



Improving wind gust and precipitation form forecasts by post-processing ECMWF data

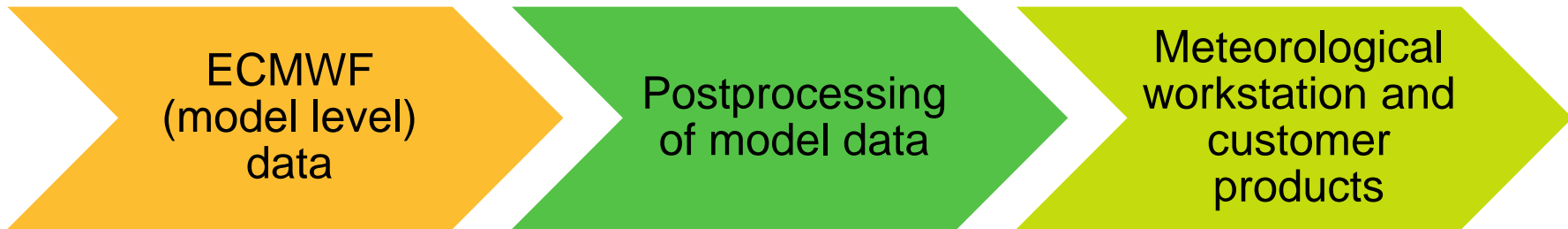
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Motivation

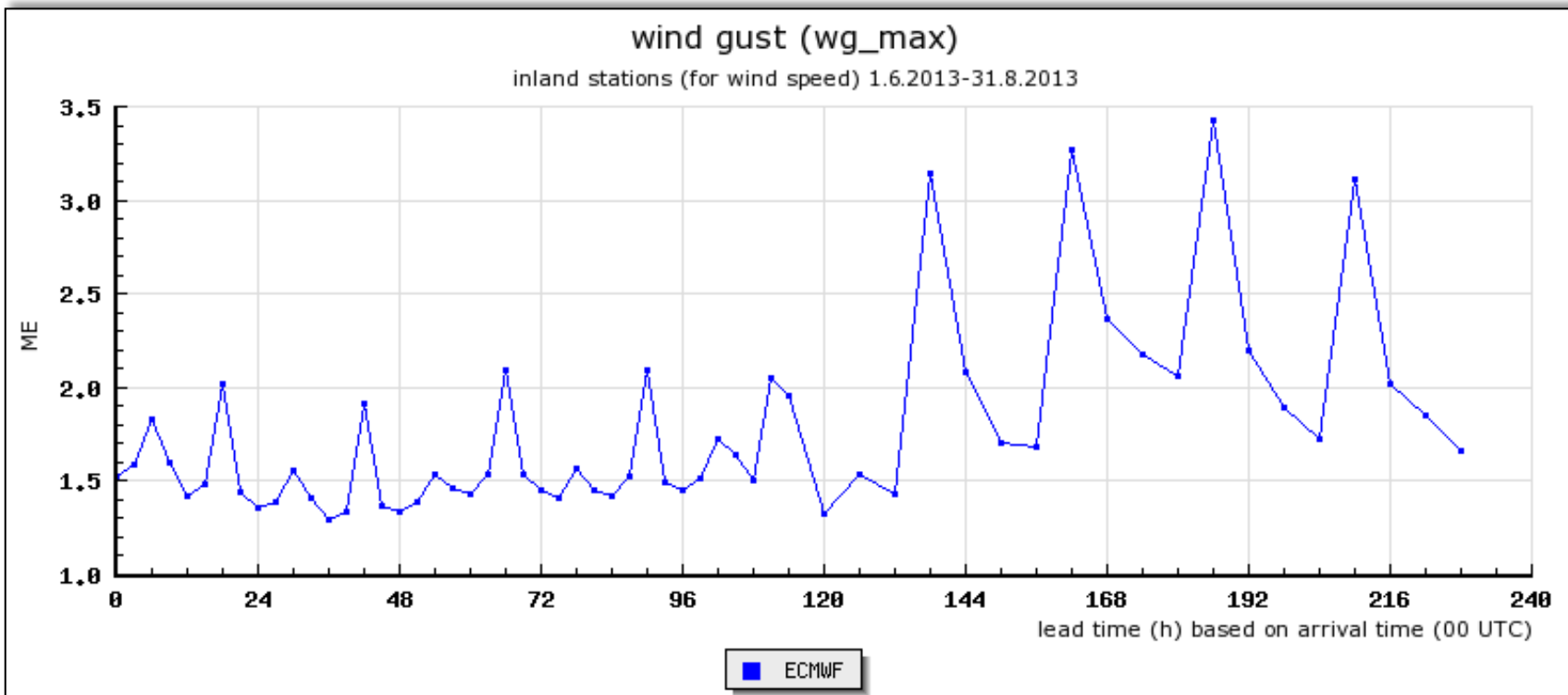
Partial renewal of NWP model postprocessing





