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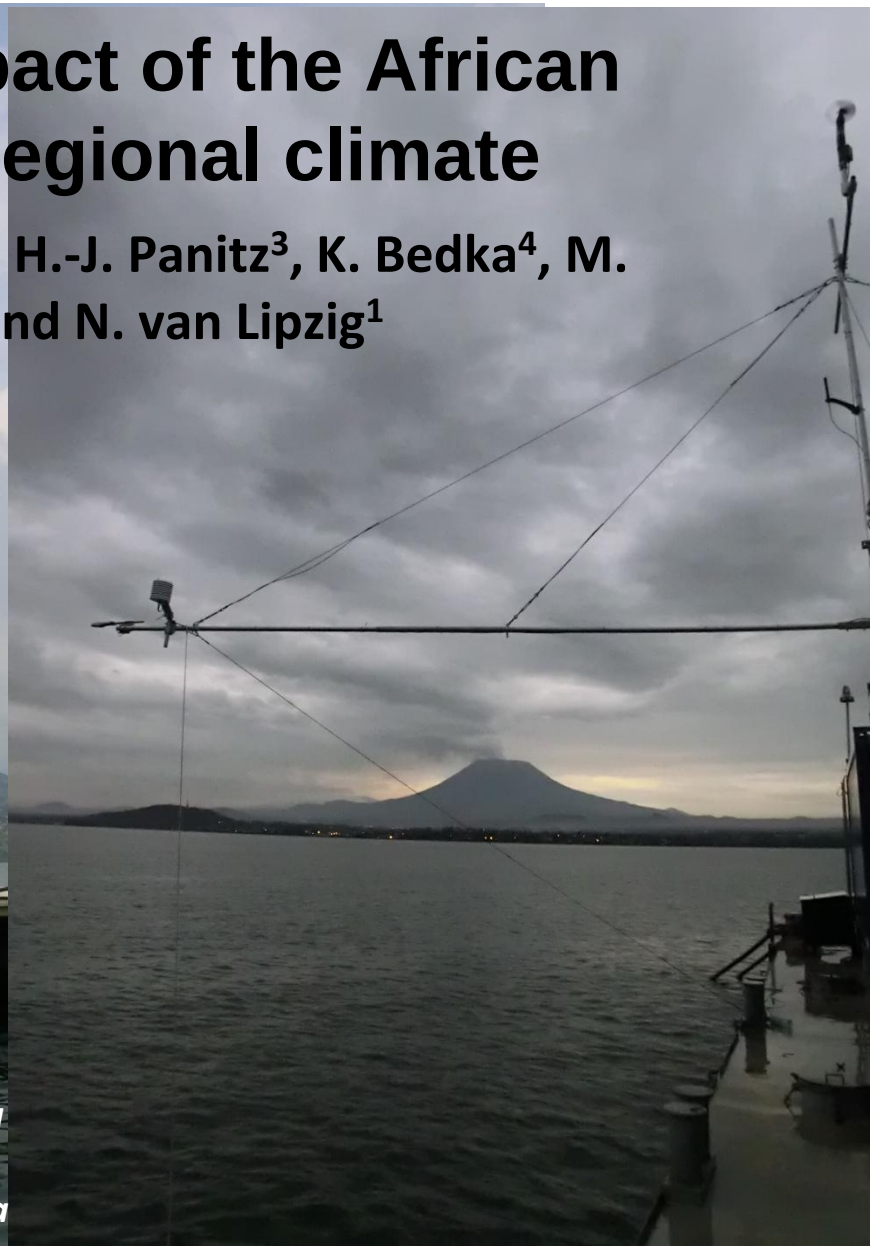
Present and future impact of the African Great Lakes on the regional climate

W. Thiery[1], E. Davin[2], S. Seneviratne[2], H.-J. Panitz[3], K. Bedka[4], M. Demuzere[1], S. Lhermitte[1] and N. van Lipzig[1]



(1) KU Leuven, Belgium
(2) Swiss Federal Institute of Technology (ETH), Switzerland
(3) Karlsruhe Institute of Technology (KIT), Germany
(4) NASA Langley Research Center, United States of America

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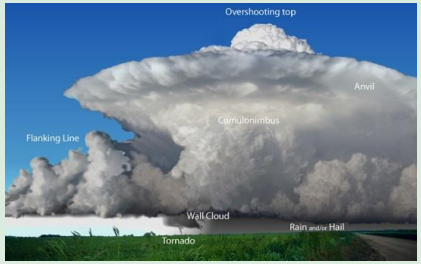
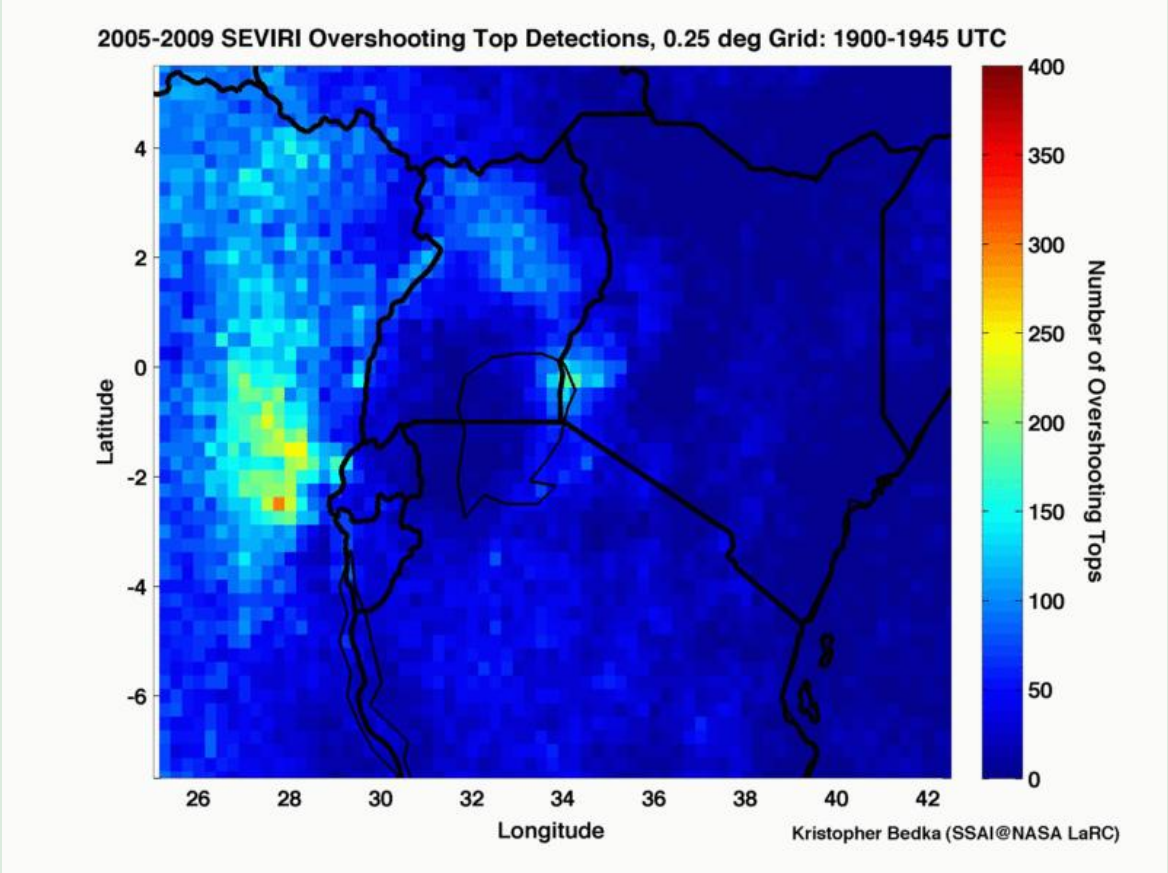
Motivation and objectives



(severe-wx.pbworks.com)



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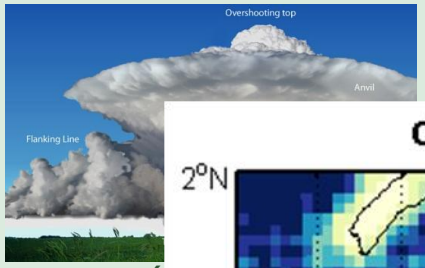
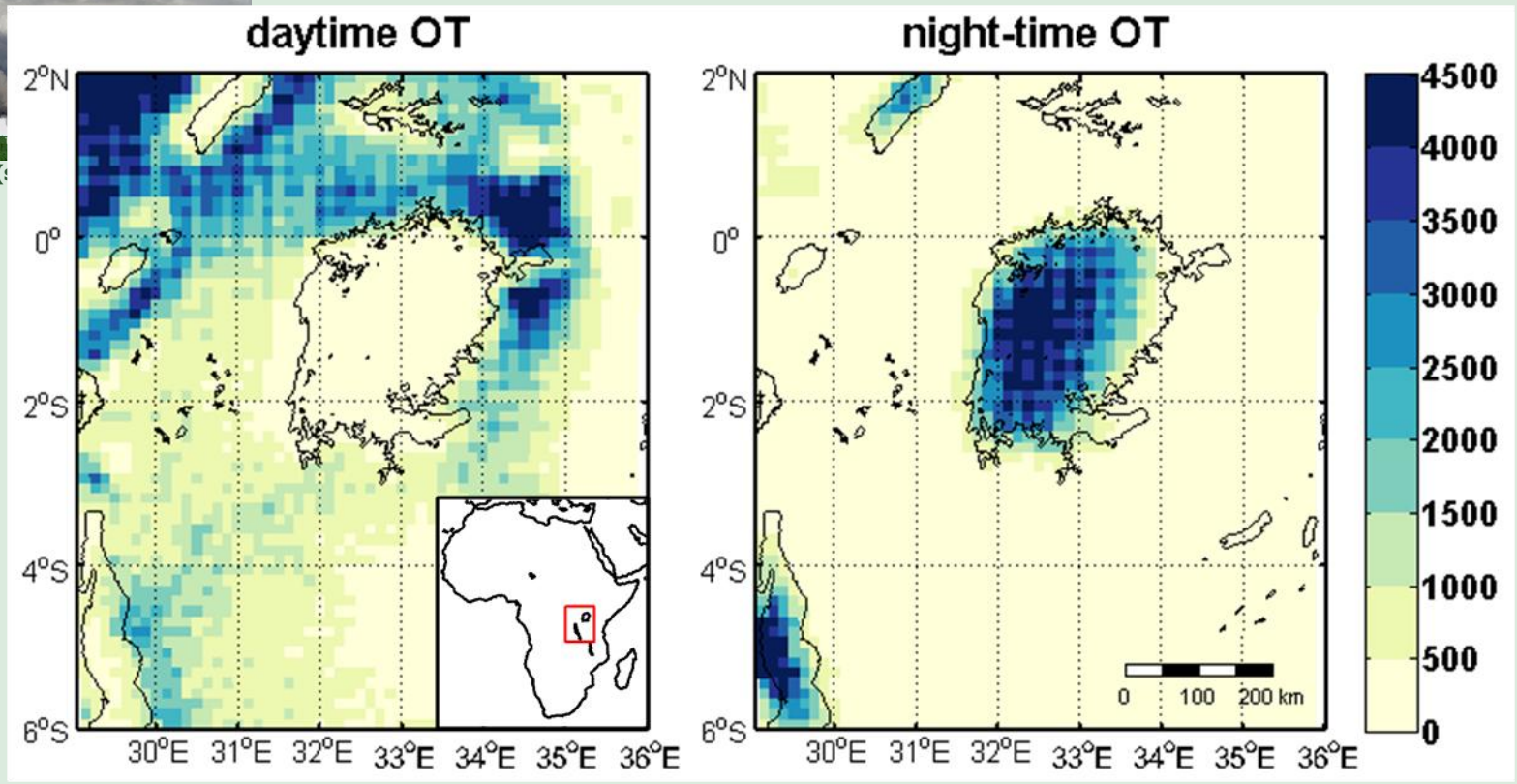
Motivation and objectives





