Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

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

Slides of COSMO-activities in verification in 2010

compiled by Francis Schubiger (MeteoSwiss)

verification activities in COSMO (1): VERSUS (verification package inside COSMO)

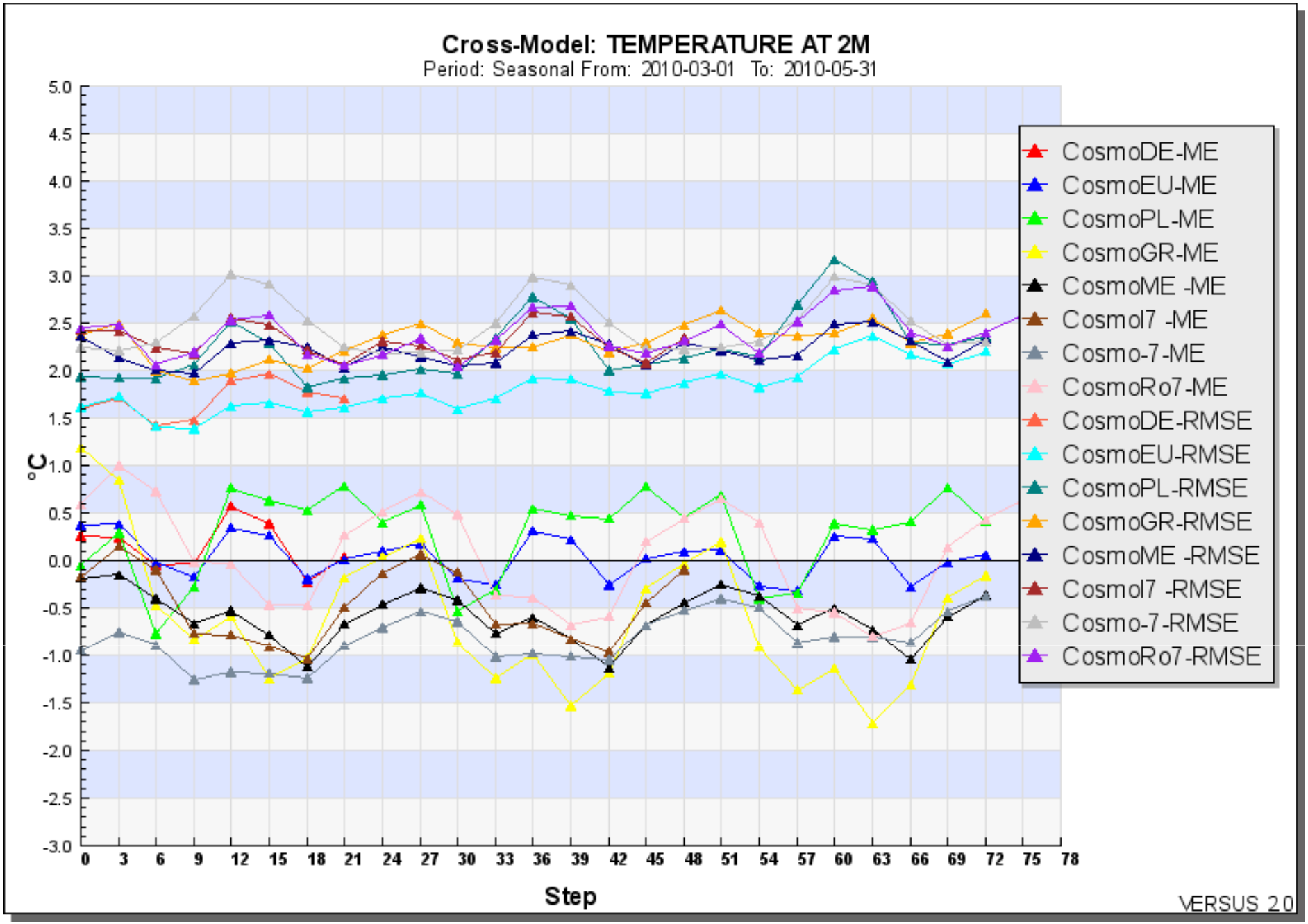
- VERSUS installed at all 7 national weather services: some pending problems but already operational in Italy, Greece, Poland and Romania
  - each season common plots of standard verification of all operational COSMO-models
  - start of conditional verification *(Italy, Greece)*
  - new developments in progress and available for all members in 2011:
    - weather type verification based on separate classification for each country *(all members)*
    - verification of the vertical structure (with TEMPS, AMDAR, VAD,…) through feedback files *(Italy, DWD)*
    - bootstrap confidence interval for visualisation of robustness of scores and to enable model comparison*(Russia)*
    - implementation of probabilistic scores *(Greece, Italy)*
    - fuzzy verification toolbox and object-oriented verification
  - COSI-index (similar to the UK Index) with total cloud cover, 2m-temperature, 10m-windvector and precipitation (long-term trends from DWD for 2003-2010 available)

Production of common verification plots of all operational COSMO-versions

- 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

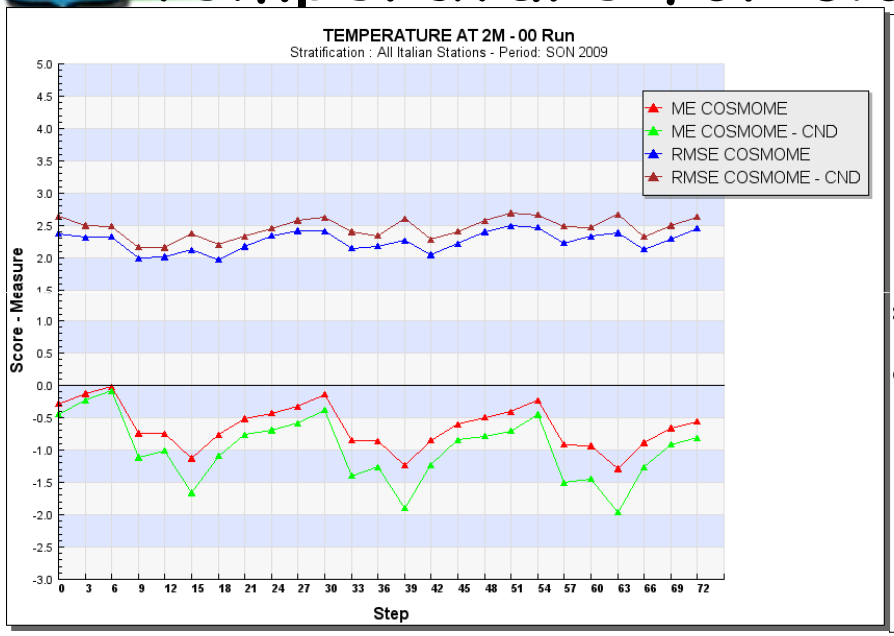


A. Raspanti, Italy

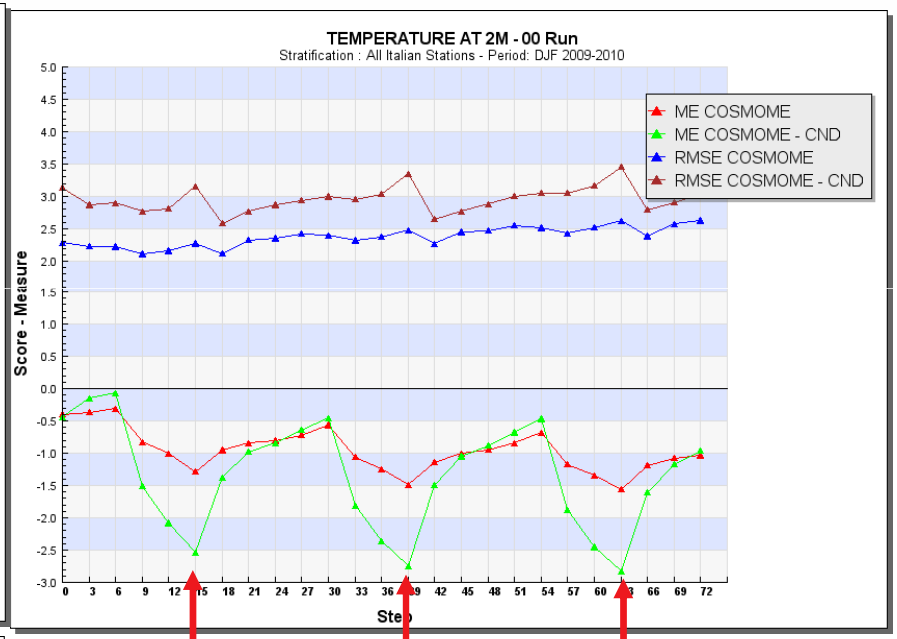
Conditional Verification

temperature for cloud cover obs <=35%

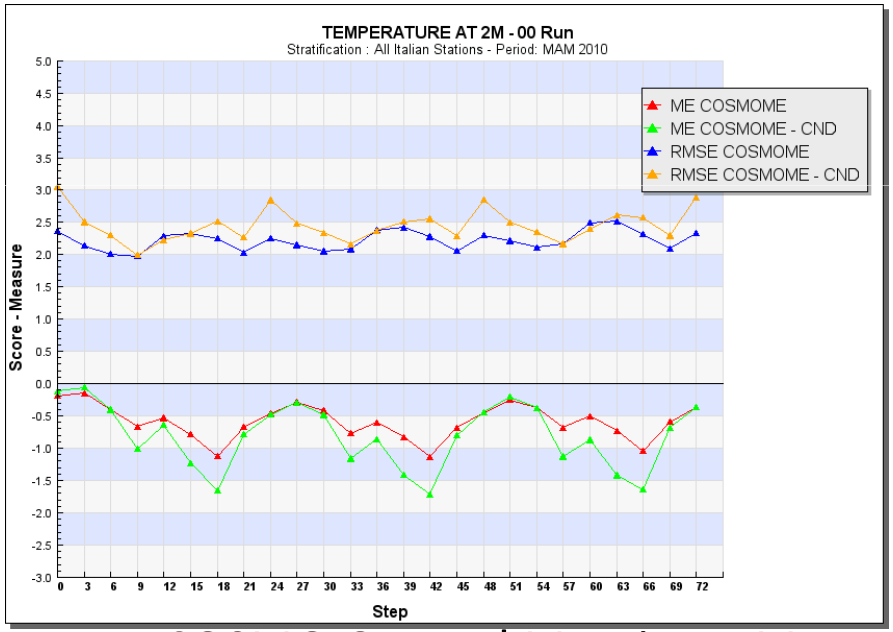
Summer



Winter



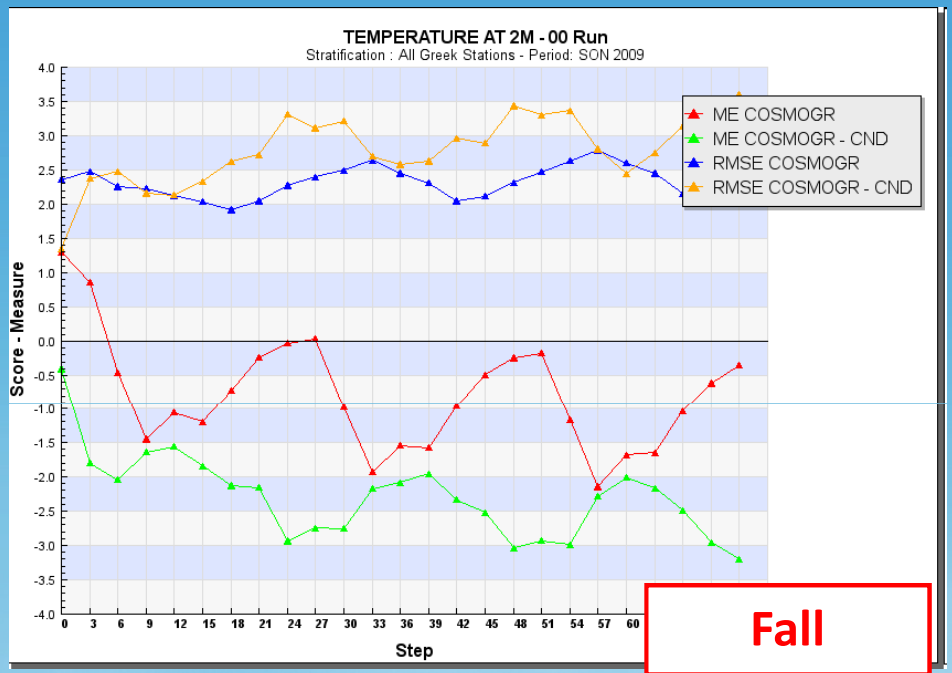
Spring



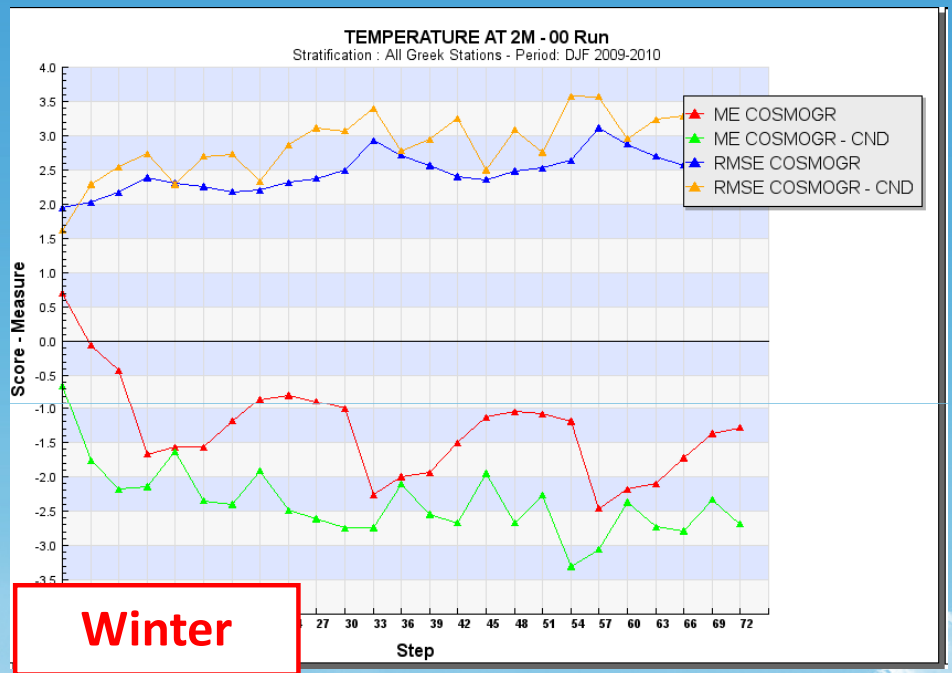
worse behaviour for all the seasons compared to no condition model, especially in winter during night

A. Raspanti, Italy

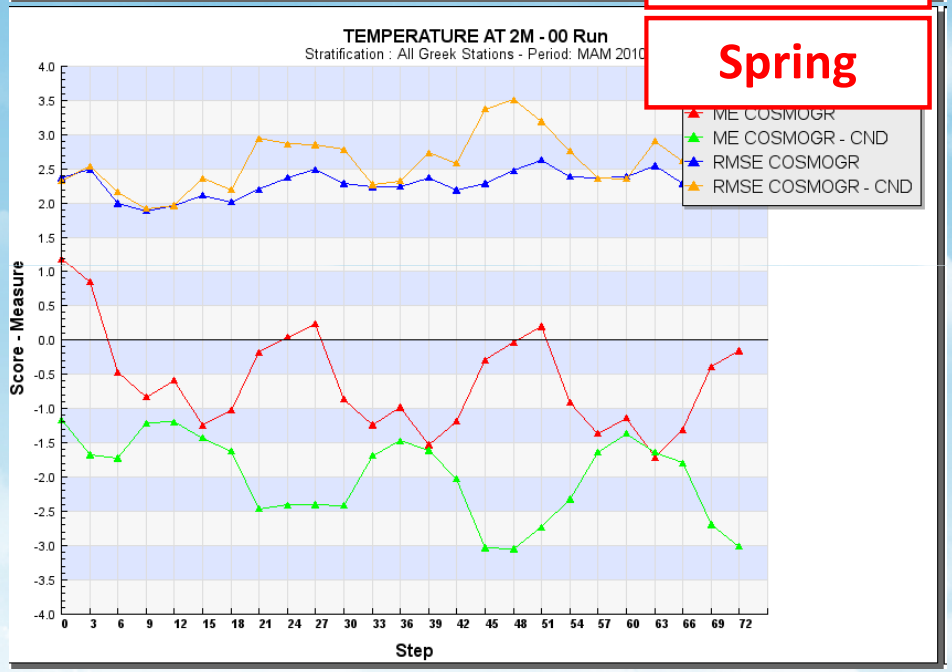
Temperature in ‘high wind’ conditions (> 10 m/s)



