What did we learn using the composite transition cases?

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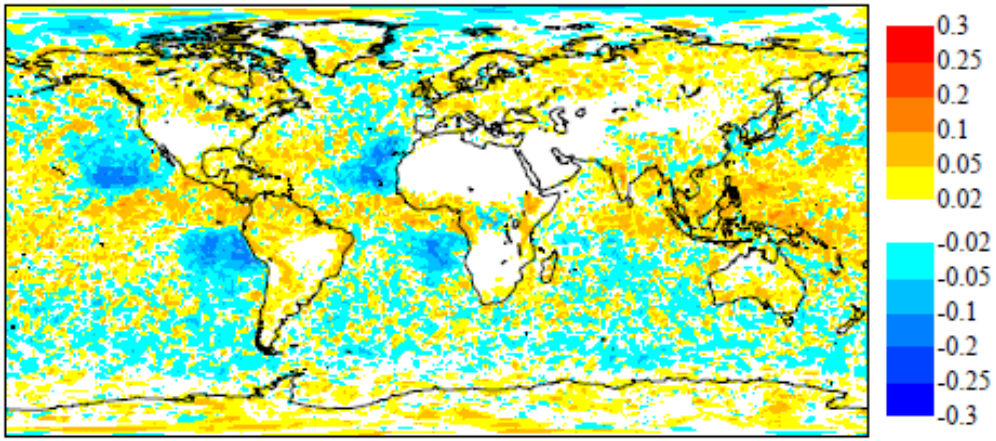
Daniel Klocke and Richard Forbes

