DYNAMICS OF LANDSLIDES ON COMETS OF IRREGULAR SHAPE.

Leszek Czechowski, University of Warsaw, Faculty of Physics, Institute of Geophysics, ul. Pasteura 7,02-093 Poland (lczech@op.pl /Fax: +48-22-5546882)

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

Properties: Comets nuclei were believed to be built of soft materials like snow and dust. However data sent by Philae from 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].

Our model: We consider nucleus of the shape of 67P/Churyumov-Gerasimenko with density 470 kg/m^3. 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') –Fig.1.

Preliminary results: 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

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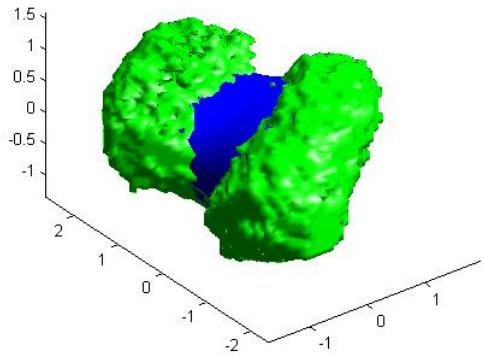

Fig. 1. An example of the surface of constant value of gravitational potential ('geoid') (blue) and physical shape of nucleus (green).