TRMM Calibration Conditioned to Weather Types in the South Pacific Region.

Goals

- Find a suitable clustering (with a low k) to differentiate weather types according to South Pacific precipitation.
- Search for trend changes in weather types over different time periods.

- Condition the calibration of the TRMM product according to the different weather types.
- Prove and conclude that correction of the TRMM product is necessary, and furthermore, that correction conditioned on weather types is necessary and that a better correction is obtained than without conditioning on weather types.

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PAPER 1, NHESS?

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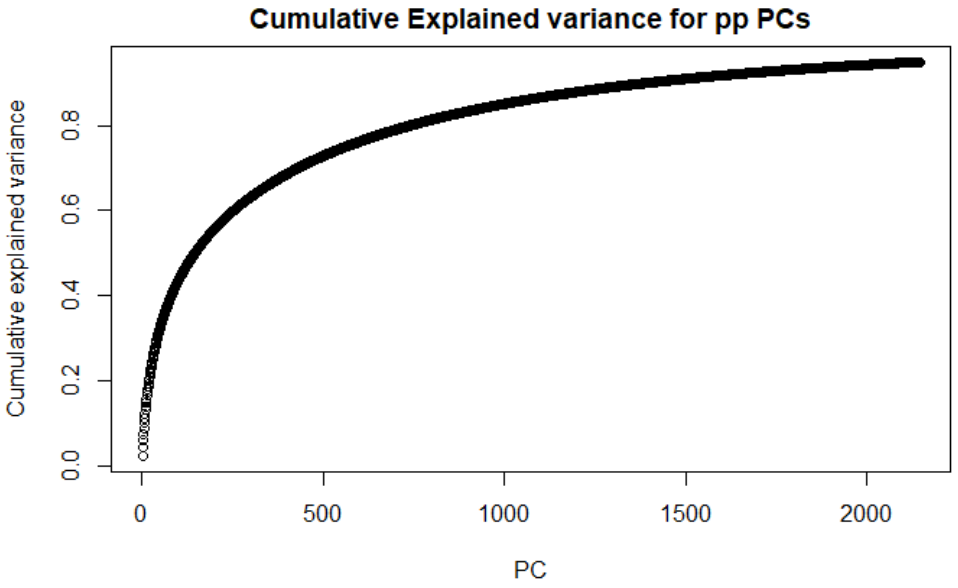
PAPER 2

Variables involved

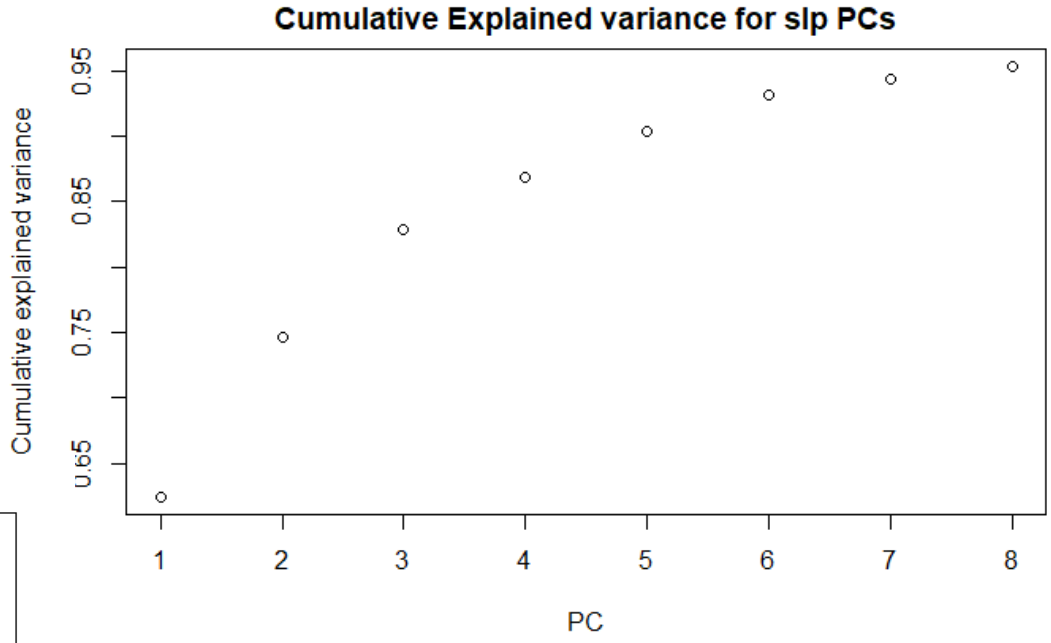
- **Precipitation reanalysis** (**pp**): From ERA5 product, time range 1998-2020.
- **Sea Level Pressure** (**SLP**): From ERA5 product, time range 1998-2020.
- **Difference of Sea Level Pressure** (**DiffSLP**): Computed from SLP Data. For the variable at time t, it is calculated by computing the difference between the SLP at time t and time $t-1$.

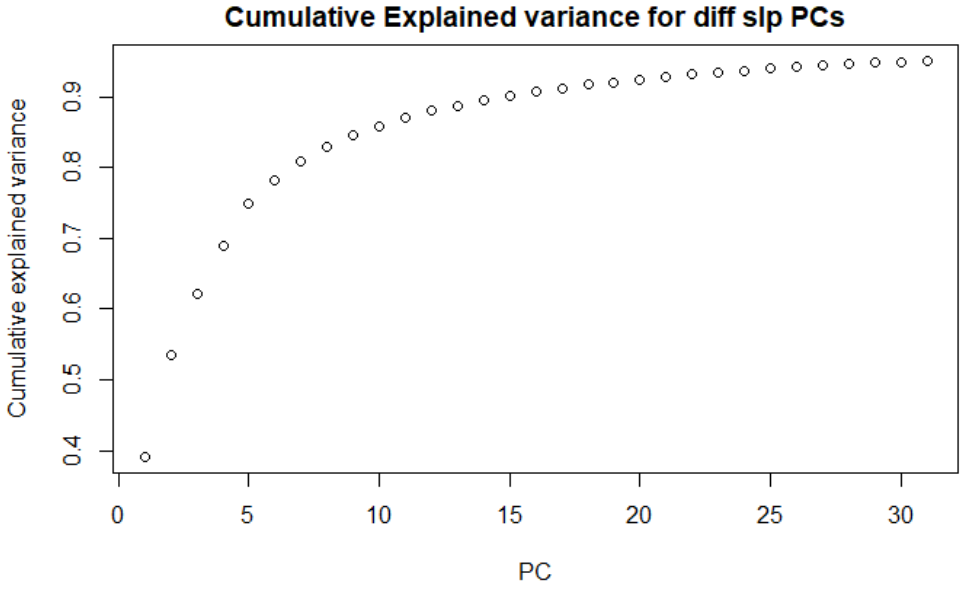
$\longrightarrow$ SLP and Diff SLP are included since they are variables frequently used in cyclone detection methodologies.

