



ESA-MOST Dragon Cooperation

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2017 DRAGON 4 SYMPOSIUM

2017年“龙计划”四期学术研讨会

Project 32439_4 : MONITORING WATER RESOURCES IN RED RIVER BASIN USING MICROWAVE REMOTE SENSING

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2017年6月26-30日, 丹麦 哥本哈根

Project packages

Work Package 1: Requirements Baseline. (KO, KO+6)

Work Package 2: Water body by remote sensing (KO+6, KO+48)

Work Package 3: Water Cycle components by remote sensing (KO+6, KO+48)

Work Package 4: Hydrologic Modelling (KO+6, KO+48)

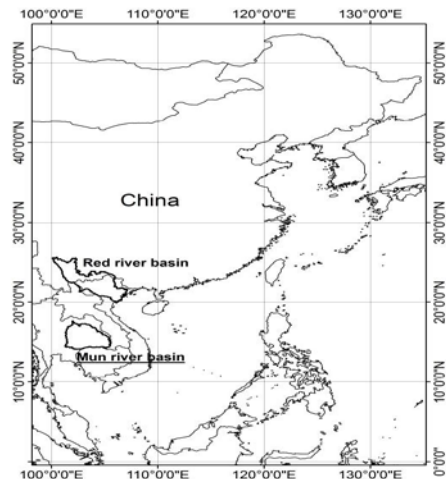
Project progress

The potential application of microwave remote sensing products for soil moisture modeling in Mun river basin, Thailand

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State Key Laboratory of Remote Sensing
Science, Institute of Remote Sensing and
Digital Earth, Chinese Academy of Sciences

June 28th, 2017



Mun river basin is located in IndoChina Peninsula. With similar tropical monsoon climate type, the basin has significant dry and rainy season.

- ✓ **Microwave remote sensing system** such as radiometer can measure both precipitation and soil moisture by using different spectral bands.
- ✓ The precipitation-soil moisture procedure in water cycle can be simulated by **hydrological model**.
- ✓ **The role of microwave remote sensing products for hydrological model simulation procedure?**



Thailand “BIG FLOOD” (2011)

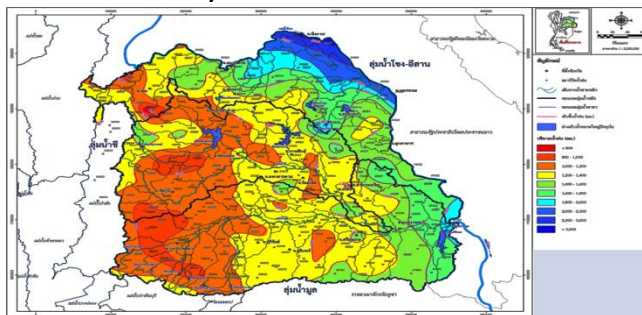


Thailand serious drought (2015)

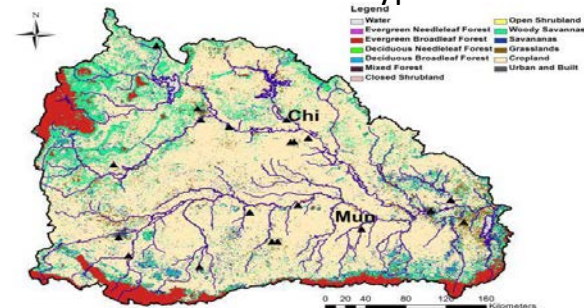
2. Mun river basin

Mun river is the longest river branch of Mekong River. The total area of the drainage is 119,180 km².

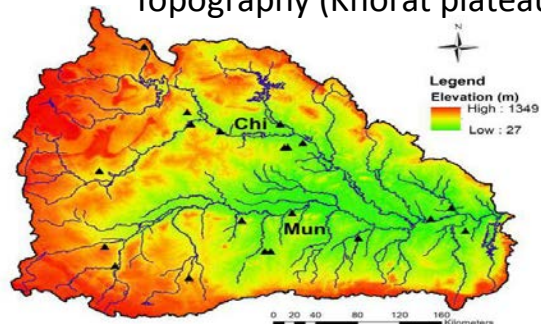
30-year mean rainfall



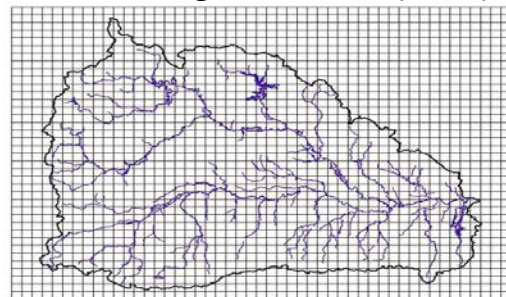
Landuse types



Topography (Khorat plateau)



