QA in HIRLAM-C 2019-2020

OUTLINE

1) HARMONIE-AROME User Meeting 19-20 November 2019
2) Harp Training Course 15-17 October 2019
3) Diagnosing precipitation characteristics using SAL from Harp
4) Summary from developments of a new verification scheme addressing spatial structure of extremes.

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HARMONIE-AROME User Meeting 19-20 November 2019 in Talent Garden DUBLIN

Participants : About 40 from 9 HIRLAM Institutes

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HARMONIE-AROME User Meeting 19-20 November 2019 (2)

Main components:

- Progress report 2019 by HIRLAM-C management
- Forecast Centre Reports: Warnings for High Impact Weather: Practices and extimated needs for products based on NWP ensembles and special (post)-processing
- Presentation on probabilistic forecasting as input to subsequent group discussions (parallel groups A and B discussing Use of Ensembles for High impact Weather Warnings)
- Presentation on Postprocessing for High Impact Weather , e.g. new approaches and examples as input to parallel groups A and B discussing Postprocessing of NWP forecasts for warning conditions.

All presentations from the meeting is uploaded at

http://hirlam.org/trac/wiki/Meetings/Users/Users201911

HARMONIE-AROME User Meeting 19-20 November 2019 (3)

Examples from discussions:

General considerations

- Ensembles are useful for less predictable situations
- In some weather conditions it is useful to call developers to be with forecasters
- Fast production using suitable graphics presentation is important, - and critical for Nowcasting
- Suggestion: Make easy overview of observations and corresponding predictions from ensembles.
- Is it desirable to select a " best member" by e.g. following the evolution of observations compared with individual members ?
- Upscaled products for precipitation, wind gusts , hail etc. are useful, and presentations of low, medium and high percentiles

HARMONIE-AROME User Meeting 19-20 November 2019 (4)

Education and training:

- More education of forecasters to use EPS products and tools and a related time for training is needed
- Are new products well enough documented to forecasters , e.g. how they should be used ?
- Understanding probabilities: New initiatives to communicate how to work with probabilities should be continued , e.g. at which probability should warnings be issued to find balance between under- and overforecasting ? The needs of forecasters education is different from the needs of general public
- Communication to the Public: How communicate probabilities to different types of users ? -
- The best possible communication of risks is still an open area. Should we give categorical forecasts because people WANT it ?

EPS not yet perfect:

- How reliable is the ensemble ? , too few members is problematic , Often too small spread, with sometimes missing signals of important events
- Calibration of EPS needs more focus to increase quality, also for treatment of extremes
- How to know systematic errors. easily accessible list of common model issues on the consortium level + local ones reachable by all forecasters (reports on hirlam.org and other means ?)
- Challenge to know the properties of new cycle compared with old one regarding extreme weather , Possible options for improved procedures: parallel model versions, improved release notes of new cycles ?

HARMONIE-AROME User Meeting 19-20 November 2019 (6)

Exchange of forecasters' experiences

- Sharing information between forecasters locally or in the future by Web-meetings between forecasters ?
- Is the concept of a HIRLAM-forum useful, e.g. to communicate experiences with new Postprocessing (increasingly relevant for UWC when forecasts and postprocessing are better shared). The continuation of `physical´ User meetings is another option.

New products :

Many proposals for new products to be realized : severe convection products, tornadoes, forest fire , hail size product, extreme forecast index (scaled with e.g. model climatology) , access to combined probabilities, - for military and aviation: Better description of near surface inversions, forecasting of icing, indices for high- and low level of turbulence, visibility on other wavelengths than visible light,….

CONCLUSION

- It seems important to consider new ideas to best realize improved future communication between model developers and forecasters .
- A next User Meeting will be held in 2021 and the special topic will be : Setups for NWP Nowcasting

Training Course
Danish Meteorological Institute
15 - 17 October 2019

Harp Training : CHARACTERISTICS

- Around 30 participants gathered from trom 15 Institutes in ALADIN-HIRLAM countries
- RSTUDIO cloud was used during the course
- An introduction to R programming (e.g. R basics)
- R packages
- Writing R scripts and R functions
- Inroduction to Harp
- Harp for point data (reading and interpolating forecasts and observations)
- Deterministic and EPS
- SQLITE-files
- Plotting data and scores (detailed training on this)
- Harp spatial
- Installing Harp.
- Discussion on future evolution steps, e.g. Documentation and Communication of Harp