Principal Components Analysis



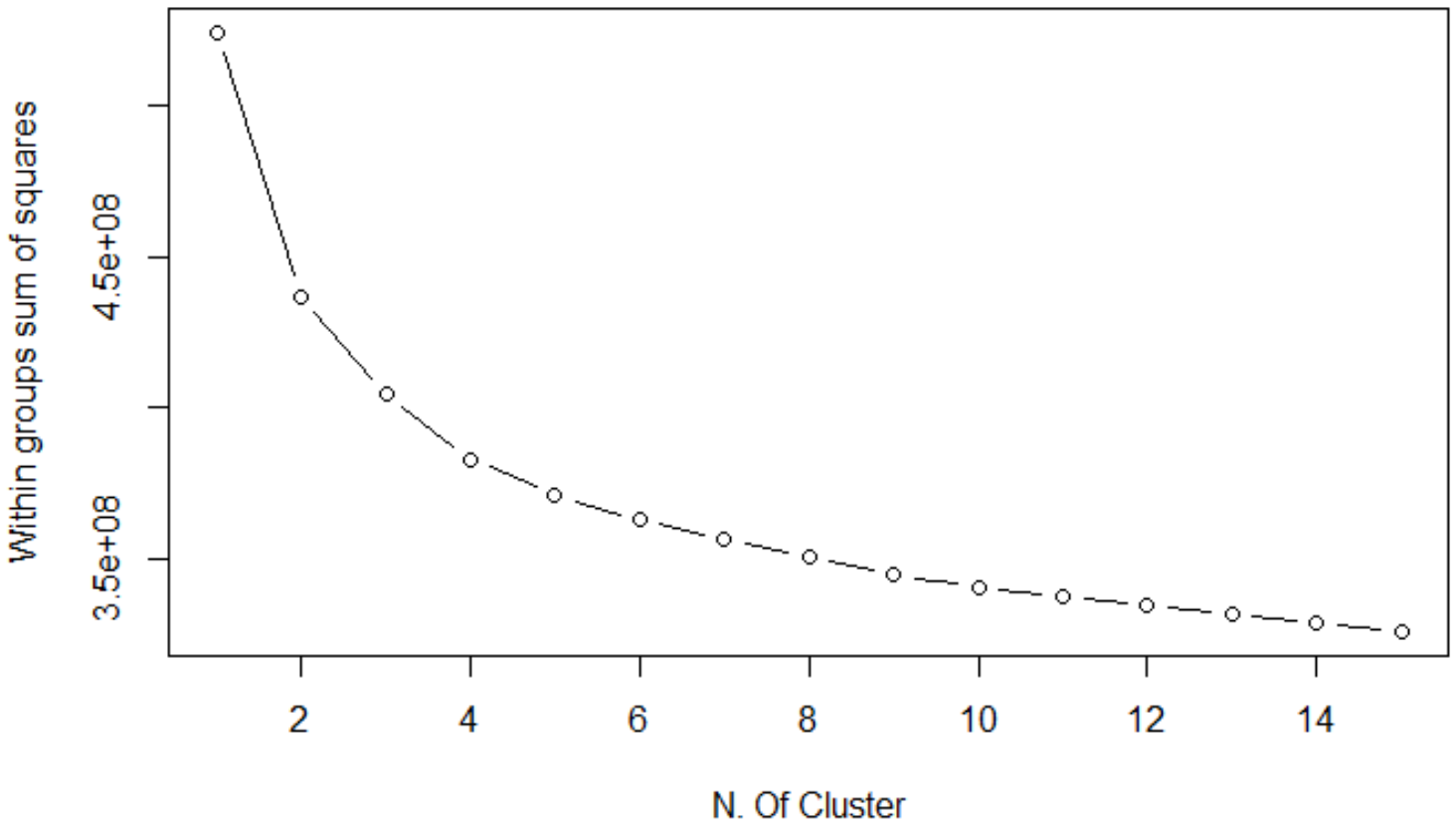
← 75% of the explained variance is chosen.





← 90% of the explained variance is chosen.

K-Means Model



K-Means Model

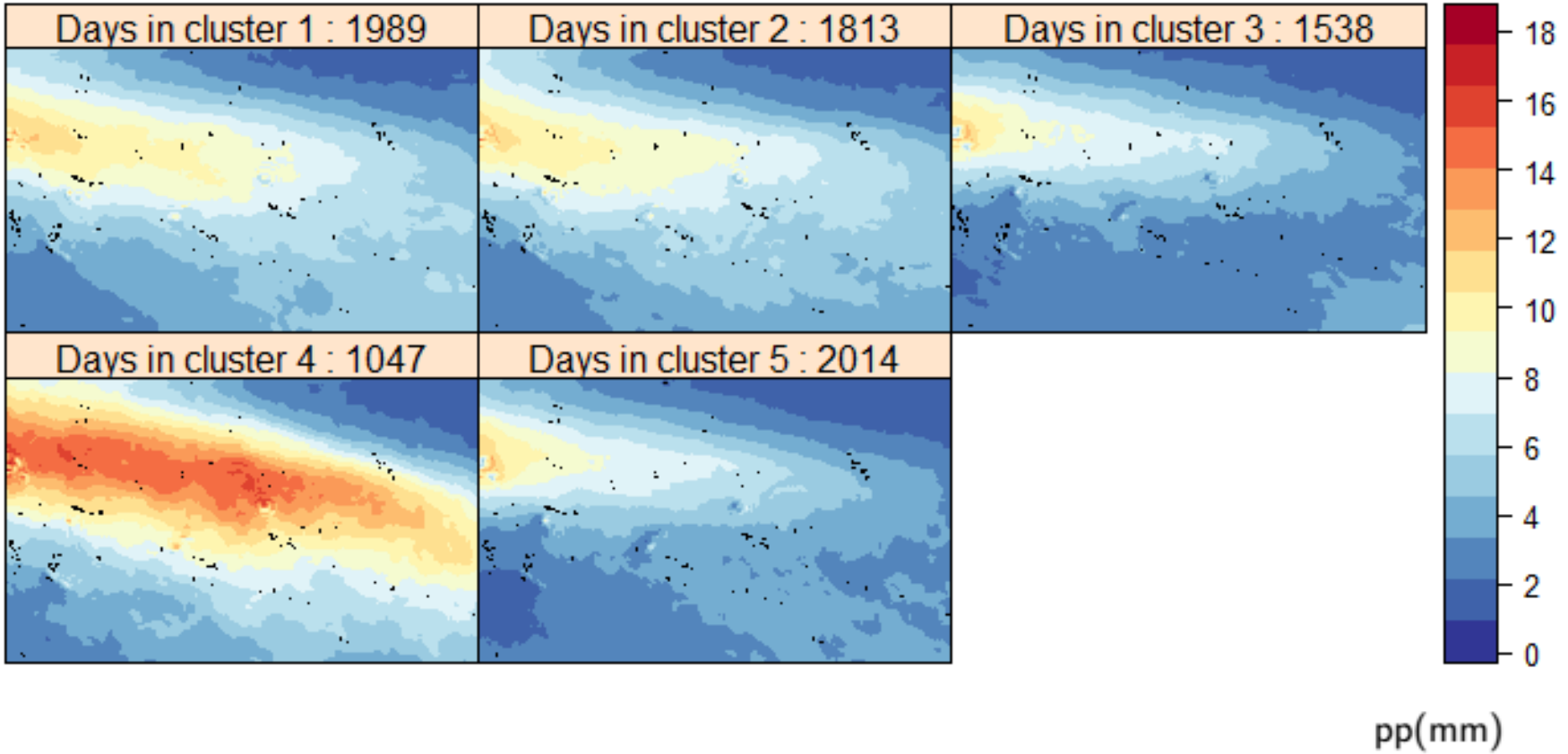
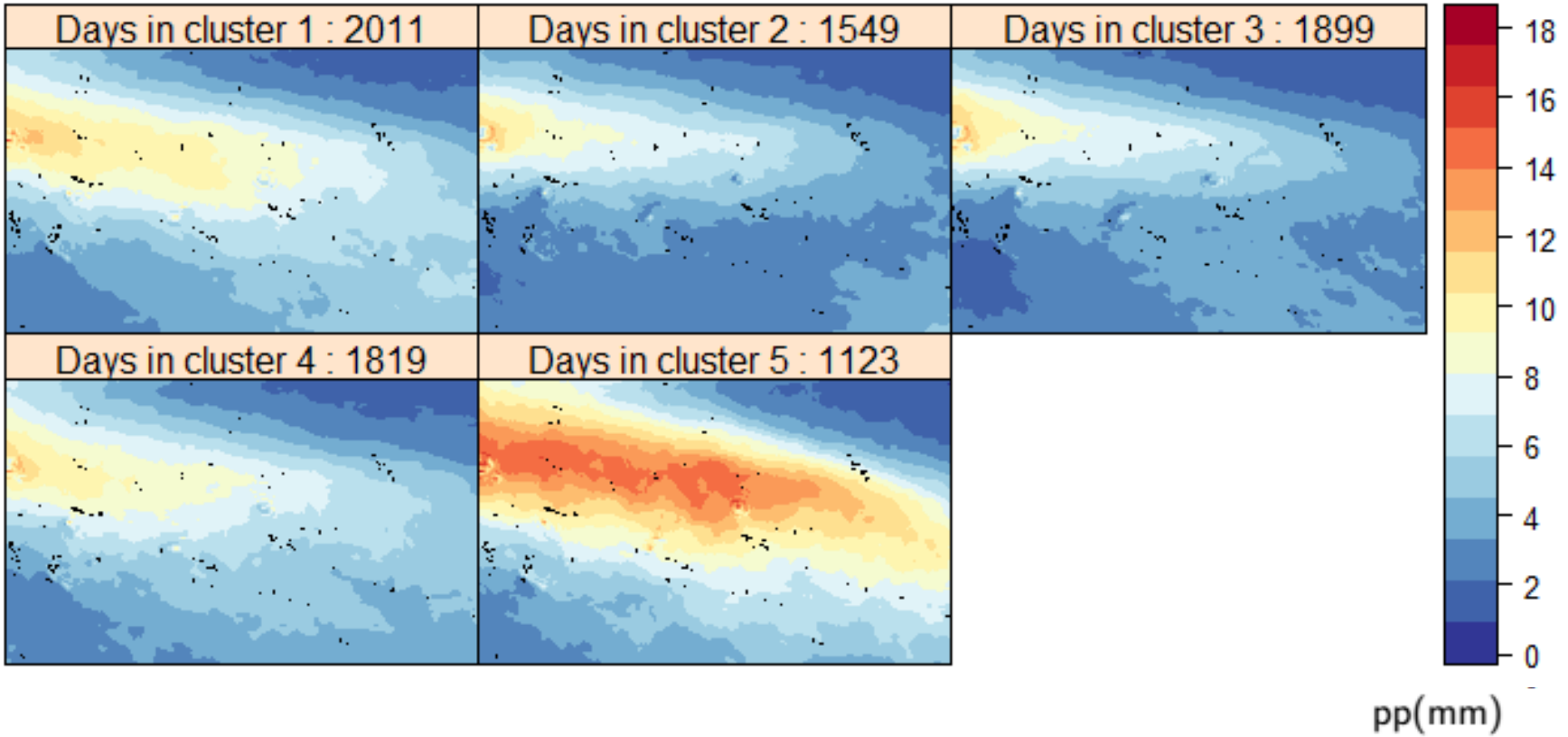


