



6th Asia-Oceania Group on Earth Observations (**AOGEO**) Workshop

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Spectrum Earth Targeting GEO's Needs, Integrating Multi-source Data, and Lowering Barriers of Application

Yan Liu

Team Member : Xingfa Gu, Juan Li, and more



Yan Liu

**Aerospace Information
Research Institute, CAS**

- **Short Bio of Speaker:**

An assistant research fellow from Aerospace Information Research Institute, Chinese Academy of Sciences. Her research interests are Bi-Directional Reflectance Distribution Functions (BRDF) inversion and application, multi-scale vegetation phenology monitoring and analysis using satellite data. She's a key researcher in several GEO related projects supported by the Ministry of Science and Technology of China.

Features and Advantages of Spectrum Earth



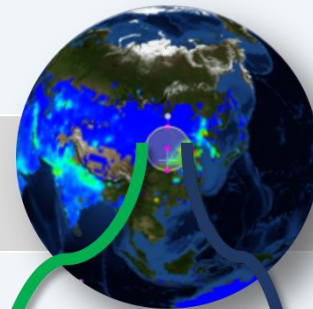
Natural Earth

- Objective Existence
- Natural and Artificial Objects

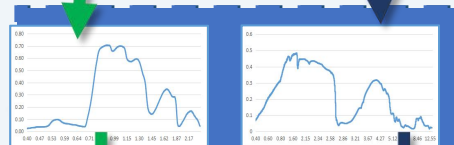


Image Earth

- Directly Shot by Remote Sensing



Spectrum Earth



Spectrum is the unique "fingerprint" of land surface and core information that satellite can capture

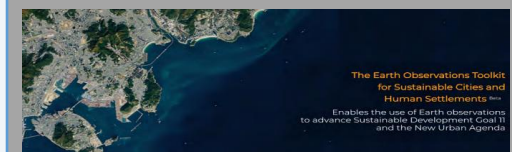


Knowledge Earth

- Information-Knowledge
- Multi-level integration

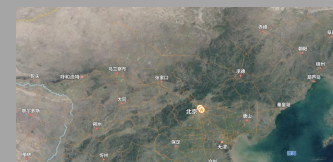
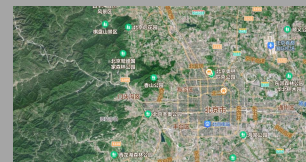
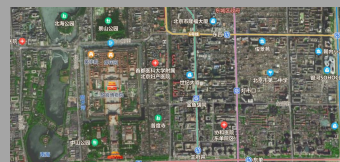
- ❑ **Comprehensive:** Multispectral, multiscale, temporal continuous satellite observed spectrum data of the earth's surface;
- ❑ **Quantitative:** Standard radiation, space, time of the earth's surface;
- ❑ **Continuous:** Full coverage, continuous time, spectral normalization.

GEO Engagement Priorities



Ideal Spectrum Earth: Full and continues information in multiple dimensions

Spatial Dimension



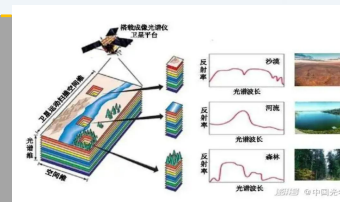
Serves applications that needs different spatial details

Temporal Dimension



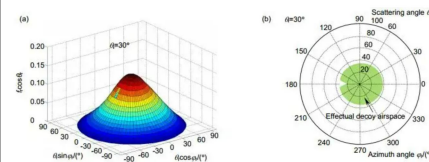
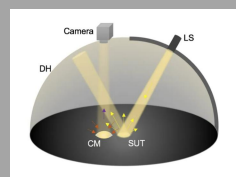
Meet the needs of observing changes in different time periods.

Spectral Dimension

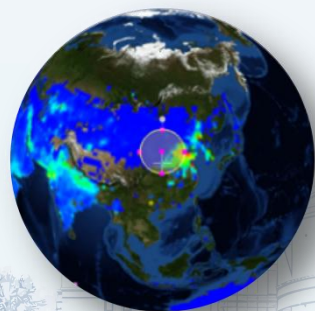


Fully reflect spectrum details.

Observation Angle Dimension



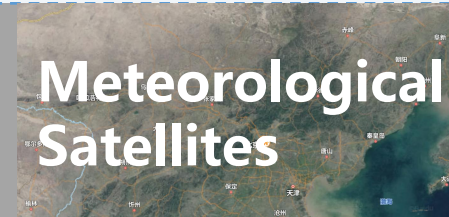
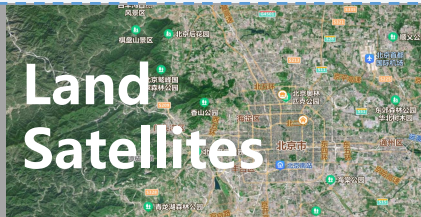
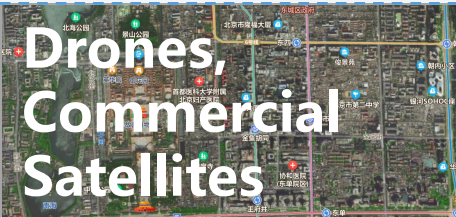
Support energy balance, surface structure analysis.



