



Institute of Remote Sensing and Digital Earth  
Chinese Academy of Sciences

# A Cloud-based Remote Sensing Data Integration and Production System

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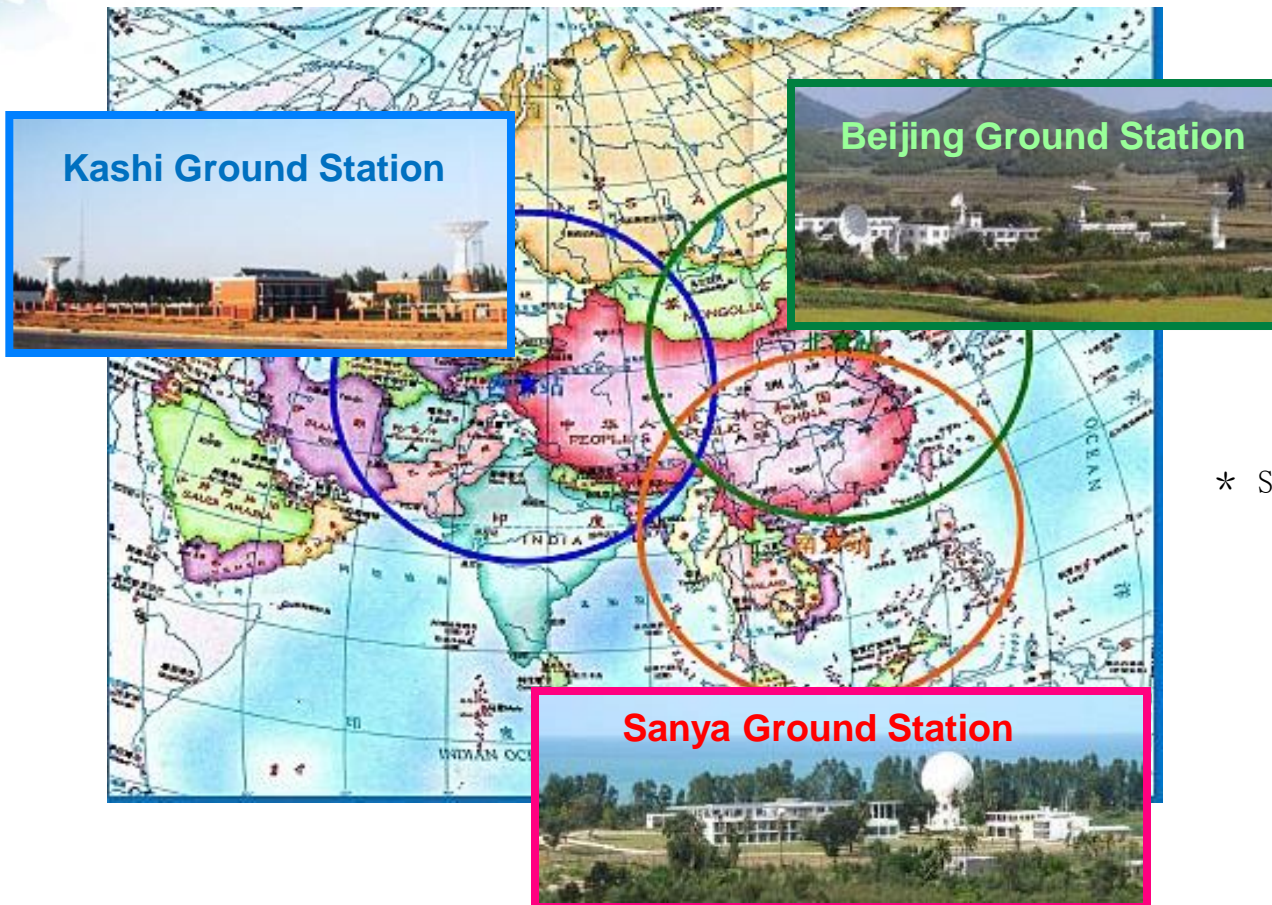
# Outline

- ①** Earth Observation in China
- ②** MCCPS: RS Data Management, Processing
  - System Overview
  - Data Integration across Multiple data Centers
  - Regional to Global Quantitative Inverse Products
  - Dynamic RS Workflow Processing Across Data Centers
  - Global RS Data Products Show
- ③** Lesson Learned (challenges)
- ④** PIPSCloud: Towards Cloud processing
  - System Overview: System Infrastructure
  - DS-RS: RS Data as a Service
  - PS-RS: Distributed Processing as a Service
  - VS-RS: RS Virtual Environment as a Service



# Earth Observation in China

- Before 2007: **1** Single Remote Sensing Satellite Ground Stations
- Year 2010 : **3** Remote Sensing Satellite Ground Stations



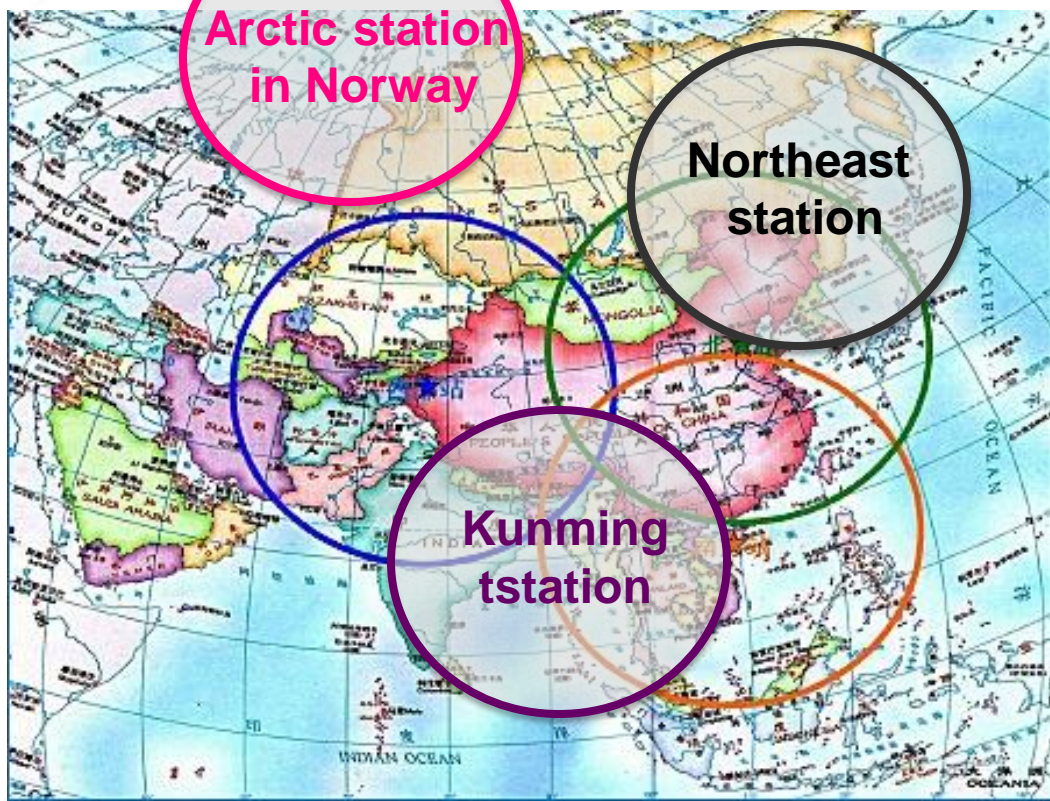
\* Stations are Owned by  
*RADI*





# Earth Observation in China

- Before 2007: **1** Single Remote Sensing Satellite Ground Stations
- Year 2010 : **3** Remote Sensing Satellite Ground Stations
- Currently: **6** Remote Sensing Satellite Ground Stations



