Atmospheric Correction of Satellite Image Using the In-orbit Measured Atmospheric Data of Synchronization Monitoring Atmospheric Corrector (SMAC) Instrument

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INTRODUCTION

The quality of satellite images of the earth's surface is degraded because of the atmospheric scattering and absorption effects. The atmospheric effects should be reduced from the total radiance of satellite remote sensing images on a purpose of improving the quantitative level of high resolution satellite images. The characteristic parameters of atmospheric aerosol and water vapor vary in temporal and spatial scale. Thus, it is very important to obtain the atmospheric correction parameters (for example, aerosol optical depth, column water vapor, and etc.) at the imaging area in real-time while the satellite images are acquired by using the satellite optical payload on orbit. According to the polarization characteristics of atmospheric scattering and the relative low polarization characteristics of ground surface reflection radiance at a lower spatial resolution scale, the synchronization monitoring atmospheric corrector (that is SMAC) was developed by our team, Anhui Institute of Optics and Fine Mechanics (AIOFM), Chinese Academy of Sciences (CAS), in 2018.

SMAC INSTRUMENT

The SMAC instrument is a integrated robust payload. It will be installed on the imaging satellite platform. There are 8 spectral bands from 490nm to 2250nm in this instrument. These bands cover the solar reflective spectral range. They are 490(P), 550, 670(P), 870(P), 910, 1380, 1610(P), 2250(P), respectively. It helps to eliminate the ground surface radiance from the total radiance of ground and atmosphere. Fig. 1 shows the SMAC payload. Tab.1 shows the specifications of SMAC instrument.

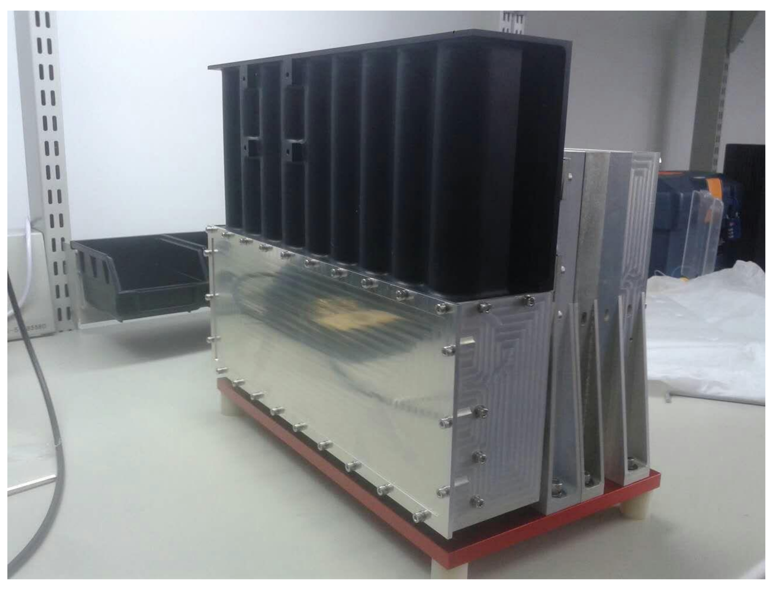

Fig.1 Synchronization Monitoring Atmospheric Corrector (SMAC)

Tab.1 The specifications of SMAC instrument

	Center wavelength (nm)	Spectral width (nm)	Application
Polarmetric and spectral channel	490（P）	20	Aerosol measurement
	550	20	Aerosol measurement
	670（P）	20	Aerosol measurement
	870（P）	40	Aerosol measurement, Water vapor measurement
	910	20	Water vapor measurement
	1380	40	Cirrus clouds measurement
	1610（P）	60	Aerosol measurement, Ground-atmosphere separation
	2250（P）	80	Ground-atmosphere separation
Quantization bits	14 bits		
Weight	≈15 kg		
Power consumption	≈ 30 W		

GROUND-BASED EXPERIMENT AND THE PRELIMINARY CORRECTION RESULT IN-ORBIT

The measured data of this instrument were verified through laboratory calibration and synchronized observation experiment with the CE318 sun photometer in the field ground before the launch. The experiment results indicate that the performance of SMAC is satisfactory.

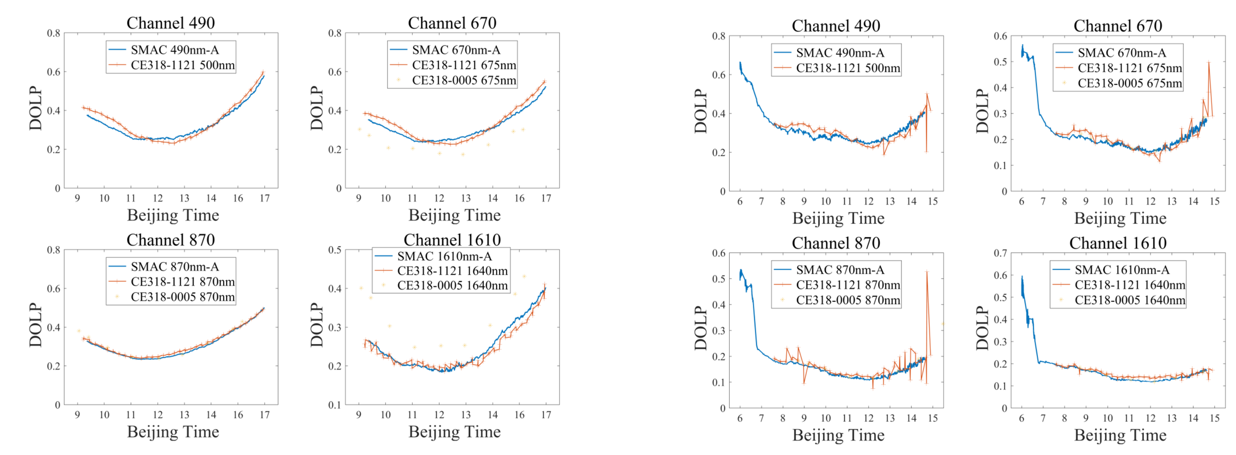

Fig.2 The calculated result of DOLP between the SMAC and the CE318 at 11,4,2017(lift) and 11,7,2017 (right)

After the launch, the measured data of SMAC in-orbit were analyzed and retrieved at the special radiance calibration site. The polarization information of atmosphere was employed when the aerosol optical thickness was retrieved. The atmospheric correction parameters were used to correct the radiance of satellite images. The method of radiate transfer model was employed in the satellite image correction activity. The several gray artificial targets with known reflectivity were set in the calibration site. Meanwhile, the black artificial target and the white one were also laid.

After using atmospheric correction, the reflectivity errors of gray targets are less than 10%. Meanwhile, The MTF value of satellite image are increased more than 10%.

CONCLUSIONS

The atmospheric correction results for the satellite images show that the inversion accuracy of the ground surface reflectivity was improved largely. In addition, the MTF value of image is close to the designed one of the satellite observation system. Hence, the real-time atmospheric correction technique based on the SMAC on board satellite is a prosperous technique in the satellite remote sensing application.

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