Figure: Precipitation Reanalysis Clustering Spatial Plot.

SOM Model

Results are robust to the clustering algorithm



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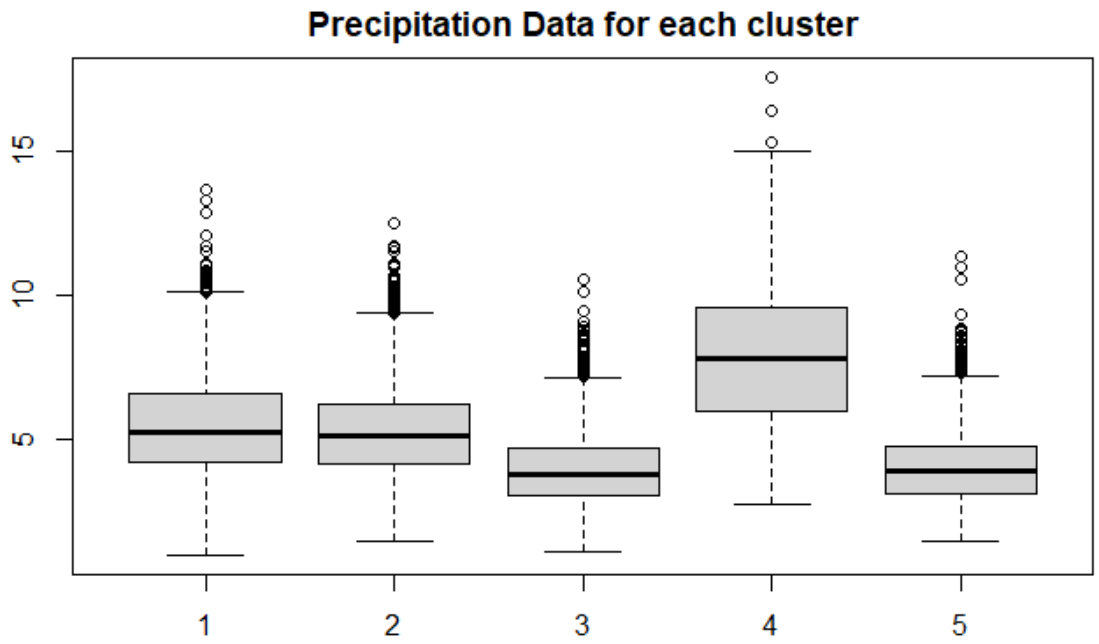
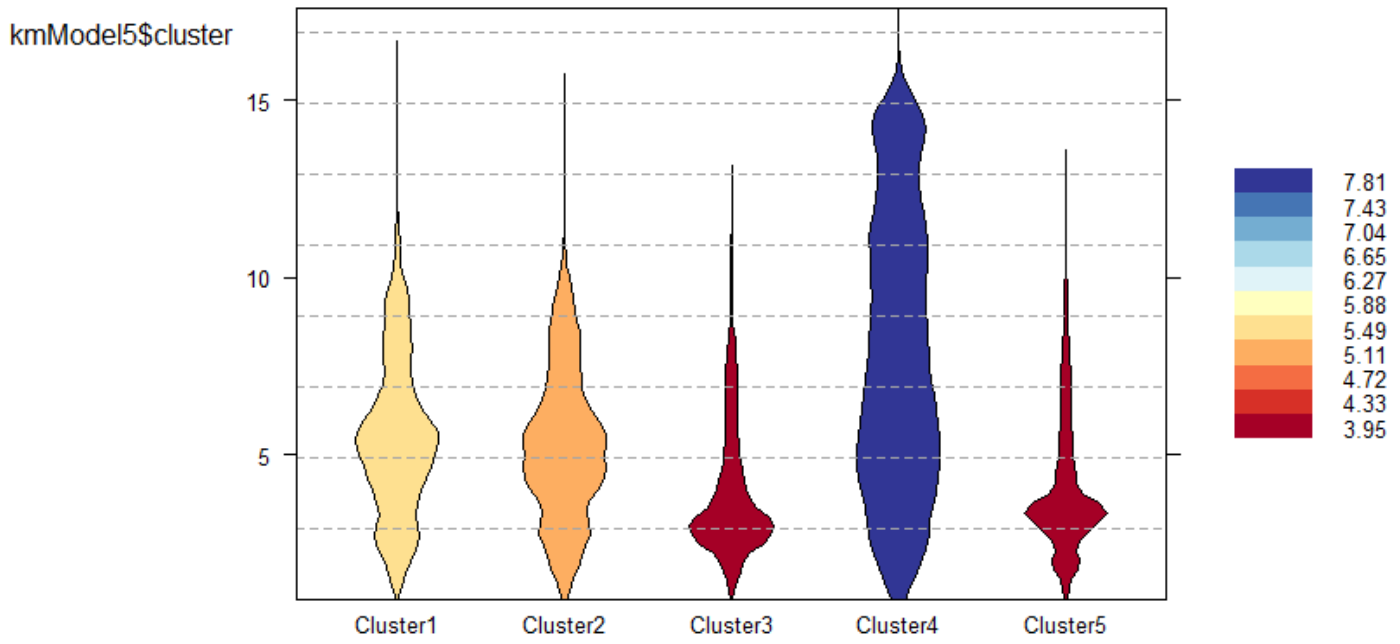
K-Means Model





