The composite Lagrangian cases: LES intercomparison

Irina Sandu,

Andy Ackerman, Peter Blossey, Chris Bretherton, Johan van der Dussen, Adrian Lock, Stephan de Roode, Bjorn Stevens

Max-Planck-Institut für Meteorologie

Alexander von Humboldt Stiftung/Foundation

ECMWF

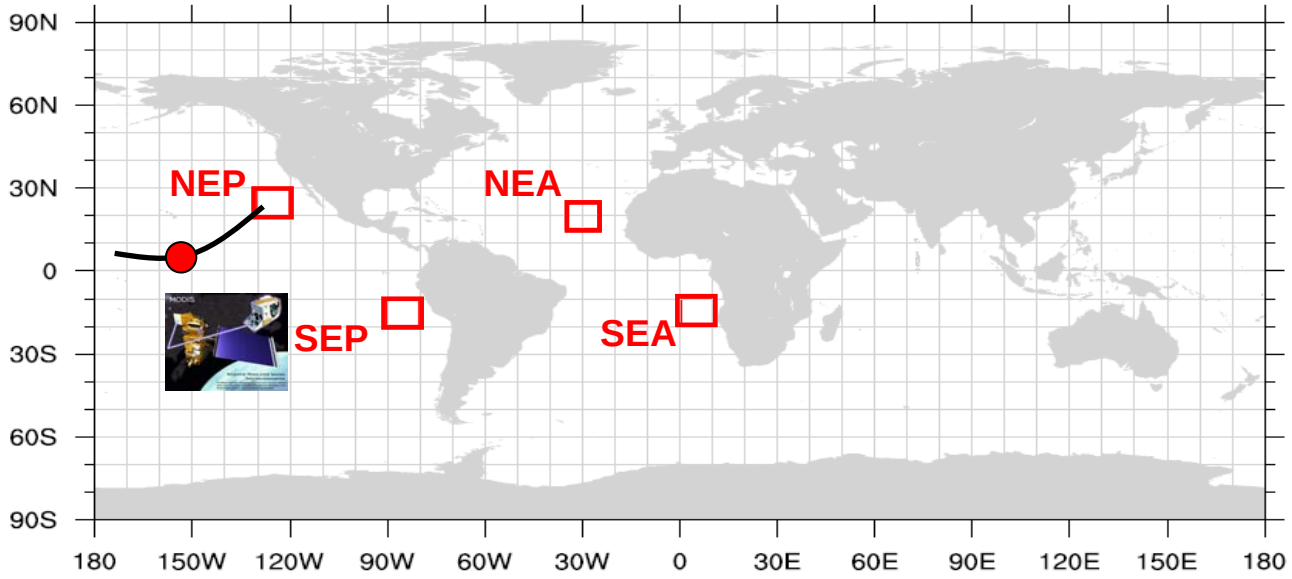
Lagrangian analysis of the air mass flow

How? Trajectories + Re-analysis + Satellite data

HYSPLIT (ERA-INTERIM) | ERA-INTERIM | MODIS (Terra, Aqua) AMSR-E

When? 2002-2007 (May to October in NE, July to December SE)
Starting time: 11 LT, Duration: 6 days, Height: 200m

