CRA method application for MesoVICT cases

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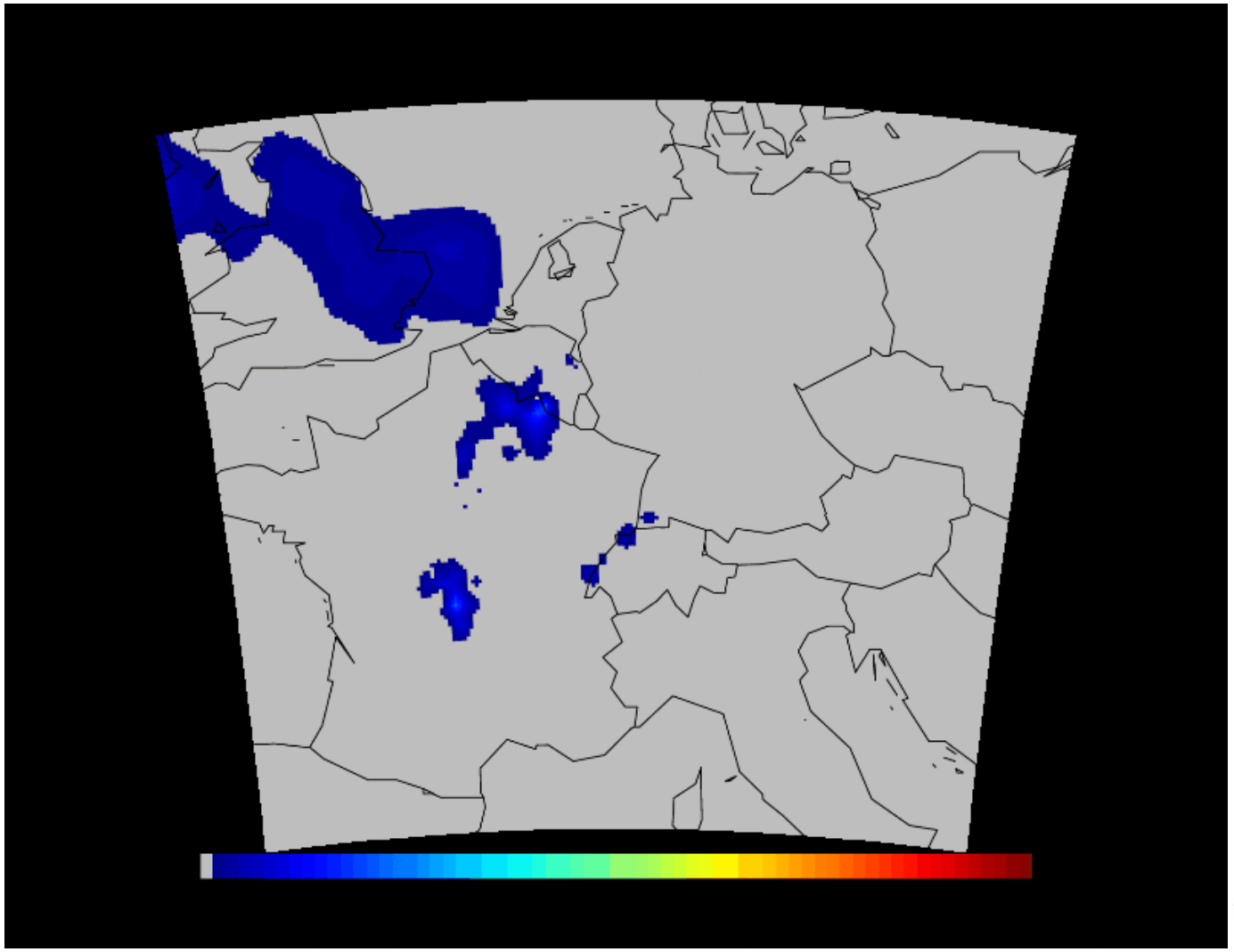
Setup of experiments

- Mesovict core case: 20-22 June 2007
- 1-h precipitation accumulations
- Obs: Vienna Enhanced Resolution Analysis (VERA)
- Frc: COSMO-2, 00 run

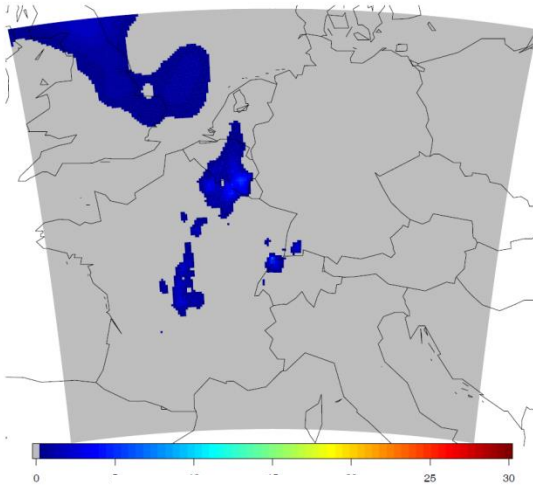
MesoVICT case 1 (core case): 20-22 June 2007

Strong convective developments north of the Alps followed by a cold front the next day. Cold air mass could not spill over the Alps

