# Summary of recent work related to STRACO scheme in the reference system

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# Main Goals

Work on convection scheme steered primarily by wishes to

1) Improve precipitation frequencies (higher frequencies of dry cases and higher frequency of large precipitation amounts, i.e. the predicted frequencies should approach the observed frequencies.

2) Improve relative humidities of the atmosphere

# Why ?

a) Operational verifications, e.g. at DMI, have shown the mentioned deficiencies in precipitation frequencies.

b) There are also indications from operations and experiments that relative humidities above ~ 500 hPa are too high using STRACO.

# conducted work

1) Work to improve the formulation of convective entrainment based on investigations and results from the litterature.

2) Triggering of convection using information on TKE.

3) Other modifications affecting convective transports of heat and moisture, e.g. precipitation release and evapotration of precipitation.

4) Modified convective cloud cover

# has the work been succesful ?

While the work on the precipitaion spectrum (a) has been successfull there is no clear general improvement yet on (b) for the upper troposphere.

Perhaps the relative humidity measurements from radiosondes are not reliable enough at upper levels indicated by various studies, e.g

i) Atmos. Chem. Phys. 5, 1843-1853, 2005) : ”The stations used in this study launch Vaisala radiosondes which suffer a known dry bias. The results of this study also confirm this dry bias in the radiaosonde data ”

ii) ECMWF does not use radiosondes at high levels of the troposphere

A study on shallow convection (up to 3000 m) on 1D idealized test cases indicates significant improvement of relative humidity in the modified scheme

# SHALLOW convection study using modified scheme

Present study described in detail in the report

`Idealized simulations of shallow convection using recent HIRLAM physics´

(contact the author B.H. Sass , DMI)

# Motivation

→the **importance of shallow convection** for describing realistic vertical structures of atmospheric forecast variables in the low troposphere.

→**new results** with HIRLAM physics

→some **results** are **much improved** relative to what has previously been published in the context of 1D simulations (e.g. EUROCS shallow cumulus case)

# (1.1) experimental setup

* In this study shallow convection  is defined as convectively unstable conditions with clouds and condensation in the lowest 3 km of the atmosphere.

* 1D-model is run with appropriate forcing specified (fluxes or tendencies from dynamics and from surface)

* Summary for 3 cases : ASTEX , BOMEX , EUROCS

# (1.2) specification of cases

Number of levels : 80 , with 17 below 1 km, 33 below 3 km

Time step: 150s, (75s)

ASTEX: (12-13 June 1992)

-Atlantic Stratocumulus Transition EXperiment –

(Bretherton and Pincus 1995), simulation period: 24 h

Forecast length: 24h.

BOMEX :(June 1969)

- Barbados Oceanographic and Meteorological EXperiment-

(Nitta and Esbensen1974), simulation period: 7 hours.

EUROCS (21 June 1997)

shallow cumulus over land - ARM site in Oklahoma-

LES-results: Brown et. al. (2002), 1D-simulation results: Lenderink et al. (2004).

# (1.3) HIRLAM physics

Nomenclature of experiments:

Turbulence scheme (HIRLAM version of CBR) based on TKE and a diagnostic length scale

