New results in COSMO about fuzzy verification activities and preliminary results with VERSUS Conditional Verification

presented by
Adriano Raspanti

Outlook

- **New results in COSMO about fuzzy verification activities (MCH,DWD)**

- **Preliminary results with VERSUS Conditional Verification (ITALY)**

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

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

New results in COSMO about fuzzy verification activities

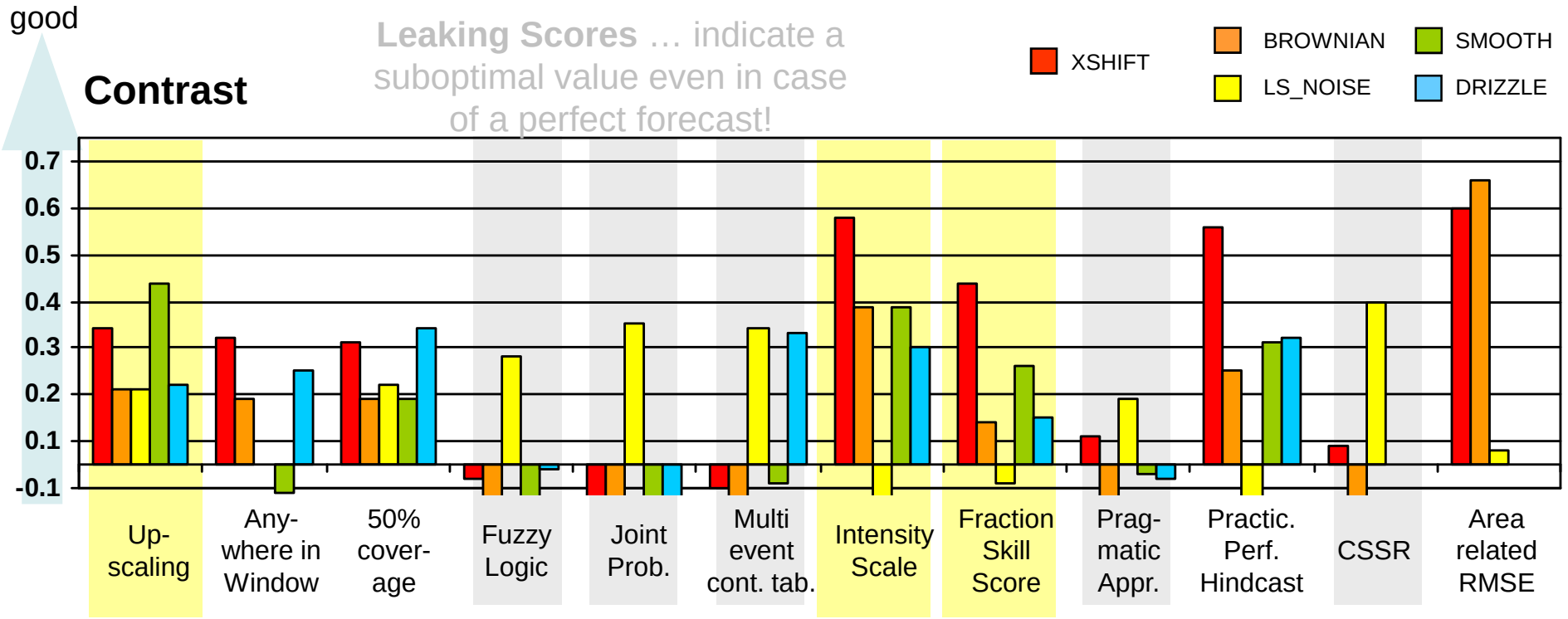
presented by
Adriano Raspanti (CNMCA)

work of Tanja Weusthoff (MeteoSwiss) and
Ulrich Damrath (DWD)

compiled by Francis Schubiger (MeteoSwiss)

Fuzzy Verification: choice of the methods

„multi-scale, multi-intensity approach“



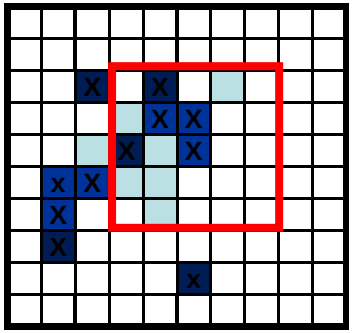
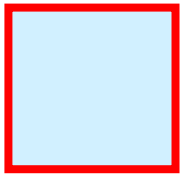
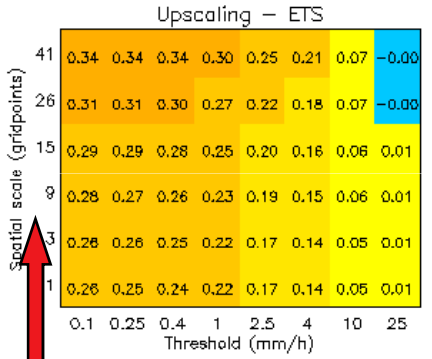
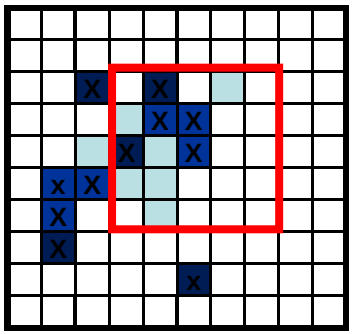
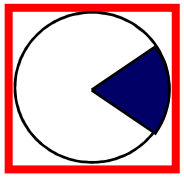
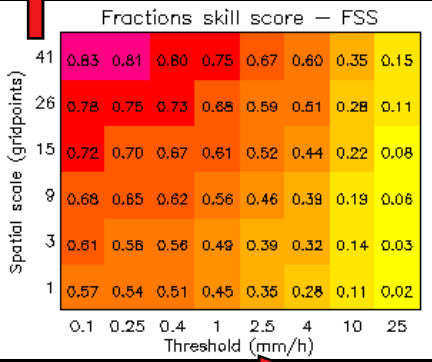
→ **Fractions Skill Score (FSS): shows good results, is widely used**

→ **Upscaling (UP): is sensitive to large-scale sample errors**

→ **Intensity scale (IS): promising method – fast and able to detect the scales of spatially errors**

Fuzzy Verification: choice of the methods (2)

Verification on coarser scales than model scale:
“Do not require a point wise match!“

Method	Raw Data	Fuzzyfication	Score	Example result
Upscaling		Average 	Equitable threat score ETS	
Fractions Skill Score (Roberts and Lean, 2005)		Fractional coverage 	Skill score with reference to worst forecast FSS	

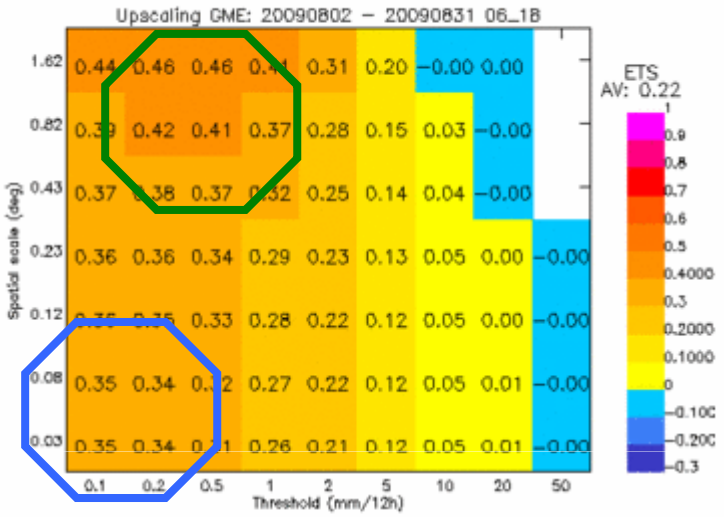
increasing box size

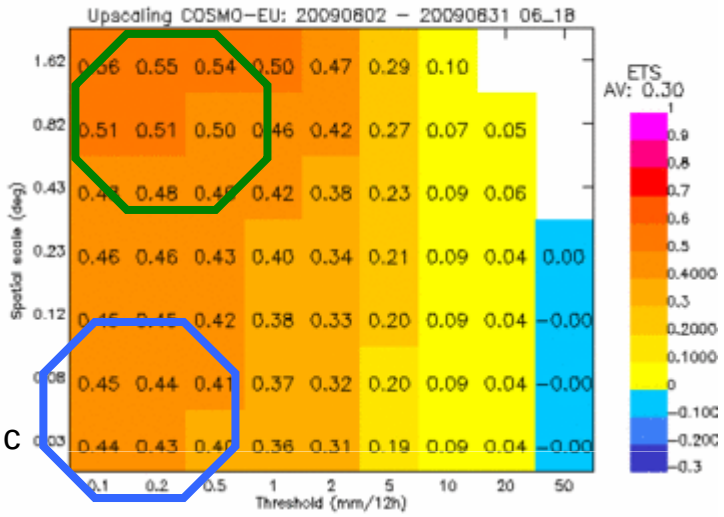
increasing threshold

Upscaling for GME, COSMO-EU and COSMO-DE

August 2009 12h sums from +6 to +18h

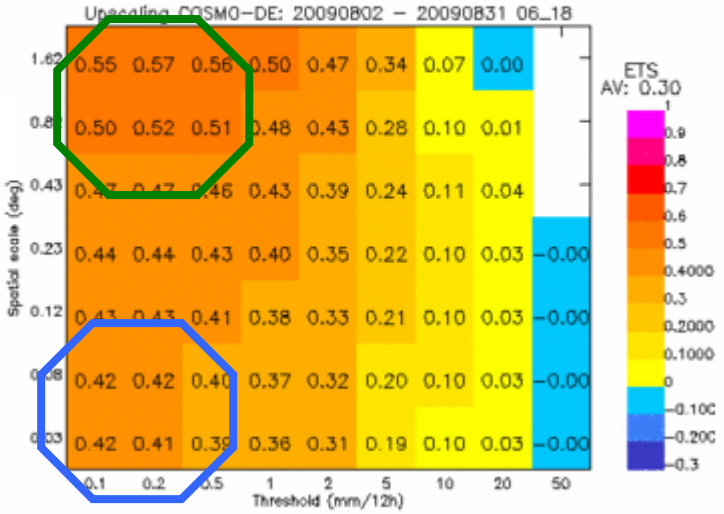
Global





Europe

DE



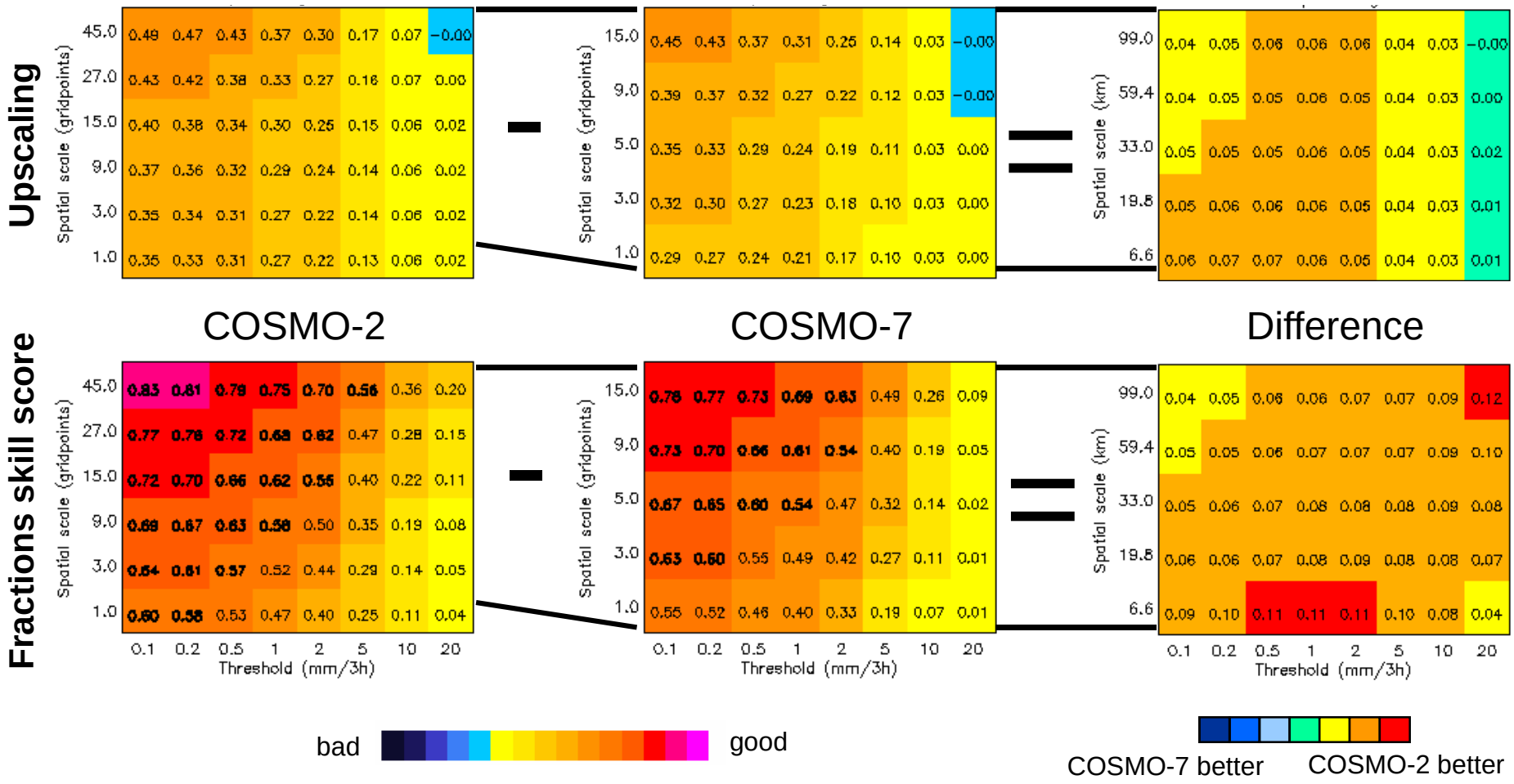
Some examples :low thresholds and Large windows size show almost the same values

U. Damrath, DWD

Upscaling and Fractions Skill Score

MAP D-PHASE period: June – November 2007

3h accumulations: +3..+6h for COSMO-2 & +3..+6h to +9..+12h for COSMO-7

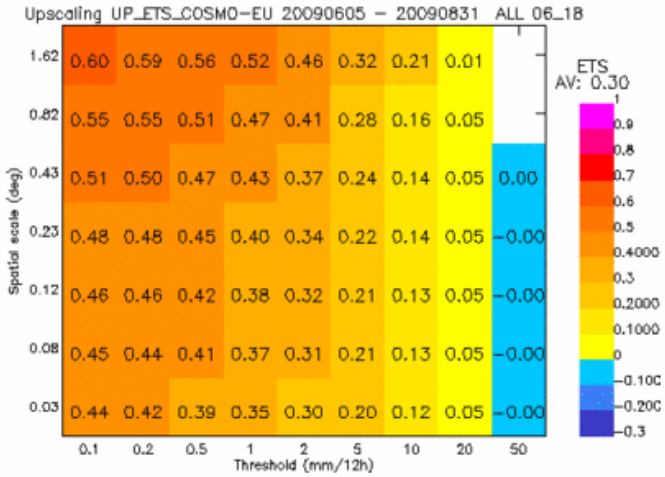


Examination of statistical significance of „fuzzy“-verification results using bootstrapping

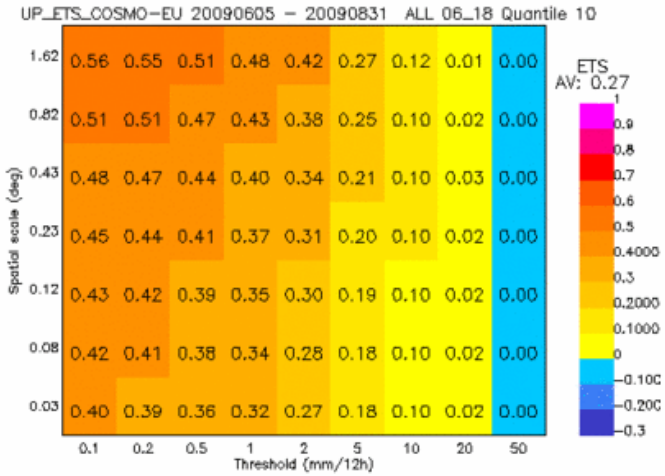
- Basic idea of bootstrapping:
  - Repeat a resampling all elements of a given in a sample of forecasts and observations as often as necessary (N times) and calculate the relevant score(s)
  - Calculate from N scores statistical properties of the sample such as mean value standard deviation, confidence intervals and quantiles
- Application to „fuzzy“-verification
  - Resampling is done using „blocks“.
  - Blocks are defined as single days.
  - Number of resampling cases: N=Days*100
  - Calculation scores from N samples for NT thesholds and NW windows
  - Calculation of quantiles for each window and threshold

