Status of Task 3.1 – Verification of forecasts of intense convective phenomena

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Introduction

”Discrete” (1, 2) vs. ”Continuous” (3) verification

1. SAL (Structure-Amplitude-Location) approach

S – structure – compare the volume of the normalized objects.

A- amplitude – corresponds to the normalized difference of the domain-averaged values

L- location –Combinations of a difference of mass centers of fields and averaged distance between the total mass center and individual objects

The perfect forecast S = A = L = 0

Wernli H, Paulat M, Hagen M, Frei C. 2008. SAL – a novel quality measure for the verification of quantitative precipitation forecasts. Monthly Weather Review 136: 4470–4487.

2. Fraction Skill Scores (FSS) assessment

Direct comparison of the forecast and of observed fractional coverage of grid-box events in spatial windows of increasing size. Most sensitive to rare events.

FSS = 0 - no correspondence between observations and forecasts

FSS = 1 - perfect match

FSS >= FSS uniform - „useful” forecast.

2. MAE, RMSE – which metric is better?

- RMSE has the benefit of penalizing large errors more so can be more appropriate in some cases
- RMSE does not describe average error alone as MAE does
- Distinct advantage of RMSE over MAE – RMSE doesn’t use the absolute value – which is good in many mathematical calculations

Done (1)

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:

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

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

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

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

Archive observations vs. forecasts (2011-2015)

Done (2)

Cases selection:

For both observations and forecasts –

– FLR max_value> 20 strikes/hour

The duration of the storm must be not less than 6 hours

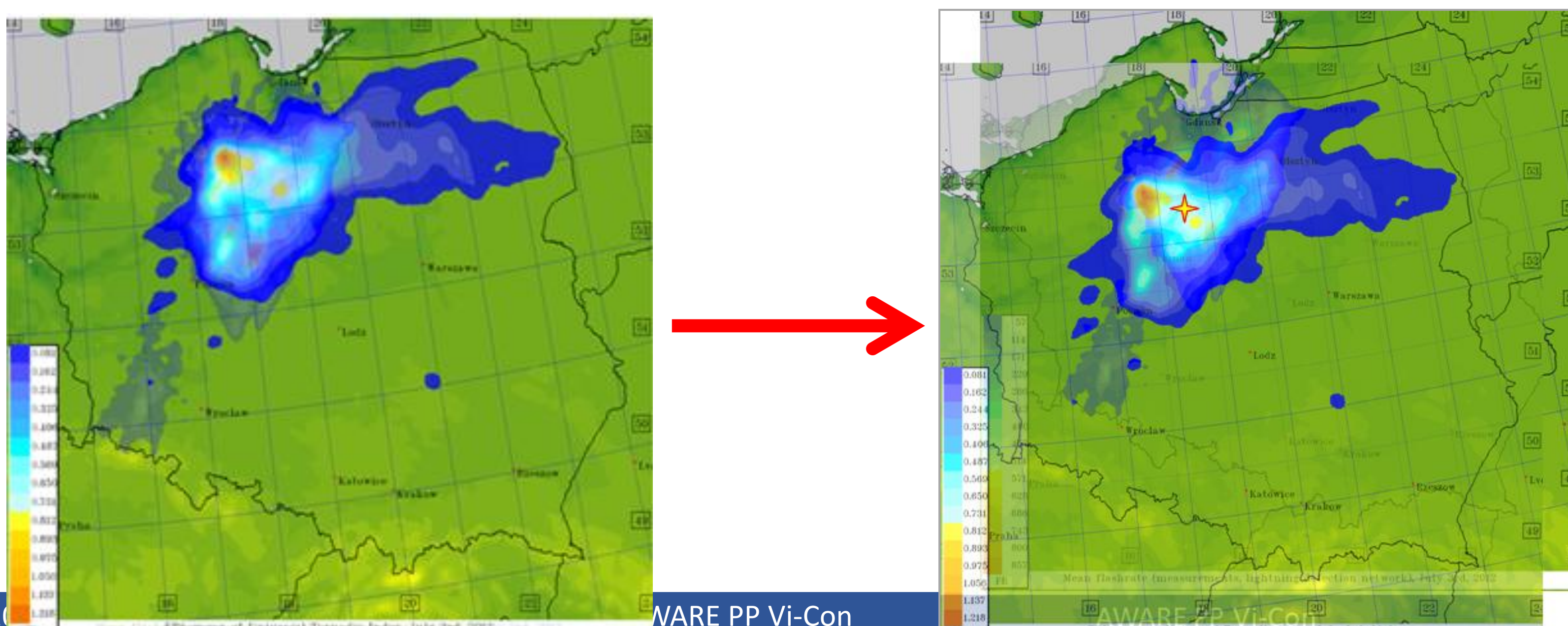
For the period 2011-2015 – approx. 10 cases per year.

Done (3)

Additional approach: space-lag correlation.

