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Numerical modelling of sedimentary structures in rivers on Titan and Earth

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1. Abstract
On Titan surface we can expect a few different geomorphological forms, e.g. fluvial valley and river channels. In our research we use numerical model of the river to determine the limits of different fluvial parameters that play important roles in evolution of the rivers on Titan and on Earth. We have found that transport of sediments as suspended load is the main way of transport for Titan. We also determined the range of the river's parameters for which braided river is developed rather than meandering river.

2. Introduction
Titan is a very special body in the Solar System. It is the only moon that has dense atmosphere and flowing liquid on its surface. The Cassini-Huygens mission has found on Titan meandering rivers, and indicated processes of erosion, transport of solid material and its sedimentation. This work is aimed to investigate the similarity and differences between these processes on Titan and the Earth.

3. Numerical model
The dynamical analysis of the considered rivers is performed using the package CCHE modified for the specific conditions on Titan. The package is based on the Navier-Stokes equations for depth-integrated two dimensional, turbulent flow and three dimensional convection-diffusion equation of sediment transport. For more information about equations see [1].

4. Parameters of the model
We considered our model for a few different parameters of liquid and material transported by a river. For Titan we consider liquid corresponding to a Titan's rain (75% methane, 25% nitrogen), for Earth, of course, the water. Material transported in rivers on Titan is water ice, for Earth - quartz. Other parameters of our model are: inflow discharge, outflow level, grain size of sediments etc. For every calculation performed for Titan's river similar calculations are performed for terrestrial ones.

5. Results and Conclusions
The results of our simulation show the differences in behaviour of the flow and of sedimentation on Titan and on the Earth. Our preliminary results indicate that suspended load is the main way of transport in simulated Titan's conditions. We also indicate that braided rivers appears for larger range of slope on Titan (e.g. S=0.01-0.04) than on Earth (e.g. S=0.004-0.009). Also, for the same type of river, the grain size on Titan is at least 10 times larger than on Earth (1 cm for Titan versus 1 mm for the Earth). It is very interesting that on Titan braided rivers appear even for very little discharge (e.g. Q=30m3/s) and for very large grain size (e.g. 10 cm). In the future we plan the experimental modelling in sediment basin to confirm results from computer modelling.

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References
[1] Misiura, K., Czechowski, L., 2015. Numerical modelling of sedimentary structures in rivers on Earth and Titan. Geological Quarterly, 59(3): 565-580.