Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Department of Home Affairs FDHA
Federal Office of Meteorology and Climatology MeteoSwiss

COSMO verification activities in 2010

compiled by Francis Schubiger (MeteoSwiss)
presented by Marco Arpagaus

Outline

- traditional verification
  - comparison between models, long-term trends
  - conditional (→ VERSUS)

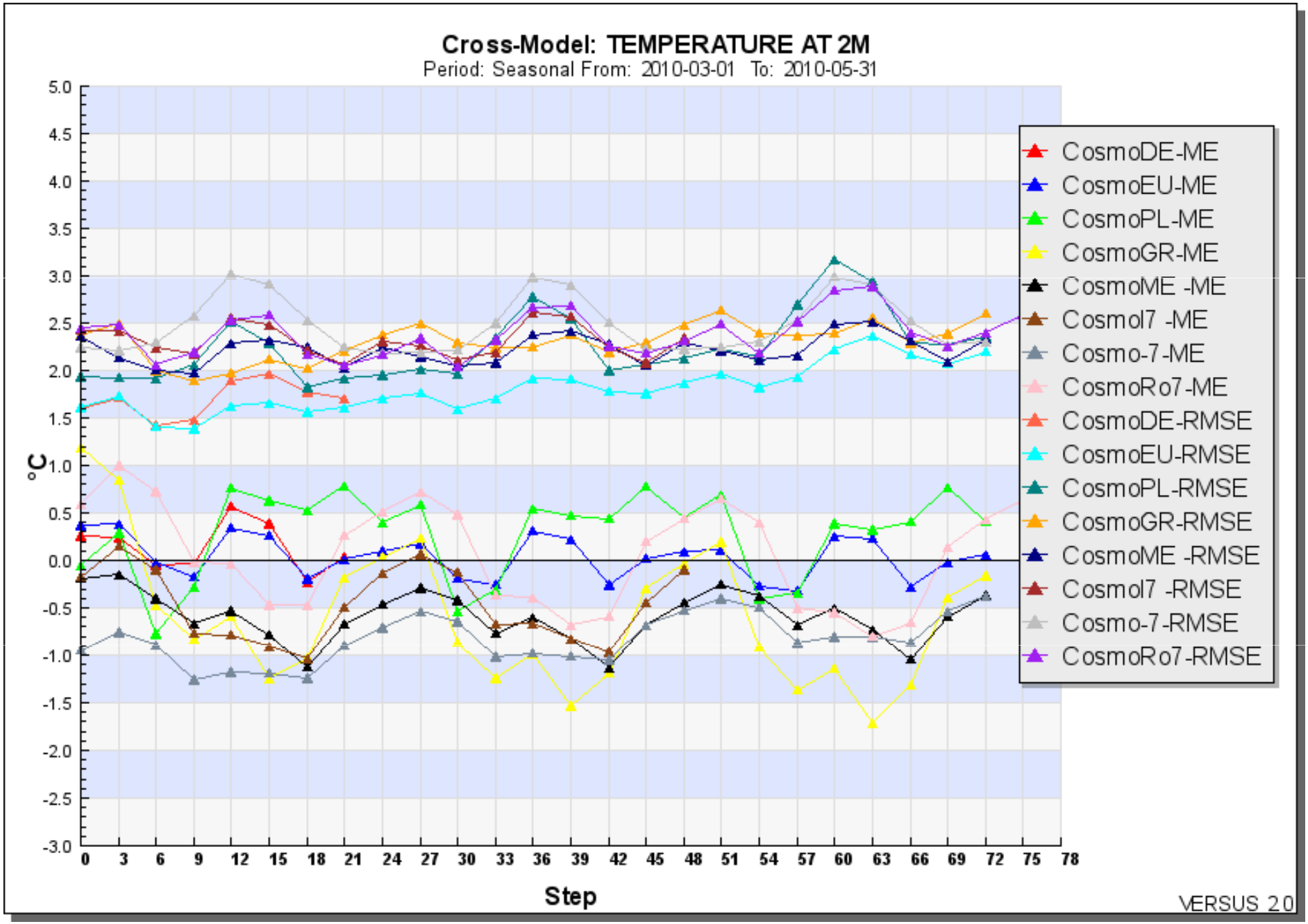
- Neighbourhood verification
  - comparison between models, long-term trends
  - weather-type dependant → talk by Pierre Eckert

Production of common verification plots of all operational COSMO-versions with VERSUS

- Period: for each season (see as example Spring 2010 -> next slide)
- Run: 00 UTC run
- **Continuous parameters**
  - T2m, Td2m, Mslp, Wspeed, TCC (optional)
    - Scores : ME, RMSE
    - Forecasts Step: every 3 hours
- **Dichotomic parameters**
  - Precipitation:
    - Scores: FBI, ETS
    - Cumulating: 6h, 12h and 24h
    - Thresholds: 0.2, 2, 5, 10 for mm/6h and mm/12h
    - Thresholds: 0.2, 2, 10, 20 mm/24h

A. Raspanti, Italy

Common verification plots for each model over its country



Precipitation verification comparison the several COSMO-Model versions

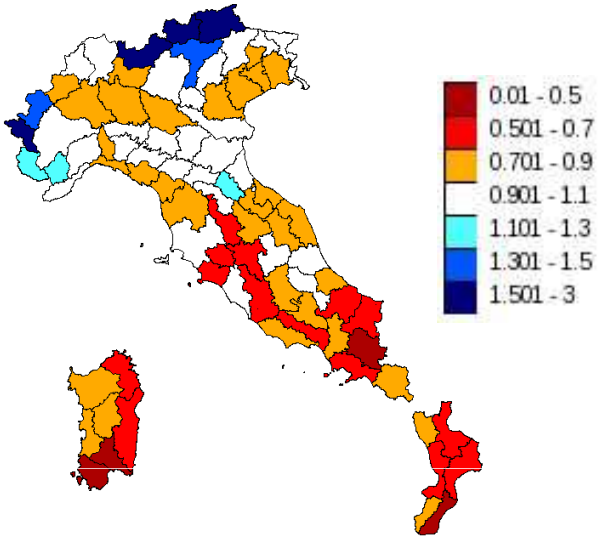
(Elena Oberto, Massimo Milelli - ARPA Piemonte)

QPF verification of the 4 model versions at 7 km res. (**COSMO-I7, COSMO-7, COSMO-EU, COSMO-ME**) with the 2 model versions at 2.8 km res. (**COSMO-I2, COSMO-IT**)

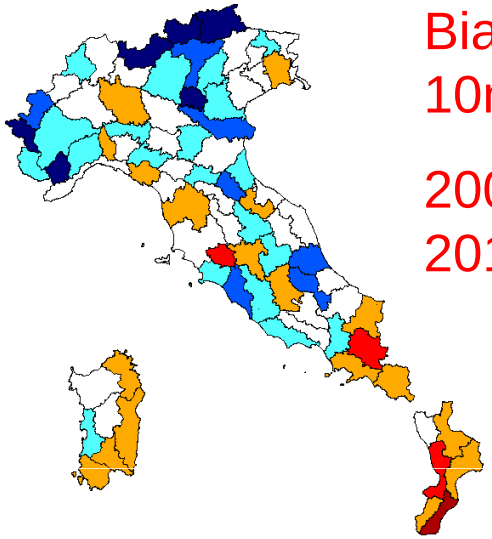
Specifications:

- Dataset: high resolution network of rain gauges coming from COSMO dataset and Civil Protection Department → 1300 stations
- Method: 24h/6h averaged cumulated precipitation value over 90 meteo-hydrological basins
- Model selection: run 00UTC, D+1, D+2