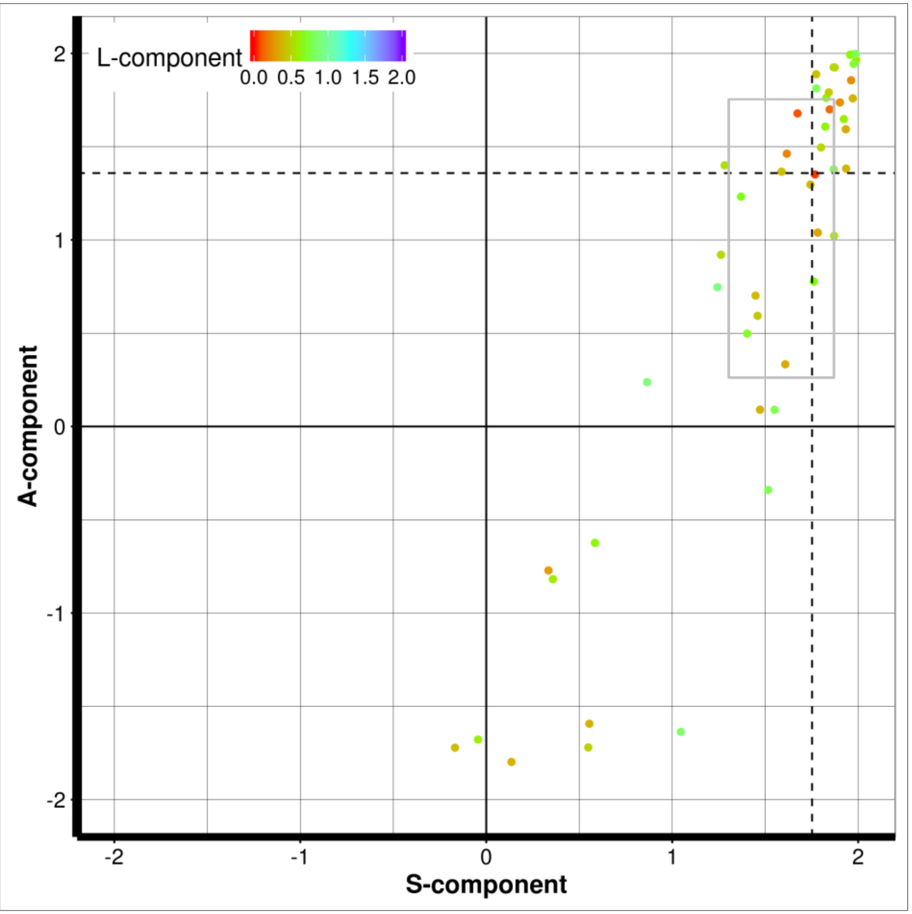
Short reminder:

1. Calculate coordinates of ”centres of mass” for both distribution patterns (obs. vs. fcst)
2. Compute vector of displacement of fcst to obs. as a difference of the two above
3. Displace linearly every value of fcst by the vector of displacement

