The operational NORLAMEPS system at Met.no

HIRLAM/ALADIN ASM
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Overview

- Motivation
- The NORLAMEPS system
- Verification of system after latest upgrades
- Case study I: Downscaling of an extreme event
- Case study II: Polar lav detection by the help of EPS
- Summary

Motivation:

- By knowing the initial state of the atmosphere -> all future states can be prognosed. (Bjerknes, 1911)
- The correct initial will never be fully known. Additionally: The models will always have deficiencies (E.g. inconclusive physics, not resolved scales etc.)

  Result -> Chaos

- Conclusion:
  The atmosphere is not a fully deterministic system! An Ensemble Prediction System (EPS) is needed to estimate the predictability of the atmospheric system.

NORLAMEPS

- Consists of two components:
  - Targeted EPS (TEPS)
  - Limited Area Model EPS (LAMEPS)

- NORLAMEPS = Combination of TEPS & LAMEPS.
  - A simple “multi” model, multi initial condition ensemble
  - 42 ensemble members [2 times (20 + control)]

TEPS – Targeted Ensemble Prediction System

- TEPS is a dedicated version of ECMWF EPS.
  - 20 + 1 ensemble members, as opposed to 50 + 1 for EPS
  - Target-area is Northern Europe and adjacent sea areas, as opposed to NH north of 30°N for EPS
  - TEPS runs at 12 UTC every day
  - Forecast length is +72h
- SV computation with T42 and 48h optimisation time
- Using ECMWF model IFS with resolution of T399L62 (~50km) for forward integration.
- The EPS/TEPS model has been considerably updated. The last update was on 6. November 2007. This update includes significant changes to the model physics, including convection schemes, with a beneficial increase in model activity. Due to the increased activity, the initial perturbation amplitude for EPS was reduced by 30%. For TEPS the reduction was set to 50%.

LAMEPS – Limited Area Model Ensemble Prediction System

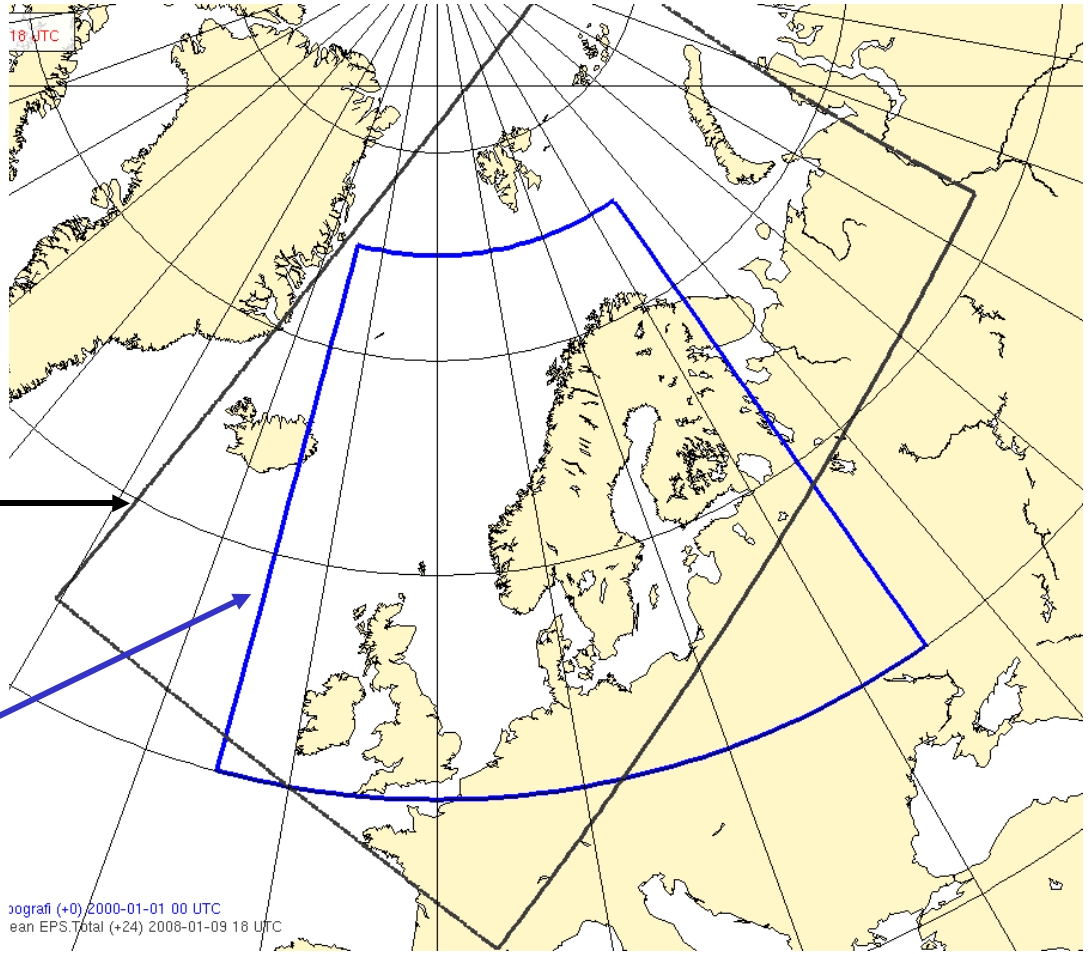
- HIRLAM in ensemble set-up (7.1.4)
- Running operational since 13. February 2008
- Resolution: 12 km (0.108°), 60 vertical levels.
- 20 members + control
  - Control based on Norwegian HIRLAM-analysis (12 km resolution)
  - 20 initial and lateral boundary conditions from TEPS.
  - Lateral boundary conditions every 3 hour.
- Runs at 06 & 18 UTC every day.
  - 6 & 18 hours time lag from TEPS
  - Forecast length is 48 & 60h

