Using the MAP D-PHASE database to evaluate the QPF Improvements of the new SIMM's BOLAM

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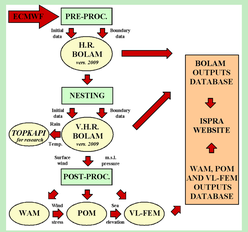
BACKGROUND & AIM

- ***The improvement of MET forecasts is one of the primary goals of any hydro-meteorological or environmental institution running a NWP model.***
- ***MET forecasts can be improved, e.g., by implementing more accurate and advanced physical parameterizations or by providing HI-RES (in time and space) initial and boundary conditions.***

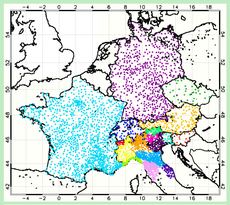
→ ***An *intercomparison* study over a long time period is <u>necessary</u> to statistically evaluate such performance improvements.*** ←

- ***A fully updated version of the 0.1° BOLAM MET model is currently implemented into the *ISPRA hydro-meteo-marine forecasting system SIMM* (Speranza et al. 2007).***
- ***In addition, experiments on a newer BOLAM version and on different model configurations (HI-RES initial and boundary conditions; different nesting design; increase of the domain size; and decrease of the horizontal grid step) are ongoing.***
- ***QPF improvements of such new versions are evaluated with respect to the previous operational version.***



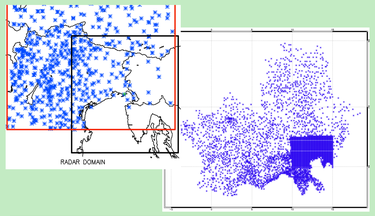
SIMM chain

DATASETS



DOP db: ca. 3900 rain gauge stations

- ***Rain gauge data collected during the Operations Period (DOP: Jun-Nov 2007) of the WMO WWRP project "*MAP D-PHASE*" are considered as observational dataset.***
  - → ***Observatinal analysis through a *two-pass Barnes scheme*.***
- ***Radar data were also collected after DOP to provide further information on selected case studies (*25–28 Sep. & 22–25 Nov. 2007*).***
  - → ***Radar and rain gauge are combined through a Bayesian-based approach: *RainMusic*.***



Fossalon radar (NE Italy – ARPA FVG) & 0.1° verification grid

- ***Forecast series: the one originally provided during DOP (<u>QBOLAM</u>); the one obtained (reforecast) with the current operational version (<u>BOLAM11</u>); the ones related to the model experiments.***
  - → ***Forecasts remapped over common verifications grids (0.1°; 0.3° and 0.5°).***

METHODOLOGY

- ✓ ***Representativeness/structure and scales of the fields compared have been addressed through a spectral analysis (Göber 2008; Lanciani et al. 2008; Weygandt et al. 2004, Chèruy et al. 2004).***
- ✓ ***Categorical scores and skill scores (e.g., Wilks, 2006) are calculated over a sum of daily contingency tables (CT) w.r.t. a set of given thresholds.***

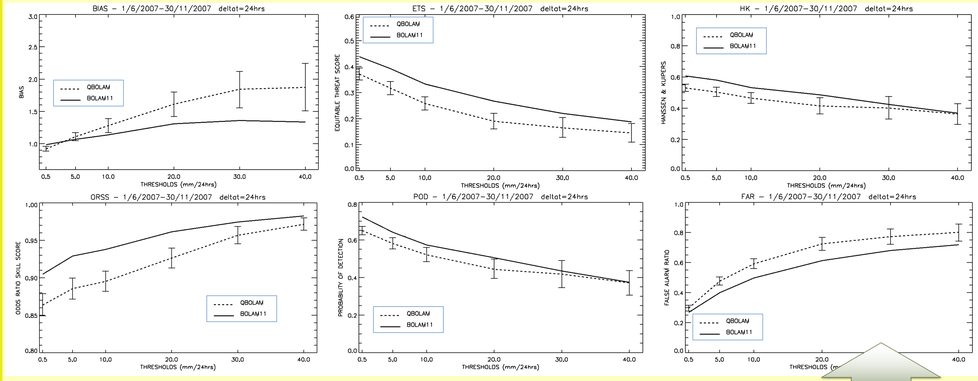
$$\mathrm{BIAS}=\frac{a+b}{a+c}$$

$$\mathrm{ETS}=\frac{a-a_r}{a+b+c-a_r}\quad\text{with}\quad a_r=\frac{(a+b)(a+c)}{a+b+c+d}$$

$$\mathrm{HK}=\frac{(ad-bc)}{(a+c)(b+d)}=\mathrm{POD}-\mathrm{F}=\frac{a}{a+c}-\frac{b}{b+d}$$

