KNMI parameterization testbed as an evaluation tool: Status and plans

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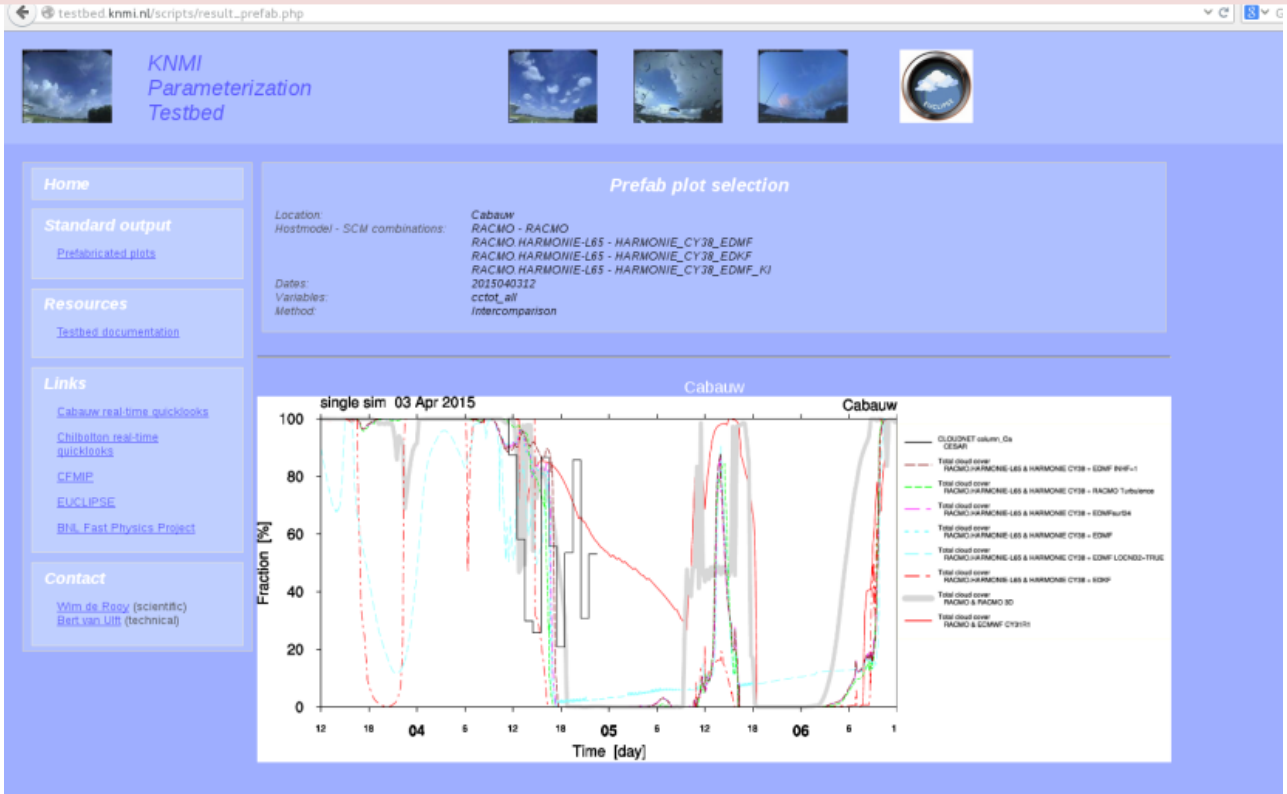


Testbed, what is it?

Data:

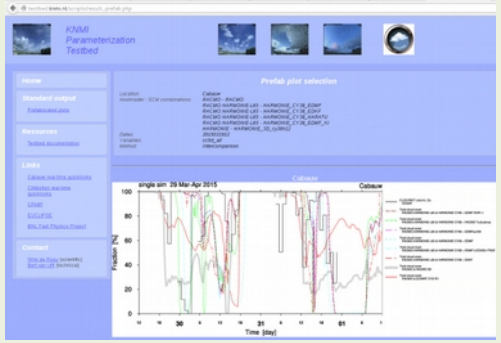
Observations: Tower obs. (200m), all kind off fluxes, lidar, cloudnet, etc. etc.
(prim. Cabauw)

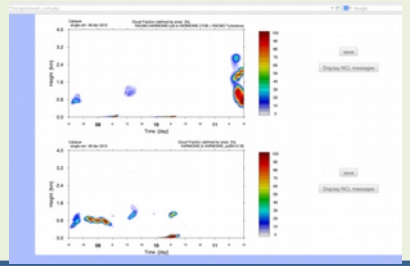
Models: 1D versions (e.g. KI, INHF, HARATU, ARP, …)
3D extractions
LES

Graphical interface:

Externally available
Still only prefabricated plots

(testbed.knmi.nl)





Internally:
Interactive GUI

Why?

Typical problems verification/validation:

1. Comparability of verifications
   Verification concerning the same process but using different set-ups (e.g. cycle version, verification period)

2. Impact <-> improvement?
   Verification against e.g. T2m is important but does not tell us if the modification is a real improvement (or a compensating error)

3. Longer-term verification is needed

The Testbed can tackle some of these verification/validation problems.