- Now: Alternating between STRACO & KF (even/odd member)
  (NB! Effect not accounted for in the following figures!)

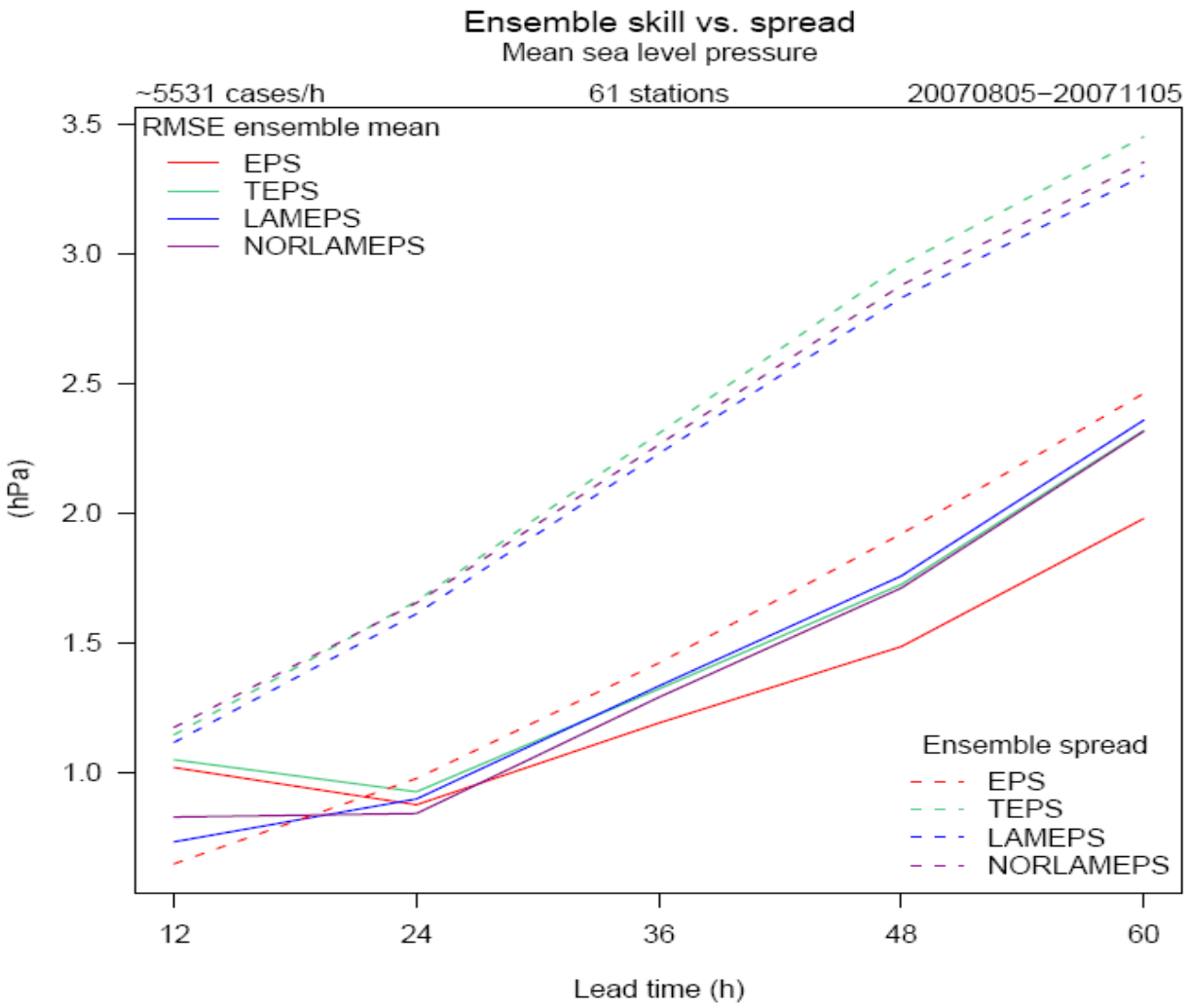
Areas presently used