Where? Klein&Hartmann (1993) zones : NE/SE Atlantic, NE/SE Pacific

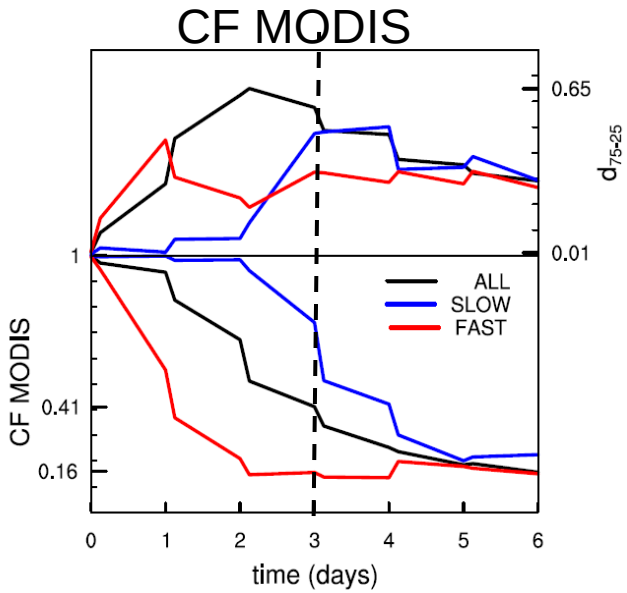


Sandu, Stevens and Pincus, ACP, 2010

Max-Planck-Institut für Meteorologie | Alexander von Humboldt Stiftung/Foundation | ECMWF

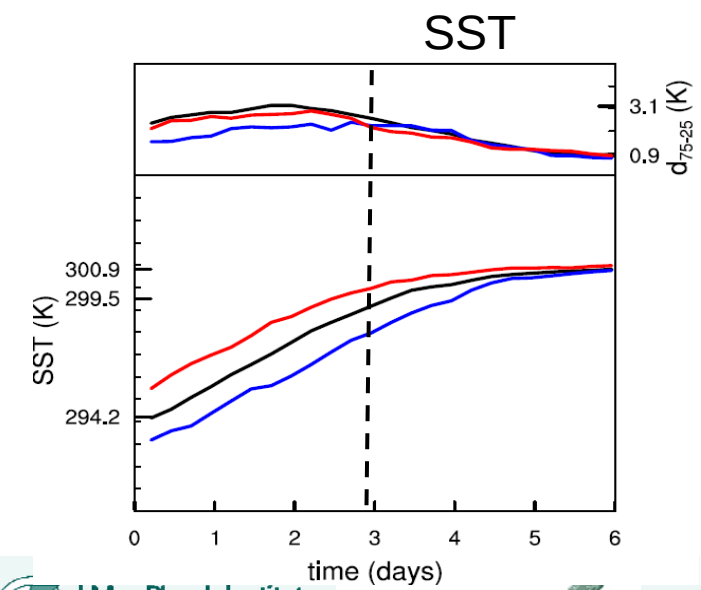
An ensemble of composite cases: slow, intermediate and fast transitions