Advantages:

1. Compare modifications within the same set-up (i.e. 1 cycle version and for the same time period)

2. In depth investigation of the processes involved (chain) thanks to the availability of many (advanced) observations and LES. Potential for "real" model improvements. Investigate many aspects of the model. Example will be given

3. Models run daily, so not only "golden" days. Also, reforecasting periods can be done (relatively rapidly) in 1D

Disadvantages:

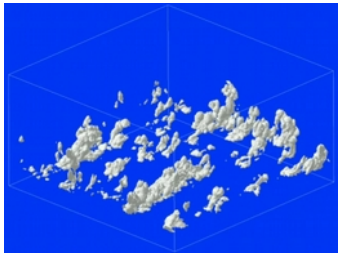
3. How representative is 1D, driven by RACMO, for 3D results? This will be investigated. (embed Harmonie 1D in Harmonie3D?) Focus on fast processes.

2. Only one (or a few) points (Cabauw) can be studied.

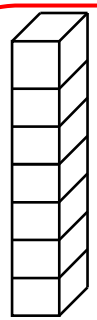
Example of "real" improvement using a testbed approach

Neggers & Siebesma (Journ. Clim., 2013)

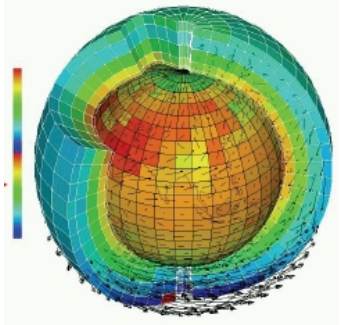
Relating Model bias to responsable physical processes.



Large Eddy Simulation



Single Column Models



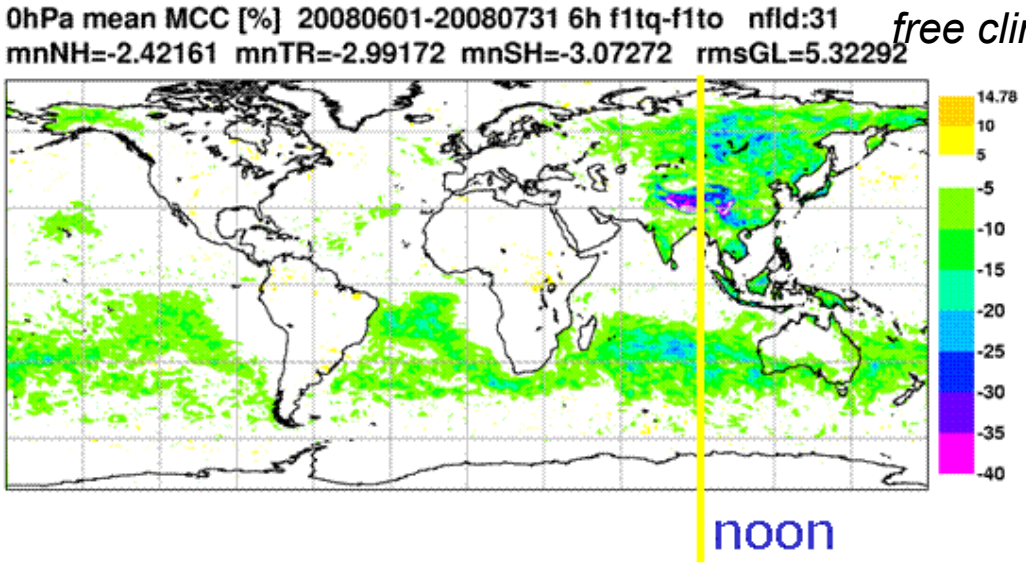
Climate Models

NWP Models

Instrumented Sites

ECMWF IFS difference in summertime diurnal cloud cover between CY32R3 + EDMF-DualM and CY32R3

