Spatial Forecast Verification and the Mesoscale Verification Intercomparison over Complex Terrain

Eric Gilleland

Research Applications Program
National Center for Atmospheric Research

Co-authors: Manfred Dorninger, Marion Mittermaier, Barbara G. Brown, Elizabeth E. Ebert, Barbara Casati

30th Conference on Climate Variability and Change/24th Conference on Probability and Statistics in the Atmospheric Sciences/16th Conference on Artificial Intelligence and its Applications to the Environmental Sciences
29 July 2017, Baltimore, Maryland, U.S.A.

Support for this work provided by the NSF in part via Earth System Modeling (EaSM) Grant number AGS-1243030.
Traditional Verification Paradox

Above Figure from Beth Ebert
What should verification tell you?
What should verification tell you?
What should verification tell you?

Flight Path

A

F

O

B
Methods

Fig. 2 from G. et al. (2010, BAMS, 91 (10), 1365 – 1373)

Fig. above from Barbara Casati
ICP:  
http://www.ral.ucar.edu/projects/icp

- Various methods described in review papers (see reference list at web site)
- Test cases available from above web site
- Results can be found in special collection of WAF papers (see web site’s reference list)
Mesoscale Verification Inter-Comparison over Complex Terrain (MesoVICT)

Vienna Enhanced Resolution Analysis (VERA) - “observations” on a grid

Joint D-PHASE - COPS (JDC) data set - observations at point locations in space (not so many methods developed for point-to-grid comparisons)

Models: Canadian high-resolution model: CMC GEMH (GEM-LAM) model output from Environment Canada

MeteoSwiss COSMO2 runs, also COSMO-LEPS for ensembles cases (can compare with ensembles of VERA “observations”).
Mesoscale Verification Inter-Comparison over Complex Terrain (MesoVICT)

MesoVICT domains: 12km, 4km, 1.5km, and 300m resolution
Precipitation accumulation periods as provided from the national and regional weather services for the JDC data set. Different accumulation periods are indicated by different colors.
Mesoscale Verification Inter-Comparison over Complex Terrain (MesoVICT)

Case 1: 20 – 22 June 2007
(ensembles of observations available for this case)

- Ahead of a trough over the UK, warm moist air advected towards the Alpine Region.
- Led to strong convective events evening of 20 June north of the main mountain range.
- 21 June: cold front reached the Alps from the west and moved rapidly to the east.
- More convective events were observed again ahead of the frontal passage.
- With the passage of the front, strong westerly winds occurred.
- The cold air mass was too shallow in vertical extent and could not spill over the Alps.

Precipitation (VERA)

Equivalent Potential temperature (VERA)
Mesoscale Verification Inter-Comparison over Complex Terrain (MesoVICT)

Case 2: 18 - 21 July 2007

Top left: Berliner Wetterkarte (synoptic weather chart). Pressure (solid lines) and equivalent potential temperature (dashed lines) at 850 hPa for 19 July 2007.

Top right: VERA precipitation for the 3-h period ending at 21 July 2007 00 UTC.
Case 2: 18 - 21 July 2007

- An almost stationary air mass boundary was located across Europe, stretching from Spain to France, impinging the Alps from the northwest and continuing in a north-easterly direction.
- During the whole episode, some very strong convective events were observed along this boundary.
- Winds were generally weak except in the vicinity of the convective cells.
• Spatial Verification introduced to provide improved information about forecast performance:
  ▪ summary metrics/measures that are robust to location errors and/or inform about such errors directly
  ▪ diagnostic information to tell how a forecast did well and how it needs to be improved

• Many methods introduced
  ▪ Image Analysis
  ▪ Computer Vision
  ▪ Spatial Statistics

• ICP - Meta-verification project
  ▪ Test cases over central United States
  ▪ Precipitation only
  ▪ Single snapshots in time

• MesoVICT (ICP phase 2) introduced
  ▪ assess how the methods handle issues with complex terrain
  ▪ how well they work with other variables besides precipitation
  ▪ ensembles of models/observations
Thank You

• R package (in progress, but available on CRAN) for performing spatial verification (SpatialVx)

• web site for MesoVICT and much more!

http://www.ral.ucar.edu/projects/icp