Spatial methods for assessing radar data assimilation performance at RHM: a framework

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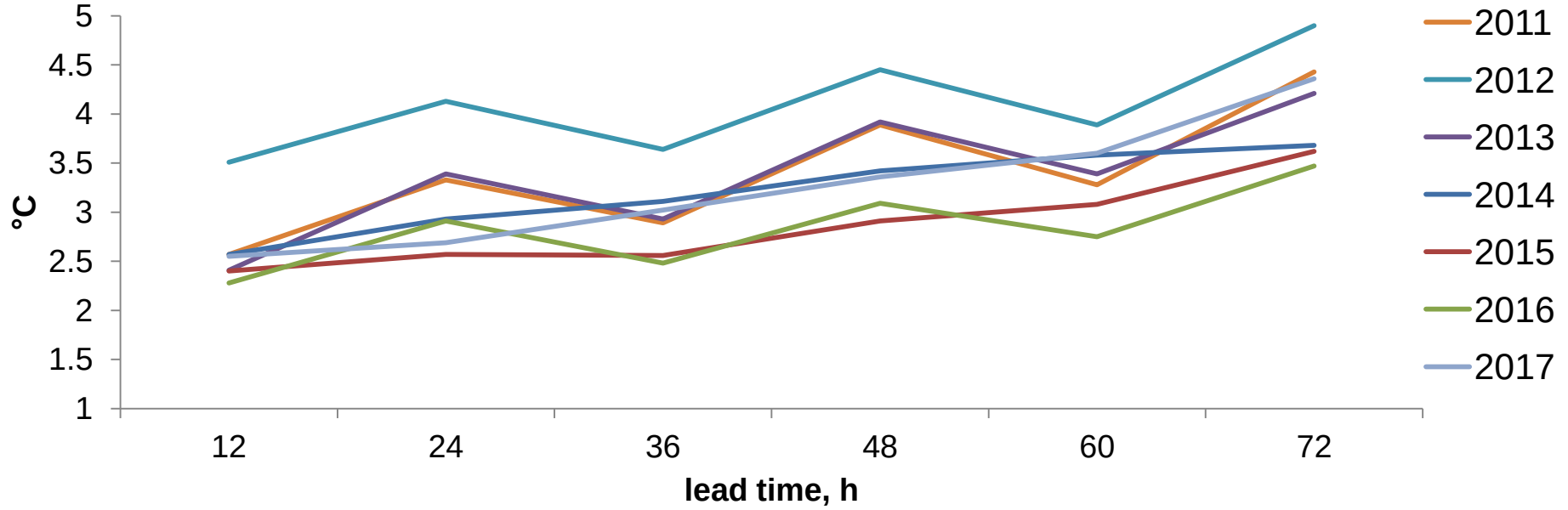
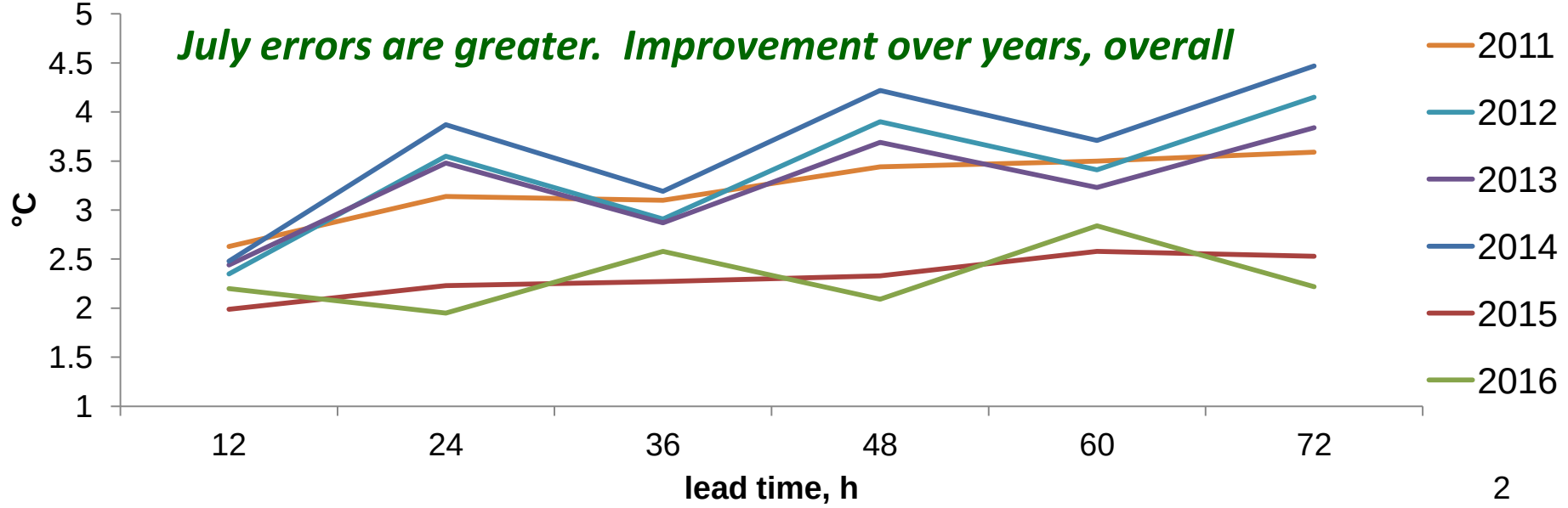
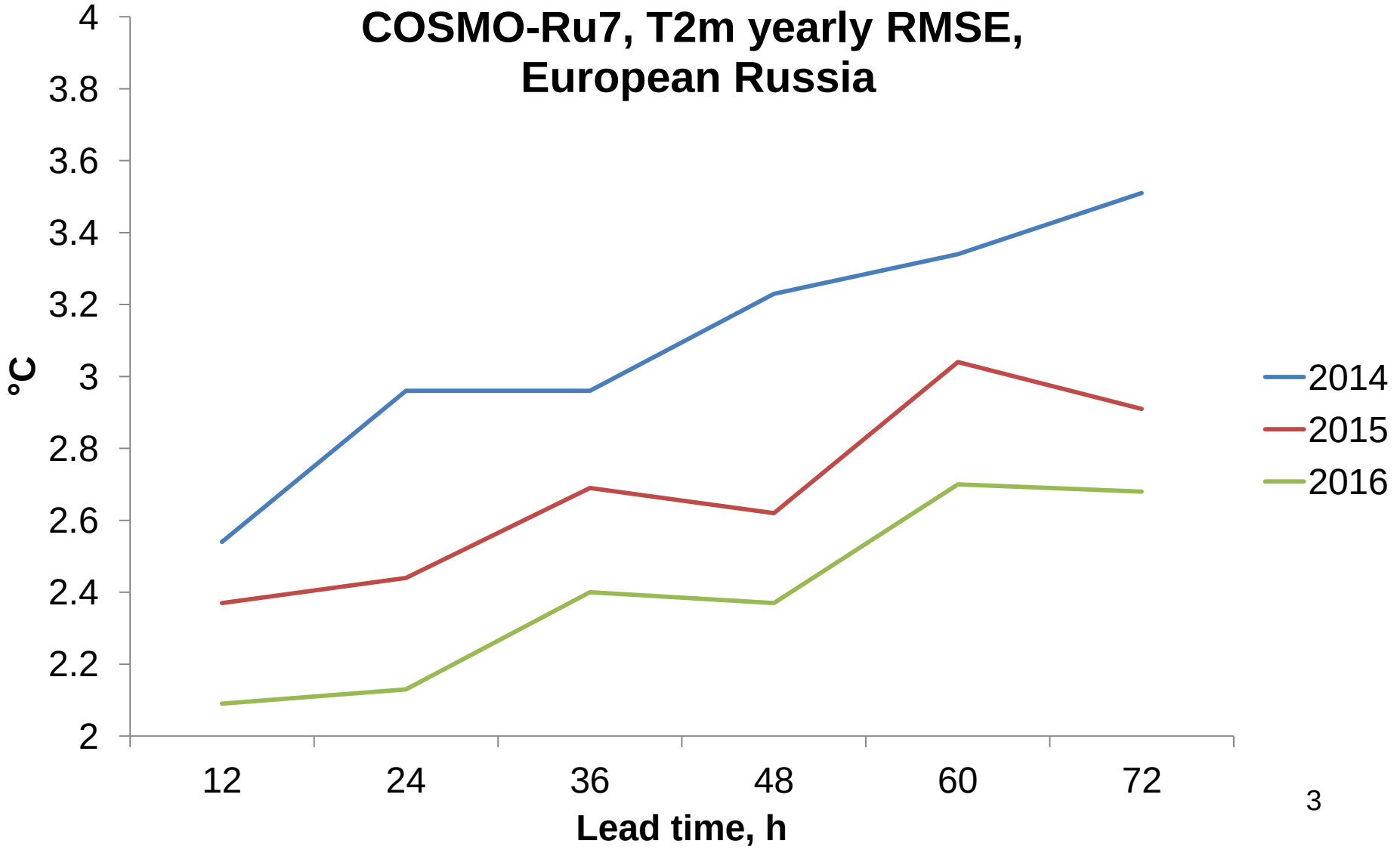
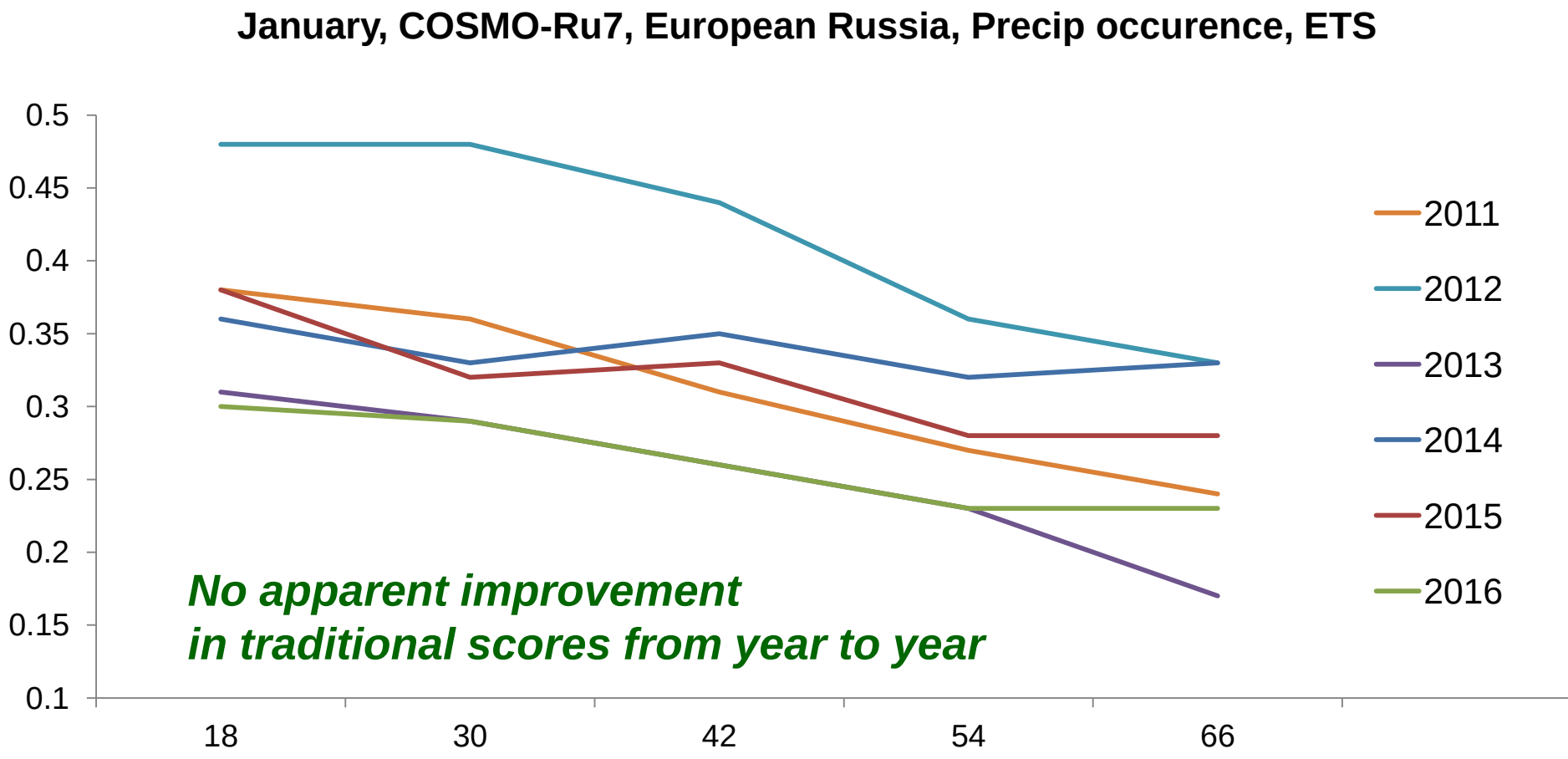