COSMO-7



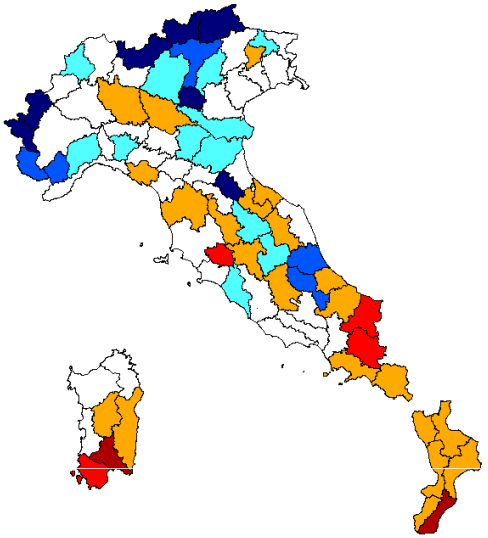
COSMO-I7



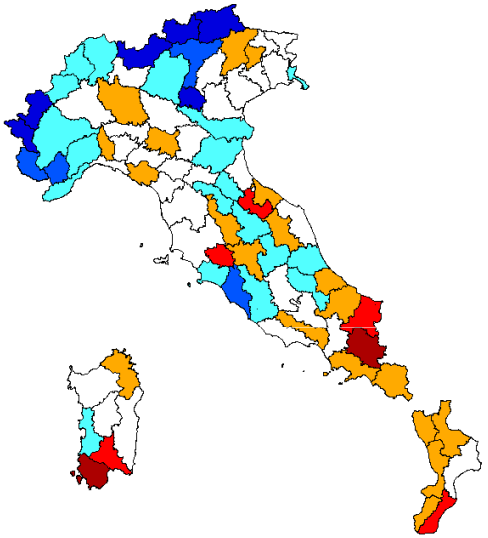
Bias, 10mm/24h

200812-201005

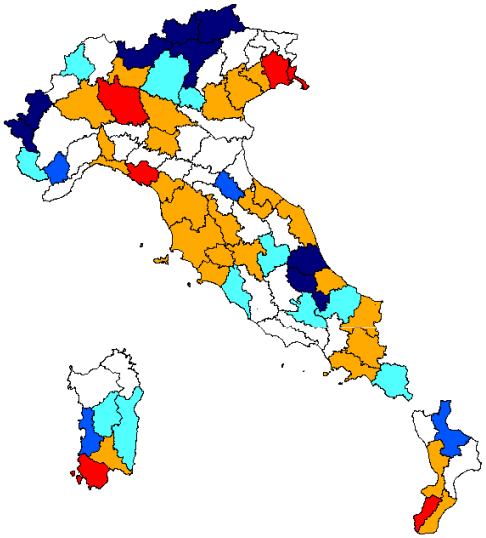
COSMO-ME



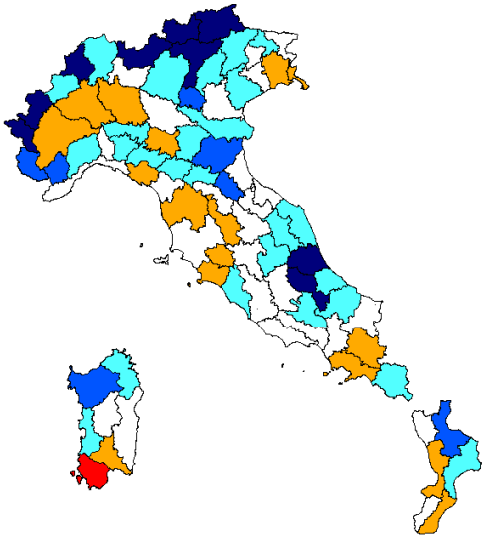
COSMO-EU



COSMO-I2



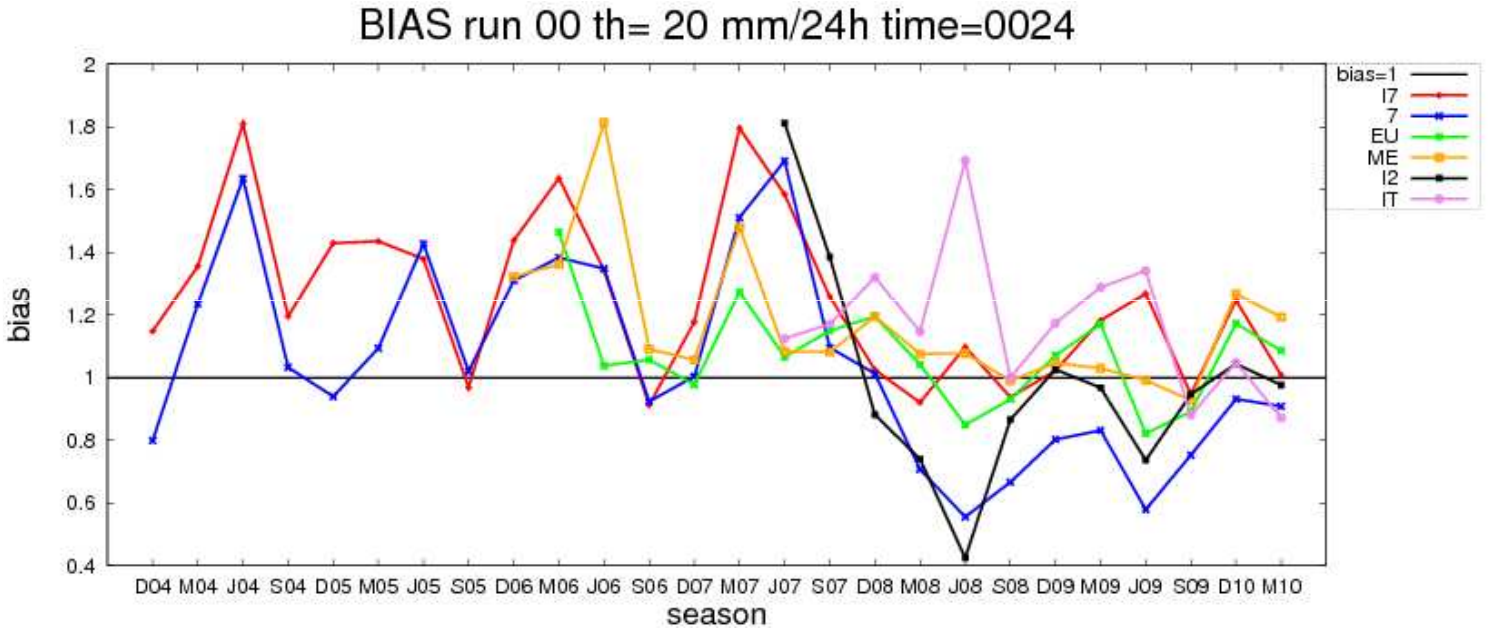
COSMO-IT

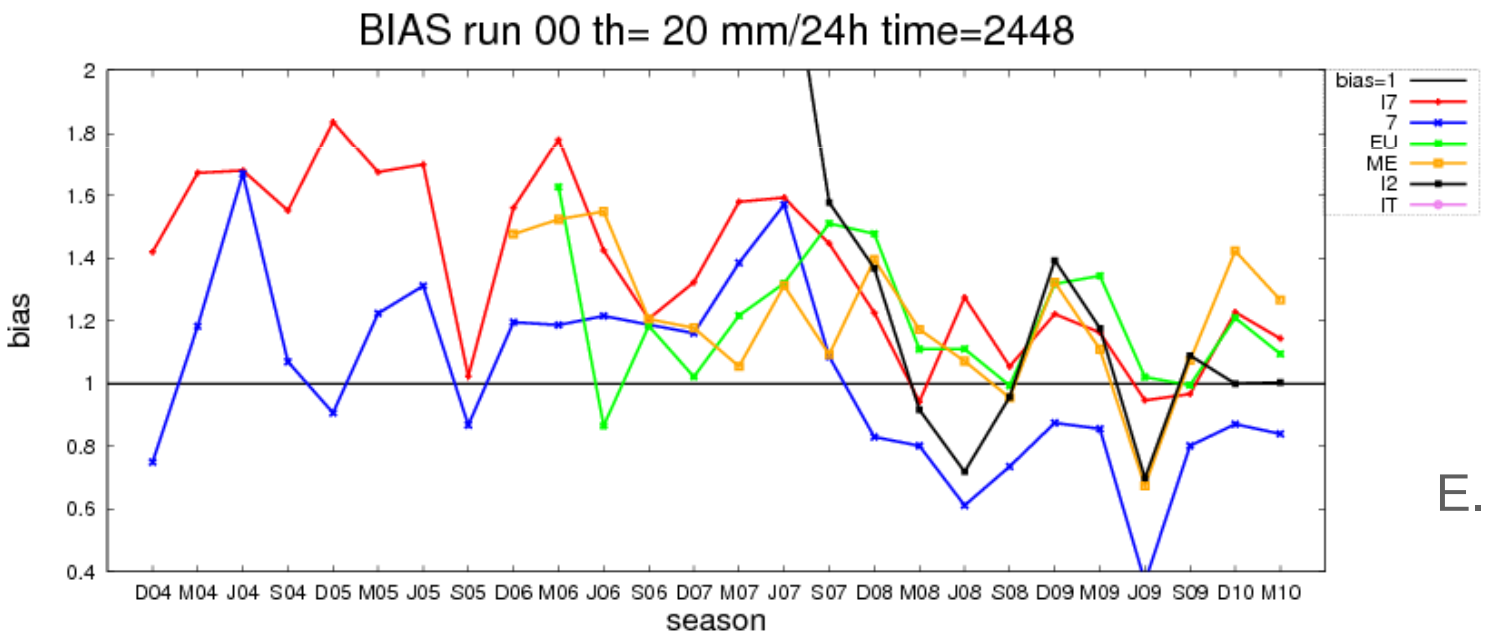


- **Systematic overestimation over Alpine areas, especially in the western part and in Veneto/Trentino-Alto Adige (incorrect representation of flow interaction with alpine chain during westerlies and north-easterlies ?)**
- **COSMO-7 underestimates especially in southern Italy (border of the domain ?)**
- **COSMO-I7 overestimates the Adriatic areas (especially during north-easterly flow → forecasters experience)**
- **COSMO-I2 underestimates, COSMO-IT overestimates**

E. Oberto
ARPA Piemonte

Seasonal trend - high thresholds





- Slight bias reduction during latest seasons
- Last winter: all the versions overestimate (probably due to lack of representativeness of the rain gauges over the plain during snowfall)
- Strong COSMO-7 underestimation BUT slight improvement during latest seasons

E. Oberto, ARPA Piemonte

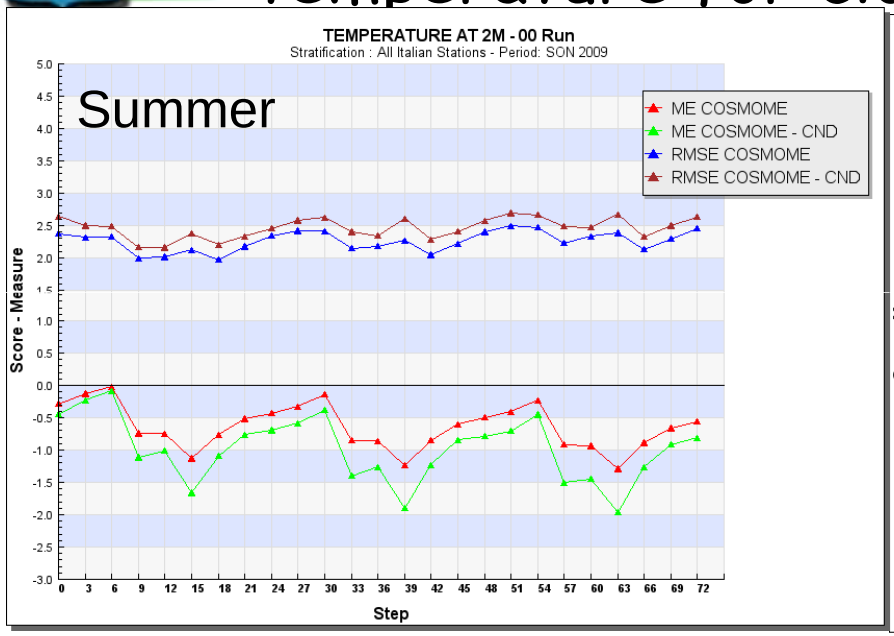
Conditional and weather-type dependant verification with VERSUS