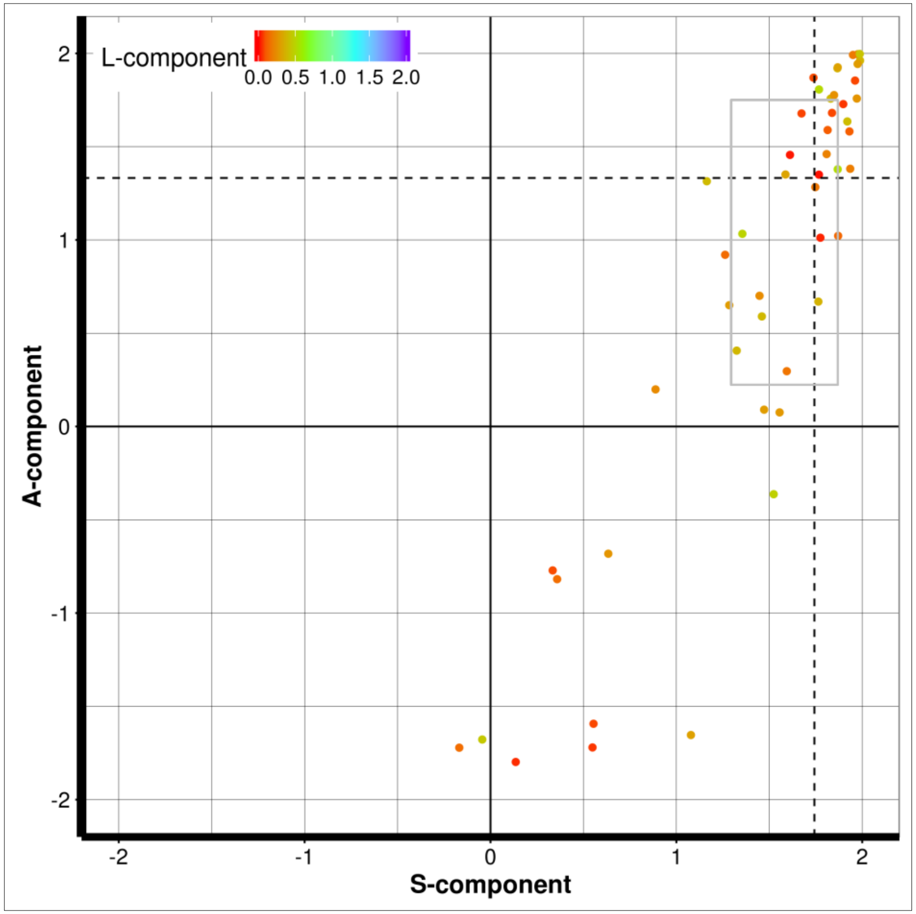


Examples (1)

SAL



SAL with cross-correlation

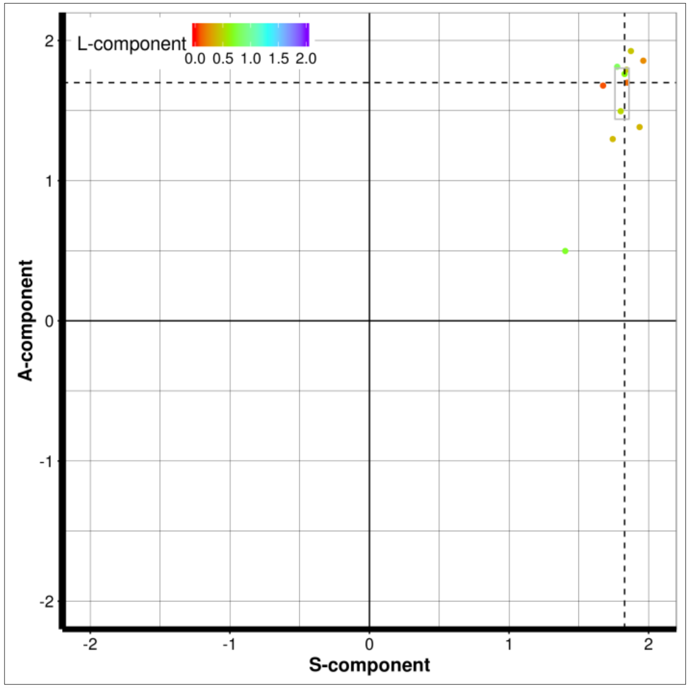


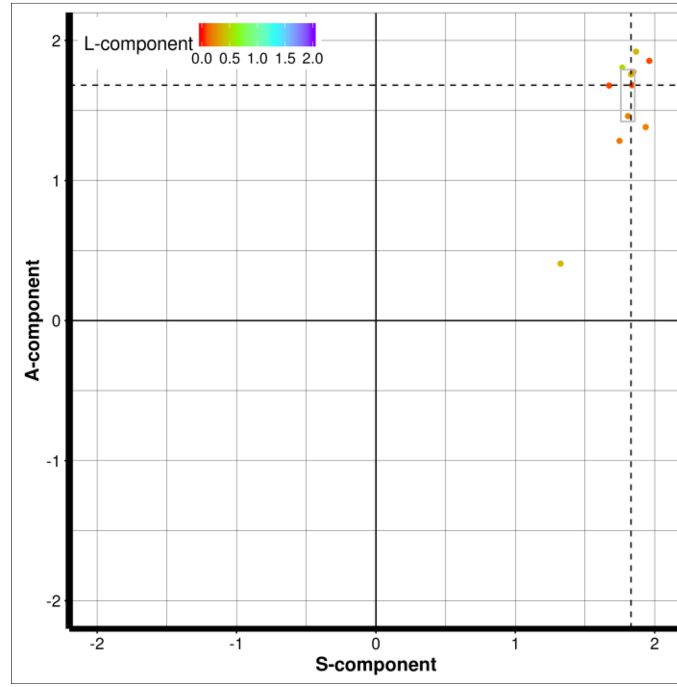
All selected cases (2011-2015)

Dotted lines denote the median Structure- and Amplitude-component scores, resp.
The box corresponds to the 25 and 75 quartiles of S (*x*-axis) and A (*y*-axis) components.

