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First verification results from an analysis-forecast smoother applied at FMI

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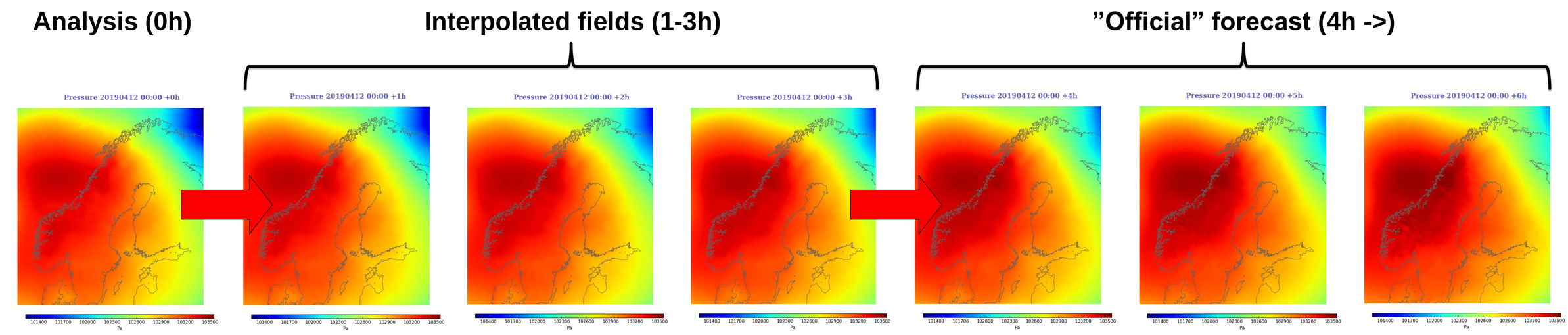
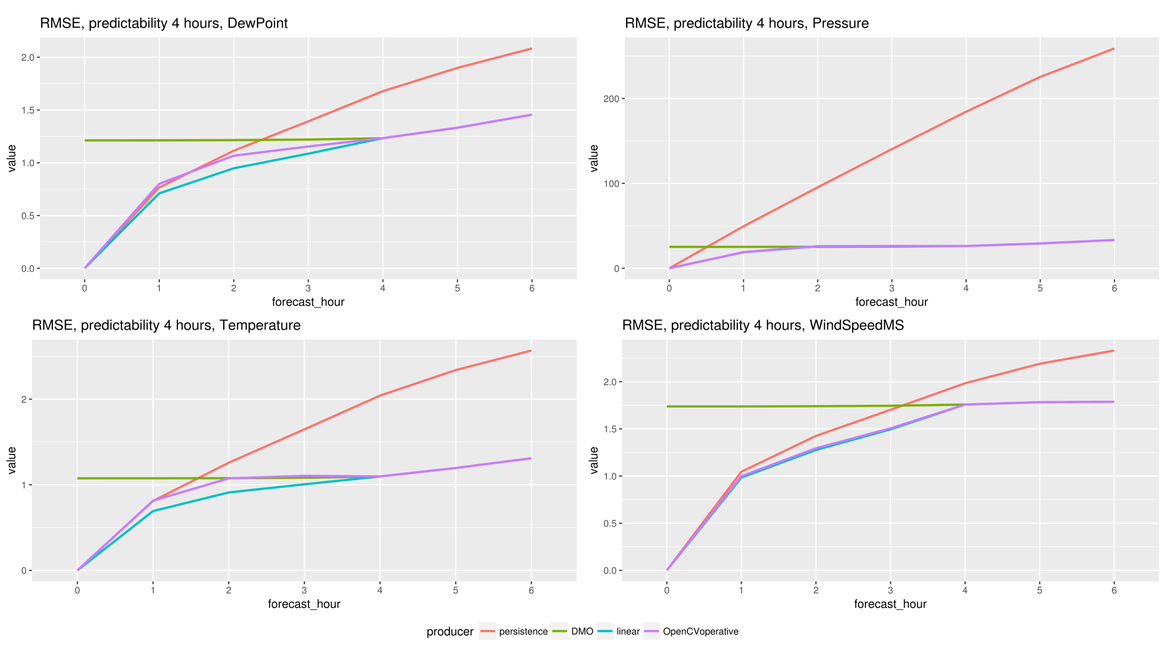
In order to provide real-time seamless forecast for operative forecasting purposes, an analysis-forecast smoother has been applied over the Scandinavian domain at FMI since July 2018. The method takes the latest analysis field from LAPS analysis system and the four-hour forecast field from the operative weather forecast. Any forecast model could be used, though. Then, the one-to-three hour forecast fields are interpolated in between of these using an OpenCV-based optical flow interpolation method. The smoother is run once an hour whenever a new LAPS analysis has been produced. Currently smoothed variables are temperature, dewpoint, wind speed and pressure. Total cloud cover and 1h accumulated precipitation are following soon.