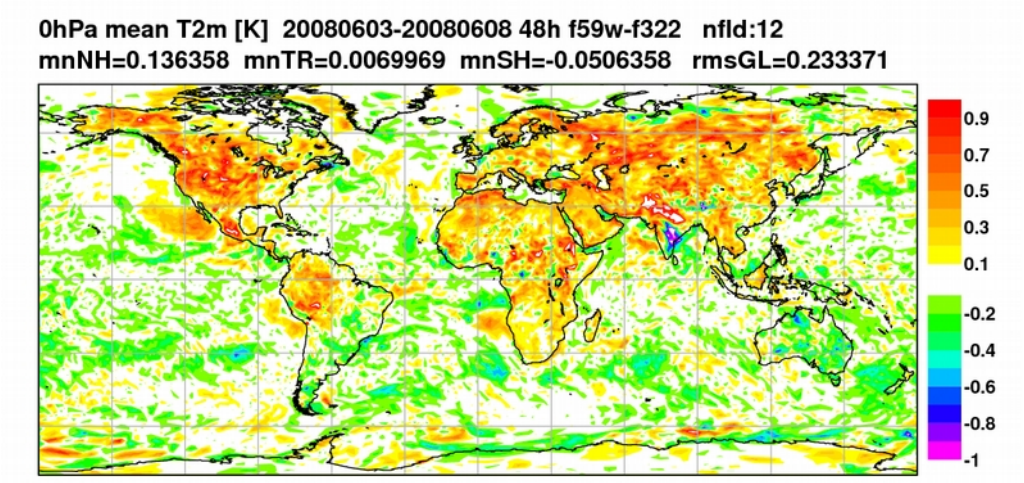
stnd new



free climate run, June-July 2008

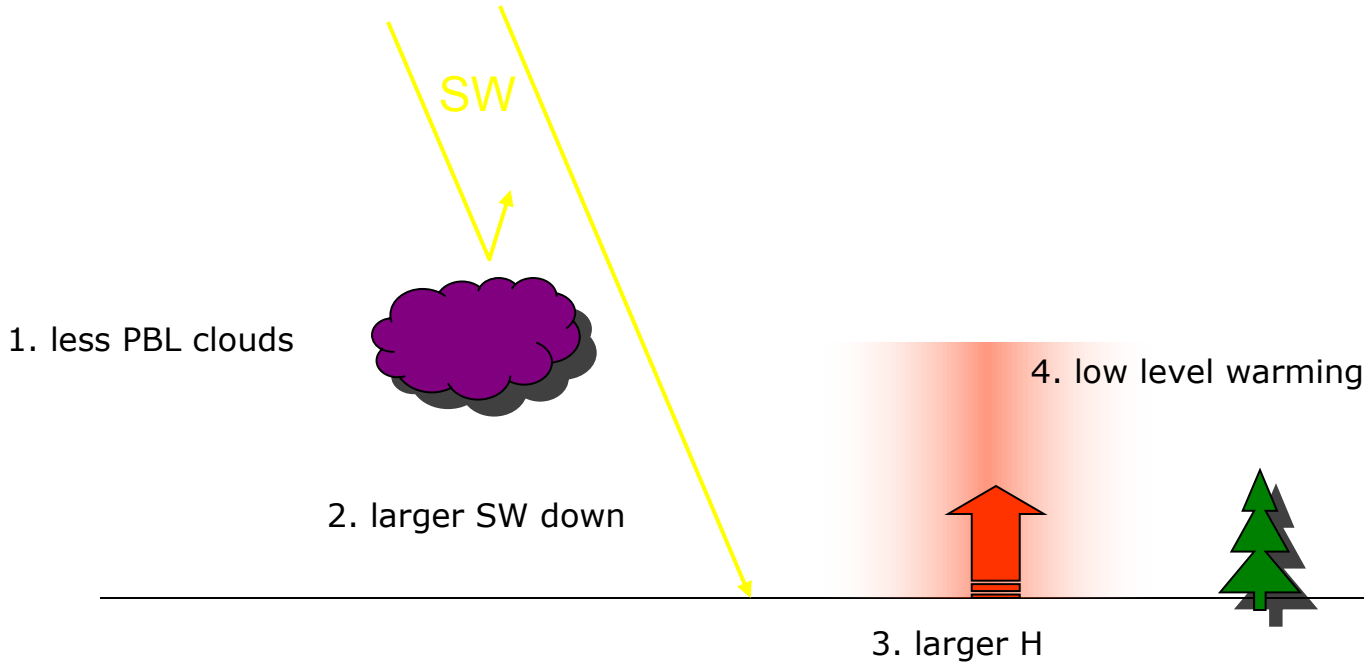
Less clouds

Thanks to Martin Köhler, ECMWF



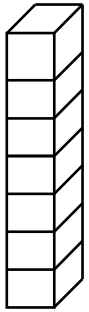
Positive bias T2m

Suggesting:



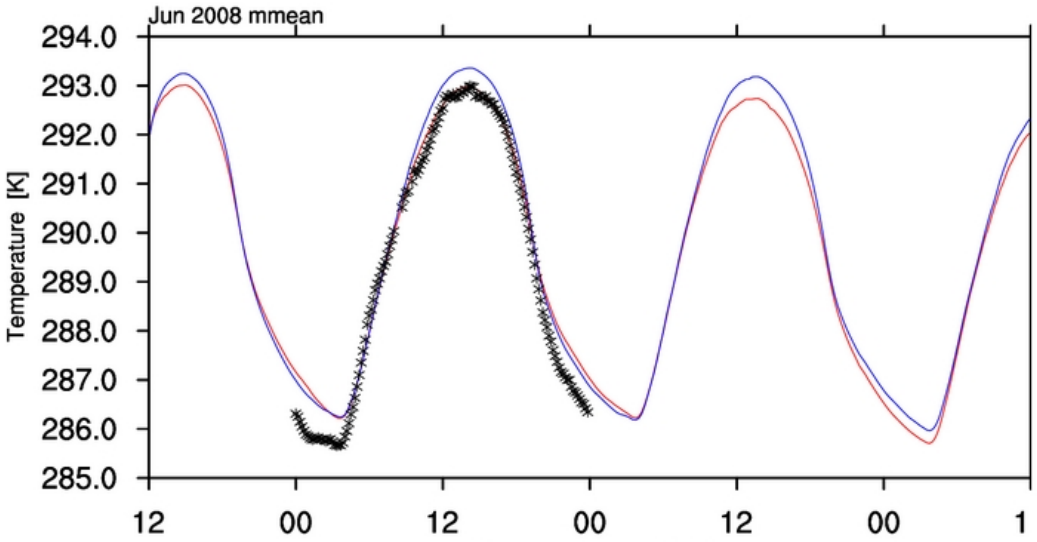
Q: Can this hypothesis be tested at a local atmospheric profiling station (i.e Cabauw)?

Step 1 Can this bias be reproduced by Single Column Model at a local site (Cabauw)?



