

# Vertical interpolation of 3-dim. fields in the 2-way coupled system CCLM-ECHAM6



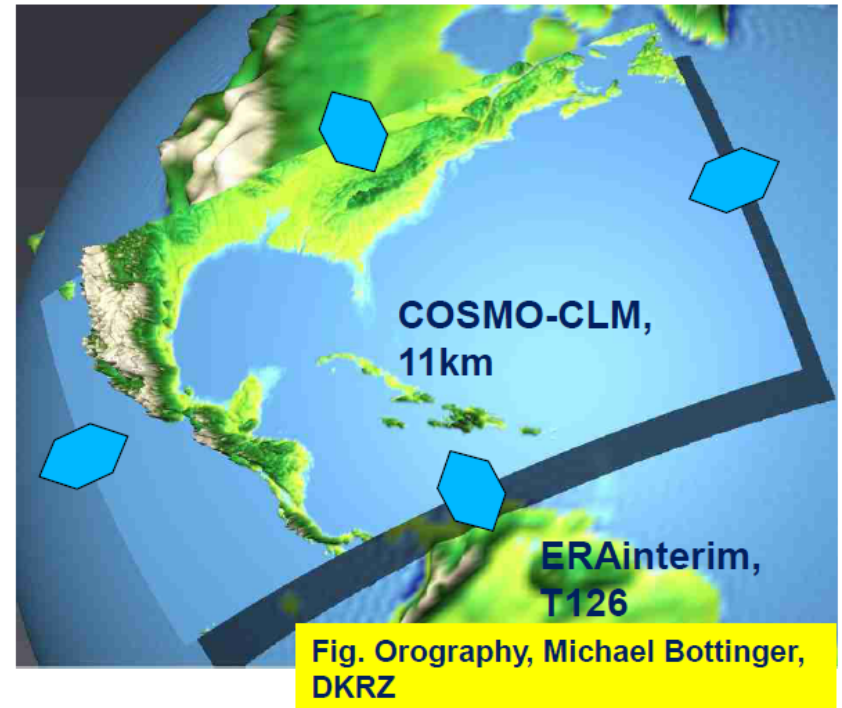
Brandenburg  
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COSMO-CLM User Seminar, 05.–07.03.2013  
DWD, Offenbach (Main)

# Introduction

## Aims of the MesoTel project

- Develop a 2-way coupled model system between CCLM and ECHAM6/MPI-OM
- Apply the coupled model system in a region of frequent Rossby Wave Train development
- Improve simulation of large-scale dynamics by feeding back information from the meso- $\beta$ -scale
- Contribute to an improvement of prediction of seasonal means over Europe on a decadal timescale

