The 11the AOGEOSS Asia Pacific Symposium, Sectional Meeting for TG 7

Overview of Environment Monitoring and Protection(GI-22-TG7)

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October 25, 2018
Kyoto, Japan

Outline

- Background and Objectives
- Progresses
- Next Plan and Expectation

Background

How to protect the environment as rapid development?

1) ecosystem degradation, reduction in biodiversity, deforestation, forest fire, etc.

2) resource shortage (water resources shortage, decrease of cultivated land, food security)

3) environmental pollution (atmospheric contamination, water pollution……)

desertification   Air Pollution

Ecosystem deterioration

➢ **SDG 2030: A new agenda for global action**

Three dimension：Economic, social, environment

SDGs related with environment:

1) SDG6: clean water and sanitation；
2) SDG7: affordable and clean energy;
3) SDG9: industry, innovation and infrastructure;
4) SDG11: sustainable cities and communities;
5) SDG13: climate action；
……

Background

Global Ecosystem and Environment Observation: Annual Report from China (GEOARC)

- To support global change studies in the framework of Earth Observation System of Systems (GEOSS)
- Released 16 reports since 2012
- Community Activity of GEO Work Programme 2017-2019
- Reports and data can download from China GEOSS Data Sharing Net (http://www.chinageoss.org/geoarc/)

Report on 2012   **Report on 2013**   **Report on 2014**   **Report on 2015**   **Report on 2016**

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- Data and information Sharing to national and global users

  Dataset Download: over 10000 times, 60TB.
  Report Download：9000+ times

Background

The environment deterioration is the significant challenge issue.
Task 7 is one of the 4 new activities of AOGEOSS, following from GEOARC

Co-Leaders: CAS, NRSCC, UTS, ISPRS,… Users: National Government, Future Earth, UNEP-IEMP…

- ✓ To inverse the quantitative products for ecological environment monitoring and assessment, based on multi-source and multi-scale remote sensing data,

- ✓ To Monitor and analyze the regional ecological and atmospheric environment condition

- ✓ To evaluate and assess the eco-environmental dynamic change, to provide scientific cognition and technology support for policy making.

AOGEOSS Activities

Applications and services

Task 1. AWCI	Task 6. Monitoring and evaluation of drought in Asia-Oceaniaregion
Task 2. AP-BON	
Task 3. Carbon and GHG Initiative	**Task 7. Environment Monitoring and Protection**
Task 4. Ocean and Society	Task 8. Ocean and Islands
Task 5. Agriculture and Food Security	Task 9. Himalayan GEOSS

Foundational tasks

- Task 10. Data Sharing
- Task 11. AO-DataCube
- Task 12. Users Engagement and Communication

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Subtask 7.1 Land use/cover change monitoring for AO region : CHEN Jun (ISPRS), Peng Gong(Tsinghua University), Zhihai Gao (CAF), Zhenguo Niu(RADI, CAS) ,…

Will monitor the regional Land use/cover by using the Chinese ZY, HJ and GF series satellites, along with other satellite such as Landsat TM, Spot, Sentinel series and others.

A7.1.1 Construct the AO regional land use/cover remote sensing product validation network, and evaluate the existing global and regional land use/cover product's accuracy and quality.

A7.1.2 Algorithm development for the Classification or change detection based on the DATA CUBE. Produce new time series of 30m AO regional land use/cover product.

A7.1.3 Annual report on the land use/cover change to evaluate the ecosystem distribution, including the urban expansion and desertification of the AO region.
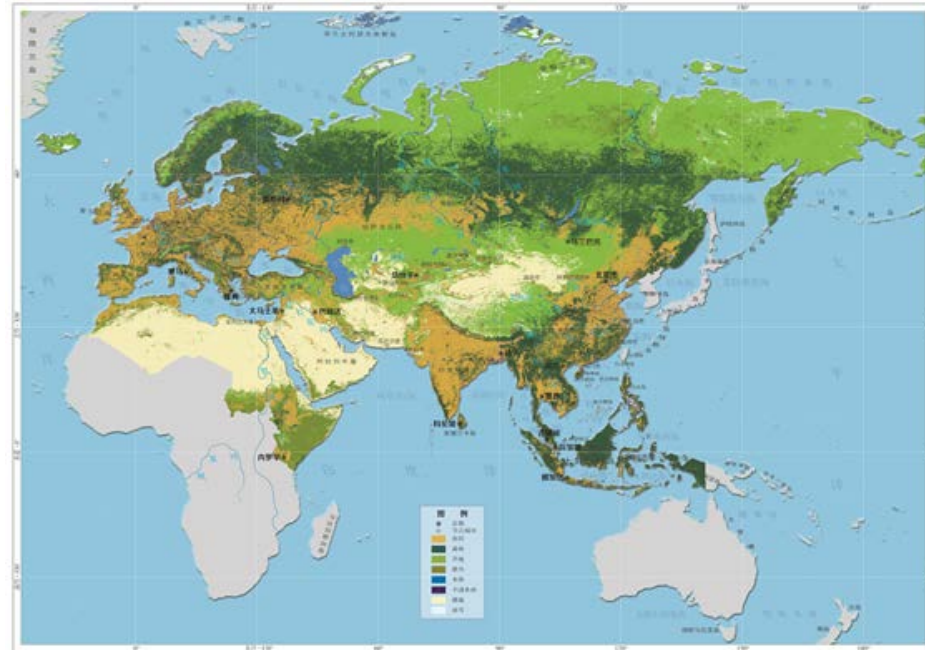
Land use and Macro Ecosystem structure

Subtask 7.2 Ecological Environment Monitoring for AO region: LIU Qinhuo (RADI, China), Alfredo Huete (UTS, Australia), Zheng Niu(RADI, China), Shunlin Liang(UMD, USA), LIU Liangyun (RADI, China), FAN Jinglong (NSMC, China),…

A7.2.1 Construct the AO regional ecosystem parameter remote sensing product validation network, and evaluate the existing product's accuracy and quality.

A7.2.2 Develop the ecosystem parameter retrieval algorithm (NDVI, EVI, LAI, FVC, FPAR, NPP, BIOMASS, and Phenology et al.,) for AO regional scale, based on the DATA CUBE.

A7.2.3 Building the ecosystem monitoring System, produce the 30m to 1km ecosystem environmental product integrating the USA, Chinese, Japanese and European satellites.

A7.2.4 Annual report on the ecosystem environmental condition and the ecosystem evaluation related with climate change for the AO region.
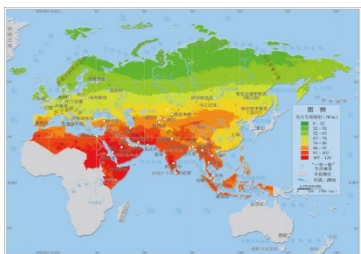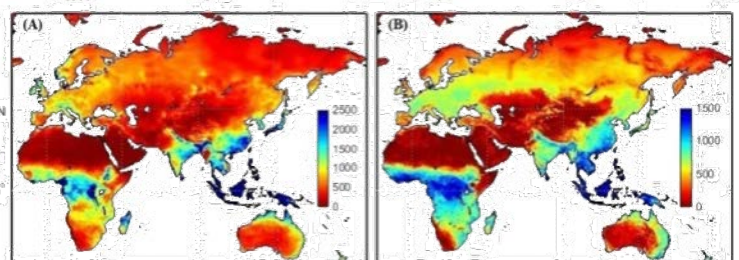
PAR   Precipitation   ET   LVC   NPP
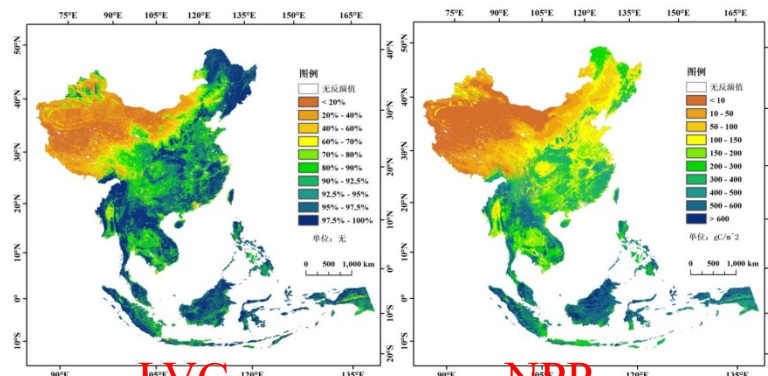
Subtask 7.3 Atmospheric Environment Monitoring for AO region: GU Xingfa (RADI, China), QIN Yi (CSIRO, Australia), CHENG Tianhai (RADI, China),...

A7.3.1 Construct the AO regional atmospheric parameter remote sensing product validation network, and evaluate the existing global atmospheric product's accuracy and quality.

A7.3.2 Develop the atmospheric parameter (aerosol optical properties, particulate matter, greenhouse gases and trace gases et al.,) remote sensing retrieval model.

A7.3.3 Building the Atmospheric environmental monitoring System for Asia-Oceania region and produce the Atmospheric environmental product based on the multi-source remote sensing data.