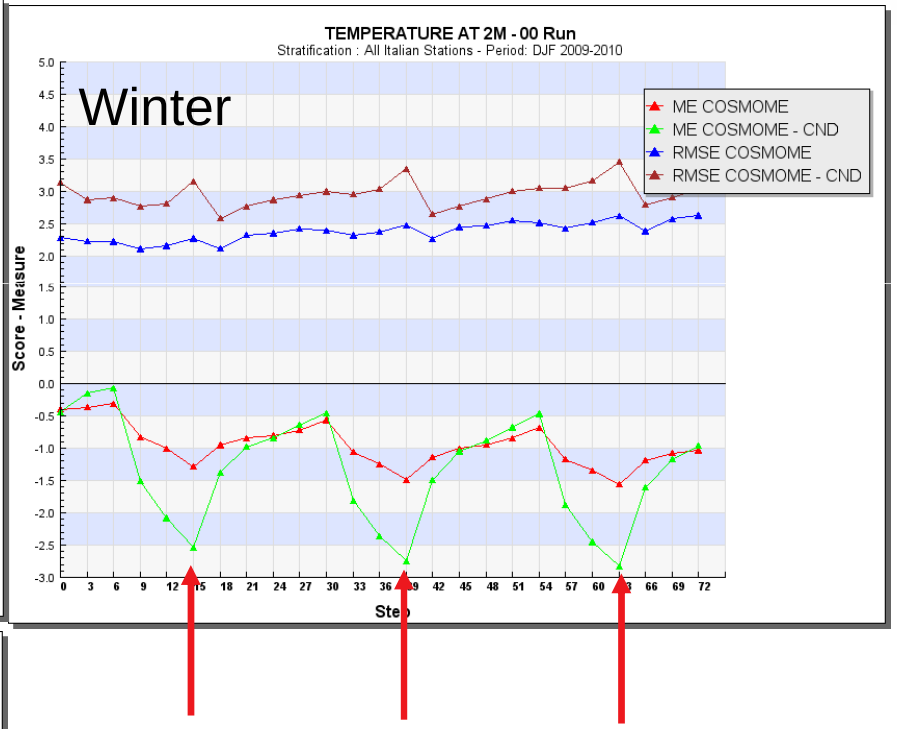
- Conditional verification
  - examples available for 2010, but not yet a systematic verification with fixed conditions
  - organisation of a workshop March 2011 with the physics working group to discuss/define useful conditions to detect model deficiencies

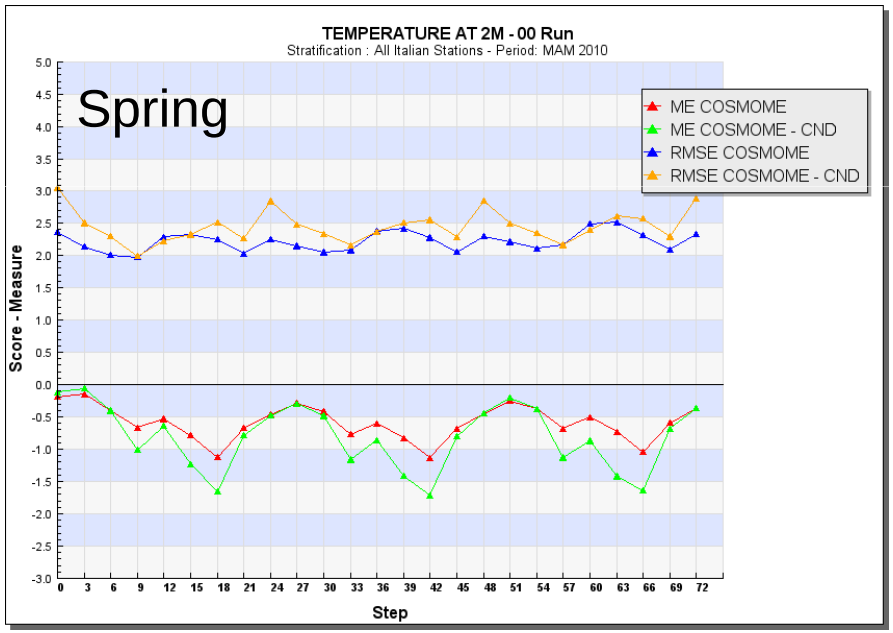
- Weather-type dependant verification
  - each country has defined interesting situations for his own domain (~ 10 / country); no results yet

Conditional Verification

temperature for cloud cover obs <=35%



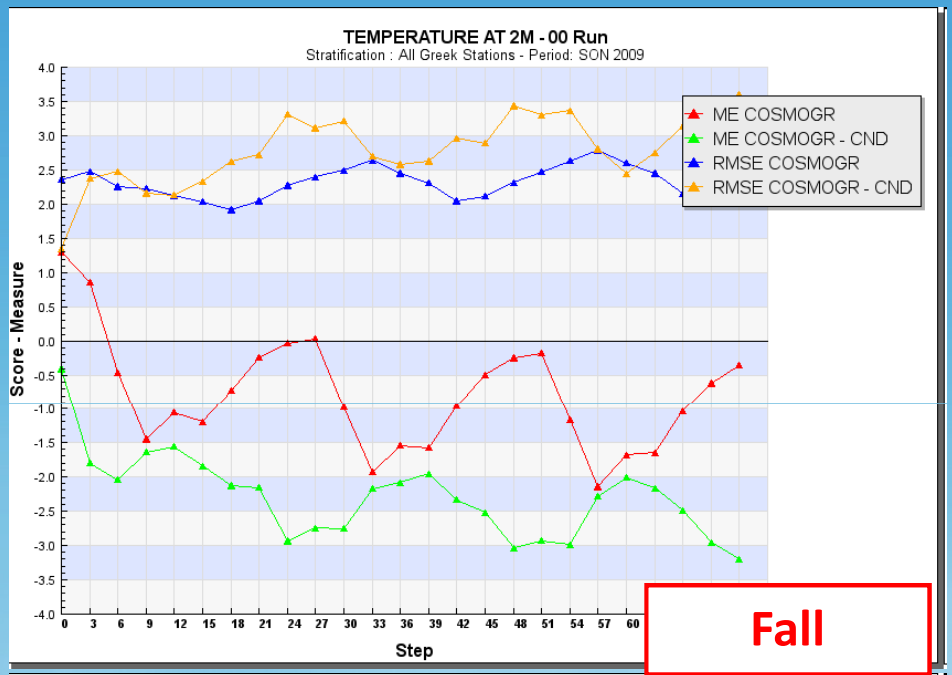




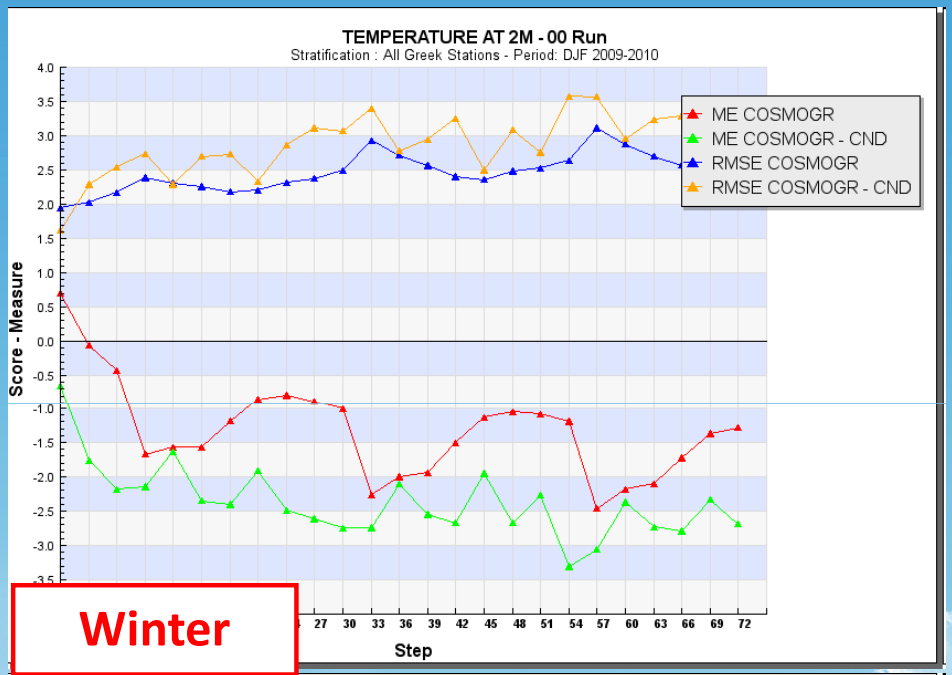
worse behaviour for all the seasons compared to no condition, especially in winter during afternoon

A. Raspanti, Italy

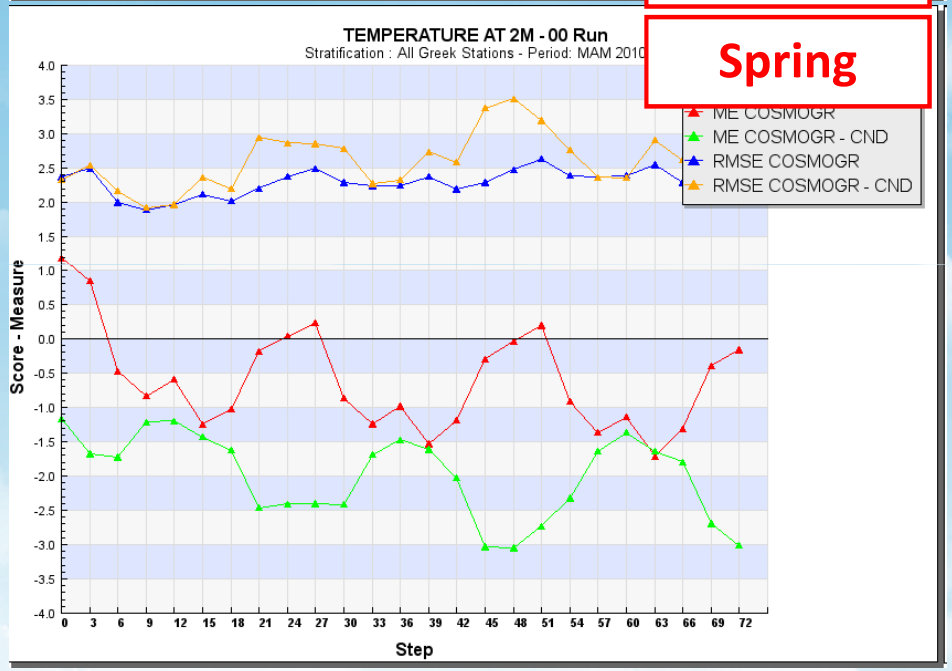
Temperature in ‘high wind’ conditions (> 10 m/s)



