ALADIN-CLIMATE: HUNGARIAN ACTIVITIES

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Contents

- Introduction, background
- ALADIN-Climate model: some basic characteristics
- Experiments
- Plans, conclusions

Introduction

- Limited area models are efficient tools for downscaling the results of general circulation climate models (Giorgi et al., early 90s)

- Based on some experience on NWP it was decided in Budapest to adapt and test regional climate models
  - REMO
  - ALADIN/Climate

Background: projects (1)

- National Research and Development Project (2005-2007)
  - Adaptation and application of regional climate models
  - Investigation of the dynamical relationships between the warming of the climate and the atmospheric circulations (regional and local scale)

- Czech-Hungarian bilateral project on regional climate modelling based on the ALADIN/Climate model (2005-2006)

Background: projects (2)

- Bilateral cooperation with Max Planck Institute (Hamburg)
- EU projects on regional climate modelling (and impacts of climate change) start soon

ALADIN-Climate

- Basic model: ARPEGE-Climat general circulation atmospheric model (CY15), derived from ARPEGE forecast global model with modification of the physical parameterization package

- ARPEGE-Climat physics + ALADIN dynamics ⇒ ALADIN-Climate

- Adaptation in Hungary (in 2005)

Experimentation in Budapest: objectives

- **Main objective: to find the best version of ALADIN for climate use**
  - **ALADIN-Climate, V4.2**
  - **ALADIN-Climate, V4.5**
  - **ALADIN cy28**

ALADIN-Climate: Basic characteristics (physics, v4.2)

- Radiation: Fouquart-Morcrette scheme, detailed aerosol description (Tegen aerosols)
- Large scale cloudiness and precipitation: Ricard and Royer statistical scheme for cloudiness, Smith scheme for precipitation
- Deep convection: Bougeault scheme
- Soil: ISBA
  - 4-layer for temperature
  - 2-layer for moisture
  - more precise snow-scheme

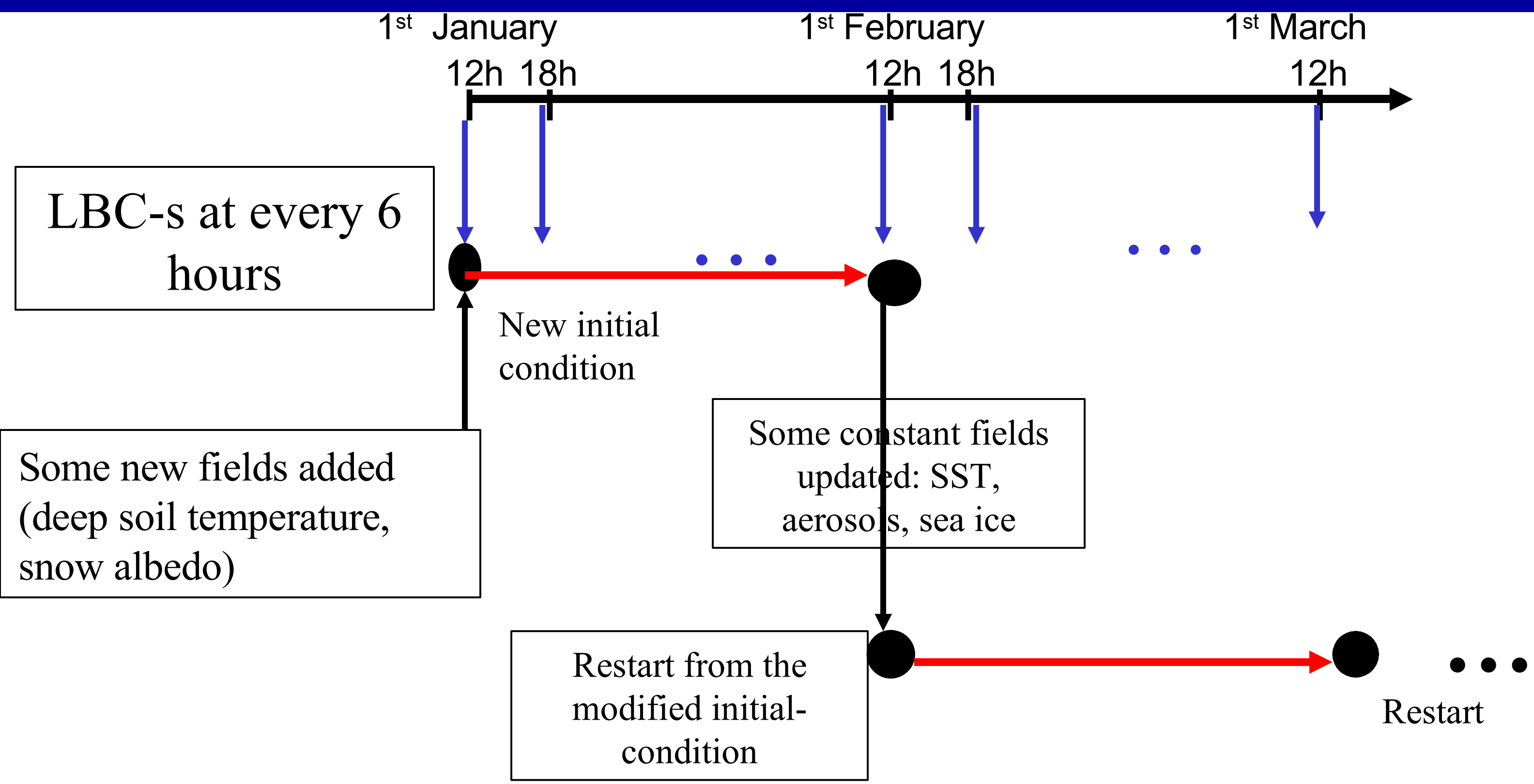
ALADIN-Climate: Basic characteristics (physics, v4.5)

- **Modifications in Version 4.5:**
  - GWD
  - Re-activate the Louis physics in stable case
  - SST changing between the months

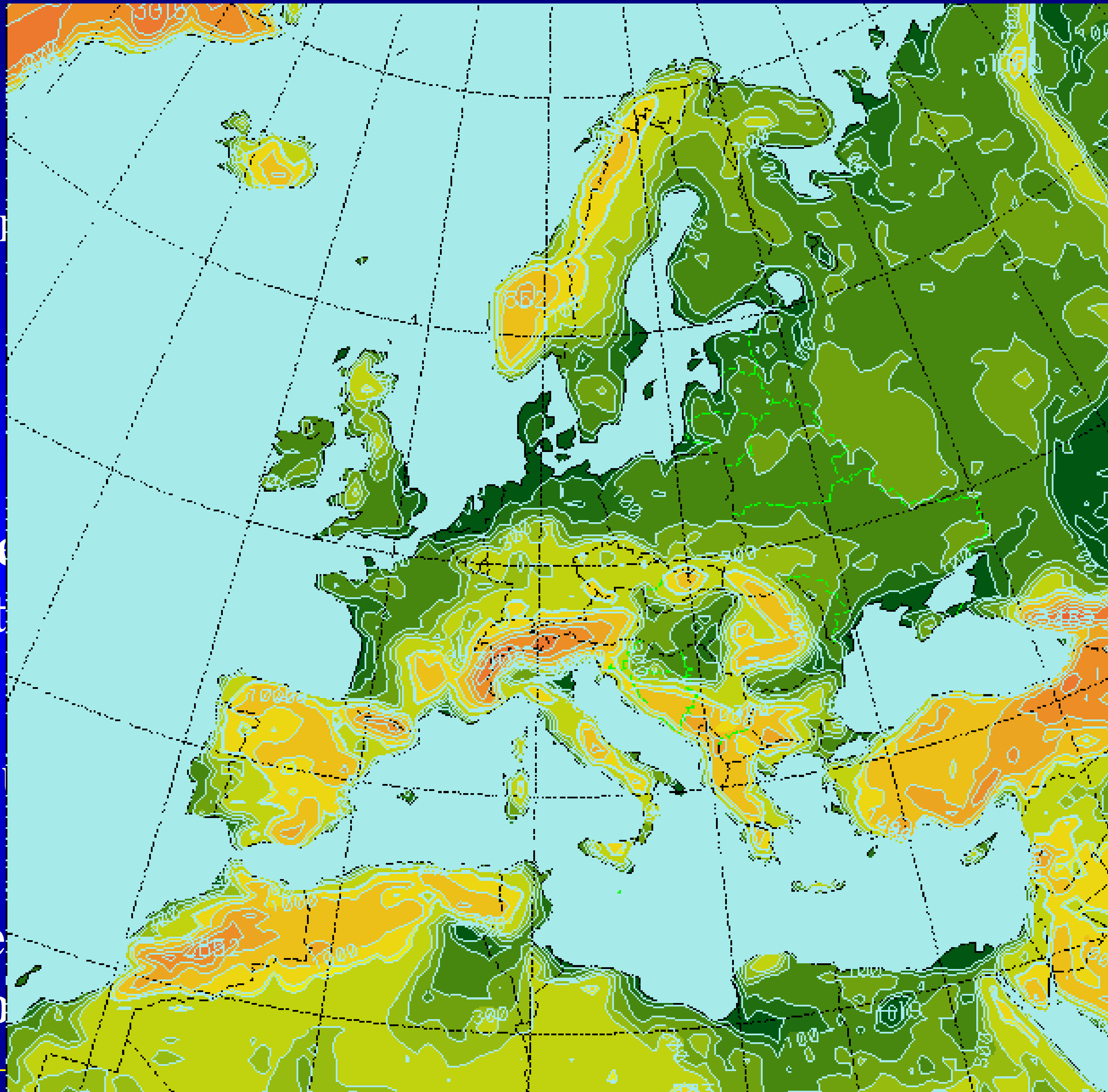
ALADIN-Climate: Basic characteristics (LBC)

