Towards Evaluating Timing Errors of Quantitative Precipitation Forecasts with the Feature-Based Technique SAL

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Concept of SAL

- novel quality measure (Wernli et al. 2008 MWR)
- pre-defined region, e.g. a river catchment
- identification of rain objects
  - → feature-based
  - → no explicit matching required
- three independent components
  - → Structure (S), Amplitude (A), Location (L)

SAL method

- **S Component (Structure) → size and shape**

too small/peaked		perfect		too large/flat
-2	...	0	...	2

- **A Component (Amplitude) → amount**

too little		perfect		too much
-2	...	0	...	2

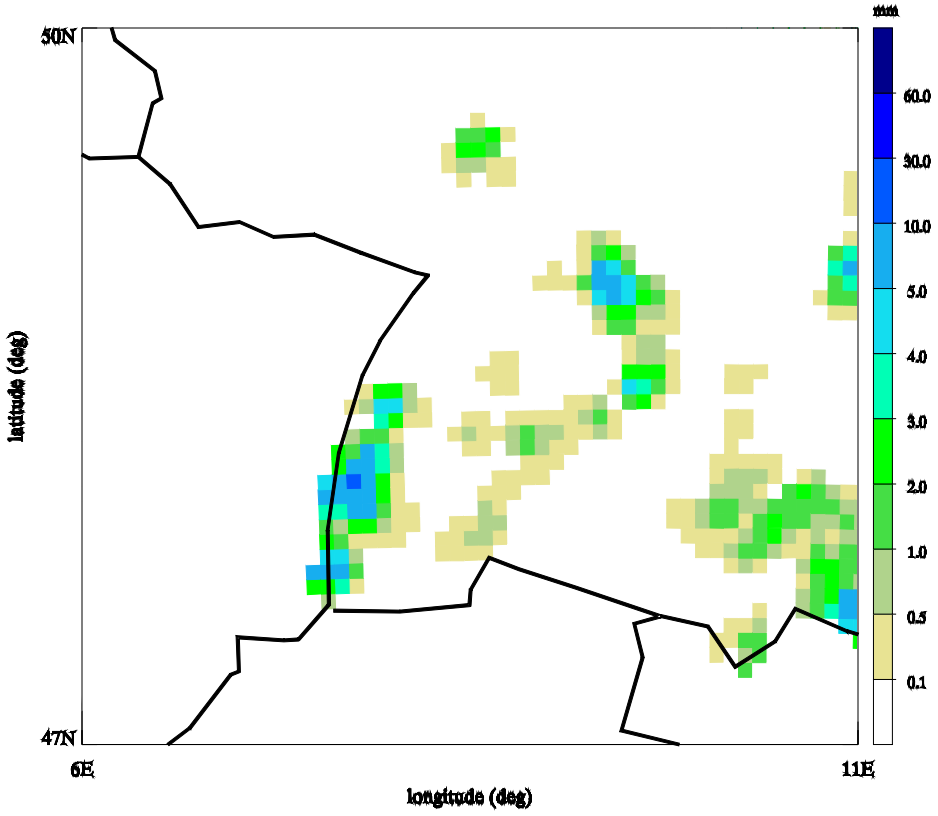
- **L Component (Location) → position**

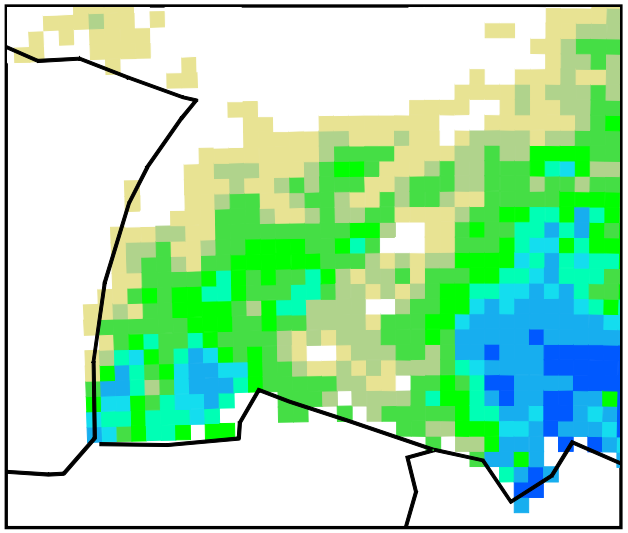
perfect		far away
0	...	2

- **perfect score: S = A = L = 0**

Example for SAL

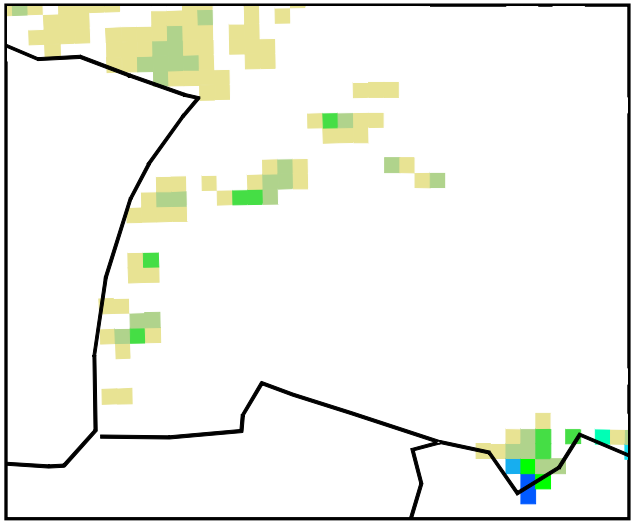
observation





Model I

S = 1,3
A = 0,6
L = 0,4

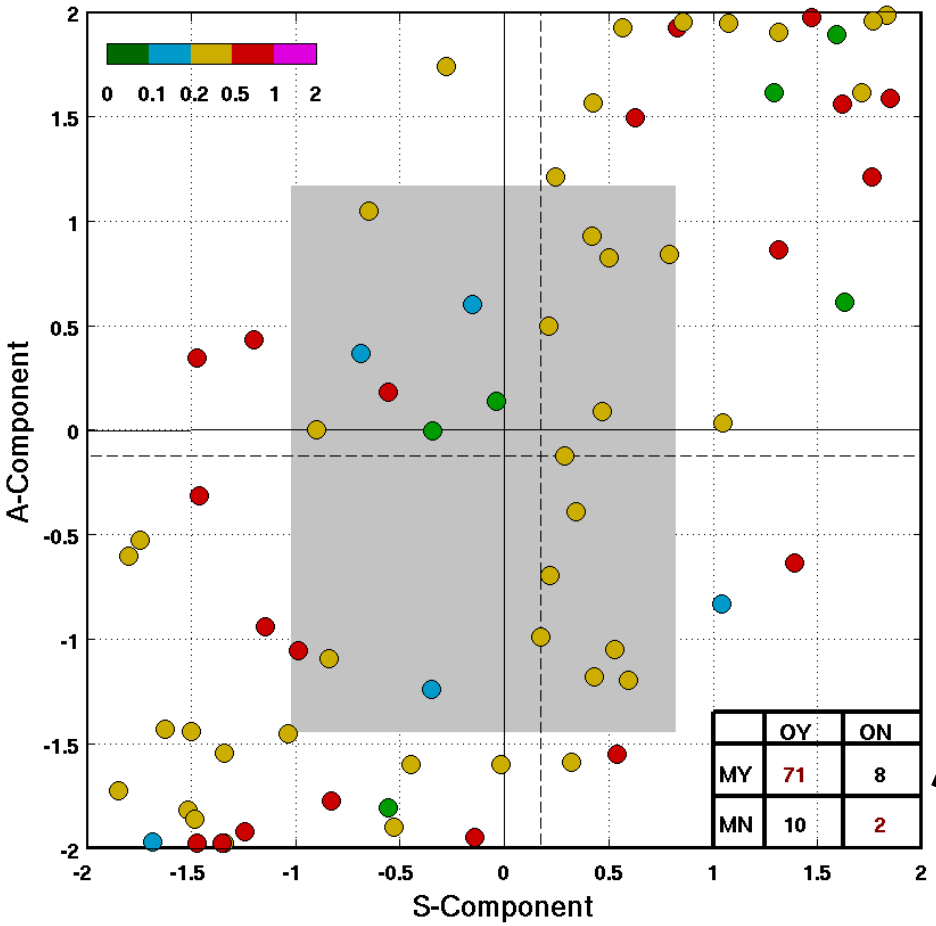


Model II

S =-1,0
A =-1,6
L = 0,2

SAL diagram

generic example



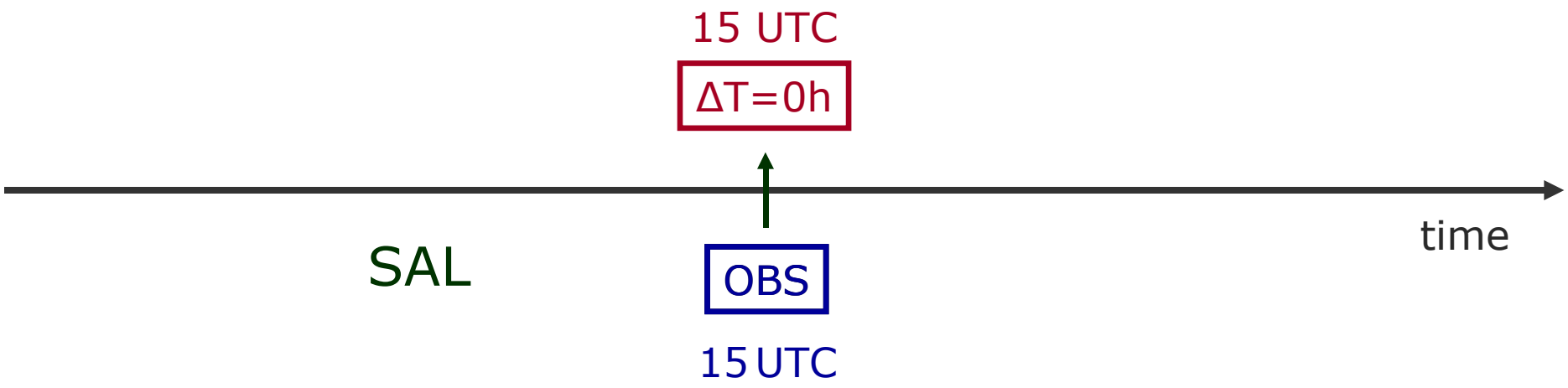
	OY	ON
