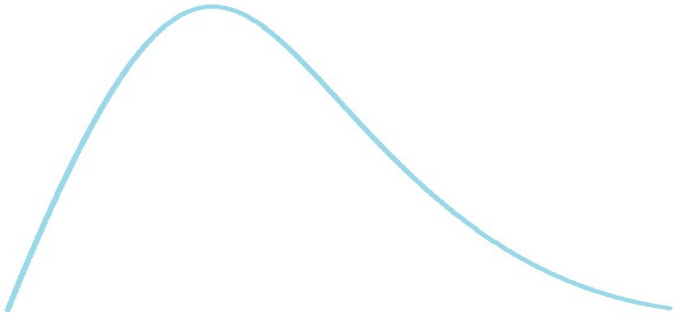
Software for ensemble post-processing on extremes using the SRNWP-EPS database



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44th EWGLAM - 29th SRNWP Workshop (26th - 29th September 2022)

Outline

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- **SRNWP-EPS calibration software**
  - Main features
  - Structure
- **Results**
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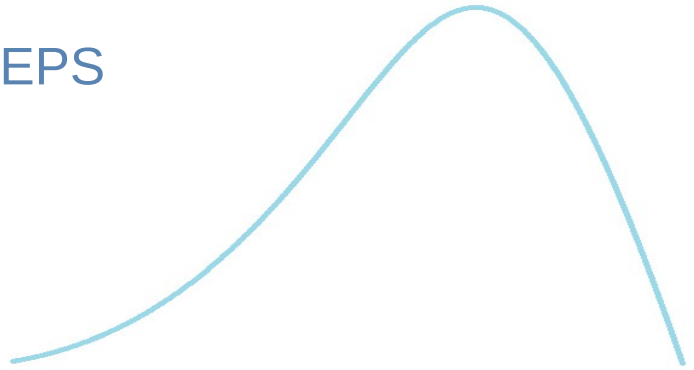
  - Daily precipitation: IREPS – COMEPS
- **Conclusions**
- **Future / ongoing work**

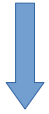


Introduction

EUMETNET SRNWP-EPS project

Short Range Numerical Weather Prediction Ensemble Prediction System (2019-2023)

- **Application task: LAM-EPS calibration focused on extremes**



Development of EPS post-processing software to calibrate different extreme variables

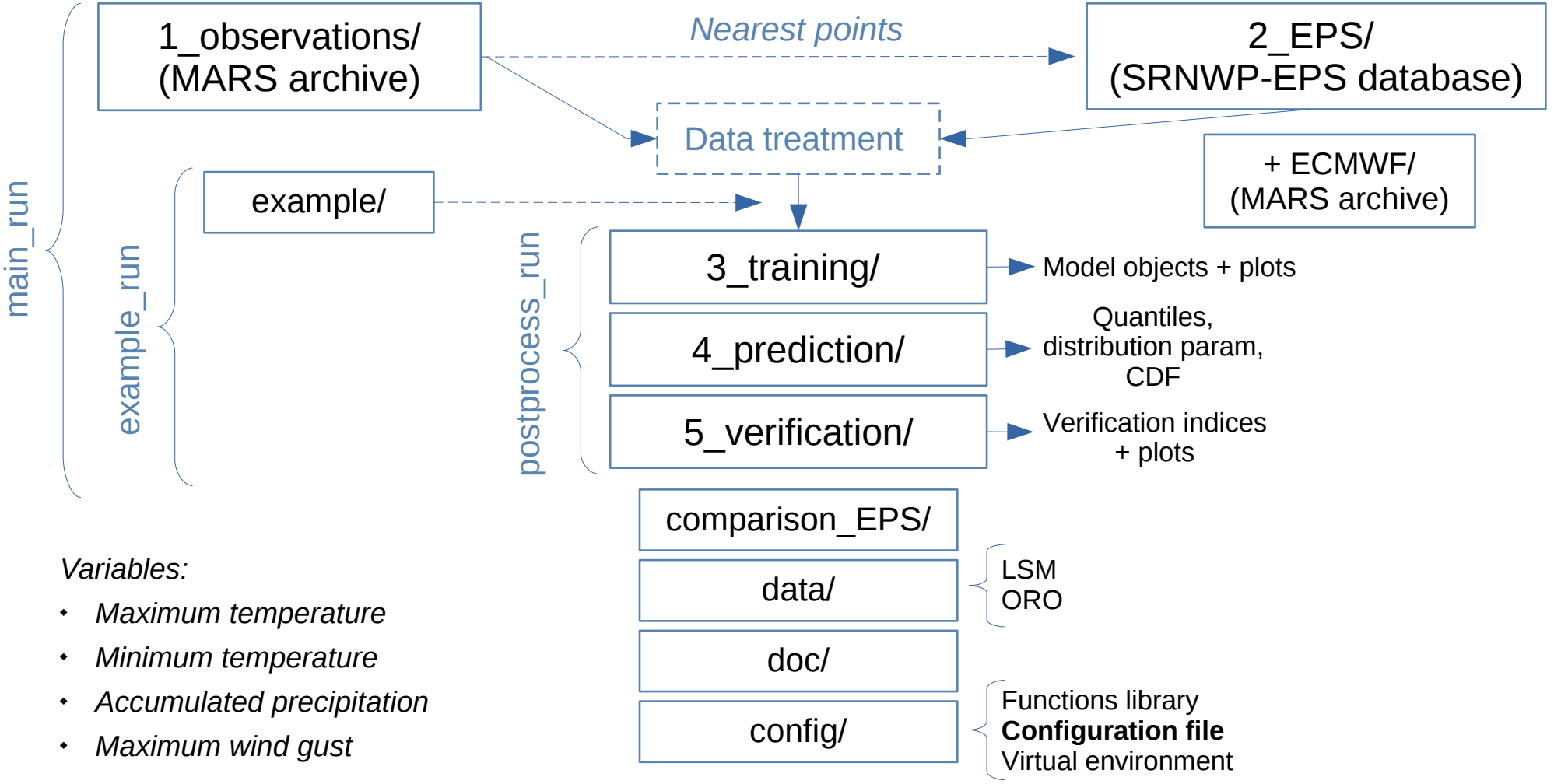
SRNWP-EPS calibration software – main features