clear lake imprint on thunderstorm occurrence

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Motivation and objectives

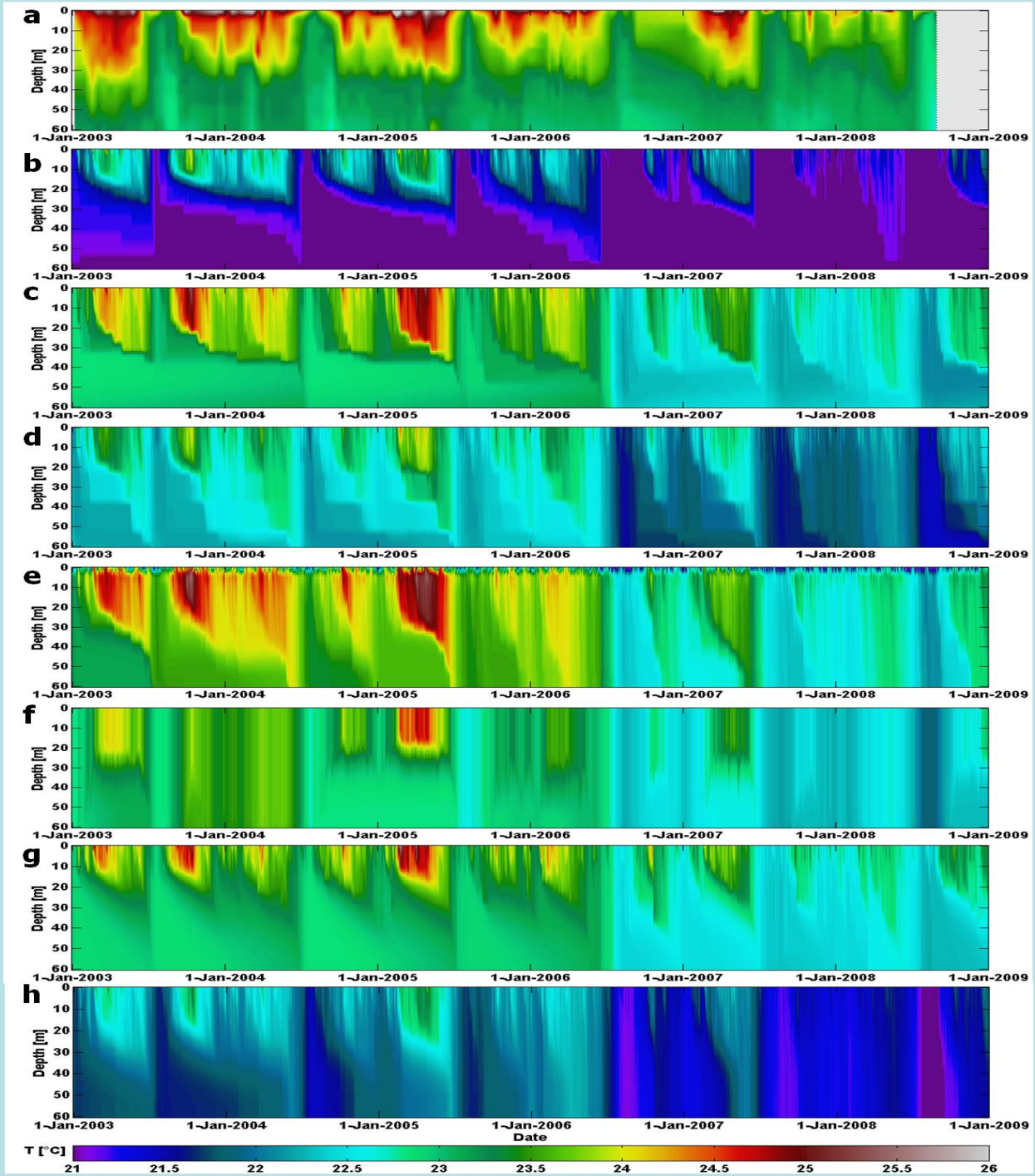
Lethal weather on 'world's most dangerous lake'

From **Errol Barnett,** CNN
January 17, 2013 -- Updated 1448 GMT (2248 HKT)

(Lake Kivu)

(www.cnn.com)

model skill? **impact?** **future climate change?**



observations

Hostetler

LAKEoneD

SimStrat

LAKE

FLake

MINLAKE2012

CLM4-LISSS

(Thiery et al., TA 2014)

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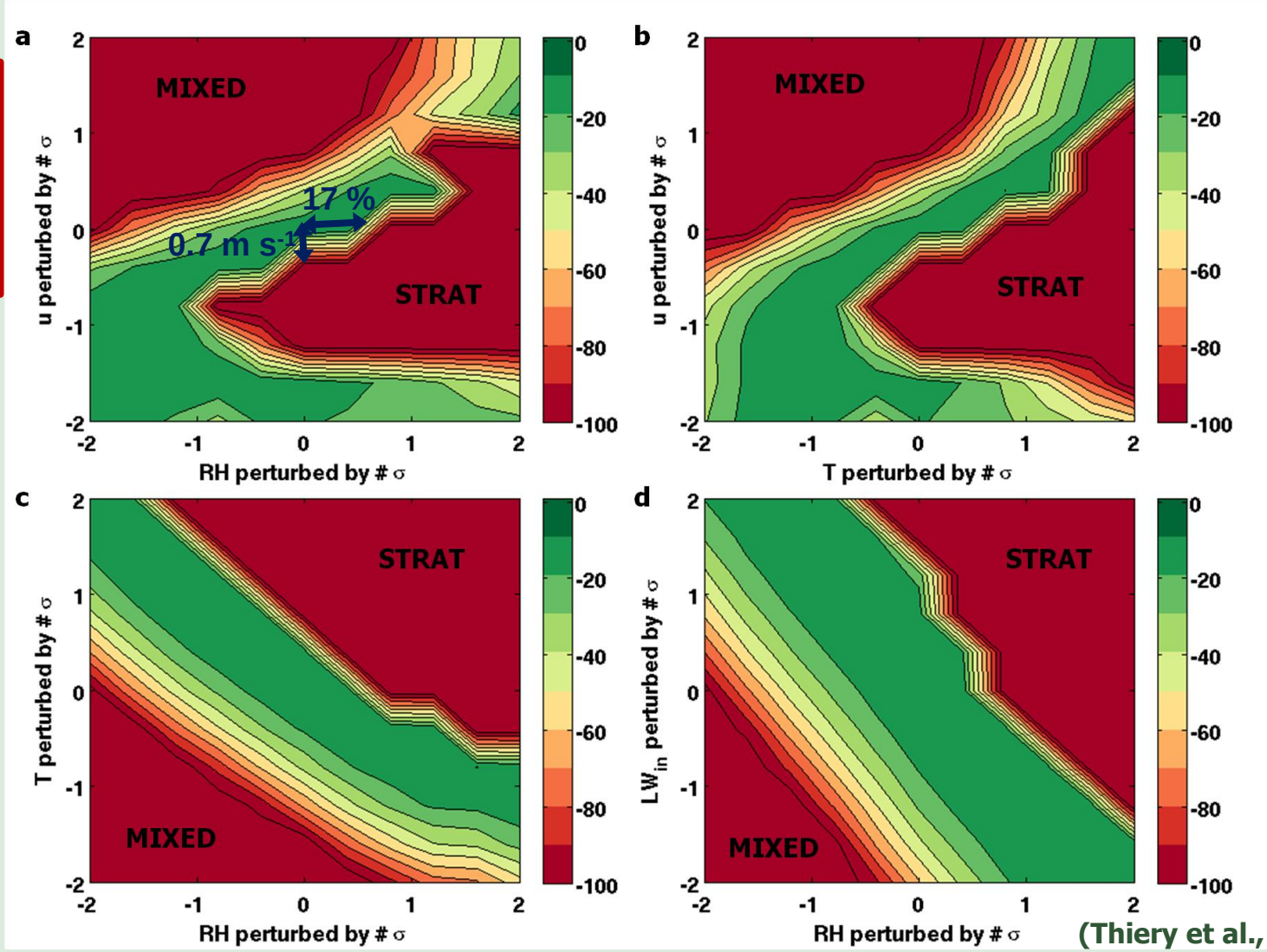
FLake Sensitivity to forcing fields

