

Verification and Case studies

Overview of activities

Flora Gofa

Status of PPCARMA: Amalia Iriza-Burca

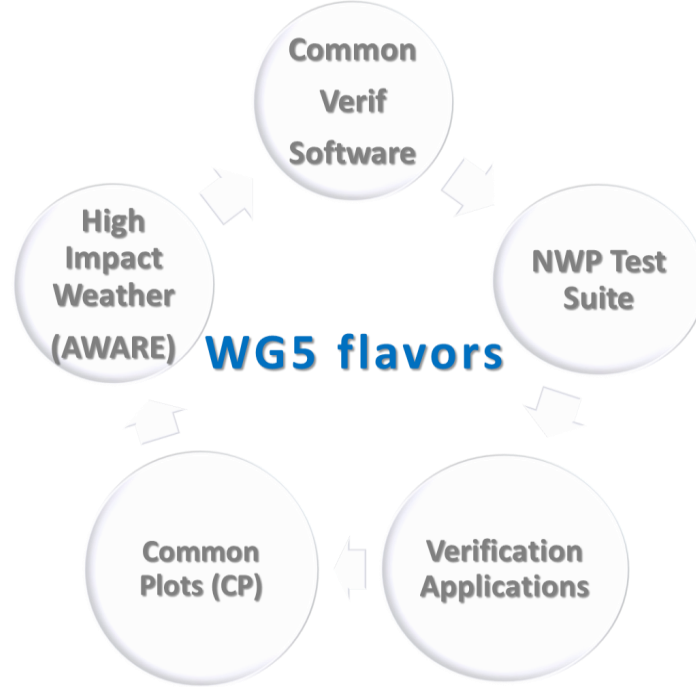
COSMO Common verification: D. Boucouvala, A. Kirshanov, N. Vela

PP-AWARE F. Gofa, A. Bundel

WG5 Guidelines, pending STC approval

https://www.cosmo-model.org/content/consortium/reports/WG5_Guidelines_2021.pdf

- **Common Verification framework:** developments concerning EPS verification with MEC-Rfdbk and its conditional verification capabilities. *PP-CARMA completed, some work through SPRT CP activity*
- **Exploitation of spatial verification techniques:** Analyse how methods relate to one another, how each method works, what information could be gleaned from each method, and whether a given method actually conveys any useful information . *PP-INSPECT, PP-AWARE on spatial methods already, new PP for EPS under consideration*
- **Severe and High Impact Weather.** Forecast methods and verification are important aspects of any HIW consideration. *PP-AWARE addresses issues* such the representation in the observations of HIW, importance of observation uncertainty, systematic and stochastic errors of HIW forecasts and their sensitivity to model resolution.
- **Utilization of non-conventional observational datasets:** obs often do not permit characterization of the phenomenon of interest for objective verification. *PP with focus to recognize the value of less conventional observations and align them with NWP parameters for verification practices.*



CP: new Common Verification Software (CVS)

- Through **PP-CARMA**, a Common Verification platform based on MEC-Rfdbk was developed for the unified production of the Common Plots (CP). Spatial verification is performed with other available tools (**VAST/Arpa-PT**).
- Centralized transfer and visualization of CP statistics on COSMO web server facilitates the easier analysis and viewing of the verification results.
- PP-CARMA concluded, with most services (**DWD, MCH, CoMET, HNMS, IMGW-PIB, NMA, IMS**) to have migrated to **MEC-Rfdbk framework for CP** point statistics production.
- **Critical issue:** unfinished work that concerns the installation in the remaining services and the **inclusion of additional features/capabilities** that can be part of **SPRT-CP activity**.



National setup: FF Processing and graphical output chain

FF INPUT
3-hourly Feedback Files
for each model and observation system



DWD Processing scripts
.Rdata statistical files
for each model and observation system

The screenshot shows the RStudio interface. The left pane contains R code for processing feedback files and generating statistical data. The right pane displays a plot of scores versus step for WSpeed in MAM 2021 across all Italian stations. The plot compares three models: ME-COSMO-IT (red line), SMC-COSMO-IT (blue line), and FRSE-COSMO-IT (green line). The ME-COSMO-IT model shows the lowest scores, while FRSE-COSMO-IT shows the highest scores. The SMC-COSMO-IT model shows intermediate scores. The plot also includes a secondary y-axis for '# Obs' ranging from 0 to 3500.

RSTUDIO software
.R scripts for graphical output



WG5/COSMO GM-2021, 10-17 September 2021



**STATUS OF OF MEC-RFDBK IMPLEMENTATION AT
COMET**

*Francesco Batignani, Nicola Zaccariello, Emanuele Regoli,
Valerio Cardinali, Francesca Marucci, Antonio Vocino*

Common Plot Activity: next phase



FF Point Verification: 0.25 FTEs - NMA

- Retrieve obs and convert to netcdf (**daily basis**)
- Align FF files from various services and run Rfdbk
- Upload Rdata files on shiny web pages for ComA-1, ComA-2, NoComA and for all different statistical outputs (continuous, categorical, by station, upper air, etc.)
- **Incorporate new features in CP activity: 6h precipitation in all intervals, conditional verification, add IFS data, etc.**
- Update the system with new versions of Rfdbk and distribute to users new versions of MEC for FF production

VAST Spatial verif: 0.1 FTEs – ARPA-PT

- Run VAST for the calculation of FSS and other neighborhood methods scores with OPERA obs. Include updates in the capabilities of VAST software

Each COSMO service: 0.05 FTEs

- Produce Feedback Files (FF) through MEC for ComA1, ComA2, NoComA
- **Analyze verif results (ICON/COSMO) over national domains**, Continue PP-C2I
ICON/COSMO verif reports

