CHARACTERIZING THE EFFECT OF BOULDER MOTION ON REPRESENTATIVE ASTEROID YORP COEFFICIENTS. J. W. McMahon[1] and D. N. Brack[1,2], [1]Smead Aerospace Engineering Sciences Department, University of Colorado, Boulder, CO USA (jay.mcmahon@colorado.edu), [2]Lockheed Martin Space, Littleton, CO, USA.

Introduction: The YORP effect is one of the dominant processes that controls the dynamical evolution of small asteroids in the inner solar system. It has recently been hypothesized that as an asteroid's spin rate increases due to YORP, the shape will change, which in turn causes the YORP coefficient to drastically change before reaching the spin limit - thus making the classical YORP cycles "stochastic." This work examines how the YORP coefficient changes when realistic boulders move around the surface of an asteroid. We examine this process on four general asteroid shapes represented by Geographos, Golevka, Itokawa, and Bennu. The motion of the boulders is determined using dynamic simulations of boulder motion as the spin rate of an asteroid changes. The results explain the possibility of boulder motion leading to changes in the YORP coefficients such that YORP evolution becomes "stochastic."

Previous work [1, 2] has hypothesized that relatively small changes in asteroid topography can lead to massive changes in YORP coefficients, leading to the idea of "stochastic" YORP. However more recent work [3, 4] showed that for Bennu, expected reshaping due to landslide type events lead to YORP coefficients that are relatively slowly changing, and certainly not changing sign as in the "stochastic" case.

Given the prevalence of boulders that have recently been discovered on Bennu [5] and Ryugu [6], it is important to understand how realistic boulder shapes influence the YORP coefficients, and how their relocation on the surface can change the coefficients.

Initial Illustrative Results: This work investigates the influence of realistic meter-sized boulder shapes on the YORP coefficients of asteroids. An example of some initial investigation of boulders on the surface of the pre-encounter Bennu shape model are shown in Fig. 1. We investigate 4 different representative asteroid taxonomies by using representative asteroids of that class: the elongated shape (Geographos), the non-classified shape (Golevka), the contact binary shape (Itokawa), and the spheroidal shape (Bennu).

Furthermore we use the SEA RATS tool, developed at CU Boulder [7], to see where boulders may move if the asteroid continues to spin up in order to determine what boulder relocation is realistic (as opposed to arbitrarily moving boulders on the surface). Combined with the results for landslides in the previous work [3, 4], this work provides detailed models for the expected variability in YORP coefficients due to surface processes on small asteroids.

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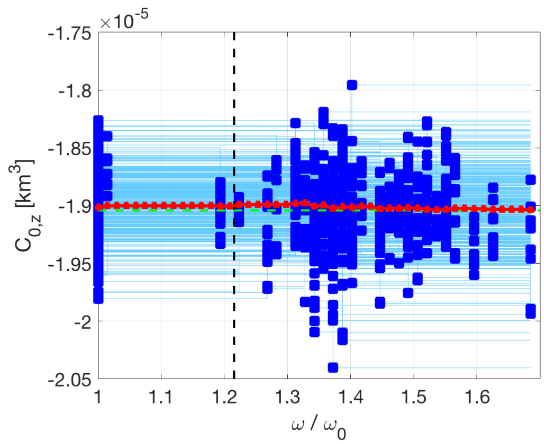

Figure 1 - A set of example single 5-m boulder evolutions and their effect on Bennu's YORP coefficient. As the angular velocity (ω) increases, boulders move, but their effect on YORP is minimal. The nominal shape YORP coefficient is shown in green, which is almost identical to the population average shown in red.