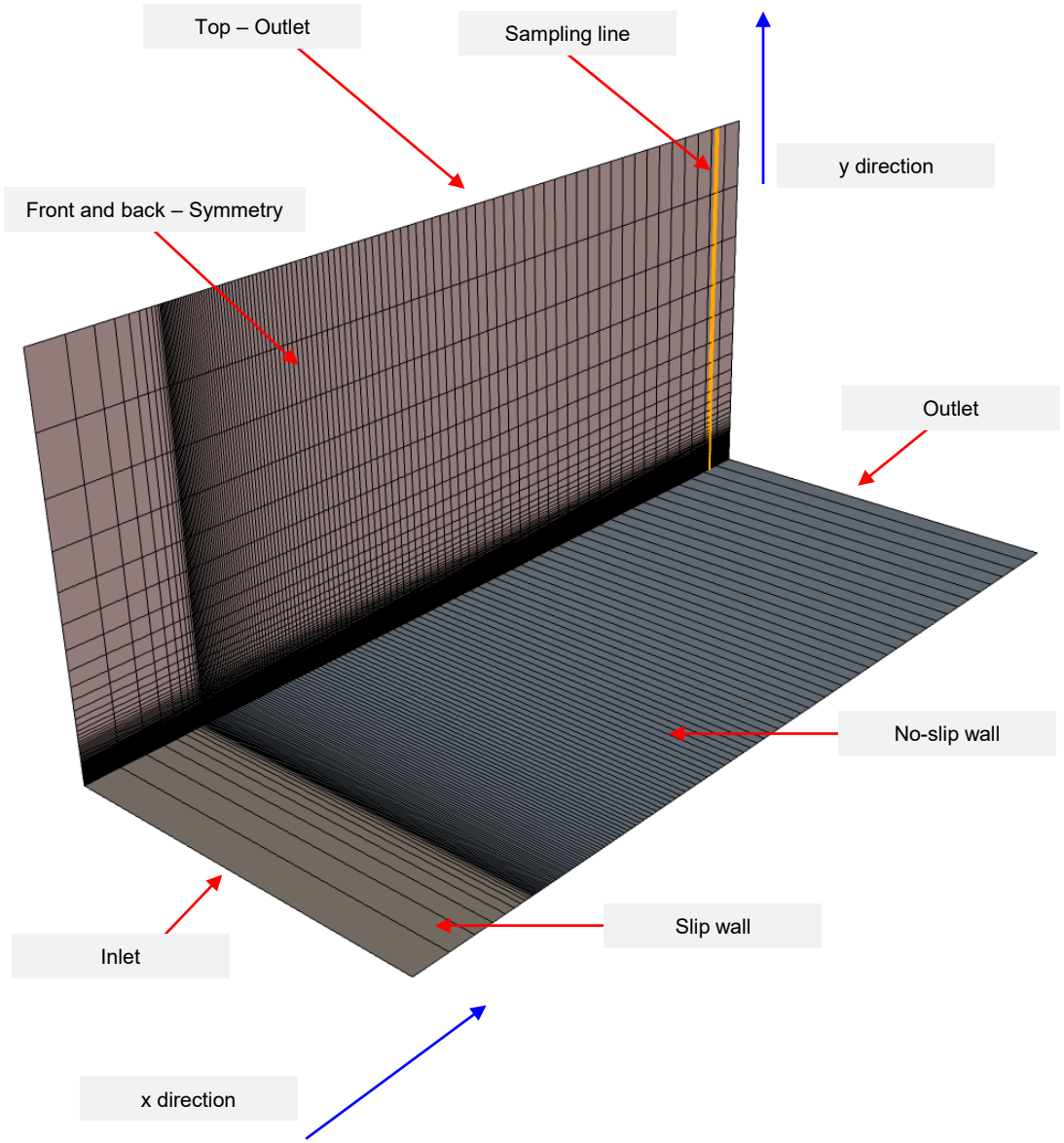
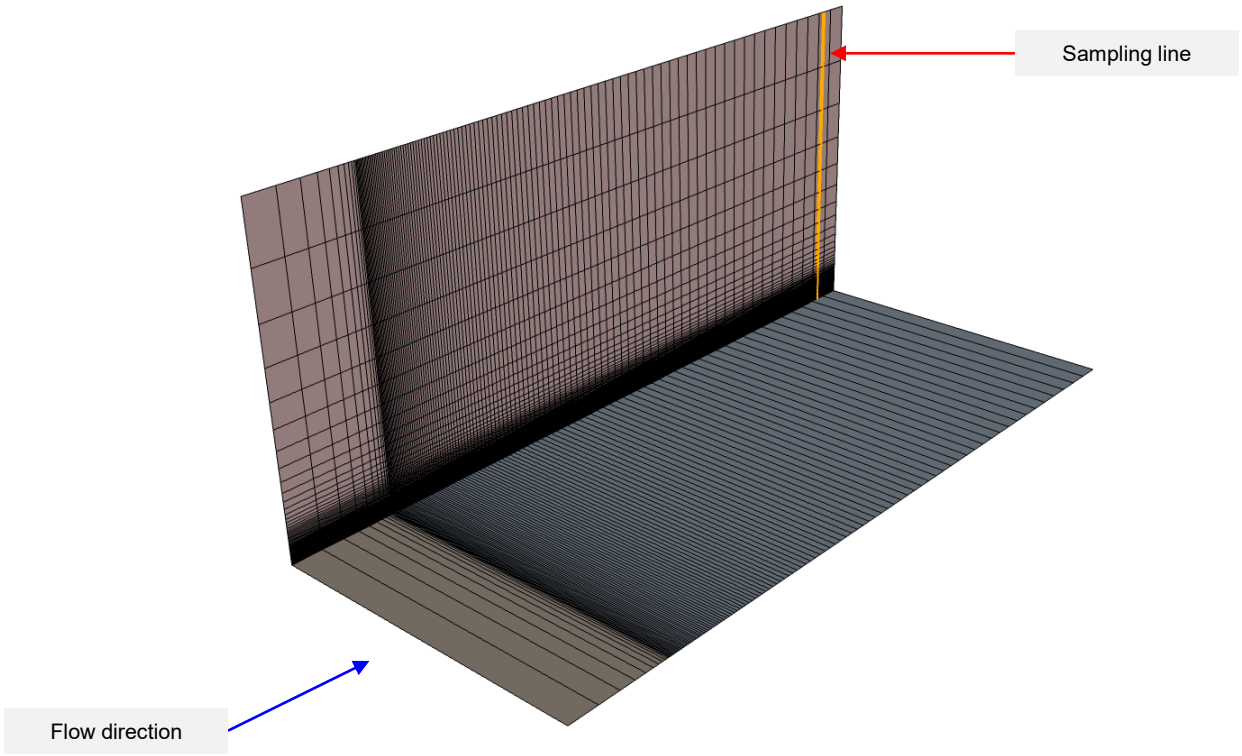
Problem definition

- Working fluid:
  - Air
  - Incompressible
  - Isothermal
  - Density = 1.0 kg/m^3
  - Viscosity = 2×10^{-7} kg/m.s
- Bottom wall length:
  - 2 m
- Reynolds number based in bottom wall length:
  - 10 000 000
- Use any turbulence model.
- Sampling line location:
  - 1.90334 m (in the x direction)
- Plot in the sampling line: velocity profile, turbulence production and dissipation terms, turbulent kinetic energy, fluid viscous stresses, fluid turbulent stresses, fluid total stresses, normalized velocity profile.
- Compare the solutions using a lowRE and a highRE approach.
- Compute friction coefficient at the bottom wall.