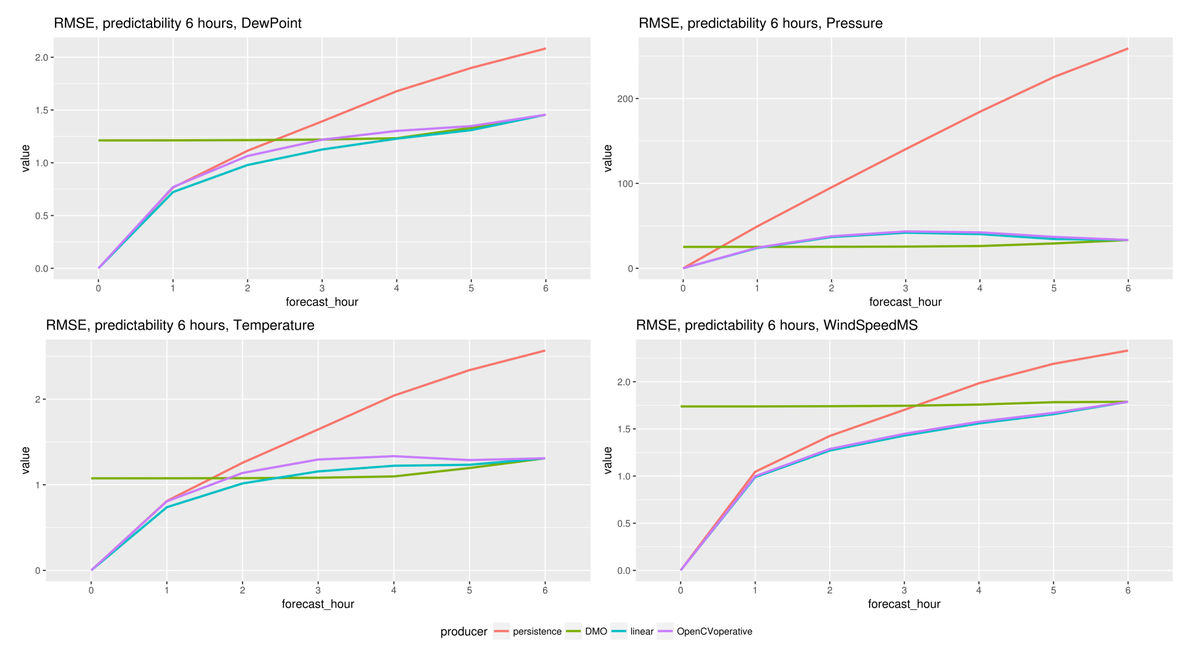
The method is able to nicely preserve well-behaving features in the animations, especially for the pressure which typically has smooth spatial characteristics. The behaviour of the other variables often is considerably more complex and they have a smaller spatial scale. This sometimes results in an apparent discontinuity on the field motion at the four-hour forecast length - The "frozen-turbulence" approximation is the better the more similar the characteristics in the analysis and model fields are. Often, either field is missing some visible feature present in the other field.

There are several ways to improve the existing scheme:
Four-hour "predictability" could be dynamically adjusted, the two input fields should be smoothed to have the same spatial characteristics and the interpolated fields in the between often behave too linearly. However, the feedback from the forecasters has in general been encouraging and our verification statistics also show that the minimum requirement of the interpolated fields is met: The RMSE of the interpolated values outperform both DMO and persistence in one to three hour forecast range. The results also reveal interesting differences on the predictability between the used variables.