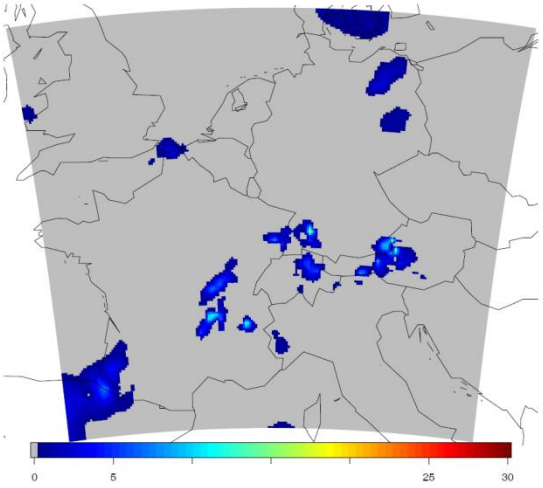


Case 1 VERA 1h precipitation fields development

2007062001



2007062020



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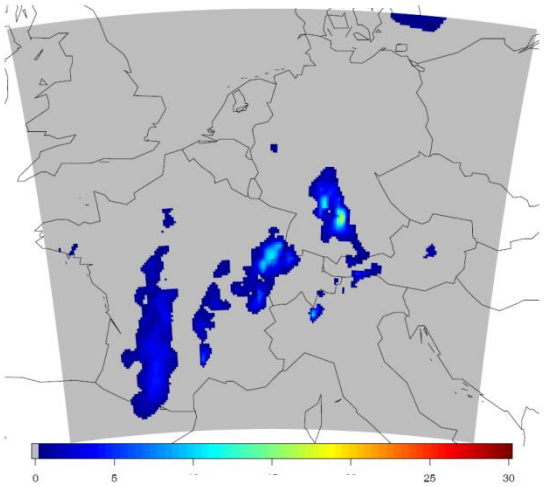
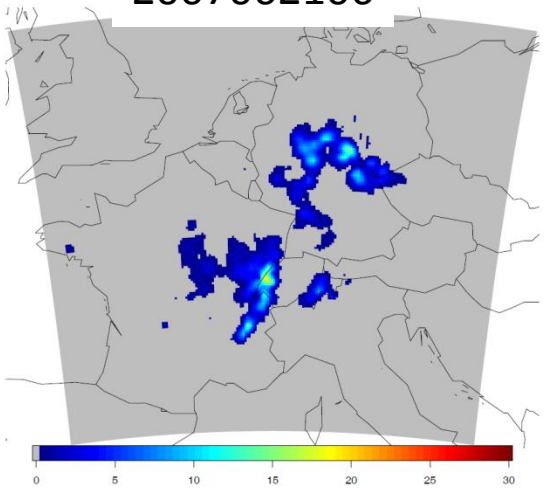
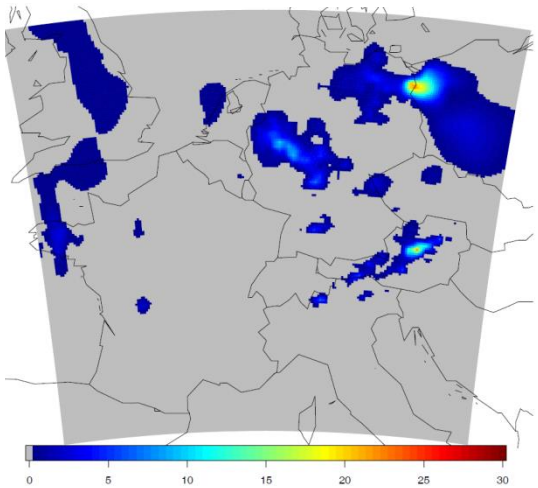