`dry´ turbulence scheme: CBRD

`moist´ variable turbulence scheme: CBRM

`new´ convection scheme (STRACO): CVNEW

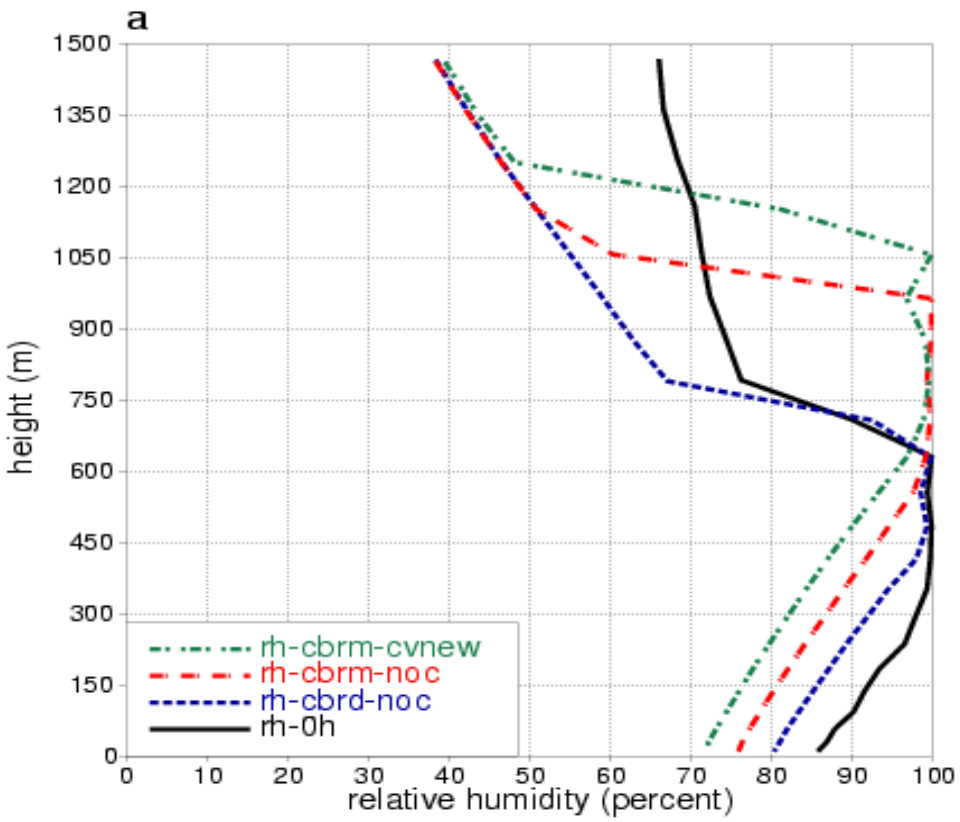
# (1.4) OUTPUT

## OUTPUT (more extensive in report)

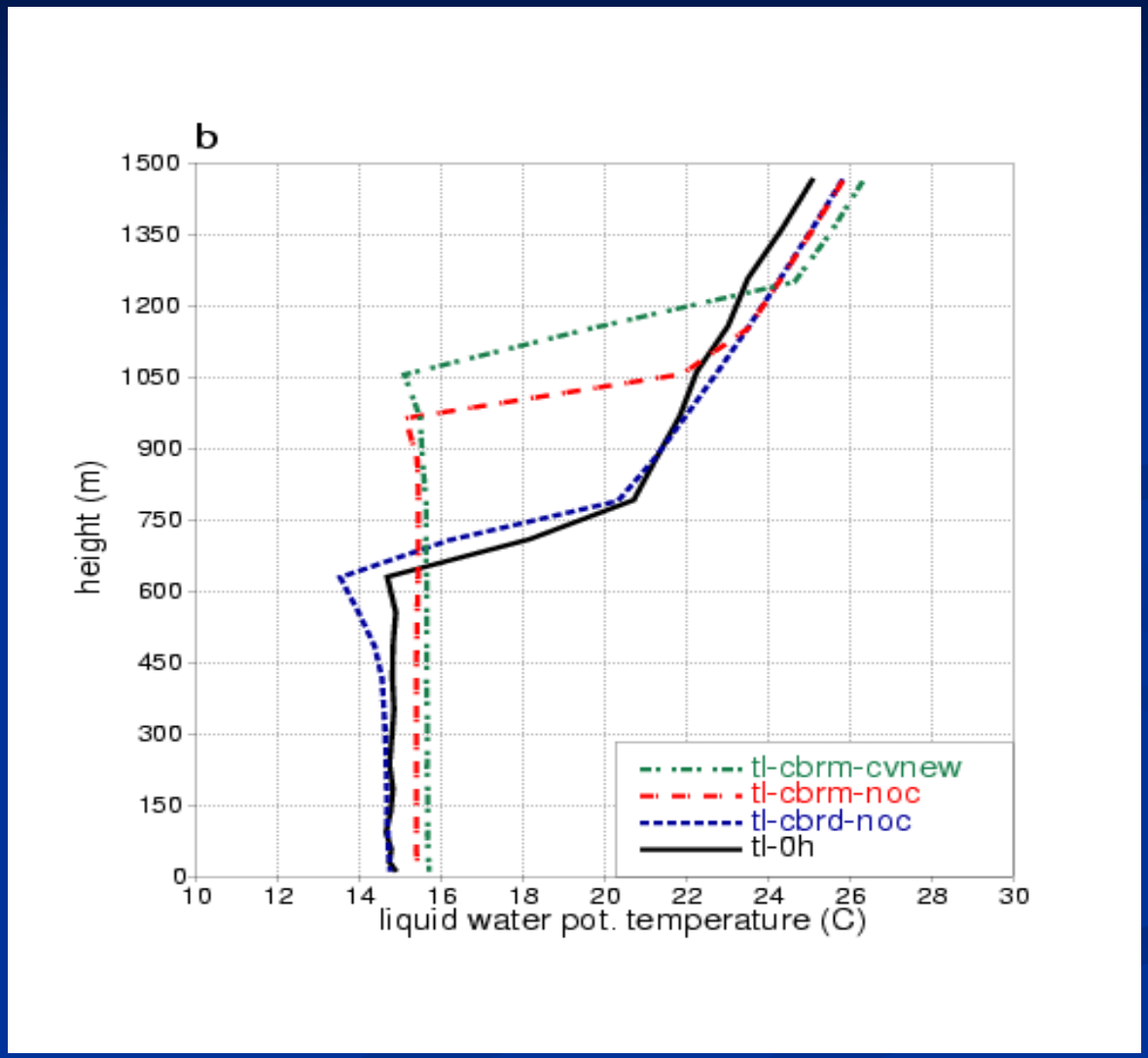
- Vertical profiles at the end of the simulation period.
  For EUROCS time series of cloud base, cloud top