Slides from the meeting at
https://speakerdeck.com/harp

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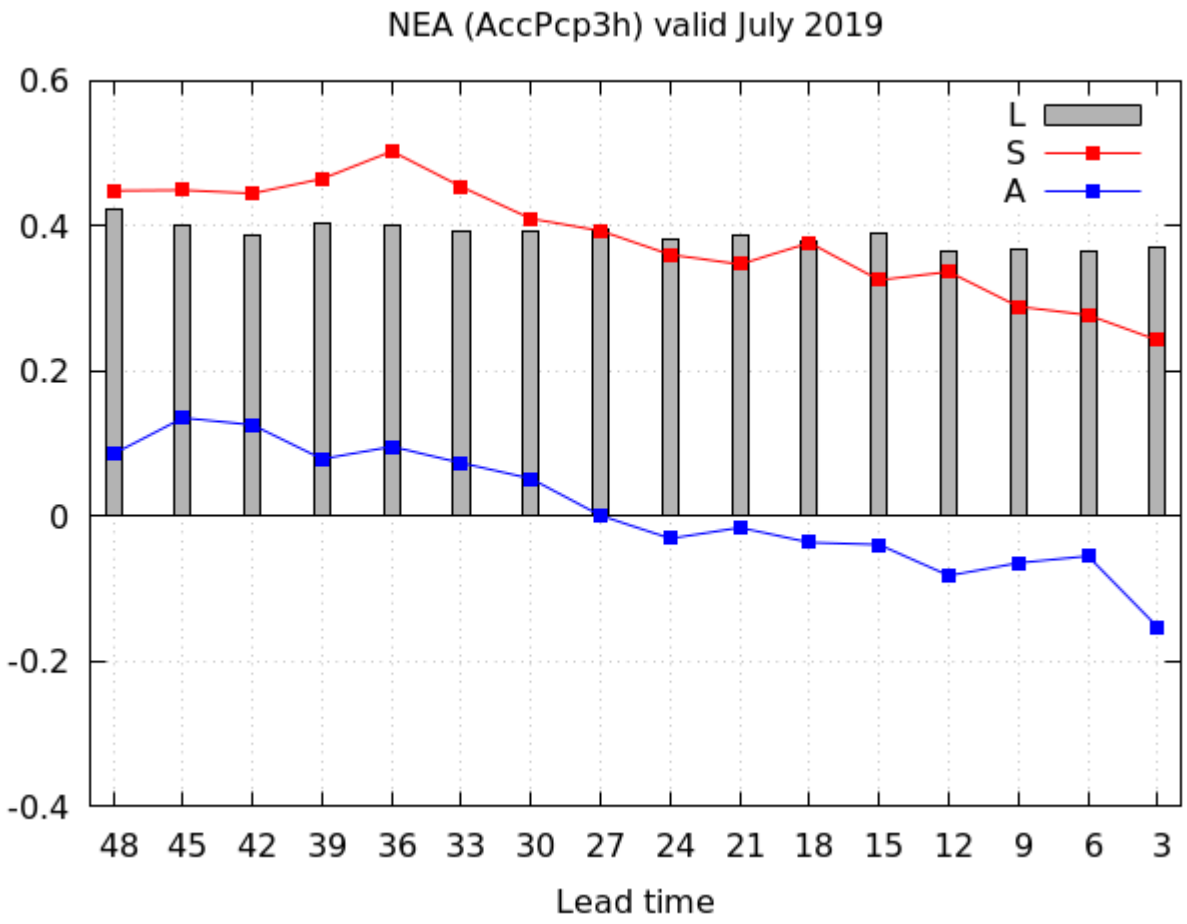
Diagnosing precipitation characteristics using SAL from Harp



Time evolution (3h -48h) of SAL components in DMI HARMONIE-AROME operational runs (NEA) over DK verified using DMI precipitation analyses combined with in-situ observations, (from Henrik Feddersen , DMI)

Summary from developments of a new verification scheme SLX,
Structure of Local EXtremes