- DWD: bootstrapping for GME, COSMO-EU and COSMO-DE
  - quantiles 0.1 and 0.9 , Wilcoxon-test
- MeteoSwiss: bootstrapping for COSMO-7 and COSMO-2
  - weather type dependant
  - significance of the differences

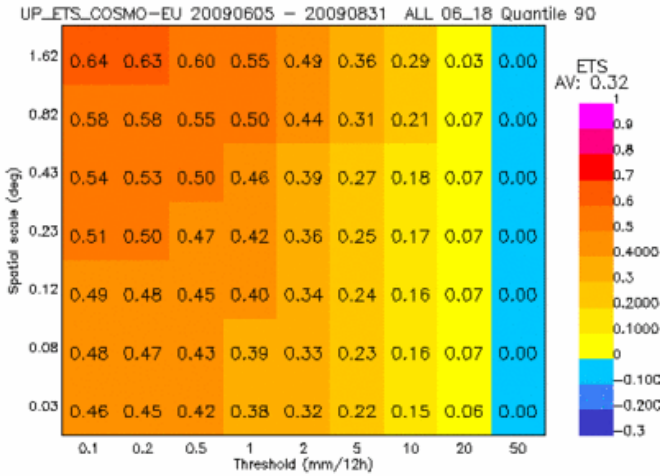
Values and quantiles 0.1 and 0.9 for Upscaling ETS COSMO-EU, period June - August 2009



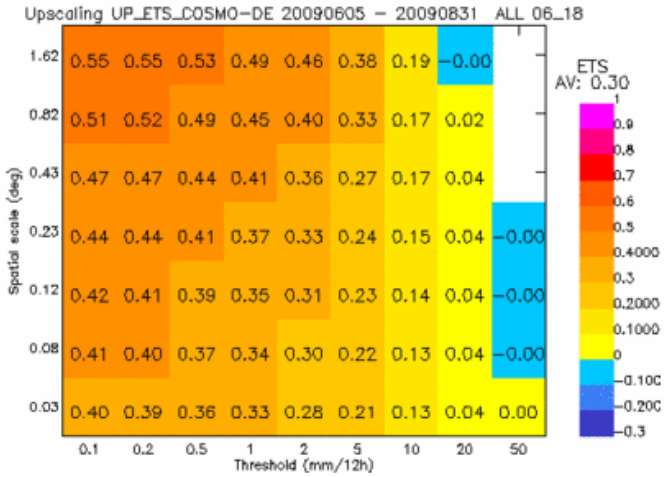
quantiles 10



quantiles 90

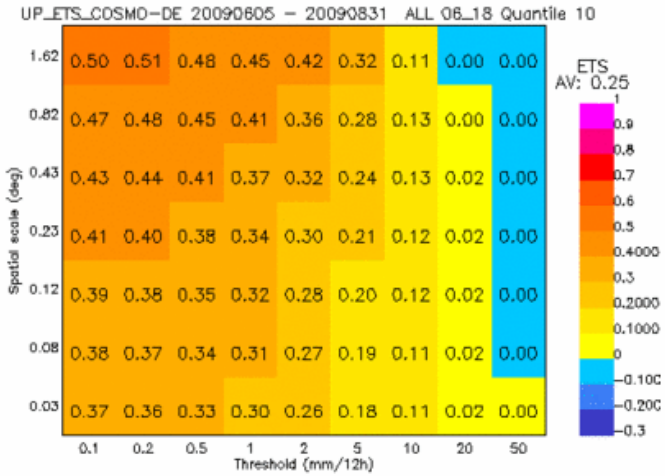


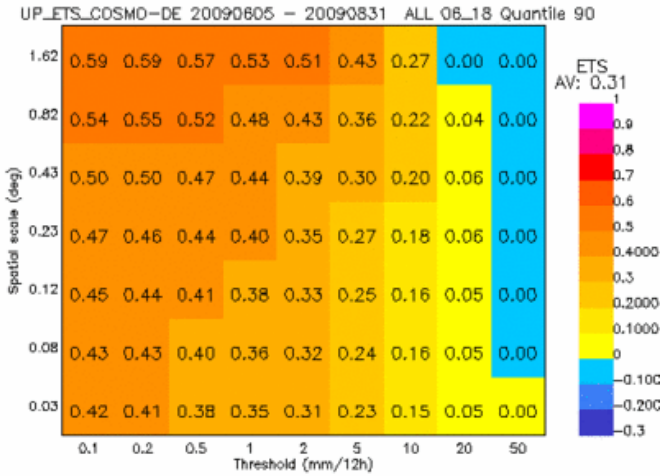
Values and quantiles 0.1 and 0.9 for Upscaling ETS COSMO-DE, period June -August 2009



quantiles 90

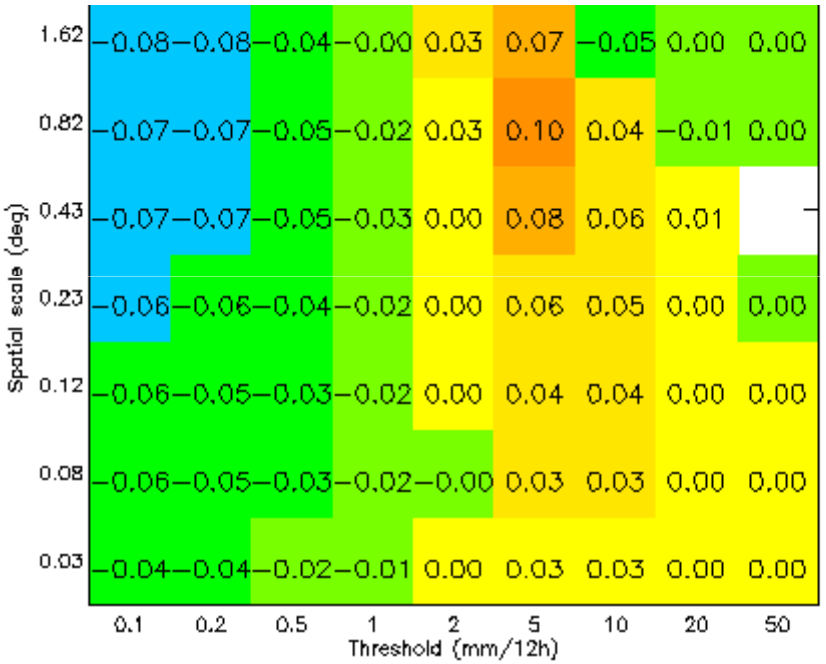
quantiles 10



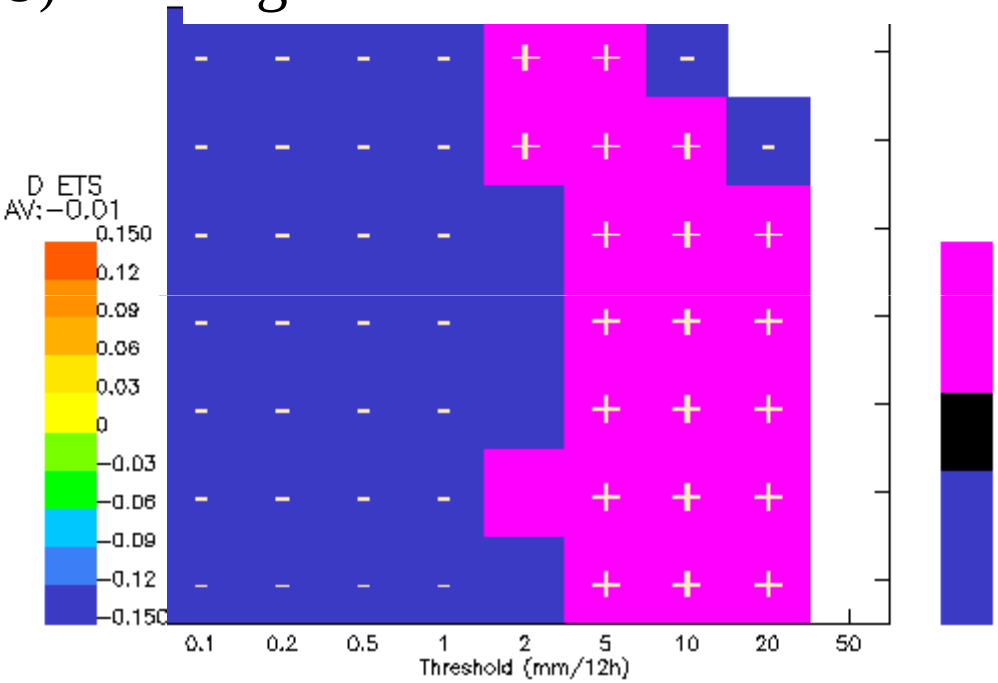


Differences between COSMO-DE and COSMO-EU

ETS(COSMO-DE) - ETS(COSMO-EU)



Significance test



COSMO-DE better than COSMO-EU

COSMO-DE worse than COSMO-EU

Summary (DWD)

- Scores like Fractions skill Score and ETS from Upscaling show in general advantages of COSMO models compared to GME
  - This is true especially for summer months.
  - For winter months all models have nearly the same quality for low precipitation amounts and large window sizes for averaging.

- Significance test lead to the results, that:
  - The advantages of COSMO models compared to GME are statistically significant for most window sizes and precipitation amounts.
  - The differences between COSMO-EU and COSMO-DE are not significant although there are systematical differences for different precipitation amounts and window sizes.

- There are some cases with very useful precipitation forecasts of COSMO-DE compared to COSMO-EU from the view of forecasters.

Bootstrapping 3 hourly accumulations june-nov 2007

COSMO-2 [values] ; COSMO-2 - COSMO-7 [colors]

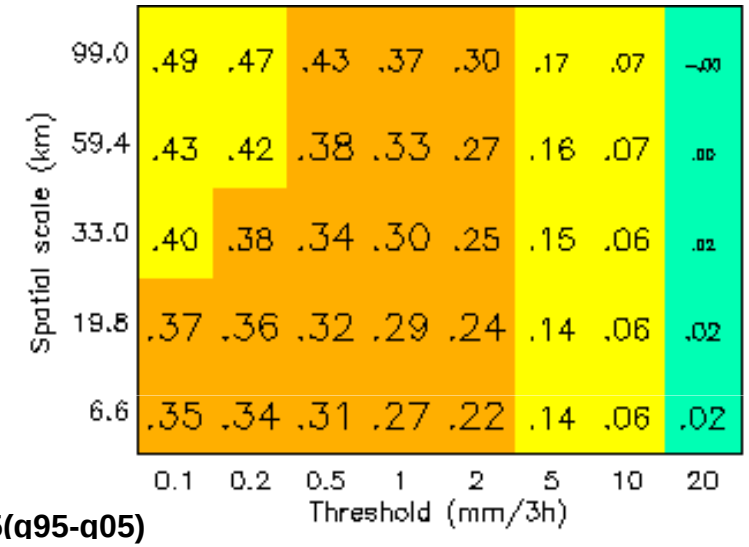
COSMO-2 better

DIFFERENCES

0.10
0.05
0.02
−0.02
−0.05
−0.10

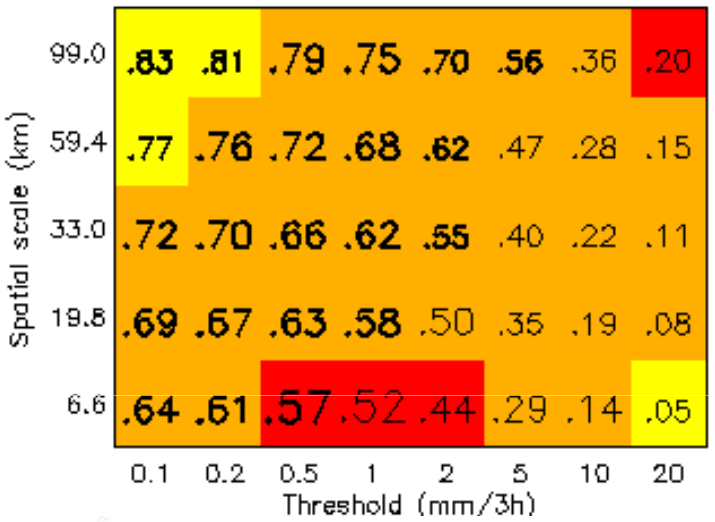
COSMO-7 better

Upscaling ETS



Fractions Skill Score

Bold indicates useful scales



abs(median) / 0.5(q95-q05)

[10 , Inf] .50

[5 , 10 [.50

[2 , 5 [.50

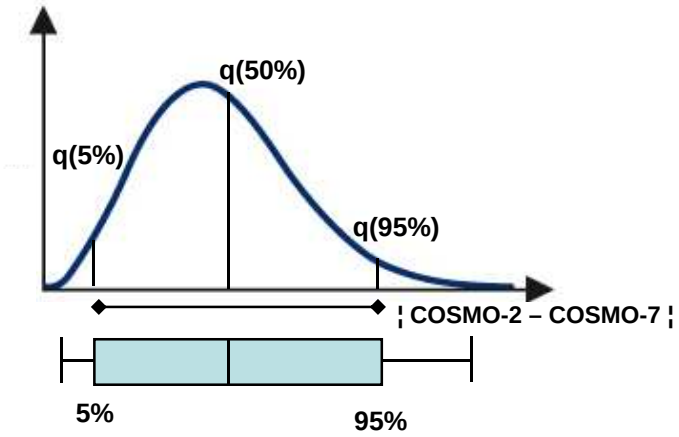
[1 , 2 [.50

[0 , 1 [.50

Size of numbers =

abs(Median) / 0.5(q95-q05)

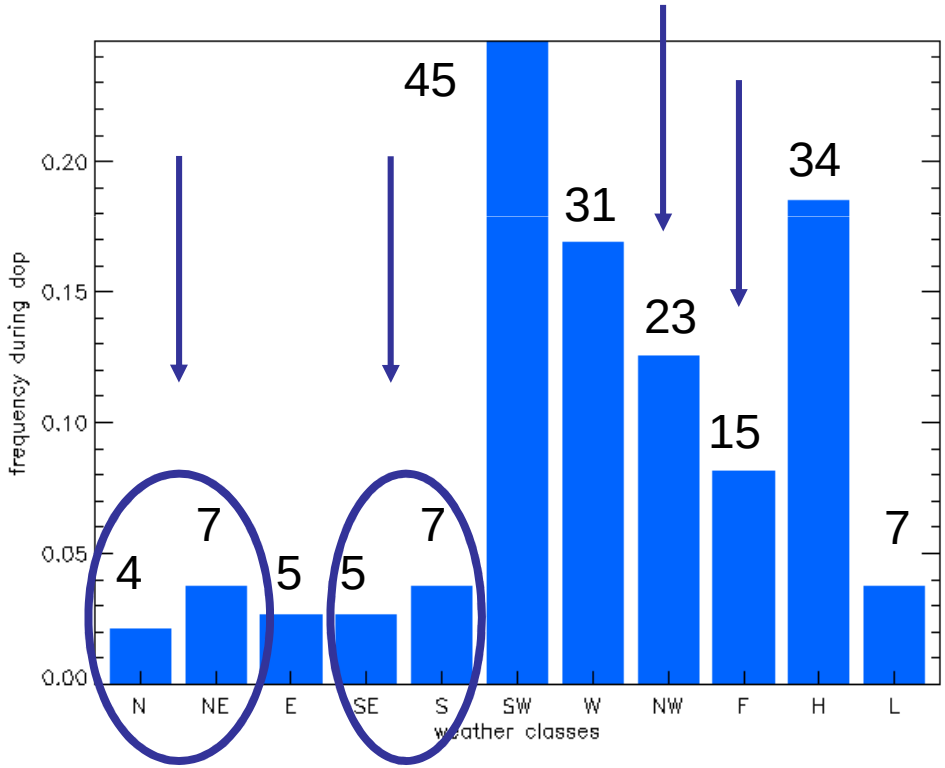
→ measure for significance of differences



Weather types: Frequency of the 11 classes
June – November 2007

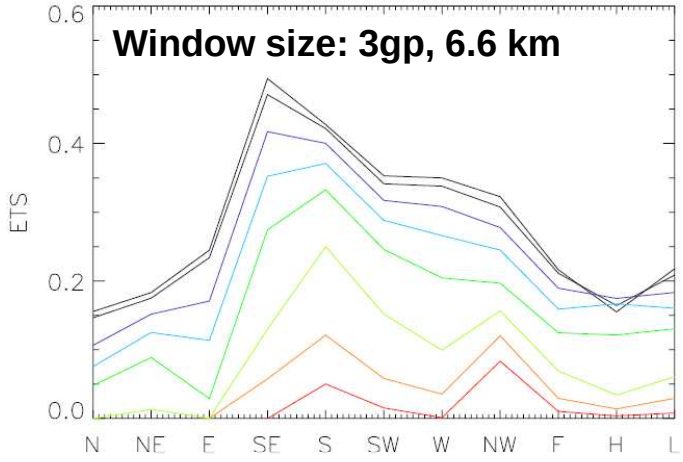
subjective classification based on 500 hPa chart (E. Zala, MeteoSwiss):