- Vertical profiles of
  -relative humidity
  -liquid water potential temperature
  -cloud cover

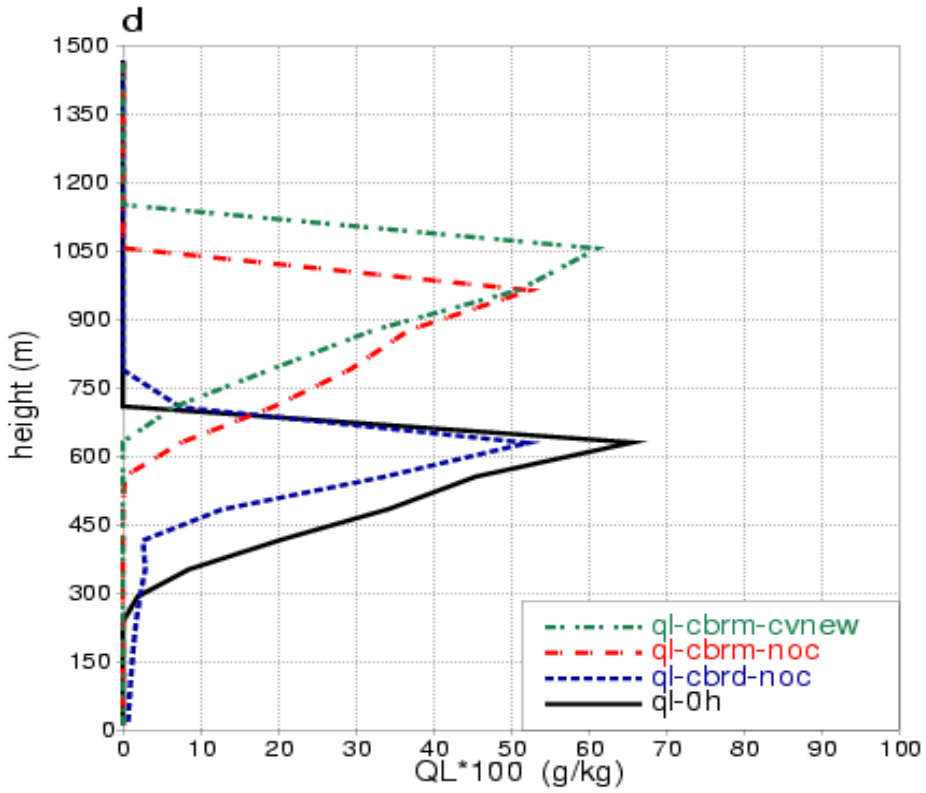
# 3.1 -ASTEX relative humidity (24h)



