

# ***Mutual verification between satellite products and climate model products***

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**GCOM-C1 PI WS 2013**

# Characteristic and relationship of typical data

## Ground truth data

**In situ observation**

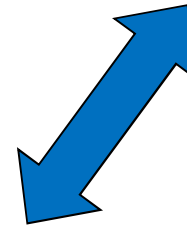
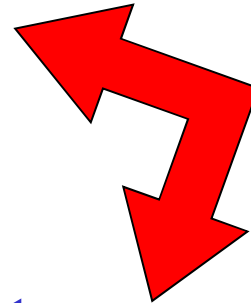
Plot scale observation

## Wide area data

**Satellite observation**

Remote sensing observation

Verification



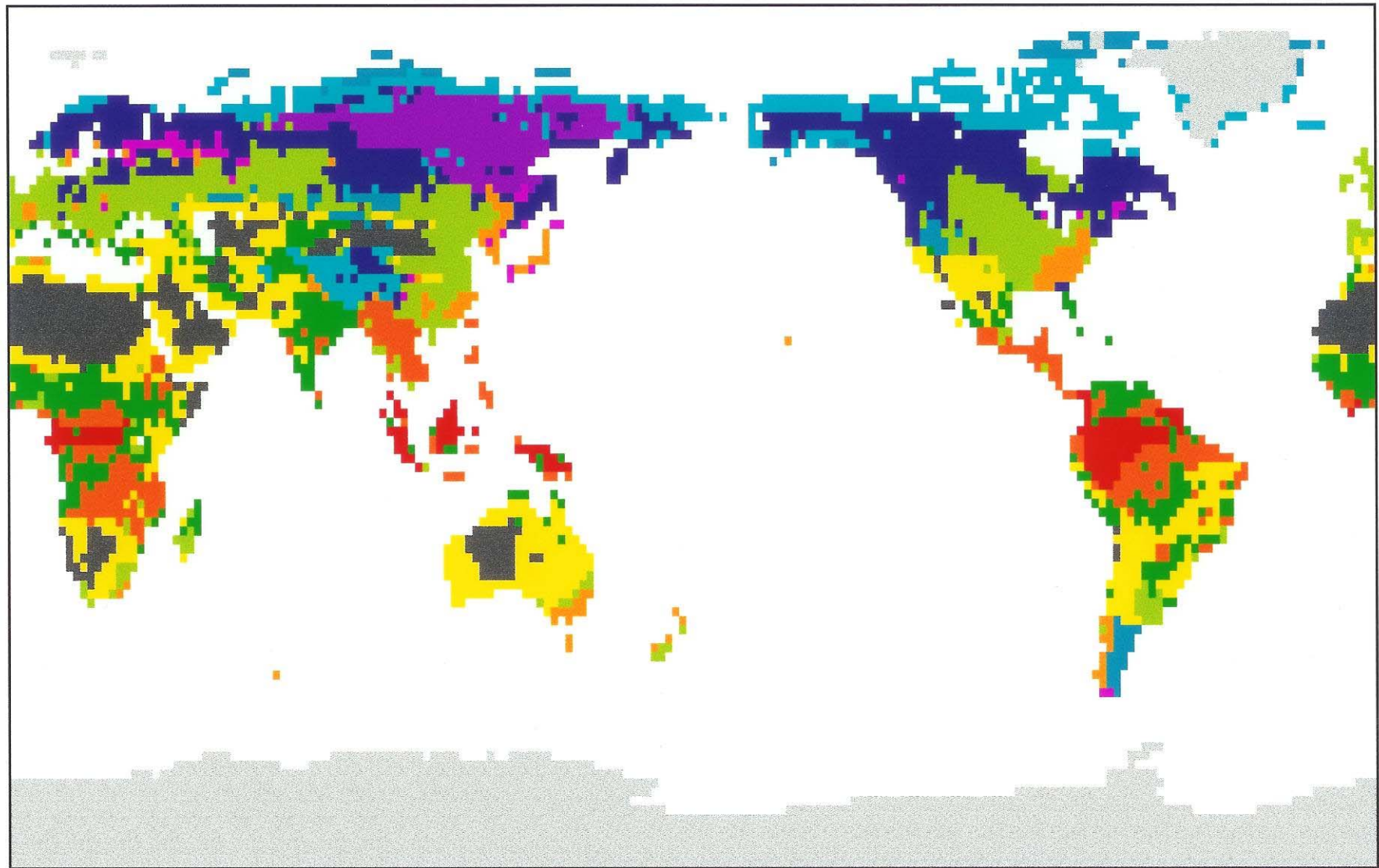
Practicable comparison

## Organized data

**Climate model simulation**

Reproduction of phenomena and interpretation

# ***A case study of mutual verification***



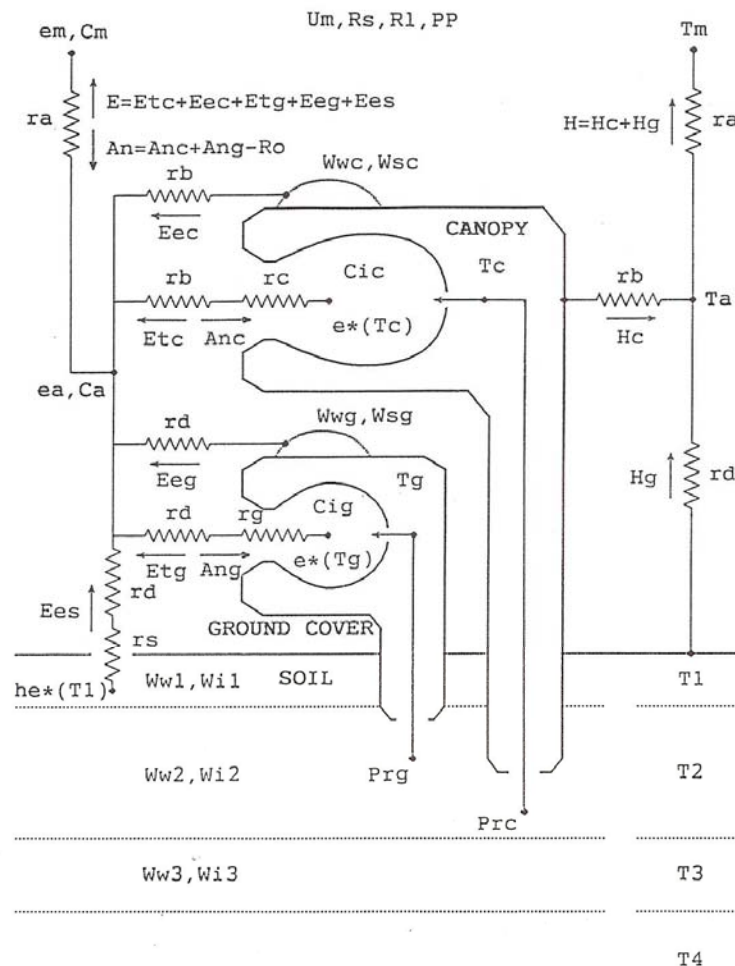
## *Vegetation map*

**Global climate model**

**Horizontal resolution: 1.875°(192 x 96 grids)**

**Vertical level: 21 layers**

# Land surface process model



The carbon storage is divided into five components, i.e., leaves, trunk, root, litter, and soil. The carbon exchanges among the components of vegetation and the atmosphere are estimated at each time step of the on-line model integration.

SNOW	
$T_g$	$W_{wg}, W_{sg}$
$T_s$	$W_{ws}, W_{ss}$
$T_0$	$W_{w0}, W_{s0}$

Energy fluxes and carbon dioxide flux between terrestrial ecosystems and the atmosphere are estimated.

## Biosphere-Atmosphere Interaction Model (BAIM) (Mabuchi et al. 1997)

- $C_3$  and  $C_4$  plants photosynthesis processes
- Snow accumulation and melting processes
- Soil water freezing and melting processes

## ***GCM simulation:***

- ◆ Land surface – atmosphere full couple simulation with the global climate model.
- ◆ Sequential 48-hour integrations using the reanalysis data for each atmospheric initial condition.
- ◆ Experiment period : 2001-2005.
- ◆ Second half 24-hour results in each 48-hour calculation were adopted for the analysis.
- ◆ Calculated values of the atmospheric CO<sub>2</sub> concentration and those of physical and biological elements of land area were taken over during the experiment period.
- ◆ Through this simulation method, the variations of atmospheric CO<sub>2</sub> concentration and land area elements and the interaction between land surface and the atmospheric under the almost actual atmospheric condition can be reproduced.

