3A.5 PERFORMANCE OF THE NCEP SEASONAL FORECAST MODEL OVER THE ATLANTIC TROPICAL CYCLONE PRONE REGION

Wilbur Y. Chen
Climate Prediction Center, NCEP/NWS/NOAA

1. INTRODUCTION

The NCEP Seasonal Forecast Model (SFM) is already operational. By the fifth day of every new month, the SFM will have generated an ensemble of 20 forecasts as well as an ensemble of 10 hindcasts, each out to 7 months into the future. The hindcasts cover 21 years, from 1979 to 1999, providing a rich data source for various simulation studies as well as a climatology that a climate anomaly can be based on.

This report assesses the hindcast skill of the SFM over the Atlantic tropical cyclone prone region. The model simulates well the tropical upper- and lower-level circulations. The vertical wind shear, which is well known to be an important environmental factor influencing the cyclone activity, is therefore simulated well also. In addition to climatological simulation, the interannual variability of the wind field is also well simulated.

2.REGION OF STRONG CORRELATION

The current resolution of the NCEP SFM is only T62 and L28. It is not intended for forecasting tropical cyclone itself. However, it is probably suitable for forecasting the large-scale tropical wind fields which can influence the cyclone activity. This is where we would like to get a feeling at. Does the SFM has some capability in long-range prediction of wind shear over the tropical Atlantic region? First of all, we would like to know which region is most sensitive and therefore to be focalized on regarding the wind shear prediction. For this purpose, a tropical cyclone index (TCI, as shown in Fig. 1) is constructed first and correlation of this index time series with the vertical wind shear is then obtained around the globe (Fig. 2). The TCI is defined as the total number of days per ASO season that a tropical cyclone with sustained wind speed larger than 17 m/s is present over the Atlantic TC prone region south of 30 N. As shown in Fig. 1, the decades of 50s and 60s were more TC active than the following two decades (70s and 80s). And, the TC activity became super active beginning in 1995. It is apparent that there are decadal as well as interannual variations regarding the Atlantic TC activity. The decadal variation is entirely consistent with the recent article of Goldenberg et al. (2001), which presents the causes and discusses the implications of this inter-decadal variability.

In order to use a more stationary time series to find a correlation of TCI with the wind shear (WS) field around the globe, we choose a much shorter period, from 1971 to 1994, for this simple purpose: determining the region showing a strong correlation between TCI and WS. The resulting correlation coefficient map is shown in Fig. 2, which indicates a very restricted region of strong correlation, about 50-90 W and 5-15 N for a negative correlation larger than 0.6. In this extended abstract, we shall denote this sensitive region as SR. Since the vertical wind shear in this SR is so strongly and negatively correlated with the TC activity, we would like to find out how the NCEP SFM is capable of performing regarding forecasting the wind field over this sensitive region.

* Corresponding Author address: Wilbur Chen Climate Prediction Center, 5200 Auth Road, Camp Springs, MD 20746-4304;
e-mail: Wilbur.Chen@noaa.gov

3. SIMULATION OF CLIMATOLOGY

Before presenting the model performance in the monthly and seasonal prediction, we would like to know how well the model simulates the wind shear climatology. Figure 3 compares the results. Areas of wind shear magnitude smaller than 8 m/s are darken in shade for easy inspection. It is well known that the TC activity favors low vertical shear area. In general the model simulates well the climatological mean pattern, with low shear over the Caribbean Sea and its northeaster-ward extension into the North Atlantic as well as its eastward extension over the subtropical Atlantic. In general, the model has a systematic negative bias between Equator and 20N. However, the climatological wind shear pattern appears to be well simulated. This gives us incentive to find out how well does the SFM perform in the monthly and seasonal predictions of the wind shear field over the TC activity sensitive region.

4. SKILL SCORES OF MONTHLY & SEASONAL HINDCASTS

Over the sensitive region, the anomaly correlation (AC) skill scores are evaluated for the months of August, September, and October, which are known to be the peak months for the Atlantic tropical cyclone activity. An ASO seasonal prediction is also made. The skill scores (Fig. 4) examined here cover altogether 21 years. The 10-member ensemble hindcasts were initiated in early July, from 1979 to 1999. The hindcast lead time is about one month for the top two panels, and two months for the September panel and three months for the October panel. Figure 4 indicates an average AC skill score of about 0.55 for the ASO seasonal hindcasts. For the August monthly hindcasts, the average AC score actually is a little bit higher, close to 0.6. This level of skill is remarkable when compared with an average of 0.3 for an extra-tropical hindcast. We see that the two-month lead September hindcasts also have an average score of about 0.5. However, the skill score drops rapidly for the three-month lead October hindcasts.