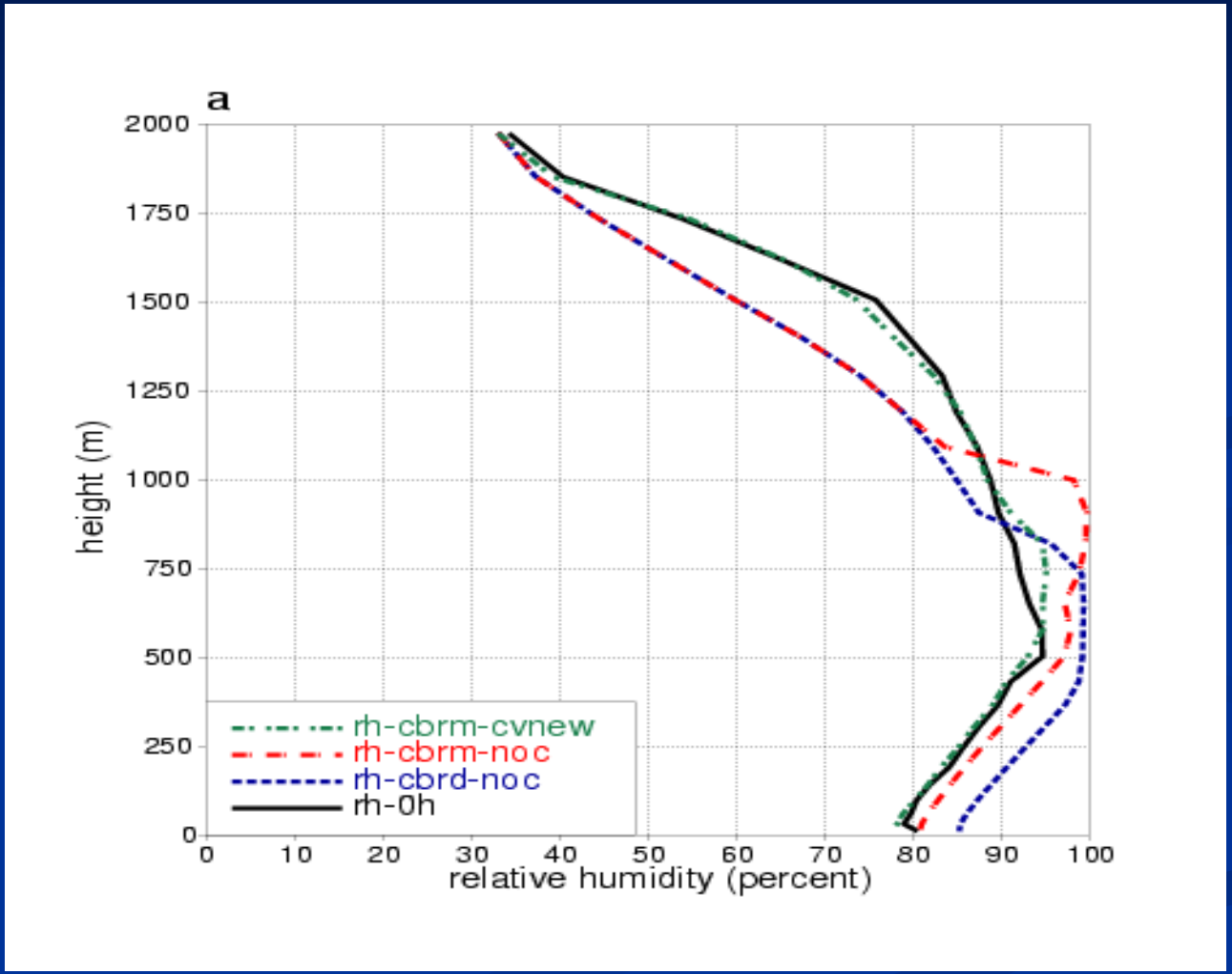
# 3.2 –ASTEX liquid water pot. temperature (24h)