Although T_{bot} is extremely sensitive to extpar and forcing, T_{surf} predictions are robust



(Thiery et al., GMD 2014)

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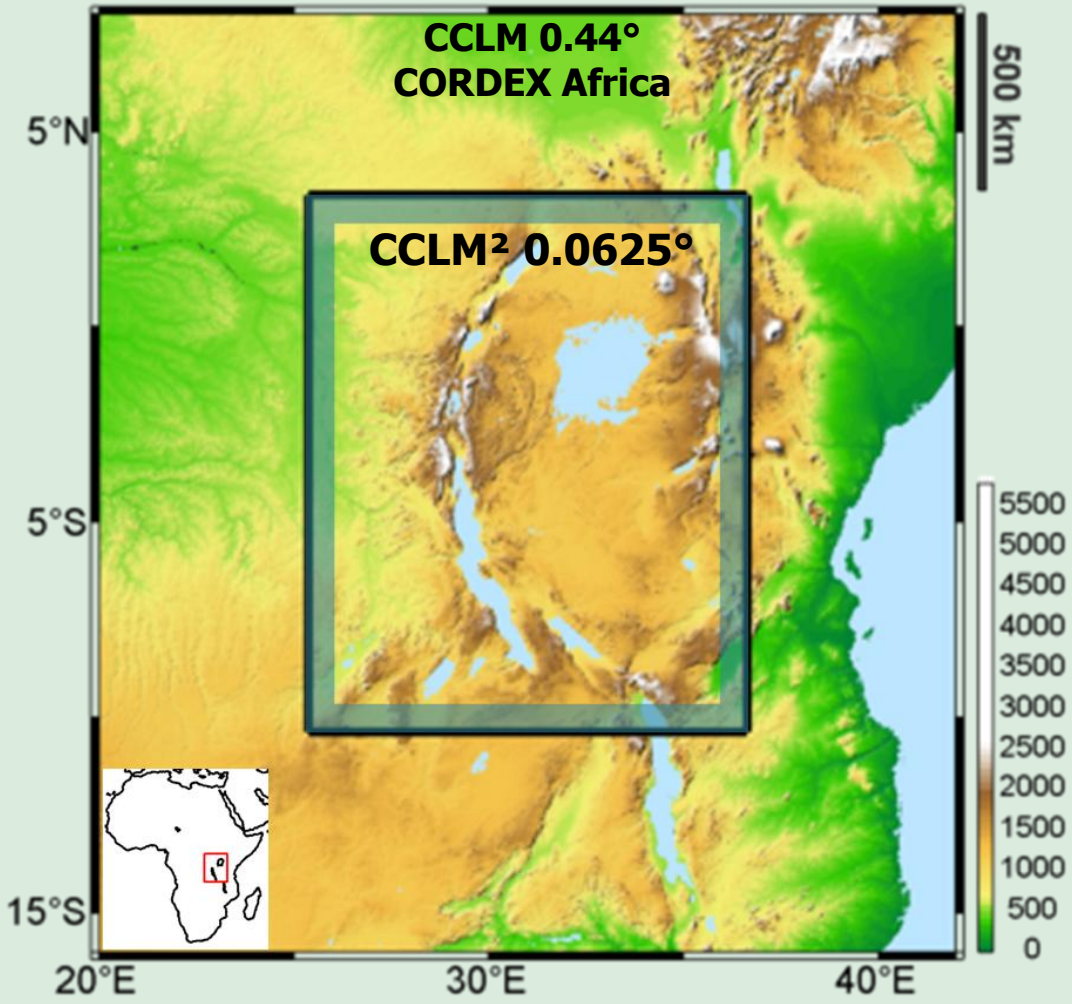
CCLM² model setup



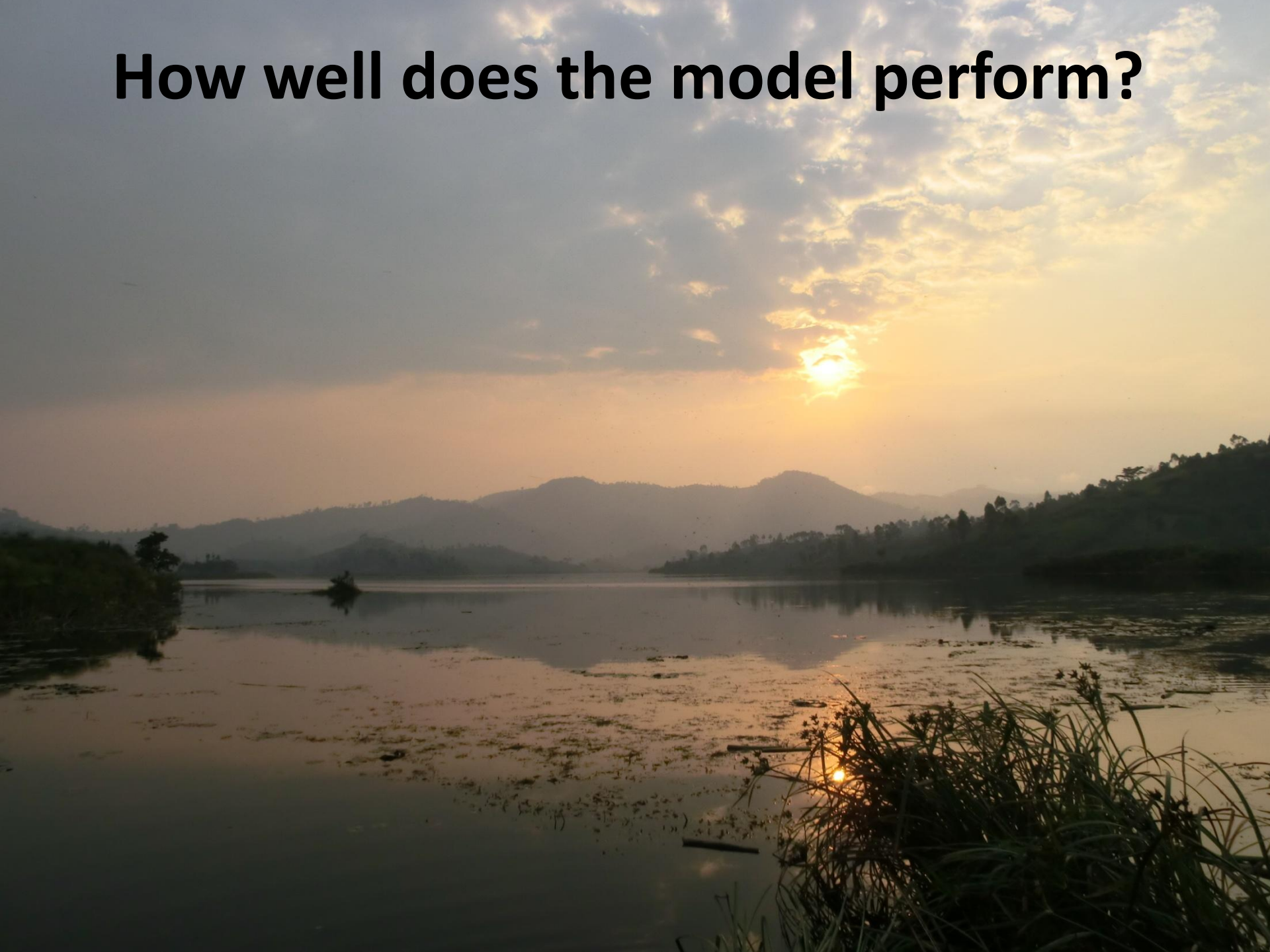
COSMO-CLM 4.8
(CORDEX-Africa set-up)

CLM 3.5 | FLake

(Davin and Seneviratne, 2012)

"RCP8.5" (1989-2008)

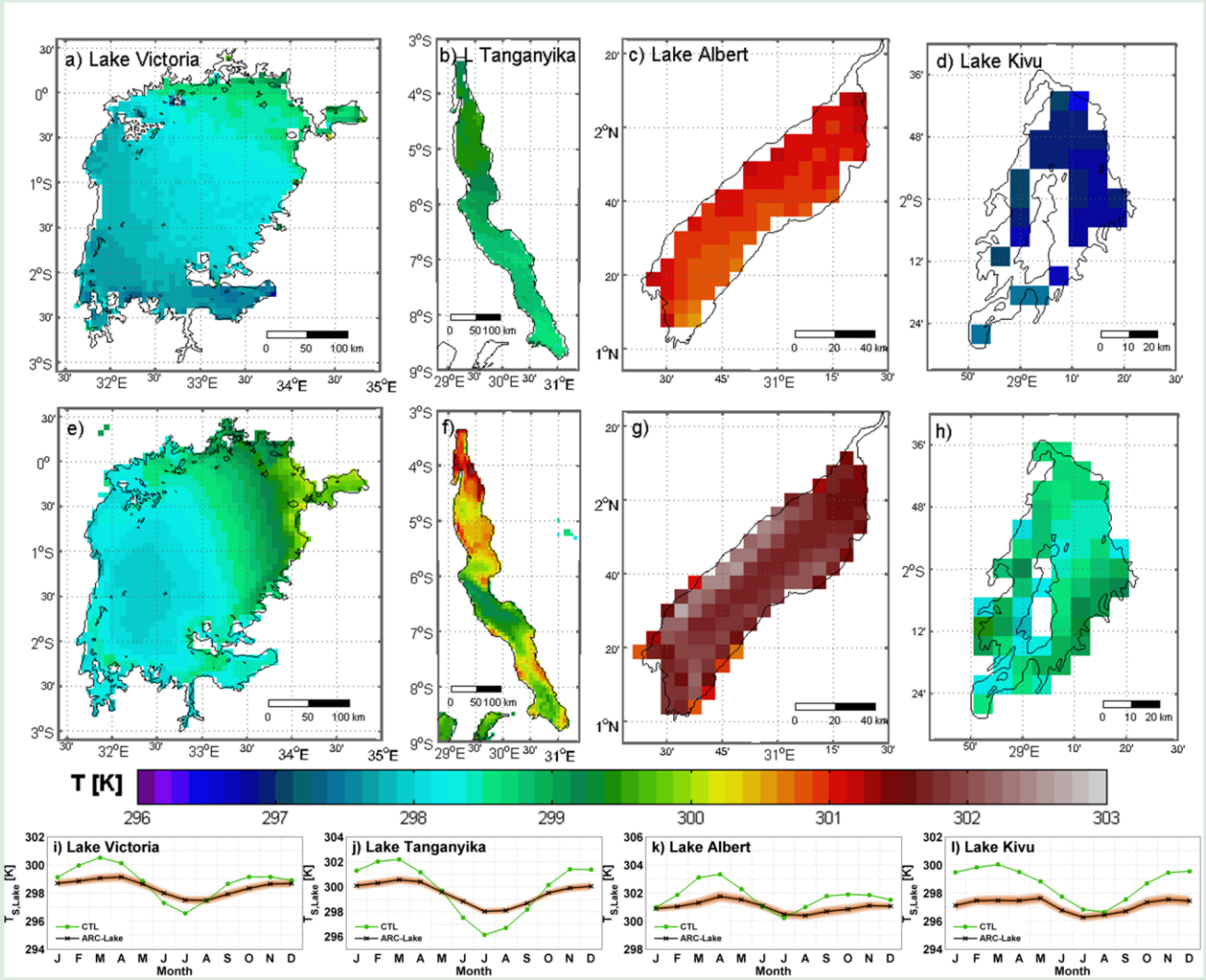
How well does the model perform?