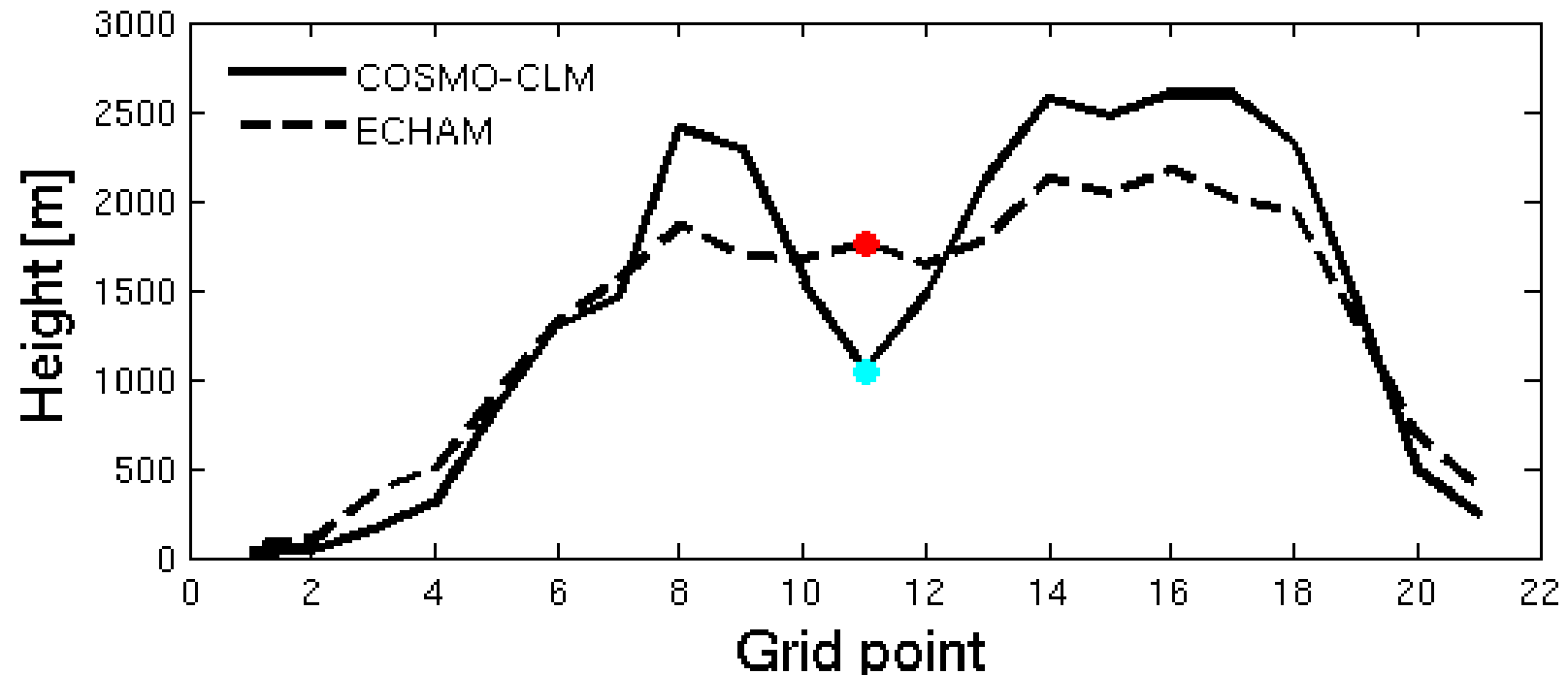


# Development of a vertical interpolation (VI) routine for cclm

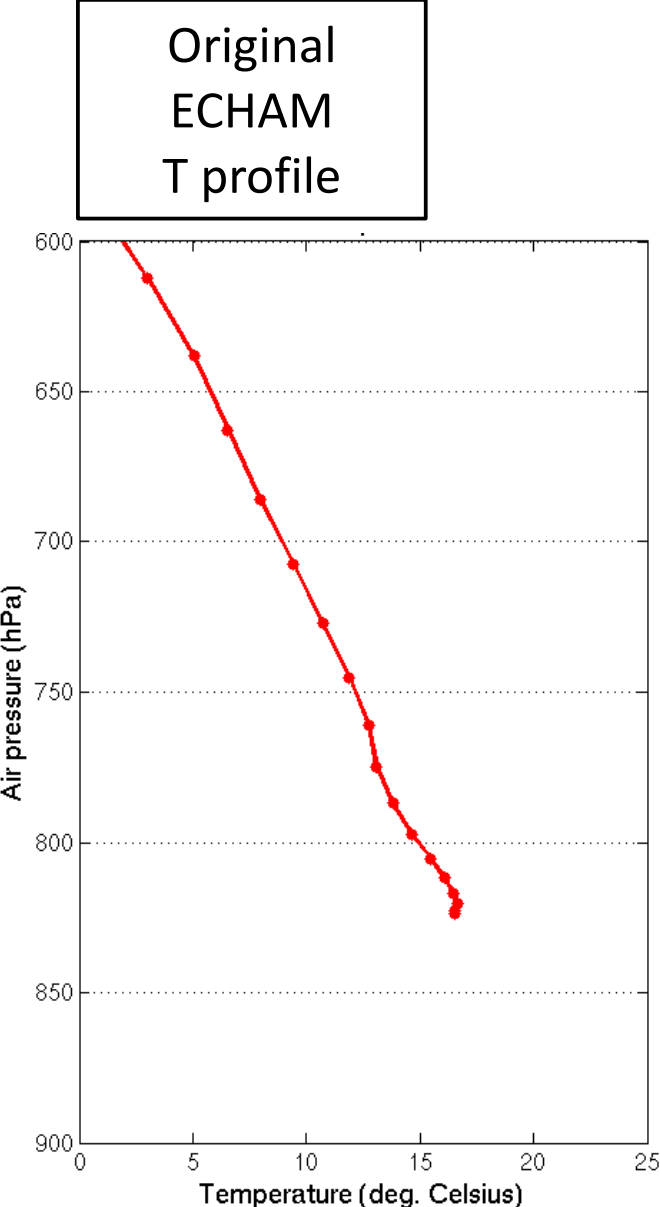
Demands of the coupling interface, i.e. communication, horizontal interpolation and **vertical interpolation**:

- Source code that is easy to maintain
- Efficient

Newly developed VI is based on interpolation routine in **int2lm**

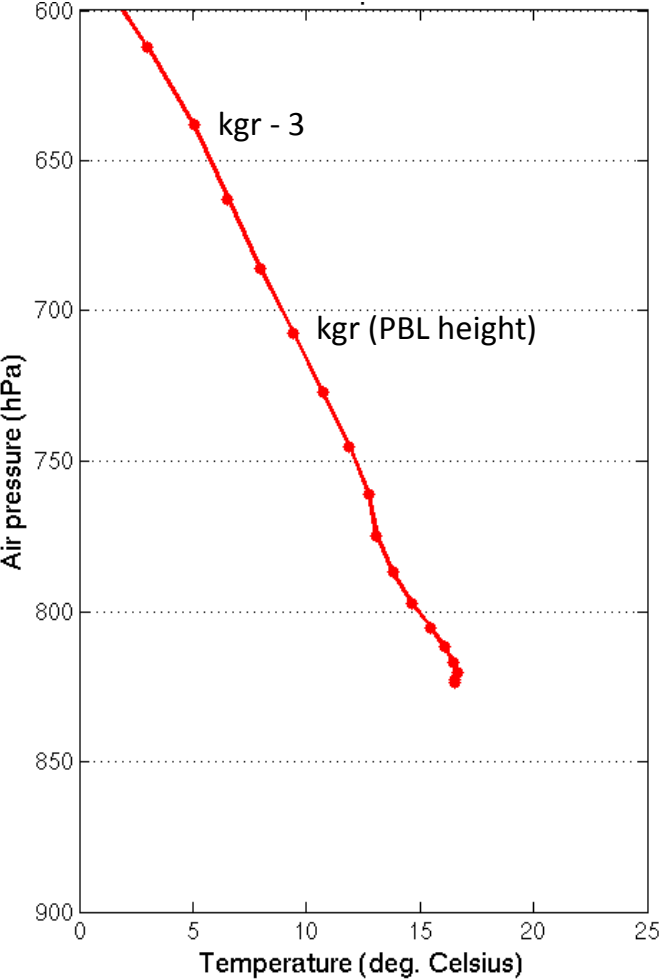


# How does the vertical interpolation routine in **int2lm** work?

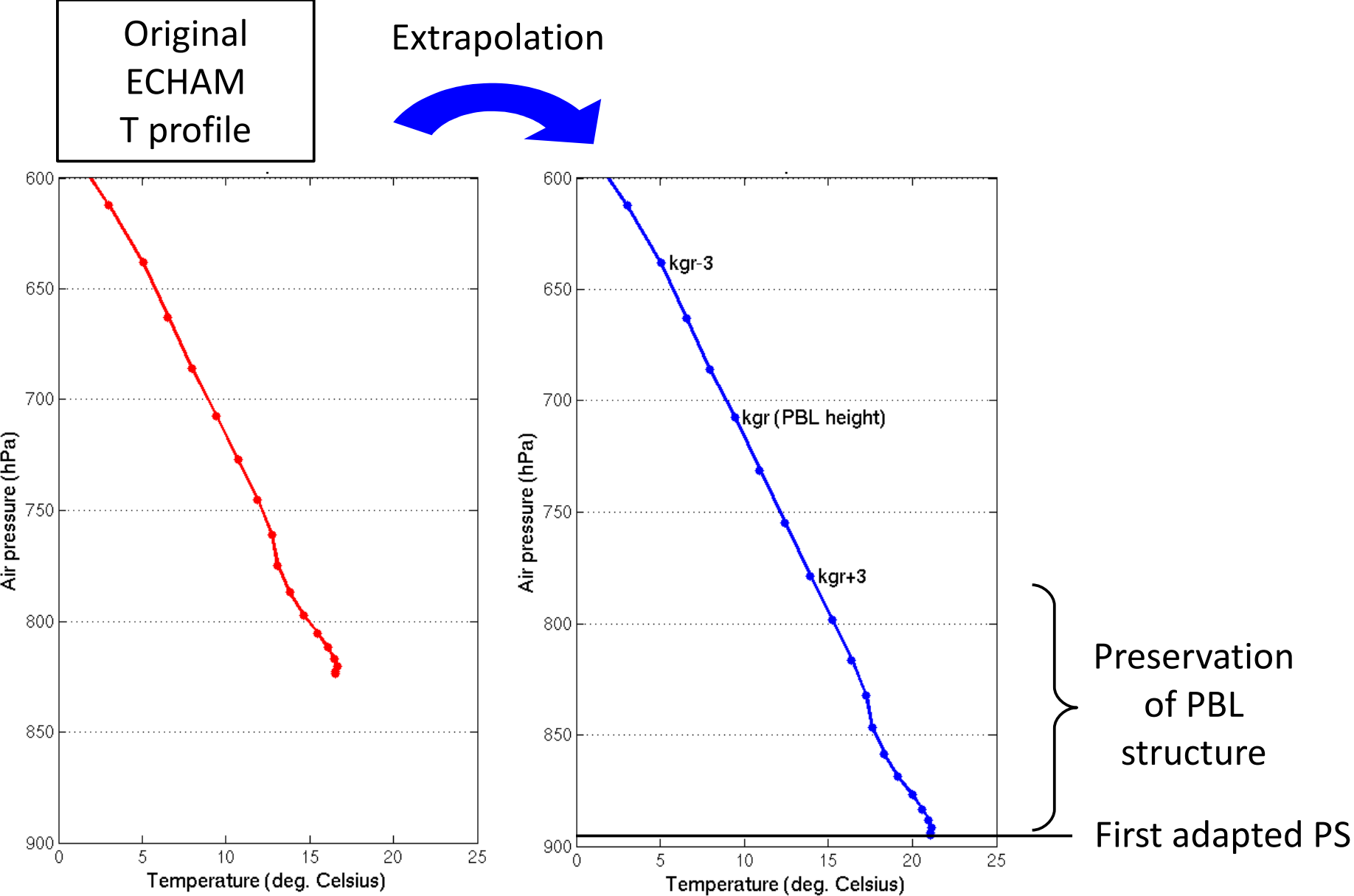


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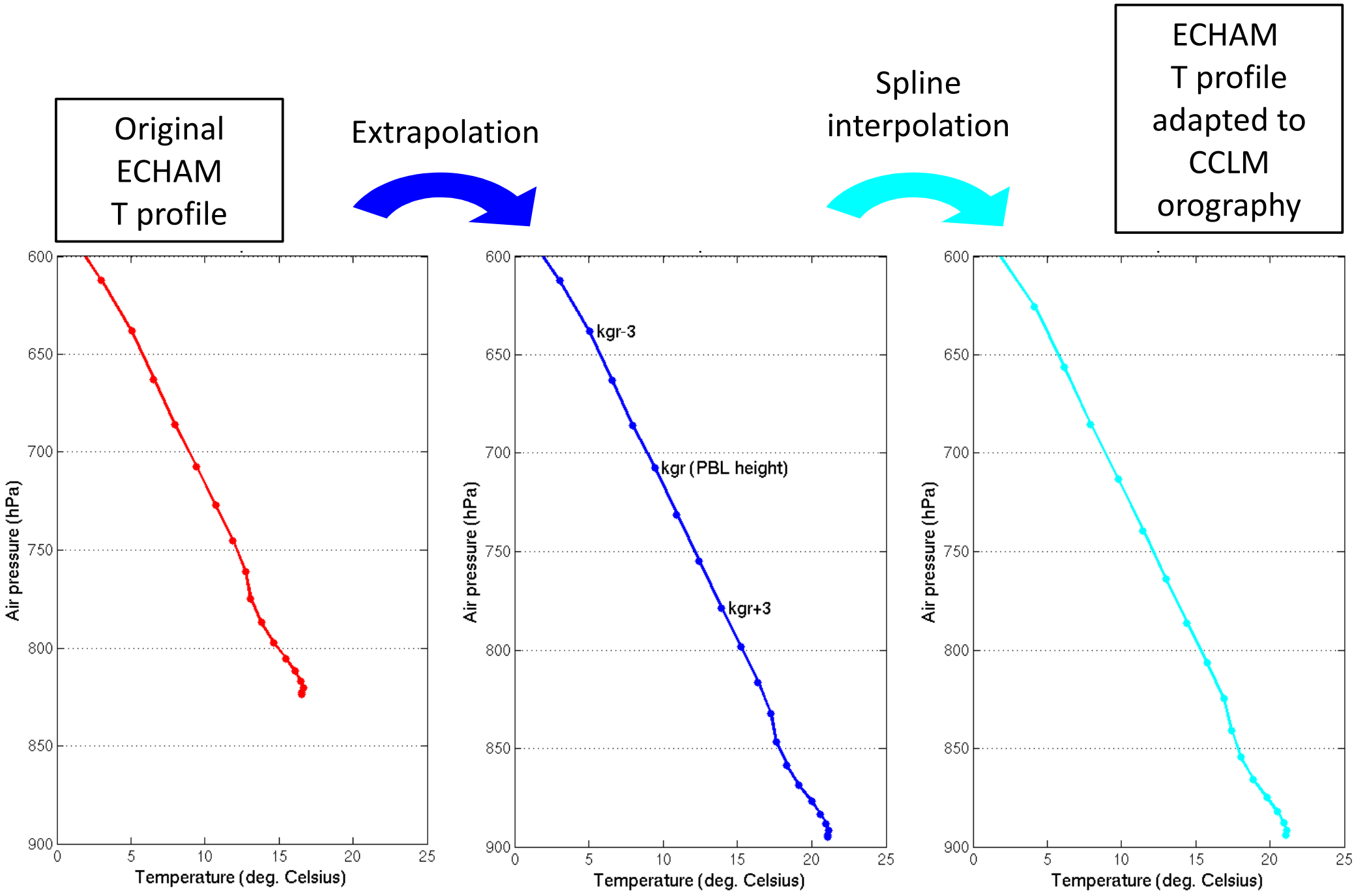
Original  
ECHAM  
T profile