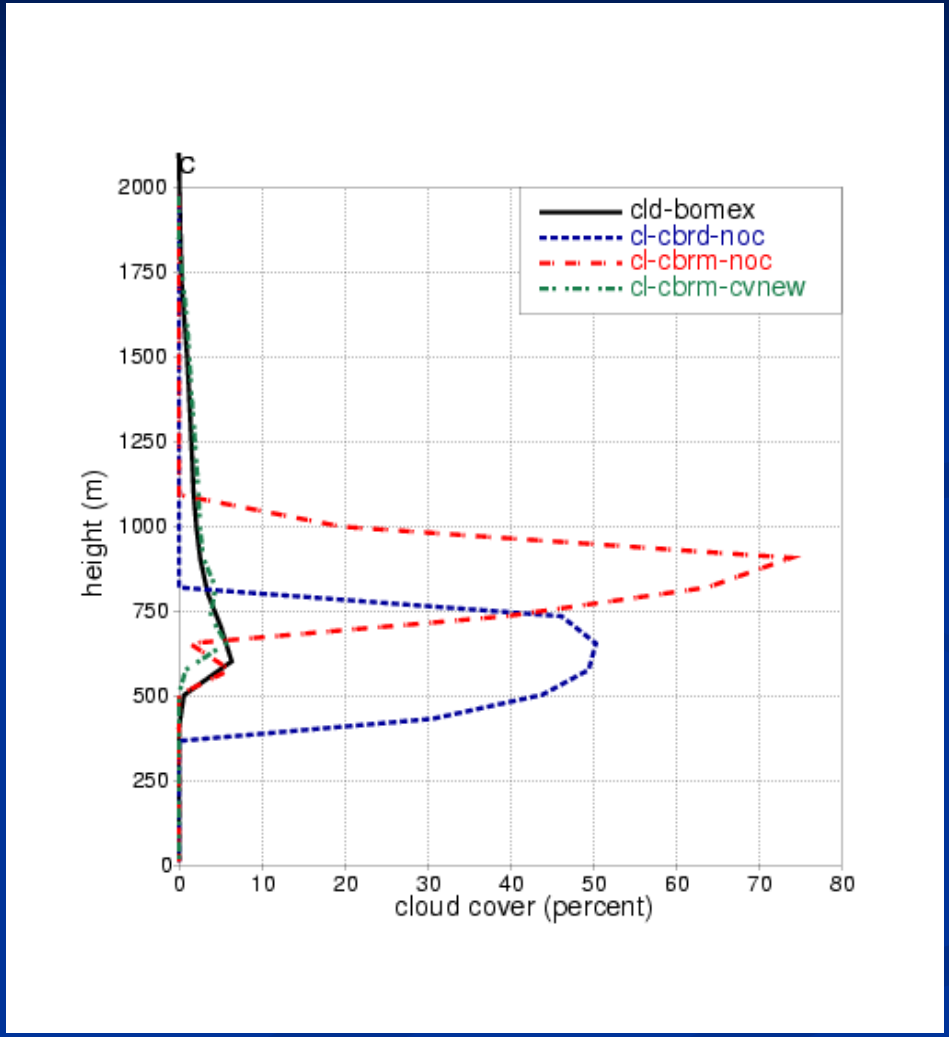
# 3.3 - ASTEX liquid water (24h)