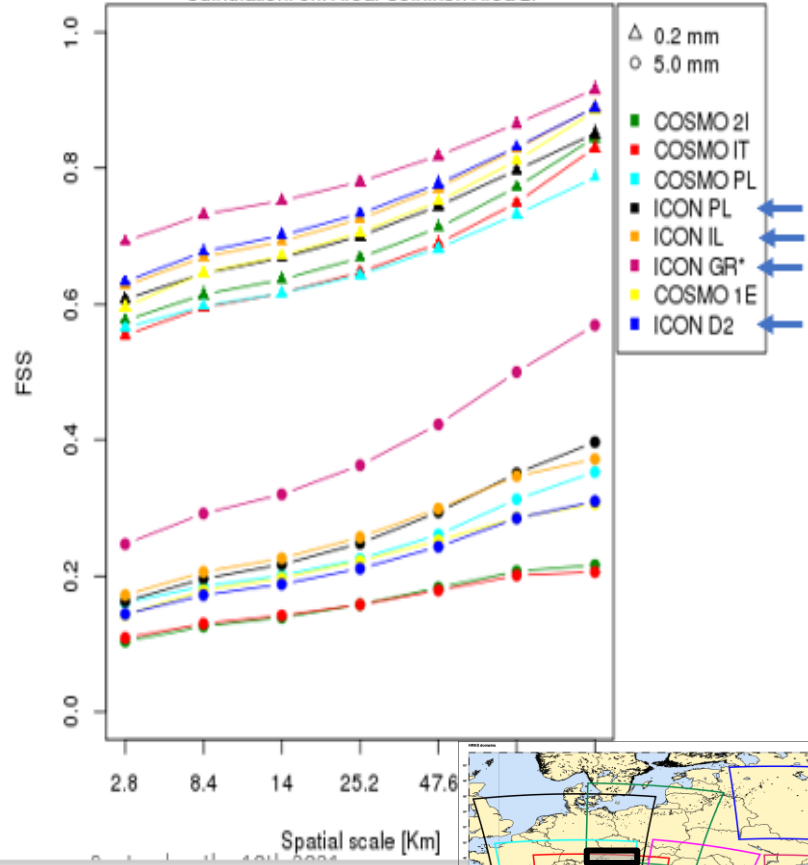
Reporting: 0.05 FTEs

- Annual guidelines for the activity, Seasonal/annual verification reports

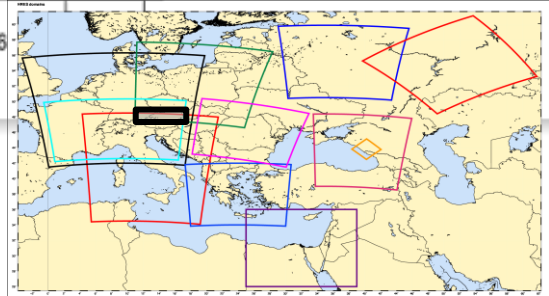
FSS – D0 - 1T – COSMO 2I, COSMO IT, COSMO PL, ICON PL, COSMO 1E, ICON D2, ICON IL, ICON GR (only MAY)

MAM2021 - FSS at 0.2 and 5.0 mm - d0 - 1t

Cumulation: 3h. Area: Common Area 2.



- 0.2 mm: ICON D2 and ICON IL have the highest performances at all scales. COSMO IT and COSMO PL (at the bottom) are very similar for small spatial scales, but COSMO 2I gets better at bigger scales.
- 5.0 mm: ICON IL and ICON PL have the highest FSS, COSMO 2I and COSMO IT are the worst.
- ICON GR*: data available only for the month of May. Very promising results.



Fuzzy verification on Common Area 2
Naima Vela



CVS: Rfdbk advances

Changes to the “Rfbk” R-Package

- New data alignment function “align”
 - More exploiting the functionality of data.tables
 - Less code
 - More straight forward to put alignment options in the namelist (planned)
 - No significant changes to memory consumption or speed observable
 - Upcoming version of the verification script require the new Rfdbk package

Rfdbk Package

<https://gitlab.com/rxf/Rfdbk>

FFV Scripts

<https://gitlab.com/rxf/FFV>

Shiny Visualization

<https://gitlab.com/rxf/ShinyApps> (restricted)

Documentation

<http://www.cosmo-model.org/shiny/users/fdbk/RfdbkVeriDoku.html>



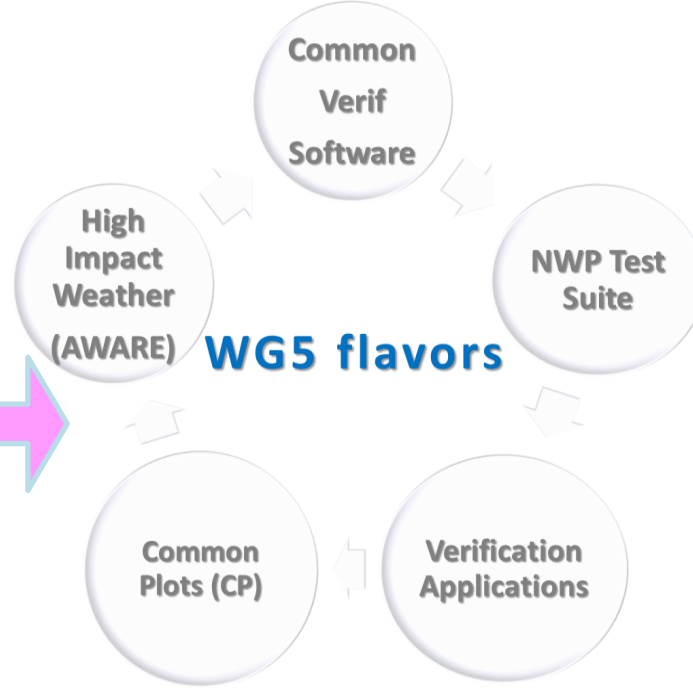
Revised TEMP-EPS verification

- New version uses EPS member information just like the SYNOP-EPS verification.
- New version uses discrete version of CRPS.
- New version has fair CRPS included (CRPSF) showing bias corrected CRPS.
- Selection of a member subgroup is possible.
- Member size has to be given in namelist.
- Outlier statistic is no longer available (planned to re-implement).

SYNOP-EPS Outlier Handling

- A recent update now filters wind observation with large difference to the ensemble mean.
- SYNOP deterministic and EPS verification are now more consistent but not identical w.r.t. wind.
- Using wind direction only if wind speed $>3\text{m/s}$ in the EPS verification is still a open issue.





WG5 flavors



NWP Test Suite

MODEL OUTPUT VERIFICATION

COSMO v5.06 (operational version) vs. 5.08 (test version)

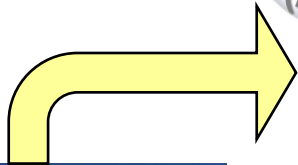
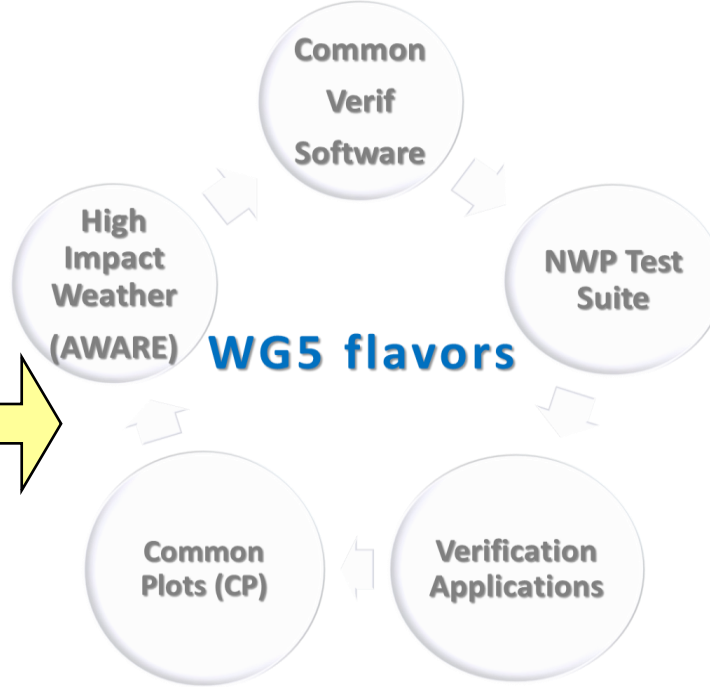
- the newer version of the model, on the whole, exhibits no significant changes in the performance, while in a few cases **outperforms** its predecessor.
- **SP-DP**: insignificant differences in the calculated indices and a smaller amount of computer resources were required to run the SP versions of the model.
- SP version of the model (7km resolution) can be an alternative to be used for NWP Test suite applications, without significant impact in the comparisons

