

***ENTROPY PRODUCTION AND RADIATION ENTROPY FLUX OF  
THE EARTH SYSTEM***

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**ABSTRACT**

Entropy production of the Earth system and the radiation entropy flux at the top of the atmosphere (TOA) are critical for improving our understanding of the Earth' climate. However, both quantities have not been well studied and various approaches/expressions have been used to estimate them. This work first reviews and compares various existing expressions for calculation of the radiation entropy flux. Then the net TOA radiation entropy flux is calculated by constructing several global models from the existing expressions under the assumption of an isotropic gray-body Earth and isotropic reflecting TOA shortwave (SW) radiation. It is shown that the differences arising from using different expressions is significant, larger than the typical entropy product rate associated with the atmospheric latent heat process. The applicability of the various existing expressions is further examined by analyzing their errors relative to the results calculated from Planck's mechanical expression. Furthermore, it is demonstrated that the estimation of the reflecting TOA SW radiation entropy flux can be improved by relaxing the commonly used Lambertian assumption.