Integration area LAMEPS

Target area for SVs



Verification of NORLAMEPS (I)



Before upgrading TEPS/LAMEPS

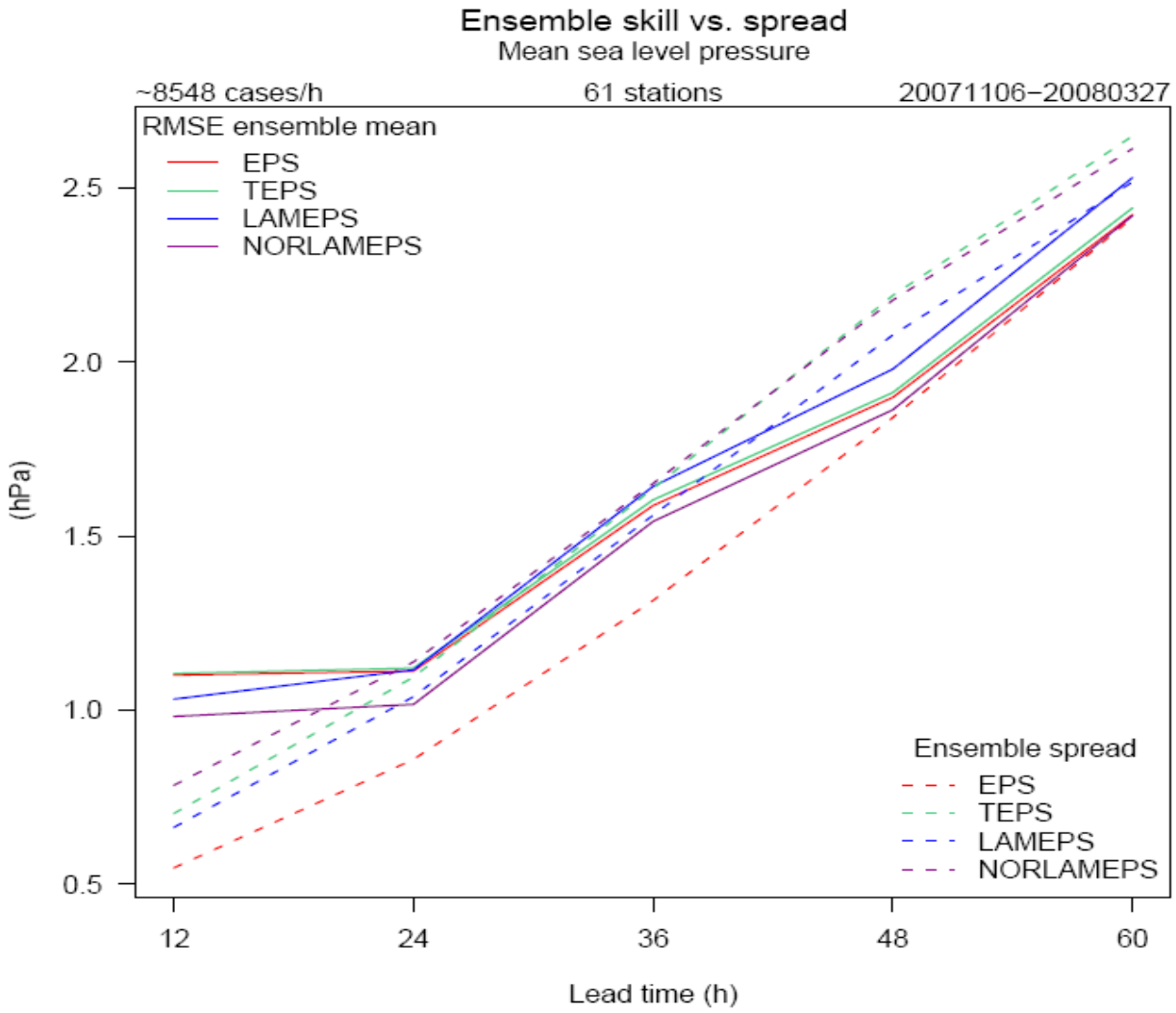
61 european stations:

Ensemble spread

vs.