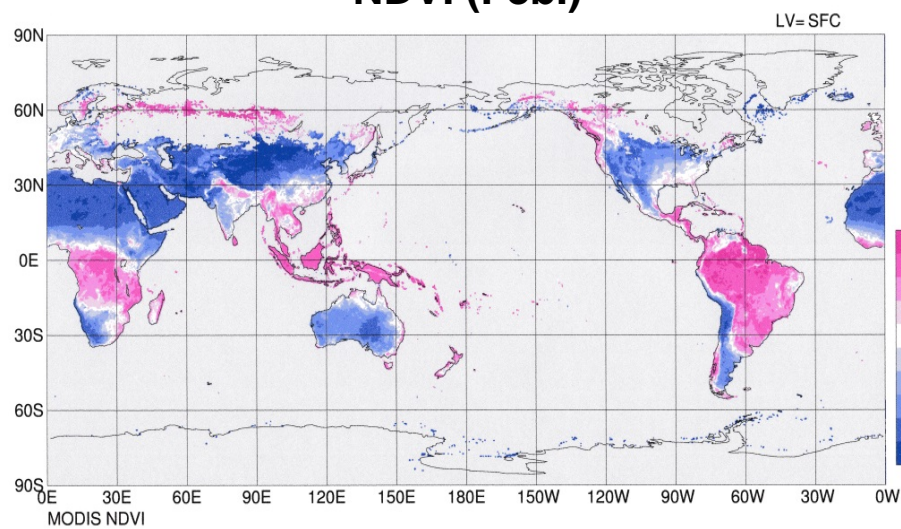
## ***Satellite data:***

MODIS data:	Downward short-wave radiation Land surface temperature <b>NDVI</b>
AMSR-E data:	Soil moisture Snow
(CMAP data:	Precipitation)