A7.3.4 Annual report on the atmospheric environmental condition and the major air pollution event evaluation for the AO region.
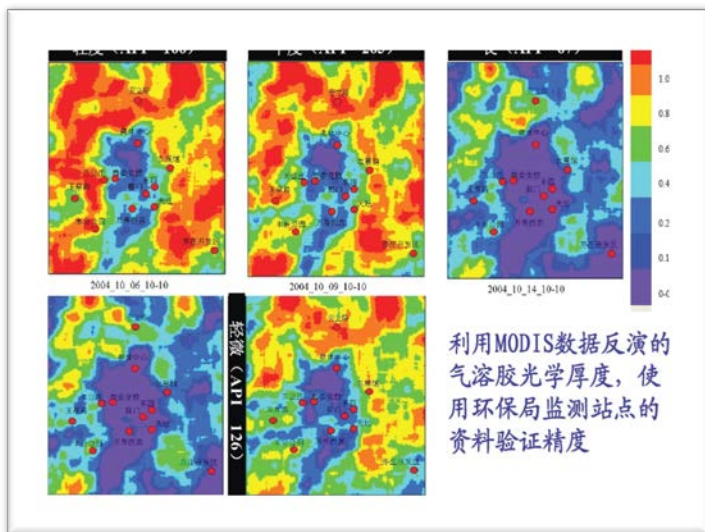
PM
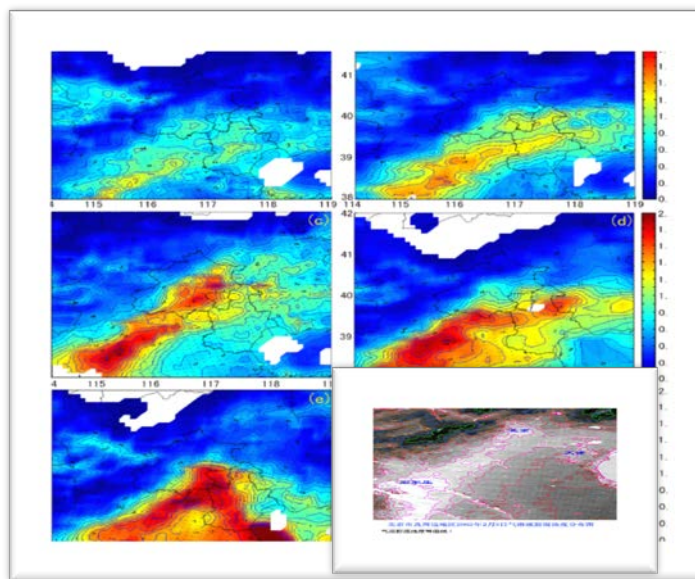
nitrogen oxides

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Outline

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Methodology

- **Main Contents**
- ✓ Remote sensing products, including land cover, PAR, evapotranspire, forest biomass, LAI, NDVI, FVC, NPP, vegetation phenology, Urban heat island effect, ocean disaster and so on.
- ✓ Monitoring indicators calculation
- ✓ Spatial pattern analysis
- ✓ Dynamic change monitoring
- ✓ Ecology and environment assessment
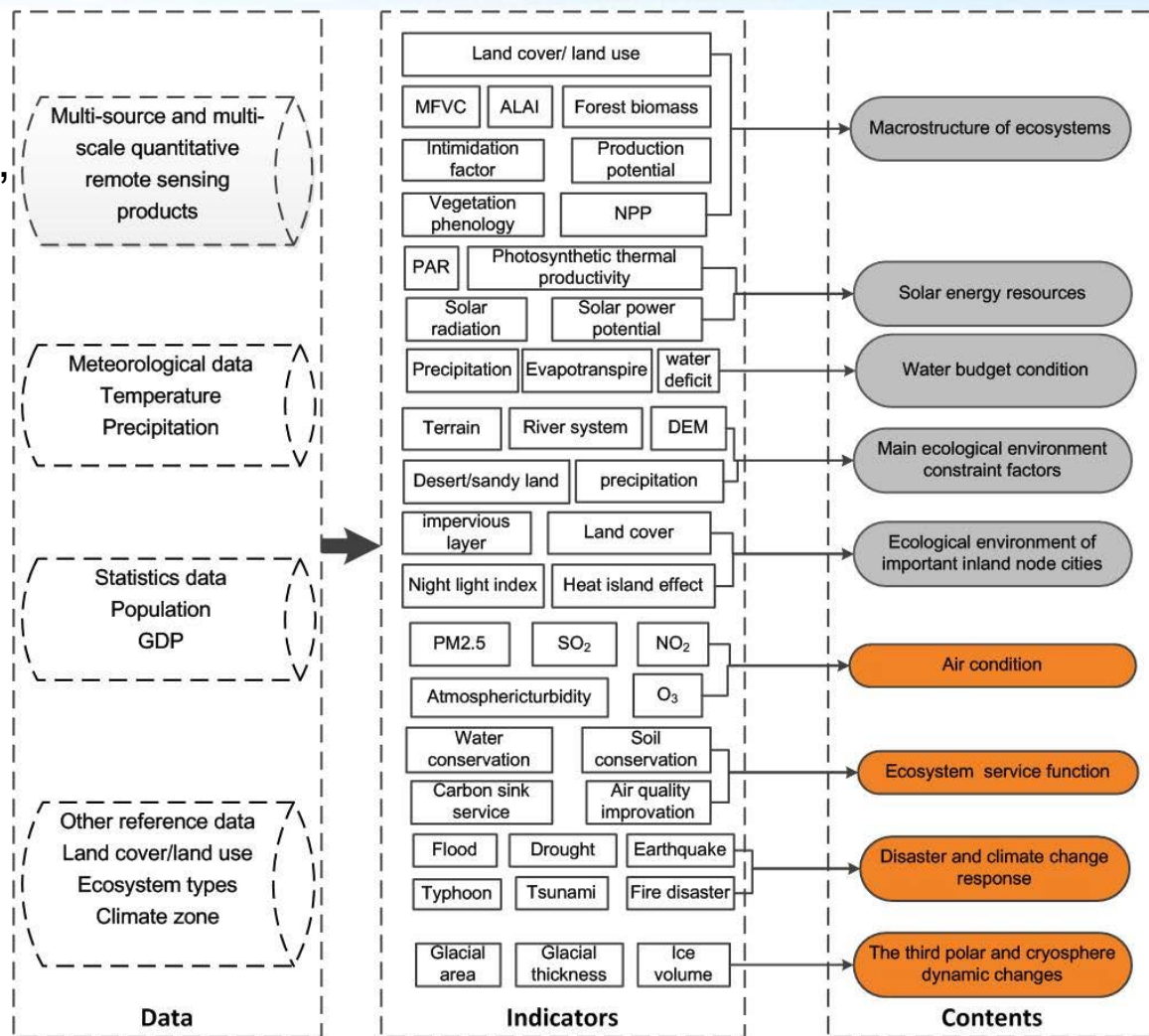
Technical route

Quantitative Remote Sensing Production

- Multi-source data Synergized Quantitative remote sensing production system (MuSyQ)

MuSyQ
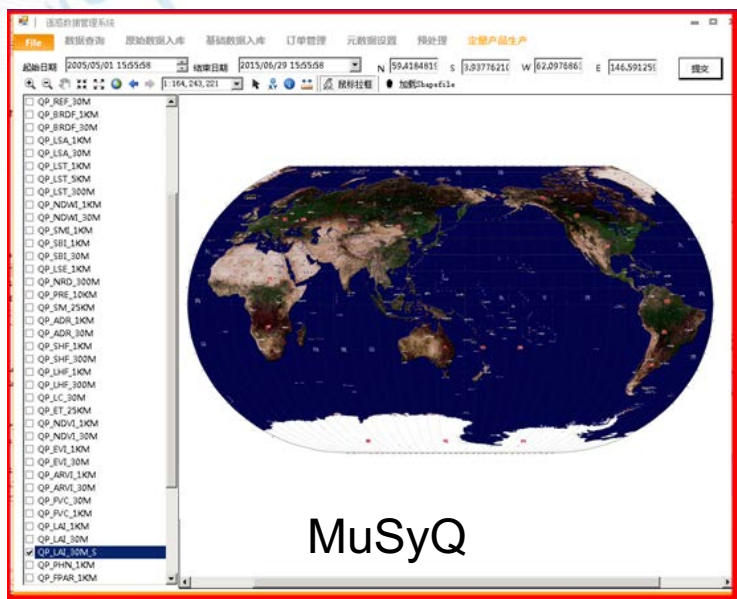
- **Higher spatial and temporal resolution;**
- **Better spatial and temporal continuity;**
- **More complete space coverage;**
- **Multi-source satellite used ;**
- **Higher precision, etc.**
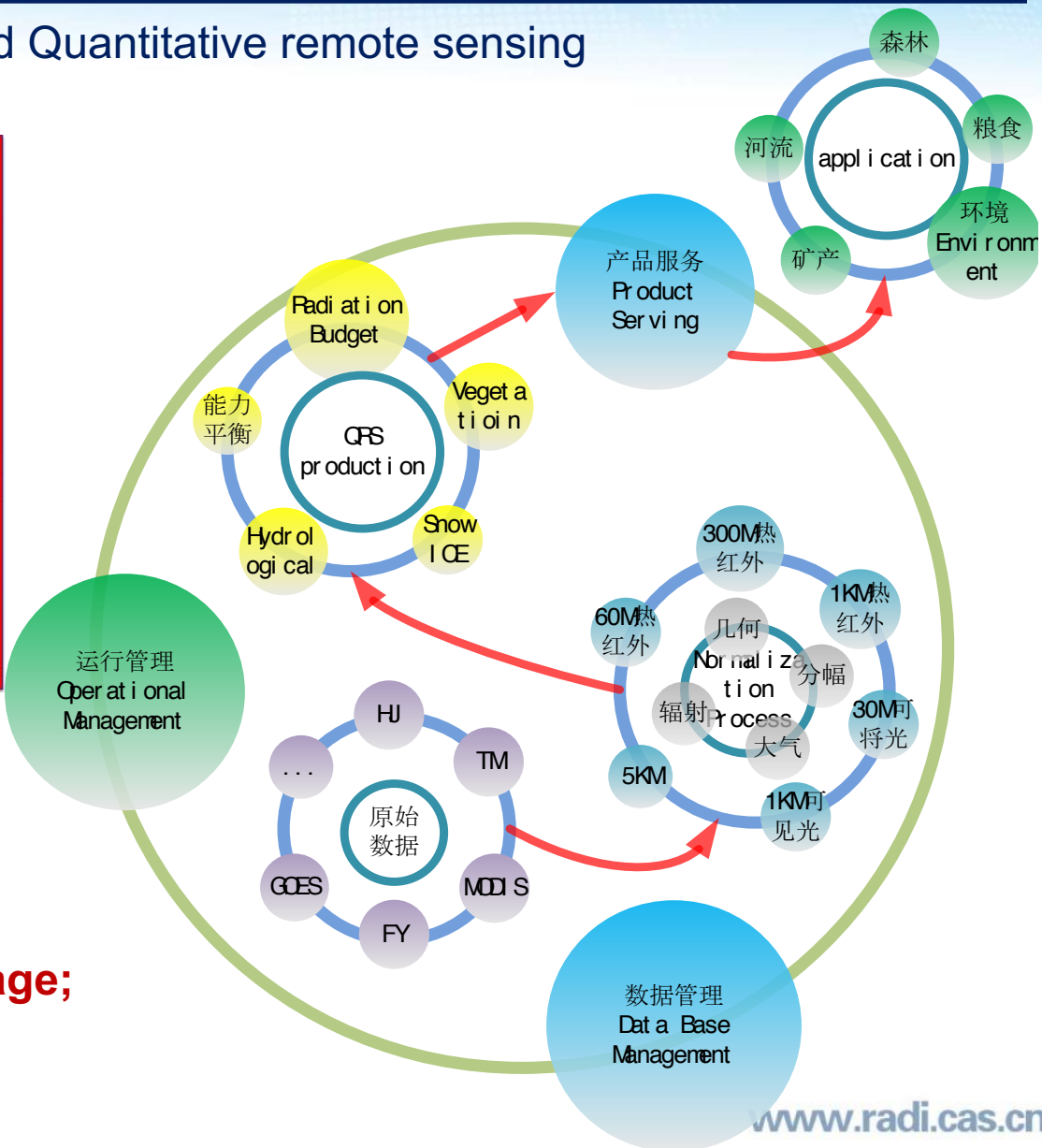
Examples of regional remote sensing products