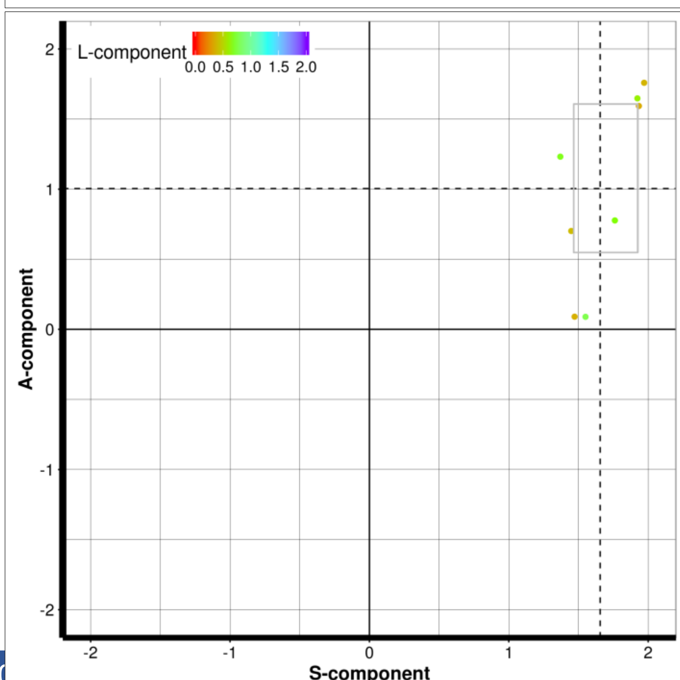
SAL

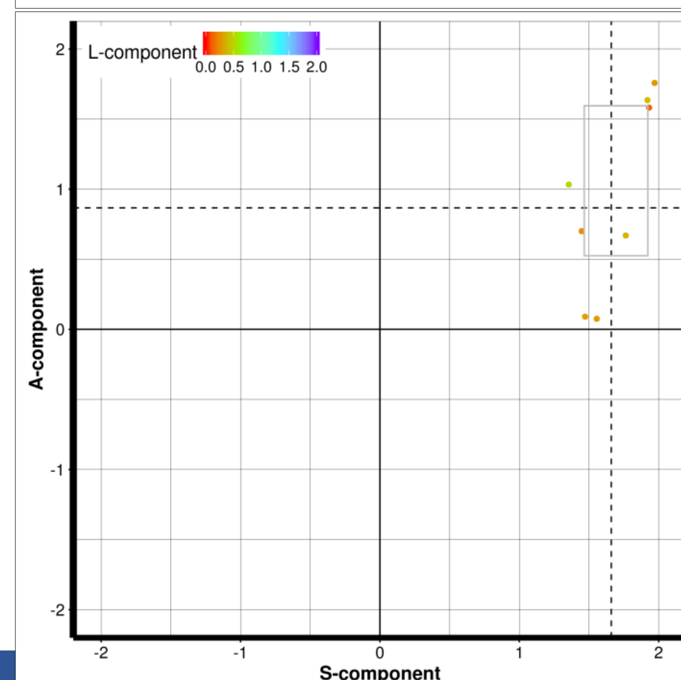
SAL with cross-correlation