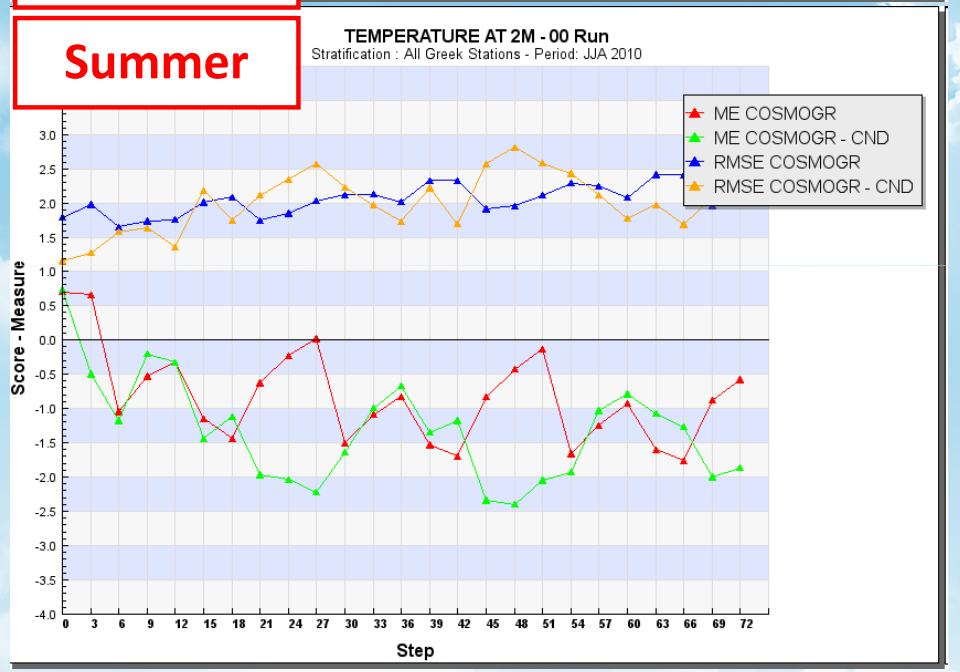
Fall



Winter

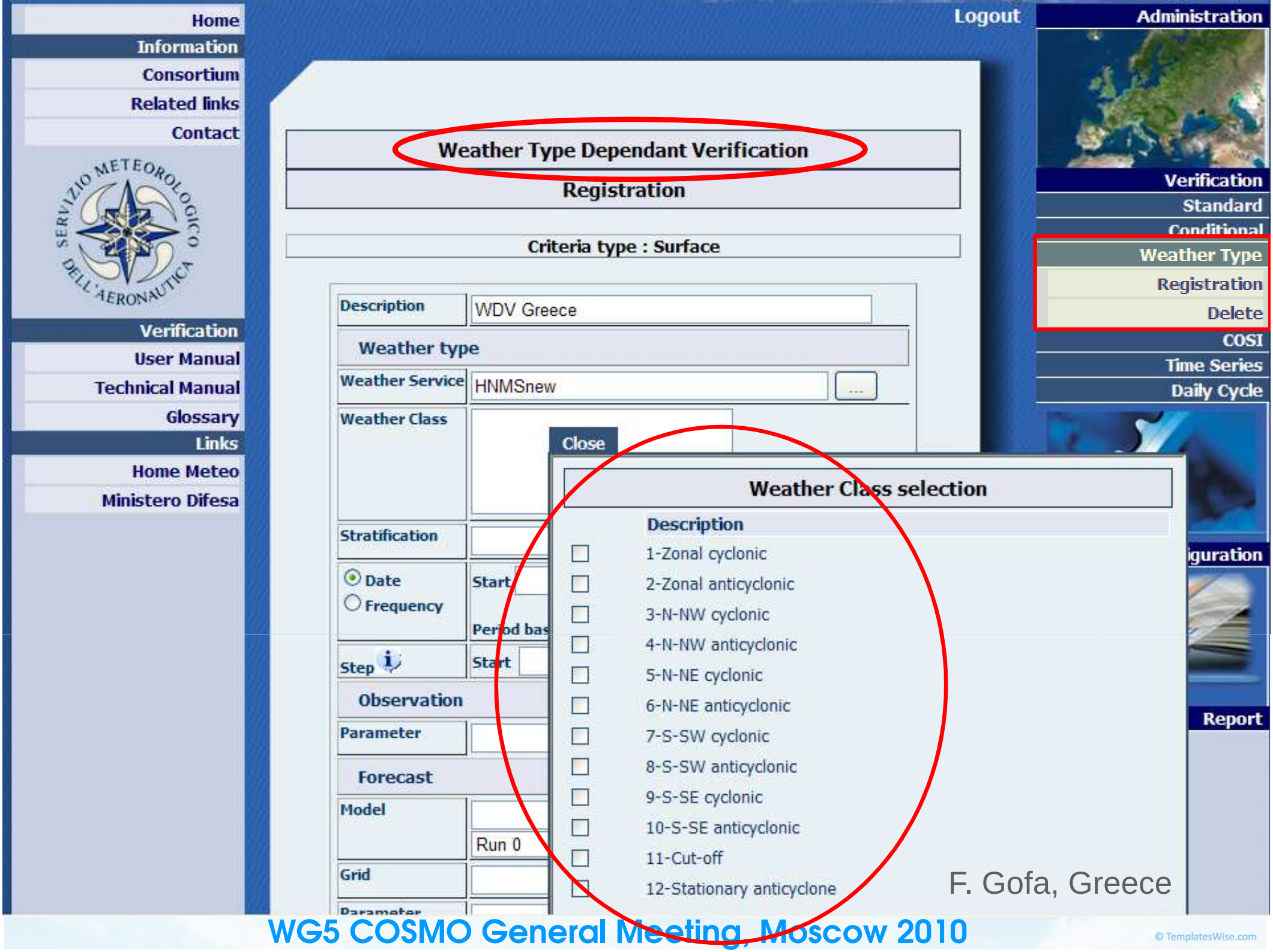


Spring



Summer

F. Gofa, Greece


Home
Information
Consortium
Related links
Contact
Verification
User Manual
Technical Manual
Glossary
Links
Home Meteo
Ministero Difesa
Logout
Administration
Verification
Standard
Conditional
Weather Type
Registration
Delete
COSI
Time Series
Daily Cycle
Report
Weather Type Dependant Verification
Registration
Criteria type : Surface
Description
WDV Greece
Weather type
Weather Service
HNMSnew
Weather Class
Close
Stratification
Date
Frequency
Start
Step
Observation
Parameter
Forecast
Model
Run 0
Grid
Weather Class selection
Description
1-Zonal cyclonic
2-Zonal anticyclonic
3-N-NW cyclonic
4-N-NW anticyclonic
5-N-NE cyclonic
6-N-NE anticyclonic
7-S-SW cyclonic
8-S-SW anticyclonic
9-S-SE cyclonic
10-S-SE anticyclonic
11-Cut-off
12-Stationary anticyclone
F. Gofa, Greece
WG5 COSMO General Meeting, Moscow 2010

Verification activities in COSMO (2): neighborhood („fuzzy“) verification

- further studies with neighborhood („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)

Neighborhood 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 04 – 07h 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)

Neighborhood (fuzzy) verification 2009, FSS and UP

Fractions Skill Score

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

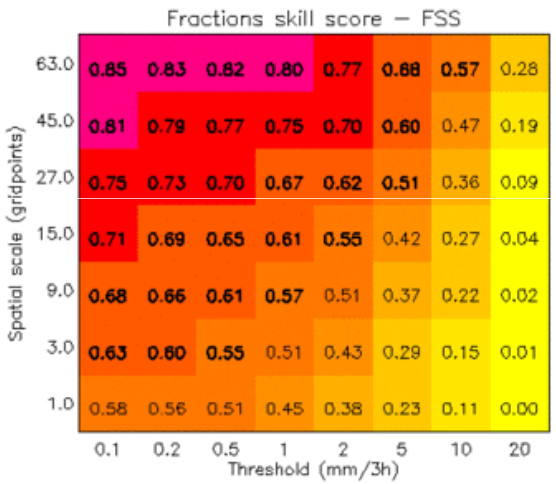
Upscaling

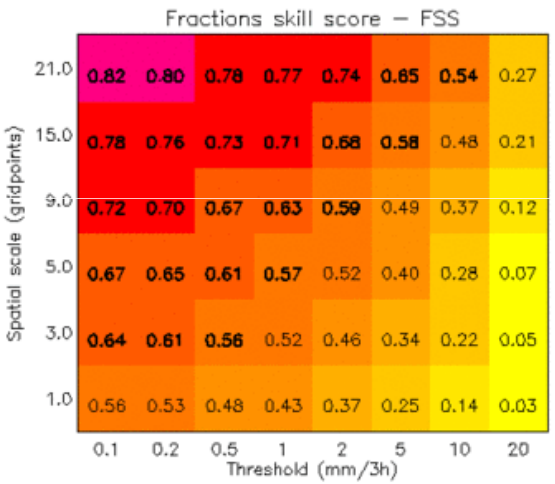
Verification in COSMO in the year 2010

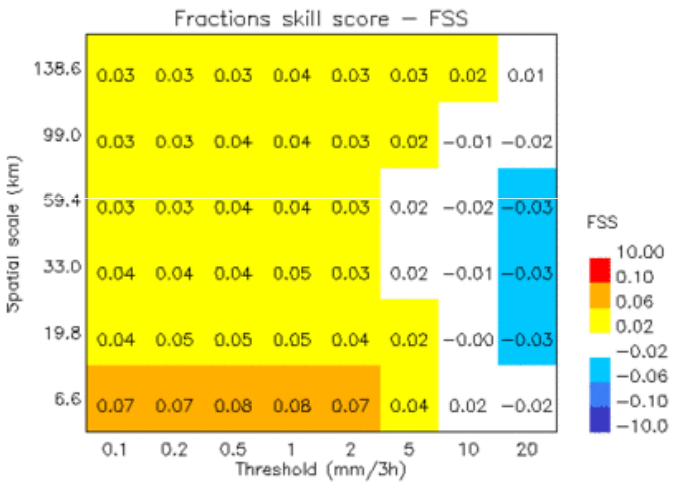
bad good

COSMO-7 better COSMO-2 better

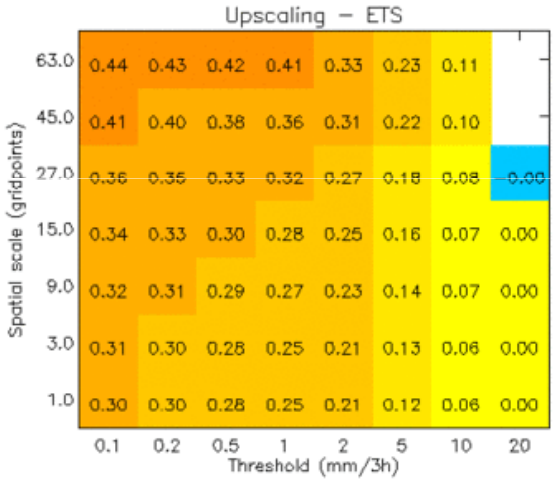
Neighborhood (fuzzy) verification: Spring 2010
COSMO-2/COSMO-7: 3h acc, leadtime +3 to +6h for all models
Fractions Skill Score (top), Upscaling (bottom)

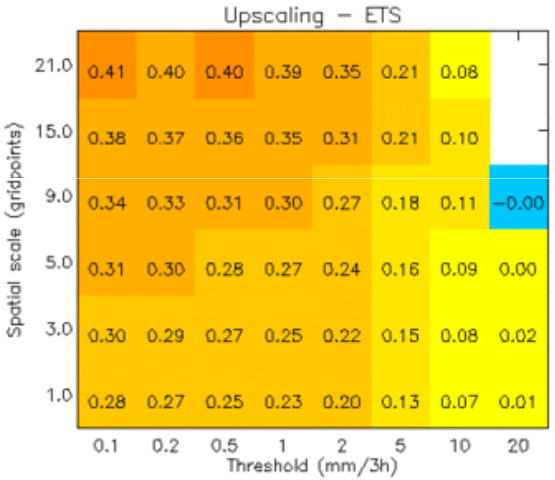


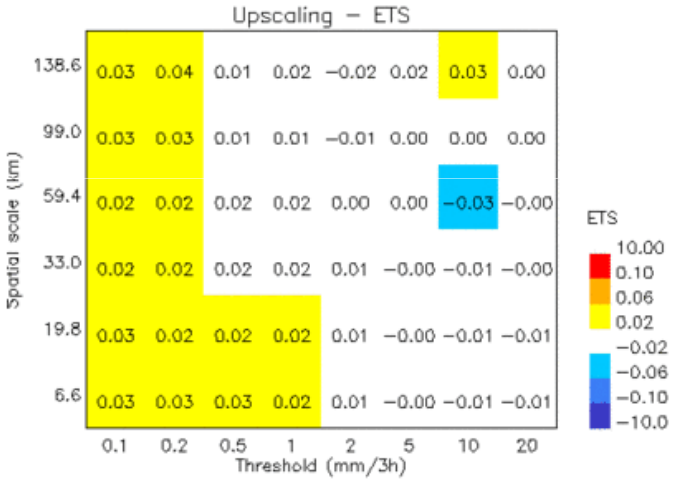




COSMO-2 | **COSMO-7** | **COSMO-2 – COSMO-7**





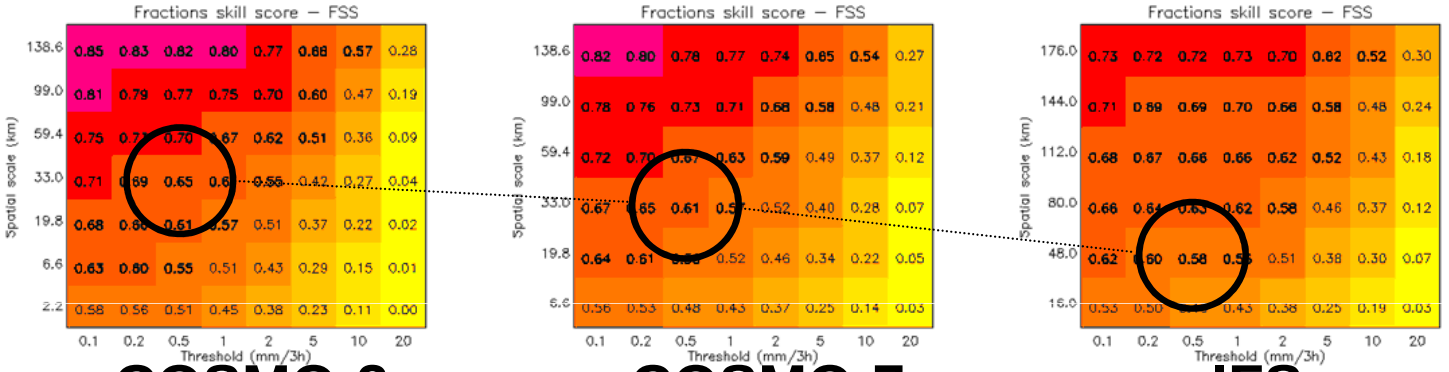


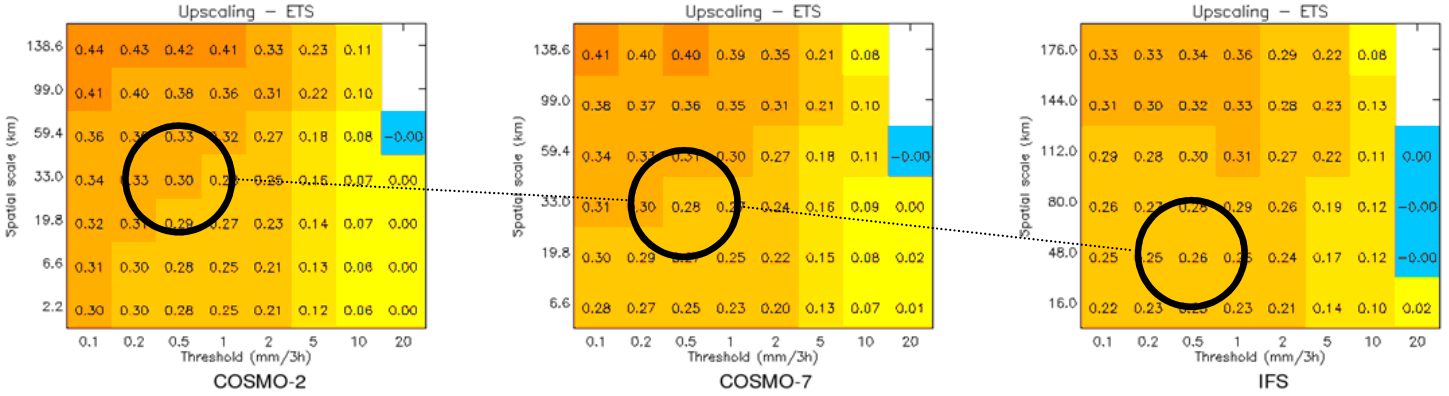
Neighborhood (fuzzy) verification: Spring 2010
COSMO-2/COSMO-7: 3h acc, leadtime +3 to +6h for all models