Figure 5 compares the full field of wind shear for the last six years. The anomalies from climatology display large interannual changes. For 1994 and 1997 tropical cyclone seasons, the model is able to foretell a change in wind shear anomaly from those years of 1995, 1996, 1998 and 1999. The cyclone seasons of the latter group of years were active, associated with negative WS anomalies, while the former group (1994 & 1997) a very subdued season associated with positive WS anomalies.

5. LONG-LEAD PREDICTION POTENTIAL

Since the hindcasts initiated in early July indicated some skills for the ensuing August and September in wind shear prediction as shown above, we next examine the model’s skill for those with even longer lead time, those initiated in early June, about two months ahead of the TC peak season. As shown in the lower panel of Fig. 6, for the two-month lead ASO prediction, a remarkable near 0.5 average AC skill score is realized for the early June ensemble hindcasts. Further encouraging results is seen in the upper panel for the JAS seasonal predictions. The average AC score is larger than 0.6. It appears the potential for long-lead monthly and seasonal prediction of the climatic conditions is present with this NCEP SFM. Further efforts to exploit the model’s capability appears to be in good order.

REFERENCE

Goldenberg, S. B., C. W. Landsea, A. M. Mestas-Nunez, and W. M. Gray, 2001: The Recent Increase in Atlantic Hurricane Activity: Causes and Implications. Science, 293, 474-479.

Fig. 1 Interannual variations of tropical cyclone activity those of >17 m/s in Atlantic basin south of 30N in ASO

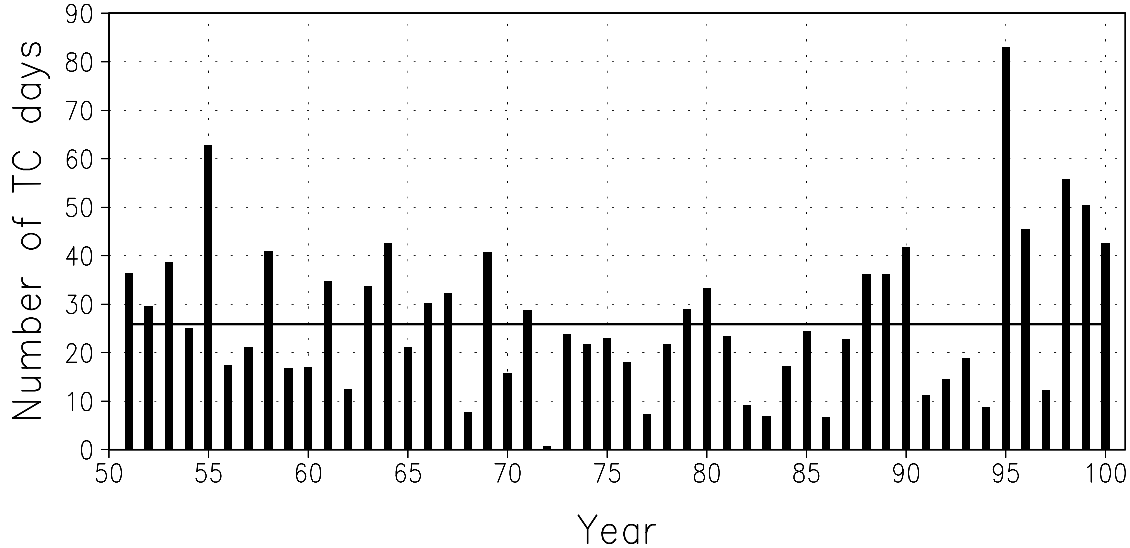

Fig. 2 Correlation Coef between Atl tropical cyclone Index (TCI) and Vertical Wind Shear (U200–U850)

Contour interval = 0.1, start at 0.5, smaller values suppressed
results shown were evaluated for the period 1971–1994
dashed contours represent negative correlations

