Implementation and validation of the

ECMWF IFS convection scheme

in COSMO-CLM

Peter Brockhaus (ETH)
Peter Bechtold (ECMWF)
Daniel Lüthi (ETH)
Oliver Fuhrer (MeteoSwiss)
Christoph Schär (ETH)

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Motivation from a climate perspective

A climate projection without at least
some estimate of the uncertainty involved
is worthless

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An estimate for the „model uncertainty“
can come from
comparing various models
or
having various configuration choices within one model

Our long-term motivation

	operational / supported?	itype_conv	tested/tuned?	quality
Ti	yes (DWD), incl. implementation	0 (default)	yes	****/*****
Ti-CAPE	no	lcape=.TRUE.	no	*
KF	no	1	partly	**
KFB	no	[2]	partly	***

Tiedtke scheme is the only supported convection scheme in COSMO!

Our long-term motivation

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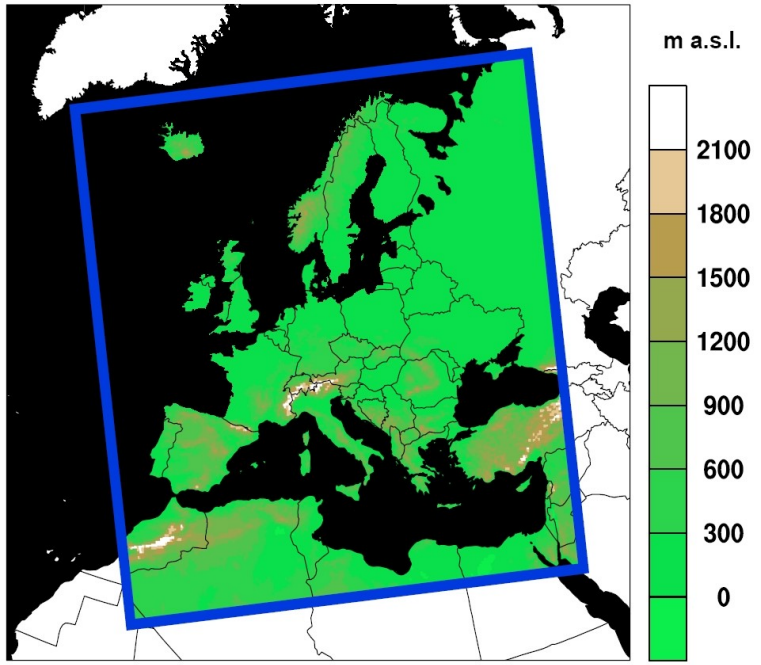
Ti-IFS	yes (ECMWF)	[4]	in progress	***** (?)

Characteristics of IFS convection scheme

	IFS	Tiedtke
Closure	instability (deep) surface fluxes (shallow) moisture converg. (mid-level)	moisture convergence (all types)
Which type	~ cloud depth	~ moisture convergence
Parcel Ascent	several mixed ones	surface parcel only
Precipitation	full microphysics prognostic rain/snow/ice/water	cloud water & conversion factor
Cloud cover	(linear with cloud depth)	linear with cloud depth

Setup

- 50km resolution (CLIMATE !!!)
- v4.7
- 1-year simulation (1980)
- diagnostic precipitation
- „old“ reference atmosphere pressure-hybrid



IFS convection scheme:

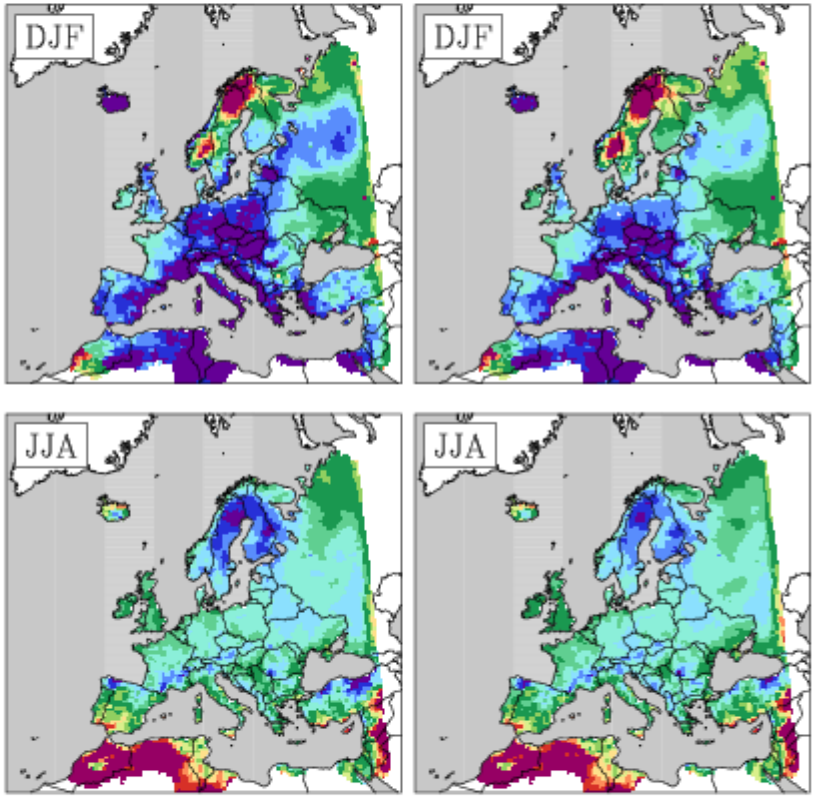
- src_conv_ifs.f90
  implementation calling a library that is compiled from 52 files (ECMWF, updates easy)