Development of EPS post-processing software to calibrate different extreme variables

Main features

- Local ensemble post-processing (point) software (e.g. airports, ensemble meteograms).
- Run in ECMWF computer facilities (Reading and Bologna).
- Broad application: prepared to be used on different LAM-EPS (SRNWP-EPS database), grib editions, weather variables...
- Different EPS point selection (nearest point, maximum and mean circle 13 nearest points to observation). Orography and land-sea filter.
- Weather variables: daily precipitation, maximum wind gust and maximum and minimum temperature.
- Allow comparing the performance between different post-processing methods (parametric and non-parametric) and raw ensemble (non post-processed EPS).
- Comparison between LAM-EPS and ECMWF ensemble (overlapping area).
- Software developed in Python and R programming language (Conda environment).
- All parts have a main script that allows them to be launched independently (i.e. only the post-processing part).
- An extensive user guide will be available to properly execute the software and with the recommendations of the most appropriate post-processing methods for each variable.

SRNWP-EPS calibration software – structure



Variables:

- *Maximum temperature*
- *Minimum temperature*
- *Accumulated precipitation*
- *Maximum wind gust*

Results

Daily maximum wind gust

IT-EPS – MFAromeEPS

Monte Cimone

max – circle nearest 13 points

Daily accumulated precipitation

IREPS – COMEPS

Paris

mean – circle nearest 13 points

Data

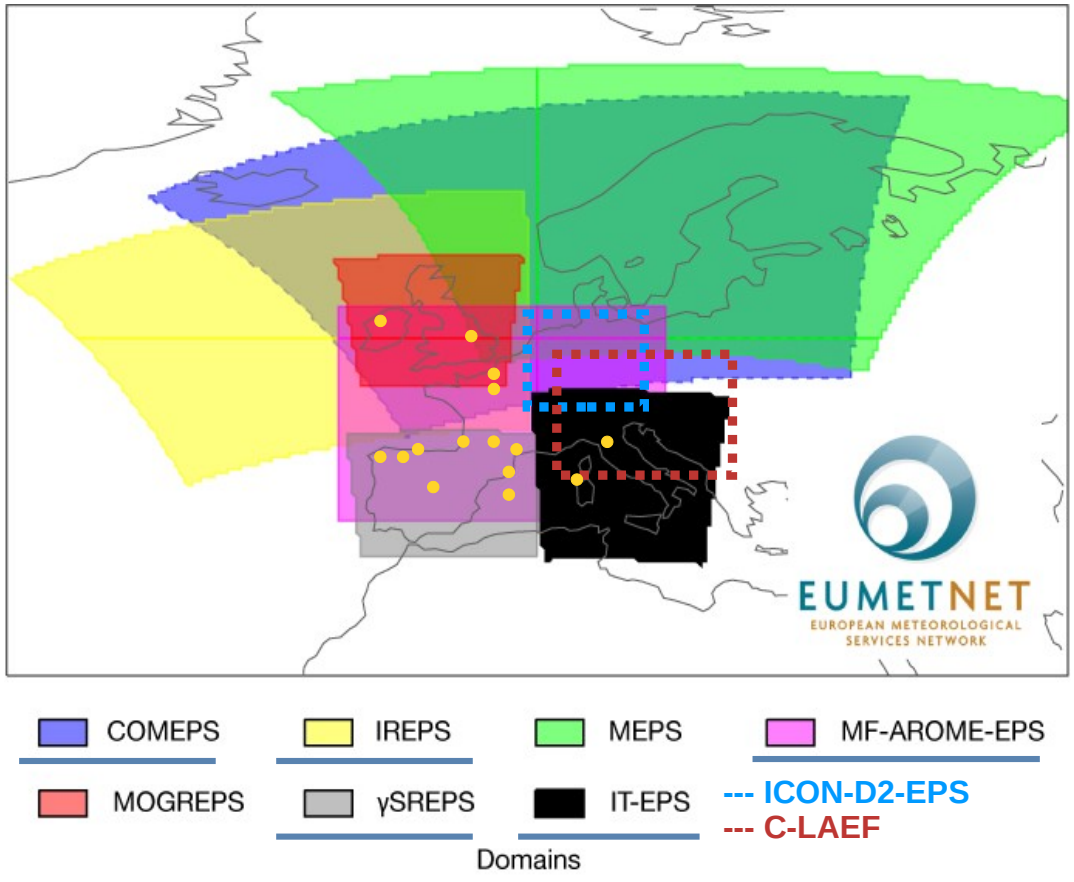
Observations: MARS archive

EPS: SRNWP-EPS database

Time period

01/06/2020 - 31/07/2022*

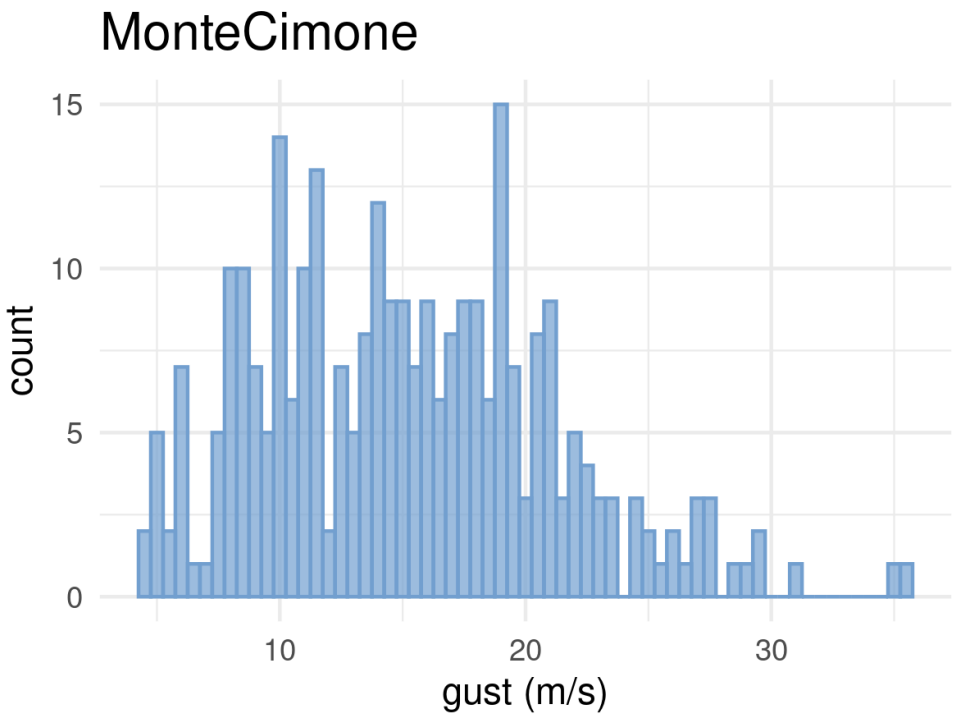
**MFAromeEPS until 31/12/2021*



- *Abbeville, Barcelona, Biarritz, Bordeaux, Capo Caccia, Gurteen, Llanes, Monte Cimone, Madrid, Montpellier, Northolt, Palma de Mallorca, Paris, Puerto de San Isidro, Santiago de Compostela, Toulouse*

Results – daily maximum wind gust

Daily maximum wind gust



Parametric post-processing models

tNGR: truncated Nonhomogeneous Gaussian Regression

tNLR: truncated Nonhomogeneous Logistic Regression

gamma: gamma distribution

RGU: Reverse Gumbel model (GEV type I)

BMA: Bayesian Model Averaging mixture with normal distribution

gBMA: Bayesian Model Averaging mixture with gamma distribution

EMOS_trunc: truncated normal EMOS modeling

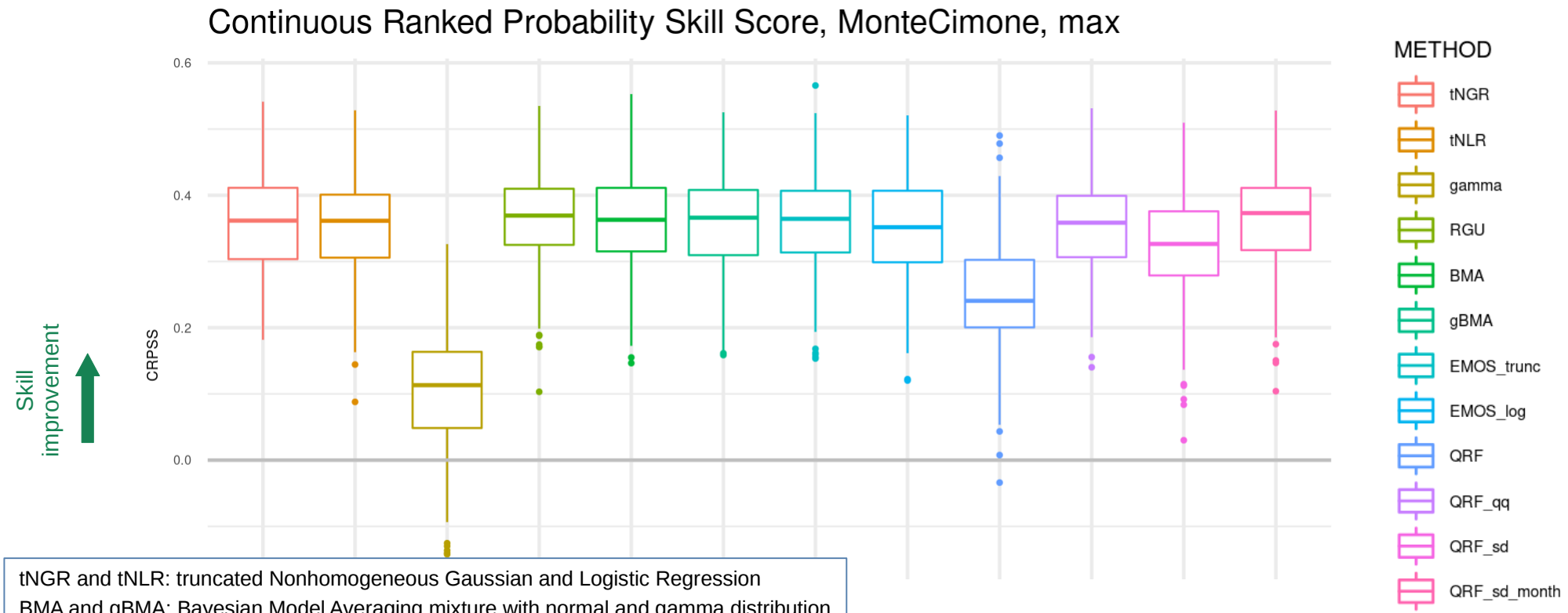
EMOS_log: log-normal EMOS modeling

Non-parametric post-processing models

QRF: Quantile Regression Forest: ensemble mean

- **QRF_qq**: ensemble mean + 10th and 90th quantile
- **QRF_sd**: ensemble mean + ensemble std
- **QRF_sd_month**: ensemble mean + ens std + month