Final Results

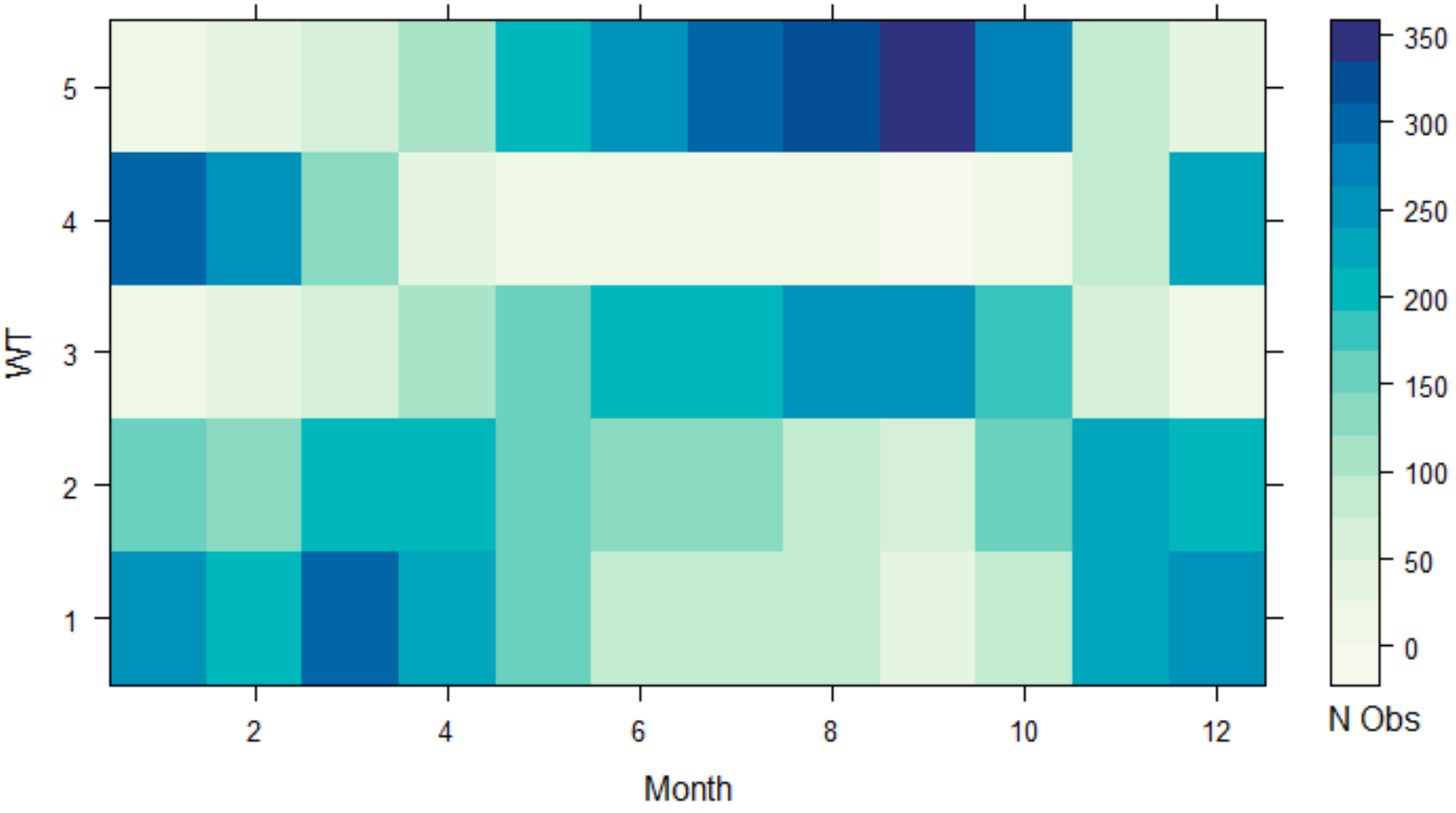
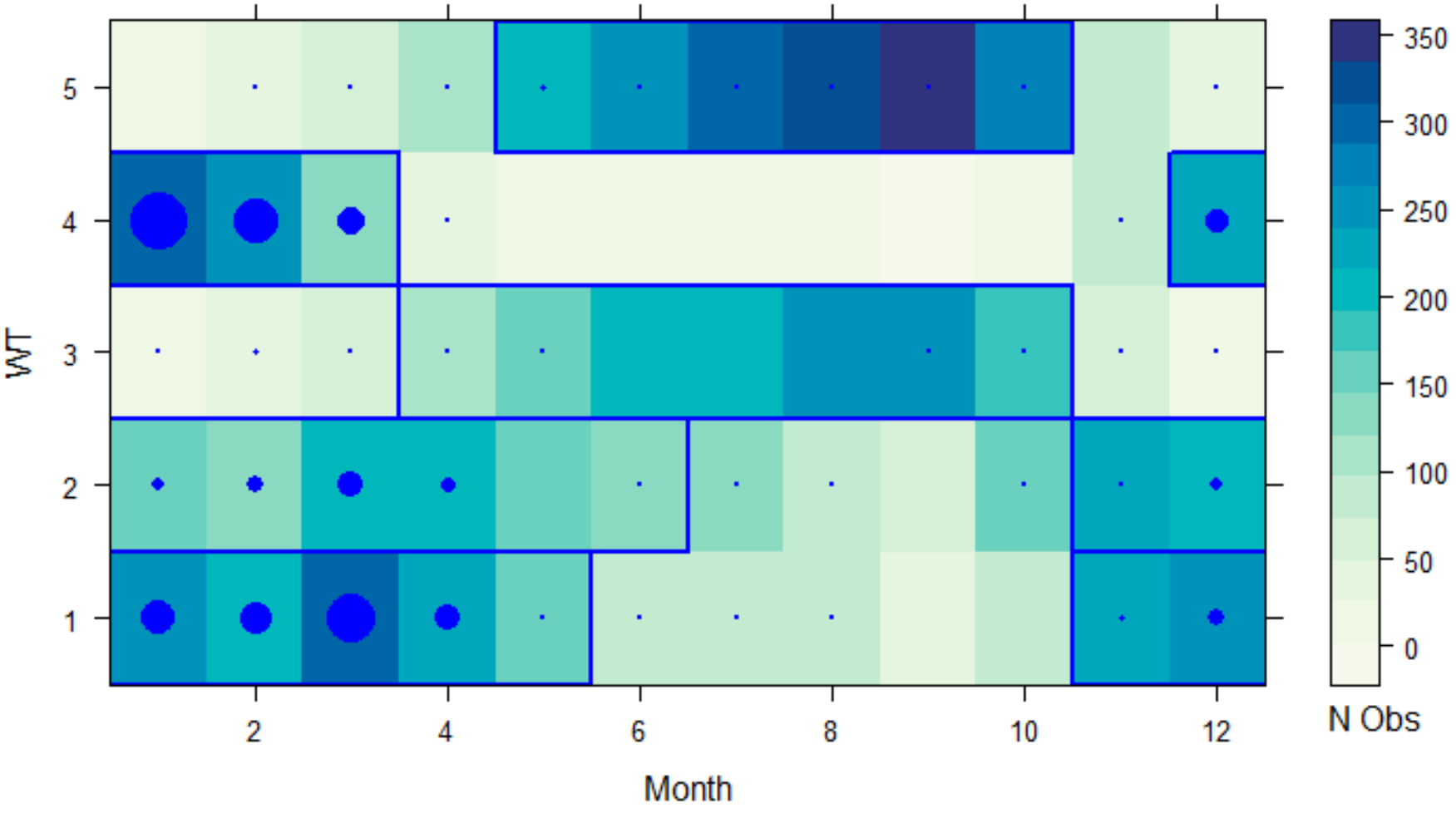


Figure: N° of observations in each season per WT. Corresponding to the period 1998-2020.