COSMO v5.08 vs. ICON v2.6.3

- more striking changes in all scores, especially for surface parameters
- a very optimistic message for the future

ICON-LAM v2.6.3 (2 different resolutions / different number of vertical levels)

- even if the impact of the resolution is positive in almost all cases, the dependency of the performance on vertical levels is not as clear even if the 65 level implementation appears to be the one with better performance in many cases



Verification Practices

FORECASTERS WIND WARNIG EVALUATION

on Emilia-Romagna region (period Jan 2021 - Aug 2021)



Every day a weather warning is issued for the next day (from 00 to 24) with 4 different levels depending on wind speed:

Green: no warning

Yellow: Beaufort 8 for at least 3 consecutive hrs

Orange: Beaufort 9 for at least 3 hrs

Red: Beaufort 9 for at least 3 hrs



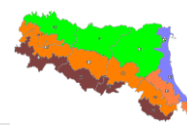
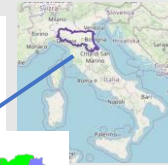
15 warning areas

- **Mountain**

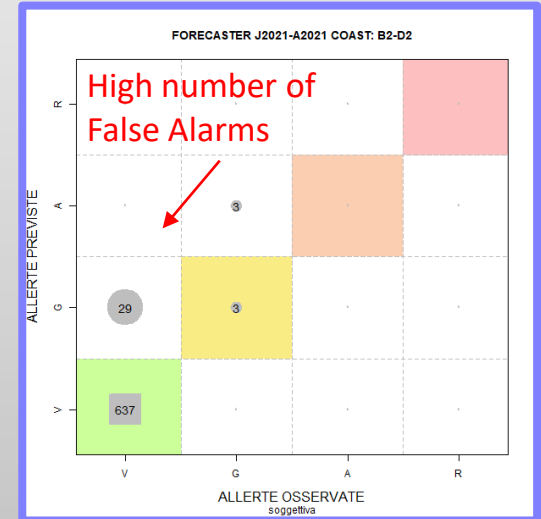
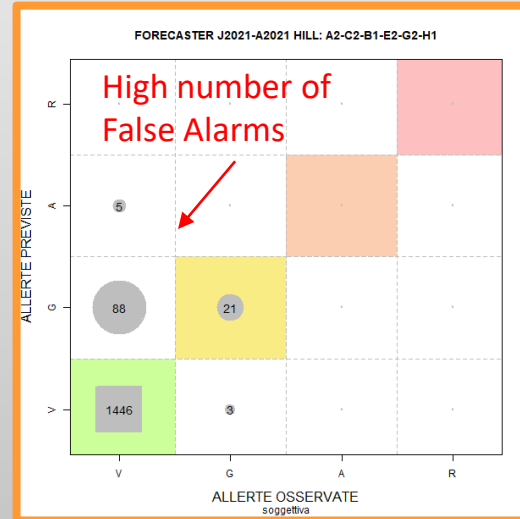
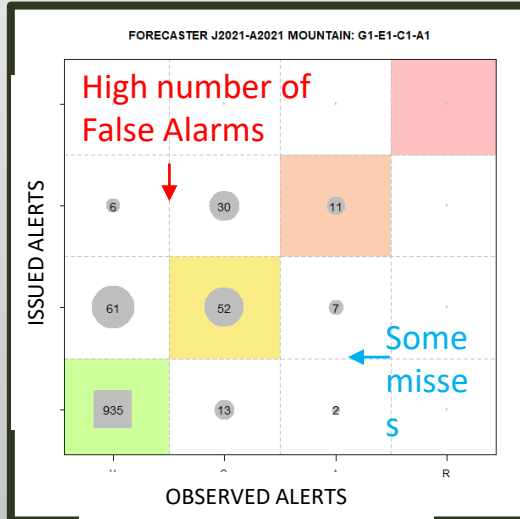
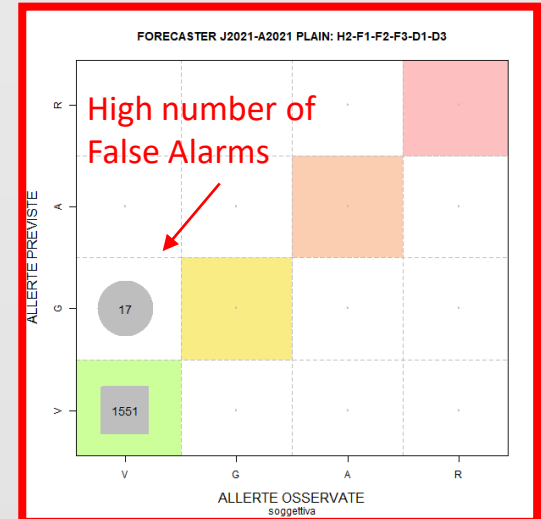
- **Hill**

- **Plain**

- **Coast**



For the verification an "observed color" is assigned subjectively to each areas using all the available wind data (synop, regional network but also from amateur stations on the web)

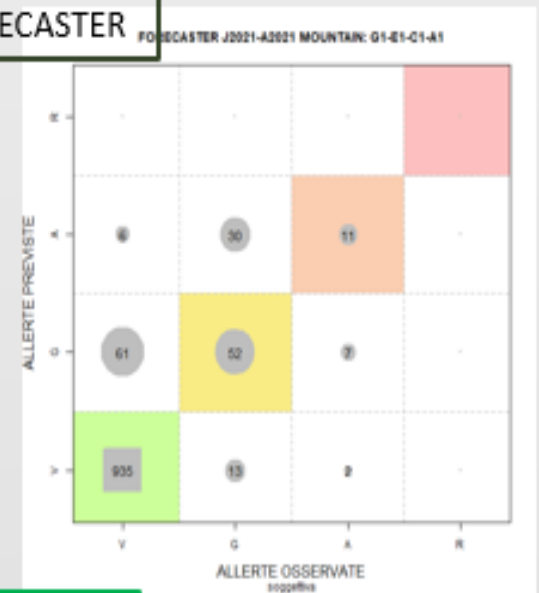


Models – mountain areas

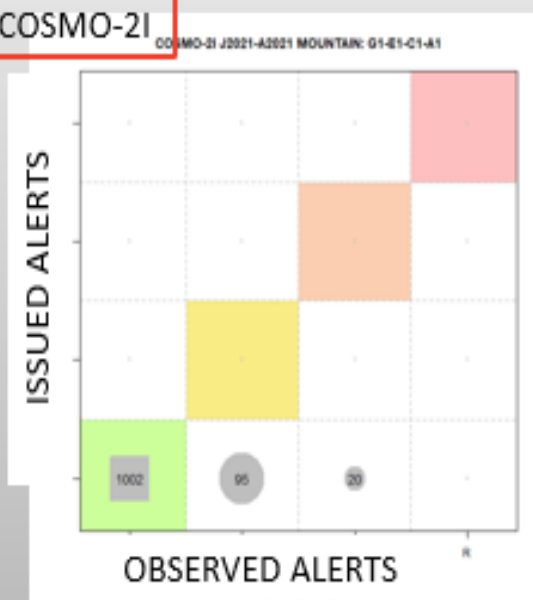
Maximum of 10m wind in the area
(at least on point in the area greater than threshold)

NO WARNING IDENTIFIED!