RMSE ensemble mean

Verification of NORLAMEPS (I)



After upgrading TEPS /LAMEPS

61 european stations:

Ensemble spread

vs.

RMSE ensemble mean

Verification (II)

- Precipitation:
  - Better for medium amounts and better scores further into the prognosis.
    - rr > 1 mm
  - Underestimates the large amounts.
  - Still problematic to correctly forecast dry conditions.
- Wind
  - In general a good improvement.
    - Was already fairly good forecasted.

Verification(III)

ROC area for different tresholds of wind 24 hours into the forecast.

EPS:

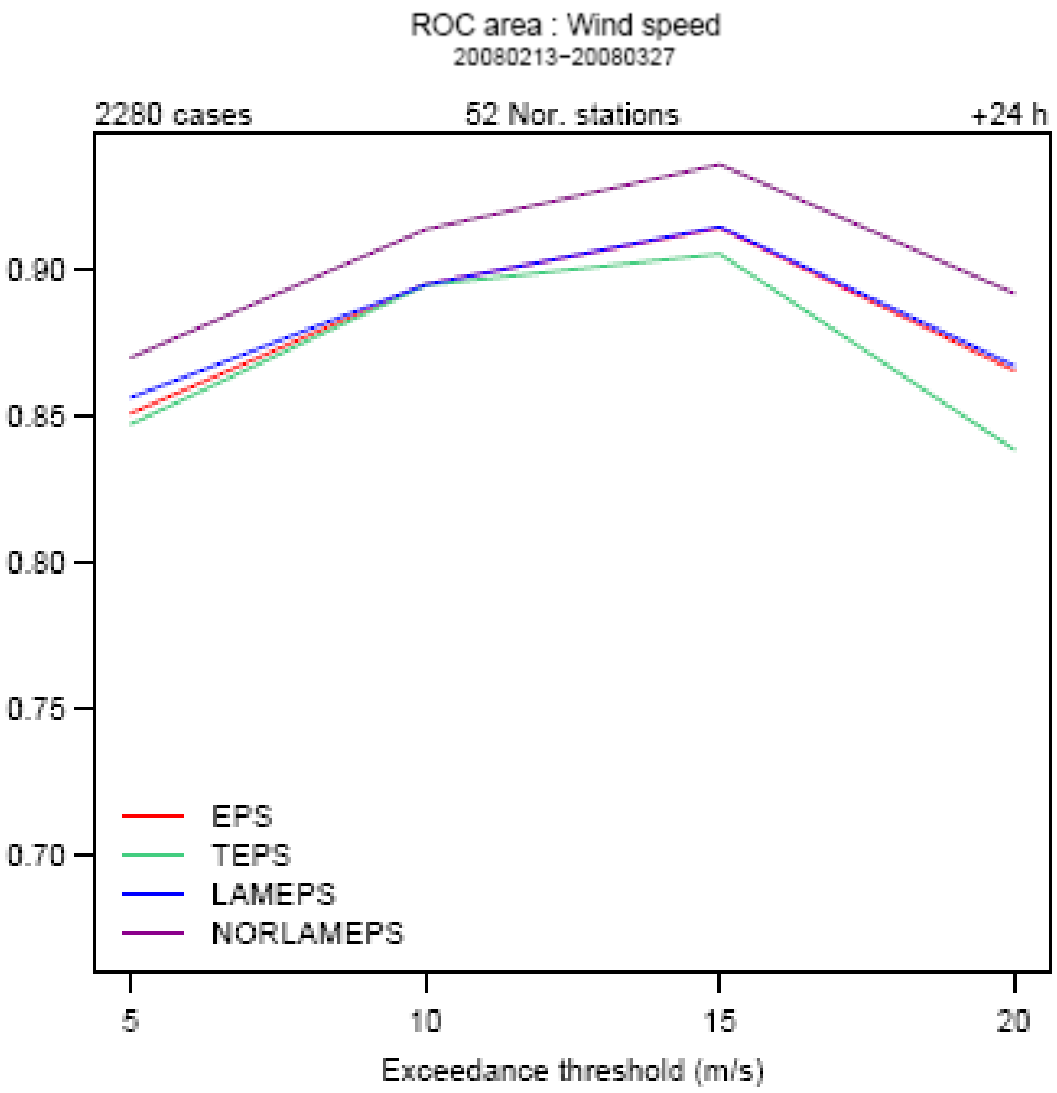
50 + 1 members

NORLAMEPS:

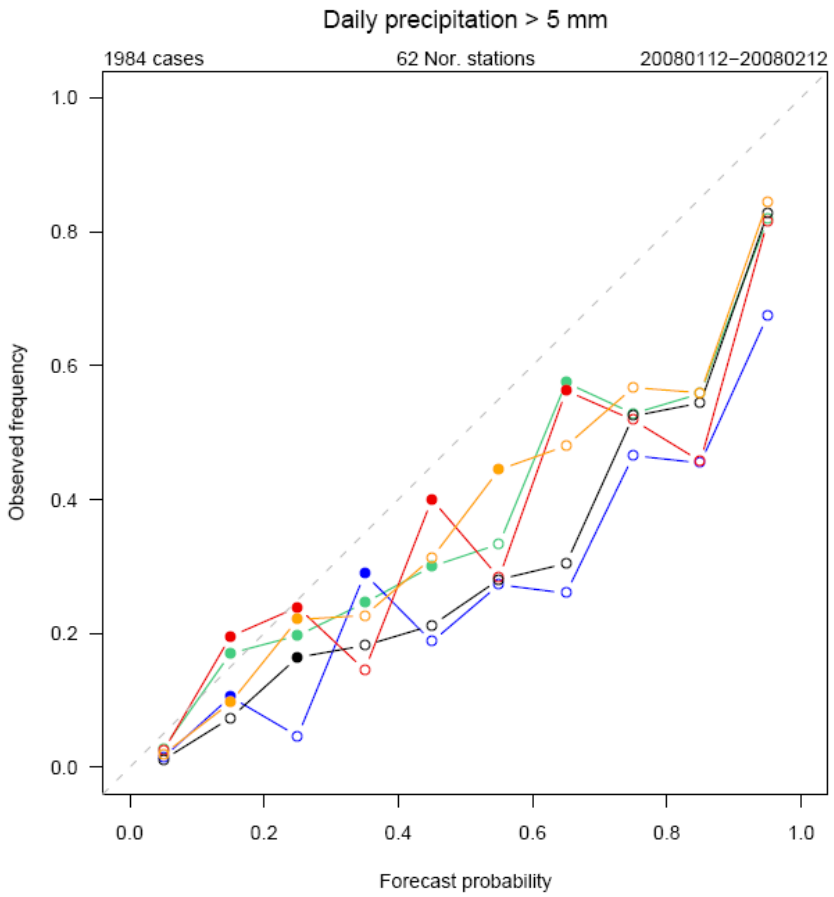
40 + 2 members

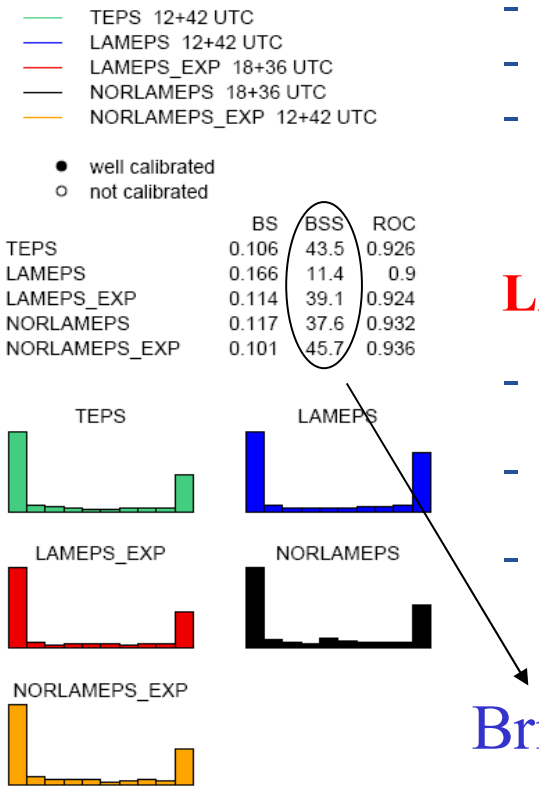
TEPS & LAMEPS:

20 + 1 members



Effect of upgrading LAMEPS



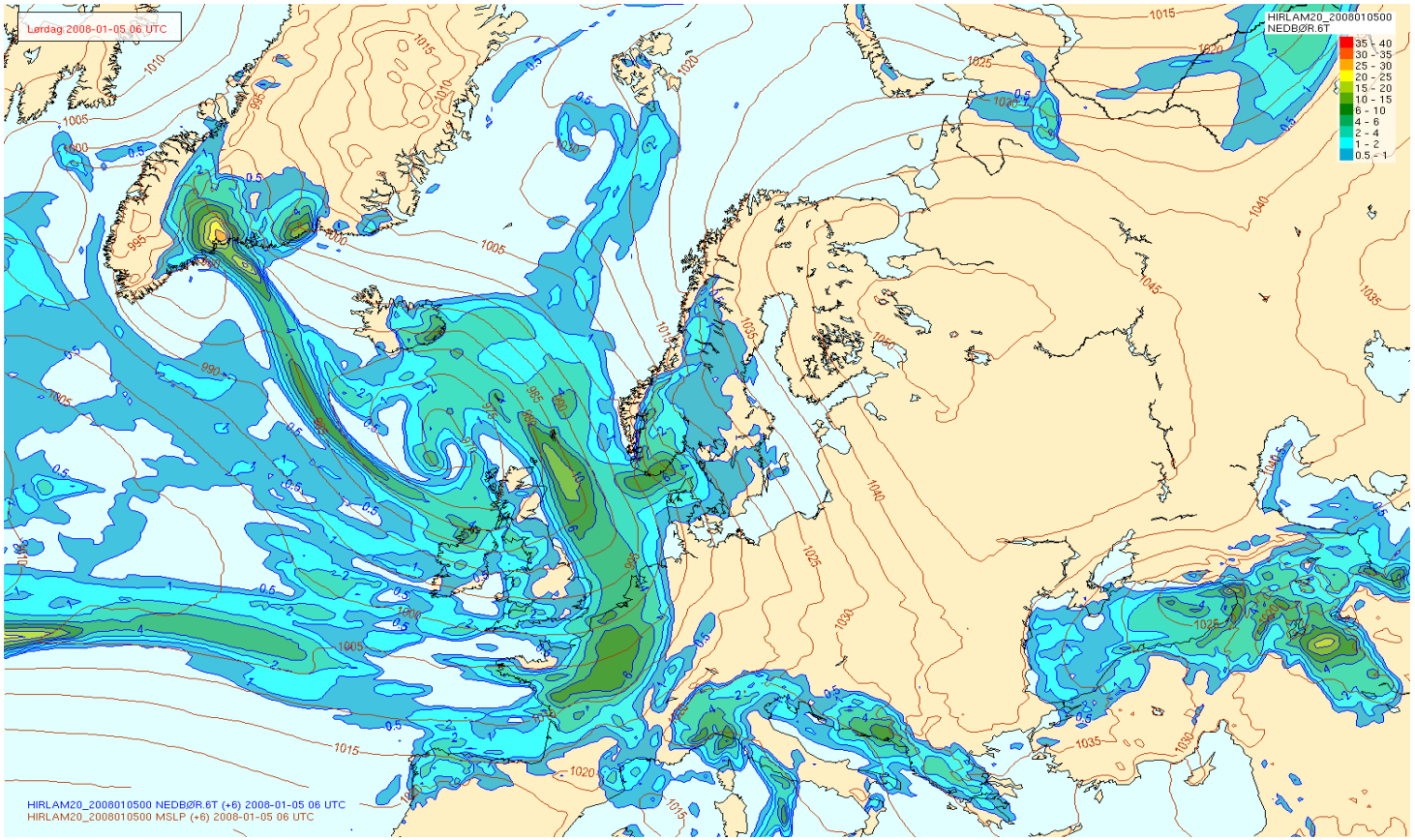


LAMEPS:
- **20 km res.**
- **Hirlam 6.4.2**
- **6 hr. LBC**

LAMEPS_EXP:
- **12 km res.**
- **Hirlam 7.1.4**
- **3 hr. LBC**

Brier Skill Score

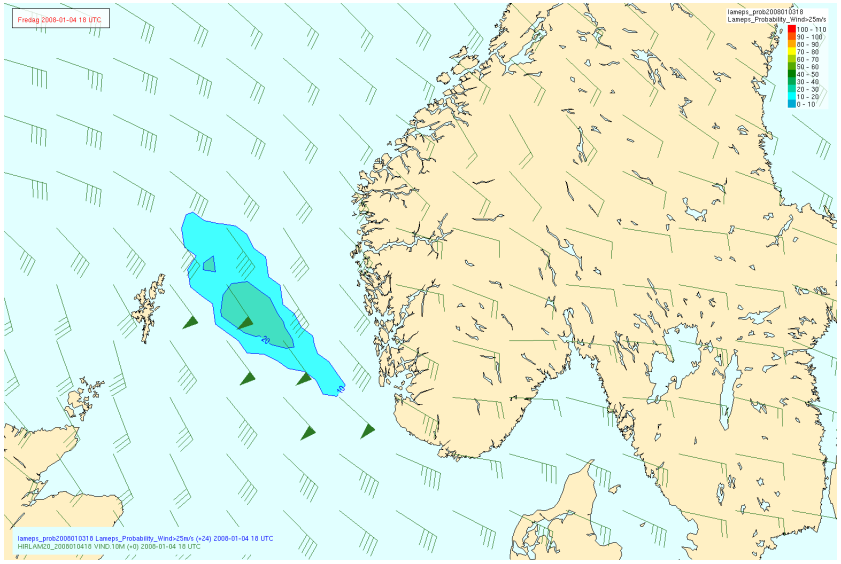
Case study I:
Extreme weather event 04-05.01.2008



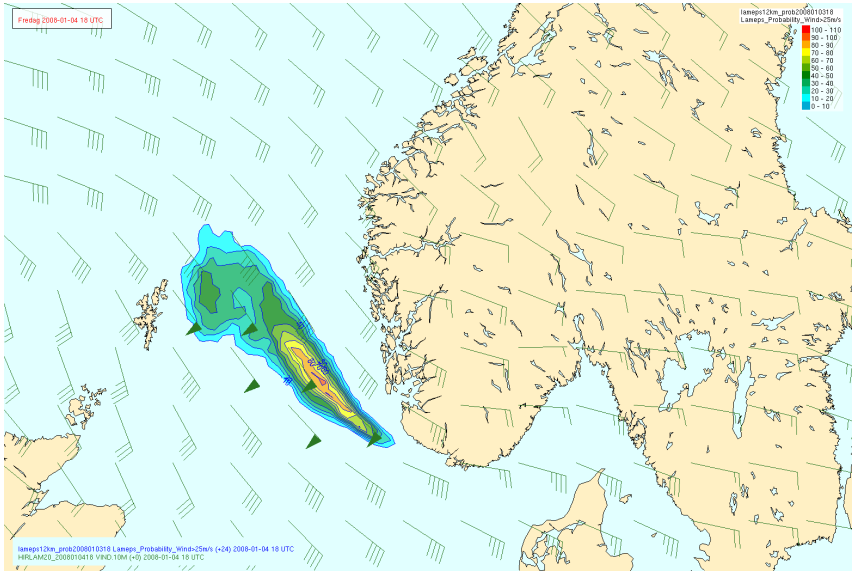
Strong winds, later heavy amounts of precipitation (1m/24hr of snow in Southern parts of Norway).

Probability of wind > 25 m/s

20 km LAMEPS

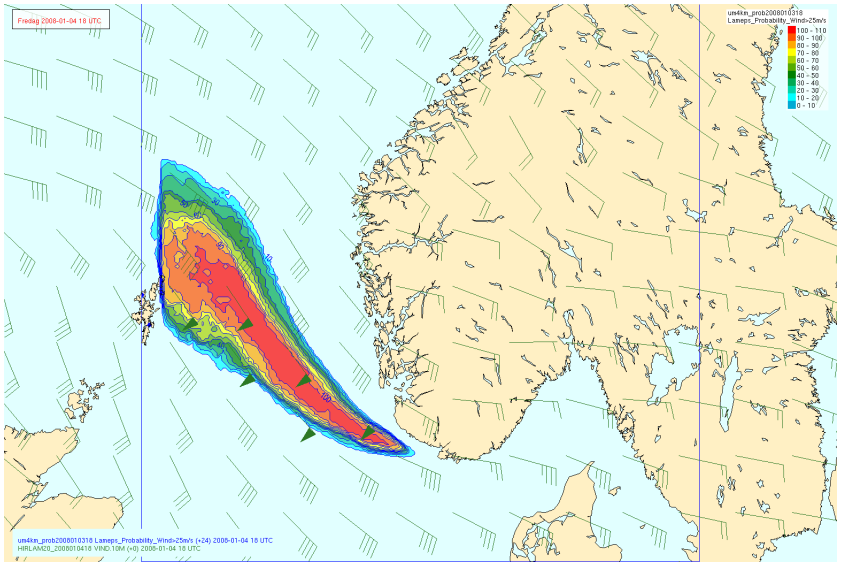


12 km LAMEPS



Downscaled to 4 km resolution.