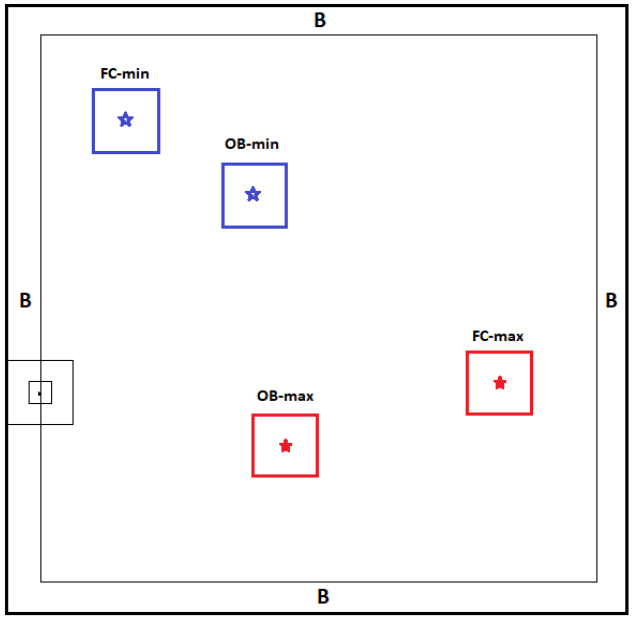
Computational scheme of the computation of SLX. Maxima in a (sub-domain) OB-max, FC-max for observed and forecasted maximum of the field respectively are determined by the scheme. Similarly OB-min, FC-min correspond to observed and forecasted local minimum respectively. The squares indicate size of local neighborhood used in the computation of the individual SLX scores.

Procedure: For OB-max a comparison is made to the forecasted maximum in the neighborhood. The difference between these defines the contribution to the score between 0 and 1. A score function S , with $0 \leq S \leq 1$ is used for this . A score of 1 for OB-max is only obtained if forecasted maximum in neighborhood equals OB-max.

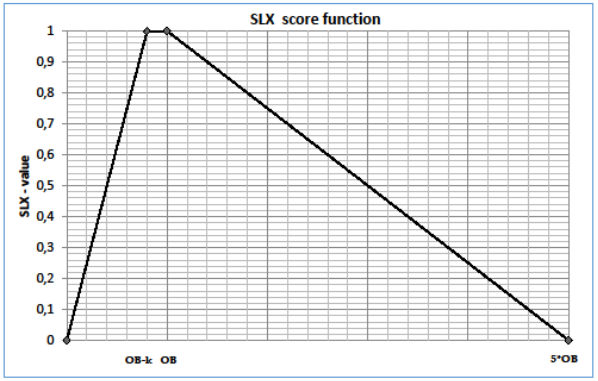
Corresonding scores and computational procedures are defined for FC-max, OB-min, FC-min respectively. These make up 4 score values. A combined values is computed as a weighted average.

Multiple points of equal extreme values are treated equally (multiple computations with equal weight)

A boundary zone of width **B is** included to allow computations using full neighborhood size close to the lateral boundaries.



Conceptual picture of SLX computations



Score function depending on fraction between Forecasted and Observed extreme value

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Summary of developments of a new verification scheme SLX addressing spatial structure of extremes (2)

$$\mathbf{SLX} = \tfrac{1}{4}\left(\mathbf{SLX}_{\text{OB-max}} + \mathbf{SLX}_{\text{OB-min}} + \mathbf{SLX}_{\text{FC-max}} + \mathbf{SLX}_{\text{FC-min}}\right) \quad (1)$$

$$\mathbf{SLX}_{\text{OB-max}} = S\left(P_{\text{OB-max}},\ P_{\text{FE-max}}/P_{\text{OB-max}}\right),\quad P_{\text{FE-max}} = \text{Max}\{\ P_{\text{FE}}(i,j,\tau)\ \},\quad \text{(OB-max)}$$

$$0 < \tau \le \tau_m,\quad i \in [\,1,\ldots,N\,],\ j \in [\,1,\ldots,N\,] \quad (2)$$

$$\mathbf{SLX}_{\text{OB-min}} = S\left(P_{\text{OB-min}},\ P_{\text{FE-min}}/P_{\text{OB-min}}\right),\quad P_{\text{FE-min}} = \text{Min}\{\ P_{\text{FE}}(i,j,\tau)\ \},\quad \text{(OB-min)}$$