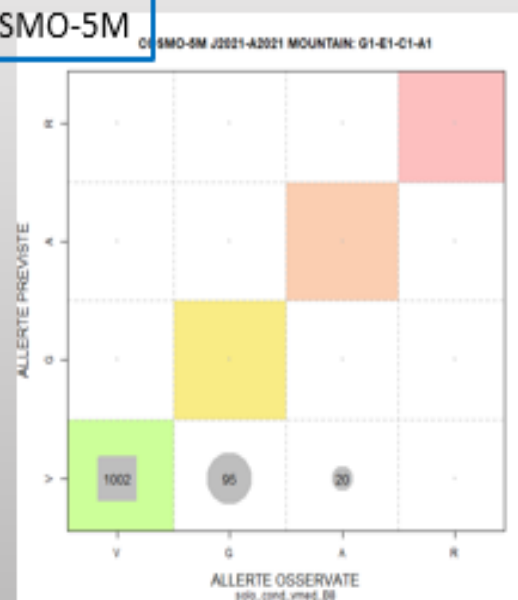
FORECASTER



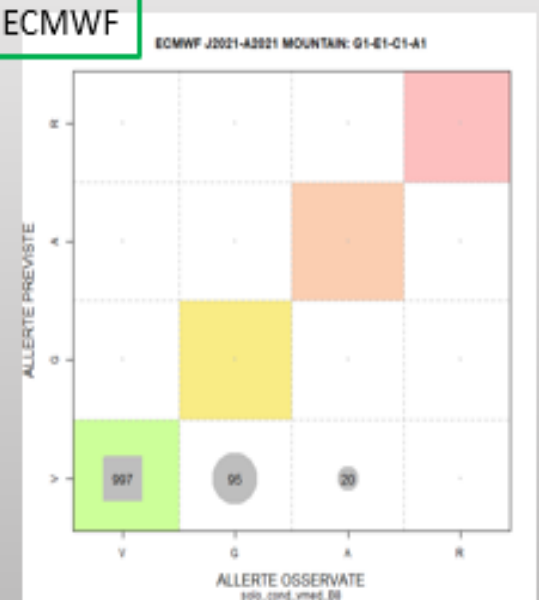
COSMO-2I



COSMO-5M



ECMWF

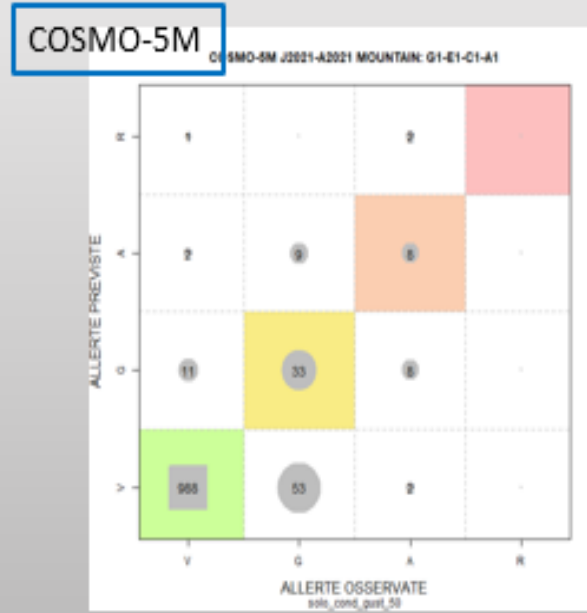
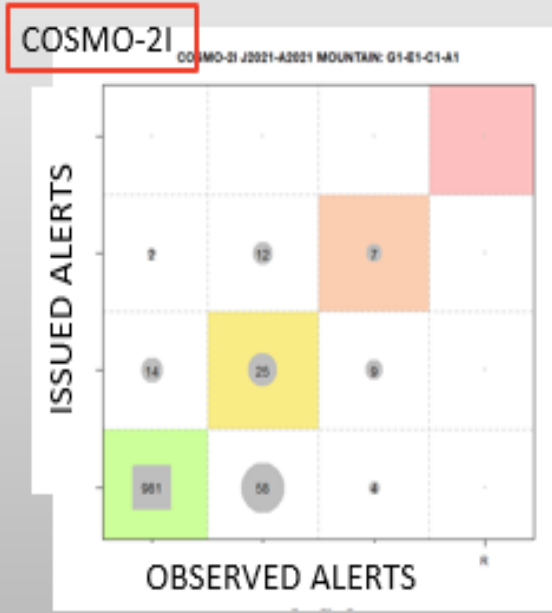
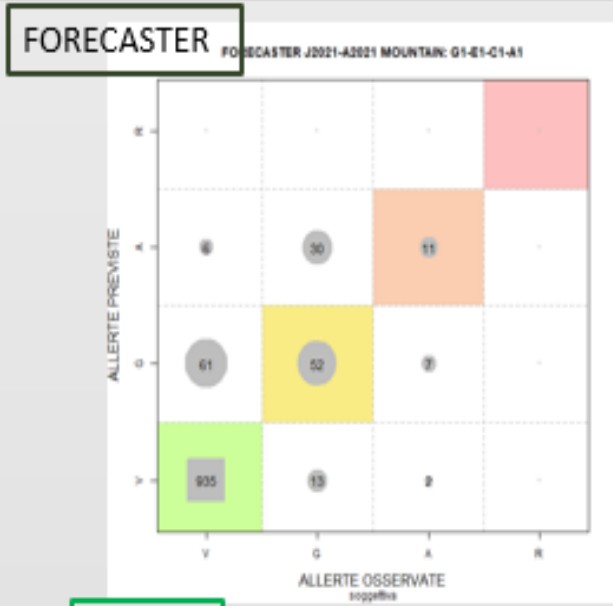


Models – mountain areas

**50th of wind gust distribution over the area
(50 % points of the area greater than threshold)**

Respect to forecaster:

- COSMO models reduce the number of False Alarms but the correct cases are lower with an increase of missed events
- ECMWF overestimates the alert cases but hits are lower



