Status of GLAMEPS and plans for HIRLAM-B

Trond Iversen

Purpose of EPS: weather forcasting

- Ideal weather forecasts provide three elements:

  1. The ”consensus” forecast: contains at any lead time all, and nothing more than, the predictable components;
  2. Reliable forecast uncertainty of the ”consensus”;
  3. Reliable probabilities of events relevant for individual users (with forecast resolution exactly reflecting predictability).

- Predictability means:

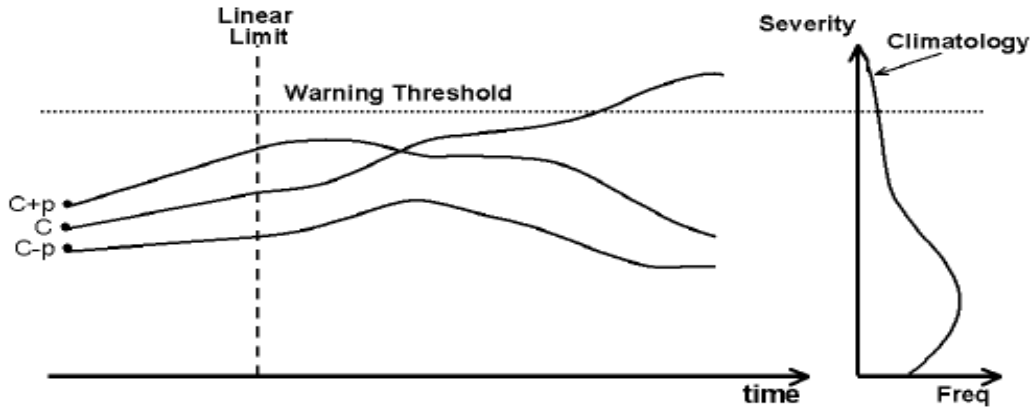
  Reliable predictions with higher forecast resolution (sharper info) than climate data, are possible

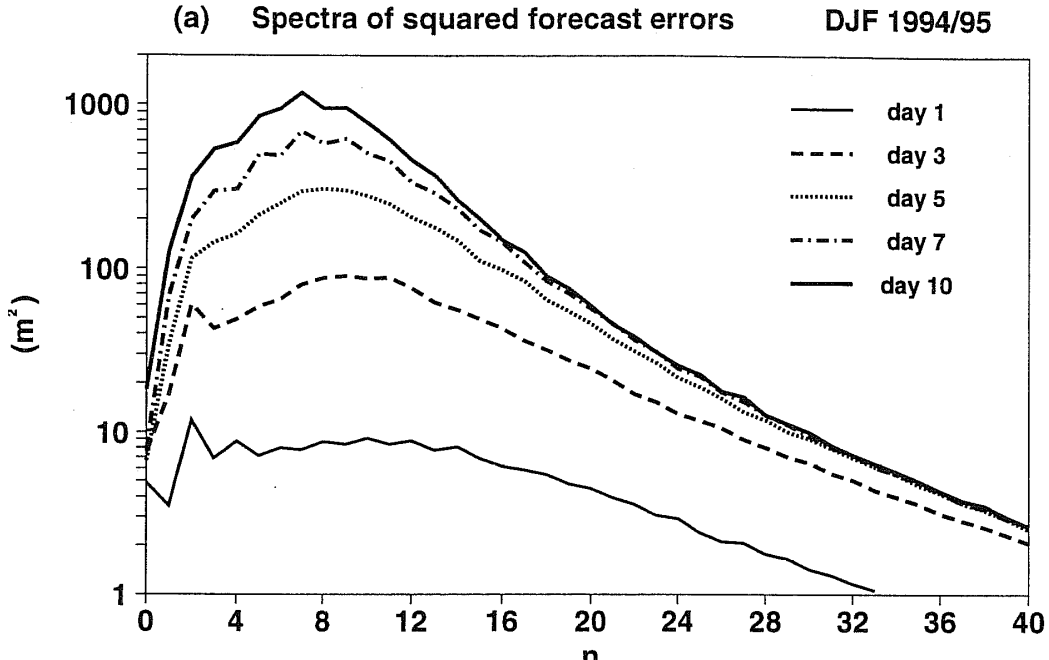
  – Forecasts can be fully reliable at all forecast lead times
  – Forecast resolution ranges
  from ~1 (analysis) to ~0 (climate data)