# How does the vertical interpolation routine in `int2Im` work?



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# Standard vs. compacted VI

- 1) Compute generalized relative humidity ( $GRH=QV+QC$ )
- 2) First hydrostatic adaption of PS
- 3) Spline interpolation to adjust the height of levels for T, GRH, QI
- 4) Second adaption of PS according to new temperature/humidity profiles
- 5) Spline interpolation to adjust the height of levels for U and V

Pressure-based  
coordinate system



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- 6) Compute  $T_S$  and  $QV_S$
- 7) Compute geopotential of ECHAM main levels
- 8) Final spline interpolation to CCLM levels for T, GRH, U, V, QI

Pressure-based  
coordinate system

Height-based  
(geopotential)  
coordinate system

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- 10) Split GRH into QV and QC

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- 2) Hydrostatic adaption of PS
- 3) Interpolation / extrapolation of T, QV and QC profiles according to orography differences
- Not done at all**
- Has to be implemented yet**
- 4) Compute geopotential of ECHAM main levels
- 5) Spline interpolation to CCLM levels for T, GRH, U, V, (QI)
- 6) Calculate pressure deviation PP
- 7) Split GRH into QV and QC

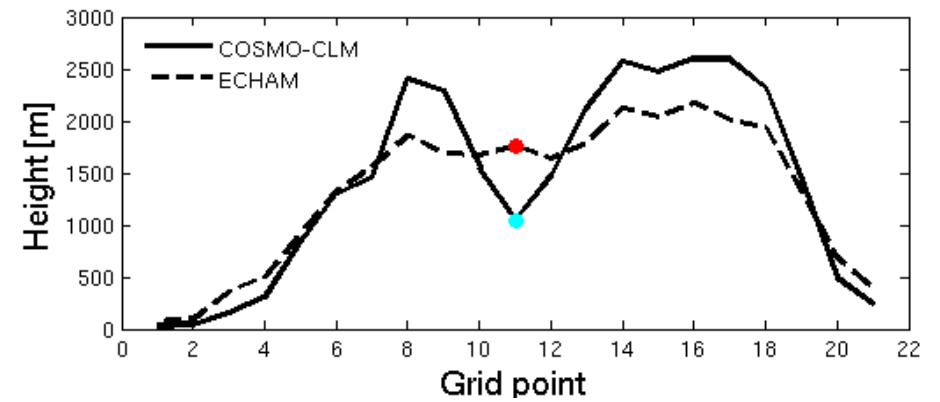
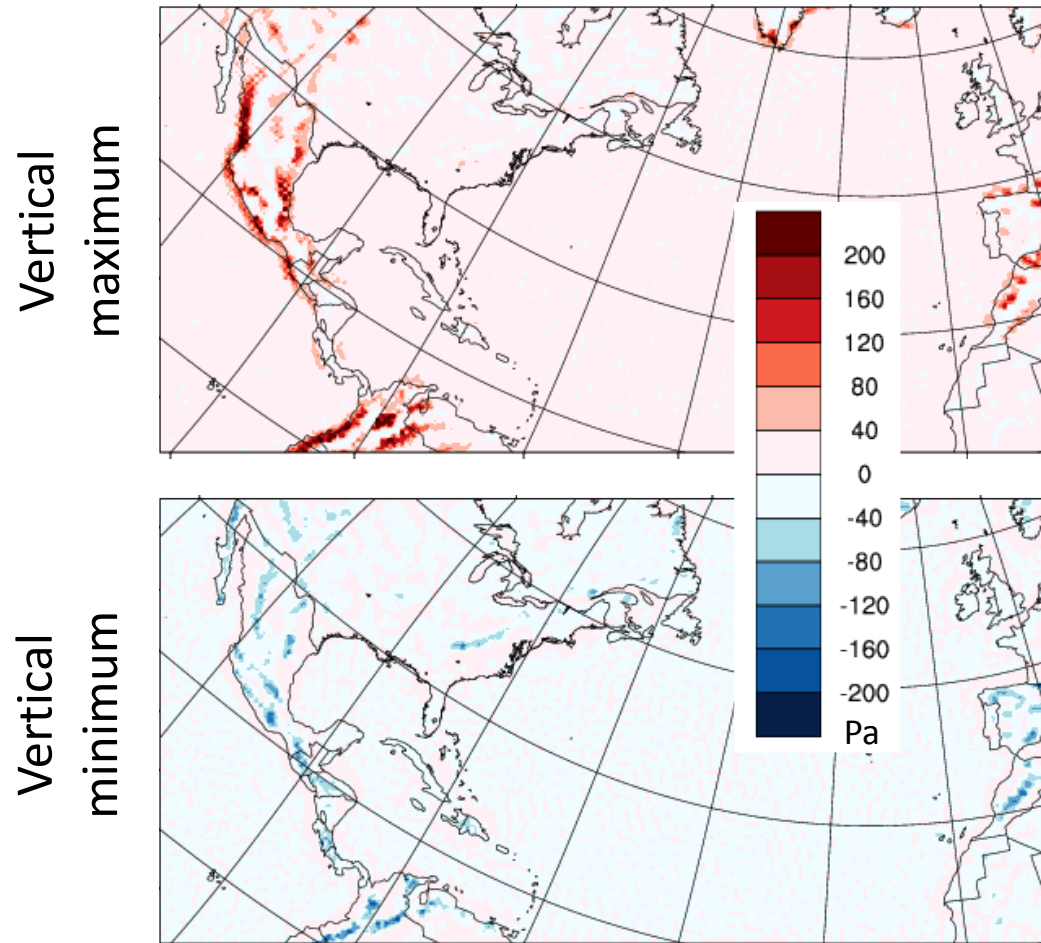
# Comparison