Completing with Tropical Cyclone Data



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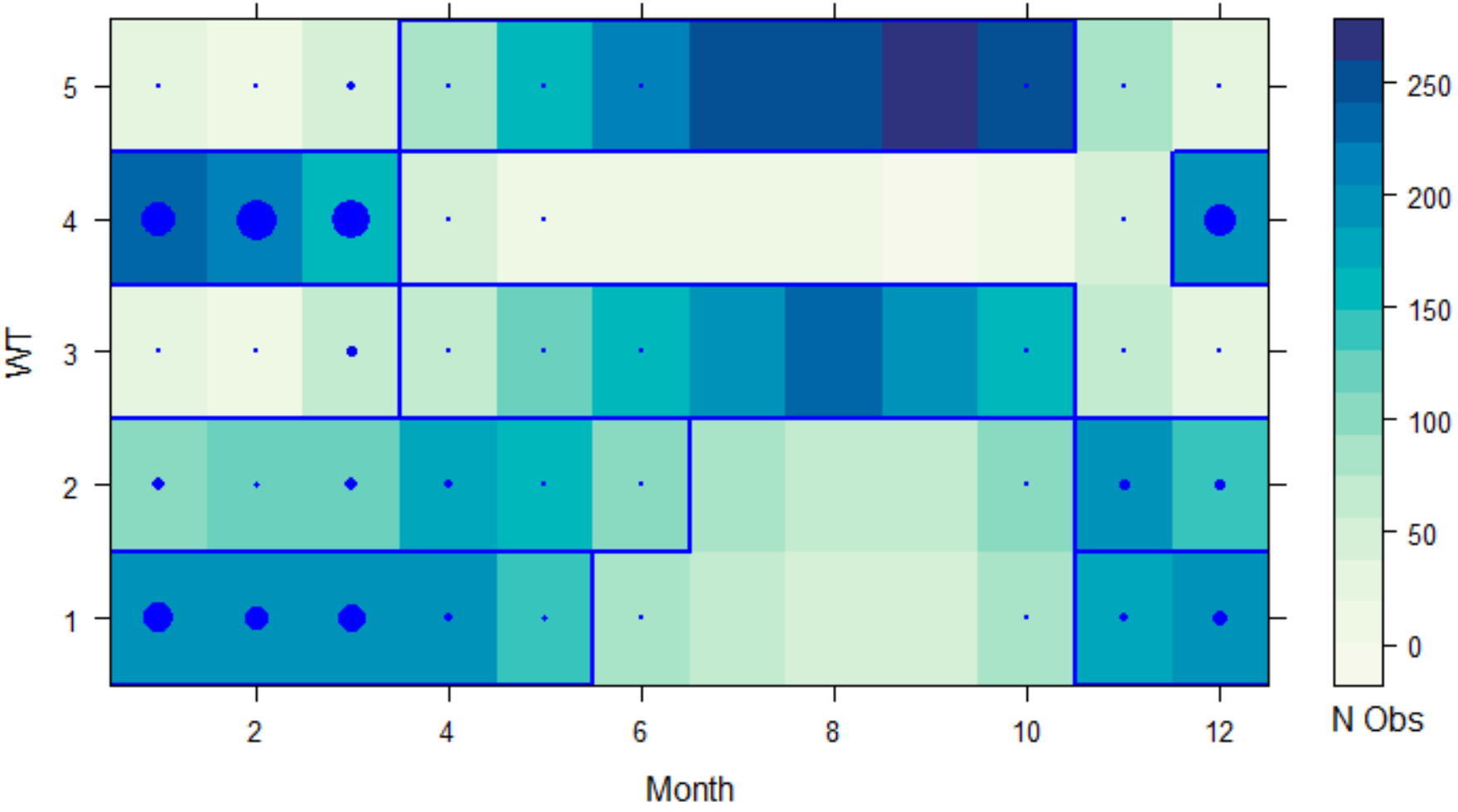
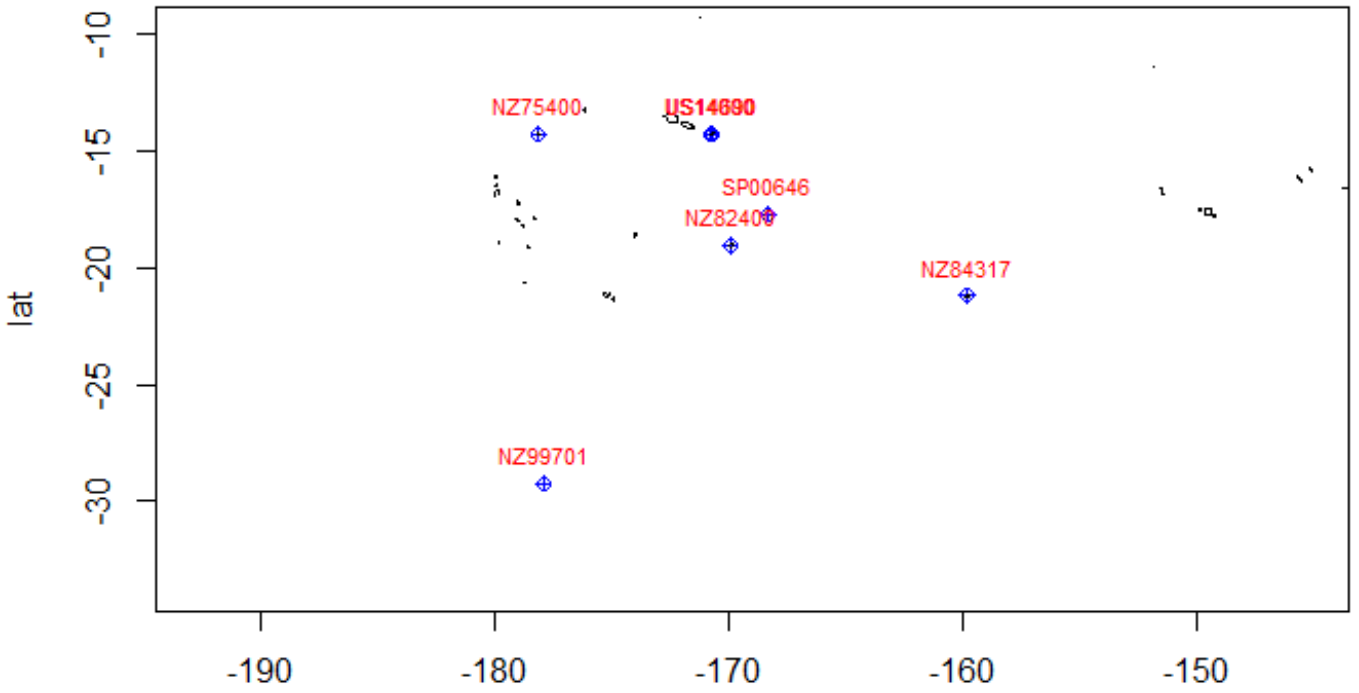


Figure: N° of observations in each season per WT. Corresponding to the period 1979-1997.

Calibration Techniques

- **Empirical Quantile Mapping (EQM).**
- **Parametric Quantile Mapping (PQM).**
- **Gamma and Generalized Pareto Distribution Quantile Mapping (GPQM).** (Threshold 0.95)
- **Gamma and Generalized Pareto Distribution Quantile Mapping (GPQM).** (Threshold 0.7)

Stations evaluated



stationID <chr>	longitude <dbl>	latitude <dbl>	altitude <int>	name <chr>
NZ75400	-178.117	-14.3167	36	Kolopelu(Wallis_and_Futuna)
NZ82400	-169.933	-19.0667	59	Alofi(Niue)
NZ84317	-159.800	-21.2000	4	RarotongaIA(Cook_Island)
NZ99701	-177.933	-29.2333	49	Bells_Beach(New_Zealand)
SP00646	-168.300	-17.7167	24	ocean_buoy
US14000	-170.767	-14.3000	408	Aoloau(American_Samoa)
US14690	-170.700	-14.3167	3	Nu'uuli(American_Samoa)

Calibration conditioned scheme

The following methodology is used for each station:

1) For cluster i (with $i = 1 \ldots 5$), all calibration methods mentioned early are applied.
2) The calibration method with the best results is selected for the cluster i. As validation, the precipitation indexes shown in the slide are used.
3) The final calibration is the composition of the best corrections in each cluster.

Code	Description	Type
Skewness	Skewness	index
Mean	Mean	index
SDII	Mean wet-day (≥ 1mm) precipitation	index
R10	Relative frequency of days with precip ≥ 10mm	index
R10p	Precipitation amount falling in days with precip ≥ 10mm	index
R20	As R10, but considering a 20mm threshold	index
R20p	As R10p, but considering a 20 mm threshold	index
P98Wet	98th percentile of wet (≥1 mm) days	index
P98WetAmount	Total amount above 98th percentile of wet (≥1 mm) days	index
RV20_max	Maximum Daily precipitation for a 20-year Return Value	index