Challenge: high-impact weather

- High-impact weather often involves a wide spectre of scales, e.g.:
  - the larger scales provide conditions for potential occurrence
  - whilst their exact nature often involves smaller scales (peak precip., peak wind speed, fast temp. changes, etc.).
- Except for occasional interactions between large-scale features and fixed surface properties, high-impact events are not predictable beyond a fraction of a day
  - Requires high spatial resolution with frequent updates
  - Requires very accurate and swiftly produced analyses
  - Large-scale flows potentially embedding high-impact weather can normally be predicted much longer

Spectral predictability & high-impact weather





Tellus 63A, No3, 2011

SR EPS special issue

(16 papers from SRNWP EPS symposium in Exeter, June 2009)

Evaluation of 'GLAMEPS'—a proposed multimodel EPS for short range forecasting

By TROND IVERSEN[1*], ALEX DECKMYN[2], CARLOS SANTOS[3], KAI SATTLER[4], JOHN BJØRNAR BREMNES[1], HENRIK FEDDERSEN[4] and INGER-LISE FROGNER[1]

EuroTEPS — a targeted version of ECMWF EPS for the European area

By INGER-LISE FROGNER[1,*] and TROND IVERSEN[1,2] [1]*Norwegian Meteorological Institute, P.O. Box*

Properties of singular vectors using convective available potential energy as final time norm

By ROEL STAPPERS* and JAN BARKMEIJER *Royal Netherlands Meteorological Institute (KNMI),*

The ETKF rescaling scheme in HIRLAM

JELENA BOJAROVA[1*], NILS GUSTAFSSON[2], ÅKE JOHANSSON[2] and OLE VIGNES[1]