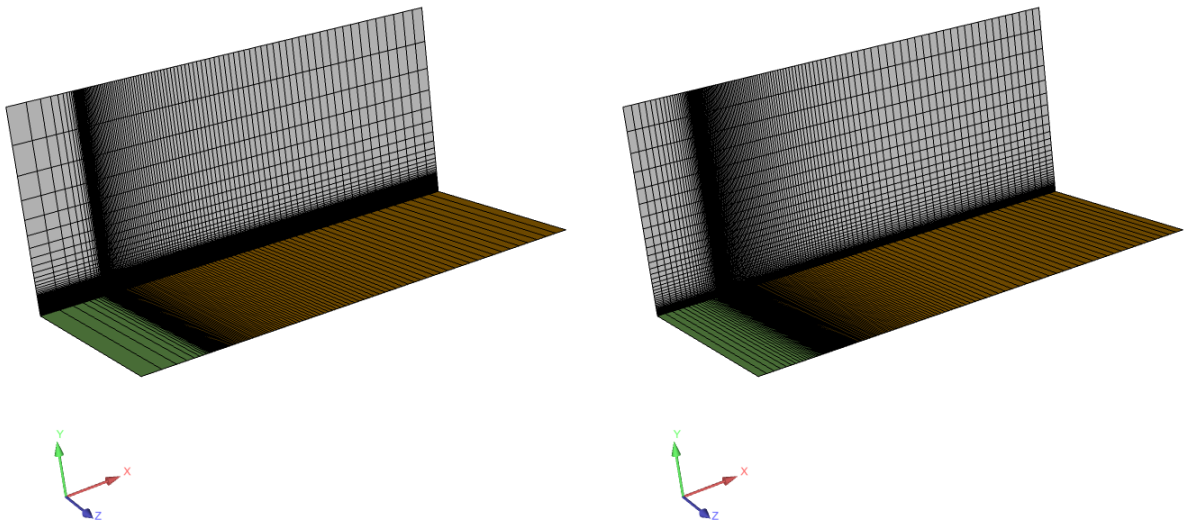
Problem definition

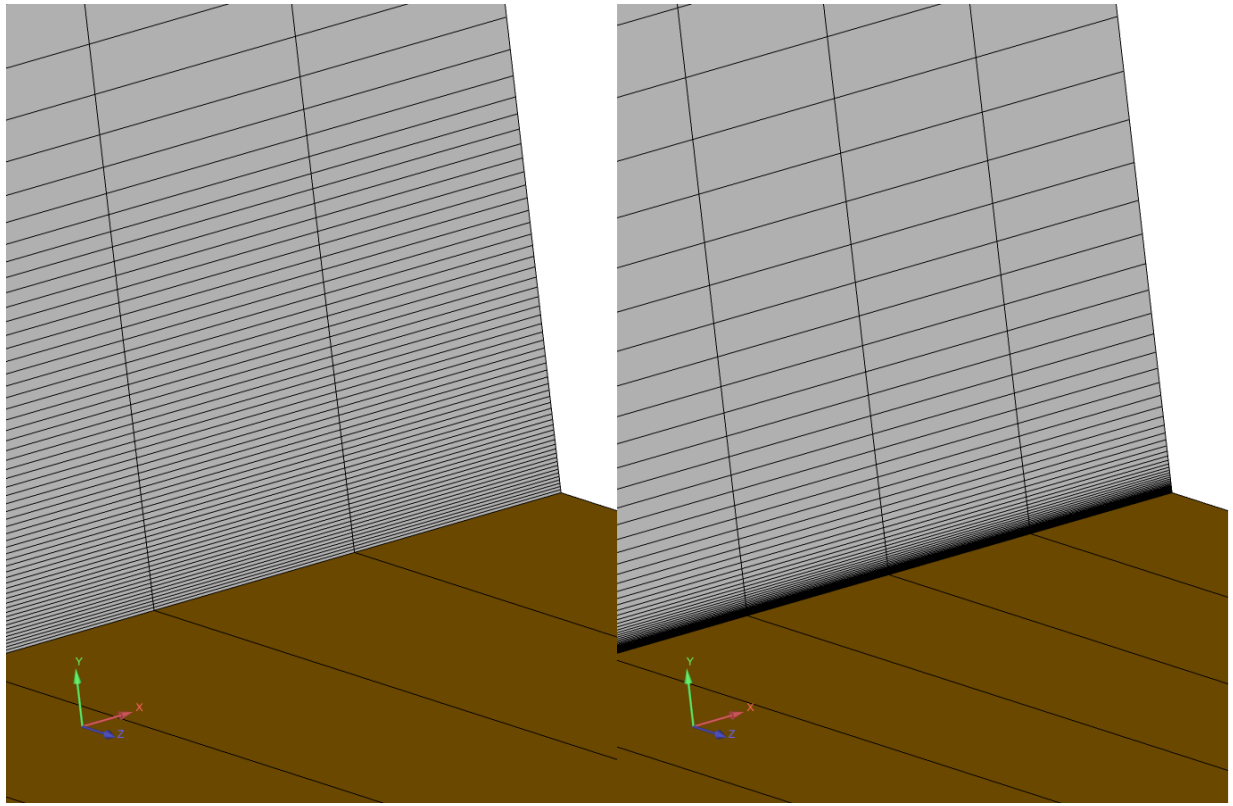


- This is another classical validation case in turbulence modeling.
- There is plenty of experimental and numerical data available.
- **A few references:**
  - https://turbmodels.larc.nasa.gov/flatplate_val.html
  - https://turbmodels.larc.nasa.gov/ZPGflatplateSS_val.html