(Unified Model)



Case study II:

04.03.2008: Polar low in the Norwegian Sea

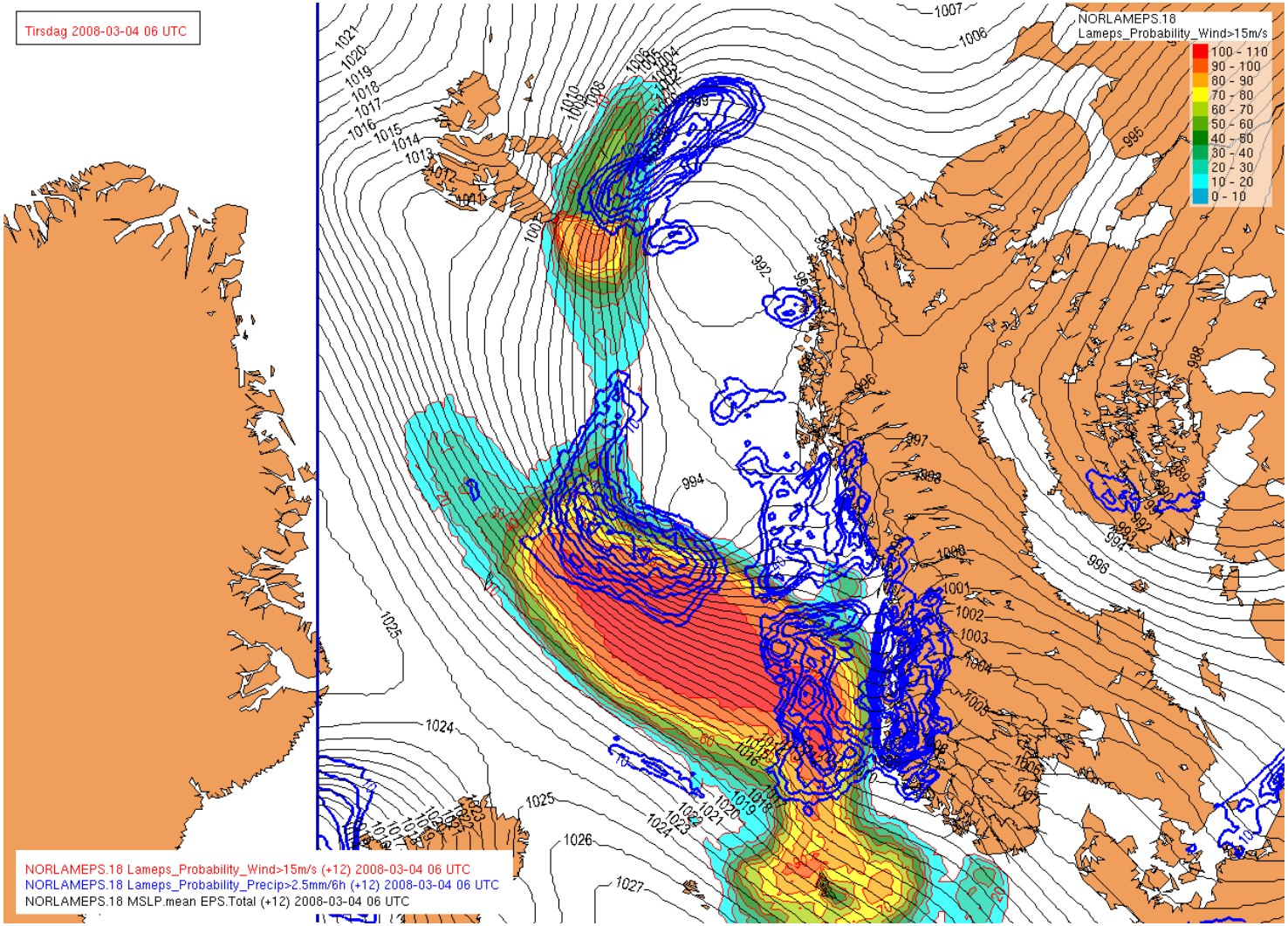
Photo: Gudmund Dalsbø

During IPY-THORPEX measurements campaign!!!

Polar Low (On the Inside….)

Photo: Erik Kolstad

Polar Low (Inside NORLAMEPS….)



LEGEND:

Black lines:

Mslp of Ensemble mean

Colour field:

Wind > 15m/s

Thick Blue:

Precip > 2.5mm/6hr

Summary

- An EPS system can estimate the predictability of the atmospheric system.
  - Good demonstration in IPY-THORPEX when it was used for the measurement campaign.
- NORLAMEPS has experienced a great improvement in the past half a year.
- An increased resolution of the atmospheric models improve the results for the shown case studies.
- Still expensive on computing time.