Progress towards an improved parameterisation of small-scale orographic impacts on the atmospheric boundary layer.

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Subgrid-scale parametrizations:

- A better understanding of the impact of small-scale orography (<5km) on the lower atmosphere.
- Reliable numerical solution is then required: Fully resolved atmosphere (LES).
- Development of parametrizations of those phenomena to be included in the numerical model.

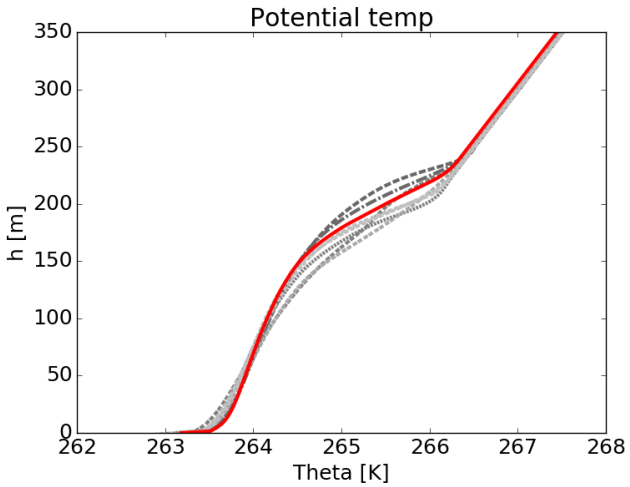
We must be sure the model (ICON) is capable of properly resolving the atmosphere in LES mode*!

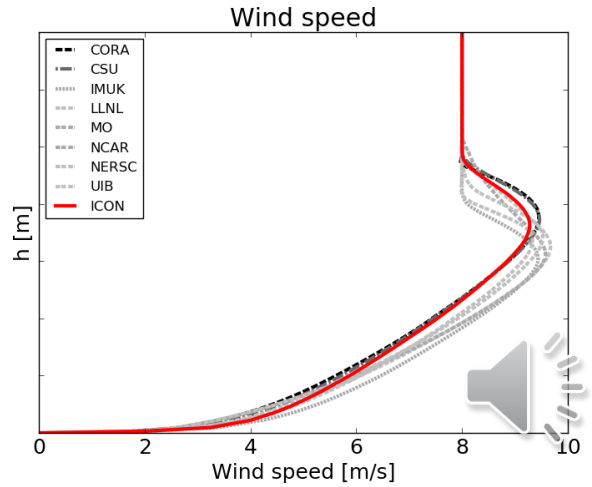
- Flat terrain
- Wave generation
- Complex terrain

*Dipankar et al., (2015) *Xue and Giorgetta (2020)

Flat terrain = GABLS I (Beare et al., 2006)

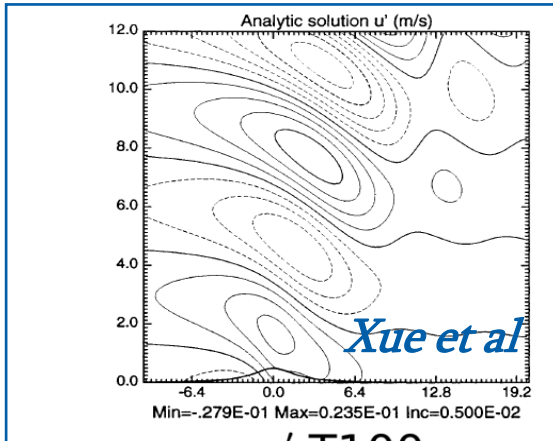
"Given the difficulty of the large-eddy simulation of the SBL in the past, a notable success here is that the spread was not any larger." **(Beare et al. 2006)**

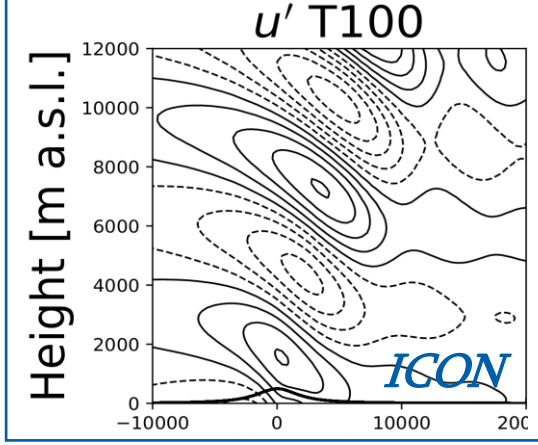




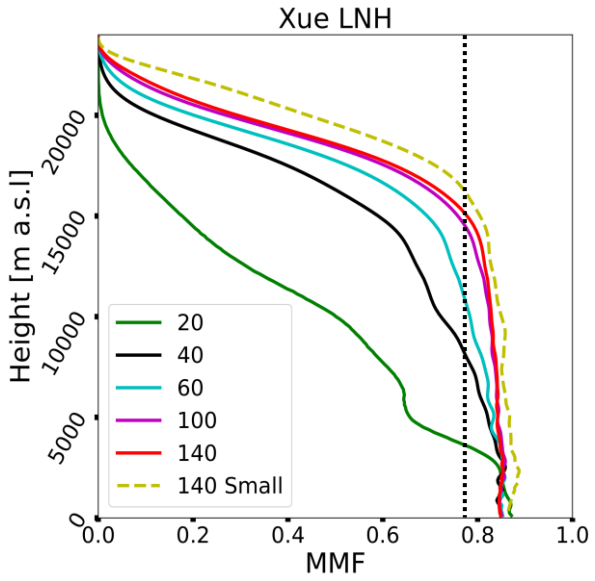
Wave generation::
Flow over bell-shaped mountain (Xue et al., 2000)

- Isothermal atmosphere at initial time
- Constant background wind speed U= $20 m/s$
- $\Delta x = \Delta y = 400\ m, \Delta z = 125\ m$
- $Lx = 430\ km,\ Lz = 24\ km$





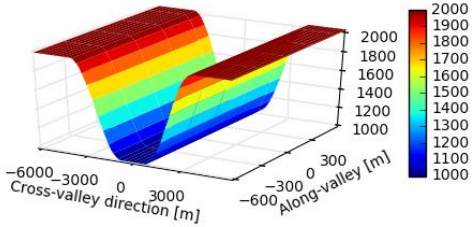
Momentum flux :



Complex terrain = 2D U-shaped valley (Burns and Chemel 2014)

- $\frac{d\theta_v}{dz} = 1.5K/km\ ,\ \theta_v(surf) = 288K$
- $\%RH = 40\%$
- All points assigned at 45.92°N, 6.87°E
- Simulation for a typical winter day (21st Dec)

Thermal structure:
Cold air pool evolution



The accumulated change of θ_v from $t = 0$ averaged along y axis