MY	71	8
MN	10	2

→ 'contingency table'-problem

→ optimization of L

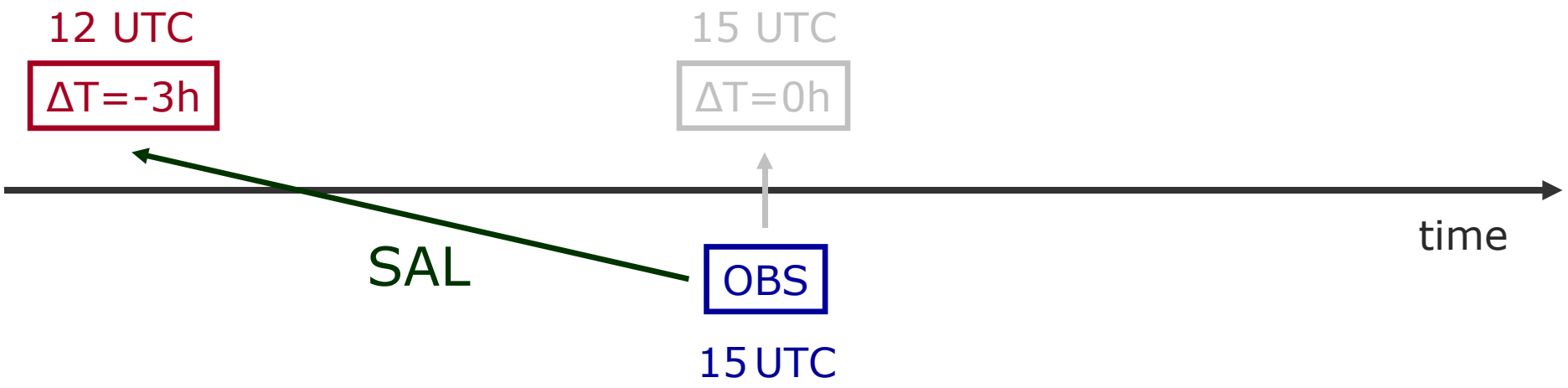
“Fuzzyness” in time

concept for the timing error determination



“Fuzzyness” in time

concept for the timing error determination



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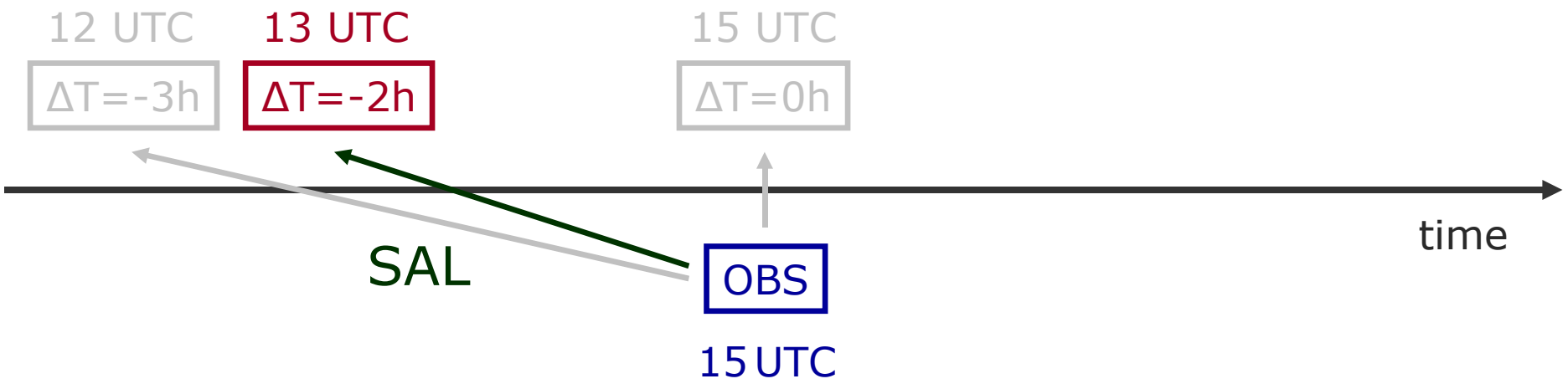
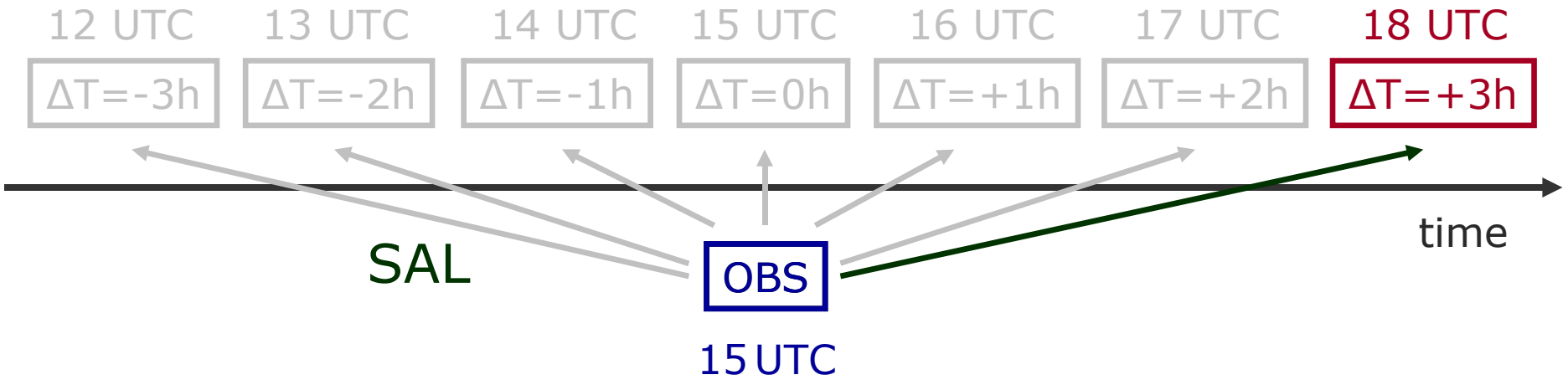


“Fuzzyness” in time

concept for the timing error determination

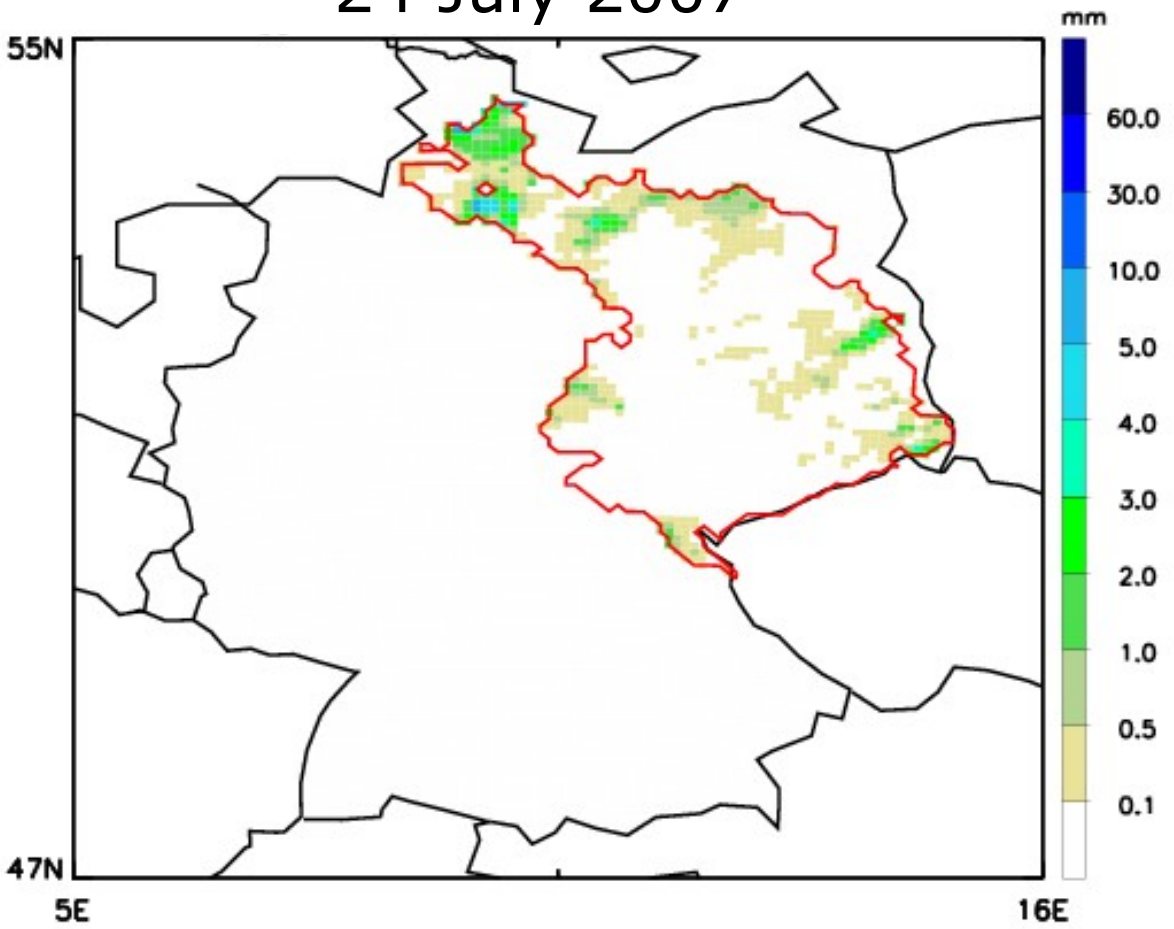


$\Delta T = [-3h, \ldots, +3h]$

min(L) → ΔT and SAL(ΔT)

