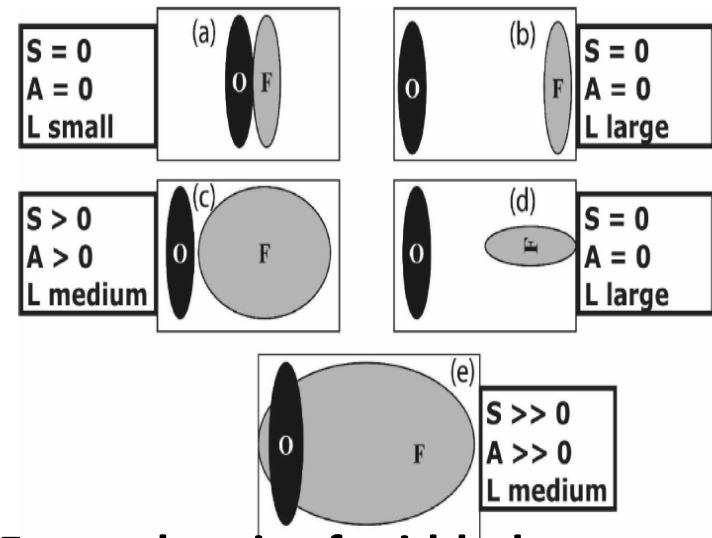




# SAL: Feature based verification measure



**SAL Method (Wernli et al. 2008, 2009)** For each pair of gridded observations/forecast field 3 indexes are calculated.

**S: Structure Component** (Compares Total Volume of Normalized Objects of obs/fcst . Captures size and shape of objects) (Values from -2 to 2)  $S=0$  perfect,  $S \gg 0$  forecast predicts more widespread pcp ,  $S \ll 0$  forecast predicts more peaked objects

**A: Amplitude Component** (Normalized difference of domain-averaged values of forecast and obs field) (Values from -2 to 2)  $A=0$  perfect,  $A \gg 0$  forecast overpredicts pcp  $A \ll 0$  forecast underpredicts

**L: Location Component** ( Consists of  $L1+L2$ ) (L Values from 0 to 2) (0 perfect)

**L1** : normalized distance between centers of mass of the obs/fcst fields (not sensitive to rotation around center of mass)

**L2**: difference of normalized distance between center of mass and individual objects over observed and forecast field.

## Methods of SAL Computation :

### 1) **Wernli et al. (2008, 2009) Fortran code** (provided by M. Sprenger).

Identifications of objects is performed by threshold : an object is identified when a grid point exceeds threshold R:

$$R = \text{factor} * R95$$

where R95 is the 95<sup>th</sup> percentile of values  $\geq 0.1$  (exclude extreme values) and factor is set to 1/15.

❖ Thresholds are different for observations and forecast.

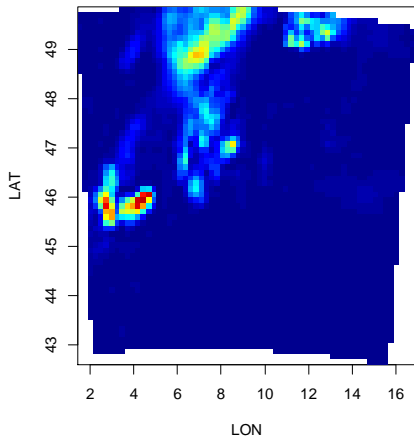
### 2) **SpatialVx** :Identification of objects by Function FeatureFinder with constant or statistically specified threshold, possibility of smoothing, and application of saller function to calculate SAL components.

Cases for this study have been obtained from the MesoVICT project (ASCII files downoladed from the site). Forecasts derived from COSMO-2 and CMH Model are compared with VERA observations.