Results – daily maximum wind gust



tNGR and tNLR: truncated Nonhomogeneous Gaussian and Logistic Regression
BMA and gBMA: Bayesian Model Averaging mixture with normal and gamma distribution
gamma: gamma distribution
RGU: Reverse Gumbel model
EMOS_trunc and EMOS_log: truncated normal and log-normal EMOS modeling
QRF: Quantile Regression Forest (ensemble mean)
QRF_qq: Quantile Regression Forest (ensemble mean + 10th and 90th quantile)
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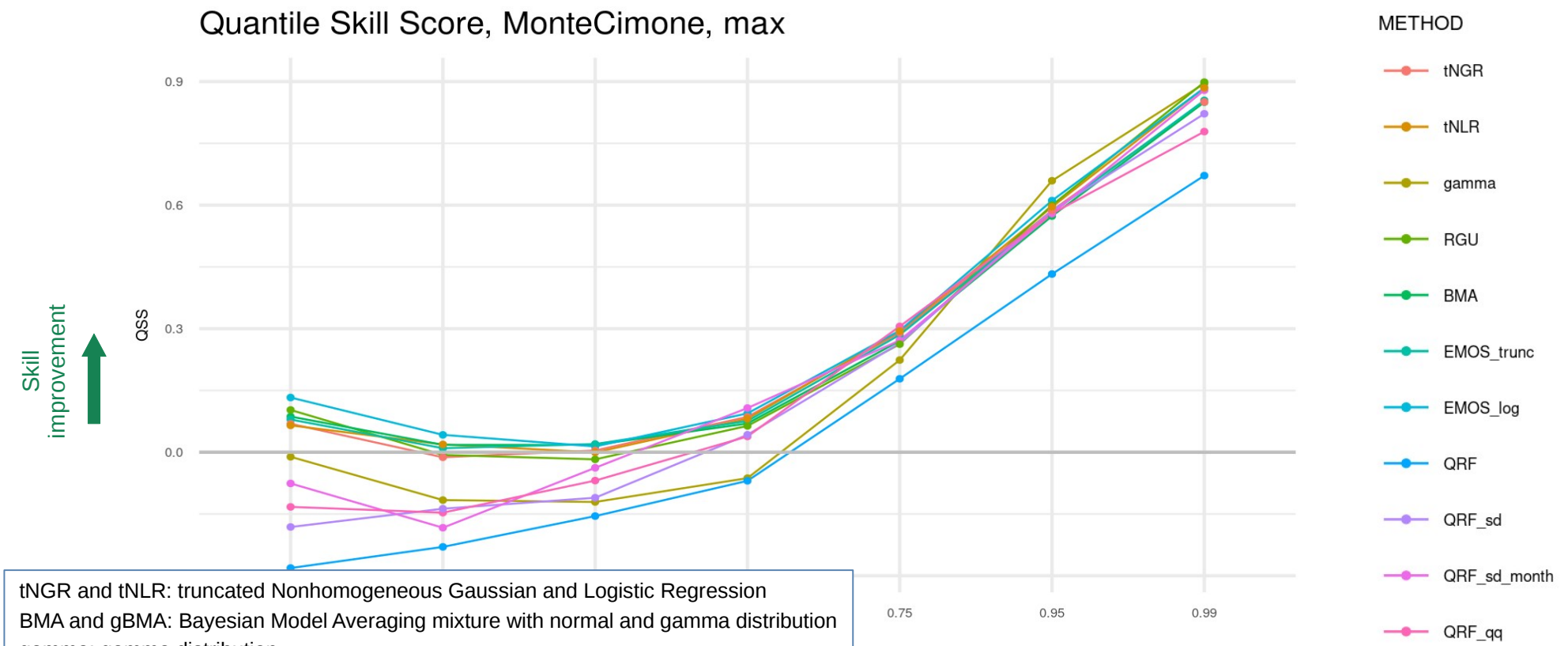
☞ *Reference = raw ensemble*

