**PREDICTED WATER ICE STABILITY ON (269) JUSTITIA AND IMPLICATIONS FOR REMOTE SENSING.**
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**Introduction:** Asteroid (269) Justitia has a very red spectrum, more so than typical main belt asteroids and more similar to Trans-Neptunian objects (TNOs) [1]. This raises a key question: are some extremely red objects in the asteroid belt implanted TNOs? A remote sensing spacecraft mission may be able to collect geochemical data to support an outer solar system origin, like for Ceres [e.g., 2]. (269) Justitia is the current final, orbital target of the Emirates Mission to Explore the Asteroid Belt. Here, we make predictions about the depths of near-surface water ice, assuming that (269) Justitia started as icy and using standard thermal and vapor diffusion models [3-6]. These predictions will help understand how $H_2O$ ice may be observed by the mission.

**Model and parameters:** We utilize the semi-implicit thermal model from [3] to calculate minimum, maximum, and mean-annual-average temperature for every 5° latitude. We select an obliquity and longitude of perihelion of 0° for these initial model runs. We assume (269) Justitia is smooth, though micro-cold traps are likely [6], and that the asteroid is spherical. (269) Justitia has a geometric albedo of 0.06, and we set the regolith to have the thermophysical properties of Ceres regolith [e.g., 3]. We use 100 µm diameter grains and other standard parameters for the vapor diffusion scheme [e.g., 5], and run this model for 4.5 Gyr.

**Results:** Maximum, minimum, and annual average surface temperatures are shown in Fig. 1 for (269) Justitia. Temperatures at which solid $H_2O$ (~106 K) and $CO_2$ (~54 K) sublimate slowly over geologic time [7] are shown by dashed lines. Water ice is only stable near the poles at 0 obliquity. In this model, no surface locations allow permanent surface $CO_2$ ice [7].

Buried water ice would retreat under less than 10 m of regolith in the current model (Fig. 2). At the equator, impact craters >~75 m diameter would be able to excavate water ice. We predict that the largest impact expected during a 6-month period at (269) Justitia would be ~2 m, making observations of recent ice exposing impacts only likely near the poles.

(269) Justitia should retain a significant fraction of water ice in its near-surface region, though only at the surface at the poles with these assumptions. Future work will focus on exploring more orbital parameters to understand the limits of ice stability on this asteroid.

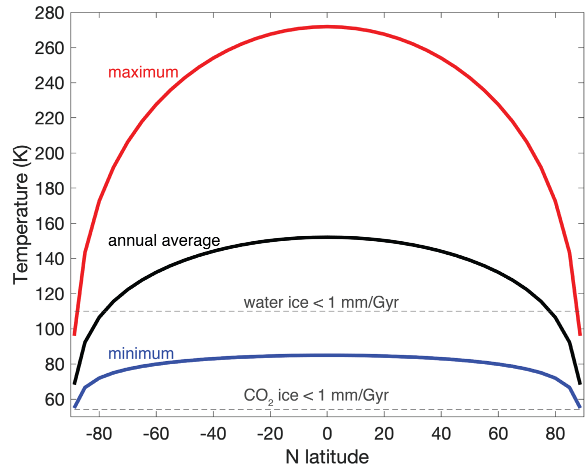


**Figure 1.** Surface temperatures from (269) Justitia using Ceres-like regolith, current orbital parameters, and 0 obliquity.

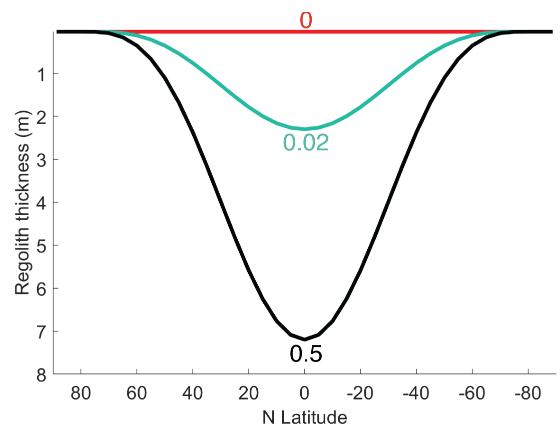


**Figure 2.** Depth of material over the ice table on (269) Justitia assuming 0 obliquity and 100 µm grain diameter. Numbers are volume fraction of ice-table regolith.

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