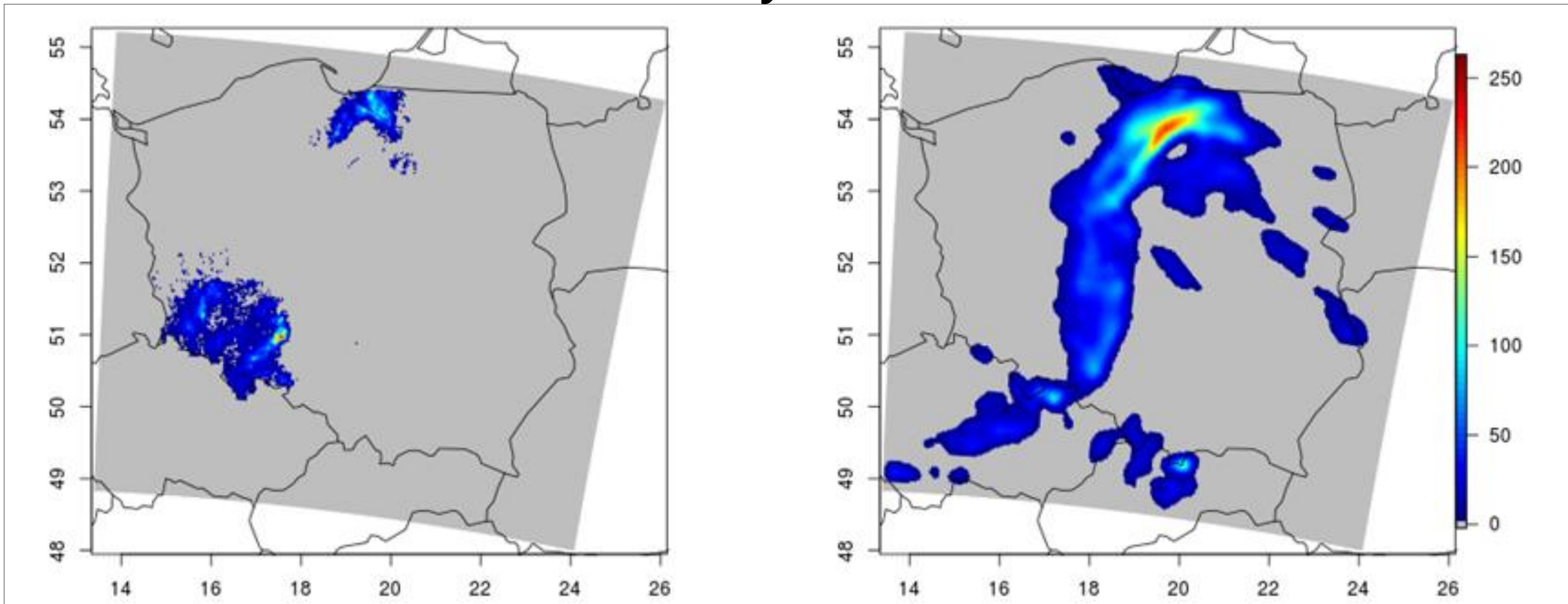
2012 worst

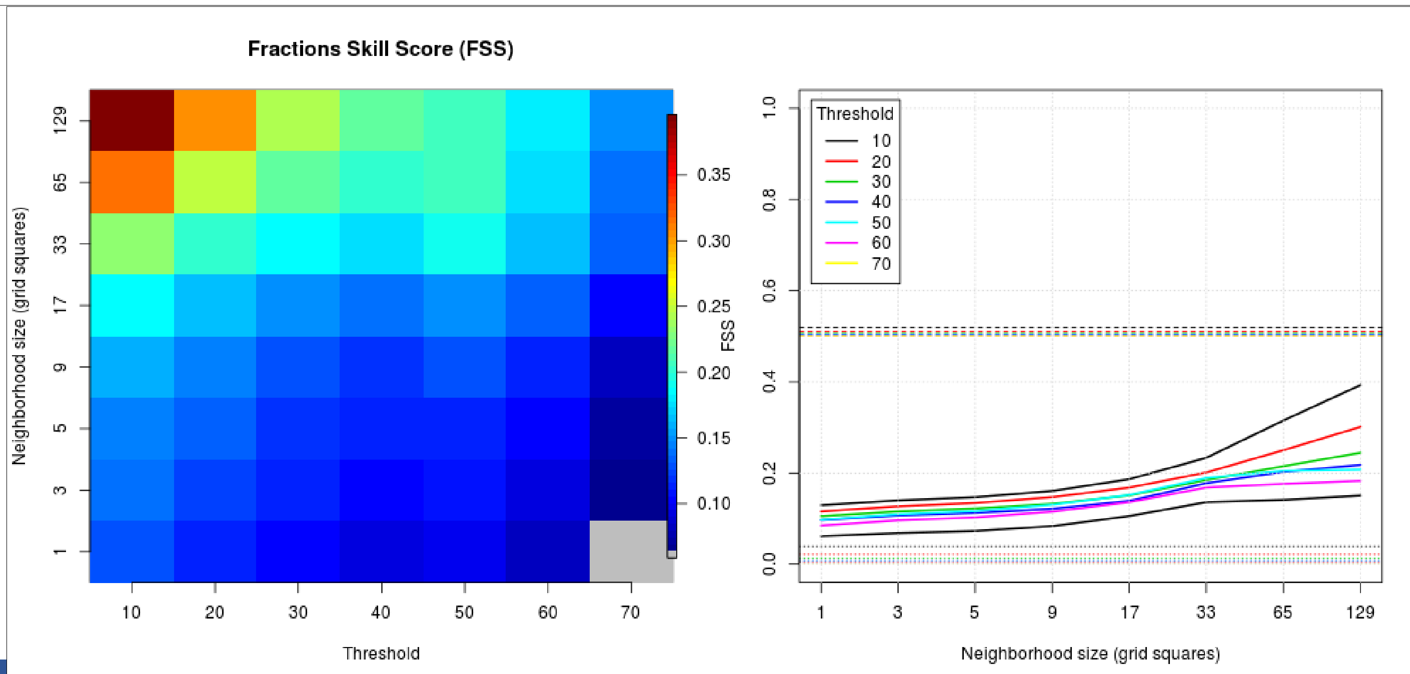