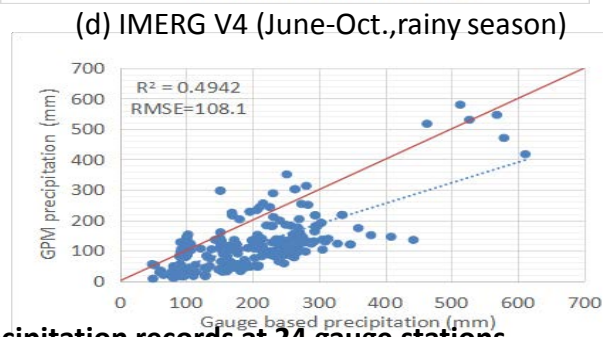
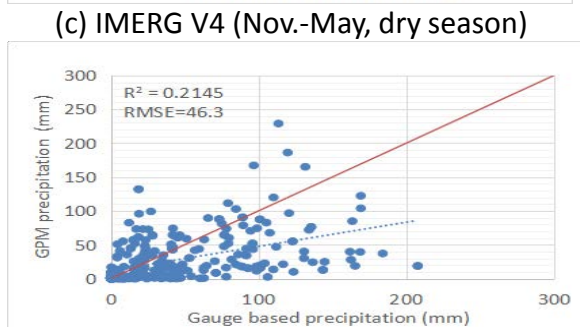
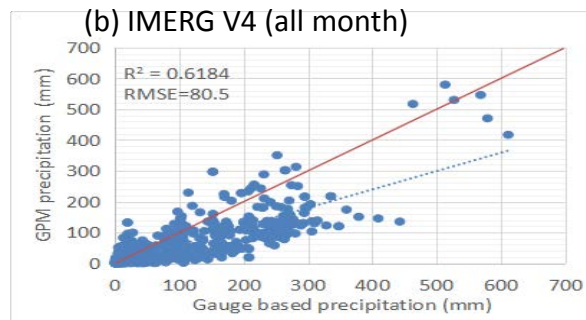
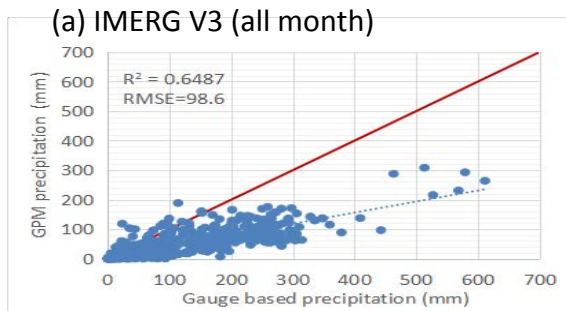
0.1 degree division (GPM)



3. Data and methods

- ✓ **Variable Infiltration Capacity (VIC) macroscale hydrological model** (4.1.2.g). The simulation period is from April 12th, 2014 to Jan.31, 2016, the driving data in 2014 were used to spin up the model.
- ✓ **Forcing data-Weather observation records** . Daily precipitation, maximum temperature, minimum temperature, wind speed at 24 stations from 2014-2016. The daily data were interpolation into 0.1 degree by using simple IDW method.
- ✓ **Forcing data-GPM IMERG daily precipitation final products** version 3 and version 4. (March, 2014 to Jan,2016) were download from GES DISC
- ✓ **MODIS 500m landuse map** in 2013 with Maryland classification legend.
- ✓ **Combined MODIS 4-day 1km LAI product** (MCD15A3) . Two tiles (H28V07, H27V07) dataset from 2014 to 2016 were mosaicked to cover Mun river basin.
- ✓ **Soil parameter** are extracted from Global 0.5 soil parameter product. Three depth (0-0.1m, 0.1-0.3m, 0.3-1.0m) of soil layers.
- ✓ **SMAP passive and active 9km L3 soil moisture dataset** from April, 2015 to Jan. 2016 were downloaded from National Snow and Ice Data Center. The daily dataset at 6 AM. were resized into 0.1 degree by bilinear interpolation.