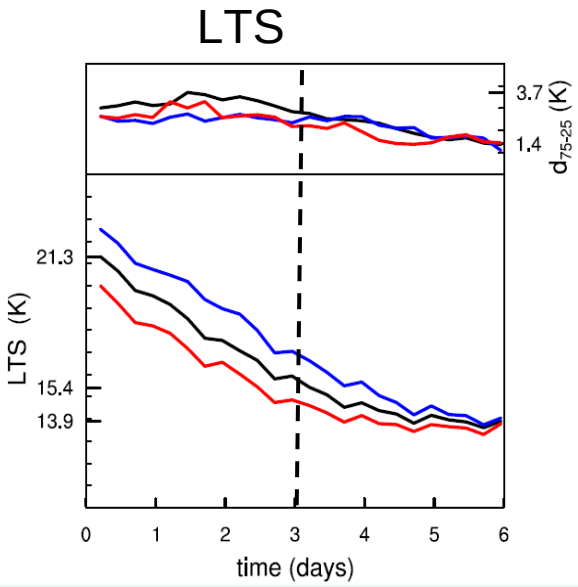
Composites NEP
JJA 2006-2007

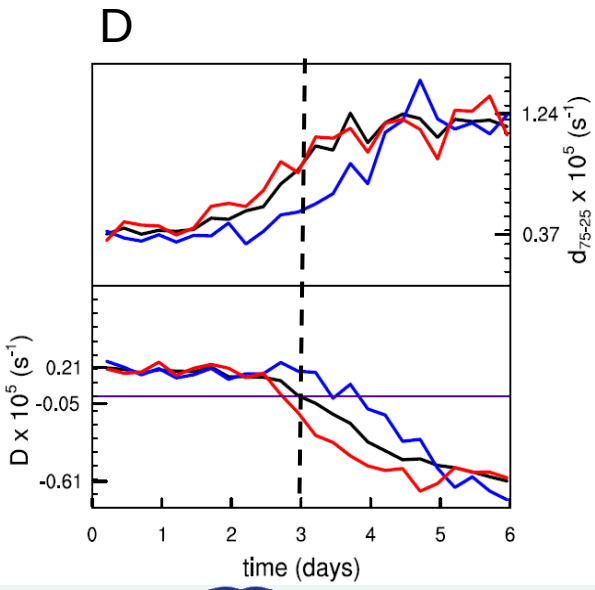


ref
slow
fast

3 days







Max-Planck-Institut für Meteorologie

Alexander von Humboldt Stiftung/Foundation

ECMWF

Our questions

Are the LES able to reproduce:

- ✓ the observed changes in cloudiness induced by changes in the SST/LTS?
- ✓ the transition's pace and its dependence on the inversion strength?

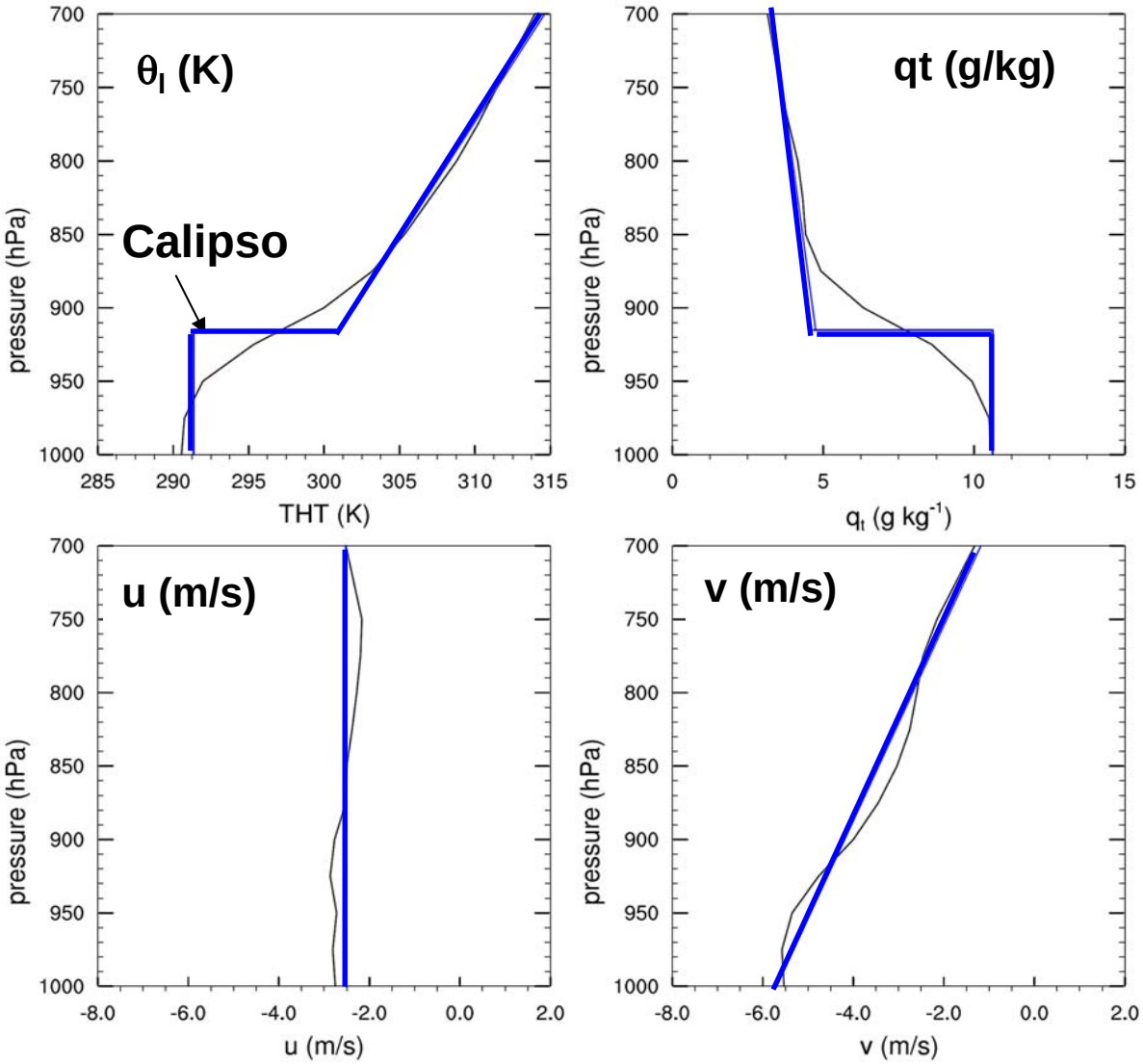
(yes … Sandu and Stevens, JAS, 2011, accepted)