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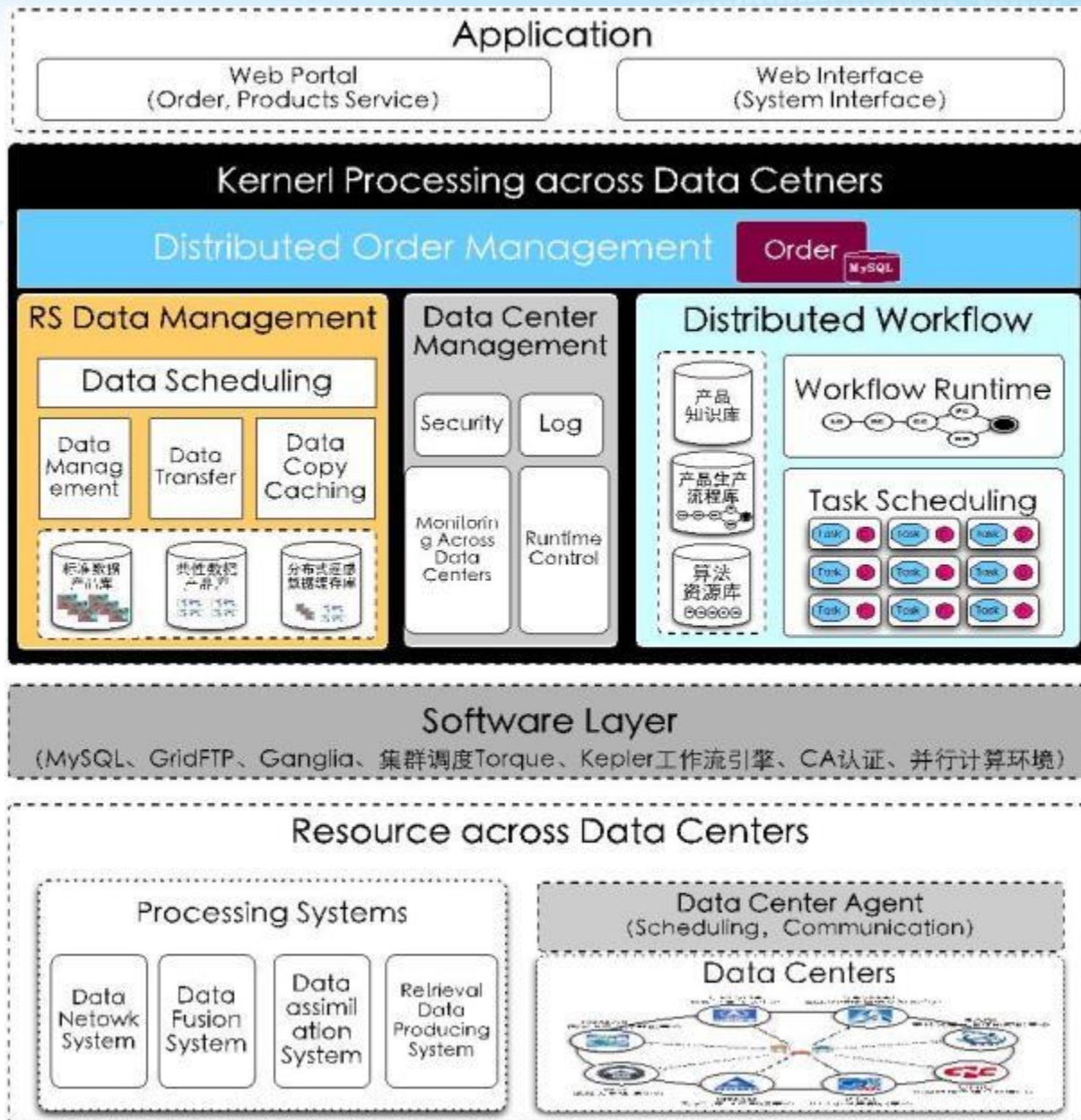
# Earth Observation in China

- Member of Landsat Ground Station Operations Working Group
- Acquiring, Processing and Distributing over **3.3 million** scenes of Remote Sensing Satellite datasets, since 1986
- **3** Stations covering the **whole** territory of China and **70%** of Asia
- Acquiring up to **> 500** Terabytes/year, data is soar up
- Downlink data rate up to **> 1 Gbps**
- Acquires data from **12** satellites currently, **50** satellites in 2025
- One of the **Largest** Remote Sensing Ground Station for civil use in the world