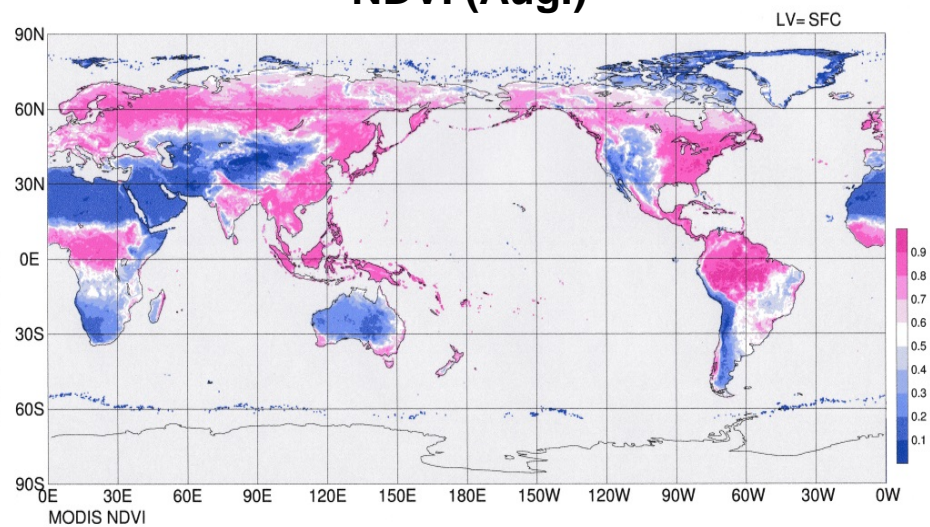


# 2003

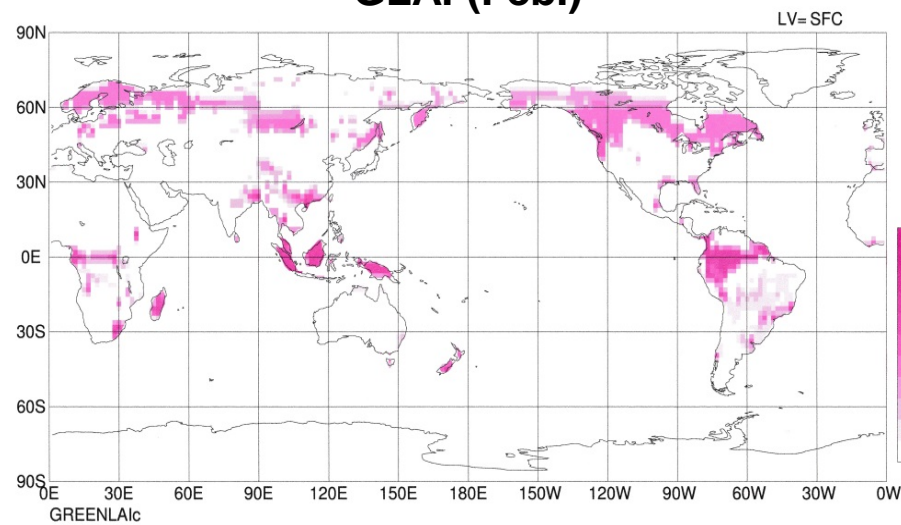
## NDVI (Feb.)



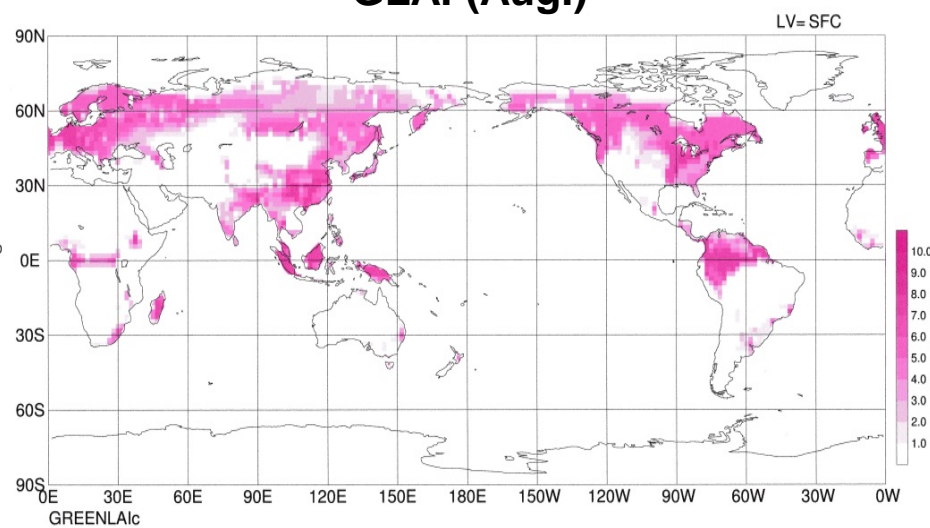
## NDVI (Aug.)



