Geophysical Research Abstracts
Vol. 19, EGU2017-4682, 2017
EGU General Assembly 2017

Dynamics of landslides on comets of irregular shape

Leszek Czechowski
University of Warsaw, Institute of Geophysics, Faculty of Physics, Warsaw, Poland (lczech@op.pl)

Landslides were observed on a few comet's nuclei, e.g. [1], [2]. The mechanism of their origin is not obvious because of very low gravity. According to [2] fluidization and multiphase transport of cometary material could be an explanation. We investigate here motion of the mass on a comet of irregular shape. The mechanism responsible for the low friction is not considered here. In fact, mass motion often occurs without contact with the surface. The motion could be triggered by meteoroids impacts or by the tidal forces.

Comets nuclei are believed to be built of soft materials like snow and dust. The landing of Philae on the comet 67P/Czuriumow-Gierasimienko indicates a different situation. According to [1]: "thermal probe did not fully penetrate the near-surface layers, suggesting a local resistance of the ground to penetration of >4 megapascals, equivalent to >2 megapascal uniaxial compressive strength". Here we assume that elastic properties of comet's nuclei could be similar to elastic properties of dry snow, namely Young modulus is assumed to be 1 – 100 MPa, see [3] and [4].

We consider nucleus of the shape of 67P/Churyumov-Gerasimenko with density 470 kg/m3. The impact or tidal forces result in changing of rotation of the comet. In general, the vector of angular velocity will be a subject to nutation that results in changing of centrifugal force, and consequently could be a factor triggering landslides. Note that nucleus' shape does not resemble the shape of surface of constant value of gravitational potential (i.e. 'geoid').

Our numerical models indicate the parts of the nucleus where landslides start and other parts where landslides stop. Of course, the regolith from the first type of regions would be removed to the regions of the second class. The motion of the mass is often complicated because of complicated distribution of the gravity and complicated shape of the nucleus.

Acknowledgement: The research is partly supported by Polish National Science Centre NCN) (decision 2014/15/B/ST 10/02117)
References
[1] T. Spohn, et al. (2015) Thermal and mechanical properties of the near-surface layers of comet 67P/Churyumov-Gerasimenko. Science 31 July 2015: Vol. 349 no. 6247 DOI: 10.1126/science.aab0464
[2] Belton M. J.S., Melosh J. (2009). Fluidization and multiphase transport of particulate cometary material as an explanation of the smooth terrains and repetitive outbursts on 9P/Tempel 1. Icarus 200 (2009) 280–291
[3] Reuter B. (2013) On how to measure snow mechanical properties relevant to slab avalanche release. International Snow Science Workshop Grenoble – Chamonix Mont-Blanc - 2013 007
[4] Ball A.J. (1997) Ph. D. Thesis: Measuring Physical Properties at the Surface of a Comet Nucleus, Univ.of Kent U.K.