An events-oriented verification

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Information content v.s. grid point verification

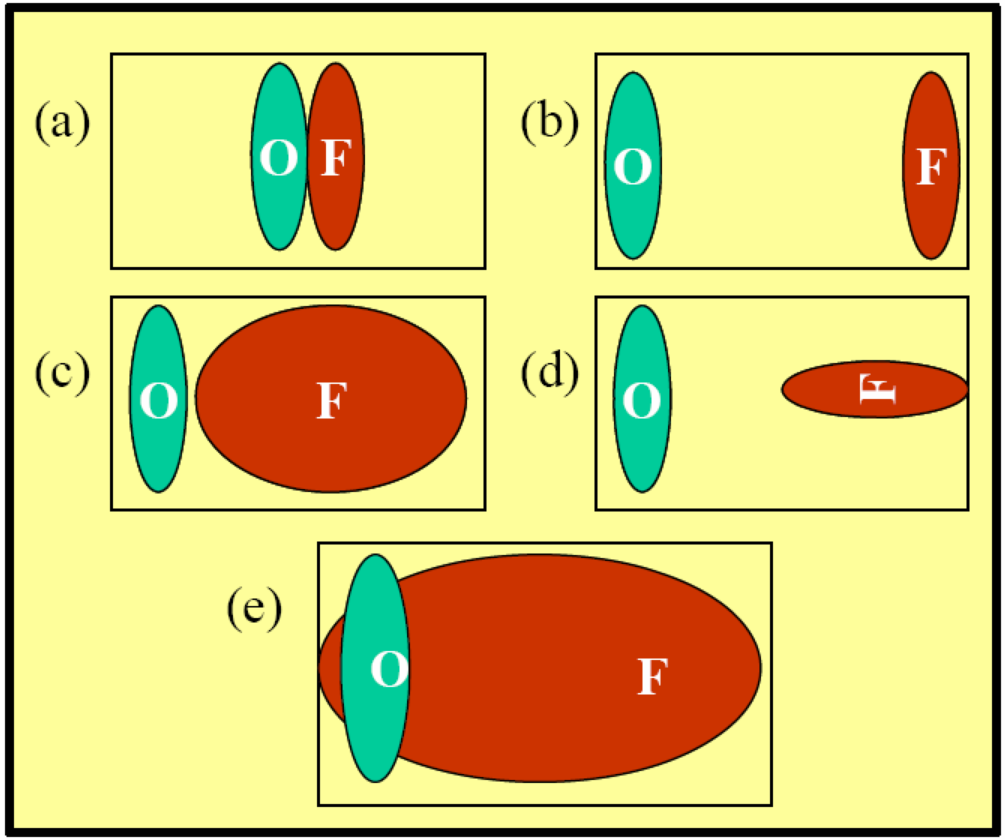
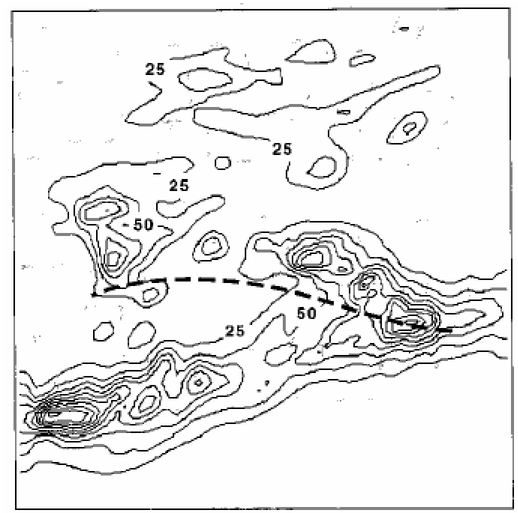


Figure 2. Simple example of the impacts of different types of errors on verification results. Each of the forecasts in (a) through (e) has 0 skill according to traditional verification approaches, whereas the forecast in (e) has positive skill. From Davis et al. (2006a).

Information content v.s. grid point verification



Analysis **Forecast**

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Events orientation: Synoptic “forcing” of precipitation

- (laplacian of) warm air advection

- (differential) cyclonic vorticity advection

- frontal circulations

- jet streak circulations

Procedure

1) **Identify contiguous precip areas from gridded observational (NPA, 4 km) and DWFE datasets**

- 24 hour accumulated (synoptic)
- agglomerative hierarchical cluster analysis (Euclidean distance, shortest distance metric)

2) **Subjective identification of precip classes for 15 Jan – 31 March 2001-05**

- artificial neural network is trained on 2001-04 to classify forcing

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Procedure (continued)

3) Precipitation clusters are "processed" as objects following Davis et al. (2006):

- precipitation centroid
- length of major and minor axes
- major axis orientation

4) Objects are "matched" between forecast and observations as a function of precipitation forcing class: (this is ongoing)

- translation and rotational errors
- areal coverage errors
- intensity errors

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Results (Observed 24-h precipitation)

	25^{th} Percentile	50^{th} Percentile	75^{th} Percentile
Sqr. Root Area (km)	176	418	716
Aspect Ratio	0.31	0.44	0.60
474 objects			

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Results (Observed 24-h precipitation)

NOT surprisingly (but good news) …

- Warm air advection objects are larger and more circular

- Frontal circulation objects are larger and more elongated

Results (Observed 24-h precipitation)

Process (WAA, CVA, FNT, JET)	Frequency (%)
CVA	24.1
CVA + WAA	12.0
CVA + FNT	9.7
CVA + WAA + FNT	8.2
FNT	7.4
JET	7.0
CVA + JET	6.3
WAA	5.3
WAA + FNT	4.4
FNT + JET	4.4
CVA + FNT + JET	3.4
WAA + CVA + FNT + JET	3.4
WAA + FNT + JET	1.9
WAA + JET	1.3
WAA + CVA + JET	1.3
ALL PROCESSES	**100.0**