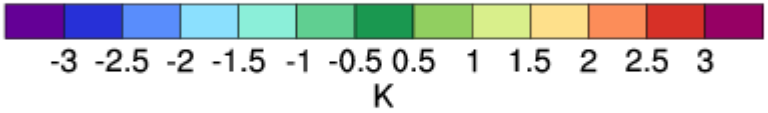
Mean Temperature Bias

IFS 4.7 Ti 4.7

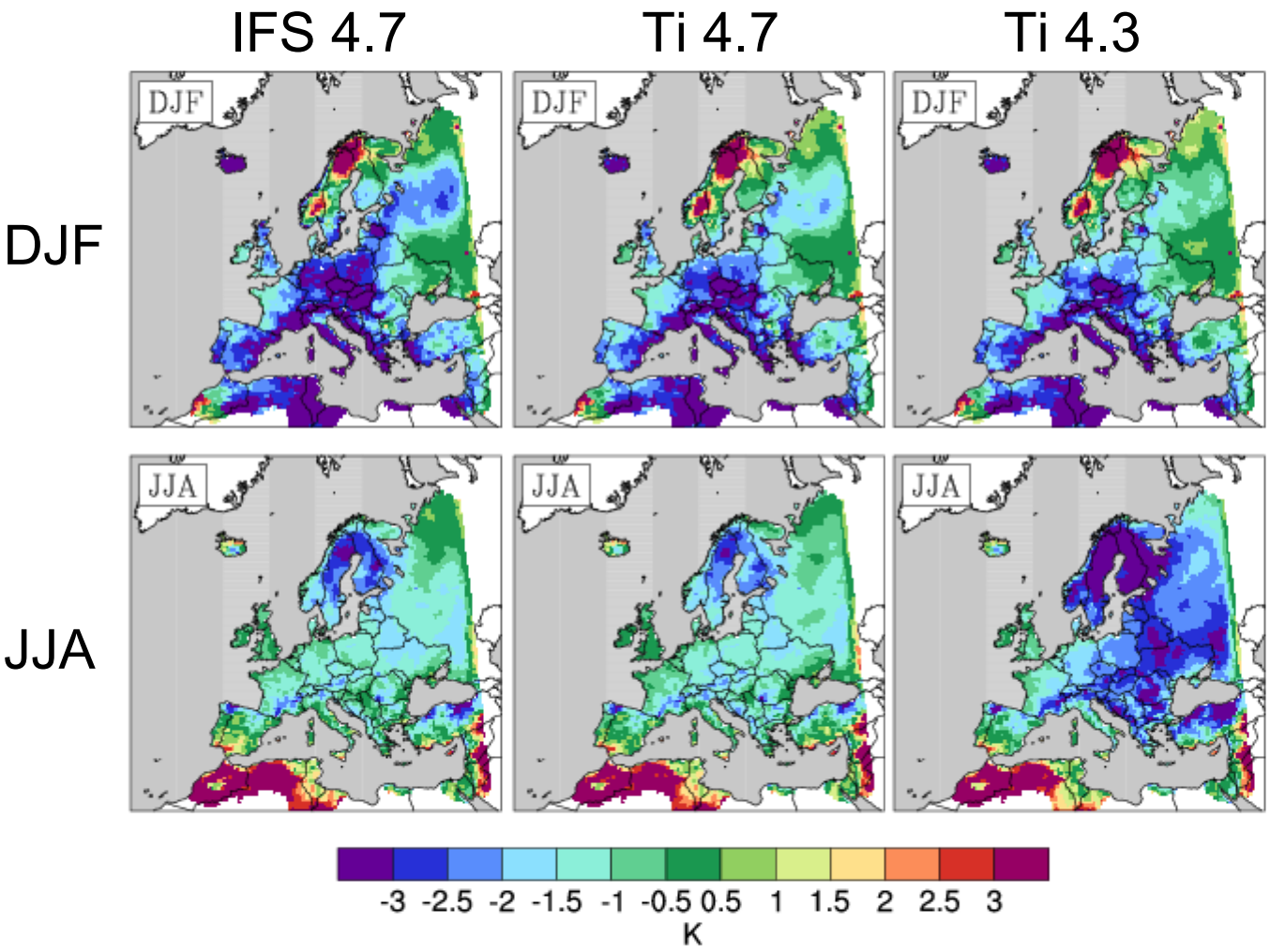
DJF

JJA



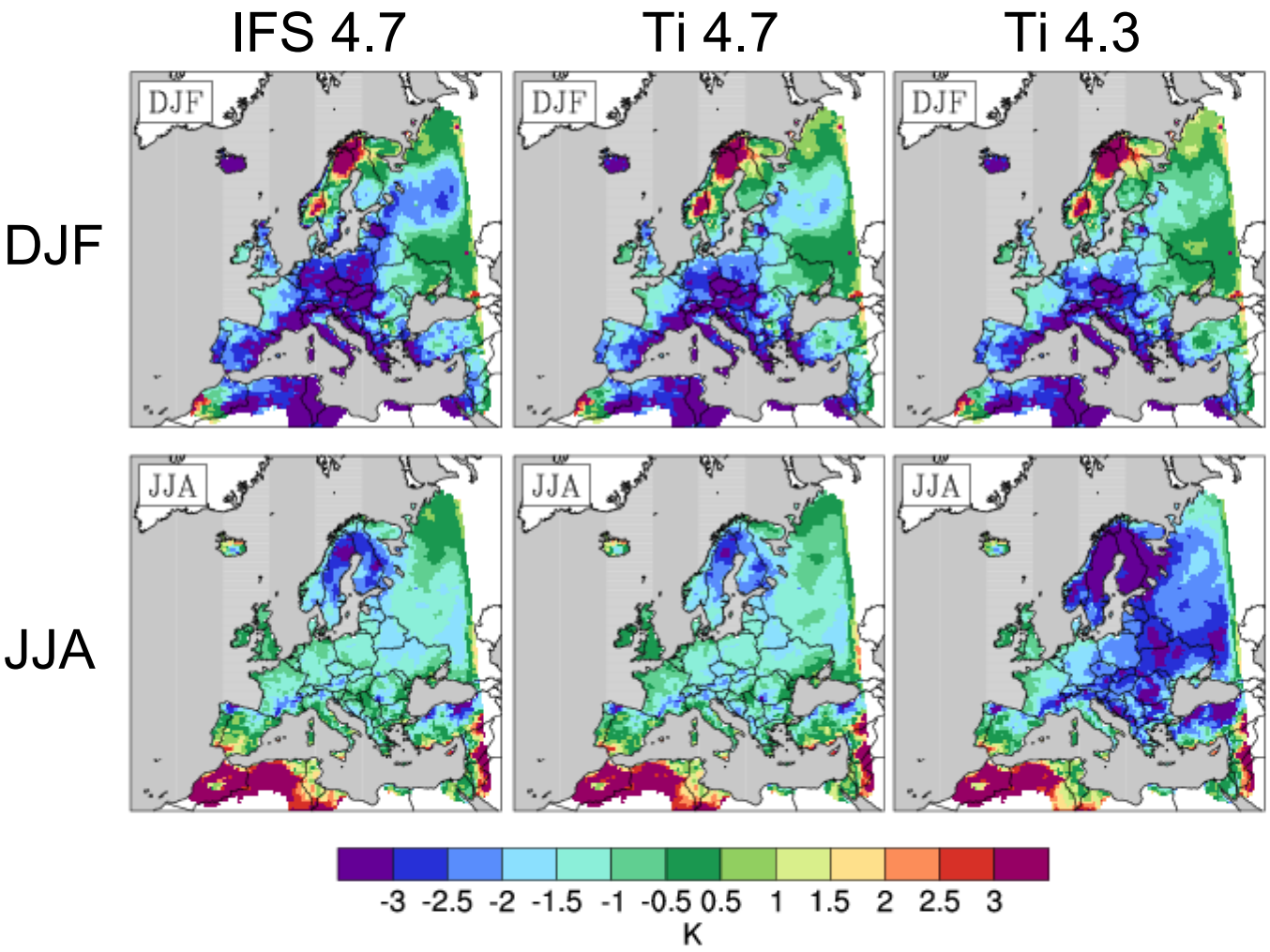