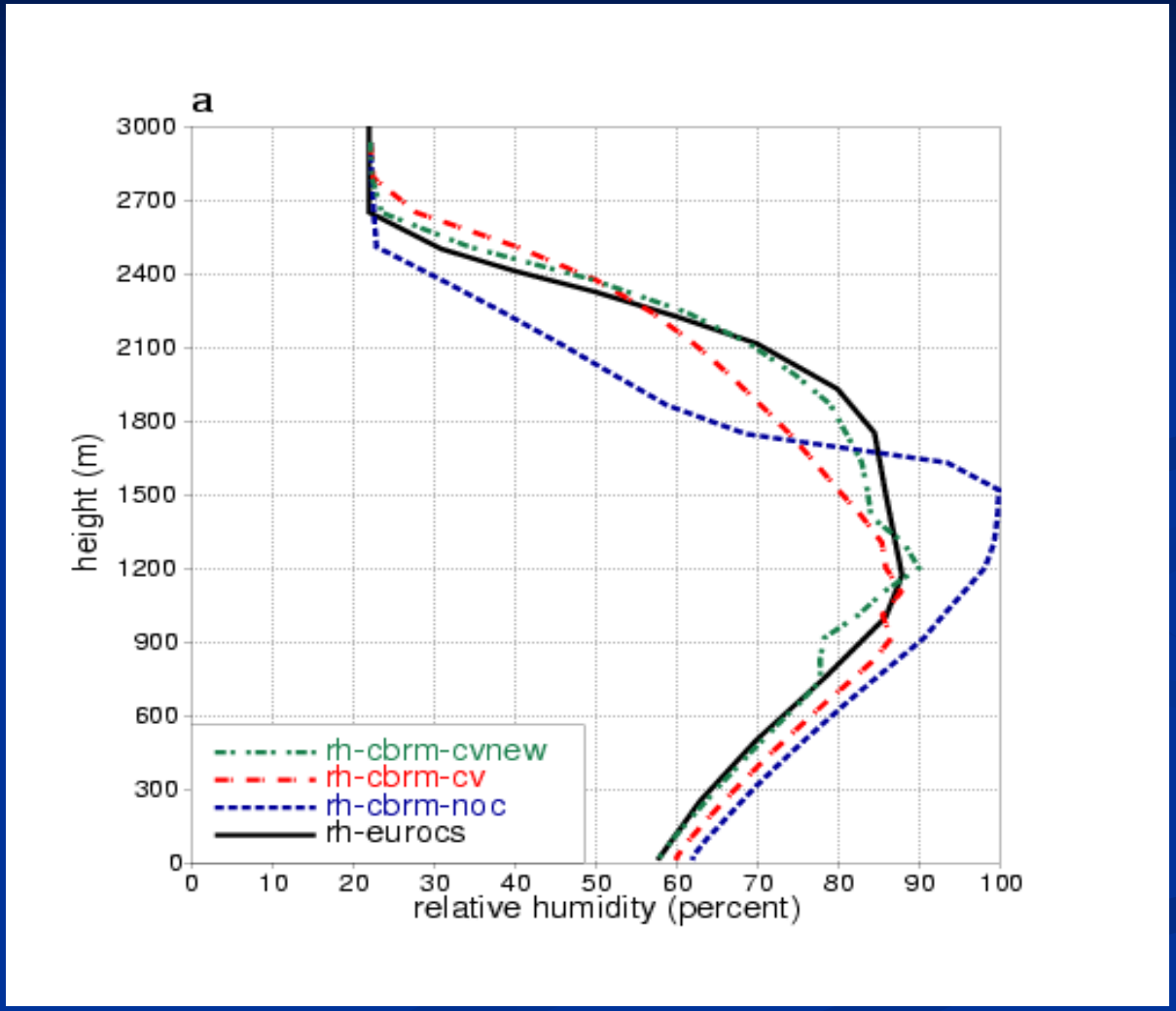
# 3.4 – BOMEX relative humidity (7h)