Do different LES models agree in term of :

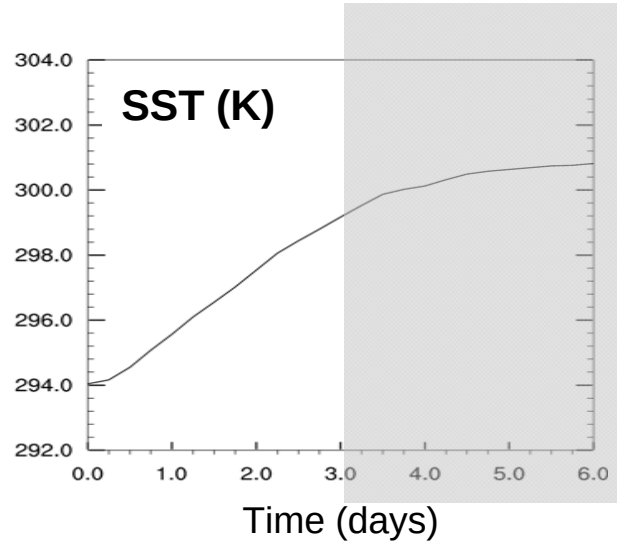
- ✓ The decrease in cloud albedo and cloud cover during the 3 days
- ✓ The time evolution of the cloud fraction
- ✓ The growth rate of the boundary layer

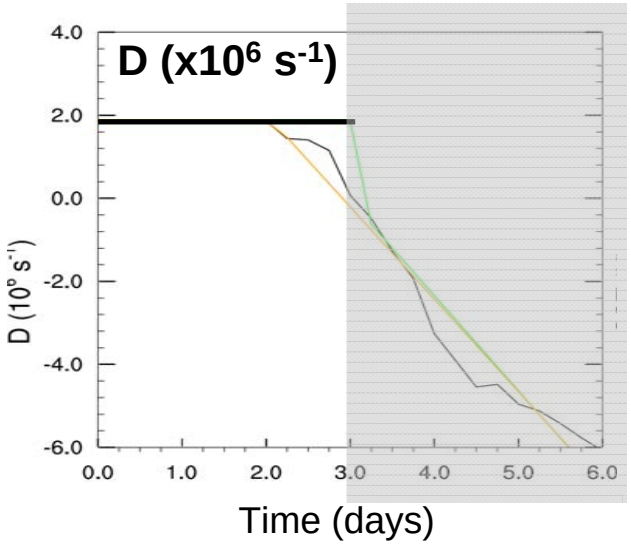
Composite REF case : NEP - JJA 2006-2007

Initial profiles (10 LT)