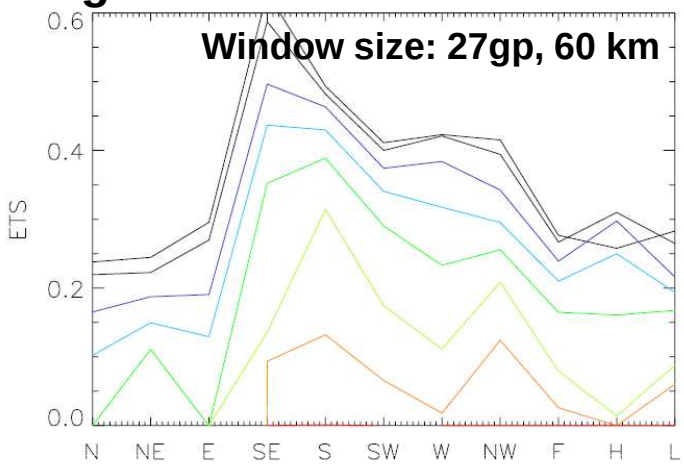
- 8 main wind directions over the Alps (N,NE,E,SE,S,SW,W,NW)
- Flat, High, Low



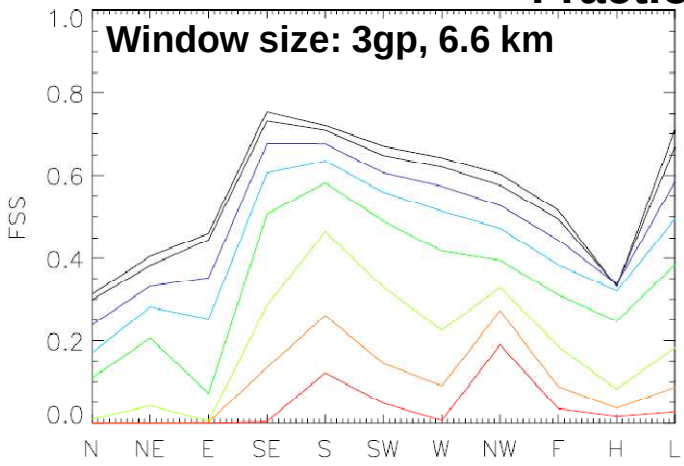
Weather type verification: COSMO-2

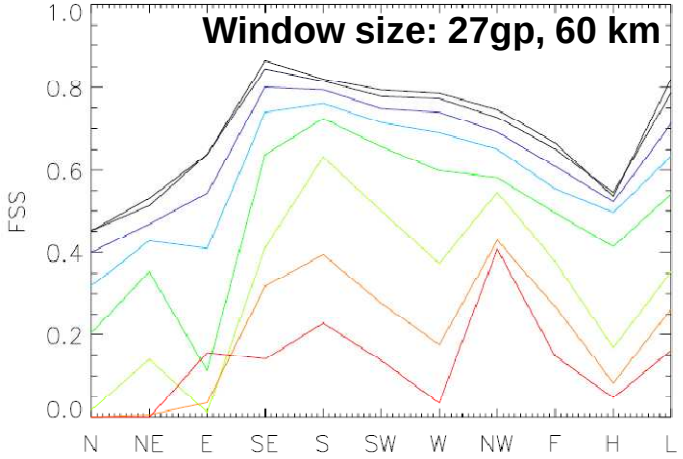
Upscaling





Fractions Skill Score





Threshold [mm/3h]

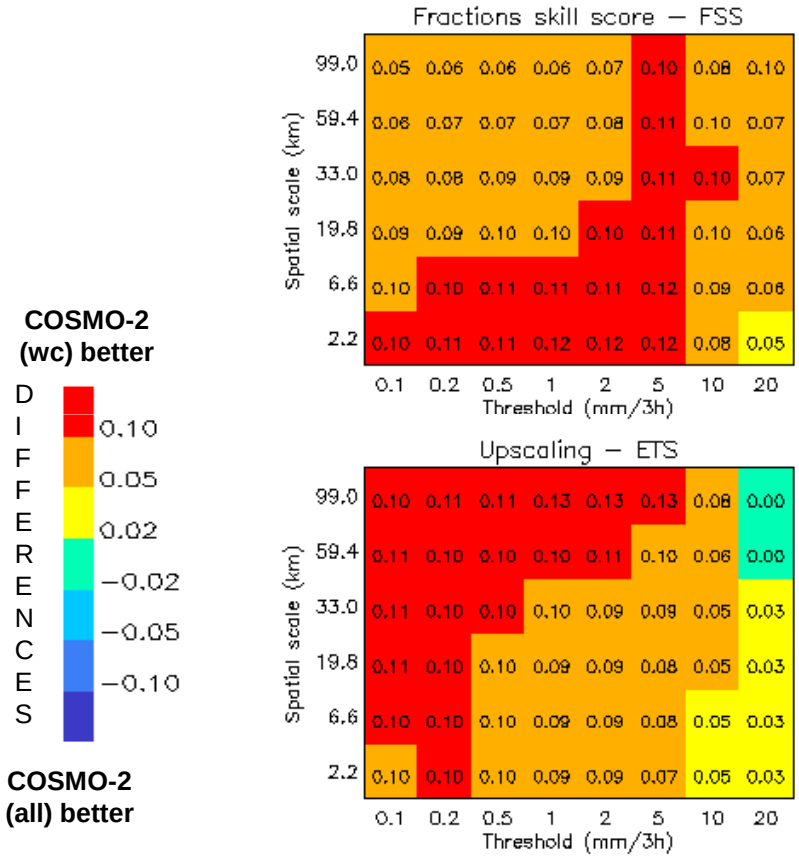
0.1
0.2
0.5
1.0
2.0
5.0
10.0
20.0

# cases	N	NE	E	SE	S	SW	W	NW	F	H	L
	4	7	5	5	7	45	31	23	15	34	7

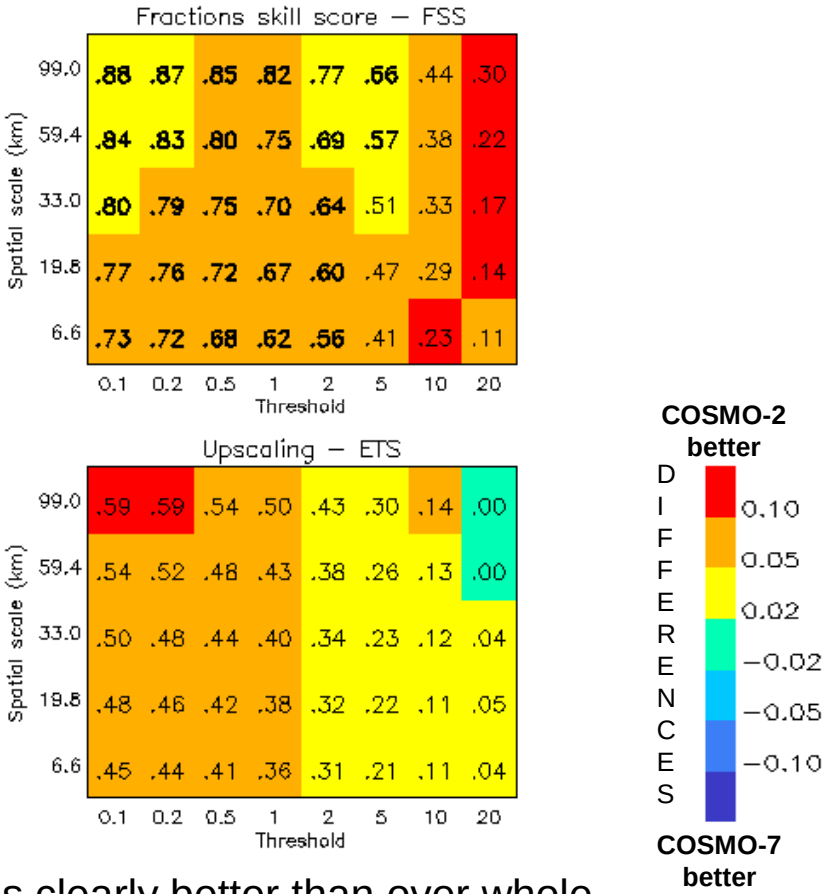
Southerly Winds (SE,S)

12 days

COSMO-2 (wc) vs.COSMO-2 (all)



COSMO-2 vs.COSMO-7

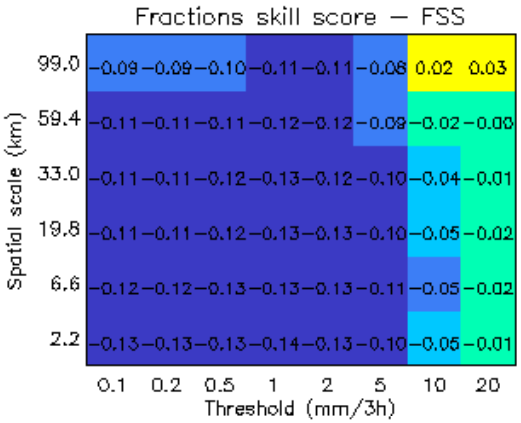


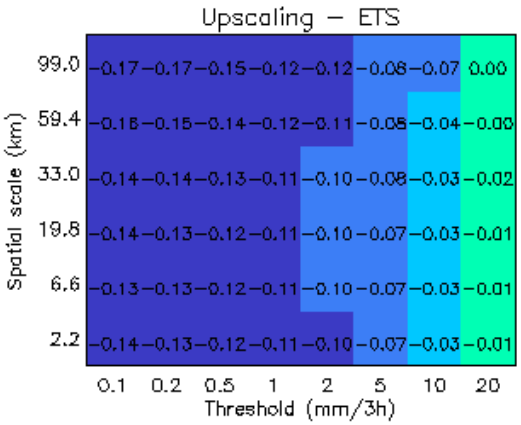
→ COSMO-2 in southerly wind situations clearly better than over whole period.

Flat (F)

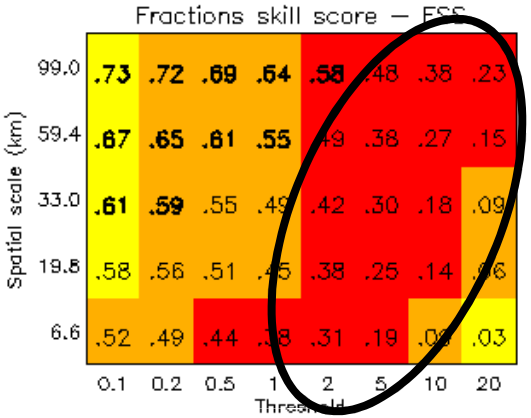
15 days

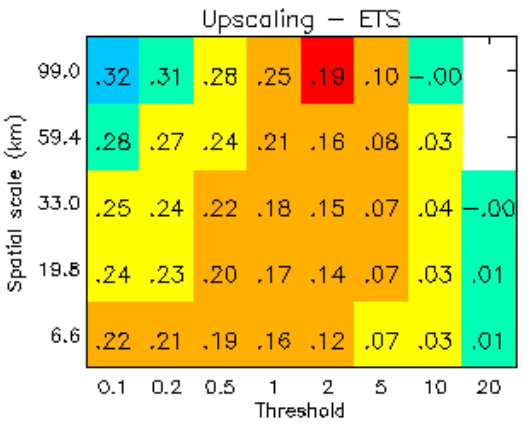
COSMO-2 (wc) vs.COSMO-2 (all)





COSMO-2 vs.COSMO-7





COSMO-2 (wc) better

DIFFERENCES

0.10
0.05
0.02
−0.02
−0.05
−0.10

COSMO-2 (all) better

COSMO-2 better

DIFFERENCES

0.10
0.05
0.02
−0.02
−0.05
−0.10

COSMO-7 better

→ COSMO-2 in flat pressure situations clearly worse than over whole period but COSMO-2 clearly better than COSMO-7 for airmass convection

Summary MeteoSwiss
for the D-PHASE period (June – November 2007)

- for **3 h accumulations:**
  COSMO-2 has better skill on nearly all scales

- the results are **robust** and the differences between the models are **significant on most scales**

- the **conditional verification** reveals differences between the weather types, skill relatively good for advective cases and southerly wind

Outlook fuzzy verification in COSMO

- Operational verification is about to start at DWD (with german radar composit) and at MeteoSwiss (with swiss radar composit) for:
  - Upscaling
    (with the scores: ETS and also FBI,FAR, POD)
  - Fractions Skill Score
  - Intensity Scale (will be further investigated with the new developments of B. Casati)

- Fuzzy framework will be integrated in VERSUS 2 in 2010

- SAL(T) approach [Wernli, etl. al.] for river catchment verification will be evaluated