IT-EPS

Results – daily maximum wind gust



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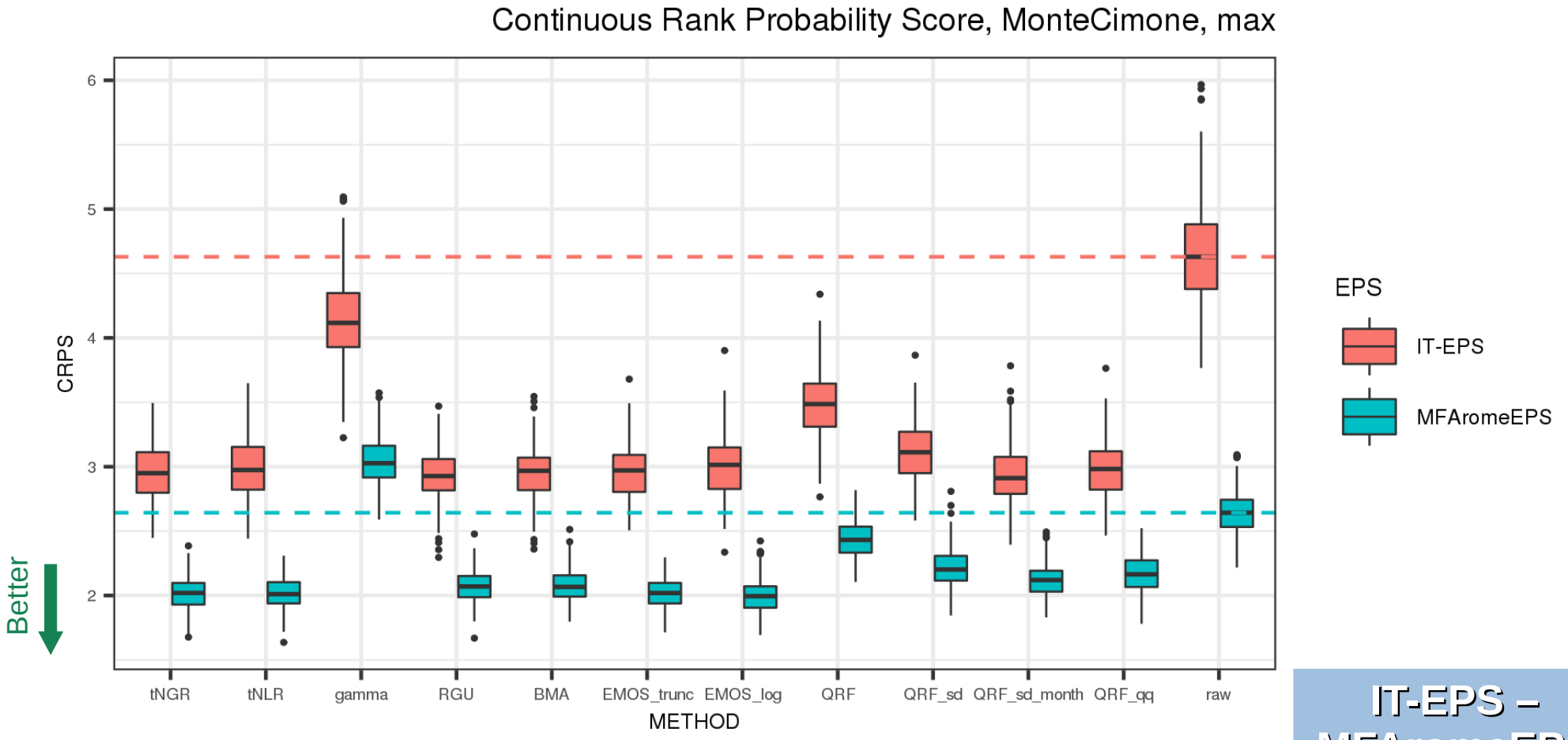
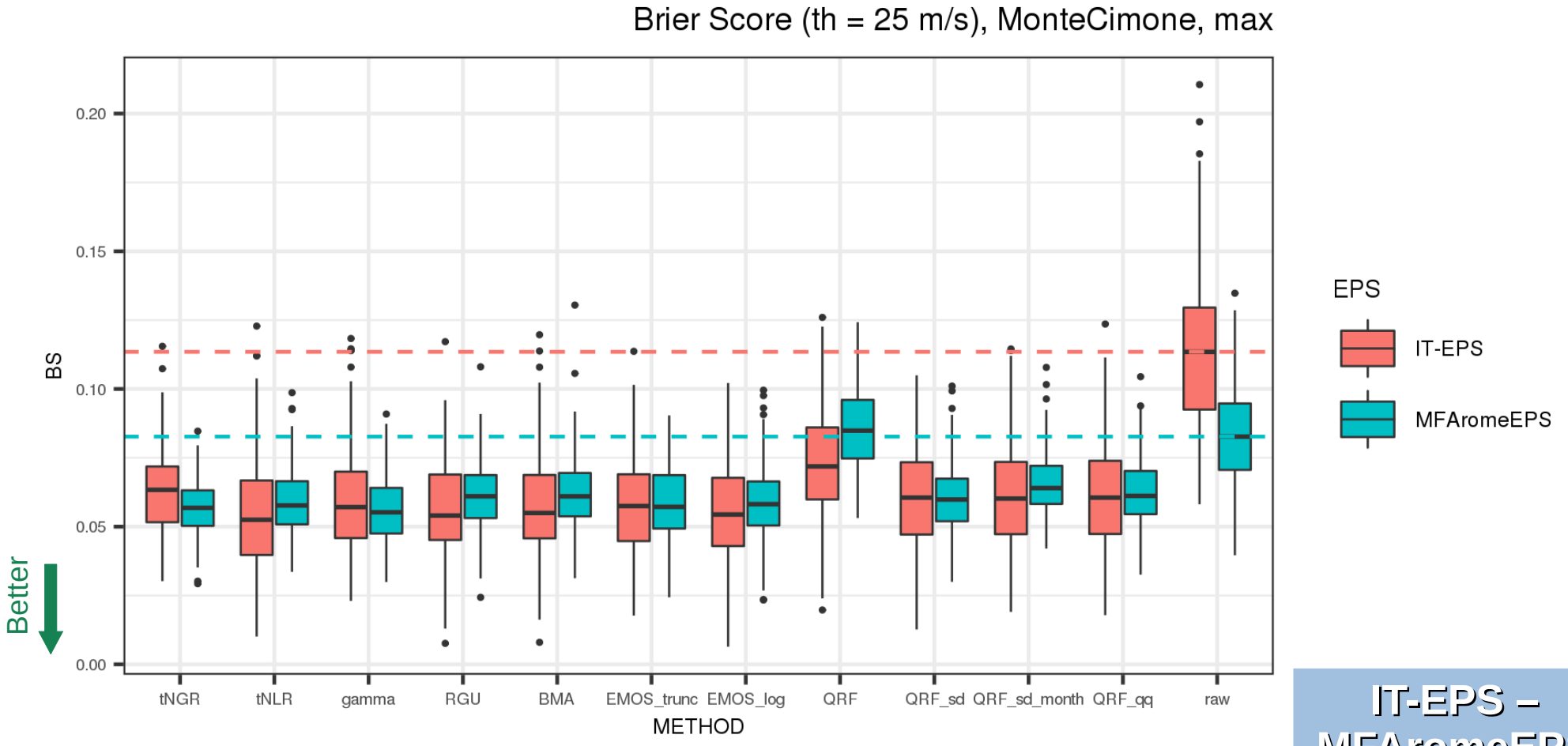
MFAromeEPS