Models – mountain areas

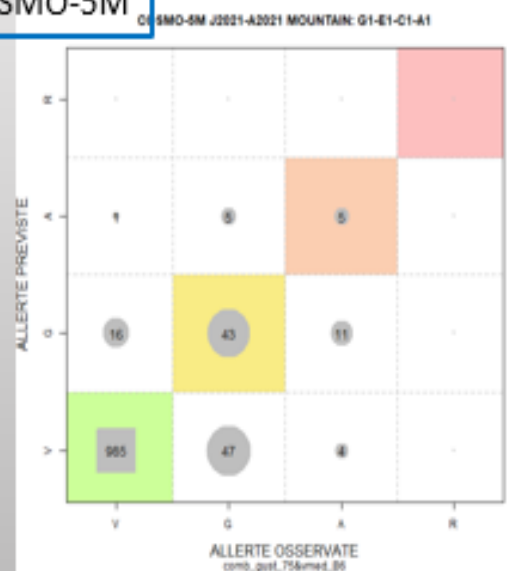
**75th of wind gust distribution over the area
(25 % points of the area greater than threshold) +
maximum in the area of 10m wind > Beaufort6**

- COSMO-2I reduces the number of false alarm and increases hits (better than forecasters)
- COSMO-5M and ECMWF reduce false alarm but increase misses

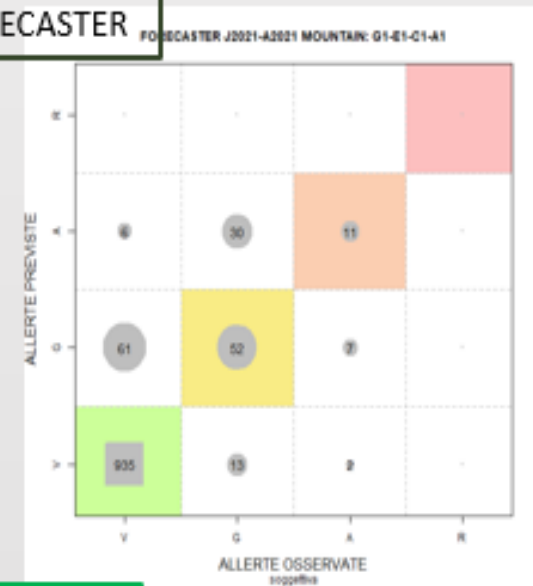
COSMO-2I



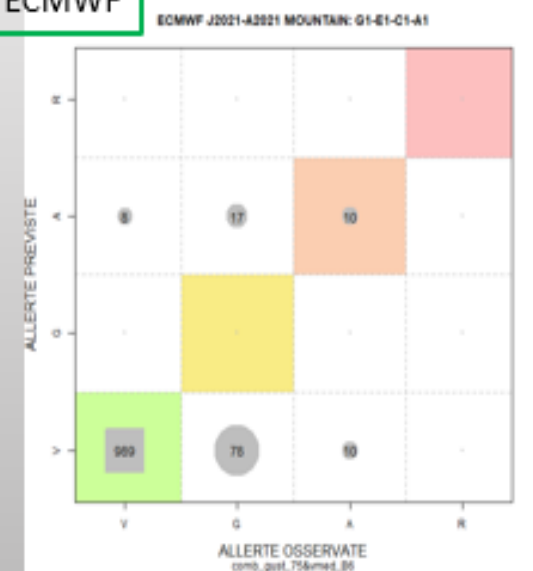
COSMO-5M



FORECASTER



ECMWF



Flash flood event in Western Germany

(Ahr valley -- 14/15th July 2021)

Precipitation forecasts of ICON model suite

WG5 parallel session – COSMO GM 2021

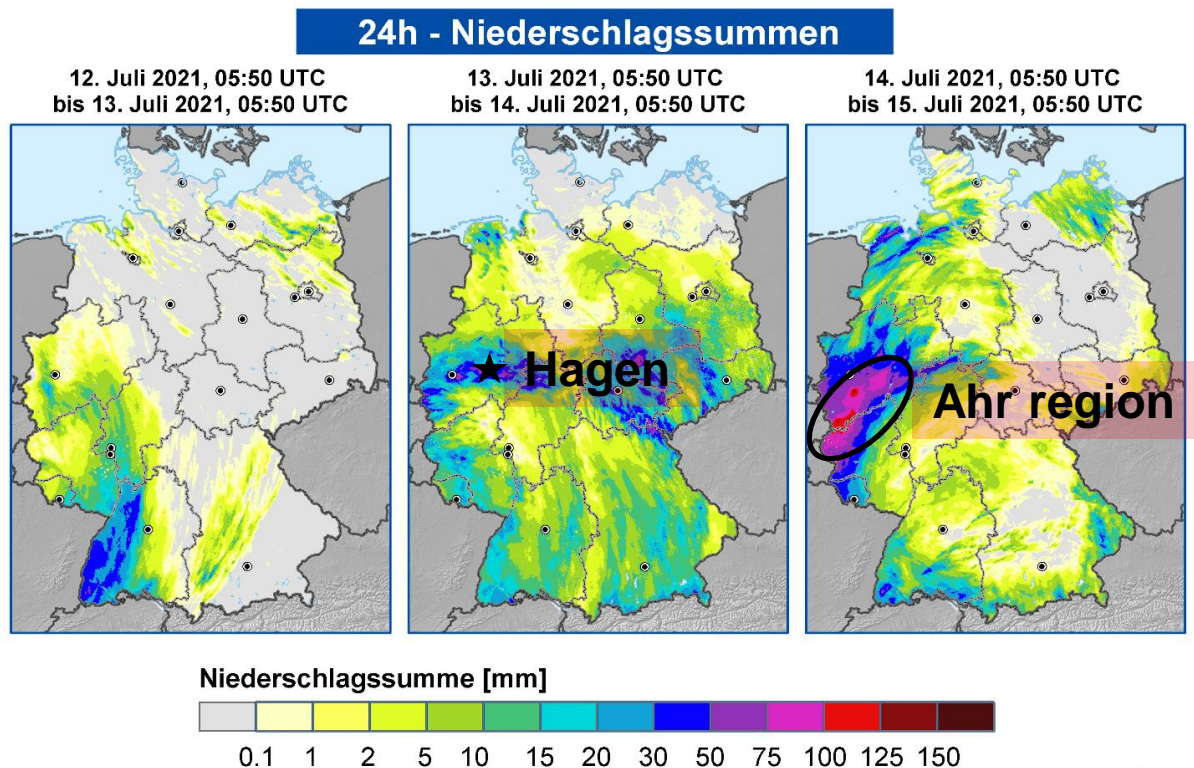
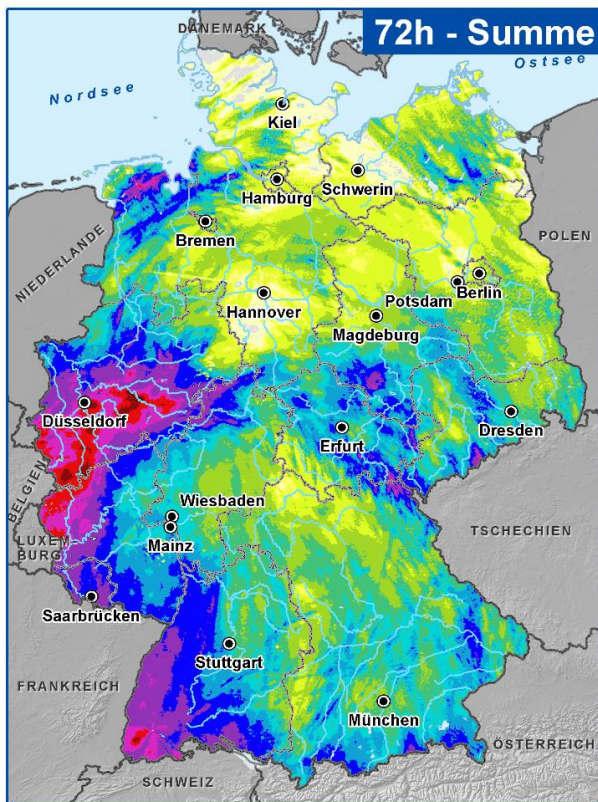
Christoph Gebhardt, Michael Baldauf, Klaus Stephan, Axel Seifert, Michael Hoff