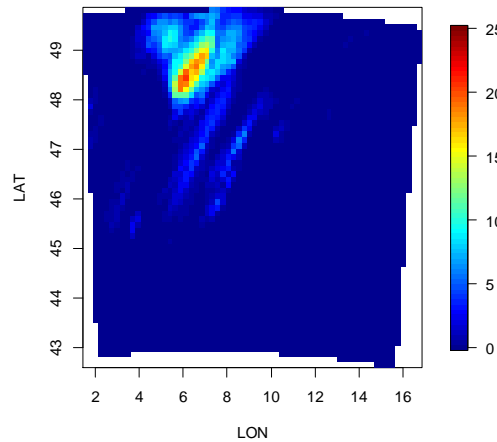
**An Example from CASE 2 of MESOVICT: 19/7/2007 12h 06-18h pcp from COSMO2 and CMH where models give different results (Wernli et al. code)**

Model	S	A	L
COSMO2	-0.12	-0.55	0.25
CMH	0.22	0.48	0.20

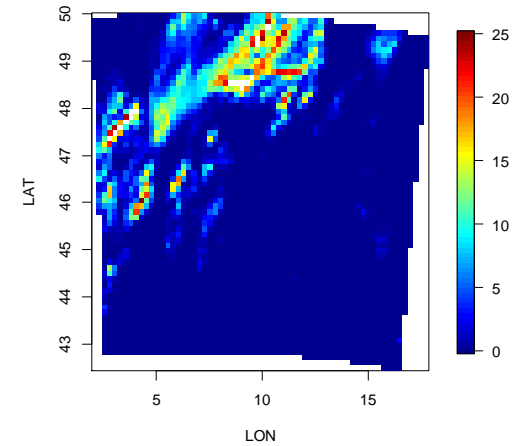
In this case , CMH slightly overpredicts domain values ( $A > 0$ ) while COSMO2 underpredicts. COSMO2 S negative values indicate slightly small or localized objects. Similar L for the 2 models.



Observations



COSMO2



CMH

# How to calculate SAL with SpatialVx

## ❖ Wernli et al. method on SpatialVx (SALLER)

```
thr1=quantile (obs_ge_01, probs=0.95) find the 0.95 quantile of the obs values  
thr2=quantile (mod_ge_01, probs=0.95)
```

```
hold <- make.SpatialVx (obs_matrix, mod_matrix, loc=lon_lat, projection=TRUE ,map=TRUE,  
field.type="precipitation", units="mm/h", data.name=c("title", "obs", "model"))  
look2 <- FeatureFinder (hold, thresh=c(thr1,thr2), do.smooth=FALSE, fac=1/15)
```

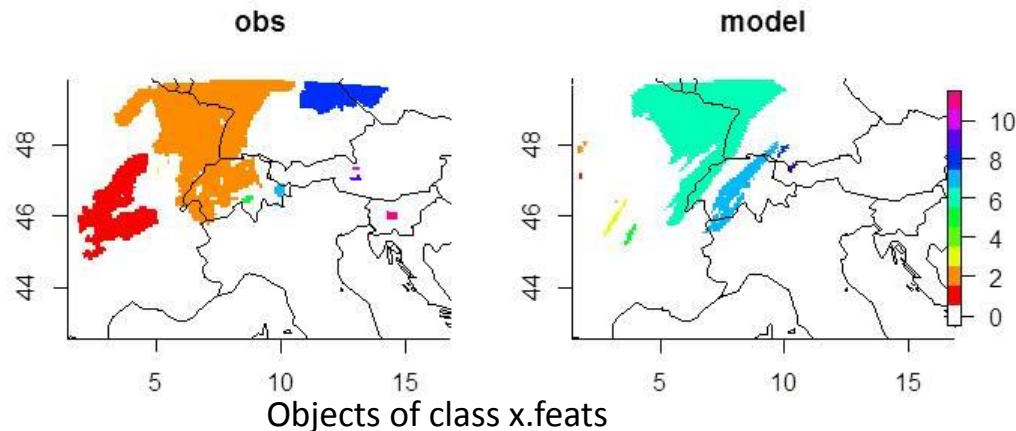
**No matching of features is required**

```
plot (look2)
```

```
Sal<-saller (look2)
```

```
Sal$L1
```

