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Federal Department of Home Affairs FDHA
Federal Office of Meteorology and Climatology MeteoSwiss

Verification @ MeteoSwiss

research activities & plans

Tanja Weusthoff

MesoVICT final meeting, 09.07.2019





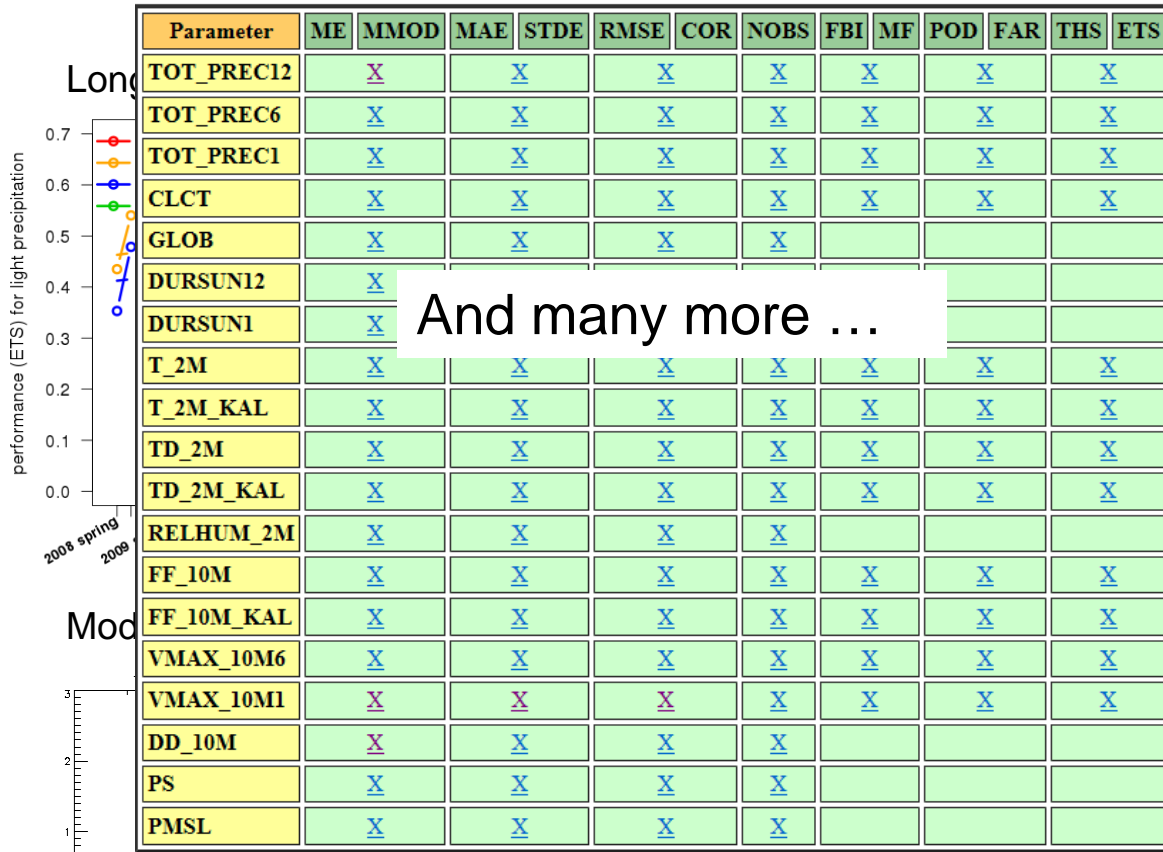
Today @ MeteoSwiss

- Verification of NWP
 - on an operational basis and for testsuites
 - all important parameters against surface measurements
 - Temperature, humidity and wind versus radiosonde measurements
 - Many deterministic scores, different models
- Verification of nowcasting
 - standard deterministic scores and spatial verification (FSS)
- Verification of forecasters forecasts and warnings
 - **Administrative purposes**, communication to the general public and to the government on the evolution of the quality of MeteoSwiss forecasts
 - easy understandable



Today @ MeteoSwiss

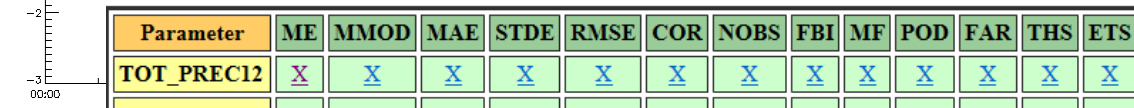
Time series of verification scores



And many more ...