4 R1:Monthly precipitation products accuracy at 24 weather stations



GPM monthly precipitation validation by precipitation records at 24 gauge stations
(April, 2014-Jan. 2016)

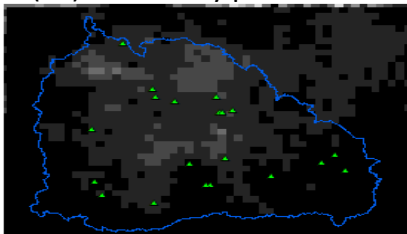
Both products **underestimate** precipitation, **IMERG V4 data** is better than IMERG V3 to depict monthly precipitation in Mun river basin, IMERG V4 have better performance in **rainy season**.

4 R2: Daily precipitation and VIC-based soil moisture

Daily precipitation

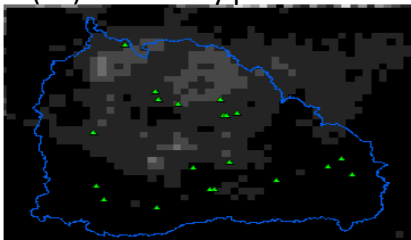
(a1) R2 of daily product

IMERG V3



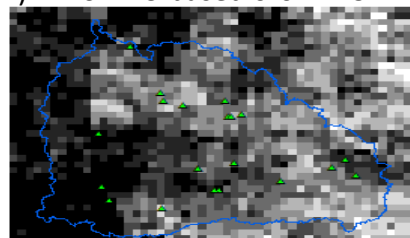
(a2) R2 of daily product

IMERG V4

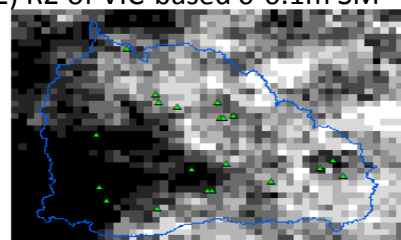


Daily 0-0.1m soil moisture

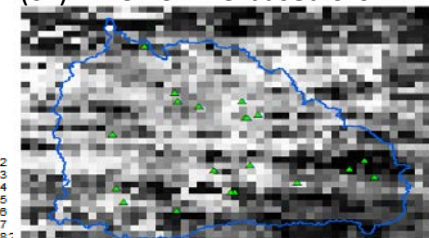
(b1) R2 of VIC-based 0-0.1m SM



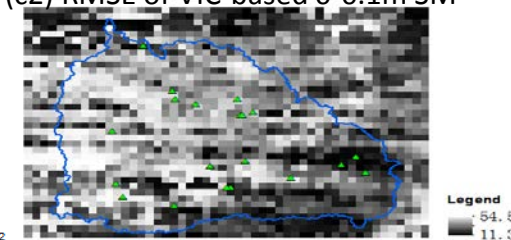
(b2) R2 of VIC-based 0-0.1m SM



(c1) RMSE of VIC-based 0-0.1m SM



(c2) RMSE of VIC-based 0-0.1m SM



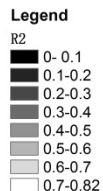
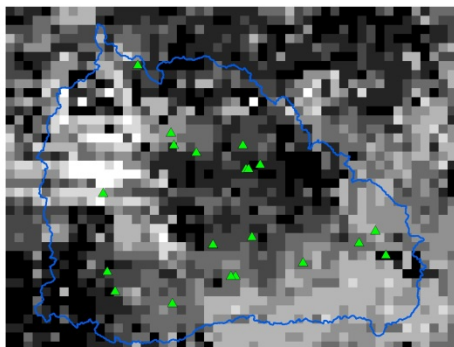
IMERG V3 V4 daily precipitation correlation by precipitation records(a1,a2), daily soil moisture correlation(b1,b2) and RMSE (c1,c2) driven by IMERG V3 and V4 (20150312-20160131)

Compard with lower accuracy of daily MW precipitation products, simulation by MW precipitation can depict the **variation of soil moisture.**

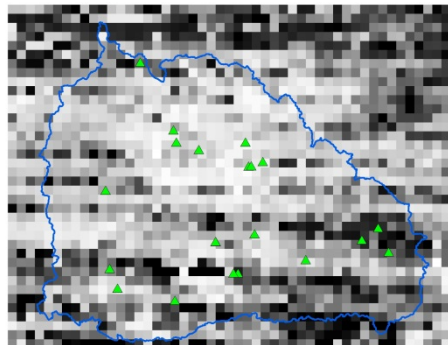
4 R2: Daily precipitation and VIC-based soil moisture

