



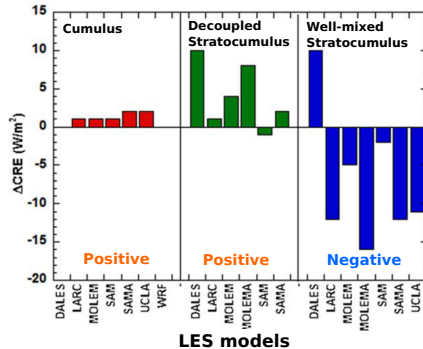
The EUCLIPSE Single-Column Model intercomparison study on stratocumulus equilibria

S. Dal Gesso, J. J. van der Dussen, A. P. Siebesma,
S. R. de Roode, I. Boutle, Y. Kamae, R. Roehrig, J. Vial

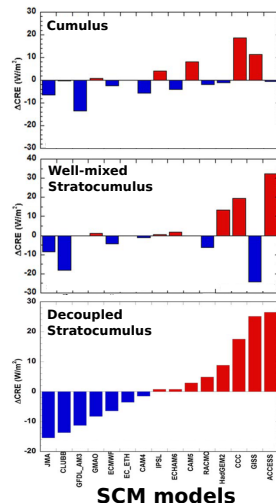
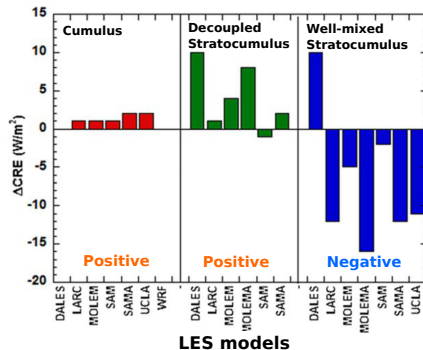
KNMI, Royal Netherlands Meteorological Institute
TUD, Delft University of Technology

EUCLIPSE-CFMIP meeting
8 July 2014

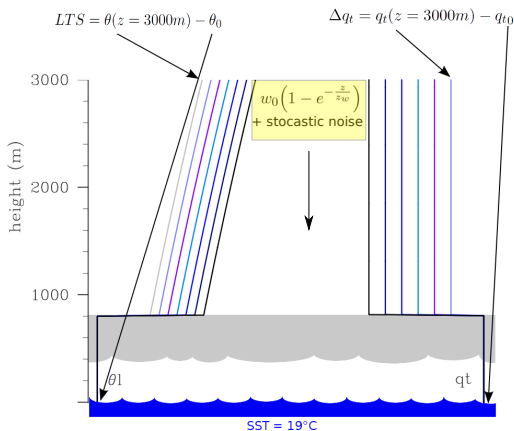
The CGILS lesson



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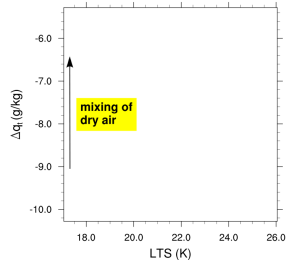
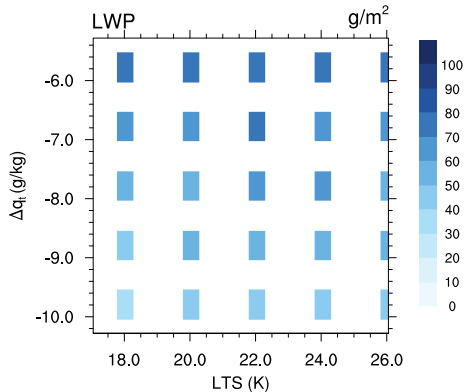


A CGILS extension



- 6 SCMs:
EC-EARTH,
HadGEM2,
HadGEM3,
LMDZ-AR4,
CNRM-CM5,
MIROC5
- 1 LES: DALES

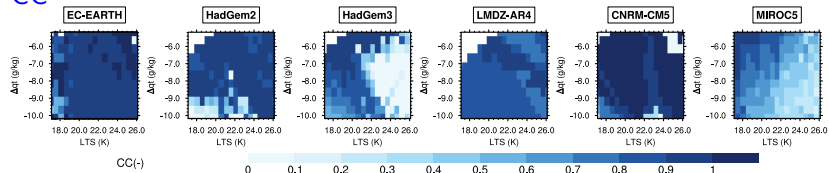
The benchmark: DALES results



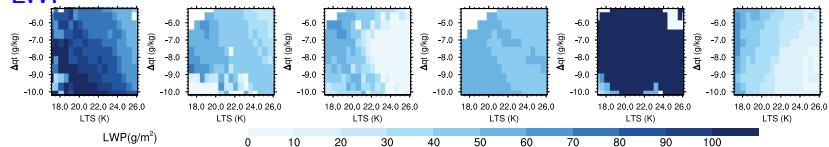
CC = 1 and LWP decreases for drier free tropospheric conditions.