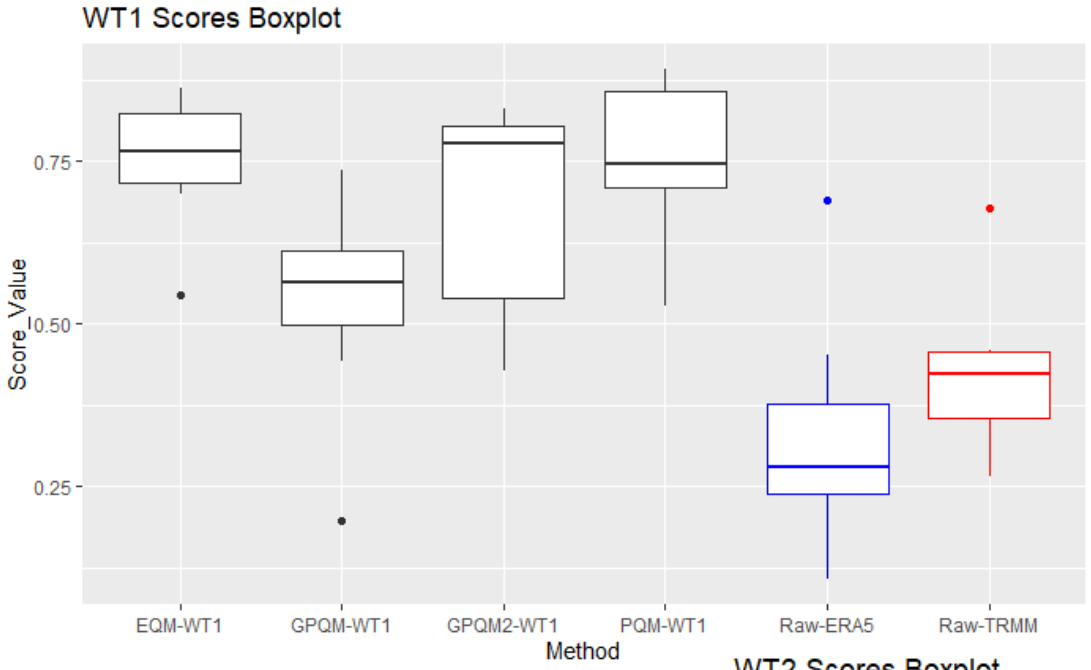
How to determine which is the best method?

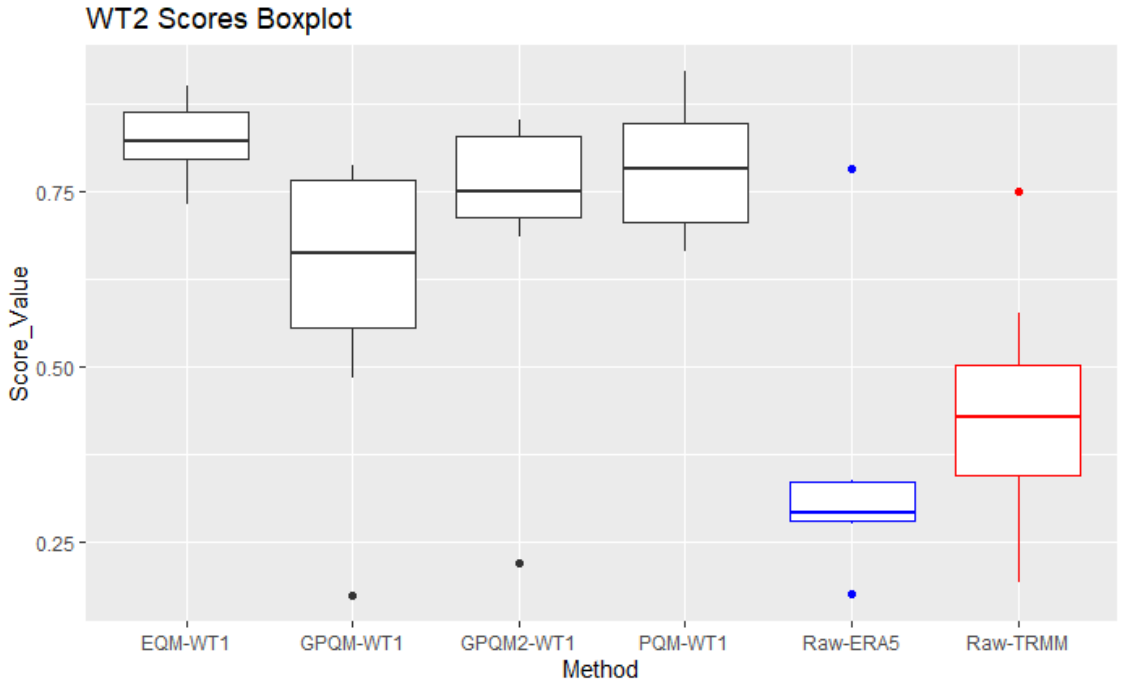
A kind of score has been computed to establish a selection of the best method . The metodology to compute this score is:

1) Validation indexes are calculated with each technique.
2) The difference in absolute value between the index values of each technique and the observations is calculated.
3) For each particular index we have a value for each technique. A normalization is applied to this set of values. The one that receives the value 0 is the index that is farthest from the observations and the one that receives the value 1 is the closest. This process is repeated for each index.
4) For each technique, the score of its indexes is taken and an average is made (arithmetic or by giving weights to certain indexes) and the score of the technique is obtained. Validation indexes are calculated for each technique.

Source: *Observational uncertainty and regional climate model evaluation: A pan-European perspective.* Kotlarski, S. et al (2017)

Ranking of calibration methods by WT





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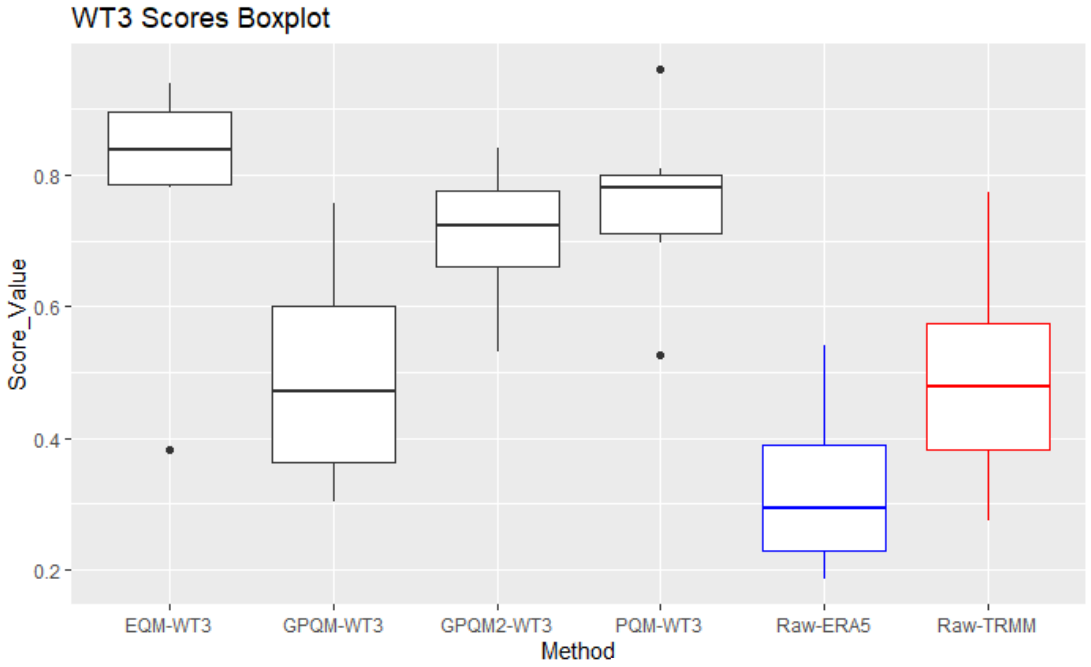