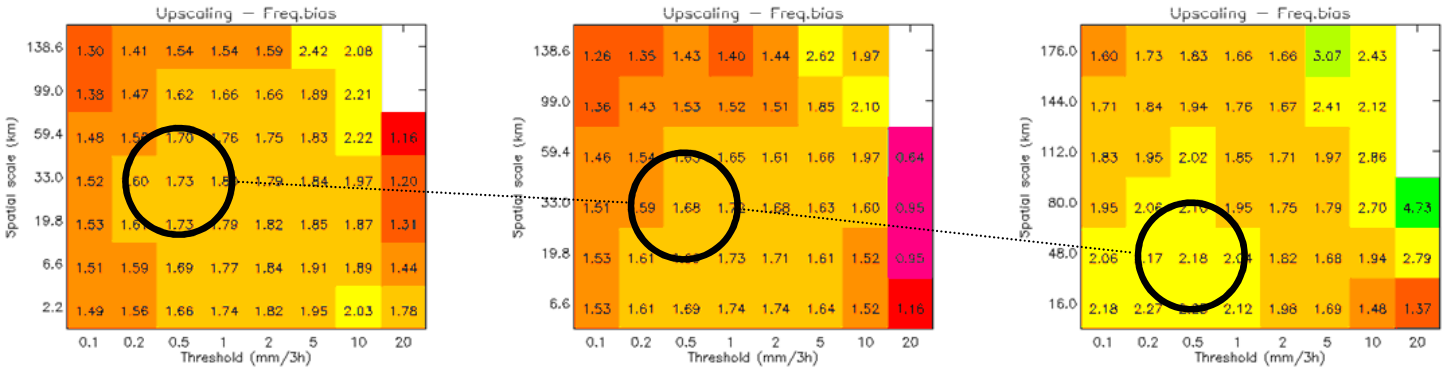
Fractions Skill Score
FSS

Upscaling
ETS

Upscaling
freq. bias
FBI







T. Weusthoff, MeteoSwiss

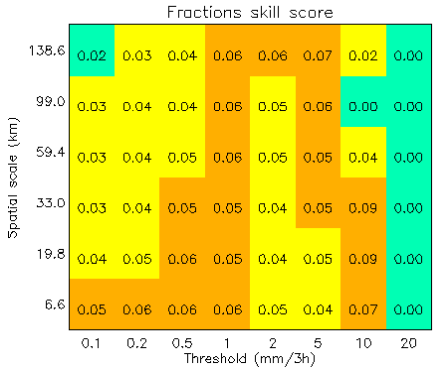
Differences in Fractions Skill score for weather-type dependant verif

COSMO-2 minus COSMO-7

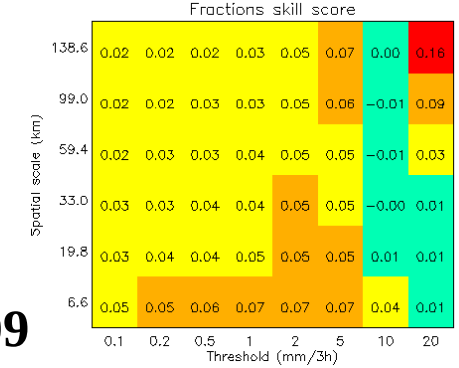
COSMO-7 better — COSMO-2 better

YEAR 2009

NE

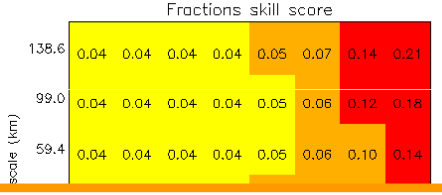


S

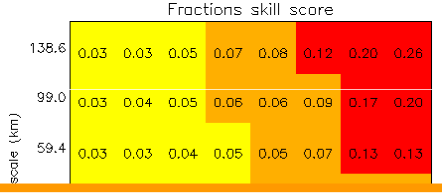


N

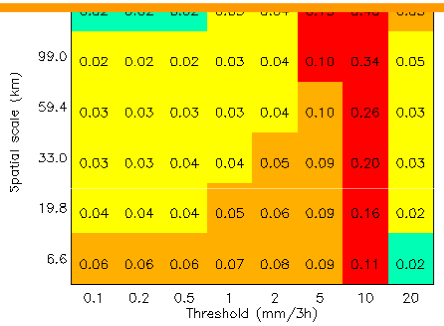
SW

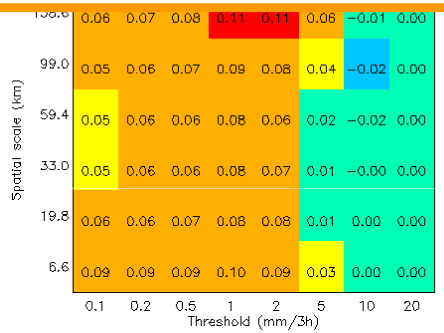


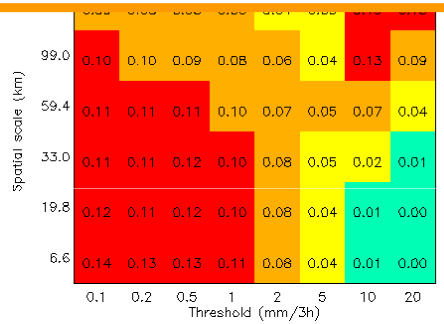
F



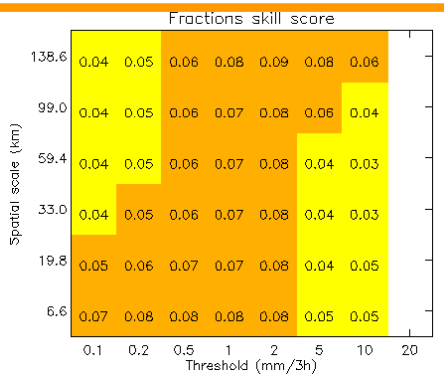
→ greatest adavantage for COSMO-2 for weather types N, NW, SW and „flat“, „high“ and „low“ mainly for higher thresholds





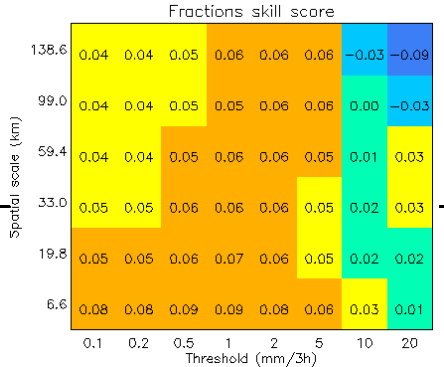


SE

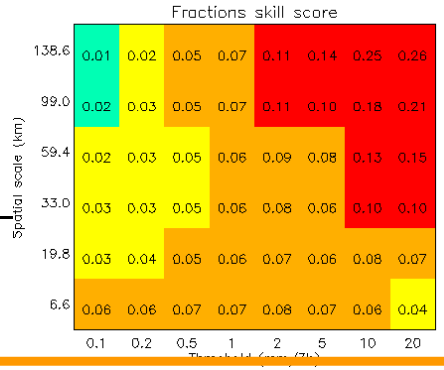


O in the year 2010

W



L



Summary of neighborhood verification @ MeteoSwiss

What did we learn from neighborhood 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 strongly varies for different weather types and also the difference COSMO-2 to COSMO-7 is differently

  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

Neighborhood verification for precipitation at DWD

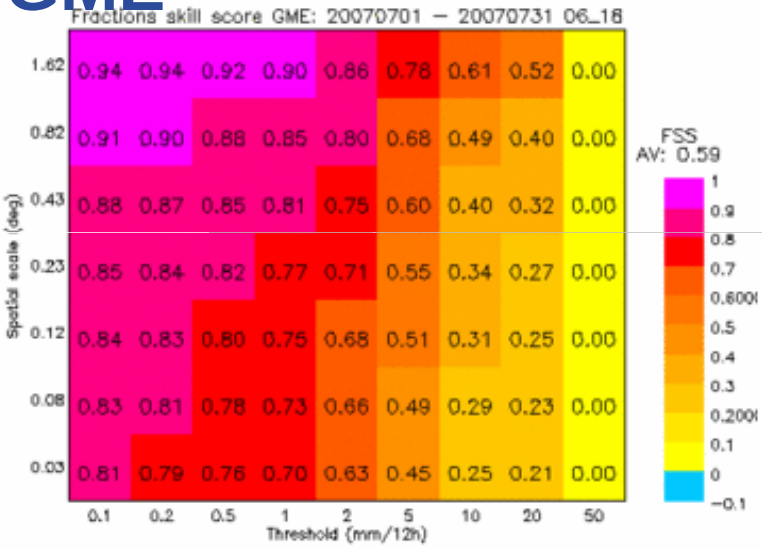
Next slides:

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

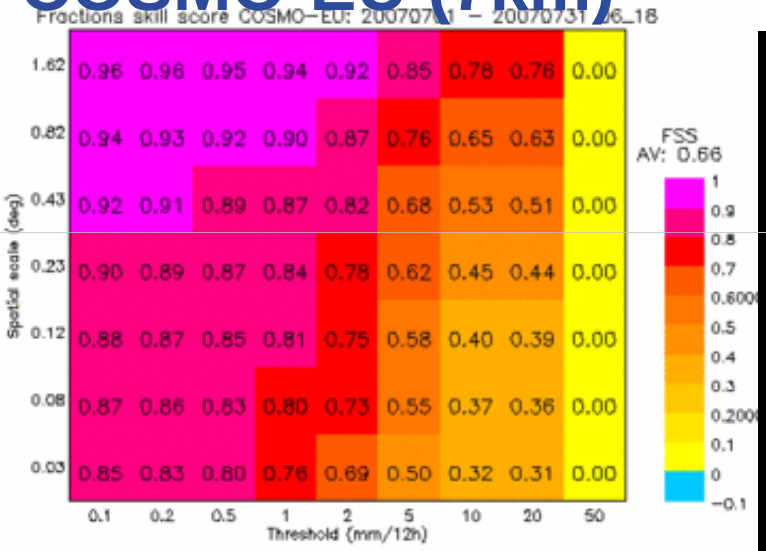
Fuzzy verification July 2007: FSS

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

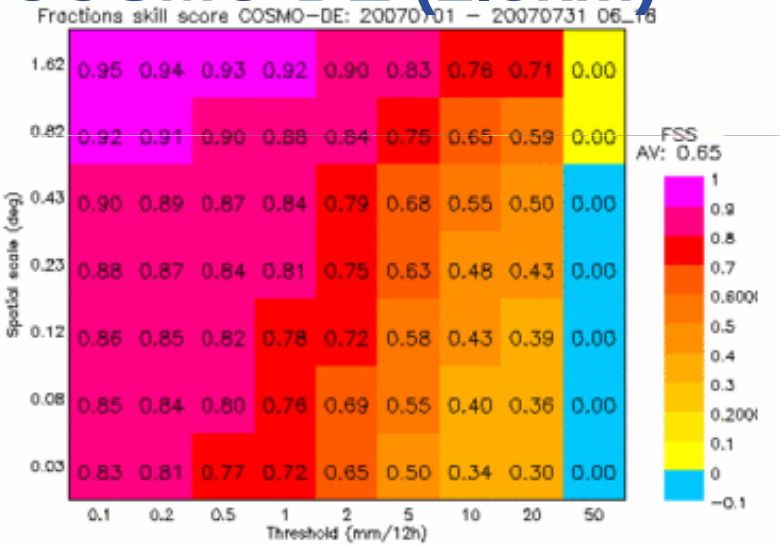
GME



COSMO-EU (7km)



COSMO-DE (2.8km)