Mean Temperature Bias



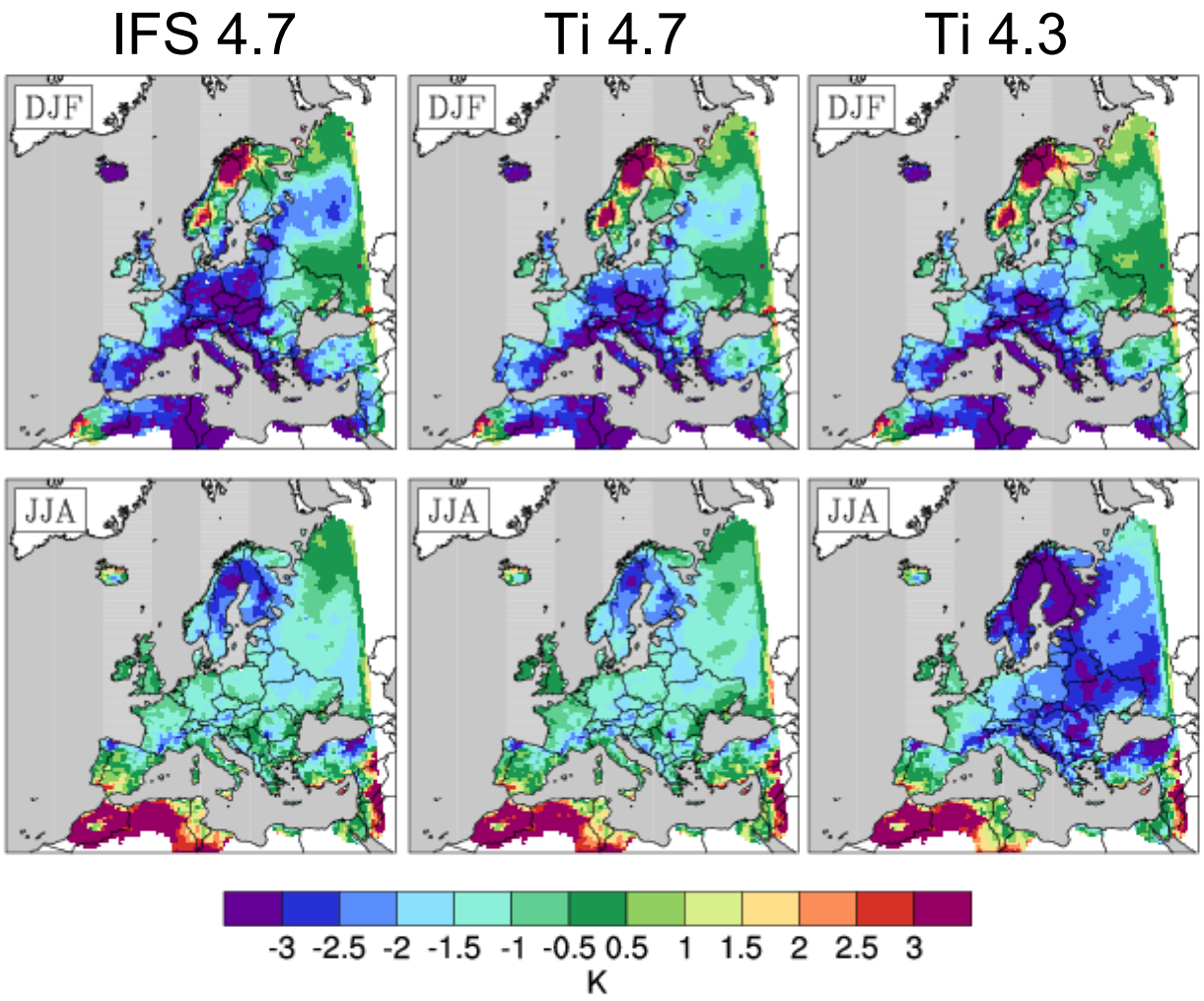
 Peter.Brockhaus@env.ethz.ch

Mean Temperature Bias



Cold bias remains, mainly in winter