January, COSMO-Ru7, European Russia, T2m, RMSE
°C
5
4.5
4
3.5
3
2.5
2
1.5
1
12
24
36
48
60
72
lead time, h
2011
2012
2013
2014
2015
2016
2017


July, COSMO-Ru7, European Russia, T2m, RMSE
July errors are greater. Improvement over years, overall
°C
5
4.5
4
3.5
3
2.5
2
1.5
1
12
24
36
48
60
72
lead time, h
2011
2012
2013
2014
2015
2016

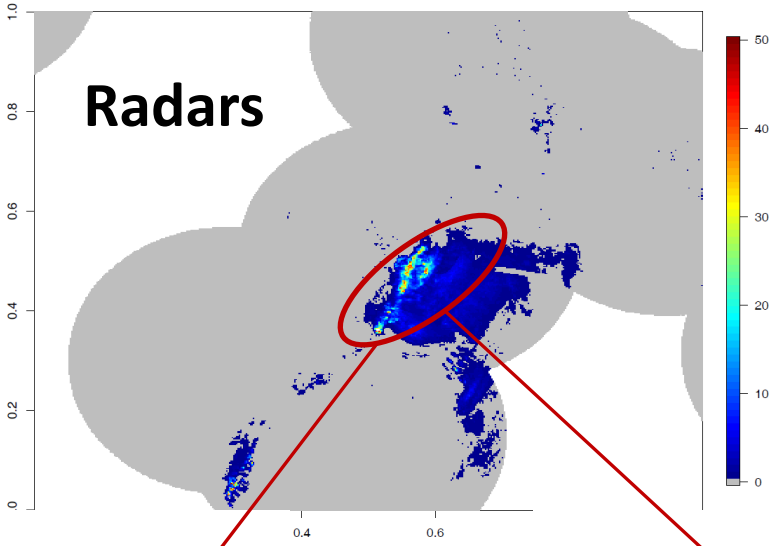
T2m RMSE aggregated over years, 00 UTC runs