## **Assess differences of two methods by**

- Creating boundary data (every 6 hours) with int2lm for one month, e. g. January, and according to both methods
- Averaging all boundary data files and calculating the differences of 3-dim. fields for vertical and meridional statistics

# Vertical max./min. PP differences

Difference: PP (new VI) – PP (standard VI)



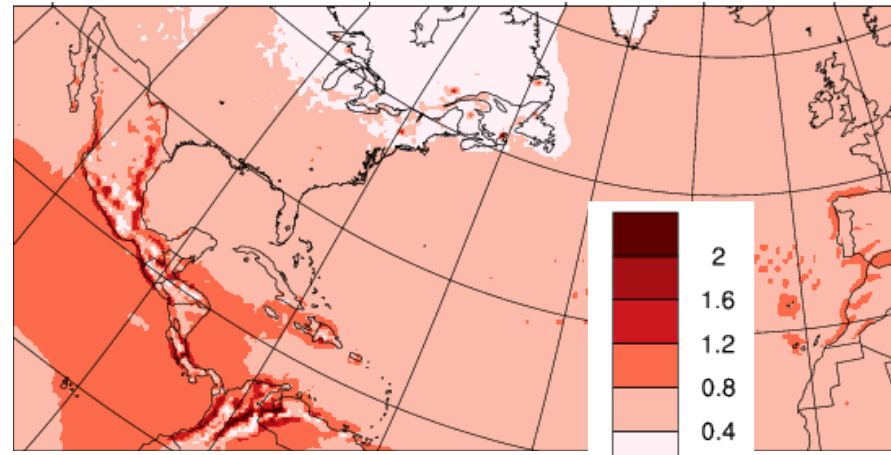
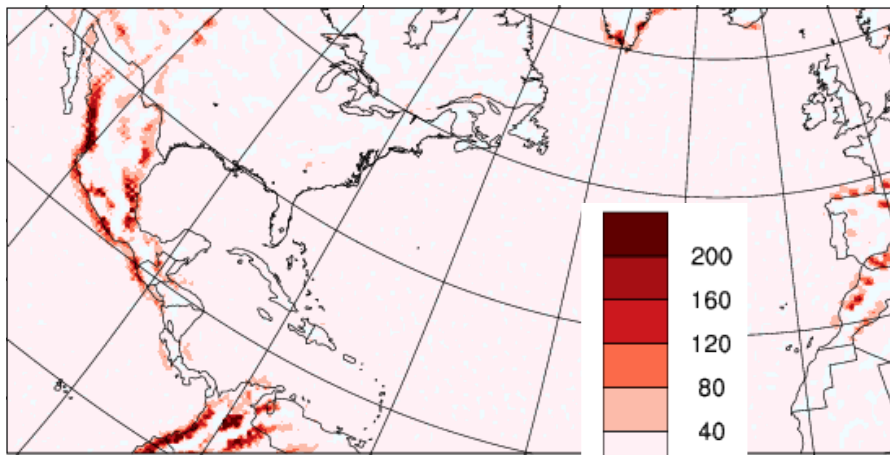
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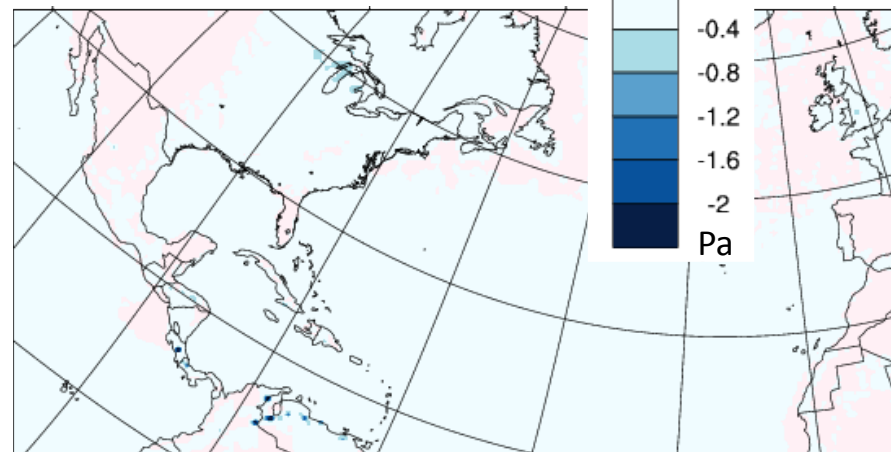
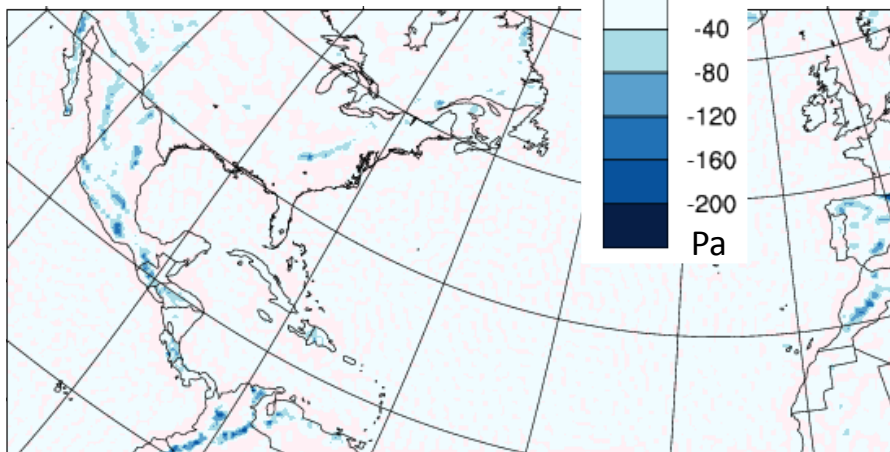
With *adapt\_pressure2*

