Status of GLAMEPS and plans for HIRLAM-B

Trond Iversen
Purpose of EPS: weather forecasting

- 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
Evaluation of ‘GLAMEPS’—a proposed multimodel EPS for short range forecasting

By Trond Iversen¹, Alex Deckmyn², Carlos Santos³, Kai Sattler⁴, John Bjørnar Bremnes¹, Henrik Feddersen⁴ and Inger-Lise Frognér¹

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

By Inger-Lise Frognér¹ and Trond Iversen¹,² ¹Norwegian 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 Bojarova¹, Nils Gustafsson², Åke Johansson² and Ole Vignes¹
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 ]

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

**Descrete Ranked probability skill score – DRPSS**
2008/0117 - 0308 (00, 12) Using T399L62 EuroTEPS

- **T2m**: > -10, -5, 0, 5, 10, 15, 20, 25, 30°C
- **ff10m**: > 3, 5, 10, 15, 20, 25, 30 m/s

**DRPSS = 1 - Reliability - Resolution**

- EPS_51, GLAMEPS_44
- GLAMEPS_52, GLAMEPS_52-BMA
- GLAMEPS_52, AladEPS_51
- HirEPS_K_51, HirEPS_S_51

**Various ensembles**
- (G02, G04, AladEPS, HirEPS_K, HirEPS_S) 61.25 members

**DRPSS 2m Surface Temperature**: [-10, -5, 0, 5, 10, 15, 20, 25, 30°C] ag. SYNOP & TEMP observations
- Analysis: 00UTC VT: T=H-01, J=0-2
- Period: 2008/01 Realiz: 10159 Analysis: 00UTC VT: T=H-01, J=0-2

**DRPSS 10m Surface Wind Speed**: [3, 5, 10, 15, 20, 25, 30 m/s] ag. SYNOP & TEMP observations
- Analysis: 00UTC VT: T=H-01, J=0-2
- Period: 2008/01 Realiz: 10159 Analysis: 00UTC VT: T=H-01, J=0-2
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

![Graphs showing DRPSS values for T2m and ff10m over Fo length (h).]
DRPSS 12-42h, 6h Precip
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 CLAMEPS_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):
  - Routines for production monitoring
  - Operational emergencies → RT-actions
  - Products and presentations
  - Raw data for download, Grib 2
  - Operational verification
Further 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.
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 *initial 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!