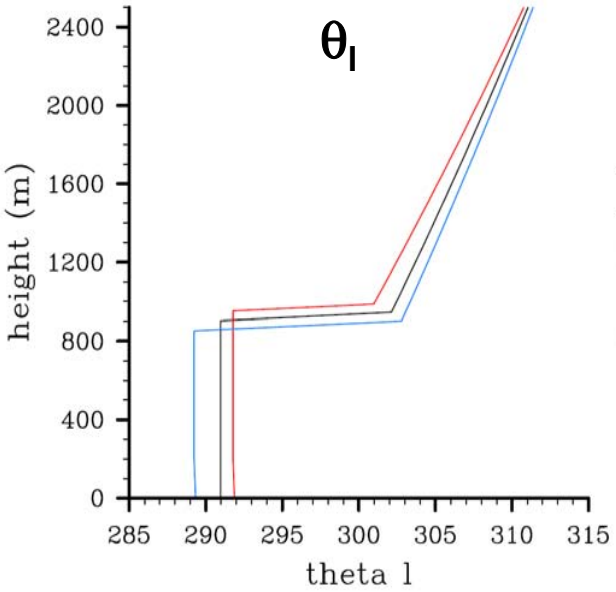


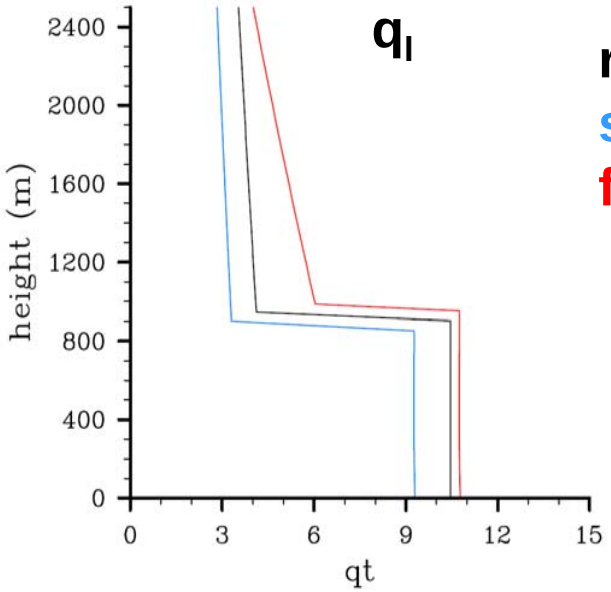
Forcing



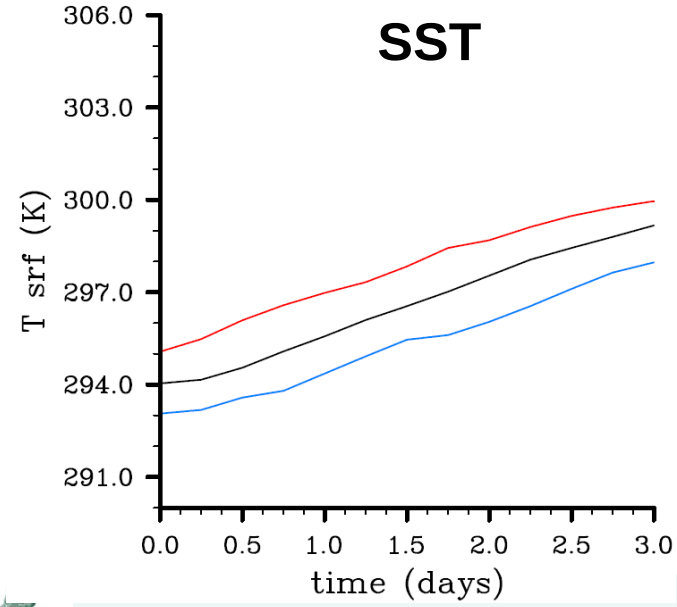


Initial conditions





ref
slow
fast



Cts divergence (the same)
No advective tendency

Simulations

- ✓ initial time : 10 LT, duration: 72 hours
- ✓ initial date: 15 July
- ✓ diurnal cycle of solar radiative forcing taken into account
- ✓ cloud droplet number concentration: 100 cm^{-3}
- ✓ resolution : x = 35m, z = 5m (at cloud top)
- ✓ domain size : 4.48 X 4.48 X 3.2 km (128 x 128 X 428 points)