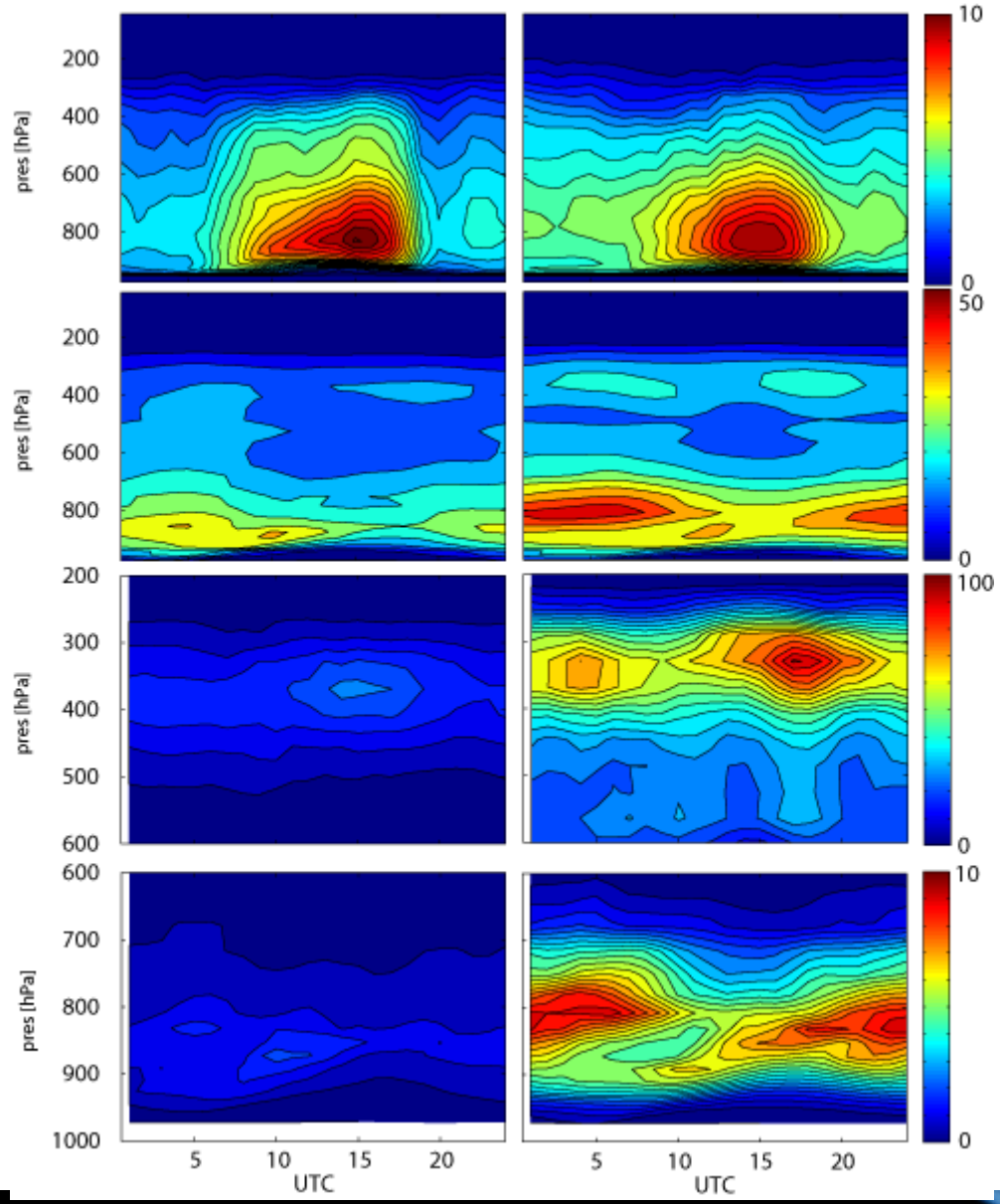
Mean Temperature Bias



Cold bias remains, mainly in winter

Why difference in summer v4.7 vs. v4.3 ?