2.56 million km²

Great Mekong Subregion

30m/30-day composite of surface reflectance
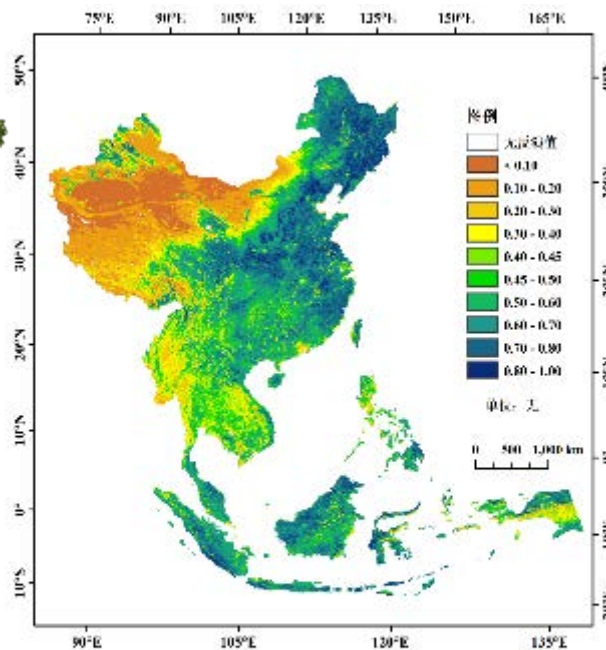
1km/5-day Leaf Area Index
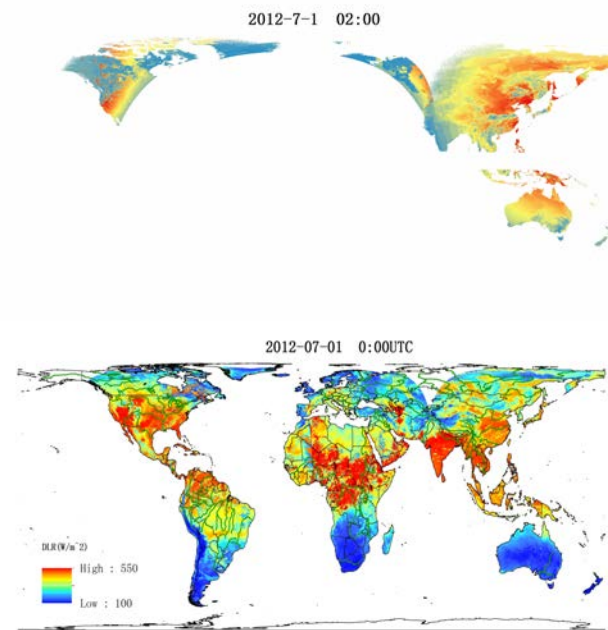
5km/3-hour Downward shortwave & longwave radiation

Terrestrial ecosystems

● **Land use/cover change monitoring** : The Land use/cover change, such as urban expansion, desertification, etc., have significant influence to and get obvious feedback from the climate change.

● Construct the regional land use/cover remote sensing product validation network, and evaluate the existing global and regional land use/cover product's accuracy and quality.

● Algorithm development for the Classification or change detection based on the DATA CUBE. Produce new time series of 30m land use/cover product.

● Annual report on the land use/cover change to evaluate the urban expansion and desertification.
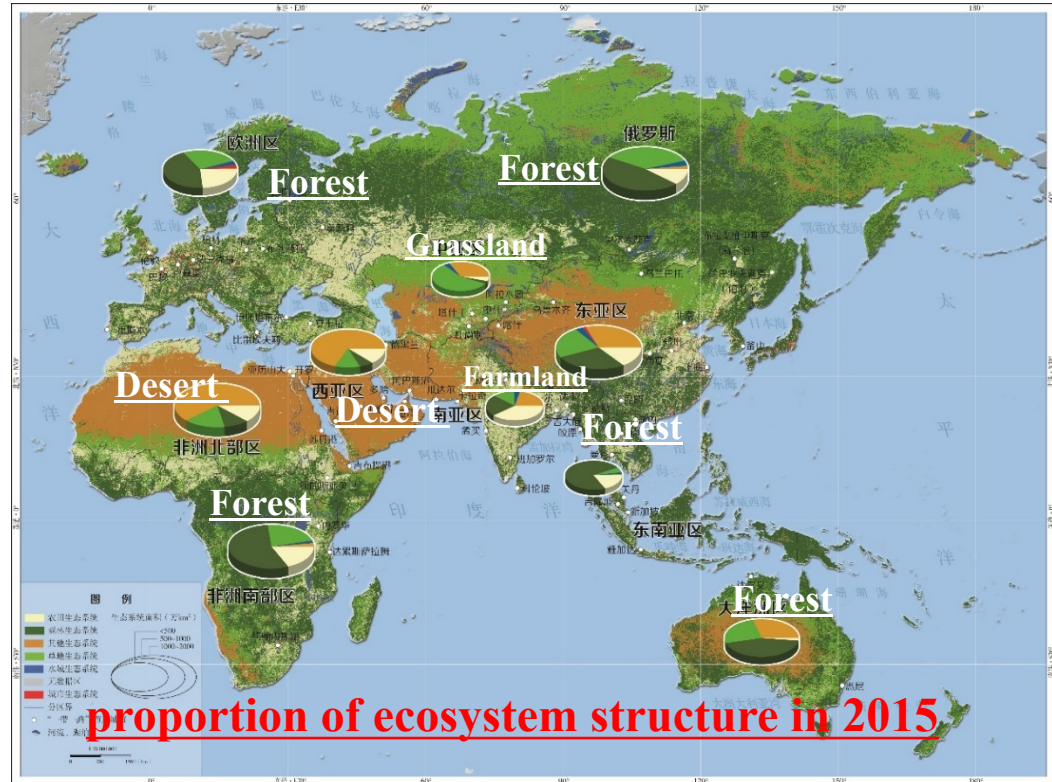
proportion of ecosystem structure in 2015

✓ There is a great disparity for the zonal climate condition, so the regional ecosystem structure is significantly different.

Vegetation ecosystems

- The ecosystem environmental change is one of the main restriction factors for the development of human society in the 21 century, to the sustainable. The forestry, agricultural and grass ecosystem have sensitive response and feedback to the climate change.

- Construct the ecosystem parameter remote sensing product validation network, and evaluate the existing product's accuracy and quality.

- Develop the ecosystem parameter retrieval algorithm (NDVI, EVI, LAI, FVC, FPAR, NPP, BIOMASS, and Phenology et al.).

- Building the ecosystem monitoring System, produce the 30m to 1km ecosystem environmental product integrating the USA, Chinese, Japanese and European satellites.

- Annual report on the ecosystem environmental condition and the ecosystem evaluation related with climate change.
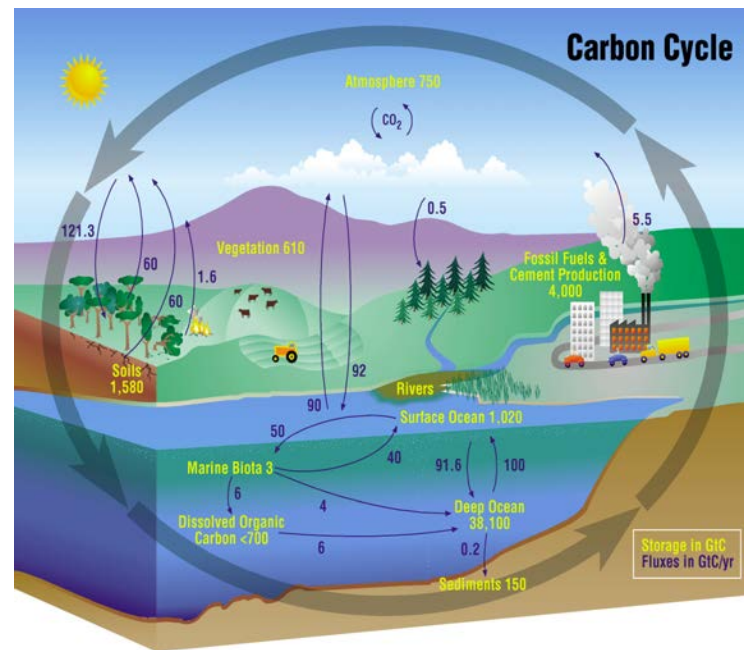
The condition and change of forest ecosystem

✓ The proportion of biomass in Russia, southern Africa, Europe, forest and mixed needle of southeast Asia and tropical rainforest of southeast Asia was 32.82%, 26.71%, 10.59%, 8.80% and 7.74%.

