

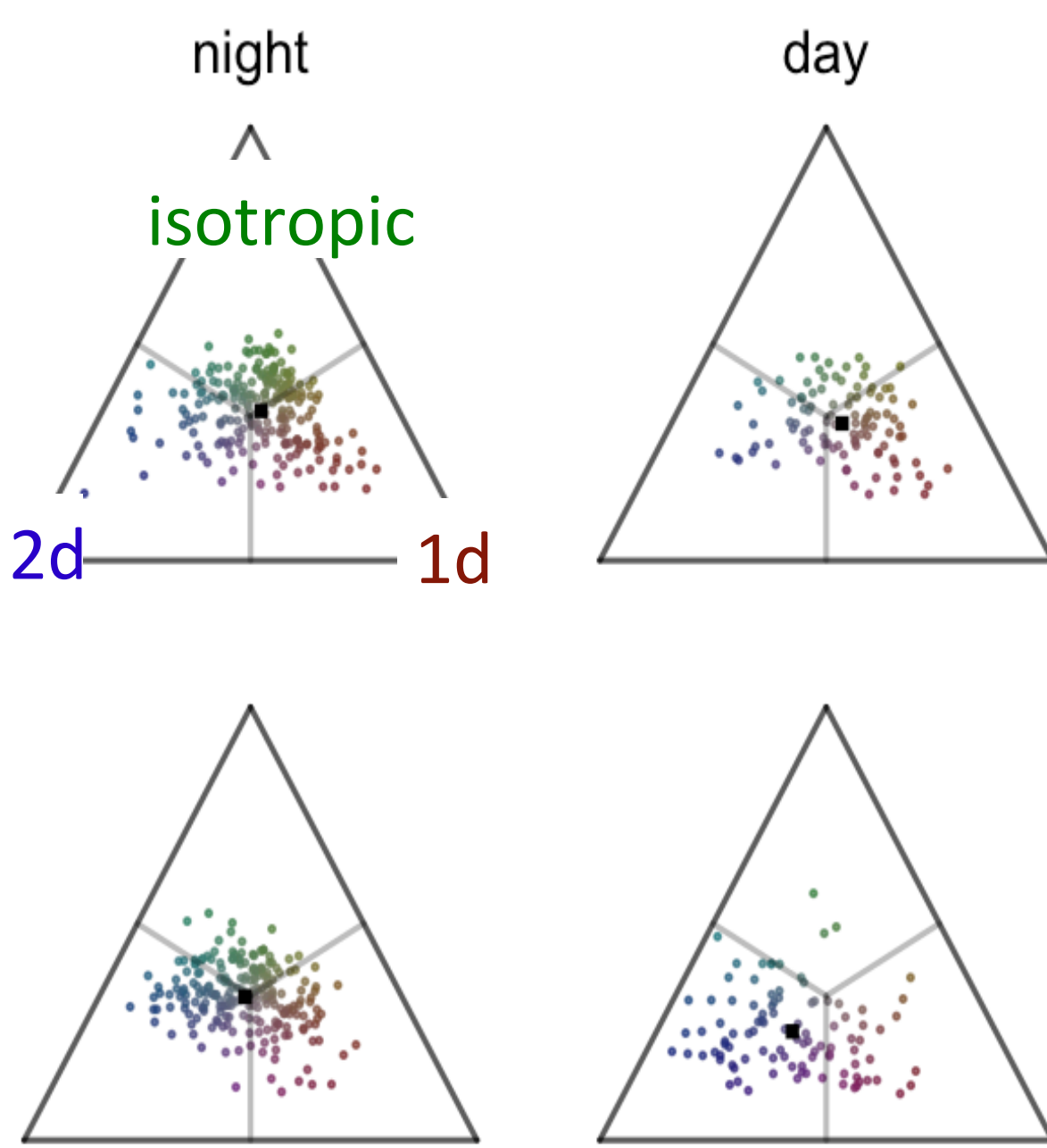
Investigating glacier-atmosphere interactions at a range of scales

