IMPACT DISTURBANCE OF THE VENUS ATMOSPHERE

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Summary. Experimental simulations of the atmosphere-surface interaction during the high-velocity impact are presented. At Venus an atmospheric vortex, generated with impact, may interacts with a local wind. Some of surface features, observed at Magellan images may be related with the simulated effect.

Introduction. A laboratory simulation of the passage of a high velocity body through the atmosphere has begun at the Explosion Branch of Schmidt Institute (now the Institute for Dynamics of Geospheres) several years ago. The effect of a long distance soil transport has been observed [1]. An atmospheric toroidal vortex originated around a zero point was discussed as a possible mechanism of this near-surface non-ballistic soil transport [2]. Here we present some new results of the experimental investigation of this effect.

1. Special experiments to visualize an impact-induced vortex has been carried out. As in our previous experiments the detonation of the long (0.9 m) and thin (3mm) line HE charge of PETN above the surface of an aluminum sheet with a sand layer has been used to simulate an impact disturbance of the atmosphere.

Fig. 1 (a-c) demonstrates a vortex origin for a vertical downward detonation. Times after the detonation are 0.1 s (a), 0.3 s (b) and 0.7 s (c). One may see the vortex formation near the surface. The vortex does not form when the detonation propagated upward from the surface. So the vortex origin is a consequence of an interaction between the downward gas flow and a solid surface.

The scaling of this effect to the natural conditions is a rather complex problem. For the first approximation we have chosen as characteristic parameter of the event the energy transferred to the atmosphere per unit length of a projectile trajectory, q_L, (or an explosive energy per unit length of a HE line charge), the velocity of a projectile, V (the detonation speed), the characteristic height of an atmosphere, H (the HE charge length), an atmospheric pressure, p, and sound velocity, c. These values may be used for a comparison of any two events, being combined in nondimensional parameters: the Mach number $M=V/c$, the characteristic length $L=(q_L/p)^{.5}/H$. Comparing with these parameters one may conclude that the described experiment simulate the early stage of the impact on Venus for a projectile with a diameter of 2.3 km and a velocity of 8 km/s.

For laboratory continuous the time scale of a vortex spreading is about 1 s. The Reinolds number for the vortex is about 10^5, so the vortex seems to be a turbulent one. Using the time scale comparison with the same parameters the real time scale for the Venusian impact is about 50,000 s or 13 hours. We are not yet sure for this estimate, but it is interesting to look at the possible consequence. For a near surface wind velocity of 1 m/s a down-wind vortex displacement is about 50 km. So the final shape of the dust deposits transported by the vortex seems to be affected with a local wind direction. It would be very interesting to analyze a possible connection of this effect with a parabola phenomenon on Venus.

2. Experiments to simulate an oblique impact has been carried out with an HE charge inclined at 45^o to the surface. Fig 2 (a-c) shows the target surface with low profiles sand strips. Frames demonstrate the initial configuration (a), the moment 0.034 s after detonation (b) and a final picture (c). Sand particles under the charge begin to move from the point of impact to periphery (b). The final picture (c) show that later part of these particles change the direction of motion, being finally displaced forward. Special side framing has revealed the formation of a vortex, which moves downrange with 3 to 5 m/s. This velocity is about 0.001 of the particle velocity in the charge which allow to estimate displaced mass of air.

Conclusions. Conducted experiments revealed two phenomena which may be observed on Venus: (i) a long lived near surface vortex may interact with an down wind atmospheric motion, and (ii) a complex time history of the soil particles displacement for an oblique impact. Experiments should be continued.

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References. 1. Provalov A.A. and B.A.Ivanòv.(1992). *LPSC XXIII*, p. 1115-1116. 2. B.A.Ivanov, I.V.Nemchinov, V.A.Svetsov, A.A.Provalov, and V.M.Khazins (1992) Impact cratering on Venus: Physical and mechanical models. *J. Geophis. Res.*, V. 97, No. E10, pp. 16167-16181.

Fig.1 (top to down: a, b, c) Fig2. (a, b, c) (top to down: a, b, c)