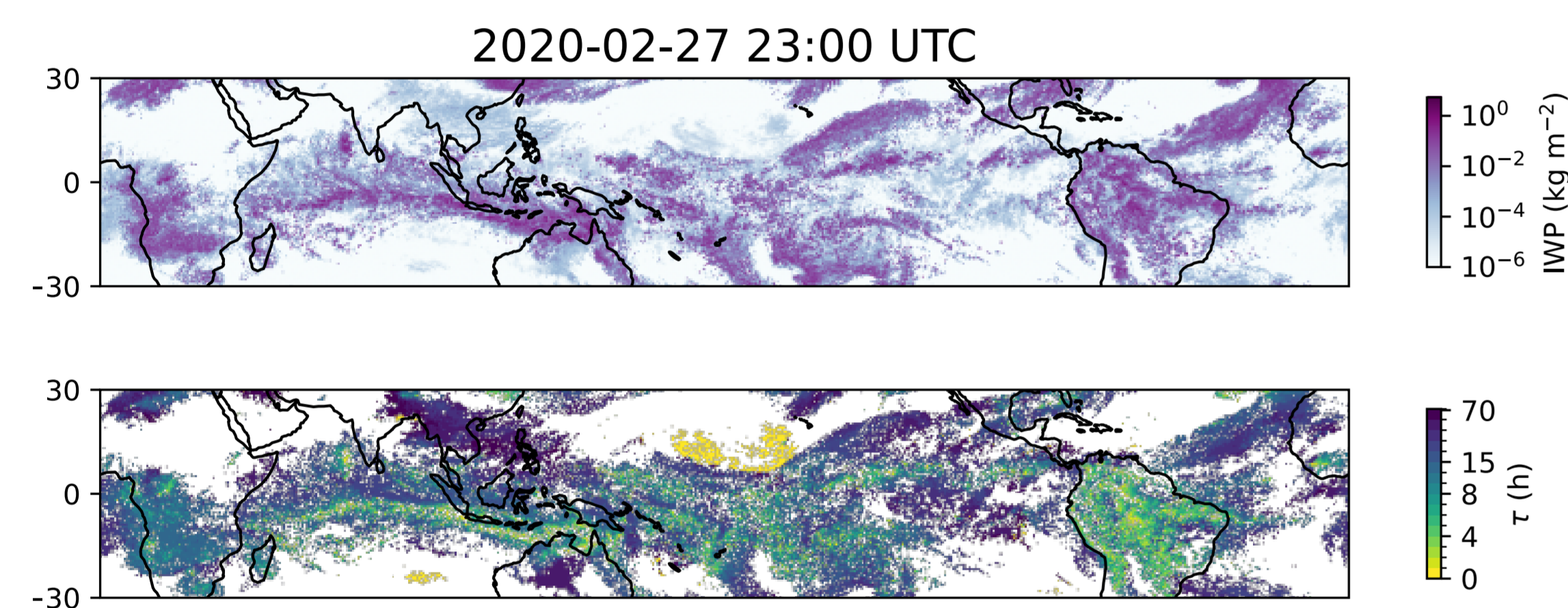


Are tropical anvil clouds thinning as the climate warms?

- Thickness of anvil clouds, and with it their radiative effects changes significantly throughout their lifetime
- Our understanding of their lifecycle in a warmer climate remains insufficient
- Recent work suggests thinning of anvil clouds in a warmer climate
- We aim to quantify changes of anvil clouds lifecycle by using passive tracers in km-scale simulations