Without *adapt\_pressure2*

Vertical  
maximum



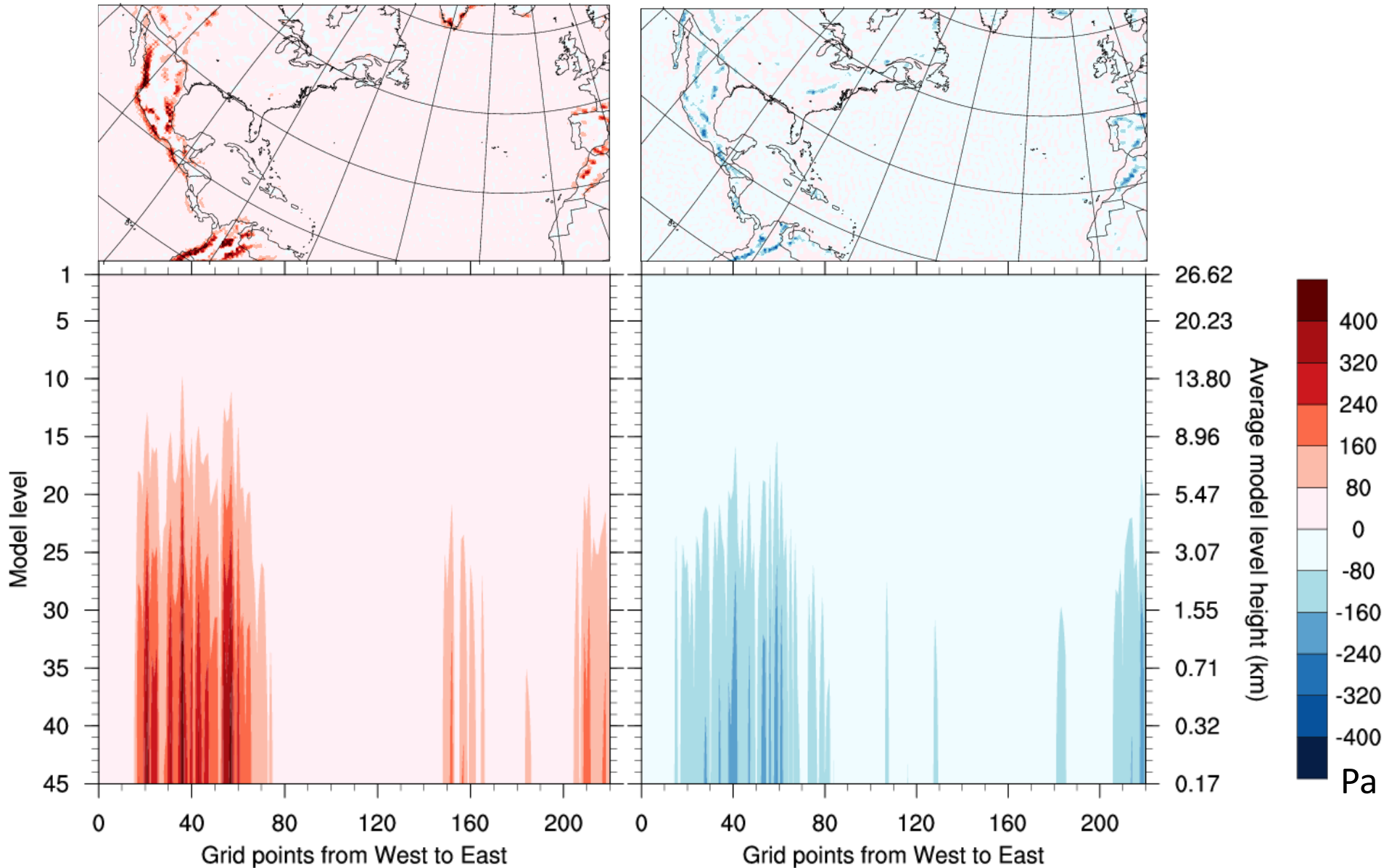
Vertical  
minimum



# Meridional max./min. PP differences

Difference: PP (new VI) – PP (standard VI)

With *adapt\_pressure2*





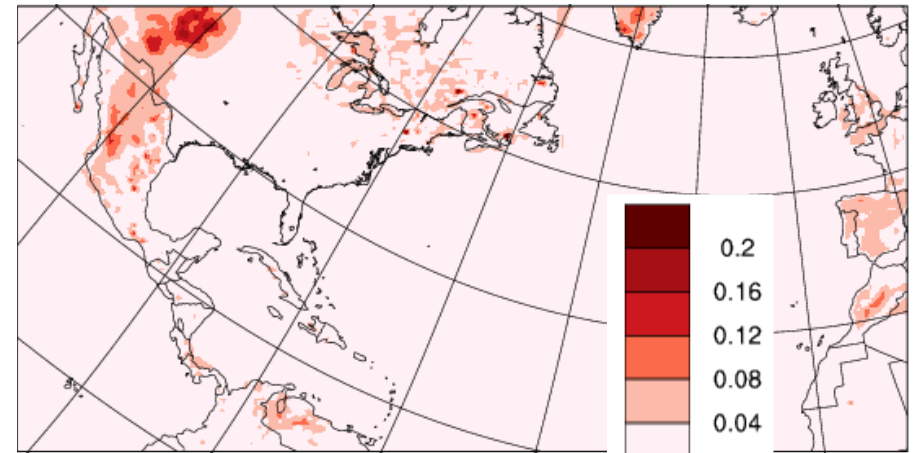
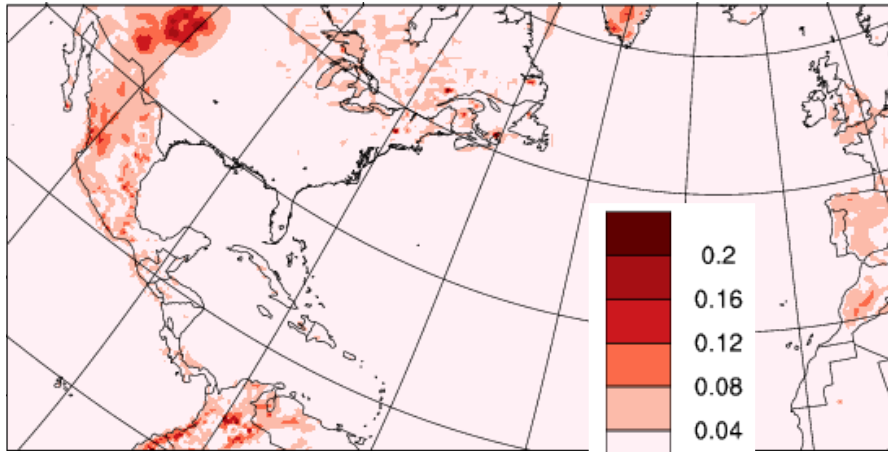
# Vertical max./min. temperature differences