Example for time shift determination

24 July 2007



observation 15 UTC

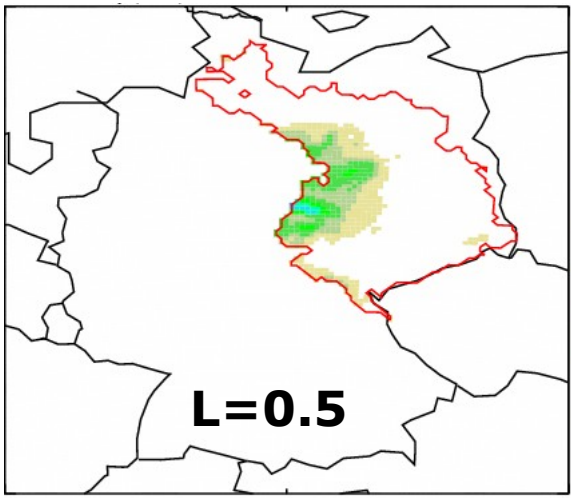
hourly accumulation

Elbe river catchment

COSMO-DE forecasts of the 00UTC run

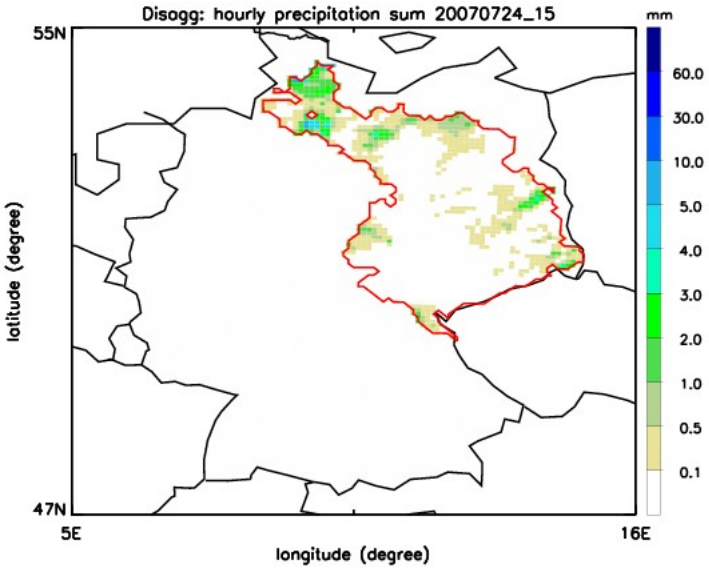
Example for time shift determination

12 UTC



13 UTC

observation15 UTC



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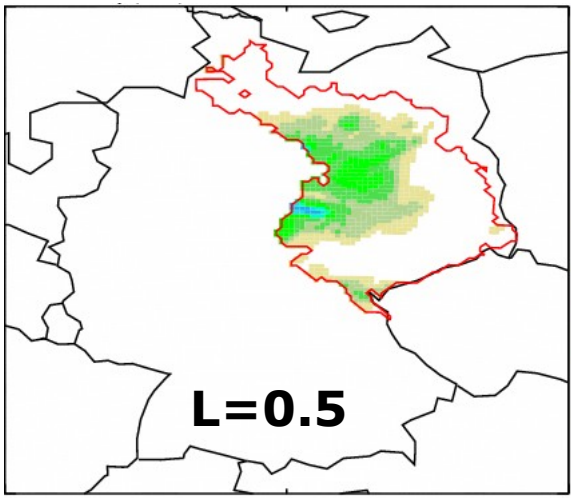
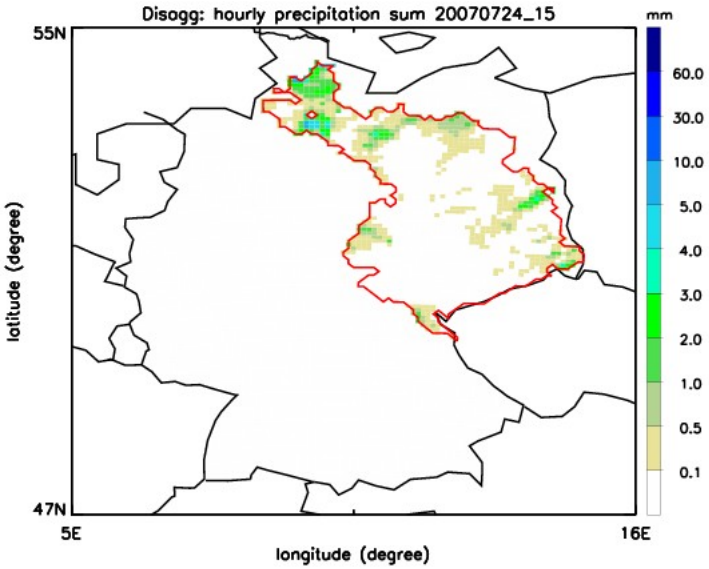


14 UTC

observation15 UTC



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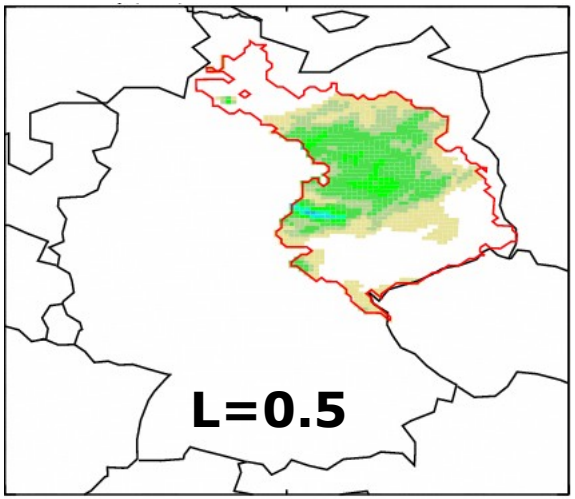
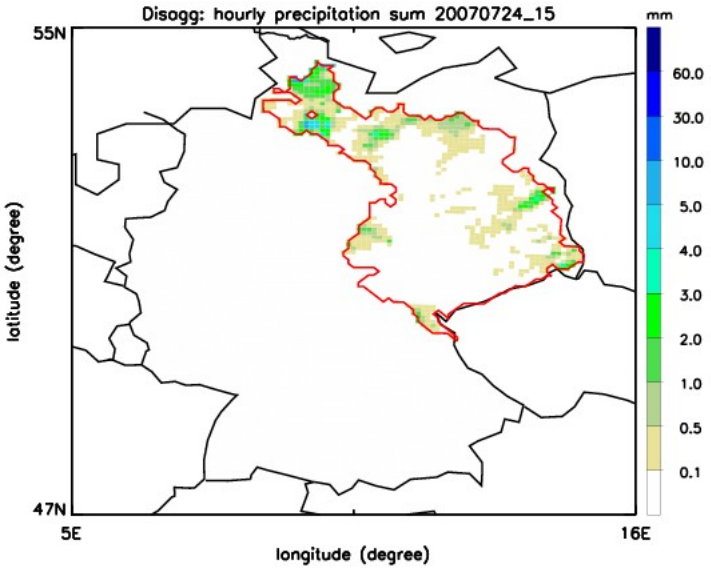


