Constraints on global distribution of regolith deposits on the asteroid 162173 Ryugu

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It is expected that the global distribution of regolith deposits is controlled by the gravitational potential fields on small asteroids because fine-grained regolith migrates to low potential regions on a small asteroid (Richardson and Bowling, 2014). Hirata et al. (2014) demonstrated that the effective gravitational potential field on the surface of a small asteroid can be expressed as the combination of two potential components; the pure gravitational potential of the mass and the centrifugal potential formed on the rotating body. Gravitational lows would be formed on the polar regions of an oblate body with a slow rotation, whereas such lowlands would be found in the equatorial region of a spherical body with a fast rotation. Hirata et al. (2014) also defined the equilibrium rotation period as the period at which the effective potential in the polar region becomes equal to that in the equatorial region. Observed or expected distributions of regolith deposits on asteroids Itokawa and Bennu can be explained with this model.
In this report, we will investigate distributions of the gravitational potential and inferred regolith deposits on the asteroid Ryugu with our model. Ryugu is a target of the Japanese asteroid exploration mission Hayabusa2. The distribution of regolith deposits on the asteroid is of interest not only scientifically but also from the engineering point of view because regions with smooth regolith deposits could be candidates for safe landing sites of the spacecraft. The total amount of regolith produced by impact events on Ryugu is estimated with an ejecta velocity distribution model by Michikami et al. (2007). Then the distribution of the effective gravitational potential field on the asteroid is explored. The latest information on physical properties of Ryugu including the shape and the rotation period are provided by Müller et al. (2016).

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