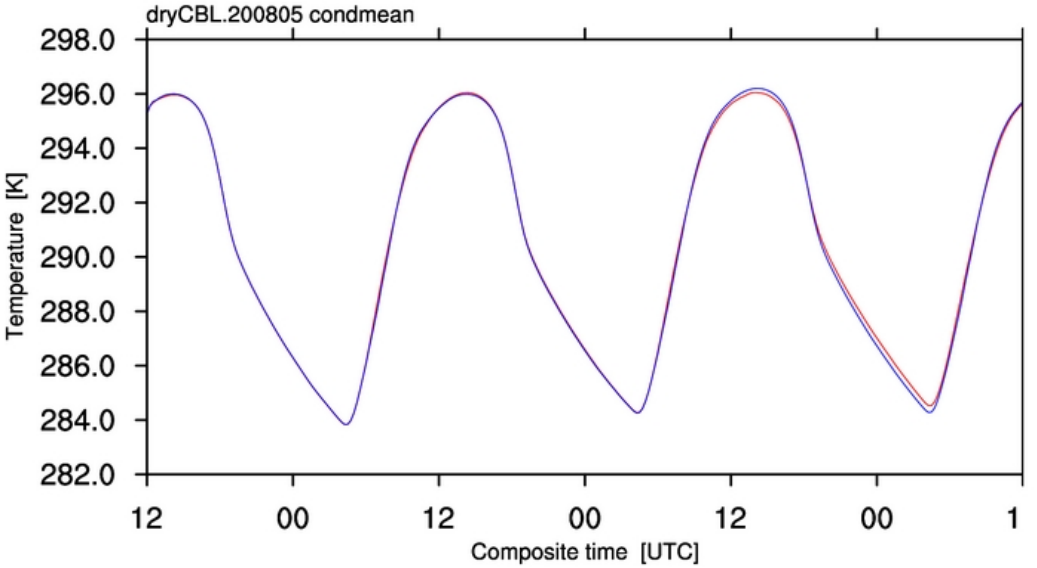
- Run Single Column Model versions in a 3-day forecast mode over the Cabauw in the Testbed for the same period with the stnd and the new scheme

- Make a composite over the diurnal cycle



stnd
new
x obs

Bias at noon in global model is similar in 1D version.

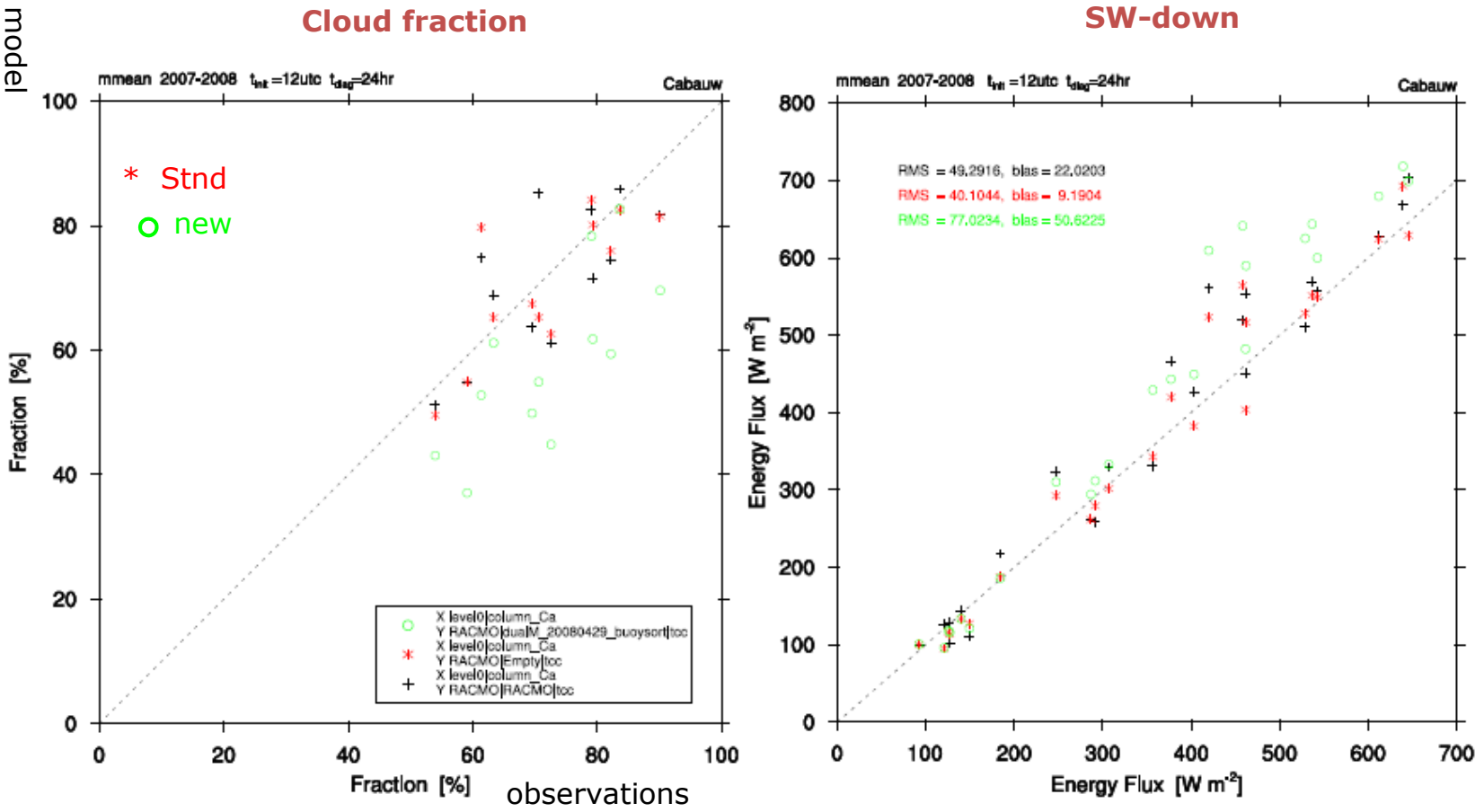


Conditional sampled clear sky days:

No bias!