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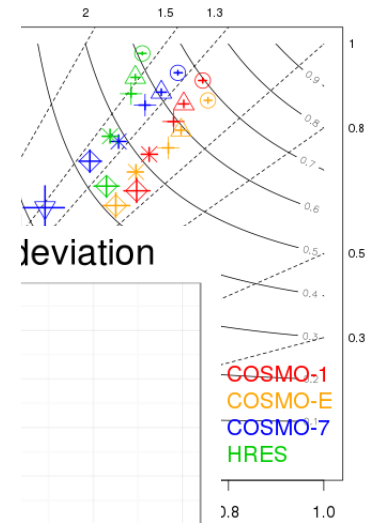
Diurnal cycle of verification scores



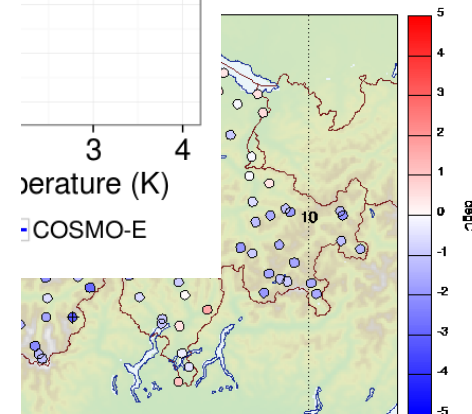
MeteoSwiss

Performance Diagram

SMO-7 vs HRES @ch for TOT_PREC12 & It 13-24



Profile Verification





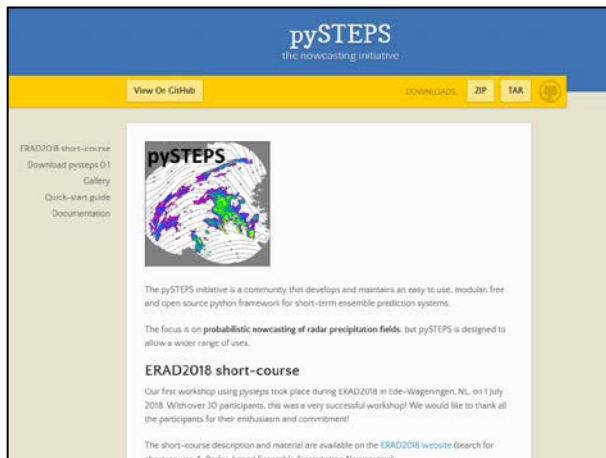
New developments / plans

- **Operational NWP verification**
 - consolidate tools and replace / improve if necessary
 - use more probabilistic verification scores
 - (re-) introduce spatial verification
 - perform conditional verification
- **Postprocessing (MeteoSwiss project PostprocVerif)**
 - development of verification along processing chain
 - common verification platform
 - concept for spatial verification
 - recommendations for development of headline scores



Research Tool: pysteps

- Research tool in precipitation nowcasting.
- Joint development within MeteoSwiss, FMI, BOM and McGill University.
- Open-source, python 3.x, available on github.
- Includes modules for io, data manipulation, optical flow estimation, field advection, stochastic simulations and verification.



