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

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Motivation and Methodology

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

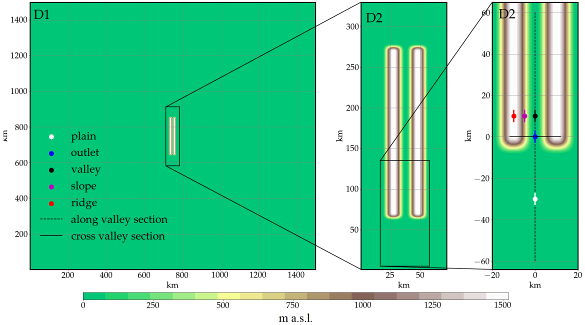
Aims:

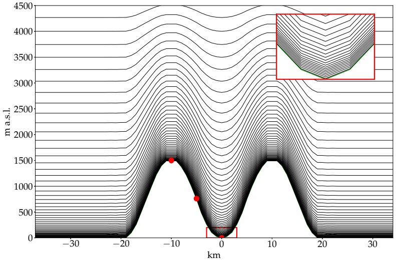
- evaluate the model's sensitivity to turbulence and land surface parameterizations, focusing on thermally-driven winds
- identify modeling issues in mountainous terrain related to turbulence and land surface parameterizations that have a large impact on the simulation of thermally-driven circulations

Methodology:

- series of RANS simulations in an idealized 3D valley-plain topography
- comparison with a LES, assumed as the benchmark

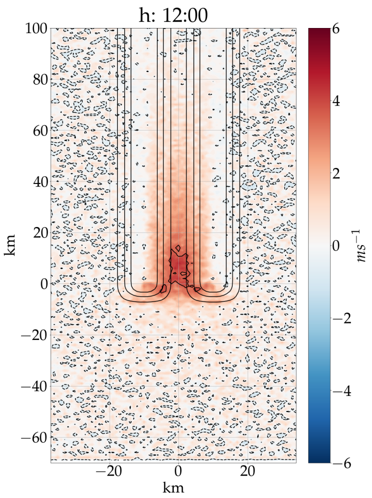
Model Setup





- 1-km res. RANS, different PBL schemes
- 100-m res. LES as reference
- $\Delta z = 5$ m close to the surface
- periodic boundary conditions
- TKE 1.5-order SGS scheme in the LES
- random T perturb. $\pm$ 0.1 K in the LES
- 06 UTC 20 March - 18 UTC 21 March
- Coordinates: 46°N - 11°E

Along-Valley Wind



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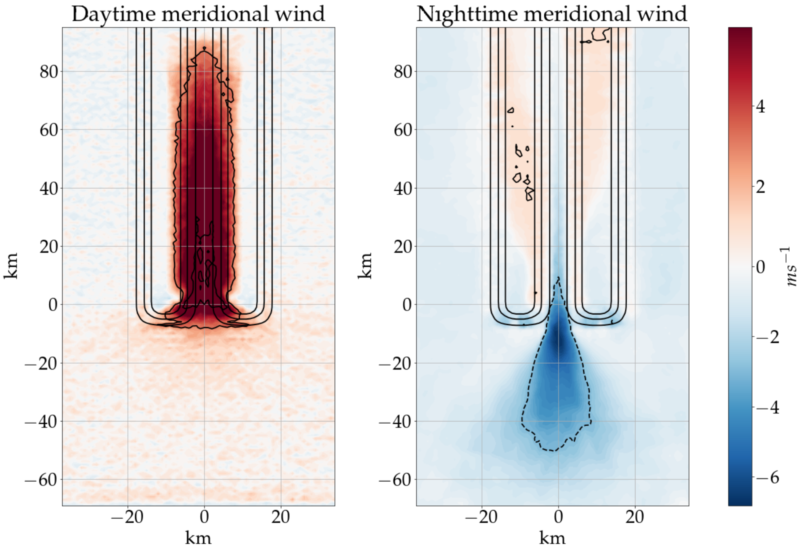
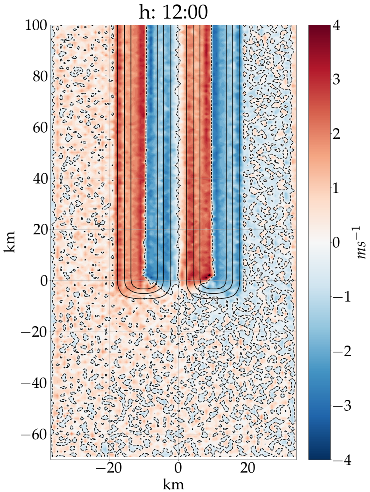


