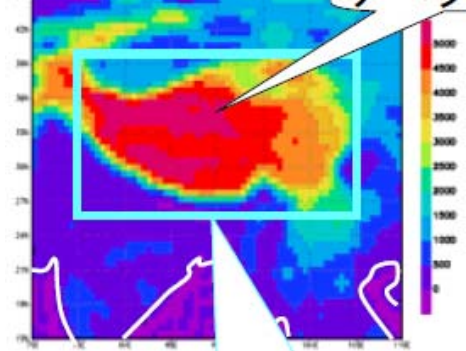


3 Day Prediction



Daytime

Impacts of the Tibet surface initial conditions on the GCM prediction of the precipitation (UT-JMA Cooperative Research)



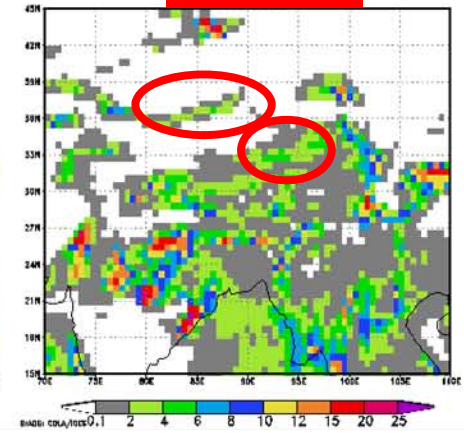
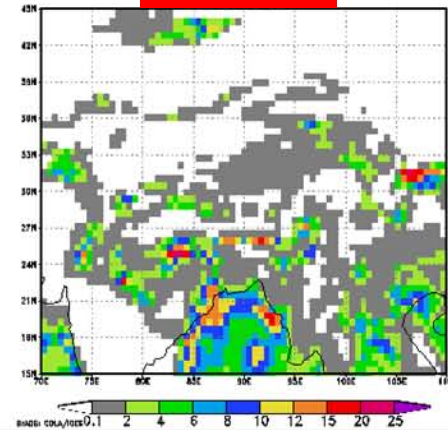
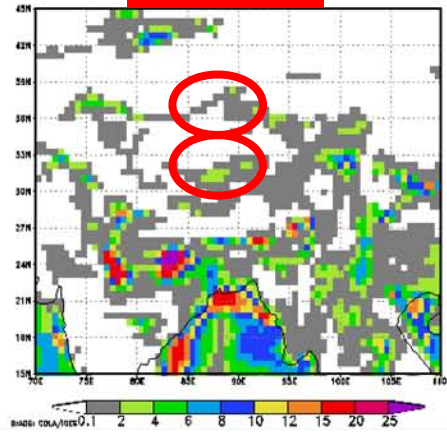
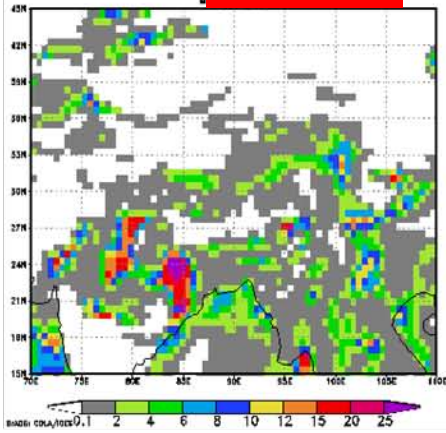
Control

