Toulouse strategy meeting 26/4 -28/4 2016

- Verification and Validation tools -

-state-of-the art-

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Verification
Current State-of the art
`Verify forecasted spatial structures in time intervals´

1) **Global trend in verification of high resolution models** since start of the Millenium: <u>Verify ability to forecast spatial structures and model variation in time intervals, in particular related to high impact weather</u>. Verification at specific points in space and time is no longer sufficient due to the `double penalty issue´ at high modelresolution

2) Examples of new trend relevant to the IFS LAM consortia:

A) **"Features/object based approaches":** **MODES** (at NCEP), identifying objects in the observed field to be compared with forecasted objects.
SAL (**S**tructure, **A**mliplitude and **L**ocation , Wernli et al., 2008): computation of observed field to be compared with forecast field

Verification
Current State-of the art
`spatial verification methods and probabilistic treatment’

B) **Neighborhood methods:**

•) **`Fractions skill score´ (FSS),** Roberts and Lean (2008)

with emphasis on predictable scales for different thresholds in observed field .

•) **Probabilistic metrics** such as the Brier score and ranked probability is applied to neighborhoods by Mittermayer (2014), UKMO.

•) **`Significant Weather Score´** (**SWS**) **,** Sass and Yang (2012), measures the ability of model to forecast maxima plus minima of observations in model domain, as a function of spatial upscaling

Verification and Validation tools (examples)

1) <u>Systematic studies of model behaviour, e.g. using MUSC</u> for Super Sites (mast data and special surface observations, e.g. measuring surface energy balance , - and model tests for field campaigns, e.g. boundary layer studies.
2) <u>Remote sensing data for verification</u>, e.g. ASCAT for verification of 10 m winds (potential demonstrated at KNMI)
3) <u>Validation of model cloud physical properties</u> from satellite derived products: Try to get synergy with studies based on surface measurements
4) <u>Regional climate simulations</u> to investigate model drifts

5) <u>Idealized test cases</u> with known solutions (”academic test cases”)
6) <u>Large-Eddy Simulations</u> (LES) as a tool to validate turbulence + shallow convection schemes
7) <u>Numerical scheme tests against accurate reference simulation</u>, e.g. validation of radiation scheme against accurate reference computations.
8) <u>Fast Stand-Alone diagnostic setups</u> for parameterization tests, e.g. testing parameter sensitivity.

Verification and diagnostics:

Recommendation related to strategy :

Recommendation: → Make Verification and Diagnostic tools a common core activity :

Justification: → Difficult to compare verification results based on different tools

→ Consortia support of the verification system to individual members

Strategy: → Put main effort into development of HARP because of its potential as a common development tool for spatial verification

→ Put special efforts into the development of probabilistic verification of ensemble prediction systems

→ Implement components from other verification systems (e.g.MONITOR) if desirable

→ Exchange diagnostic tools between consortia whenever relevant

→ Participate inside SRNWP /EumetNet activities on verification and diagnostics

Requirements: → Secure staff availability from both HIRLAM and ALADIN consortia for developing common verification tools

Working Practices : → Working weeks , workshops and knowledge sharing essential

Selected references

Gilleland et al, 2010: Verifying forecasts spatially, BAMS issue October 2010, 1365 -1373.

Mittermaier, Marion (2014): A Strategy for Verifying Near-Convection-Resolving Model Forecasts at Observing Sites. *Weather and Forecasting* ***29****:2, 185-204.*

Roberts, N.M. and H.W. Lean, 2008: Scale-selective verification of rainfall accumulations from high resolution forecasts of convective events. *Mon Wea. Rev.* ***136****, 78-97 .*

Sass B.H. and X Yang, 2012: A verification score for high resolution NWP: Idealized and preoperational tests. *HIRLAM Tech. Rep. no.69, Dec. 2012.*

Wernli, H., M. Paulat, M. Hagen, and C. Frei, 2008: SAL – A novel quality measure for the verification of quantitative precipitation forecasts : *Mon Wea. Rev.* ***136****, 4470 -4487 .*