JJA 1980 **4.7** **4.3**



Side remark: v4.7 versus v4.3 (Tiedtke)

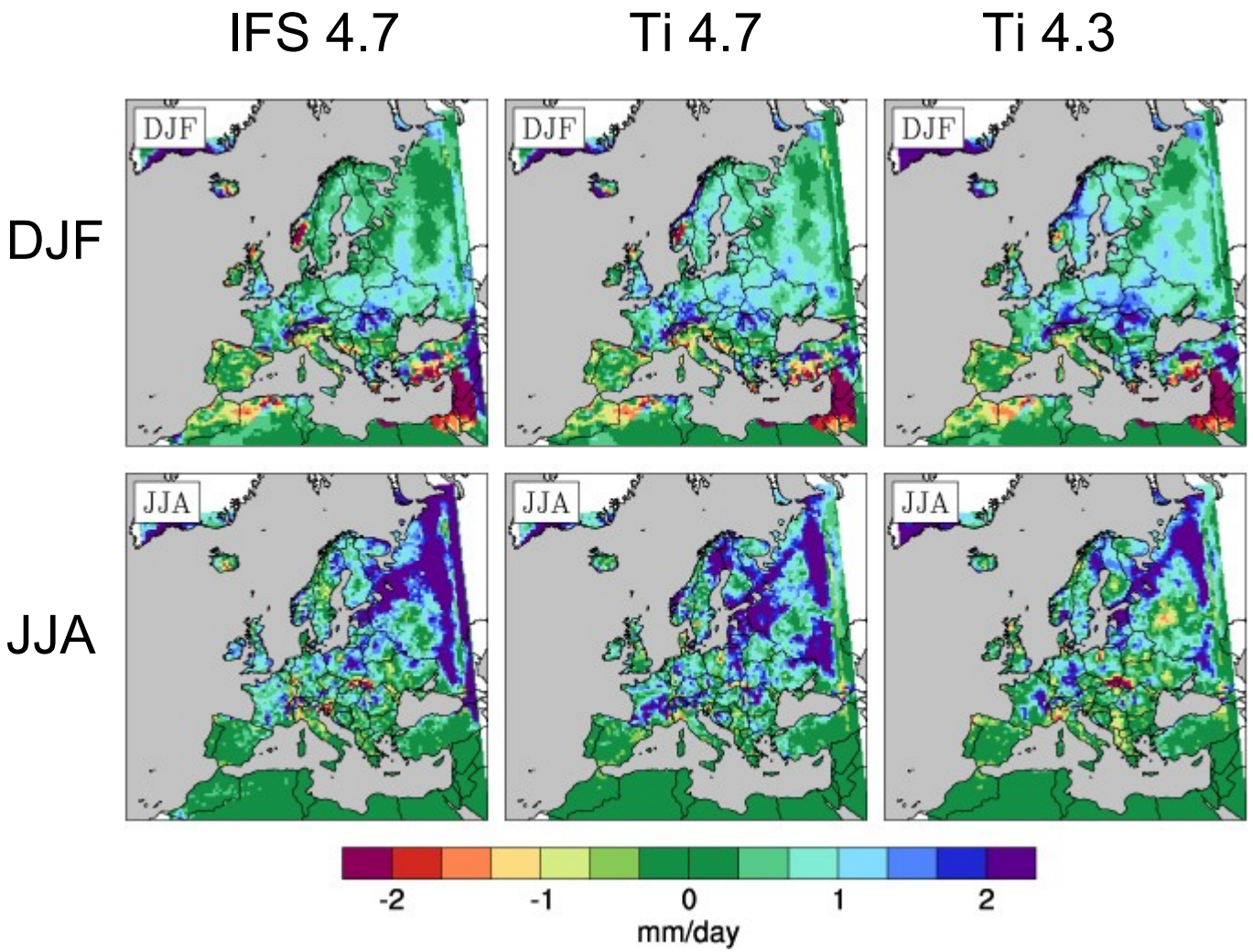
conv. cloud cover (%)

non-conv. cloud cover (%)

Cloud ice (mg/kg)

Cloud water (mg/kg)

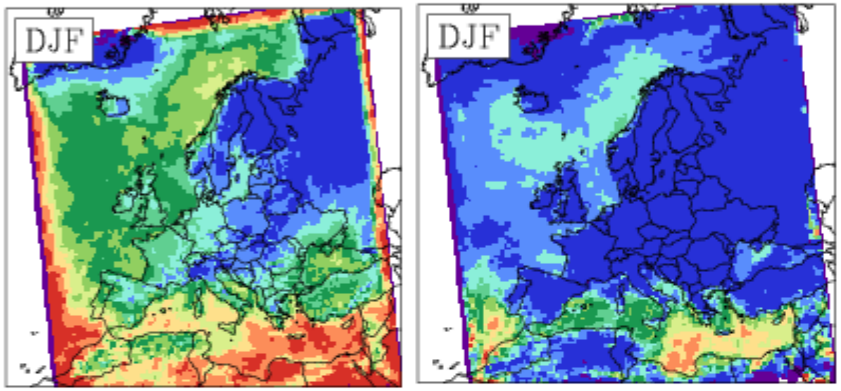
Mean Precipitation Bias



Convective Ratio

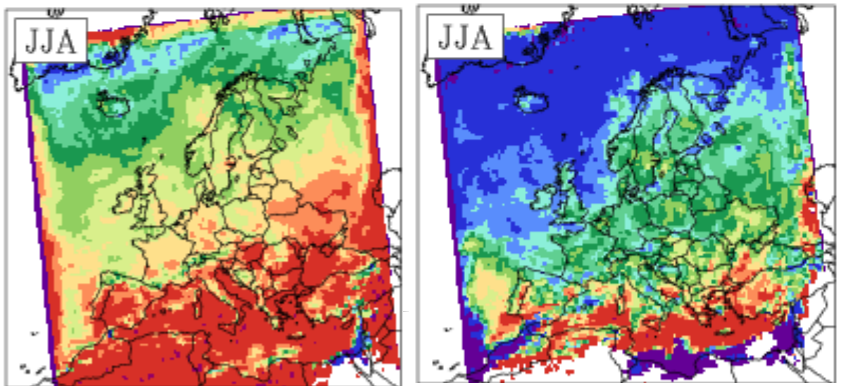
IFS 4.7 Ti 4.7 @Langen:

DJF

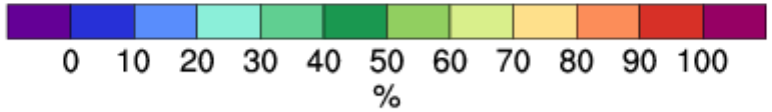


30% vs. 2%

JJA



80% vs. 40%

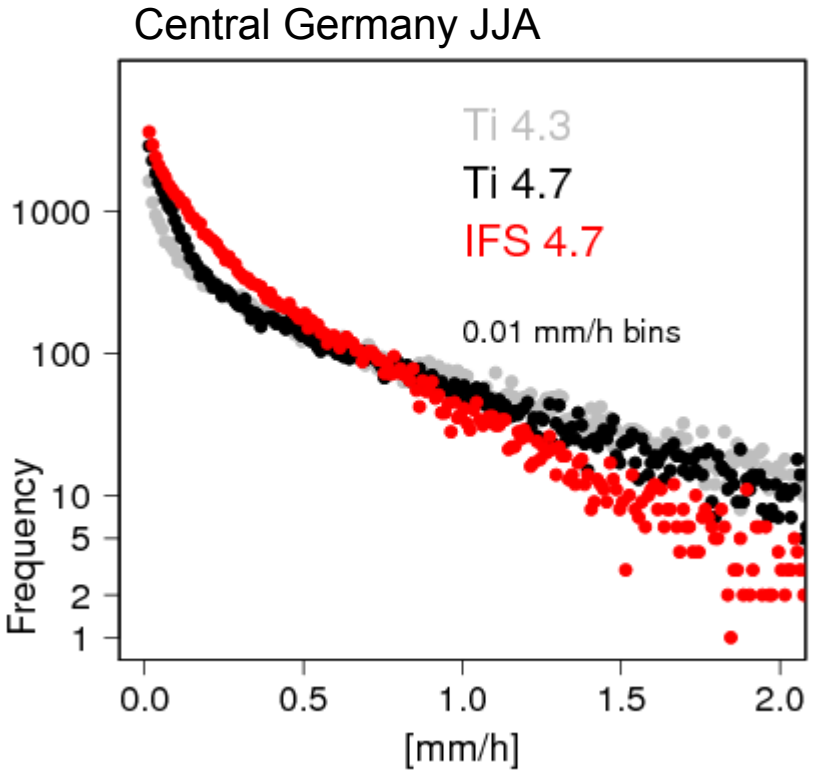


„which one is correct?“

multiple parcels vs. surface parcel

may play a role here

Hourly Intensity-Frequency Distribution



 Peter.Brockhaus@env.ethz.ch

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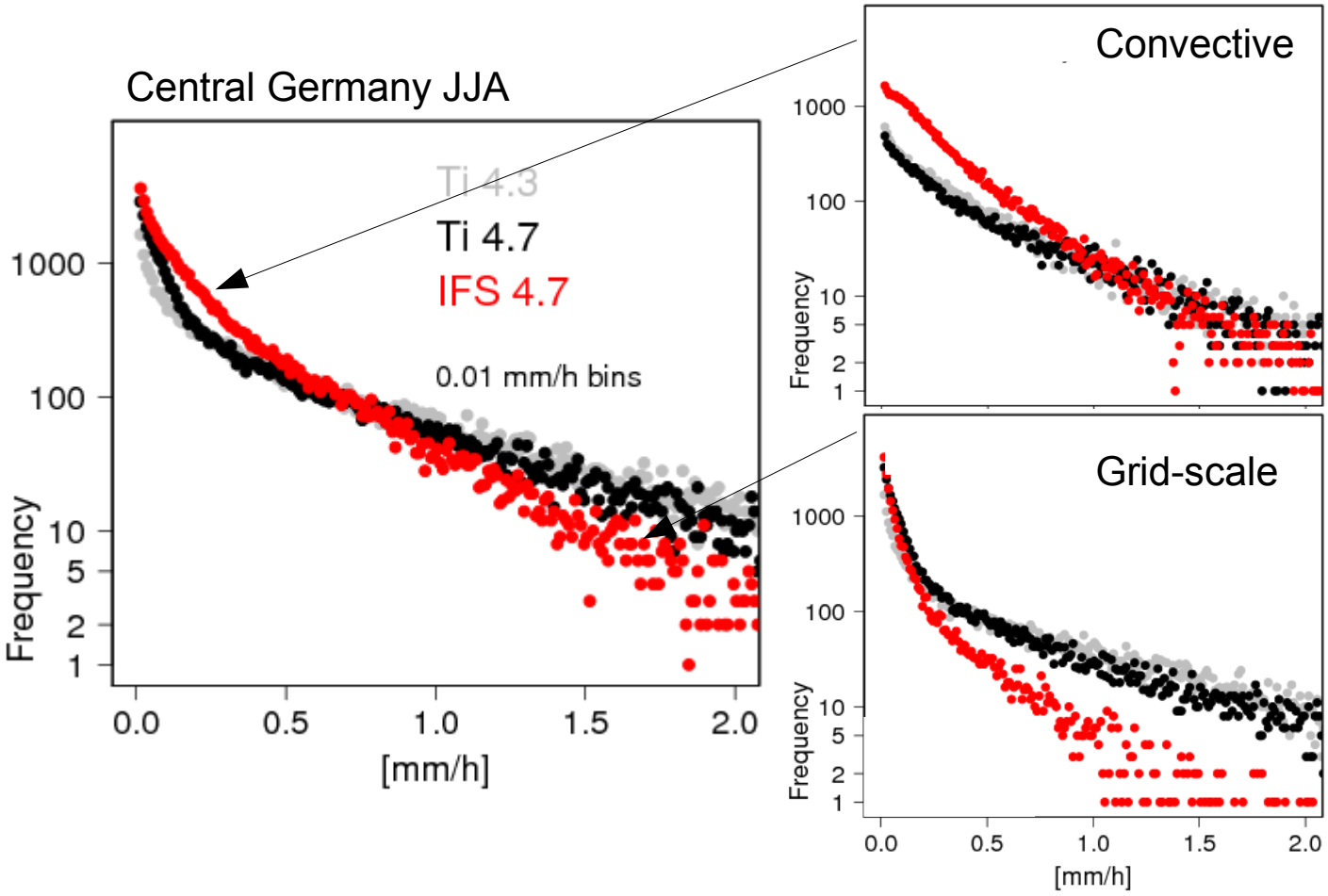


