AOMSUC-11

Spatial Downscaling of FY-4A Land Surface Temperature Using both Temporal and Spatial Information

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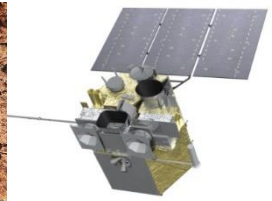
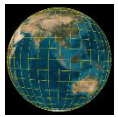
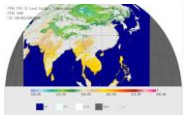
1. Introduction

- Importance of LST: Land surface temperature (LST) can well indicates regional and global environment and climate change and plays an important role in the process of material and energy exchange between earth and atmosphere. Due to the observation advantages in large coverage and short revisit time, remote sensing has increasingly become an important tool in LST monitoring.

- FY-4A AGRI: FengYun 4A (FY-4A) is the first test satellite of China's second generation meteorological satellite, launched on December 11th, 2016. The Advanced Geosynchronous Radiation Imager (AGRI) is one of the most important payloads onboard it, which has a significant advancement over the first-generation geostationary meteorological satellite such as more spectral channels，faster imaging and higher spatial resolution. Among its 14 channels, there are three thermal infrared channels which can be used for LST retrieval.







Full disk & Regional observation

2.Purpose

Limits of traditional methods:
Different platforms—matching uncertainty
LST related factors—temporal information

Proposed methods:
Temporal information—high time-frequency
Spatial information—local energy conservation theory

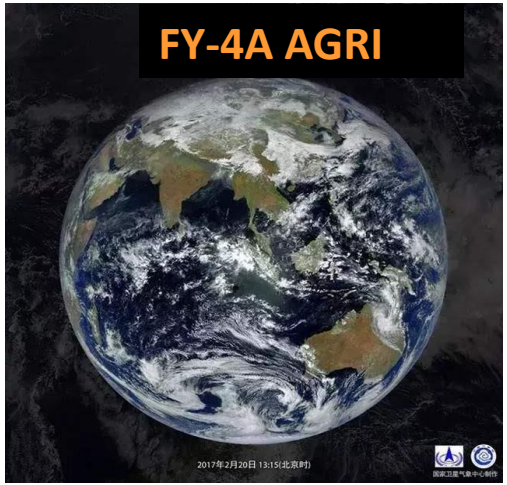
FY-4A AGRI LST (2 km)

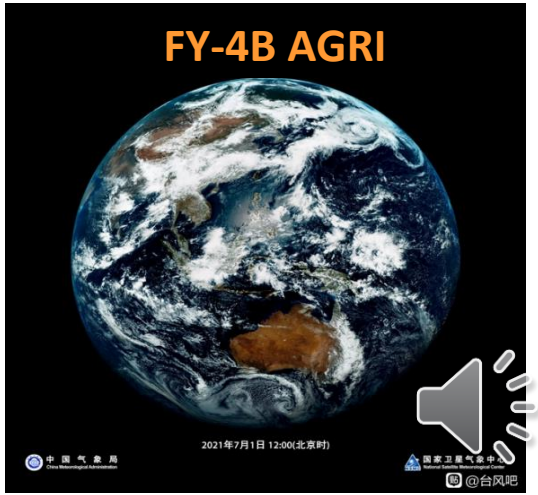
Spatial downscaling

Cross validation

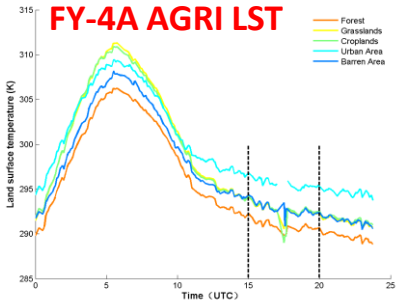
Long term LST data sets

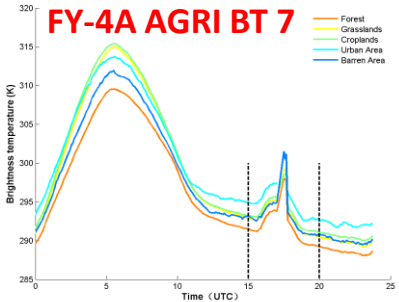
HIMAWARI AHI LST (2 km) **VS.** FY-4A AGRI LST(4 km) ✚ FY-4B AGRI LST(2 km)