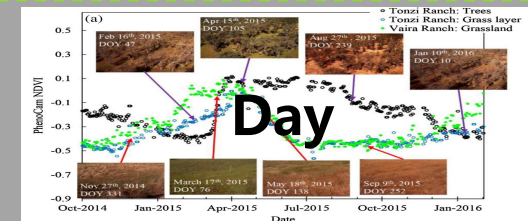
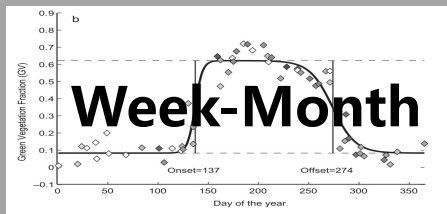
Spectrum Earth

Reality: A single satellite or sensor can realize near-completeness in a certain dimension.

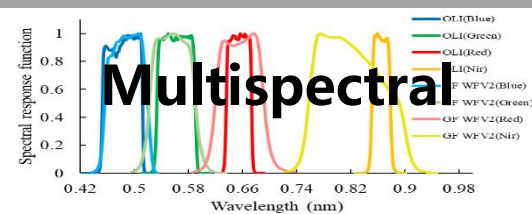
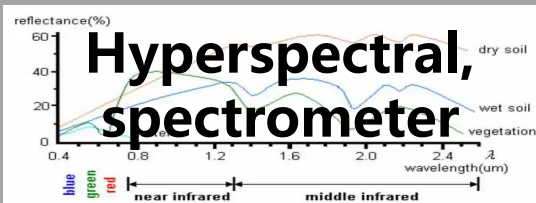
Spatial Dimension



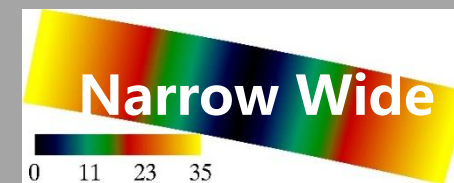
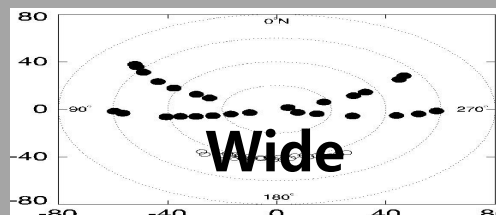
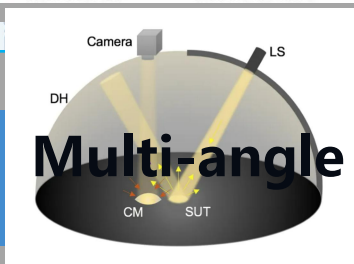
Temporal Dimension



Spectral Dimension



Observation Angle's Dimension



- The ideal spectral earth is a complex and huge **scientific research and engineering system**, which is difficult to realize in short time.
- **Seek a suitable start for technical research and system development.**
 - Pressing needs in local and international community, especially in GEO.
 - Enough satellite data.
 - On a certain technical basis.
- **Gradually realize the multi-dimensional integrity and continuity of land surface spectrum information.**



Research on Development of Medium Spatial Resolution of Spectrum Earth and its Application Technology