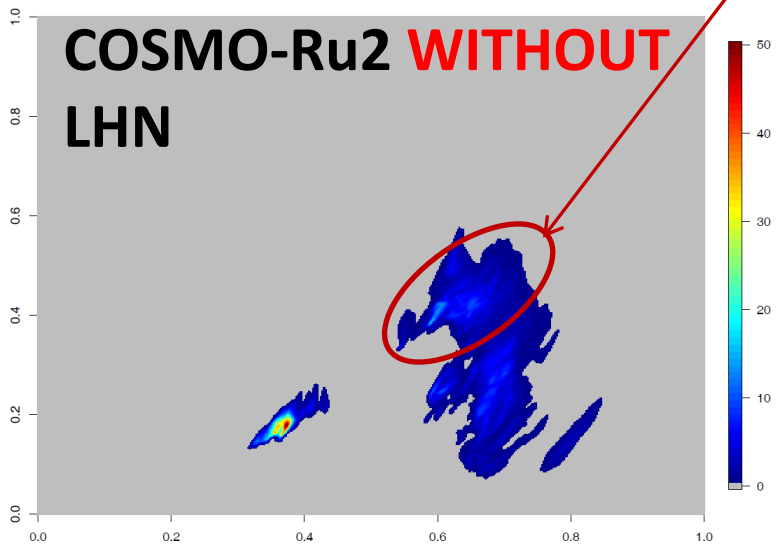
12h precipitation occurrence ETS, 00 UTC runs

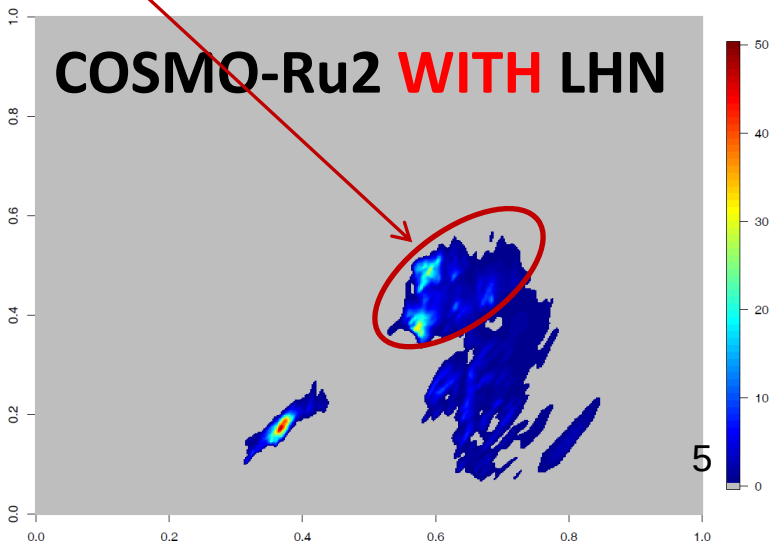


1h precipitation totals (mm/h) from radar data and COSMO-Ru2, 13 July 2016 (heavy showers and thunderstorms), 19-20 UTC, initial data 2016071318 (2h lead time)