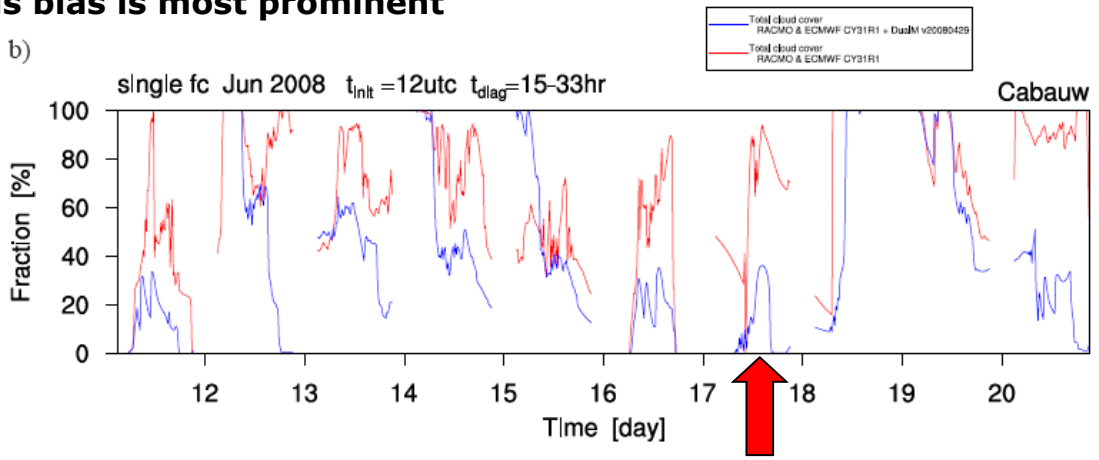
So it must be the clouds!

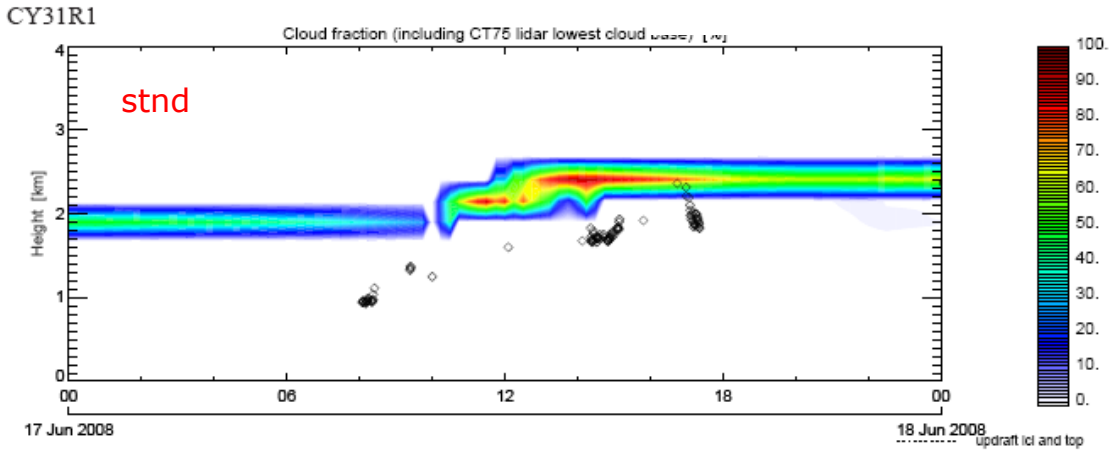
Step 2: take a 2 year period and compare monthly mean cloud fraction and downwelling SW radiation with observations. (still consecutive 3 day-forecasts in a scm)



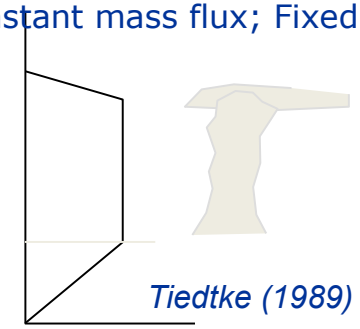
New scheme: too few clouds (bias= -15%) and too much downwelling SW radiation (bias 51W/m2).

