ACC:

The anomaly correlation coefficient (ACC) measures the quality of a forecast system.

Calculates correlation between forecasts and observations.

Due to seasonal variations, correlating forecasts directly with observations may give misleadingly high values.

Therefore, the climate average is subtracted from both the forecast and observed anomalies.

The basic idea behind the ACC is as follows:

a) Imagine the existence of three 500-hPa geopotential height maps for the NH for 16 Feb 2016 as follows: (c) climatology, (f) 120-h forecast, and (a) observed analysis. (see ACC diagram in scanned notes)

b) Calculate (f-c) to yield a NH map of the 120-h forecast 500-hPa height anomaly departure from climatology.

c) Calculate (a-c) to yield a NH map of the observed departure of the 500-hPa height anomaly from climatology.

d) Calculate the skill forecast relative to climatology on the basis of how well (a-c) is correlated with (f-c) in the formulas on the bottom of p. 83 and the top of p. 84.
ACC is positively oriented with increasing numerical values indicating increasing “success”

e) If \((f - c)\) and \((a - c)\) are perfectly correlated in terms of amplitude and phase (the observed troughs and ridges coincide with the forecast troughs and ridges) and the ACC is 1.0.

f) If \((f - c)\) and \((a - c)\) are perfectly anti correlated in terms of amplitude and phase (the observed troughs and ridges are 180 degrees out of phase with the forecast troughs and ridges) and the ACC is -1.0.

g) If \((f - c)\) and \((a - c)\) are uncorrelated in terms of amplitude and phase and the ACC is 0.0.

Using the WMO definition, the mean error can be taken into account as follows:

\[
ACC = \frac{\frac{(f - c)(a - c)}{\sqrt{(f - c)^2 (a - c)^2}}}{\sqrt{\frac{[(f - c) - (f - c)] [(a - c) - (a - c)]}{[(f - c) - (f - c)]^2 [(a - c) - (a - c)]^2}}}
\]

It turns out that the ECMWF folks decided ago that a useful minimum ACC score is 0.6. But, why??

According to Lance, “the answer is somewhat analogous to the ‘cosmic answer (42)’ to the unknown “cosmic question” in the Hitchhiker’s Guide to the Galaxy by Douglas Adams. Decades ago, the ECMWF modelers gave a huge pile of paper maps to forecasters and asked them to sort them into two piles, one considered useless and other considered useful. The forecasters did as they were told. The modelers calculated the ACC for all the forecasts for each pile and determined that an ACC of 0.6 was a pretty good separator of useful from useless forecasts.”
Improvement of 500-hPa geopotential heights forecasts have been small over the last several years. Why? Is there a limit to improving model performance?

Gap between NH and SH ACC decreased quite a bit during late 90s and early ‘00s. Why? Improvement of data coverage over SH?

D5 forecasts now are just as good as D3 forecasts were in the mid to late ‘90s
D7 forecasts now are just as good as D5 forecasts were in the mid to late ‘90s
D10 forecasts now are just as good as D7 forecasts in the ‘80s
“The plot shows for each month the range at which the month mean (blue line) or 12-month mean centered on that month (red line) of forecast anomaly correlation dropped below 80%.”

“Anomalies are computed with respect to ERA-Interim-based climate.”

From late ‘90s to late ‘00s there appeared to be a steady increase in the lead forecast time for the 500-hPa ACC to drop below 80%, from about 5 to 6.5 days.

However, over the last several years, there has not been a noticeable increase in this lead time. Why?

A similar pattern is noted with the same chart, but of forecast lead time of ACC dropping below 60%.

Lead time increased from close to 7 days to 8.5 days from late ‘90s to 20120. Since, then, the lead time has remained around 8.5 days

Now show information on contingency tables and SEEPS (in scanned notes)
CRPSS:

Definition of CRPS/CRPSS from “Decisions, Decisions”:

“The continuous ranked probability score (CRPS) compares the forecast probability distribution of a quantity to its analysed value. Both forecast and analysis are expressed as cumulative distribution functions. The CRPS is the squared difference between these distributions, integrated over the range of the quantity being assessed. The CRPSS then compares CRPS of the verified forecast to that of a reference unskilled forecast.”

“So, putting all this together, the CRPSS is simply a normalised measure of the potential economic value of a forecast system (typically an ensemble forecasting system) for a family of users which span the possible range of cost-loss ratios and for weather events which span the range of possible rainfall thresholds. That is to say, CRPSS is perhaps the simplest single measure of the overall value of a forecasting system for decision-making!”

See CRPSS example and derivation in scanned notes

“The plot shows for each month the range at which the 12-month mean centred on that month of the continuous ranked probability skill score of the 24-hour precipitation ensemble forecast dropped below 10%. This is a secondary headline score for the ECMWF ENS.”

CRPSS of total precip has improved.
“The plot shows for each month the range at which the 3-month mean (blue line) or 12-month mean (red line) centred on that month of the continuous ranked probability skill score of the 850hPa temperature ENS dropped below 25%. This is a primary headline score for the ECMWF ENS.”

The CRPSS of lead time of 850hPa temperature has not improved over last several years, similar to trends noted earlier in ACC of lead time of 500-hPa geopotential heights.

Show other diagrams from ECMWF charts catalogue website.