Sensitivity of the Simulation of Thermally-Driven Circulations in an Idealized Valley to Planetary Boundary Layer Parameterizations

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Motivation

Project **ASTER - Atmospheric boundary-layer modeling over complex terrain**

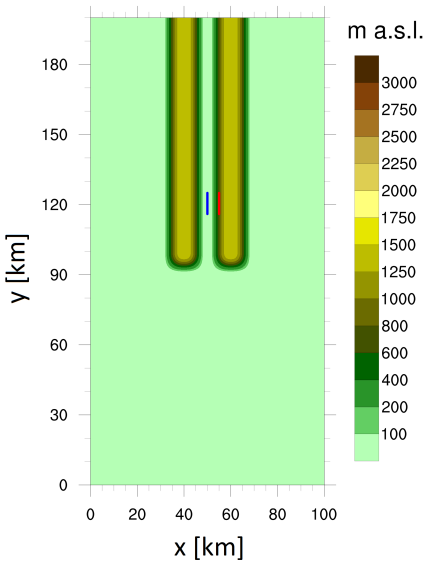
Aims:

- evaluate the model's sensitivity to turbulence and land surface parameterizations or their input parameters.
- identify modeling issues in mountainous terrain related to the turbulence and land surface parameterizations that have a large impact on the forecast

Methodology:

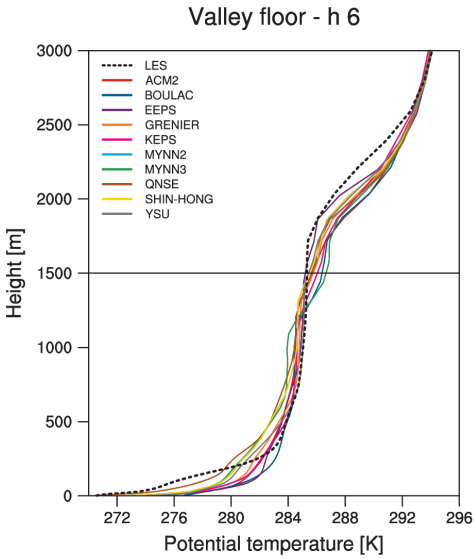
- series of RANS simulations in an idealized 3D valley-plain topography
- comparison with a LES, assumed as the benchmark
- use of different statistical methods to identify the parameters most affecting model results (see next presentation by Dario Di Santo)

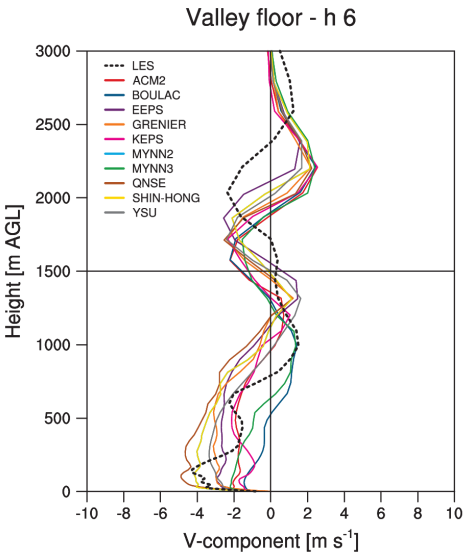
Model Setup



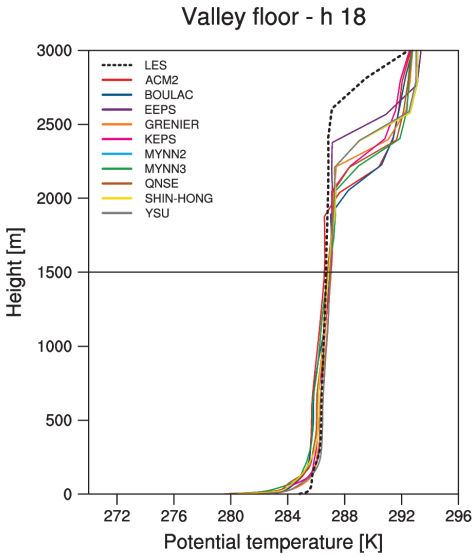
- WRF model
- 1-km resolution RANS with different PBL schemes
- 100-m resolution LES as reference
- $\Delta z = 5$ m close to the surface, $\Delta z = 130$ m at 1500 AGL
- Boundary conditions: periodic W and E, symmetric N, open S
- Coordinates: 45°N, 11°E
- Period: 06 UTC 20 March - 18 UTC 21 March, first 12 h not analyzed