Some preliminary results Conditional Verification

Model verified: COSMO-Me 7 km mesh size

Period: DJF 2008 – JJA 2009

Parameter: T, TD, MSLP, P

Conditions on Observation space only

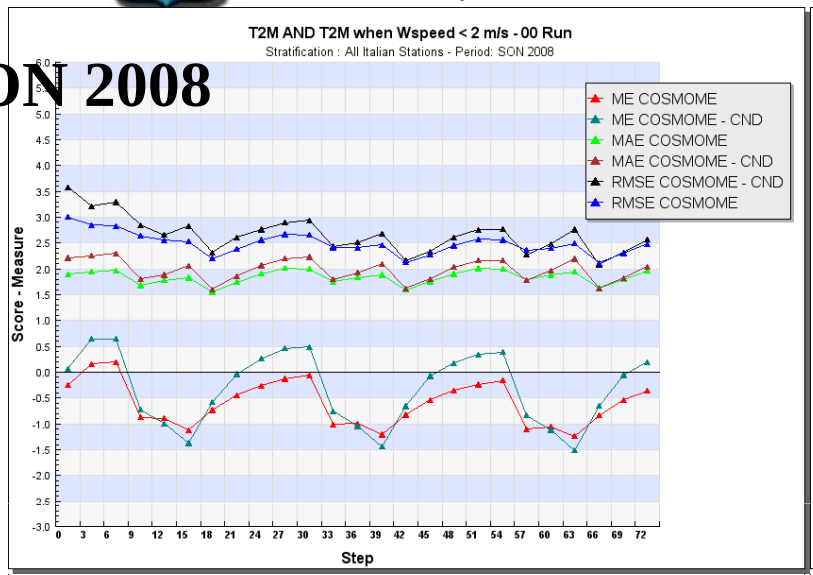
Verification package: VERSUS

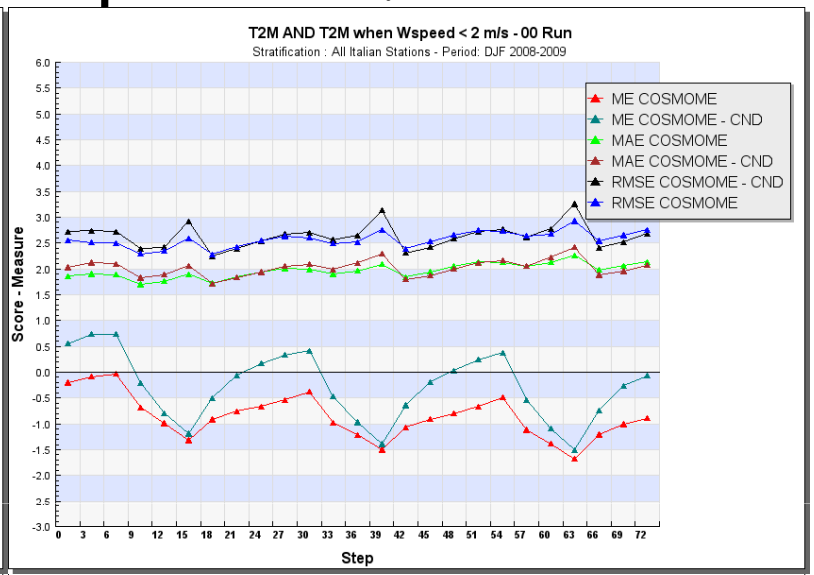
Conditional Verification

2mT cond: WSpeed<2 m/s

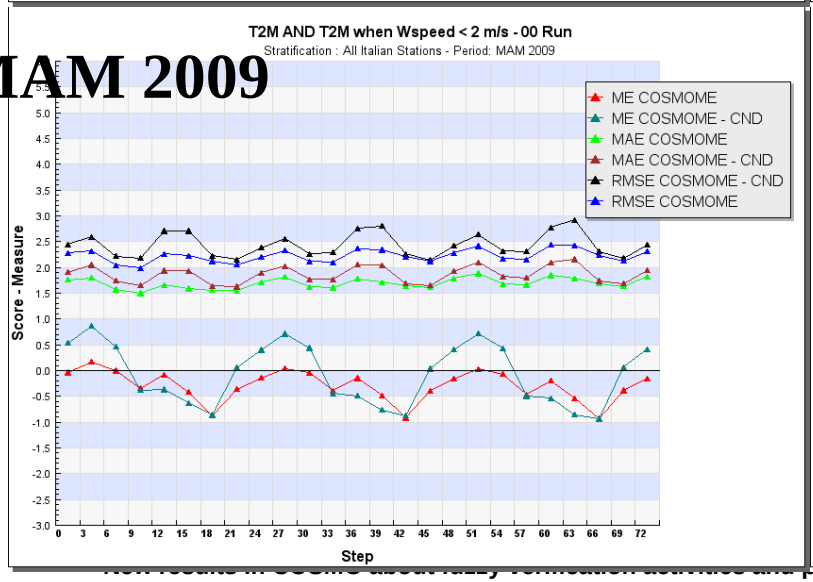
DJF 2008-9

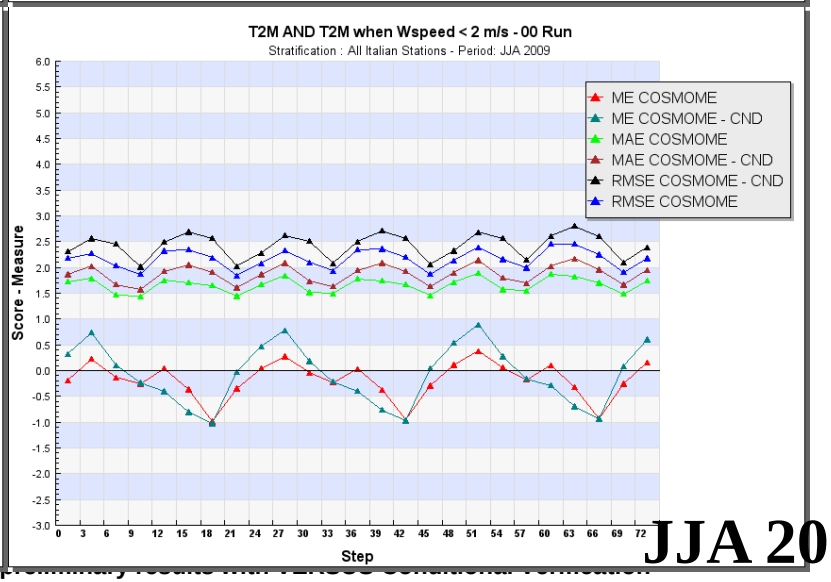
SON 2008





MAM 2009



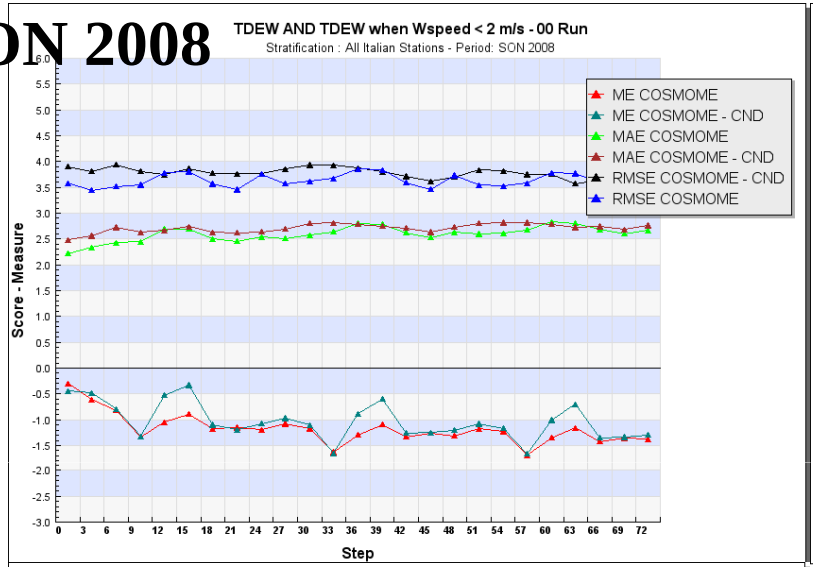


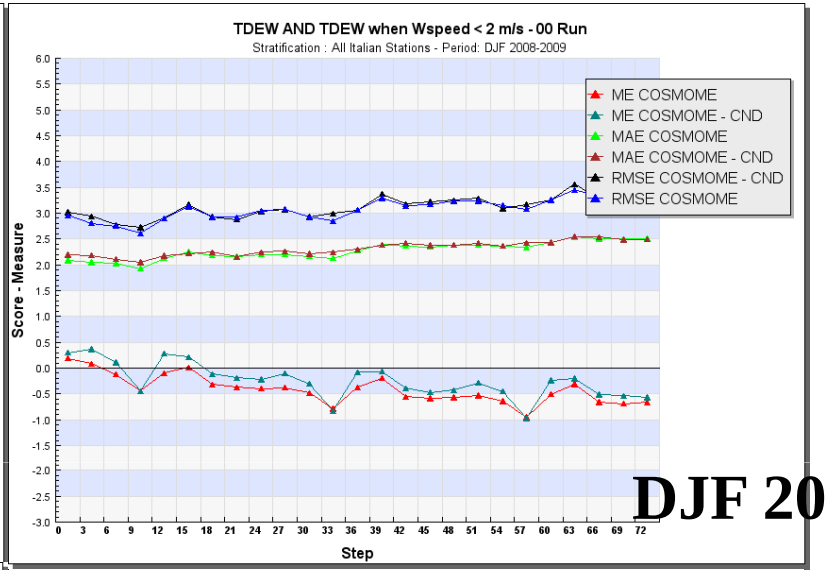
JJA 2009

Conditional Verification

2mTd cond:WSpeed<2 m/s

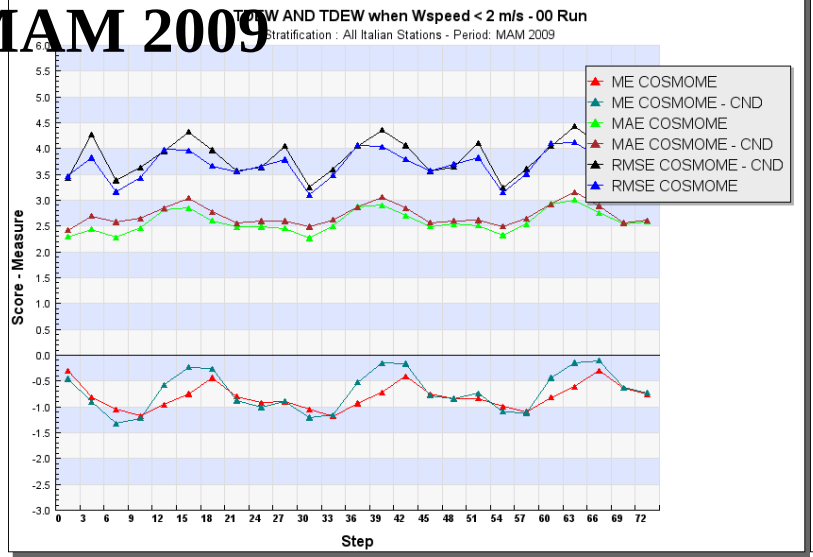
SON 2008

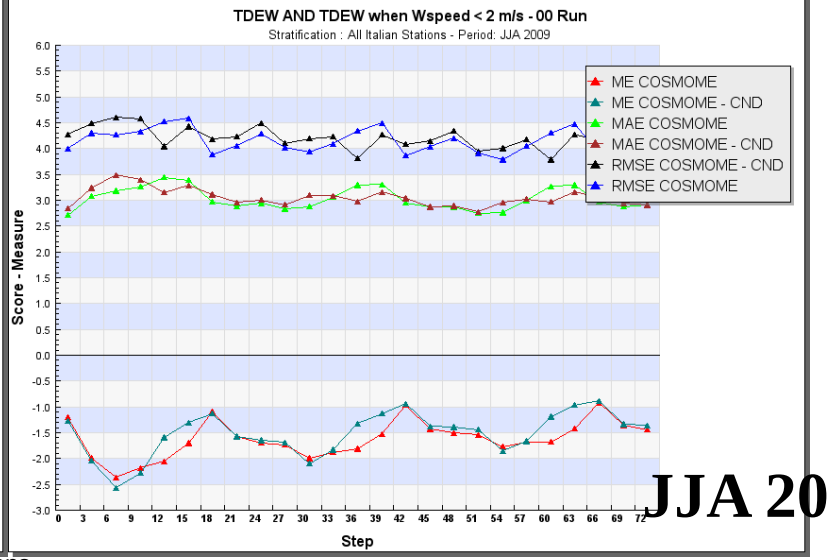




DJF 2008-9

MAM 2009





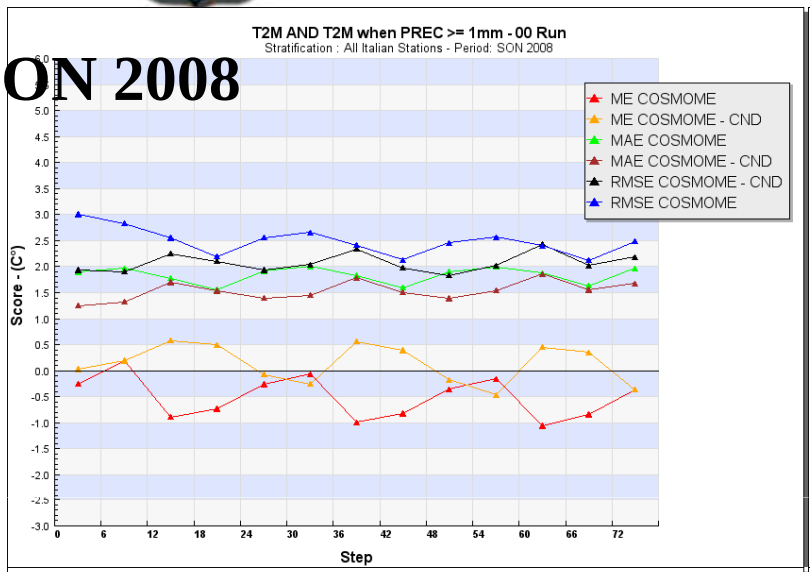
JJA 2009

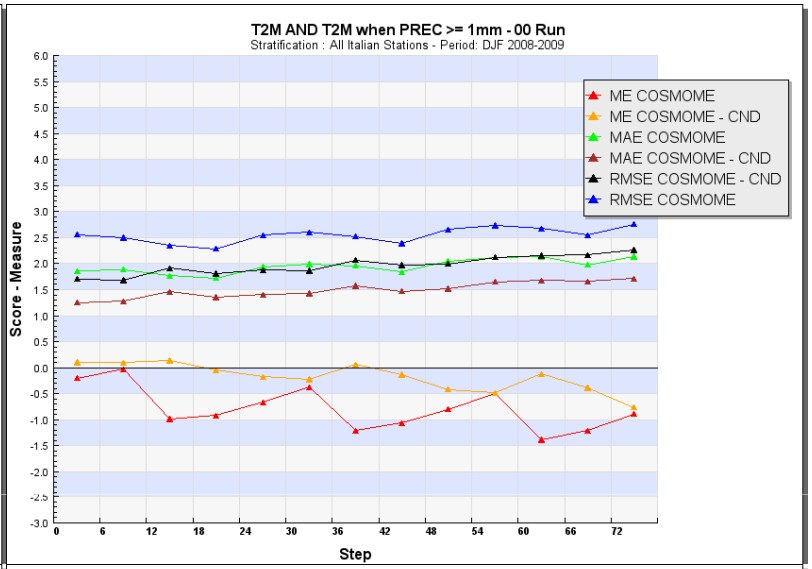
Conditional Verification

2mT cond: Prec >=1 mm