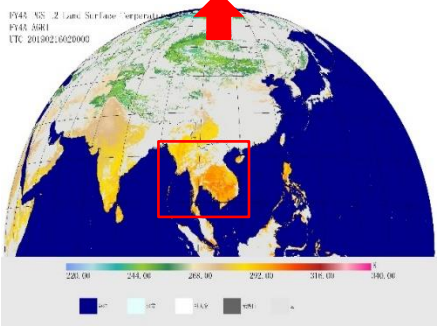


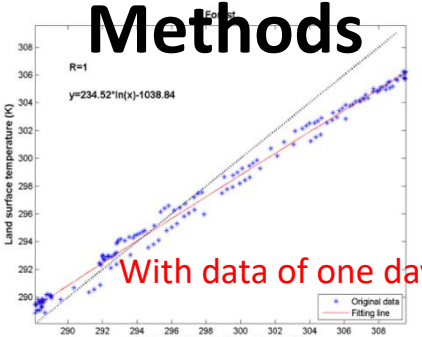


3. Methods









With data of one day

Downscaling model

$$y = a \times \ln(x) + b$$

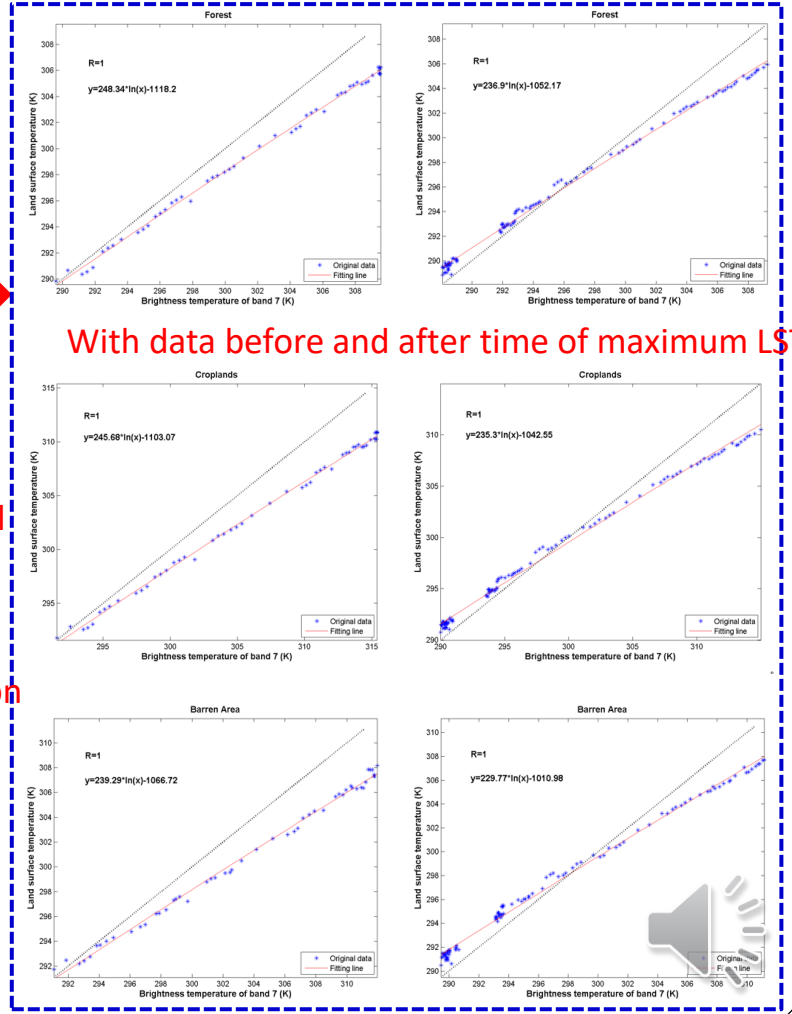
Results optimization

$$\Delta LST_{(i_0,j_0)} = LST^{tdu}_{(i_0,j_0)} - LST^{ori}_{(i_0,j_0)}$$

$$LST^{sdo}_{(i,j)} = LST^{sd}_{(i,j)} \pm 4 \times p_{(i,j)} \times \Delta LST_{(i_0,j_0)}$$

$$p_{(i,j)} = \frac{BT^{7}_{(i,j)}}{\sum_{m=1}^{i+1}\sum_{n=1}^{j+1} BT^{7}_{(m,n)}}$$

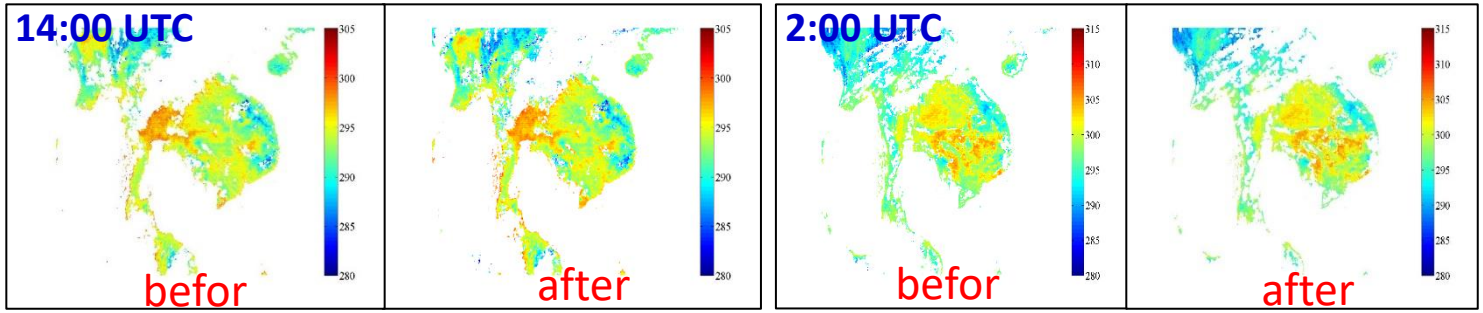
$$i_0 = int\left(i/2\right), j_0 = int\left(j/2\right)$$