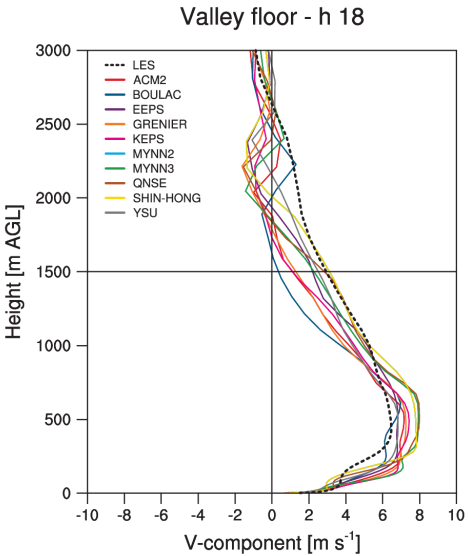
Results: Valley Floor



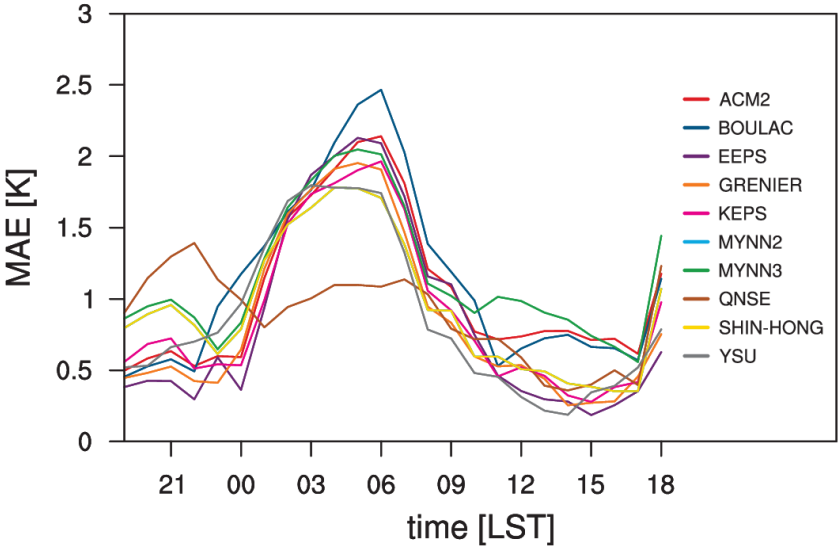


Results: Valley Floor

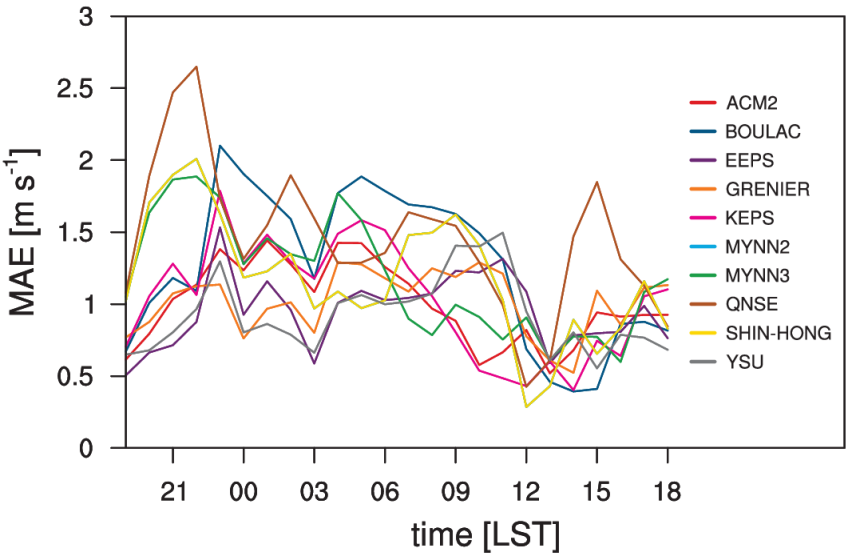




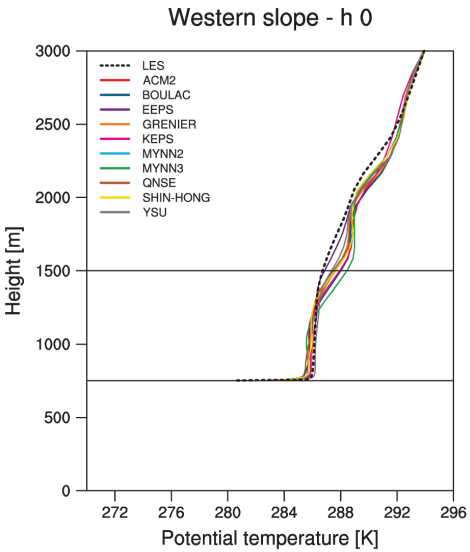
Results: Valley Floor - Potential Temperature Error

