Improving existing post-processing methods: Use of MLR, adaptive/recursive LMS and/or ANN techniques

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## **1. Introduction**

## 2. Done

## 3. Examples

## 4. To-dos & conclusions



Differences...

- 1. In Sub-task 3.1 verification of **DMO** against observations
- 2. In Sub-task 4.2 verification against observations of various **post-processed results** (In parameterization we trust...)
- 3. The quality of (any) post-processing is assessed via <u>continuous</u> <u>verification</u> MAE, RMSE <u>only</u>.



### Various methods of post-processing

- 1. Multi-Linear Regression (MLR) class of LMS method with multidimensional input data vector, yet constant over time
- 2. Adaptive/Recursive LMS methods
- 3. ANN transferring the problem from EPS- to deterministic forecasts
- Various set-ups of post-processing of various methods have been tested over the seven-years period.

## Improving existing post-processing methods: Use of MLR, A/R-LS and/or ANN techniques Introduction (3)



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Observations: lightnings (C2G, C2C) from the Polish lightning detection network PERUN, covering Poland + parts of neighbouring countries

Forecast: CAPE-based FLR (Flash Rates) as follows:

$$W = 0.3 \cdot \sqrt{2 \cdot CAPE}$$

$$FR = \left(\frac{W}{14.66}\right)^{4.54}$$

$$if \quad CTT > -15^{\circ}C \quad FR = FR \cdot \left[\max\left(\frac{-CTT}{15}, 0.01\right)\right]$$

$$if \quad CBT < -5^{\circ}C \quad FR = FR \cdot \left[\max\left(\frac{CBT + 15}{10}, 0.01\right)\right]$$

Archive observations vs. forecasts (2011-2017) Learning/testing period: 2011-2016, verification: 2017

Again, VOD (cross-correlation) procedure was applied afterwards.

Improving existing post-processing methods: Use of MLR, A/R-LS and/or ANN techniques **Examples (1)** 

#### MAE/RMSE





### RMLS



GW

Improving existing post-processing methods: Use of MLR, A/R-LS and/or ANN techniques Examples (2)

# GW

#### MAE/RMSE with cross-correlation



#### ANN

#### RMLS

MLR

mproving existing post-processing methods: Use of MILR, A/R-LS and/or ANN ter Examples (3)			or ANN techniques
	ME	MAE	RMSE
ANN 4 hidden neurons	0.8406	1.6856	11.8038
ANN 3 hidden neurons	0.4088	1.8395	11.8919
RLS λ=0.95	0.1203	2.1109	12.3525
RLS λ=1.00	0.0538	2.1911	12.7302
MLR 6 predictors	0.5957	2.1503	13.0064
MLR 3 predictors	1.0369	2.2140	13.4703

mproving existing post-processing methods: Use of MLR, A/R-LS and/or ANN techniques Examples (3)			
	ME	MAE	RMSE
ANN 6 hidden neurons	0.0036	1.6283	11.5729
ANN 3 hidden neurons	-0.0775	1.6971	11.7552
RLS λ=0.95	1.2364	2.0847	12.1510
RLS λ=1.00	-0.7295	2.1130	12.4476
MLR 6 predictors	0.6641	2.1769	12.9326
MLR 4 predictors	1.2260	2.1990	13.3877

#### Applied VOD

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Conclusions and to-dos (?)



1. Best method?



2. ... with VOD?



3. RLMS not necessarily works as good as expected, still, better than MLR...

4. Now what?