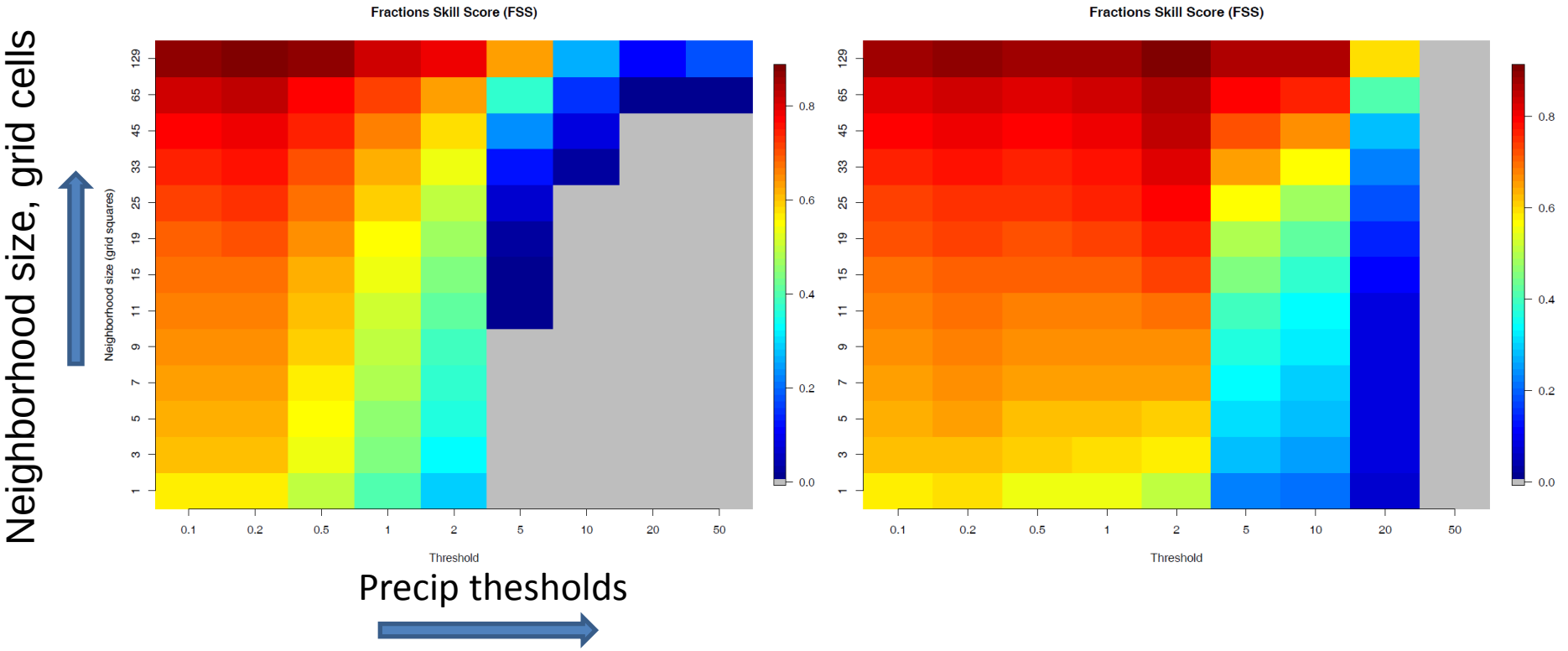


Latent Heat Nudging (LHN) assimilates precipitation intensities derived from radar composites over Central Russia





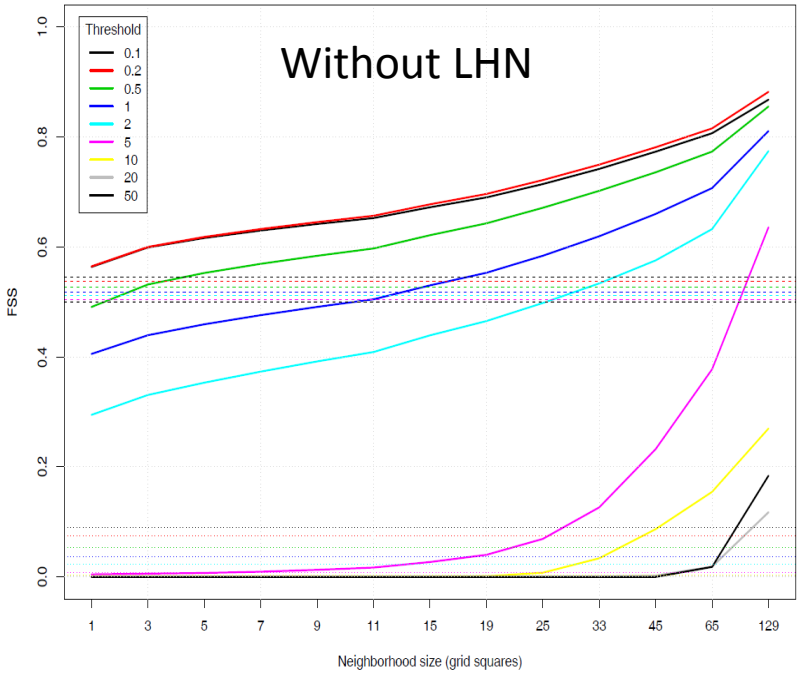
Fractions skill score (FSS) COSMO-Ru2
13 July 2016, 19-20 UTC, Central Russia

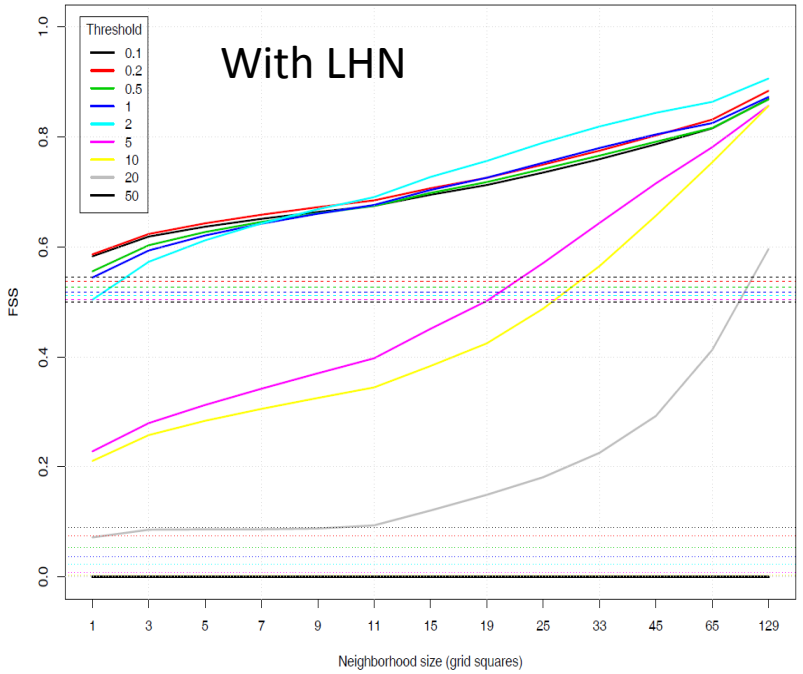


The “redder” the better.