<https://pysteps.github.io/>

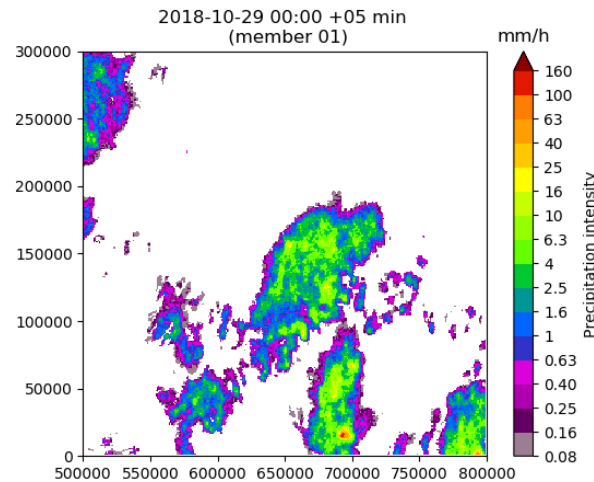
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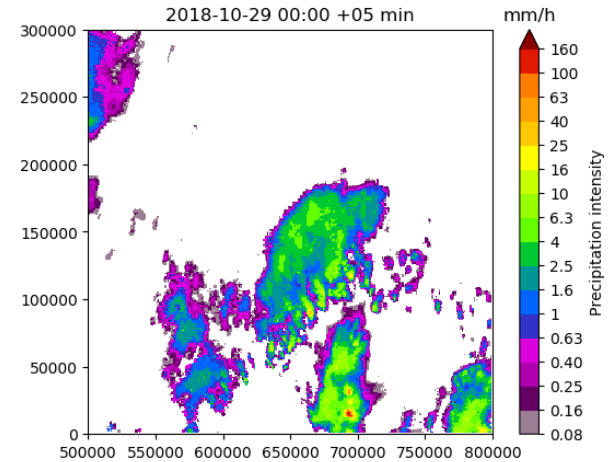
An example ensemble nowcast

- 2018102900 – 2018103000
- 1 run/hour (i.e. 24 runs)
- 20 ensemble members
- 1 hour lead time
- RZC radar QPE
- 5 min/1 km

The forecast



The observation

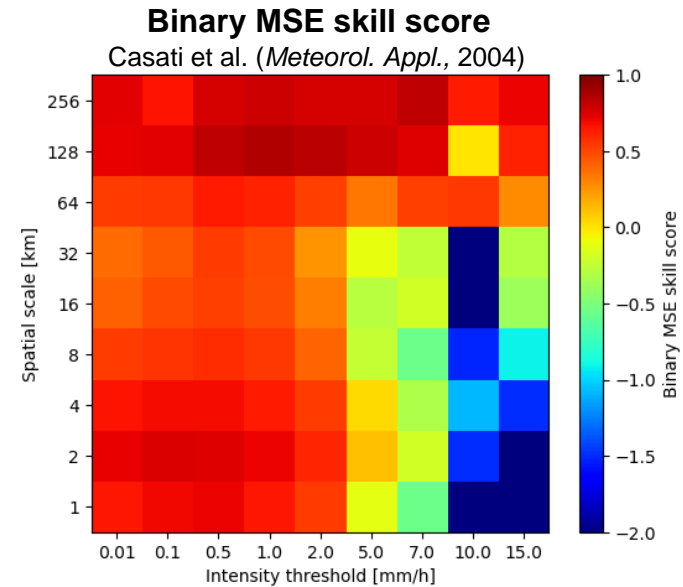
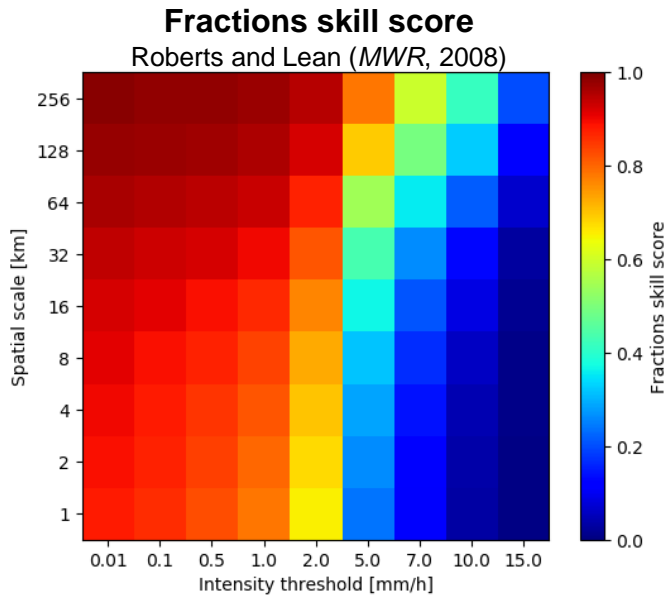