Results – daily maximum wind gust



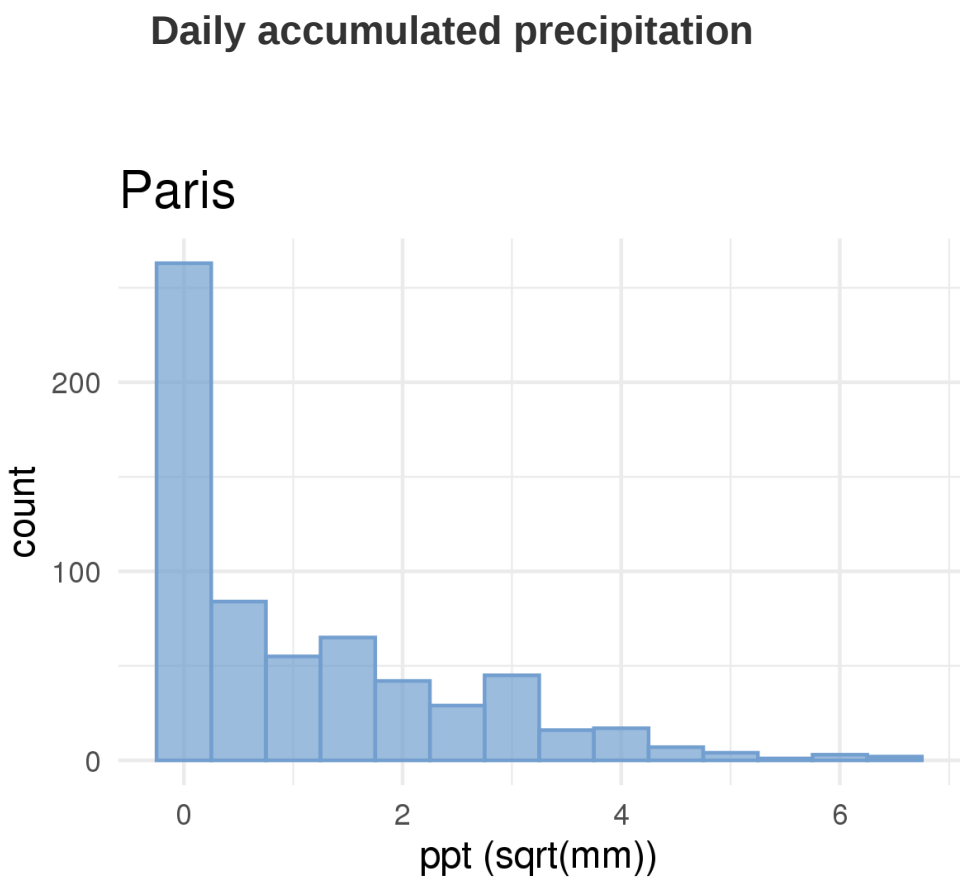
IT-EPS – MFAromeEPS

Results – daily maximum wind gust



IT-EPS – MFAromeEPS

Results – daily precipitation



Parametric post-processing models

cNLR: censored Nonhomogeneous Logistic Regression

gamma0: zero adjusted Gamma distribution

gBMA0: Bayesian Model Averaging mixture with gamma0 distribution

EMOS_csg0: censored and shifted gamma EMOS modeling

EMOS_gev0: censored generalized extreme value distribution EMOS modeling

Non-parametric post-processing models

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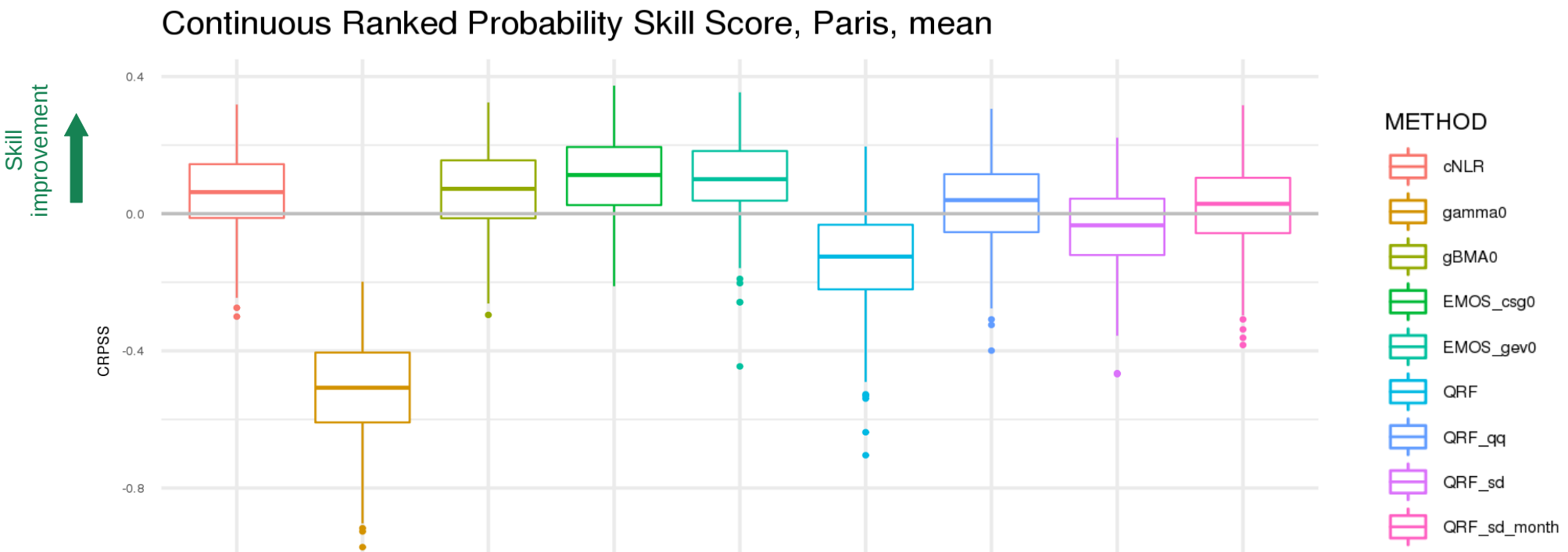
Results – daily precipitation