Problem definition

Geometry and mesh

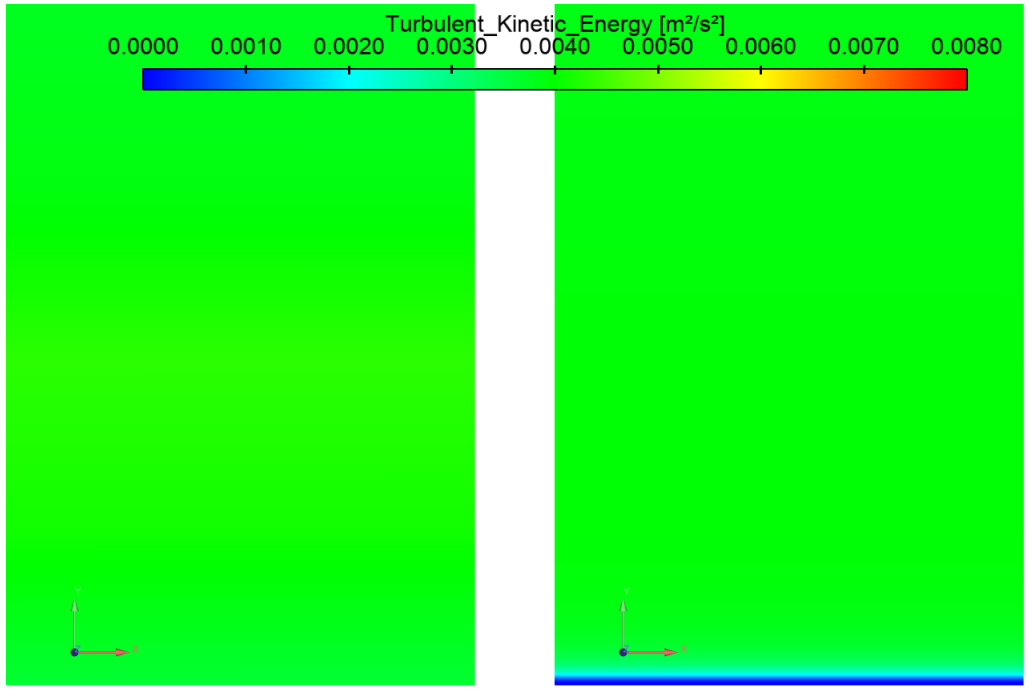




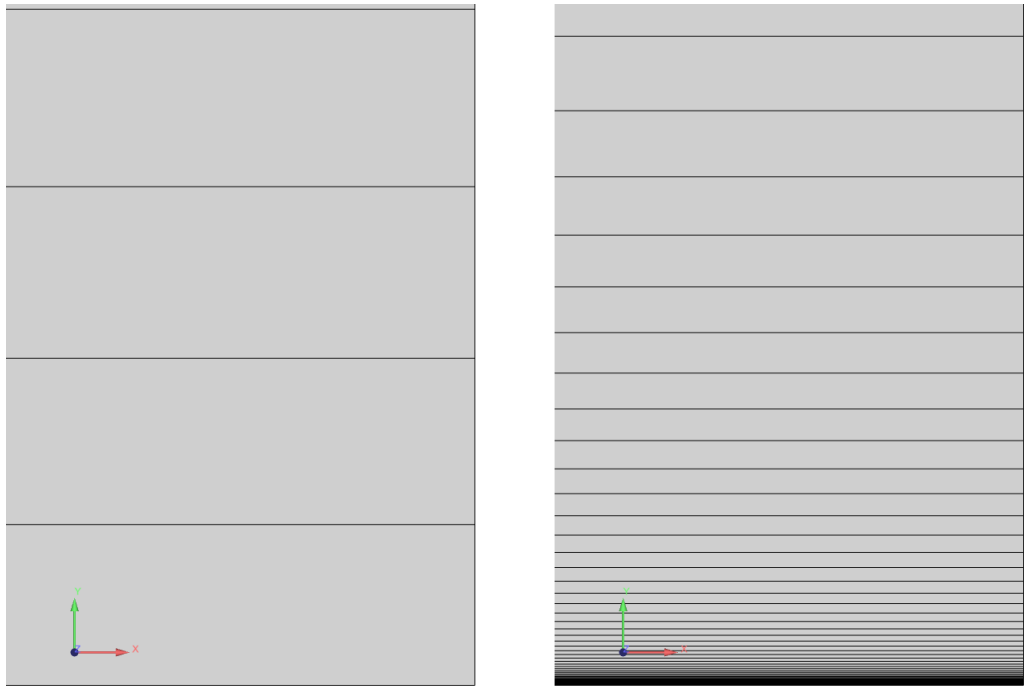
- Comparison of a wall resolving and a wall modeling mesh.
- For scale resolving simulation of transition modeling, the streamwise spacing is also important.
- In this case, the mesh is not very fine in the streamwise direction.

Qualitative and quantitative results

Zero Pressure Gradient Flat Plate – Re = 10 000 000



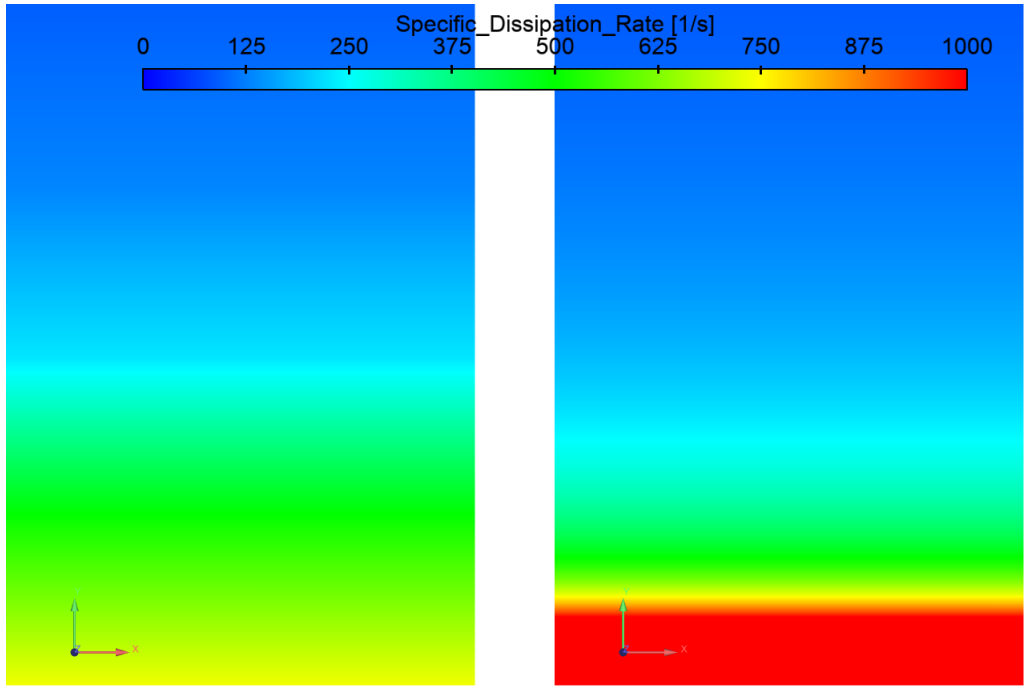
Contours of TKE
Left image: wall modeling mesh.
Right image: wall resolving mesh.