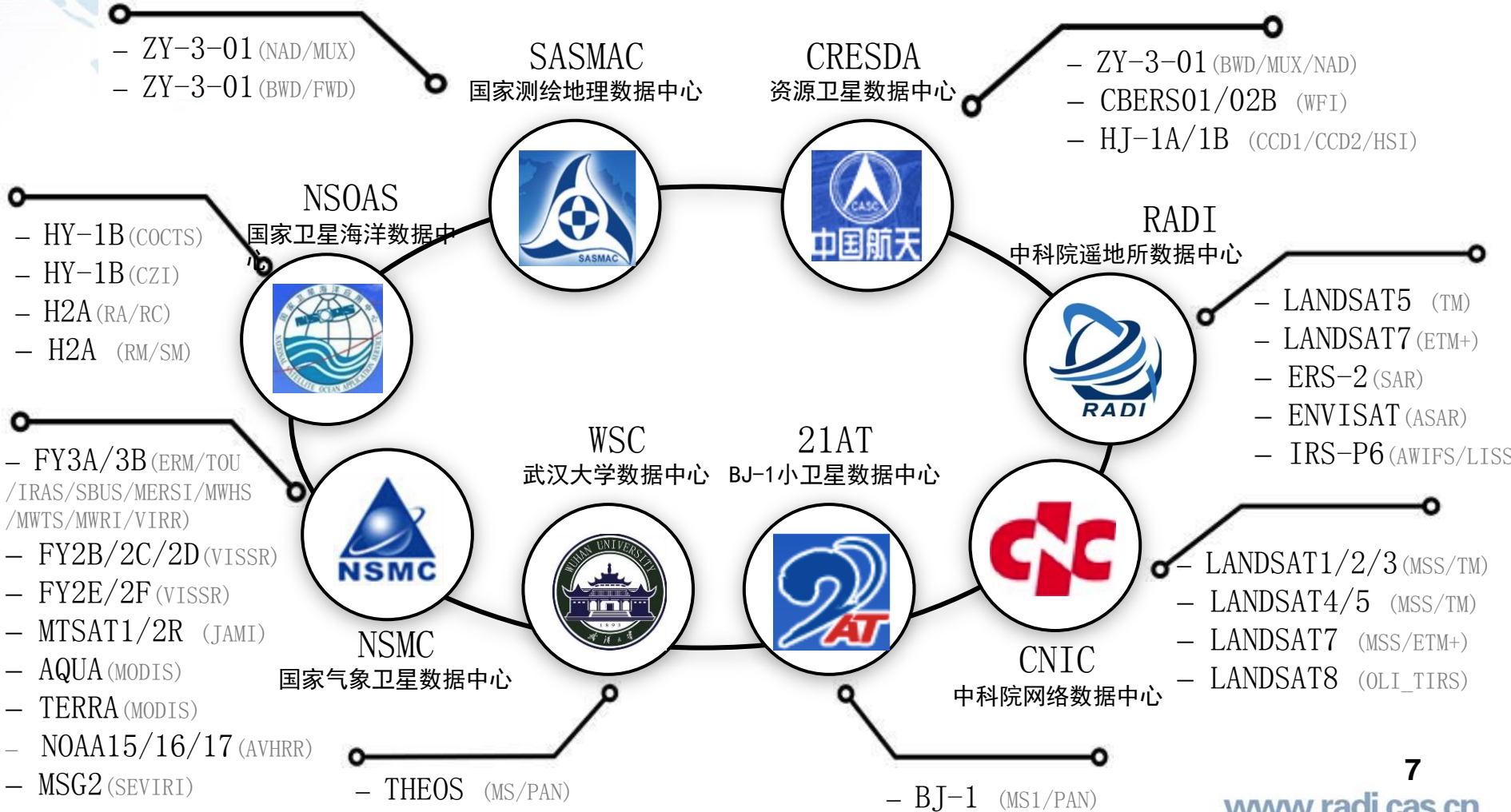




# MCCPS-System Overview

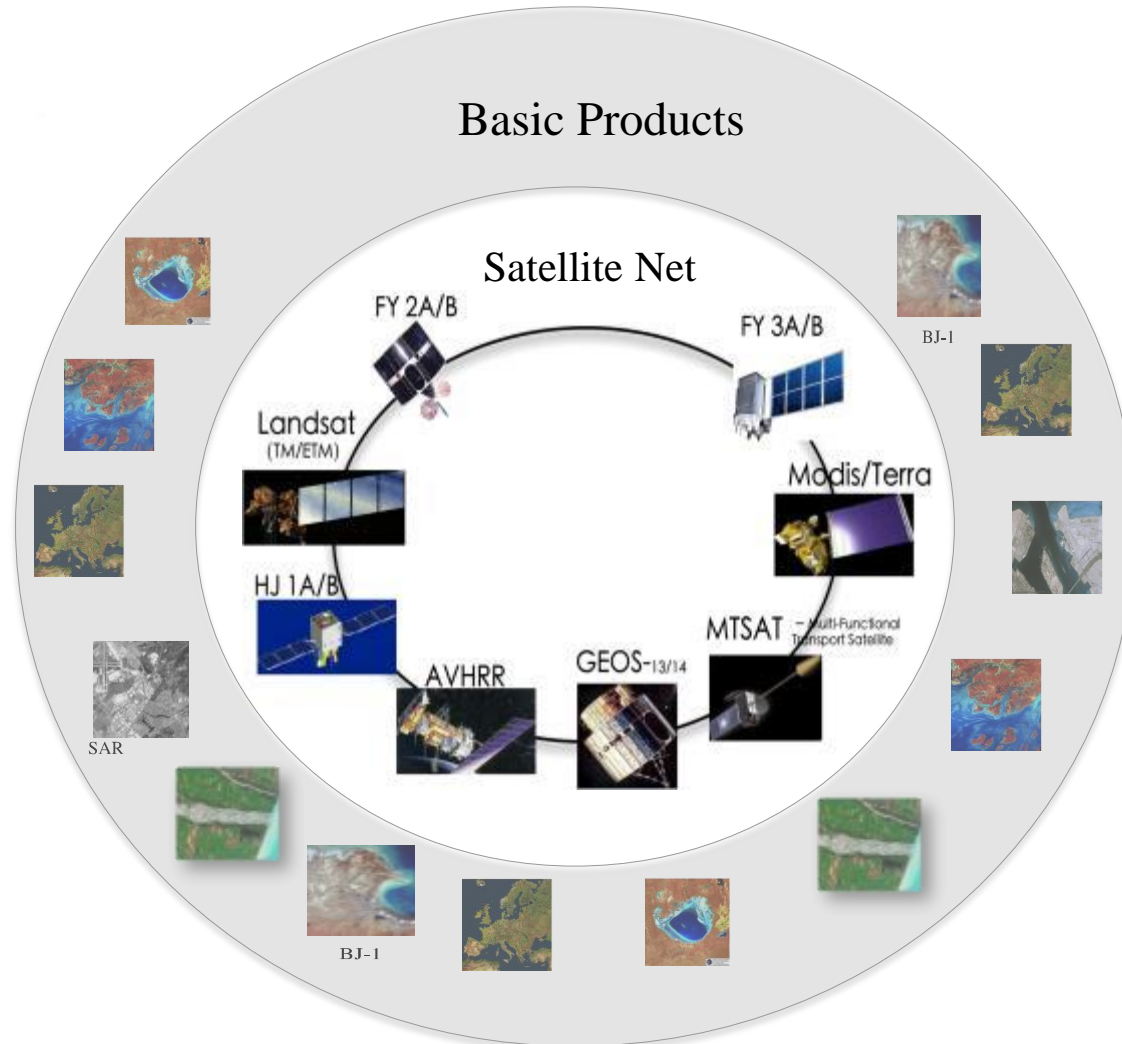


- Integrated 8 Data Centers





# Regional to Global Quantitative Inverse Products







# Regional to Global Quantitative Inverse Products

## Ecological Health Diagnosis (H. D.)

### Thematic Products

### Common Products

### Basic Products

**Vegetatio**

- 植被指数 EVI/NDVI/ARVI
- 植被净初级生产力 NPP/FPAR
- 物候期
- 植被分类/覆盖度
- 叶面积指数
- 叶绿素含量

**Radiant**

- 地表反射率AOD/BRDF
- 反照率/发射率
- 下行短/长波辐射
- 地表/灌层温度
- 净辐射

**Flux**

- 土壤水分含量
- 空气动力学粗糙度
- 感热通量
- 带热通量

**Snow**

- 冰雪面积
- 海冰分布
- 海冰温度
- 冰盖高度
- 冰雪质量变化

**Agriculture H. D.**

- 物产按量
- 种植结构
- 作物单产
- 种植面积

**Agriculture**

- 农作物面积
- 农作物长势
- 农作物产量

**Water H. D.**

- 洪涝灾害
- 水体悬浮物浓度
- 总氮、总磷
- 水体叶绿素浓度
- 水体有机物浓度

**Water**

- 全球近海/大型湖泊水体离水辐射日检测
- 水体悬浮物浓度日检测
- 年/季全球植被总初级生产力

**Mineral H. D.**

- 成矿带蚀变
- 矿区环境污染

**Mineral**

- 矿区土壤异常
- 矿区植被异常
- 地球化学异常
- 烃异常

**Soil H. D.**

- 土壤墒情
- 土地沙漠化
- 土地盐渍化
- 土壤侵蚀
- 植被覆盖

**Environment**

- 全球/区域陆表水储量
- 陆表水储量季节性和年度变化特征

**Air H. D.**

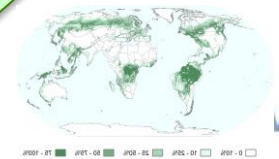
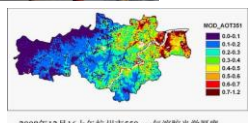
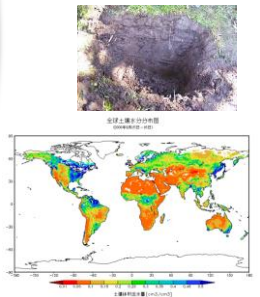
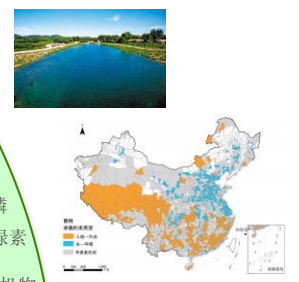
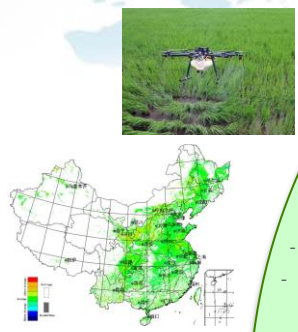
- 颗粒物浓度
- 温室气体含量
- 污染气体含量