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Intensity-scale verification with pysteps

- spatial verification scores
- deterministic (here shown for member 1)
- hourly accumulations at + 1 hour lead time



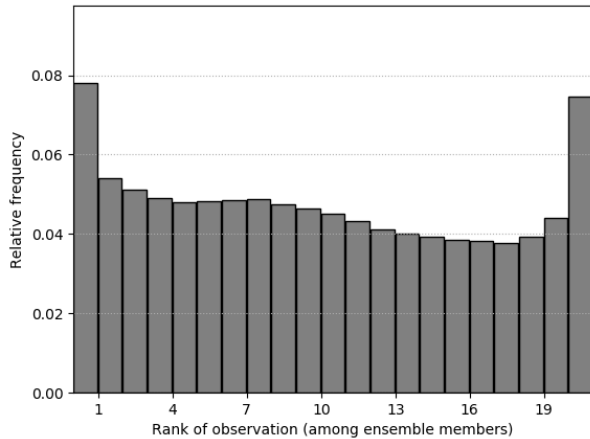
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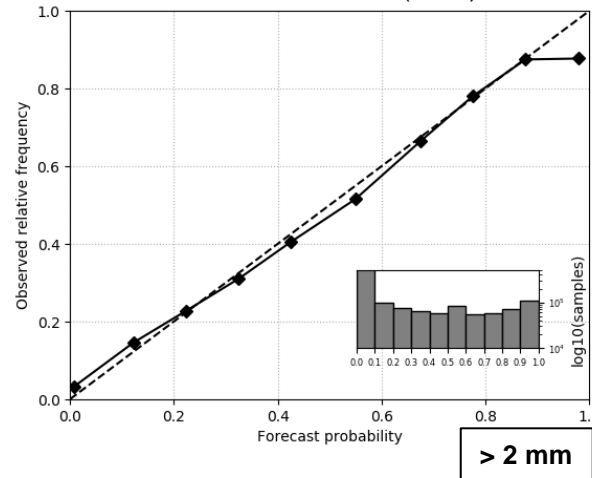
Ensemble and probabilistic verification with pysteps

- hourly accumulations at + 1 hour lead time.
- 20 ensemble members
- threshold = 2.0 mm

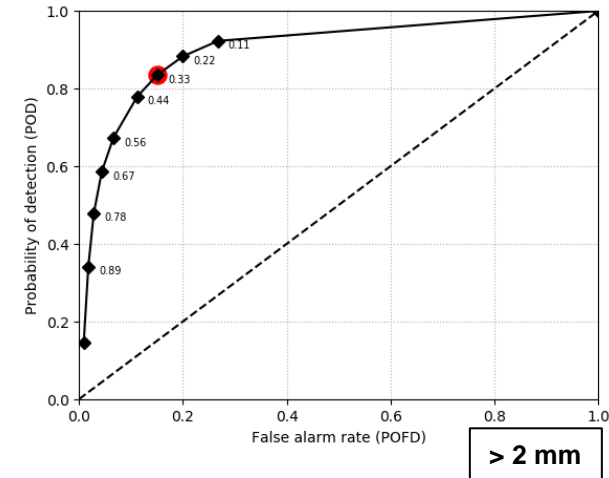
rank histogram
Hamill (2001)



reliability diagram
Bröcker and Smith (2007)



ROC curve
Joliffe and Stephenson (2003)