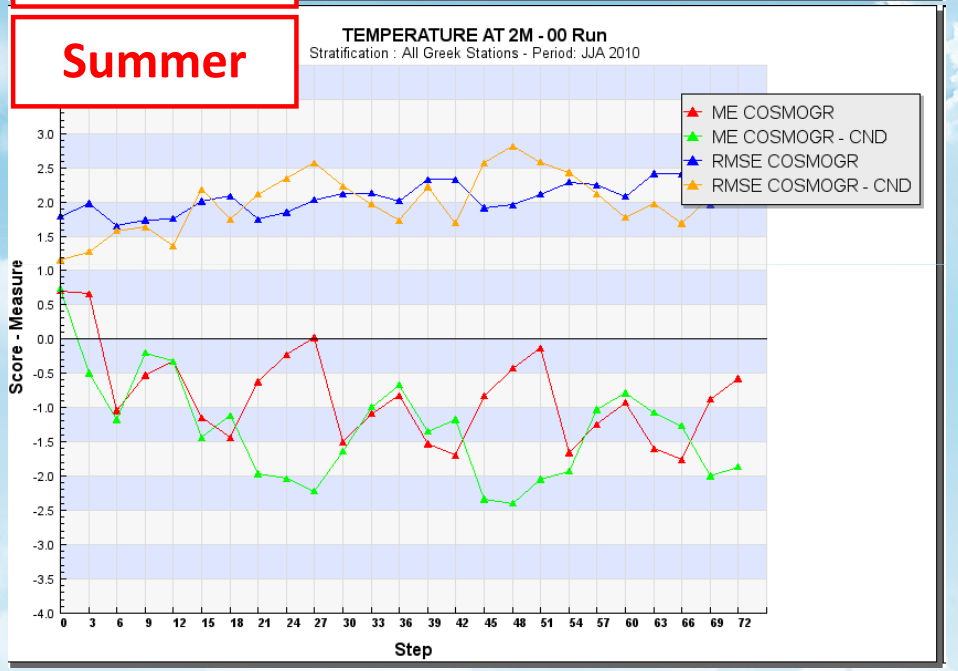
Fall



Winter



Spring



Summer

F. Gofa, Greece

Neighbourhood („fuzzy“) verification

- further studies with neighbourhood („fuzzy“) verification for precipitation at DWD and MeteoSwiss
  - start of pre-operational verification with Fractions Skill Score and Upscaling
  - in 2011 start of verification with other parameters: cloudiness, global radiation (from CM-SAF data)

Neighbourhood verification for precipitation at MeteoSwiss

results for 2009

3h accumulated precipitation sums
over the domain of the Swiss radar composit

models: COSMO-2 and COSMO-7

leadtimes +3h to +6h for all 8 daily forecast runs

obervation

precipitation estimates of the Swiss radar composit

in case of missing radar data (at any interval),
the whole day is not evaluated (total of 28 days)

Neighbourhood (fuzzy) verification 2009, FSS and UP

Fractions Skill Score

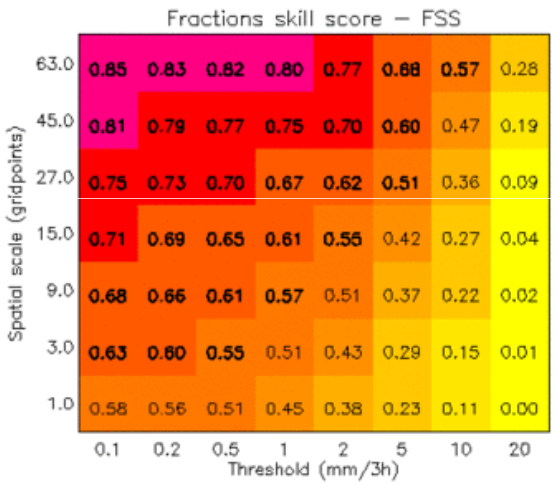
COSMO-2 **COSMO-7** **COSMO-2 – COSMO-7**

Upscaling

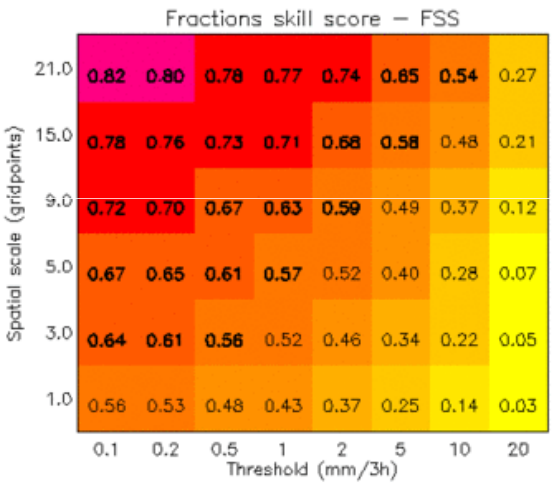
bad good

COSMO-7 better COSMO-2 better

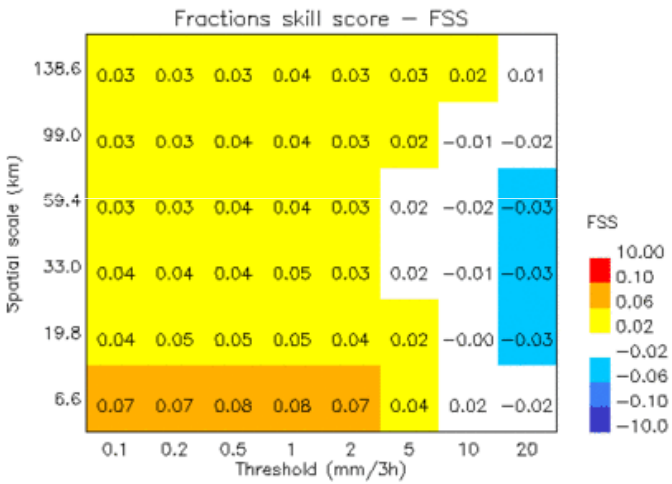
Neighbourhood (fuzzy) verification: Spring 2010
3h acc, leadtime +3h to +6h
Fractions Skill Score (top), Upscaling (bottom)



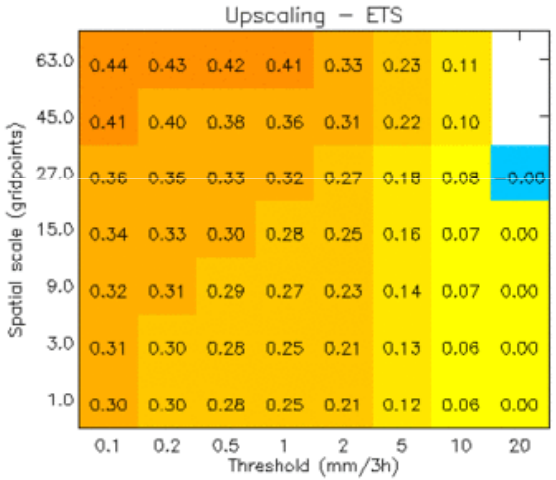
COSMO-2

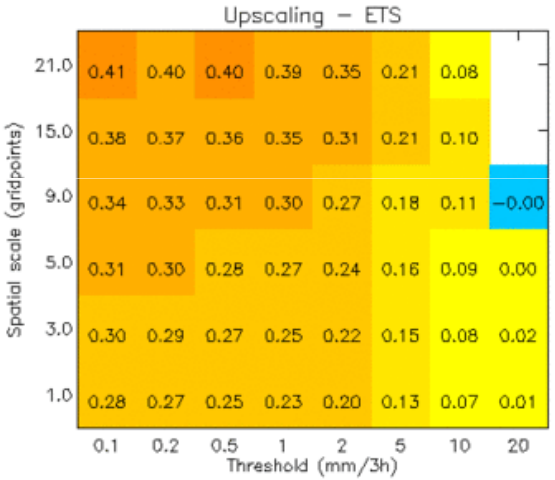


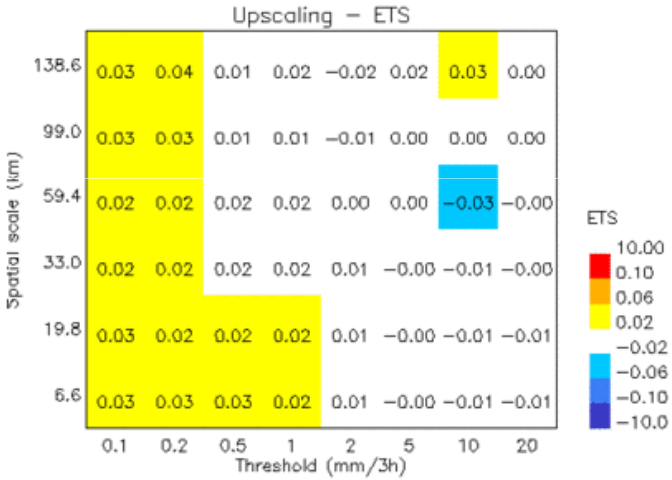
COSMO-7



COSMO-2 – COSMO-7

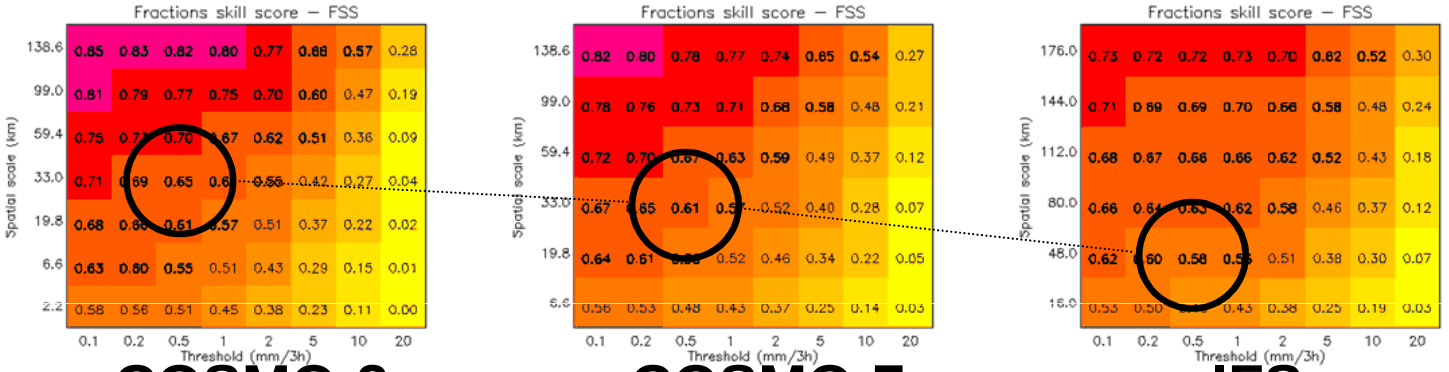






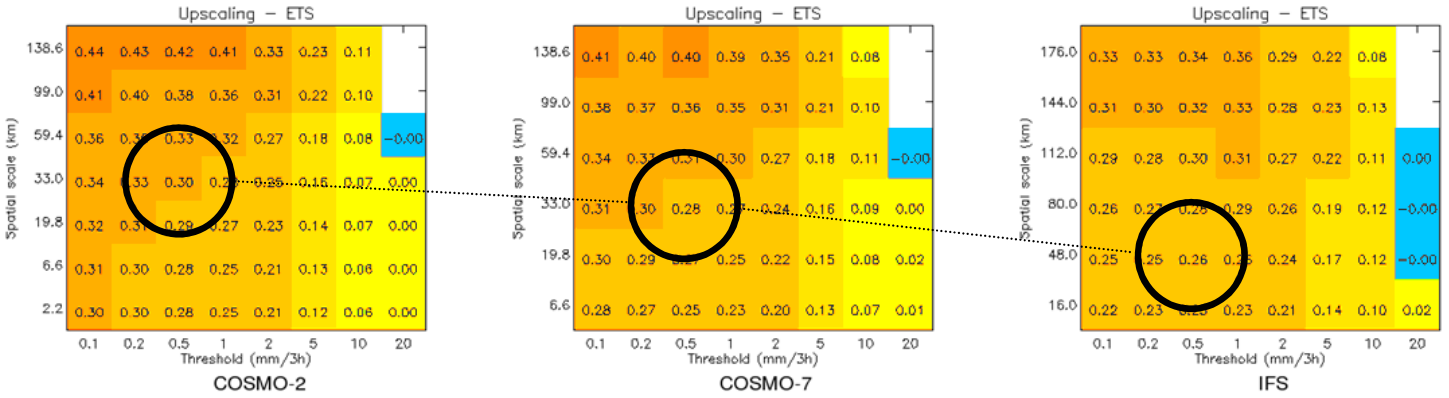
Neighbourhood (fuzzy) verification: Spring 2010
3h acc, leadtime +3h to +6h for COSMO, +3h to +15h for IFS