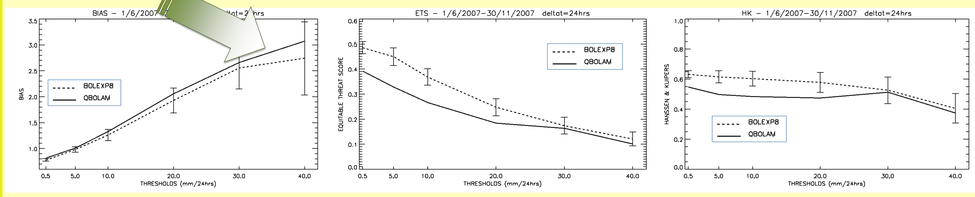
$$\mathrm{ORSS}=\frac{\mathrm{ODDS}-1}{\mathrm{ODDS}+1}=\frac{ad-bc}{ad+bc}\quad\text{where}\quad \mathrm{ODDS}=\frac{ad}{bc}$$

- ✓ ***ROC (deterministic) curves (Mason, 1982).***
- ✓ ***Bootstrap-based hypotesis test (Hamill, 1999) to provide the score differences between two "competing" models with confidence intervals.***
- ✓ ***Geographical mapping (on a 0.5° grid) of CT elements to provide a physical interpretation of the scores.***
- ✓ ***Case-study approach: eyeball subjective verification + objected-oriented approach.***

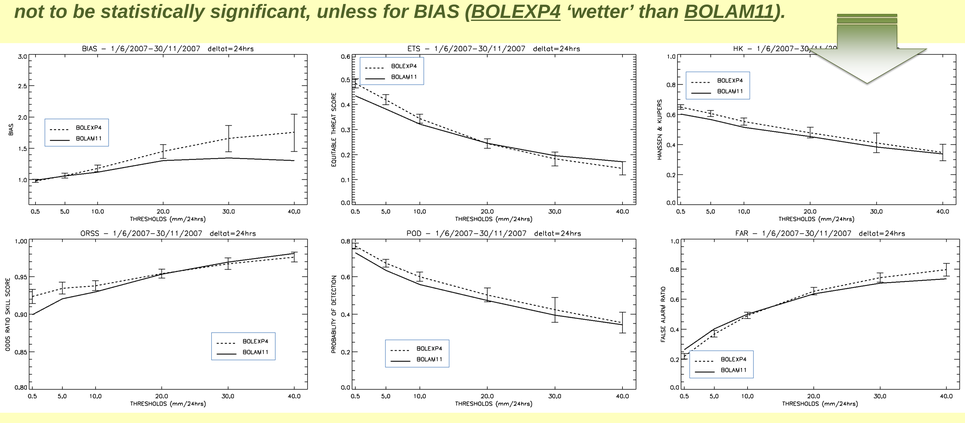


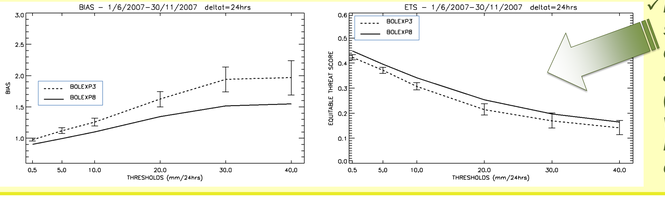
SKILL SCORE COMPARISON

- ✓ ***<u>BOLAM11</u> (solid line) statistically performs better than <u>QBOLAM</u> (dashed line) over a 0.1° verification grid. Since <u>QBOLAM</u> spectra have more small-scale structure than <u>BOLAM11</u> ones, a fair comparison should be done on a coarser (0.5°) verification grid.***
- ✓ ***On a 0.5° grid, <u>BOLAM11</u> still performs better than <u>QBOLAM</u> in terms of ETS and HK, at least at the low-medium thresholds (not shown). The same result is obtained when comparing <u>QBOLAM</u> against <u>BOLEXP8</u>. However, forecasts remapped over a 0.5° grid result to be wet (BIAS values > 1).***



