8.1 Score definitions

The following definitions should be used:

Mean error:

$$M = \sum_{i=1}^{n} w_i (x_f - x_v)_i$$

Root mean square (rms) error:

$$rms = \sqrt{\sum_{i=1}^{n} w_i (x_f - x_v)_i^2}$$

Correlation coefficient between forecast and analysis anomalies

$$r = \frac{\sum_{i=1}^{n} w_i (x_f - x_c - M_{f,c})_i (x_v - x_c - M_{v,c})_i}{\left(\sum_{i=1}^{n} w_i (x_f - x_c - M_{f,c})_i^2 \right)^{1/2} \left(\sum_{i=1}^{n} w_i (x_v - x_c - M_{v,c})_i^2 \right)^{1/2}}$$

rms vector wind error

$$rms = \sqrt{\sum_{i=1}^{n} w_i (\overrightarrow{V}_f - \overrightarrow{V}_v)_i^2}$$

mean absolute error

$$MAE = \sum_{i=1}^{n} w_i \left| x_f - x_v \right|_i$$

rms anomaly

$$rmsa = \sqrt{\sum_{i=1}^{n} w_i (x - x_c)_i^2}$$

standard deviation of field

$$sd = \sqrt{\sum_{i=1}^{n} w_i (x - M_x)_i^2} \quad \text{where} \quad M_x = \sum_{i=1}^{n} w_i x_i$$

S1 score

$$S_i = 100 \frac{\sum_{i=1}^{n} w_i (e_g)_i}{\sum_{i=1}^{n} w_i (G_L)_i}$$

where:

x_f = the forecast value of the parameter in question

x_v = the corresponding verifying value

x_c = the climatological value of the parameter

n = the number of grid points or observations in the verification area

$M_{f,c}$ = the mean value over the verification area of the forecast anomalies from climate

$M_{v,c}$ = the mean value over the verification area of the analysed anomalies from climate

$\overrightarrow{V}_f$ = the forecast wind vector

$\overrightarrow{V}_v$ = the corresponding verifying value

where the differentiation is approximated by differences computed on the verification grid.

$$e_g = \left(\left| \frac{\partial}{\partial x} \left(x_f - x_v \right) \right| + \left| \frac{\partial}{\partial y} \left(x_f - x_v \right) \right| \right)$$

$$G_L = \max\left(\left| \frac{\partial x_f}{\partial x} \right|, \left| \frac{\partial x_v}{\partial x} \right| \right) + \max\left(\left| \frac{\partial x_f}{\partial y} \right|, \left| \frac{\partial x_v}{\partial y} \right| \right)$$

The weights w_i applied at each grid point or observation location are defined as:

Verification against analyses: $w_i = \cos \phi_i$, cosine of latitude at grid point i

Verification against observations: $w_i = 1/n$, all observations have equal weight