FT 54

FT 60

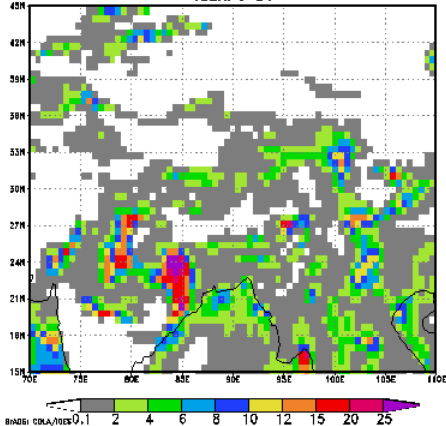
FT 66

FT 72

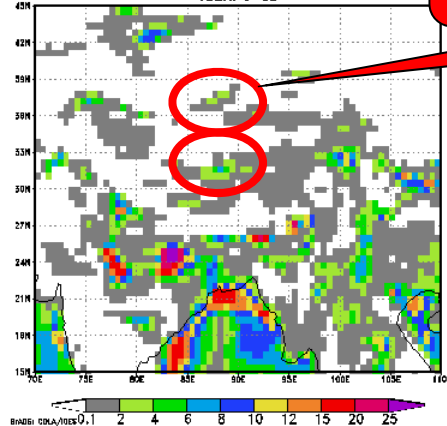


Anal UT

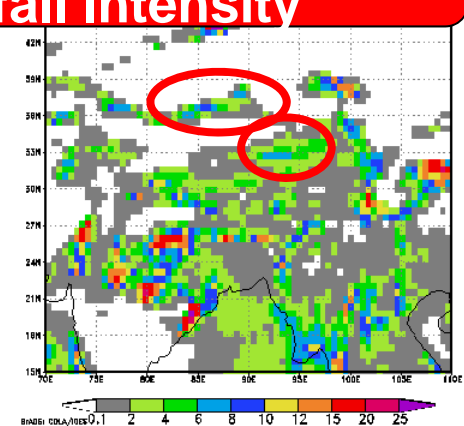