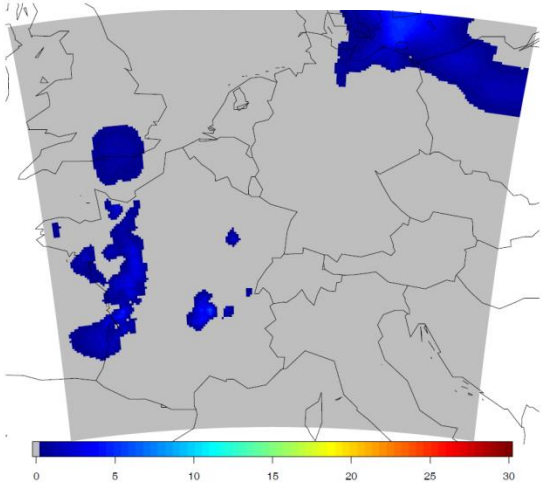
2007062106



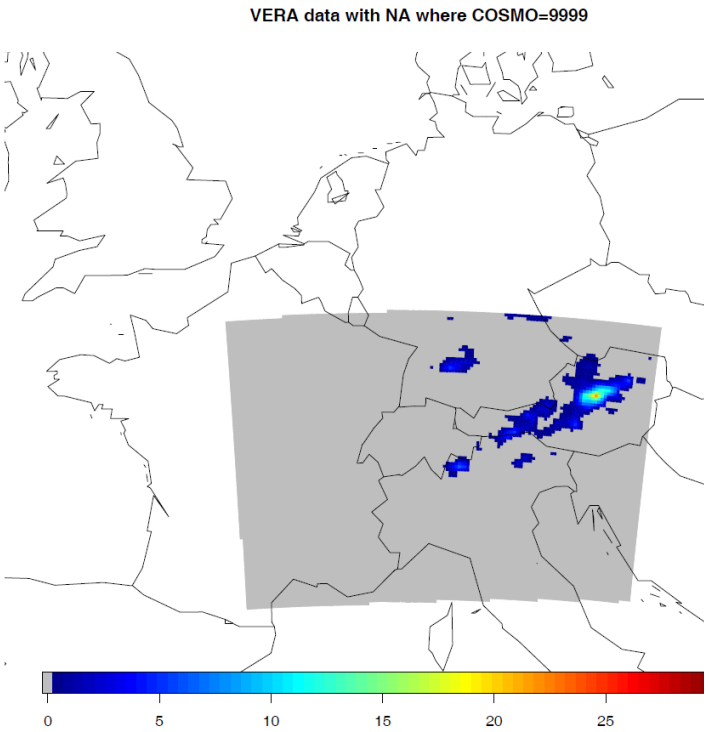
2007062115

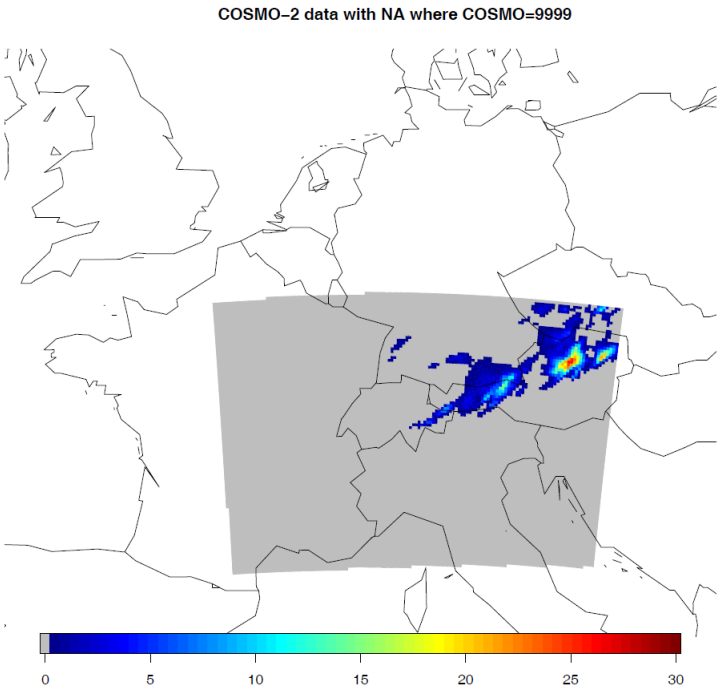


2007062202



2007062115, VERA and COSMO-2 precip





Overall, COSMO-2 tends to overestimate maximum precipitation values

Identification of objects in R SpatialVx

- **Function: *FeatureFinder*:**

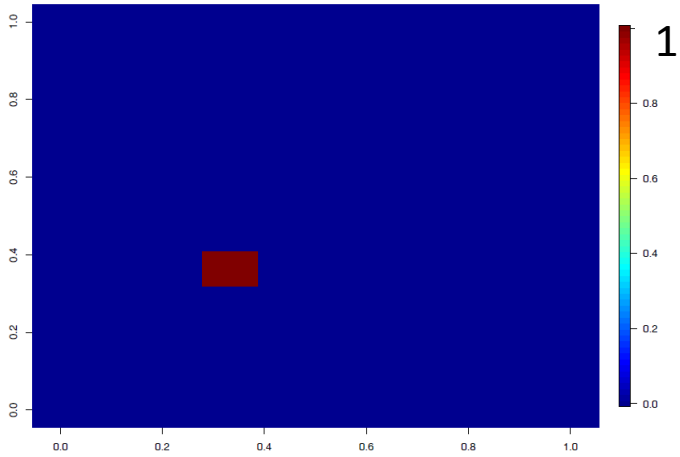
  First, the field is smoothed using a convolution smoother, and then it is set to a binary image where everything above a given threshold (**0.5 mm/h in our case**) is set to one (Davis et al, 2006)

  Feautres are identified by groups of contiguous “events” (or connected components in the computer vision/image analysis literature).

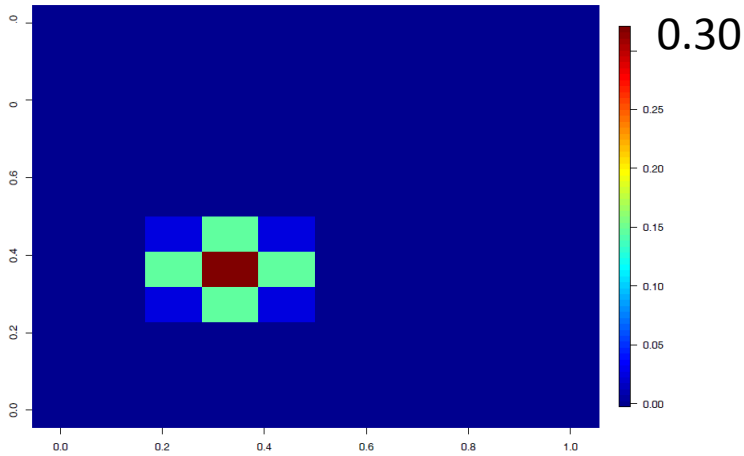
  Option *min.size*: eliminates small features