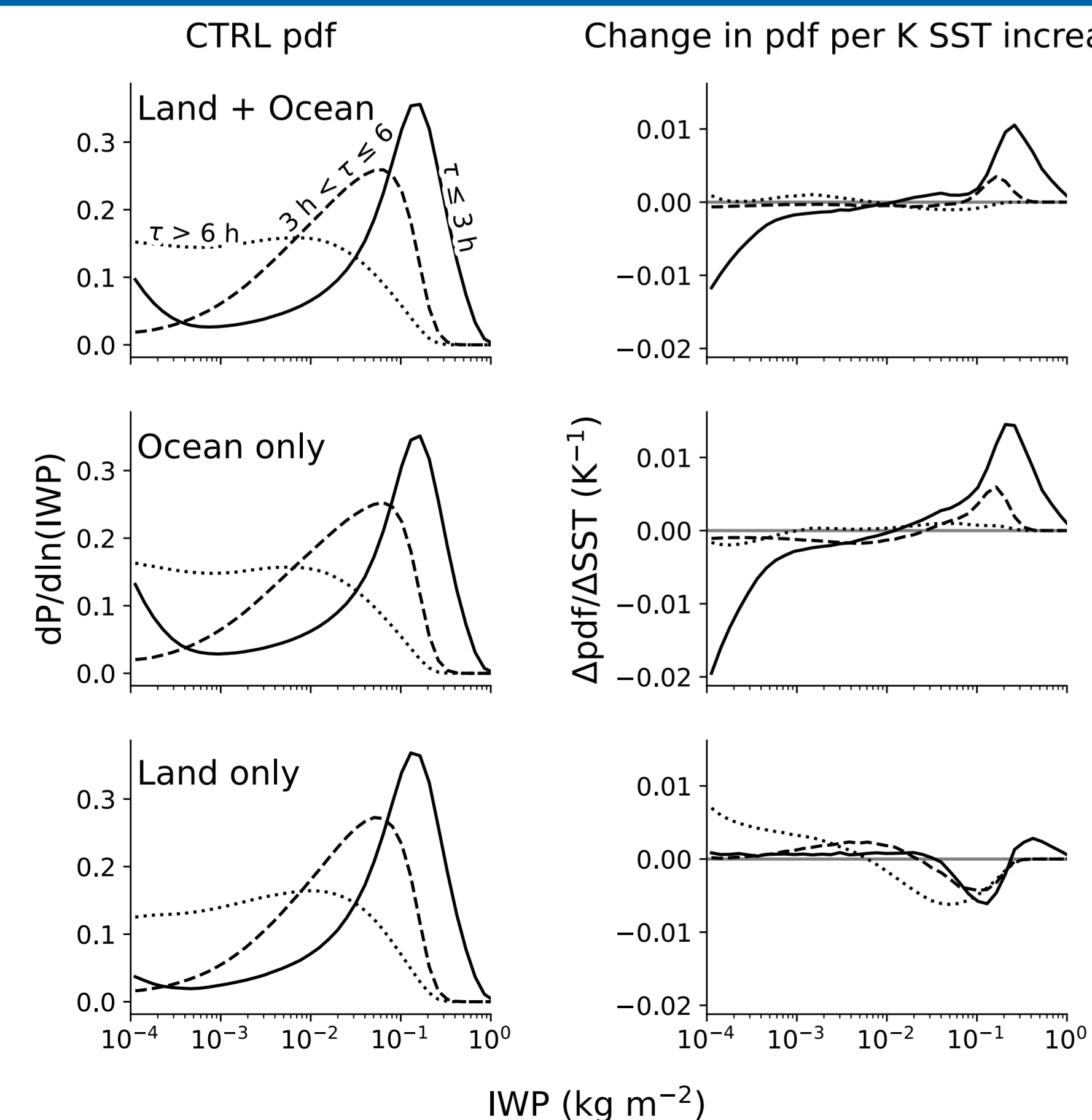
Simulations with passive tracers

- In-house simulations at Austrian Scientific Computing (ASC)
- $\Delta x \approx 5$ km, 90 levels, $\Delta z \approx 400$ m in upper troposphere
- 2 simulations: present day (CTRL), warming with uniform 4 K SST increase (SST+4K)
- 40 days, from 20.01.2020, instantaneous hourly 2D output, 5-hourly 3D output



- We implement passive tracers into the model, marking cells containing anvil clouds
- The tracers provide a temporal marker, assigning a Lagrangian age to each cell