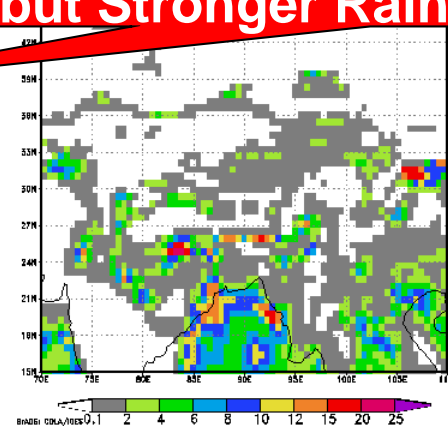
TODAI T=54



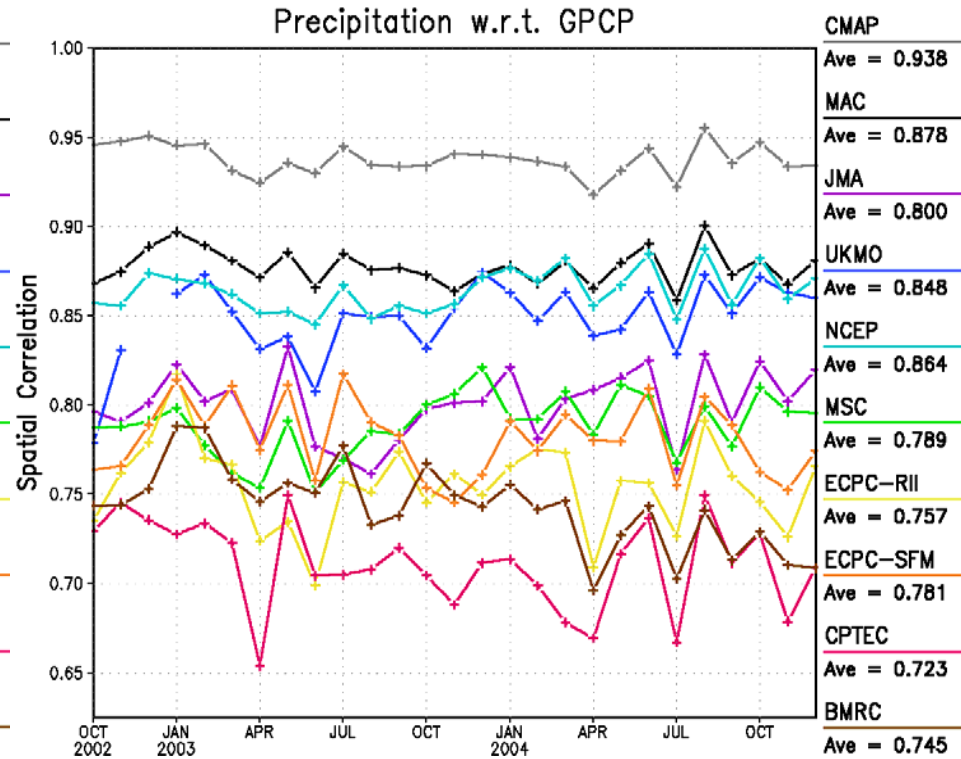
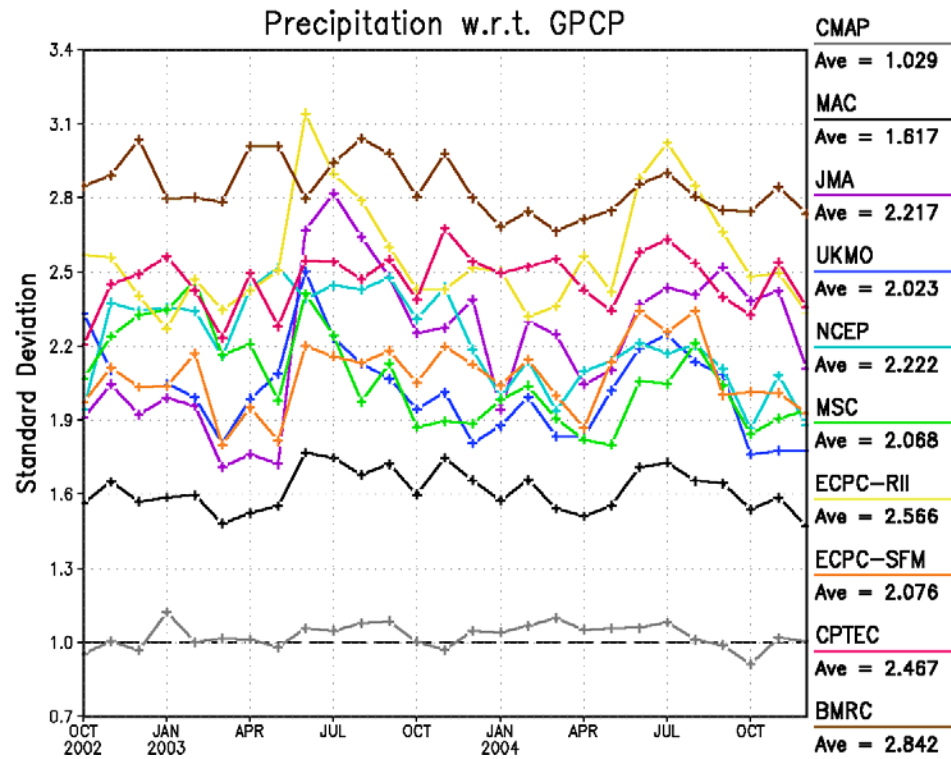
TODAI T=60