## GLAI (Feb.)



## GLAI (Aug.)

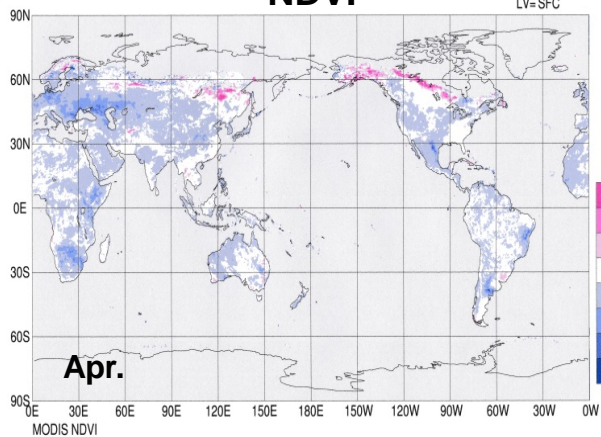




2003-2004

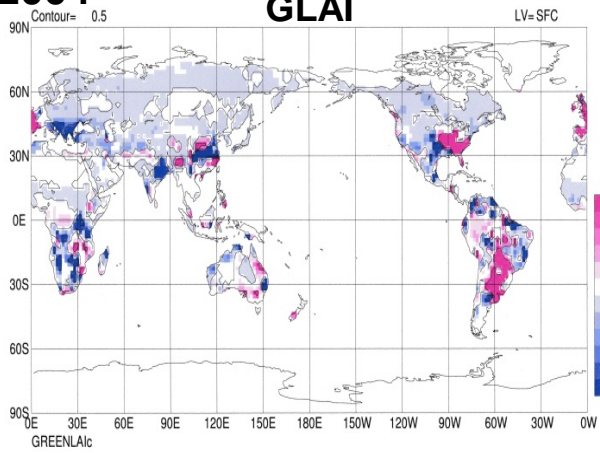
NDVI

LV=SFC



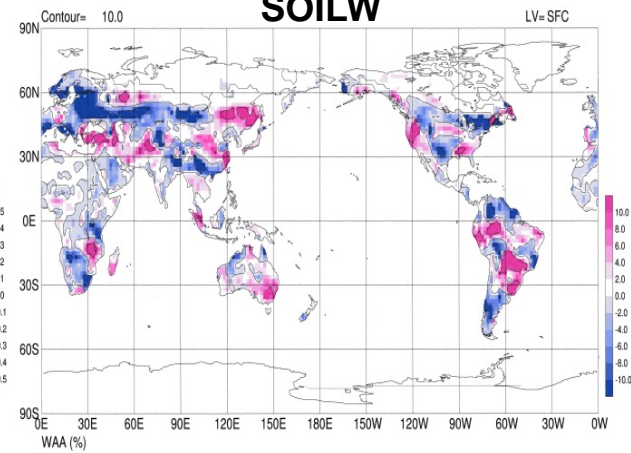
GLAI

LV=SFC

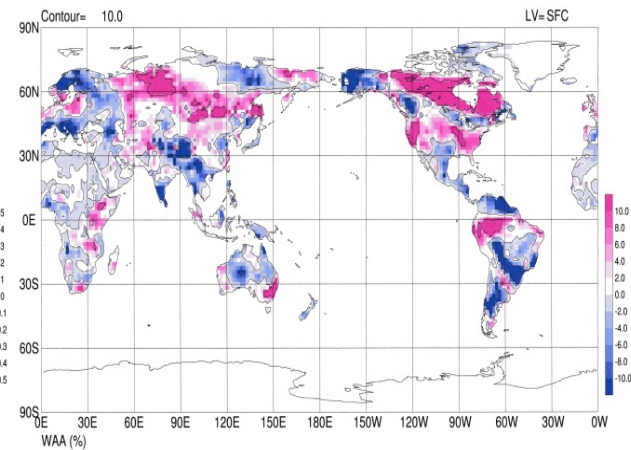
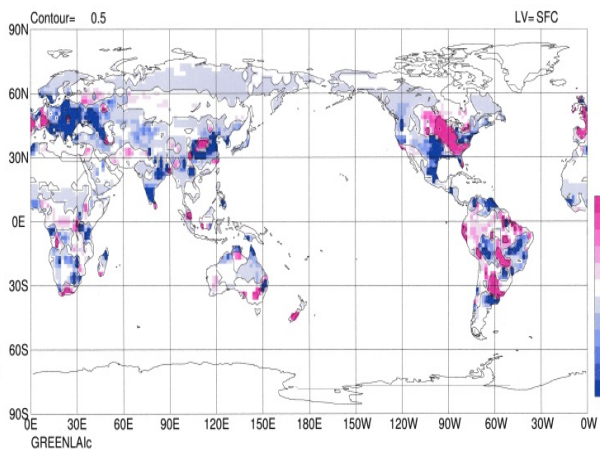
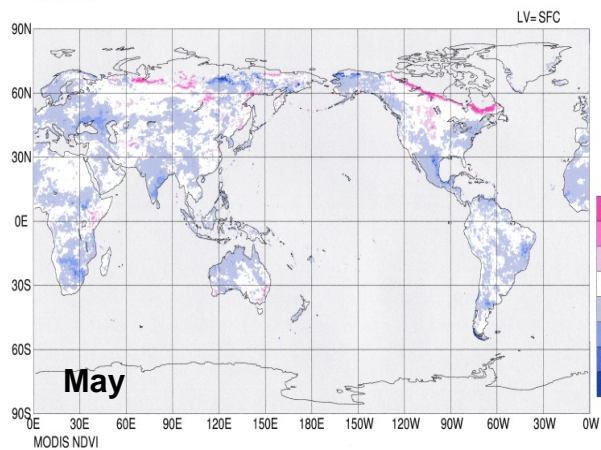