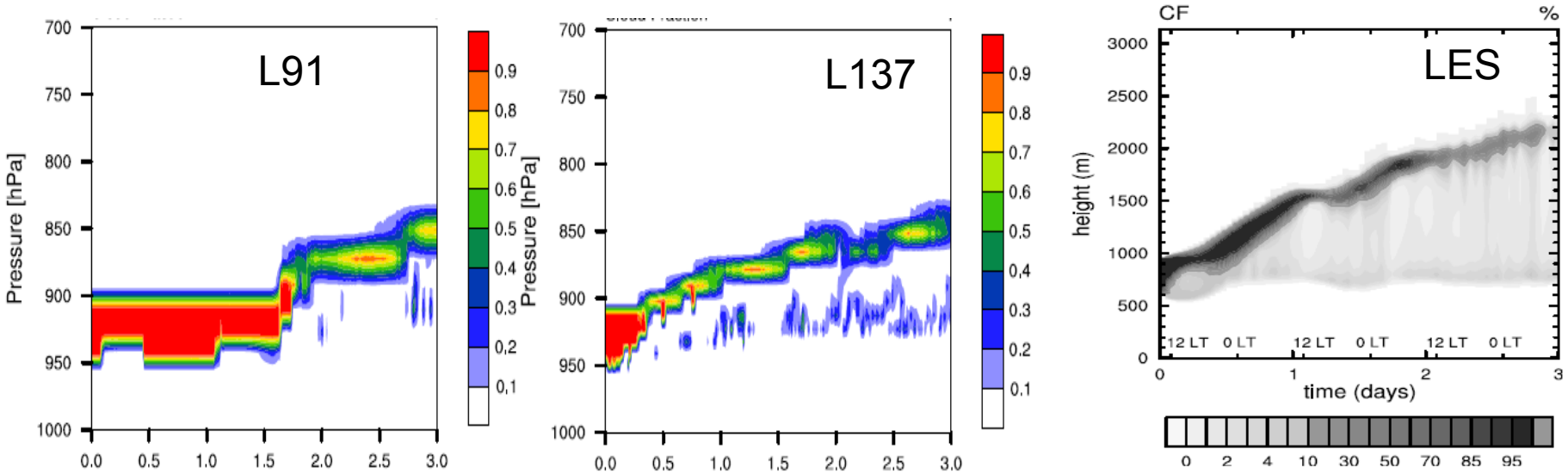
Context : vertical resolution increase

Difference in LCC between 137 levels forecasts and 91 level forecasts

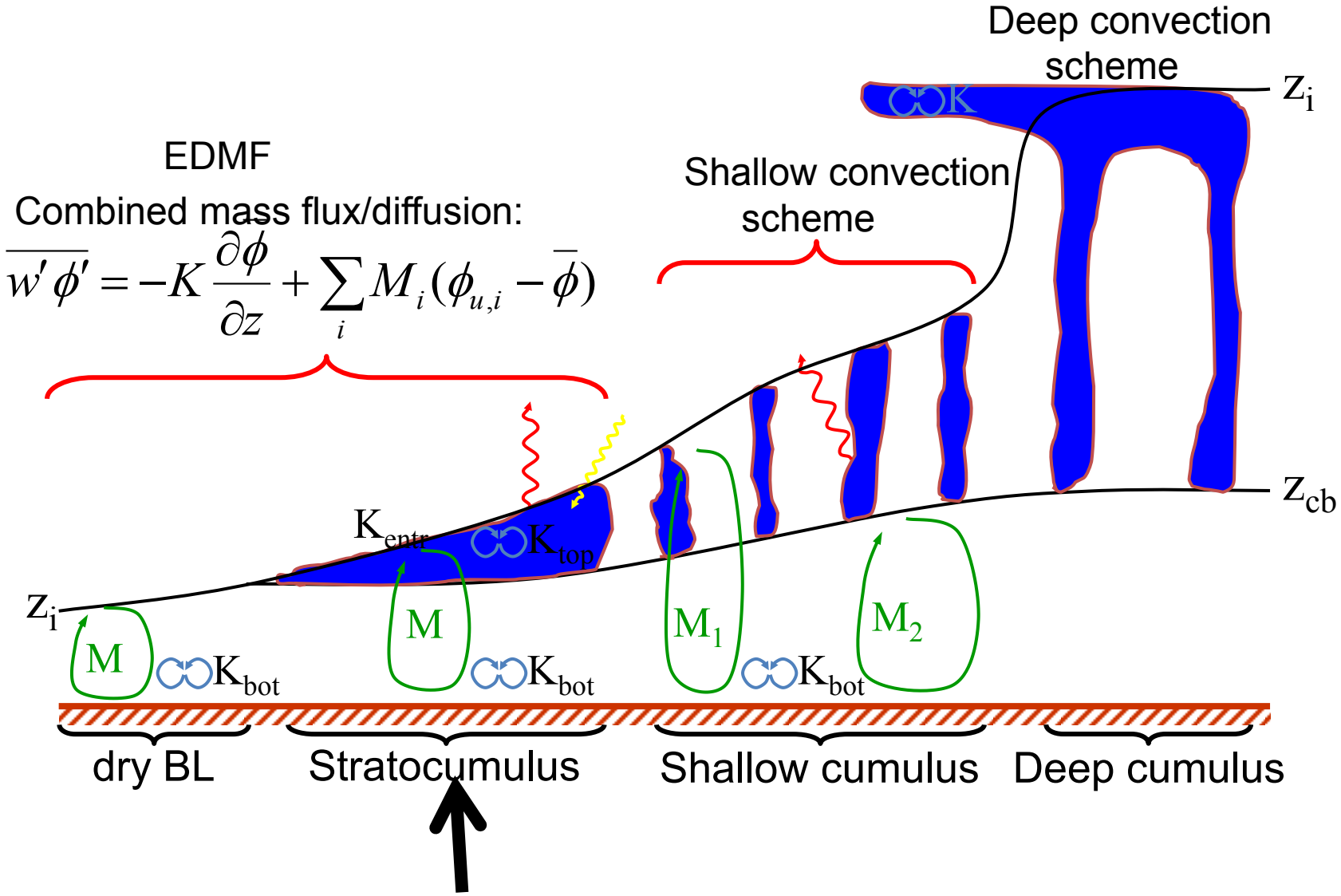


L91 : 20 levels below 700hpa
L137: 32 levels below 700hpa

SCM of the fast composite case



Turbulent transport – a combination of schemes

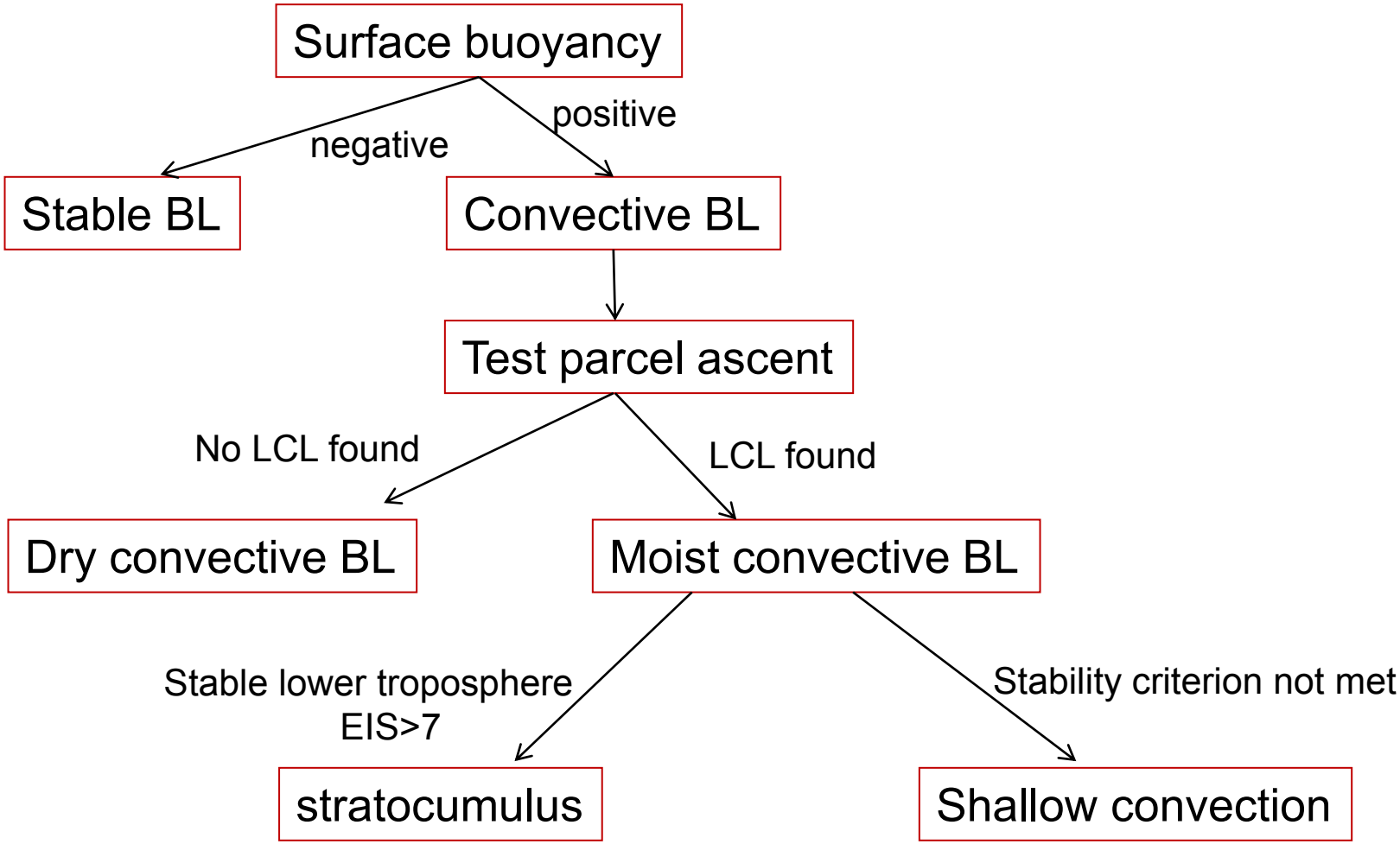


This is only true if convective boundary layer (buoyancy flux at the surface > 0)