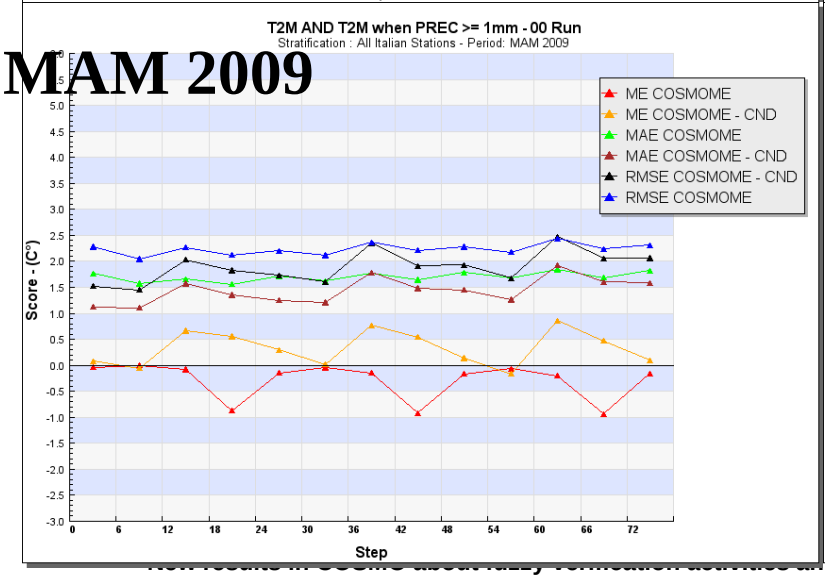
DJF 2008-9

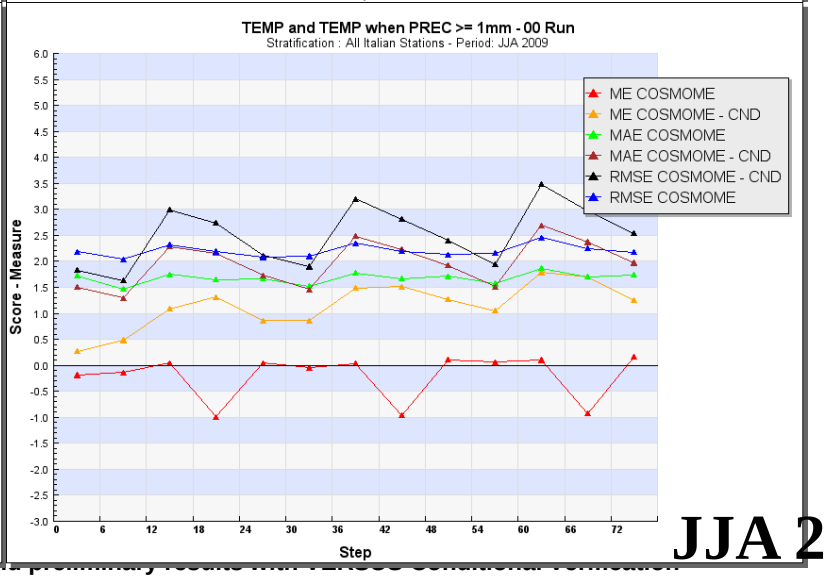
SON 2008





MAM 2009





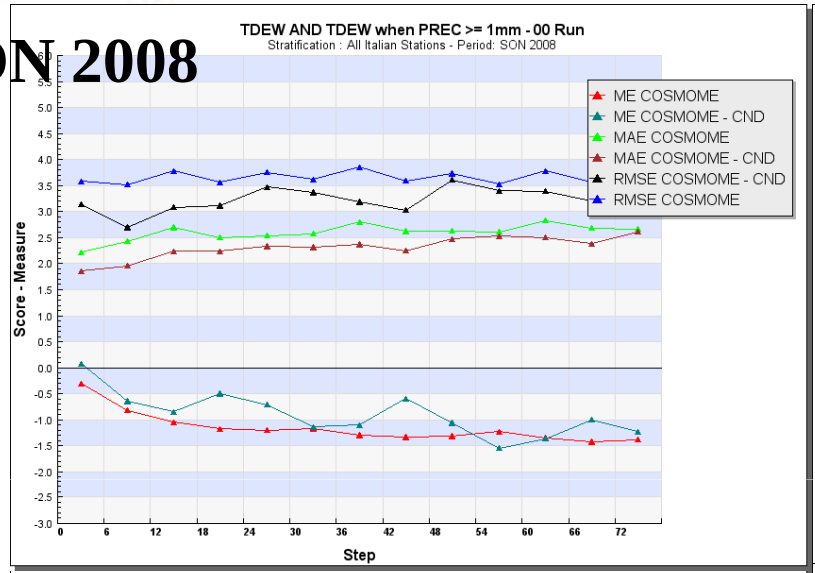
JJA 2009

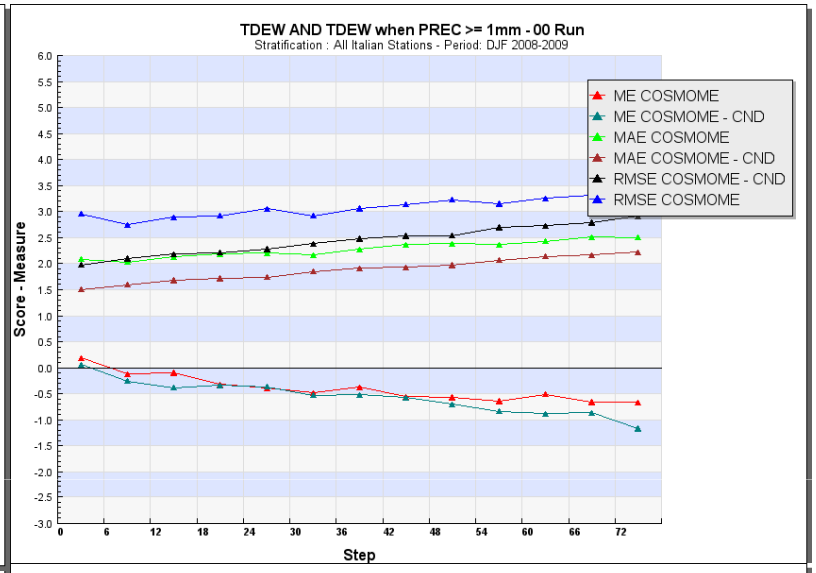
Conditional Verification

2mTd cond: Prec >= 1 mm

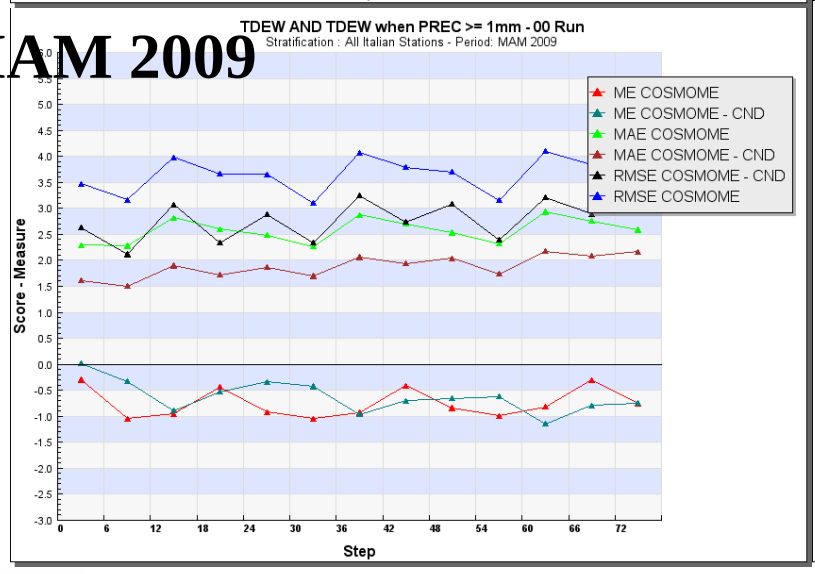
DJF 2008-9

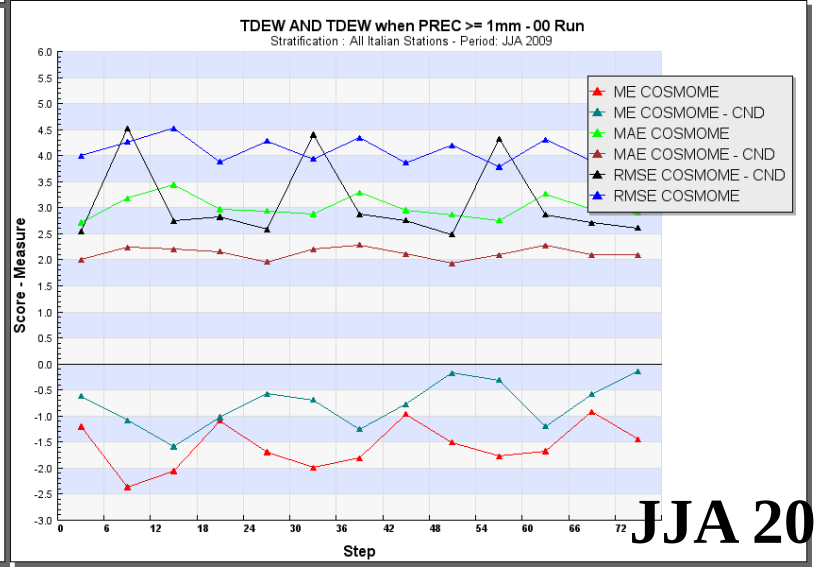
SON 2008





MAM 2009





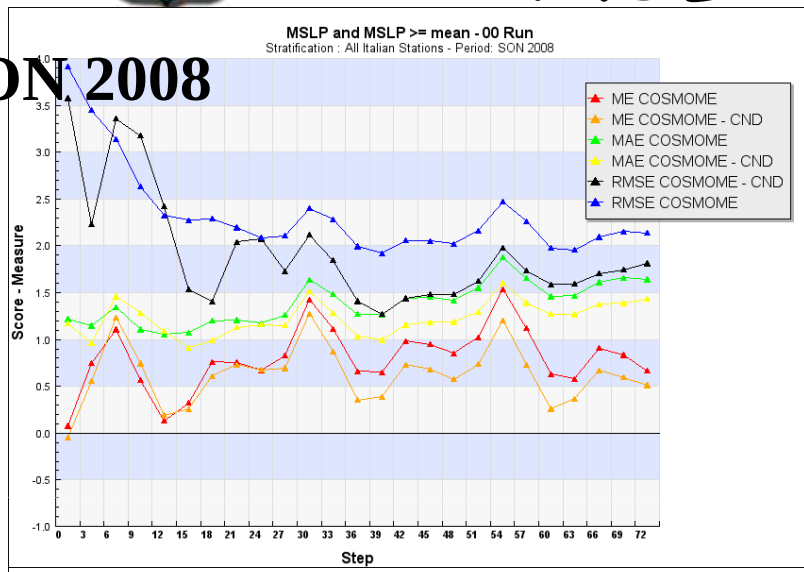
JJA 2009

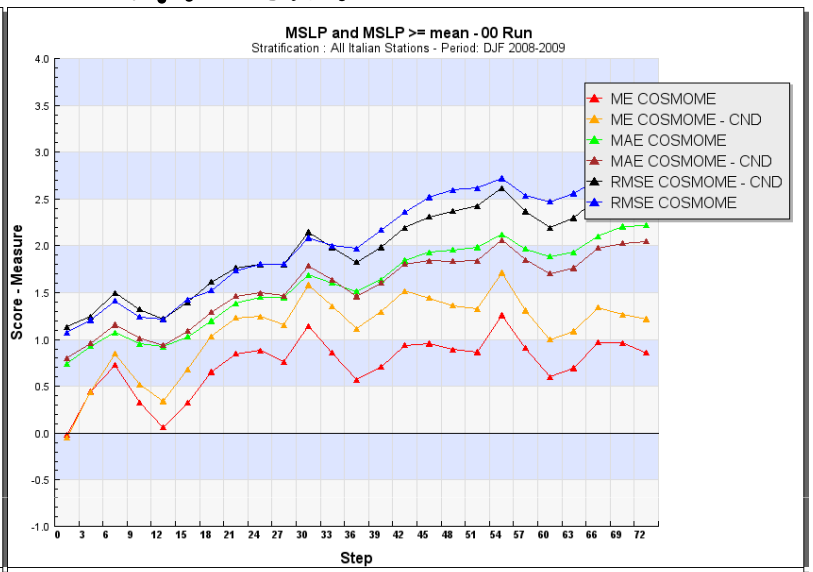
Conditional Verification

MSLP >= mean

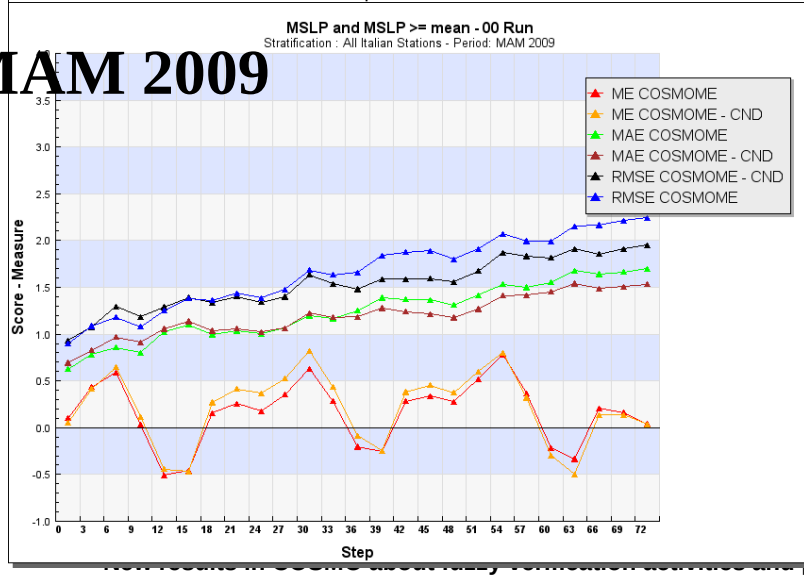
DJF 2008-9

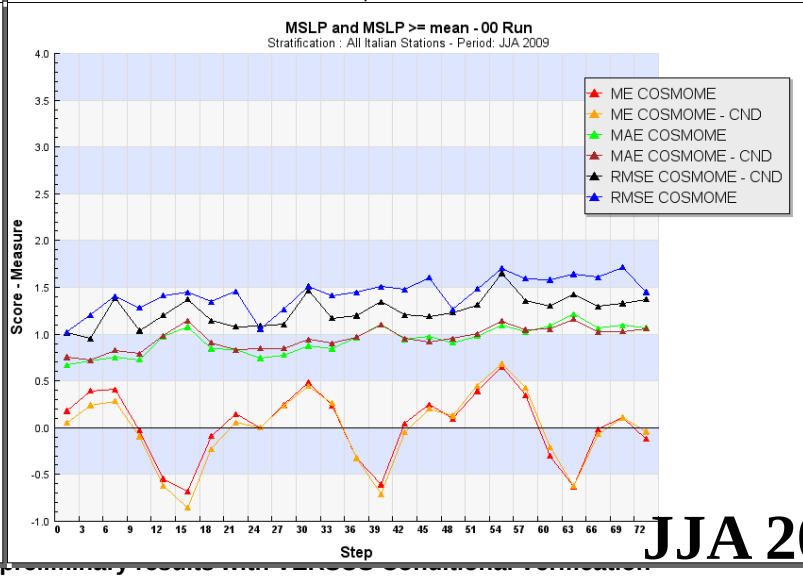
SON 2008





MAM 2009





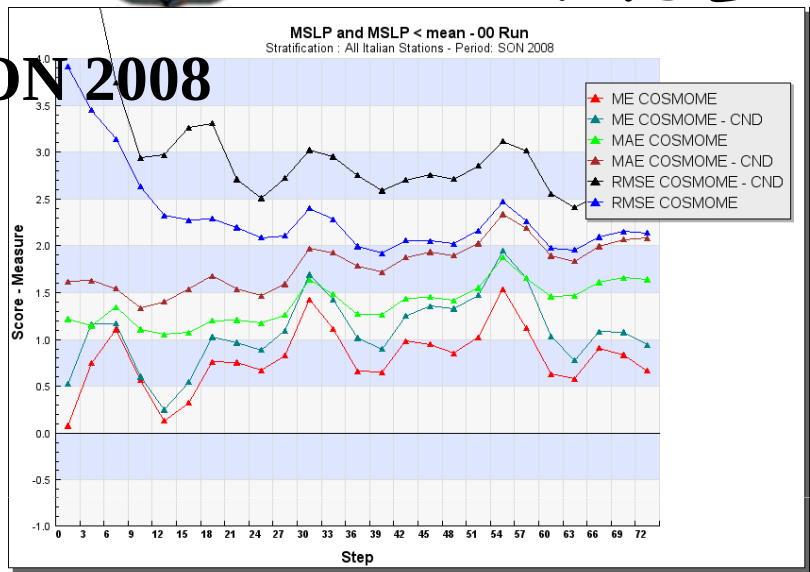
JJA 2009

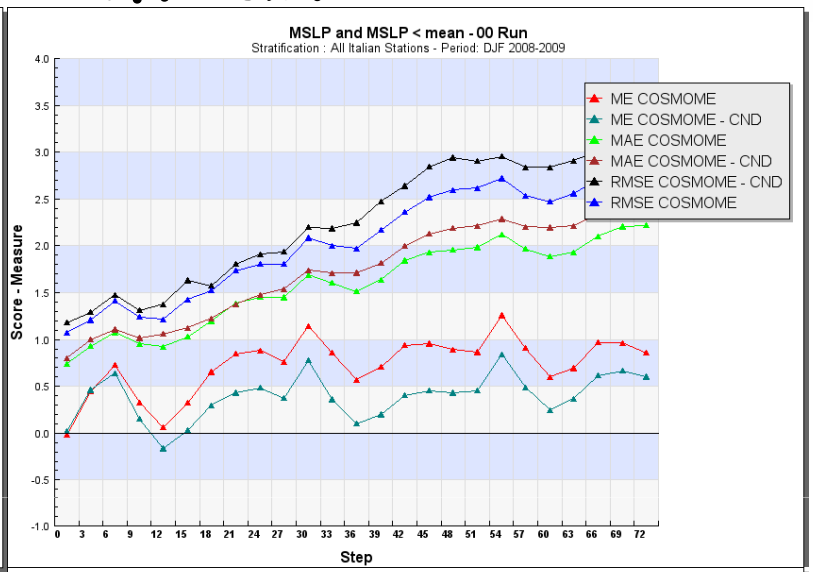
Conditional Verification

MSLP < mean

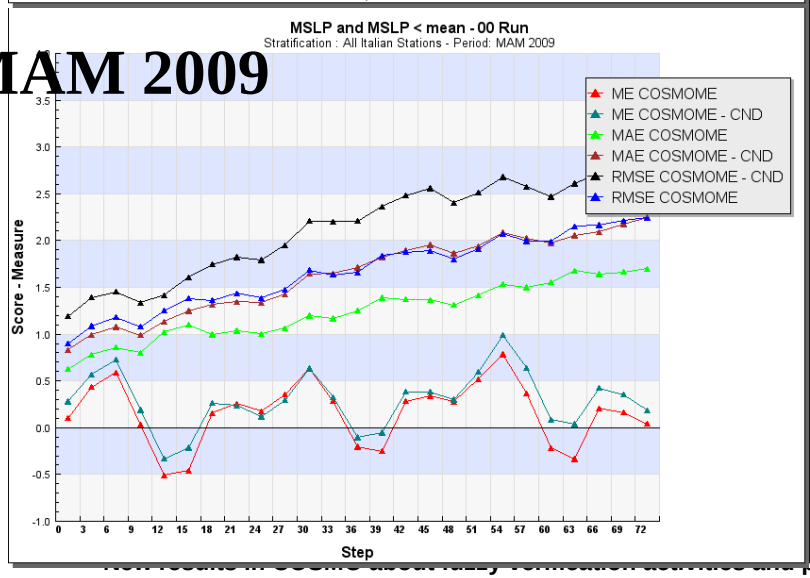
DJF 2008-9

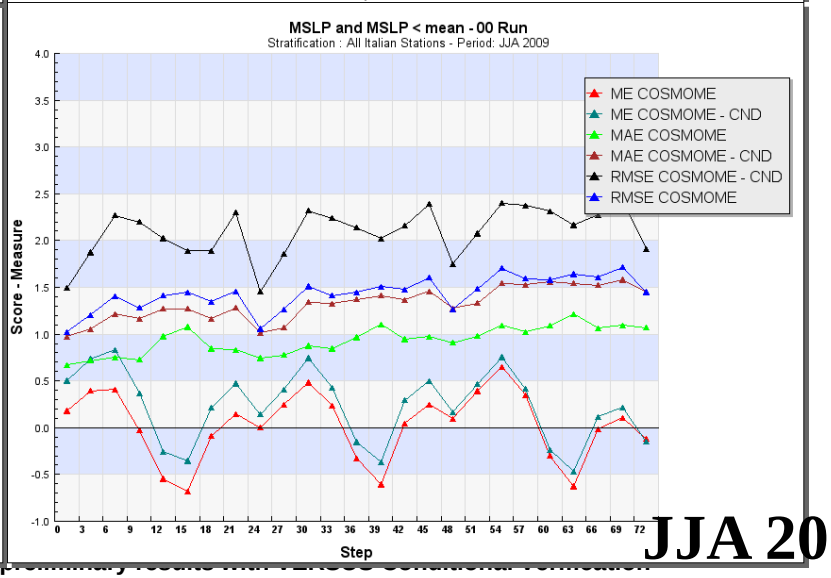