15 UTC

observation15 UTC

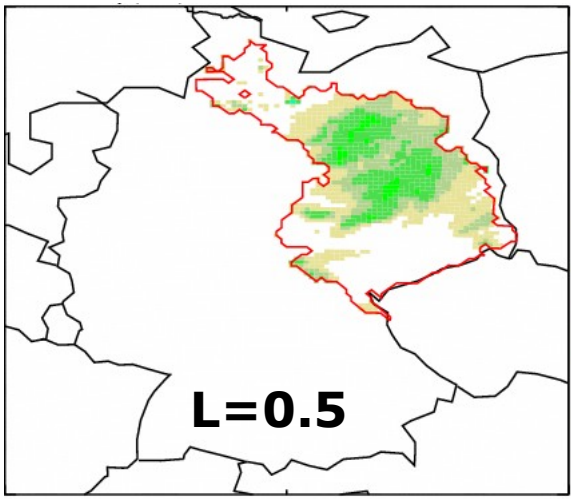


Example for time shift determination

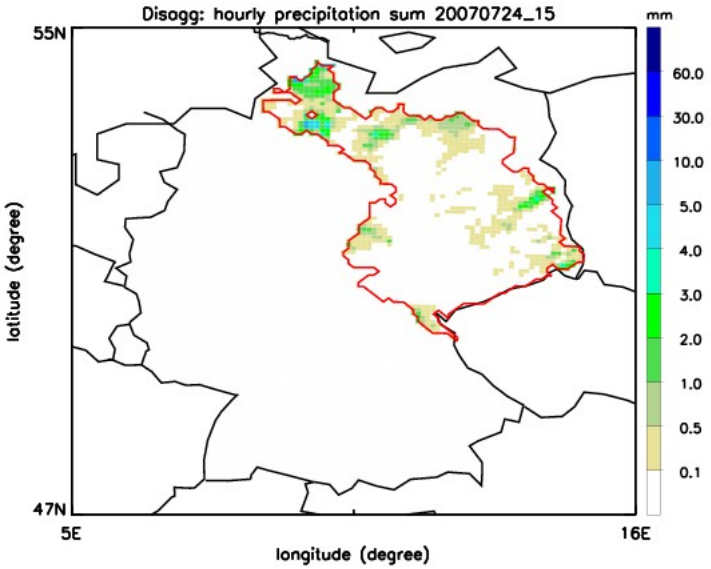
14 UTC

15 UTC

16 UTC



observation15 UTC



Example for time shift determination

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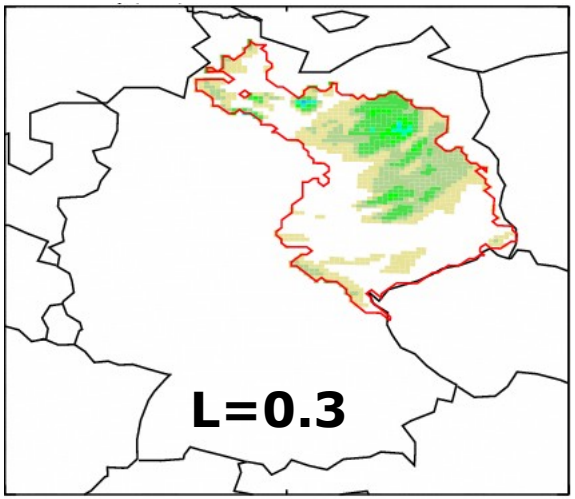
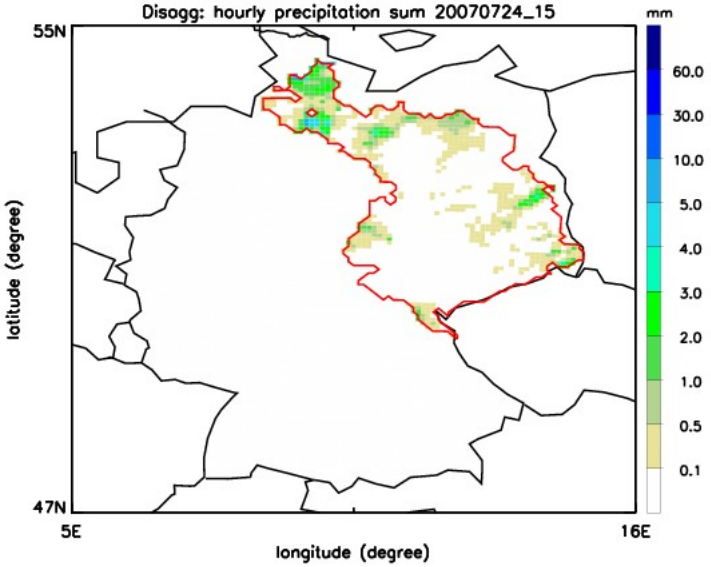
17 UTC