Motivation

ECMWF model overestimates wind gusts





SmartTool algorithm development

Group of forecasters write short algorithms, SmartTools (wind gusts, precipitation form etc.)

Forecasters test and finetune algorithms in meteorological workstation

Finetuned algorithms are moved to server (faster calculation)

Postprocessed data for grid editing and customer products

In case of bad results more finetuning



Common factors for SmartTools

Have physical reasoning (wherever possible)

May be partly based on semiempirical studies and forecasting experience

Easy to convert to SmartTool language

Easy to finetune



Wind gust SmartTool is based on vertical profiles of potential temperature and wind speed

Estimation of well-mixed layer thickness ($d\theta/dz$)

In case of very strong winds, more stable stratification is allowed (mechanical turbulence).

Calculation of mean wind in well-mixed layer => surface wind gust estimate

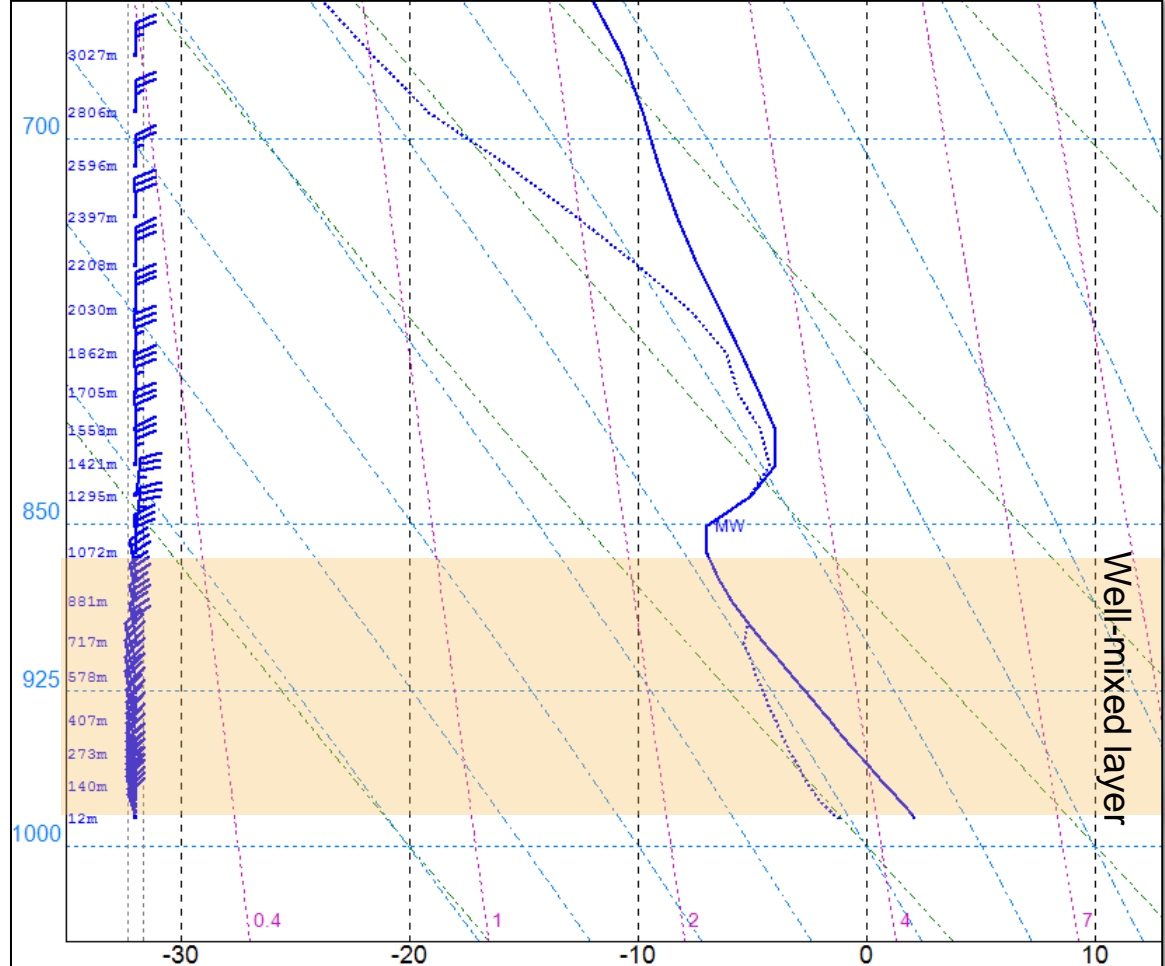
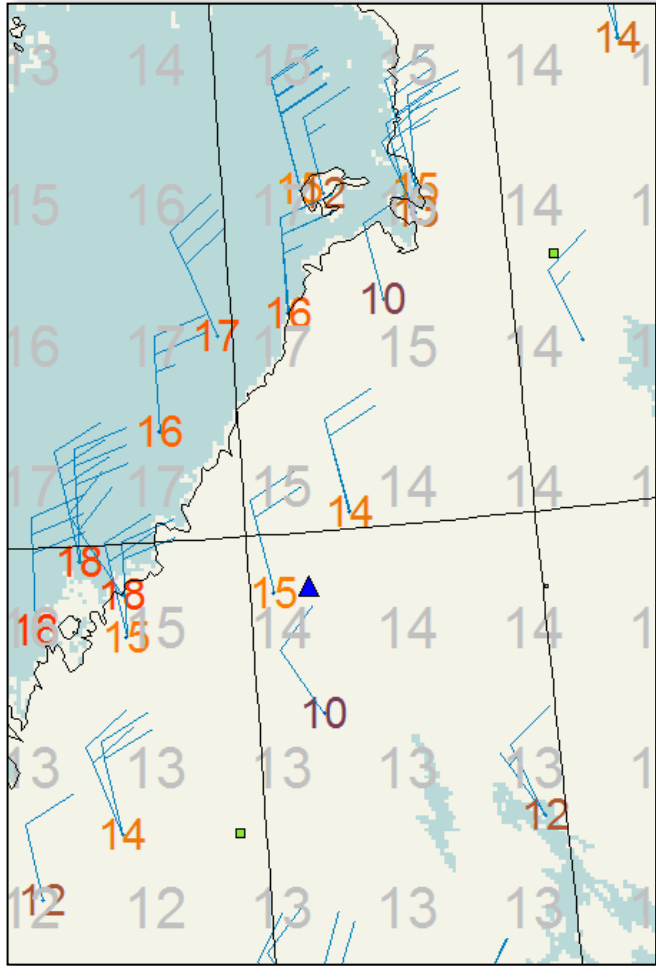
In case of stable stratification, the gust estimate is close to 10-200m mean wind. In very stable conditions, the gust estimate nears the model 10m wind speed.