IMERG V3

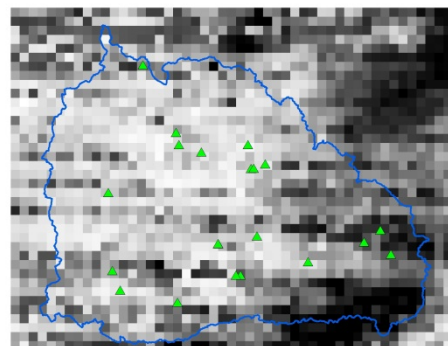
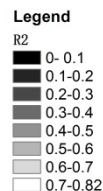
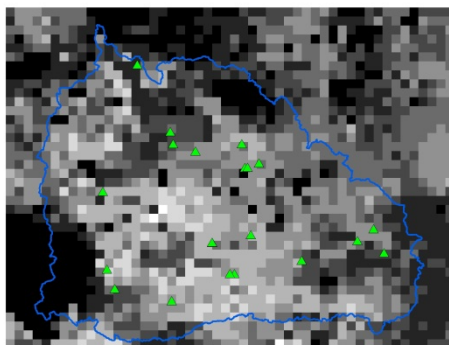
R2 of VIC-based 0.1-0.3m SM



RMSE of VIC-based 0.1-0.3m SM



IMERG V4

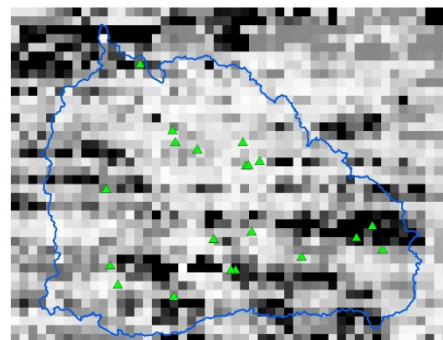
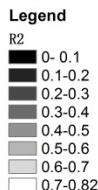
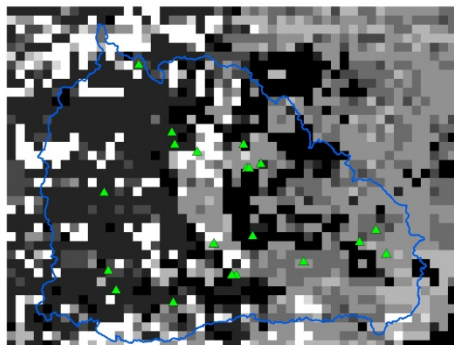


4 R2: Daily precipitation and VIC-based soil moisture

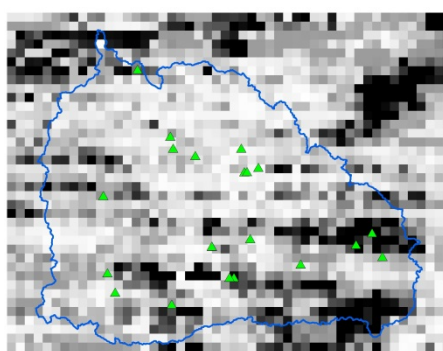
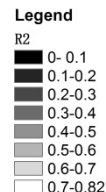
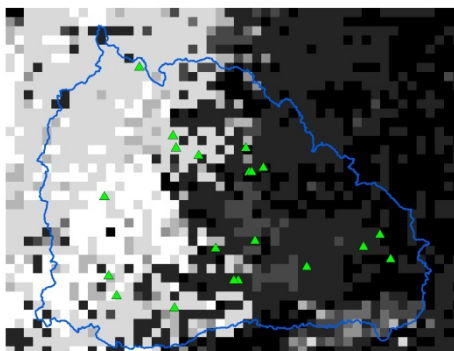
R2 of VIC-based 0.3-1.0m SM