COSMO-CLM 4.8

CLM 3.5 FLake

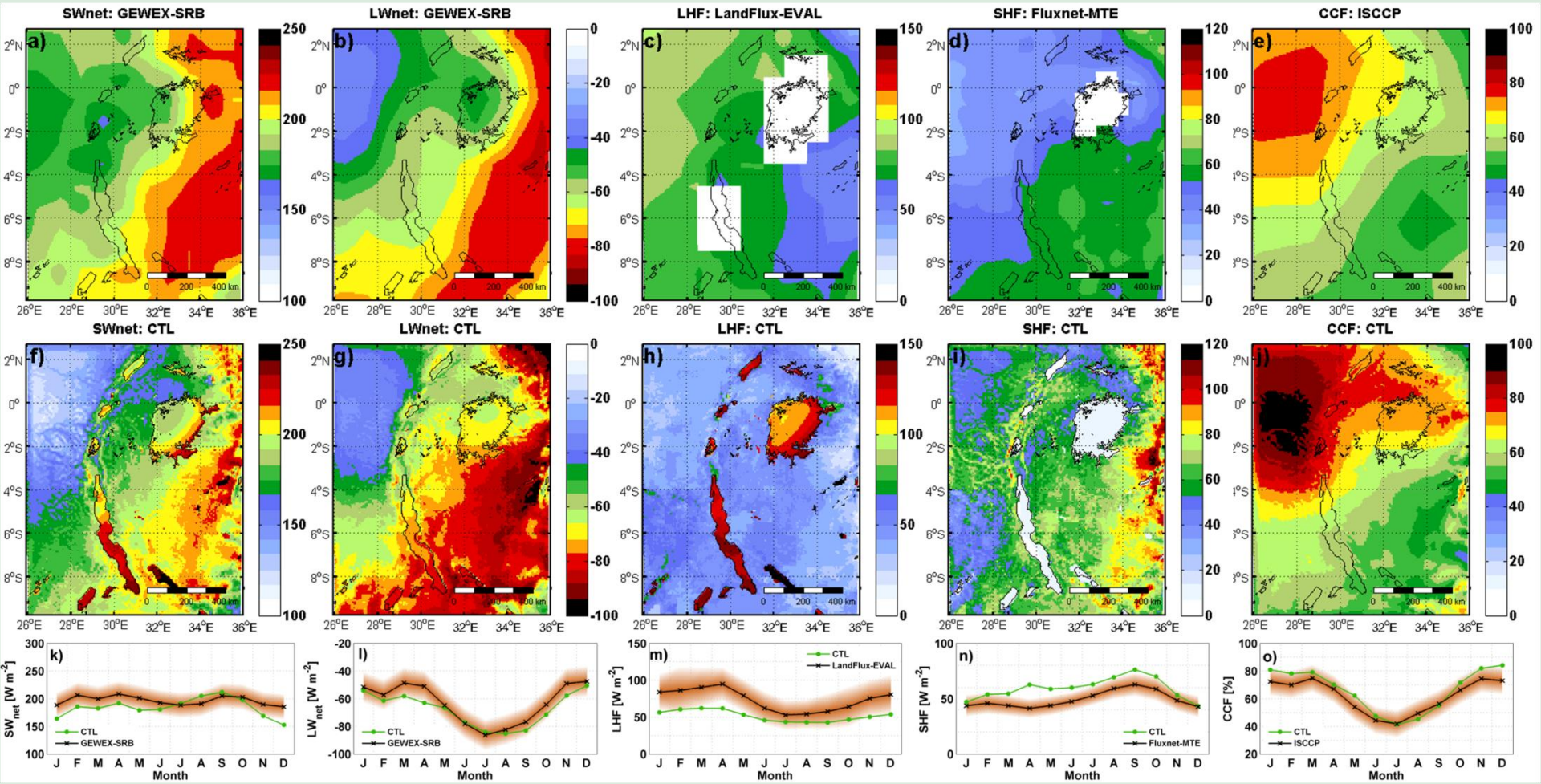
Evaluation: lake temperature



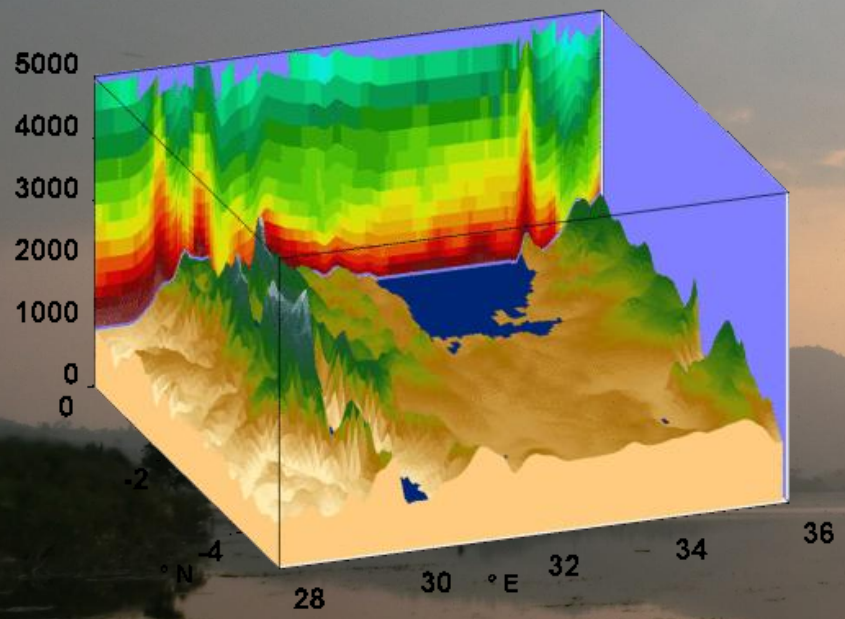
COSMO-CLM 4.8

CLM 3.5 FLake

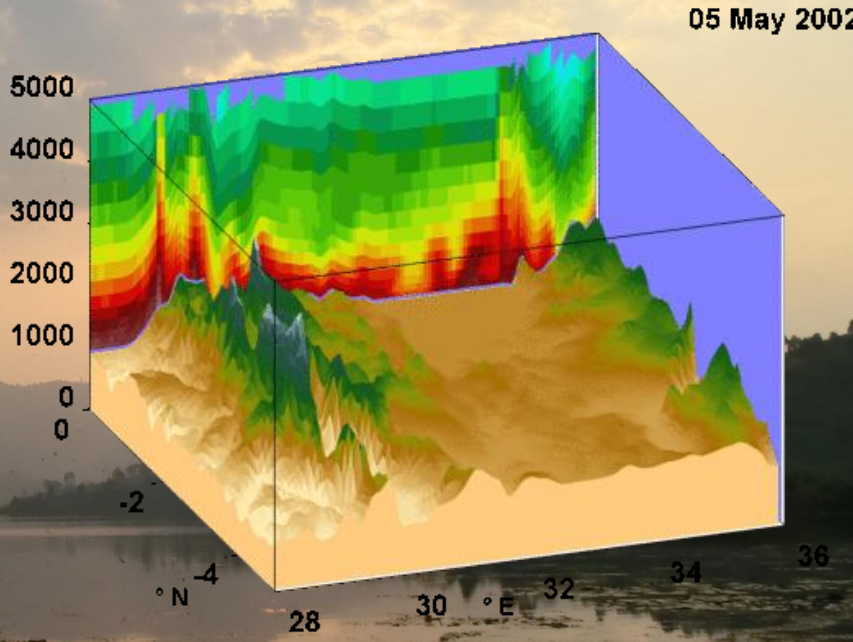
Evaluation: SEB and clouds



Impact on the regional climate?