- **For the past: *ERA40***
- **For the future: *ARPEGE-Climat***

ALADIN-Climate: integration



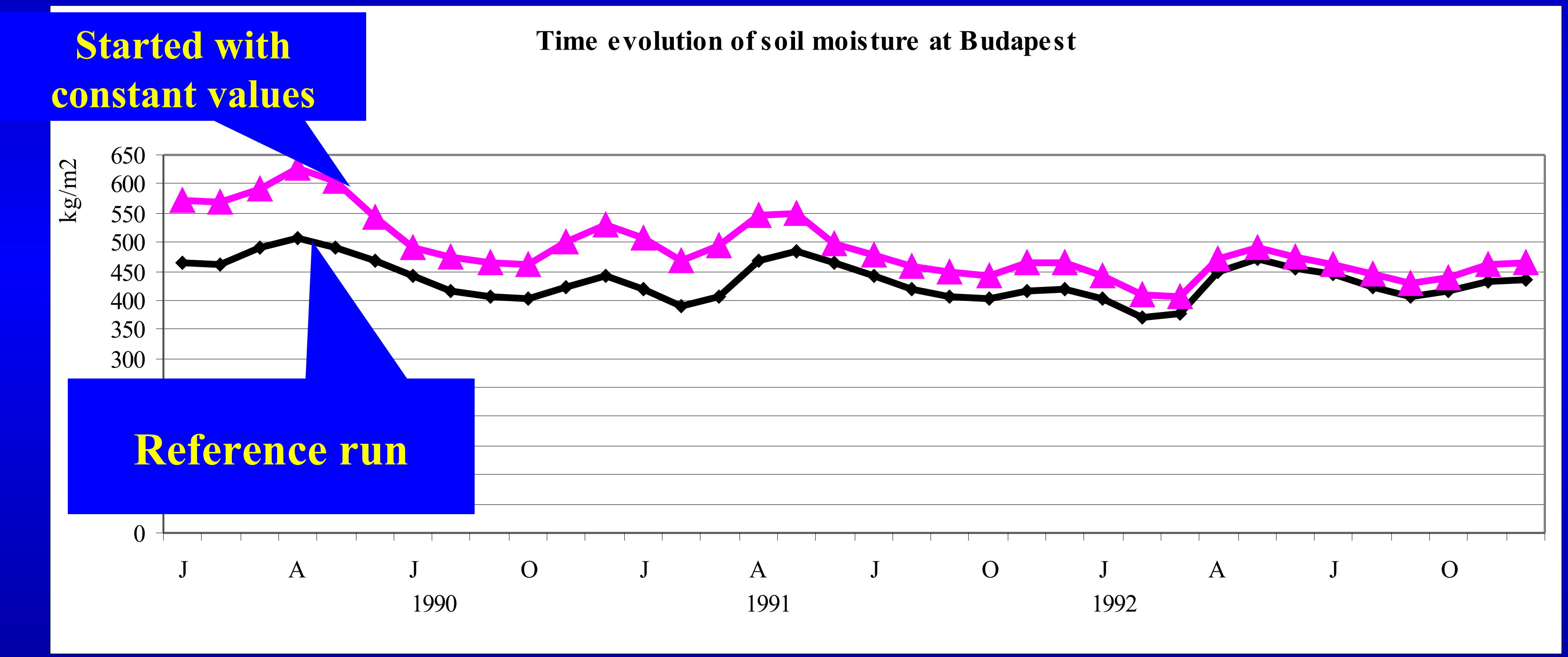
Continuous correction of SST is necessary



- Versio
- 3-year
- Europe
  resolut
- ~10 ho
- Time e ... al deep
  soil mo

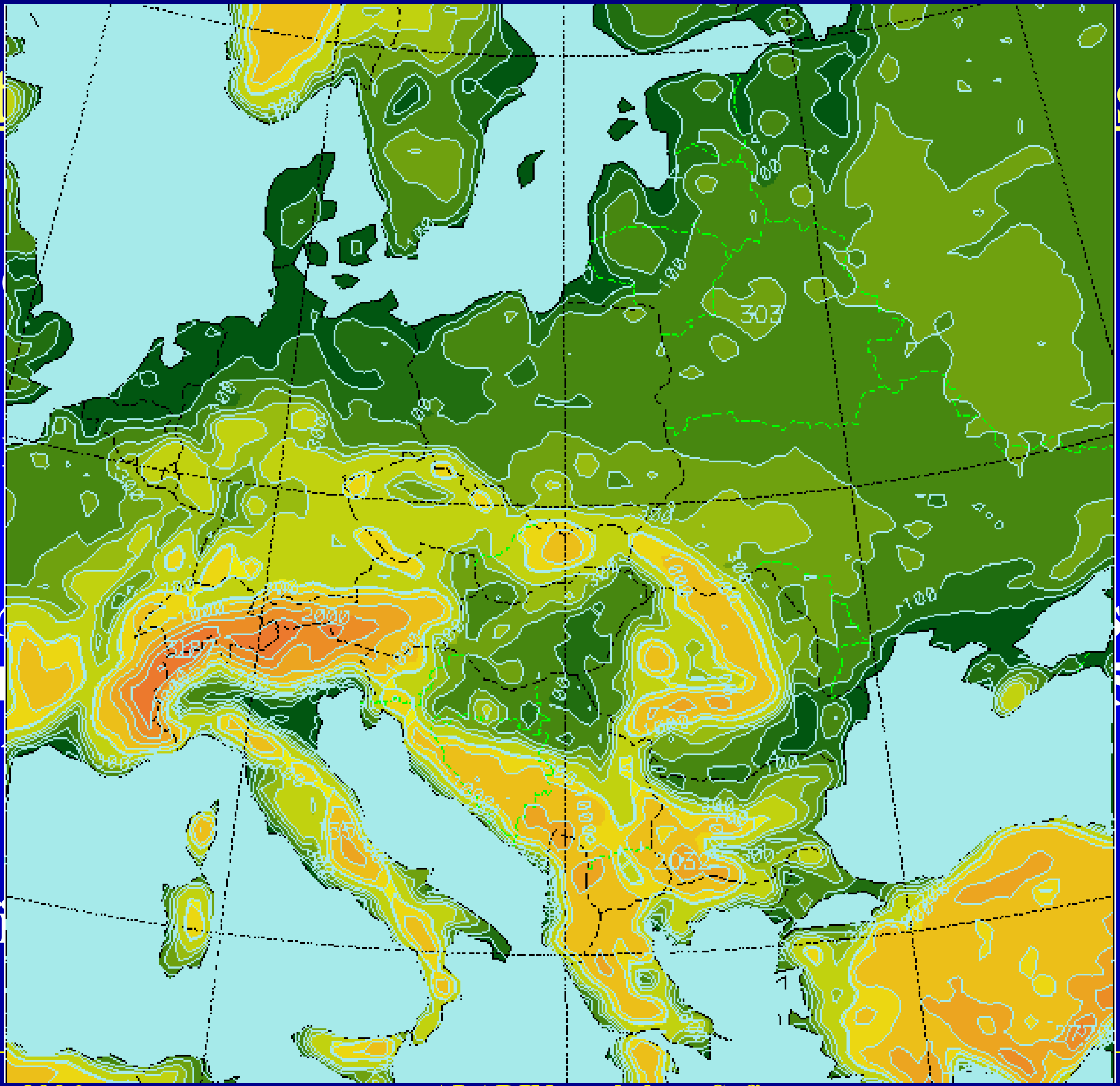
Study of spin-up: results

Time evolution of soil moisture: (reference: with normal deep soil moisture, test: started with constant values: 600 kg/m³)