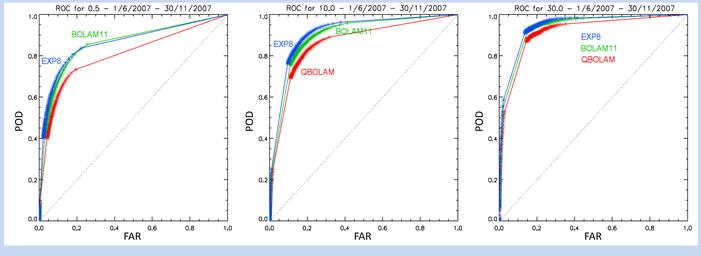
- ✓ ***It is also under investigation the extension in LON-LAT of the model domain together with the decrease of the grid size (0.07°) and the use of HI-RES initial and boundary conditions (<u>BOLEXP4</u>). From the preliminary results, score differences between <u>BOLAM11</u> (solid line) and <u>BOLEXP4</u> (dashed line) seems not to be statistically significant, unless for BIAS (<u>BOLEXP4</u> 'wetter' than <u>BOLAM11</u>).***



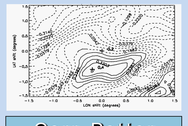


- ✓ ***Differences result to be instead statistically significant when comparing <u>BOLEXP8</u> forecasts against <u>BOLEPX3</u> forecasts (obtained using the newer version, HI-RES initial and boundary conditions and the original nesting configuration).***

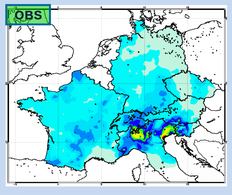
ROCS & CT GEO-LOCALITATION & CRA ANALYSIS

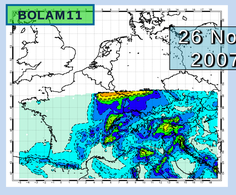


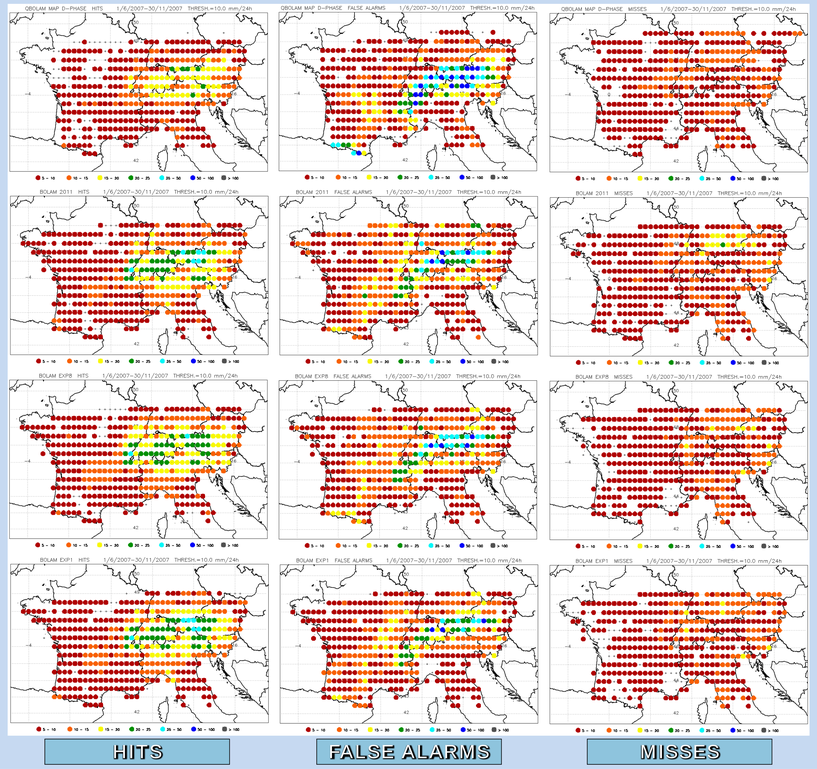
- ✓ ***ROC: Increase in model performance moving from <u>QBOLAM</u> to <u>BOLAM11</u>. A slight increase is observed w.r.t. forecasts obtained with the newer BOLAM version, using the same model configuration (<u>BOLEXP8</u>).***
- ✓ ***CT geo-location: improvement in <u>BOLAM11</u> QPF quality especially over the previously-critical areas (high mountains; Accadia et al. 2005) and heavily-flooded areas (NE Italy). When considering the <u>BOLEXP8</u> forecasts, it is observed an increase in terms of 'HITS' and a decrease in terms of 'MISSES'. A reduction of the 'FALSE ALARMS' is not so evident. <u>BOLEXP1</u> forecasts – obtained using a newer BOLAM version, HI-RES initial and boundary conditions and a different nesting configuration (no "father" model) – shows a CT geo-location similar to those of <u>BOLEXP8</u>.***



Corr. Patter match 5.0 mm 24–1 thres.







HITS | FALSE ALARMS | MISSES