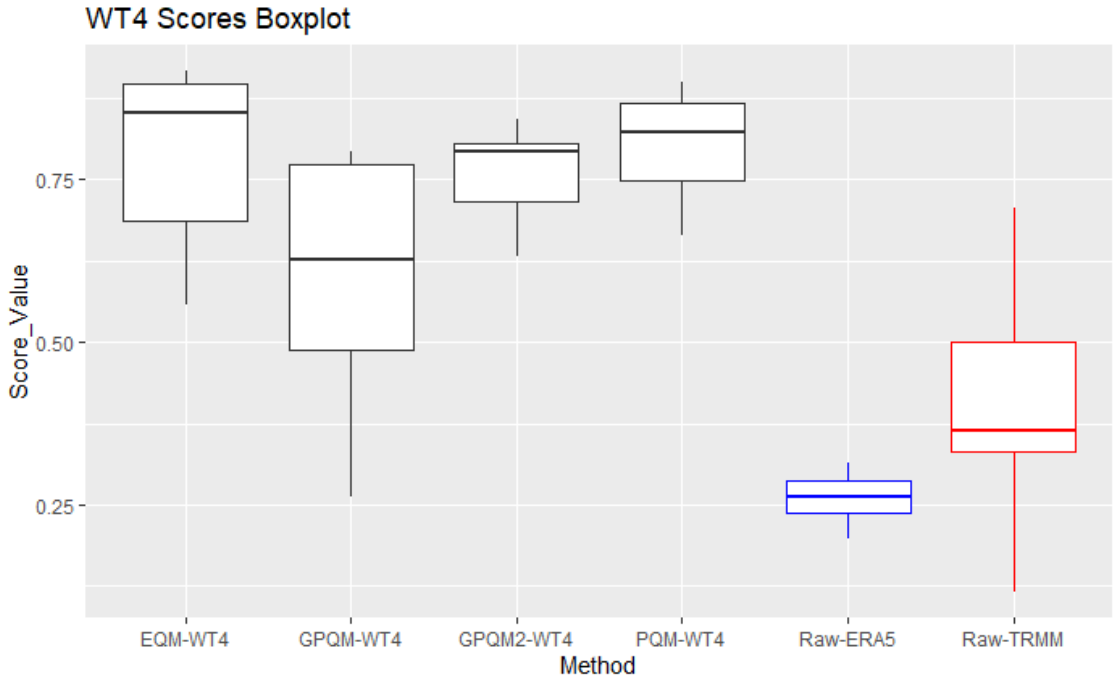

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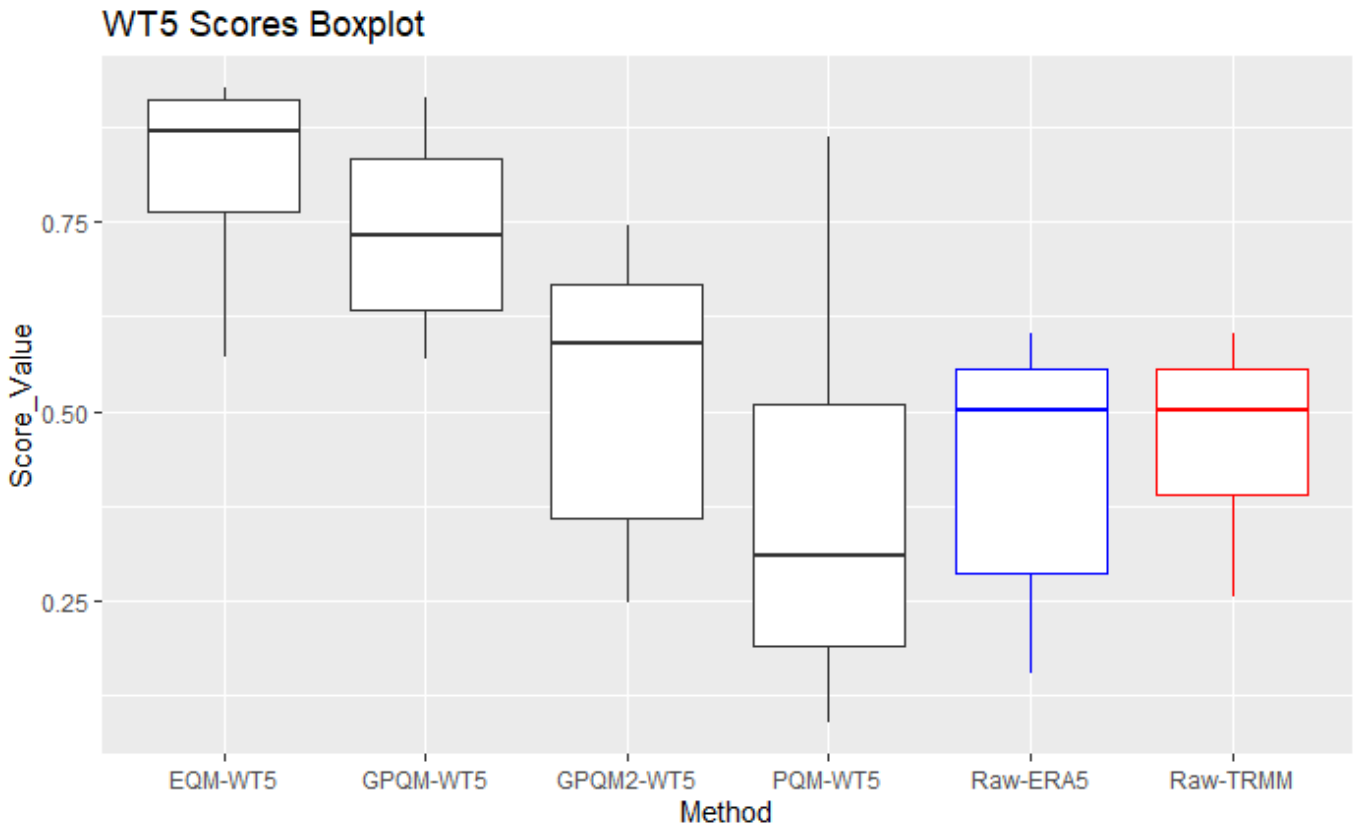

Score comparison between EQM-Conditioned and EQM

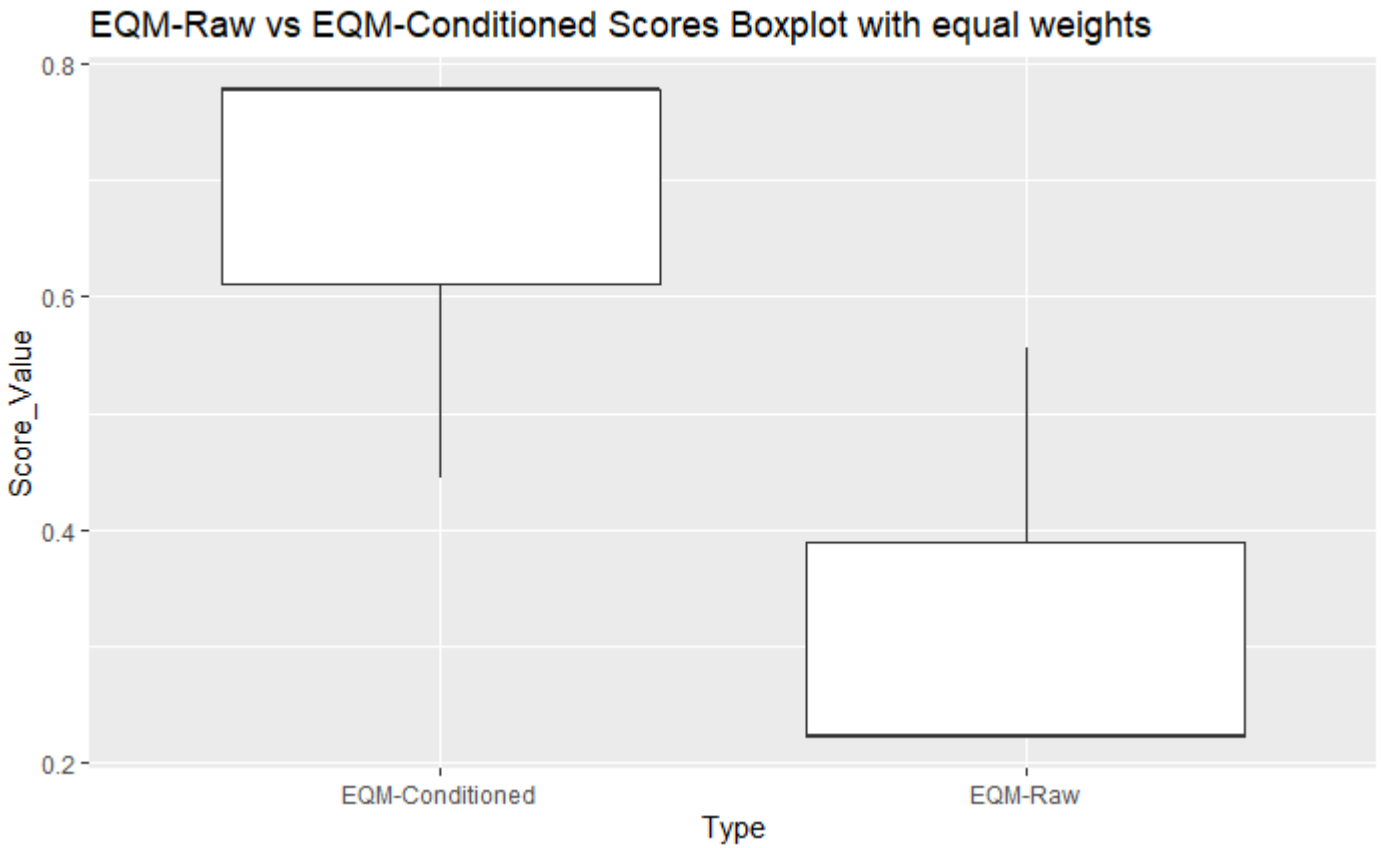

Figure: Score values comparison EQM-Conditioned vs EQM boxplot .