LHN improves the forecast of precipitation, especially of intense one

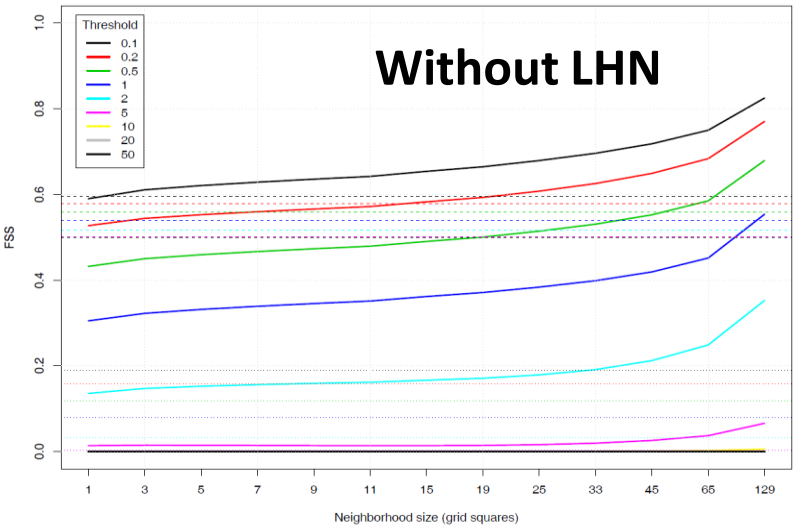
Fractions skill score (FSS) COSMO-Ru2
13 July 2016, 19-20 UTC, Central Russia

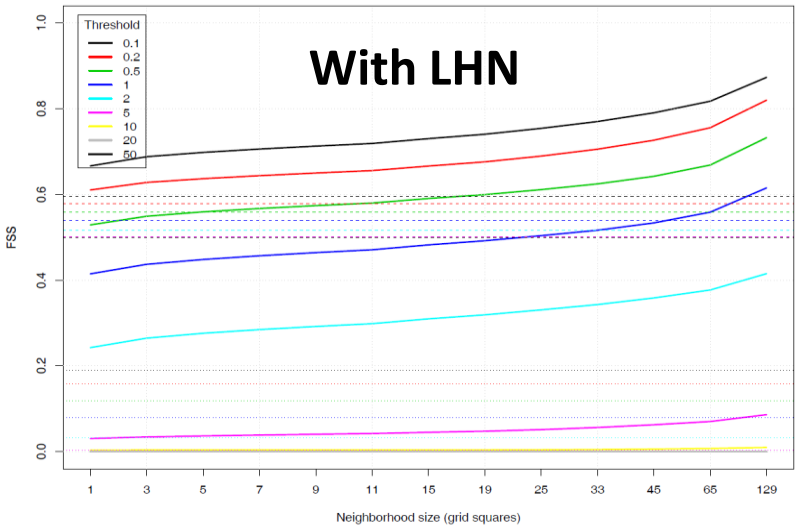




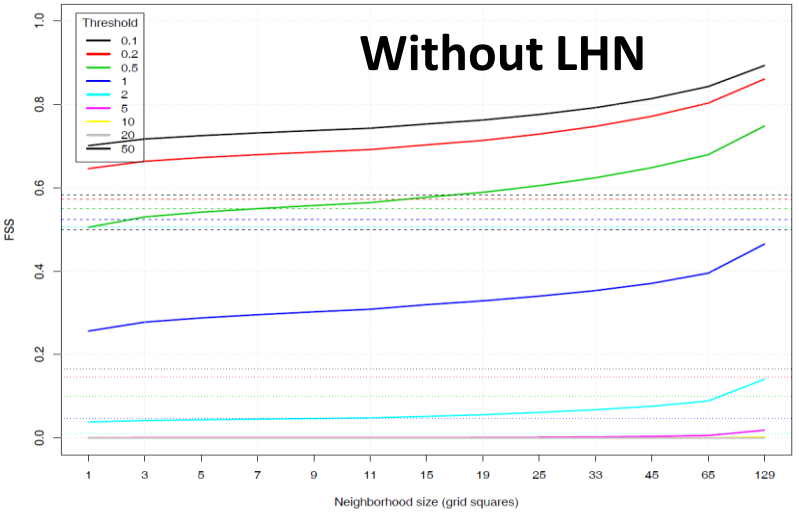
Starting from the threshold 0.5 mm/h,
FSS is higher for the model with LHN