Pink curve fits to the black one ⇒ ~2-year spin-up

St… s



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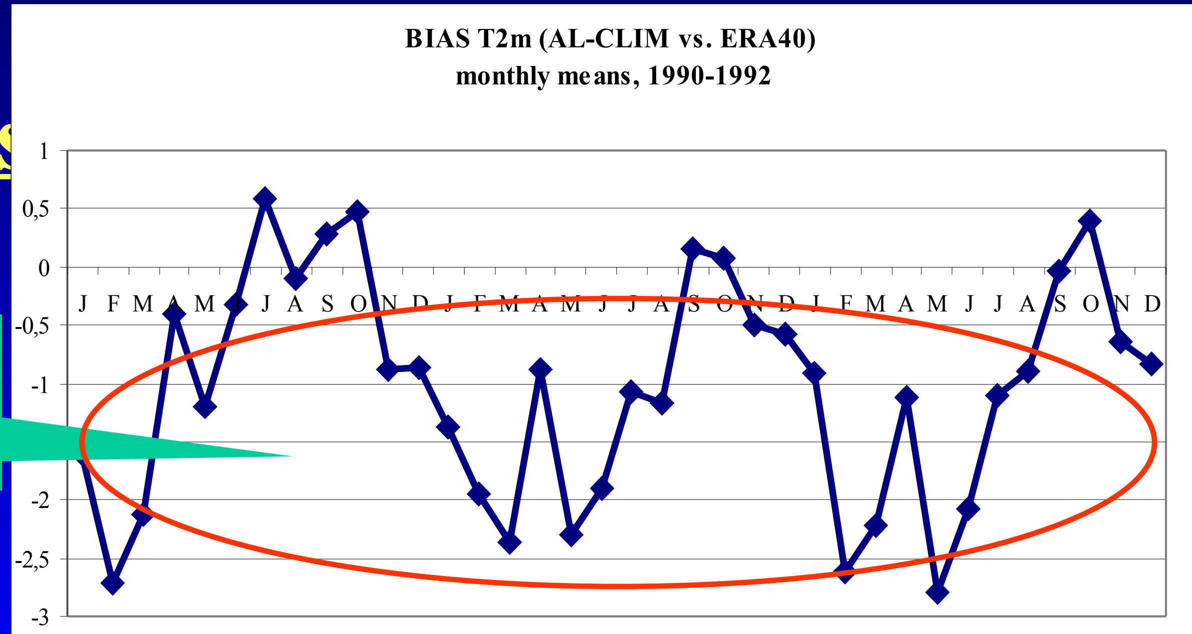
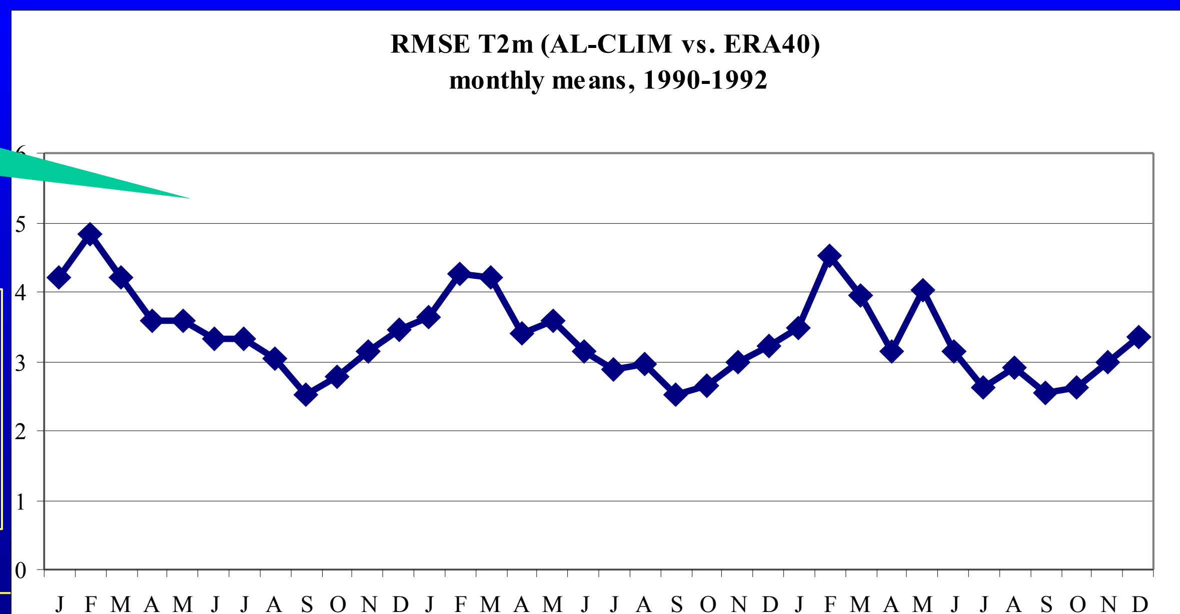
- 3-yea…
- Centr… s (C+I+… 5 min times…
- Verifi…

Study of s

T2m bias, RMSE



The model is cold except the summer periods

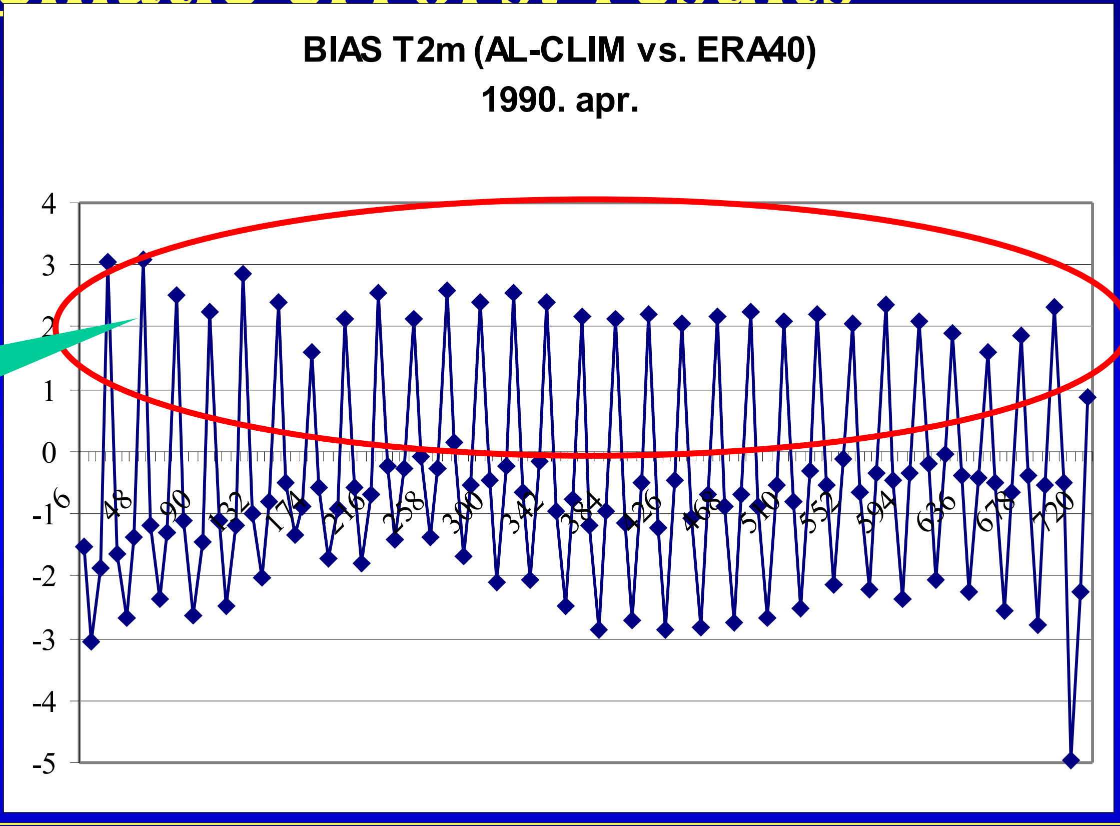


Big RMSE (3-5 K)

No accumulation of systematic error, but very big RMSE and cold BIAS

Study of systematic errors: results

Time evolution of T2m BIAS in a selected month (April, 1990)



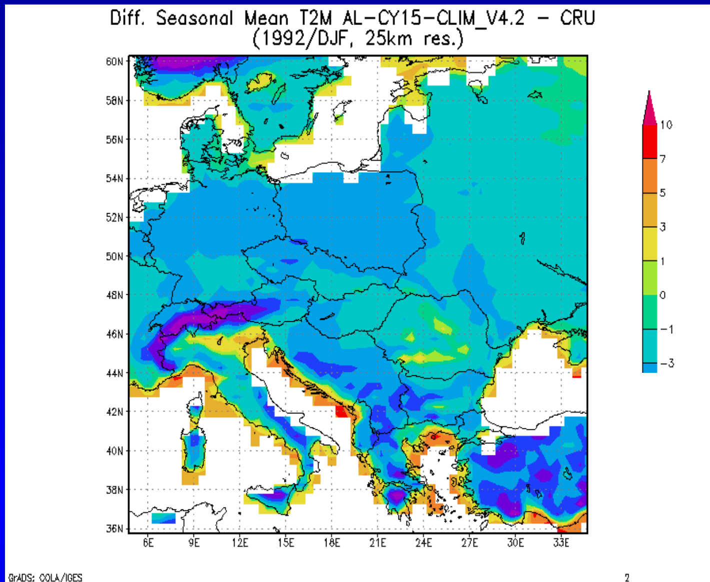
Positive BIAS in the daytime (12 UTC), negative in other time (00, 06, 18 UTC)

Similar behavior for almost the whole integration period ⇔ lack of cloudiness (small amount of cloud. ⇒ strong outgoing LW radiation ⇒ cold nights & strong incoming SW rad. ⇒ warm daytime)

Inter-comparison: settings

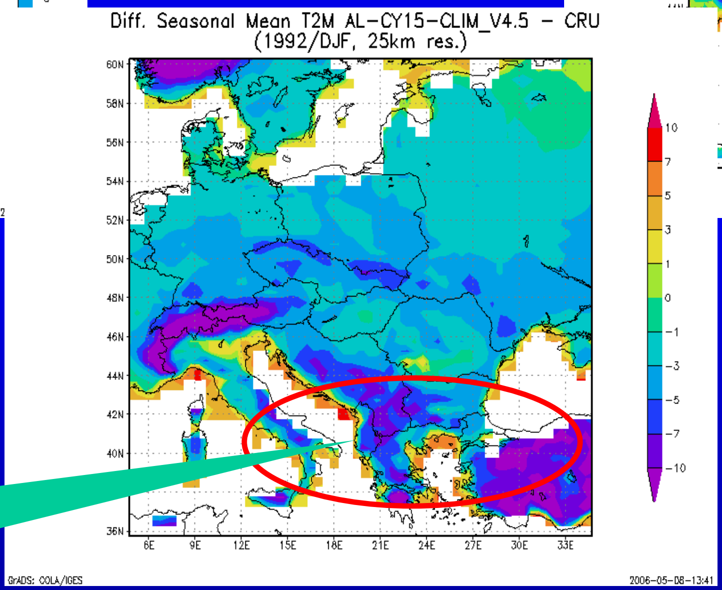
- Versions 4.2, 4.5 and cy28
- 3-year run (1990-1992) without considering the first two years (only 1992)
- Central-European domain (same as before), 120x120 gridpoints (C+I+E), 25 km resolution, 31 vertical layer, 15 min timestep
- Evaluation: CRU (Climate Research Unit, www.cru.uea.ac.uk) and ERA40