Cross-Valley Wind



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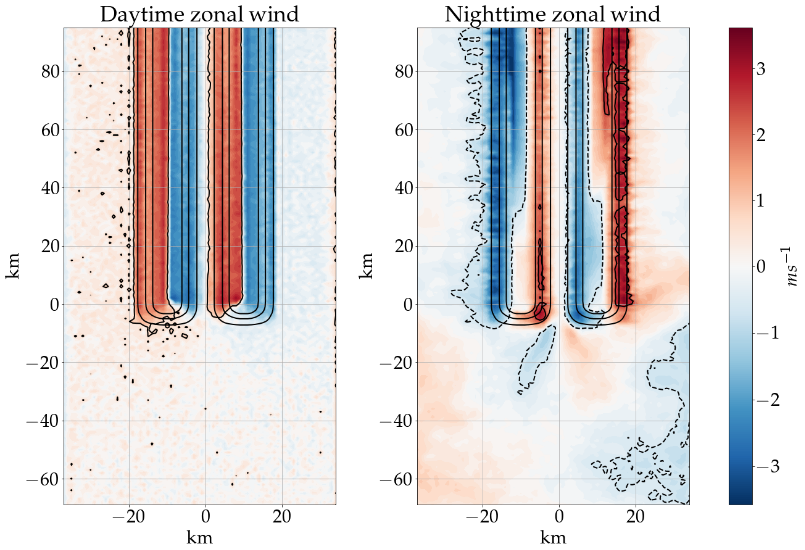

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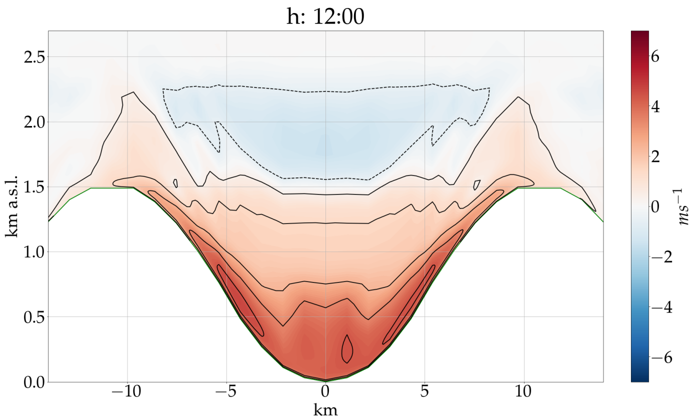

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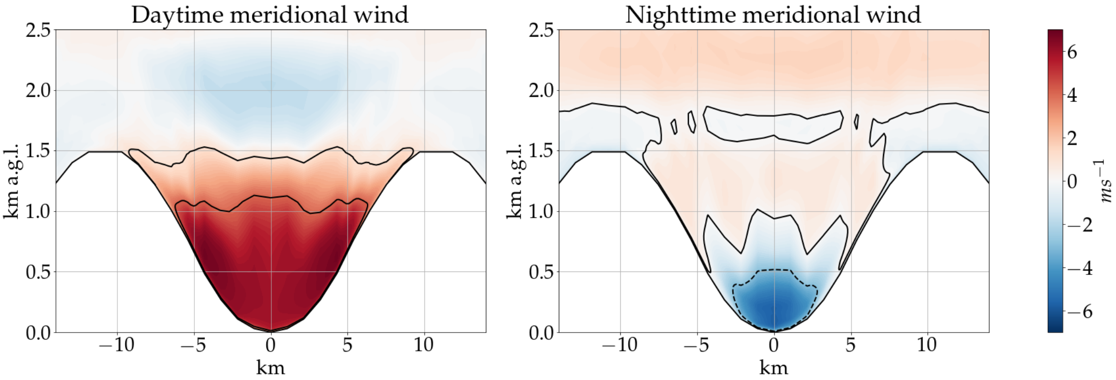