Multiple "forcing" in 56% of events

- CVA 68%

- FNT 43%

- WAA 38%

- JET 29%

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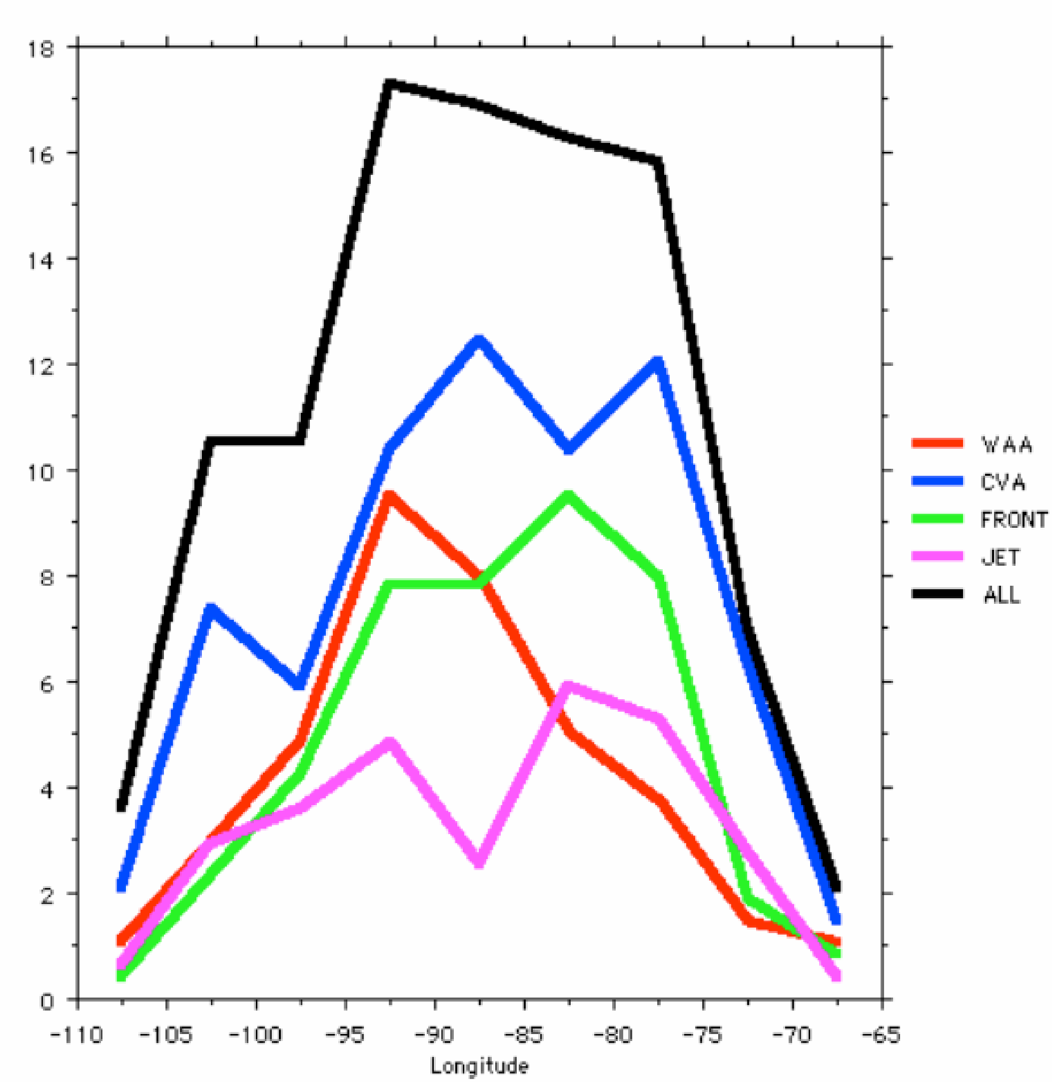
Results (Observed 24-h precipitation)



Can we train an ANN to classify like me?

- Used the 2001-04 data for training + cross-validation
- Used the 2005 data for independent testing
- Two hidden layer MLP with "schematic" inputs:

  lat/lon of surface lows, 500 hPa vorticity maxima, 300 hpa wind speed maxima

-These inputs provide a "pattern" which the ANN tries to map to the desired output (which "forcing")

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Can we train an ANN to classify like me?

Class	Pct Correct	POD	FAR	CSI
WAA	65%	0.65	0.40	0.45
CVA	68%	0.68	0.10	0.63
FRONT	70%	0.80	0.29	0.60
JET	57%	0.68	0.56	0.36

Can we train a student to classify like me?

- Percent agreement with student is about 60%.

- Certain degree of subjectivity to these classes beyond this level, so can't expect network to perform much better.

-Note: could "define" what constitutes a particular forcing, but there would be inevitable subjective determinations as to what constitutes a particular class or set of classes.

- Still useful as a means for organizing our thinking regarding model errors (yet to be determined).

What remains to be done:

1) **Match the precipitation objects to the observed objects (cluster analysis for both is complete, still need to quantify the DWFE precip objects)**

2) **Perform the verification and break down the results as previously described: for each "forcing":**

   - location errors (translation and rotation)
   - size errors
   - intensity errors

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How can this be of value to community?

1) **Precip cluster analysis protocol and code (courtesy of Caren Marzban)**
2) **Protocol and code for obtaining schematic synoptic "elements" from reanalysis/model data**
3) **Protocol and code for neural network classification of synoptic forcing – could be extended to other scales and elements**
4) **Code (following Davis et al. 2006) that produces precipitation objects from cluster data**

5) **How does model performance vary as a function of synoptic forcing – can quantify this, using synoptic classification combined with precip objects**

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