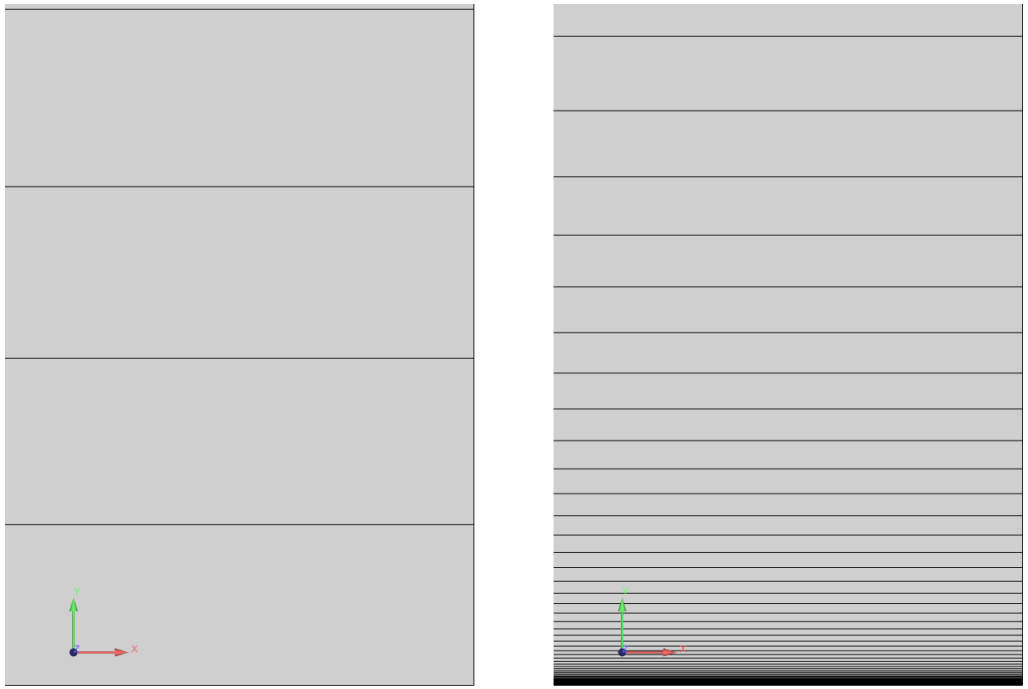
Mesh resolution close to the wall
Left image: wall modeling.
Right image: wall resolving

Qualitative and quantitative results

Zero Pressure Gradient Flat Plate – Re = 10 000 000



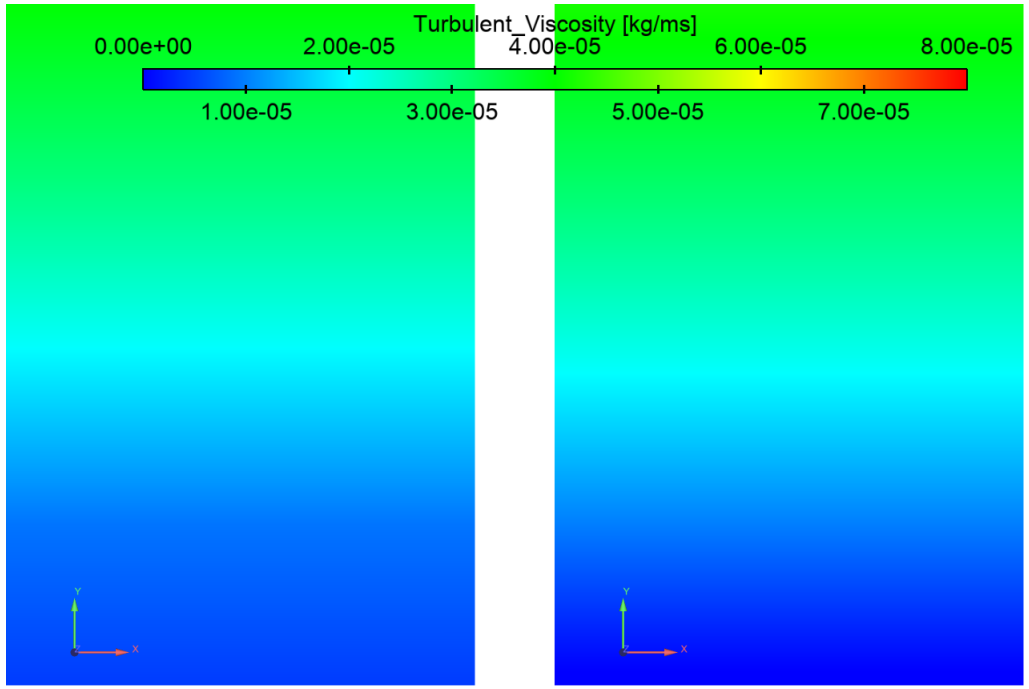
Contours of specific dissipation rate
Left image: wall modeling.
Right image: wall resolving



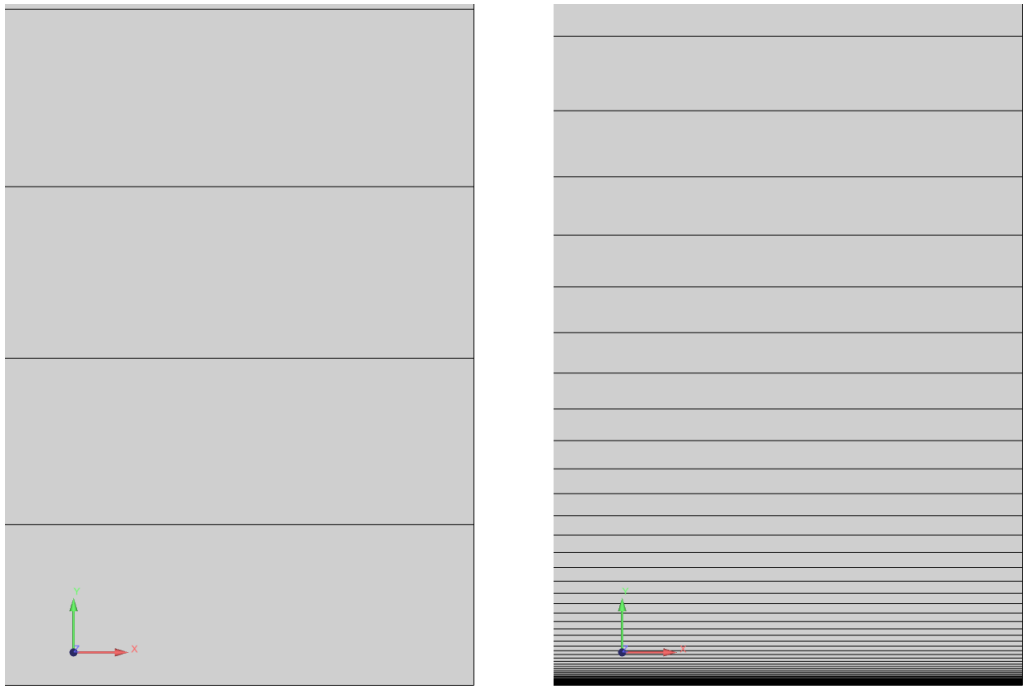
Mesh resolution close to the wall
Left image: wall modeling.
Right image: wall resolving