No anvil thinning

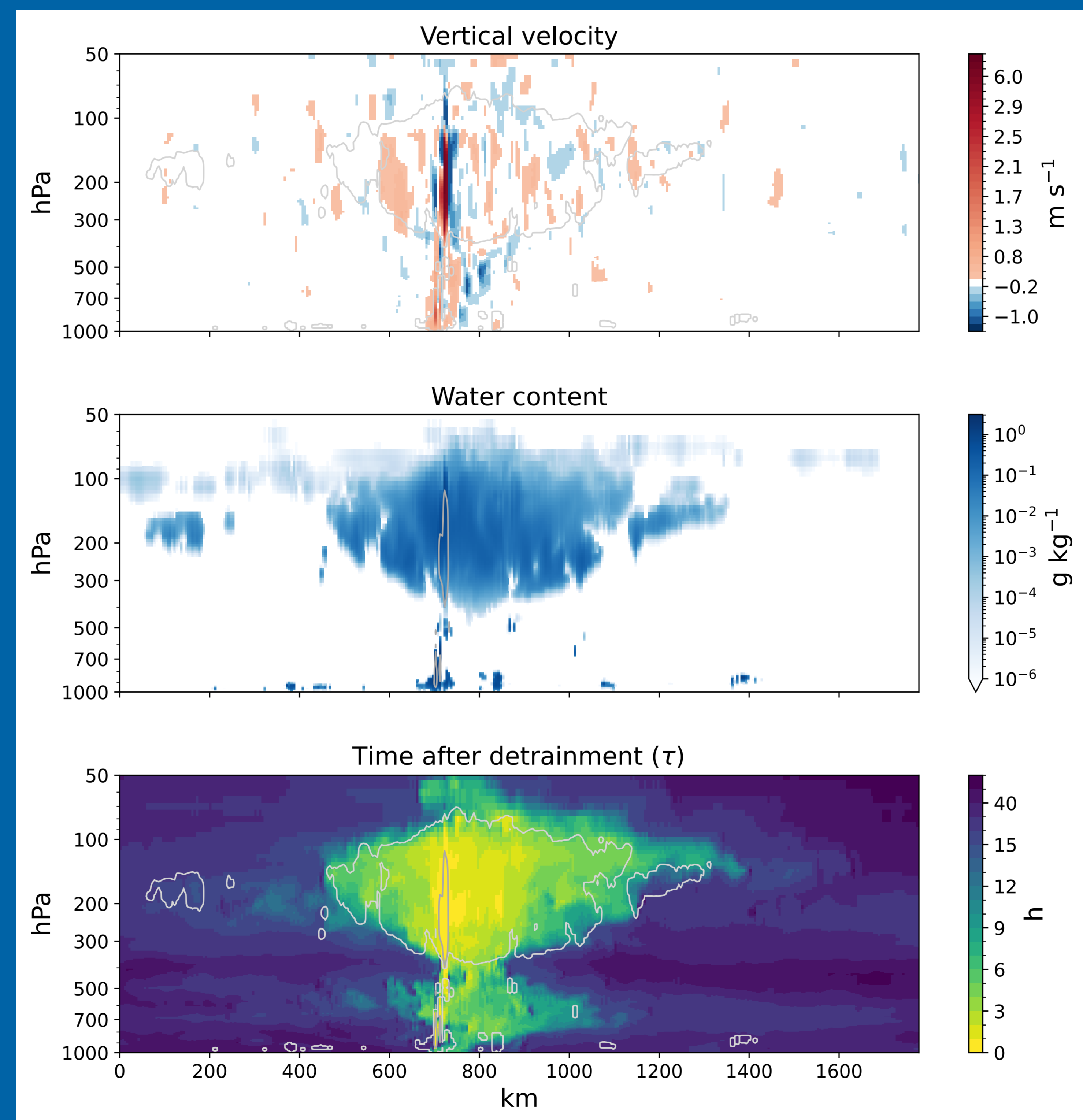


Lifecycle of anvil clouds in a warmer climate as seen by passive tracers in km-scale ICON simulations