Wind gust example

Post-processed wind gust forecast in gray

Observed wind gusts in orange and red

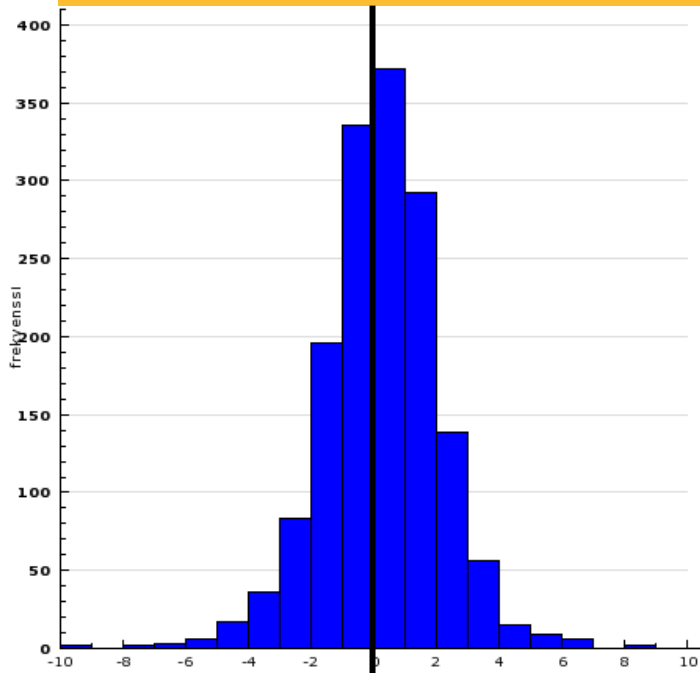
Forecast sounding for the location with a blue triangle



ECMWF model overestimates wind gusts

Forecaster data is based on ECMWF model output => postprocessing removes or decreases the positive bias (NOTE: ECMWF data is a 3-hourly maximum wind gust)

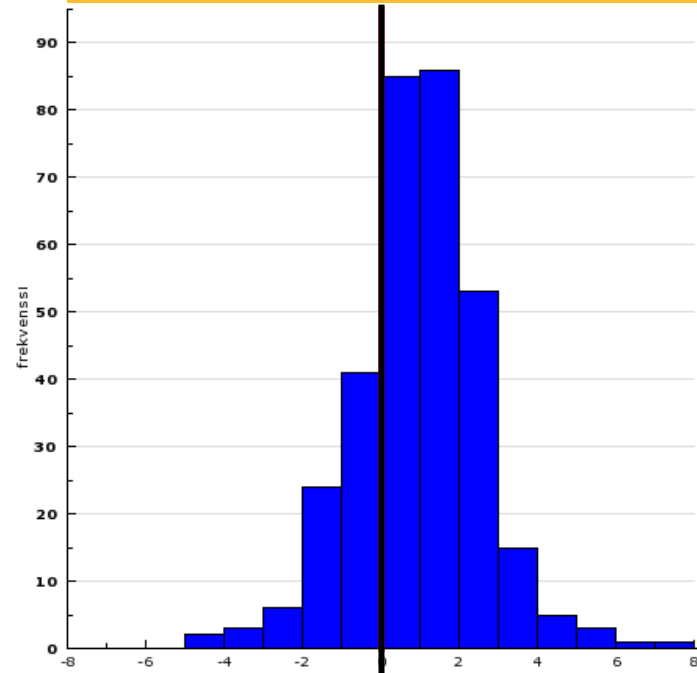
FORECASTER
 Forecast error (fct – obs)
 Helsinki airport



'underestimate'

'overestimate'

ECMWF model
 Forecast error (fct – obs)
 Helsinki airport



'underestimate'

'overestimate'



Precipitation form is determined step-by-step by examining the vertical structure of troposphere

Freezing drizzle: T_{2m} below zero, low St-cloud base, thick Stratus-layer, cloud-free layer above St (no cloud seeding)...

Freezing rain: T_{2m} < 0°C, elevated above zero layer with below zero layer underneath it.