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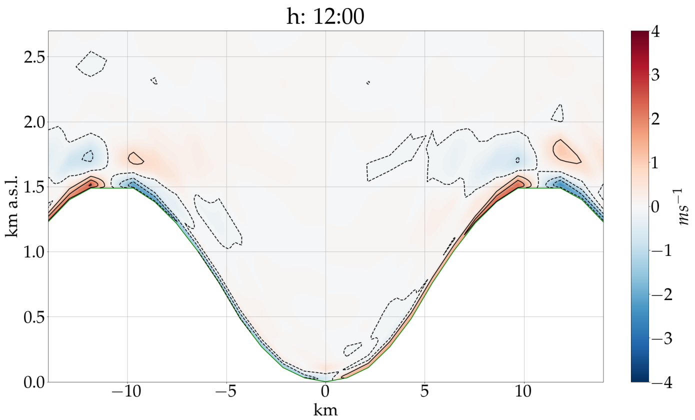

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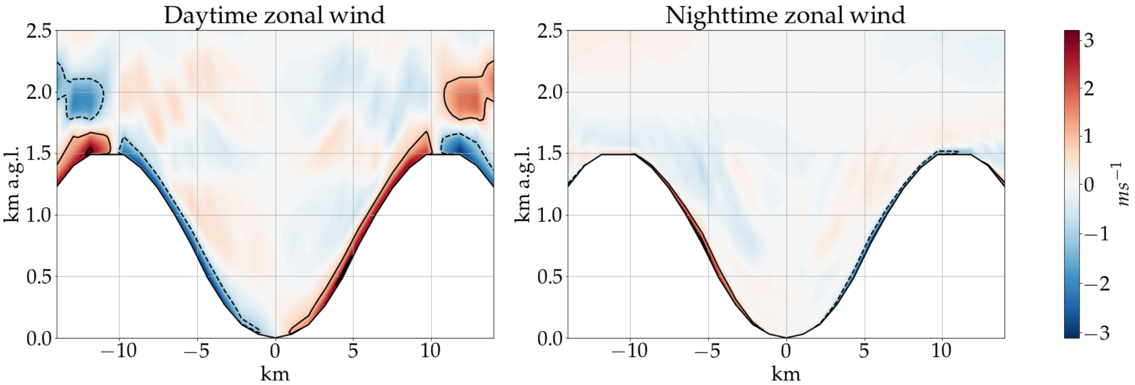
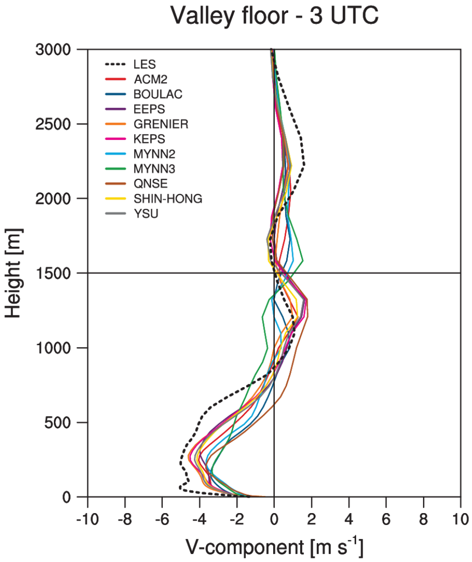
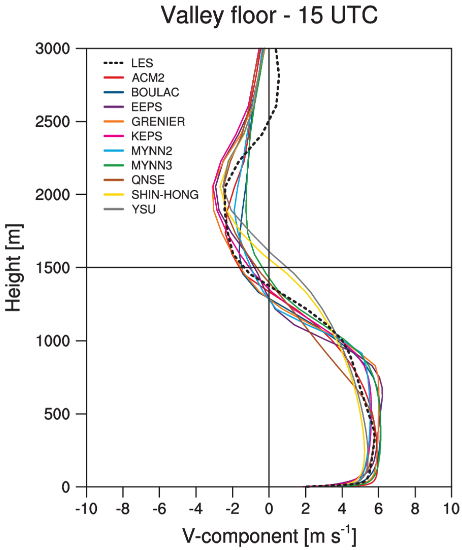
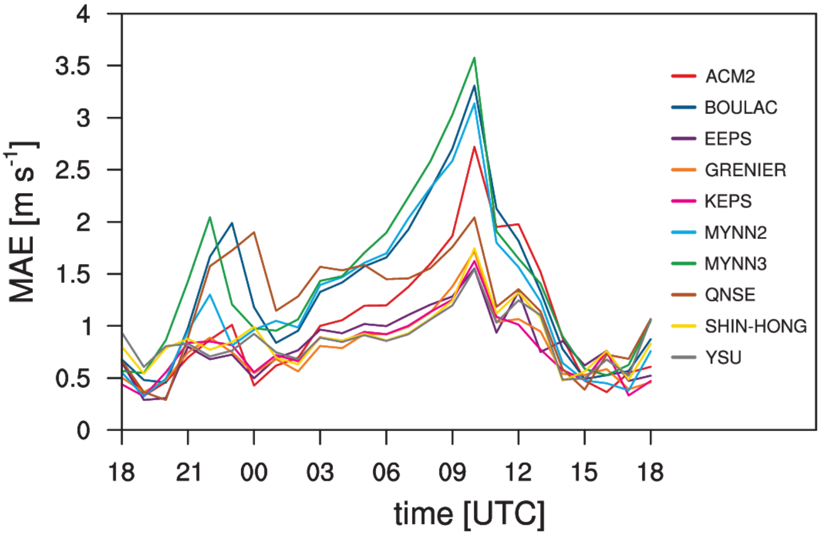


