SIMULATION OF THE ATMOSPHERIC BOUNDARY LAYER APPLYING LARGE EDDY SIMULATION TECHNIQUE WITH FLUENT

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The atmospheric boundary layer flow (ABL) is the part of the atmosphere in which we live and take place most human activities. Therefore, a deep knowledge of ABL is essential and computational fluid dynamics (CFD) is a powerful tool to model this type of flow. Present literature points out that Reynolds-Averaged Navier-Stokes (RANS) is not sufficient to represent the ABL flows and more sophisticated turbulence modeling such as large eddy simulation (LES) is needed. The present DC project is the continuation of Crasto's Diploma Course Project and it is aimed to simulate neutral, stable and convective ABL with using DES module of FLUENT with home-made Smagorinsky-Lilly subgrid-scale model. The energy equation is introduced to take into account the heat flux at the ground. Home-made Smagorinsky-Lilly subgrid-scale model written by Crasto is modified to be sensitive to physical parameters such as distance to the ground and atmospheric stability.

Density variations are introduced into FLUENT with defining new material like air. Source term is also introduced in vertical momentum in order to have hydrostatic balance taken in account by FLUENT. The flow field is firstly described by the RANS turbulence closure such as k-ε model, Spalart-Almaras and Shear Stress Transport (SST) turbulence models. Results obtained by RANS approach are perturbed and perturbed velocities are used for initial conditions of LES simulations. The results presented in this paper include comparisons with respect to earlier numerical solutions. It is shown that the wall shear stress never reaches the equilibrium with the default initialization module of FLUENT and the turbulence does not develop itself. Different perturbations are tested to get accurate flow statistics and influences of initial perturbations should be investigated for future works.

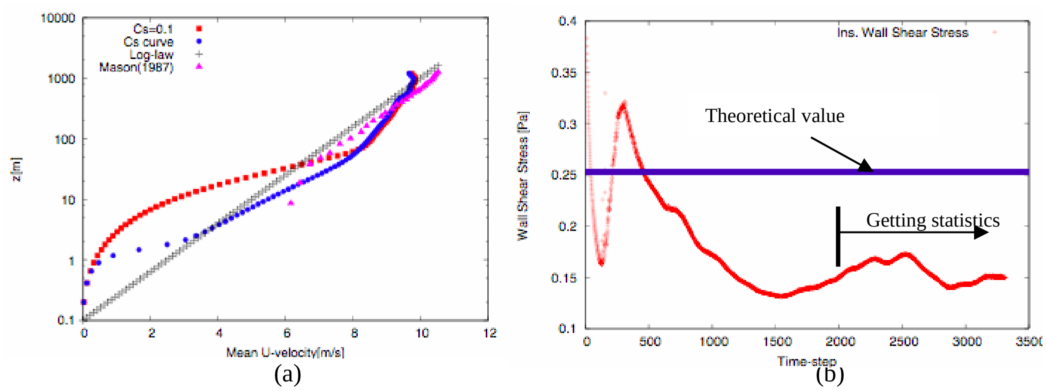

Figure 1-a) Horizontal velocity profile with Smagorinsky constant equal to 0.1 and changes with height. b) Time evolution of wall shear stress