**Forestry**

- 森林生物量
- 森林蓄积量
- 森林碳储量

**Forestry H. D.**

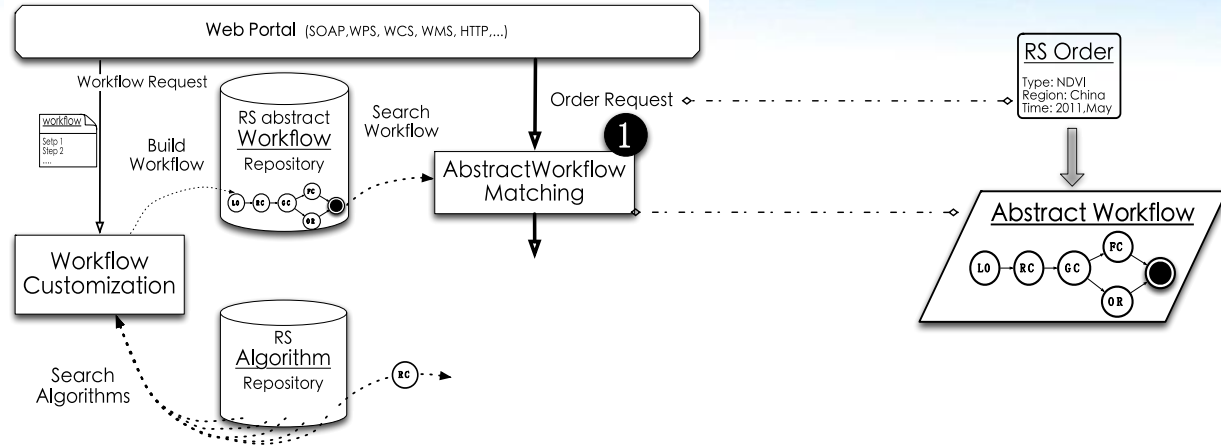
- 森林生态资产
- 森林生物量
- 森林覆盖率
- 森林总初级生产力



## 1

### Workflow Match

- Workflow Interpretation
- Abstract → Concrete Workflow Mapping



## Workflow Match

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- Abstract Concrete Workflow Mapping

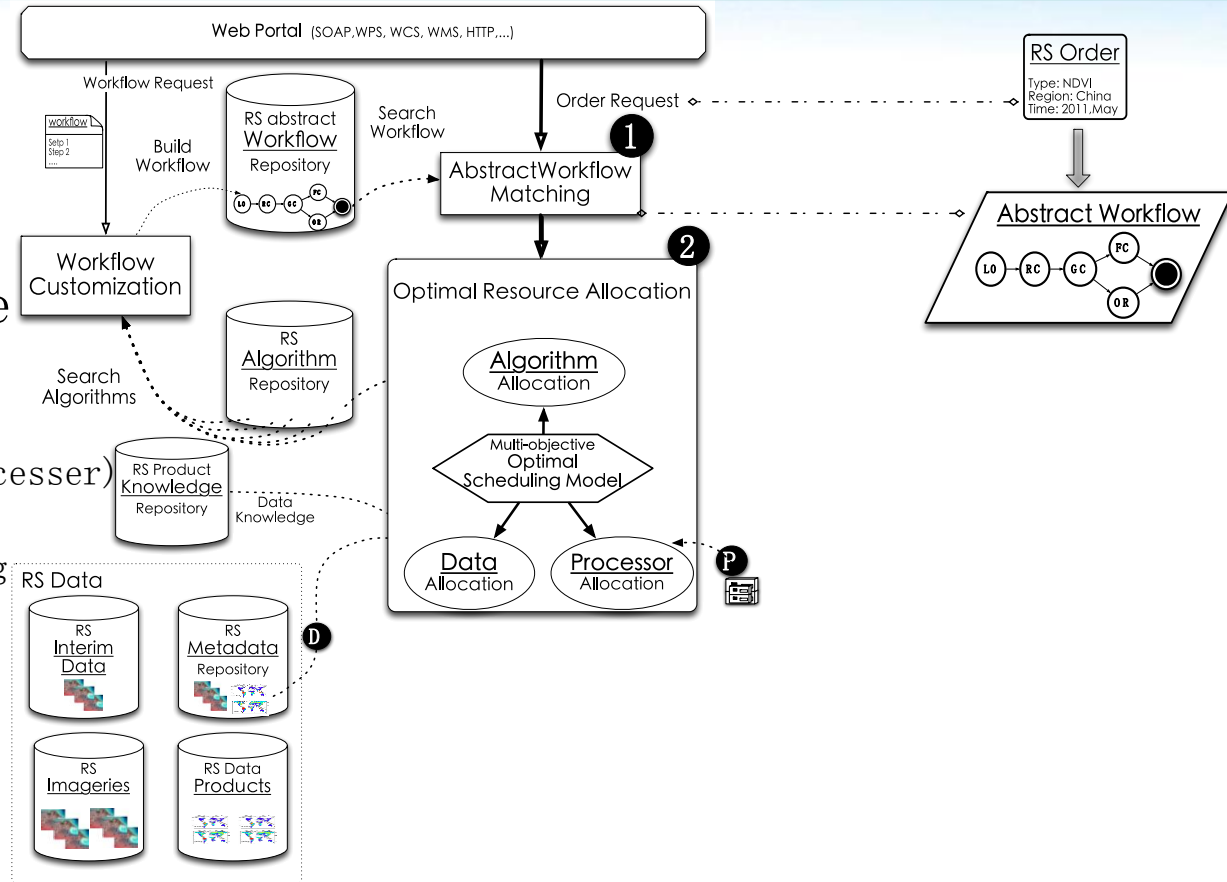


2

## Resource Schedule

### Dynamic Resource Assignment across Data Centers

- Data Center Selection (Processor)
- Algorithm Selection
- Data Discover and Preparing