"CTL"



"NOL"

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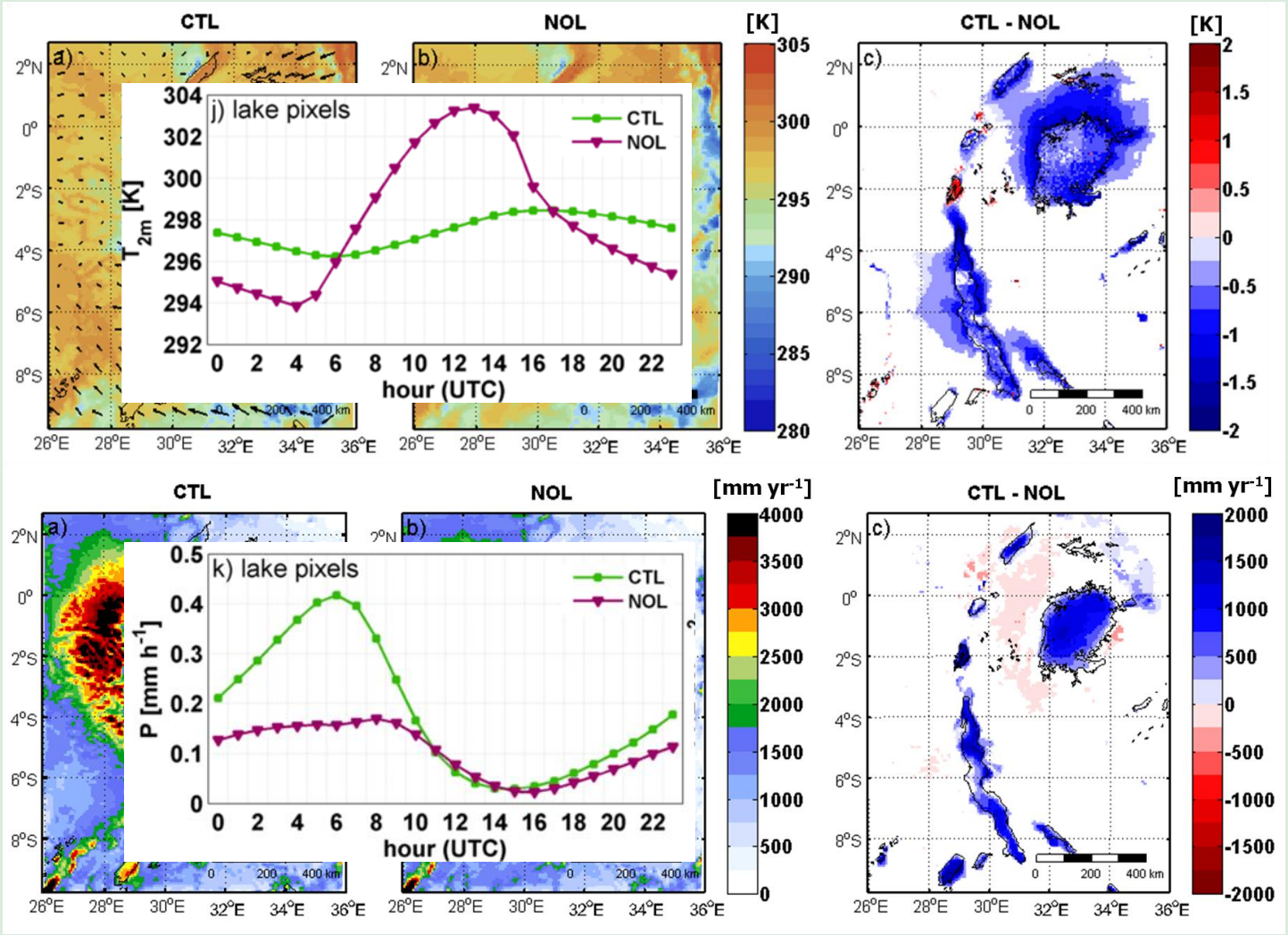
AGL impact on the mean climate

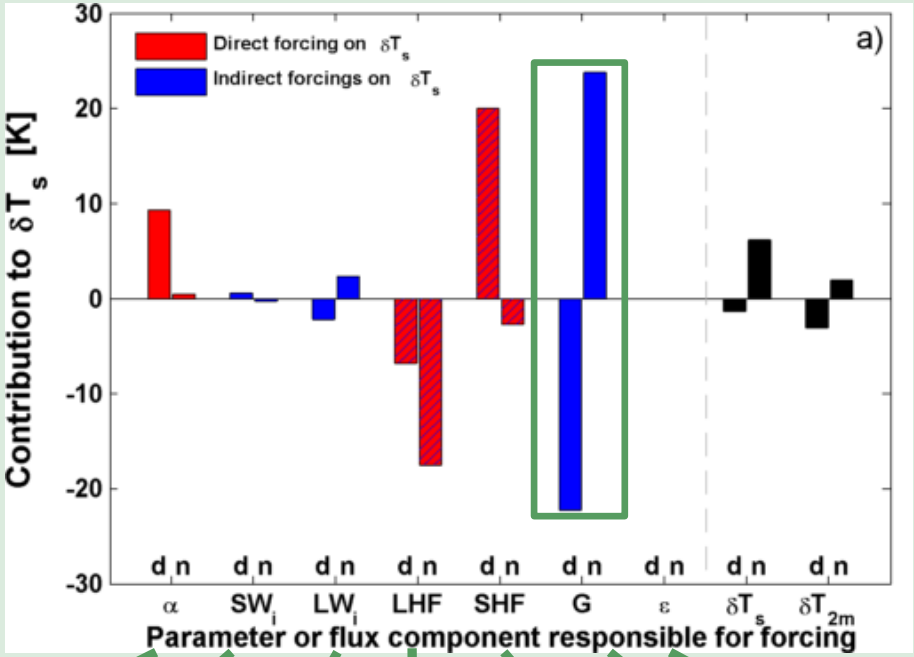
T_{2m}

Precipitation



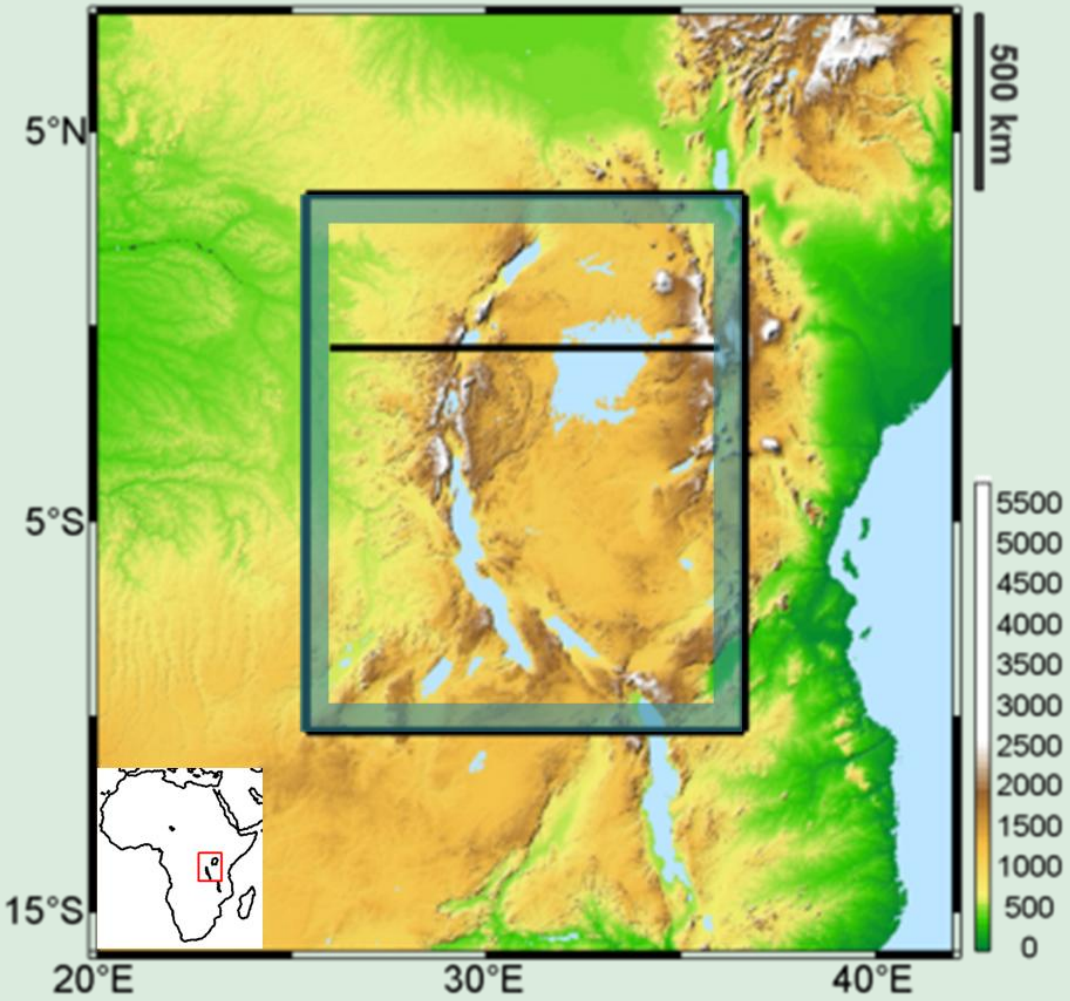
SEB decomposition: day-night contrast

Lake pixels



$$\delta T_s = \frac{1}{4\epsilon\sigma T_s^3}(-SW_{in}\delta\alpha + (1-\alpha)\delta SW_{in} + \delta LW_{in} - \delta LHF + \delta SHF - \delta G - \sigma T_s^4 \delta\epsilon)$$