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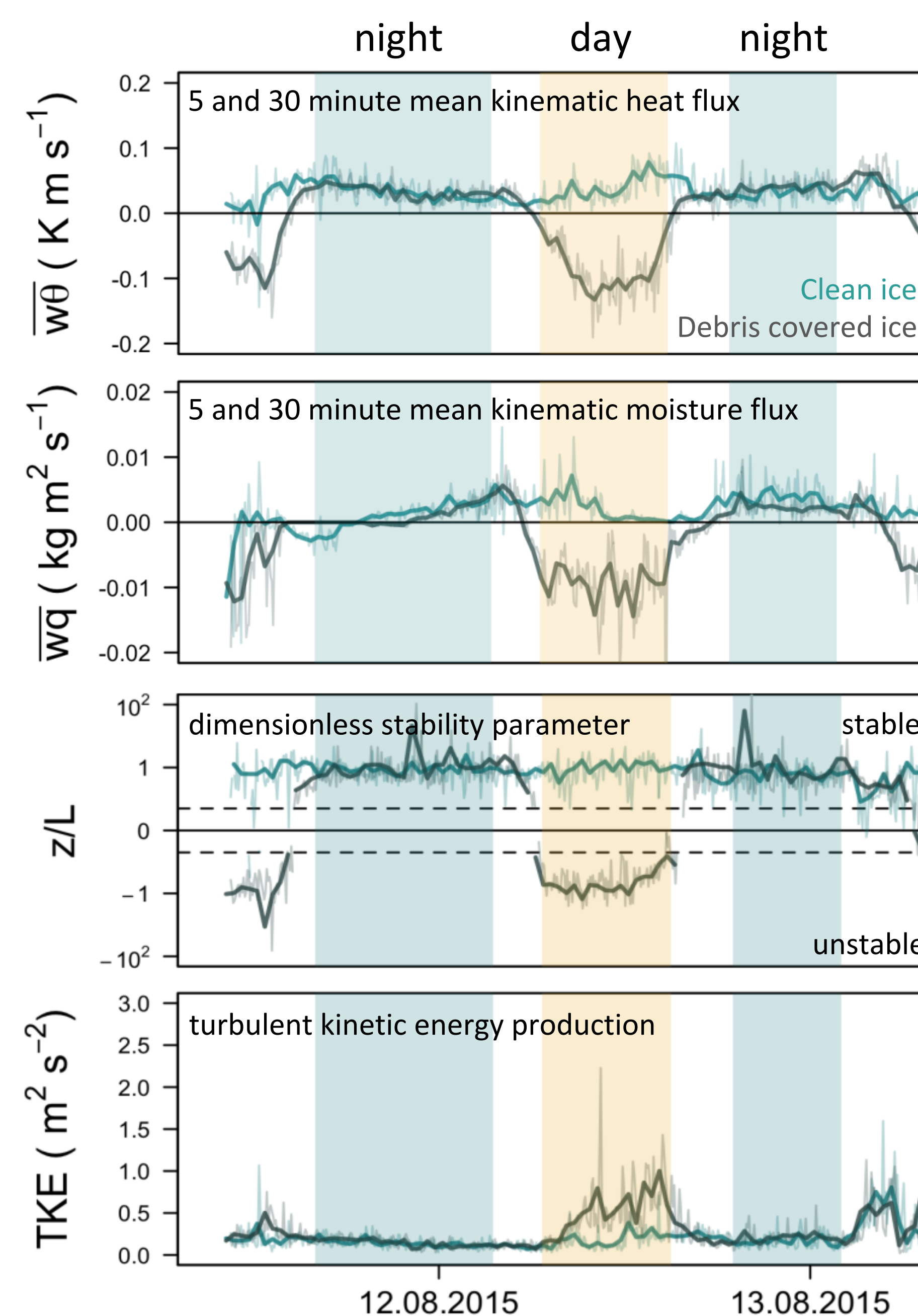
Diminishing glaciers and changing glacier surface properties, such as decreasing snow covered area, and increasing debris-covered area, alter the feedbacks from the glacier surface to the atmosphere, potentially affecting valley circulation. This in turn can alter the microclimate feeding back into the pace of deglaciation and ecosystem adaptation to mountain climate change. Better understanding these interactions will help refine our projections of the pace of change in mountain systems.