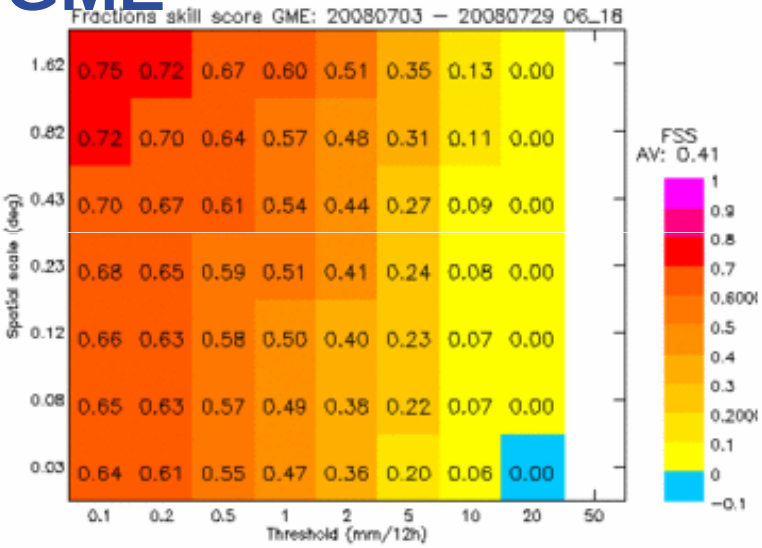
U. Damrath
DWD

Monthly average of precipitation: 120 mm

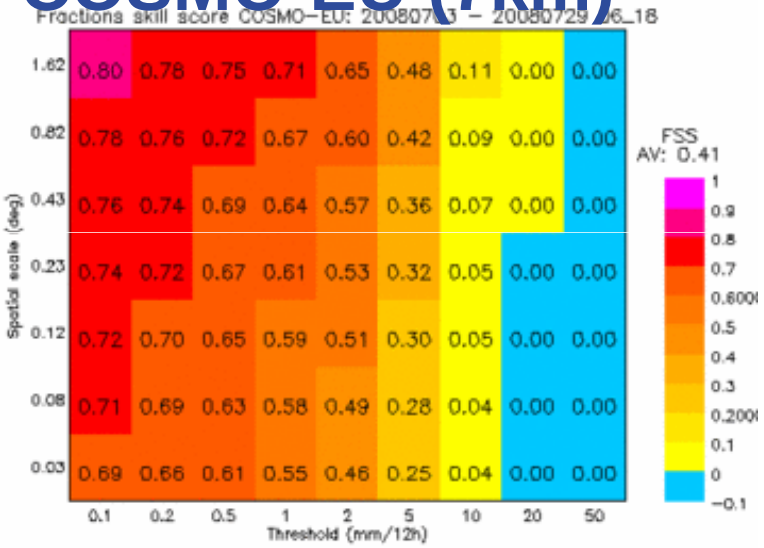
Fuzzy verification July 2008: FSS

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

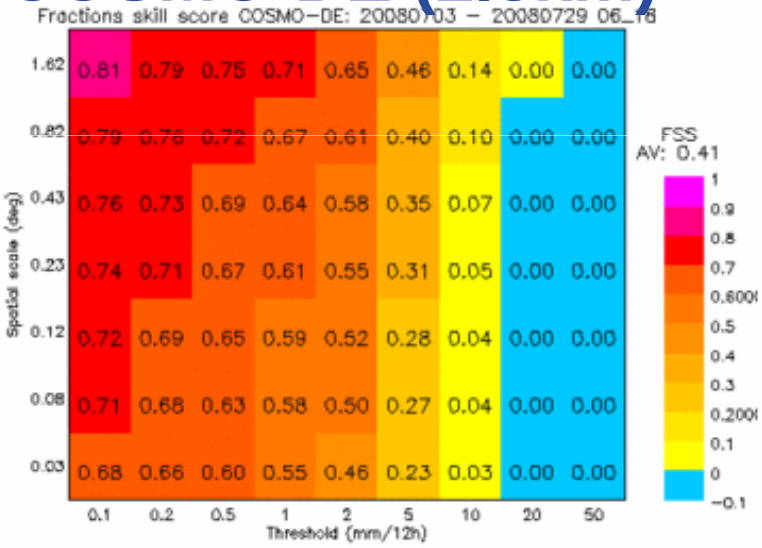
GME

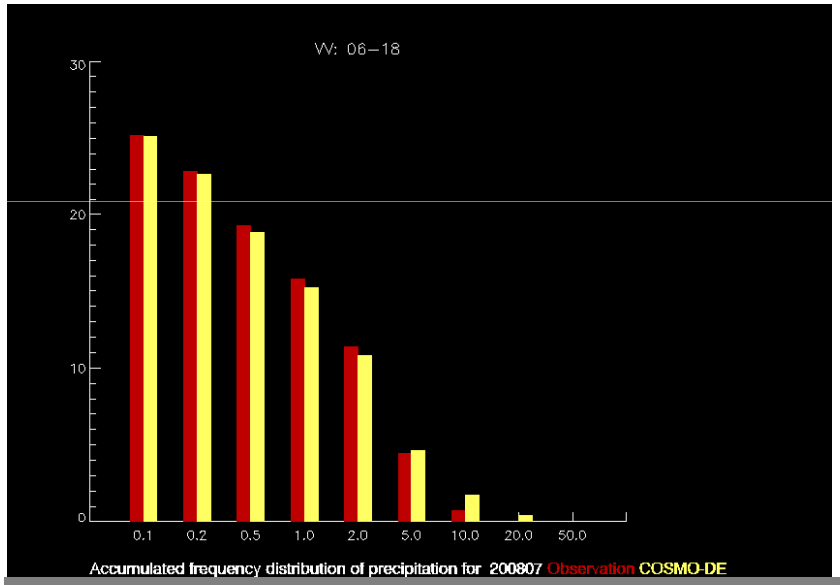


COSMO-EU (7km)



COSMO-DE (2.8km)





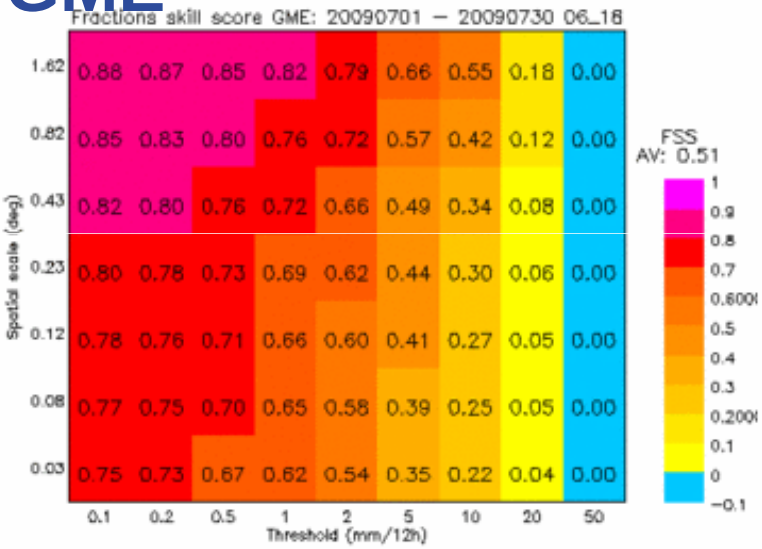
Monthly average of precipitation: 88 mm

U. Damrath
DWD

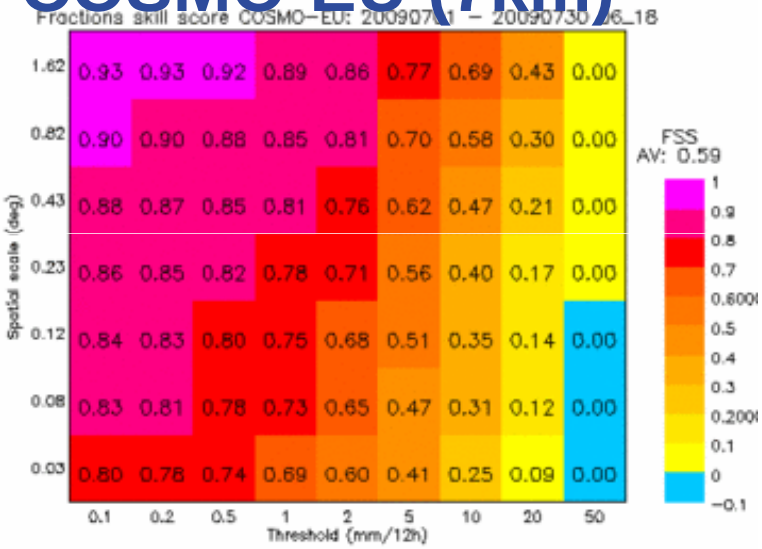
Fuzzy verification July 2009: FSS

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

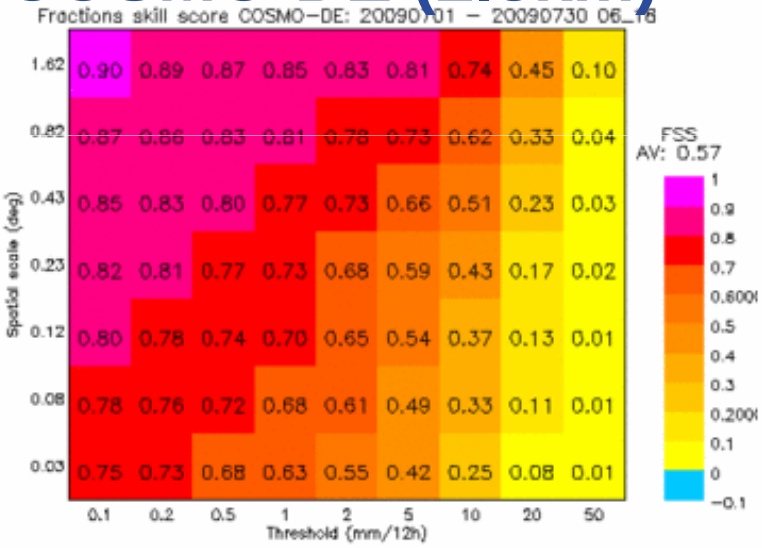
GME

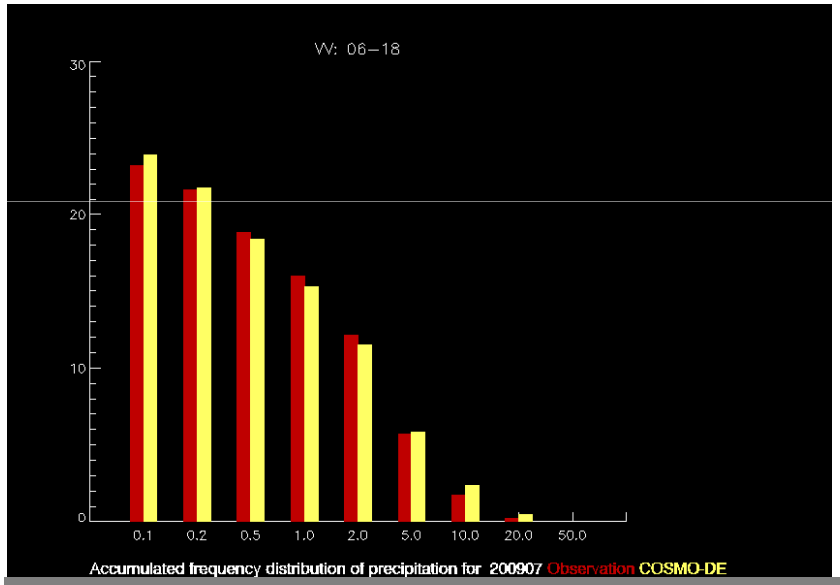


COSMO-EU (7km)



COSMO-DE (2.8km)





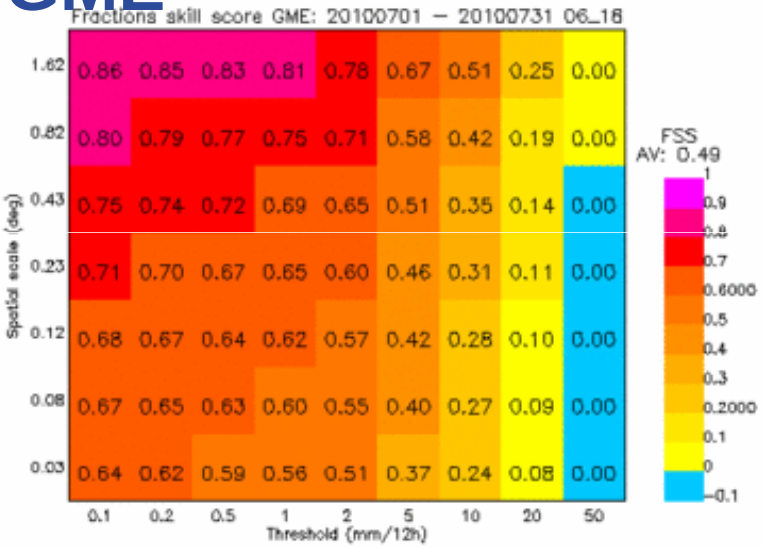
Monthly average of precipitation: 108 mm

U. Damrath
DWD

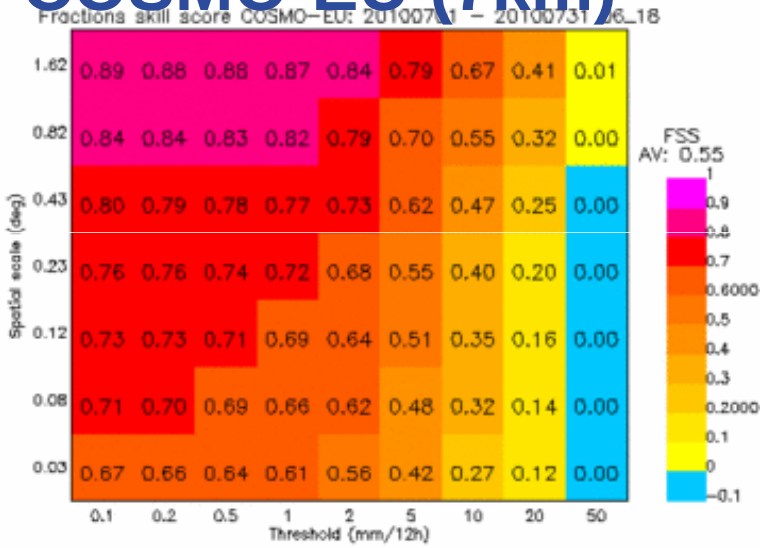
Fuzzy verification July 2010: FSS

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

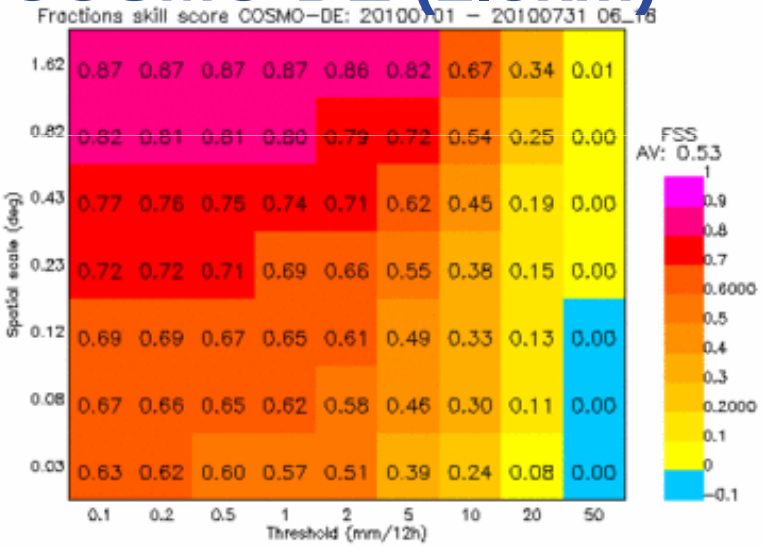
GME

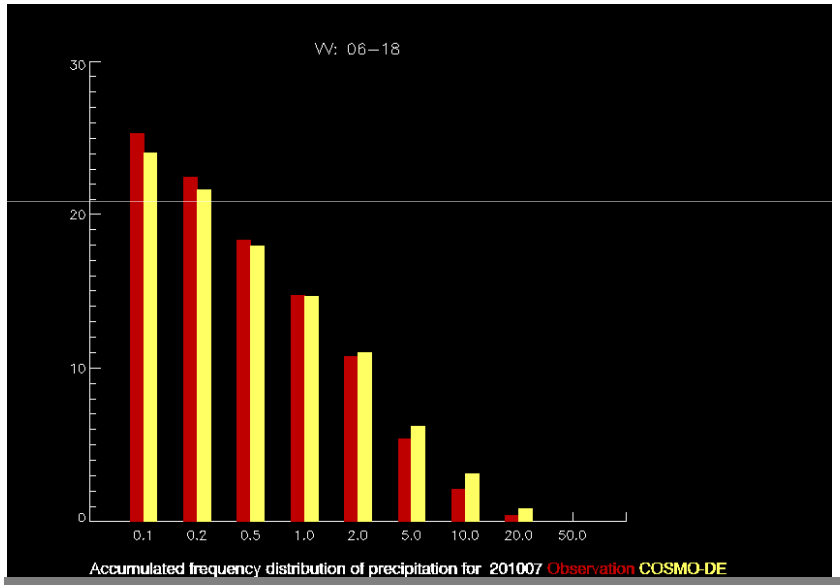


COSMO-EU (7km)



COSMO-DE (2.8km)