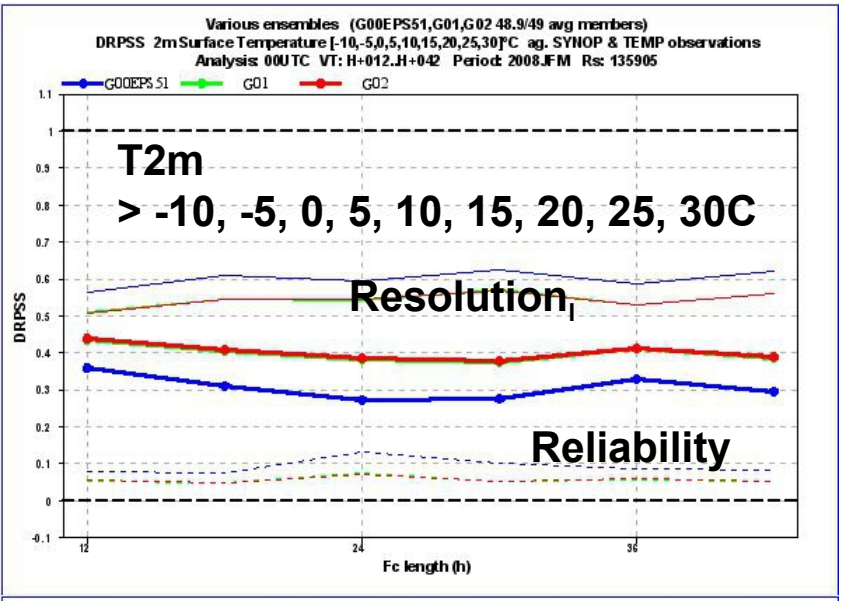
This talk

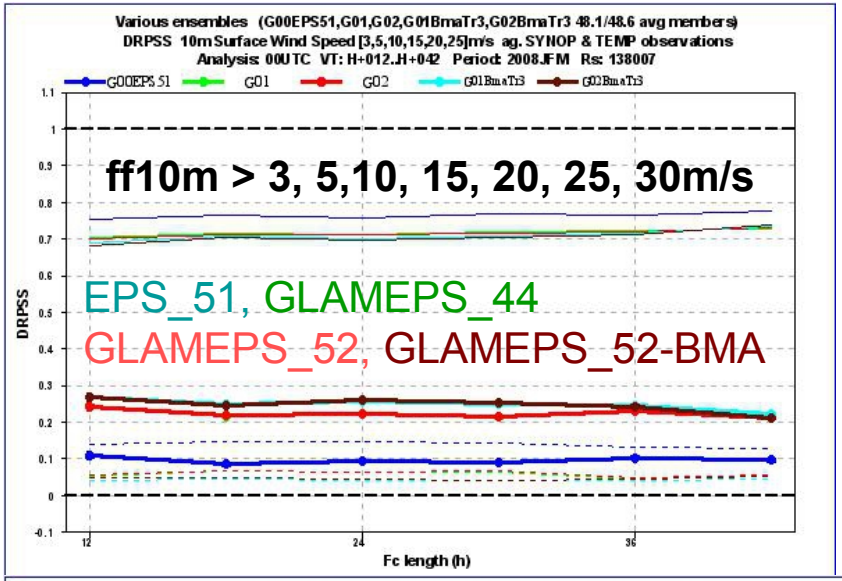
- Test-operational GLAMEPS_v0
- Preparing for operational GLAMEPS_v1
- Experiments for further GLAMEPS development
- Preparing for convection-permitting HarmonEPS - experiments

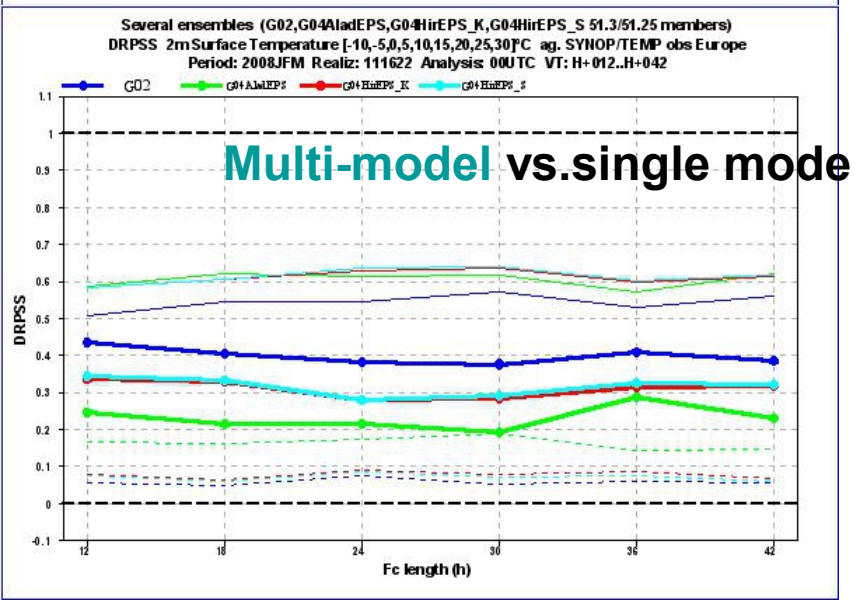
Descrete Ranked probability skill score – DRPSS

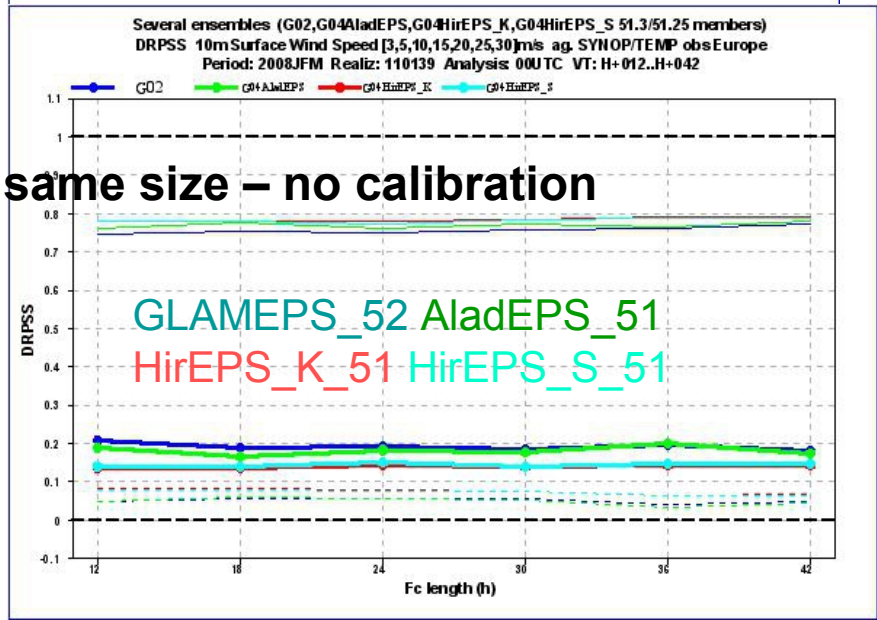
2008/0117 - 0308 (00, 12) Using T399L62 EuroTEPS