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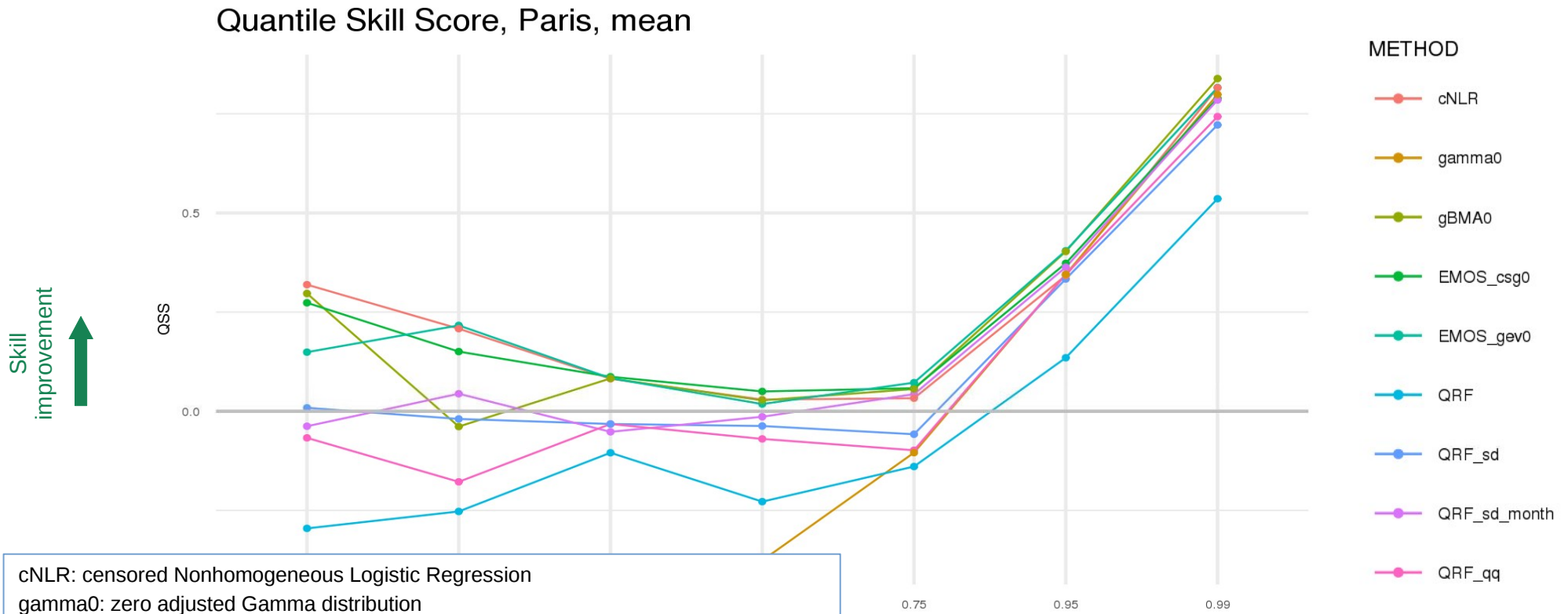
COMEPS