Step 3: Zooming in on days where this bias is most prominent



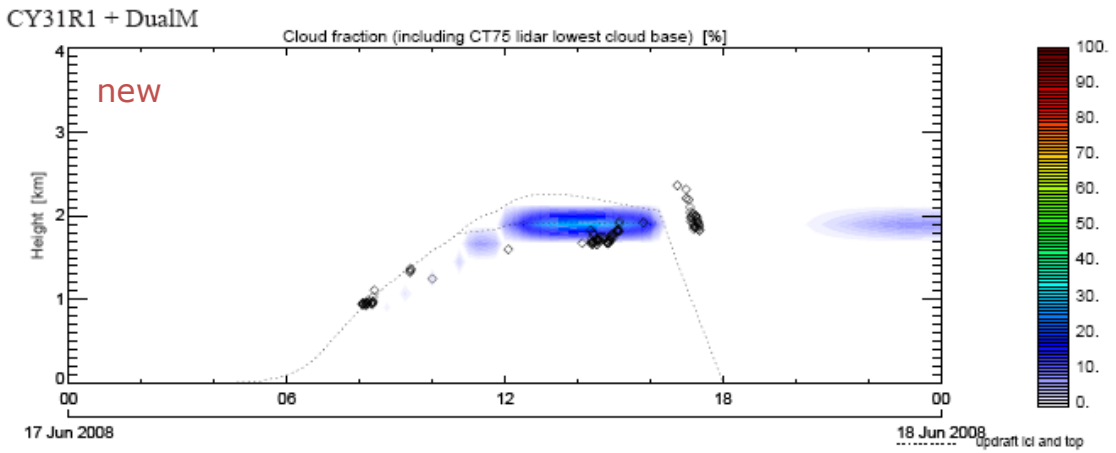


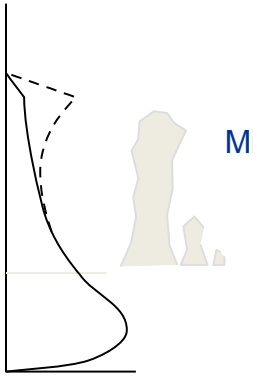
Constant mass flux; Fixed structure



Tiedtke (1989) stnd

M



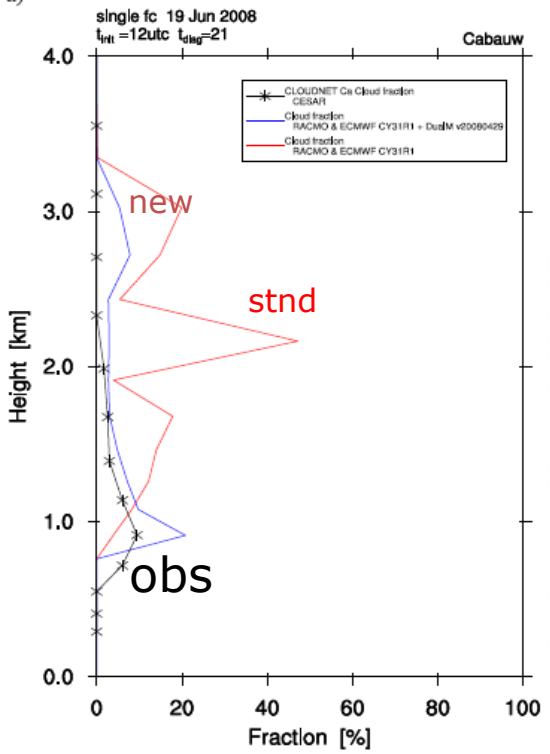


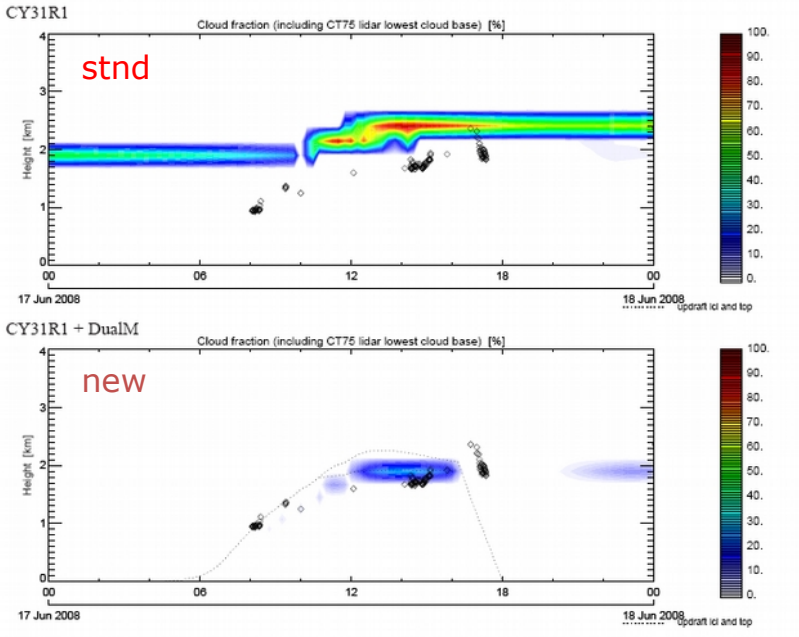
Mixing; Flexible structure

EDMF-DualM (new)

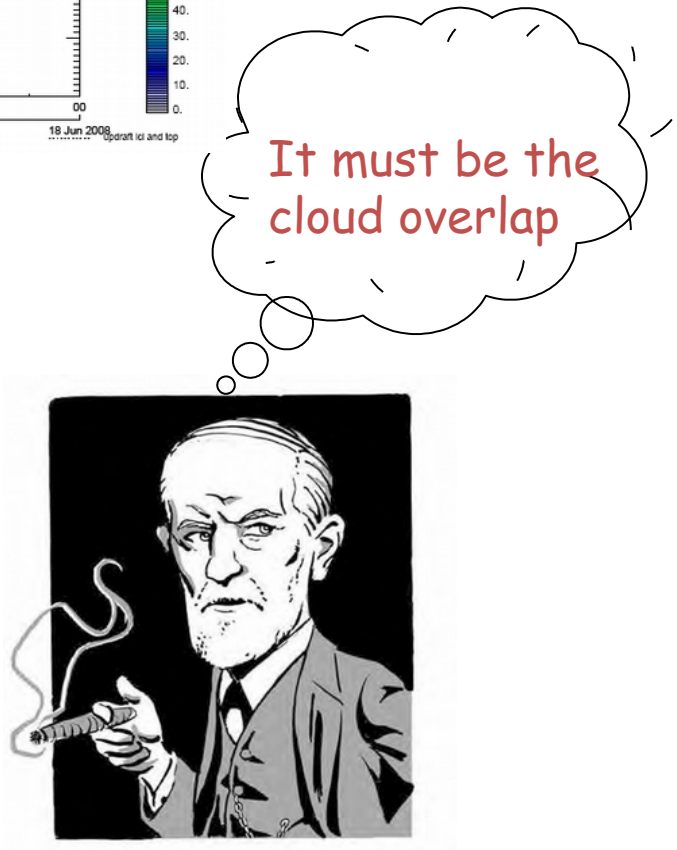
M

a)