✓ The total biomass of forest land was 281.3 billion tons in 2015, an increase of about 1% over 2010.
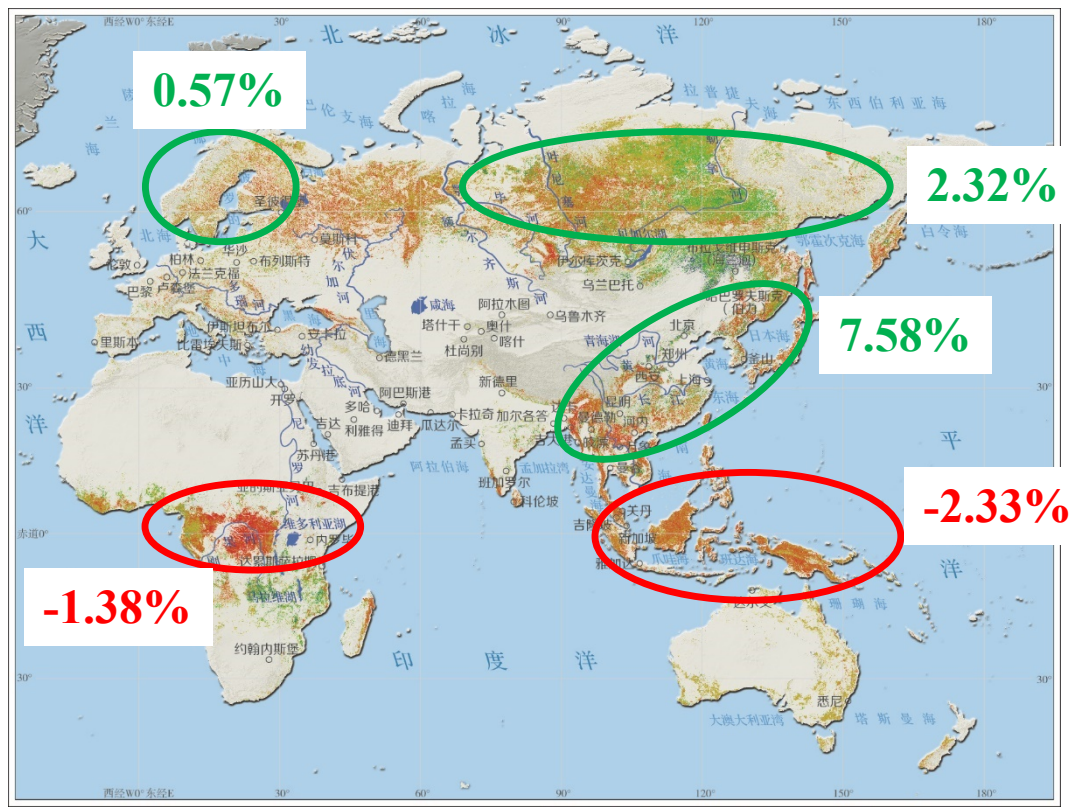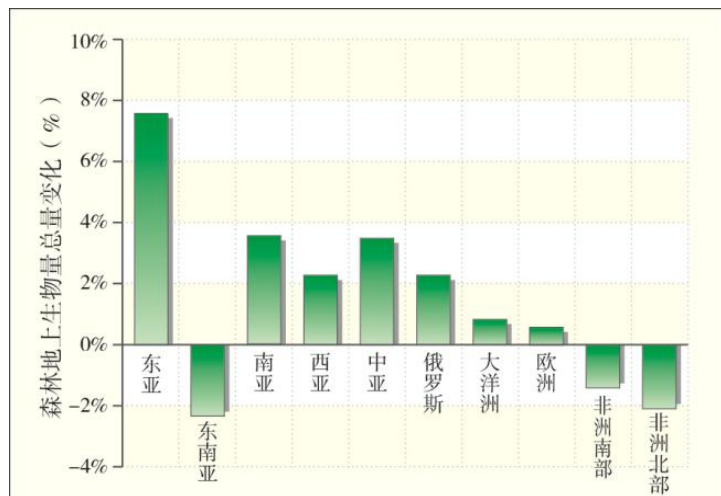
Distribution of forest biomass on the ground in 2015

The condition and change of grassland ecosystem

✓ Mainly distributed in the Mongolian plateau, southern Europe, southern Africa region and northern Australia.

✓ The annual maximum vegetation coverage and the average leaf area index is higher in southern Russia cold grasslands, European temperate grassland and southern African savanna.

MFVC in 2015

ALAI in 2015
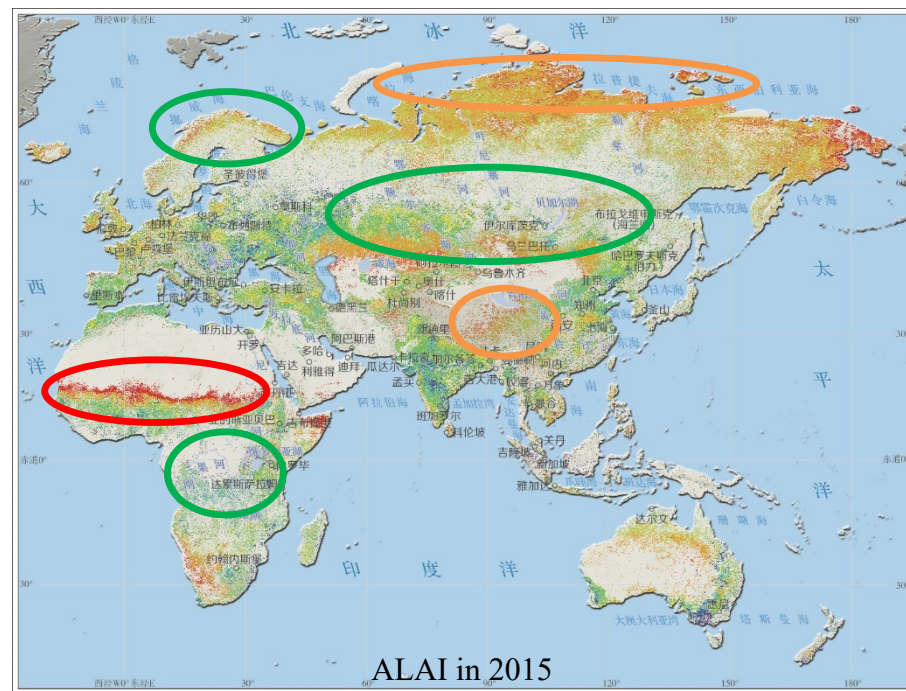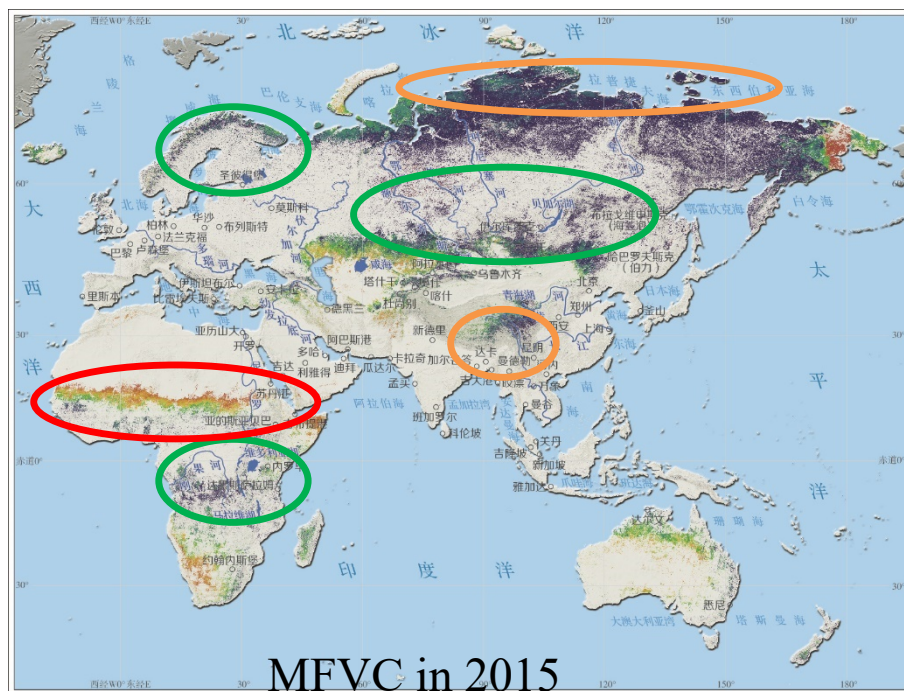
The condition and change of farmland ecosystem

✓ Affected by el Niño events in 2015, in these three farmland regions, the annual average leaf area index change respectively 4.10%, 5.13% and1.97% because of the reduced rainfall and drought, causing bulk grain and oil crops reduction.