Dec 1st, 2020- Dec 1st, 2023

Key R&D Program of the Ministry of Science and Technology

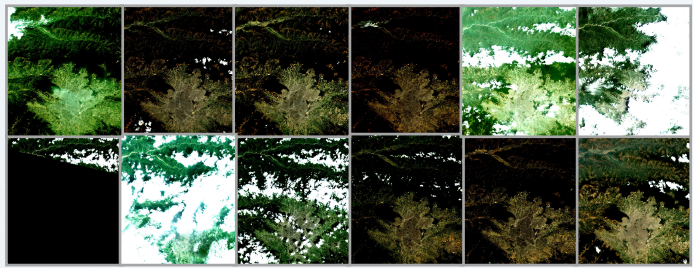
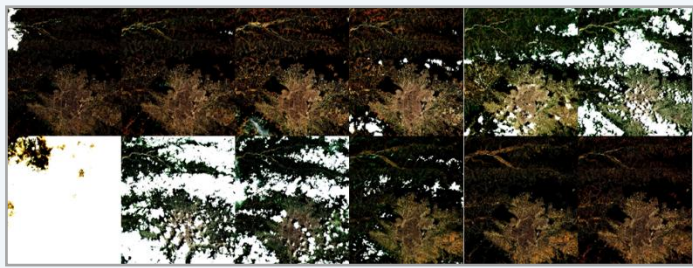
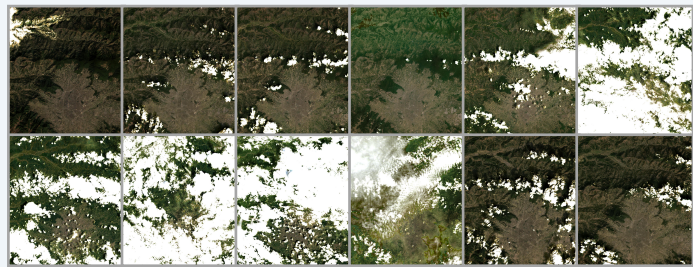
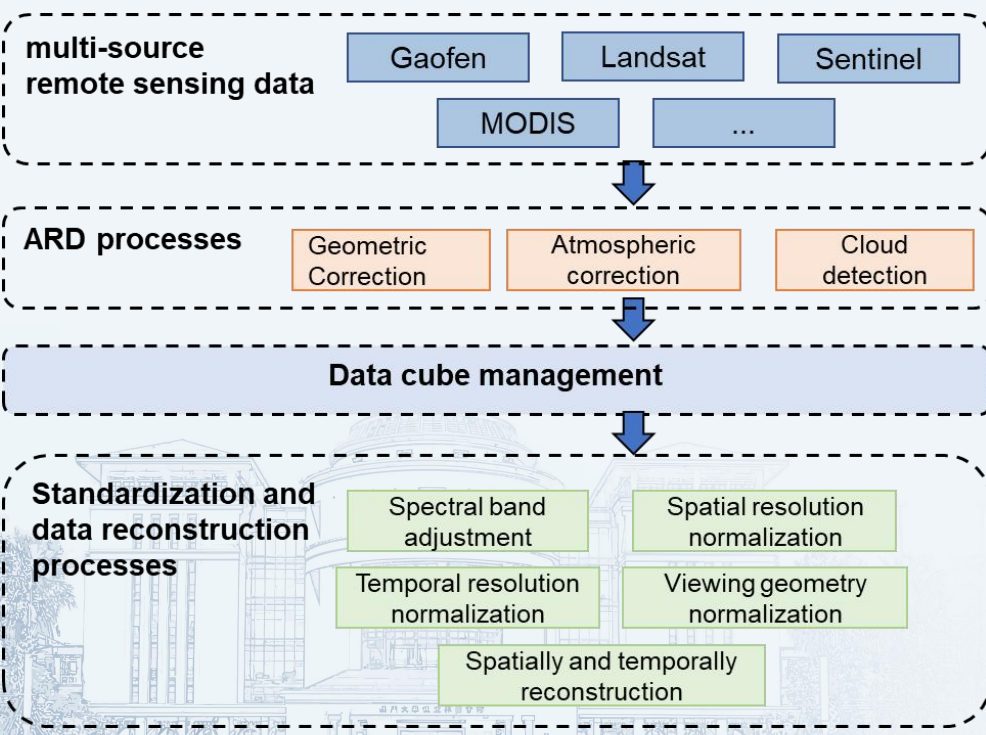
Key projects of intergovernmental scientific and technological innovation cooperation

Overseas Cooperation Teams: Geoscience Australia  International Centre for integrated Mountain Development 

Research Areas: Australia, Nepal, France, Cambodia—Taking into account both ecosystem diversity and GEO activity

- Research Tasks:**
1. Multispectral Data Processing Technology System of Spectrum Earth;
 2. Expanding Technology from Multispectral Images to Hyperspectral Images;
 3. Research and Development of 10-meter level Spectrum Earth platform;
 4. Application and Demonstration based on Spectrum Earth.

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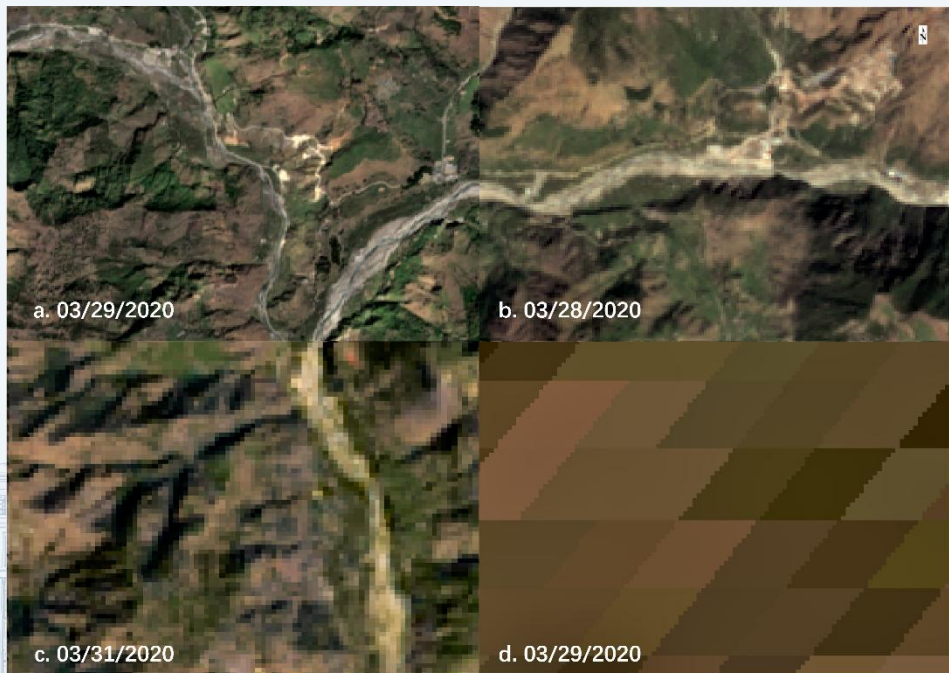
Monthly best observations of Landsat 8 (a), Sentinel 2 (b), and Gaofen 1 (c).