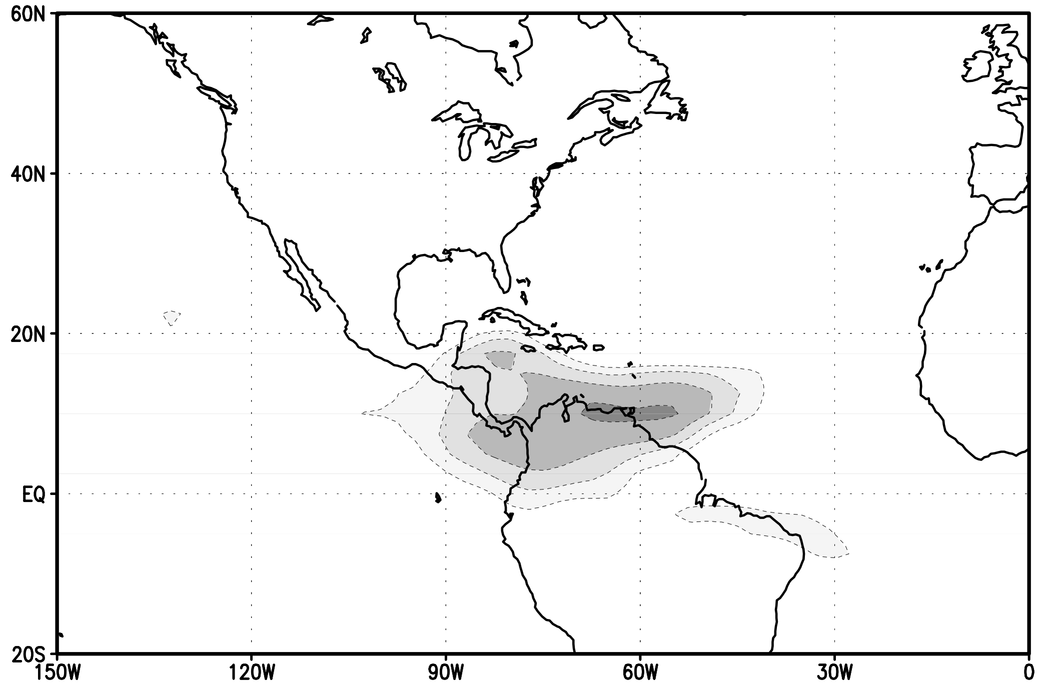

Fig. 3 Simulation of MDL Windshear Climatology (1979 – 1999)

contour interval = 8 m/s
values smaller than 8 were darken

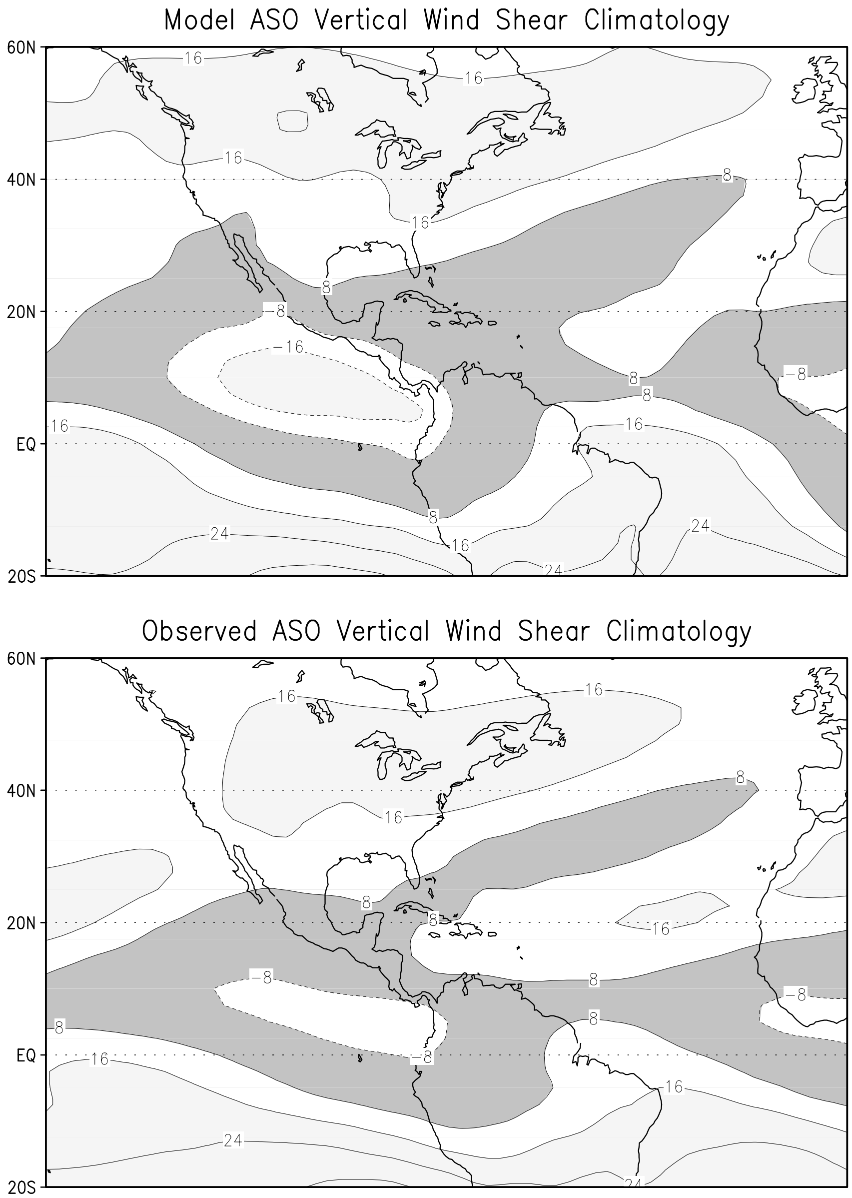

Fig. 4 ACs of the Long-lead Vertical Shear Hindcasts
evaluated for the TC prone region (90–50W & 5–15N)