Country	Crop types	Change of production
India	Corn	**-6.4%**
	Wheat	**-4.5%**
France	Corn	**-1.8%**
	Rice	**-6.9%**
Australia	Wheat	**0.9%**
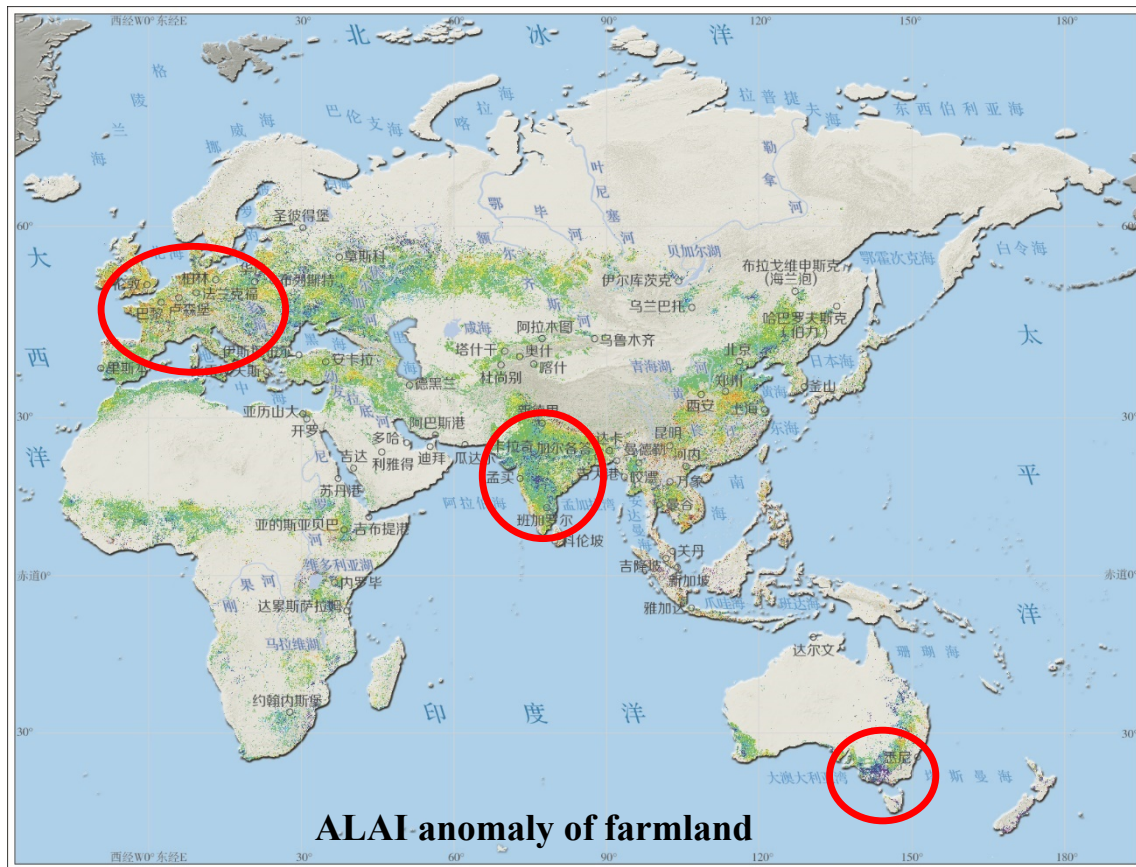
ALAI anomaly of farmland

Transportation condition

Monitoring indexes

- ✓ **road network density**
- ✓ **road traffic capacity**
- ✓ **road access index**

- ● **The road density in coastal area is higher than that of the inland;**

- ● **The road density is related higher with the economic corridor capacity and regional population density, as well as the development degree of social and economic.**
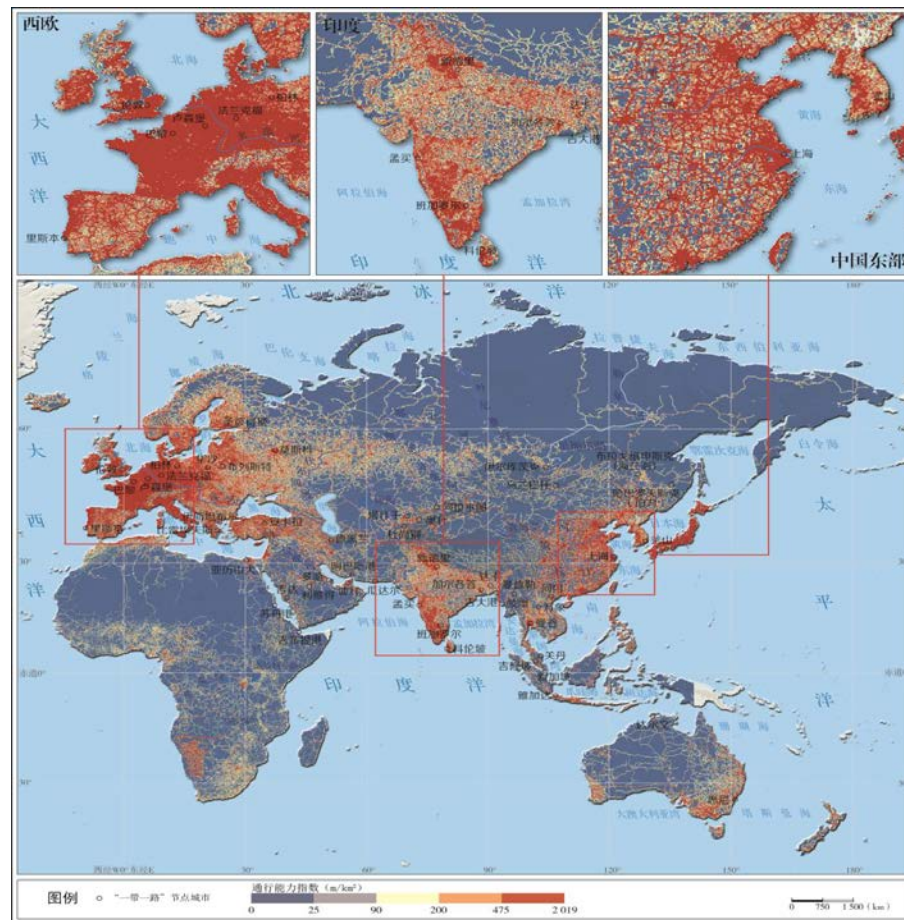
Distribution of road capacity

Radiation and energy balance

Key parameters:
Atmospheric optical depth
Solar Radiation
FAR
Albedo
Land surface temperature
Emissivity
Latent Heat Flux
Sensible Heat Flux

……
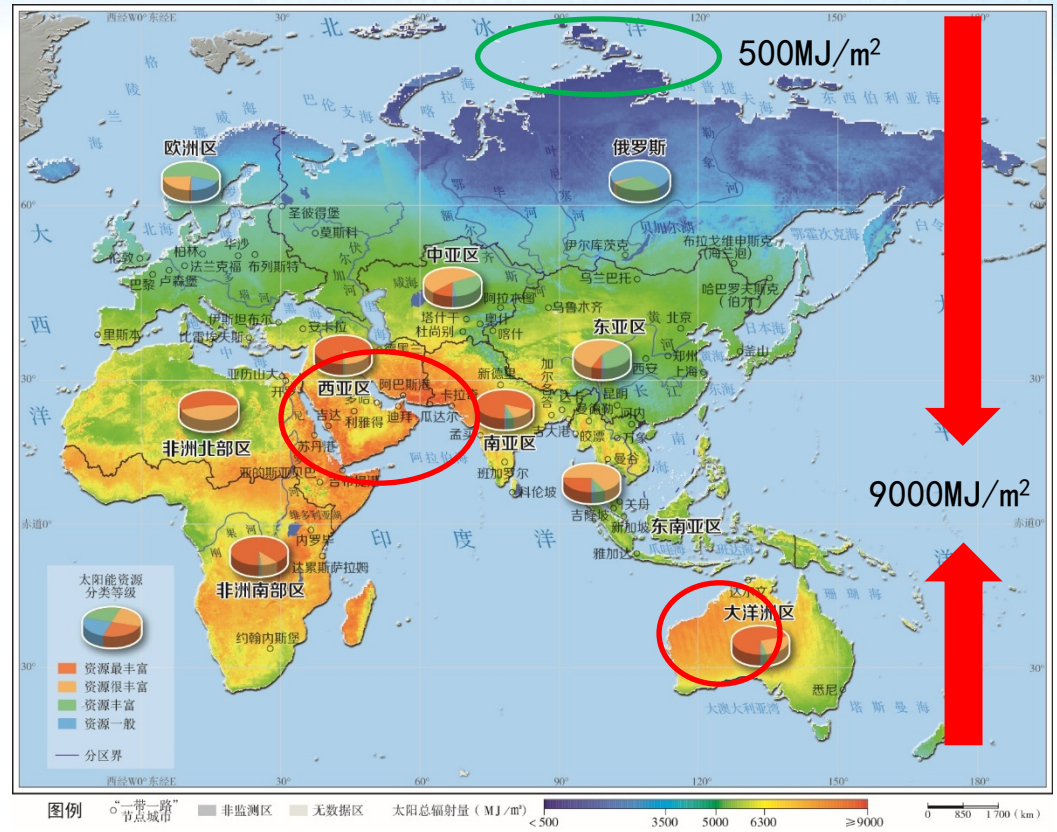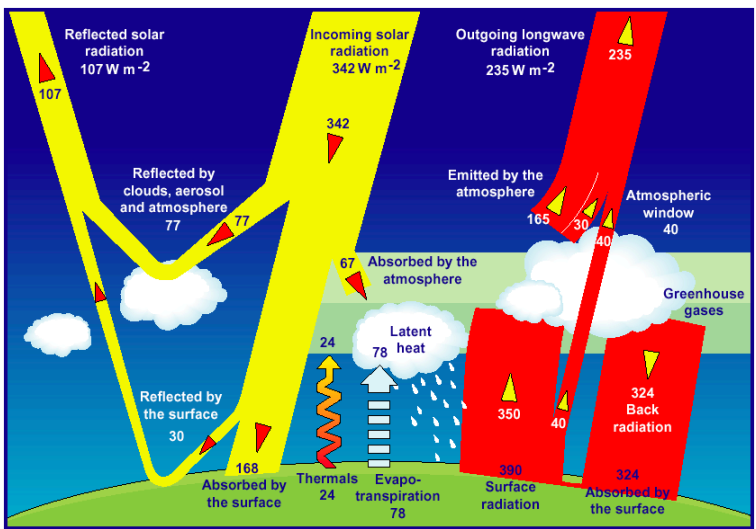
The annual total solar radiation
(Grade classification reference national standard QX/T 89-2008)

● **The spatial distribution of solar energy resources is mainly influenced by latitude, topography and cloud.**

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Solar power generation potential and development status