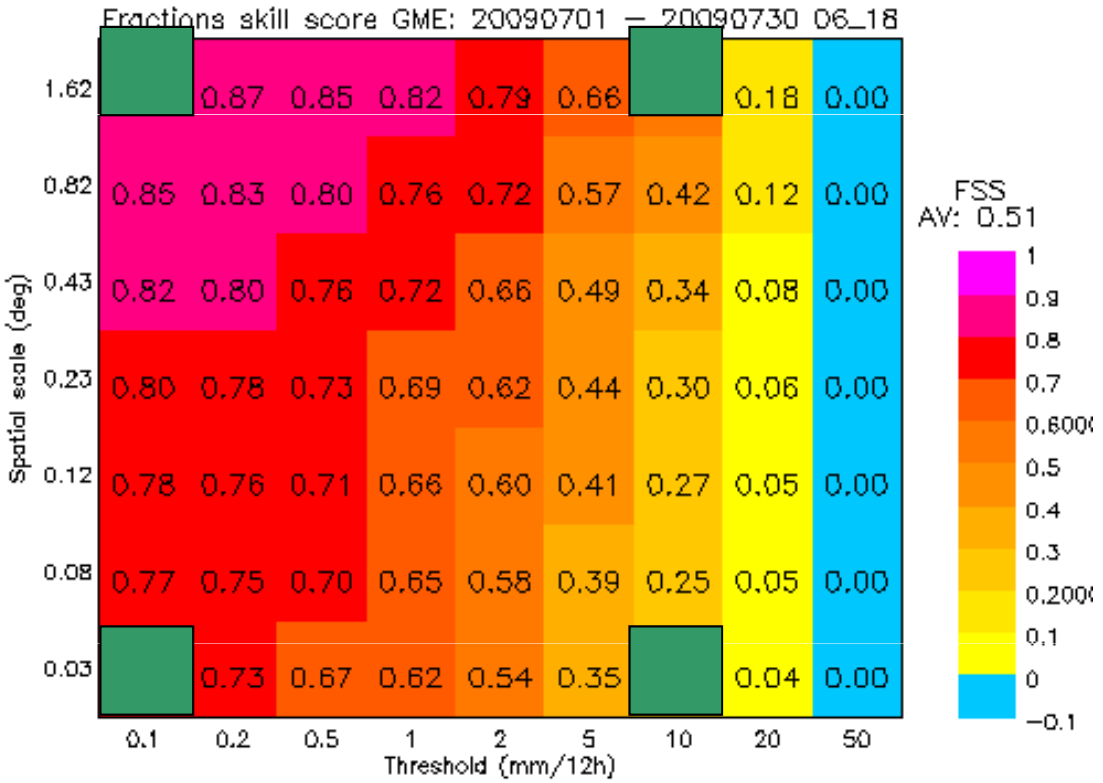


Monthly average of precipitation: 78 mm

U. Damrath
DWD

Fuzzy verification: Time series, choice of windows and thresholds

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

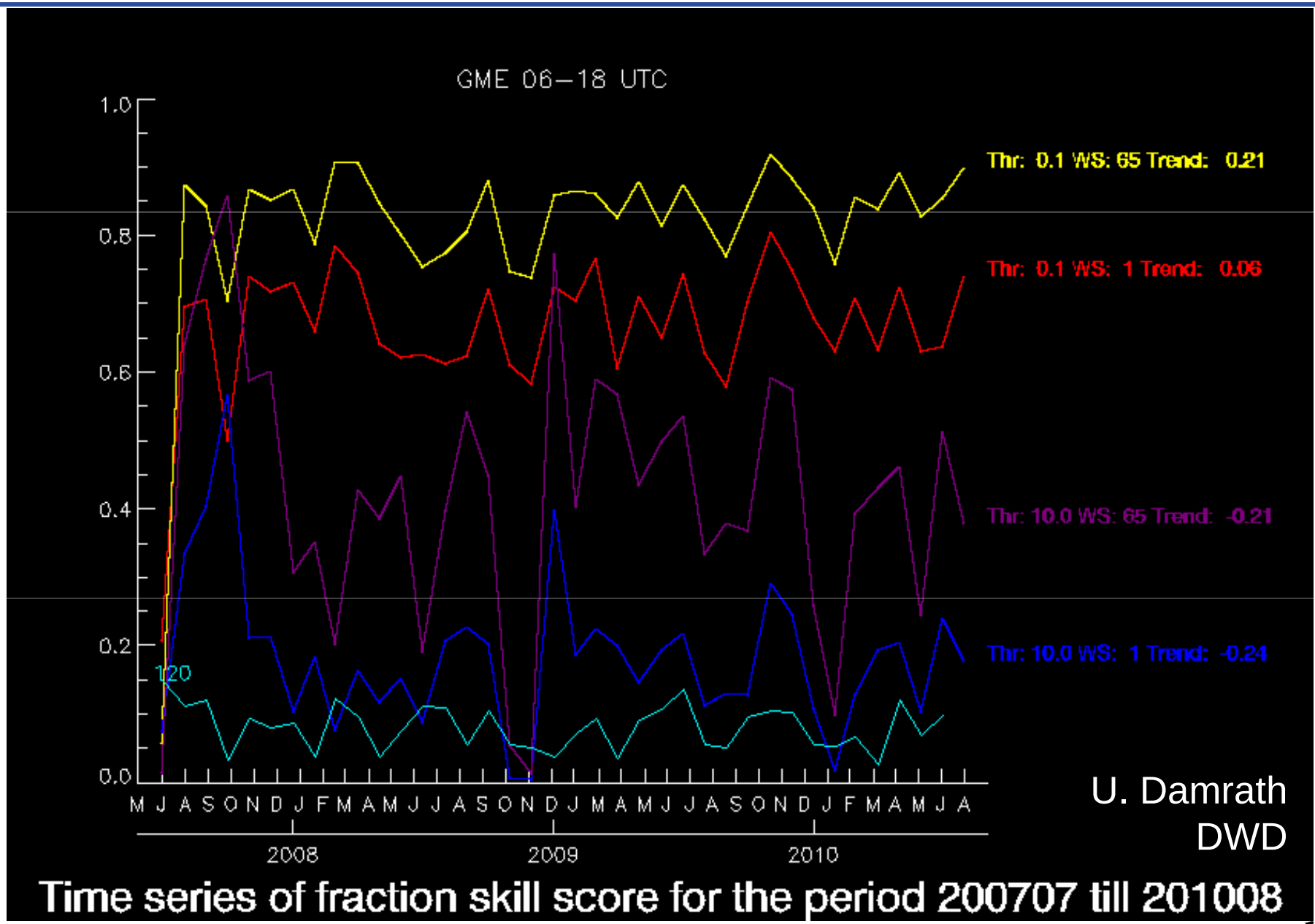


U. Damrath
DWD

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

GME

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

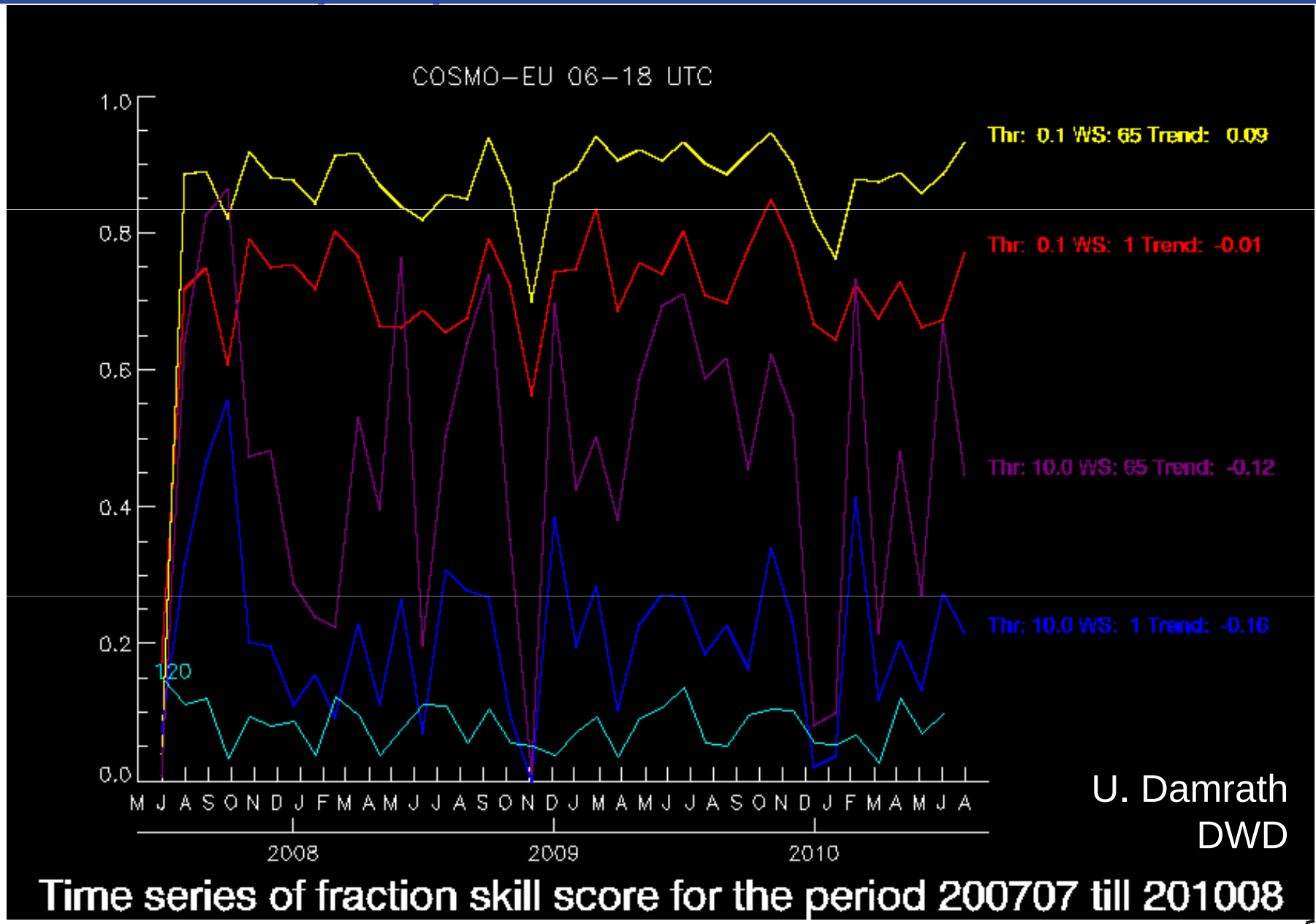


U. Damrath
DWD

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

COSMO-EU (7 km)

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

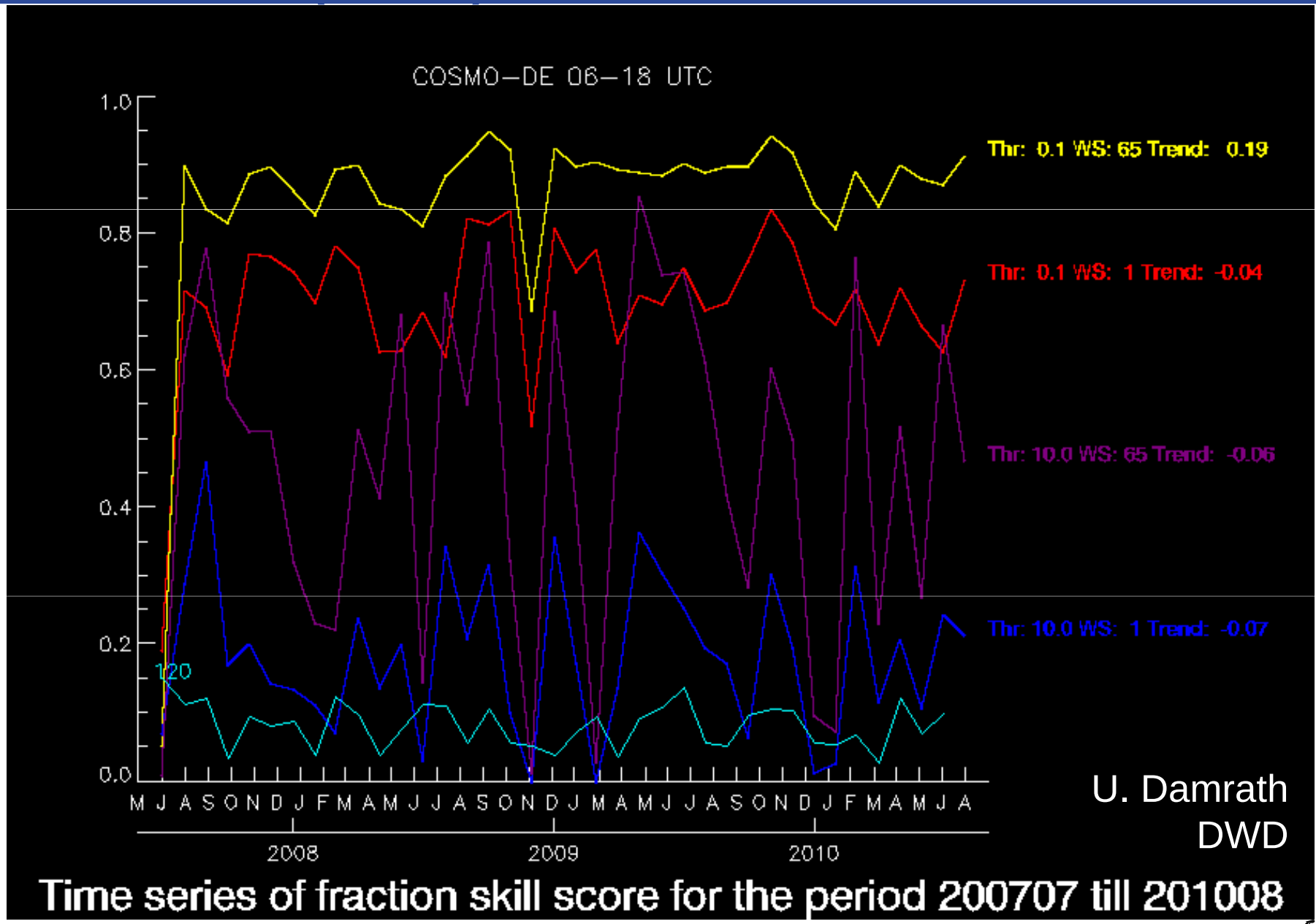


U. Damrath
DWD

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

COSMO-DE (2.8 km)

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



Summary of neighborhood verification @ DWD

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

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.**
- **A positive long term trend of precipitation quality can be seen for low precipitation values and large window sizes. No clear trend is visible for high precipitation values for any window size.**
- **Results for the check of consistency of precipitation forecasts lead to the expected (but proved) results that for high thresholds the inconsistency is most obvious. During winter time pattern errors are dominant. During summer times displacement errors are prevailing.**

Verification activities in COSMO (3): regional centres (ARPA‘s) in Italy

- ARPA-SIM (Bologna):
  verification of 2m-temperature over the Po Valley
  (high-resolution network)

- ARPA-Piemonte (Torino):
  verification of precipitation verification over Italy (raingauges)
  among the several COSMO-Model versions

Precipitation verification comparison the several COSMO-Model versions

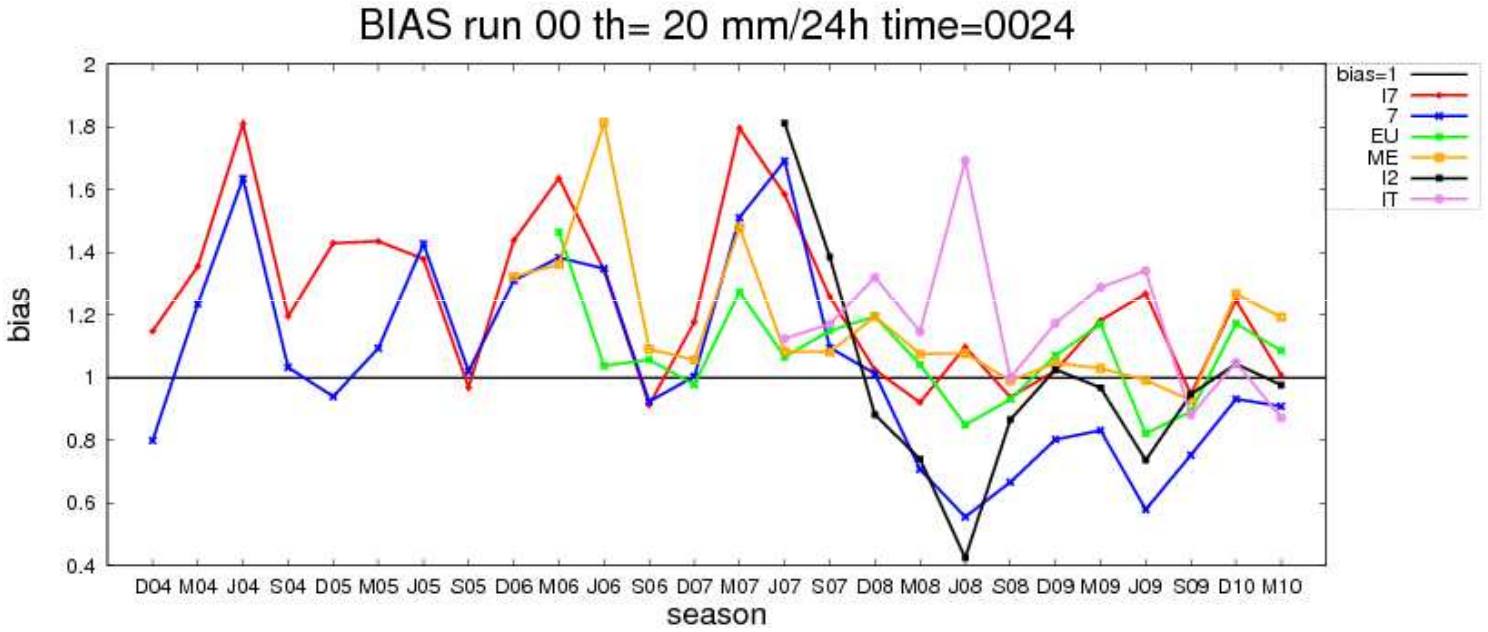
(Elena Oberto, Massimo Milelli - ARPA Piemonte)