Deutscher Wetterdienst, DWD



precipitation (radar) 12th July 05:50 UTC to 15th July 05:50 UTC

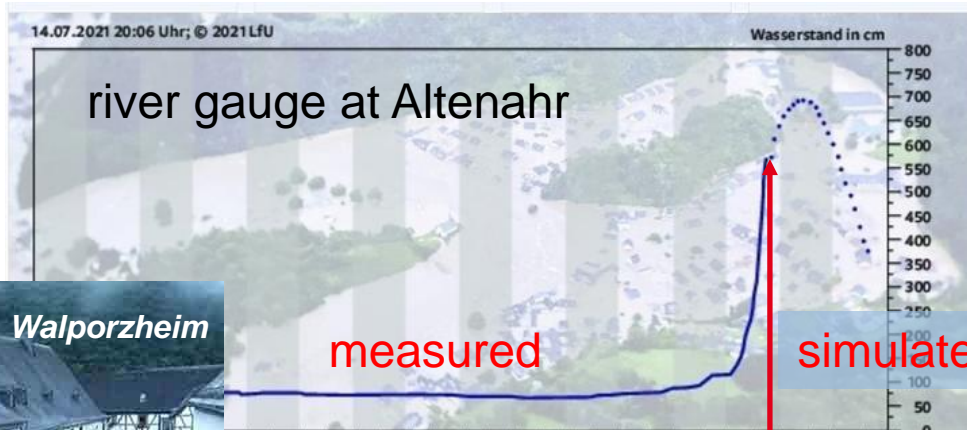
Tief **Bernd** über Deutschland,
Summe des Niederschlags aus Radar: 12. Juli, 05:50 UTC - 15. Juli 2021, 05:50 UTC



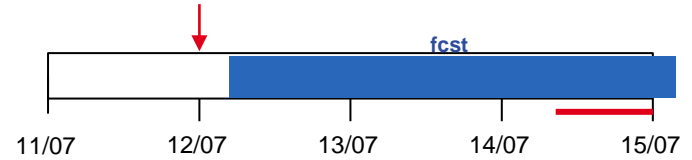
Junghänel et al.

Klimadaten und Darstellung: © Deutscher Wetterdienst 2021 (Stand: 15.07.2021); Geodaten: © GeoBasis-DE/BKG 2020 (Stand: 01.01.2020).

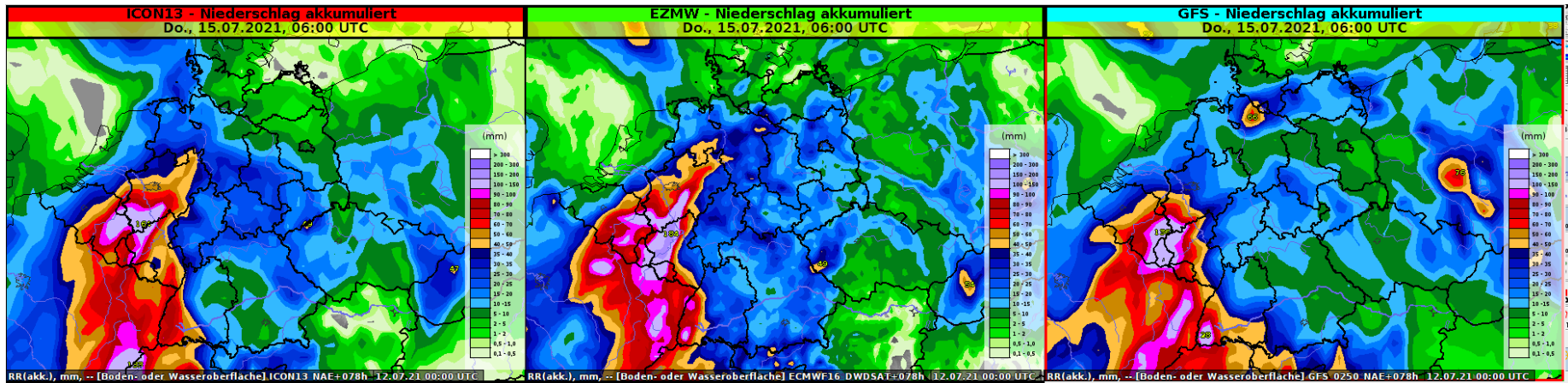
Impact in the Ahr-Valley *Village Schuld*



forecasts of global models



accumulated precipitation for 72 hours 12th 06UTC to 15th July 06UTC
(forecast start at 12th 00 UTC)



