Verification setup – Some visions
FROST-2014

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Finnish Meteorological Institute

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JWGFVR Goals

Verification component of WWRP, in collaboration with WGNE, WCRP, CBS

- Develop and promote new verification methods
- Training on verification methodologies
- Ensure forecast verification is relevant to users
- Promote importance of verification
- Encourage sharing of observational data
- Promote collaboration among verification scientists, model developers AND forecast providers
Verification planning #1

✓ All forecast producers verify their own output, anyway (point 2, below)
✓ Centralized AND ”external” verification ⇔ Verify verification results
✓ Two separate, complementary, approaches ⇔ like SNOW-V10
  1. High temporal resolution Point verification ⇔ User needs
     ▪ Users require thresholds for their decisions ⇔ Categorical approach
  2. Research-oriented verification ⇔ Model comparisons
     ▪ Verification of nowcasts and regional model output
     ▪ Verification of EPS – larger scale phenomena
✓ User-oriented pointwise verification of all forecasts, tuned to the decision points of the decision maker ⇔ Activities take place at points
✓ Follow SNOW-V10 approach, ref. George Isaac presentation
   ▪ Guidance from published literature ⇔ List from George
✓ Lesson learnt from SNOW-V10 !
Verification planning  #2

✓ Details of ALL available/planned models/systems + obs ⇔ Already there?
  ▪ Forecast lead times and projections ⇔ Already there?
  ▪ Enhanced obs network with ~ 30 (?) new AWS ⇔ Status?
  ▪ Hi-Fi site-specific (point) observations of high importance/relevance

✓ Collect all available forecast products from all contributors ⇔ Already started?
  ▪ Common data base structure
  ▪ ”Freeze” the (FDP) system at certain stage ⇔ When?

✓ Standardized formats for fc & obs archiving ⇔ Already there?

✓ Aim at (close to) real-time verification, i.e. immediately when data(sets) become available ( SNOW-V10 verification apparently only/mostly done afterwards ? )

✓ Retrospective or real-time verification, or both ?

✓ Comprehensive post-verification possible only after all fc-obs archived (in standardized manner) and QCd

✓ Also analyses to be used as ”truth” ? ⇔ Pitfalls, independence
  ▪ Availability of model independent analyses, e.g. INCA ?
Observations are **THE** cornerstone of forecast verification!

- Linking of various observing means and data platforms
  - Highly relevant in forecast verification

- Observation needs always to be associated with forecast verification
  - Verification may help in identifying observation gaps

Acknowledgement: Dr. TANG / SMB
Observations are **THE** cornerstone of forecast verification!

Always best verification scores when using your **own** analysis

- Model climatology advantage
- Difference largest in tropics and at low levels

RPS for 850 mb temperature (tropics, TIGGE data) (from Park et al, 2008)
Verification planning #3

- Pointwise verification of all forecasts at all forecast = decision points
  a) "Baseline quality" from a coarse model as reference
  b) Hi-res models at various (time/space) resolutions
  c) Statistical adaptations ⇔ Available?
  d) End forecasts produced by the Olympics forecast team ⇔ Available?
  e) Inter-comparisons between, and added value, if any, (a) to (d)

- Define sports activities relevant obs sites and forecast variables and thresholds
- Use of verification software tools: R, MET, VerSUS (COSMO) … ?
  - Roshydromet decided to go for MET?
  - FMI verification software poss. available, if run locally @ FMI ⇔ data feed?

- Preliminary simulation/testing phase during pre-winter 2012/13
  - "Beta" versions should be there by next winter
- Definition of required manpower and/or how much is expected to be available (Roshydromet vs. external)
Verification planning #4

To consider:

✓ Verification wrt observation uncertainty
✓ Timing (error) of events – onset, duration, cessation
✓ High-impact, severe event verification ⇔ What is hi-impact ⇔ Thresholds
✓ Sample size issue; statistical inference; confidence intervals
✓ Stratification vs. Aggregation ⇔ Both are needed
✓ New categorical verification measures, SEDS, EDI, ...
✓ Spatial verification (CRA, SAL, MODE, FSS, wavelets, “neighborhood”, FSS, ...) ⇔ Applicability of remotely sensed data ⇔ Requires lotsa efforts
  ▪ Case studies; Never generalizable
✓ Spatial verification of ensembles ⇔ Requires even more efforts
✓ User-oriented probability forecast verification
  ⇔ Are prob fcs provided to users or Olympics forecast team, Sochi decision-makers or end-users ?
✓ Road weather forecasting and verification ( ⇔ FMI interests )
Desirable specific properties for a verification measure:

- Should remain useful for rare events (Most conventional scores become unusable beyond the 90-92 percentile)
- Behaviour should not depend on the base rate (climatology)
- Behaviour should not depend on the base value (magnitude of verified quantity)
- Dependency on spatial and temporal scales and sampling of observational data should be minimised
- Should be accompanied by estimates of uncertainty - error bars
- Dependency on the verification grid should be minimised
- Should take both hits and false alarms into account
- Should converge quickly for relatively small samples
- Should not reward “hedging”

⇒ No currently available metrics satisfy all these !!!
FROST-2014: Model output variables and thresholds

- Data delivery to “external” verification systems
- ALL available obs data are required for verification in real-time
  ⇔ Also for ”external” verif. systems

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Thresholds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precipitation Type</td>
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<tr>
<td>Precipitation accumulation</td>
<td></td>
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<tr>
<td>Precipitation rate</td>
<td></td>
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<tr>
<td>Wind</td>
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<td>Wind gusts</td>
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<td>Wind direction</td>
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<td>Visibility</td>
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<td>Temperature</td>
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<td>Wind Chill</td>
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<tr>
<td>RH</td>
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</tbody>
</table>

“Concept paper”

✓ Deterministic
✓ EPS, probabilistic
✓ Decision-makers
✓ FDP vs. RDP
⇒ SNOW V-10 guidance
### FROST-2014: Weather parameter categories & thresholds

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cat 1</th>
<th>Cat 2</th>
<th>Cat 3</th>
<th>Cat 4</th>
<th>Cat 5</th>
<th>Cat 6</th>
<th>Cat 7</th>
<th>Cat 8</th>
<th>Cat 9</th>
</tr>
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<tbody>
<tr>
<td>Temperature (°C)</td>
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<td>RH (%)</td>
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<td>Winds (m/s)</td>
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<td>Wind Gust (m/s)</td>
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<td>Wind Direction</td>
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<td>Visibility (m)</td>
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<tr>
<td>Ceiling (m)</td>
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<td>Precip Rate (mm/hr)</td>
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<tr>
<td>Precip Type</td>
<td>No Precip</td>
<td>Liquid</td>
<td>Freezing</td>
<td>Frozen</td>
<td>Mixed</td>
<td>(w/Liquid)</td>
<td>Unknown</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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**“Concept paper”**

- **Definition of events**
- **Deterministic**
- **EPS, probabilistic**
- **Decision-makers**
- **FDP vs. RDP**
- **SNOW V-10 guidance**
<table>
<thead>
<tr>
<th>Model output contributors</th>
<th>Deterministic models</th>
<th>EPS</th>
<th>Data Assimilation</th>
<th>Verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russia (HMC)</td>
<td>Attempts to introduce data assimilation into Sochi-area COSMO based forecasting.</td>
<td></td>
<td>Regional 3D-Var based cyclic data assimilation scheme over the Sochi area.</td>
<td>Operational mesoscale verification package Interfacing of radar data for the mesoscale verification package.</td>
</tr>
<tr>
<td>Italy (USAM)</td>
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<tr>
<td>Italy (ARPA SIMC)</td>
<td>Consolidation of SOCHMEL7. Generation of new products. Generation of point forecasts (météogrammes) with dissemination in xml format. Generation of products from the combination of different LAM-EPS</td>
<td></td>
<td></td>
<td>Subject to observation availability, the performance of SOCHMEL7 will be assessed.</td>
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<td>DWD</td>
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<tr>
<td>Canada</td>
<td>Items to work on:</td>
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<tr>
<td></td>
<td>1. nesting down to 250 m (very achievable on new EC supercomputers) 2. install this system in real time</td>
<td></td>
<td>It is not expected that any progress will be achieved for this aspect.</td>
<td></td>
</tr>
<tr>
<td>Austria (ZAMG)</td>
<td>Setup of Post-processing domain in ALADIN-LAEG for Sochi (Summer 2012) Implementation of ALADIN-LAEG data flow to the project server (Autumn 2012)</td>
<td></td>
<td>1. 3DVAR or 4DVAR for 10-km LAM (to replace Global-53km as driving model) 2. 100 m – from external land surface modeling system 3. high-resolution snow analysis.</td>
<td>If data from the various observation networks over the Sochi area, and if resources are available, objective evaluation will be performed.</td>
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<tr>
<td>NOAA</td>
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<tr>
<td>TIGGE</td>
<td>Generation of products from available global EPS. Combination of global EPS and LAM-EPS output.</td>
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<tr>
<td>HIRLAM</td>
<td>Providing GLAEMPS results routinely. Run HarmonEPS experiments for the area of Sochi. Calibration of EPS forecasts.</td>
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<tr>
<td>NCAR</td>
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</tr>
<tr>
<td>Switzerland (university of Basel)</td>
<td>High resolution (1 km) fog forecast for Sochi region, Eventually semi-operational (depending on data availability). Extensive postprocessing for selected locations, and point forecast products.</td>
<td></td>
<td>Objective verification if observations are available.</td>
<td></td>
</tr>
</tbody>
</table>