SON 2008





MAM 2009



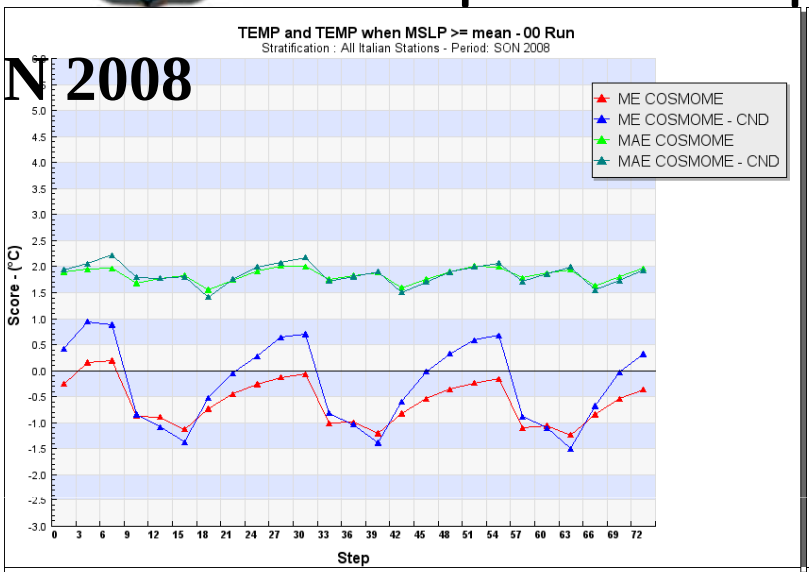


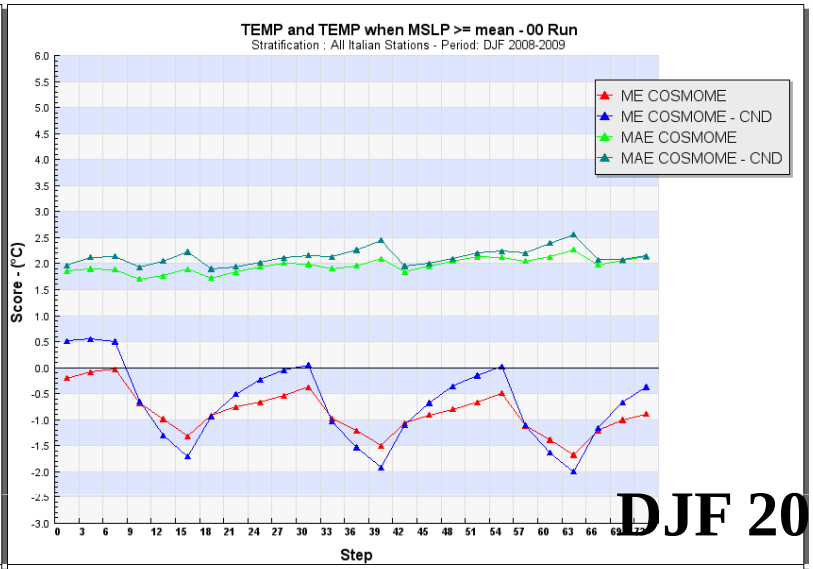
JJA 2009

Conditional Verification

Temp and Temp when MSLP >= mean

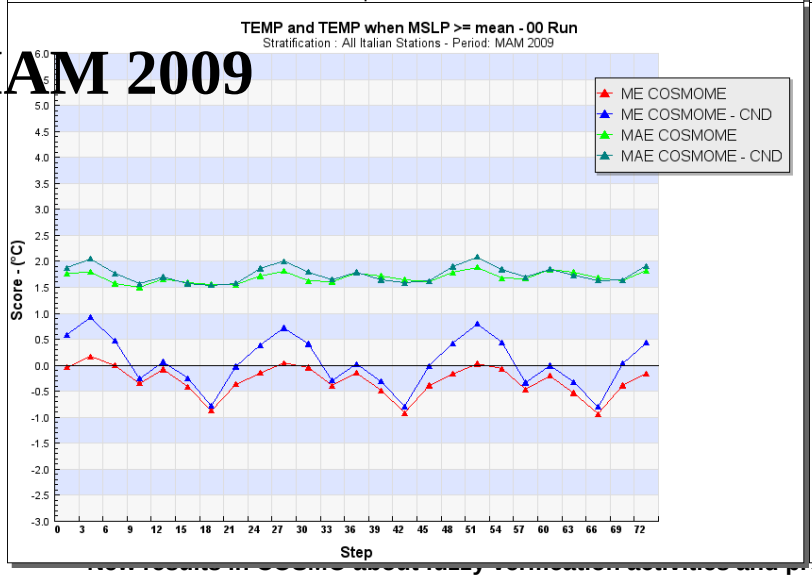
SON 2008

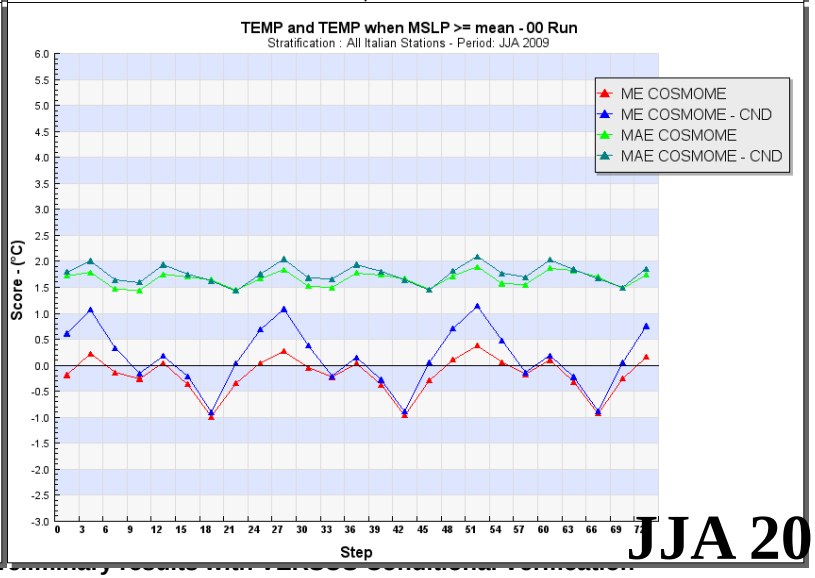




DJF 2008-9

MAM 2009



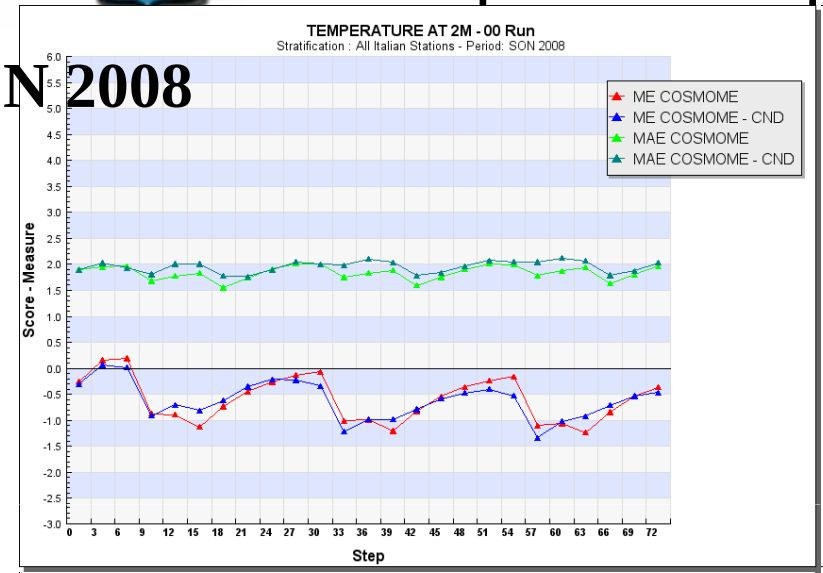


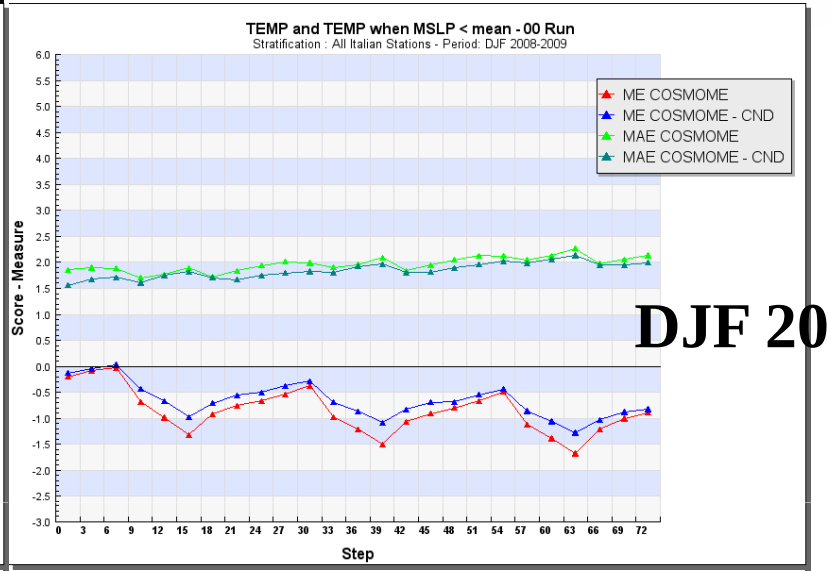
JJA 2009

Conditional Verification

Temp and Temp when MSLP < mean

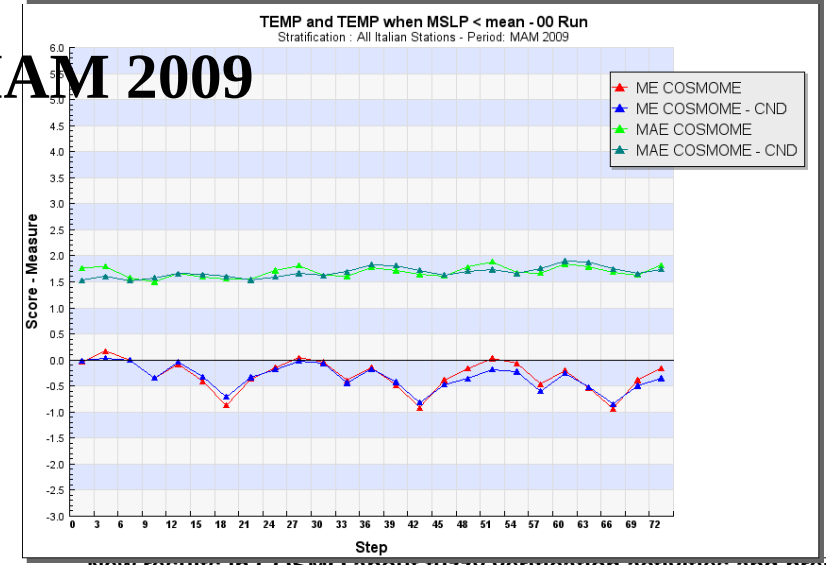
SON 2008

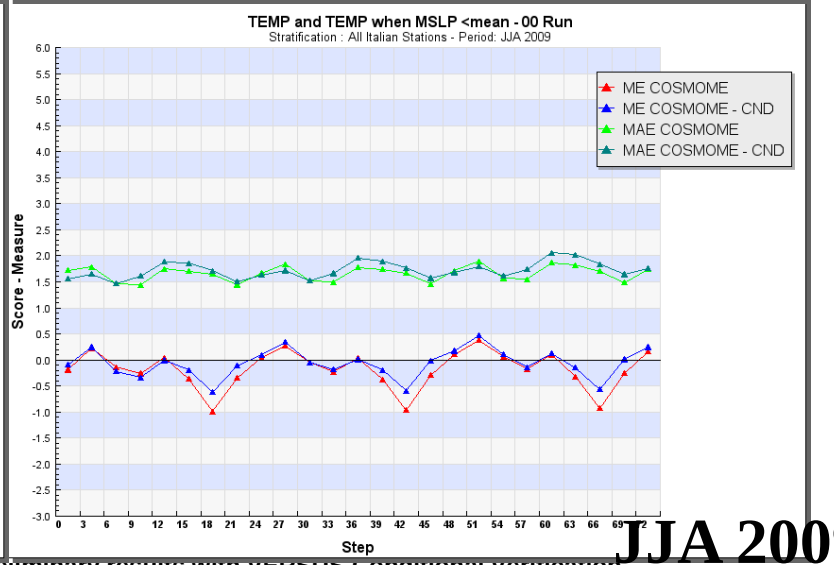




DJF 2008-9

MAM 2009



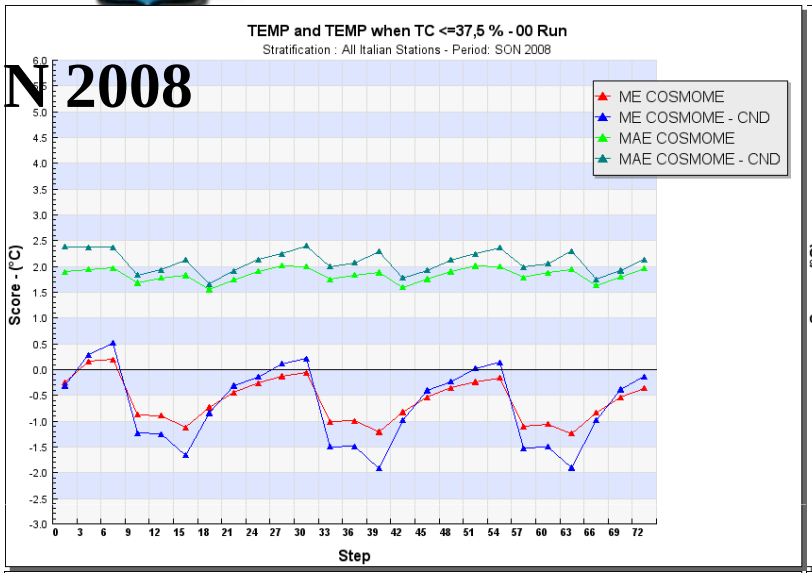


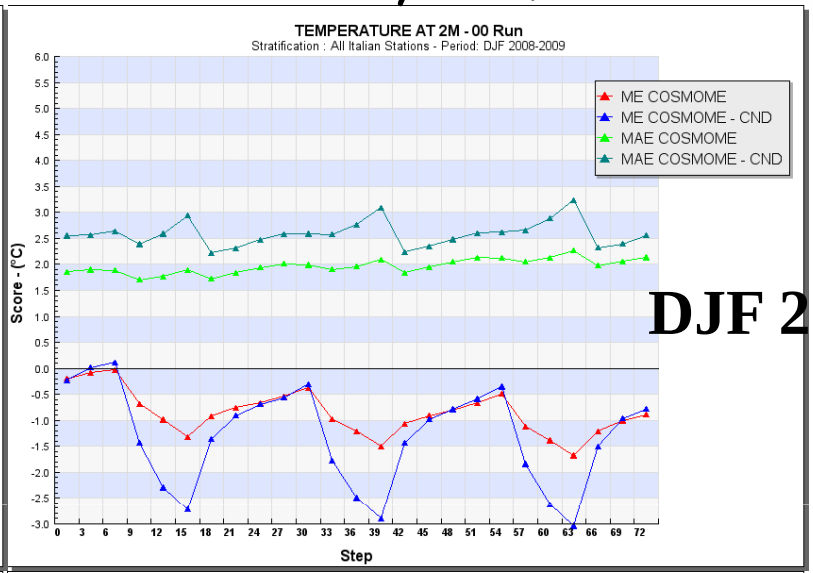
JJA 2009

Conditional Verification

2mT when Total cloud <=37,5% from Obs

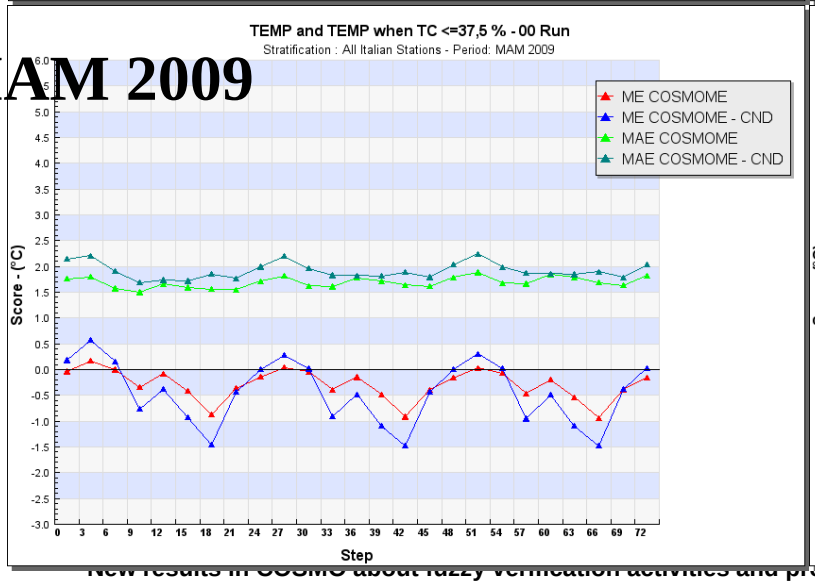
SON 2008

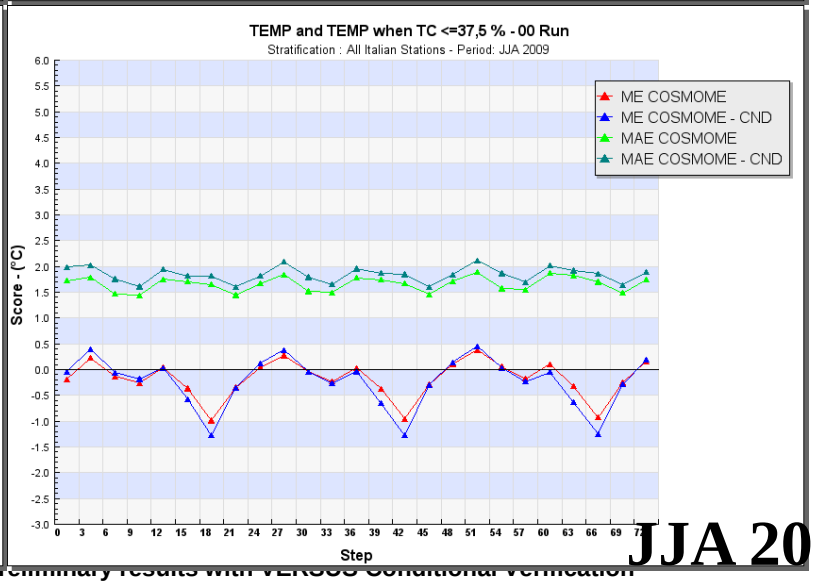




DJF 2008-9

MAM 2009