Shirin Hamzeh Marand, Blaž Gasparini, Aiko Voigt

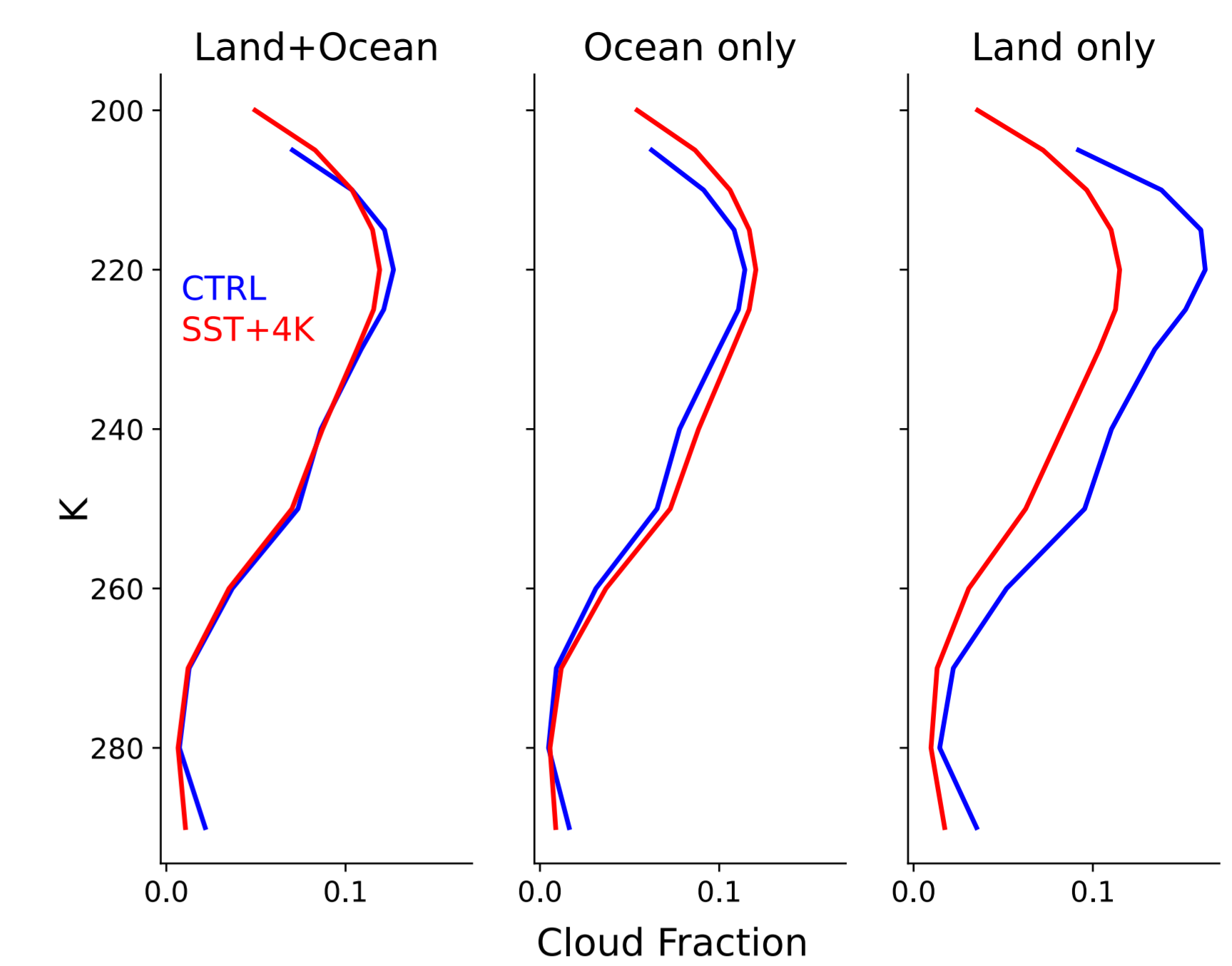
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Convective system simulated by the model. The first panel shows vertical velocity in the system, the second panel the water content in the system and the third panel shows values of the activated tracer.