Fractions Skill Score
FSS

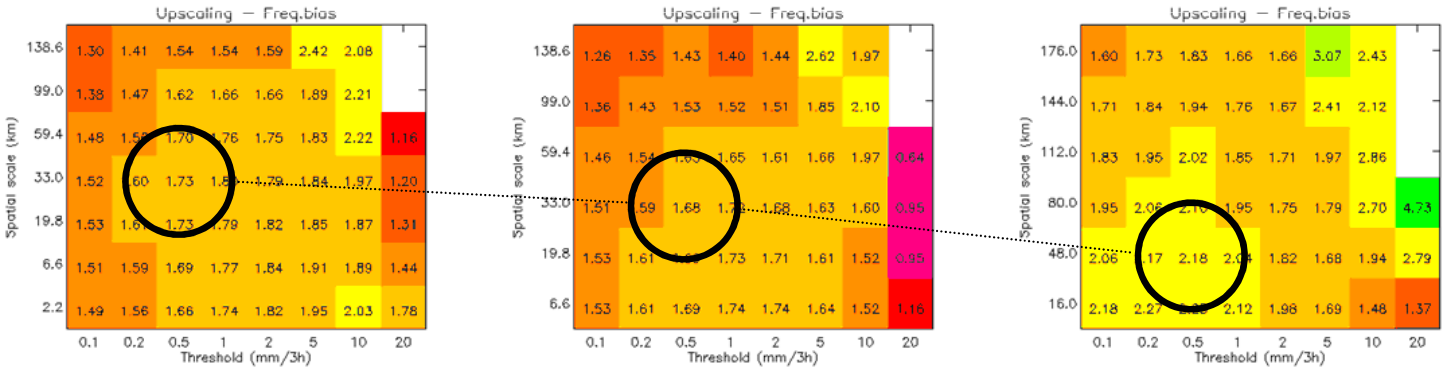


COSMO-2 COSMO-7 IFS

Upscaling
ETS



Upscaling
freq. bias
FBI



Summary of neighbourhood verification at MeteoSwiss

What did we learn from neighbourhood verification?

- COSMO-2, COSMO-7, and IFS have skill
- best forecast of the spatial structure on larger scales (higher FSS values)
- skill of the models as well as the difference between COSMO-2 and COSMO-7 strongly varies for different weather types

  → best skill: early summer and autumn, resp. south and westerly flow
  → greatest difference COSMO-2 minus COSMO-7: summer (May to September) resp. for northern and westerly flow and in convective situations

Neighbourhood verification for precipitation at DWD

Next slides:

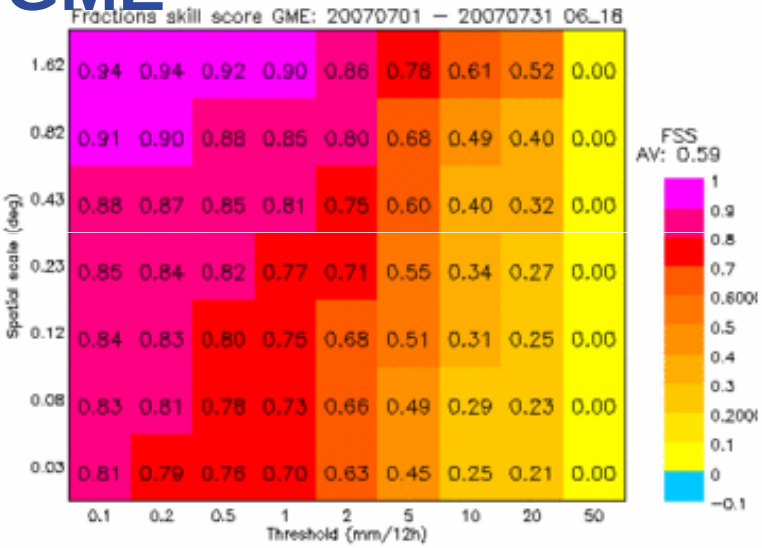
- Fractions Skill Score (FSS) for the three german models:
  - GME
  - COSMO-EU (7km)
  - COSMO-DE (2.8km)
- for each July month: 2007, 2008, 2009 and 2010

Fuzzy verification July 2007: FSS

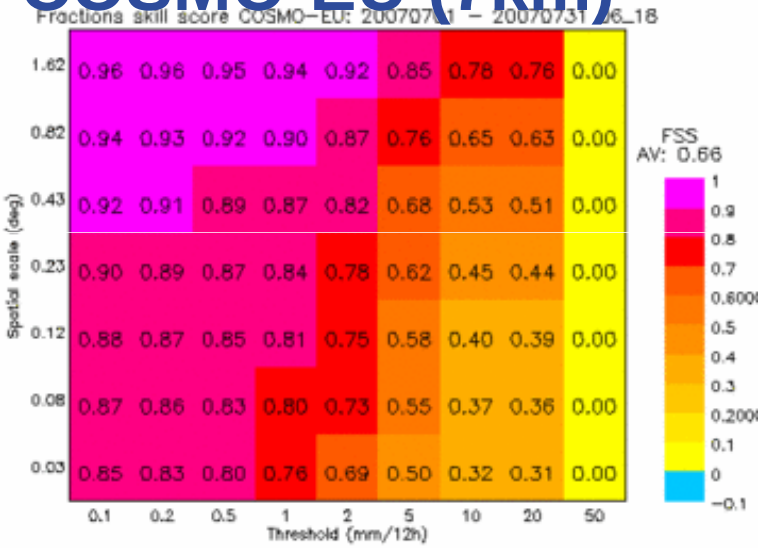
CONSORTIUM FOR SMALL SCALE MODELING COSMO

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

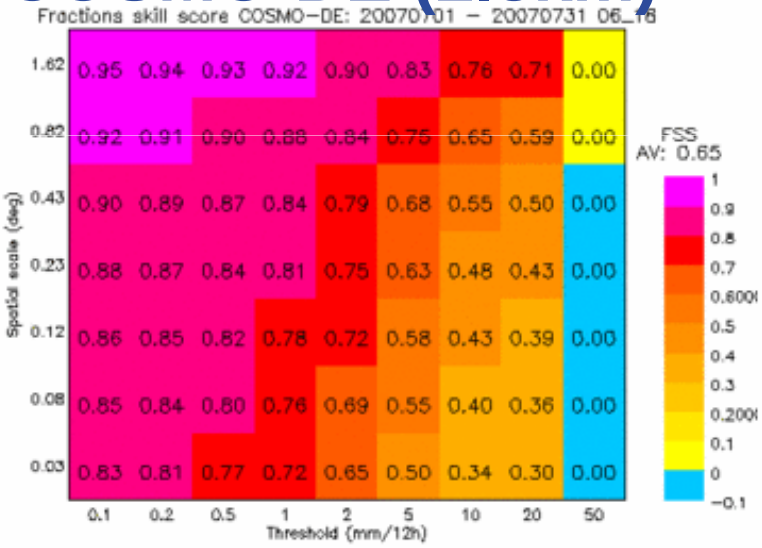
GME



COSMO-EU (7km)



COSMO-DE (2.8km)



U. Damrath
DWD

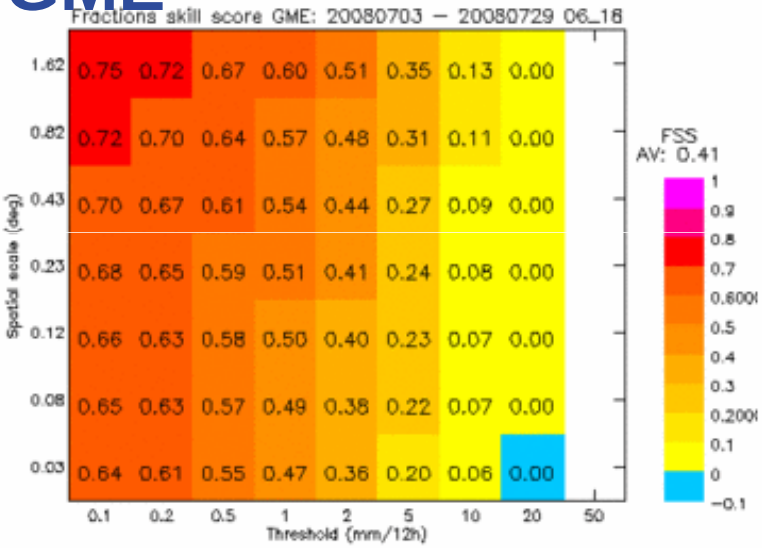
Monthly average of precipitation: 120 mm