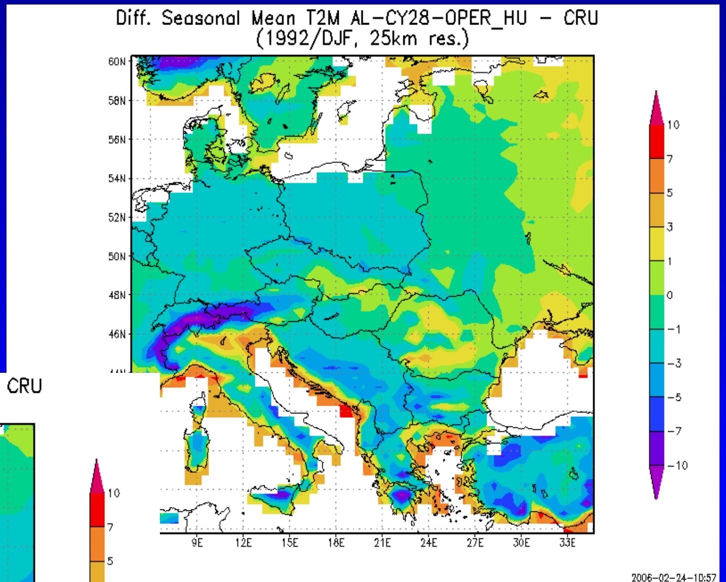
Inter-comparison: results (T2m winter)



V4.2

V4.5



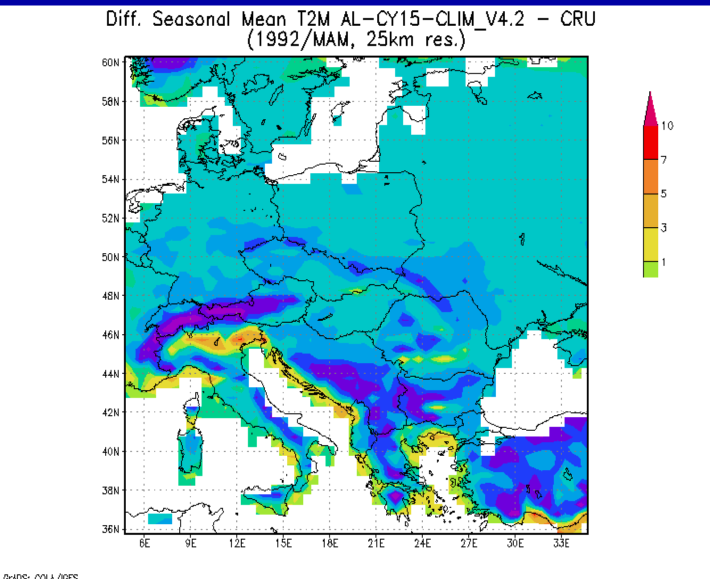


cy28

extremely cold areas over SE

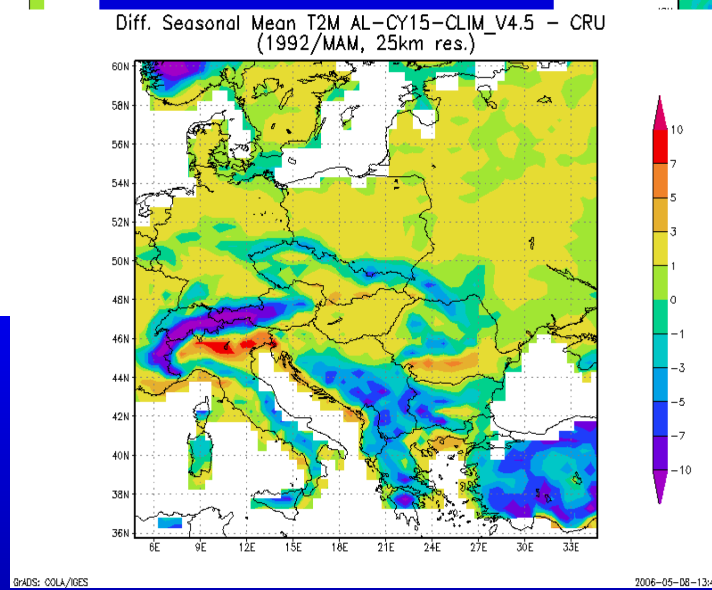
⇒ Best version: CY28

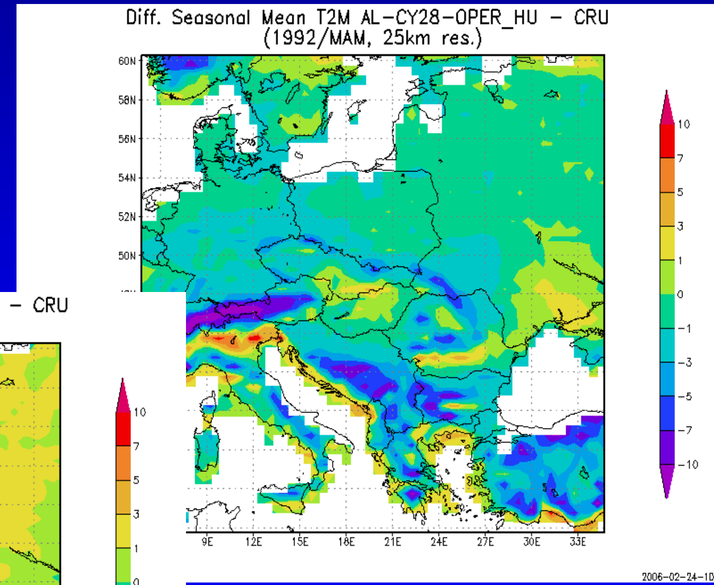
Inter-comparison: results (T2m spring)



V4.2

V4.5



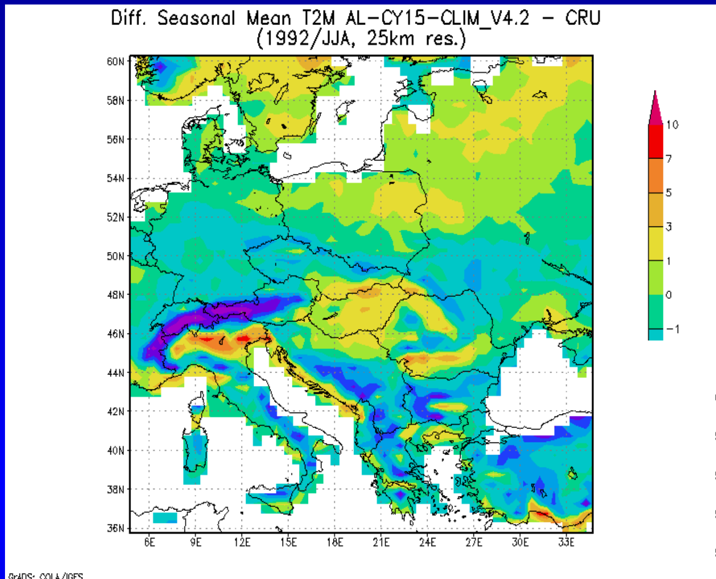


cy28

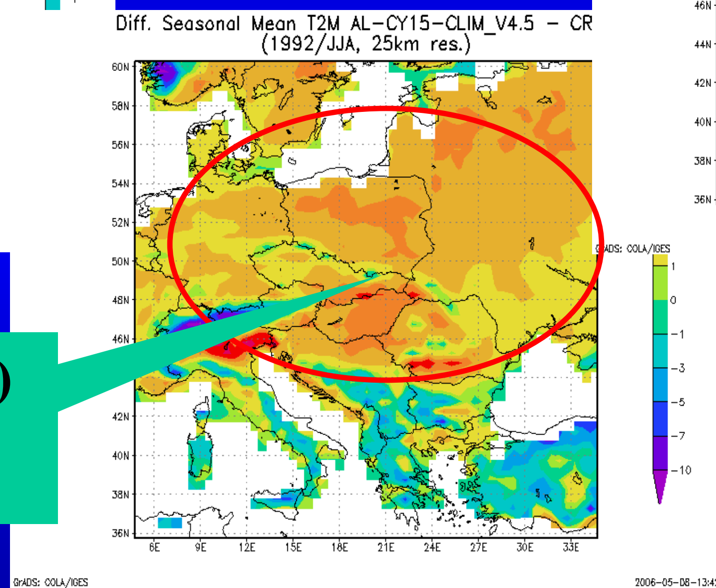
⇒ **V4.5: overestimation, V4.2 and CY28 underestimation**

the best: CY28 and V4.5

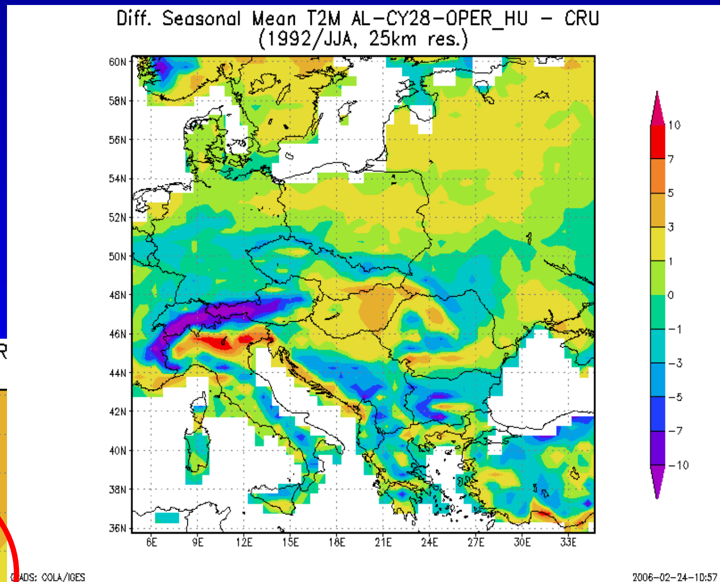
Inter-comparison: results (T2m summer)