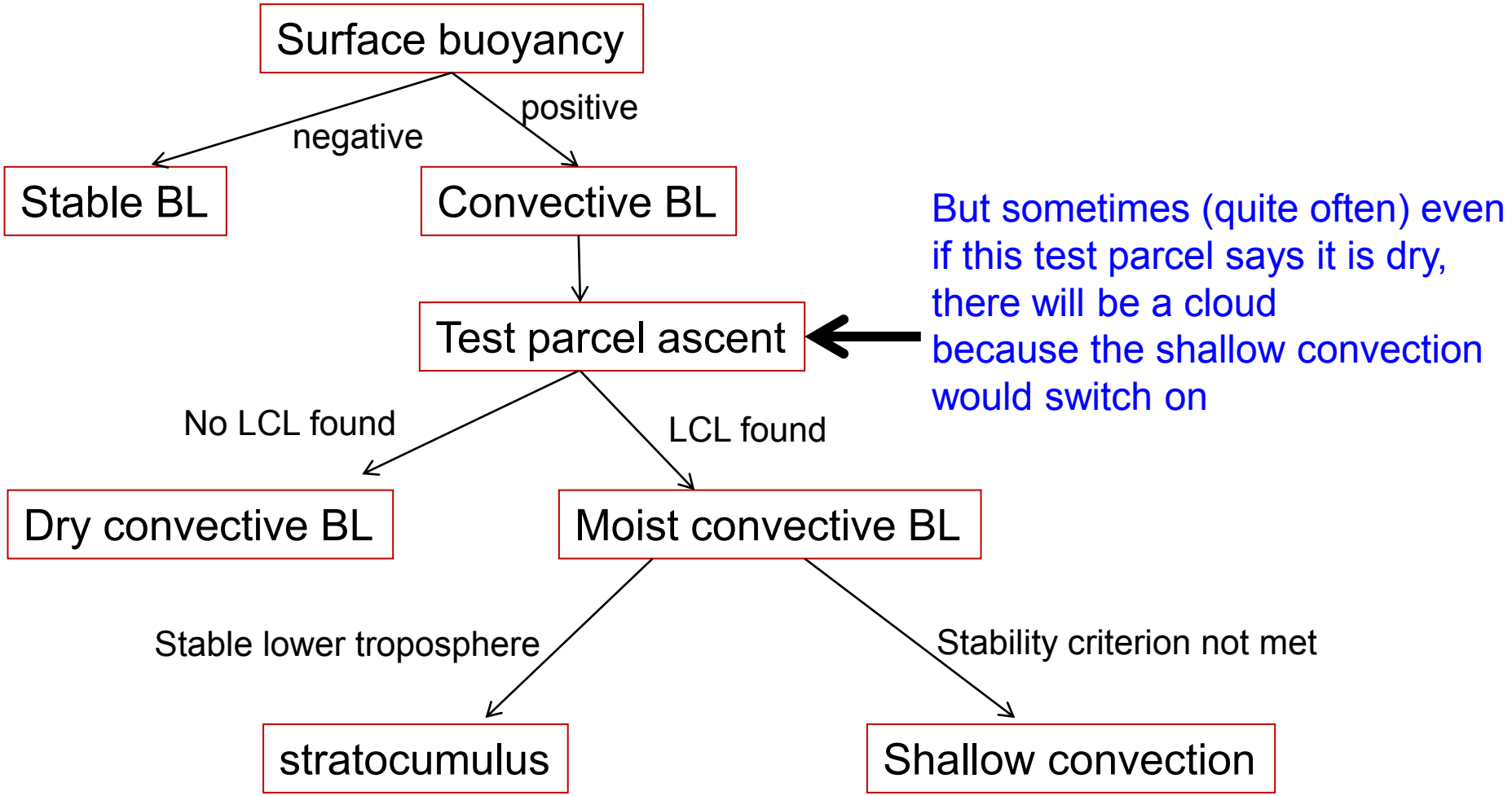
Koehler et al. 2010

ECMWF

The switches between schemes

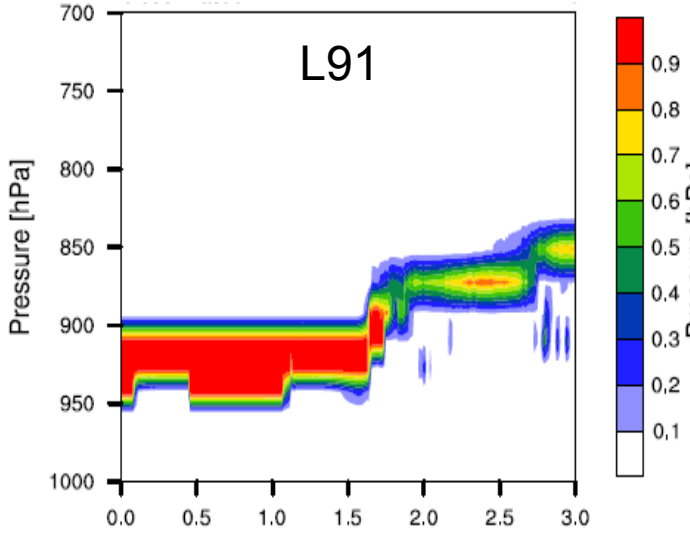


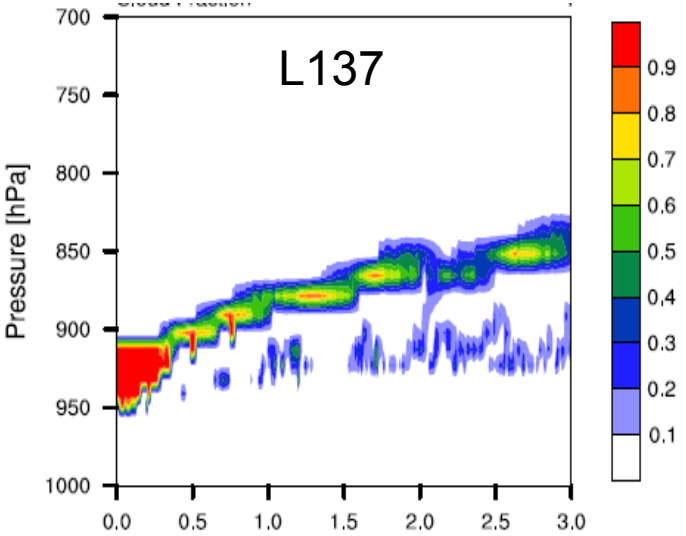
The switches between schemes

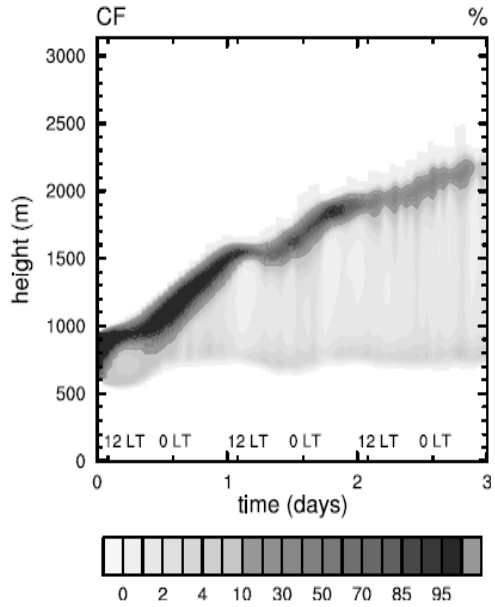


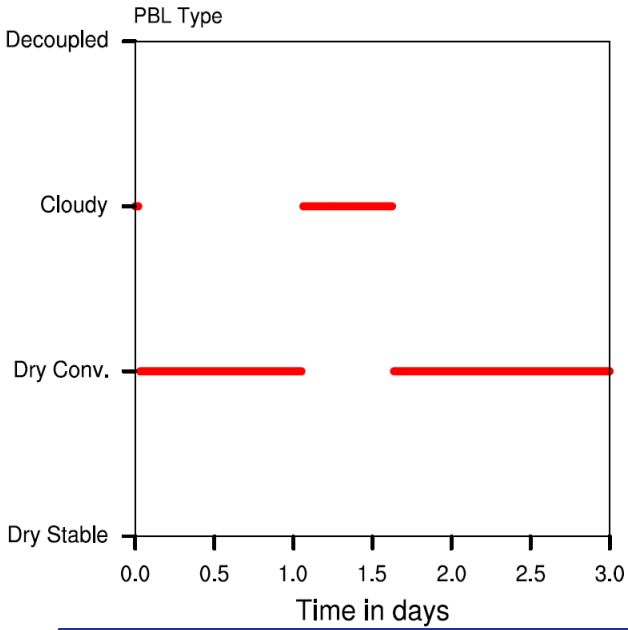
But sometimes (quite often) even if this test parcel says it is dry, there will be a cloud because the shallow convection would switch on