Monthly spectrum dataset.



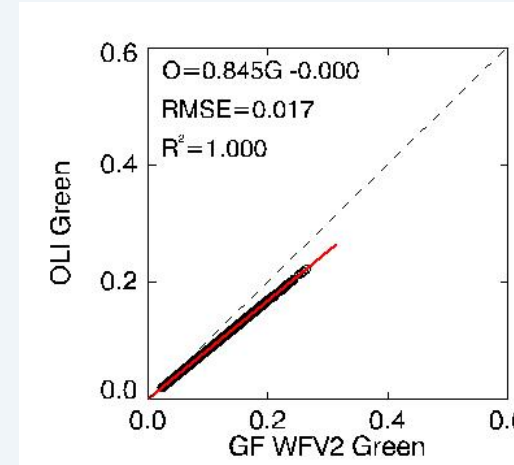
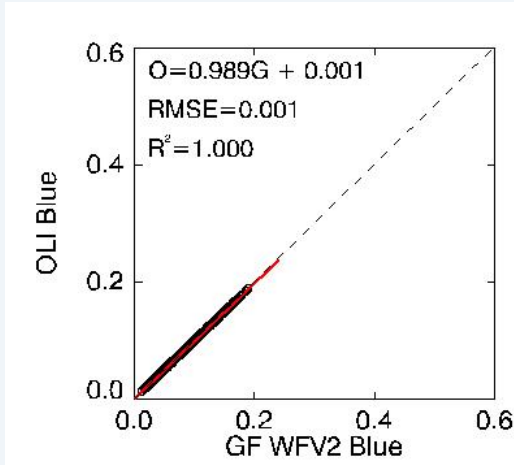
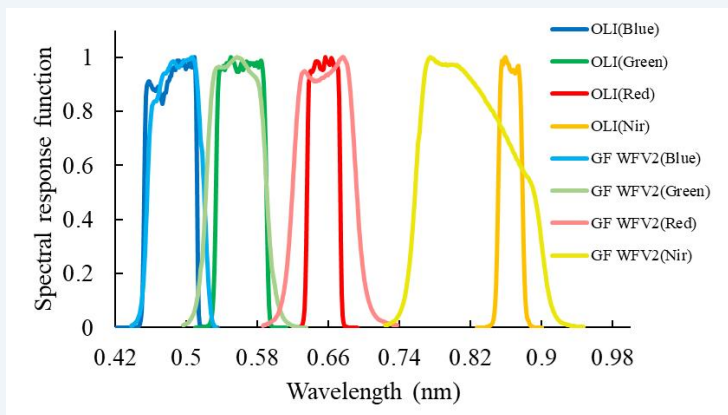
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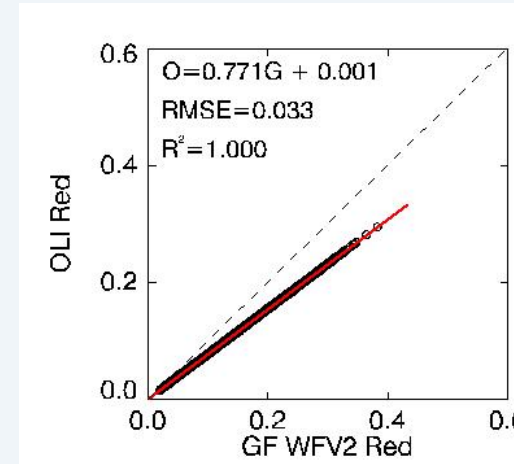
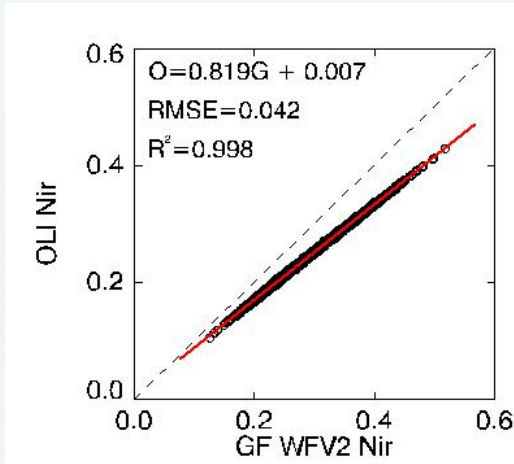
Spatial normalization