LOCAL SCALE: Effect of surface debris @ Suldenerferner

Simultaneous eddy covariance measurements over exposed and debris covered (0.14cm depth) allows assessment of impact of surface debris.



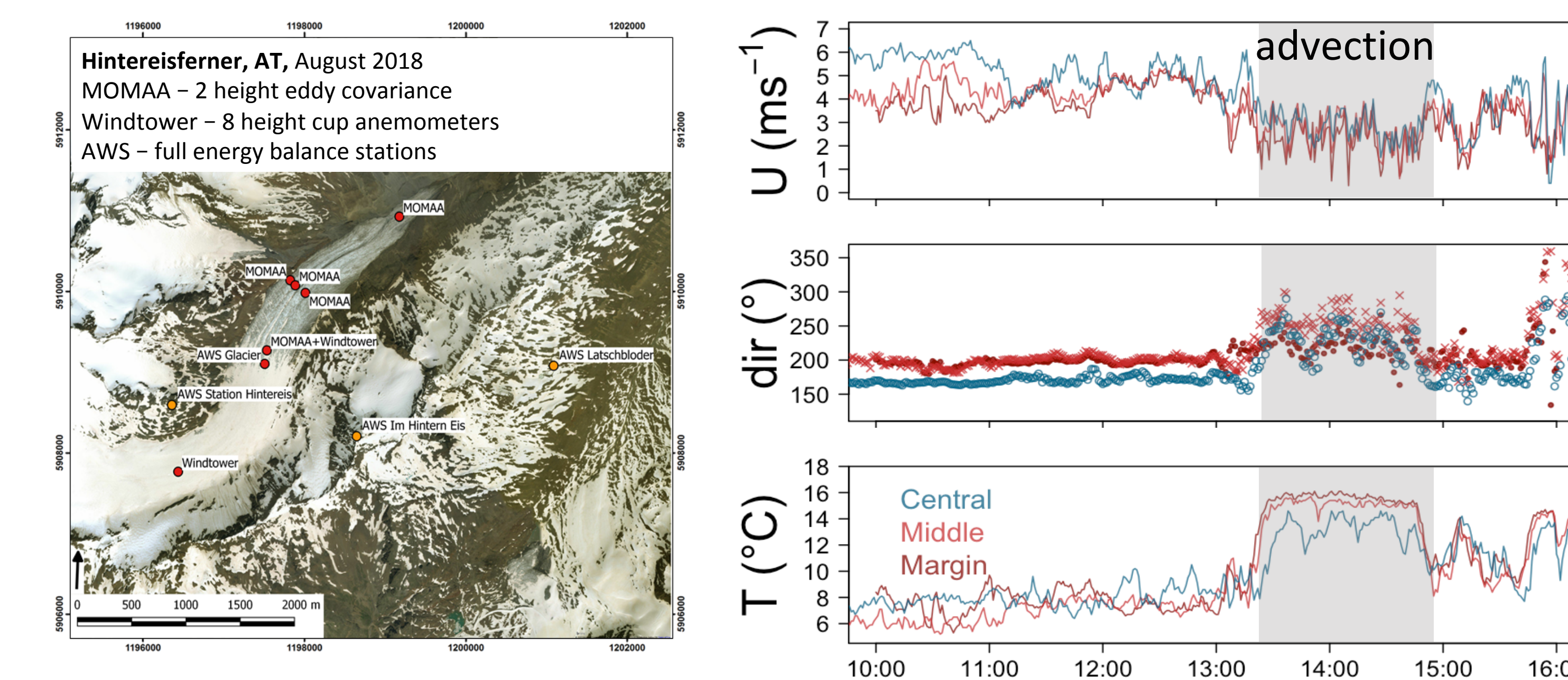
5 minute Reynolds tensor anisotropy shows eddy topology is similar at night, less isotropic over debris during daytime.



Instability (z/L) over debris cover under sunny conditions (day) causes immediate/gradual switch from prevailing positive heat/moisture fluxes to negative fluxes. Though an order of magnitude less than heat fluxes, moisture is both deposited and removed from all types of glacier surfaces.