$$0 < \tau \le \tau_m,\quad i \in [\,1,\ldots,N\,],\ j \in [\,1,\ldots,N\,] \quad (3)$$

$$\mathbf{SLX}_{\text{FC-max}} = S\left(P_{\text{FC-max}},\ P_{\text{OE-max}}/P_{\text{FC-max}}\right),\quad P_{\text{OE-max}} = \text{Max}\{\ P_{\text{OE}}(i,j,\tau)\ \},\quad \text{(FC-max)}$$

$$0 < \tau \le \tau_m,\quad i \in [\,1,\ldots,N\,],\ j \in [\,1,\ldots,N\,] \quad (4)$$

$$\mathbf{SLX}_{\text{FC-min}} = S\left(P_{\text{FC-min}},\ P_{\text{OE-min}}/P_{\text{FC-min}}\right),\quad P_{\text{OE-max}} = \text{Min}\{\ P_{\text{OE}}(i,j,\tau)\ \},\quad \text{(FC-min)}$$

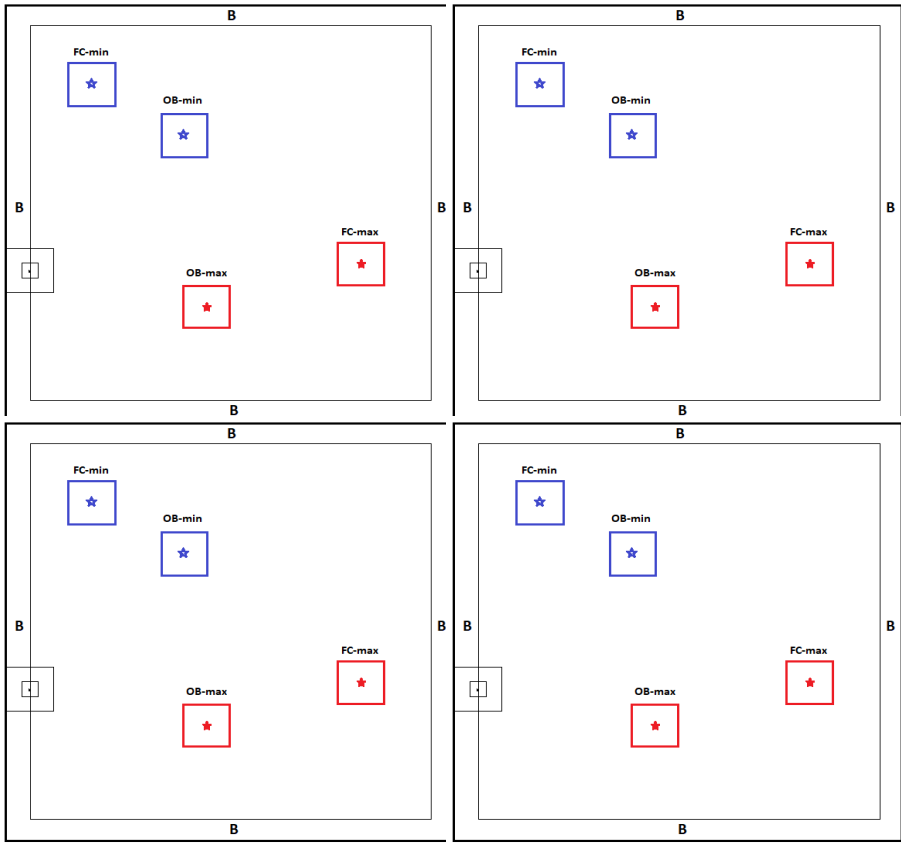
$$0 < \tau \le \tau_m,\quad i \in [\,1,\ldots,N\,],\ j \in [\,1,\ldots,N\,] \quad (5)$$

A model domain may be divided into many sub-domains each of which defines the 4 extremes. The resulting output may be stored for each sub-domain to enable

statistical knowledge about SLX in sub-areas as the scheme is run over long periods.

Also some **statistics of the individual components**, e.g. **$\mathbf{SLX}_{\text{FC-max}}$ using data from subareas may be computed . Thus SLX of a forecast is not necessarily based on 1 single computation per model integration domain**

Summary of developments of a new verification scheme SLX addressing spatial structure of extremes (3)



Example of 4 sub-domains each identifying 4 (local) extreme parameters .