- China and Australia has excellent solar resources and good development.
- In Europe, promoted by "roof project" policy.
- In African, economy is not developed, solar energy utilization is lack.
- In west Asia, the photovoltaic installations are small.
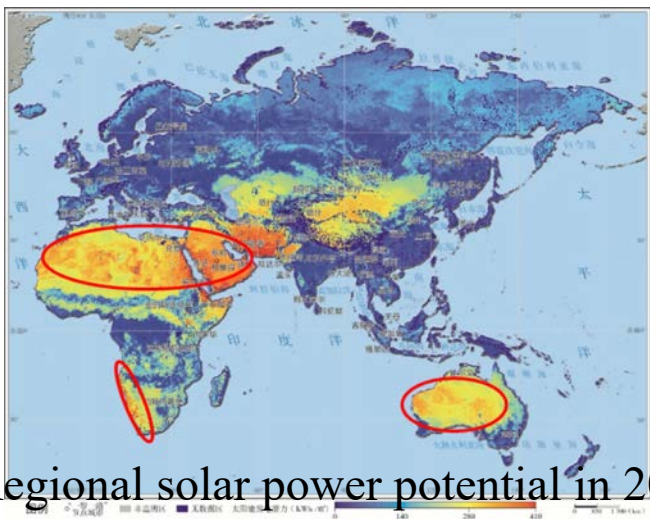
Regional solar power potential in 2015

Country	Area	Installed photovoltaic capacity (GW) (PV ermeability)	Solar Energy Potential ($10^3 \times$ TWh)	GDP (10^{11}\$)	Power generation potential per capita ($10^4 \times$ KWh)	GDP per capita (10^3\$)	electricity consumption per capita ($10^2 \times$ KWh)
China	East Asia	78.1(1.8%)	1055.8	110.1	77.0	8.0	39.1
Japan		42.8(4.9%)	4.9	43.8	3.8	34.5	78.4
Korea		4.4(1.15%)	1.5	13.8	2.9	27.2	105.2
Germany	Europe	41.2(7%)	11.5	33.6	14.1	41.3	88.8
Italy		19.3(7.3%)	7.0	18.2	11.6	30.0	50.0
United Kingdom		11.6(3.4%)	5.0	28.6	7.7	43.9	50.9
France		7.1(1.63%)	22.9	24.2	34.3	36.2	68.9
Spain		5.5(3.33%)	27.6	12.0	59.5	25.8	53.6
Belgium		3.4(4.25%)	0.8	4.6	6.7	40.3	76.6
Greece		2.6(7.4%)	3.5	1.9	32.5	18.0	50.9
Netherlands		2.1(1.78%)	0.7	7.5	4.2	44.3	66.8
Czech Republic		2.1(3.4%)	1.6	1.9	15.6	17.5	62.4
Switzerland		1.6(2.83%)	1.7	6.7	20.3	80.9	74.3
Romania		1.5(2.88%)	8.5	1.8	43.0	9.0	25.9
Austria		1.1(1.78%)	2.8	3.8	32.4	43.8	82.9
Denmark		0.9(2.75%)	0.3	3.0	5.2	52.0	58.3
India	South Asia	9(1.55%)	126.8	21.0	9.7	1.6	8.0
Pakistan		1.7	153.8	2.7	81.4	1.4	4.6
Thailand	Southeast Asia	2.2(1.93%)	27.0	4.0	39.7	5.8	25.6
Philippines		0.9	6.3	2.9	6.2	2.9	7.0
Israel	West Asia	0.9(2.85%)	3.8	3.0	45.5	35.7	64.7
Turkey		0.8(0.48%)	75.8	7.2	96.4	9.1	39.0
Australia	Oceania	5.9(3.85%)	1563.9	13.4	6576.4	56.3	99.4
South Africa	Africa	1.5(1.03%)	197.1	3.1	358.6	5.7	41.7

Regional ecosystem trends along the Belt and Road

Global Spatiotemporal Distribution of Carbon Source and Sink

Supply Situation of Maize, Rice, Wheat and Soybean

2018 Annual report

Core area

Key area

2015/ 2017 Annual report

Farming-pastoral ecotone

Fragile areas along the Silk Road Economic Belt

National parks

Positive effects of human activity

Belt and Road

Negative effects of human activity

Key traffic construction projects

Fragile areas along the 21st Century Maritime Silk Road

Coast and the coastal zones
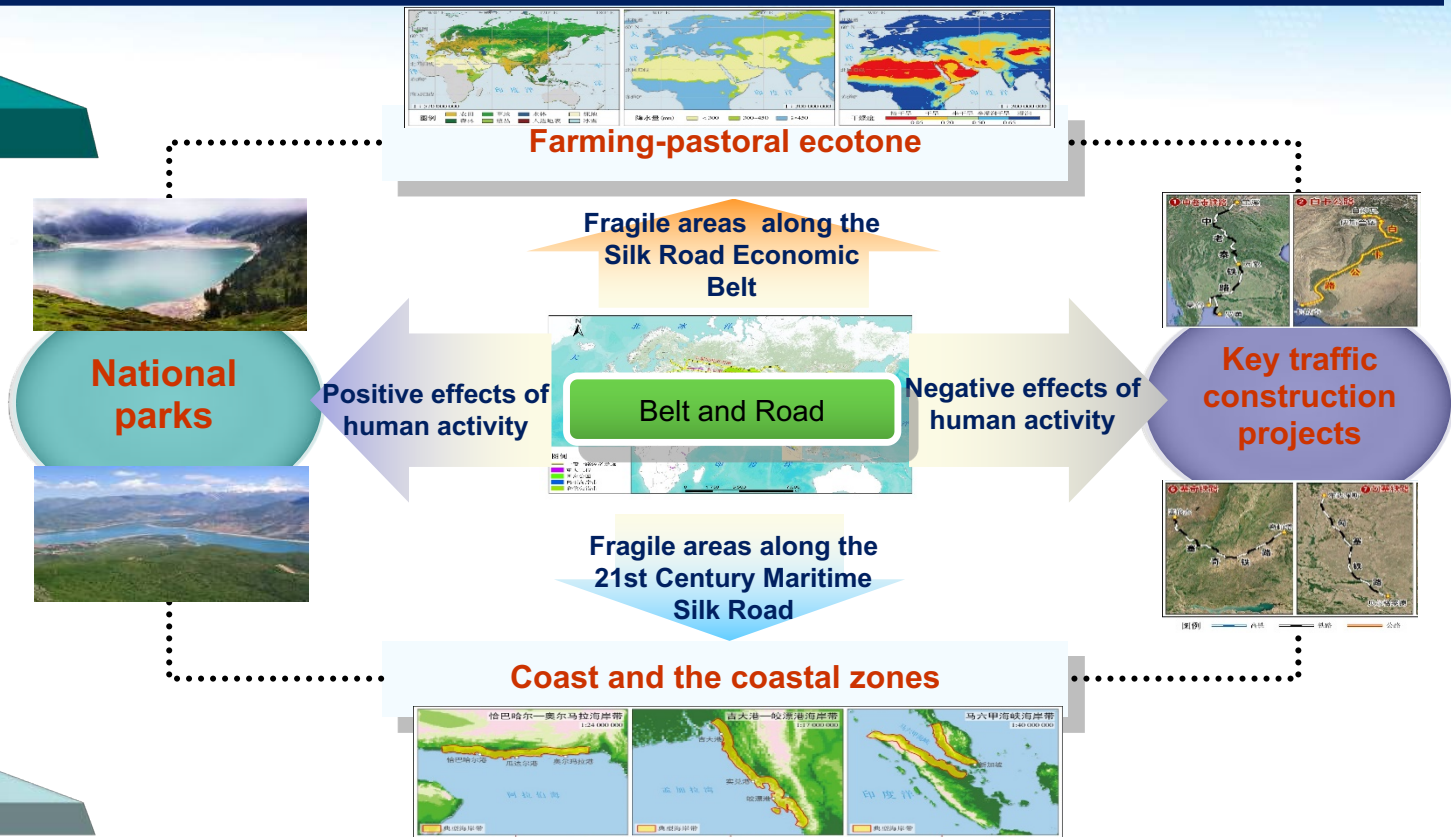
Focusing on monitoring the ecologically fragile areas
- The farming-pastoral ecotone
- The coast and the coastal zones
- The natural protected areas such as national parks
- Key traffic construction projects which aim to enhance infrastructure interconnectivity.

- Monitoring the CO2 spatiotemporal change at the global scale
- Monitoring the distribution of global carbon source and sequestration
- Analyzing the reason of the carbon change.
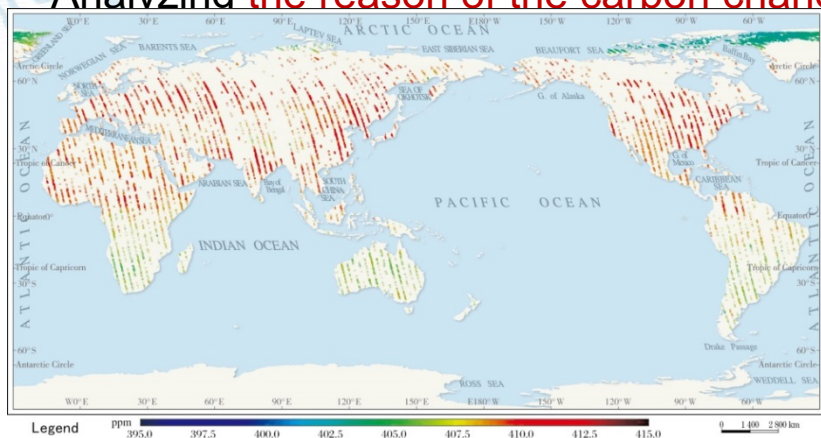
Global column atmospheric CO_2 distribution in April 2017 retrieved from ChineseTanSat

Continental regions carbon sources and sinks averaged from 2012 - 2016. The bar graph represents the total carbon fluxes of each region (the left bar graph represents the prior anthropogenic emissions; the right bar graph represents the optimized ecosystem land-to-atmosphere carbon fluxes).