Models & participants

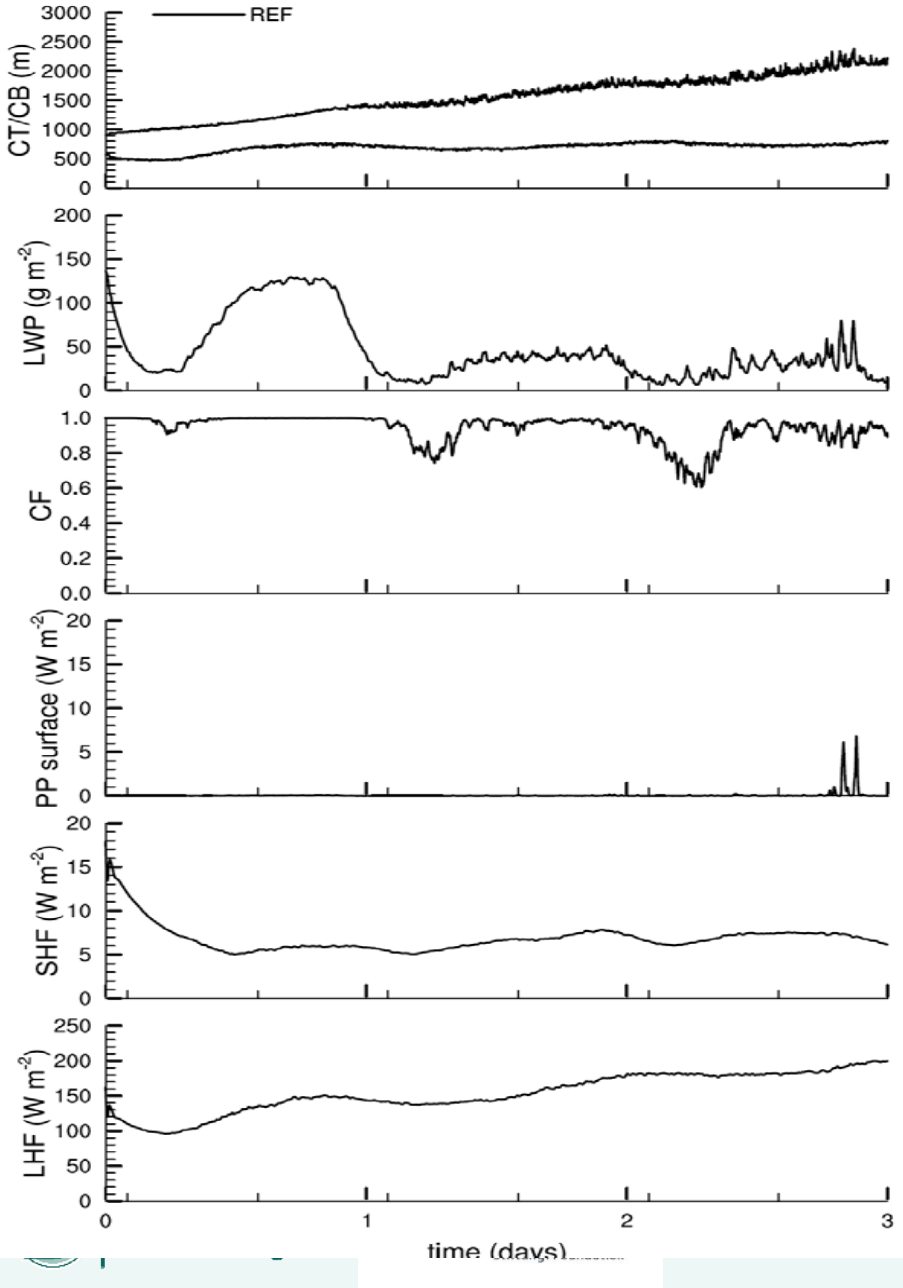
	REF	FAST	SLOW	ASTEX
✓ UCLA-LES (Irina Sandu)	✓	✓	✓	✓
✓ DALES (Johan van der Dussen, Stephan de Roode)	✓	✓	✓	✓
✓ UKMO (Adrian Lock)	✓	✓	✓	✓
✓ SAM (Peter Blossey, Chris Bretherton)	✓	✓	✓	✓
✓ DHARMA (Andy Ackerman)	✓	✓	✓	✓
✓ Univ. of Warsaw	✗	✗	✗	✗