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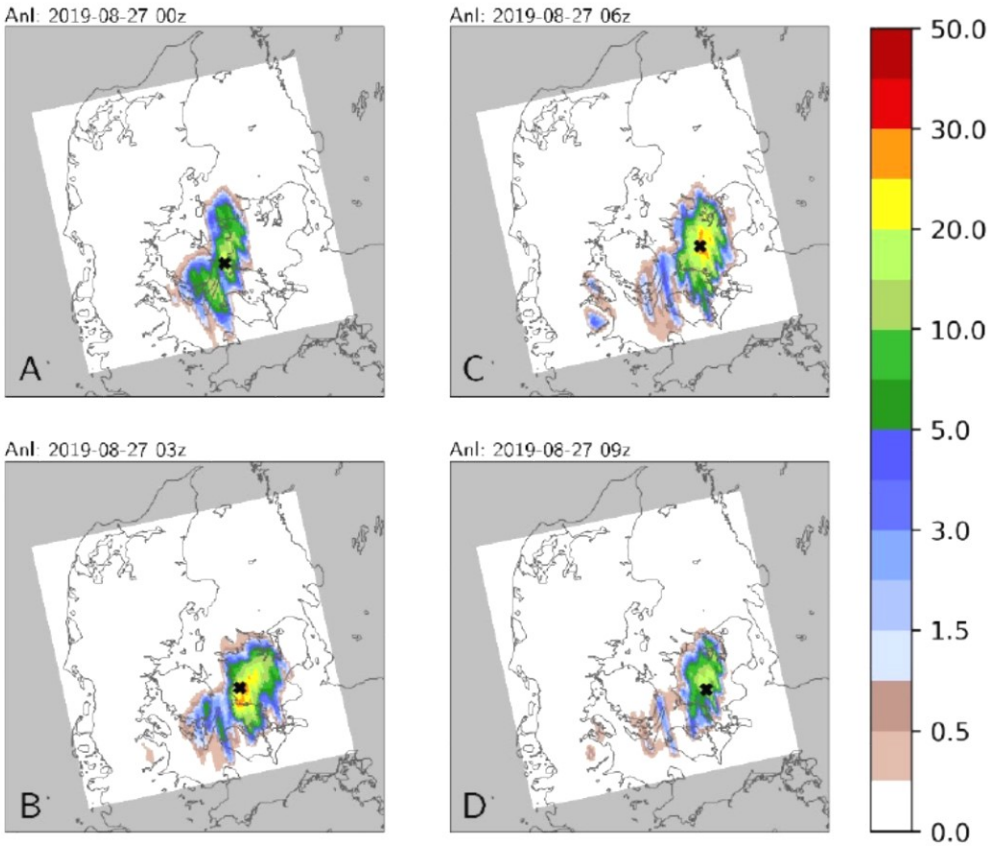
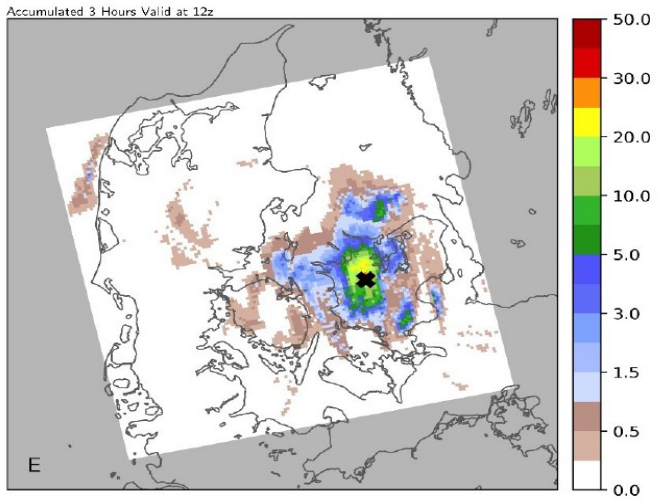
Summary of developments of a new verification scheme addressing spatial structure of extremes (4)





Forecasted accumulated precipitation (mm) valid from 9 UTC -12 UTC 27 August 2019 over the light squared areas. Figure A, B, C and D apply to forecasts starting at 00 UTC , 03 UTC , 06 UTC and 09 UTC respectively. Figure E shows the corresponding analyzed field of precipitation 9-12 UTC 27 August 2019. The black crosses indicate the maxima analyzed.