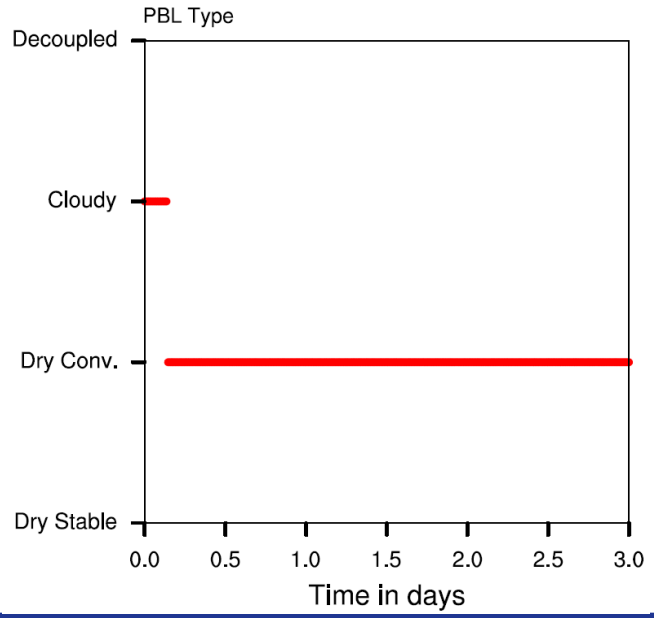
SCM of the fast case







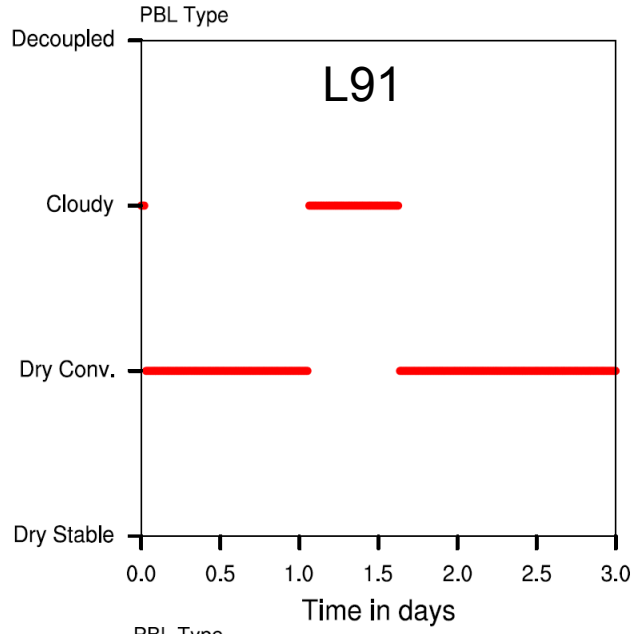


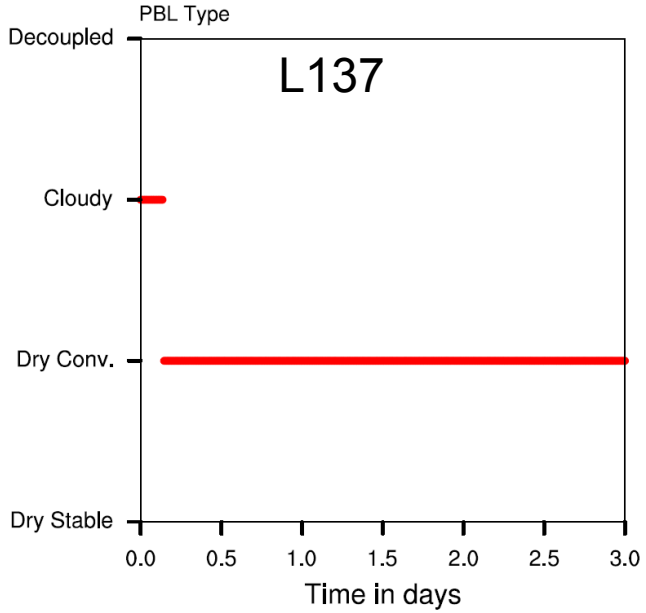


Different entrainment formulation in the test parcels used in the PBL and shallow convection schemes