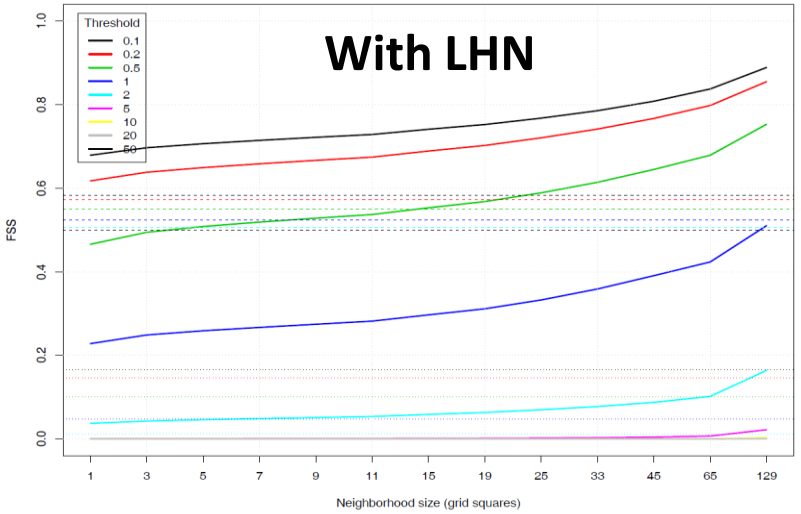
FSS of 6 h precip accumulations. 13 July 2016 18 UTC – 14 July 2016 00 UTC (first 6 hours of forecast period)





FSS of 6 h precip accumulations, 14 July 2016, 00-06 UTC (second 6 hours of forecast period)





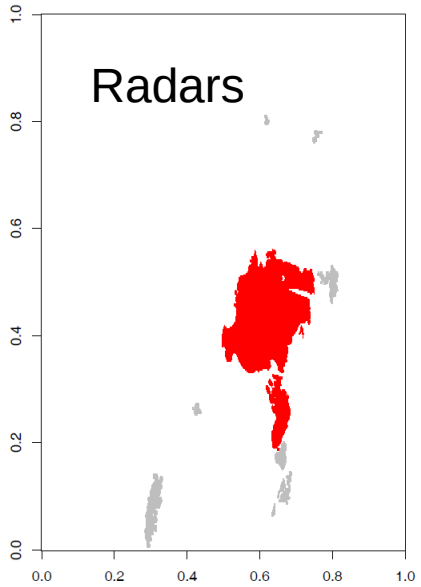
No improvement with LHN after the first 6 hours of forecast period

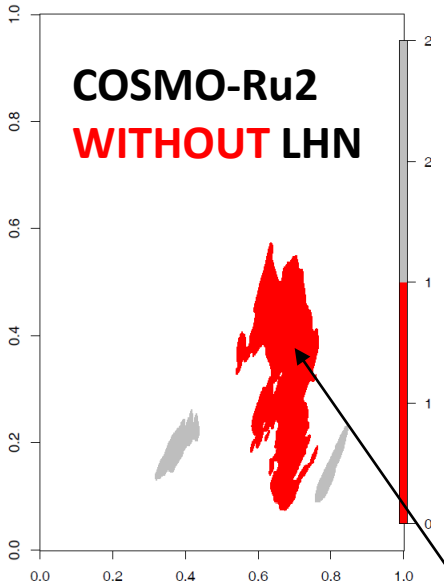
Experiments with object-based methods

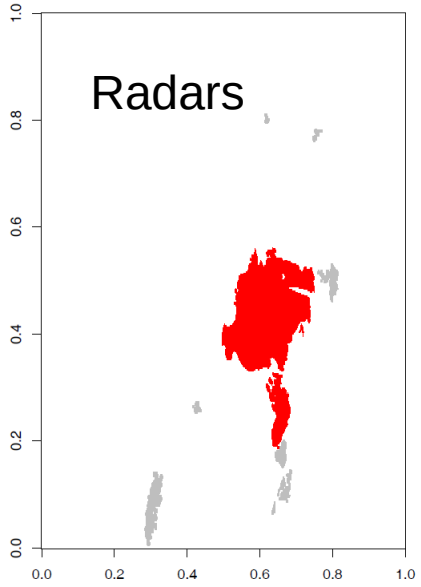
Objects are contiguous areas with precipitation values greater than a certain threshold.

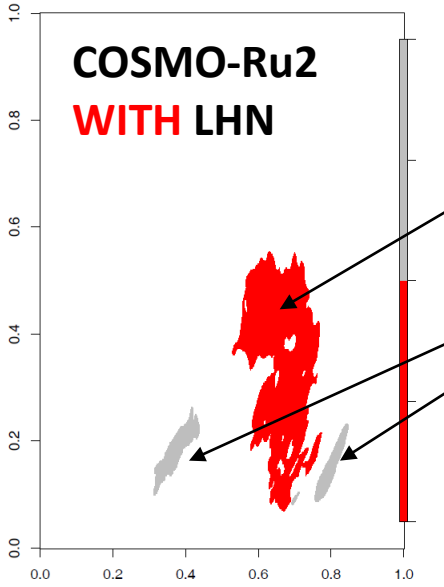
Objects for threshold > 0.5 mm/h, 13 July 2016, 19-20 UTC.
Colors indicate simply object order numbers