V4.2



V4.5

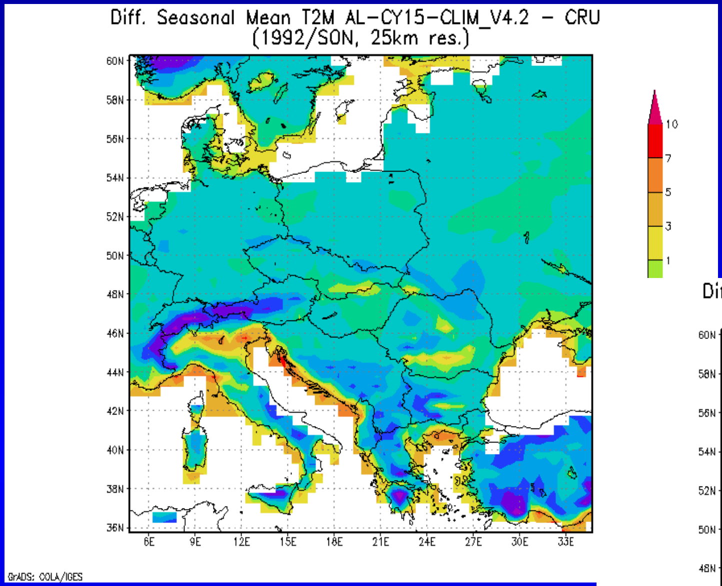


cy28

Big overestimation (3-7K)

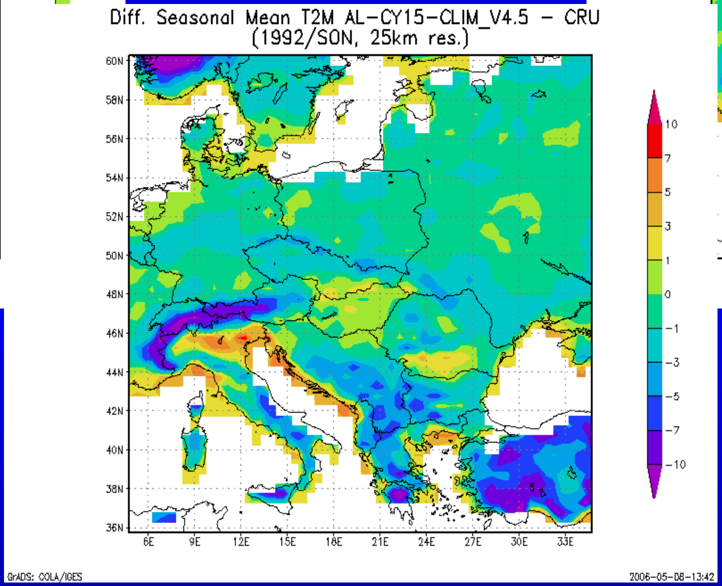
⇒ **Best version: V4.2 (very good result for the Carpathian Basin)**

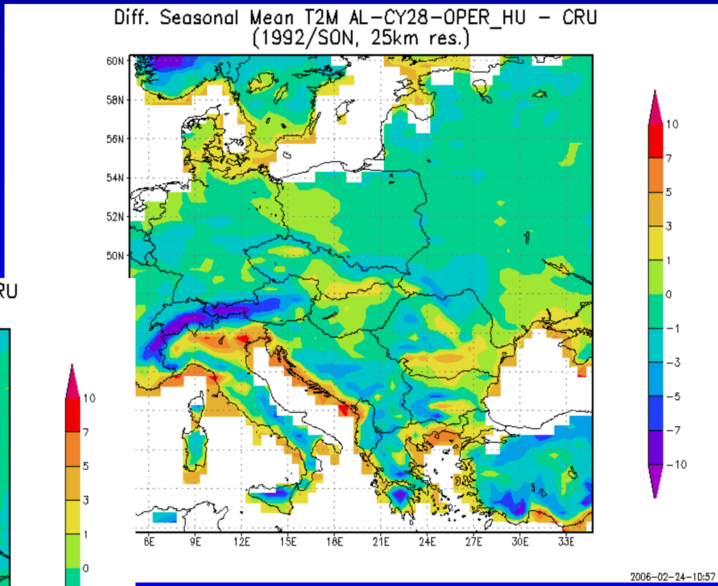
Inter-comparison: results (T2m autumn)



V4.2

V4.5

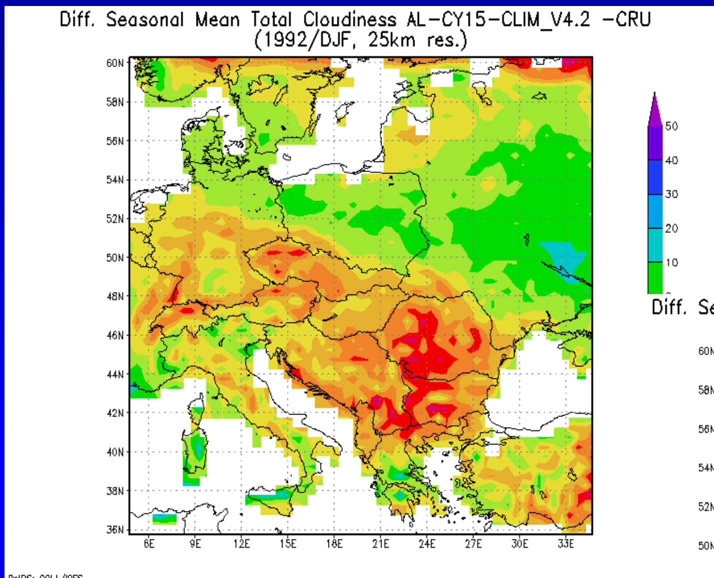




cy28

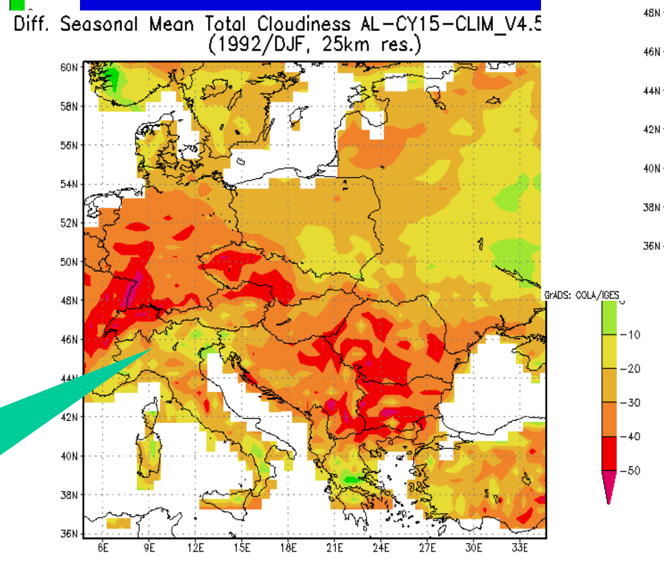
⇒ Underestimation for all versions , best versions: V4.5 and CY28

Inter-comparison: results (cloudiness, winter)