Qualitative and quantitative results

Zero Pressure Gradient Flat Plate – Re = 10 000 000

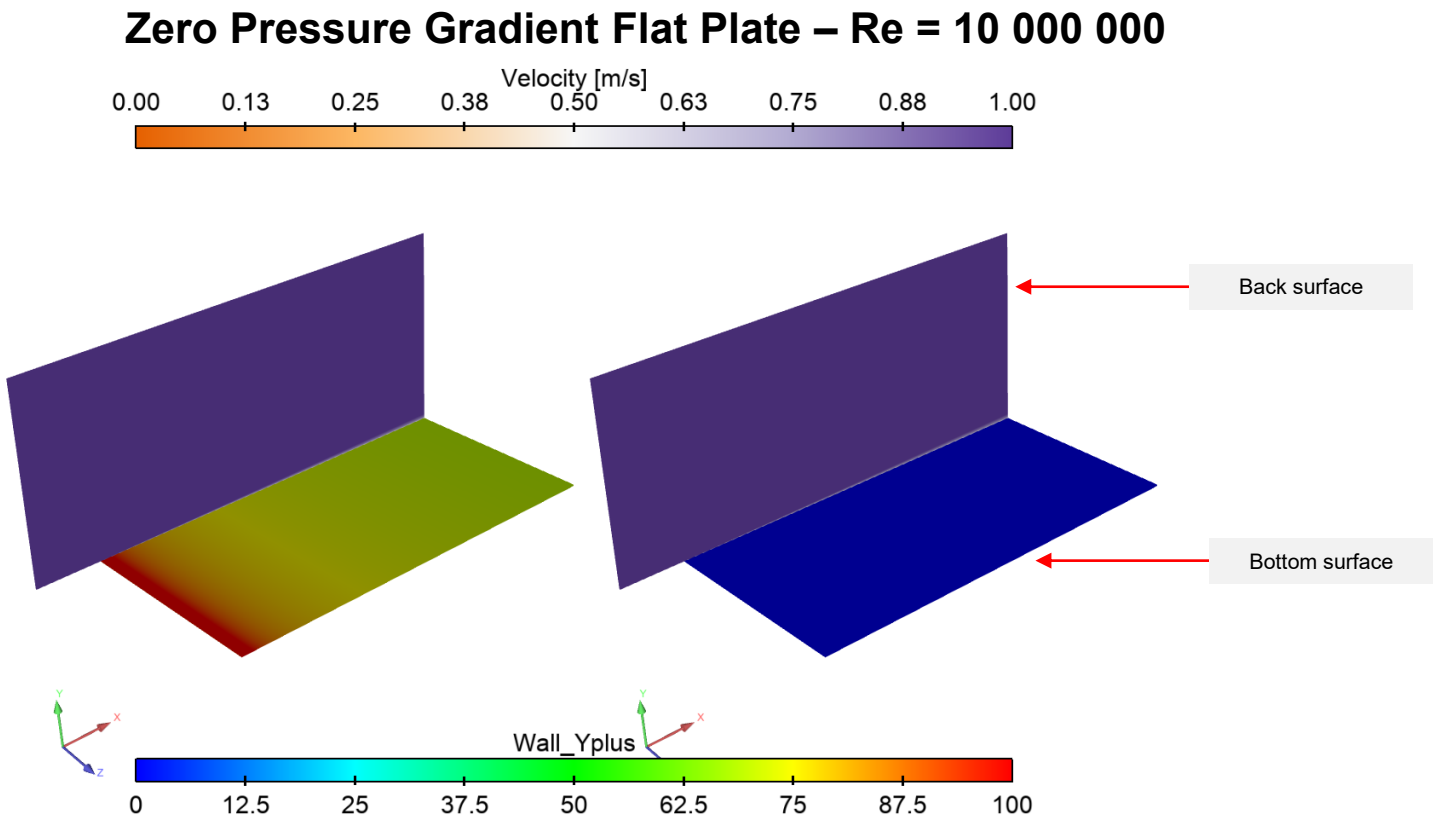


Contours of turbulent viscosity
Left image: wall modeling.
Right image: wall resolving



Mesh resolution close to the wall
Left image: wall modeling.
Right image: wall resolving