Matched object pairs
> 0.5 mm/h 13 July 2016, 19-20 UTC









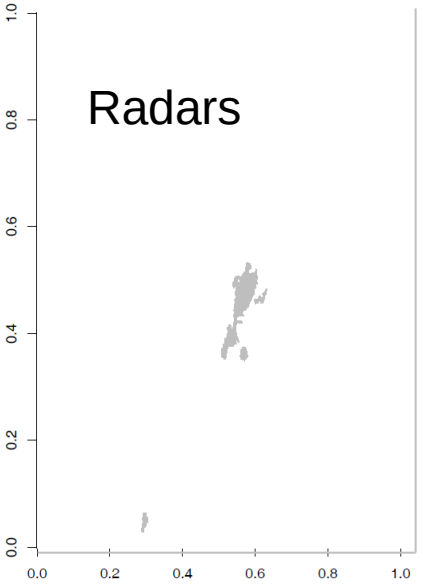
Matching criterion:
Centroid distance between forecast and observed objects is less than the average object size
(object size is the square root of object area)

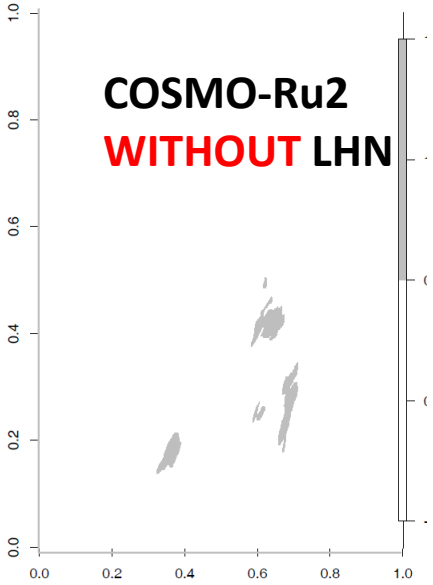
Colors indicate matched pairs

These objects are considered forecasted

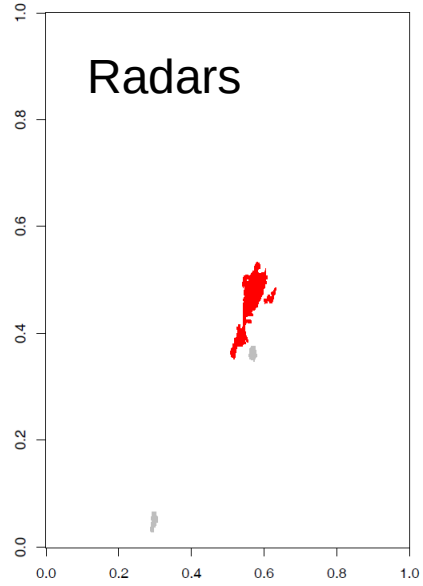
Grey objects are not matched

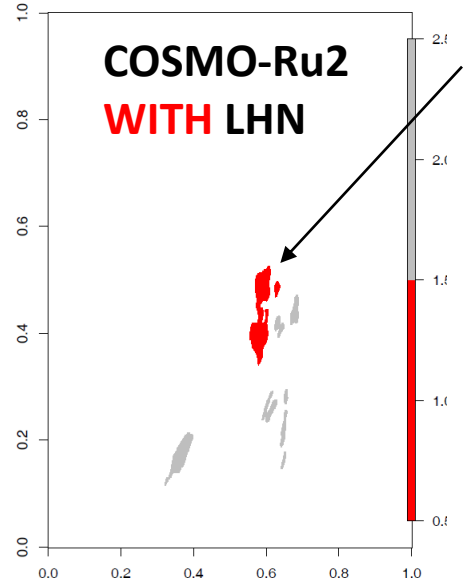
Matched object pairs
> 5 mm/h 13 July 2016, 19-20 UTC





No paired objects for the model without LHN





The area of intense precipitation is greater in the model with LHN, sufficiently to satisfy the matching criterion

Many unpaired objects

Conclusions

- T2m RMSE in COSMO-Ru7 is improving from year to year, however, in 2016-2017 winter T2m was strongly underestimated resulting in lower RMSE.
- There is no apparent improvement in point-wise precipitation scores from year to year, but COSMO-Ru7 scores are at the average level of COSMO versions of other countries (Common Plots!).
- An experiment was made on evaluating the effect of latent heat nudging (LHN) in COSMO-Ru2 using precipitation intensities derived from radar composites over Central Russia (heavy rainfalls and thunderstorms on 13-14 July 2016). The neighborhood and object-base approaches were applied. It was found that the LHN effect is positive if there are large areas of intense precipitation. As these areas are dispersed, the scores with for the model with LHN become equal to that withoug LHN or even worse. More test cases are needed!
- It is difficult to choose the best universal matching function for the object-based methods that require pair-wise matching of observed and forecast objects. The study is being continued.

Thank you for your attention!