Comparison between EQM-Conditioned and EQM

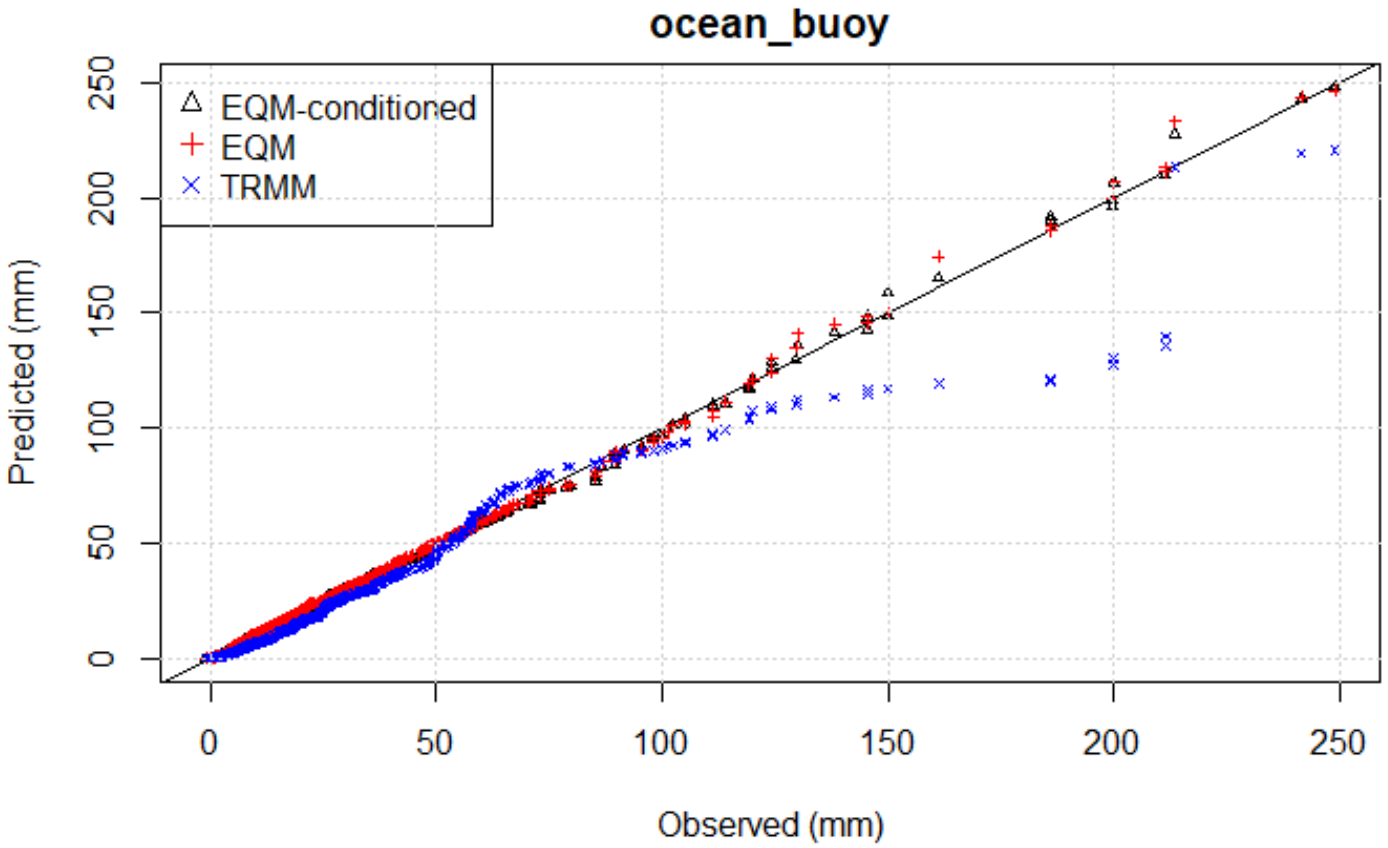

Figure: QQplot comparison EQM-Conditioned, EQM and TRMM

Example of combinated calibration

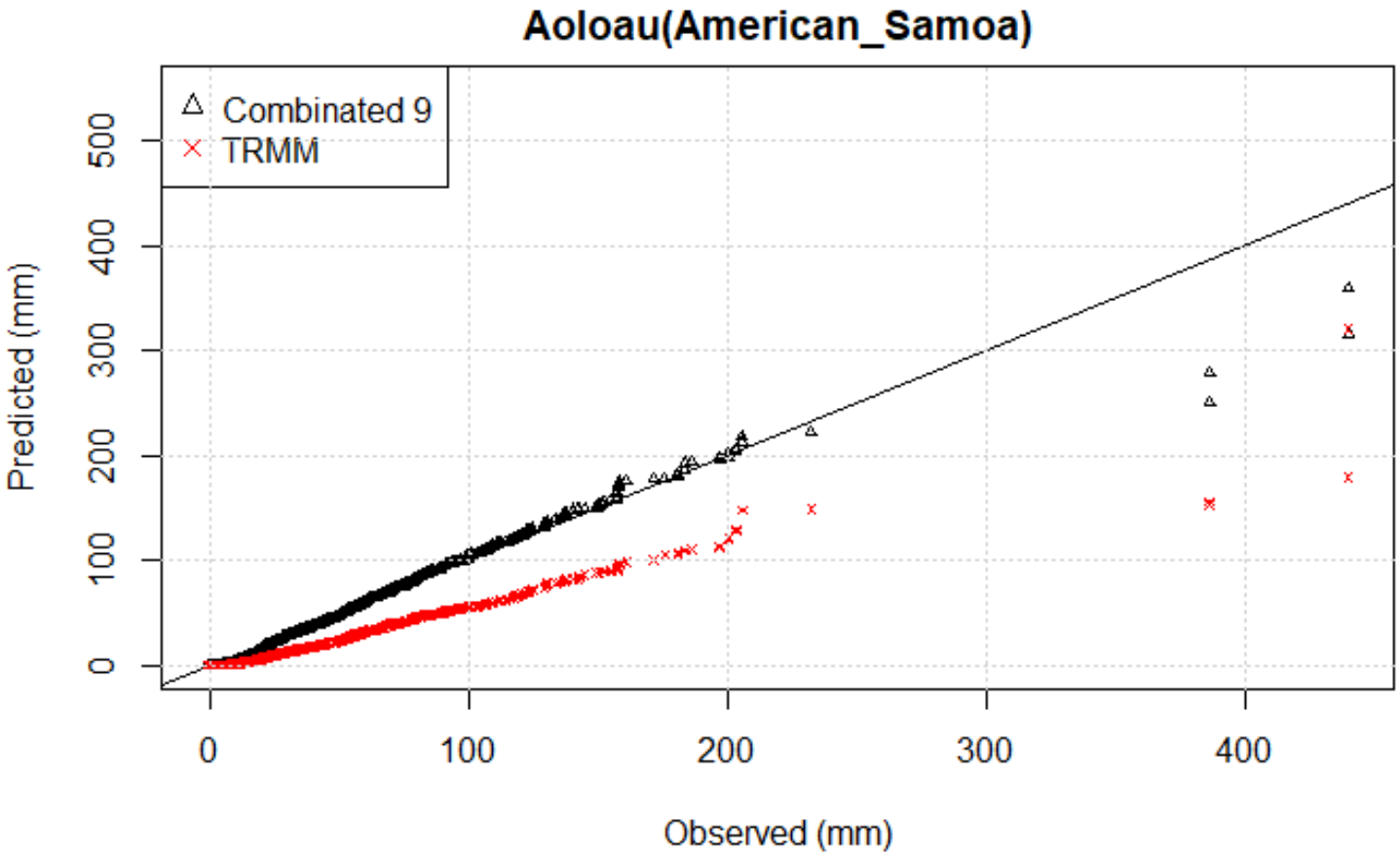

Figure: Example of combinated calibration. This calibration is composed of eqm correction for WT 1, 2 and 5 and pqm correction for WT 3 and 4.