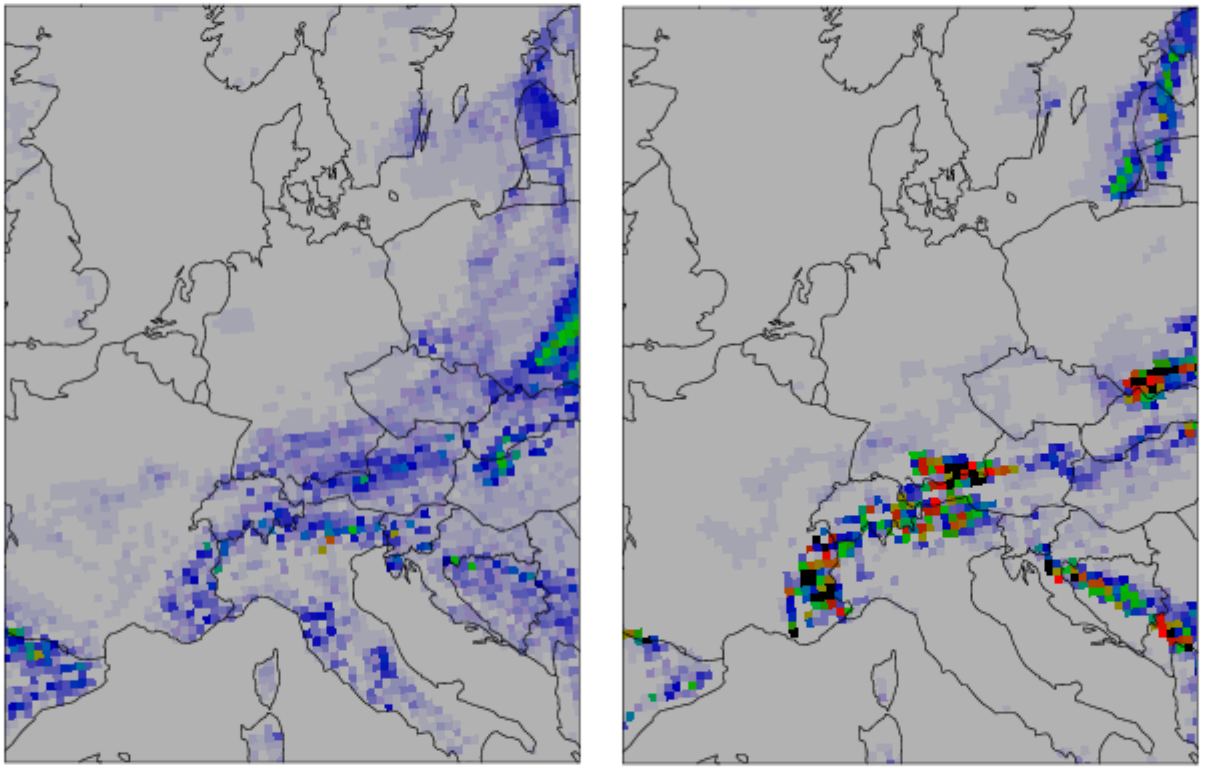
Convective drizzle
is enhanced
(some may not like this...)