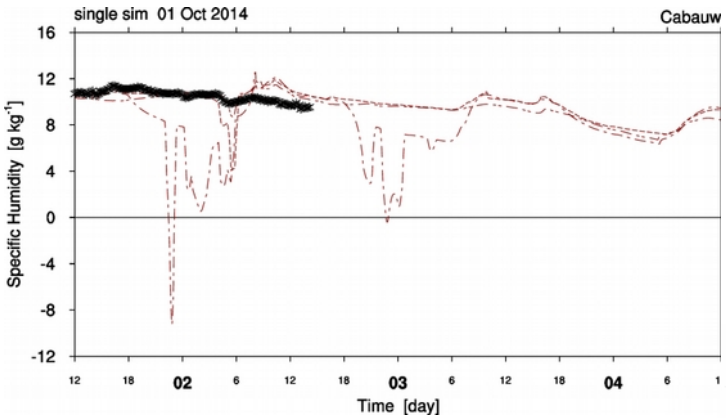
- New scheme has more realistic mixing
- New scheme has a better cloud fraction profile
- But……. Systematic too low cloud cover??



New Testbed results?

Some delay, due to …

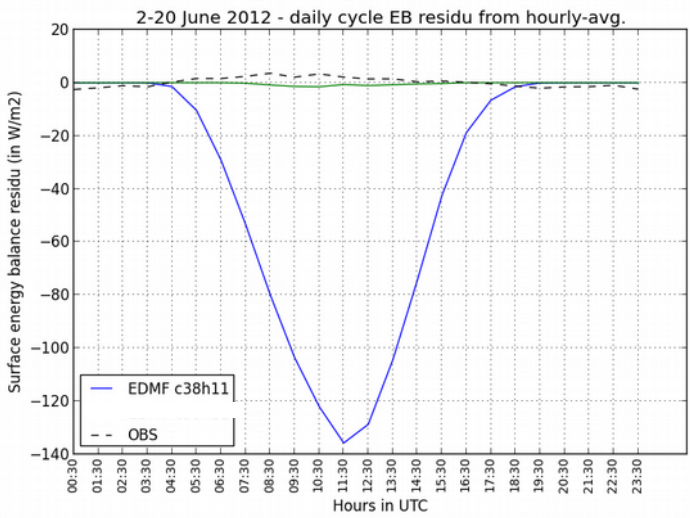
q2m = -7 gr/kg ?!?



Sanity checks!

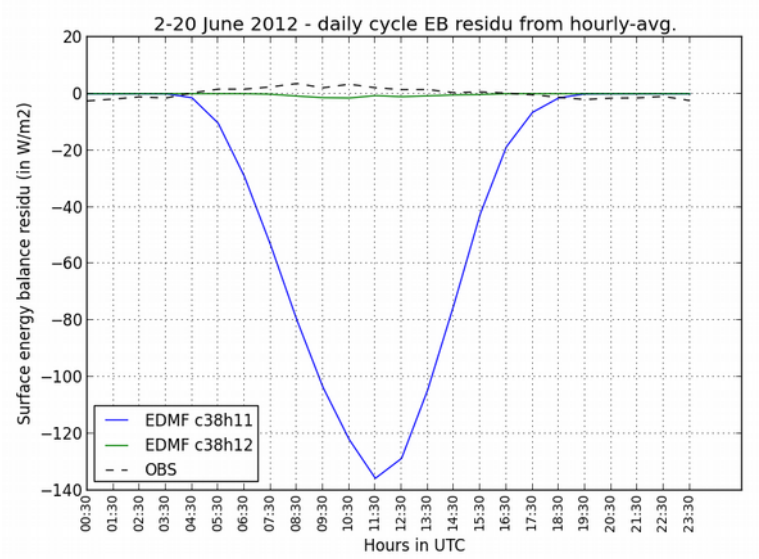
A few months

No energy balance ?!?