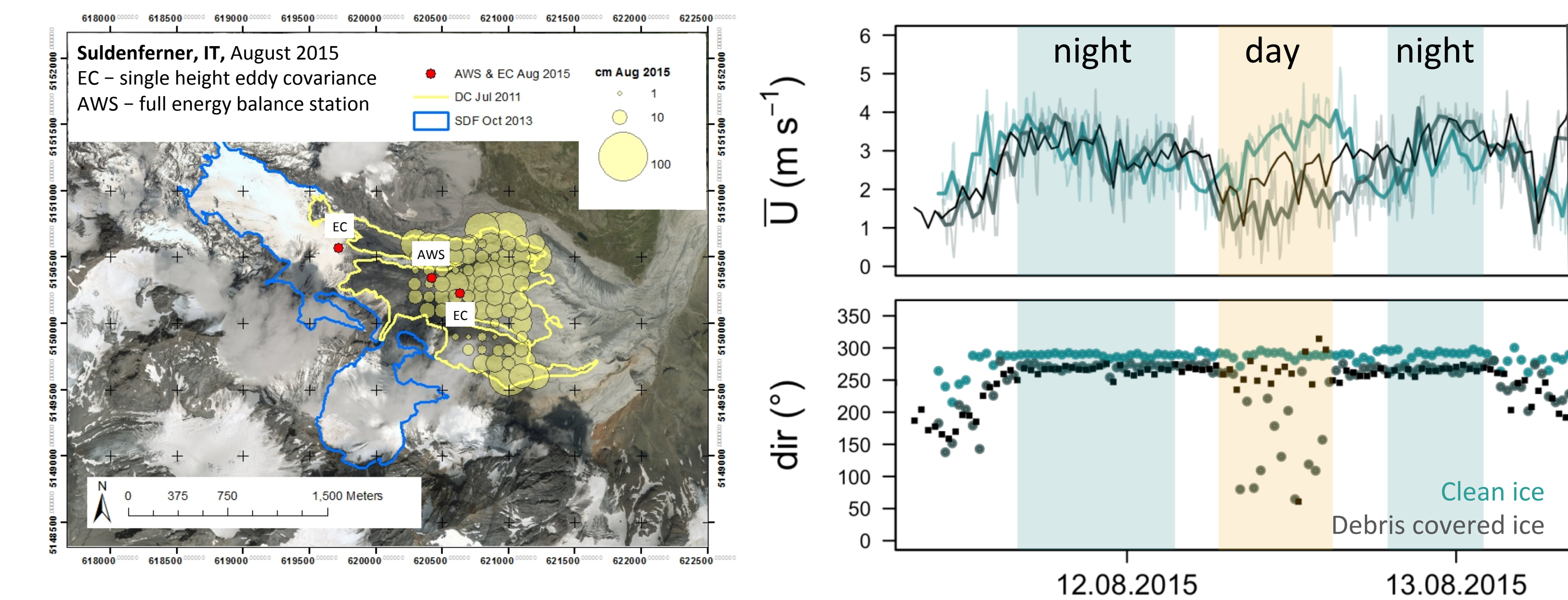
■ ■ Turbulence properties and fluxes over clean and debris-covered ice only differ during sunny days.

GLACIER SCALE: Extent and persistence of glacier katabatics as glaciers diminish and develop surface debris @ 2 glaciers