[DRPSS = 1 - Reliability - Resolution]





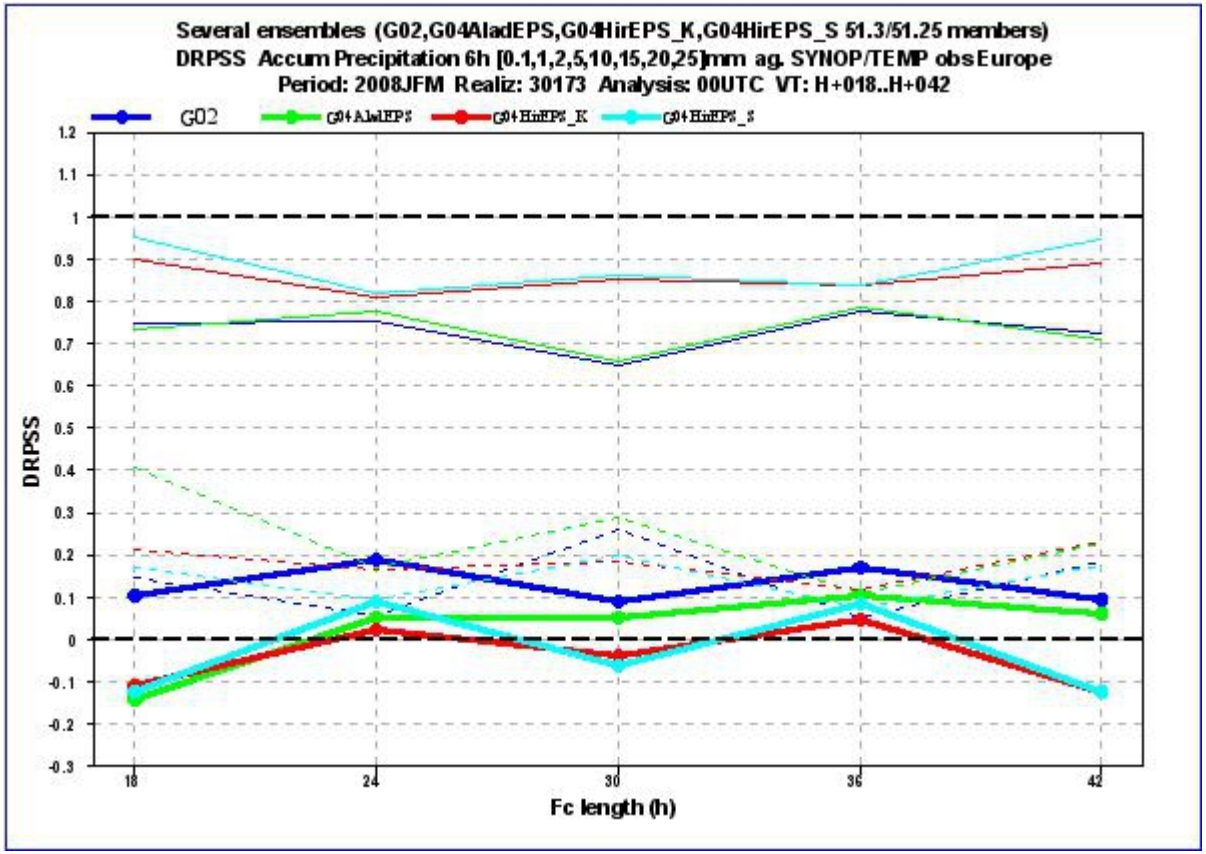




DRPSS 12-42h, 6h Precip

Multi-model vs.single model EPS of same size – no calibration

Pr6h > 0.1, 1, 2, 5, 10, 15, 20, 25, mm/6h