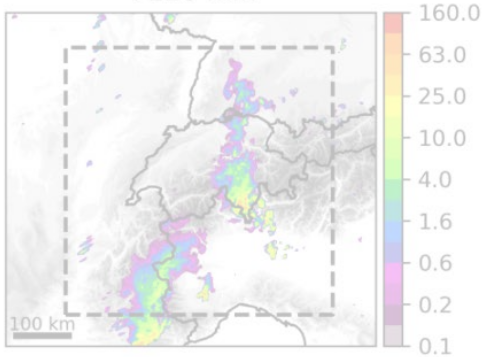


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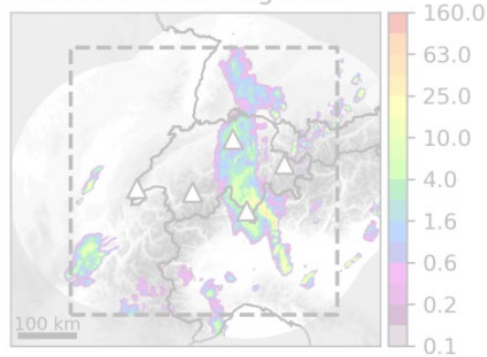


Scale-aware verification

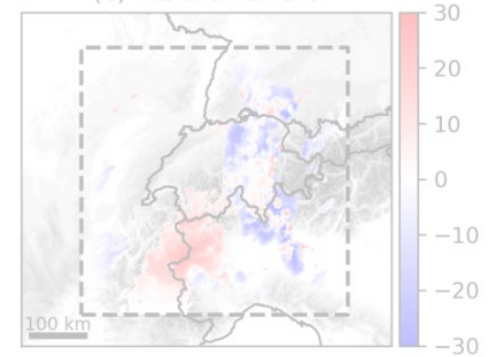
(a) COSMO-1 QPF
+120 min



(b) Radar QPE
1700 UTC 09 Aug 2018

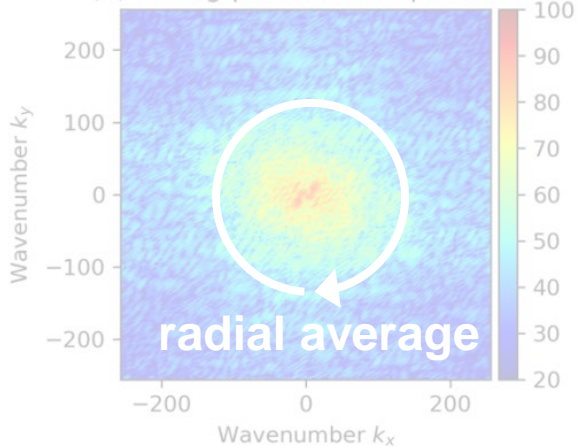


(c) Field of errors

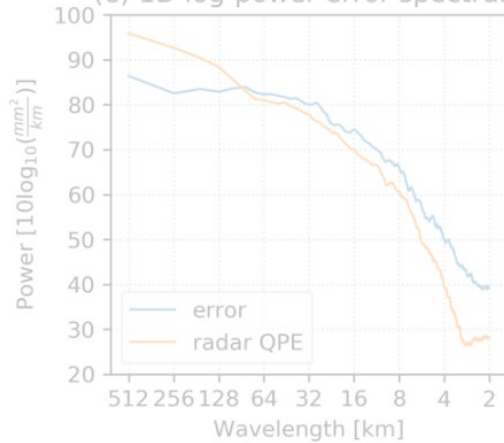


error = COSMO1 - Radar

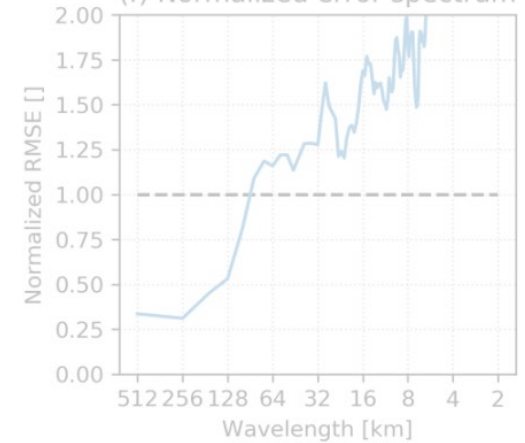
(d) 2D log-power error spectrum



(e) 1D log-power error spectrum



(f) Normalized error spectrum

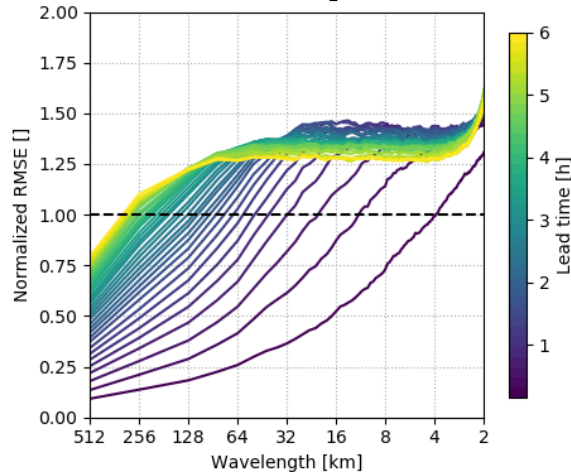


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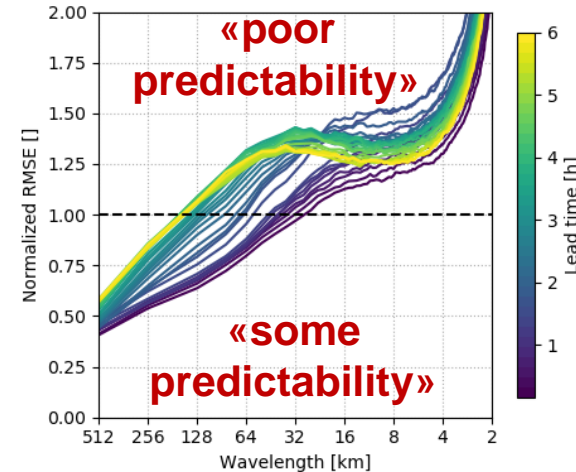


Average spectra of normalized errors

Radar extrapolation



NWP



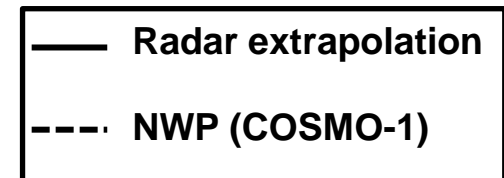