Along-Valley Wind - Valley Floor

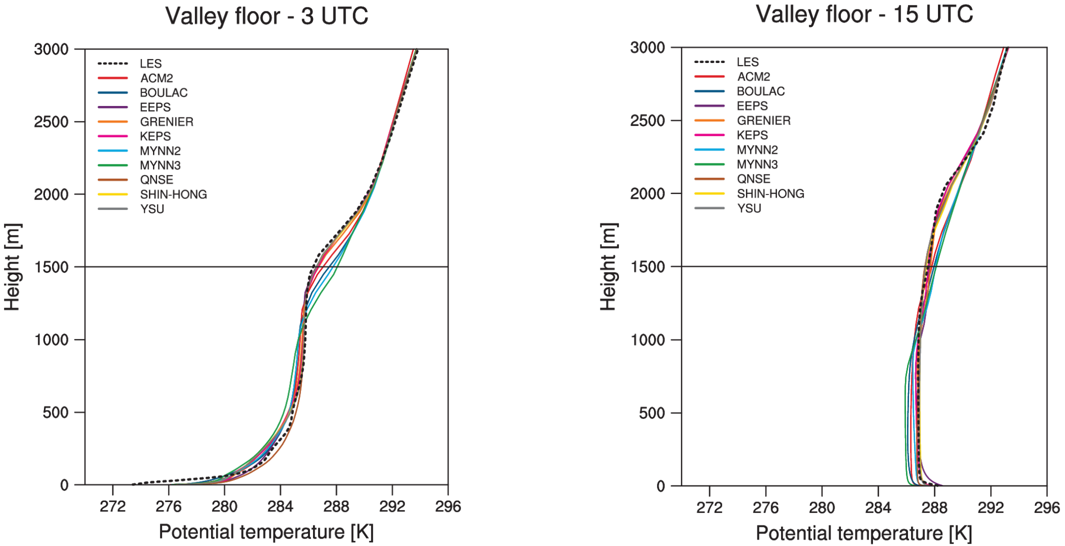




Along-Valley Wind Error - Valley Floor



Potential Temperature - Valley Floor



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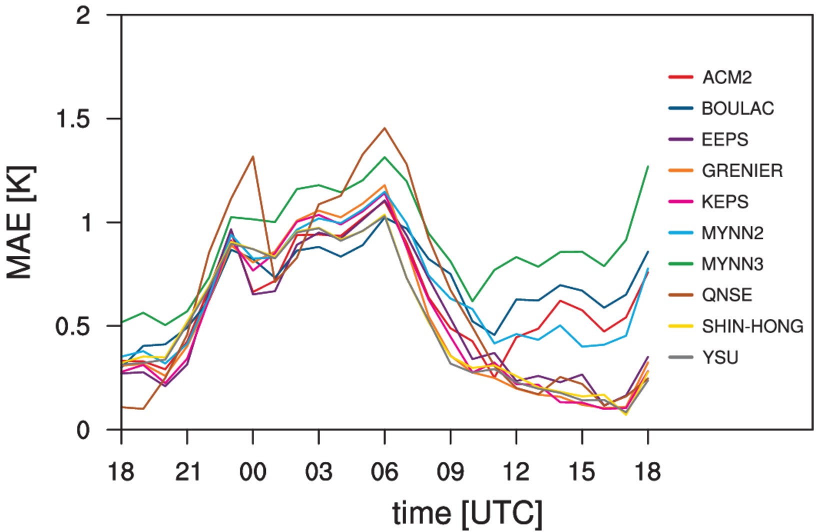