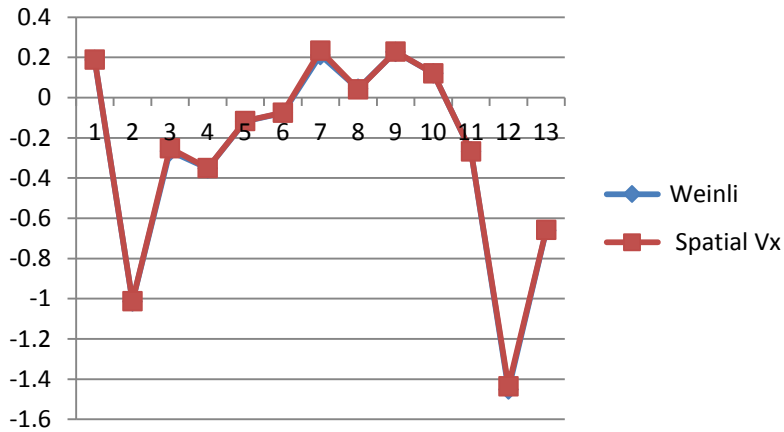
```
Sal$L2
```



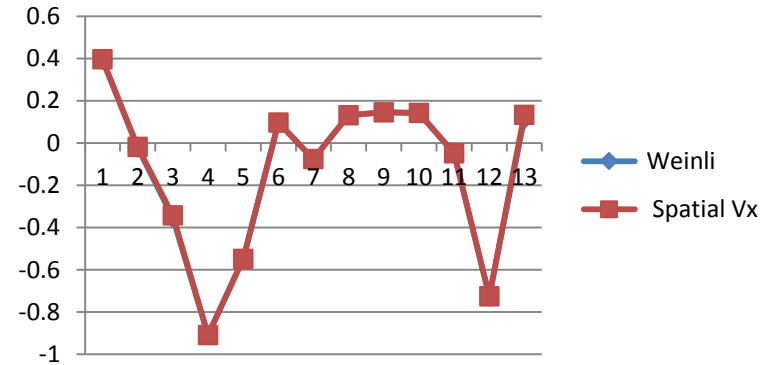
COSMO2 19/7	S	A	L
Wernli code	-0.12	-0.54	0.24
SpatialVx	-0.10	-0.55	0.19