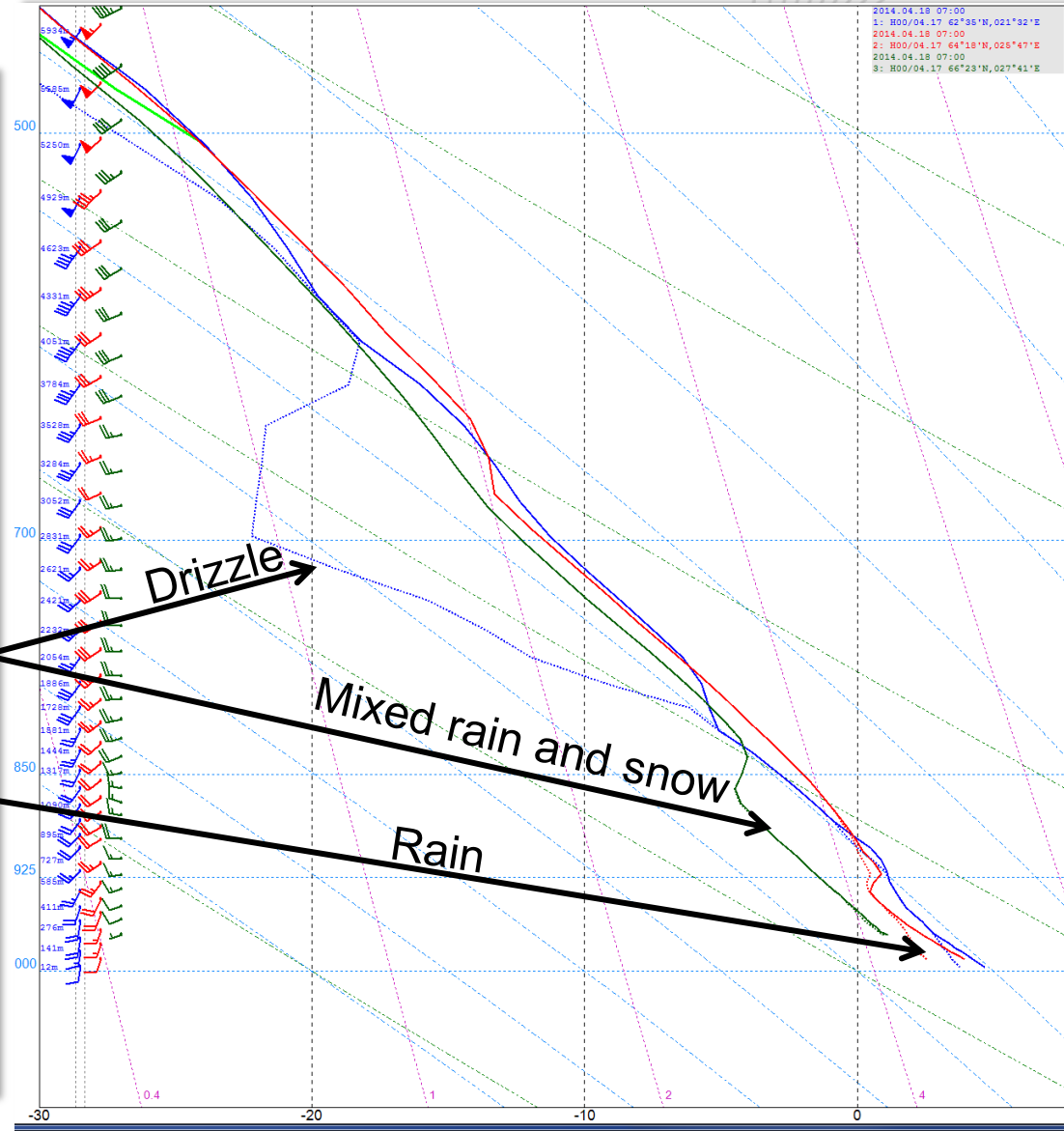
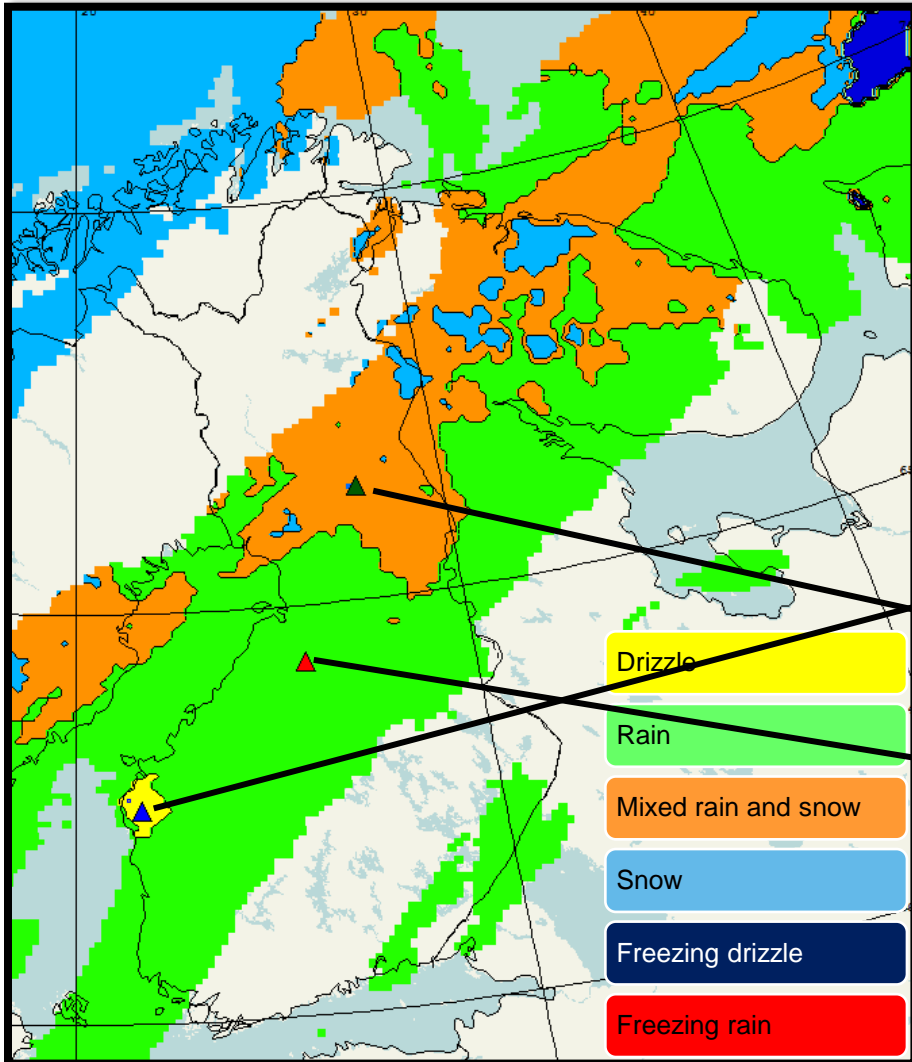
Drizzle/Rain: low cloud base, thick Stratus-layer, otherwise rain

Mixed rain and snow: shallow layer of above zero temperatures

Snow: rest of the grid points with precipitation



Precipitation form example





Summary

- **ECMWF** model data are post-processed with the aid of SmartTools. These algorithms are developed by a group of FMI forecasters.
- **SmartTools** have been created for many purposes. So far, precipitation form and wind gust algorithms are in operative use.
- **Preliminary** verification results show that the wind gust SmartTool performs better than the ECMWF wind gust parameter.
- **Precipitation** form SmartTool has not been verified but the first experiences have been encouraging.
- **SmartTools** for clear-air turbulence, aircraft icing and probability of thunder are most likely the next operative parameters.