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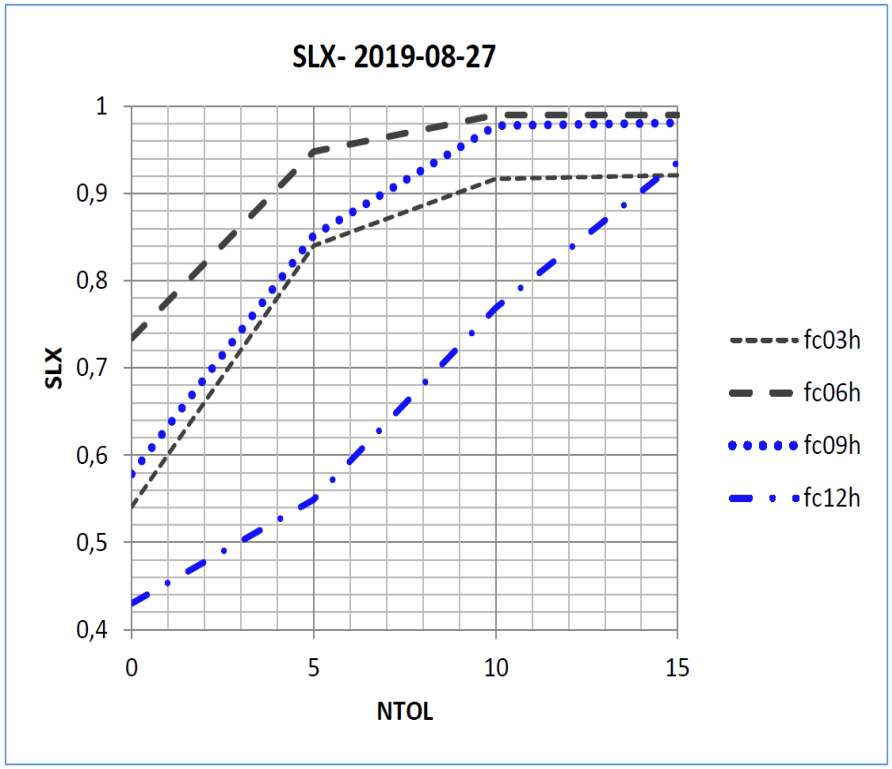
Summary of developments of a new verification scheme addressing spatial structure of extremes (5)



Combined SLX valid for the 4 different forecast ranges 03h, 06h, 09h, 12h valid at 12 UTC 27 August 2019.

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In addition, the SLX scheme has been tested

- **on many idealized cases**
- **on synthetic forecast- and analysis fields constructed on the basis of 5 years verification data of HARMONIE-AROME i.e. statistics of 12 hour precipitation verification at obs-points in Denmark used in simulation.**
- **Plan to implement SLX fully in Harp**
- **Article for a journal about ready to be submitted.**

SUMMARY

Examples of Quality Assurance were provided from

- **HARMONIE-AROME User meeting 2019**
- **Harp training**
- **Diagnosing precipitation performance using SAL**
- **A new spatial verification scheme regarding extremes**

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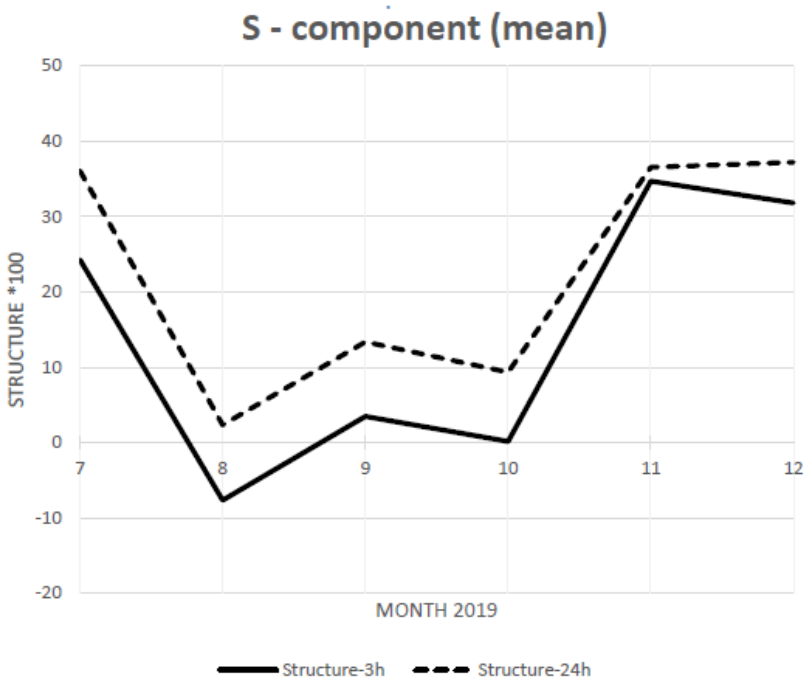
EXTRA SLIDES