Carbon emissions from global fossil fuel combustion and cement production in 2016
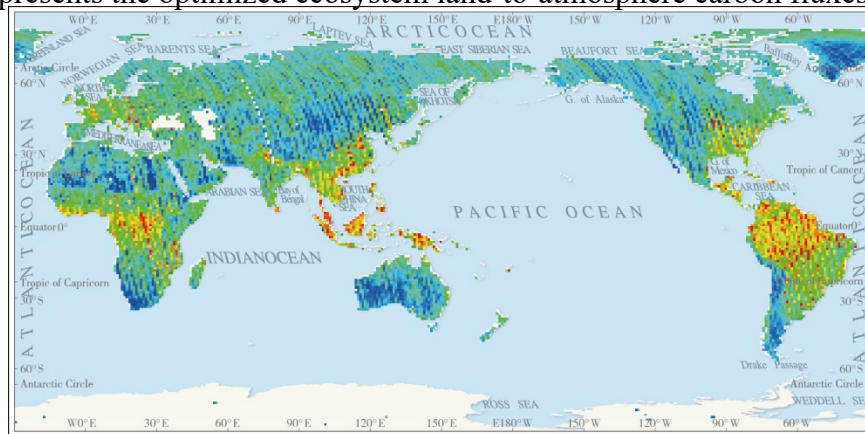
Global solar induced chlorophyll fluorescence product in 2017 retrieved from TanSat

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(3) Supply Situation of Maize, Rice, Wheat and Soybean
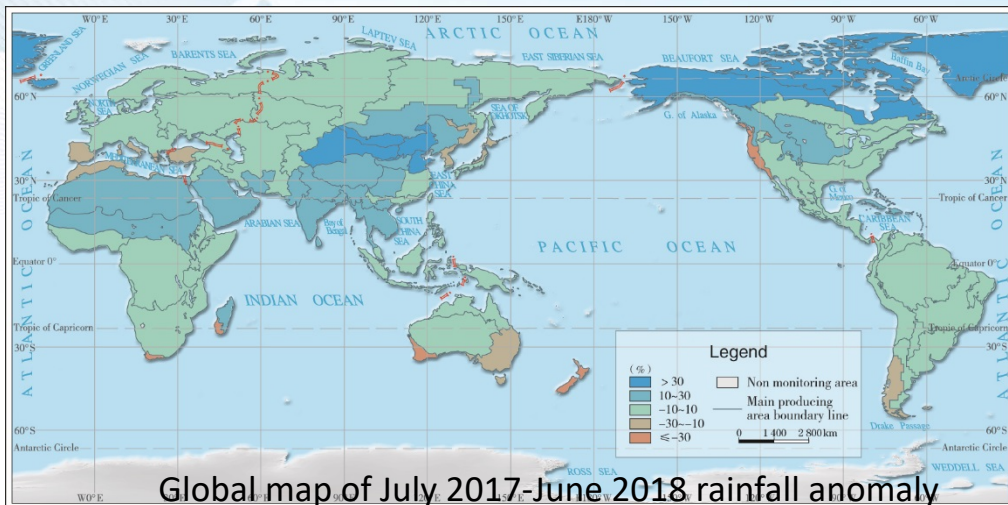
Global map of July 2017-June 2018 rainfall anomaly (as indicated by the RAIN indicator) by MRU, departure from 15YA (percentage)
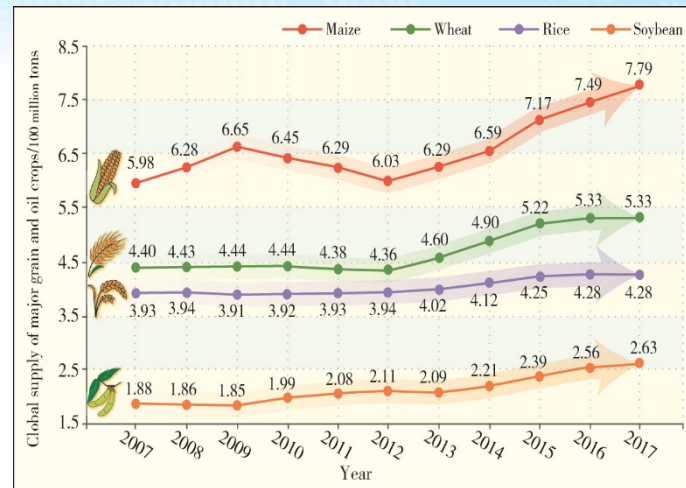
The changing global supply of major grain and oil crops

Crop condition map in China and surrounding areas during in early - September 2017
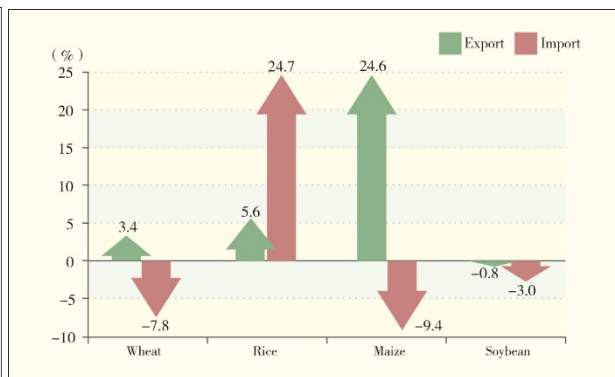
Change in imports and exports for four main crops in China, 2018 (percentage)

- Overview of global agroclimatic conditions
- Cropping patterns and stresses over major production areas
- Agronomic conditions in China and a global and national outlook for 2018 food production and supply.

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Next Plan
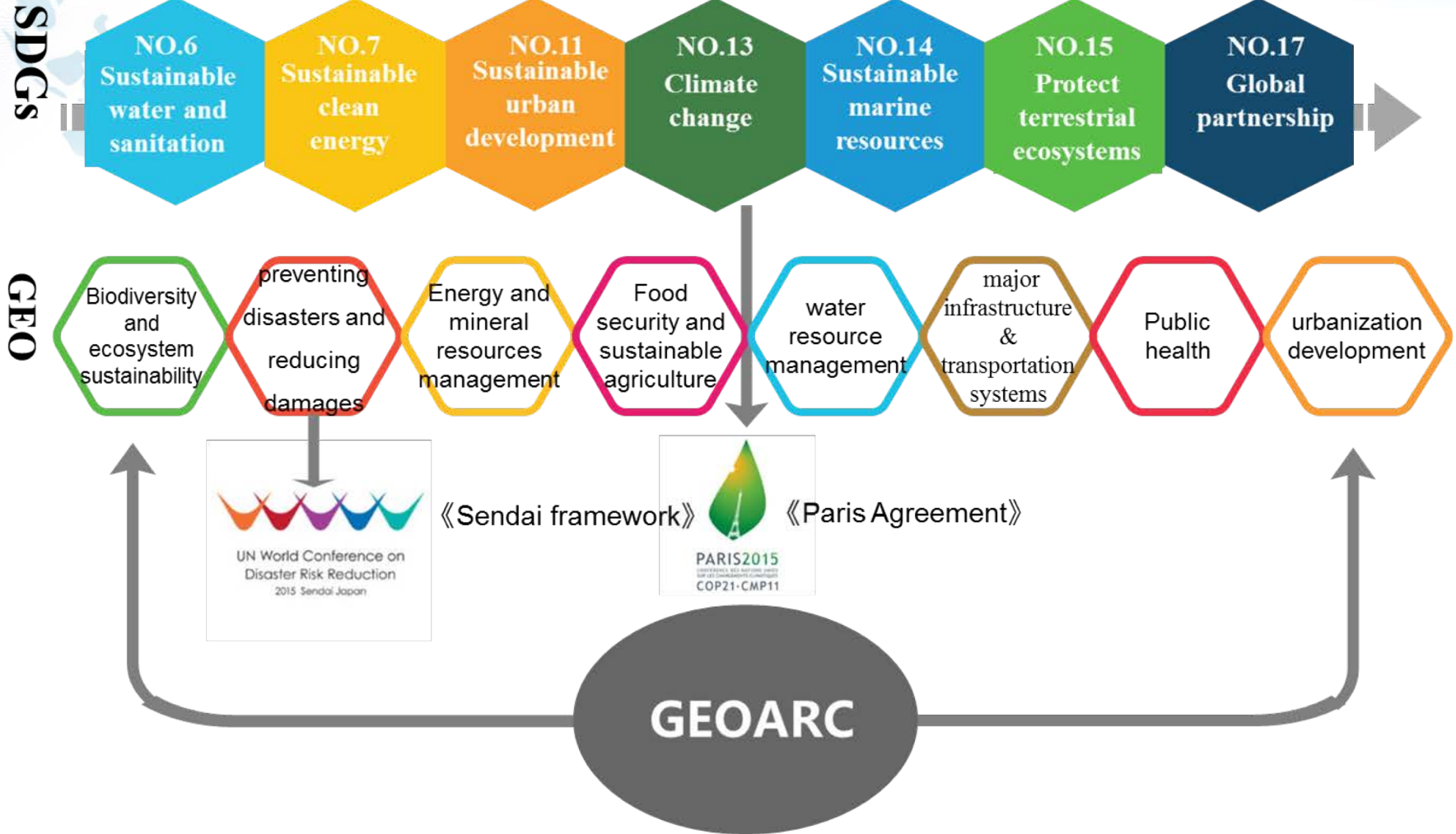
Next Plan

Type 1：	Continuous monitoring of typical elements	
1-1	**Supply Situation of Maize, Rice, Wheat and Soybean** (**2019**-2021）	
1-2	**Ecological environment monitoring of global major disasters** （**2019**-2021）	
1-3	**Atmospheric environment monitoring and climate change response** （TBD）	

Type 2：	Regularly updated monitoring of typical elements	
2-1	**Global forest cover and fire impact analysis** （2019）	
2-2	**Globle Spatiotemporal Distrubition of Carbon Source and Sequestration** （2020）	
2-3	**Macrostructure and service function of global ecosystem** （TBD）	
2-4	**Ecological environment monitoring of marine/coastal** （TBD)	
2-5	**Sustainable development of water resources and quality** （TBD）	

Next Plan

| Type 3：	Hot regions	
3-1	Major projects monitoring in the "Belt and Road" region（TBD）	
3-2	Sustainable development of ecological environment in the "Belt and Road" region（2021）	