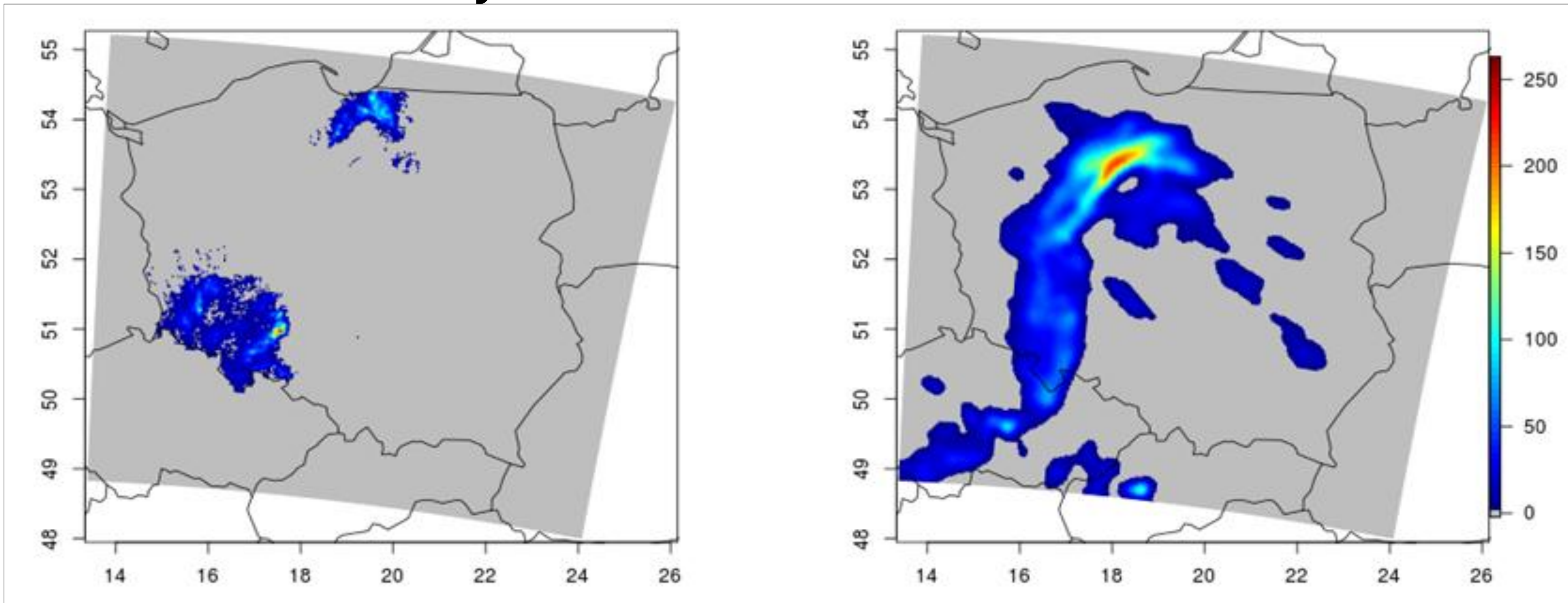
2014 best

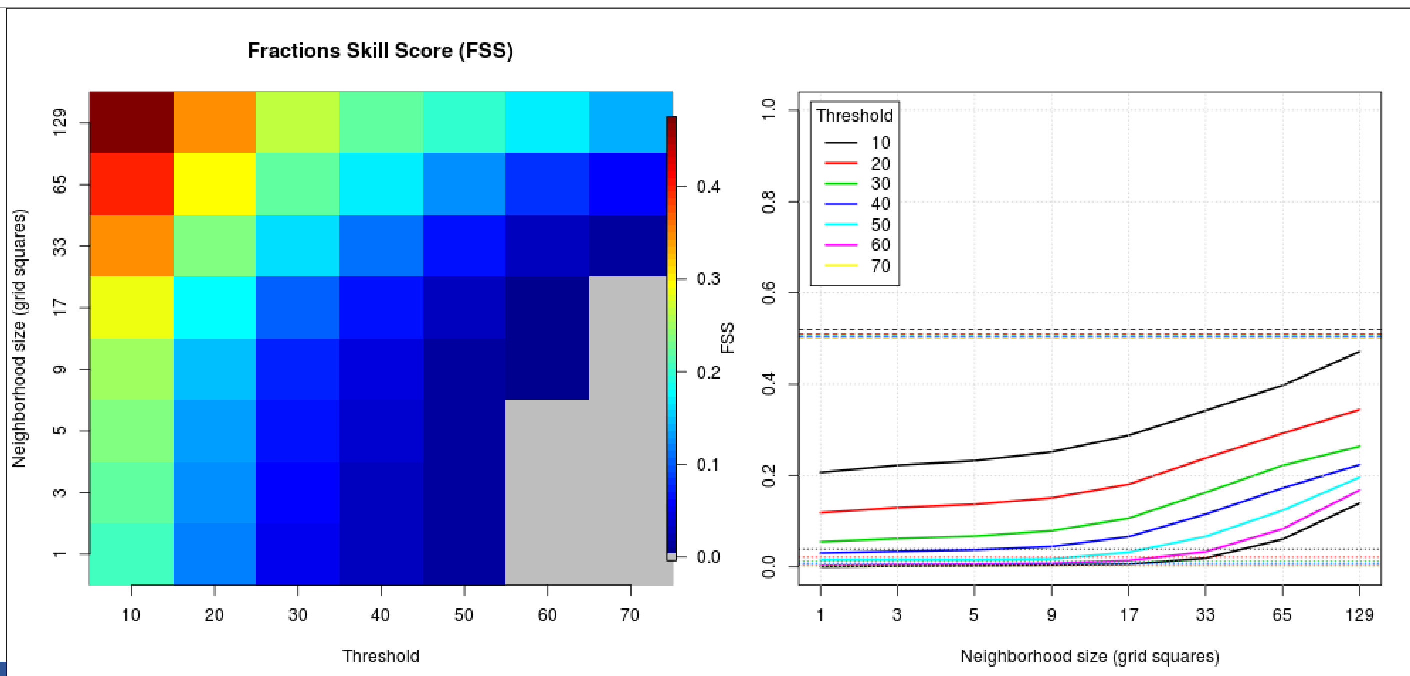
FSS Case study 2013072918