Fuzzy verification July 2008: FSS

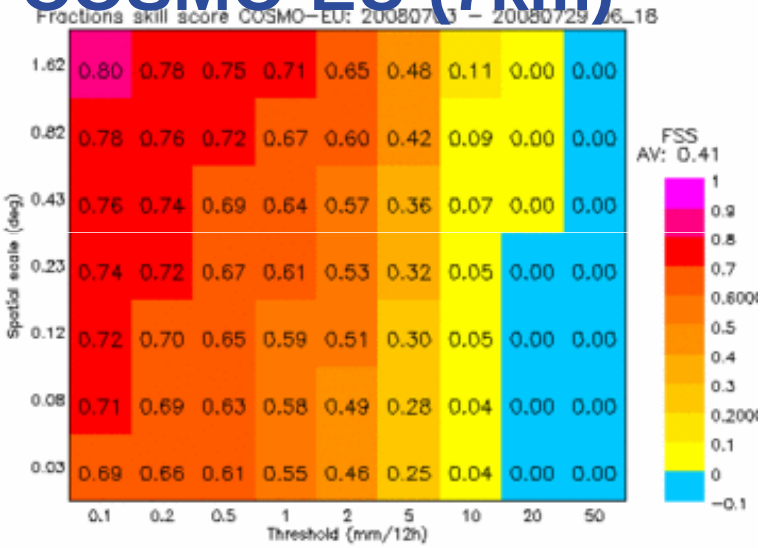
CONSORTIUM FOR SMALL SCALE MODELING COSMO

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

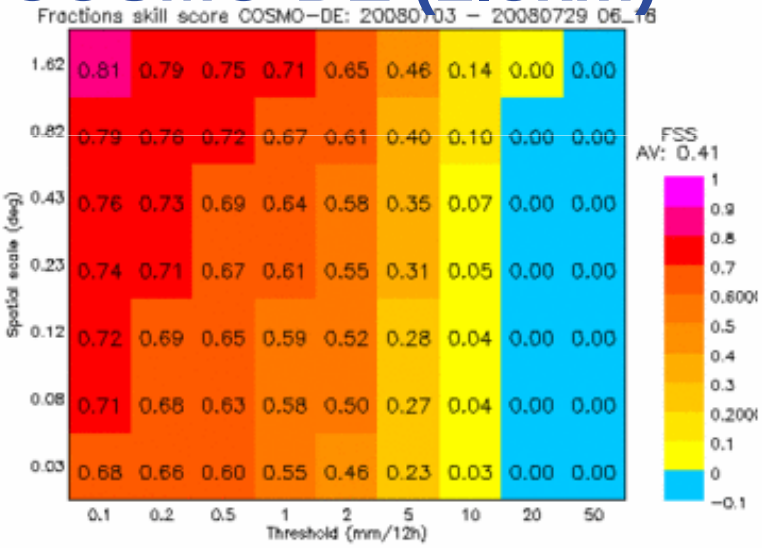
GME

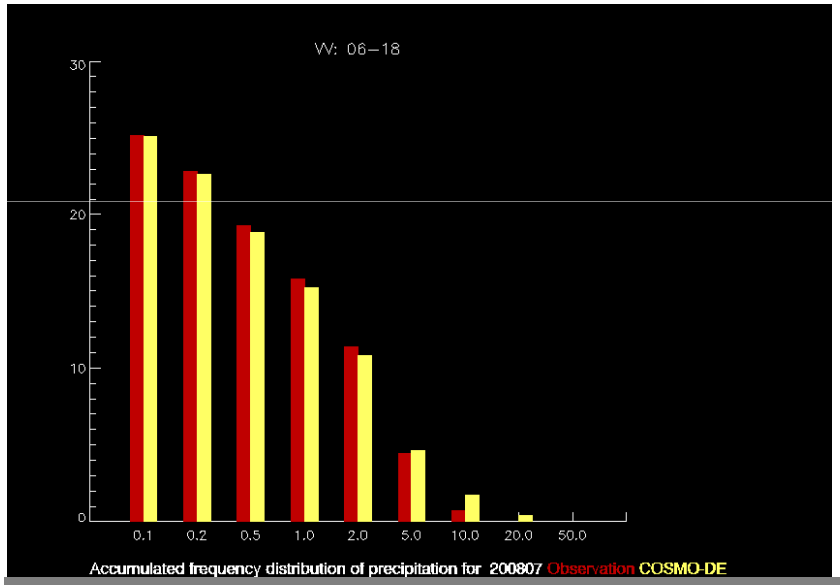


COSMO-EU (7km)



COSMO-DE (2.8km)





Monthly average of precipitation: 88 mm

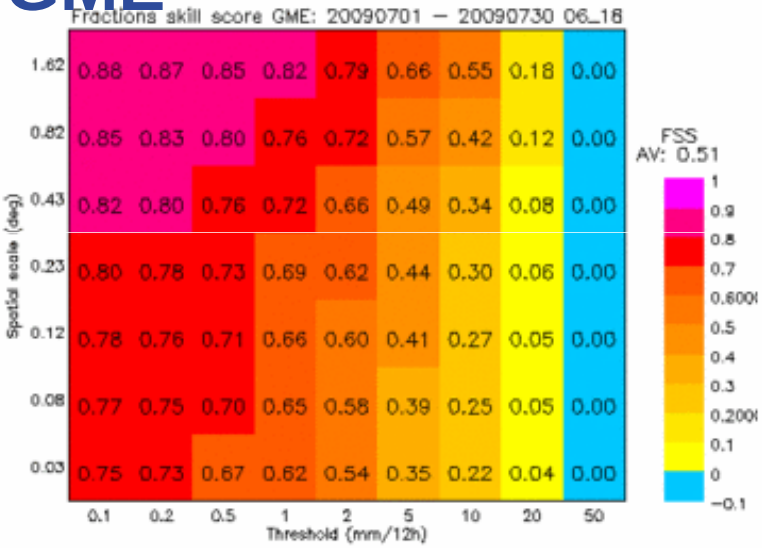
U. Damrath
DWD

Fuzzy verification July 2009: FSS

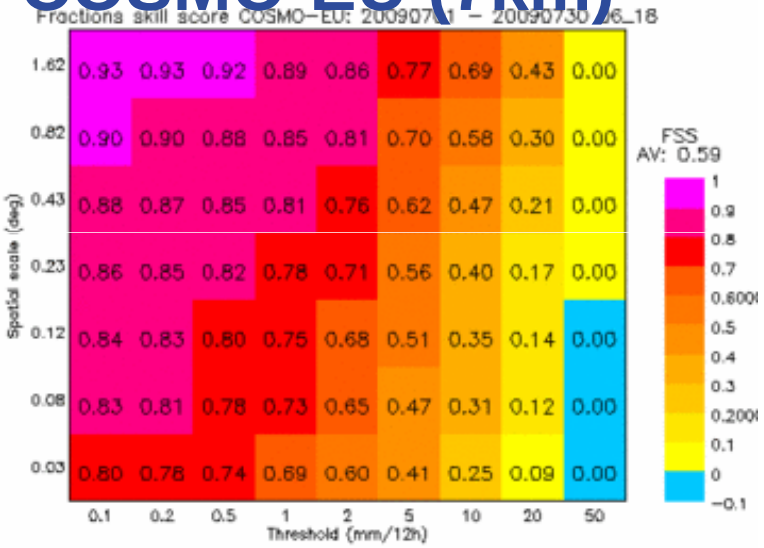
CONSORTIUM FOR SMALL SCALE MODELING COSMO

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

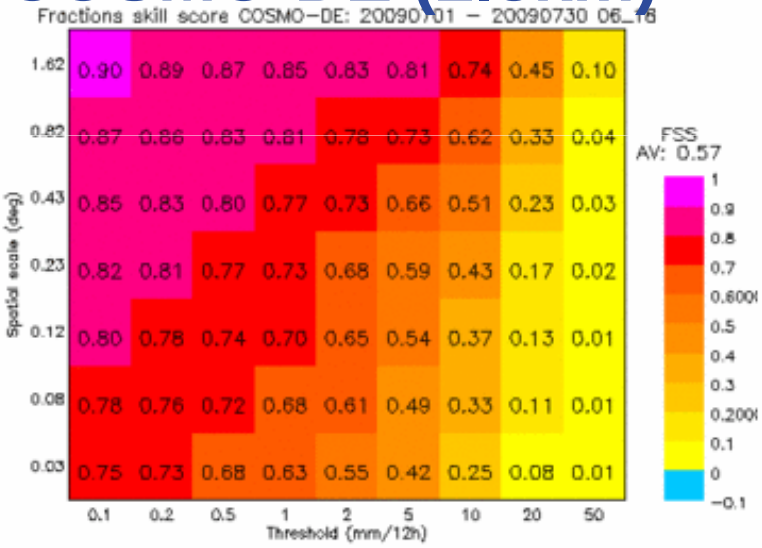
GME

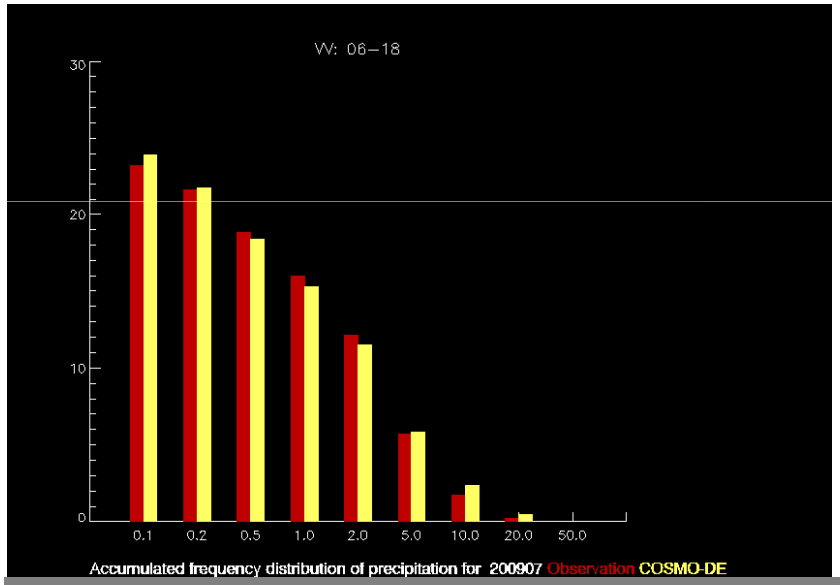


COSMO-EU (7km)



COSMO-DE (2.8km)