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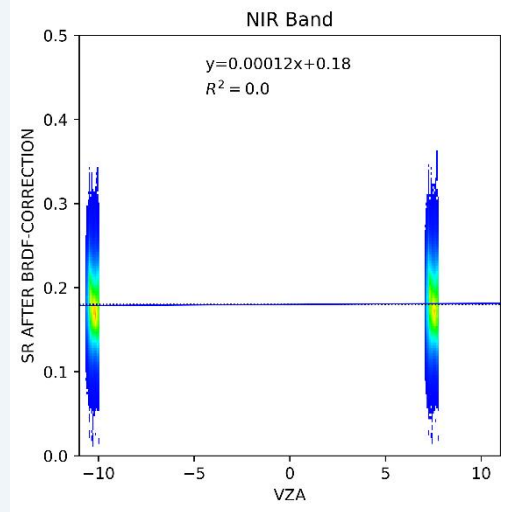
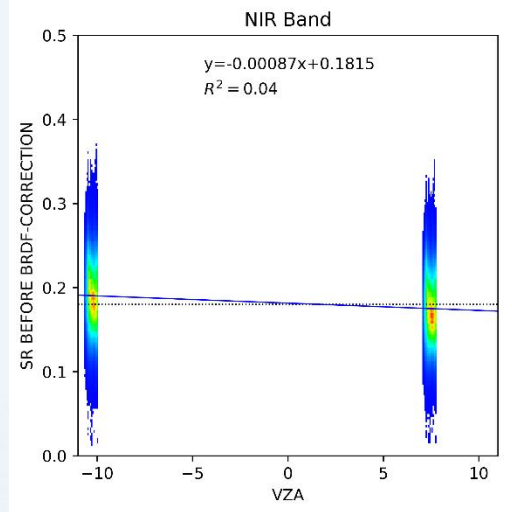
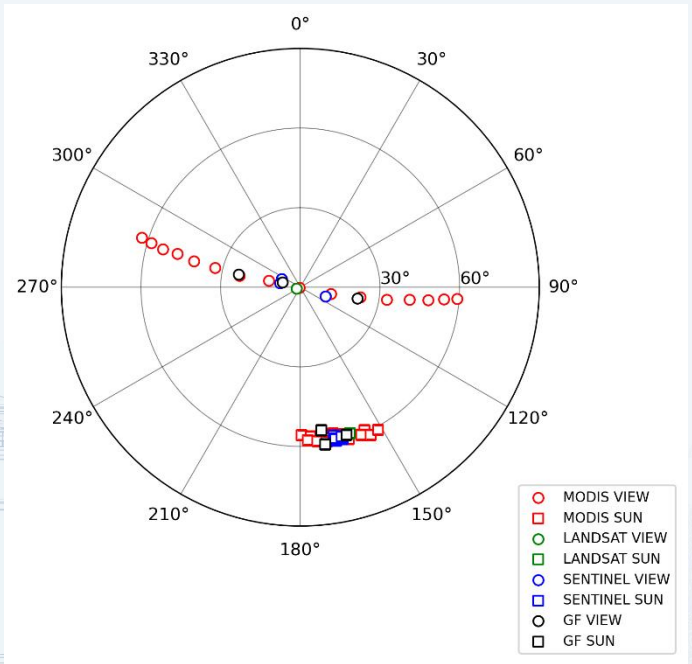


Spectral differences and normalization technique





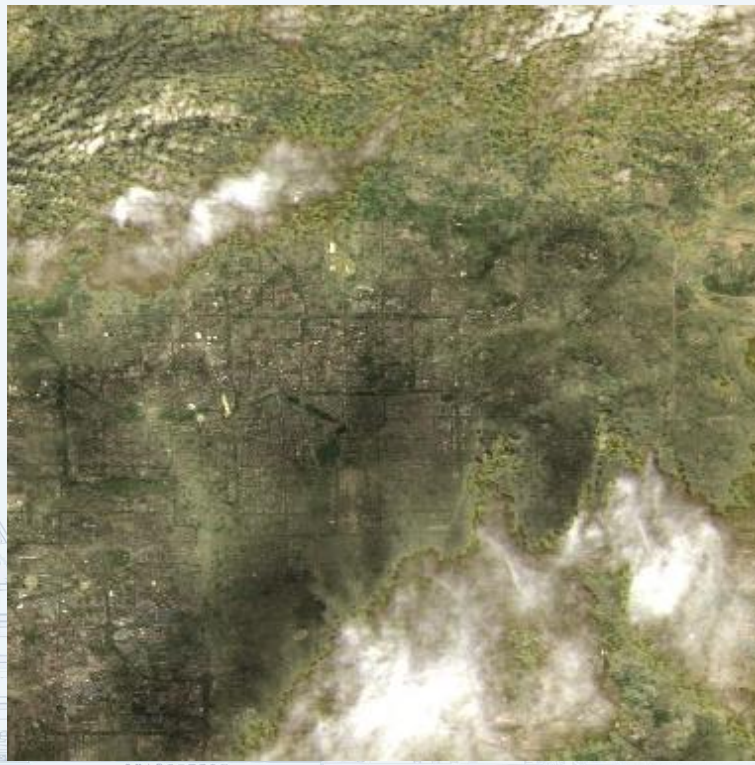
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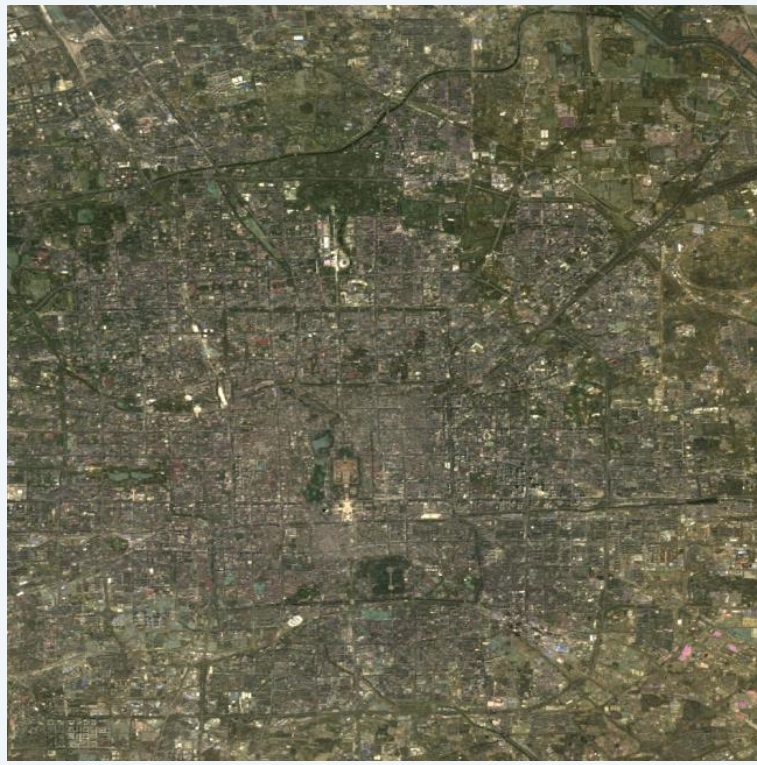
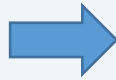
Angular distribution and normalization technique