RMSE of VIC-based 0.3-1.0m SM

IMERG V3



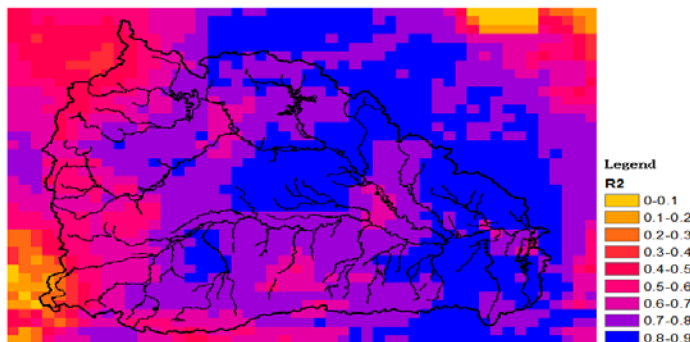
IMERG V4



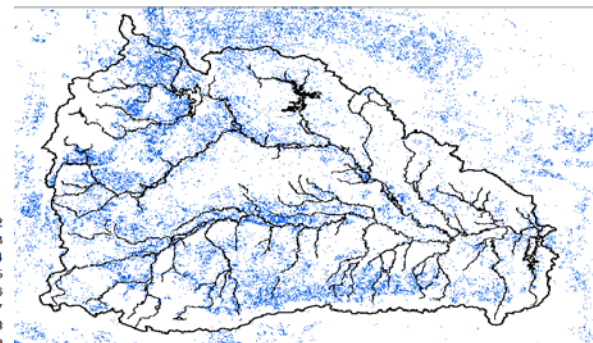
IMERG V4 is better than V3 to simulate deep layer of the soil

4 R3:Correlation between VIC-based soil moisture and SMAP soil moisture

Weather station-based



R2 of 4-day 0-0.1m VIC-soil moisture
and SMAP AM SM 20150331-20160131

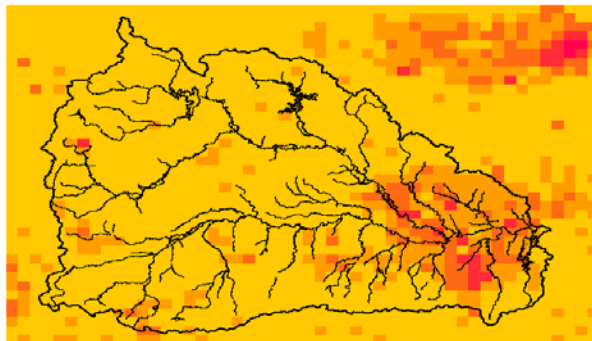


ESA irrigated cropland GlobCover 2009

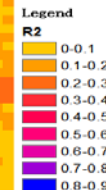
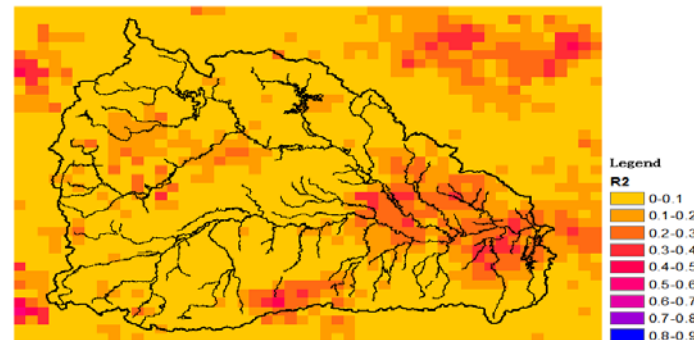
SMAP MW and VIC-based soil moisture are **comparable**. **Irrigation application** and landcover type influences consistency of two dataset.

4 R3: Correlation between VIC-based soil moisture and MW soil moisture

V3



V4



Correlation of 4-day 0-0.1m VIC-soil moisture and SMAP AM SM
20150331-20160131

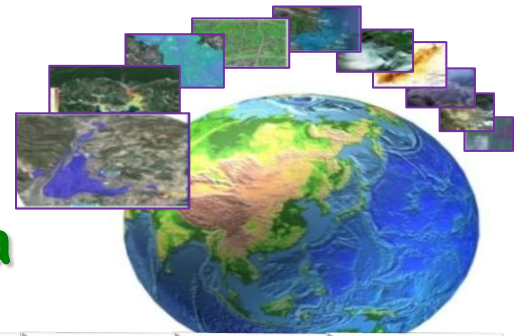
There is **lower correlation** between soil moisture simulation driven by IMERG products and retrieved by SMAP. **IMERG V4** shows better correlation than IMERG V3.