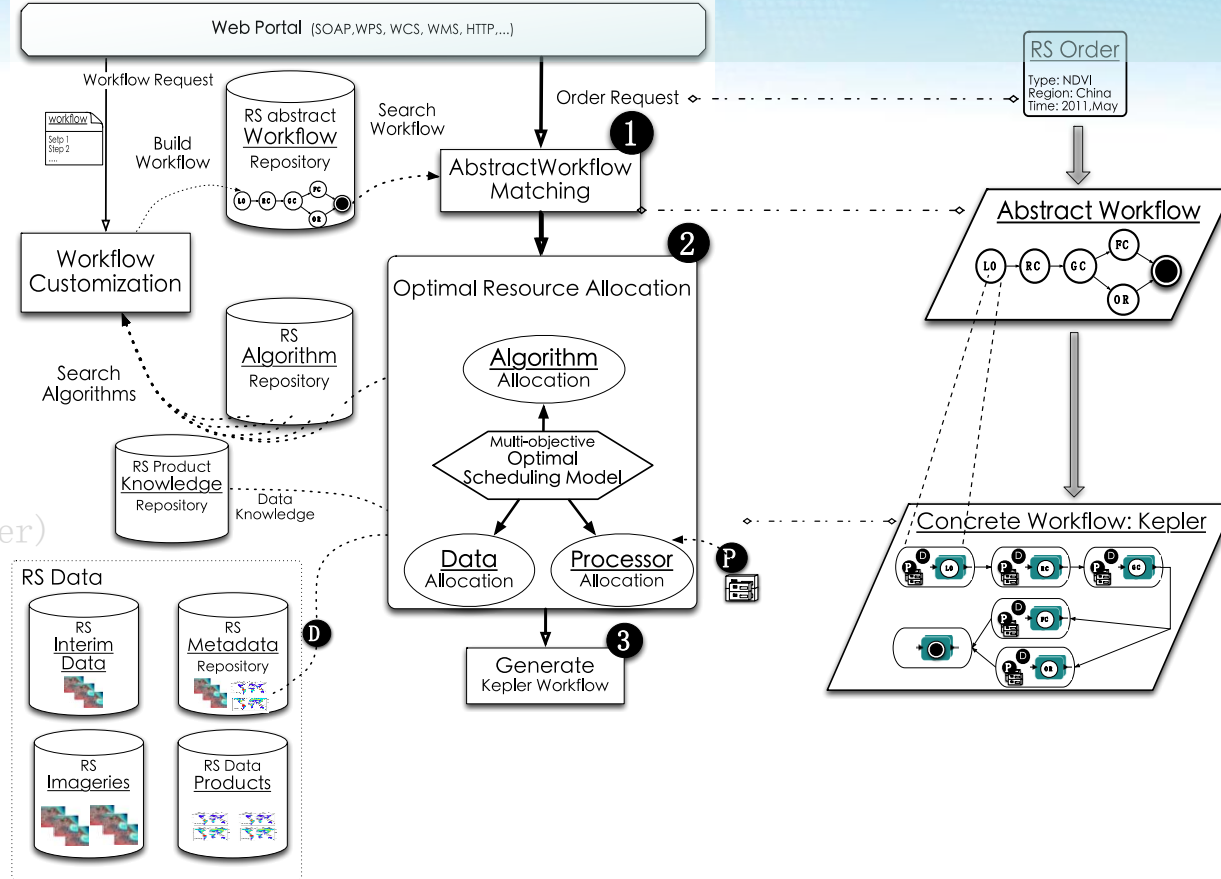
## 1 Workflow Match

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## 2 Resource Schedule

- Dynamic Resource Assignment across Data Centers
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## 3 Create Workflow





# Dynamic RS Workflow Processing Across Data Centers

## 1 Workflow Match

- Workflow Interpretation
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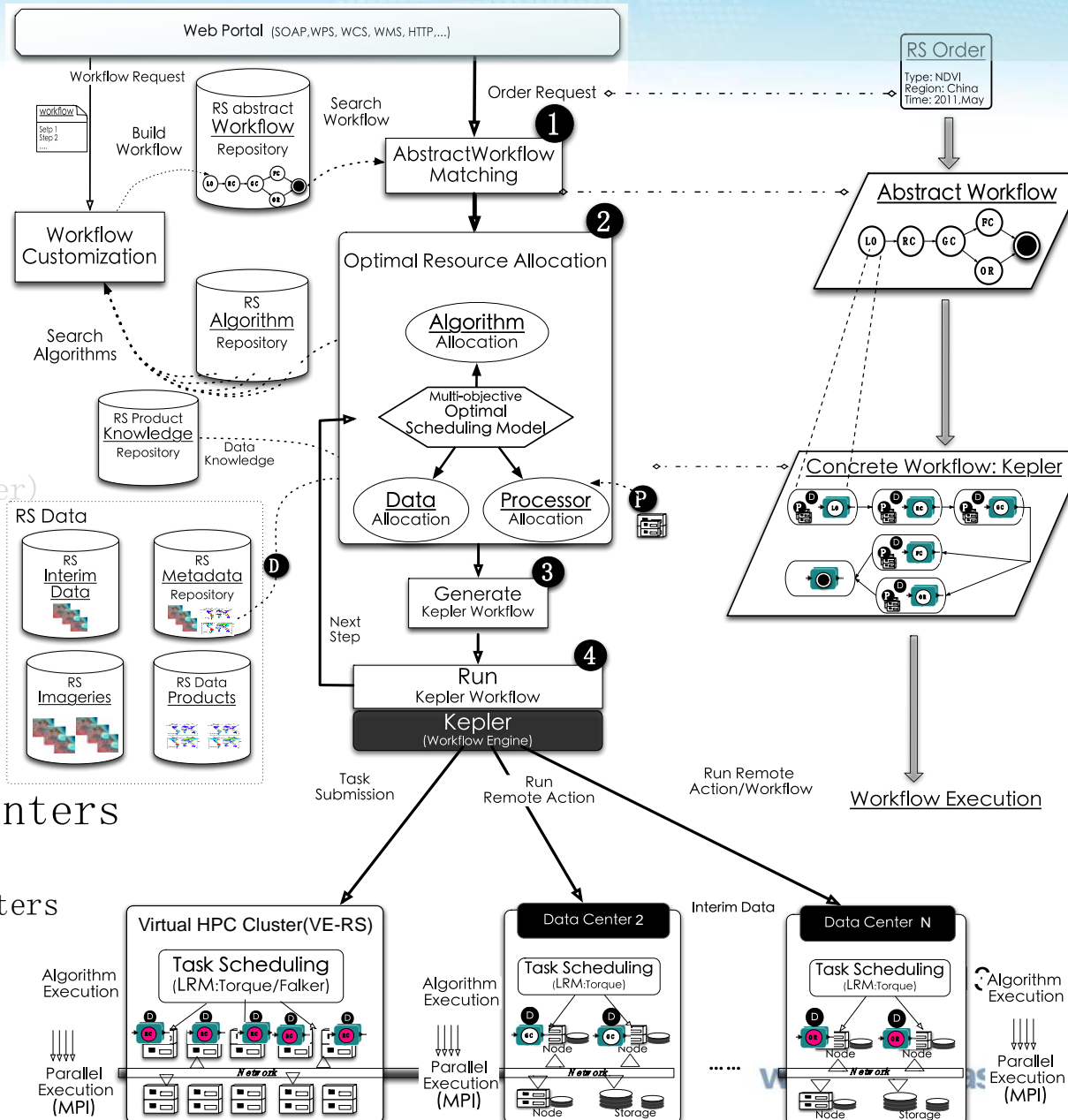
Dynamic Resource Assignment across Data Centers

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## 3 Create Workflow

## 4 Processing Across Centers

- Kepler workflow engine
- Parallelism: among/inside Centers
- Caching: interim data





# Dynamic RS Workflow Processing Across Data Centers

## 1 Workflow Match

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Dynamic Resource Assignment across Data Centers