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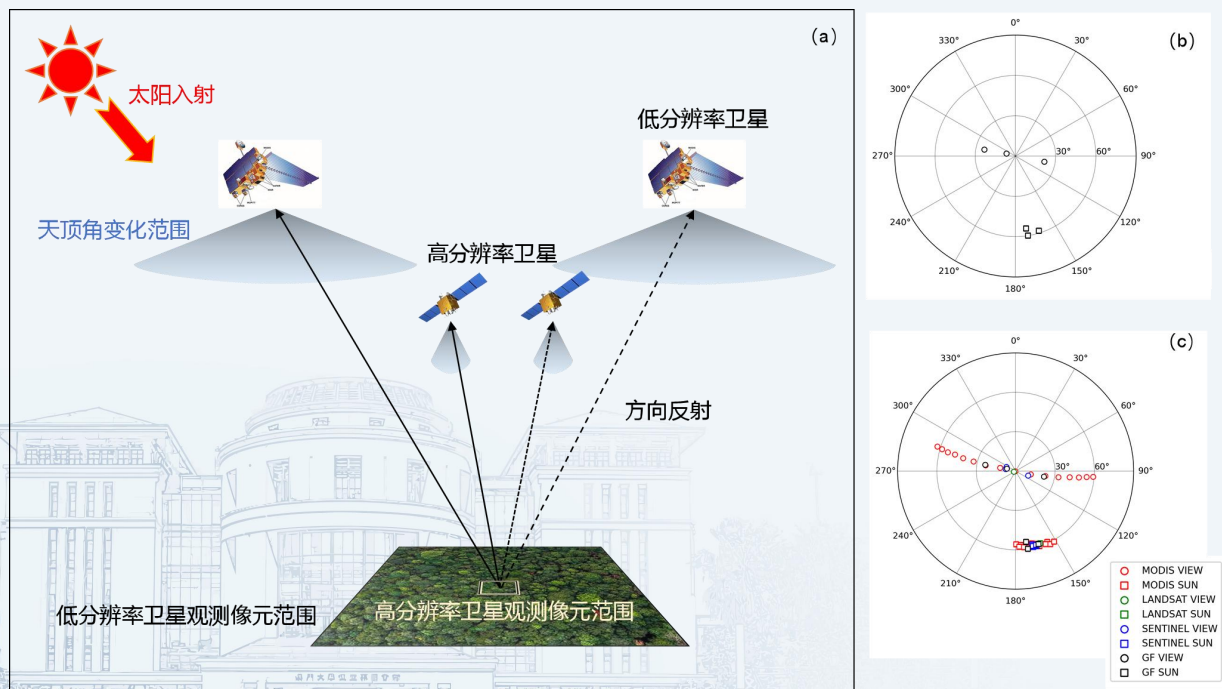