Monthly average of precipitation: 108 mm

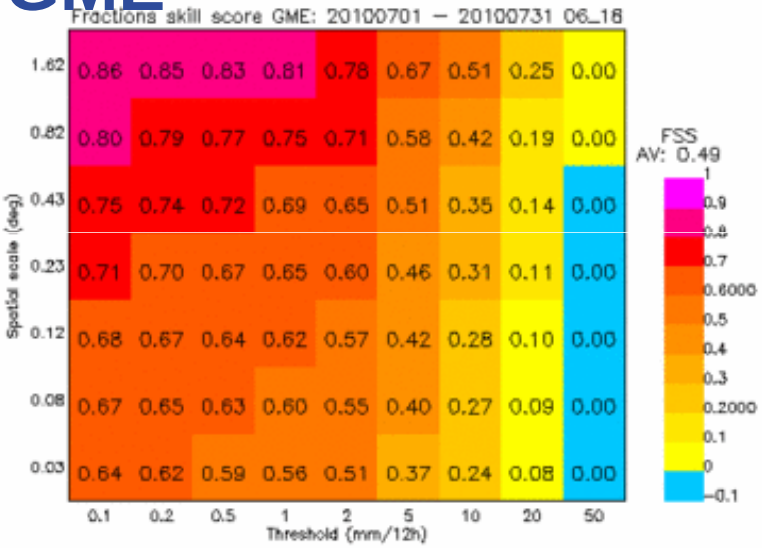
U. Damrath
DWD

Fuzzy verification July 2010: FSS

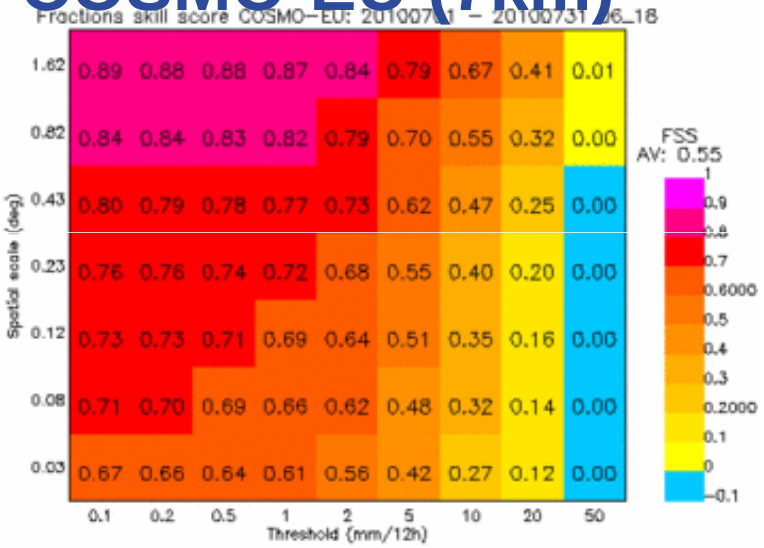
CONSORTIUM FOR SMALL SCALE MODELING COSMO

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

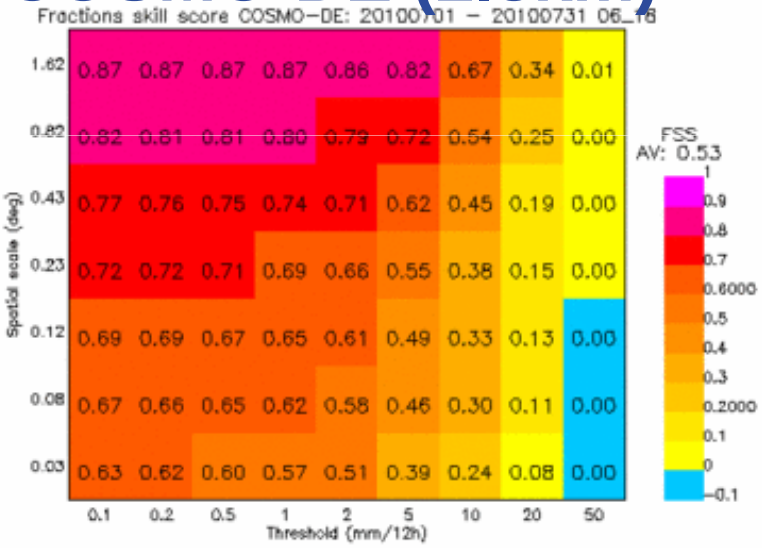
GME

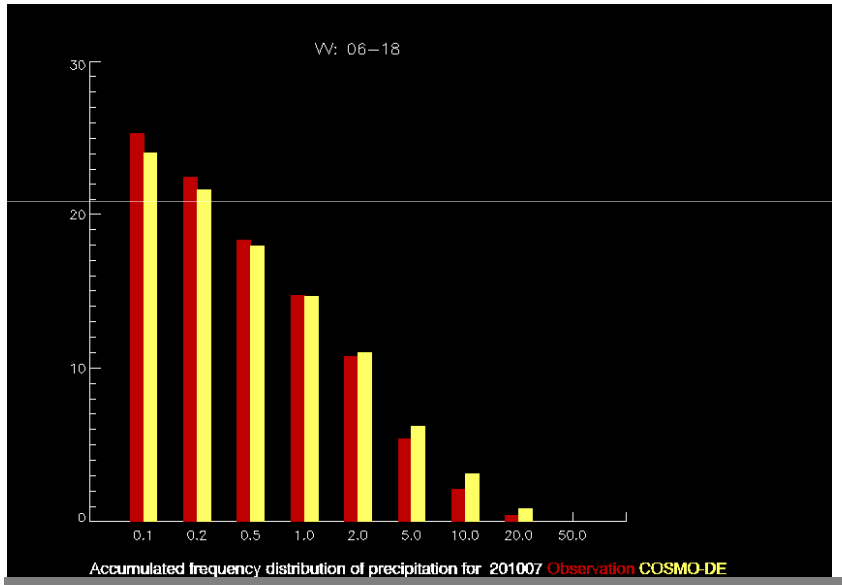


COSMO-EU (7km)



COSMO-DE (2.8km)

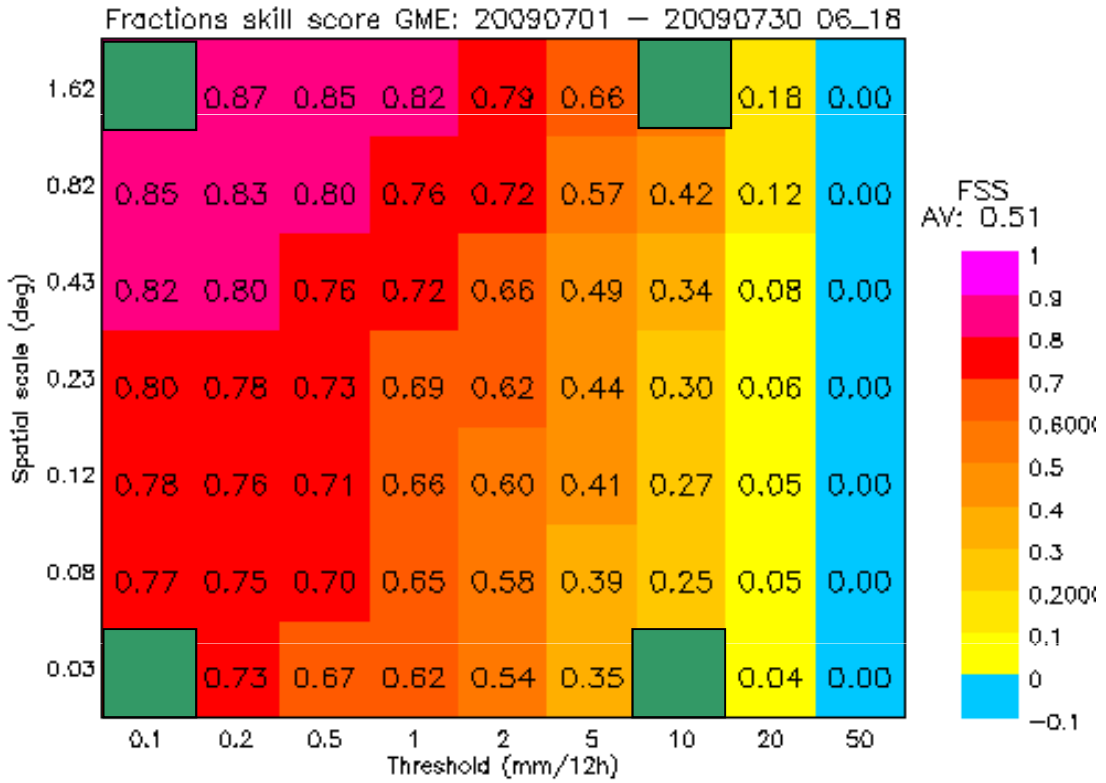




Monthly average of precipitation: 78 mm

U. Damrath
DWD

Time series, choice of windows and thresholds



next slides: monthly scores for the four green boxes for GME, COSMO-EU and COSMO-DE