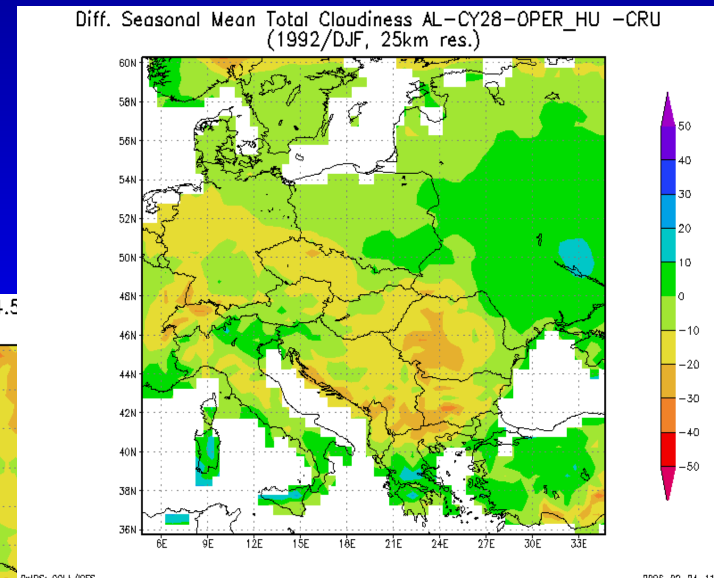


V4.2

V4.5



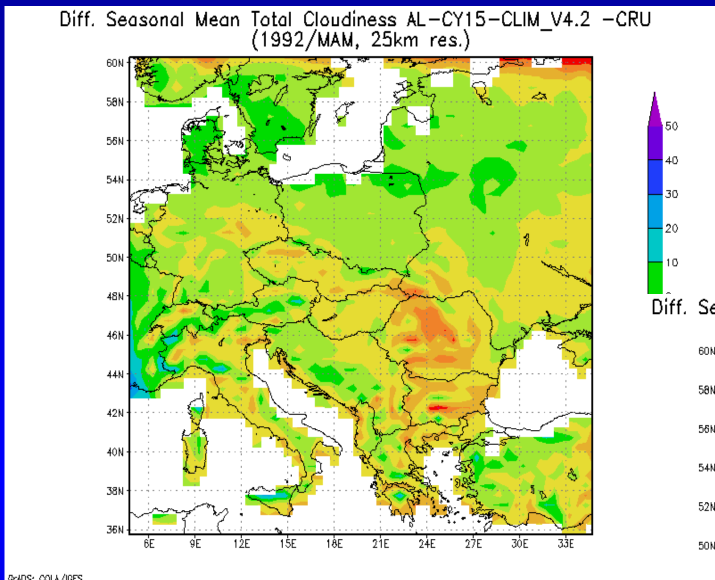
Big underestimation all over Europe (20-40%)



cy28

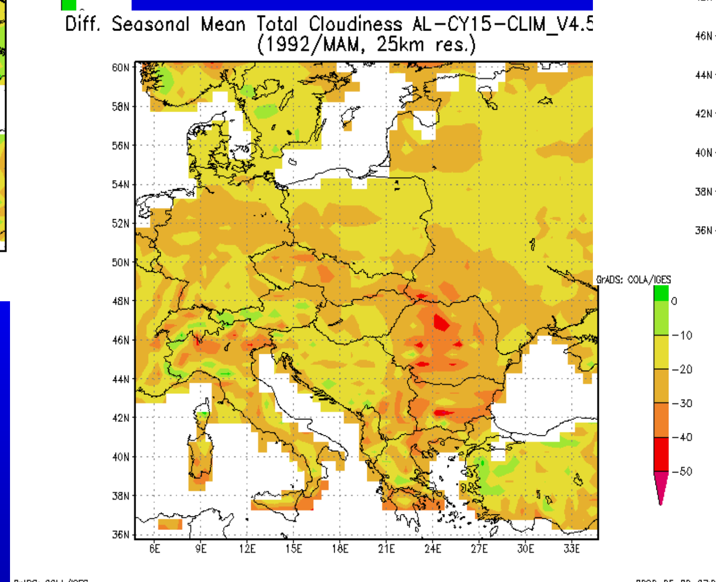
⇒ V4.5 produced less amount of cloudiness than V4.2, the best: CY28

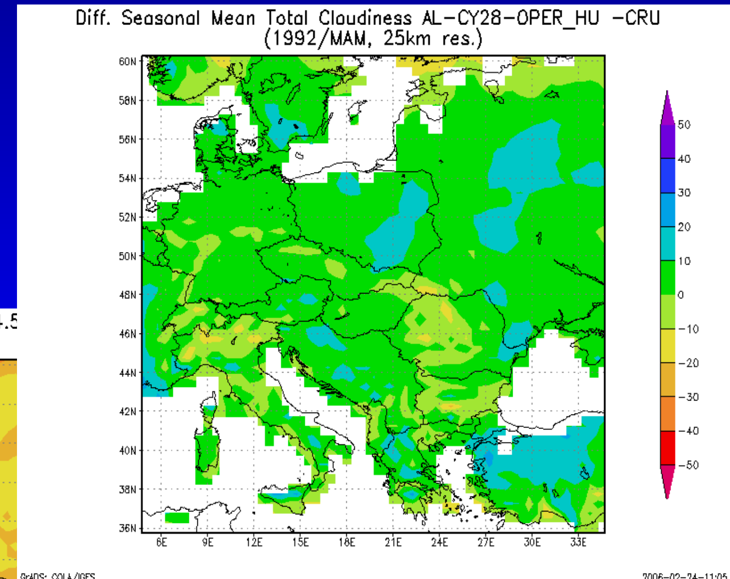
Inter-comparison: results (cloudiness, spring)



V4.2

V4.5

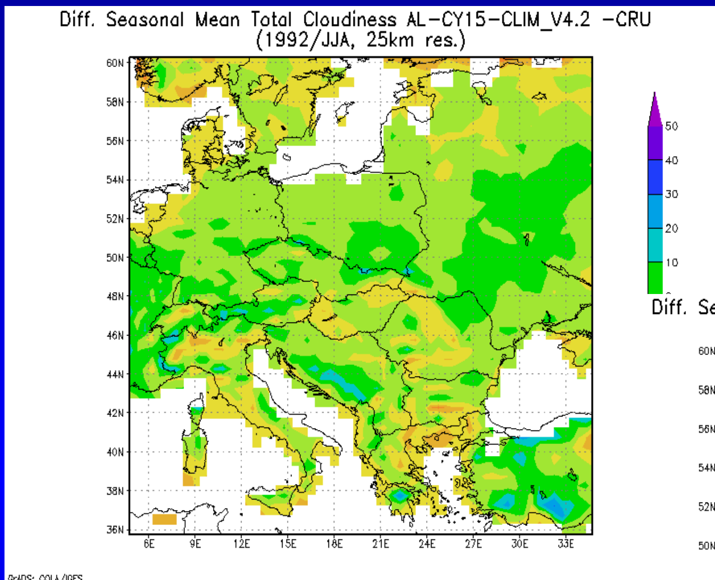




cy28

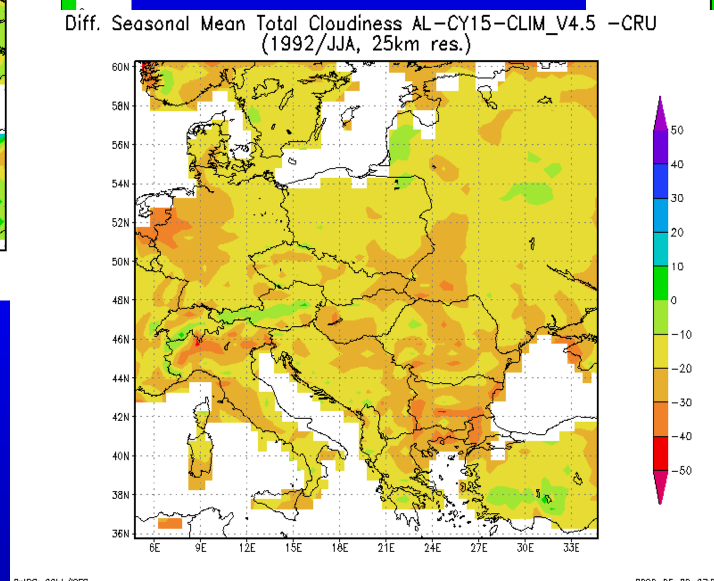
⇒Best versions: V4.2 (underestimation ~0-20%) and CY28 (overestimation ~0-20%)

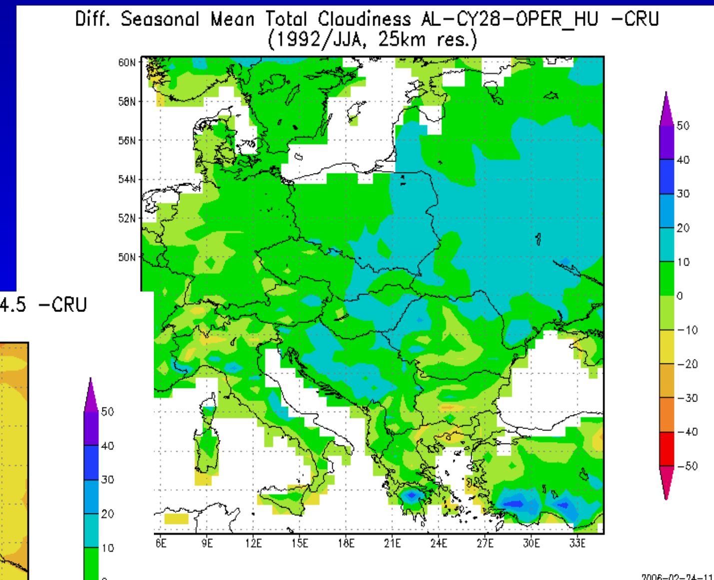
Inter-comparison: results (cloudiness, summer)