Data reconstruction

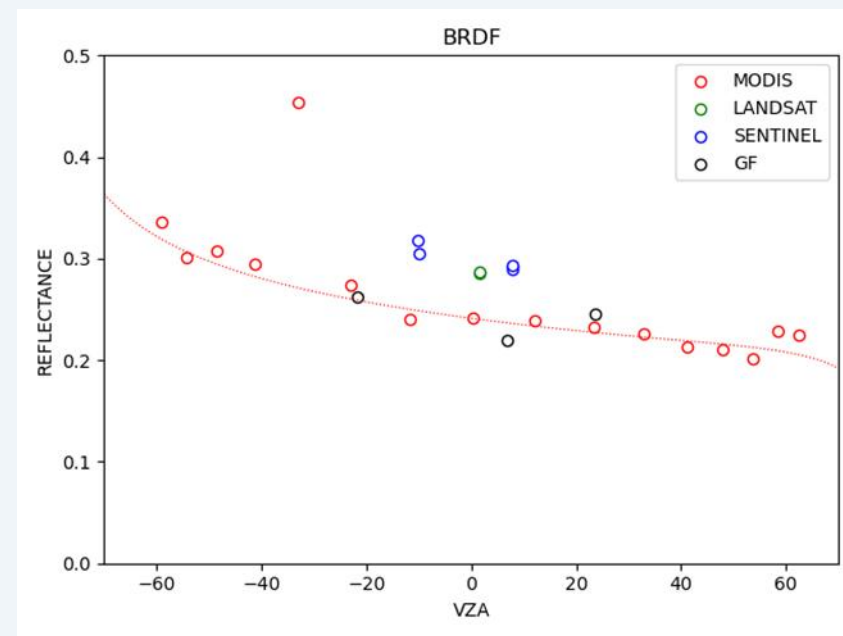


Images captured by Landsat 8 of Beijing on June 16th of 2020

Explore the integration use of multiple satellites in BRDF inversion

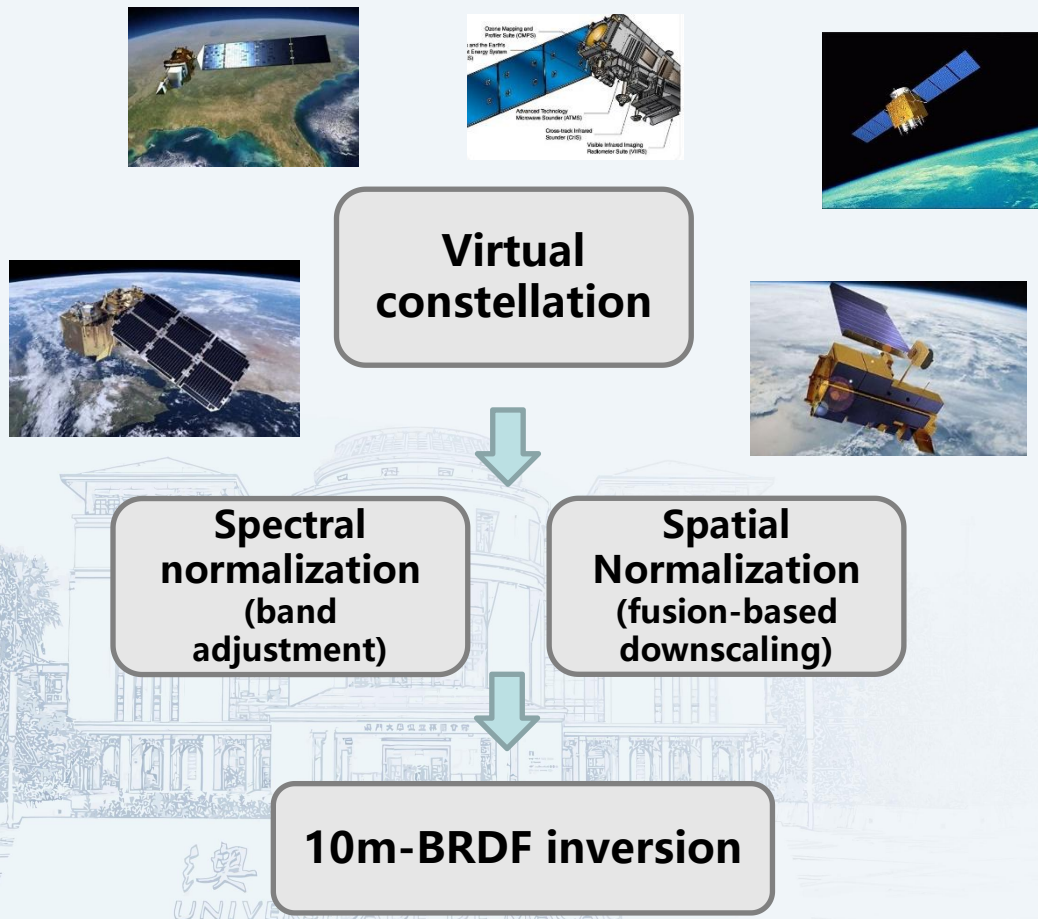


BRDF effect and angle-integration of virtual constellation

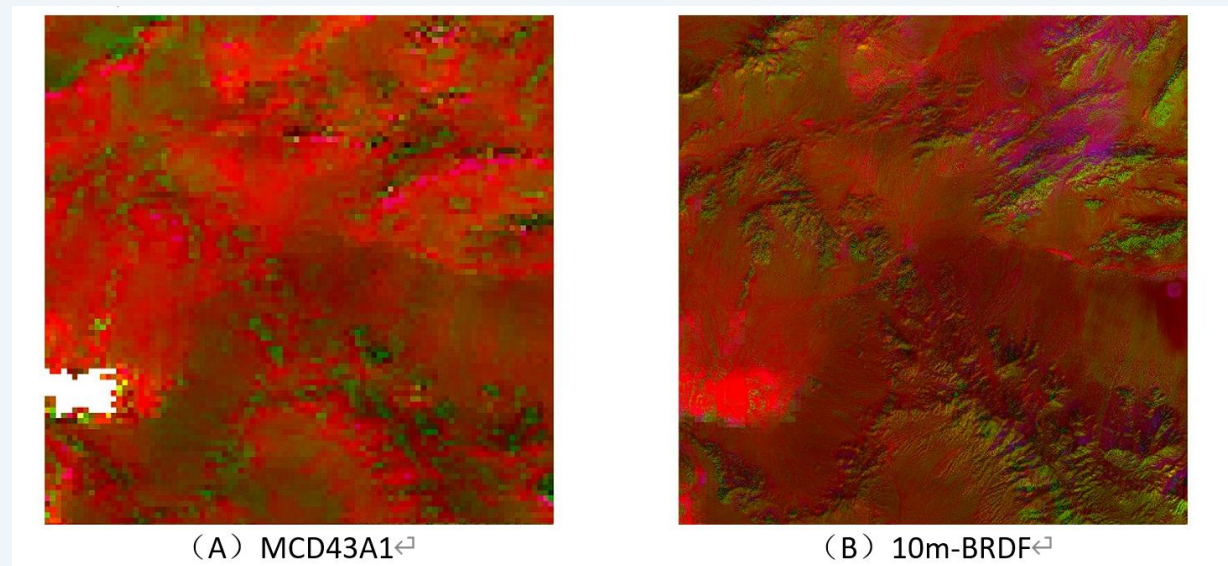


Original reflectance of satellites compared with mcd43a1 brdf(NIR)

10m-BRDF inversion



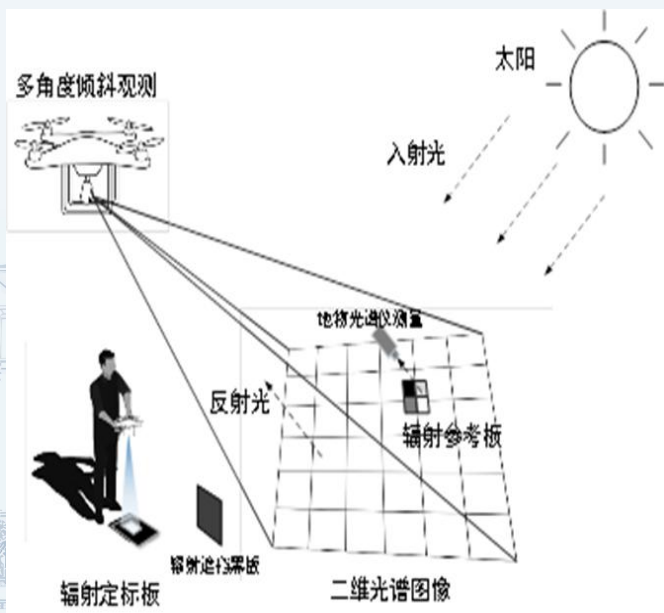
FSDAF fusion-based BRDF downscaling