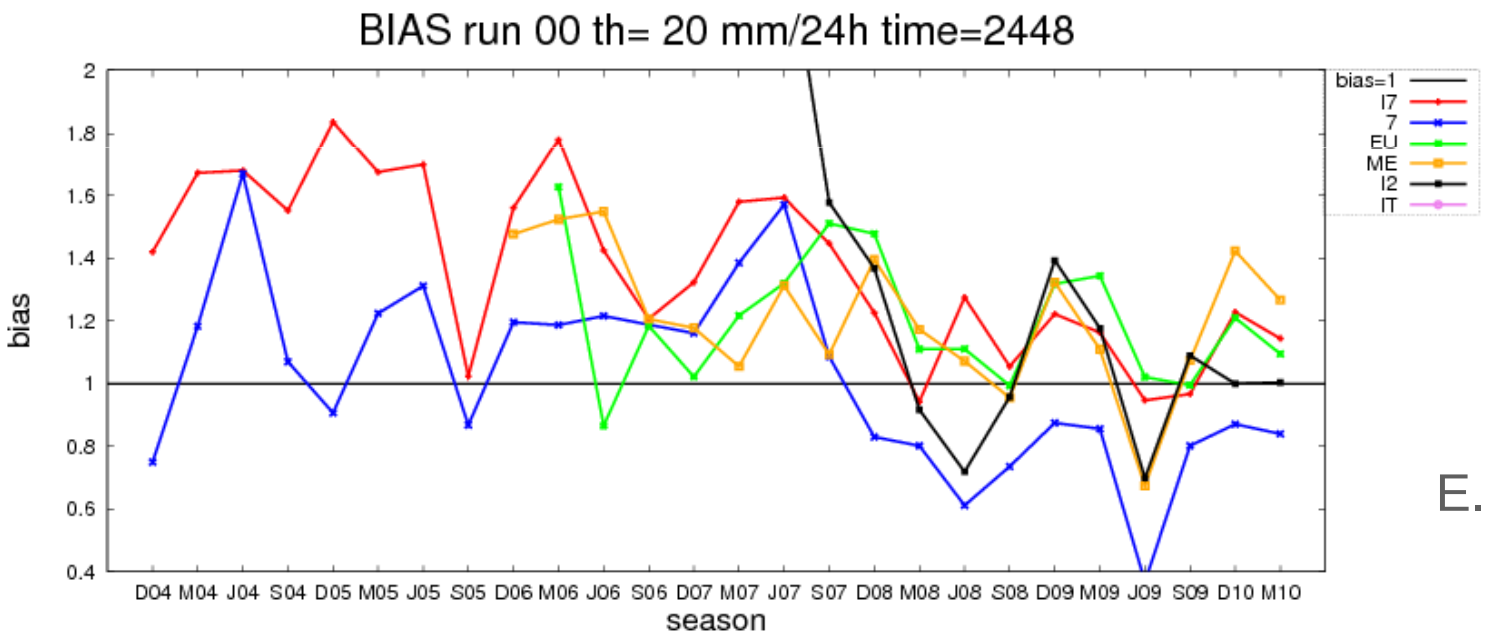
QPF verification of the 4 model versions at 7 km res. (**COSMO-I7, COSMO-7, COSMO-EU, COSMO-ME**) with the 2 model versions at 2.8 km res. (**COSMO-I2, COSMO-IT**) and **ECMWF**

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

Seasonal trend - high thresholds

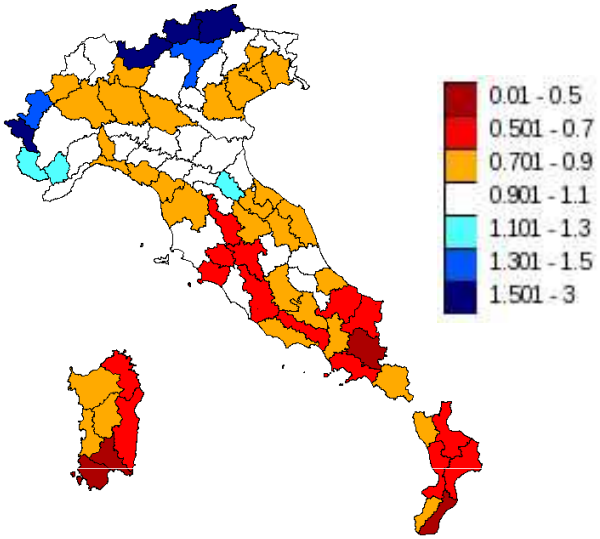




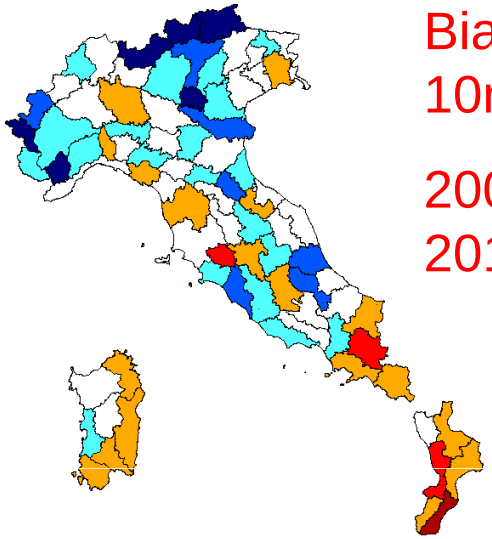
- Slight bias reduction during latest seasons
- Last winter: all the versions overestimate (probably due to lack of representativeness of the rain gauges over the plain during snowfall)
- Strong COSMO-7 underestimation BUT slight improvement during latest seasons

E. Oberto, ARPA Piemonte

COSMO-7



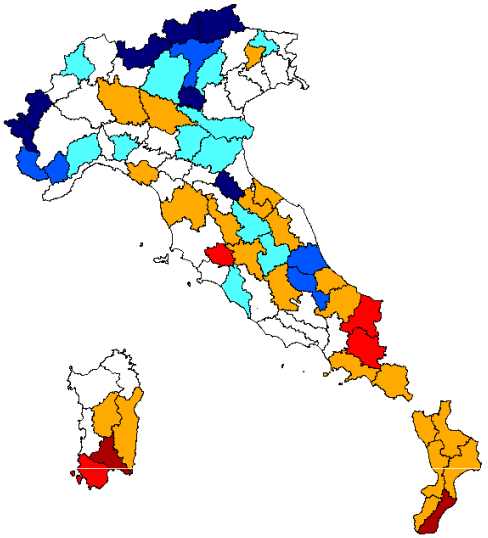
COSMO-I7



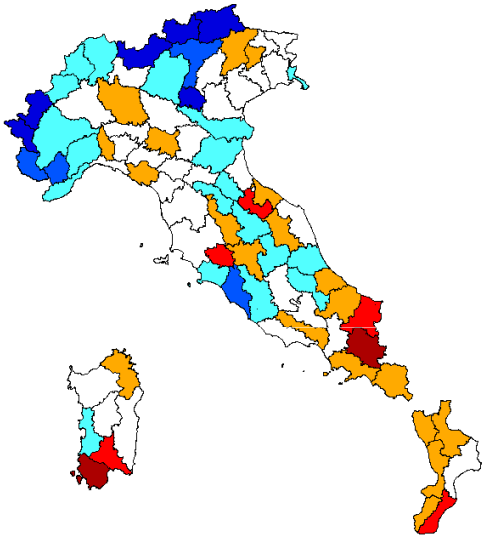
Bias, 10mm/24h

200812-201005

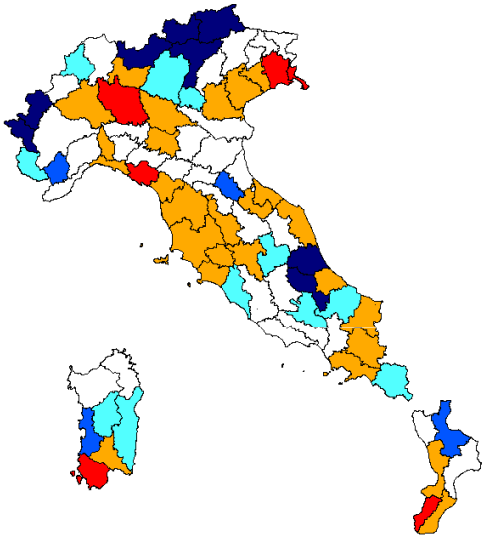
COSMO-ME



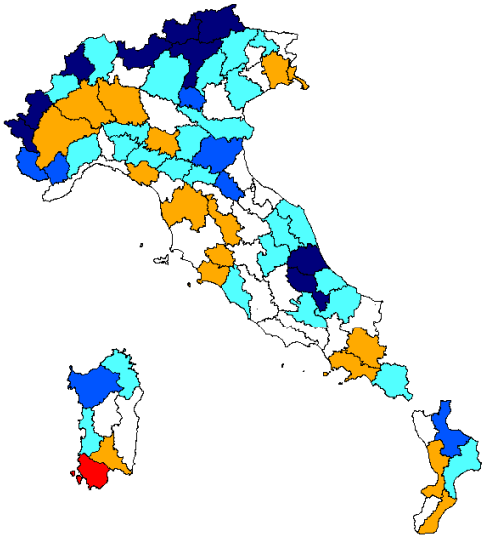
COSMO-EU



COSMO-I2



COSMO-IT

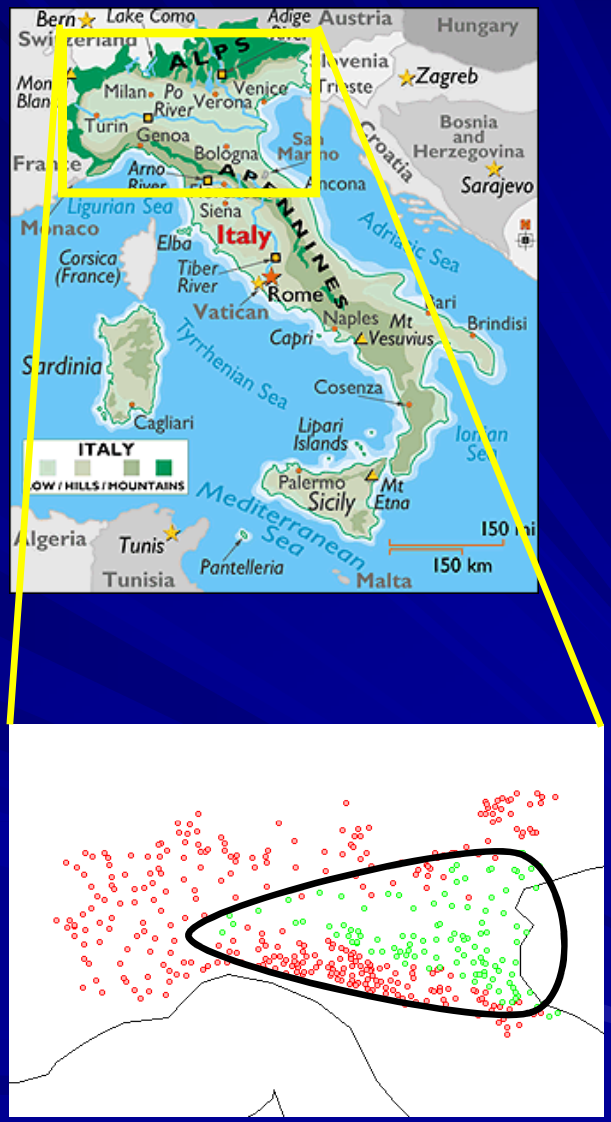


- **Systematic overestimation over Alpine areas, especially in the western part and in Veneto/Trentino-Alto Adige (incorrect representation of flow interaction with alpine chain during westerlies and north-easterlies ?)**
- **COSMO-7 underestimates especially in southern Italy (border of the domain ?)**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

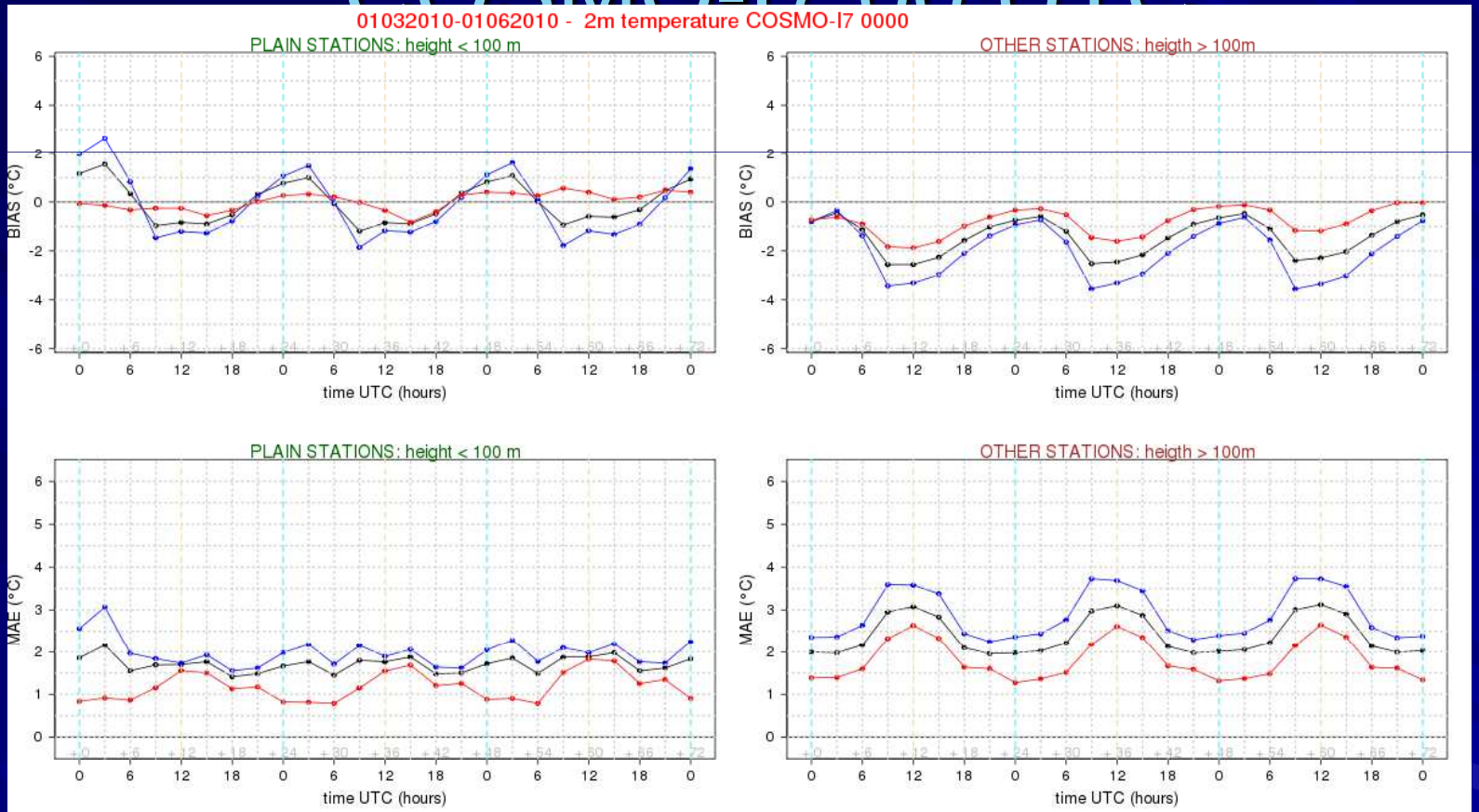
E. Oberto
ARPA Piemonte

Observed weather conditions in the Po valley

- Days are classified on the basis of the observed weather conditions in plain region in a subjective way
- They are divided in 4 classes:
  - Clear
  - Partly cloudy
  - Mostly cloudy/Cloudy
  - Rain/Snow
- Verification has been performed for days in each group