Similar Rainfall Pattern but Stronger Rainfall Intensity



Full EOP 3-4 time series (Monthly)

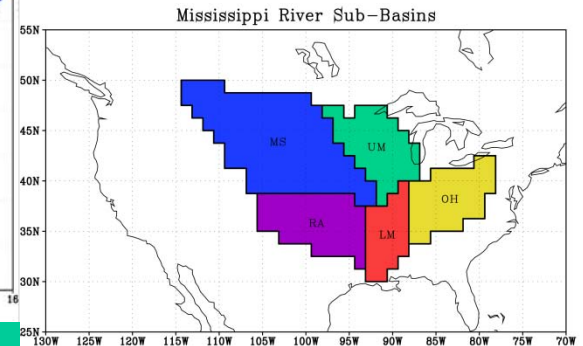
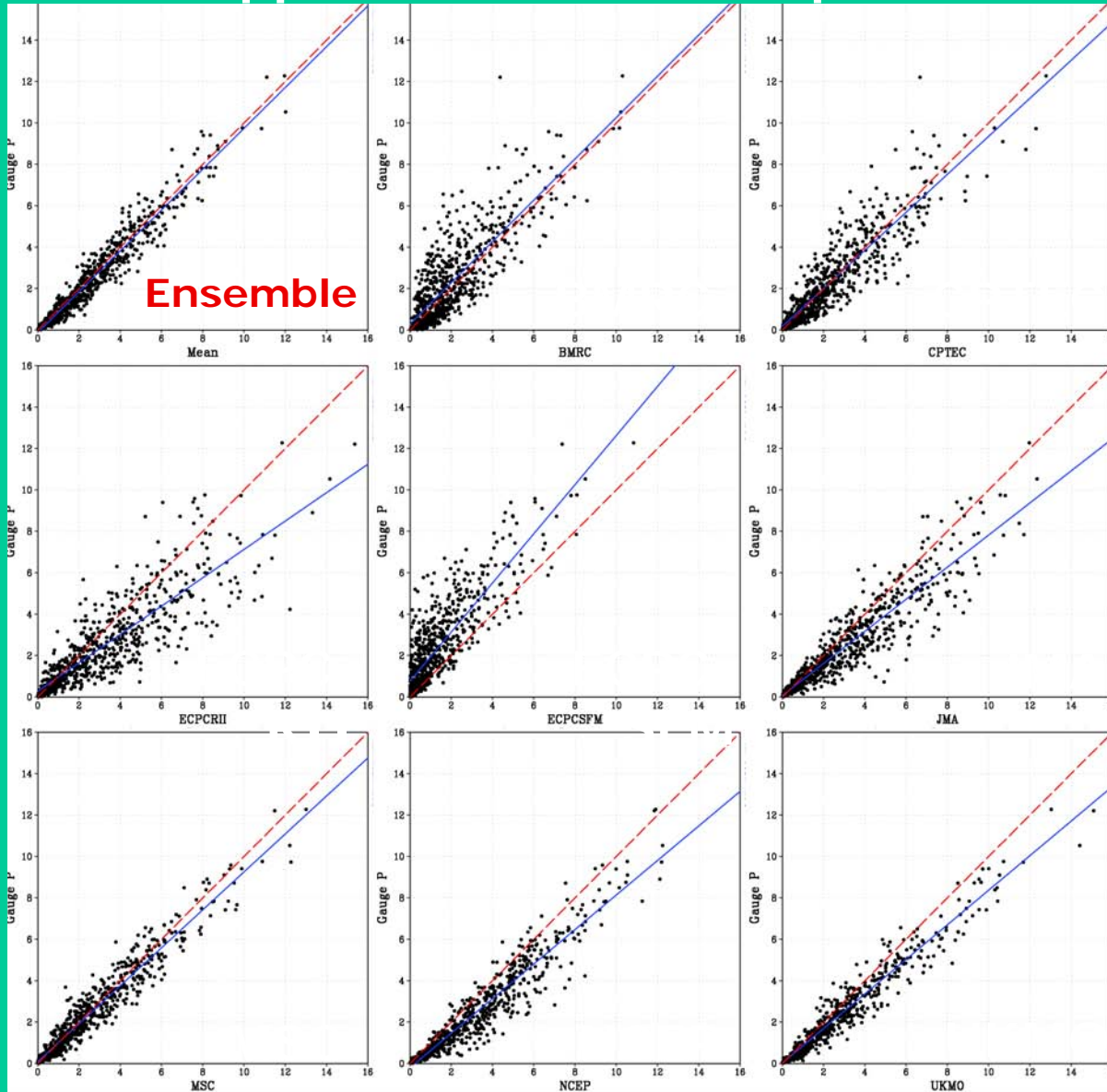