Disc kernel convolution smoother using the R package “smoothie”

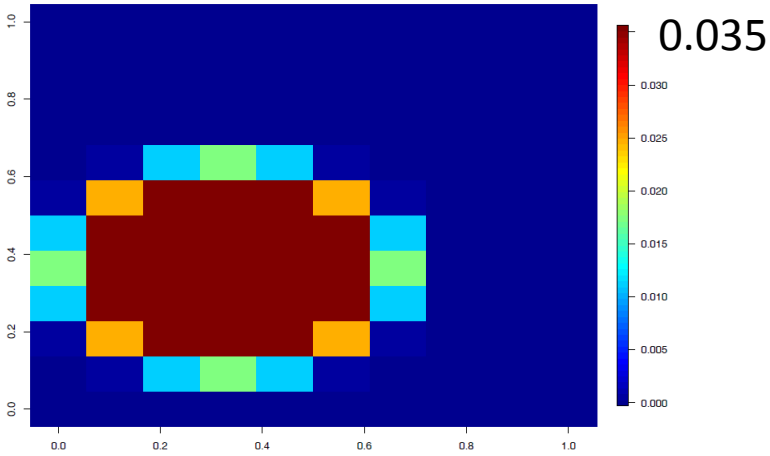
Smooth.par=0.5, No smoothing



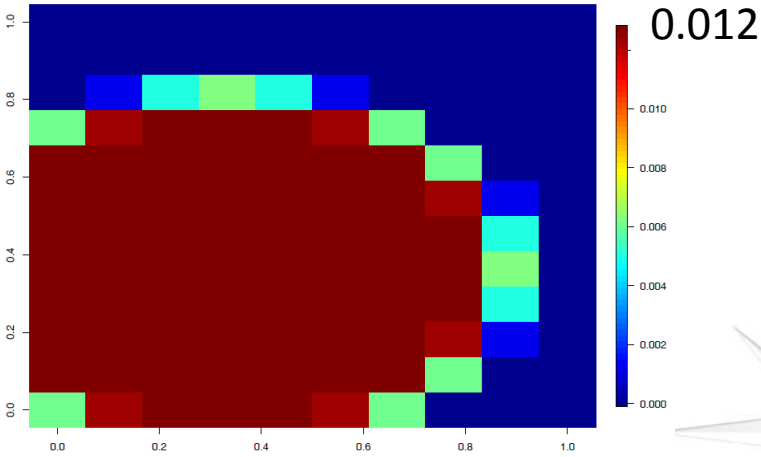
Smooth.par=1



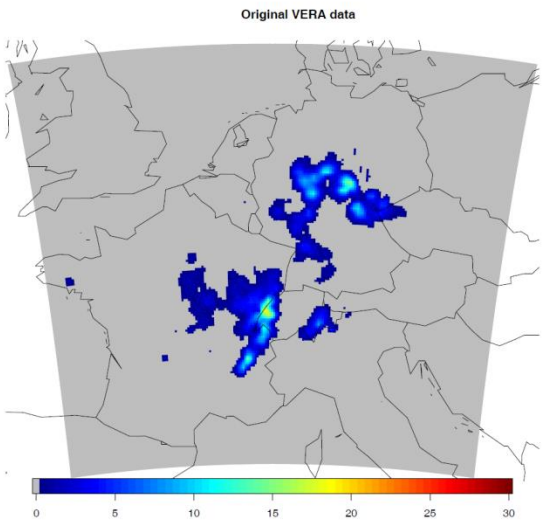
Smooth.par=3

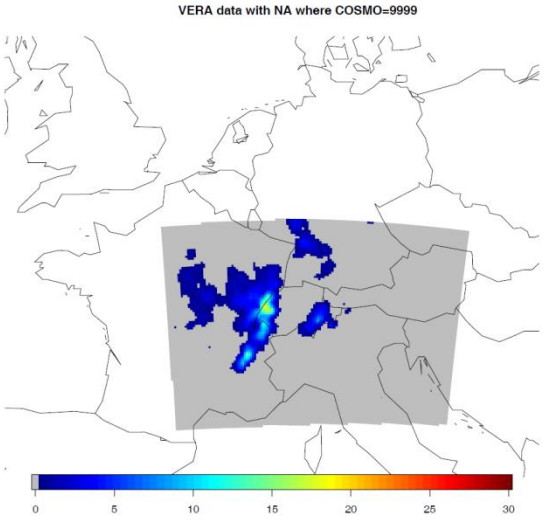


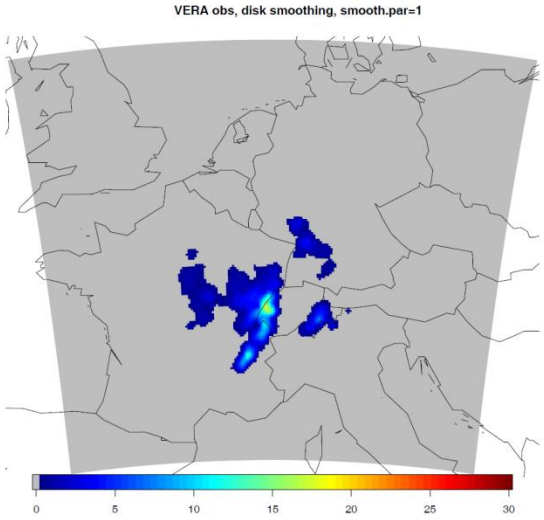
Smooth.par=5