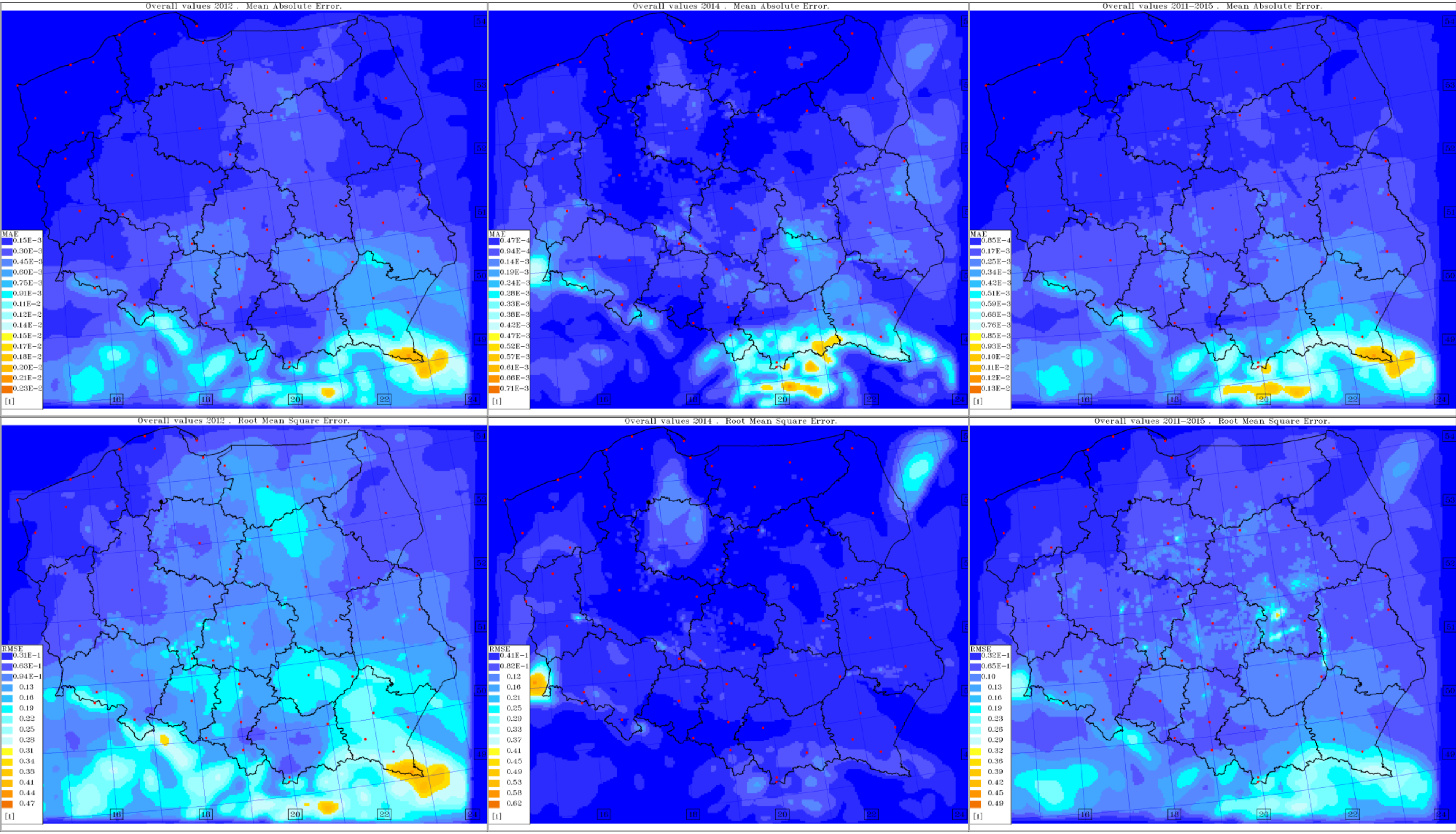
FSS Case study 2013072918 with cross-correlation





Examples (5)