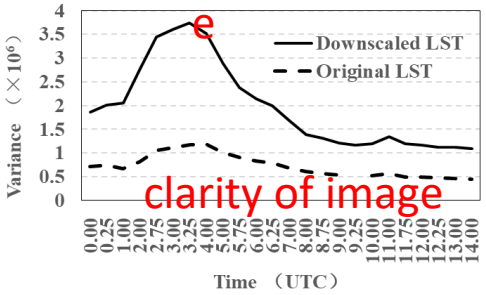
With data before and after time of maximum LST

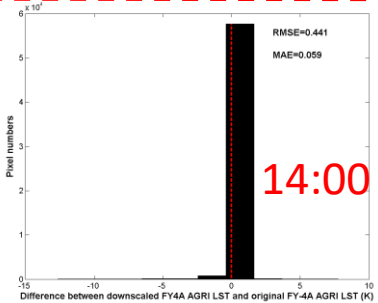
4. Test and validation

FY-4A AGRI LST before and after spatial downscaling at different times



Validation of the downscaled FY-4A AGRI LST





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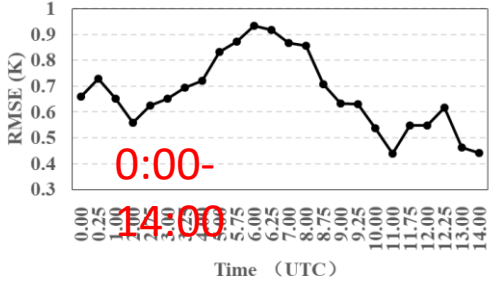
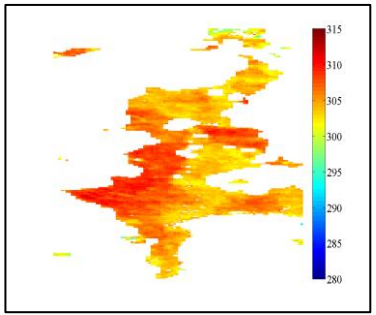
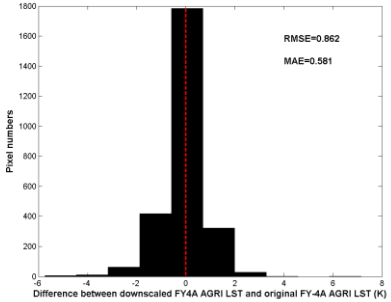
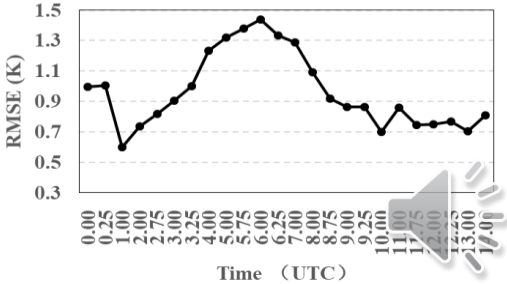


Effect of projection on the downscaled FY-4A AGRI LST







5. conclusions

From our test，the following conclusions can be drawn:

- The proposed FY-4A AGRI LST spatial downscaling algorithm is designed on the high time-frequency observations of new generation geostationary meteorological satellite and the local energy conservation theory. Not only both static and dynamic influencing factors of LST are taken into consideration, but also the diurnal variation of the dynamic factor. Except for the land cover, other parameters are all obtained from the same remote sensing platform as LST. So that the uncertainty of downscaling results caused by spatio-temporal matching between different observations can be reduced as much as possible.

- The quantitative analysis based on Variance and Vollath function shows that the downscaling algorithm can well improve the clarity of LST image. The comparison between statistical characteristics of land surface temperature before and after downscaling presents that the downscaled results can better maintain the accuracy of LST before downscaling. Without projection conversion, the biggest RMSE and MAE between after and before downscaling image is only 0.93 K and 0.16 K. With projection conversion, the accuracy of the downscaled results will slightly reduce with the biggest RMSE and MAE increased to 1.44 K and 0.94 separately.