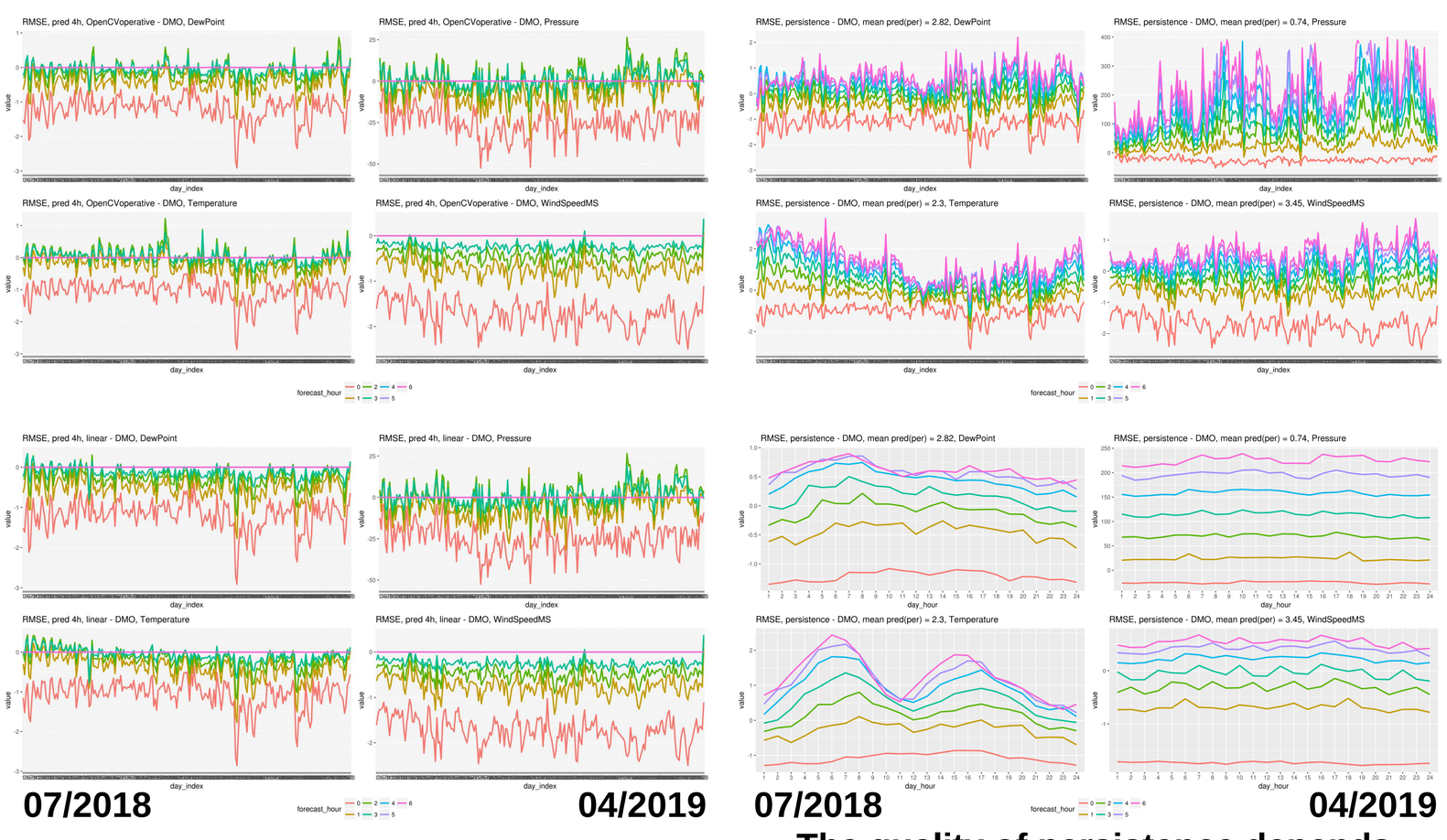


Motion vector field is calculated between the analysis and the 4 hour forecast fields.