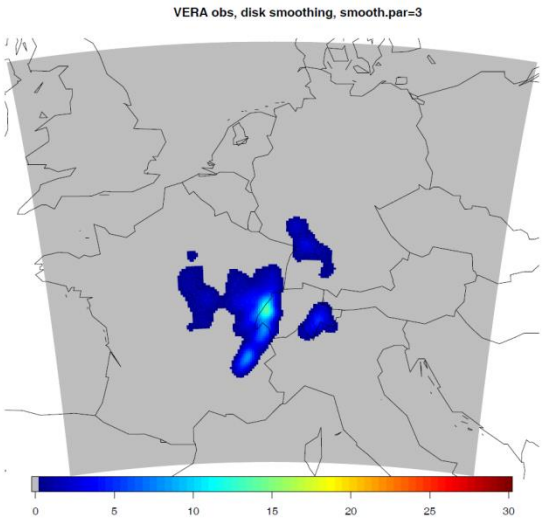


Smoothing of the VERA obs field, 2007062106



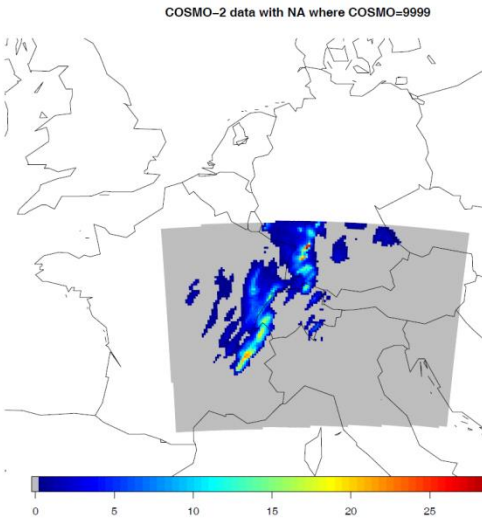


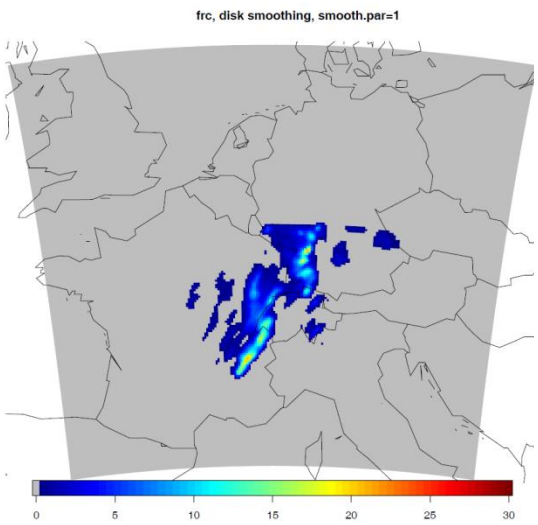


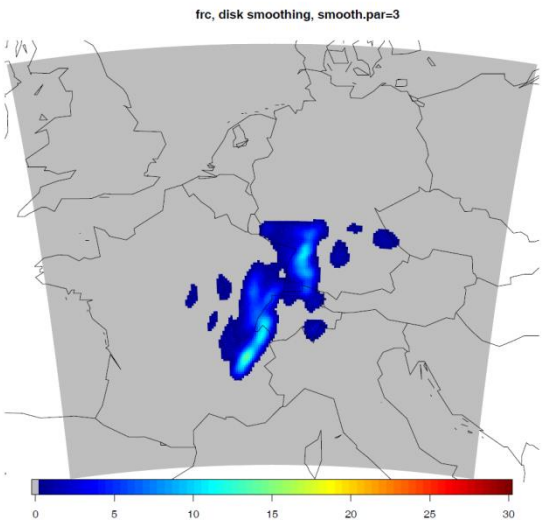


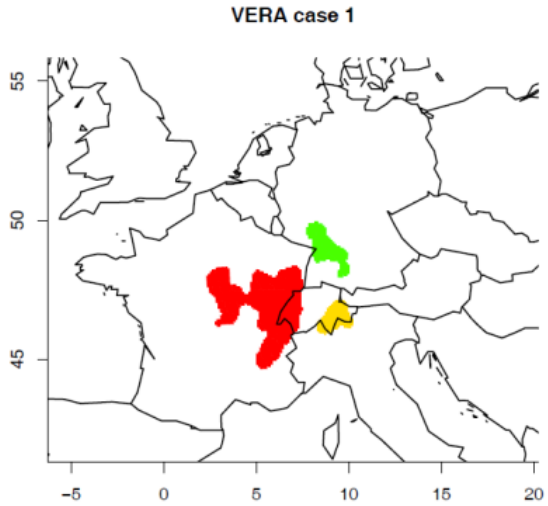
The more smoothing parameter, the less precip maximum. Total precipitation volume is the same, but spread over in space