Results – daily precipitation



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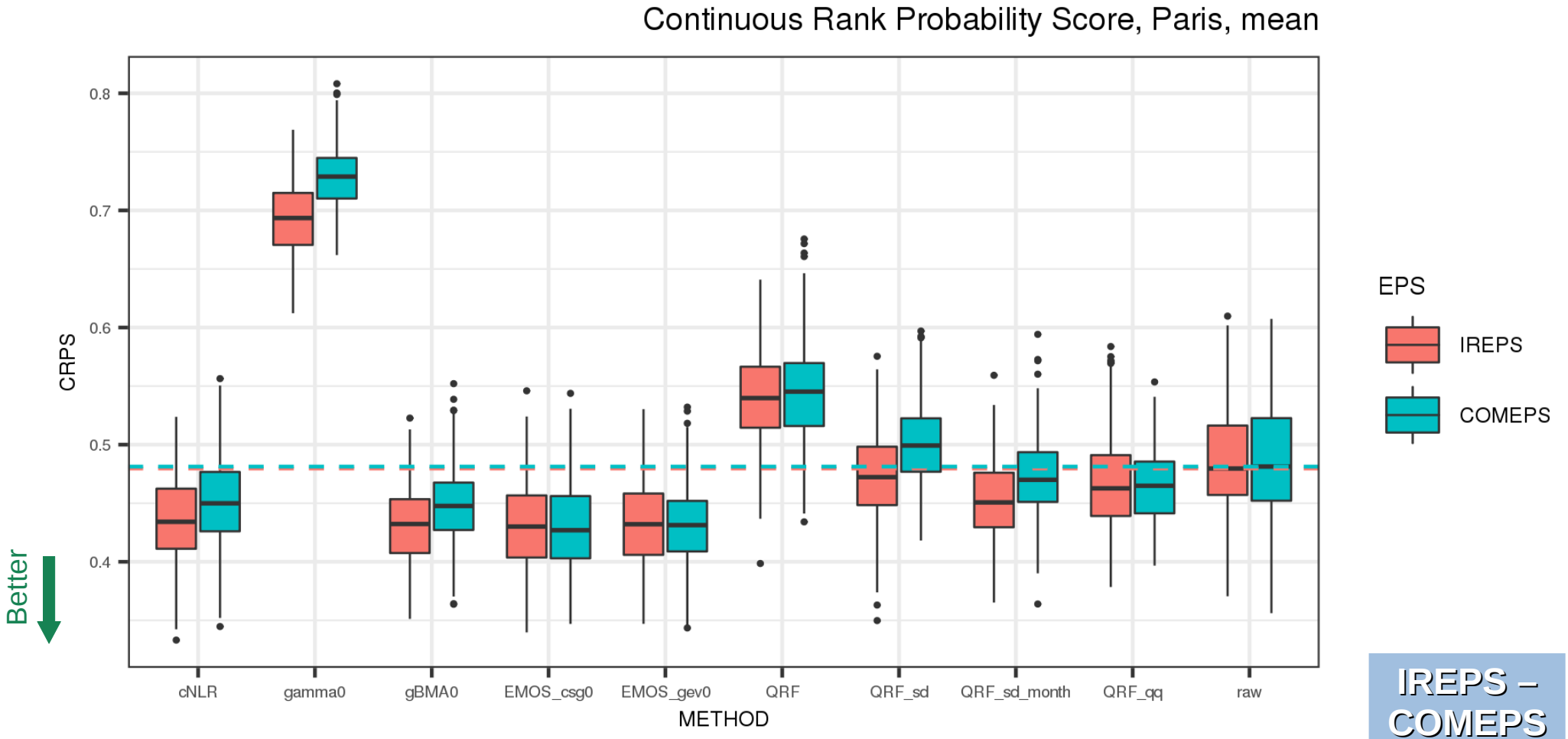
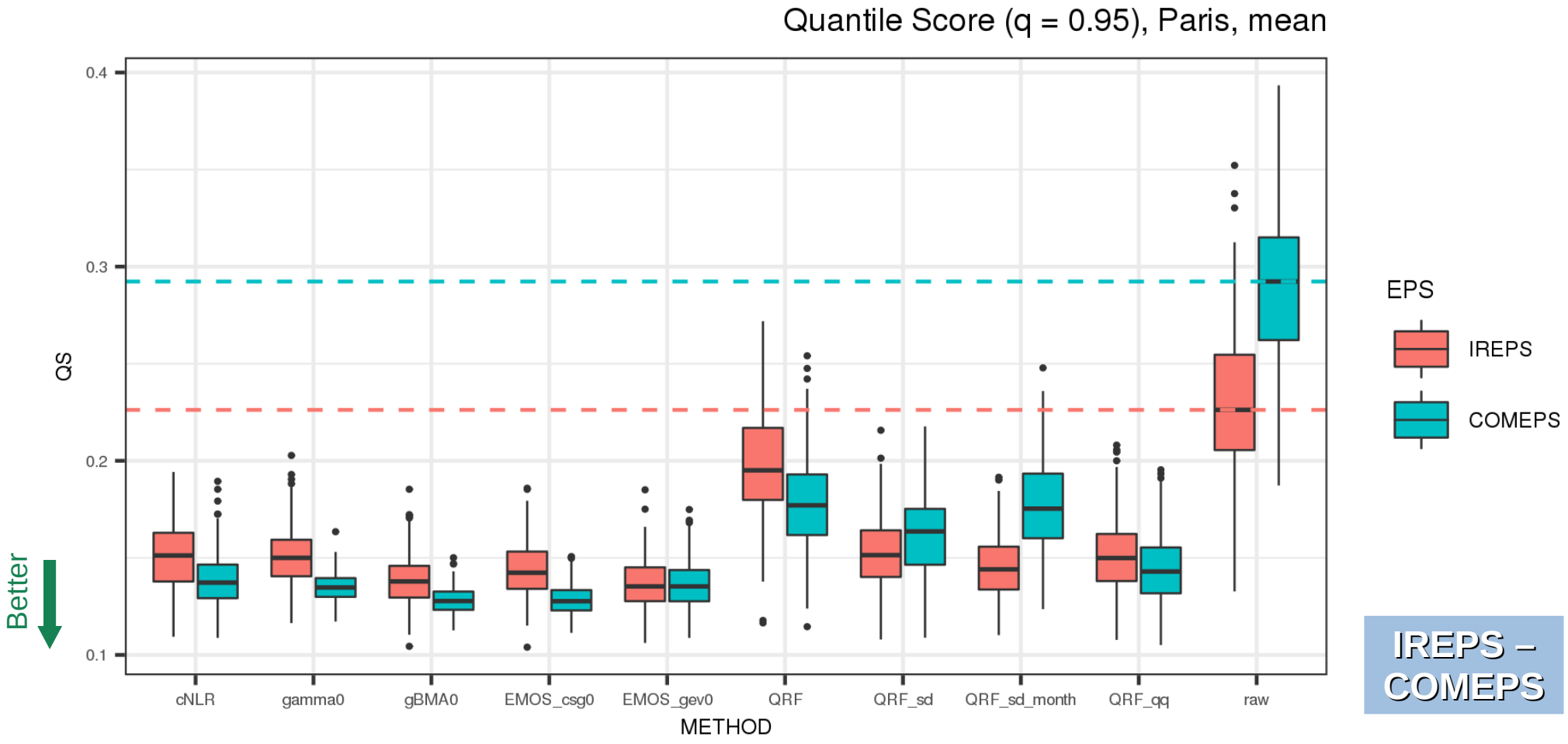
IREPS

Results – daily precipitation



IREPS – COMEPS

Results – daily precipitation



IREPS – COMEPS

Conclusions

- A post-processing software to calibrate different extreme variables is being developed within the EUMETNET SRNWP-EPS project.
- The software has been tested on 5 different EPS of the SRNWP-EPS database.
- It allows the comparison of the the performance of different post-processing methods and LAM-EPS.
- Results show that postprocessed EPS usually outperform raw ensembles.
- EMOS and BMA methodology with different distributions shows good performance for the bulk of the distribution as well as for the tail.
- QRF methods usually outperform raw ensembles, however, can not easily extrapolate beyond data (e.g. extremes) and are highly sample-size depending.
- Mixture models (e.g. QRF + GEV) could provide better calibrate EPS for the whole distribution.

Future / ongoing work

- Implement new methodologies (e.g. mixture models).
- Test the software using other observation stations and LAM-EPS.
  - ☞ Request: 3 synoptic stations for each country to test these methods and compare the performance of the LAM-EPS of the database.
- Finish developing the software and make it available for the EUMETNET SRNWP-EPS project.
- Publish results in a scientific journal.

THANK YOU VERY MUCH FOR YOUR ATTENTION!

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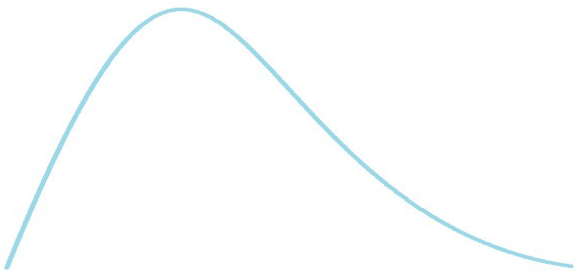

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