Diagnosing precipitation characteristics using SAL from Harp (1)

Verification of SAL components in DMI



SAL structure component (S- score) from NEA-model at DMI for July –December 2019. Spatial SAL-computation based on analyzed and forecasted 3h accumulation over Denmark, at + 3 hours (solid line) , and at 24 hours (dashed line)

Result: Drift from 3h to 24h towards higher positive values (more large-scale during forecast)

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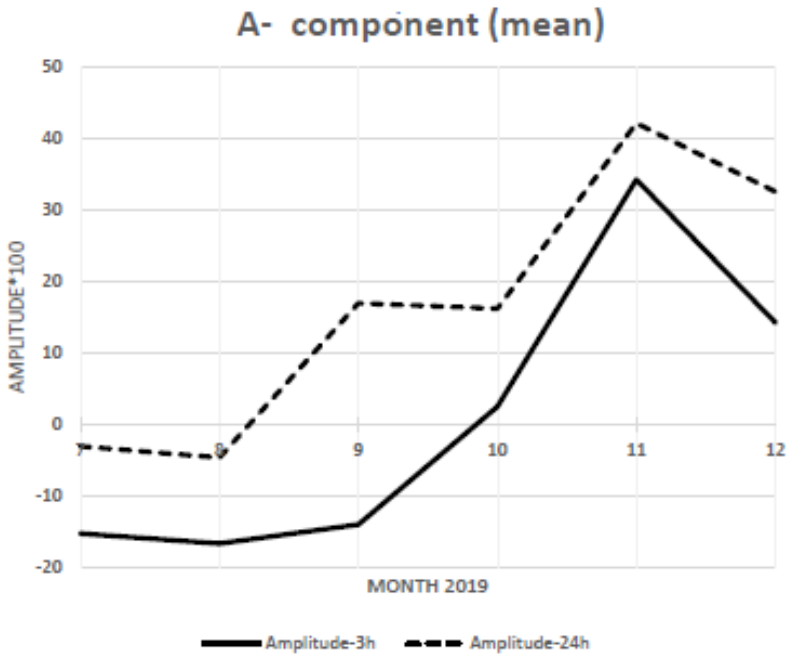
Diagnosing precipitation characteristics using SAL from Harp (2)