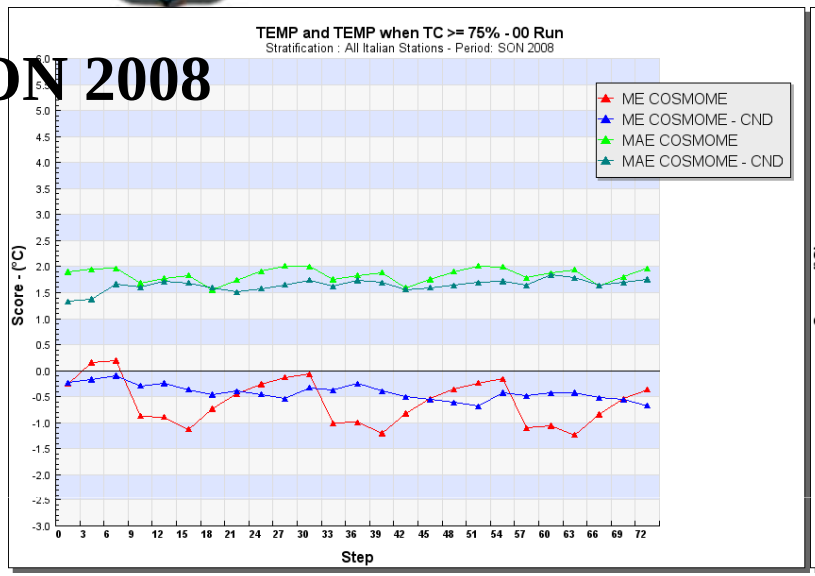


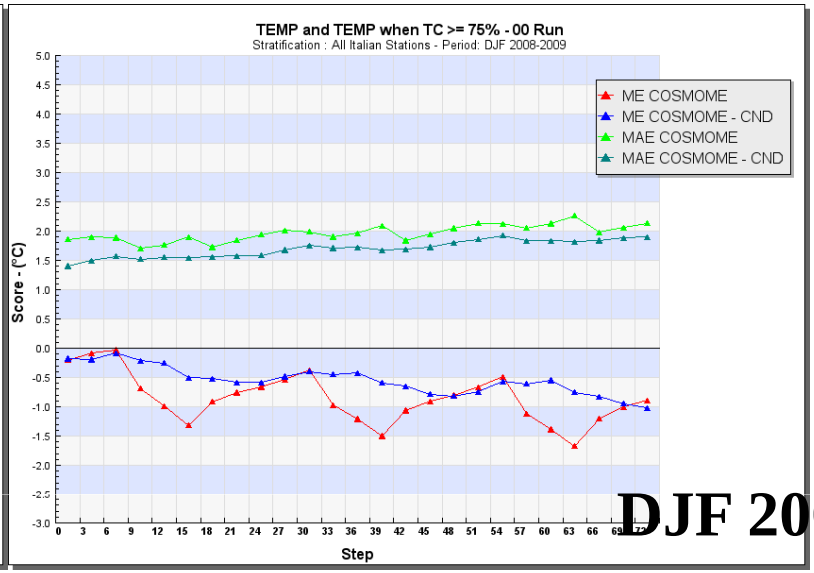
JJA 2009

Conditional Verification

2mT when Total Cloud >=75% from Obs

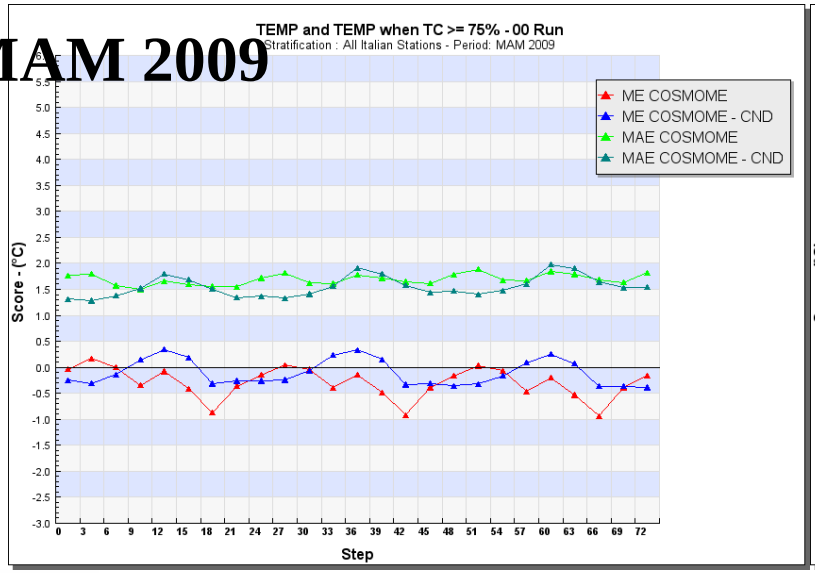
SON 2008

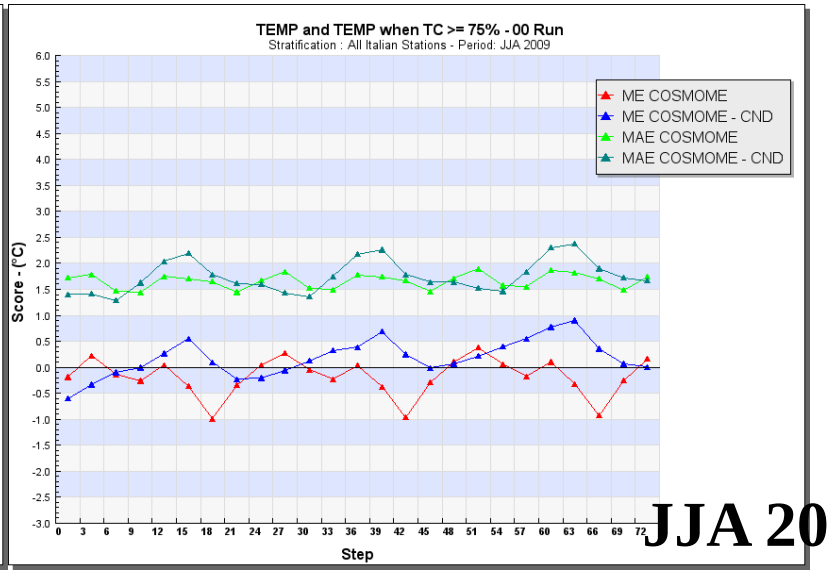




DJF 2008-9

MAM 2009





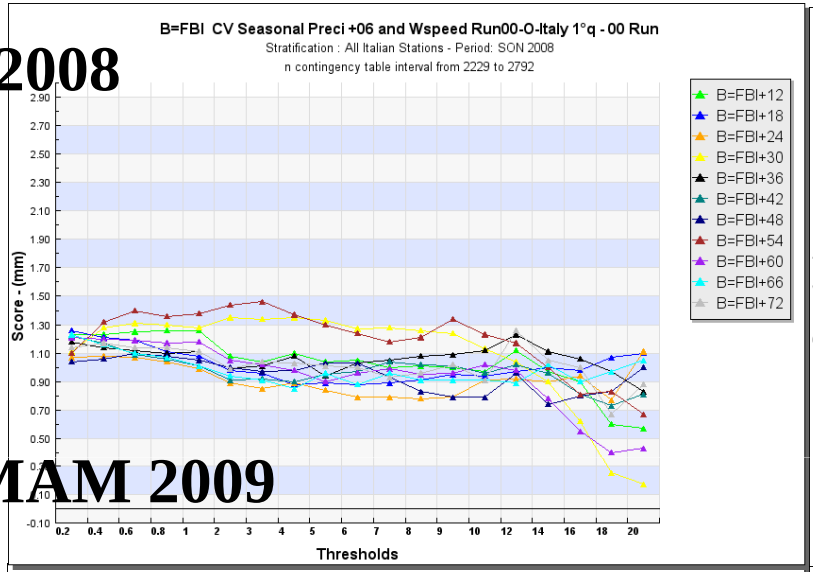
JJA 2009

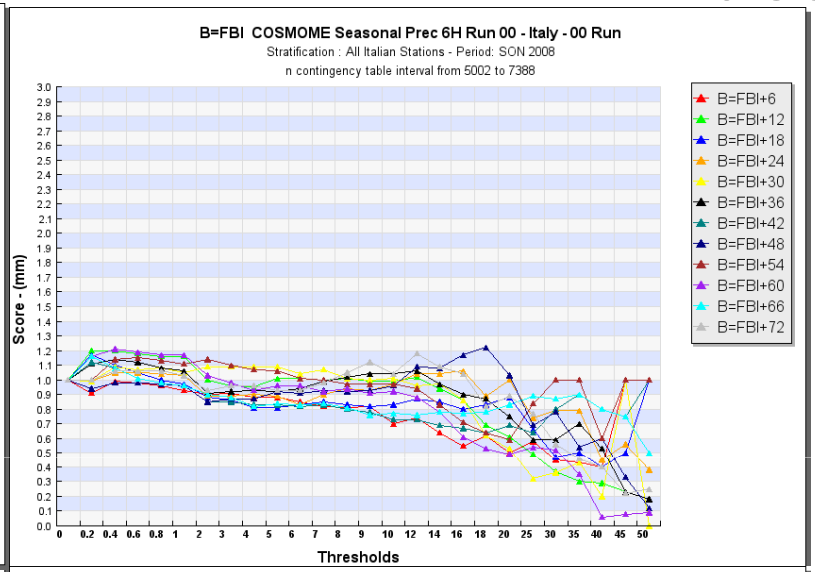
Conditional Verification

Prec. +06 Wind 1°quad. from Obs FBI

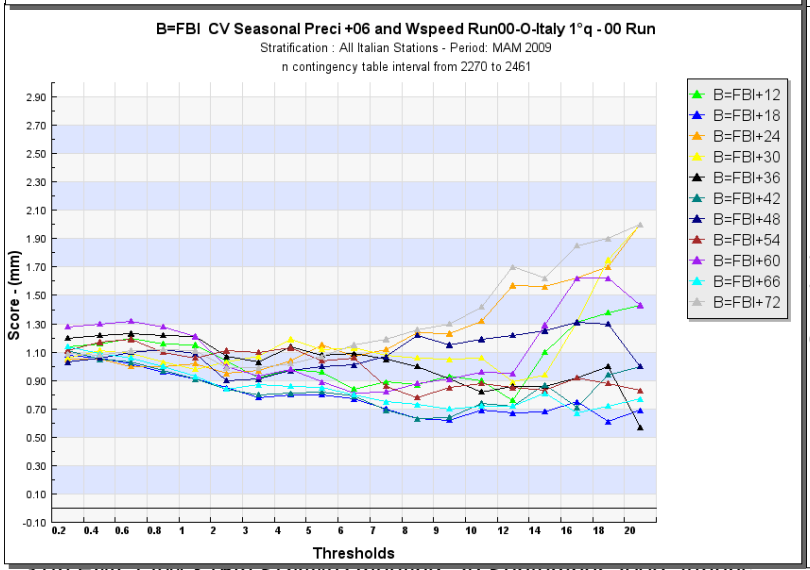
No COND

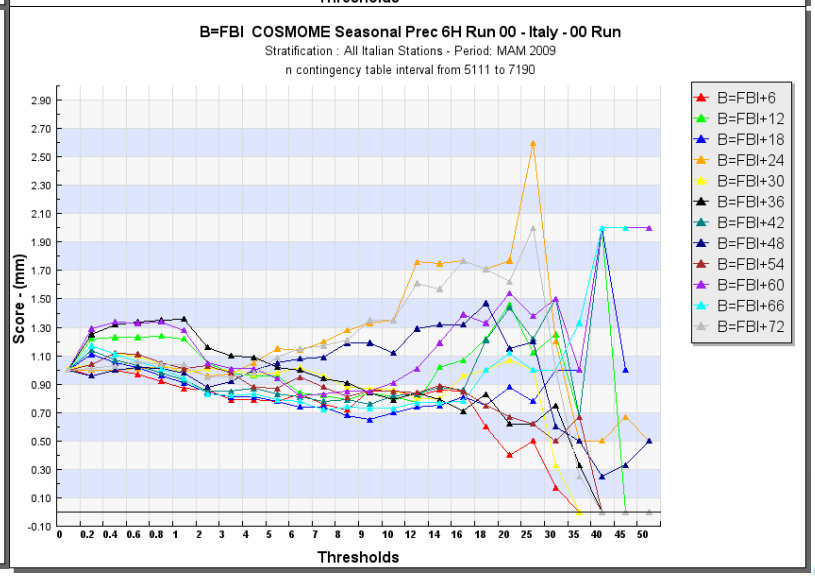
SON 2008





MAM 2009



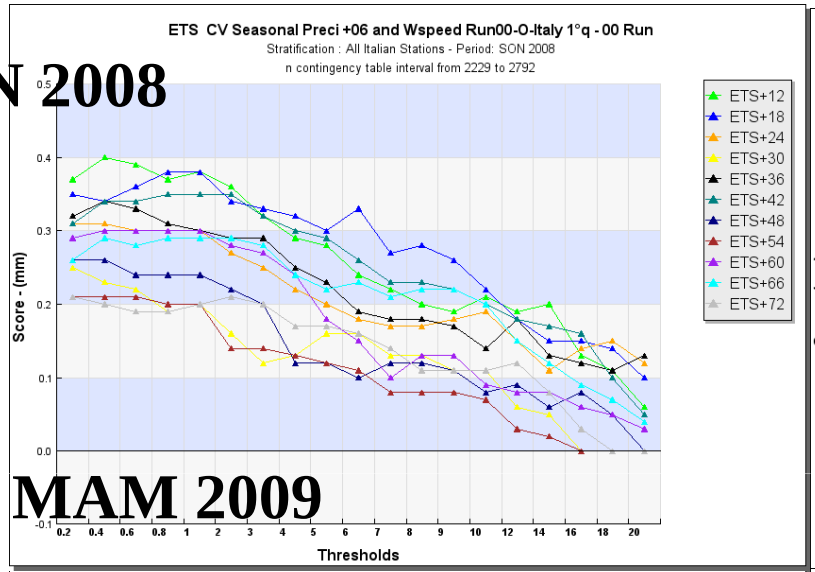


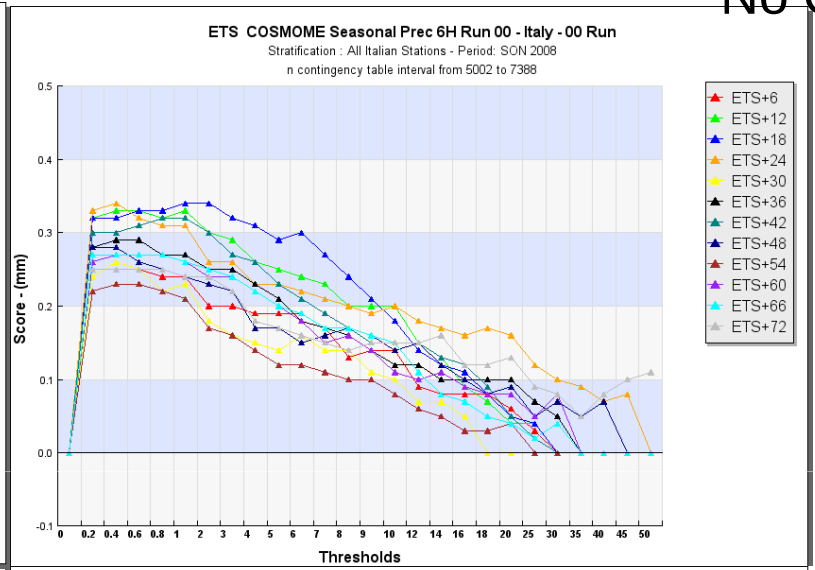
Conditional Verification

Prec. +06 Wind 1°quad. from Obs ETS

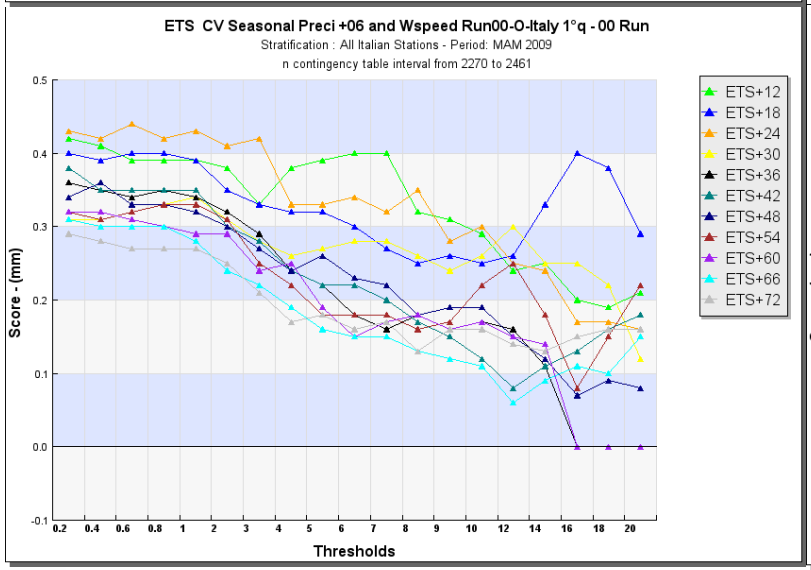
No COND

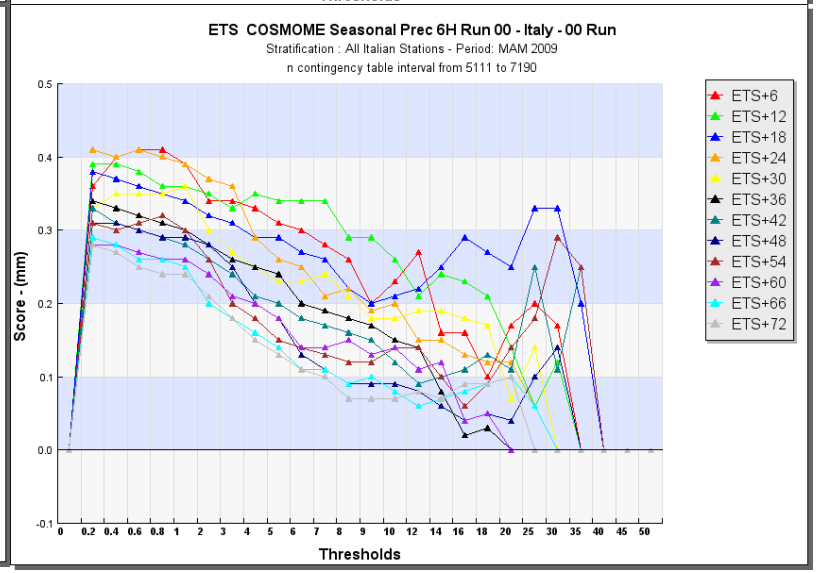
SON 2008





MAM 2009



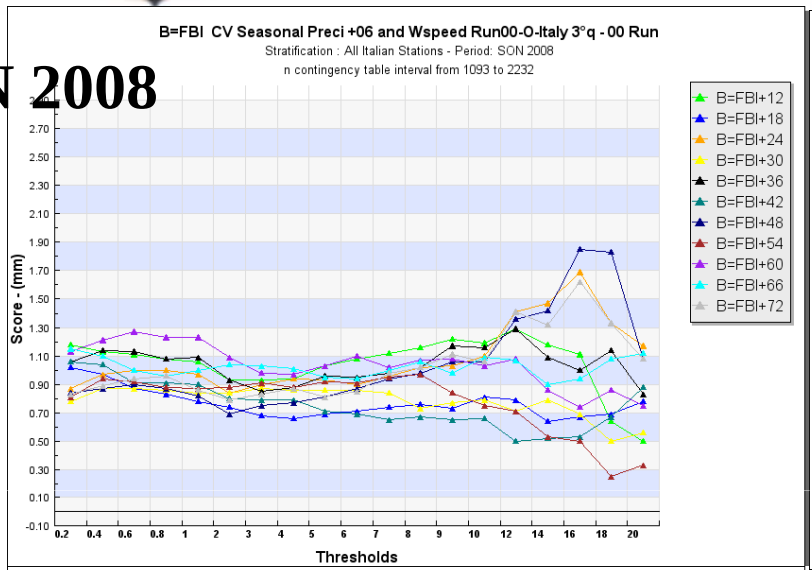


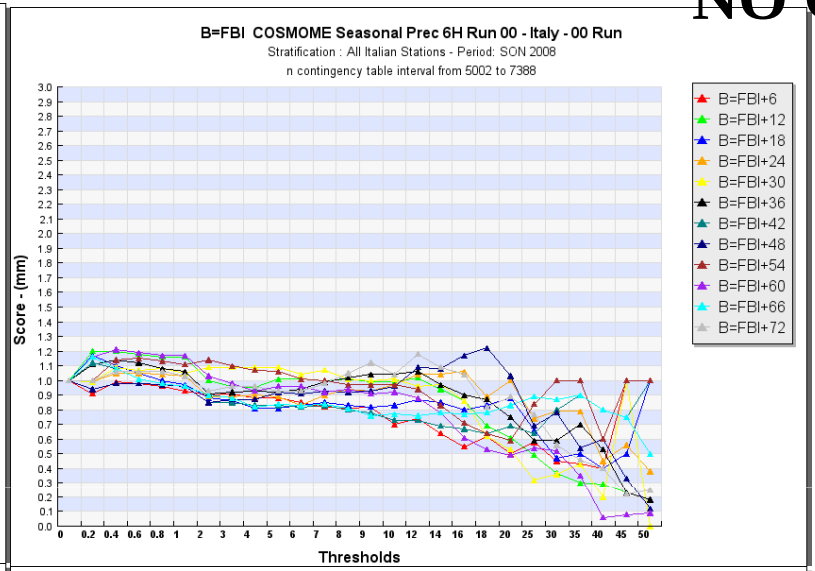