Grid-scale precipitation at
mid- & high intensities
is reduced in turn

Snapshot on a strongly convective day

IFS 4.7

Ti 4.7

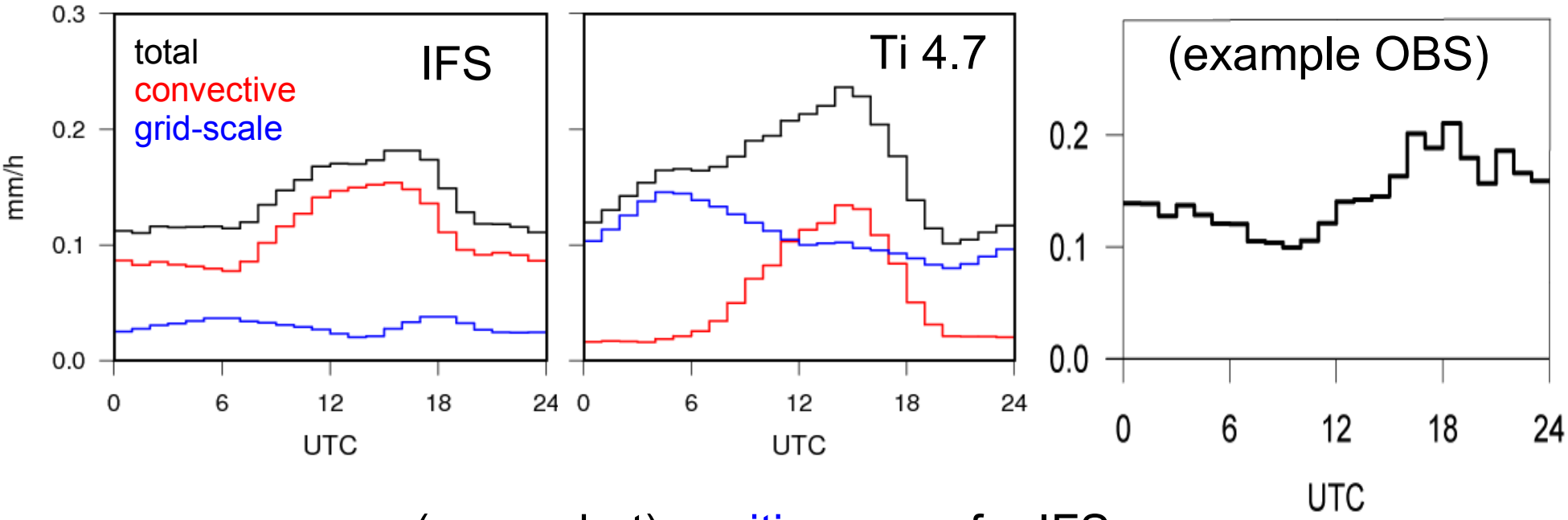


14 July 2006
13-14 UTC

 Peter.Brockhaus@env.ethz.ch

Diurnal Cycle of Precipitation

Central Germany JJA 1980



(somewhat) positive news for IFS:

- smaller amplitude
- smoother decay
- slightly later peak (?)

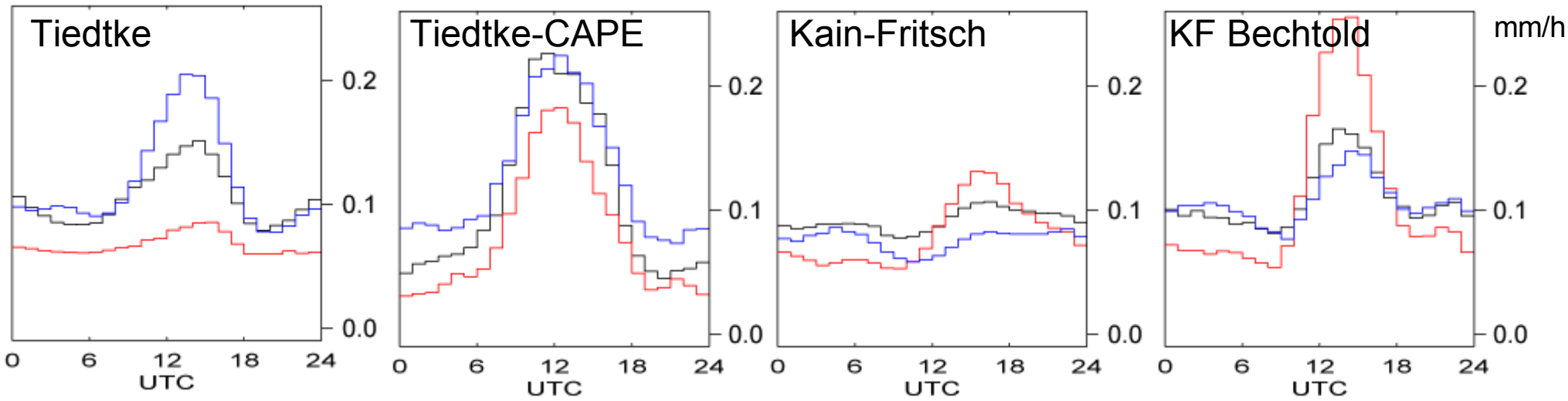
Summary

- Implementation routine for the ECMWF IFS convection scheme, which calls a convection library
- One-year simulation (longer studies needed)
- Performance comparable to Tiedtke for mean temperature and precipitation
- Considerably higher convective contribution
- More convective drizzle, in turn less mid-high grid-scale precipitation

 Peter.Brockhaus@env.ethz.ch

Our immediate motivation: soil-moisture precipitation feedback

July 2006



Diurnal cycle of July precipitation,
with varied initial soil-moisture (+-30%)

Soil-moisture precipitation feedback varies even in sign!!

Hohenegger *et. al.*, JC, revised

Our immediate motivation: soil-moisture precipitation feedback

Impact for:

- Seasonal and annual forecasts:
  - Soil moisture memory
  - Heatwave & flash flood incidence
- Climate Simulations:
  - Potential impact on precipitation statistics, expecially extreme value statistics

We need various convection schemes in COSMO-CLM to span this uncertainty!