The case studies / Models and datasets

In both the events, precipitation on Eastern Alps is connected with the passage of small depressions over the western Mediterranean Sea. For a synoptic analysis of the 2002 event, see the poster: "Backtracking the forecast error from precipitation to mesoscale dynamics: some qualitative conjectures".

Models include the hydrostatic QBOLAM model operational at APAT and two non-hydrostatic LAMs: the Slovenian version of ALADIN operational at the Environmental Agency of the Republic of Slovenia (EARS) and the WRF running at the Regional Meteorological Observatory (OSMER) of Friuli-Venezia Giulia (Italy). ALADIN is initialised with 0000 UTC Météo-France ARPEGE analysis and forecast; the other two models use 1200 UTC ECMWF products. QBOLAM and WRF are covering Northern and Central Italy, Austria and Slovenia (766 rain gauges for the 2002 event, 781 for the 2005 one). Two common verification grids (0.1° and 0.5°) have been employed. A reampling procedure (see, e.g., Accadia et al., Wea. Forecasting, 18, 2003), and bilinear interpolation were used to post-process model fields on the two grids. A two-pass Barnes objective analysis scheme (Barnes, J. Appl. Meteor., 3, 1964) was used to provide 24-h accumulated gridded precipitation fields from observations.

Acknowledgements: thanks to ARPA Lombardia, EARS, OSMER and ZAMG for giving us observed and forecast data; thanks also to ARPA Emilia Romagna and Liguria for rainfall data over their territory.

Results / I: Spectra

For the comparison, the most rainy days of the two events were considered. • 18 Nov. 2002: ALADIN seems to be the best in reproducing the observed pattern; WRF in catching the rainfall maxima. Differences can be partly described in terms of shifting error (linked to error in the depression trajectory) • 9 Sep. 2005: ALADIN strongly underestimates the event; QBOLAM seems to give the best match; WRF displays the best ability in matching the maximum rainfall peak.

Multiscale verification: Power Spectra

Power spectrum, a simple but powerful multiscale diagnostic tool, can be computed (according to the Wiener-Khinchin theorem) by multiplying the 2-D Fourier transform by its complex conjugate:

\[ E(k_x, k_y) = \frac{1}{2\pi} \int dxdy e^{-i(k_x x + k_y y)} \rho(x, y) \]

In this work, calculations (done with the IDL FFT routines) include:

• using a Hanning window to filter the data and to reduce aliasing
• an angular average of 2-D spectra to provide isotropic power spectra, \( E(\Delta k) \)

Wavenumber grid size \( \Delta k \), physical grid size \( h \), number of points \( N \) and the maximum resolvable frequency (Nyquist) \( v \) are linked:

\[ \Delta k = \frac{\Delta \lambda}{v} = \frac{1}{2(\Delta \lambda)} = \frac{\lambda}{2} \]

Scaling occurs if \( E(k) \sim k^{-4} \). Smooth structures have high \( \mu \) values.

Results / II: Subjective verification

For the comparison, the most rainy days of the two events were considered. • 18 Nov. 2002: ALADIN seems to be the best in reproducing the observed pattern; WRF in catching the rainfall maxima. Differences can be partly described in terms of shifting error (linked to error in the depression trajectory) • 9 Sep. 2005: ALADIN strongly underestimates the event; QBOLAM seems to give the best match; WRF displays the best ability in matching the maximum rainfall peak.

Non-probabilistic scores

- ALADIN has the best scores and lowest bias up to 30 mm/24h
- At higher thresholds WRF has the best skill scores, but high BIA
- Global ECMWF model outperforms LAMs at the highest thresholds

8-10 September 2005:

- ECMWF and ALADIN have a "dry" BIA at higher thresholds;
- WRF and QBOLAM have a "wet" BIA at all thresholds;
- WRF shows the best ETS and HK values at medium thresholds, QBOLAM at higher thresholds.

CRA analysis

18 Nov. 2002: a westwards shift of the models improves the fit with observations, especially for ALADIN (displacement error \( \sim 42\% \) of total); for QBOLAM and WRF the pattern error is about 80%.

9 Sep. 2005: For all models, the pattern error is prevailing; QBOLAM shows no location error at all. WRF forecast need to be moved E, while ALADIN needs to be shifted SE.

Dissemination


"Verification and intercomparison of precipitation fields modelled by LAMs in the Alpine Area: Two FORALPS case studies", S. Mariani, M. Casaioli, C. Accadia, A. Lanciani, and N. Tartaglione, 29th International Conference on Alpine Meteorology (ICAM), Chambéry, (France), 4 – 8 June 2007. ⇒ ICAM proceedings.

⇒ Meteorology and Atmospheric Physics, under revision.