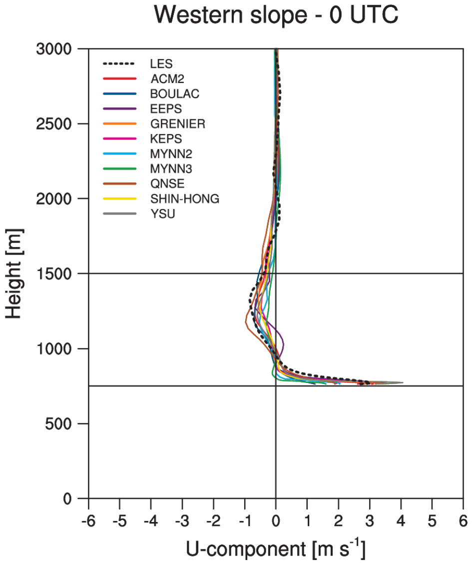
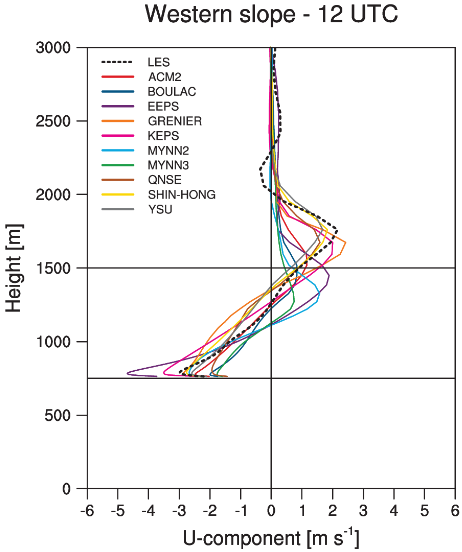


Cross-Valley Wind - Western Slope





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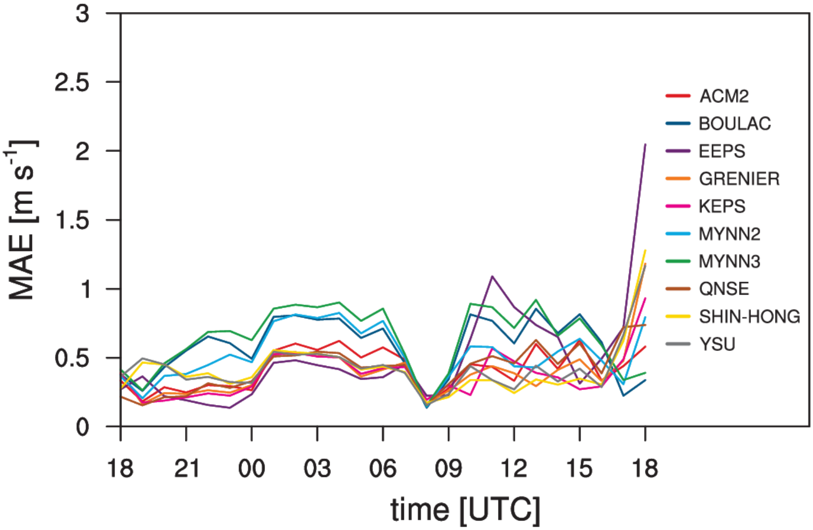