# S, A, L Comparison 2 methods

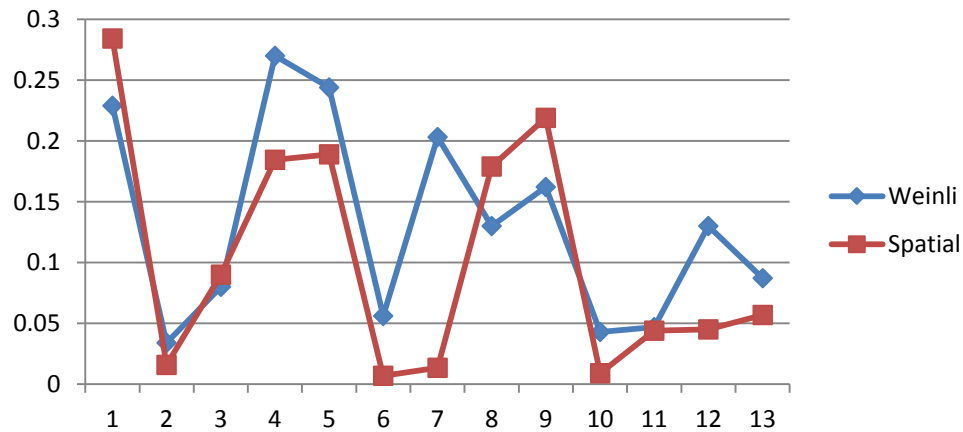
## S Comparison



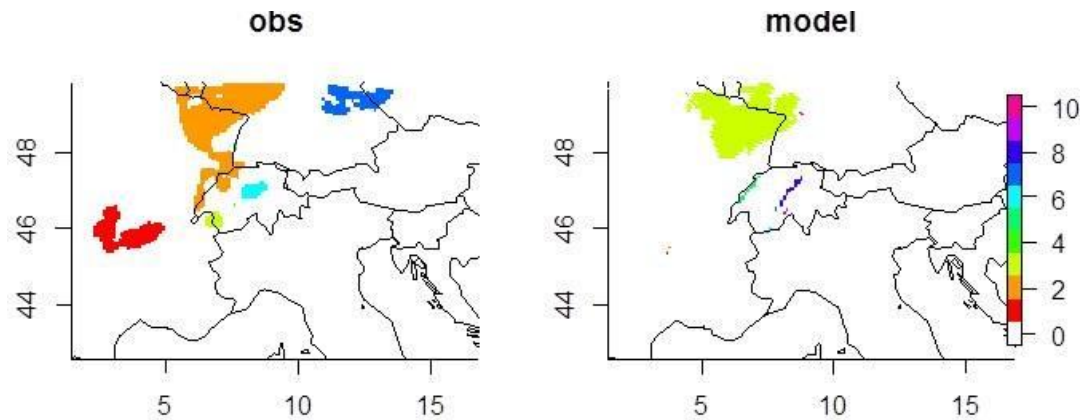
## A Comparison



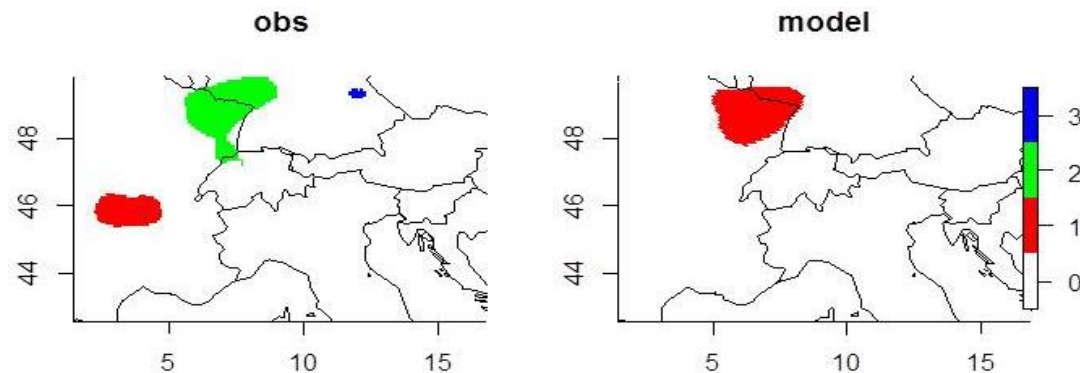
## L Comparison



- Locate higher pcp events look2 <- FeatureFinder (hold, thresh=5, do.smooth=FALSE)



- Smooth fields look2 <- FeatureFinder (hold, thresh=5, smoothpar=8)



COSMO2 19/7	S	A	L	L1	L2
P 0.95	-0.10	-0.55	0.20	0.002	0.19
Thresh=5	-0.18	-0.54	0.30	0.005	0.29
smooth	-0.04	-0.54	0.36	0.007	0.35