SCM results

CC

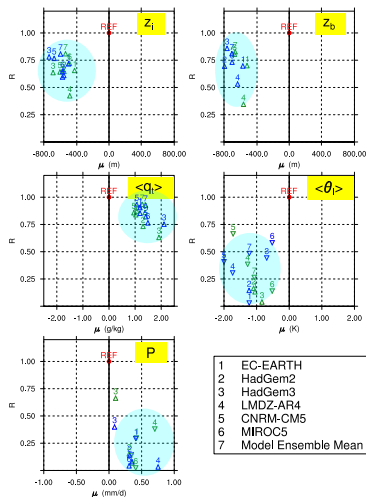


LWP



- large variety of patterns;
- none of the SCMs reproduce the LWP dependence on LTS and Δq_t found in DALES.

SCM common biases



- Dependence of z_i , z_b and $\langle q_t \rangle$ on LTS and Δq_t are well described, too large variation of $\langle \theta_l \rangle$ in the phase space.
- The Scu-topped ABL is too shallow, too cool, too moist. Systematic underestimation of CC and overestimation of P.

Scu response in DALES

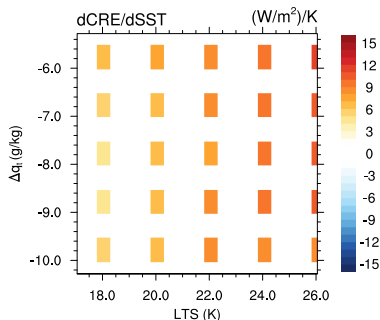
Climate perturbation

- SST + 2K \implies warming and moistening of the atmosphere (RH unperturbed).
- No change in the subsidence and horizontal wind velocity.

Scu response in DALES

Climate perturbation

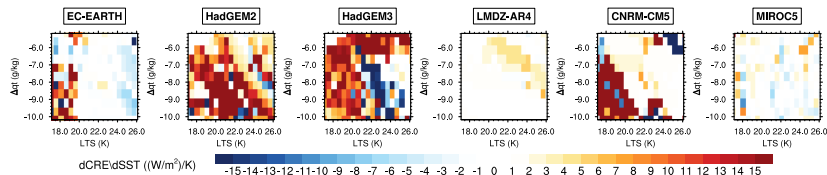
- SST + 2K \Rightarrow warming and moistening of the atmosphere (RH unperturbed).
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Change in CRE as an estimate of the feedback:

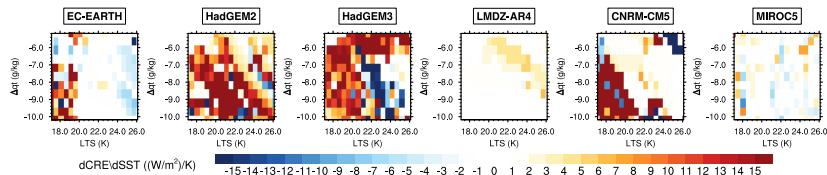
- POSITIVE feedback;
- no change in CC;
- LWP decrease.

SCM results



- noisy patterns, no distinct dependence on LTS and Δq_t ;

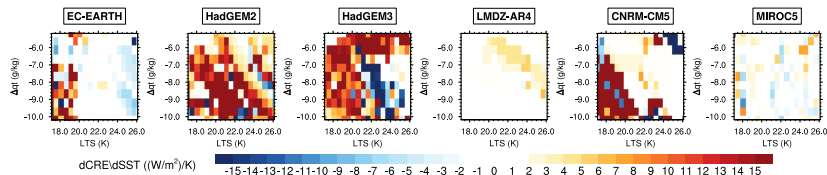
SCM results



- noisy patterns, no distinct dependence on LTS and Δq_t ;
- overall POSITIVE feedback;

$dCRE/dSST$ (W/m²)/K	
DALES	7.95
EC-EARTH	1.23
HadGEM2	11.95
HadGEM3	6.18
LMDZ-AR4	1.34
CNRM-CM5	11.03
MIROC5	0.34

SCM results



- noisy patterns, no distinct dependence on LTS and Δq_t ;
- overall POSITIVE feedback;
- the SCMs do not reproduce the feedback found in DALES through a LWP change only: only for the models that present a CC change the feedback is comparable to DALES results.

$dCRE/dSST$ (W/m^2)/K	
DALES	7.95
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Summary

Control climate

- variety of dependencies of CC and LWP on LTS and Δq_t ,
- none of the SCMs agrees with the LES results;
- common biases: Scu-topped ABL is too shallow, too cool and too moist, lack of clouds and excess of precipitation.

Summary

Control climate

- variety of dependencies of CC and LWP on LTS and Δq_t ,
- none of the SCMs agrees with the LES results;
- common biases: Scu-topped ABL is too shallow, too cool and too moist, lack of clouds and excess of precipitation.

Perturbed climate

- both LES and SCMs predict an overall POSITIVE feedback;
- SCMs present noisy patterns, no distinct dependence on LTS and Δq_t .

Recommendations

- including horizontal advection: to increase surface fluxes and aid reformation of clouds once they disappear;
- sensitivity study on vertical resolution: the cloud thickness change predicted by DALES is smaller than the vertical resolution;
- some suggested improvement of the physical parametrizations: the cloud scheme, the microphysics, the cloud-top entrainment, the interaction between components...

Thank you!