V4.2

V4.5

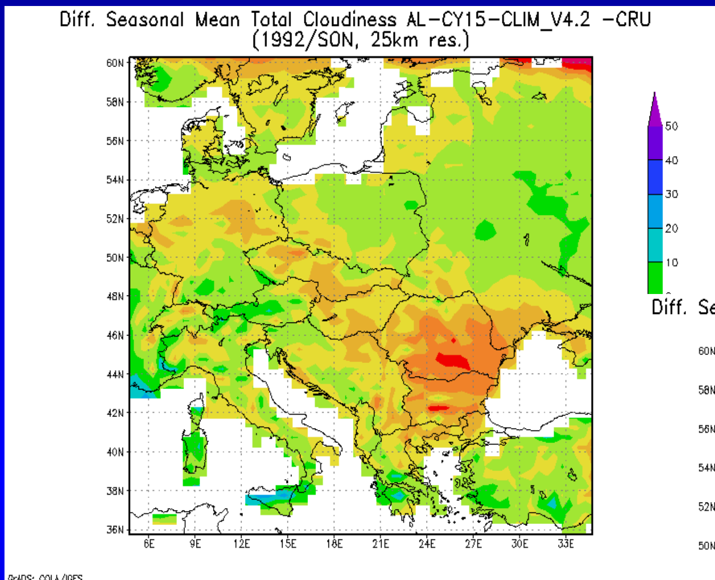




cy28

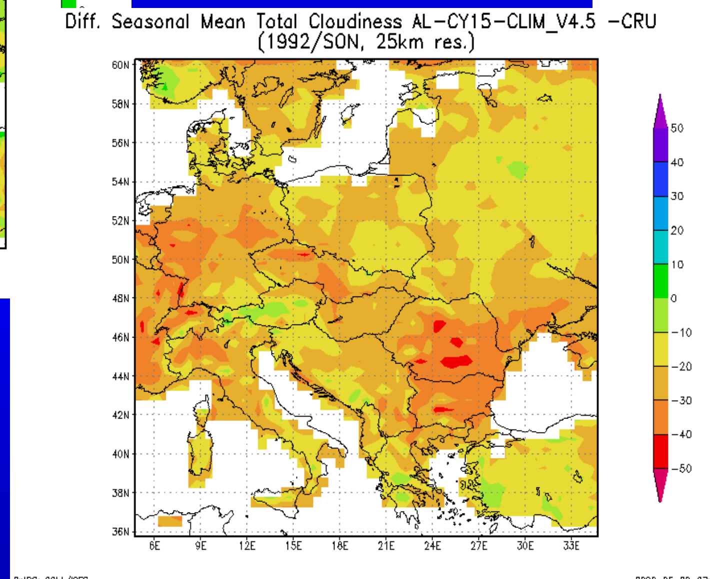
⇒Best version: V4.2

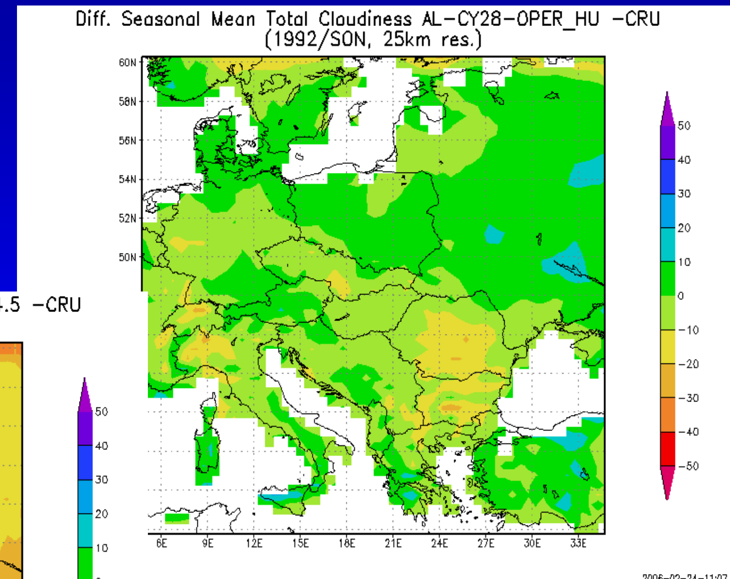
Inter-comparison: results (cloudiness, autumn)



V4.2

V4.5





cy28

$\Rightarrow$**Best version: CY28**

Inter-comparison: results

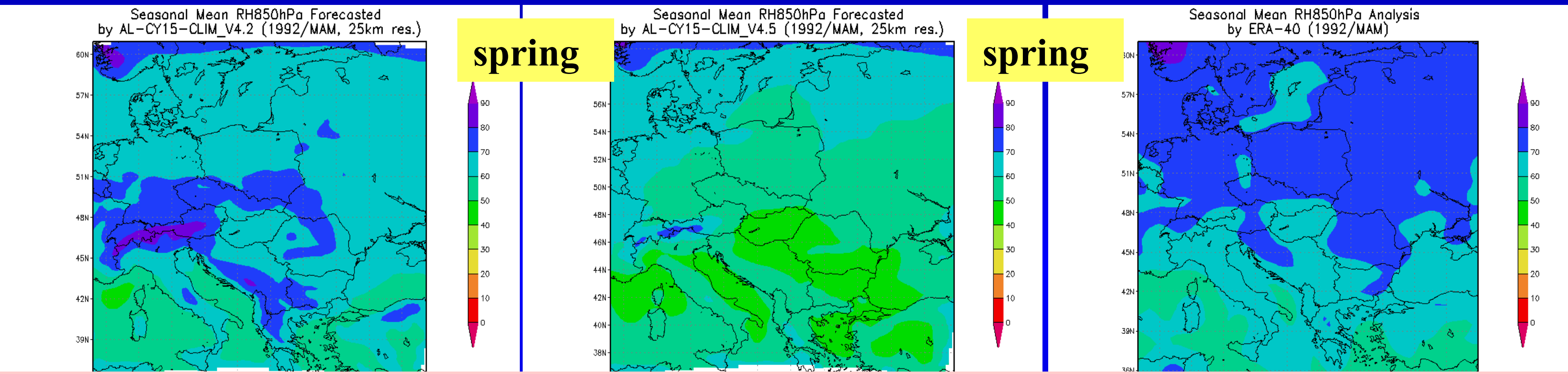
- Relative humidity
  - At 700 and 500 hPa the two climate versions are rather similar to each other and to ERA40 data
  - At 850 hPa on winter and autumn they are similar, but totally different for spring and summer

- Temperature
  - At 700 and 500 hPa the two climate versions are rather similar to each other and to ERA40 data
  - At 850 hPa they are different for spring and summer (V4.5 is too warm, V4.2 and ERA40 are similar)

Inter-comparison: results (relative humidity at 850 hPa)

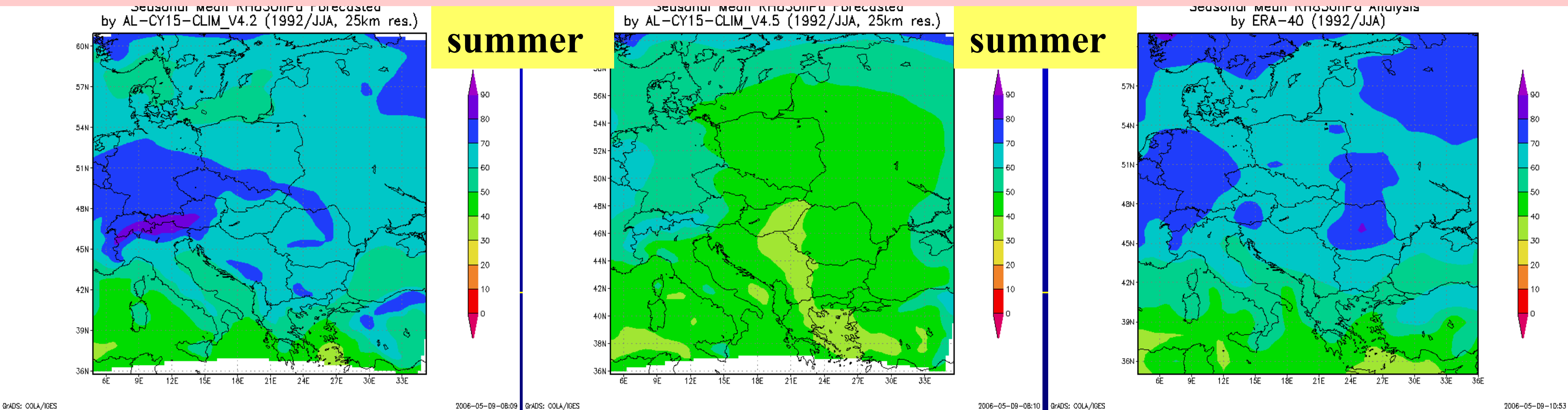
V4.2 **V4.5** **ERA40**

spring **spring**



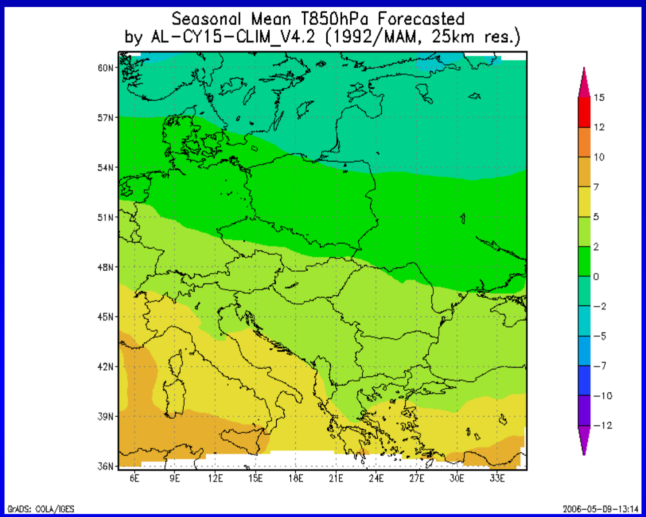
RH-850hPa (level of low-level cloudiness) is extremely dry in V4.5