500m and 10m-BRDF of Desert Rock(SURFRAD site)

10m-BRDF inversion: validation

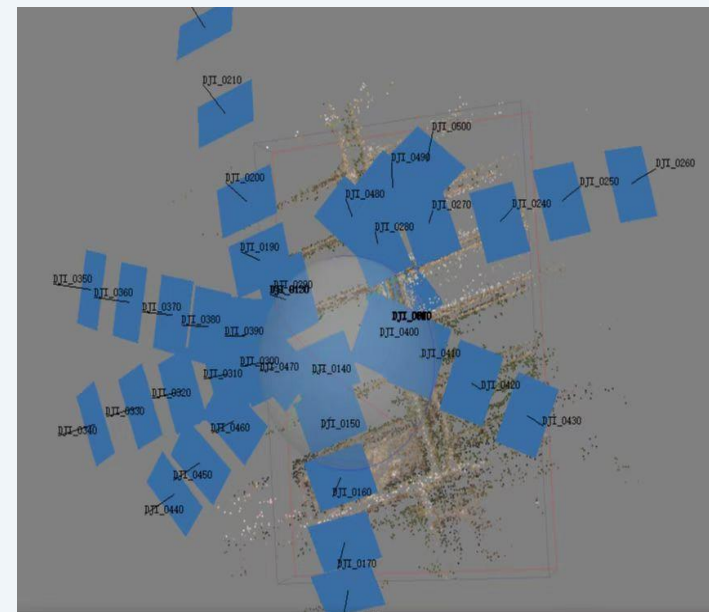
- (a) Albedo sites (SURFRAD)
- (b) 3D-DART simulation
- (c) drone-brdf upscaling validation



Inclined photography of drone



Near-nadir UAV's image



Muti-angular BRDF sampling pattern



Earth Observations
for Asia-Oceania

THANKS

5th Asia- Oceania Group on Earth Observations (AOGEO) Workshop

<https://aogeo-workshop-2022.casconf.cn/>

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