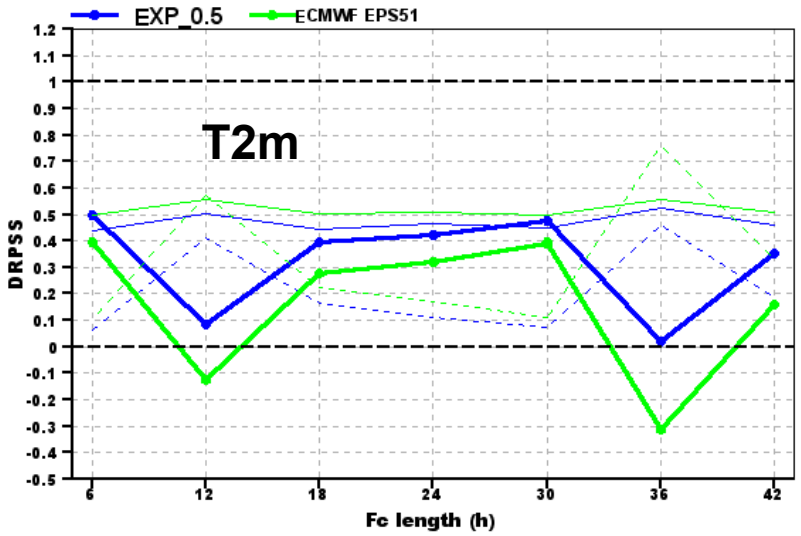
Verification GLAMEPS.org

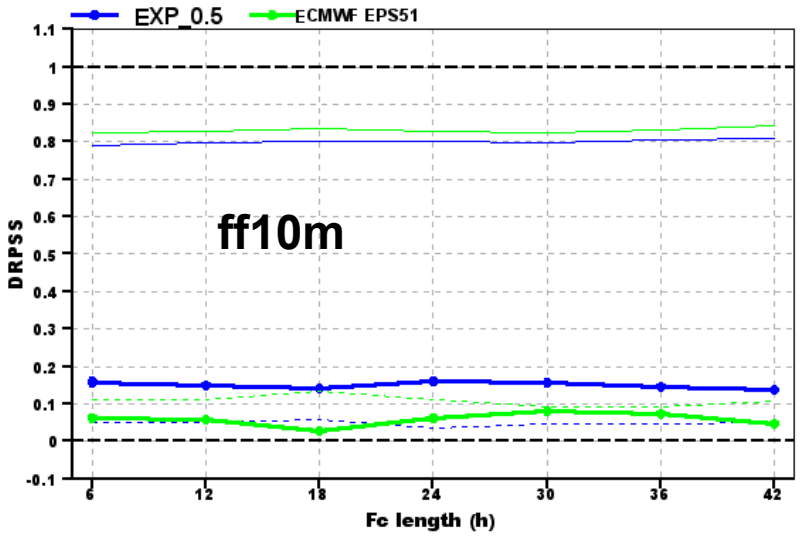
Aug-Sept-Oct 2010

EuroTEPS →Operational 51-member EC EPS, T639L62 & EDA