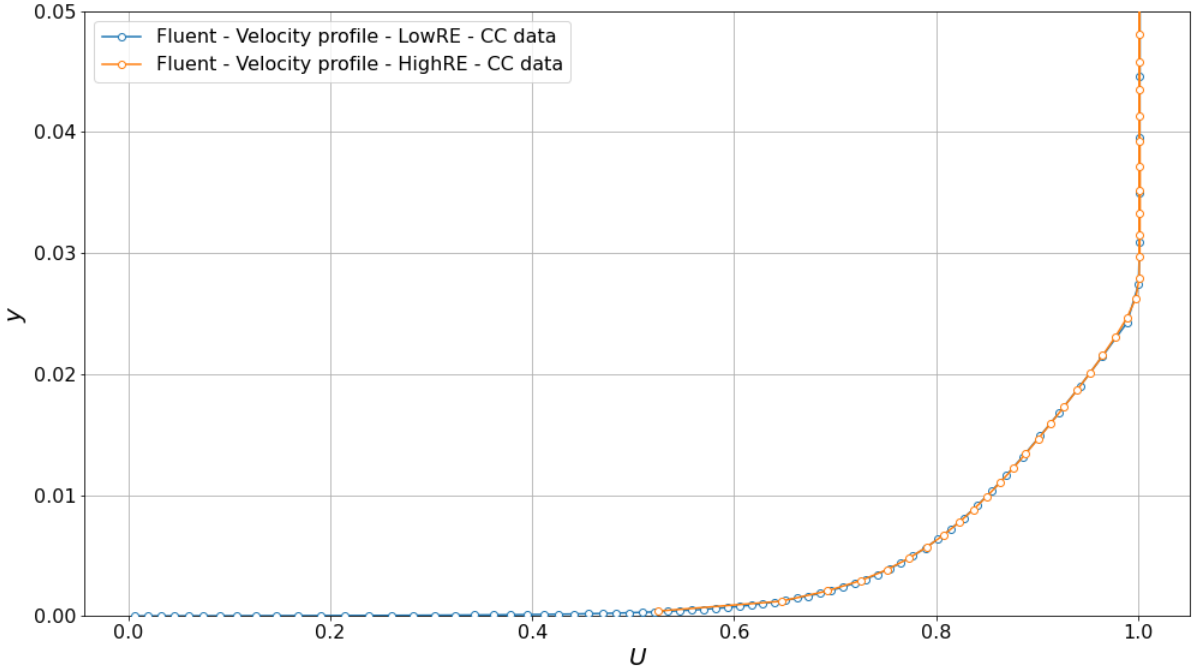
Qualitative and quantitative results



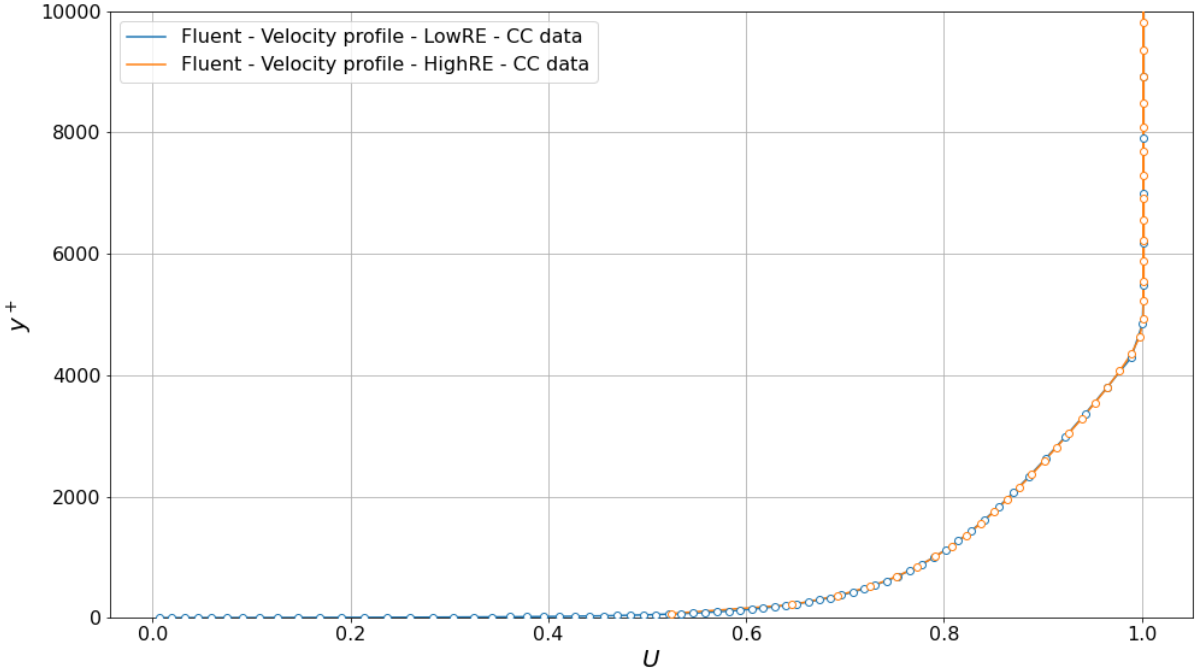
Left image: wall modeling mesh. Right image: wall resolving mesh.
Bottom surface: contour of y^+. Back surface: contours of velocity.

Qualitative and quantitative results

Zero Pressure Gradient Flat Plate – Re = 10 000 000



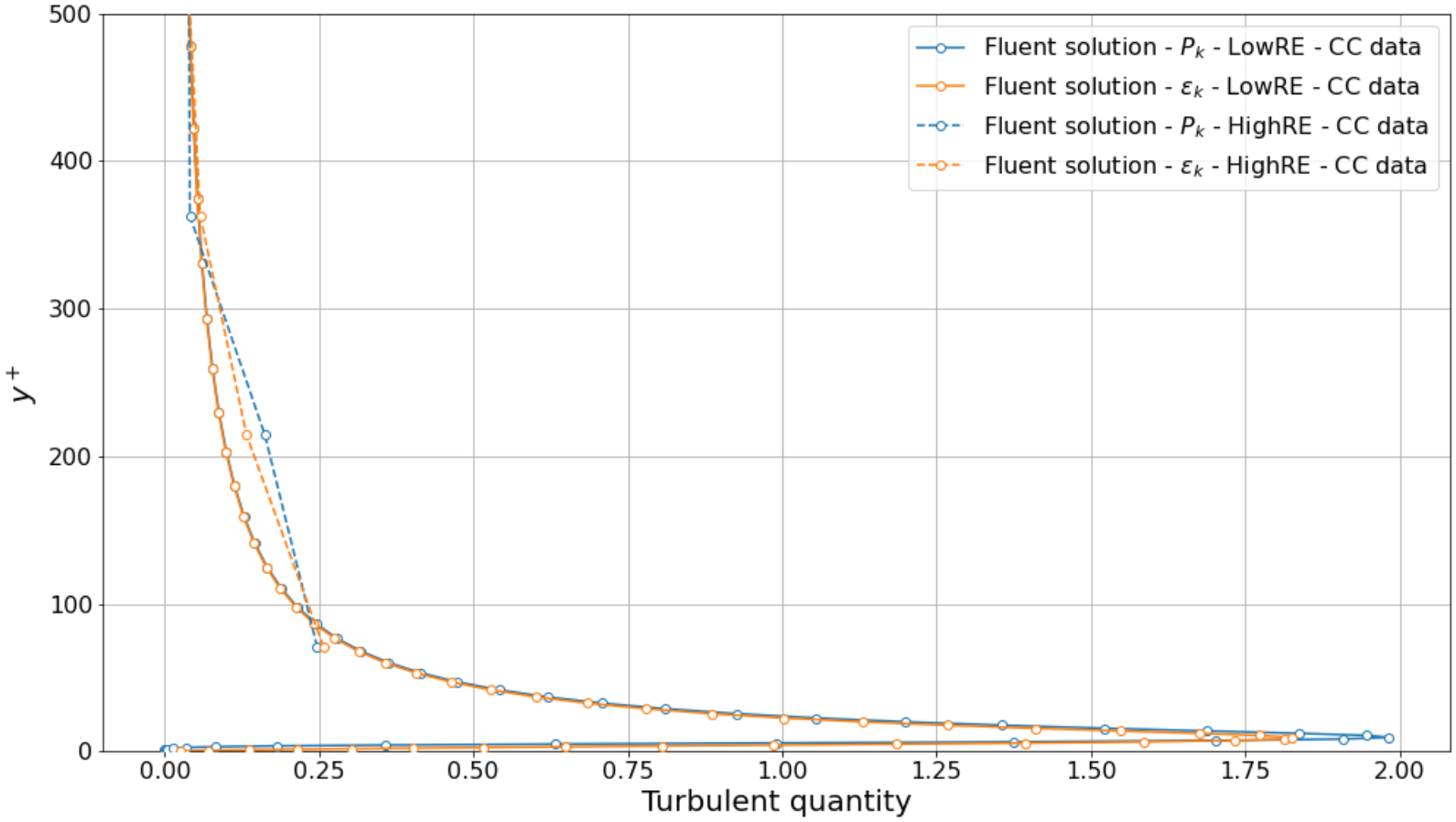
Plot of the velocity profile in function of the distance normal to the wall