Difference:  $T(\text{new VI}) - T(\text{standard VI})$

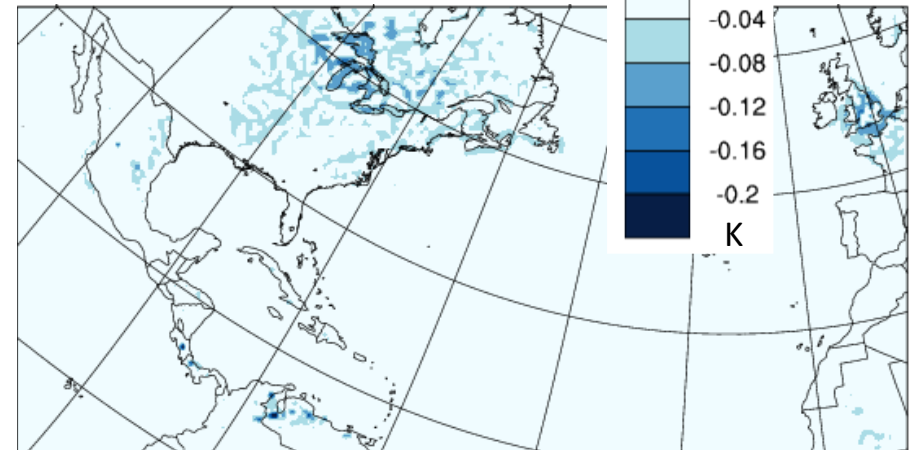
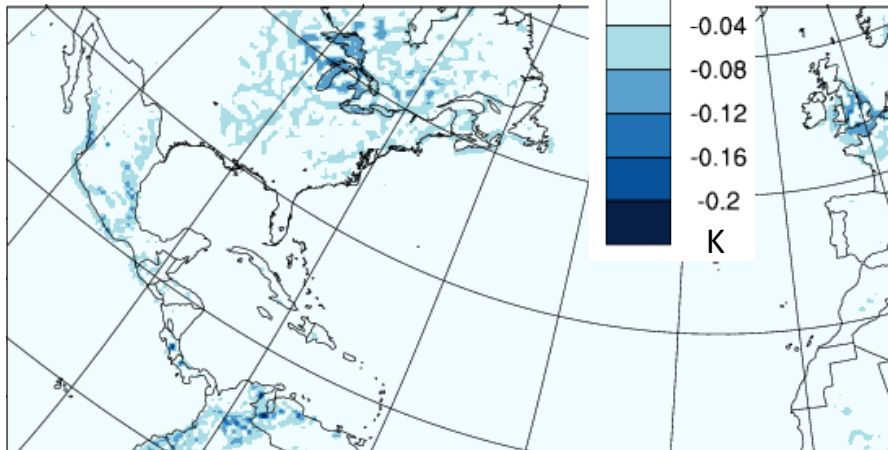
With *adapt\_pressure2*

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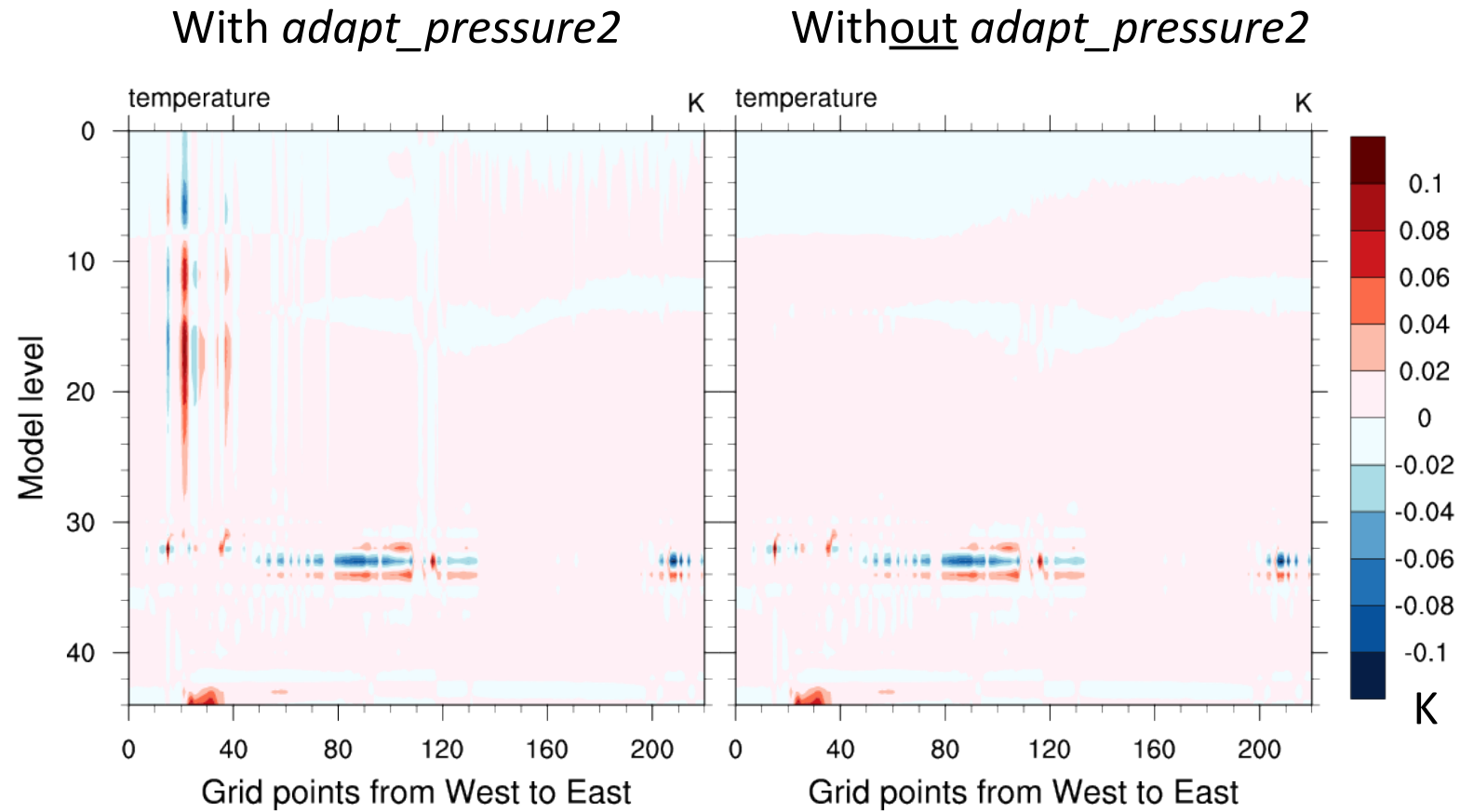
Vertical  
maximum