Cross section



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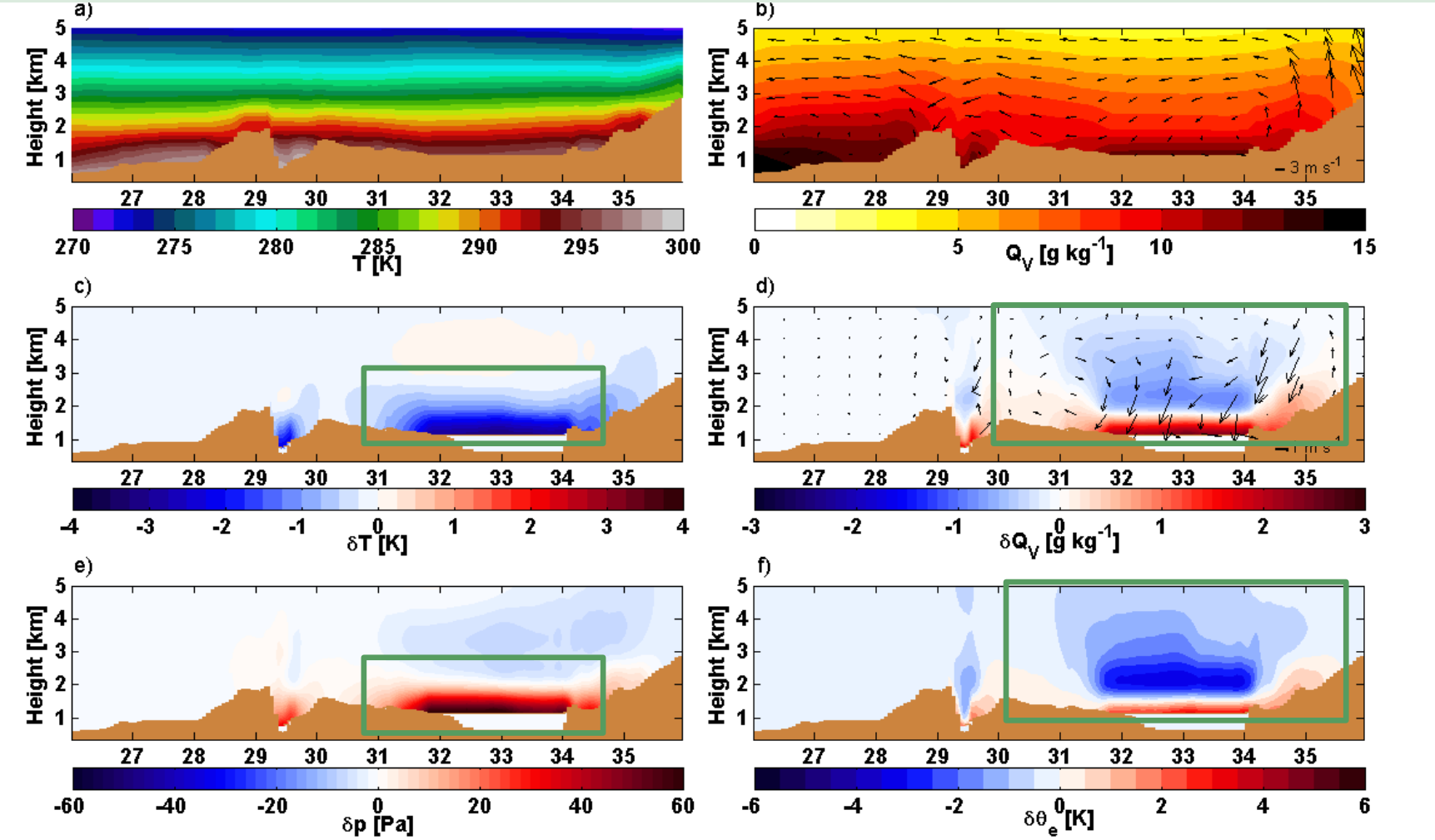
Dynamical response: daytime

CTL

CTL - NOL



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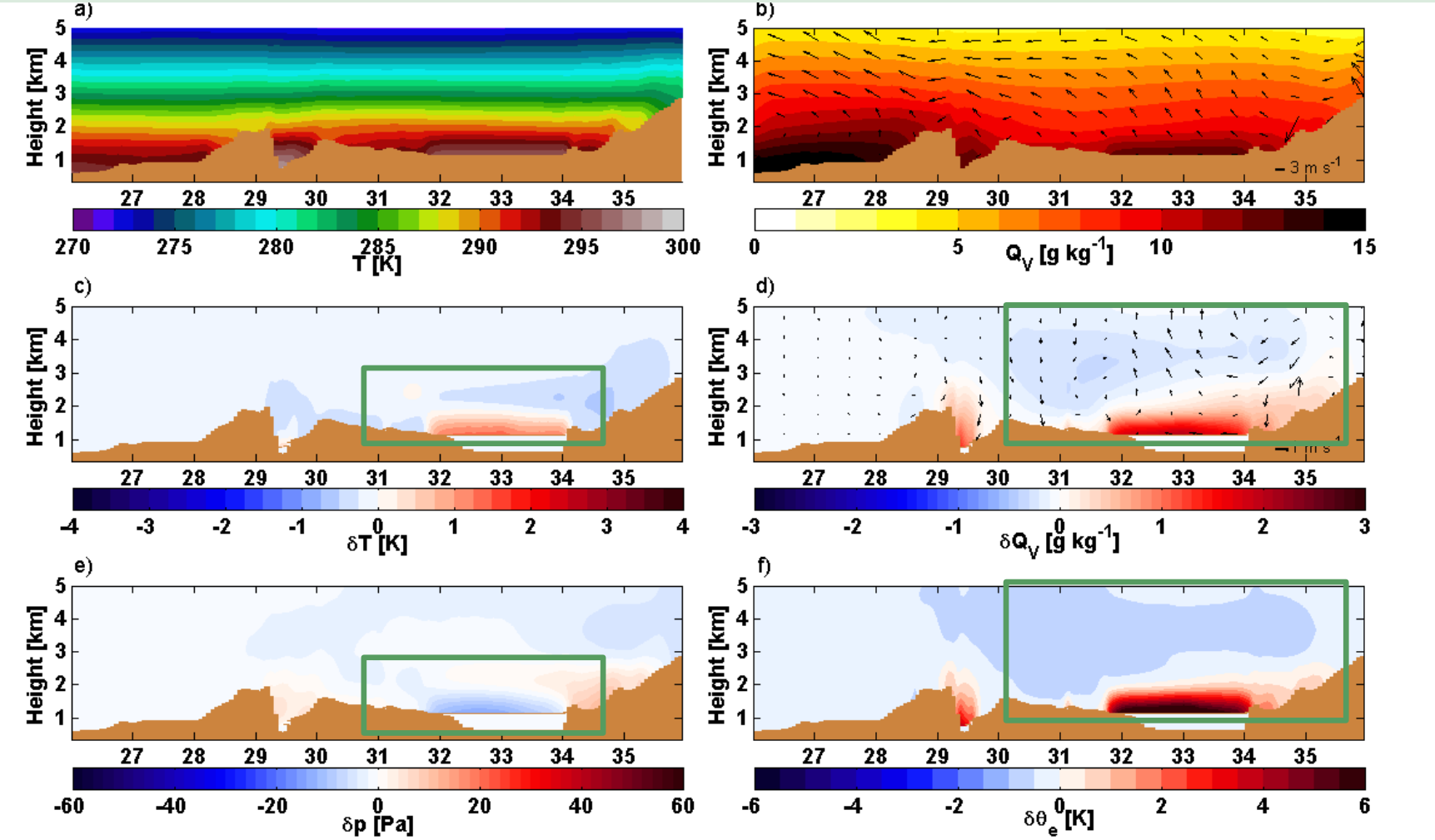
Dynamical response: night-time

