Simulation of High Precision Nighttime Radiation Transmission based on MODTRAN

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ABSTRACT

The atmosphere is an important factor that affects the accuracy of remote sensing radiation at night. Effective atmospheric correction for night-light satellite data is a prerequisite for realizing the quantitative application of night-light remote sensing. In this study, the high-precision lunar irradiance model MT2009 was introduced into MODTRAN, and the MODTRAN night radiance model was improved to achieve the accurate simulation of night radiation transmission, aiming at the problem of inaccurate simulation of night radiation transmission caused by the low accuracy of lunar irradiance at the top of atmosphere of the MODTRAN model. And the improved model is used for atmospheric correction of luminous remote sensing data.

The results show that the accuracy and stability of the improved model are greatly improved compared with MODTRAN. When the absolute value of the lunar phase Angle is less than 40°, the atmospheric correction accuracy of the model is better than 10%, and when the lunar phase angle is greater than 0, the atmospheric correction results are closer to the reference value.

INTRODUCTION

Effective atmospheric correction for night-light satellite data is a prerequisite for realizing the quantitative application of night-light remote sensing. The transmission mechanism of atmospheric radiation at night is the same as that under daytime conditions. The main difference between day transmission and night transmission is that the radiation source at night is the moon. The brightness of the moon will change due to the changes of the moon phase angle and the moon-earth distances, which will affect the upward and downward radiation during transmission. MODTRAN is designed with night radiance mode, but the model does not consider the changes of moon-earth distances, and the moon phase function does not consider wavelength correlation, etc, which can lead to a certain error to the MODTRAN night radiance mode and reduce the accuracy of atmospheric correction. To solve the problem, this research couples the MODTRAN model and MT2009 to simulate radiative transmission at night at a high precision.