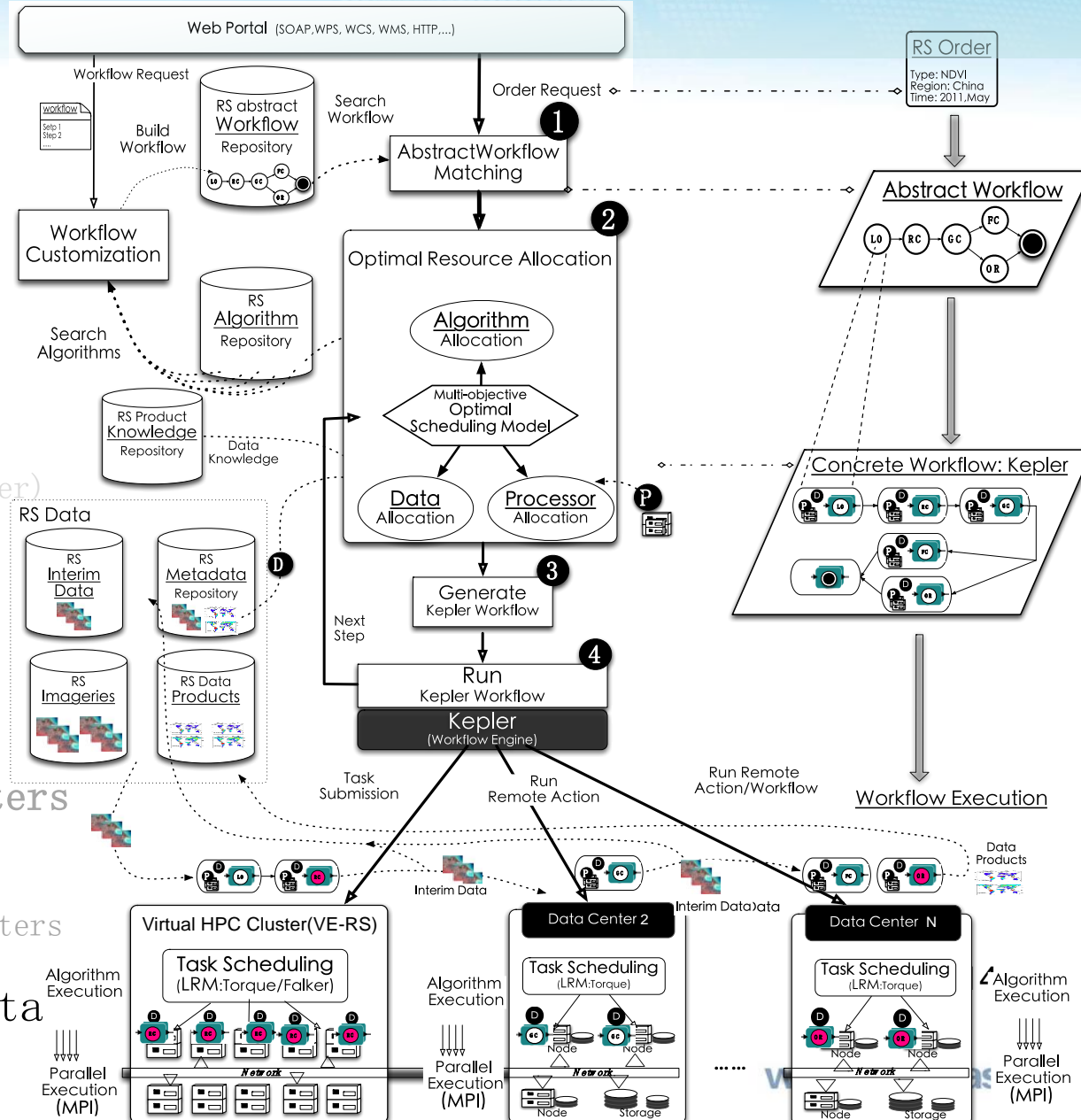
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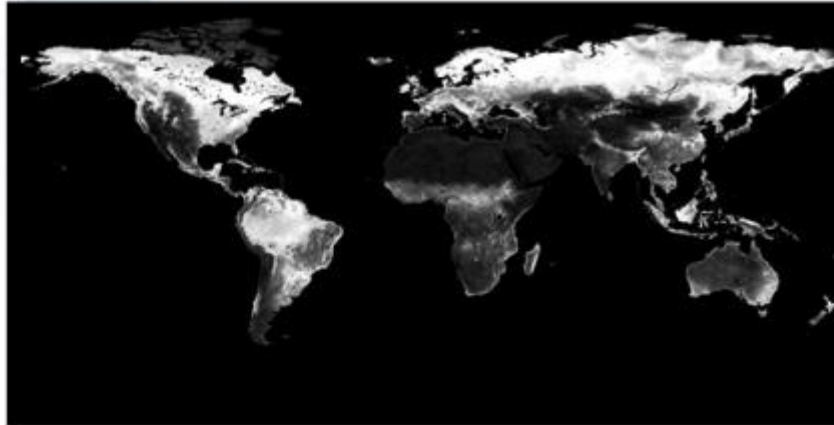
## 5 Caching: interim data