ECMWF

Making the entrainment formulations consistent

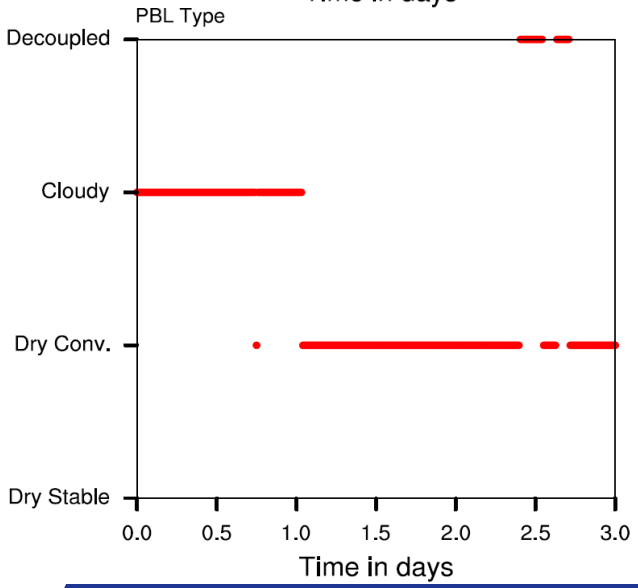


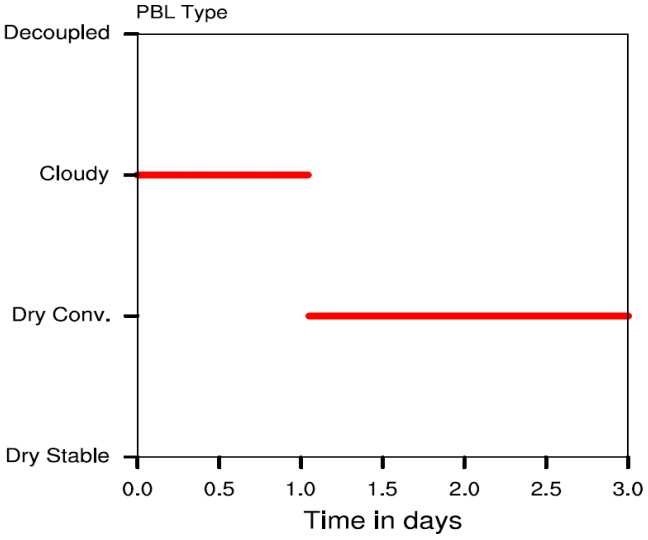


Before

PBL: $\frac{a}{z}+\frac{1}{\omega\tau}$

SH: $\frac{c}{z}+d$



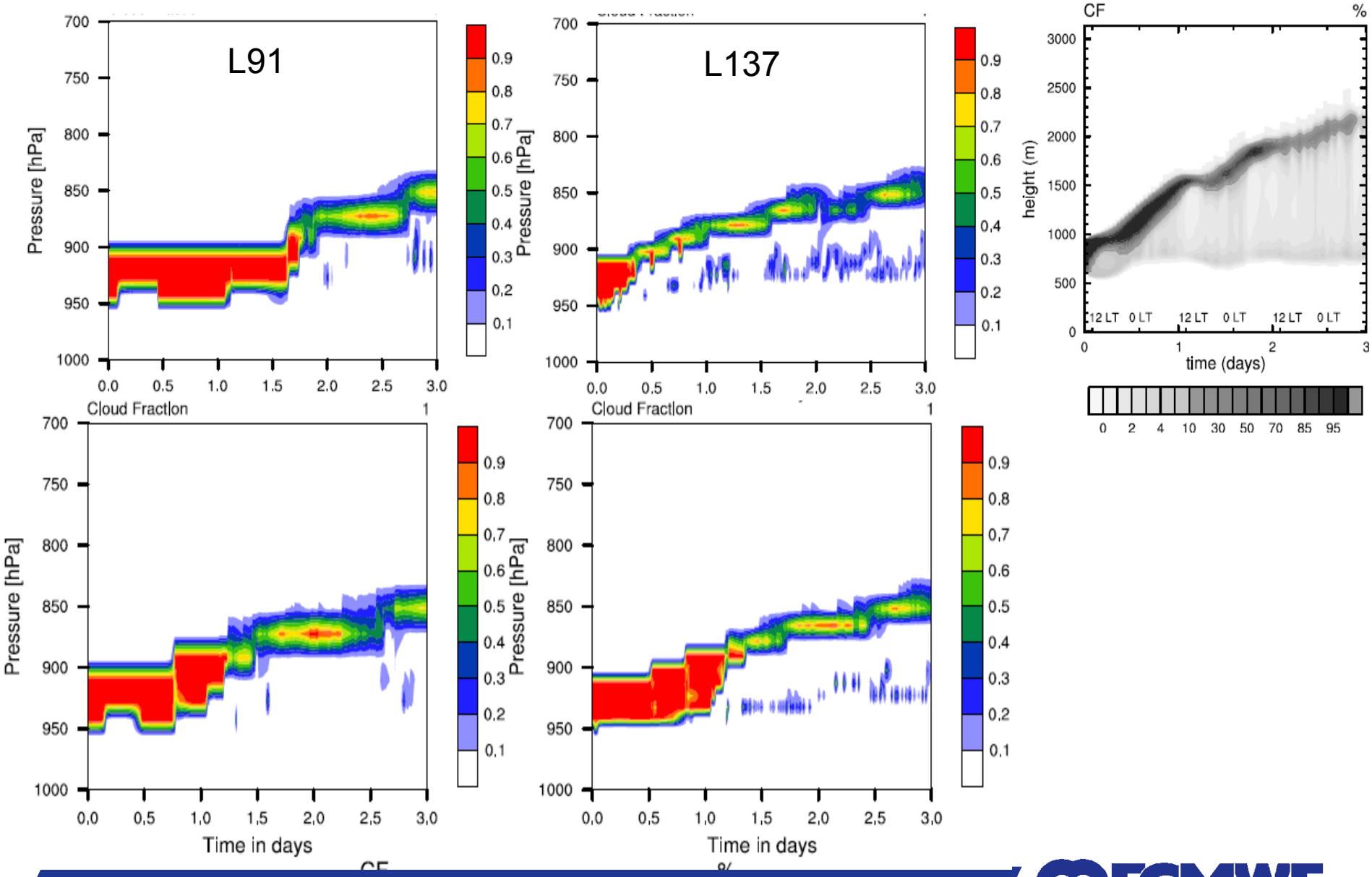


After

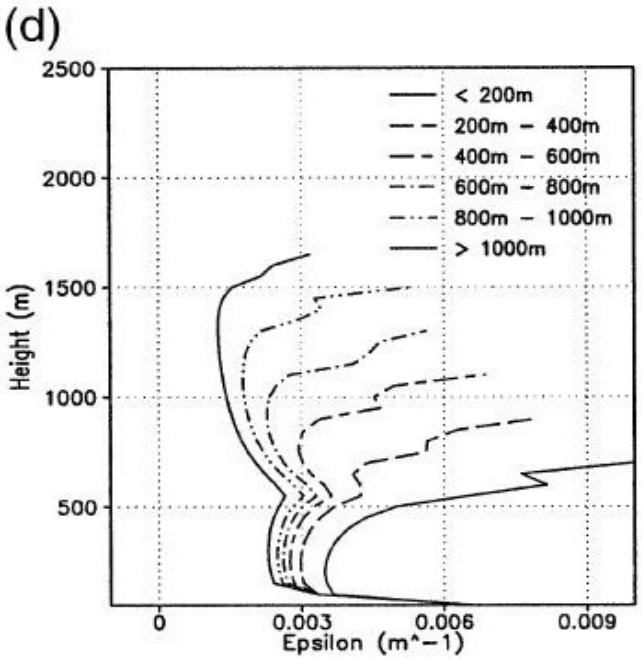
PBL and SH:

$\frac{c'}{z}+d'$

Making the entrainment formulations consistent

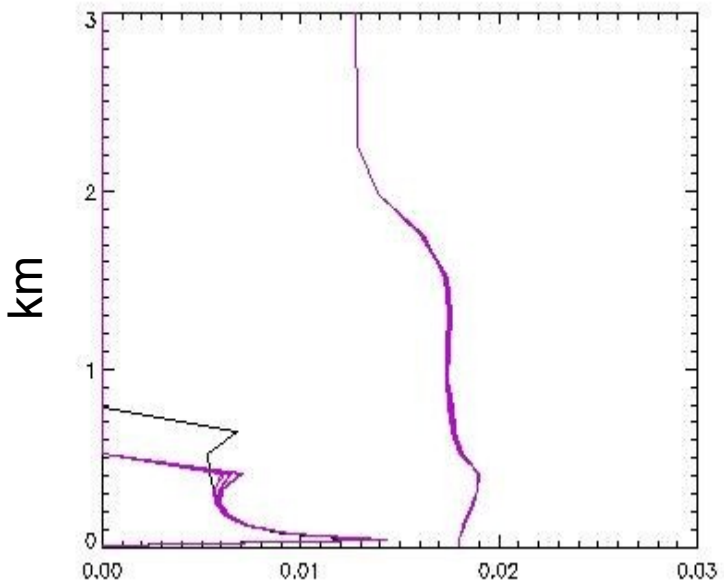


$$ZEPS = \frac{1}{\omega\tau}$$



LES BOMEX

BOMEX SCM



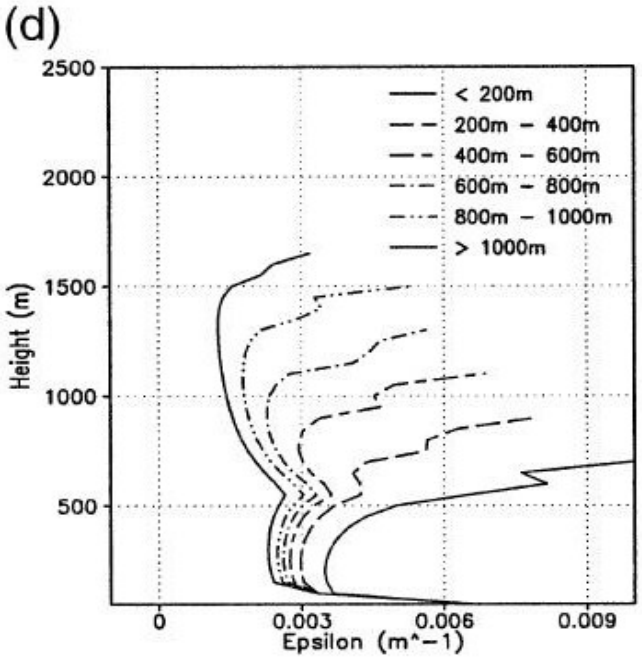
ZEPS/RH

Control :

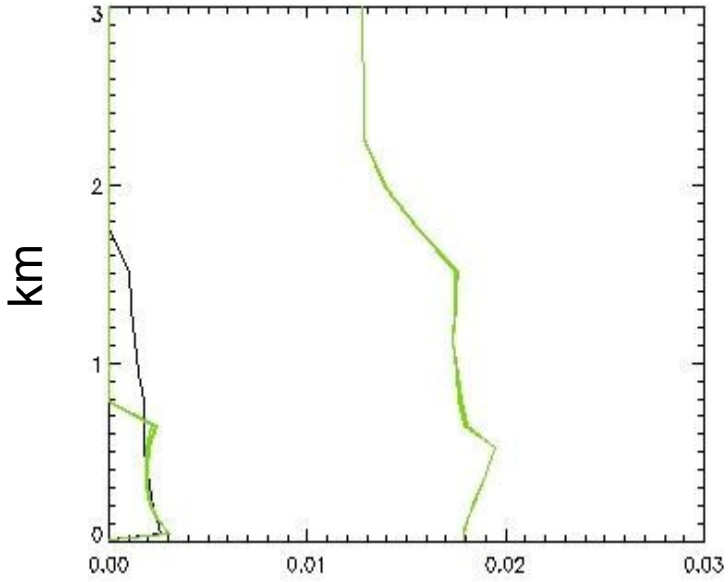
$$\frac{a}{z}+\frac{1}{\omega\tau}$$

$$\text{ZEPS} = \frac{1}{\omega\tau}$$

BOMEX SCM



LES BOMEX



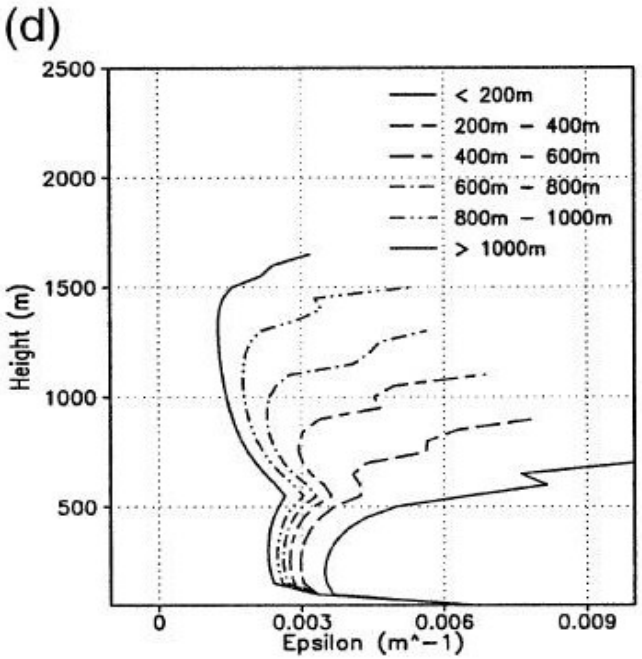
$\frac{1}{\omega\tau}$

ZEPS/RH

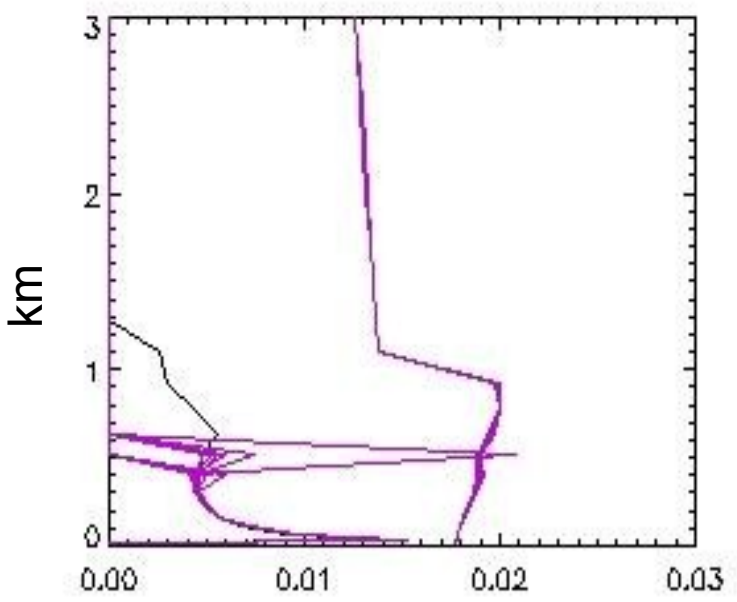
It would be great to see how ZEPS behaves from the LES of the transition cases…..

$$\text{ZEPS} = \frac{1}{\omega\tau}$$

Transition SCM



LES BOMEX



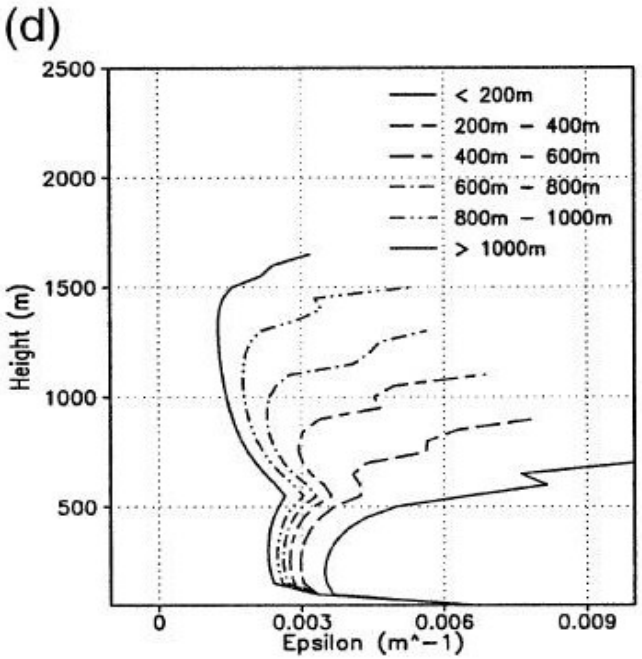
ZEPS/RH

Control :