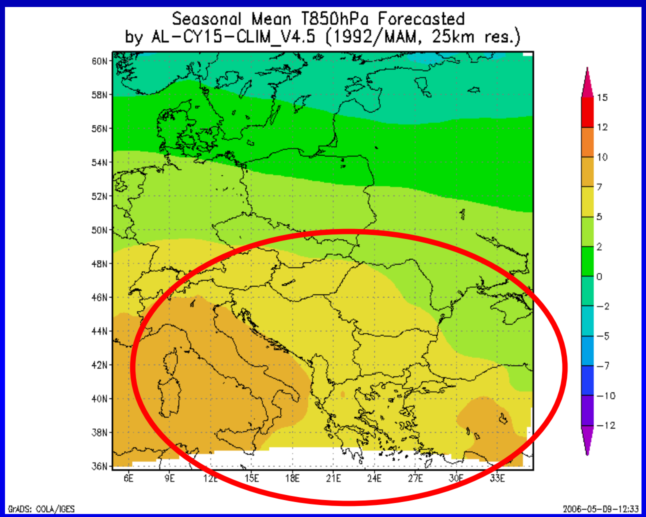
summer **summer**



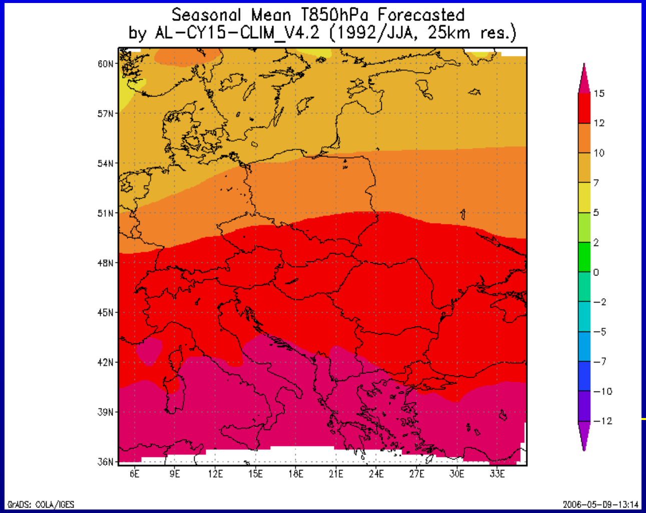
Inter-comparison: results (temperature at 850 hPa)

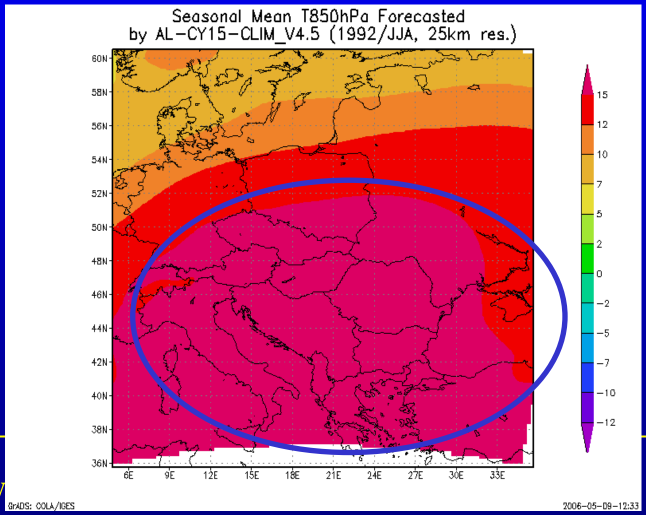
V4.2 | **V4.5**





spring

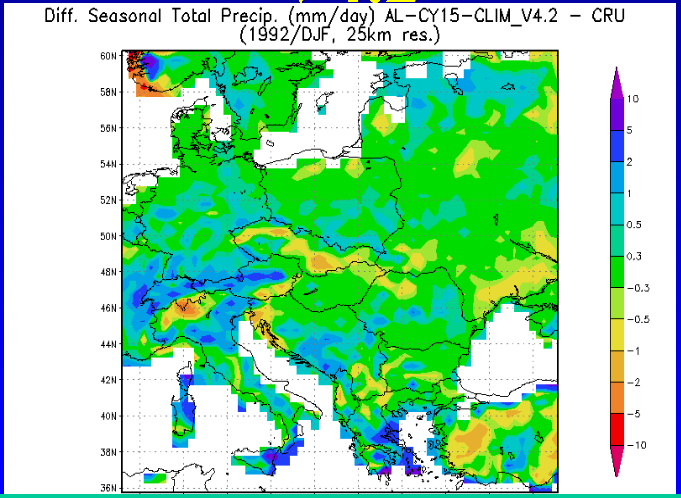


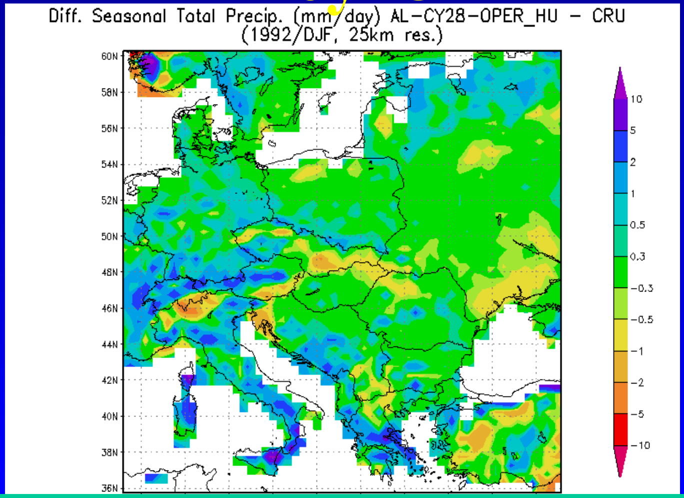


summer

Inter-comparison: results (precipitation)

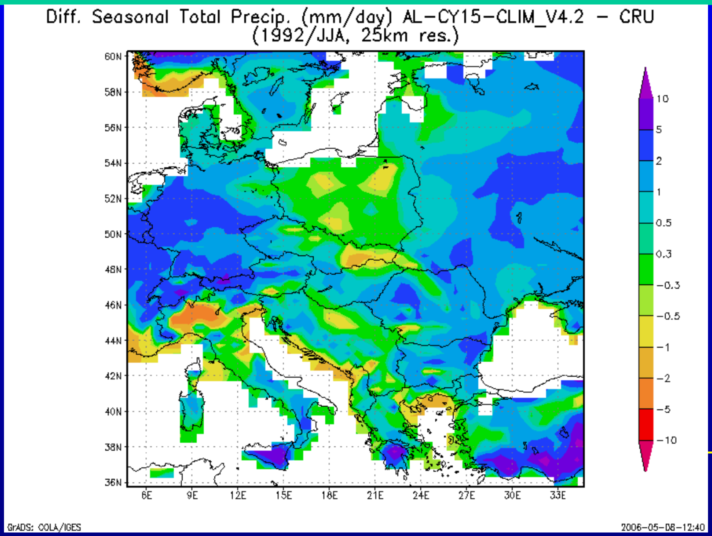
V4.2 | **cy28**



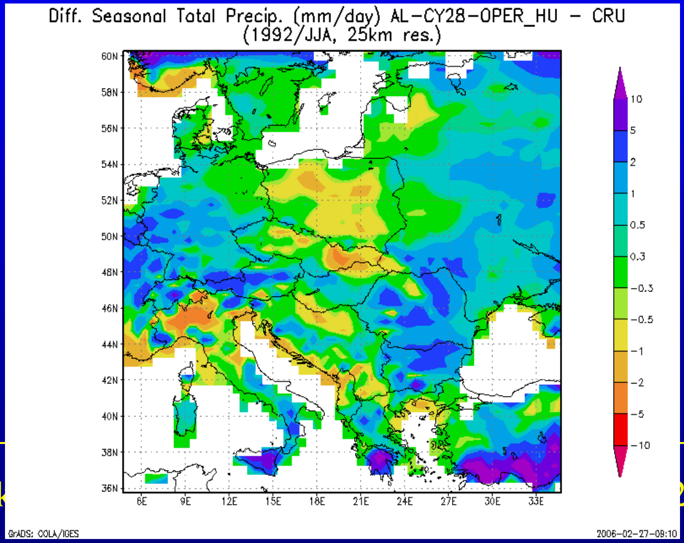


winter

Very similar behaviors, overestimation during summer



summer



Conclusions

- T2m: CY28 is the most reliable version, V4.2 is too cold on winter and spring, V4.5 is also too cold on winter, but too warm on summer. The cold bias disappears from V4.5 T2m on spring and summer, but not on winter.

- Cloudiness: CY28 produced the best cloudiness simulation, V4.5 underestimated the cloudiness for the whole period, over the whole domain. The examination of relative humidity fields showed the lack low-level humidity, e.g. on 850hPa. $\Rightarrow$ warm spring and summer because of the stronger incoming SW radiation

- Precipitation: similar behaviors for all model versions

Plans

– Study of the moisture transport in the model

– 40-year integration for the past with ERA40 as LBC-s over Central-Europe, on 25km resolution

– Evaluation of the results (means, variances, other climate parameters: e.g. Taylor-diagrams)

– Making projections for the future climate of the Carpathian Basin based on initial and lateral boundary conditions from ARPEGE-Climat

– Compare results to other regional climate models

Acknowledgements

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  - Samuel Somot
  - Michel Deque
  - Pascal Marquet
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