

Development of RANS boundary condition for AMR-Wind

Document all notes here.

1 RANS ABL grid stretching

2 RANS k- ϵ ABL boundary conditions

Implemented in `MODData.cpp` as `calc_phi_m_alinot()`:

$$\phi_m(\zeta) = \begin{cases} (1 - \beta_m \zeta)^{-1/4}, & \zeta < 0 \\ 1 + \gamma_m \zeta & \zeta > 0 \end{cases} \quad (1)$$

where $\zeta = z/L$ (see [1])

Implemented in `MODData.cpp` as `calc_phi_eps_alinot()`:

$$\phi_\epsilon(\zeta) = \begin{cases} 1 - \zeta & \zeta < 0 \\ \phi_m(\zeta) - \zeta & \zeta > 0 \end{cases} \quad (2)$$

The following calculations are implemented in `ShearStress.H`.

As `ShearStressAlinot.calc_mu()`

$$\mu_{t0}(z) = \frac{\rho \kappa u_* z}{\phi_m(\zeta)} \quad (3)$$

As `ShearStressAlinot.calc_eps()`

$$\epsilon_0(z) = \frac{u_*^3}{\kappa z} \phi_\epsilon(\zeta) \quad (4)$$

As `ShearStressAlinot.calc_tke()`

$$k_0(z) = \sqrt{\frac{\mu_{t0}(z) \epsilon_0(z)}{\rho C_\mu}} \quad (5)$$

As `ShearStressAlinot.calc_omega()`

$$\omega_0(z) = \frac{\epsilon_0(z)}{C_\mu k_0(z)} \quad (6)$$

References

- [1] ALINOT, C., AND MASSON, C. k- ϵ model for the atmospheric boundary layer under various thermal stratifications. *Journal of Solar Energy Engineering* 127, 4 (06 2005), 438–443.