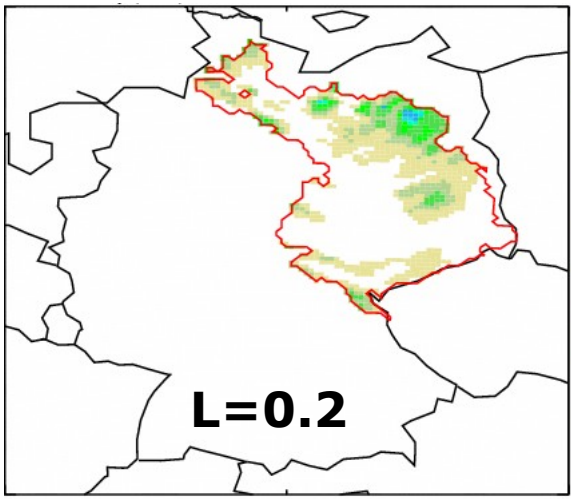
observation15 UTC



Example for time shift determination

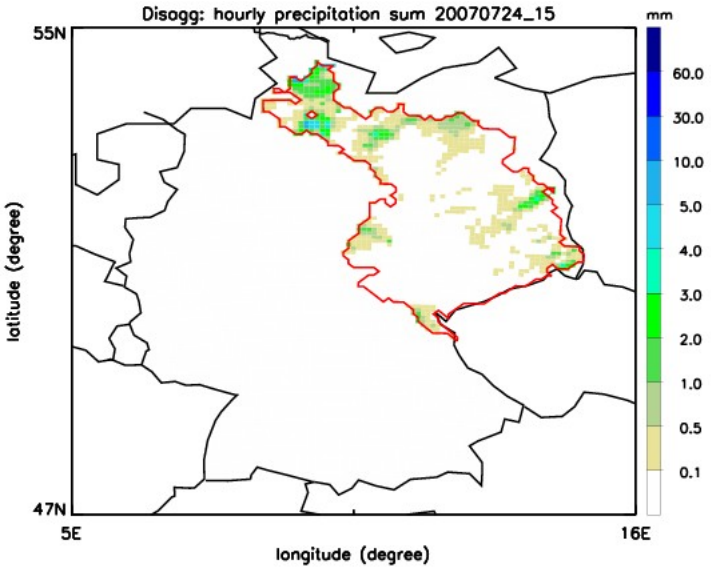
16 UTC

17 UTC



18 UTC

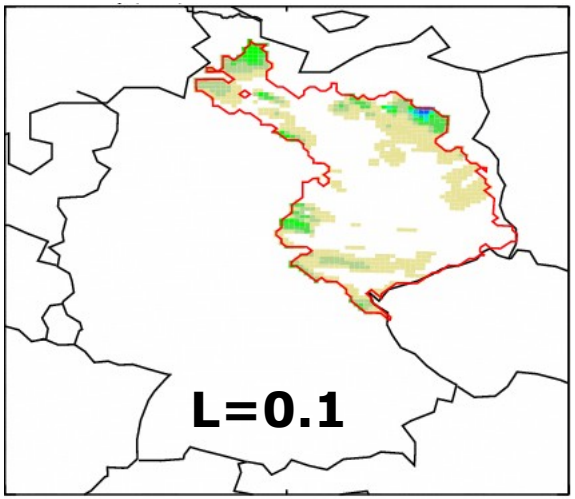
observation15 UTC



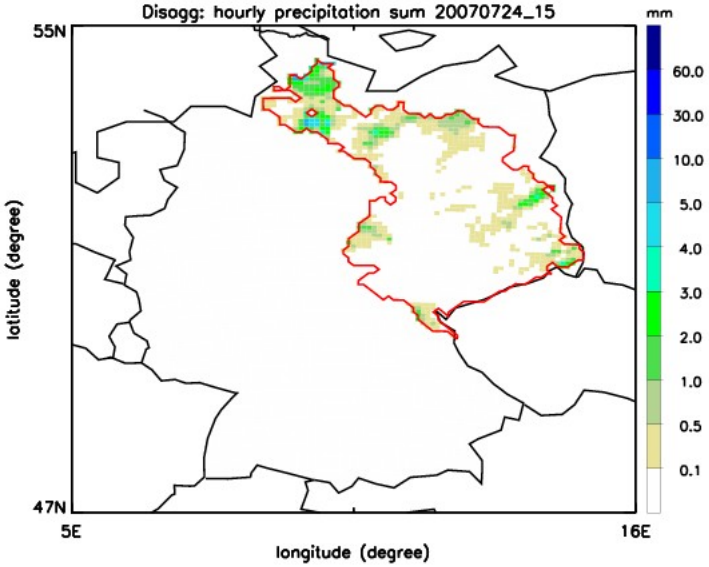
Example for time shift determination

17 UTC

18 UTC



observation15 UTC

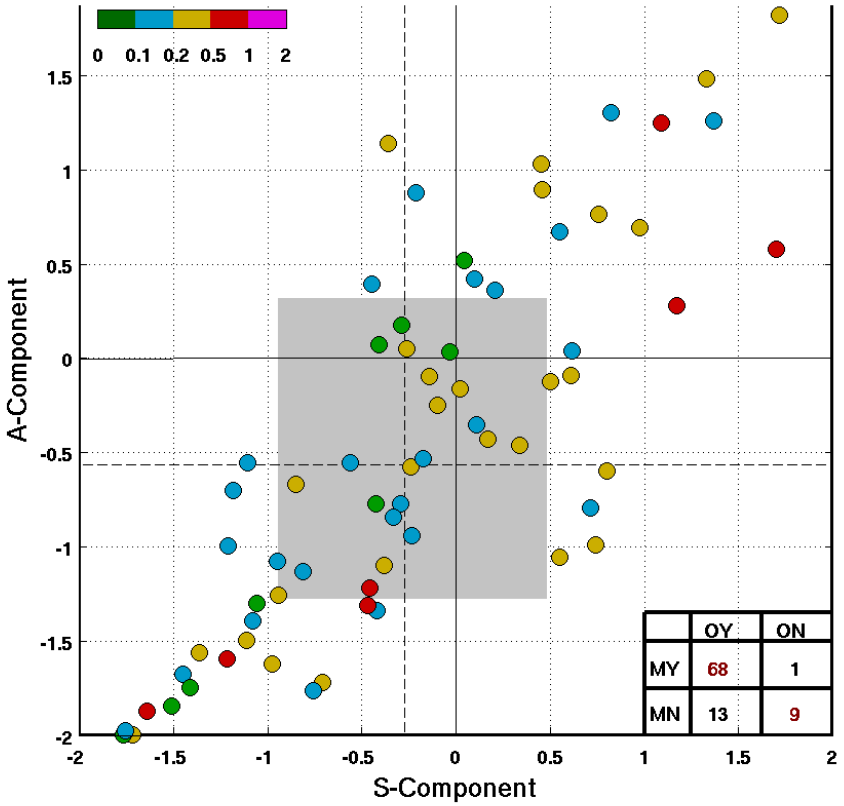


ΔT=3h best

L(ΔT=0h) = 0.5
L(ΔT=3h) = 0.1

SAL diagram

without time shift

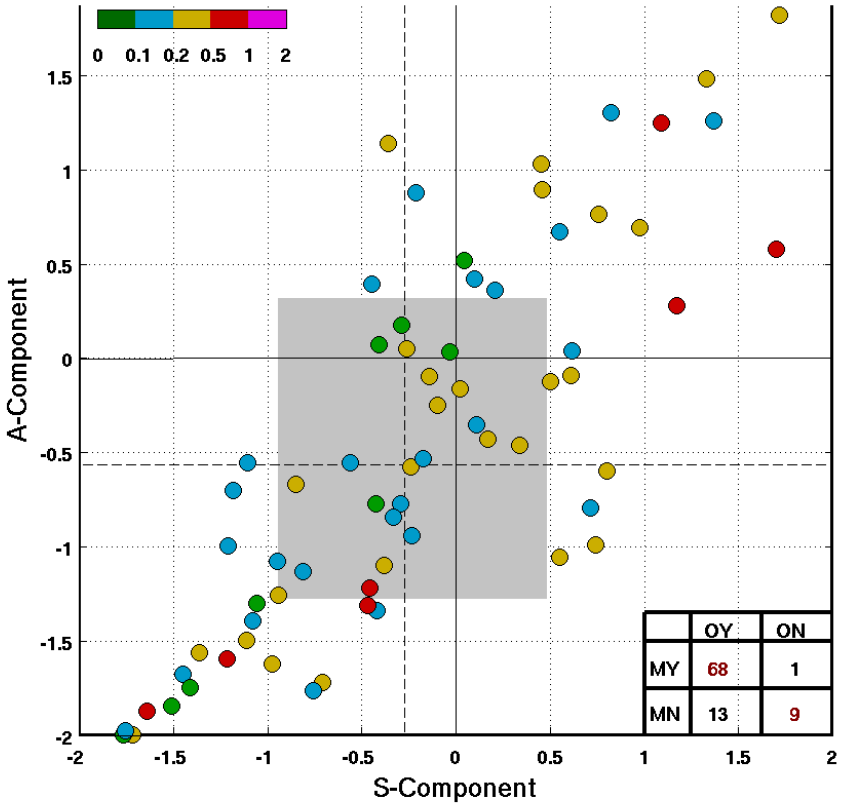


median of L: 0.21

- COSMO-DE forecasts
- 00-UTC runs
- hourly accumulations
- June-August 2007
- Elbe river catchment
- observation time: 15 UTC

