Pertti Nurmi and Sigbritt Näsman

Finnish Meteorological Institute
P.O. Box 503, FI-00101 Helsinki
pertti.nurmi@fmi.fi

SAL Verification in Hydrological Catchments

Entity-, Object-, Features-, Displacement –based family of verification measures

Three independent components addressing forecast quality:

Structure *(size and shape; pattern)*

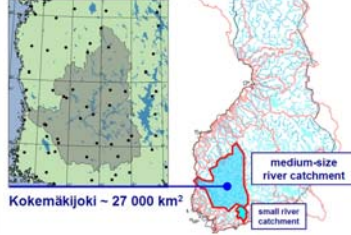**A**mplitude *(volume)*

Location *(displacement)*

For definitions and details :

Wernli, Paulat, Hagen, Frei, 2008. MWR, 136, 4470-4487

Catchments ⇔ Sub-domain for SAL verification

Rain gauge distribution

Kokemäkijoki ~ 27 000 km²

medium-size river catchment

small river catchment

Medium-size, Kokemäki, river catchment in Finland used in SAL verification, and the rain gauge distribution in the area (left, enlarged).

Forecasts: Deterministic 24 hr catchment area QPFs, by

1. **Global ECMWF model** ~ 25 km resolution
2. **Regional HIRLAM_RCR (Reference) model** ~ 16 km resolution
3. **Local HIRLAM_MB71 (Meso-beta) model** ~ 7.5 km resolution
4. **MET_Edit : Forecasters' grid-edited output** ~ 15 km resolution
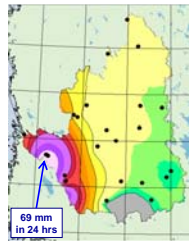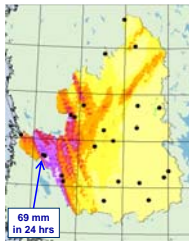
Q: What is the "truth" ? Three case examples of radar QPE vs. interpolated rain gauge observations [using Kriging]:

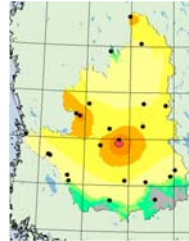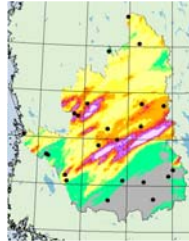**Case example₁**

2008-08-17 Radar QPE   2008-08-17 Rain gauge

69 mm in 24 hrs   69 mm in 24 hrs
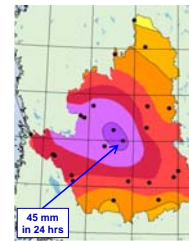
Case example₂

2008-08-20 Radar QPE   2008-08-20 Rain gauge
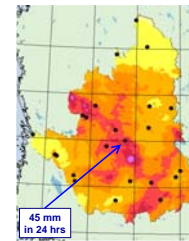

Case example₃

2008-08-28 Radar QPE   2008-08-28 Rain gauge

45 mm in 24 hrs   45 mm in 24 hrs

S A L

> **Uncertainty in observations ⇔ Uncertainty in verification** <

2008-08-17: SAL verification against radar QPE (1 km)

ECMWF ~ 25 km	HIR_RCR ~ 16 km	HIR_MB71 ~ 7.5 km	MET_Edit ~ 15 km
S: 1.13	S: 0.76	S: 0.06	S: 0.48
A: 0.15	A: 0.50	A: -0.42	A: -0.64
L: 0.22	L: 0.17	L: 0.15	L: 0.15

2008-08-17: SAL verification against gauges

ECMWF ~ 25 km	HIR_RCR ~ 16 km	HIR_MB71 ~ 7.5 km	MET_Edit ~ 15 km
S: 1.28	S: 0.95	S: 0.29	S: 0.69
A: 0.41	A: 0.74	A: -0.16	A: -0.39
L: 0.31	L: 0.29	L: 0.17	L: 0.27

S	**Structure**	-2 ... Rain area too small or too peaked	0 Perfect	+2 Rain area too large or too flat
A	**Amplitude**	-2 ... QPF under-estimated	0 Perfect	+2 QPF over-estimated
L	**Location**		0 Perfect	+2 Wrong location of Total Center of Mass (TCM) and / or of objects relative to TCM

ECMWF vs. radar

- Too large / flat precip objects almost always

- Amplitude somewhat overestimated

1.25
0.27

Met_Edit vs. radar

- Large / flat precip objects very typical

- Amplitude clearly underestimated

1.07
- 0.43

HIR_RCR vs. radar

- Large / flat precip objects very typical

- Amplitude on average realistic

0.92
- 0.04

HIR_MB71 vs. radar

- Large / flat precip objects very typical

- Amplitude somewhat overestimated

0.84
0.28

S vs. A plots in the Kokemäki river catchment for individual 24 hour periods during summer 2008 for the ECMWF (25 km resolution), HIR_RCR (16 km resolution) and HIR_MB71 (7.5 km resolution) models, and for human edited forecasts (MET_Edit; 15 km resolution). Radar QPE is used as verifying "truth". L values (not shown) had generally quite small differences between models.

Summary - Future …

✓ **Need to better understand SAL behavior**

✓ **Include meso-scale 2.5 km <AROME> model**

✓ **Cover more / all catchments (incl. Lake catchments)**

✓ **Define meaningful QPF thresholds / amounts for flooding**

✓ **Use gauge ⇔ radar ⇔ *merged QPE* as observed "truth"**
   ⇔ **Deeper understanding of observation uncertainty**

✓ **Comparison with traditional scores and other features-based measures (e.g. *CRA, MODE*)**

✓ **Finer scale models *do* produce better SAL scores !!!**

✓ **Operational implementation with the hydrological community ?**

SAL aggregated seasonal statistics

	Summer 2008						Spring 2008			Winter 2008		
	Gauge			Radar			Radar			Radar		
	S	A	L	S	A	L	S	A	L	S	A	L
ECMWF	.66	.50	.15	1.25	.27	.27	.91	.21	.12	.72	.20	.08
HIR_RCR	.18	-.10	.14	.92	-.04	.25	.64	-.21	.13	.65	-.03	.08
HIR_MB71	-.01	.28	.16	.84	.28	.26	.48	.03	.15	.39	.11	.09
MET_Edit	.38	-.28	.16	1.07	-.43	.27	.66	-.39	.16	.65	-.17	.10