Plot of the velocity profile in function of y^+

Qualitative and quantitative results

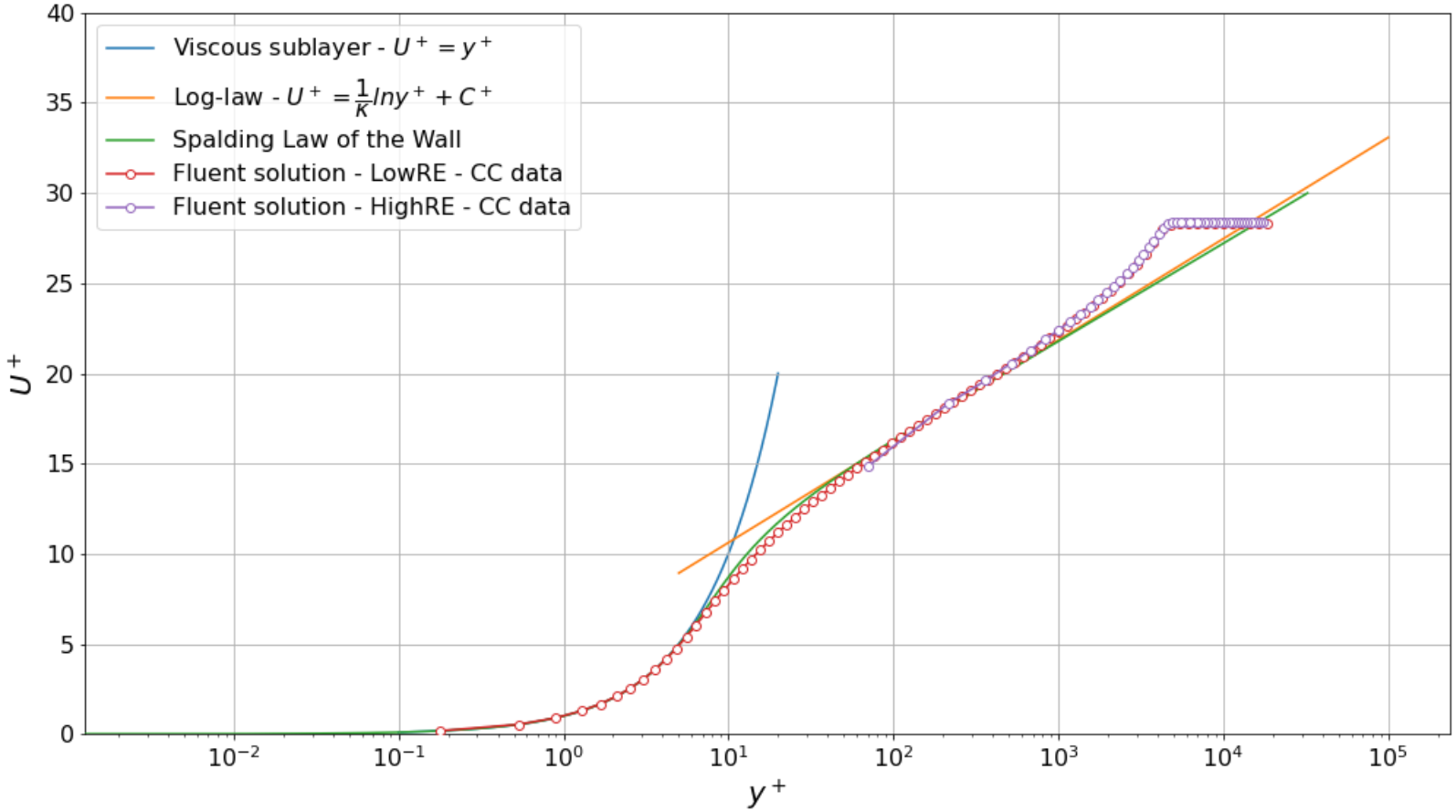
Zero Pressure Gradient Flat Plate – Re = 10 000 000