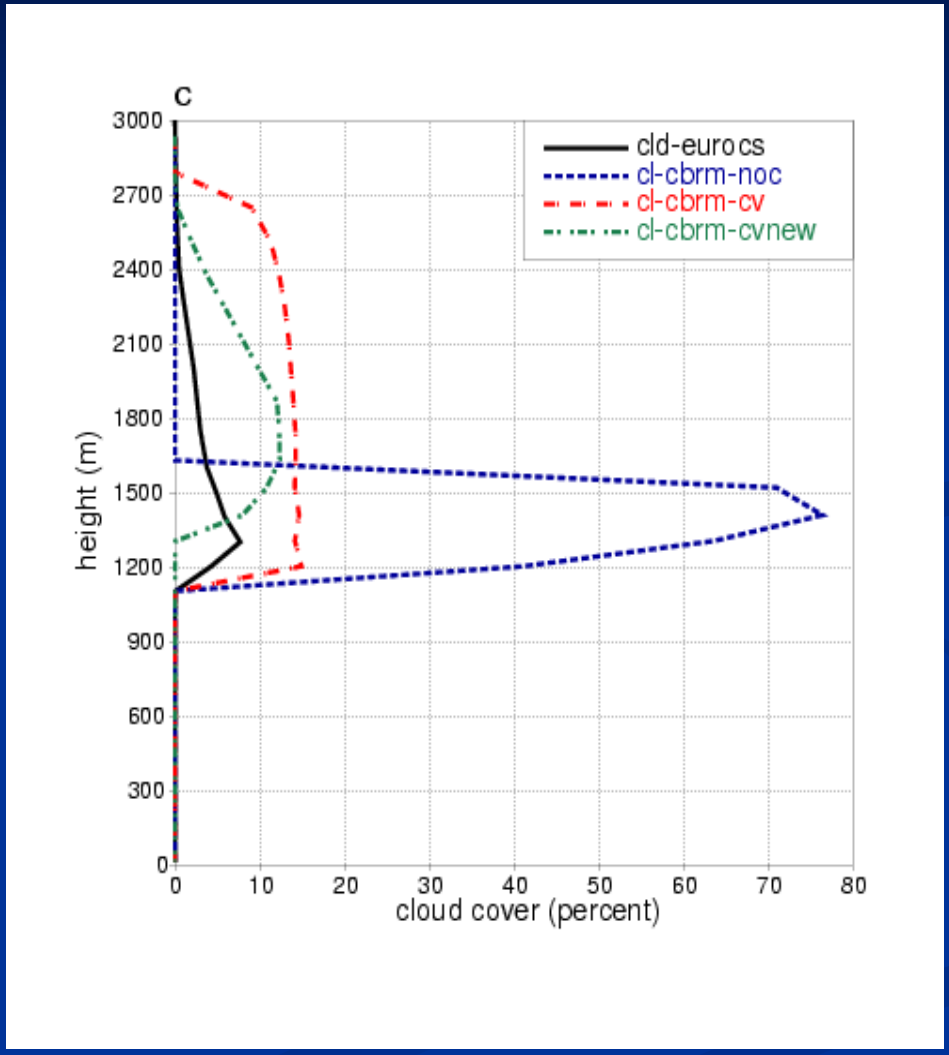
# 3.5 BOMEXcloud cover (7h)



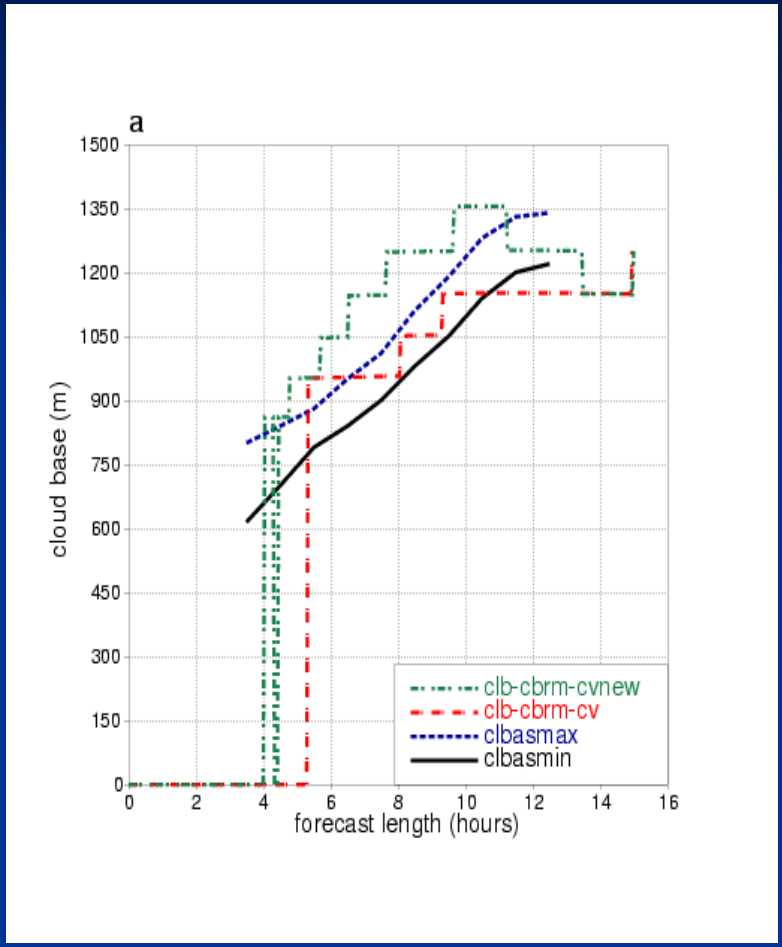
# 3.6- EUROCS relative humidity (10h)