Observed weather conditions in the Po valley: T2m Spring 2010 – COSMO-I7 00 UTC



The groups are made using weather conditions in plain region

RAIN	CLEAR	TOTAL
10 days	38 days	92 days

End of slides for presentation

Extra slides

VERSUS2 Priority Project

Phase3 – 2010-2011

Task 0: Help Desk, bug-fixing activities and release of a VERSUS update

Main Activities

- Help Desk activities for VERSUS users
- Software maintenance
- Test/release of package and Manuals updates to be delivered to the users
- Stress test of the system (definition of benchmark)

Task 1: Improvement of VERSUS security, “plug&play” installation and Web pages

Main Activities

Task 1a: Collection of requirements
Task 1b: Implementation of improved security of the system
Task 1c: Development of a new installation and patch update procedures
Task 1d: Development of back-up functionalities for the DB
Task 1e: Review of Web GUI search pages for improved functionality

A. Raspanti, Italy

Task 2: Final Implementation of Feedback Files (FF) in VERSUS

Main Activities

- Task 2a: Implementation of Loader module for FF
- Task 2b: Creation of new Web GUI for FF
- Task 2c: Conditional Verification for data from FF (Requirements by DWD)
- Task 2d: Stand-alone tool for FF creation for all partners with Documentation
- Task 2e: Dedicated test phase for FF tool implementation and FF functionalities in VERSUS

Task 3: **Improvement of graphical representation of scores**

Main Activities

- Task 3a: Survey and collection of requirements for new graphics and improvements of existing graphics from the partners for both surface and upper air. Review of R package plots availability and compliance with requirements and their full description for VERSUS implementation (input data format and expected output)
- Task 3b: Creation of new plots, if any, based on the requirements using “R” or JpGraph. Fulll description of data input. Test phase.
- Task 3c: Implementation in VERSUS system (interface with database)

A. Raspanti, Italy

Task 4: **Implementation of Probabilistic Scores**

Main Activities

- Pre-Task 4: Delivery of the reviewed EPS Document
- Task 4a: Comparison between the Guidelines and the “R” verification package documentation, including graphics
- Task 4b: Full description of R code and associated graphics (from the Guidelines)
- Task 4c: Implementation of “R” package in VERSUS with documentation (or other software code)
- Task 4d: Creation of new Web pages for GUI

Task 5: Fuzzy Verification Toolbox and Object-oriented Verification

Main Activities

- Pre-Task 5: Completion and test of standard verification with gridded analysis
- Task 5a: Test and documentation of C version of Fuzzy Toolbox developed by Romania. Creation of graphics (from High- Resolution Verification Priority Project Report) using “R”.
- Task 5b: Implementation in VERSUS system
- Task 5c: Feasibility study on the implementation of SAL and other methods objected oriented (from MET software e.g.). Complete description for possible implementation in VERSUS (e.g. input and output data).

A. Raspanti, Italy

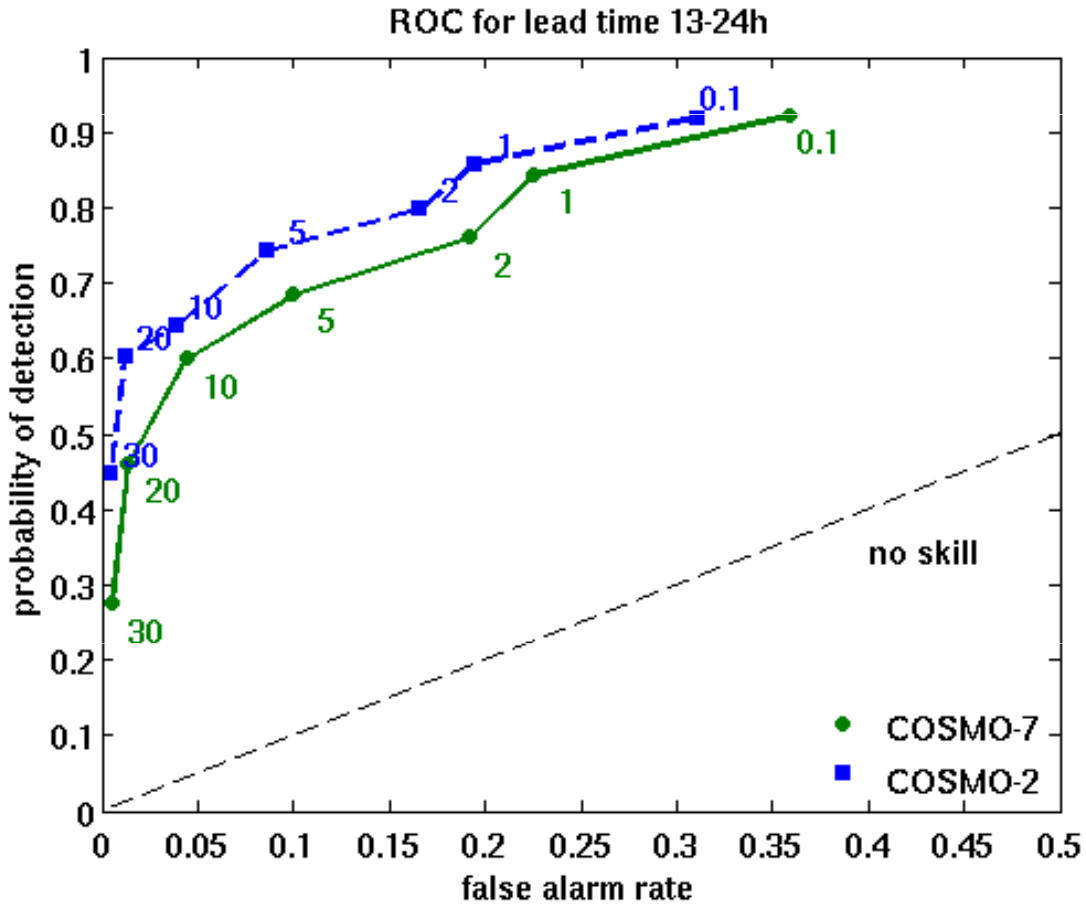
Weather type verification

- implemented in VERSUS
- functionality in test phase
- classification of weather types currently used in Italy
- first early results (only 5 months) show different behaviour of the model
- method seems to be promising
- more stratifications are possible (attention to the sample size)

A. Raspanti, Italy

Precipitation (12h-sums +12 to +24h): Spring 2010 over Switzerland (SYNOP's)

COSMO-7 & COSMO-2



V. Stauch, MeteoSwiss

Confidence Intervals

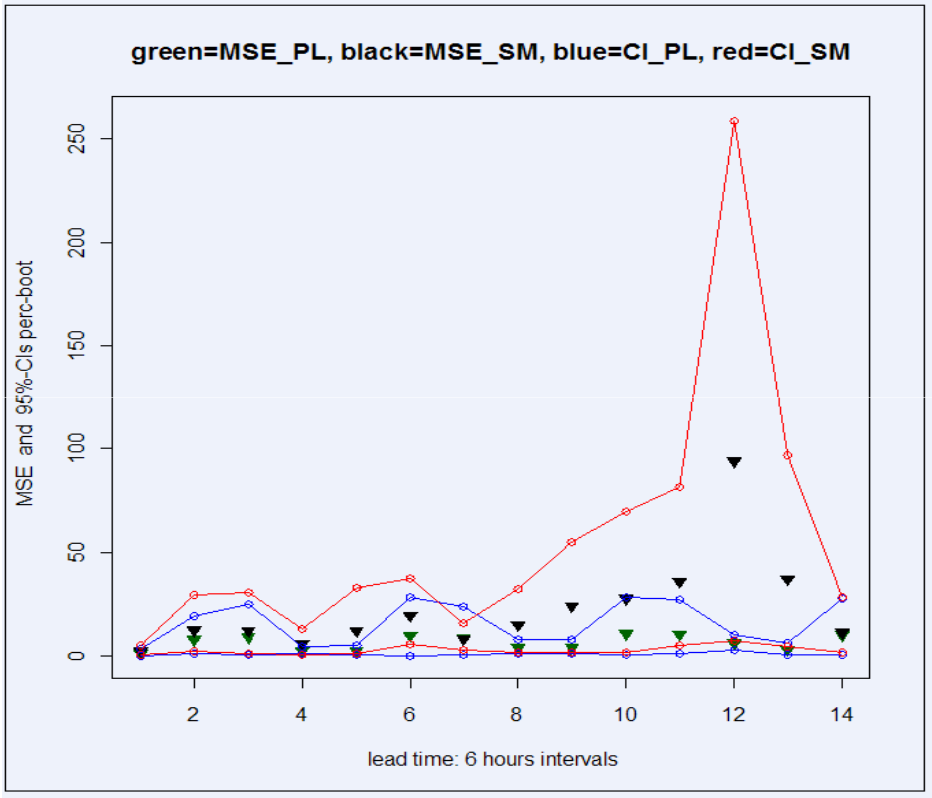
- **Confidence intervals** (CI) for all scores and skill scores are highly important (MET experience)
- **R-scripts**: bootstrapping codes written and run on test data
- **Graphics**: Several R-graph tools for CI depiction in quality assessment plots tested
- **Expectations**: Forecast verification and models' quality discrimination in geographical mappings

Example of MSE bootstrapped CIs

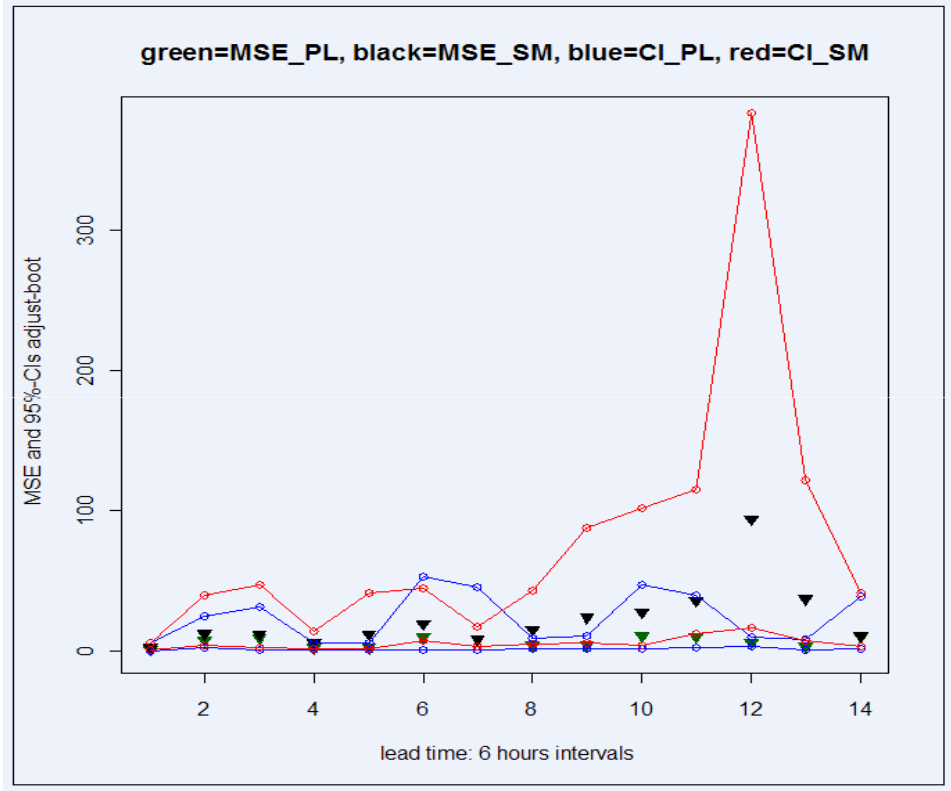
Anastasia Bundel, Russia

- MSE of St. Petersburg precipitation forecasts with the RHM semi-Lagrangian model (PL▼) and T169 spectral model (SM▼)
- CIs of 95% confidence level: blue for PL and red for SM

Percentile method



Adjusted percentile method

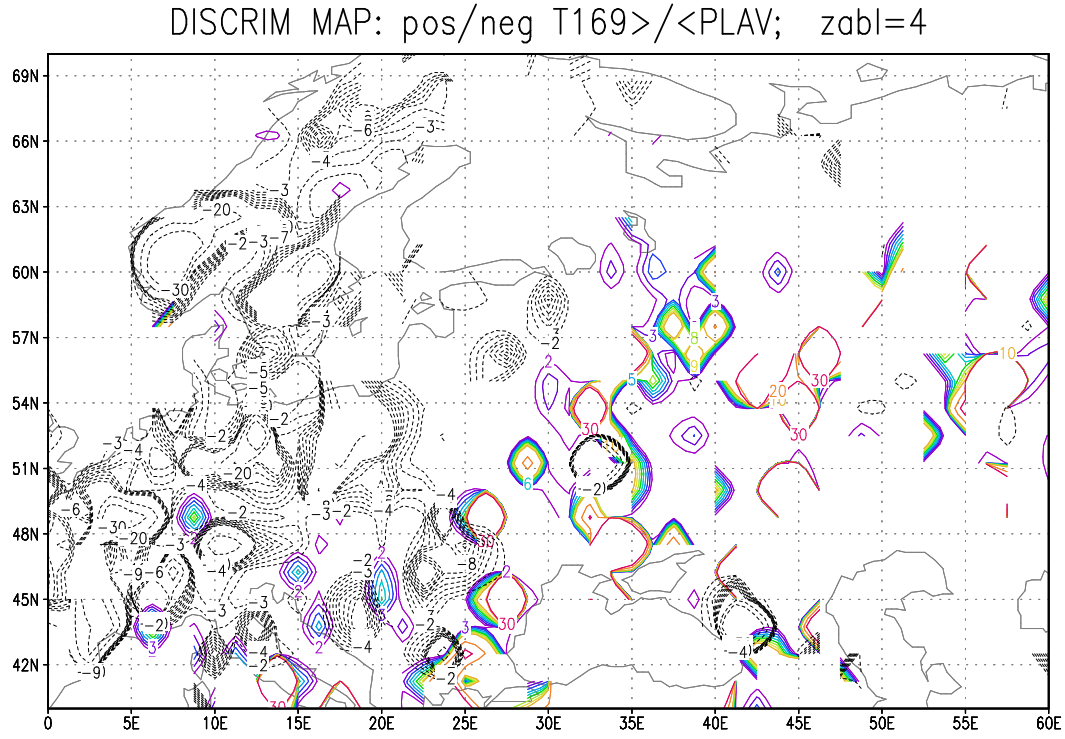


initial dates = 2010Jul17-2010Aug13,12 UTC; lead times: 6, 12, … 120hs

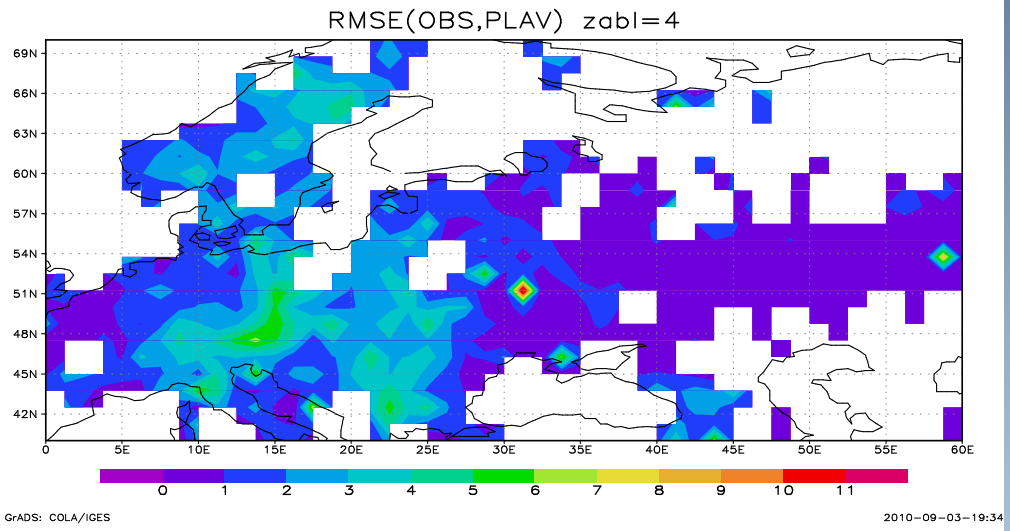
Models' quality discrimination in geographical mappings