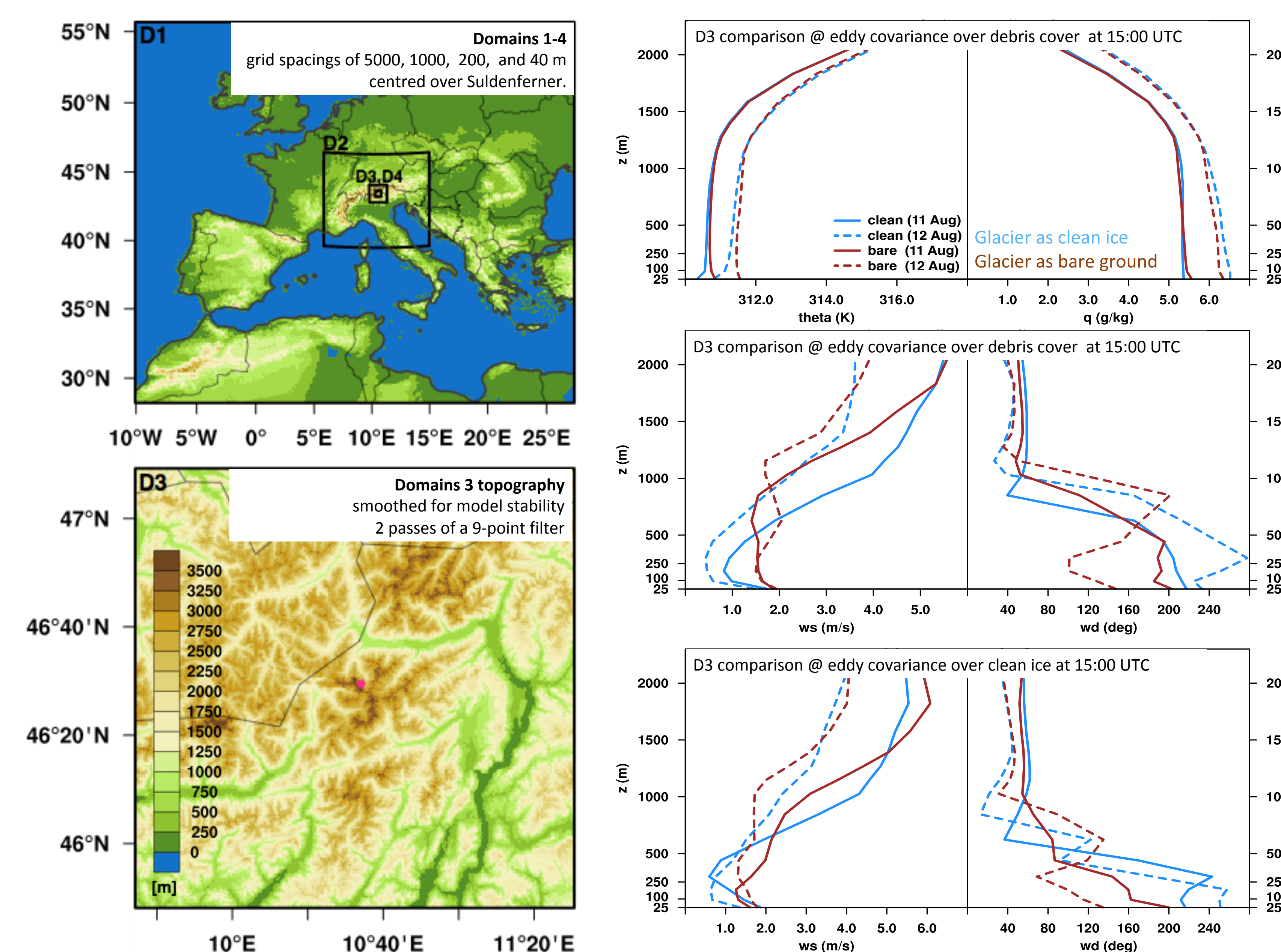
Heat advection from surrounding terrain, brought with katabatic flow from flanking formerly confluent glaciers.

■ ■ Glacier shrinkage/fragmentation/debris cover → interruption of glacier katabatics, reducing extent and persistence.



Katabatics broken down over debris covered part of ablation zone due to strong convection over surface during sunny days.

VALLEY SCALE: Impact of changing glacier surface properties and extent on atmospheric exchanges @ Suldenerferner



What is the impact of changing glacier surfaces and deglaciation on valley circulation?

WRF LES modelling to assess impact of different ways of representing changing glacier surfaces over valley scale at Suldenerferner. D4 terrain from high resolution airborne laser scan. Debris covered part of glacier classified as either glacier ice, or bare ground.

200m resolution surface representation alters glacier wind circulation and valley wind structure up to heights of 1-2km.

■ ■ Glacier surface becoming debris covered or retreating – causes change in valley circulation though our cases do not show large change in top-of-valley heat/moisture exchanges.