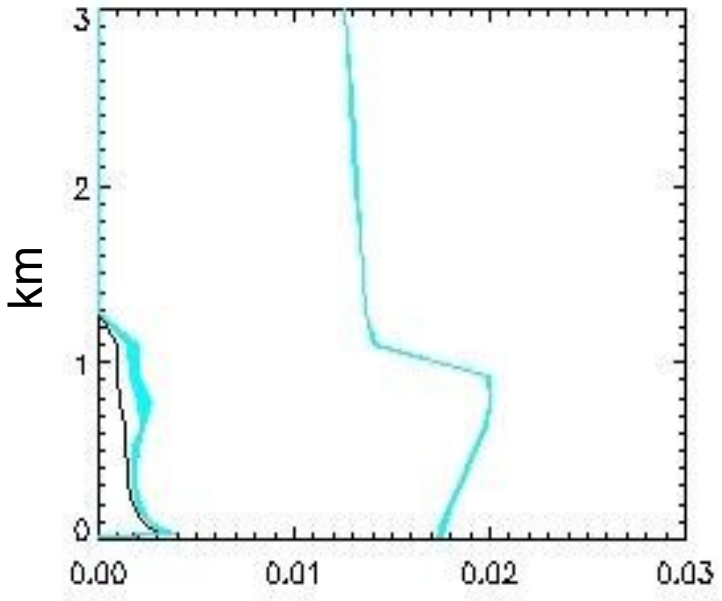
$$\frac{a}{z} + \frac{1}{\omega\tau}$$

$$\text{ZEPS} = \frac{1}{\omega\tau}$$

Transition SCM



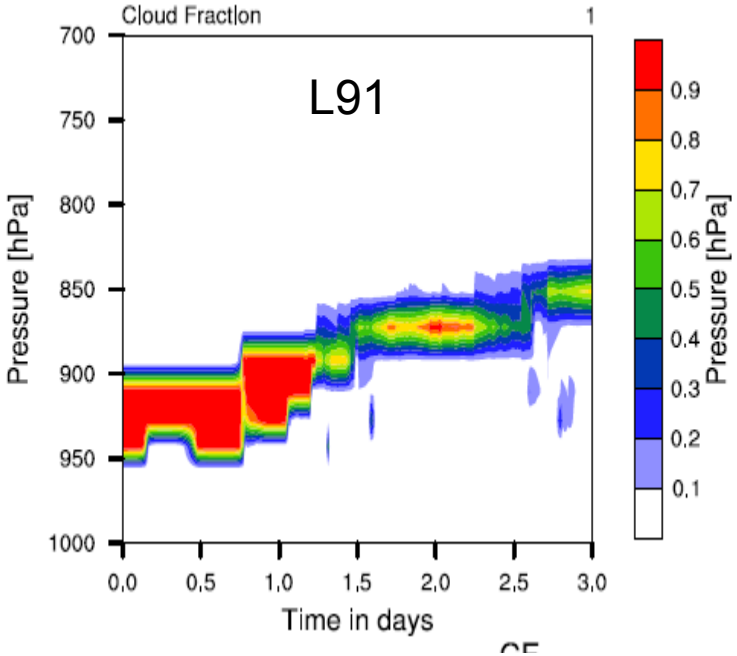
LES BOMEX

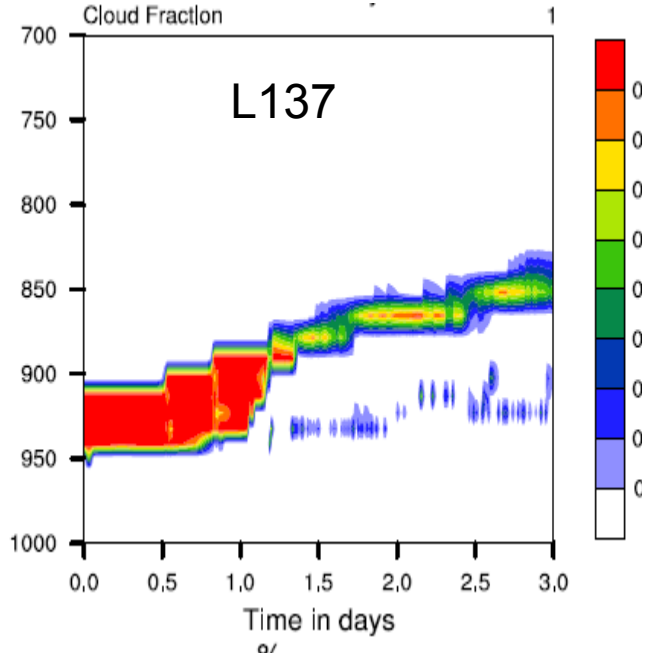


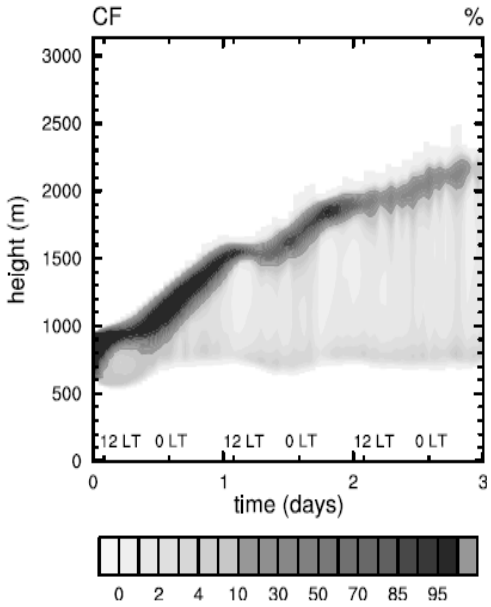
$\frac{1}{\omega\tau}$

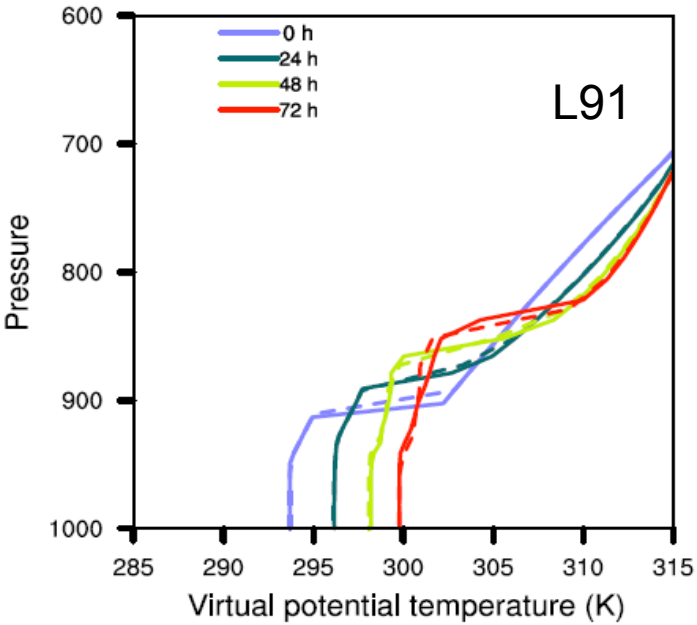
ZEPS/RH

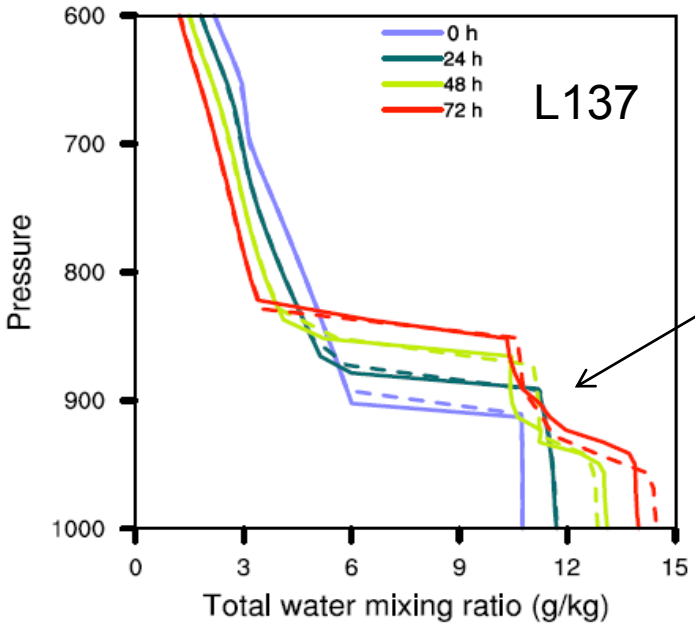
The benefit of the vertical resolution increase









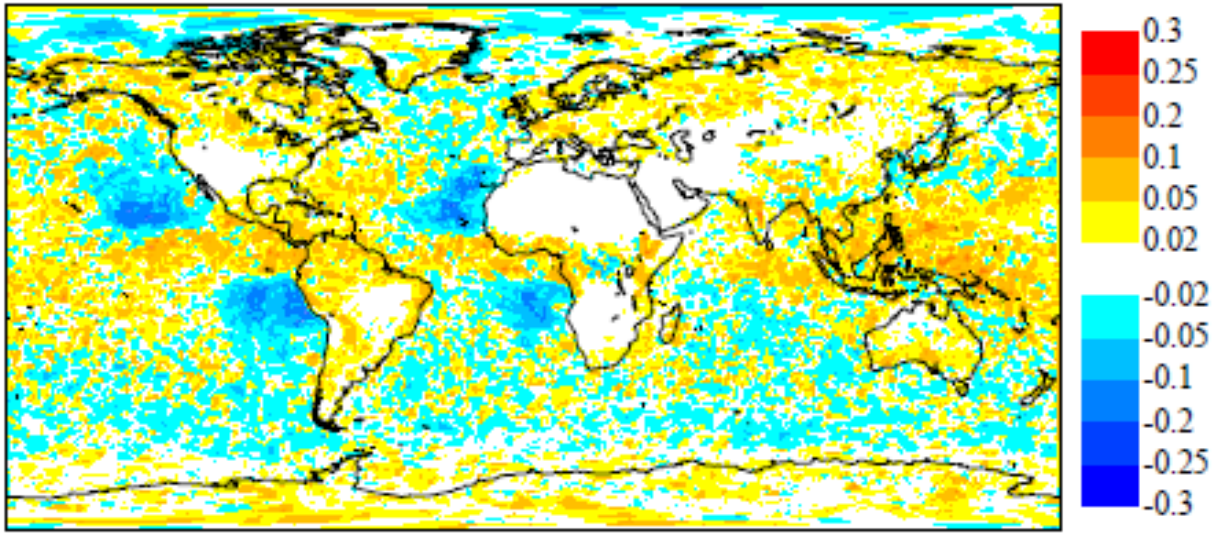