**Add: FMI HARMONIE @ 2.5 km**

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FROST-14 Verification visions 19.4.2012 12
Self-learning guidance for verification

Eumetcal
The European Virtual Organisation for Meteorological Training

Eumetcal Radar Course has started (10 November 2010)
Eumetcal Course on "Weather Radar Applications in Nowcasting" started 9 November with a plenary introduction online session. All 49 participants (…)

SCENARIO workshop: excellent outcomes (16 October 2010)
The Eumetcal SCENARIO workshop ended last Friday 15.10, after a 2½ days of lectures and hand-on sessions in the excellent training facilities of (…)

> EUMeTrain on CALmet Online 24 November 2010 at 14 UTC
CALmet Online Session 4: EUMeTrain on CALmet Online 24 November 2010 at 14 UTC Instructors: the EUMeTrain team
Session Date: Online session 24 November 14 UTC Topic: EUMeTrain has gained (…)

> Sixth Eumetcal Workshop 30 Nov - 2 Dec 2010 (WMO, Geneva)
The sixth international EUMETCAL Workshop will be held from 29 November - 2 December 2010 in Geneva, Switzerland, hosted by the World Meteorological Organization (WMO). This Workshop is aimed at (…)

> Eumetcal Radar course 2010-1011
The Eumetcal blended course "Weather Radar Applications in Nowcasting for Weather Forecasts" will start next November.
The course will be the second course in the field of radar meteorology (…)

> Eumetcal SCENARIO Workshop 2010
The Eumetcal SCENARIO workshop will take place 13-15 October 2010. The course will be the first offered by Eumetcal on this topic and will be run in the Deutscher Wetterdienst (DWD) training (…)

> EUMeTrain Warning Week 4-7 October
From 4 to 7 October 2010 the EUMETSAT sponsored training project EUMeTrain will organise an event week on weather warnings. This event week consists of several online sessions dealing with (…)

Verification Training
XXII Olympic Winter Games
Feb-Mar 2014
www.eumetcal.org

CAL Verification training modules

Comprehensive guidance in self-learning of forecast verification

Verification Training

... produced by Pertti Nurmi, Laurie Wilson & Sigbritt Näsman, 2006-09
Forecast Verification

Welcome to the modules on forecast verification. The modules are designed both for users of verification results, who wish to understand what the results really mean, and those who wish to dabble in verification methodology themselves.

There are **4 modules in this course**. The introductory module covers general issues about reasons for verifying, and the different types of forecast and observation data used in verification. The other modules are organized by type of forecast. If you are new to the subject of verification, then it is highly recommended that you complete the introductory module, which will help put the other modules into better perspective. If, on the other hand, you already know what a "deterministic forecast of a continuous variable", or a "probability forecast of a categorical variable" is, then feel free to skip the generalities of the introduction and go directly to the modules on the various forecast types.

You can return to this index page at any point by clicking on the icon on the left hand side which looks like this:

Centers

**Module Index**

- **Introduction**
- **Verification of continuous variables**
- **Verification of categorical forecasts**
- **Verification of probability forecasts**

**4 CAL modules!**

---

**Credits**

**Content** Laurence Wilson (Environment Canada) and Pertti Nurmi (Finnish Meteorological Institute)

**Storyboard** Laurence Wilson (Environment Canada)

**IT authoring** Sigbritt Näsman (Finnish Meteorological Institute)

**Project Manager** Pertti Nurmi (Finnish Meteorological Institute)

... produced by Pertti Nurmi, Laurie Wilson & Sigbritt Näsman, 2006-09
Discussion : Suggestions by WWRP JSC wrt Verification
(Geneva, last week, as reported by Beth Ebert)

- Observation error needs some focused activity due to its importance not only for verification but also for DA
- Post-processing and verification go hand-in-hand, and are of interest to many groups
- Probabilistic verification is important not only in medium and long ranges but also in very short range
- Wind verification is important; Need to post-process model winds properly prior to verification
- Impact verification is important. Examples could include flight path timing error, multi-variate error (e.g. temperature AND wind)
  - Road weather : “bullet” added by Pertti
- Users are more interested in simple metrics like POD, FAR, success ratio
Discussion : Summarizing some issues to consider

- Local vs. “external” verification (contributors “do their own thing”)
- Real-time verification (RTFV)
  - Visualization of fc-obs time series and inter-comparison on-the-fly
  - Aggregate verification statistics from the beginning of Games
- How to guarantee obs quality, quantity, availability
  - Observation uncertainty
- Event-based verification – How to define the event - Thresholds
  - Event-based vs. statistics
- User-focused vs. Model-focused verification
- Verification training; self-learning vs. Face-to-face tutorial
- Societal aspects
- Timelines of actions