Abstracts of MMA2015, May 26–29, 2015, Sigulda, Latvia

WEAKLY NONLINEAR INSTABILITY OF SHALLOW FLOWS WITH FREE SURFACE

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Methods of weakly nonlinear theory are often used in an attempt to describe the evolution of linearly unstable mode just above the threshold [1]. General asymptotic scheme can be described as follows. First, a linear stability problem is solved and the critical values of the parameters are determined (for example, bed friction number in shallow flows). If the actual bed friction number is slightly smaller than the critical value, the flow becomes linearly unstable with a very small growth rate. Second, the velocity components or stream function of the flow are represented by asymptotic series where the small parameter characterizes the difference between the actual bed friction number and its critical value. Third, equations at orders one, two and three are obtained. The form of the solution at the next order depends on the solution structure at the previous order. Finally, using solvability condition at order three we obtain an amplitude evolution equation for the most unstable mode.

It is shown in the previous studies that for shallow water flows under the rigid-lid assumption the amplitude evolution equation is the complex Ginzburg-Landau equation [2]. In this talk we show that the amplitude evolution equation for shallow flows with free surface (when water depth is not constant) is also the complex Ginzburg-Landau equation. The coefficients of the equation are obtained in the form of integrals depending on solutions at orders one and two.

REFERENCES

[1] P. J. Schmid and D.S. Henningson. *Stability and transition in shear flows.* Springer, New York, 2001.

[2] A.A. Kolyshkin and M.S. Ghidaoui. Stability analysis of shallow wake flows . *Journal of Fluid Mechanics*, **548** 355-377, 2003.