The Night Emission Simulated Thermal Model for Near-Earth Asteroids

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The Near-Earth Asteroid Thermal Model (NEATM, Harris, 1998) has proven to be a reliable model for radiometric diameter determination. However NEATM assumes zero thermal emission on the night side of an asteroid, affecting the best-fit beaming parameter η, overestimating the effective diameter D_{eff} and underestimating the albedo p_v at large phase angles. The Night Emission Simulated Thermal Model (NESTM) is introduced. NESTM models the night side temperature (T_{night}) as an iso-latitudinal fraction (f) of the maximum day side temperature (T_{max} calculated for NEATM with η = 1): $T_{night} = fT_{\max} \cos^{1/4} \phi$, where ϕ is the latitude. A range of f is found for different thermal parameters, which depend on the surface thermal inertia (Γ). NESTM is tested on thermal IR fluxes generated from simulated asteroid surfaces with different Γ.

NEATM and NESTM diameters are compared with radar diameters. For NEATM, we discuss the possibility that diameters obtained using default η may be systematically underestimating the diameter while diameters obtained by best-fitting η may be overestimating the diameter. It is found that NESTM may reduce a systematic bias in overestimating diameters. From these tests, it is suggested that a version of the NESTM which assumes Γ = 200 J m^{-2} s$^{-1/2}$ K^{-1} is adopted as a default model when the solar phase angle is greater than 45°.