Plot of turbulent quantities profiles in function of y^+

Qualitative and quantitative results

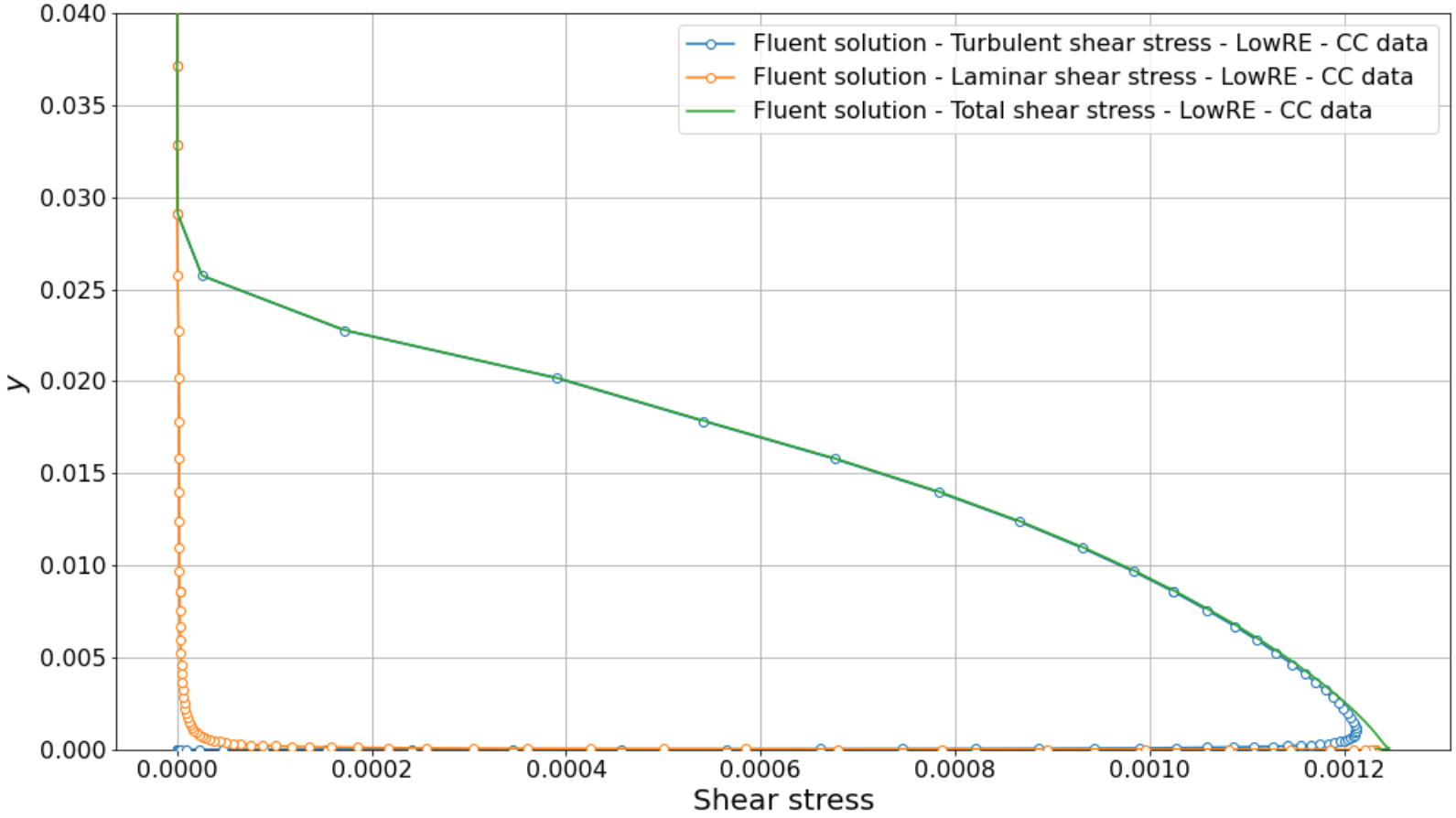
Zero Pressure Gradient Flat Plate – Re = 10 000 000



Plot of non-dimensional velocity profile in function of y^+

Qualitative and quantitative results

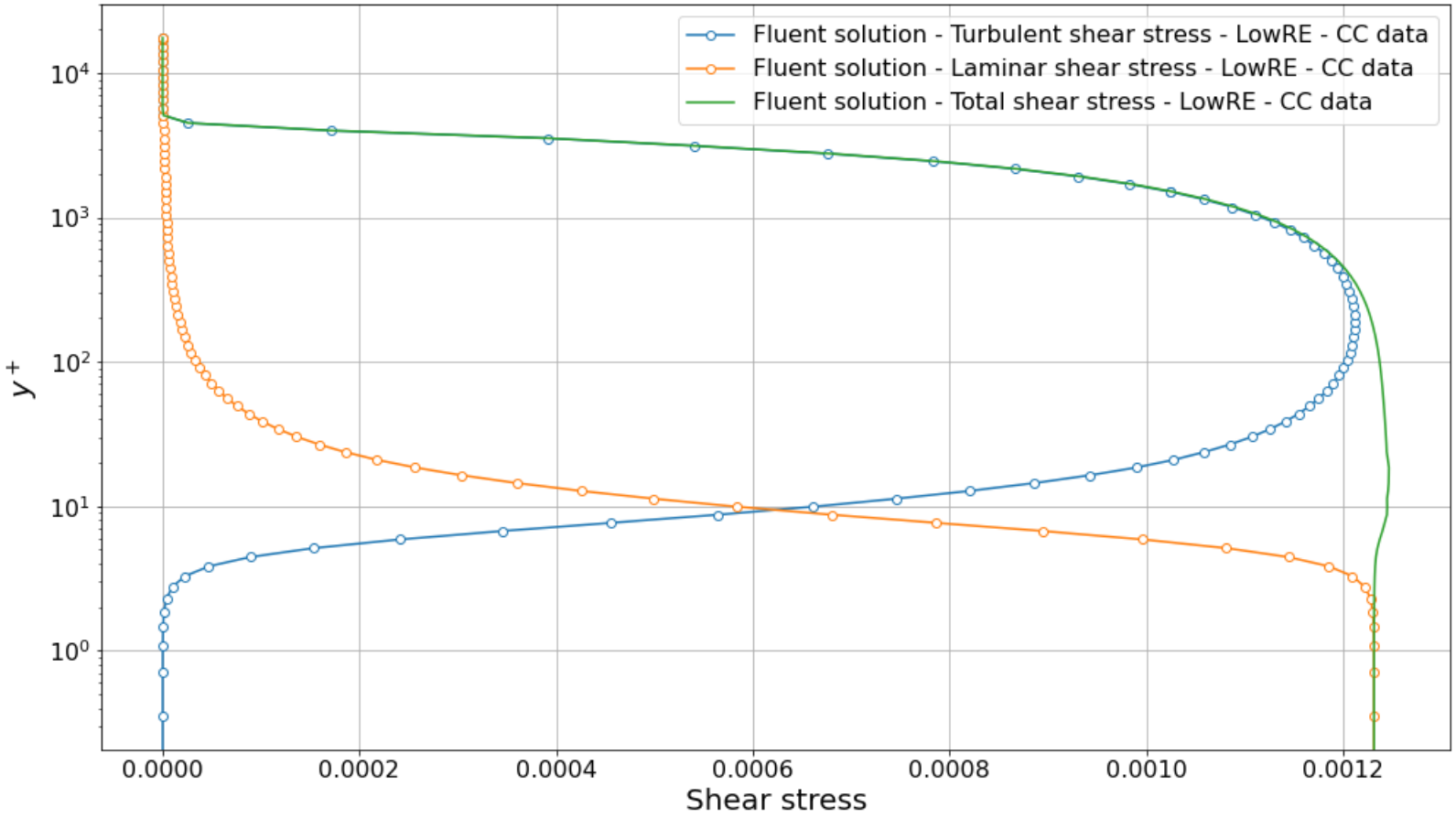
Zero Pressure Gradient Flat Plate – Re = 10 000 000



Plot of shear stresses in function of the distance normal to the wall

Qualitative and quantitative results

Zero Pressure Gradient Flat Plate – Re = 10 000 000



Plot of shear stresses profile in function of y^+