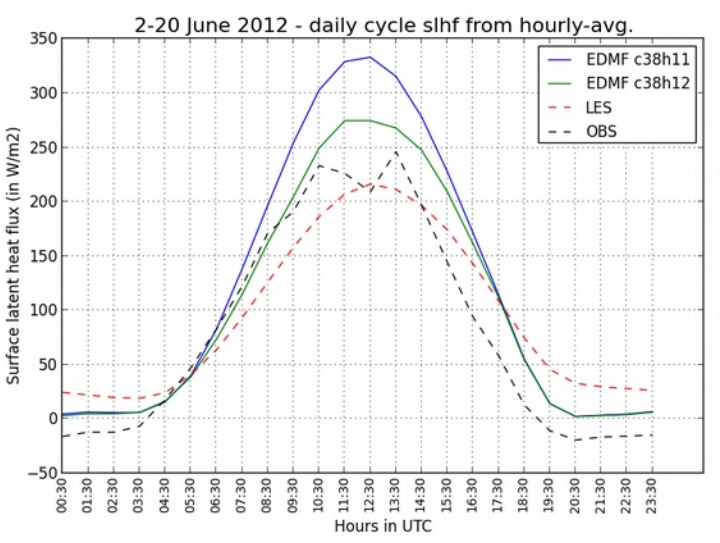


About the energy balance: cy38h11 <-> cy38h12

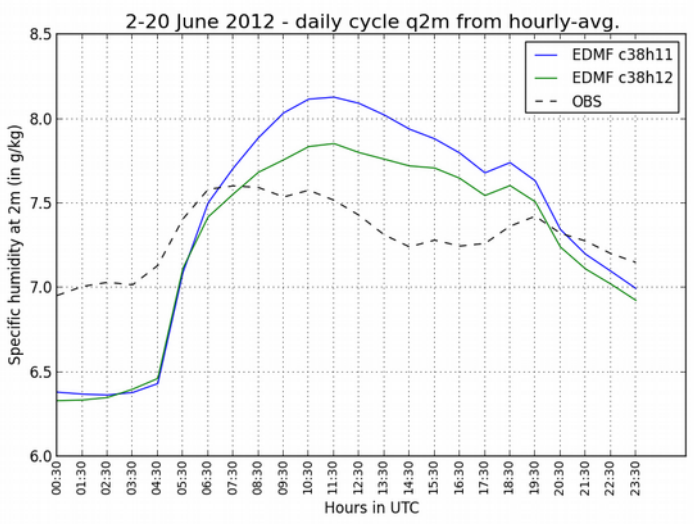
Energy (im)balance



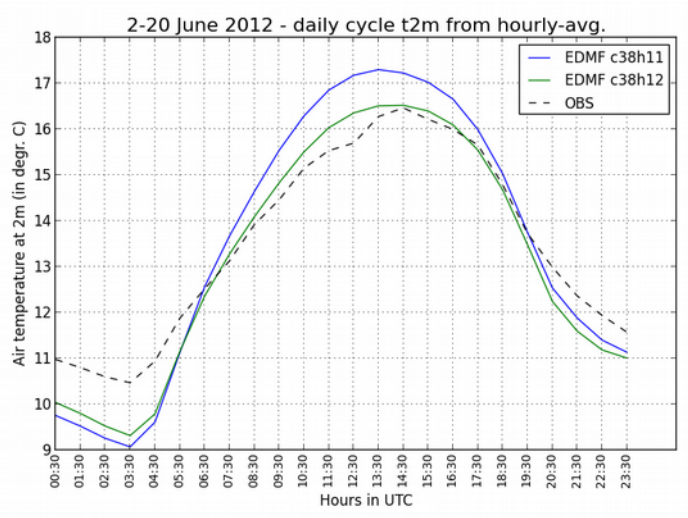
Latent heat flux



q2m



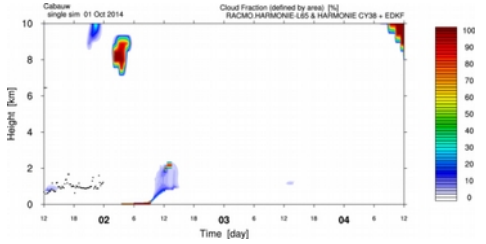
T2m

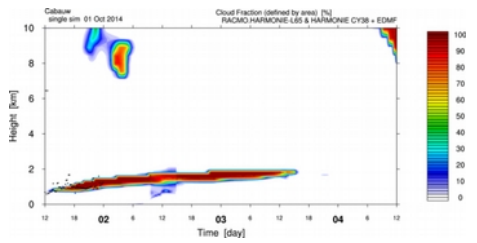


So, previous daily runs and 2012 1D reforecast (38h1.1) can not be trusted!

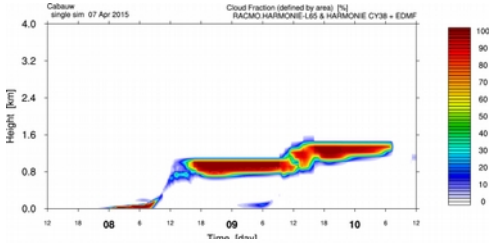
However, some typical behavior can be seen and is understood ,e.g.:

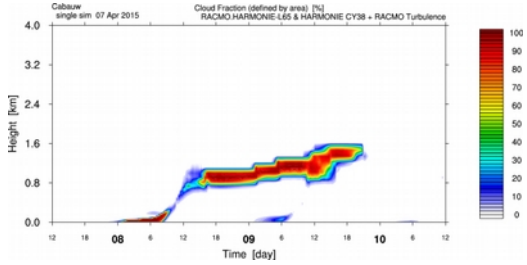
Large impact extra variance



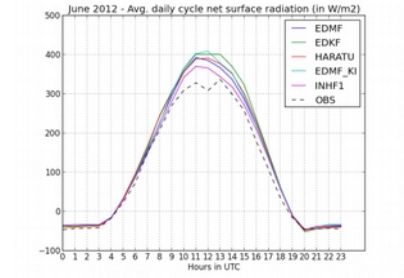


Extra top entrainment and less low clouds with RACMO turb.





Inhomogeneity factor=1
Less SW radiation, lower H,LE, T2m, q2m



Etc., etc.

Plans

Objective, long-term verification (benchmark 2012) of Harmonie versions:

1D: EDMF, EDKF, HARATU, KI, KPN, INHF, ARP,..
…your modifications?

More about this in WG meeting
Limit amount technical work!

3D: 36h1.2, 38h1.2, 4DVAR, HARATU,AROME(?)….
(test validity 1D approach)

Typical validation: usage e.g. 2m, tower obs, all fluxes, Cloudnet,…..

"Exotic" validation: e.g. variance terms cloud scheme (LES), momentum mixing (LES), ….

In short: a lot of data

but exiting

Conclusions

Much “technical” work/debugging

Some Testbed strengths:

- Combining many observations (and LES) to investigate chain of processes (insight)
- Long-term validation of many versions
- Build (and combine) on one set-up
- Link the Hirlam/Aladin community
- Potential for real model improvement

Possible weakness:

- 1D representative for 3D? (process dependent)