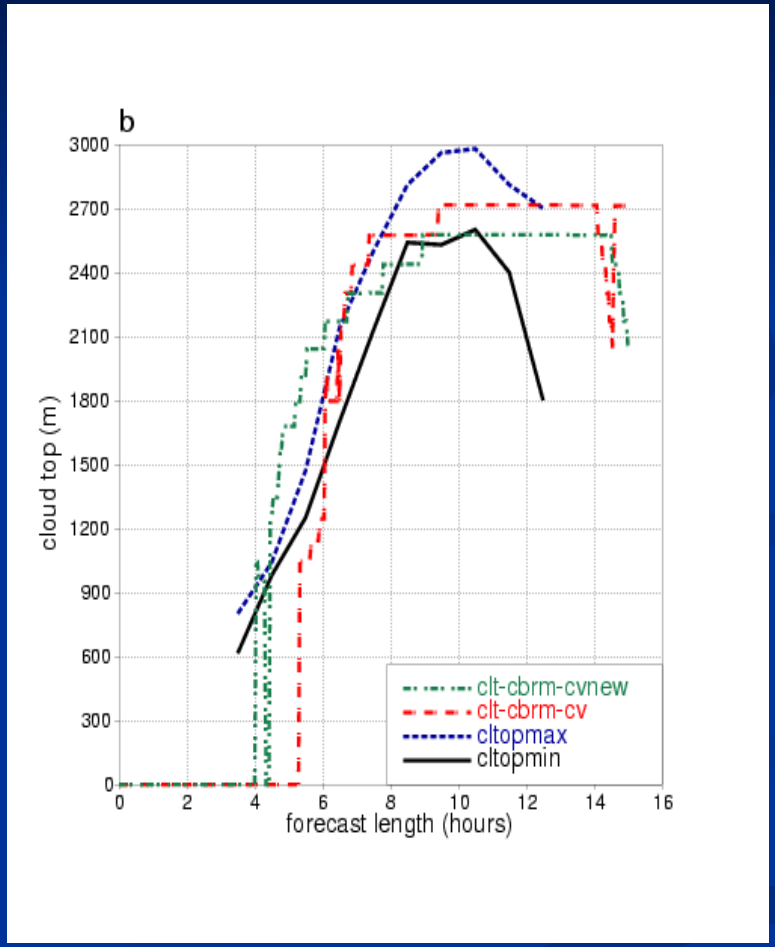


# 3.7 – EUROCS cloud cover (10h)



# 3.7- EUROCS cloud base and top



## Concluding remarks (1)

* Traditional turbulence schemes as currently used in HIRLAM needs a convection scheme in order to describe shallow convection adequately Exception: moist stratocumulus cases such as ASTEX handled well by moist turbulence scheme.

* It is difficult to obtain a realistic interaction between turbulence and convection parameterization.

## Concluding remarks (2)

* The new version of the convection scheme has given improved results for BOMEX compared to previous version (not shown). Also for EUROCS the results are much improved to what has been previously shown with HIRLAM physics and probably competitive to the results of most other schemes for important key parameters, e.g. relative humidity.

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