- Global spatial statistics of MAC precipitation compared to GPCP

Mississippi River Basin Precipitation

CEOP EOP 3-4 Daily MRB Precipitation

- Precipitation is independent (not assimilated)
- In general, Models have different characters
- Most overestimate high rain events
- Daily spatial correlations highest in the ensemble



Gauge Observations

Analysis

Global Land Energy

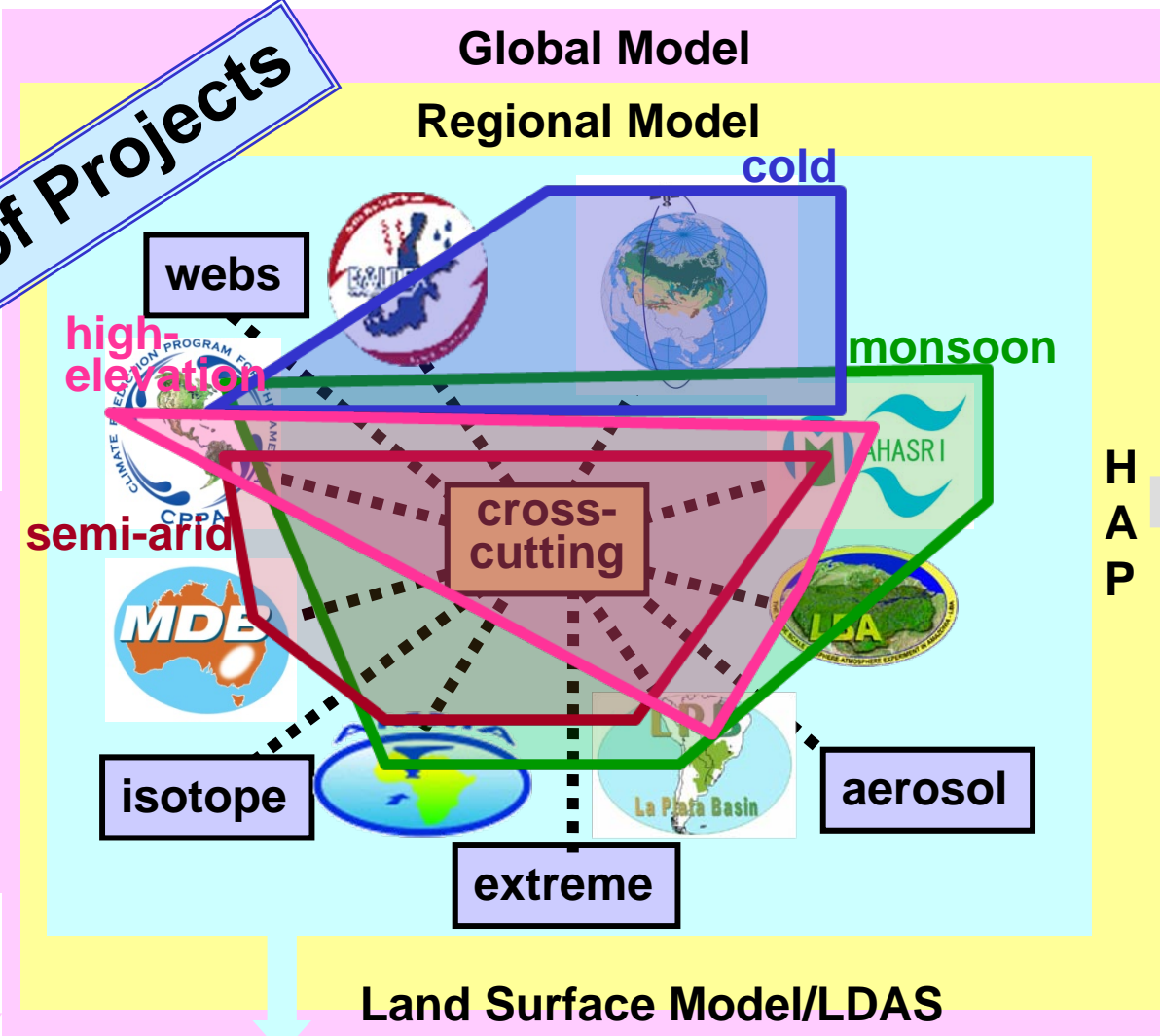
b) Land	LH	SH	RLd _{sfc}	RLu _{sfc}	RSd _{sfc}	RSu _{sfc}	RLu _{toa}	RSd _{toa}	RSu _{toa}	Net _{sfc}	Net _{toa}	Precip
BMRC	51	46	326	401	212	40	-	-	-	0.1	-	2.40
CPTEC	55	54	333	401	224	44	253	-	106	2.3	-15.3	2.46
ECPC-RII	87	-3	322	393	208	42	246	343.2	105	12.4	-7.5	2.81
ECPC-SFM	54	42	313	396	232	45	255	343.2	89	7.4	-0.6	1.95
JMA	53	27	301	391	219	46	260	343.1	95	1.7	-11.9	2.45
MSC	49	43	319	392	206	43	250	342.0	103	-2.6	-10.5	2.34
NCEP	65	23	322	392	208	44	249	-	101	5.8	-7.2	2.84
UKMO	58	31	328	396	196	38	240	343.4	104	1.2	-0.9	2.64
MAC	59	33	320	395	214	43	250	343.0	100	3.5	-7.8	2.48
Sdev	12.2	18.0	9.9	3.9	11.3	2.7	6.3	0.5	6.1	4.8	5.5	0.28
TFK	39	27	304	383	185	40	232	330.2	113	0.0	-15.6	-
SRB/GPCP	-	-	329	402	192	35	243	343.1	-	-	-	2.30

- **Model data are for Jan 2003-Dec 2004**
- **MAC ensemble average based on 6 hourly means (not the average of global values)**
- **Sdev is the standard deviation of the models global values**
- **TFK - Trenberth, Fasullo and Keihl (2009, BAMS)**
- **P in mm/day, others W/m²**
- **SRB/GPCP 2003-2004, as in the models, TFK for Mar00-May04, GRFA due soon**



A Project of Projects

- NWPCs/ACs**
NCEP, JMA
ECPC, BoM
UKMO, CMC
ECMWF
CPTEC
NCMWF
EPSON MET
GMAO GLDAS



H
A
P

Societal Benefits

Global Dataset Projects

WDC-C
MPI-M

Reference Sites
River basins

NCAR/EOL

UT&JAXA

- Satellite data
CEOS
JAXA
NASA
ESA
NOAA
EUMETSAT
WGISS
WGCV

DATA INTEGRATION & ANALYSIS

Centralized System U. Tokyo	Distributed System WTF-CEOP
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