Type 4：	Hot issuses	
4-1	Global land degradation monitoring and evaluation（2019）	
4-2	Glacier monitoring and dynamic change evaluation（2020）	
4-3	Sustainable development of clean energy（ TBD ）	
4-4	Global radiation balance and climate change（ TBD ）	

Examples

Ecosystem Service Function Assessment

➤ **The SDG Goal 15 incorporated the sustainable land ecosystems and their services into the assessment of SDG 2030. Ecosystem services include support services, supply services, regulatory services and cultural services.**


regulatory services

Support services

supply services

cultural services
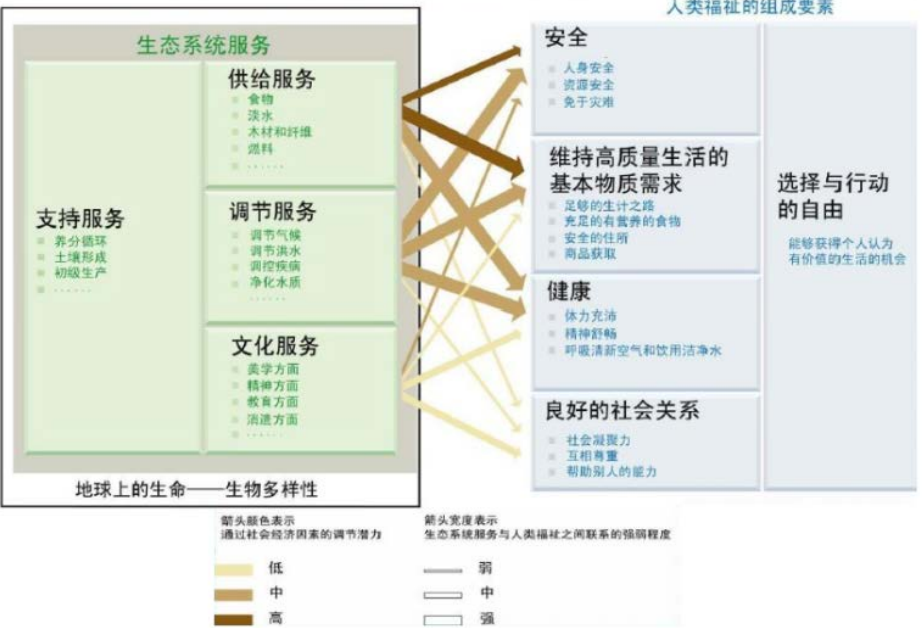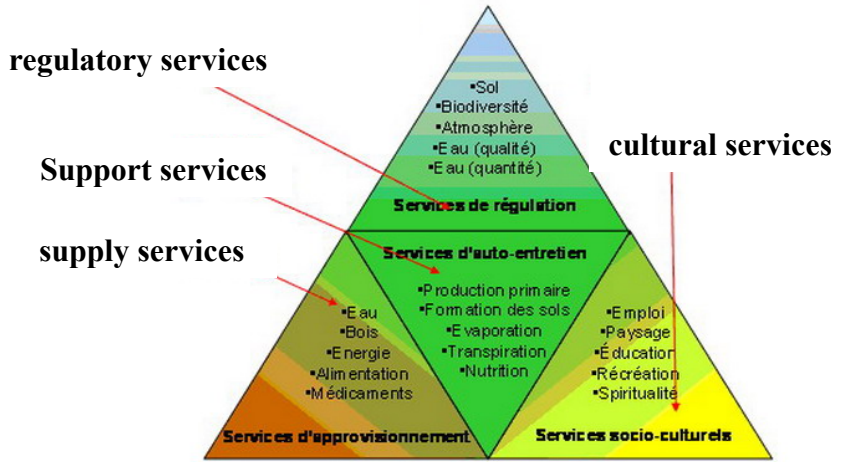
➤ **ecosystem service function**

- **Water conservation**
- **carbon sink service**
- **landscape recreation service**
- **improve air quality**

- **soil conservation**
- **adjusting climate,**
- **maintaining biodiversity**

Examples

Atmospheric Environment Monitoring

the global area faces serious Atmospheric environment problem: particulate matter (PM2.5, PM10), greenhouse gases and noxious gases (NO, SO). This task will monitor and evaluate Atmospheric environment quality and providing technology and data for the regional air quality monitoring and regional coordinated control, improving the prediction of air quality.
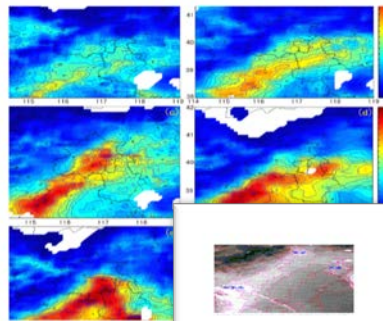
aerosol optical thickness
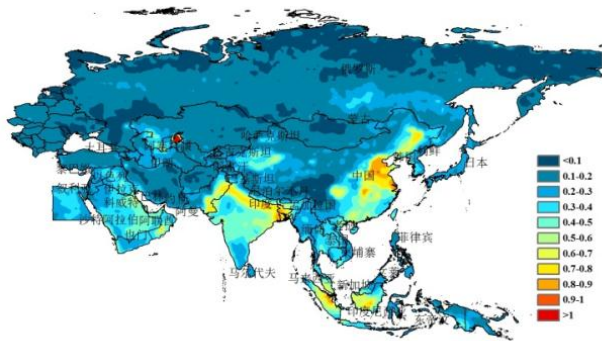
atmospheric transparency

PM
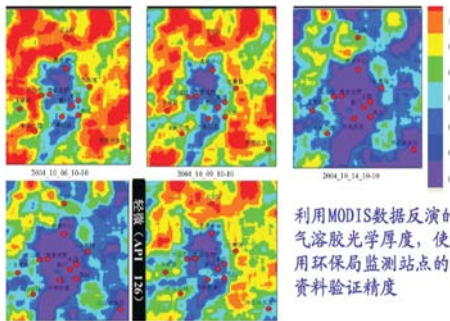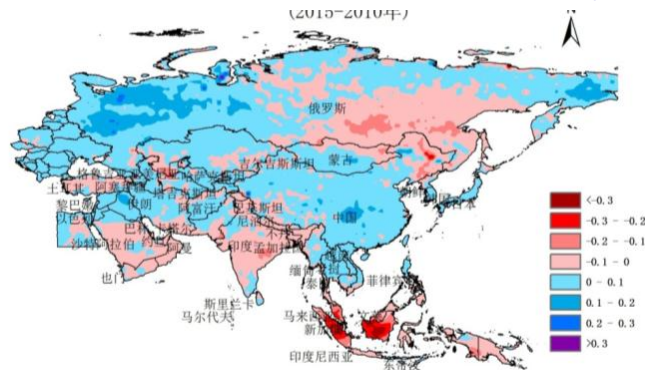
nitrogen oxides

Examples

Solar power potential and sustainable development of clean energy

Solar energy resource is the source of atmospheric circulation and earth's various life activities, and is also the main energy source of plant and animal.

Issues

1. Solar energy affected by latitude and the vertical zonality, its distribution is uneven;
2. to increase the proportion of renewable energy in the global energy structure of sustainable development(2030)

Response

1. Analyzing the spatial and temporal patterns and dynamic changes of solar energy resources by solar radiation and photosynthetic effective radiation, etc.
2. Analyzing the potential area of clean energy layout and benefits by potential solar power level.
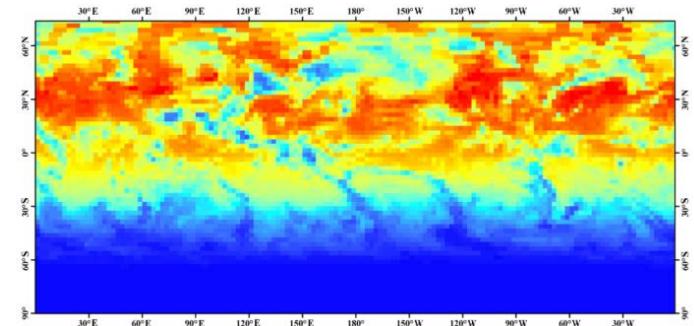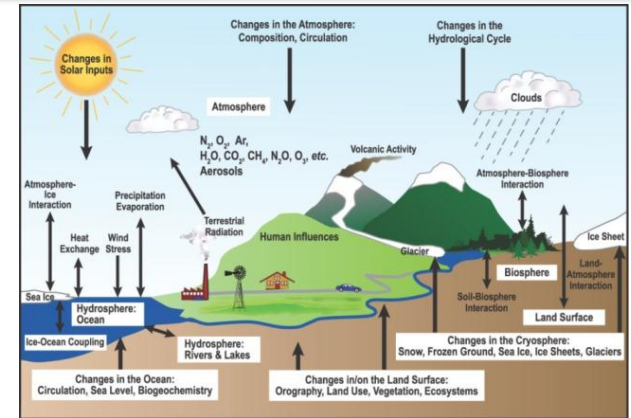
Call for Participation

There are 3 sub group in WG7:

- WG7-1 Land Cover/Use

- WG7-2 Ecosystem Environment Monitoring

- WG7-3 Atmospheric Environment Monitoring
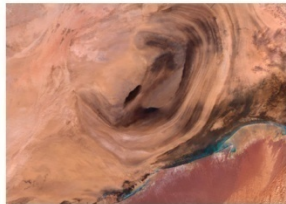
AOGEOSS WG 7 welcome all participants in AO GEOSS.

➤ **GEO Members** and countries in AO region

Australia、Bangladesh、**China、**India、**Japan、Korea、**Laos、Mongolia、Myanmar 、Nepal、Pakistan; Vietnam.

➤ **POs and other societies:**

UNEP-IEMP、UNESCO-HIST、WMO、UNESCAP、CEOS、ICSU/Future Earth、ICSU/IRDR、ICIMOD、POGO、ISDE、ISPRS、GRSS、APSCO.

Thanks!

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