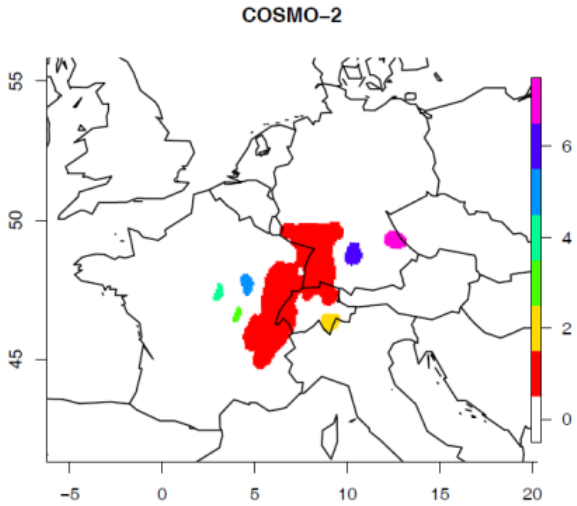
Smoothing of the COSMO-2 field, 2007062106











Features, smoot.par=3,
Min.size=20 grid points
(~36*36 km)
precip threshold=0.5 mm/h

Do we need smoothing for more intense precipitation?
Probably, not.

Functions for matching objects in R SptialVx

- ***Minboundmatch*** (in single matches mode): each object is paired to only one object according to the smallest minimum boundary separation
- ***Deltamm*** – merges and/or matches using Baddeley's Delta Image Metric (Gilleland 2008), which yields a type of average pixel distance between sets (objects) *A* and *B*
- ***Centmatch*** is similar to *deltamm*. It is based on the method proposed by Davis et al. (2006a). It is possible for more than one object to be matched to the same object in another field.

  Objects are matched, if the centroid distance D is less than

  1) the sum of the sizes of the two objects in question (size is the square root of the area of the object) (D=1)

  2) the average size of the two objects in question (D=2)

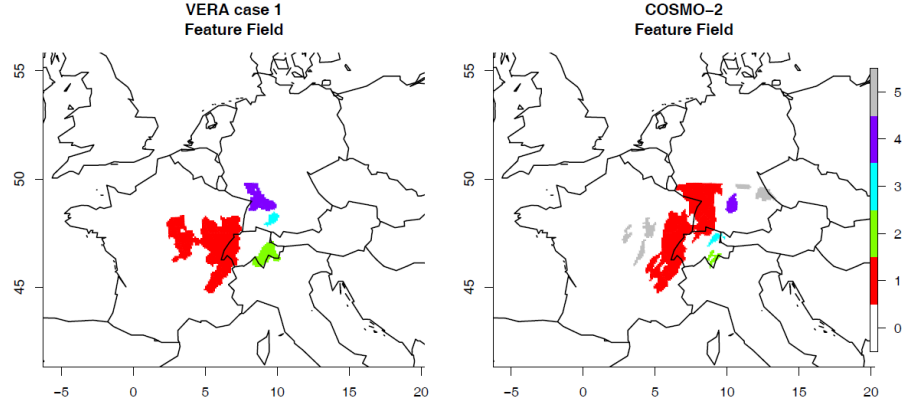
  3) a given constant (D=3)

  D=1 and D=2 were used.

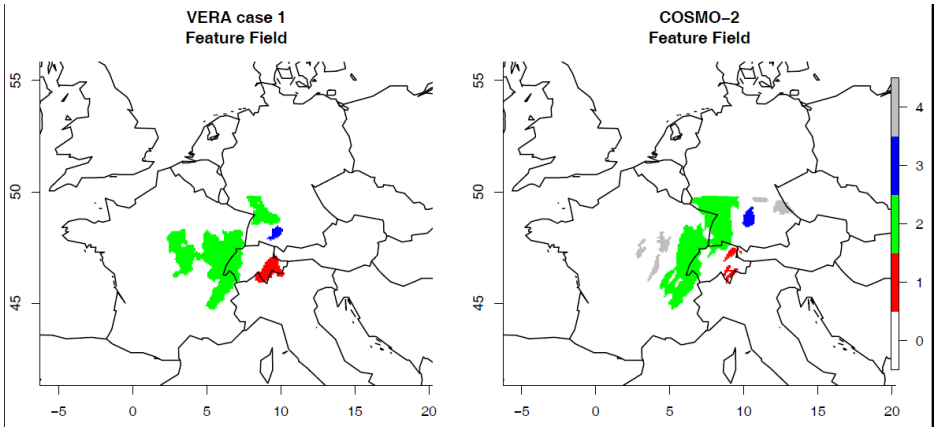
  Centmatch doesn't merge objects explicitly, but determines possible merges applied if ***MergeForce*** function is run after *centmatch* (**used in this case**)