## SAL PLOTS:

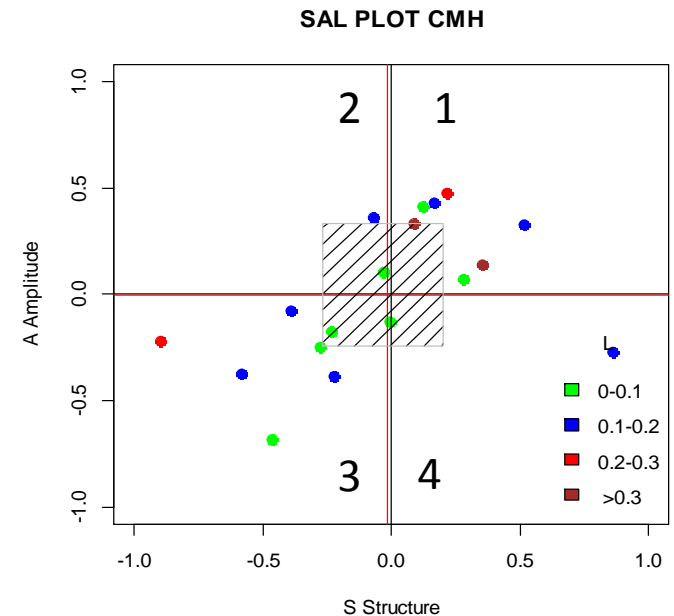
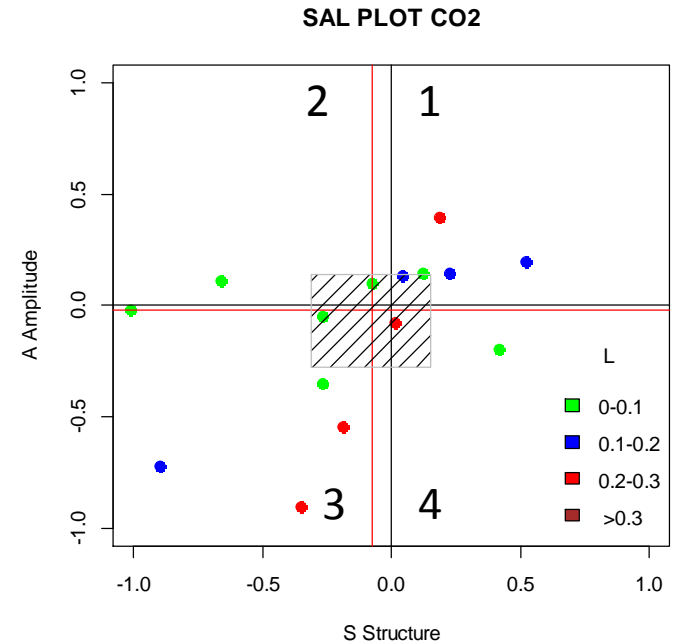
- 12h pcp 06-18h from 5 MESOVICT cases calculated by Wernli et al. code for COSMO2 and CMH.

- The x-axis is S, y-axis A, and the point colors depend on L.

- Red lines represent median values of S and A. Grey area represents the 25%-75% percentiles.

- The figures show that median values are close to zero and COSMO2 S values have a negative tendency (predicts too peaked objects). CMH values show more spread.

- Points are in area 1 produce too much rain with too large or too flat objects. In area 3 rain is underestimated and objects are too peaked.



## SAL PLOTS for EPS :

- SAL method can be applied in order to estimate the performance of an ensemble forecast(Barrett et al. 2015).
- Each point of the SAL plot represents one member, and an ensemble performance is estimated.
- R program using Spatial Vx has been developed which reads and adjusts the appropriate LEPS MESOVICT COSMO2 and observation files with 3h acc. precipitation, calculates SAL parameters and creates SAL diagrams
- An example case shown here used data for COSMO2 LEPS 16 members of the run 20/06 12 UTC:

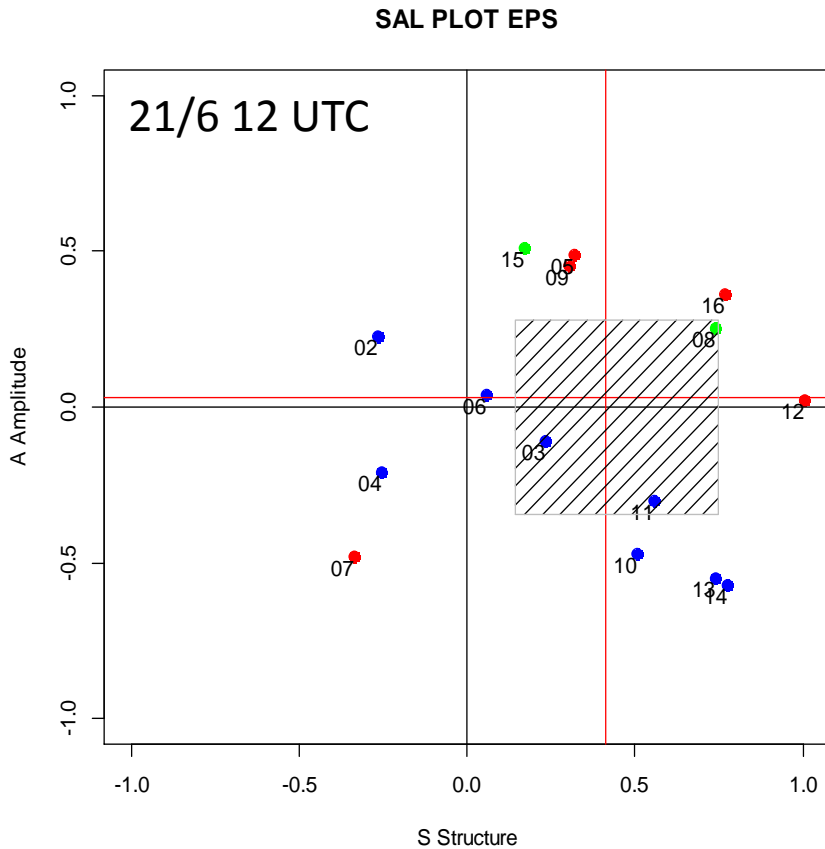
Results for

21/06 12 UTC (24h of simulation)

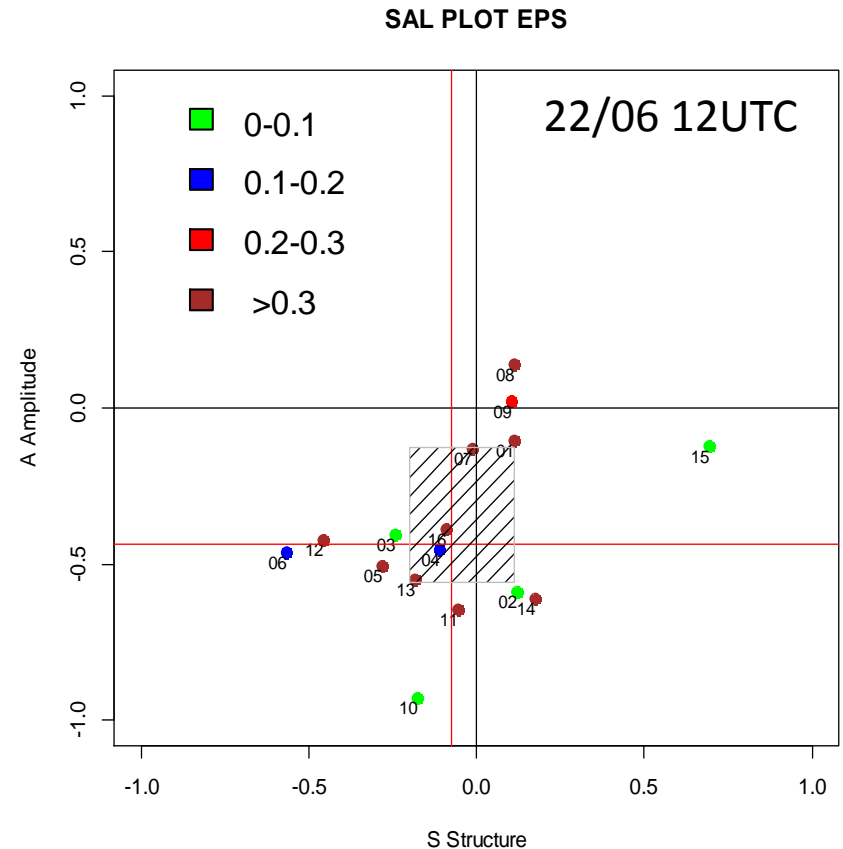
22/06 12UTC (48h of simulation)



# SAL plots for LEPS



$S > 0$  too large or too flat objects are produced.



$A < 0$  underestimation, More red points

## **To verify the quality of a model prediction with SAL :**

- Domain should not be very large and include different pcp conditions (convective and stratiform) that may counterbalance SAL components.
- Many cases are needed to conclude about model performance
- Application of SAL for more EPS datasets for INSPECT

**Thank you for your attention !!**