Verification of 52-member GLAMEPS
compared with operational EC EPS

DRPSS 12-42h





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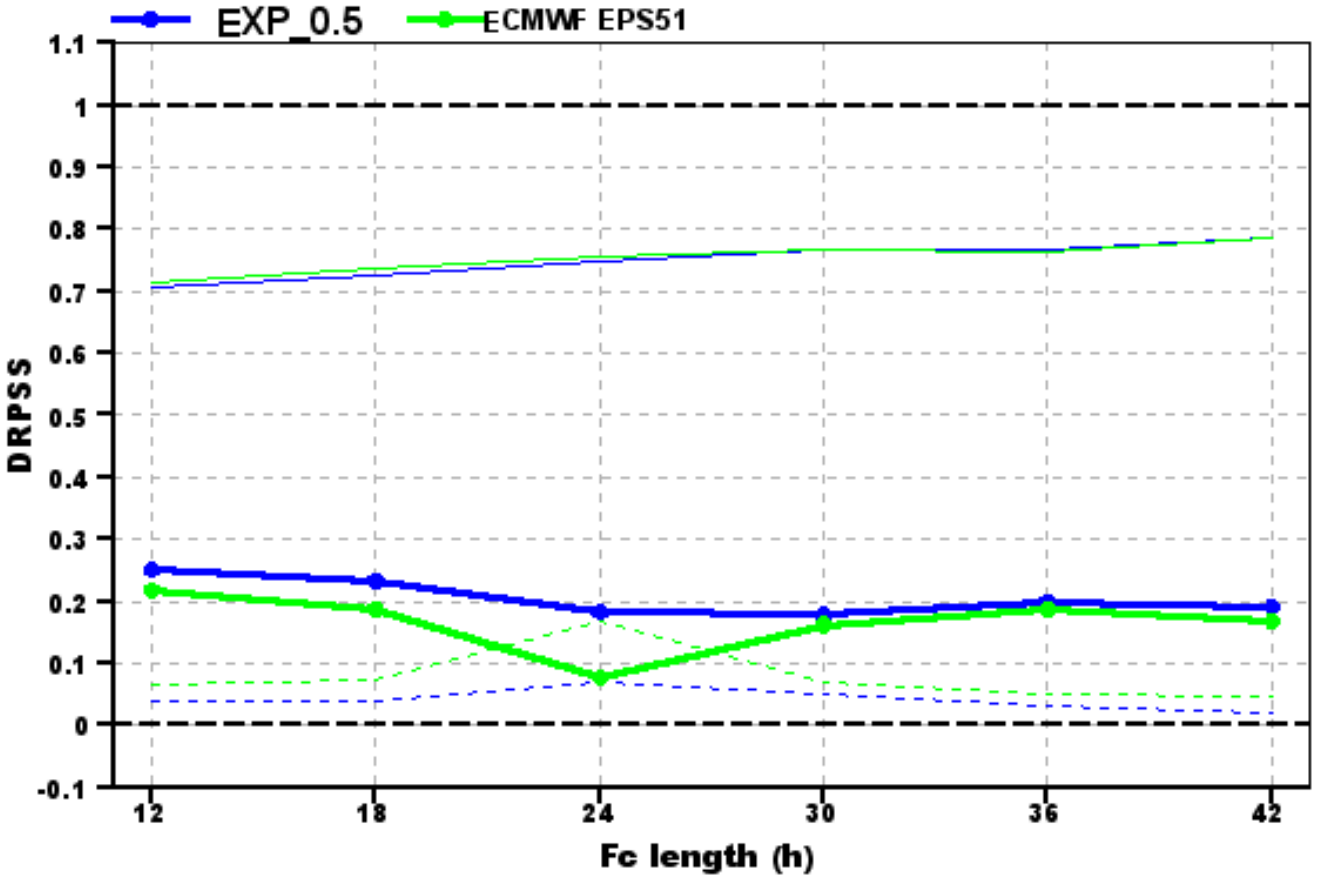
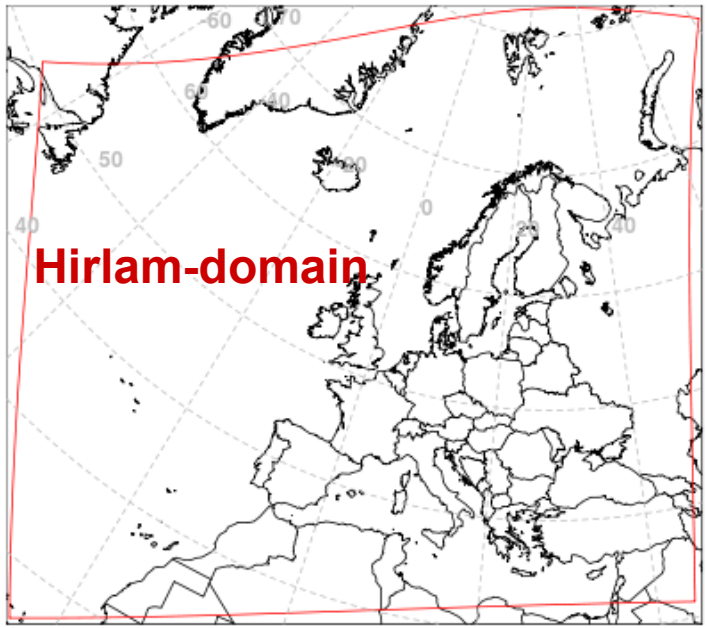