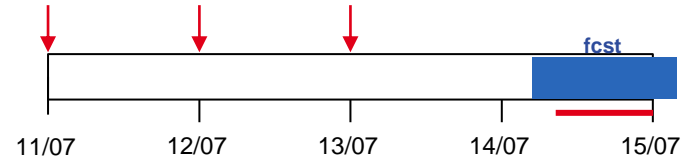
ICON global

IFS

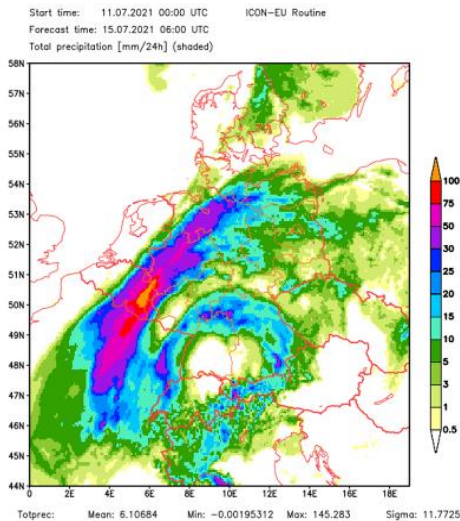
GFS

more than 100mm in the affected regions in all three models

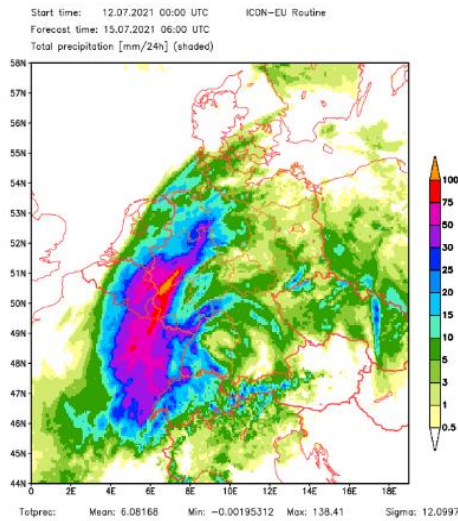
forecasts of ICON-EU



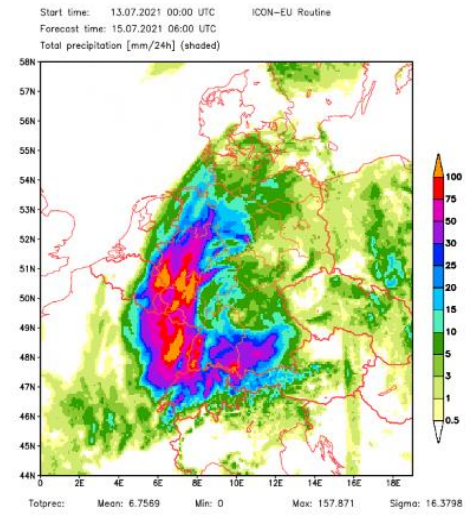
accumulated precipitation for 24 hours from 14th 06 UTC to 15th July 06UTC



11/07 00 UTC run



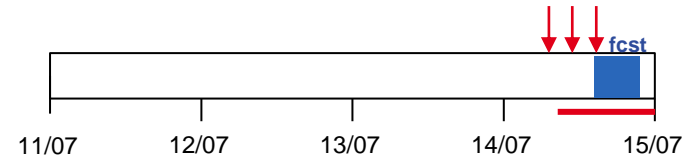
12/07 00 UTC run



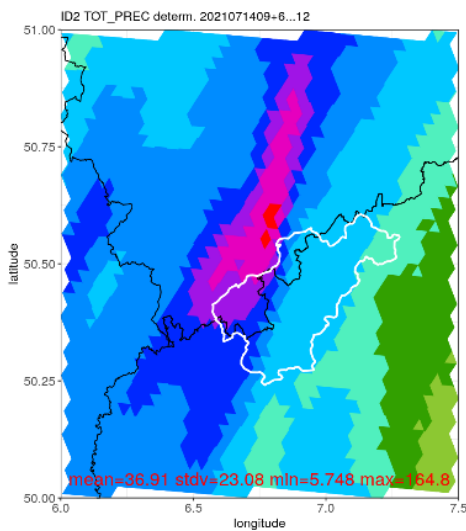
13/07 00 UTC run

high precipitation sums over 100mm close to or in the relevant region
(a bit too far to the west in the oldest forecast)

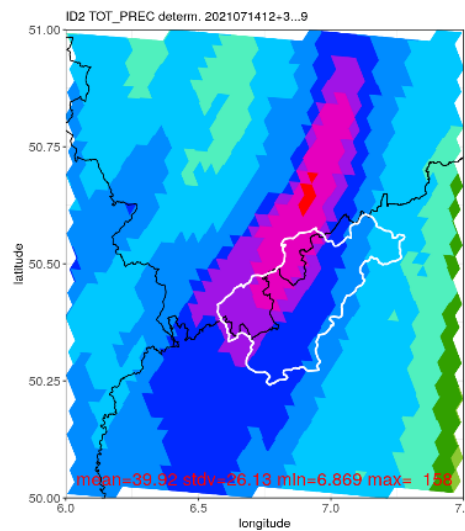
forecasts of ICON-D2(-EPS)



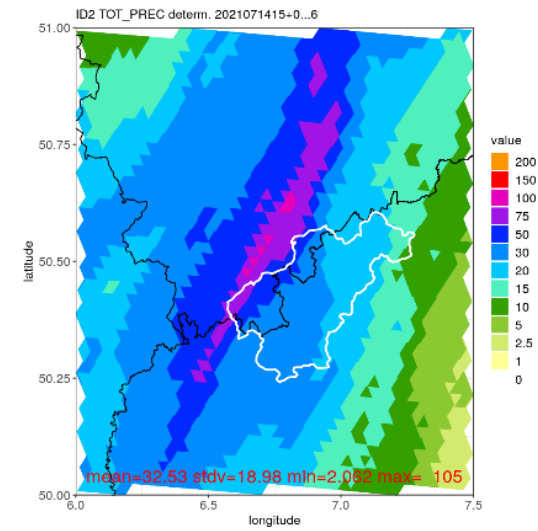
deterministic forecast of 6hr precipitation sum for 14th July 15 UTC to 21UTC



14/07 09 UTC run



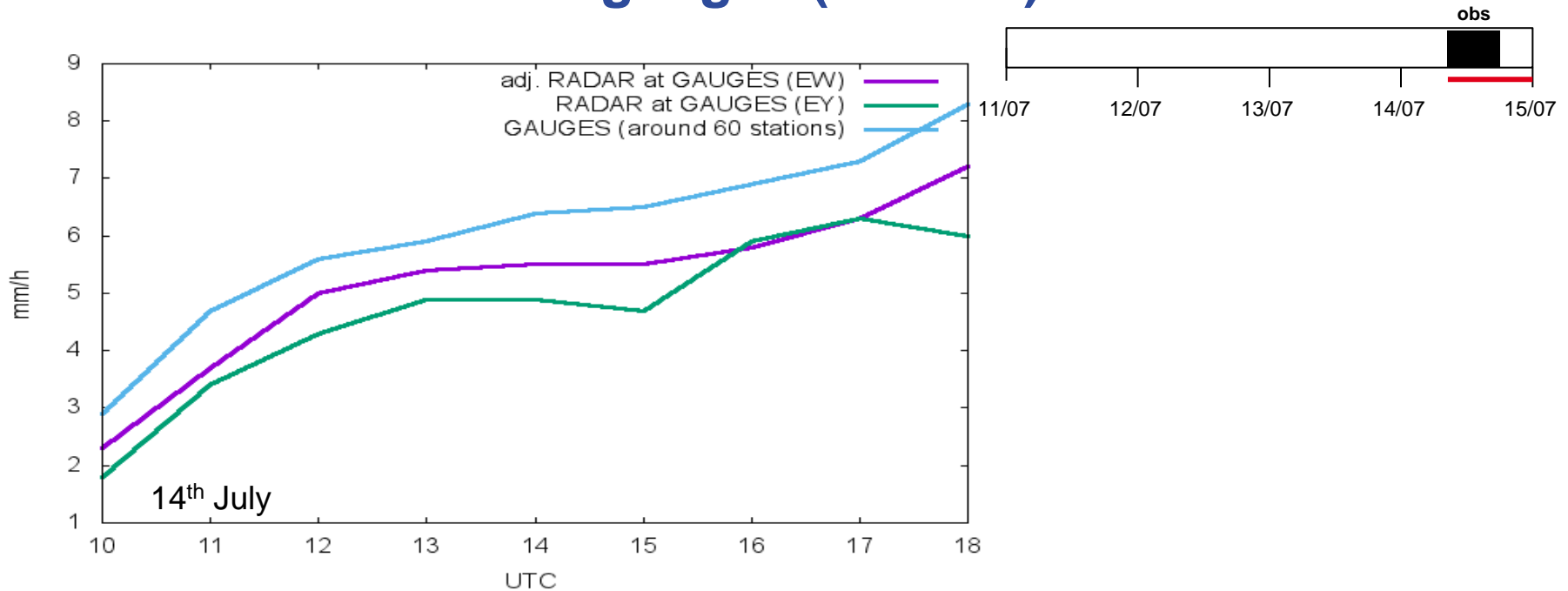
14/07 12 UTC run



14/07 15 UTC run

Values $\geq 100\text{mm}/6\text{h}$ within the drainage area of the Ahr (white contour) for 09 and 12 UTC run, but clear decrease in the 15 UTC run