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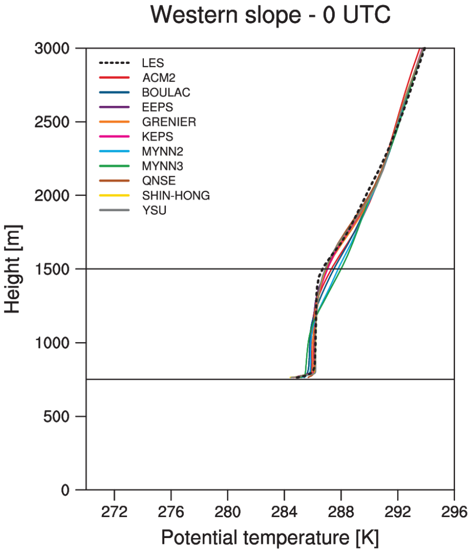

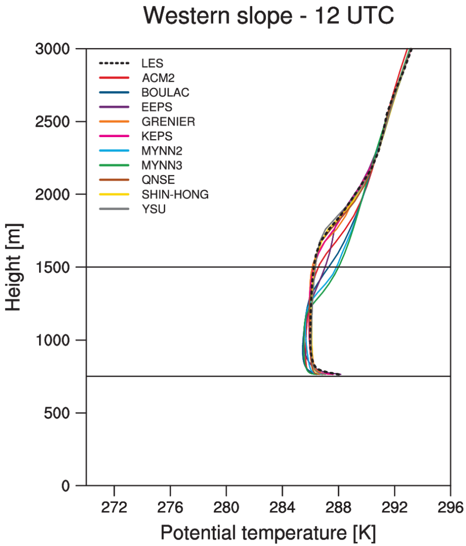

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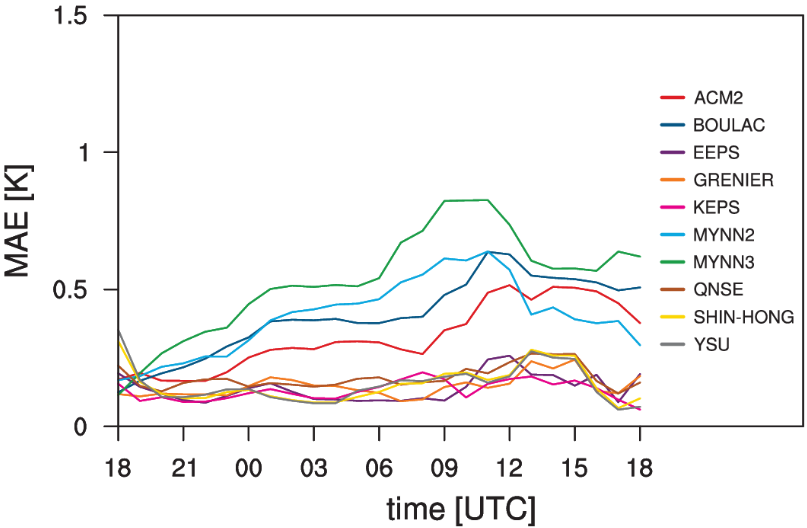

Conclusions

- **along-valley wind**: larger differences between RANS simulations and LES in the nighttime phase and in the morning transition
- **slope wind**: higher variability between the RANS simulations during daytime
- **potential temperature**: on the valley floor larger differences between the RANS simulations and the LES during nighttime
- significant differences in the simulation of the **PBL height**

Acknowledgments

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Aster Alpinus