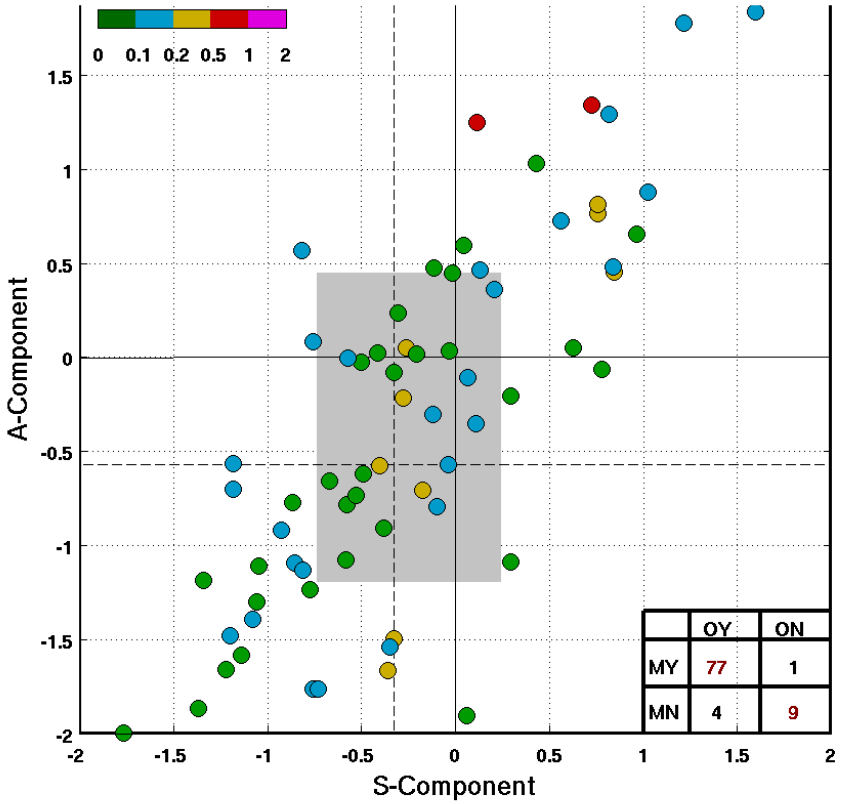
SAL diagram

without time shift



median of L: 0.21

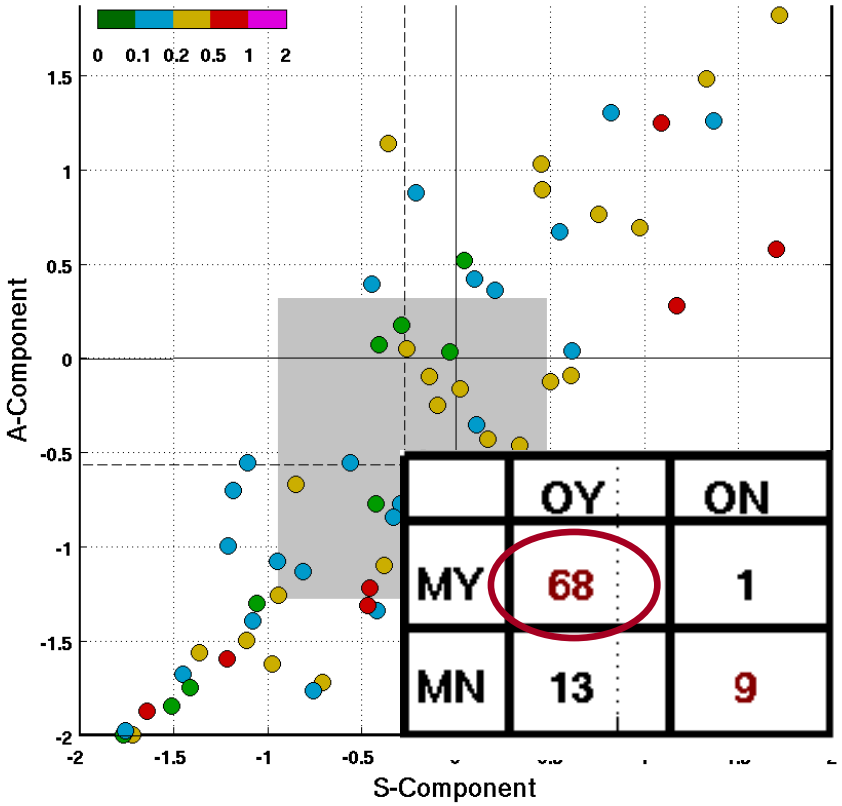
with time shift



median of L: 0.12

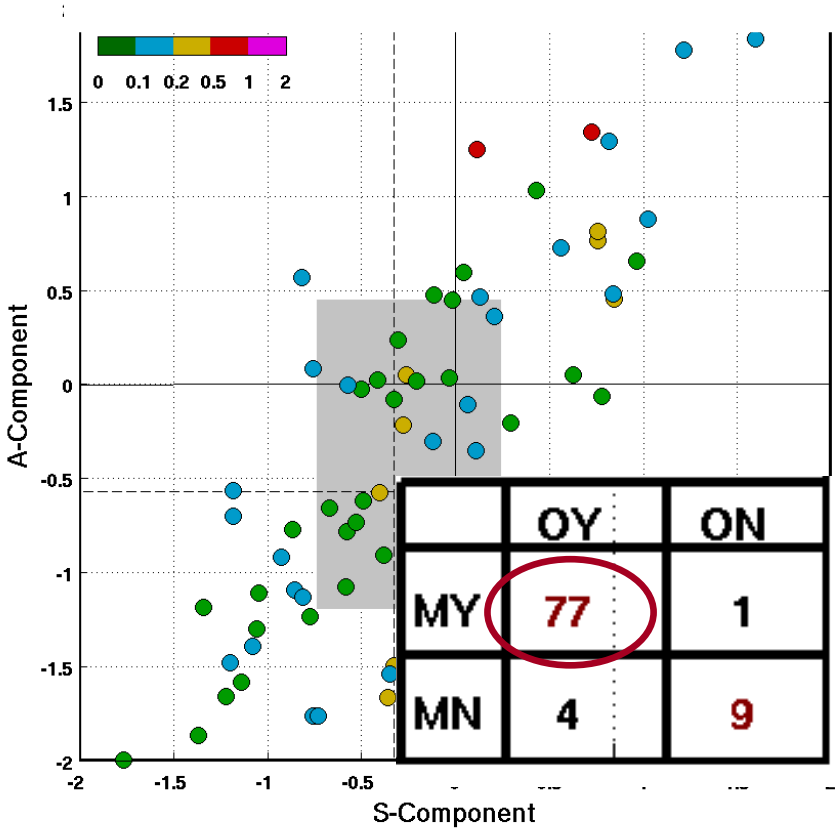
SAL diagram

without time shift



median of L: 0.21

with time shift

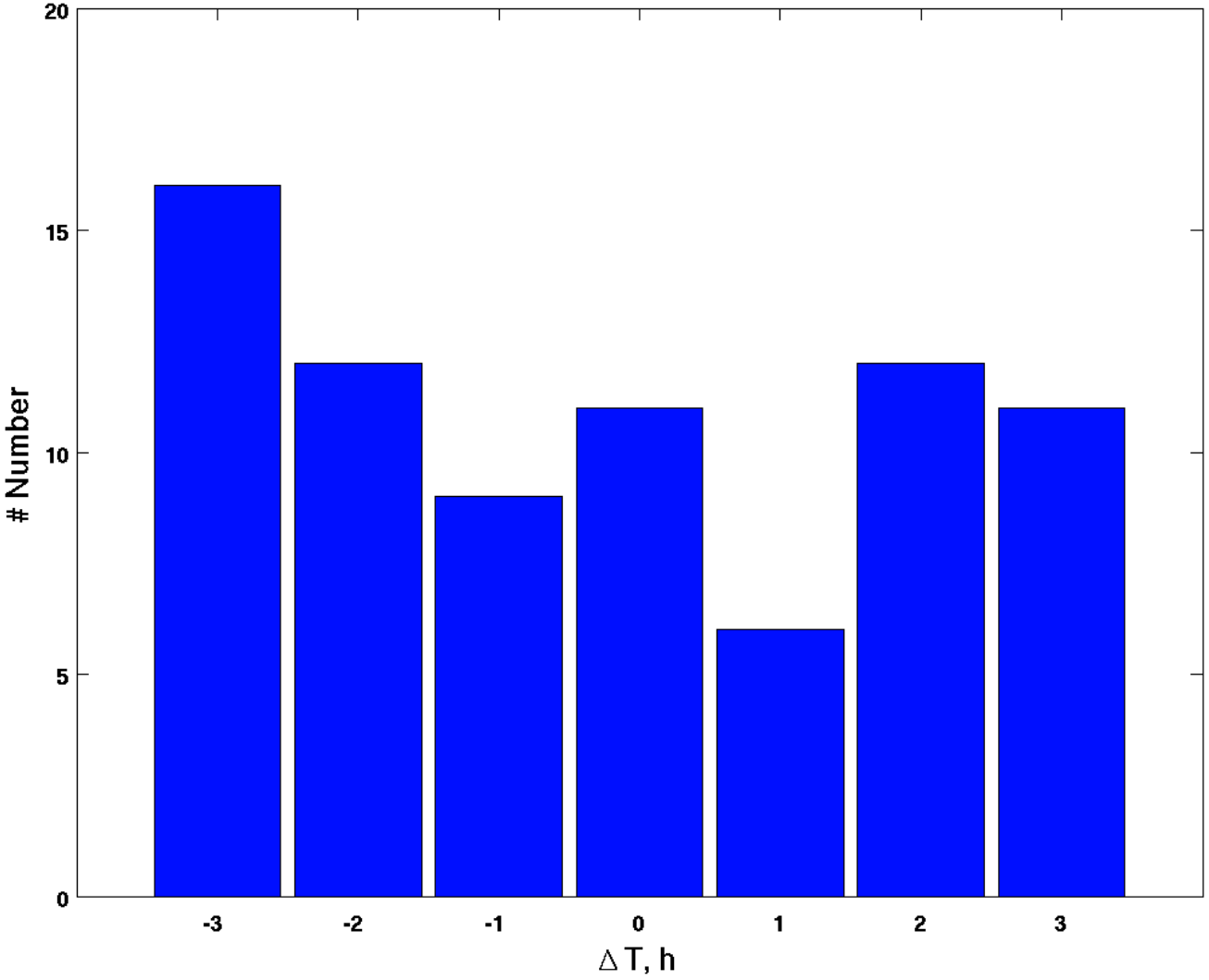


median of L: 0.12

+9 events

Time Shift

histogram of time shift (77 days)



Summary & Conclusions

Development of a timing error determination with SAL:

- fuzzy representation of timing of precipitation
- optimization of the location component
- example for summer 2007

First evaluations of the time shift determination show:

- feasibility of the fuzzy approach
- more situations can be verified with SAL (ca. 10 %)
- optimum time shift
  → potential to capture the structure of QPFs
  as indicated by a lower inter-quartile range of S

Outlook

- determination of the time shift with the use of additional information
- consideration of the non-precipitation events for the time shift determination
- different daytime and/or leadtime
- weather-type based investigation

Thank you very much for your attention!!!

interested in using SAL?
mail to: zimmerm@uni-mainz.de

S A L – Definition of the components

$$A = (D(R_{mod}) - D(R_{obs})) / 0.5*(D(R_{mod}) + D(R_{obs}))$$

D(…) denotes the area-mean value (e.g. catchment)
normalized amplitude error in considered area
$A \in [-2, \ldots, 0, \ldots, +2]$

$$L = |r(R_{mod}) - r(R_{obs})| / dist_{max}$$ + measure of distance of objects to r(…)

r(…) denotes the centre of mass of the precipitation field in the area
normalized location error in considered area
$L \in [0, \ldots, 2]$

$$S = (V(R_{mod}*) - V(R_{obs}*)) / 0.5*(V(R_{mod}*) + V(R_{obs}*))$$

V(…) denotes the weighted volume average of all scaled precipitation objects in considered area
normalized structure error in considered area
$S \in [-2, \ldots, 0, \ldots, +2]$