Max-Planck-Institut für Meteorologie

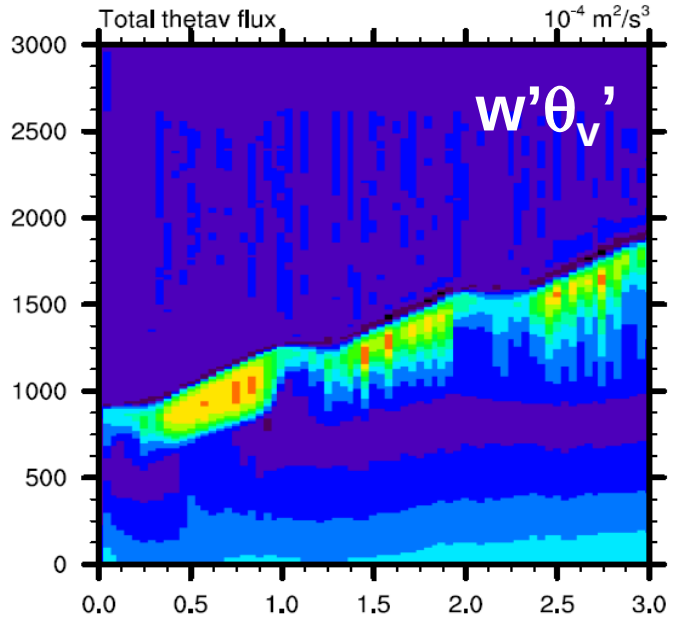
Alexander von Humboldt Stiftung/Foundation

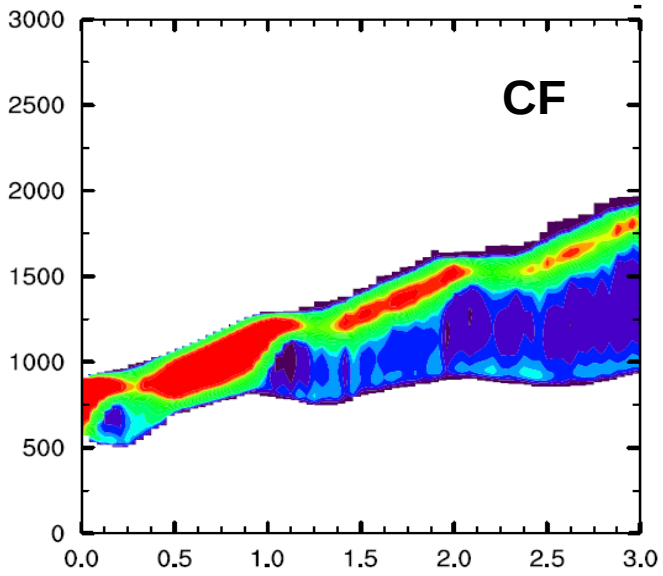
ECMWF

The simulations capture the major observed features of the SCT, and corroborate the conceptual model proposed by Bretherton (1992) to explain it



UCLA





Slow against fast SCT (UCLA – big domain)