Microwave water products can be not only used to **drive** hydrological model for water resources simulation, but also for model **validation**.

- GPM **IMERG V4** data is better than V3 to depict monthly precipitation.
- There is lower accuracy of daily IMERG MW precipitation product, VIC-based soil moisture by the MW product can depict the **variation of soil moisture**, especially by using V4.
- **SMAP soil moisture products** can be used for VIC model validation. Irrigation application and landcover influences consistency of two dataset.

We will **calibrate** and **validate** our analysis based on measured soil moisture dataset, using modified soil parameter; Soil moisture is related with runoff generation. We will use microwave RS product for **runoff concentration simulation** in red river basin in next studies.

Global Ecosystems and Environment Observations: Annual Reports from China

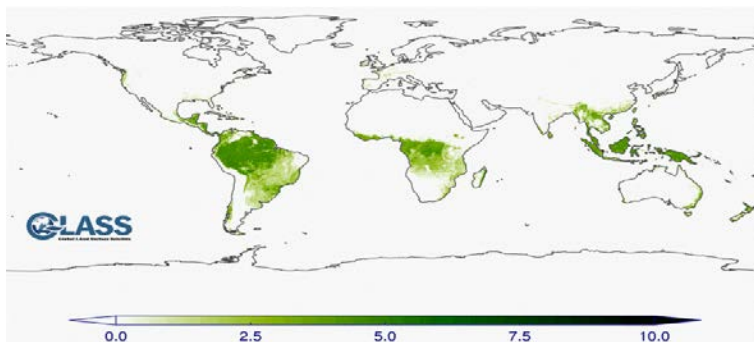


- Since 2012.
- Support **global change studies** and **international cooperation** via GEO.
- **The National Remote Sensing Center of China (NRSCC)**, Ministry of Science and Technology (**MOST**) of the People's Republic of China supports the work.
- Integrated a series of **products** from **the National Research and Development Program**.

Data Sharing

China GEOSS-DSNet

- Continuously updated Water Areas and Vegetation Distribution since 2012
- <http://www.chinageoss.org/geoarc/>
- Total downloads of datasets > 10TB



Data Sharing by China GEOSS DSNet Portal			
Global Datasets	1	1km Global Dynamic Change Dataset of Vegetation Leaf Area Index (GLASS-LAI) between 1982 and 2014	2014
	2	1km Global Vegetation Net Primary Productivity (NPP) Dataset (Outside North America)	2015
	3	1km Global Forest Above-ground Biomass Dataset	2015
	4	1km Global Vegetation Coverage Dataset	2013, 2014, 2015
	5	5km Global Photosynthetically Active Radiation (PAR) Dataset	2015
	6	Global Distribution Dataset of Large Terrestrial Surface Water Areas by 2012	2013
	7	Global Dynamic Change Updated Datasets of Typical Lakes from 2002 to 2013	2014, 2015
	8	Global Classification and Dynamic Change Dataset of International Important Large Wetlands	2014
	9	10km Global Degree of Land Use Dataset	2015
	10	250m Global Landcover Dataset	2015
Regional Datasets	11	Africa Land Cover Dataset by 2014	2014
	12	5km China-ASEAN Photosynthetically Active Radiation (PAR) Dataset by 2013	2014
	13	1km China-ASEAN Terrestrial Evapotranspiration Dataset by 2013	2014
	14	1km China-ASEAN Vegetation Growing-Season Length Dataset	2014
	15	1km China-ASEAN Annual Maximum Vegetation Coverage Dataset	2014
	16	1km China-ASEAN Annual Accumulative Vegetation Net Primary Productivity Dataset	2014
	17	30m Annual Maximum Vegetation Coverage Dataset of Greater Mekong Subregion	2014
	18	Forest Biomass Remote Sensing Inversion Dataset of Greater Mekong Subregion	2014
	19	Rainfall Runoff and Typical Lake Areas Distribution Dataset of Lancang- Mekong Drainage Basin	2014
	20	30m Urban Built-up Area Landcover Dataset of 'The Belt and Road' Initiative Main Cities	2015
	21	Coastline Classification Dataset of 'The Belt and Road' Initiative Main Port Cities	2015
	22	Land Cover Classification Dataset of 'The Belt and Road' Initiative Main Port Cities	2015
	23	Marine Ecological Environment Remote Sensing Dataset of 'The Belt and Road' Initiative Area	2015

Thank you for your attention !