CTL

CTL - NOL



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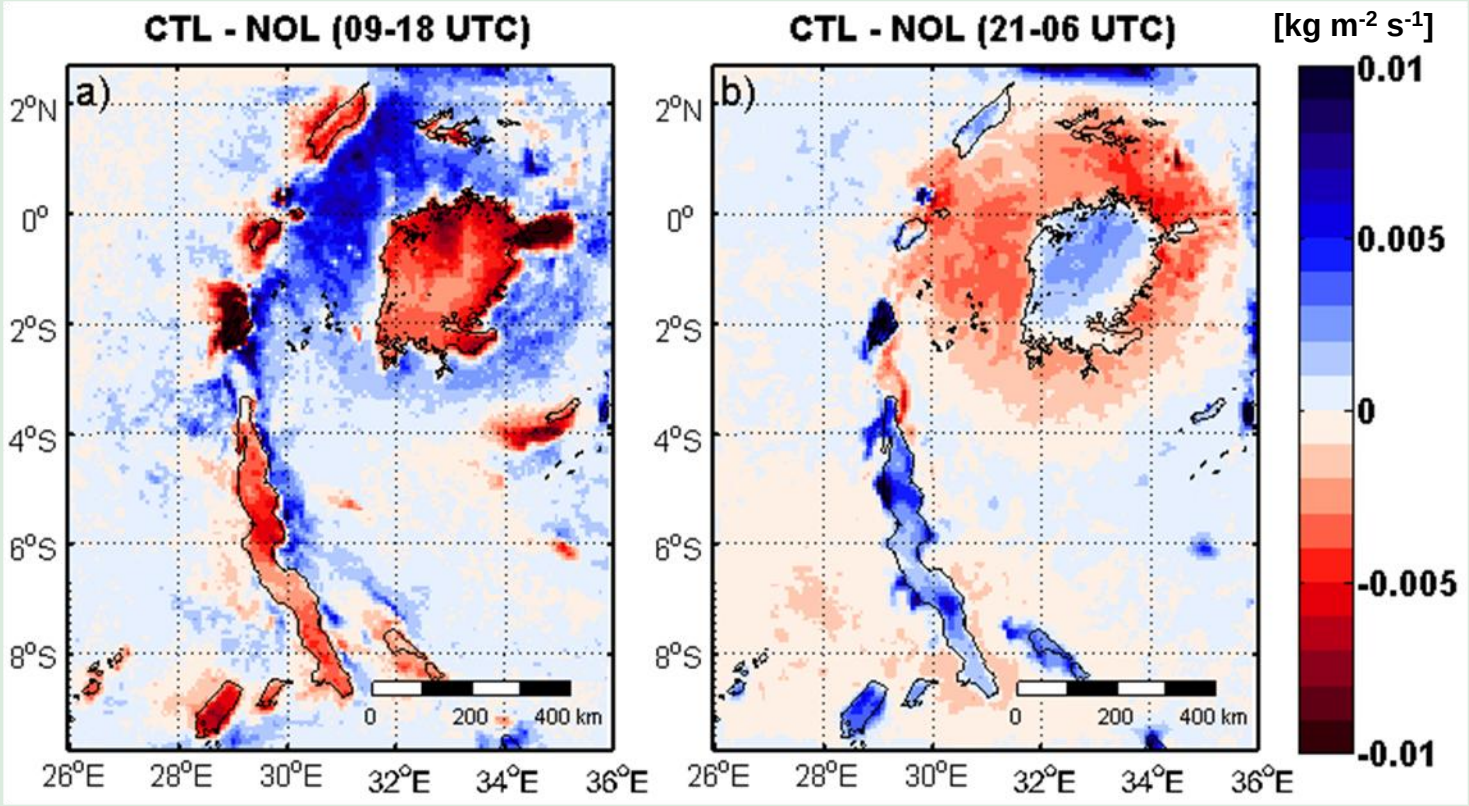
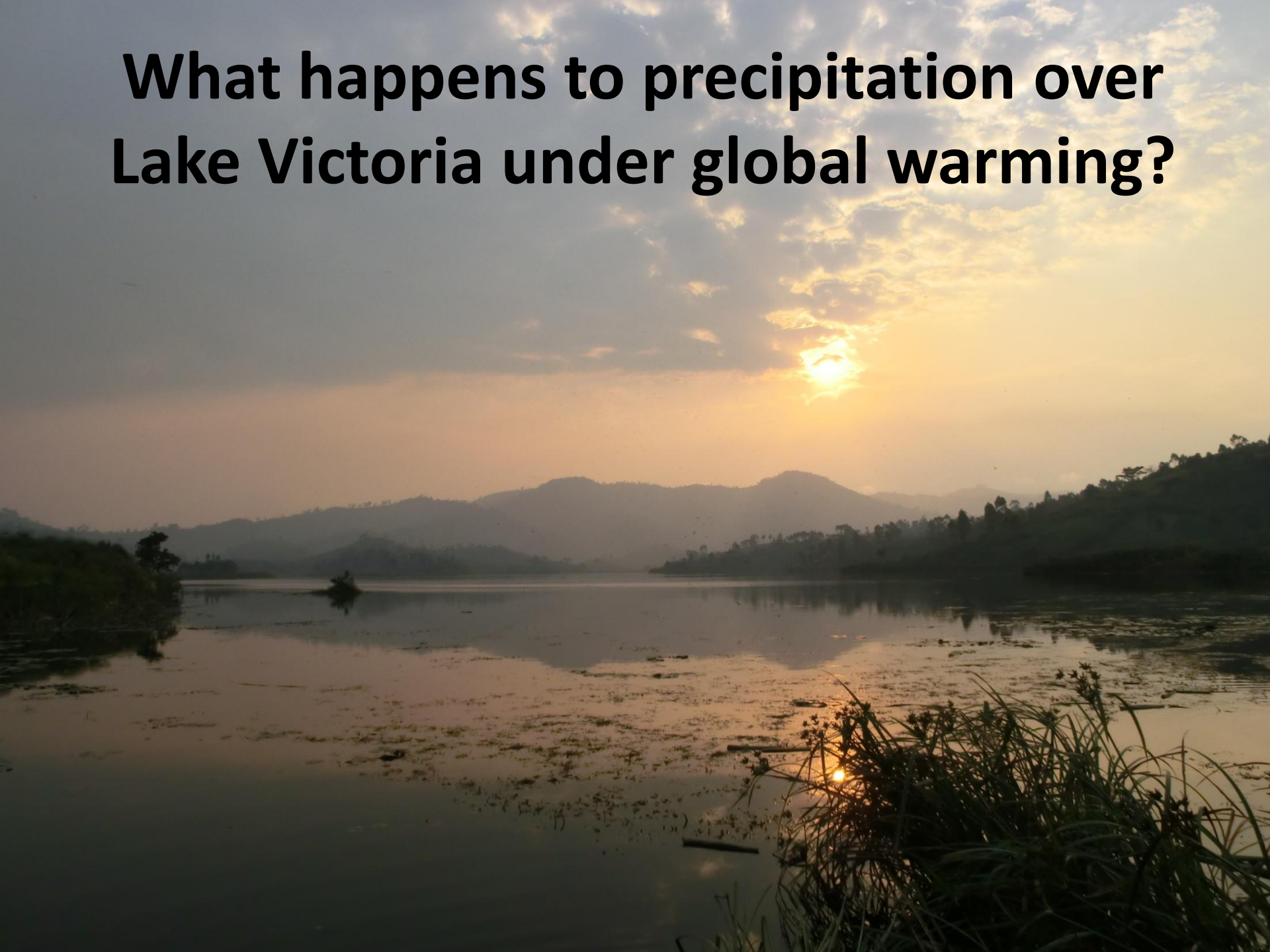
Change in convective mass flux density at cloud base height



What happens to precipitation over Lake Victoria under global warming?



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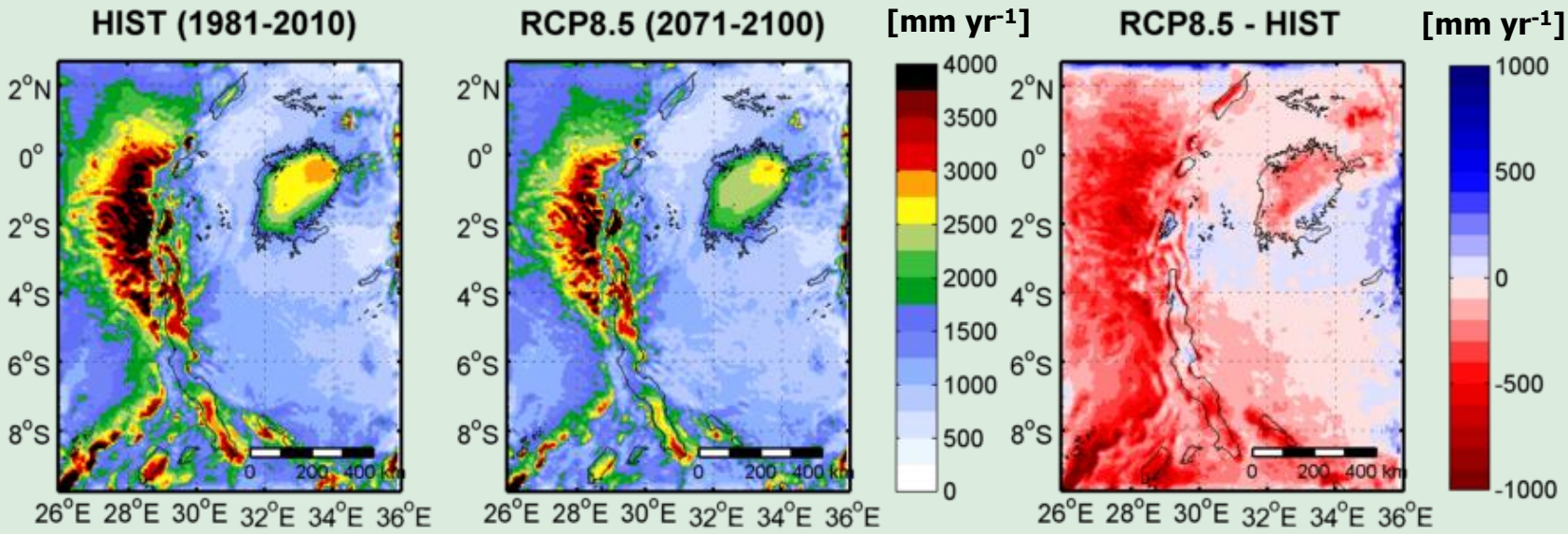
Precipitation under climate change

Precipitation



Domain: - 7.95 %
AGL : -7.46 %

IPCC AR5 (EAF, 14SM-36): + 11%
(-11% - +34%)