Verification of SAL components in DMI

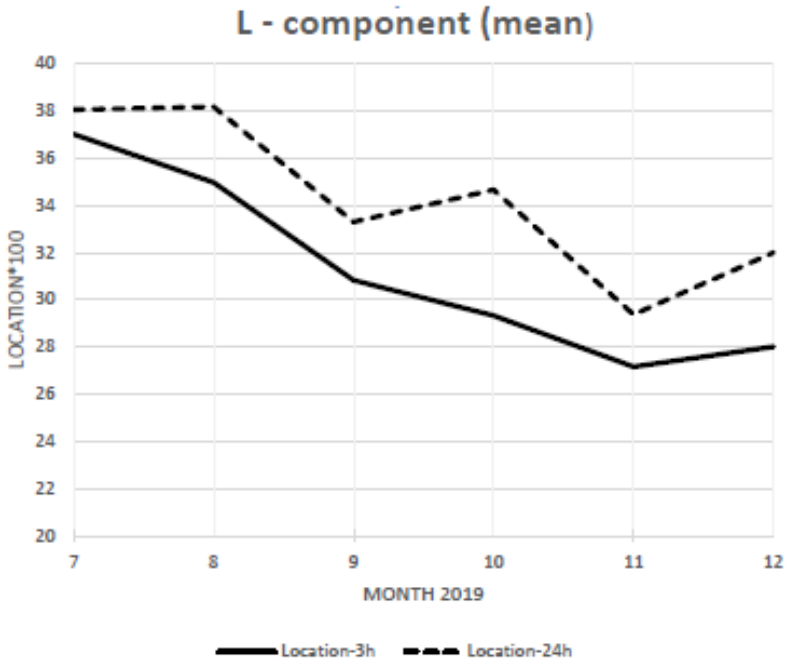


SAL amplitude component (A –score) from NEA-model at DMI for July –December 2019. Spatial SAL-computation based on analyzed and forecasted 3h accumulation over Denmark, at + 3 hours (solid line) , and at 24 hours (dashed line)

Result: More positive values at +24 h compared with +3 hours. Negative values in Summer indicative of some spinup-problems)

Diagnosing precipitation characteristics using SAL from Harp (3)

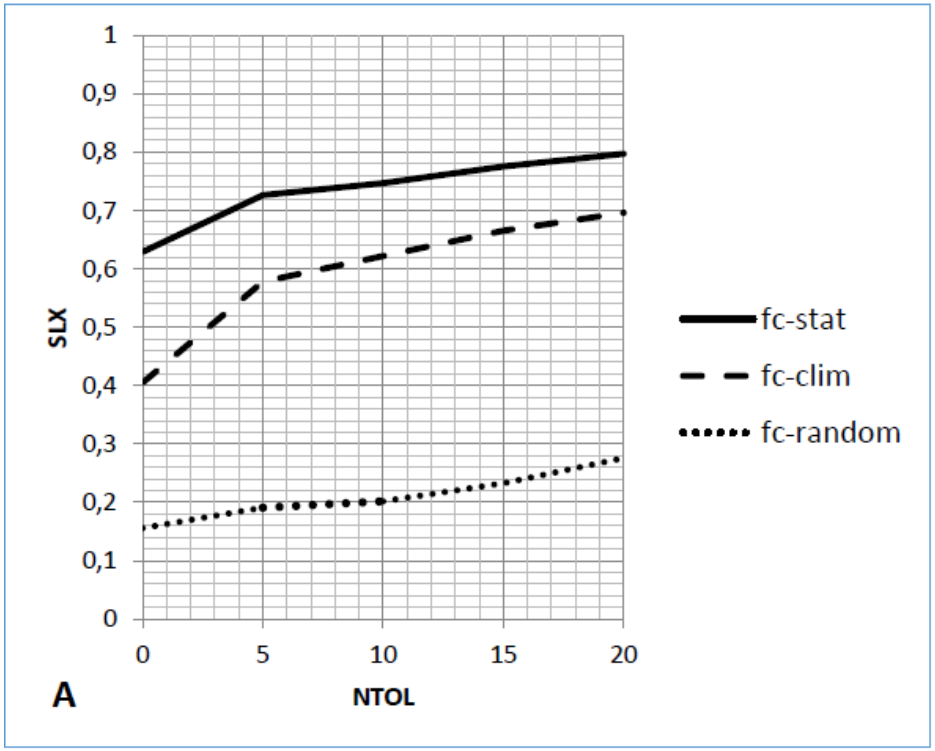
Verification of SAL components in DMI



SAL location component (L- score) from NEA-model at DMI for July –December 2019. Spatial SAL-computation based on analyzed and forecasted 3h accumulation over Denmark, at + 3 hours (solid line) , and at 24 hours (dashed line)

Result: Negative slope towards lower values indicate improved location of precipitation in winter time

Summary of developments of a new verification scheme addressing spatial structure of extremes



SLX statistical simulation related with operational conditions of June 2014-2018. `Fc-stat´ is representing SLX of operational runs at different neighborhood sizes (NTOL). `Fc-clim´ corresponds to a run with forecast based on observed frequency during the period, in each class. `fc-random´ corresponds to a random forecast [0, 40 mm]. 720 Synthetic forecast fields representing operational statistics (fc verus versus obs are reflected as well as different spatial scales in an arbitrary field selection process)

Article ready to be submitted to a Journal

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END