Object matching, 2007062106

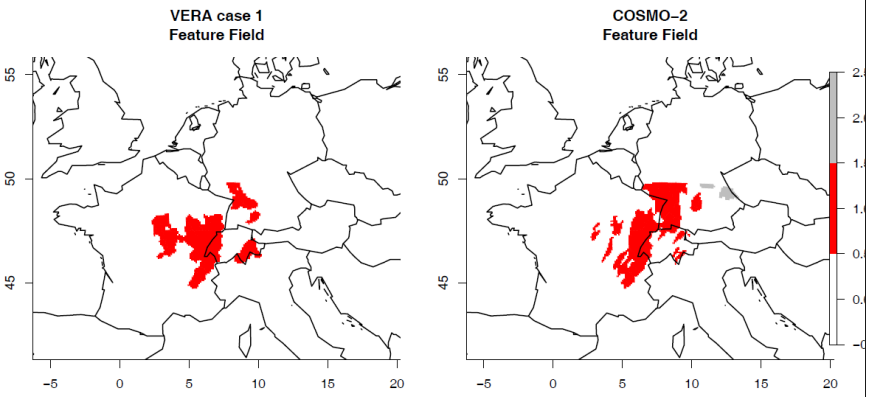
Minboundmatch



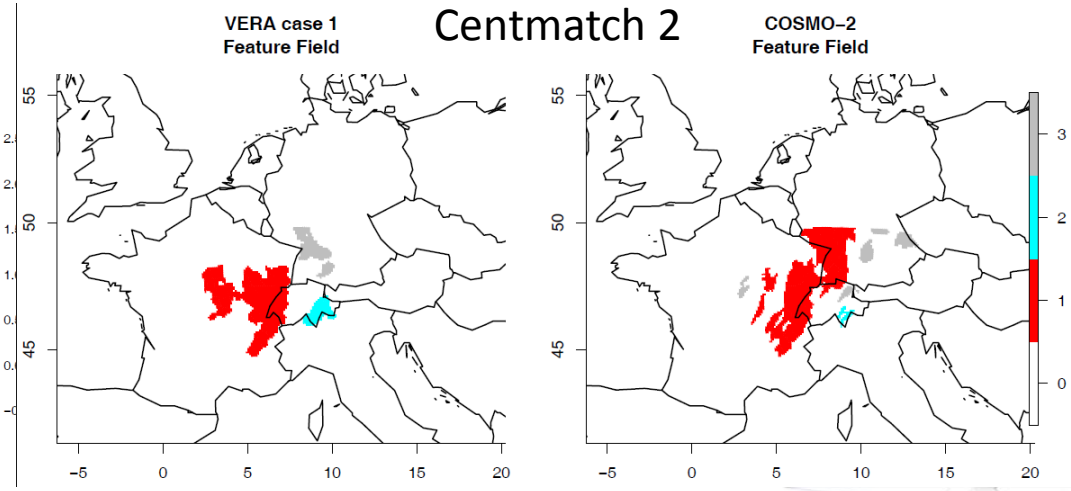
Deltamm



Centmatch 1



Centmatch 2



CRA – Contiguous Rain Area (E.E. Ebert, J.L. McBride 2000)

