KNMI

EUCLIPSE

Estimating the low cloud-radiative feedback in a perturbed climate from steady-states of Scu-topped boundary layers

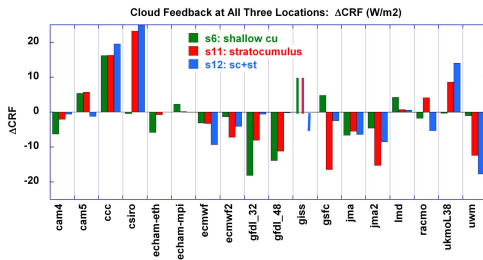**S. Dal Gesso, P. Siebesma, R. Neggers, S. de Roode**

KNMI, Royal Netherlands Meteorological Institute
TUD, Delft University of Technology
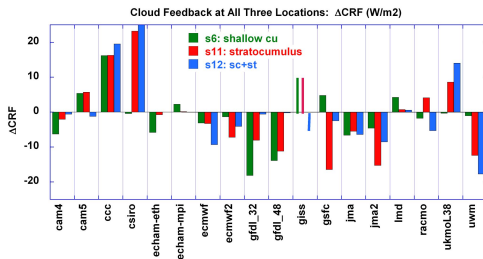
30 May 2012
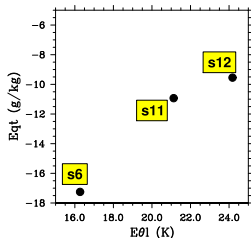EUCLIPSE/CFMIP meeting

A new framework

CGILS results:

A new framework

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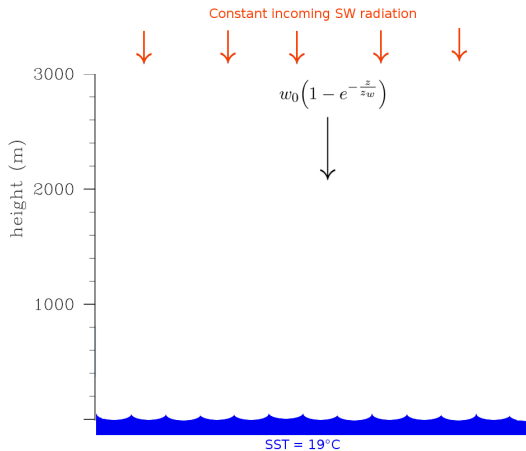
Cloud Feedback at All Three Locations: ΔCRF (W/m2)

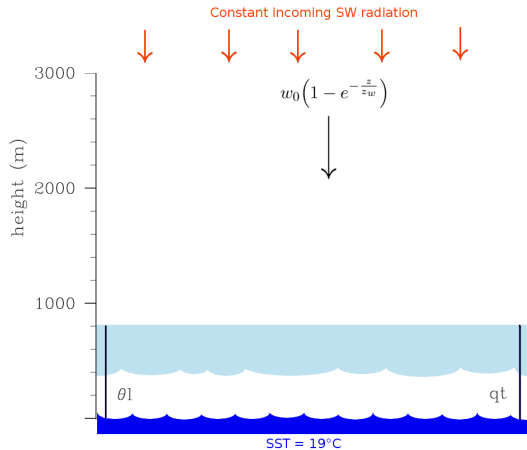Idea: new framework for mapping the entire phase space

1. Which are the conditions which arise marine boundary layer clouds deepening or breakup?
2. What is the effect of perturbed large scale conditions which are intended to mimic climate change?
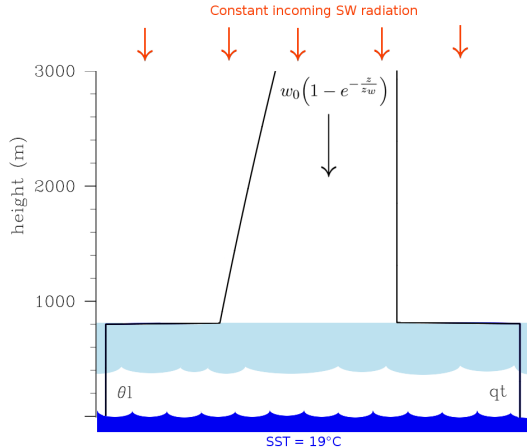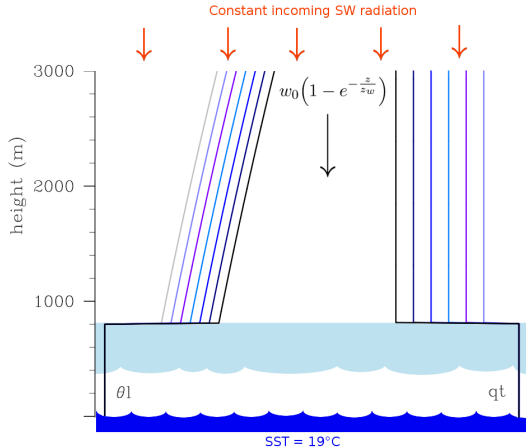
Experiments set-up

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Constant incoming SW radiation

$$w_0 \left(1 - e^{-\frac{z}{z_w}} \right)$$

height (m)

3000

2000

1000

θl

qt

SST = 19°C

Bellon and Stevens, 2011

Experiments set-up

Experiments set-up

RACMO SCM results: cloud cover

Phase space definition:

$E_{\theta_l} = \theta_l(z = 3000m) - \theta_{l\,surf} \approx LTS$ $E_{q_t} = q_t(z = 3000m) - q_{t\,surf}$
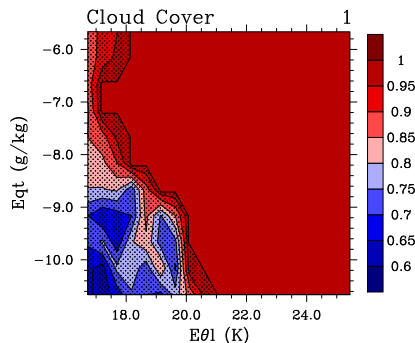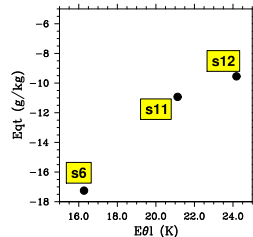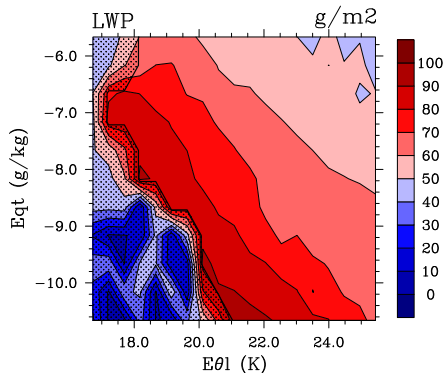
RACMO SCM results: cloud cover

Phase space definition:
$$E_{\theta_l} = \theta_l(z = 3000m) - \theta_{l\,surf} \approx LTS \qquad E_{q_t} = q_t(z = 3000m) - q_{t\,surf}$$

Broken-clouds solutions: $\frac{rms(LWP)}{LWP} \geq 30\%$

RACMO SCM results: liquid water path

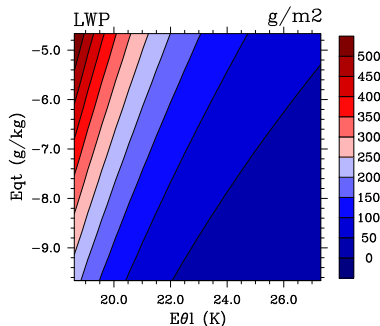Qualitative correspondence with CGILS cases.

MLM results: different entrainment parameterizations

How important is the entrainment parameterization in determining the model fingerprint?
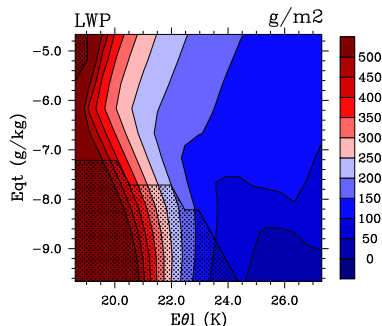
MLM results: different entrainment parameterizations

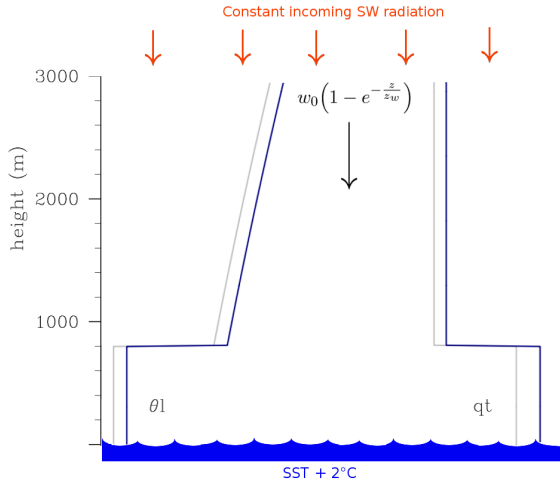How important is the entrainment parameterization in determining the model fingerprint?
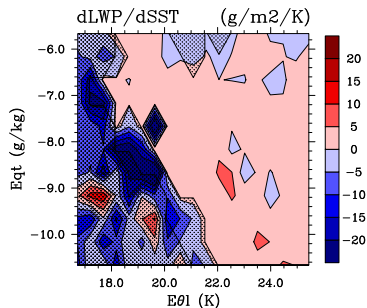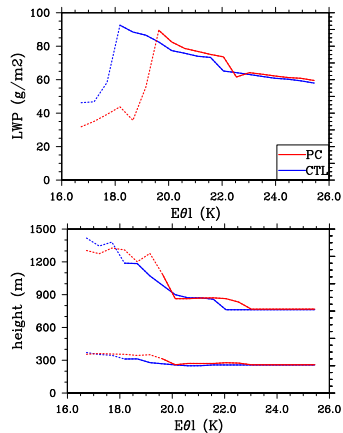

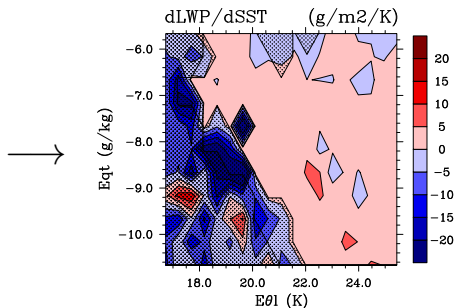Simplified Moeng:

Lock (as in the SCM):

Perturbed climate (PC) set-up

RACMO SCM: PC results

RACMO SCM: PC results

Conclusions and outlook

Conclusions:

▶ this framework is now ready to become a new intercomparison study for CMIP SCMs (more on Friday);

▶ specific results for RACMO SCM:

→ fingerprint of the model, important role of entrainment parameterization;

→ qualitative explanation with a MLM framework;

→ negative cloud feedback in the Scu dominated region of the phase space;

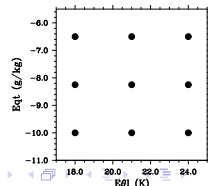→ positive feedback in the broken-clouds region (earlier transition).

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- ▶ specific results for RACMO SCM:
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  - ➜ qualitative explanation with a MLM framework;
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  - ➜ positive feedback in the broken-clouds region (earlier transition).

Outlook:

LESs for some of the considered experiments:

Thank you!