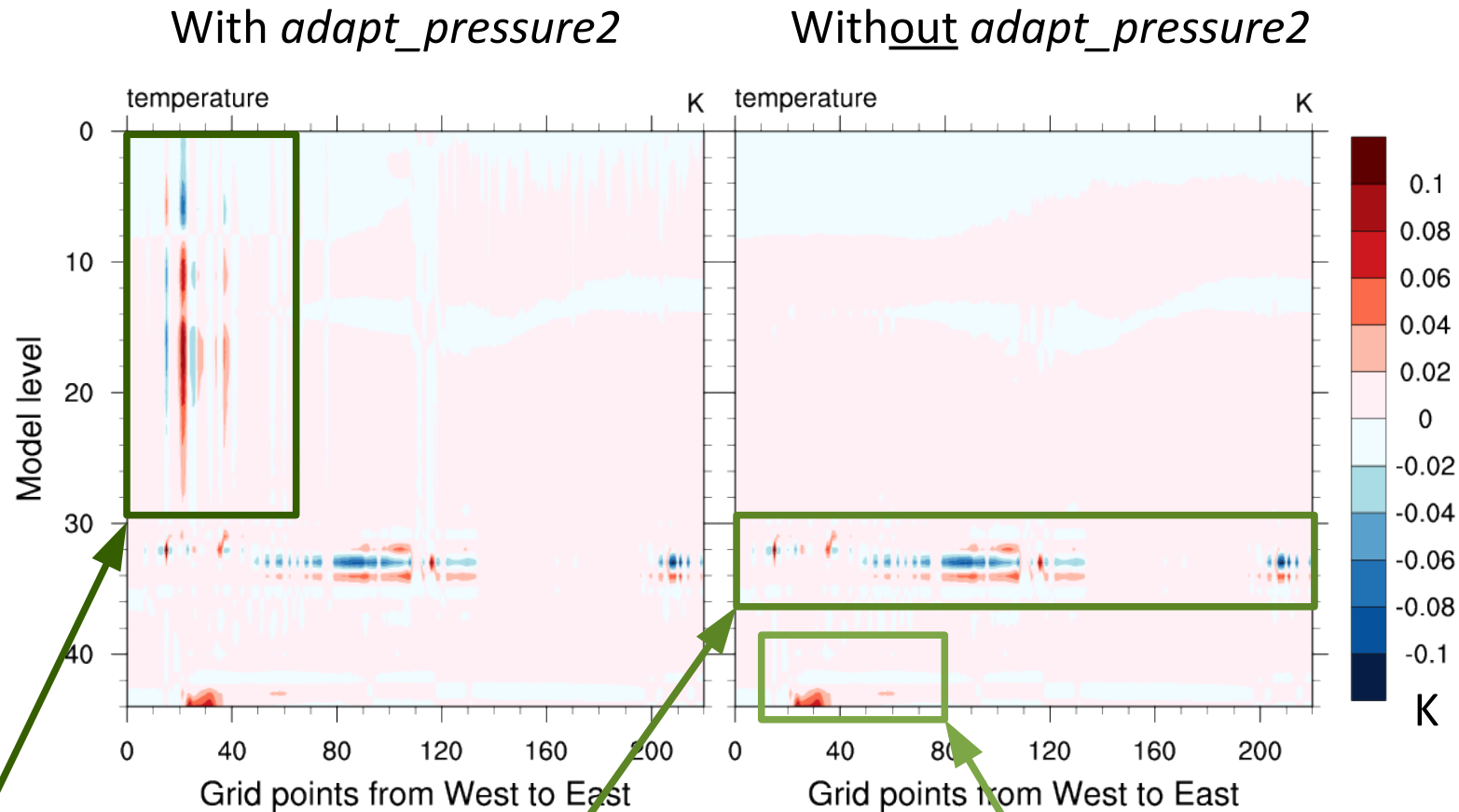
Vertical  
minimum



# Cross section of temperature differences



# Cross section of temperature differences



## Cause

Too high/low PS/PP  
in areas of high orogr.  
differences; no 2nd  
adaption of PS

## Cause

Different layering in  
PBL height

## Cause

No intermediate  
calculation of T<sub>S</sub>

# Conclusions

## **So, which algorithm is better?**

- Differences seem to be of acceptable magnitude
- Effects of the new VI must/could be tested in
  - Climate runs
  - NWP mode

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## **Current status of model development**

- The communication and horizontal interpolation of fields technically works in a 2-way coupled mode
- 1-way nesting is almost ready (some bugs need to be found and fixed yet)
- 2-way nesting: to be done during spring & summer 2013

## **Performance**

- No significant overhead created by communication and hor. interpolation