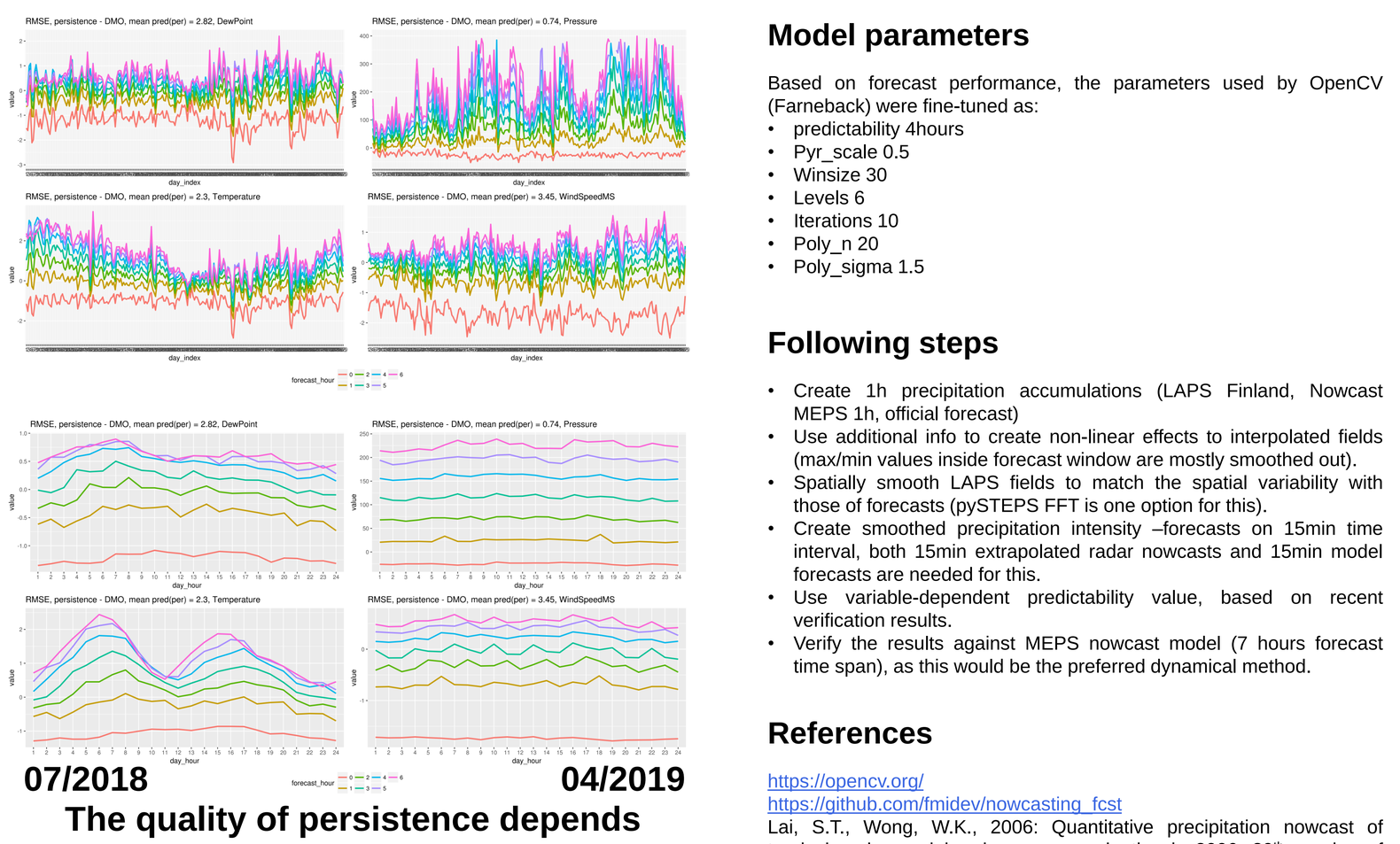




Too long predictability results as worse forecasts. The optimal predictability value is variable-dependent!



Weather affects performance



The quality of persistence depends strongly on the variable used

Model parameters

Based on forecast performance, the parameters used by OpenCV (Farneback) were fine-tuned as:

- predictability 4hours
- Pyr_scale 0.5
- Winsize 30
- Levels 6
- Iterations 10
- Poly_n 20
- Poly_sigma 1.5

Following steps

- Create 1h precipitation accumulations (LAPS Finland, Nowcast MEPS 1h, official forecast)
- Use additional info to create non-linear effects to interpolated fields (max/min values inside forecast window are mostly smoothed out).
- Spatially smooth LAPS fields to match the spatial variability with those of forecasts (pySTEPS FFT is one option for this).
- Create smoothed precipitation intensity –forecasts on 15min time interval, both 15min extrapolated radar nowcasts and 15min model forecasts are needed for this.
- Use variable-dependent predictability value, based on recent verification results.
- Verify the results against MEPS nowcast model (7 hours forecast time span), as this would be the preferred dynamical method.

References

https://opencv.org/
https://github.com/fmidev/nowcasting_fcst
Lai, S.T., Wong, W.K., 2006: Quantitative precipitation nowcast of tropical cyclone rainbands – case evaluation in 2006, 39th session of ESCAP/WMO typhoon committee