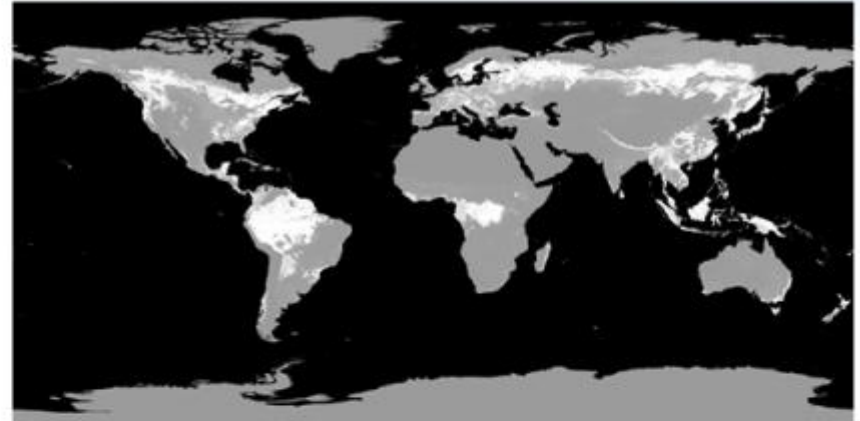




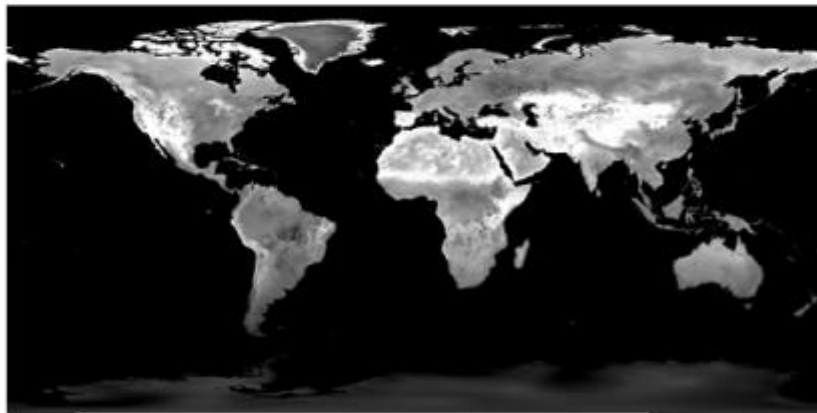
# Global RS Data Products Show



1km Soil moisture index



1km Aerodynamic roughness



1km Sensible heat flux

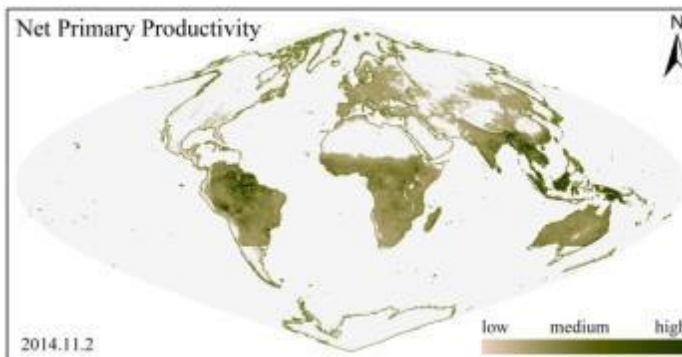
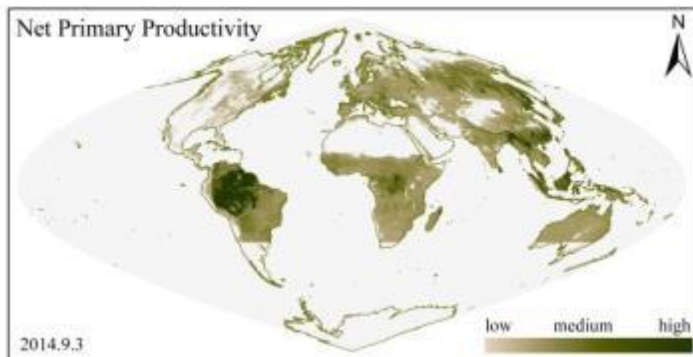
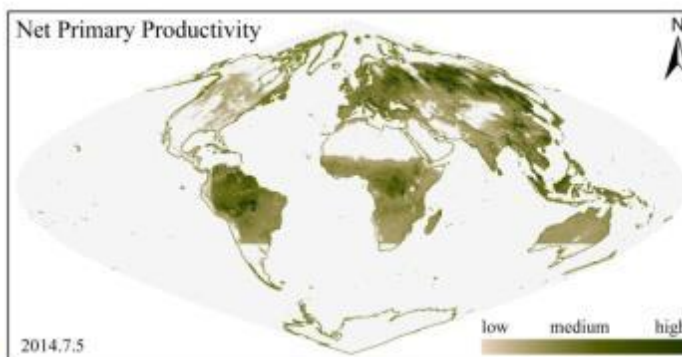
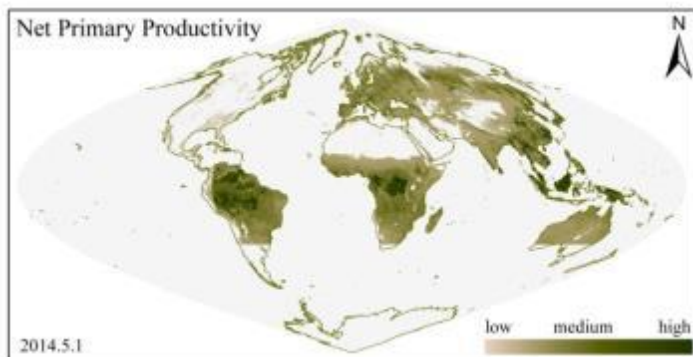
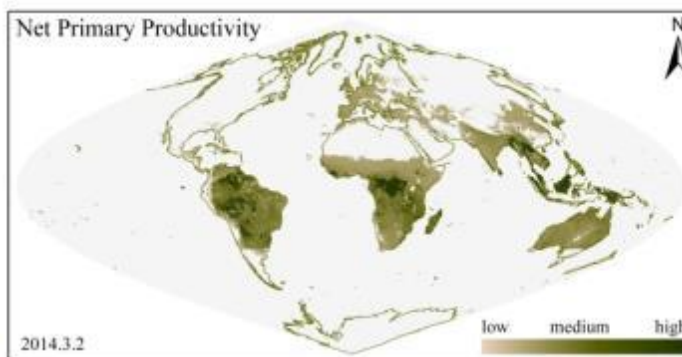
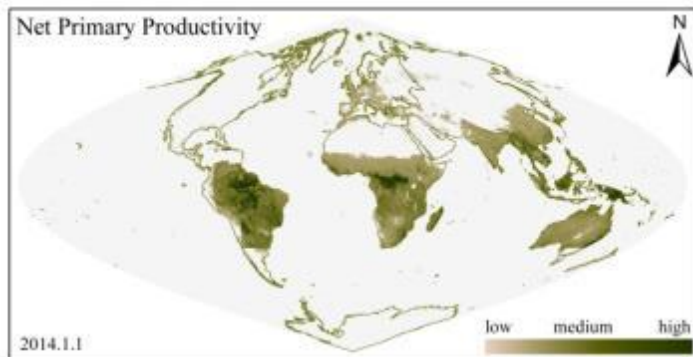


1km Latent heat flux

25



# Global RS Data Products Show



NPP is clearly tied to seasonal change, with productivity peaking in each hemisphere's summer. The Boreal Forests of Canada and Russia, for example, experience high productivity in July and then a slow decline through fall and winter. Year-round, tropical forests in South America, Africa, Southeast Asia, and Indonesia have high productivity, not surprising with the abundant sunlight, warmth, and rainfall. This was well adaptive in natural animal growing.



# Lesson Learned: Challenges

## ① RS Big Data Management

- Massive Data in Explosive Growth: TB to PB
- Multi-sources: Multi-sensor, Multi-resolution, Multi-Platform
- Distribution (Different formats): Across data centers or organizations
- Diversities of RS Data (Data Relationships):

## ② Large-scale RS Data Processing

- Large-region covered : Regional to Global
- Time Serial Analysis
- Collaborative across data centers

## ③ Application-Specific HPC Platform

- Limited Resources: Computing nodes and Storages
- Lack of RS-oriented Platform: Lack RS software, not RS application-specific
- Difficult and expensive to manage HPC Infrastructure





# pipsCloud — A Remote Sensing Cloud Platform

## ① Cloud Services

### RS Data Processing Service

- On-line RS Processing
- Seasonal Auto-Producing
- Collaborative Processing across Data Centers

### RS Data Service

- RS Big Data Service
- RS Metadata Service
- Thematic Data Subscription
- Data Harvest and Integration
- Data Tracing

### RS-specific HPC Platform as a service

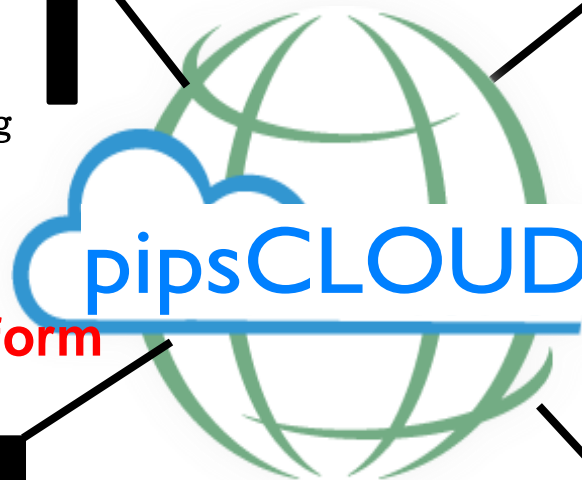
- On-demand HPC service
- *RS Software* Auto-deploy
- Mount Virtual RS Data Catalog and Storage
- VM and PM Provisioning