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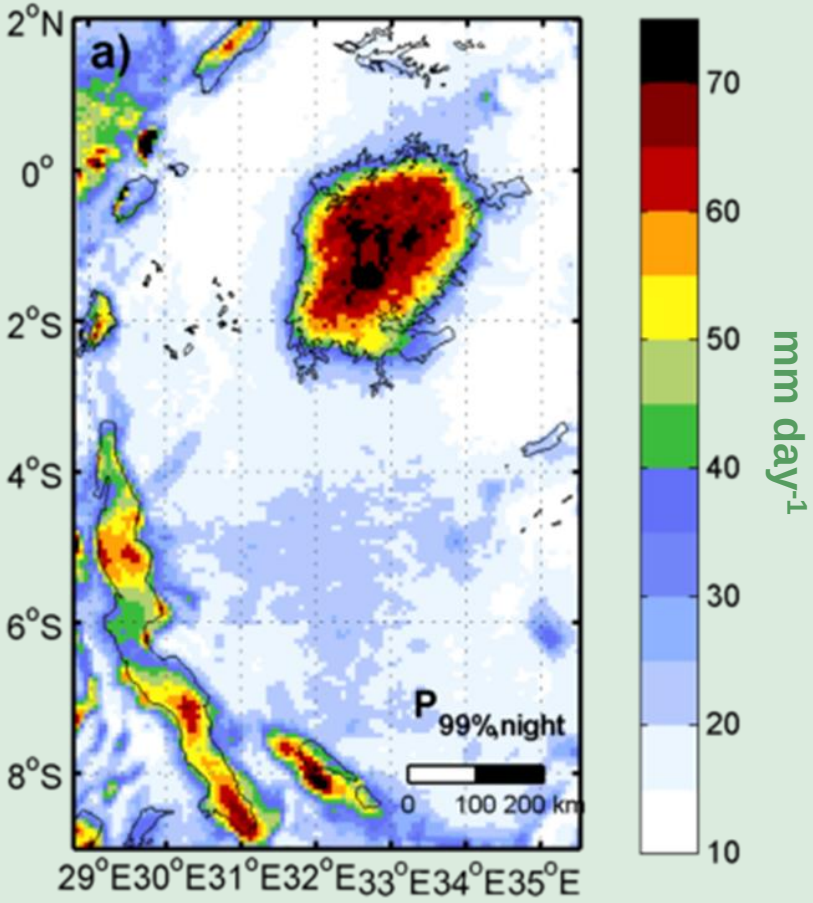
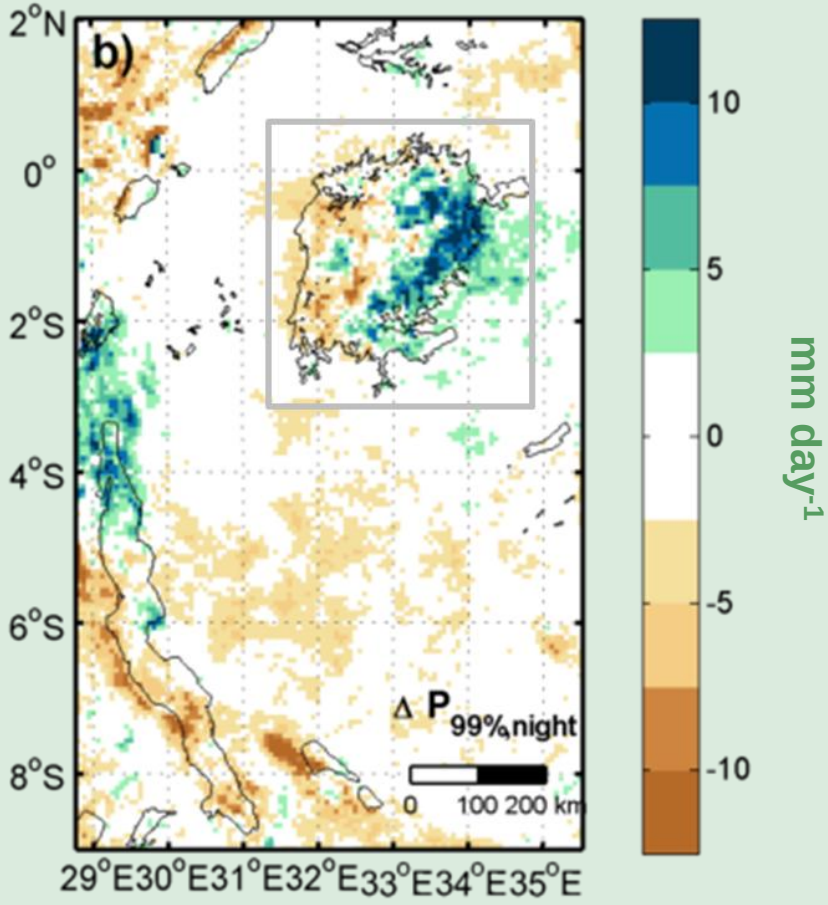
Climate change impact on extremes





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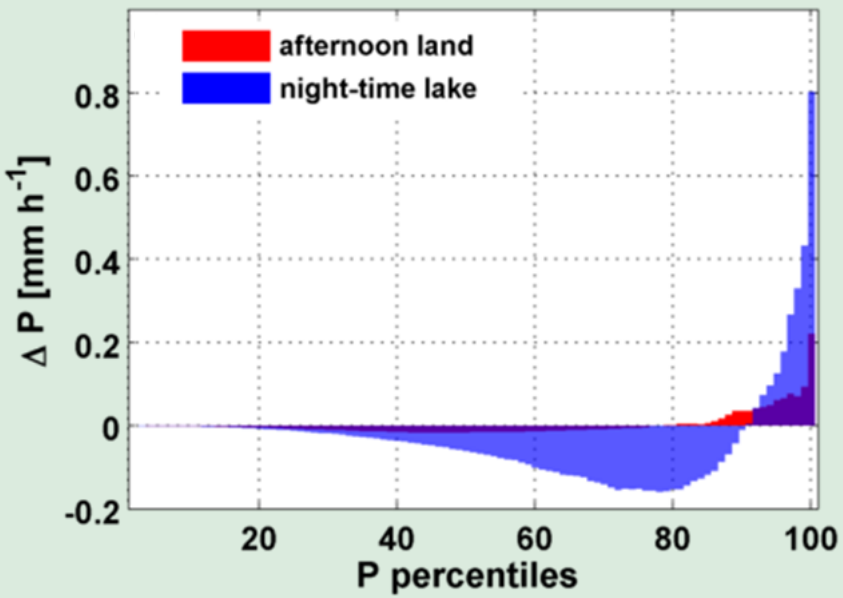
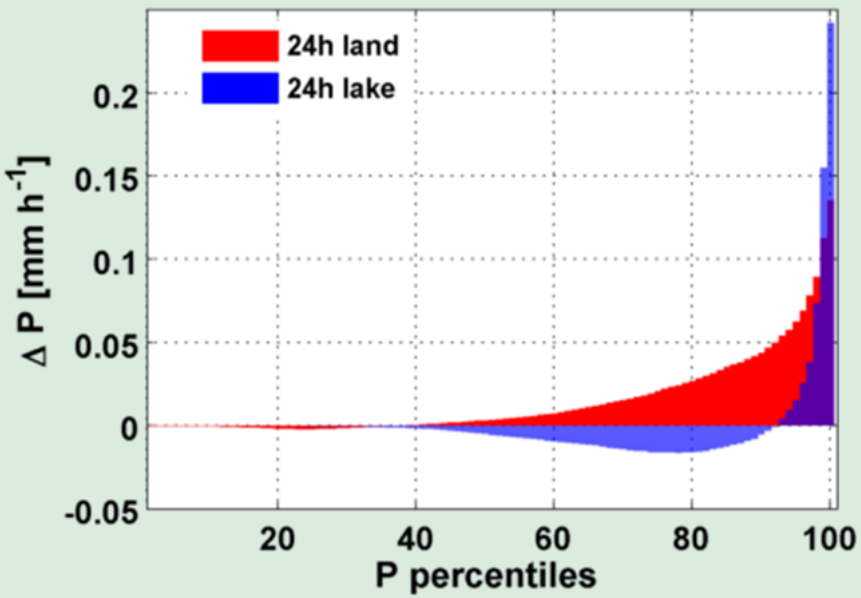
Climate change impact on extremes

CCLM²



CORDEX-Africa



1. **robust?**
2. **why?**

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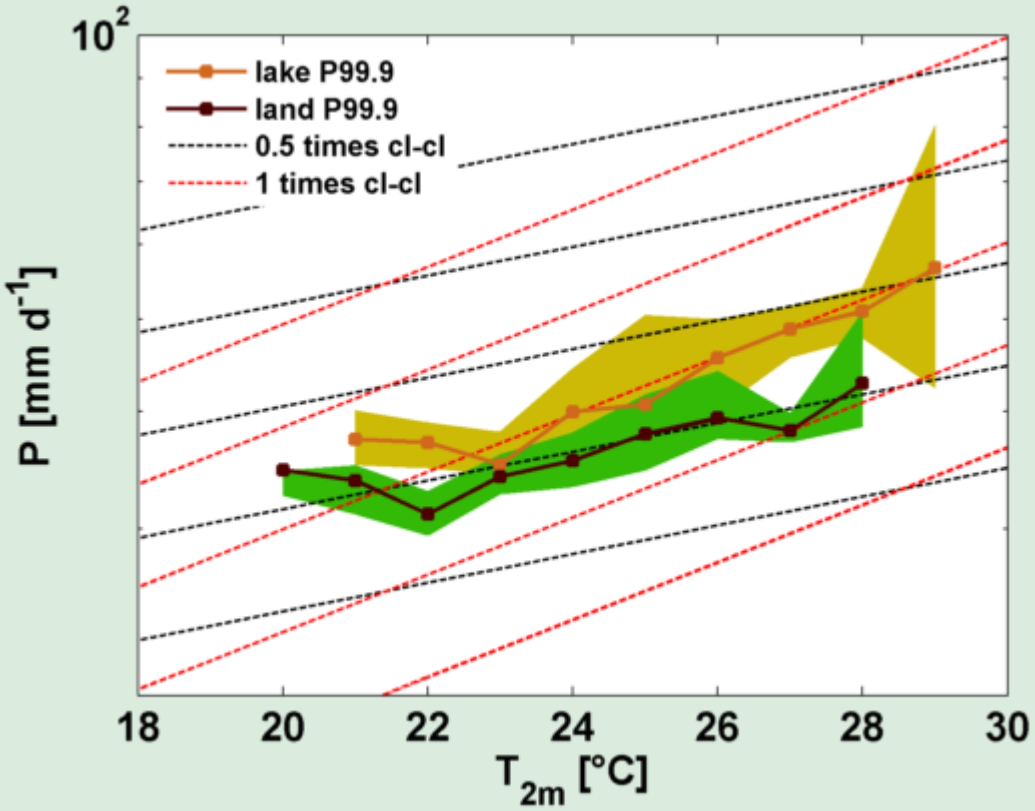
Clausius-Clapeyron scaling



Scaling over the lake twice as strong compared to land

Thank you for your attention

Thiery, W., Davin, E.L., Panitz, H.-J., Demuzere, M., Lhermitte, S., and van Lipizg, N.P.M., 2015: The impact of the African Great Lakes on the regional climate, J. Climate, 28(10), 4061-4085.

Acknowledgements: FWO, BELSPO, COST Action ES1404 “A European network for a harmonised monitoring of snow for the benefit of climate change scenarios, hydrology and numerical weather prediction”.

Conclusions

- Mean climate
  - CCLM² 0.0625° simulation outperforms state-of-the art reanalysis and RCM simulation.
  - AGL exert profound influence on near-surface temperature and precipitation…
  - … through its impact on the SEB and mesoscale circulation

- Extremes and climate change
  - LV extremes will become more intense under global warming
  - this result is robust and more pronounced compared to surrounding land
  - Clausius-Clapeyron scaling holds only over the lake, suggesting limited moisture availability over land