Summary on GLAMEPS_v0

- Clear improvement over operational EC EPS
  - Ready for preparing operational GLAMEPS_v1
- Multi-model better than single model EPS
  - Exceptions exist: systematic un-even model quality
  - Model-specific bias-correction may help
- Replacing EuroTEPS with EPS-selection degrades
  - but only slightly (re: talk by Inger-Lise Frogner)

The design of the LAMEPS_v1

- *Replace EuroTEPS with 51-member EC EPS*
  - *Utilize all 51 ensemble members*
- *HirEPS and AladEPS with ~11-11.5 km on 30% larger domains*
- *for longer lead-times (54h) starting from 06 and 18 utc*
- *Aladin and Hirlam upgraded to latest versions*
- *Multiple surface DA in Aladin (SURFEX + CANARI).*
- *SMS-scripts for operational prod at ECMWF (TCF Opt 2):*



Aladin-domain

-Routines for production monitoring
-Operational emergencies →RT-actions
-Products and presentations
-Raw data for download, Grib 2
-Operational verification

Further GLAMEPS development

LAM-specific SVs

- CAPE , CAPE suppressing, or other SVs in HIRLAM and HARMONIE
- Investigate role of diabatic processes, resolution, and optimization time
- Blending with larger scale perturbations

ETKF, EDA, Hybrid etc.

- Further studies on inflation factors
- blending with larger scale perturbations
- Comparison between EDA-Hybrid and ETKF-Hybrid

Introduce higher-resolution ensemble members in GLAMEPS

Perturbations in lower boundary data and atmospheric physics tendencies

- Explore
  - physics parameter variations
  - stochastically perturbed tendencies
  - stochastic backscatter (cellular automata)

  in GLAMEPS / Harmonie

Probabilistic calibration

- Refine the R-based BMA (or alternative methods -ELR), to better account for spatial variations in climatology
- Investigate other calibration methods (Extended Logistic Regression - ELR)

Probabilistic verification

- Refine and optimize Hppv (or an alternative) for operational verification

- Establish flexible alternatives for quick verification of calibration and ad hoc experiments.

GLAMEPS test-periods

- July-August 2010
- December 2010 - January 2011

EC-EPS-data (T639 with EDA) prepared for experiments with GLAMEPS.

Intention also to prepare data for verification, diagnostics, calibration, and benchmarking for further developments

Preparing for convection-permitting HarmonEPS

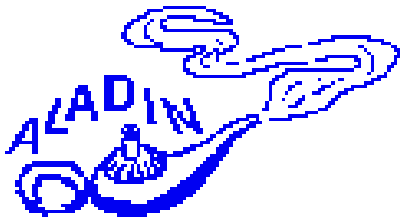
- Preparation of alternative BC-data,
  - Fine-scale(T1279) EC-EPS with EDA, 20+1 members
  - or fine-scale EuroTEPS (T1279, with EDA) 12+1 members **?**
- Build a basic, exploratory, setup for N.H. HarmonEPS downscaling on a sub-European domain enabling further experimental developments:
  - a 4km or finer Harmonie with Alaro.
  - a 2.5km or finer Harmonie with Arome
  - Scale-dependent predictability studies
  - Multimodel combinations, incl. other models (e.g. UM)
- **Challenge:** Prepare for high-resolution probabilistic verification.

Considered HarmonEPS experiments over a 3-5 year period – with links to DA

- EDA and/or ETKF? Hybrid with 3d-Var or 4D-Var?
- Due to short predictability and small error saturation levels: time-efficient and accurate methods are needed for
  - data-assimilation,
    - **high-resolution observations**
    - **time-dep. model error,**
    - **ground surface analysis;**
  - simpler DA run as RUC rather than ”the perfect”
  - generation of intial state perturbations
  - accounting for surface and lateral boundary data errors
  - running the forecasts
- Is there any need for initial-state LAM SVs?
- Experiments with physics perturbations:
  - Multiphysics (e.g. Alaro and Arome?)
  - Multimodel (e.g. HarmonEPS and UM EPS?)
  - Stochastic tendencies / backscatter, Cellular Automata.
  - Parameter perturbations and optimal perturbations

Plans are ambitious

- Need dedicated, competent personnel
  - There is a golden chance now to enter into a pioneering activity with exciting research and potentials for advancing into a new paradigm for weather-forecasting
- Need computer resources (BU at ECMWF, & nationally)




Thank You!