Radar data and rain gauges (SYNOP)



- Radar estimates consistently below gauge measurements in the relevant region
- „dip“ at 15 UTC *one possible* reason for the reduced intensity of the 15 UTC run
- this „dip“ *could be caused* by damping along the radar beam or by a wet radom
- *further investigations needed !!!!*

Verification against radar for JJA 2021 (fraction skill score)

(for thresholds faaaaar below the values of the 14th July)

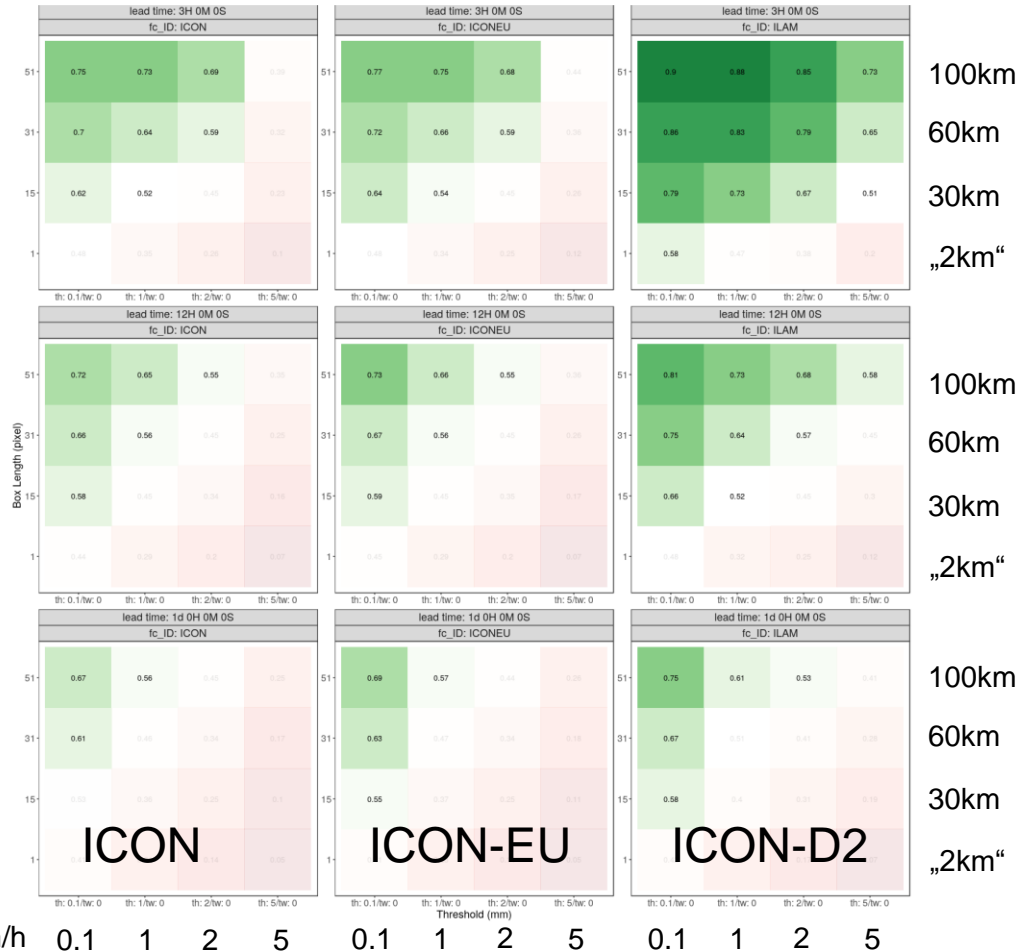
the **greener**,
the higher above 0.5

unskillful FSS faded out

lead time 1h

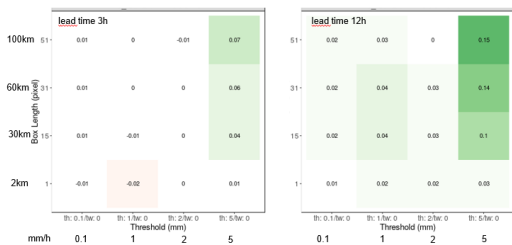
lead time 12h

lead time 24h



ICON-D2 vs. COSMO-D2 for JJA 2020 (fraction skill score)

difference in FSS
green: ICON-D2 better than COSMO-D2



WG5 Contributions



Cisco Webex Meetings | Meeting Info | Hide Menu Bar ^

File Edit Share View Audio & Video Participant Meeting Breakout Sessions Help

Layout

Sharing PPAWARE-GM2... 3 September 2021

| Chair: Flora Gofa and Anastasia Bundel | | |
|--|-----------------------------------|--|
| 13:20 – 13:30 | F. Gofa, A. Bundel | Set-up and Welcome (minutes) |
| 13:30 – 15:00 | F. Gofa, A. Bundel (10') | Progress of PP-AWARE – Short Extension |
| | A. Bundel, (for A. Muravev) (15') | Overview of appropriate verification measures for HIW - Extreme Value Theory (EVT) approach (Task 2.3) |
| | A. Mazur, J. Lipkowska (15') | Verification of forecasts of intense convective phenomena (Task 3.1) |
| | A. Bundel (15') | MET application for gridded COSMO-Ru/ICON forecasts (Task 3.3) |
| 15:00-15:15 | P. Gregor, A. Hoff (15') | Verification of precipitation objects from SINFONY-RUC simulations during summer 2021 (Task 3.6) |
| | F. Gofa, D. Boucouvala (15') | LPI evaluation and correlation with thermodynamical indices (Task 3.5) |
| | All | BREAK |
| | D. Cattani (15') | Calibration of the Lightning Potential Index (LPI) in COSMO-1E and COSMO-2E (Task 3.2) |
| | C. Marsigli (for M. Salmi) (15') | Verification of the LPI of COSMO-D2-EPS against lightning |

Participant List:

- Flora Cohost, me
- Amalia Iriza Burca Host
- Anastasia Bundel Cohost
- Aleksander Gochakov
- Andrzej Mazur
- Christoph Gebhardt DWD
- Daria Vaskova

Thank You