More decoupled

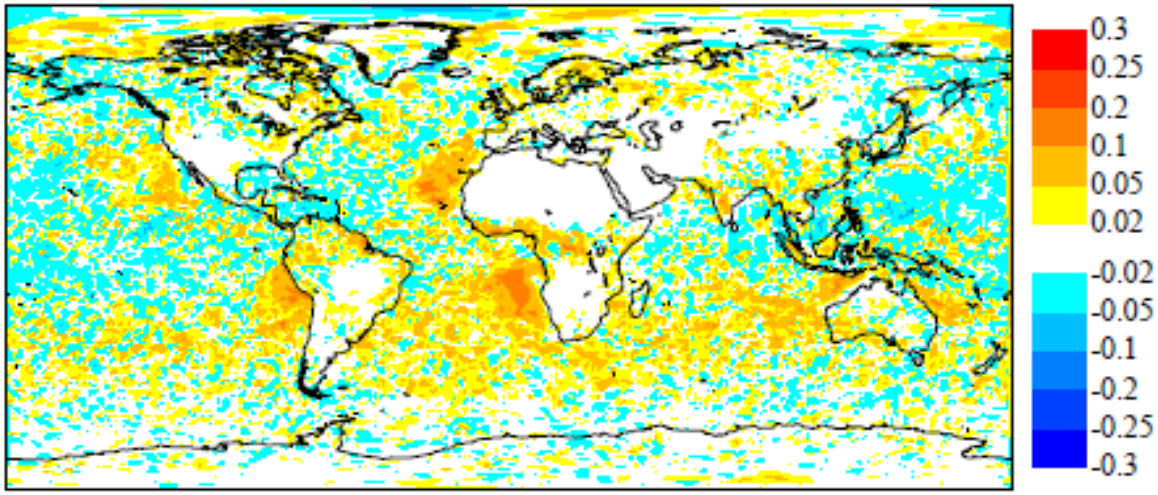
ECMWF

Does it work in 3D?

Difference in LCC L137 –L91



Difference in LCC new L137 – L137



Future work

Understand why the BL and shallow convection parcels still disagree…

Apply the mixing in stratocumulus even in case when the BL is not convective, night time and winter

Perhaps a more physical criterion for the transition then a fixed EIS…..

Revise the rain formation/evaporation formulation