# Transition to turbulence in the bottom boundary layer under a solitary wave.

M. Sadek, L. Parras and P. Diamessis.

[1] School of Civil and Environmental Engineering, Cornell University, NY, 14853, U.S.A.

[2] Universidad de Málaga. E.T.S. Ingeniería Industrial, Málaga, 29071, Spain.

October 10, 2016

**Abstract**

In this study we explore the transition to turbulence in the unsteady bottom boundary layer (BBL) driven by a surface solitary wave. Based on the experimental observation reported by Sumer *et al* (J. Fluid Mech. vol. 646, 2010) for such a base flow, two potential transition scenarios exist. The primary scenario is associated with the classical transition resulting from the breakdown of the exponentially growing 2D Tollmien-Schlichting waves. We show that this time varying flow can be characterized as stable, conditionally unstable and unconditionally unstable. The alternative scenario consists of a characteristically different path to transition, resulting from the formation of localized turbulent spots. The formation of these turbulent spots leads to a bypass transition to turbulence. We show that this flow is able to produce high gains of energy for 3D structures resembling elongated streaks by means of non-modal stability analysis. Furthermore, the evolution of the streaks into the turbulent spots is captured using a fully non-linear three dimensional direct numerical simulation with a spectral multidomain penalty method model.

**Bio**

Luis Parras earned his MS in Mechanical Engineering at Málaga University (Spain) in 2003 and his PhD in Fluid Mechanics in the same university. His doctoral studies dealt with the interaction of vortices with walls to be used as tornado models. He finished in 2007 and that year he started to work in the FAR-WAKE European Project, studying the stability of vortices behind airplanes. Later in 2008, he got a postdoc position at IRPHE research institute (Marseille, France) where he worked on the stability of compressible jets and vortices. He returned to Málaga with an Assistant Professor position in 2010 and finally he got an Associate Professor position in 2013. At the moment, his research is related to aerodynamics, numerical simulations of industrial problems and stability of fluid flows.