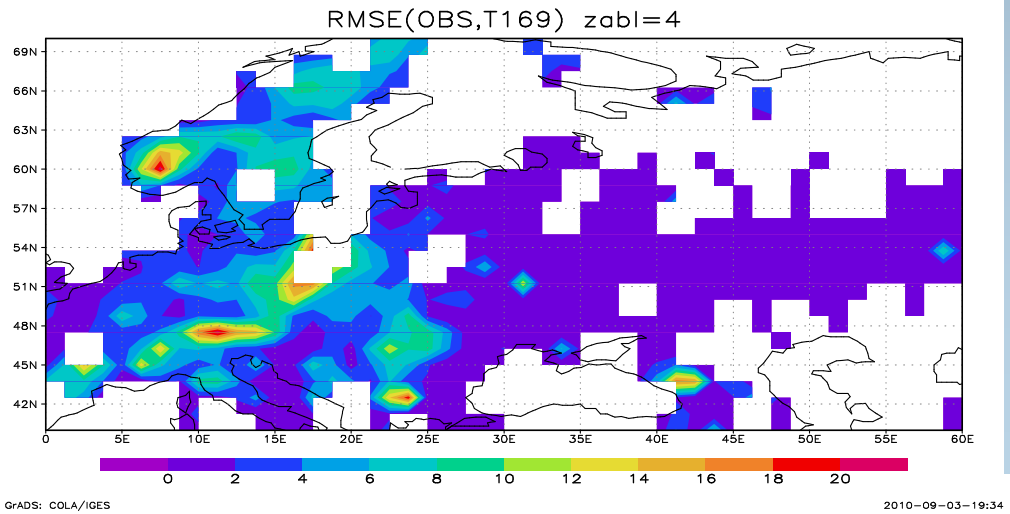
Anastasia Bundel, Russia

Ratio of MSEs of two models:
2 times greater MSE = significantly lesser quality (analog of the Fisher test):

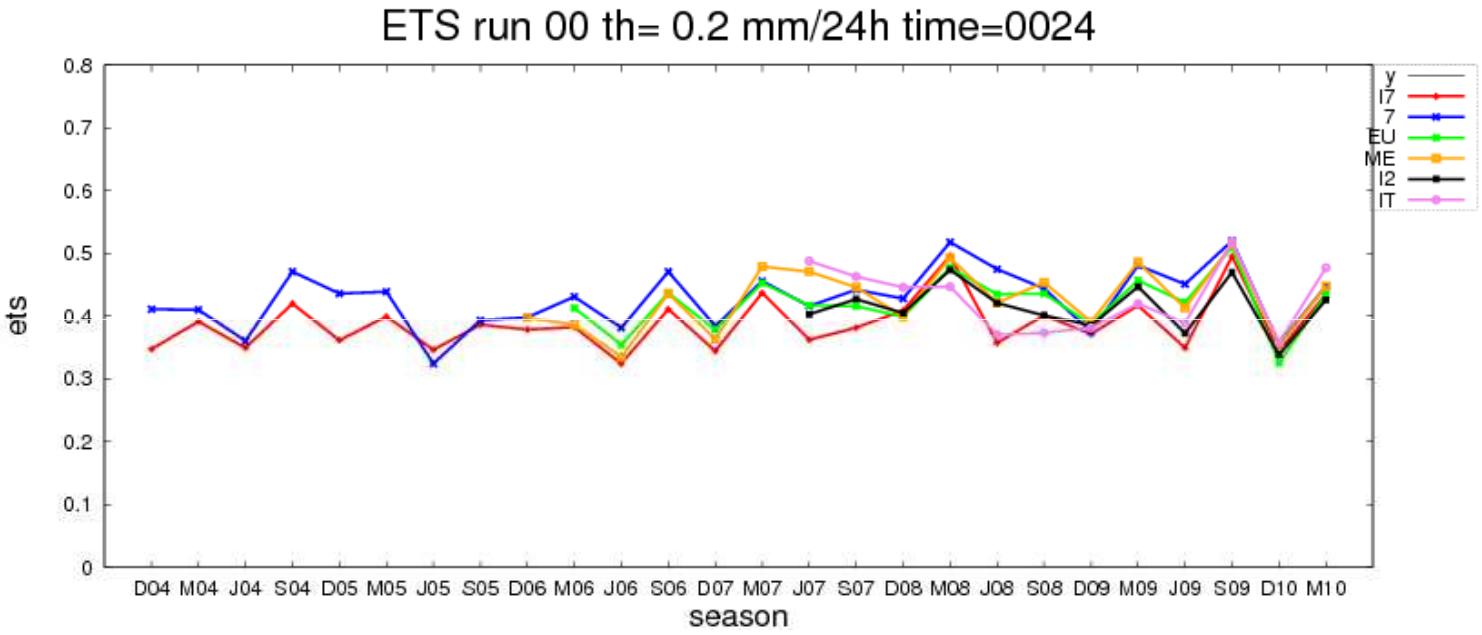


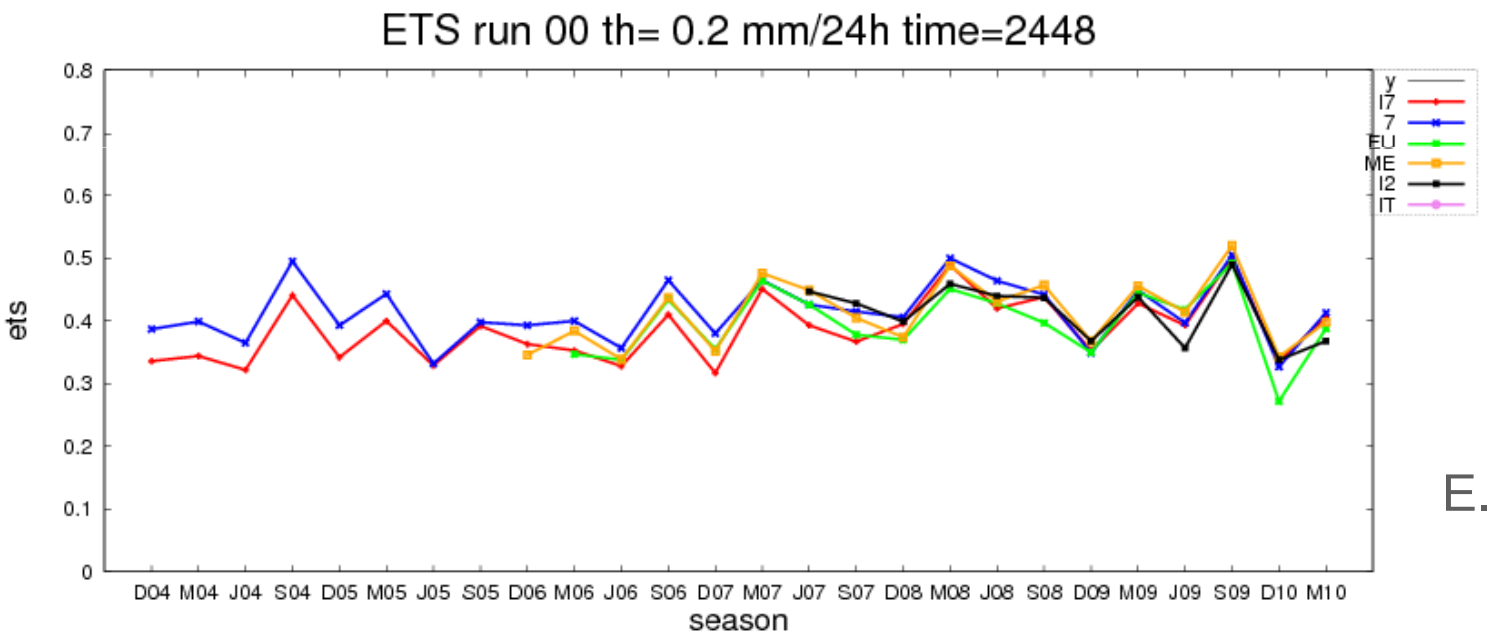
RMSEs of two models:





Seasonal trend - low thresholds (ETS)

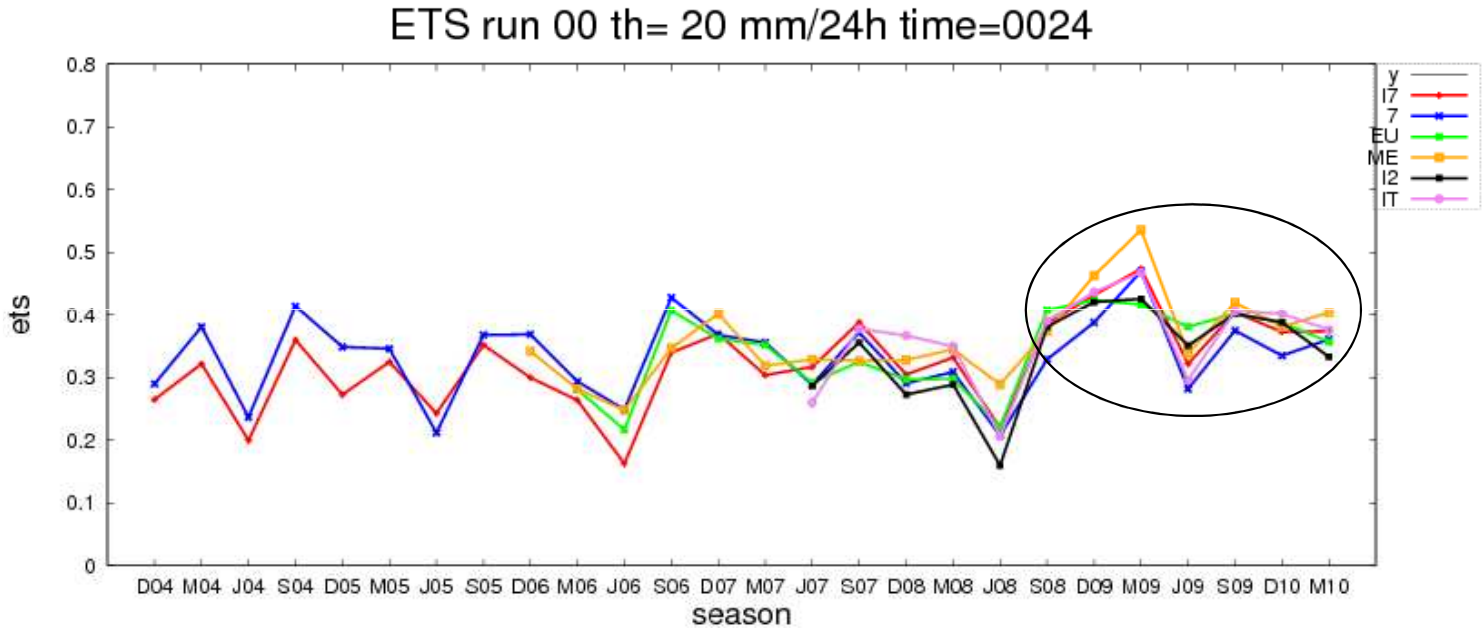


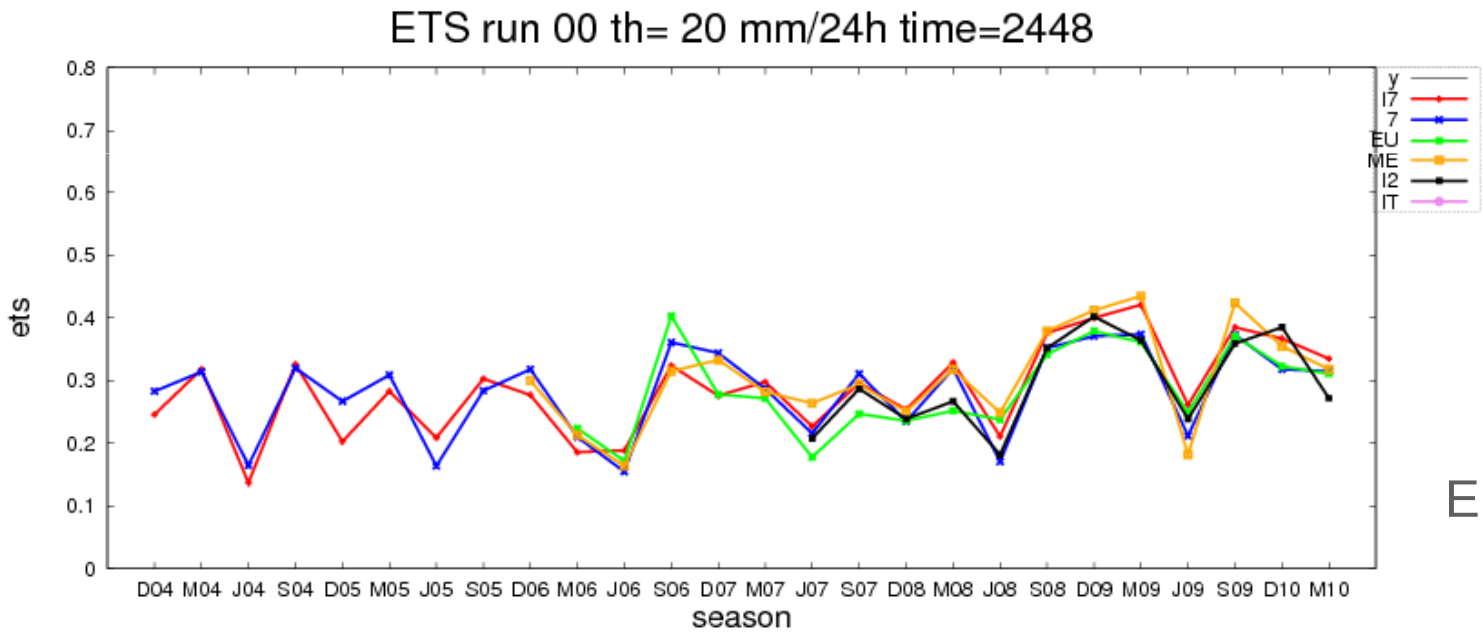


- Very light improvement trend
- Seasonal error cycle: lower ets during winter and summertime
- no significant differences between D+1 and D+2
- Last winter (very snowy particularly in Northern Italy): low ets value (D+1 and D+2)→ model error or lack of representativeness of the rain gauges over the plain during snowfall ?

E. Oberto, ARPA Piemonte

Seasonal trend - high thresholds





- Low values during summertime
- In general, quite stationary error since son2008 up to now
- All the versions present a jump around son2008: ets increases from 0.2-0.4 up to 0.3-0.5
- Skill decreases with forecast time

E. Oberto, ARPA Piemonte