SOILW

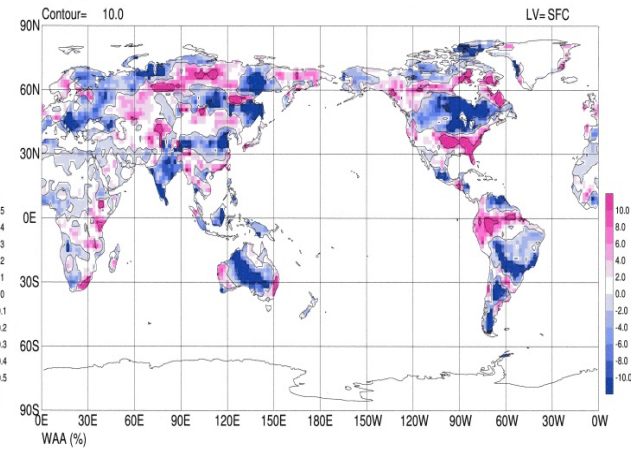
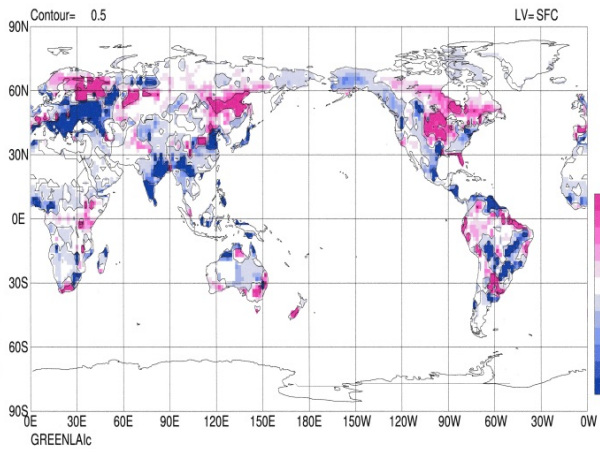
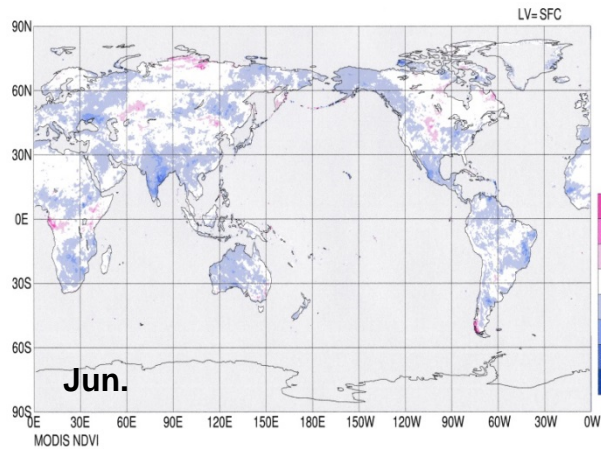
LV=SFC



May



Jun.