http://www.cawcr.gov.au/projects/verification/CRA/CRA_verification.html

MSEtotal = MSEdisplacement + MSEvolume + MSEpattern

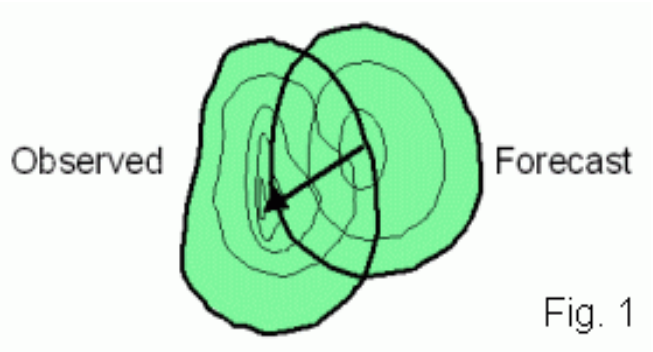


Fig. 1

MSEdisplacement = MSEtotal – MSEshifted

MSEvolume = (***F*** - ***X***)2

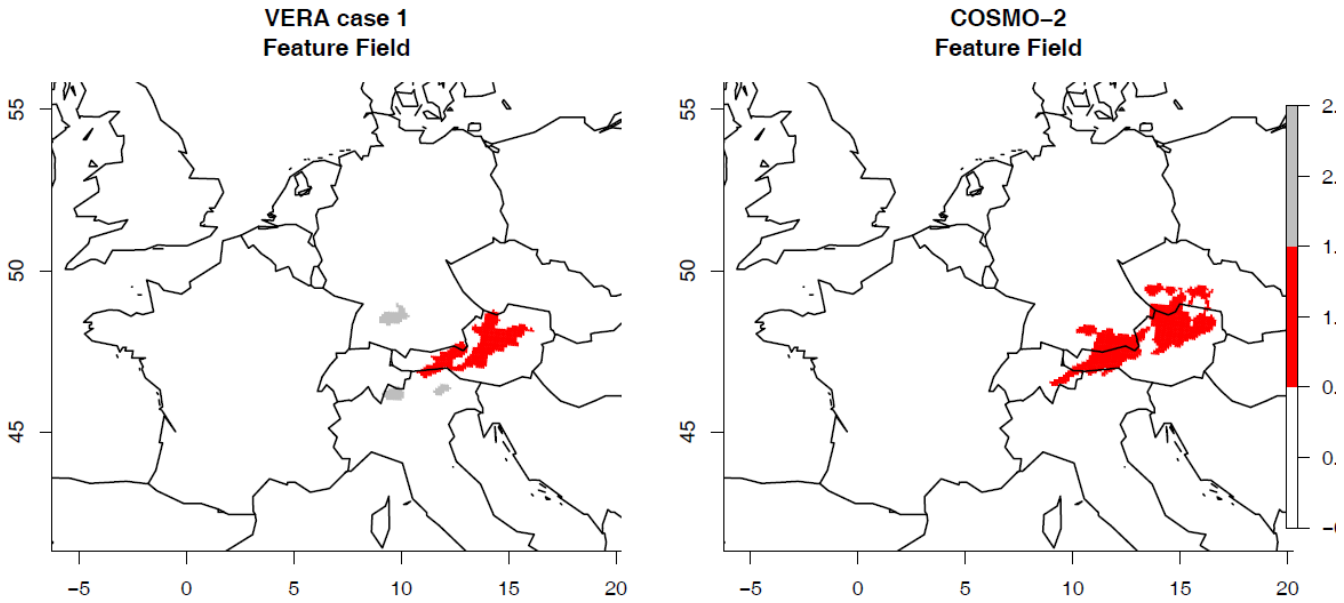
where ***F*** and ***X*** are the CRA mean forecast and observed values after the shift.

MSEpattern = MSEshifted – MSEvolume

The CRA concept is easy to understand, but there are many important issues and nuances in application of the CRA

CRA scores, 2007062115, intense precipitation

Centmatch 2



ir	MSE.total	MSE.shift	MSE.displace	MSE.volume	MSE.pattern
1	0.0193	0.0165	0.0028	0.0002	0.0163

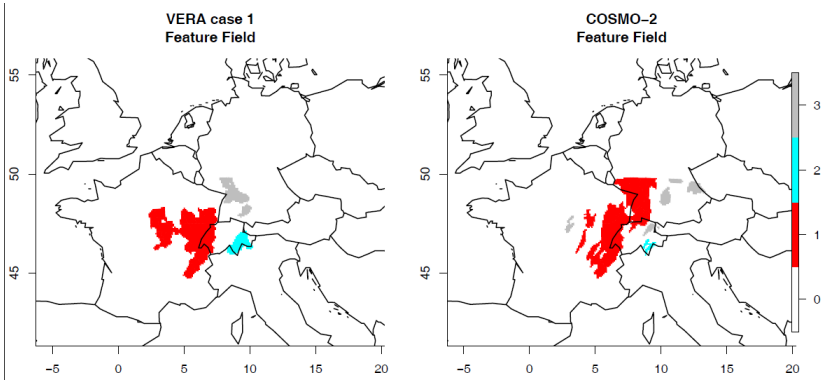
Conclusions

- COSMO-2 tends to overestimate maximum intensities (unlike the behavior of most models, including COSMO-Ru2, for the Sochi region in winter 2014)
- Smoothing can be unnecessary for estimation of intense precipitation
- Option for splitting objects is desirable
- Centmatch method where matching is made if the centroid distance is less than the average size of two objects gives overall the most reasonable results
- Centmath where matching is made if the centroid distance is less than the sum of the sizes of two objects makes too much mergings (after the application of MergeForse function)
- According to CRA, most of the error usually comes from the fine structure of the fields (MSE.pattern)
- Futher investigation is in process (other precip thresholds, analysis of different situations, etc.)

Thank you!

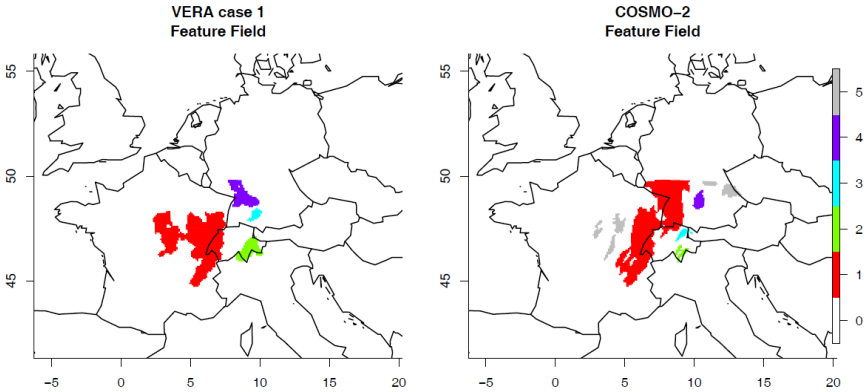
CRA scores, 2007062106

Centmatch 2



ir	MSE.total	MSE.shift	MSE.displace	MSE.volume	MSE.pattern
1	0.0347	0.0404	-0.0057	0.0000	0.0404
2	0.0030	0.0030	0.0000	0.0000	0.0030

Minboundmatch



ir	MSE.total	MSE.shift	MSE.displace	MSE.volume	MSE.pattern
1	0.0352	0.0404	-0.0051	0.0000	0.0403
2	0.0030	0.0030	0.0000	0.0000	0.0030
3	0.0081	0.0049	0.0032	0.0000	0.0049