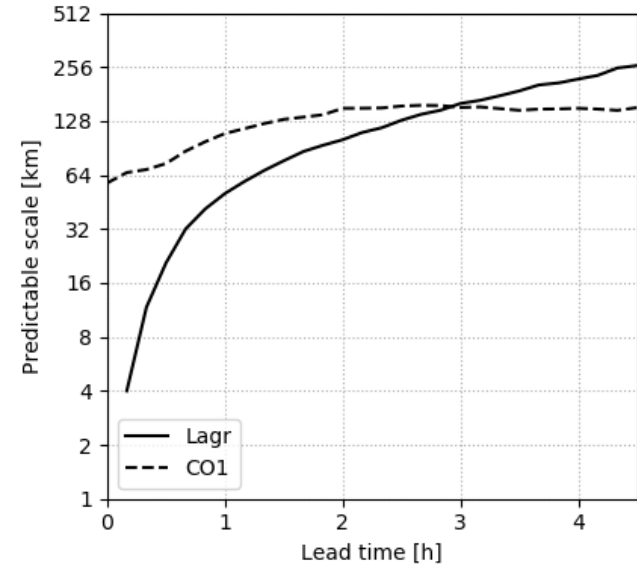
- Forecast RMSE as a function of **spatial scale** and **lead time**, and normalized by the observed root-mean-squared precipitation intensity.
- Average results for the **whole 2018**, 8x forecasts per day, **10 min** accumulations.
- The normalized RMSE can be used as a **measure of (practical) predictability**.

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Limits to prediction

- Radar-based nowcasting is essential for applications requiring predictive skill for precipitation scales **below 60 km**.
- The extrapolation of radar images is, on average, superior to the numerical forecasts from COSMO-1 **up to 3 h**.
- After 4.5 h, only precipitation on scales **above 128 km** is somewhat predictable.



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