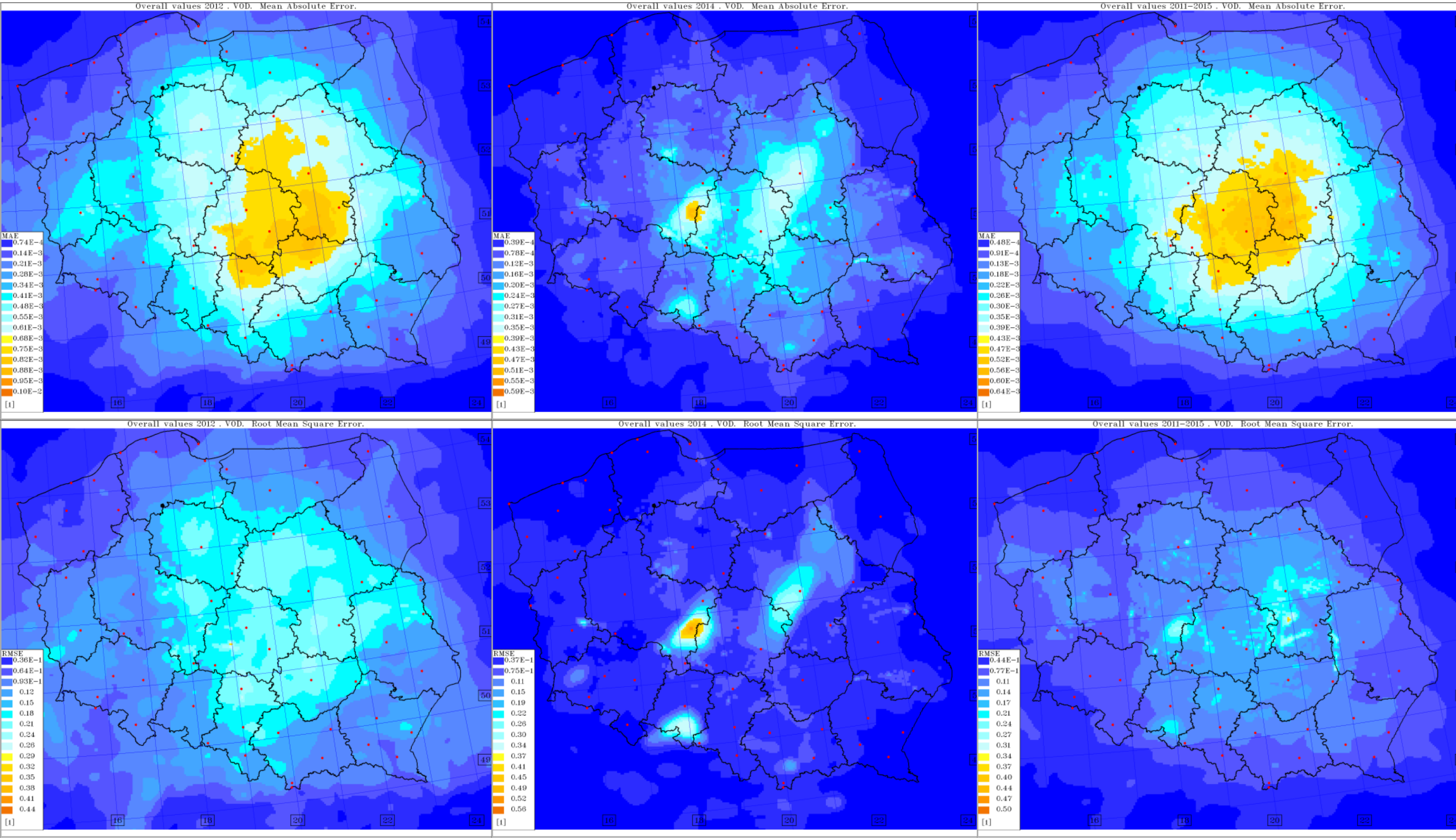
MAE/RMSE



2012 2014 2011-2015

Examples (6)

MAE/RMSE with cross-correlation



2012 2014 2011-2015

Examples (7)

MAE/RMSE with vs. w/out cross-correlation

	Raw results				VOD			
	Selected cases		All year		Selected cases		All year	
Year	MAE	RMSE	MAE	RMSE	MAE	RMSE	MAE	RMSE
2011	18.628	51.695	4.712	18.904	16.744	49.429	4.213	18.051
2012	10.214	28.531	5.913	18.866	9.604	27.773	5.027	17.482
2013	4.973	17.386	2.184	10.556	4.741	16.997	1.949	9.970
2014	2.833	9.769	1.516	9.186	2.553	9.346	1.374	8.960
2015	2.758	13.987	2.025	11.871	2.435	13.384	1.819	11.391
2011-2015	8.255	29.623	3.360	14.695	7.550	24.467	2.950	13.904

Conclusions (?)

1. SAL – VOD forces some improvement in L-component and (to some extent) in A-component. S-component to a large extent remains unchanged.
2. In the future work – choose smaller domain (SAL is more effective) and more cases to study.
3. FSS – results are not very impressive. VOD not necessarily improves it (though these are preliminary tests…)
4. Possible reason (?) FSS is most sensitive to rare events
5. MAE/RMSE (direct comparison) – The worst values in mountainous regions – hard(er) to predict thunderstorms?
6. MAE/RMSE w. cross-correlation – slight improvement compared to direct verification, maxima moved towards domain centre.
7. Discrete vs. continuous verification?