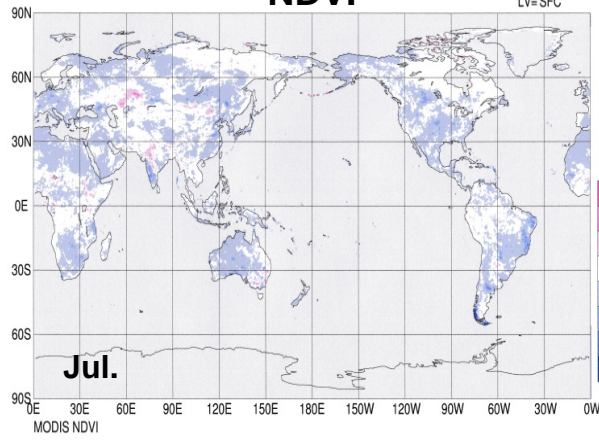




2003-2004

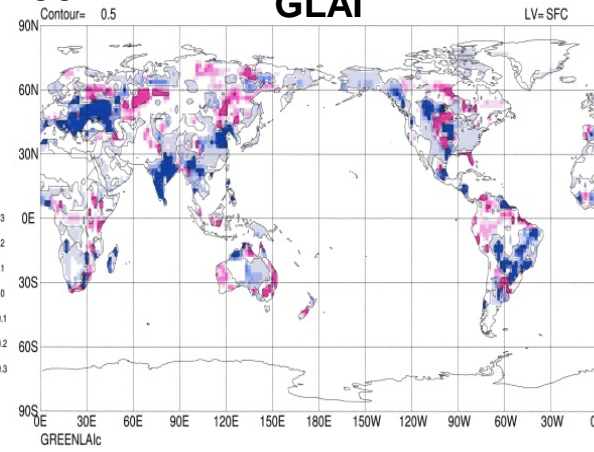
NDVI

LV=SFC



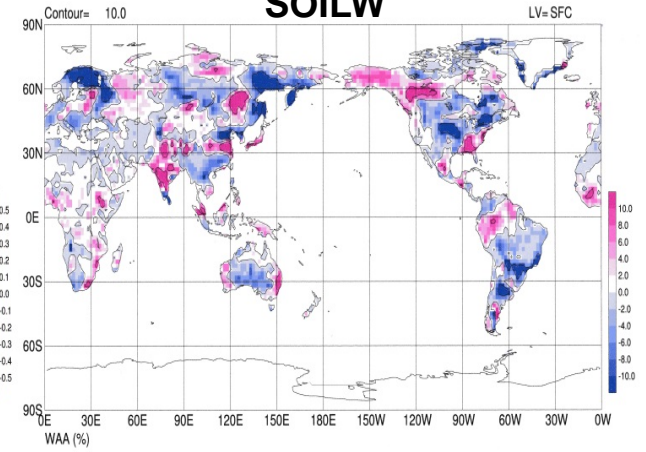
GLAI

LV=SFC

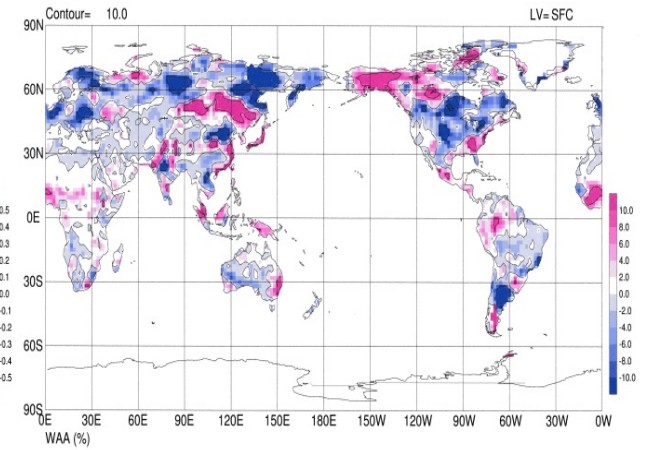
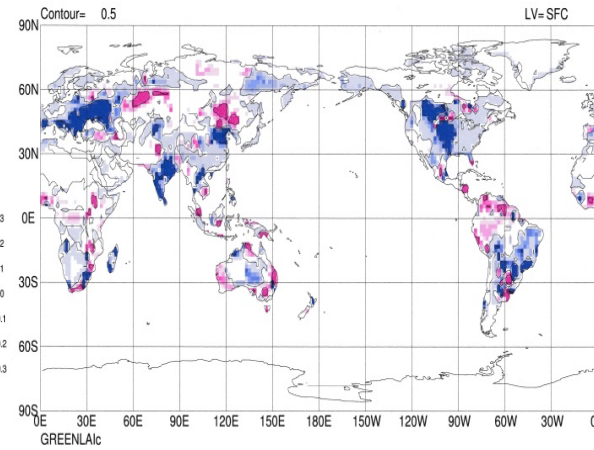
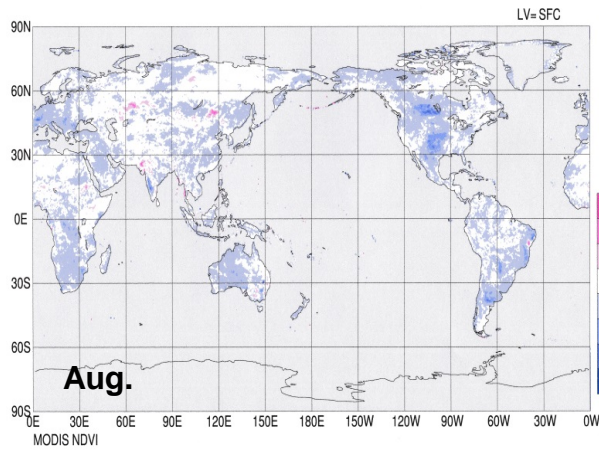