Conditional Verification

Prec. +06 Wind 3°quad. from Obs FBI

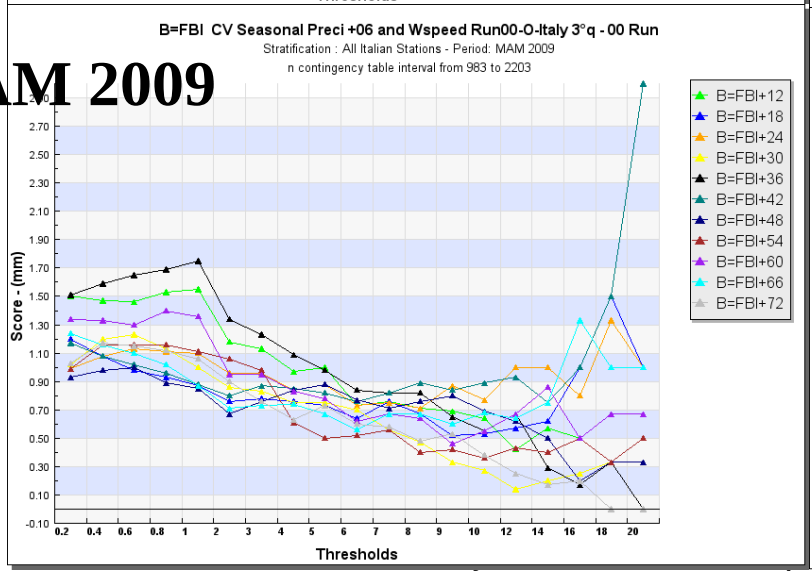
NO COND

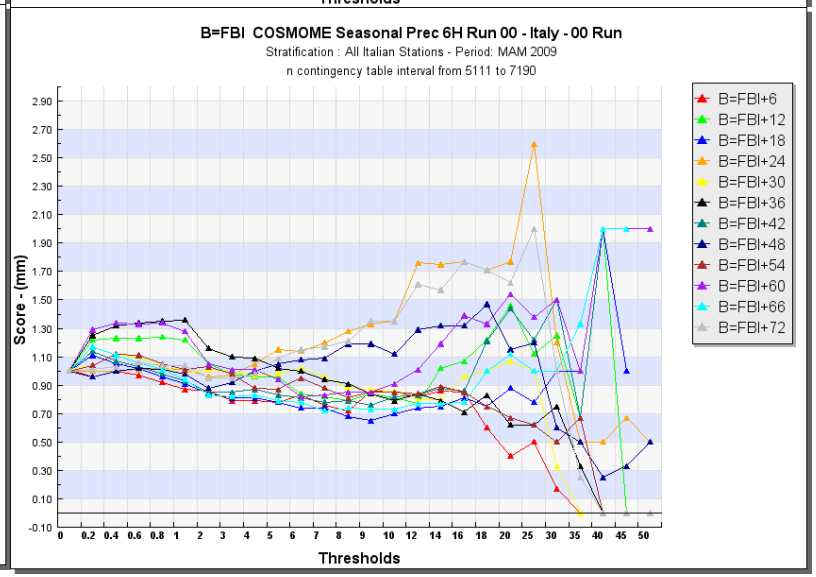
SON 2008





MAM 2009

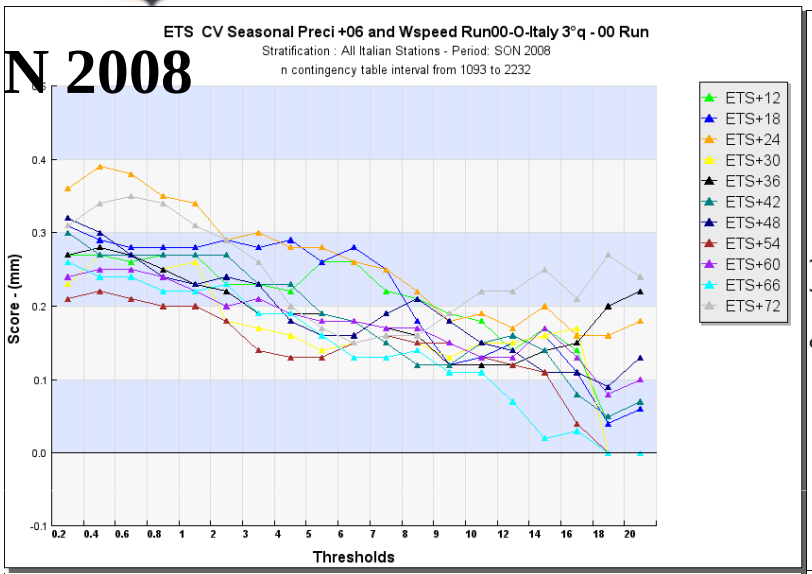




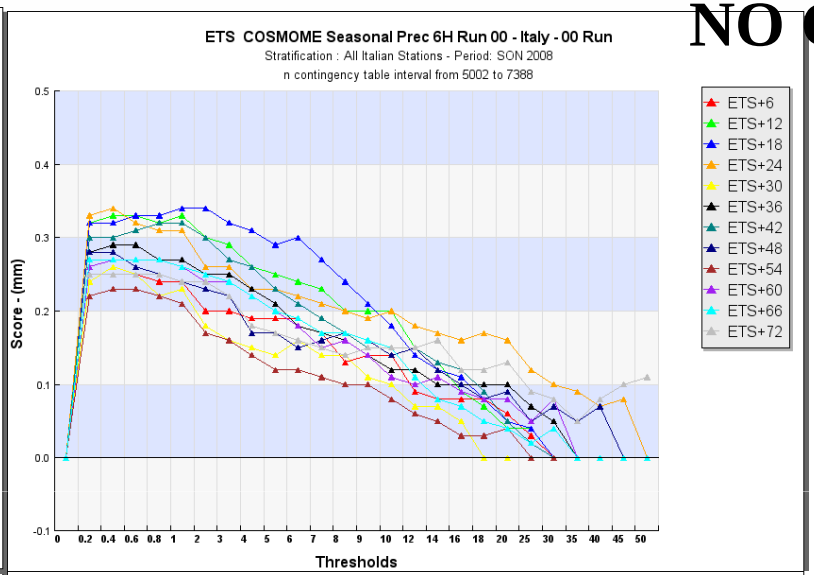
Conditional Verification

Prec. +06 Wind 3°quad. from Obs ETS

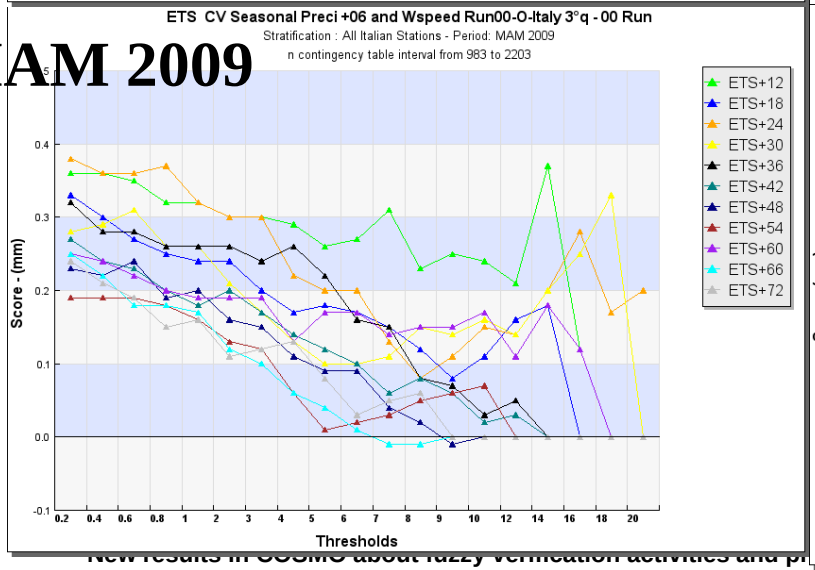
SON 2008

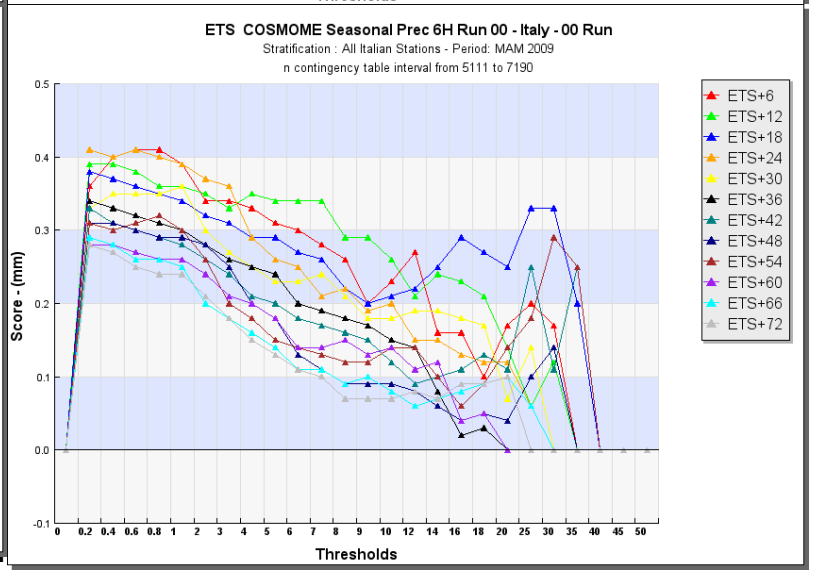


NO COND



MAM 2009





New results in COSMO about fuzzy verification activities and pr

Future Outlook

- Conditional verification also on COSMO-I2

- Conditions also on special parameters of the model not only weather parameters (e.g. some soil parameters)

- Closer look to all the plots produced especially on precipitation

- Closer connection with people involved in model maintenance and development

Thanks for your attention