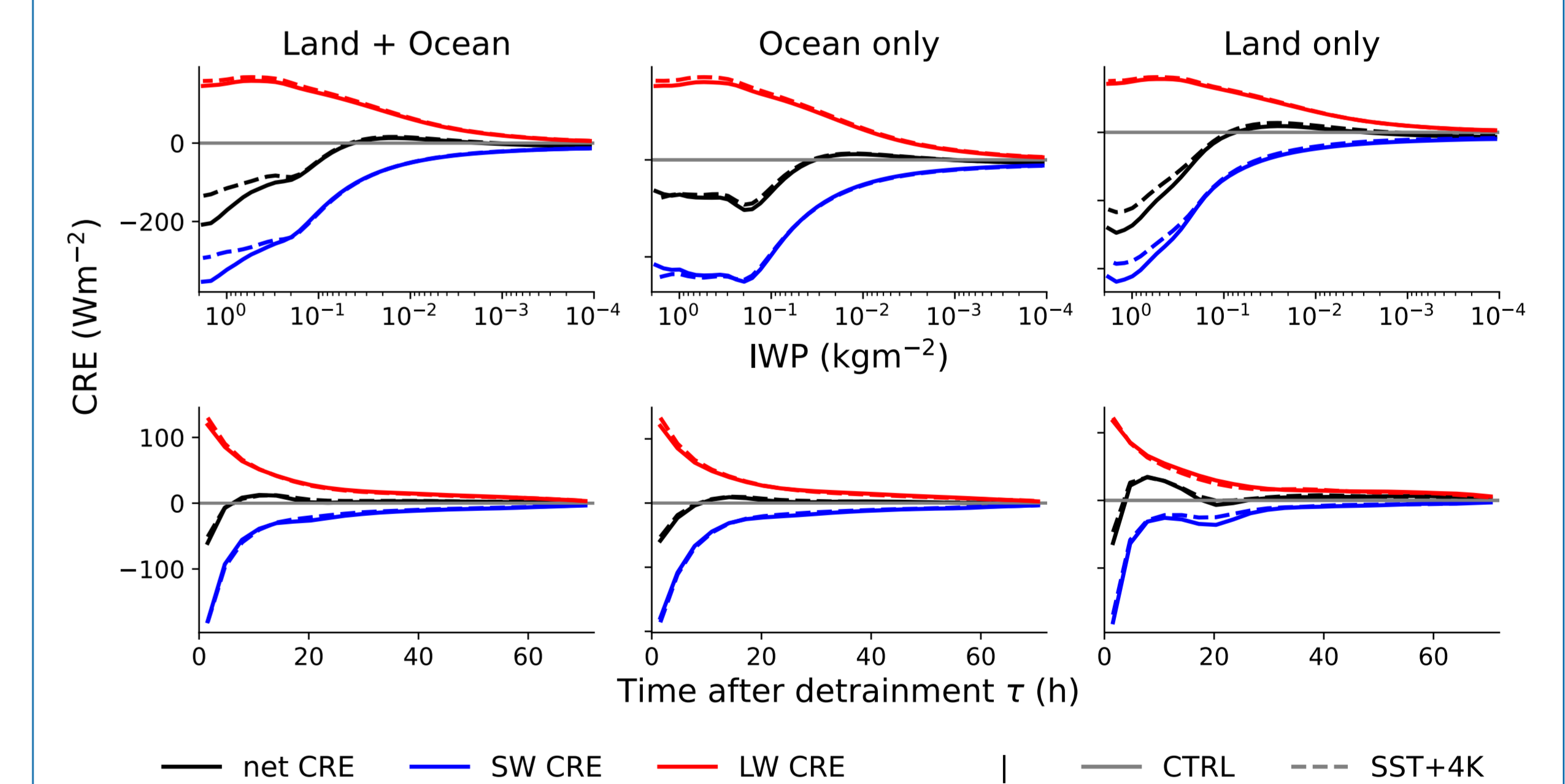
Increase of static stability but complex cloud responses



The mean cloud fraction at anvil level (220 K) increases over ocean and decreases over land. As expected, static stability at that level increases with warming.

	Stability Increase at 220 K per K SST increase ($\text{mK hPa}^{-1}\text{K}^{-1}$)
Land + Ocean	5.62
Ocean only	5.20
Land only	6.26

Changes in Cloud Radiative Effects (CREs)



Conclusions

- **Opposed to Sokol et al. (2024), we find an increase of young, thick anvils**
- We find an increase of static stability over the whole domain
- We find that Stability Iris, a decrease in anvil coverage due to an increase of stability with warming, over land, but does not explain the anvil increase over ocean
- We find a decrease in SW cooling and hence an increase of net CRE for thick anvils, further we find a small increase in LW warming and a small increase of net CRE in thin anvils.