SOILW

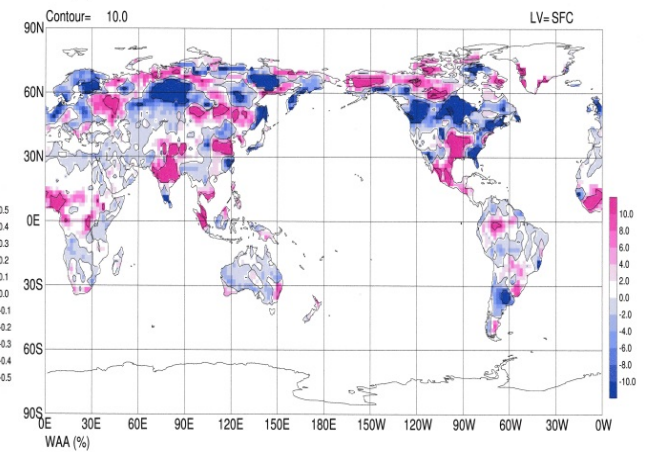
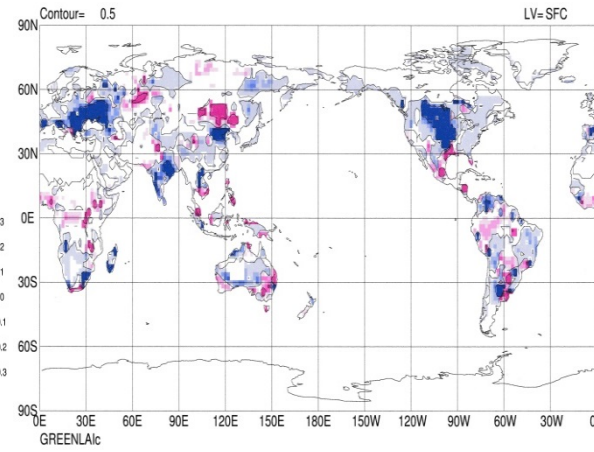
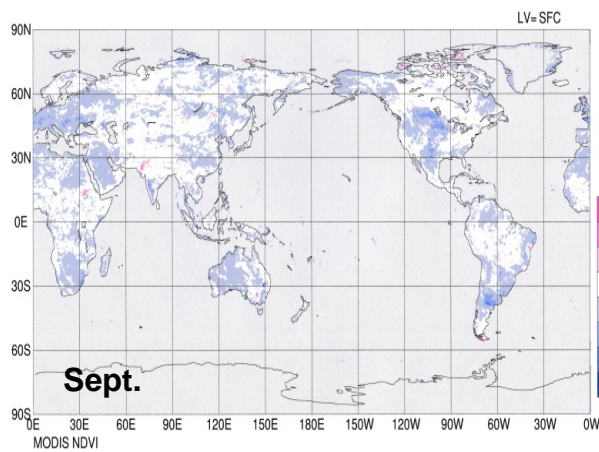
LV=SFC



Aug.



Sept.



## ***Concluding remarks :***

◆ The values of elements calculated by the model are physically and bioecologically consistent each other in the model. By comparing satellite data with model data, utilizing for judgmental standards the elements whose spatial and temporal characteristics correspond, the mutual verification between satellite data and model data and the investigation of each change mechanism can be achieved. The physical-biological relationship of biosphere change also can be investigated

◆ We had continued verifications on the physical elements until the last fiscal year. In this year, we performed verifications on biological elements. MODIS NDVI data were compared with the biological elements calculated by the model.

◆ **Seasonal changes of MODIS NDVI and those of model green LAI (GLAI):**

The areas where the values of NDVI are 0.6 or more almost correspond with those where the values of GLAI are 3.0 or more.

Inconsistency is seen in the southern hemisphere land area (Africa and South America). Further investigation is required.

◆ **Comparison of the differences between 2003 and 2004:**

Feature of the differences of NDVI and GLAI is mostly in agreement.

In the growing season, the pattern of differences in GLAI corresponds with that in the soil wetness of one month ago. In the mature season, the feature of differences is almost consistent in each month.

◆ Making this result into an example, utilizing other physical and biological elements, we will indicate capability of mutual verification of satellite data and model data and the earth system understanding method using them synthetically.