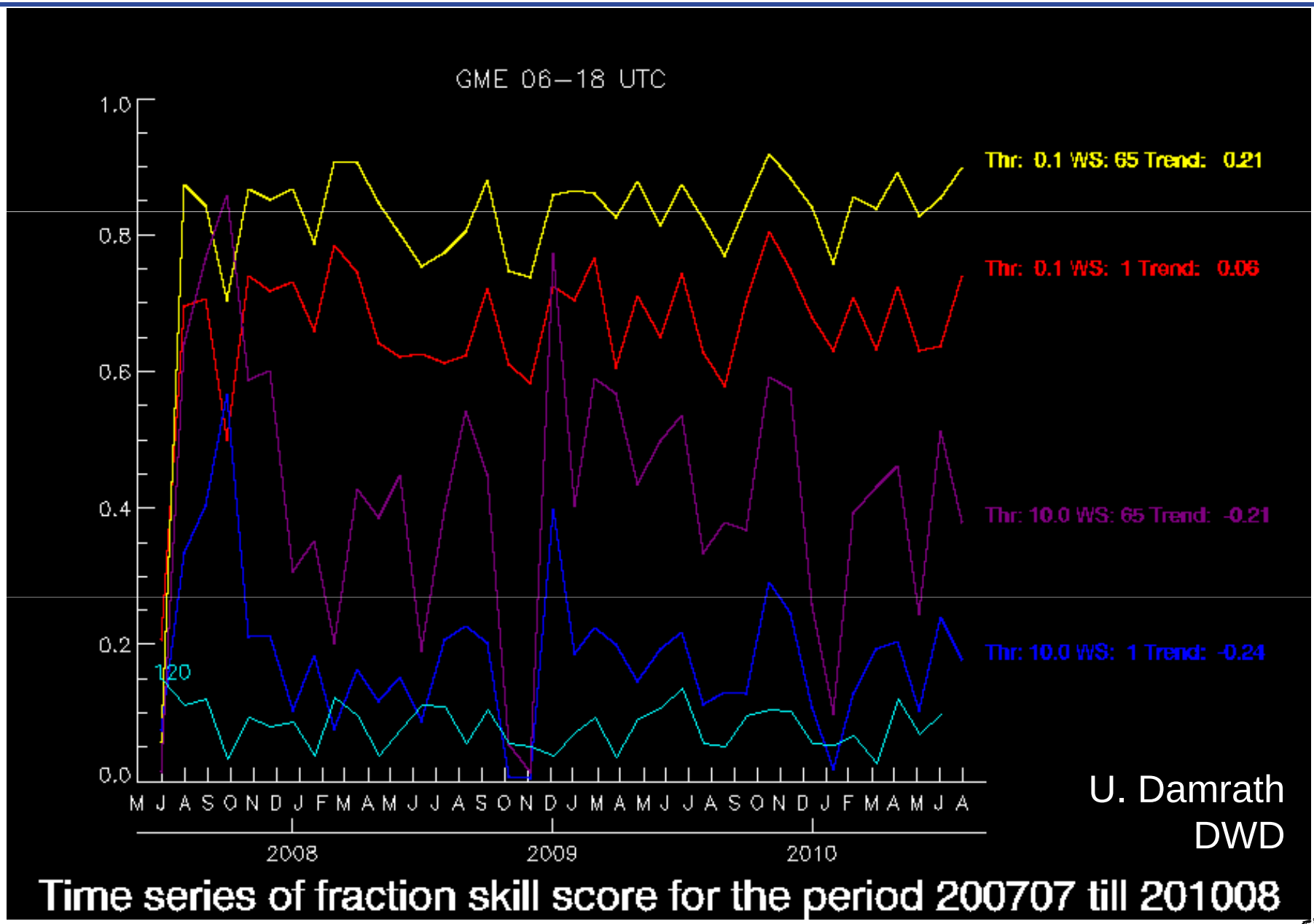
U. Damrath
DWD

Fuzzy verification: Time series, FSS GME VV:06-18

CONSORTIUM FOR SMALL SCALE MODELING
COSMO

GME

Deutscher Wetterdienst
Wetter und Klima aus einer Hand
DWD



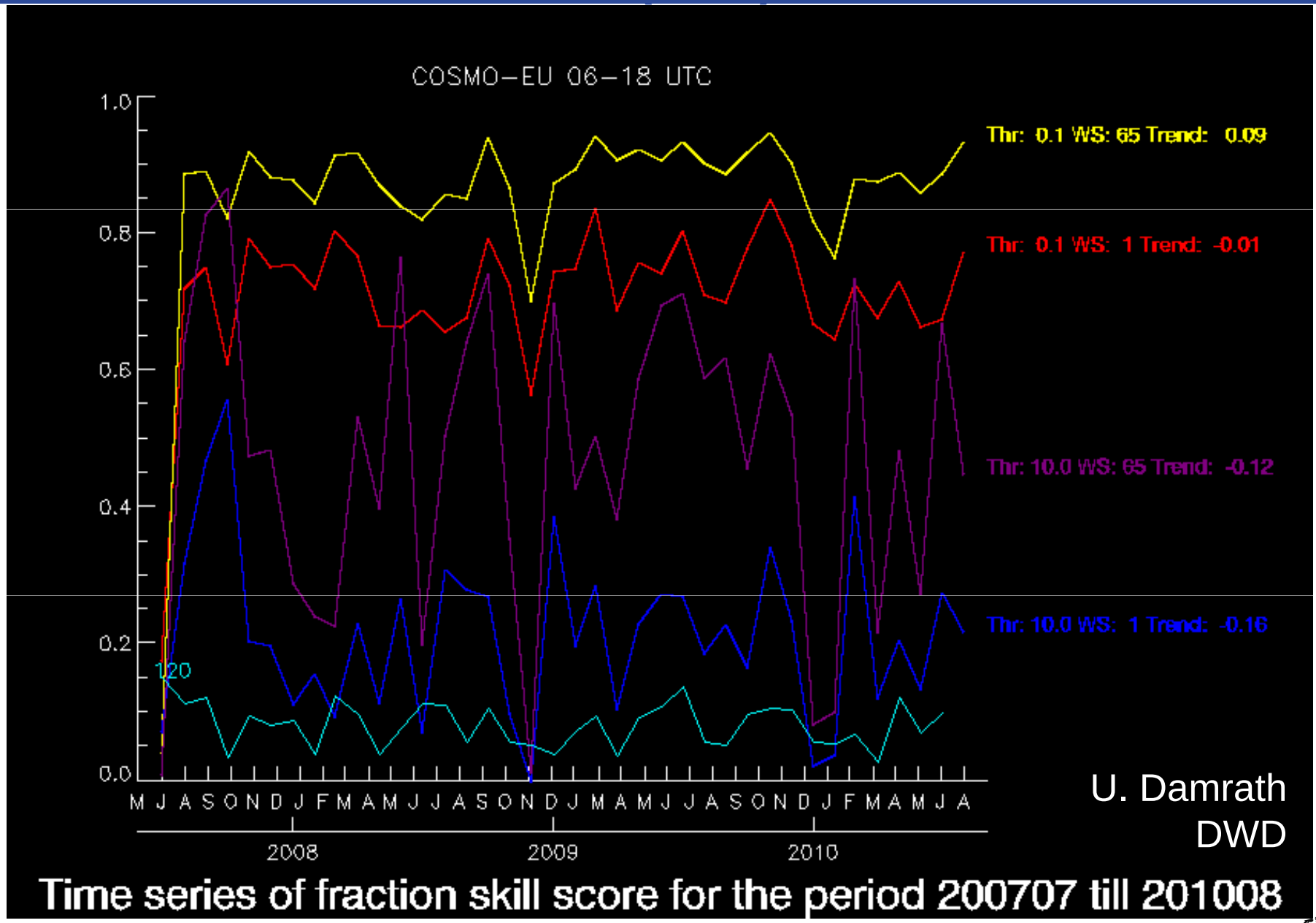
U. Damrath
DWD

Fuzzy verification: Time series, FSS CEU VV:06-18

CONSORTIUM FOR SMALL SCALE MODELING COSMO

COSMO-EU (7 km)

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



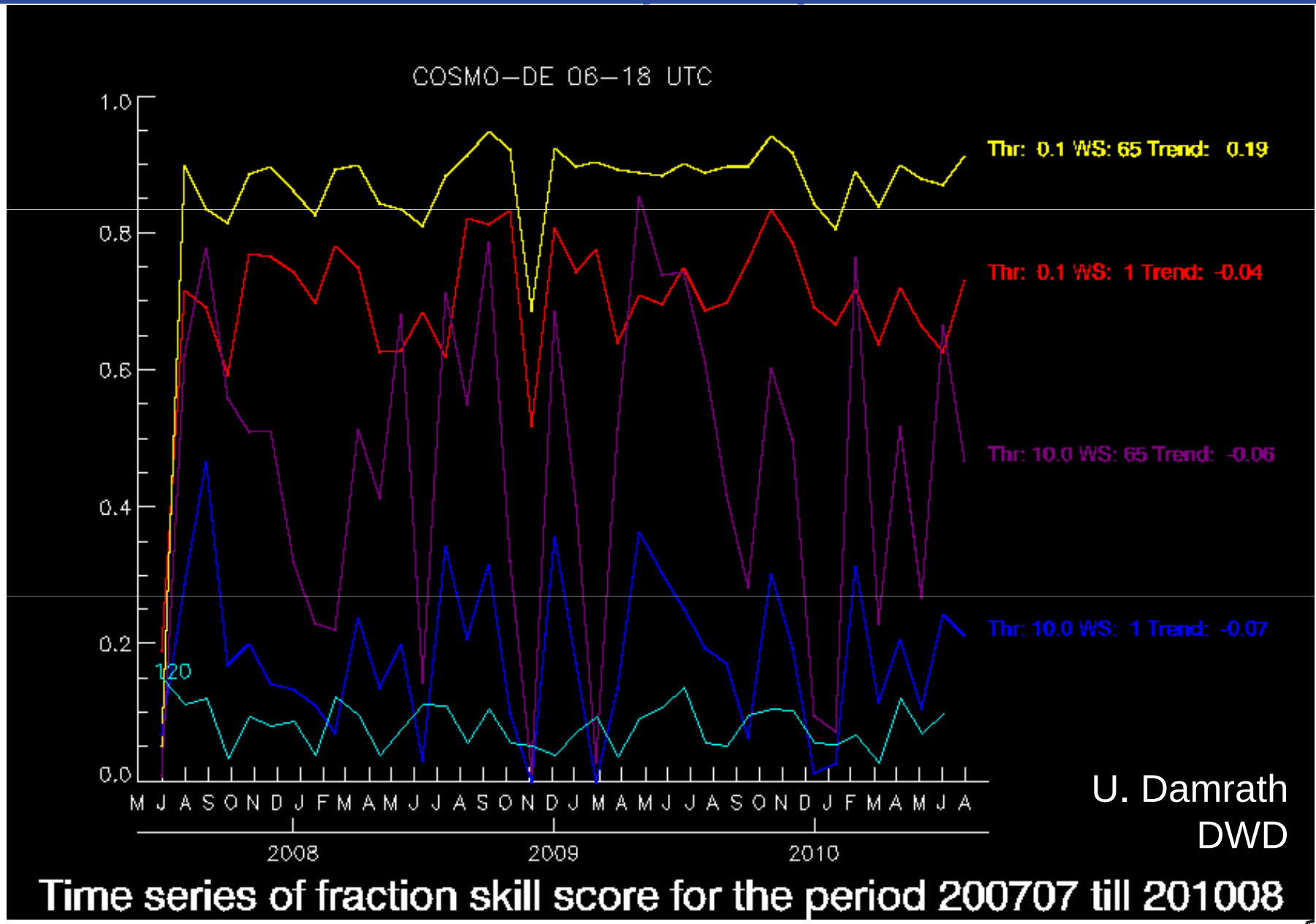
U. Damrath
DWD

Fuzzy verification: Time series, FSS CDE VV:06-18

CONSORTIUM FOR SMALL SCALE MODELING COSMO

COSMO-DE (2.8 km)

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



Summary of neighbourhood verification at DWD

U. Damrath
DWD

Long-term trends in precipitation (2007 – 2010)

- **Fraction skill score and upscaling ETS are considered. Both scores are relatively high correlated.**
- **Fuzzy verification in general shows best results for low precipitation values and large window sizes**
- **For some months best results can be seen for precipitation amounts around 2 mm $(12\ h)^{-1}$**
- **COSMO-EU and COSMO-DE have nearly the same quality and are better than GME especially during summer times.**

Summary

- First version of the common verification software VERSUS is available
  - intercomparison of models
  - conditional verification
  - and much more …

- Neighbourhood verification
  - provides information on skill as fct of spatial scale
  - convection resolving models outperform their coarser-resolution driving models (cf. also Weusthoff et al. (2010), *MWR*, on D-PHASE data)