### RS Processing System as a Service

- PIPS System Service
- On-demand System Deploy
- RS *IDE* Service

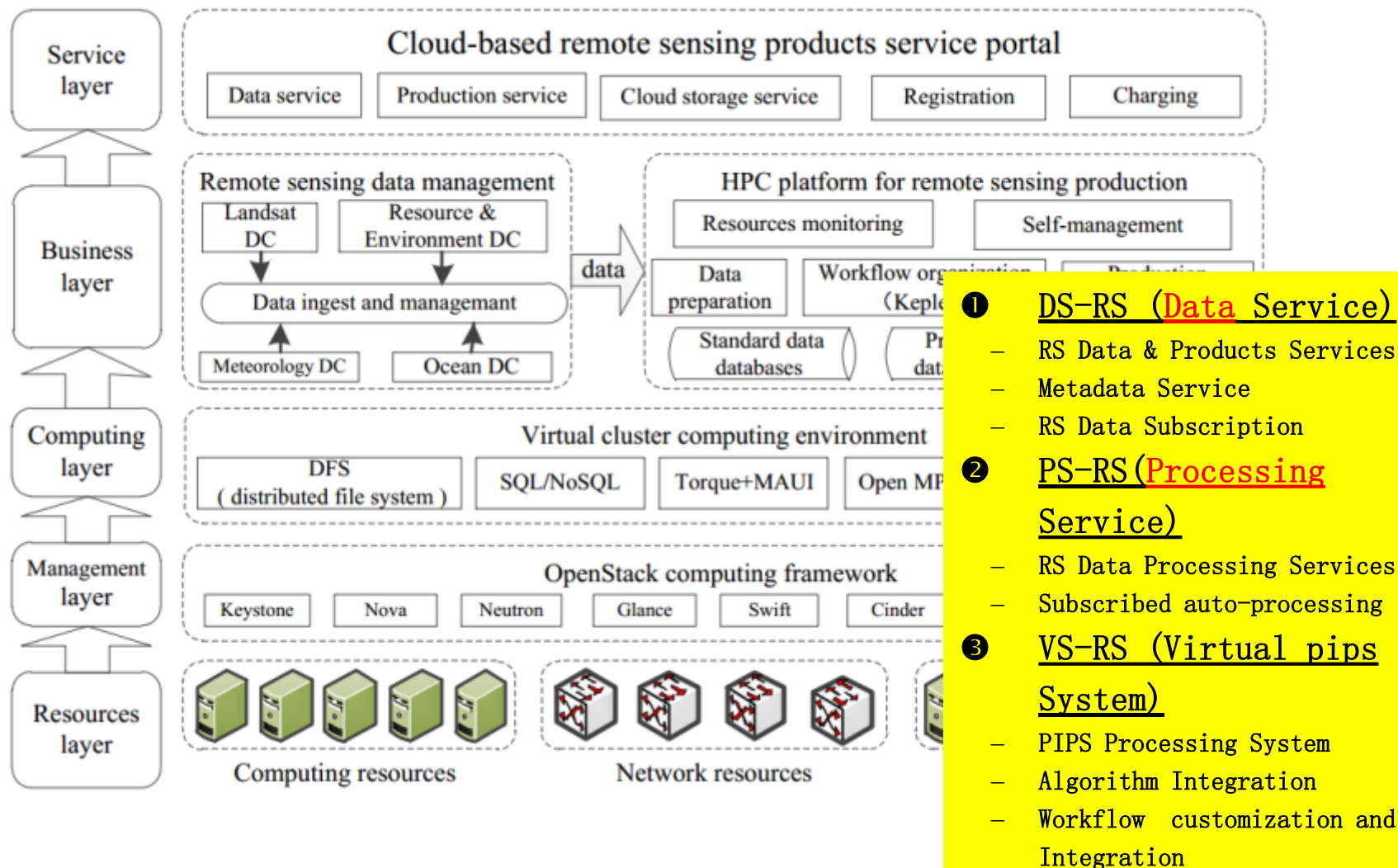
integrate algorithm ,  
workflow





# pipsCloud — System Infrastructure

## System Infrastructure of pipsCloud





# DS-RS — DAAS Portal

The screenshot displays the DAAS Portal interface. On the left, there is a search panel with the following sections:

- 查询 (Search):** Includes filters for region (京津冀), province (北京), and search type (查询). It also has buttons for "重置" (Reset) and "查询" (Search).
- 卫星选择 (Satellite Selection):** Shows "LANDSAT7" selected for the satellite and "ETM" for the sensor.
- 时间条件 (Time Conditions):** Includes a date range selector and a "Q检索" (Q Search) button.

The main area is a map of the Beijing region, with a blue outline highlighting a specific area of interest. The map shows major cities like Beijing (北京市), Tianjin (天津市), and Zhangjiakou (张家口市), along with various districts and counties.

提供遥感数据云存储功能

提供遥感数据云存储功能

提供遥感云虚拟环境构建和自定义虚拟环境功能





# DS-RS — ProAAS Portal

• *Online-Processing and Production*

The screenshot shows the ProAAS Portal website. At the top, there is a navigation bar with the RADI Remote Sensing Cloud logo and the text "您好! 欢迎访问遥感云 请登录 | 注册 购物车 我的遥感云". Below this is a main menu with links for "首页", "遥感数据服务", "信息产品服务", "遥感处理服务", "云平台服务", "云存储服务", and "联系我们".

The main content area features a diagram illustrating the product flow: "反演指数产品" (Inverse products) and "精处理产品" (Fine processing products) are combined (indicated by a plus sign) to produce "专题产品" (Thematic products). To the right of this diagram is a globe showing a global map.

Below the diagram is a form for ordering products. The form includes the following fields:

- 产品类型: 5KM 3小时合成下行长波辐射产品
- 左上经度: 数字
- 右下经度: 数字
- 开始时间: [calendar icon]
- 订单提交: [button]
- 工作流号: [input field]
- 右下纬度: 数字
- 结束时间: [calendar icon]
- 左上纬度: 数字

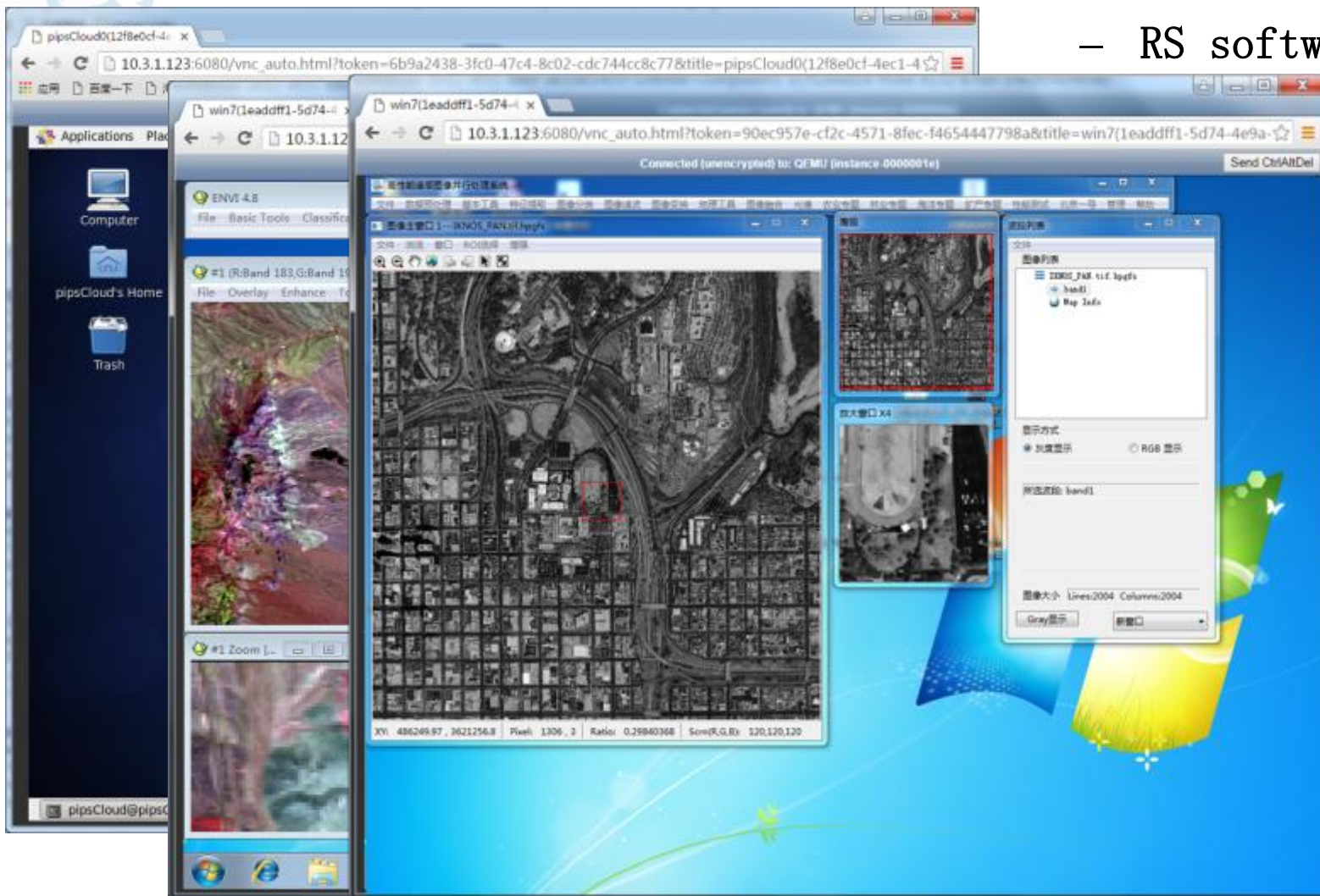
- ① Fine processing products
- ② Inverse products
- ③ Thematic products



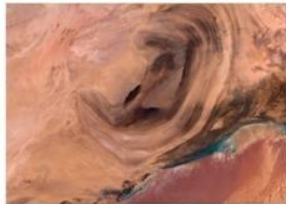
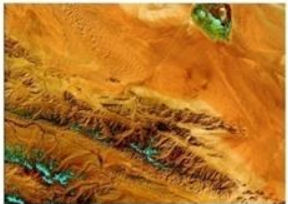
# pipsCloud — Virtual RS HPC Environment

## ④ *Virtual RS HPC Environment*

- ① Auto-deployment
  - HPC software,
  - RS software



# Thanks!



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