MODEL and STUDY AREA

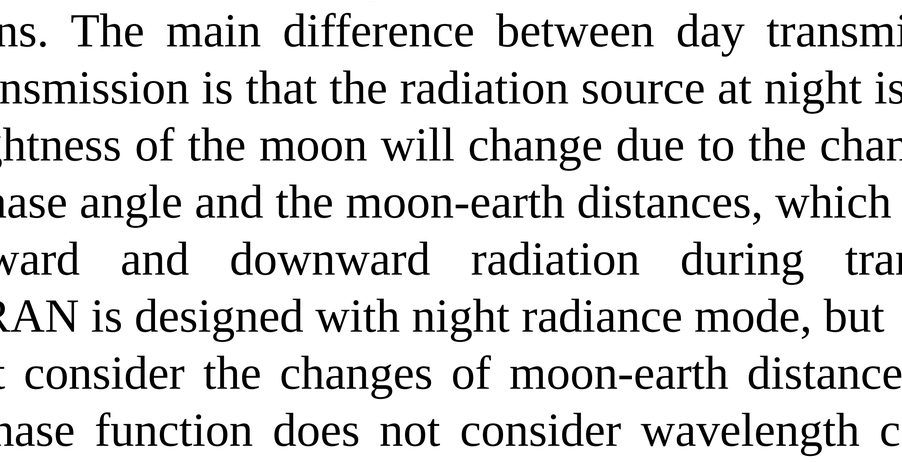


Figure 1. MT2009 lunar irradiance model

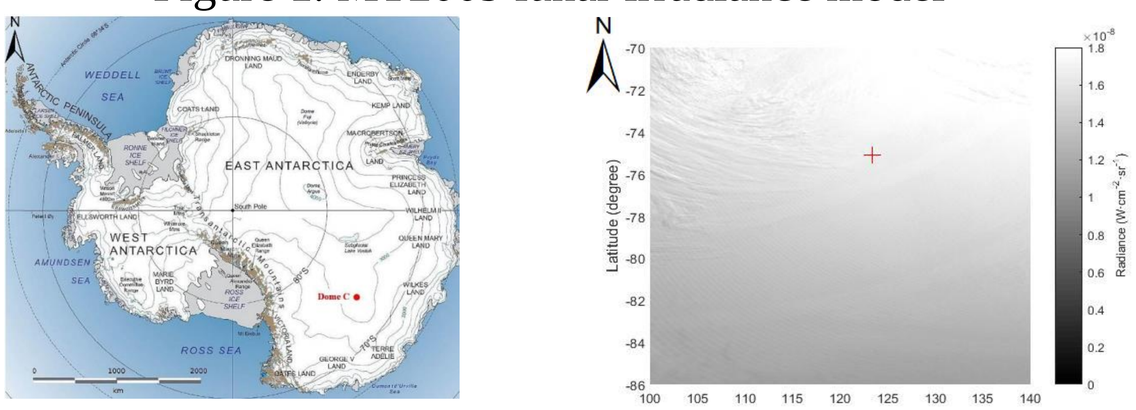
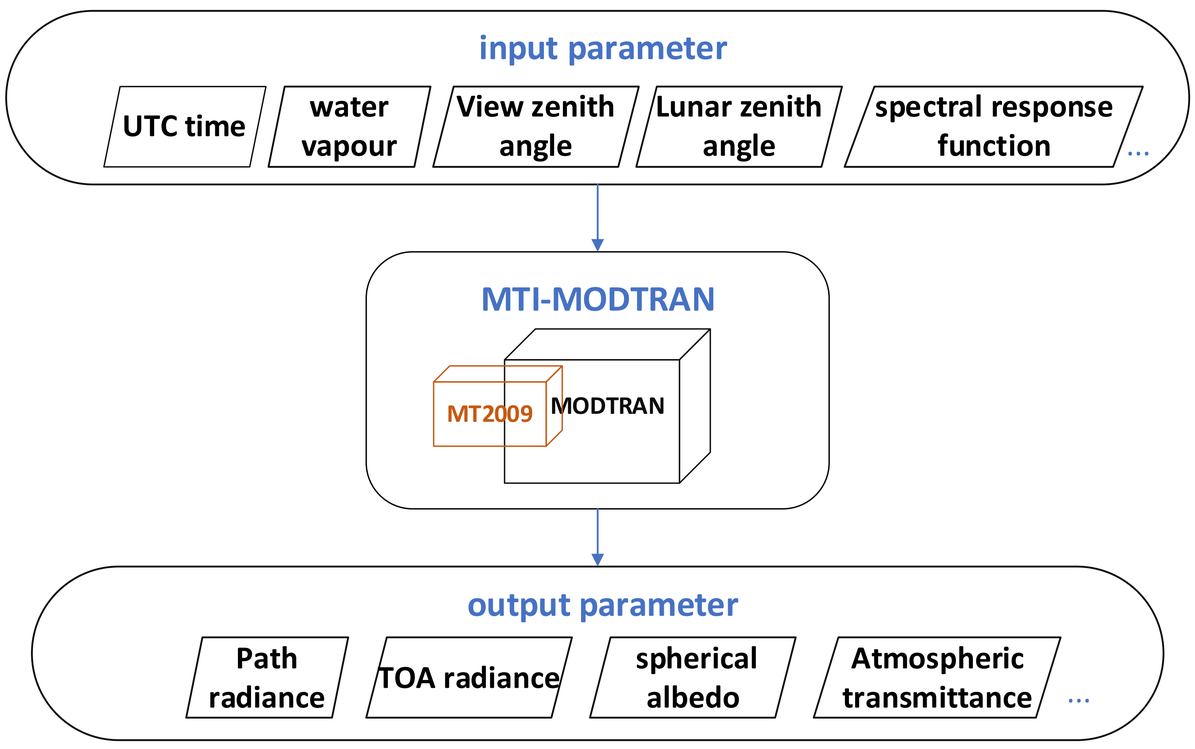


Figure 2. The location of Dome C site and VIIRS DNB image

METHODOLOGY



RESULTS

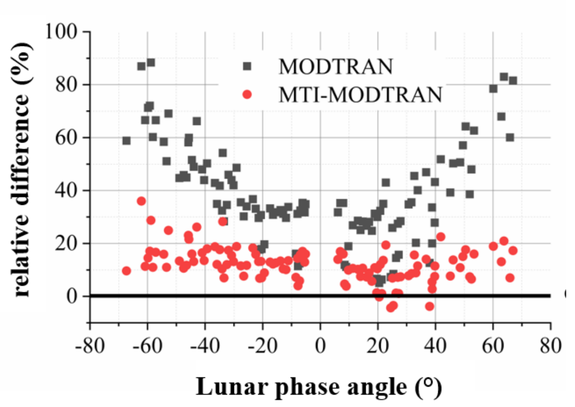


Figure 3.Relative differences in surface albedo simulated by the models

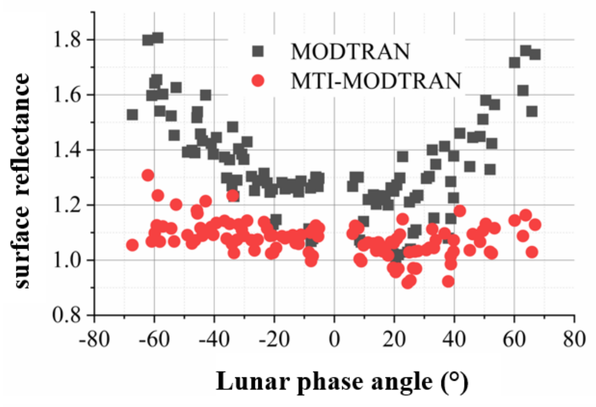


Figure 4. Surface reflectance simulation by models

Table 1. Relative differences under different ranges of lunar phase angles

Lunar phase angle（°）		-20~20	-40~-20/20~40	-60~-40/40~60	-75~-60/60~75
MODTRAN	mean value	25.79%	30.03%	54.58	71.42%
	variance	0.69%	1.59%	1.30%	1.18%
MTI-MODTRAN	mean value	9.84%	9.11%	14.63%	15.76%
	variance	0.18%	0.49%	0.32%	0.82%

CONCLUSION

In this study, MODTRAN is improved, and the improved model MTI-MODTRAN is used to carry out atmospheric correction on the night light remote sensing data. The Dome C region of Antarctica is selected as the verification site to verify the feasibility of atmospheric correction by using MTI-MODTRAN, and the application range of the night atmospheric correction is analyzed. However, the improved model can only simulate the radiation transmission of the moon, while the artificial light emitted from the ground cannot be considered and cannot adapt to the complex radiation environment at night. It is hoped that it can be improved in the future research work.

MAJOR REFERENCES

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