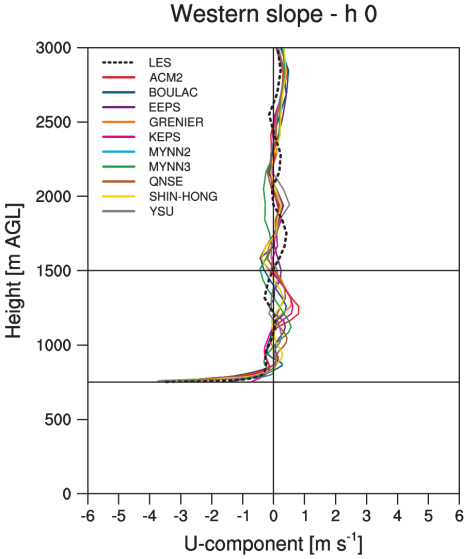


Results: Valley Floor - V-Component Error

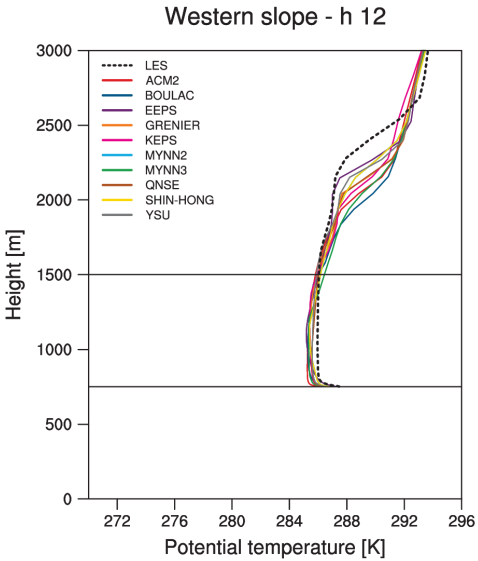


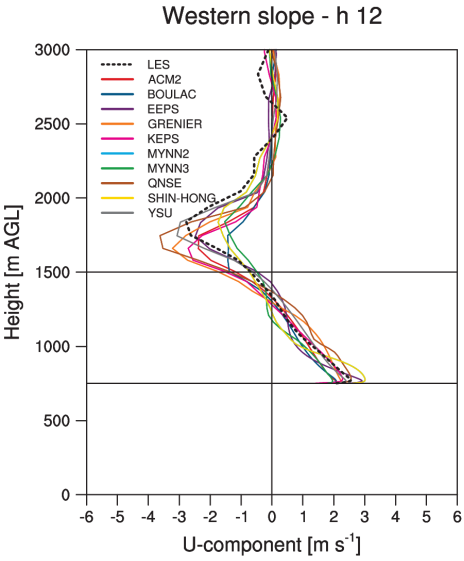
Results: Western Slope



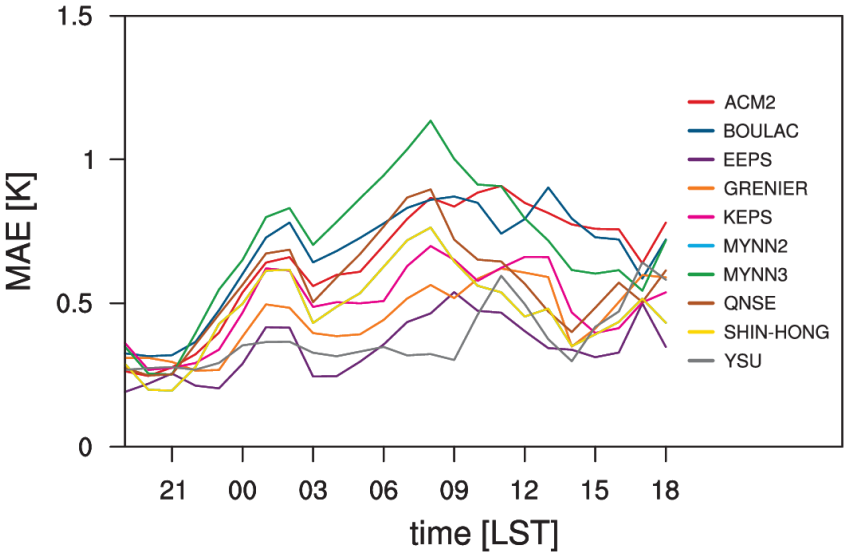


Results: Western Slope

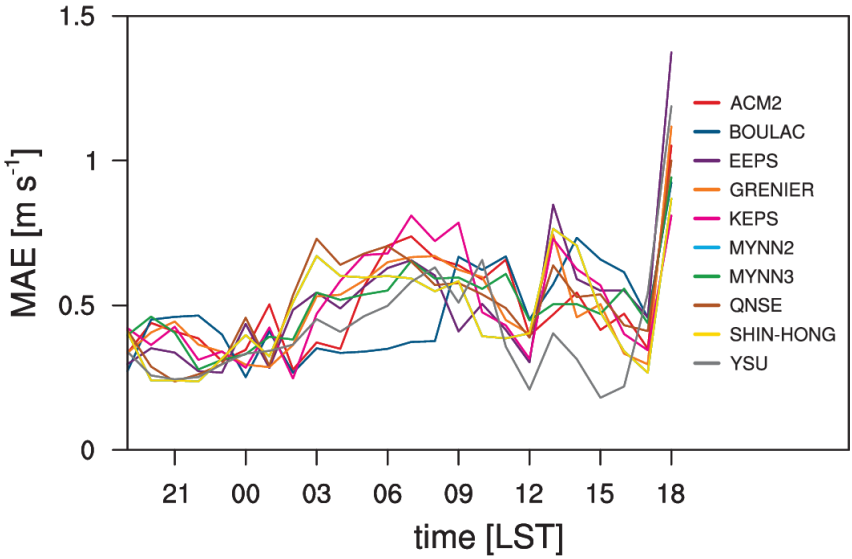




Results: Western Slope - Potential Temperature Error



Results: Western Slope - U-Component Error



Conclusions

- along-valley wind: higher variability between the RANS in the nighttime phase
- slope wind: small differences between the RANS both during daytime and nighttime
- potential temperature: on the valley floor smaller differences with the LES during daytime
- significant differences in the simulation of the PBL height

Acknowledgments

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