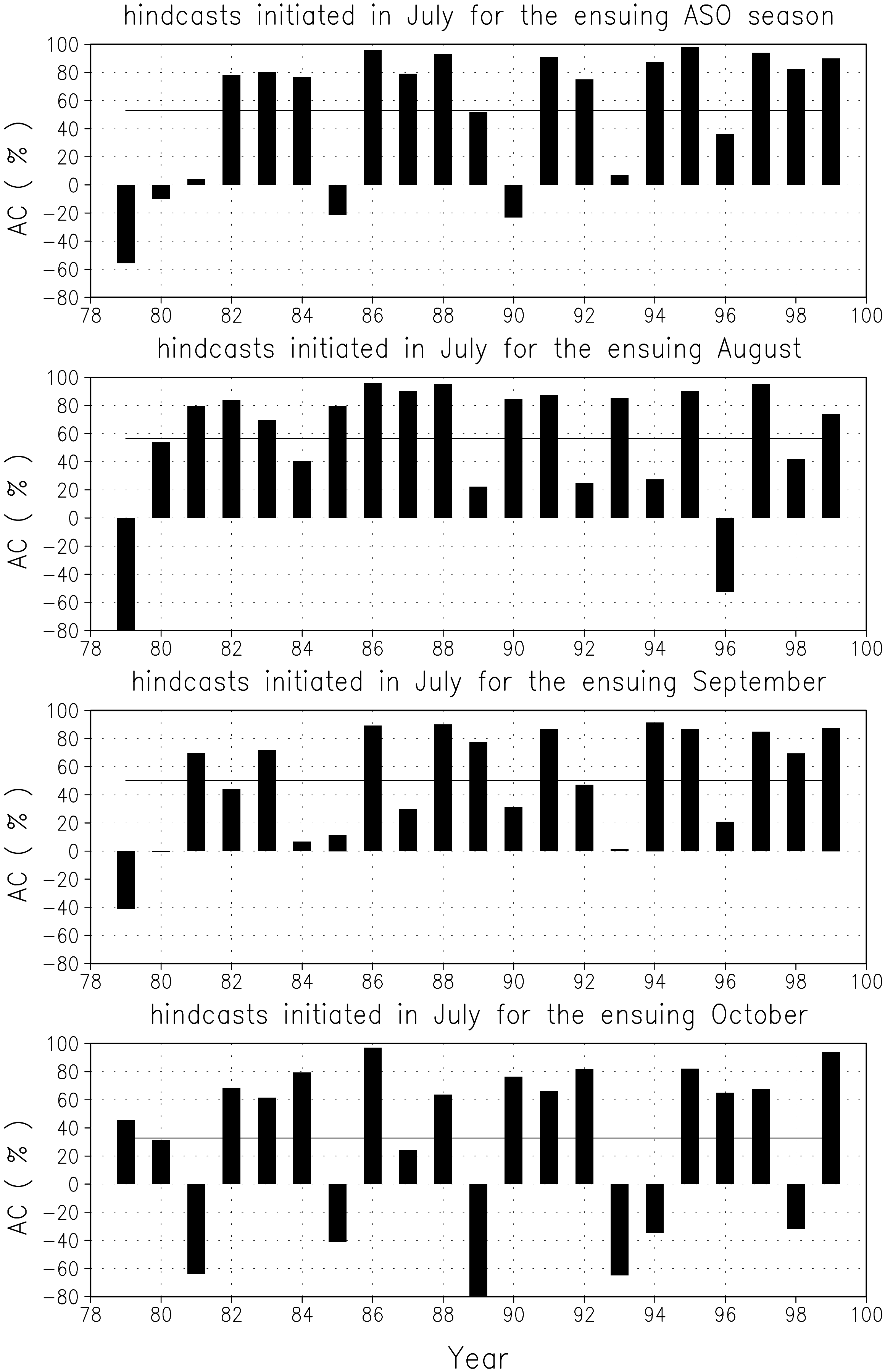

Fig.5 Seasonal Hindcast & Verification of Windshear Fields

for the Atlantic tropical cyclone prone sector
hindcast initiated in July for the ensuing ASO season

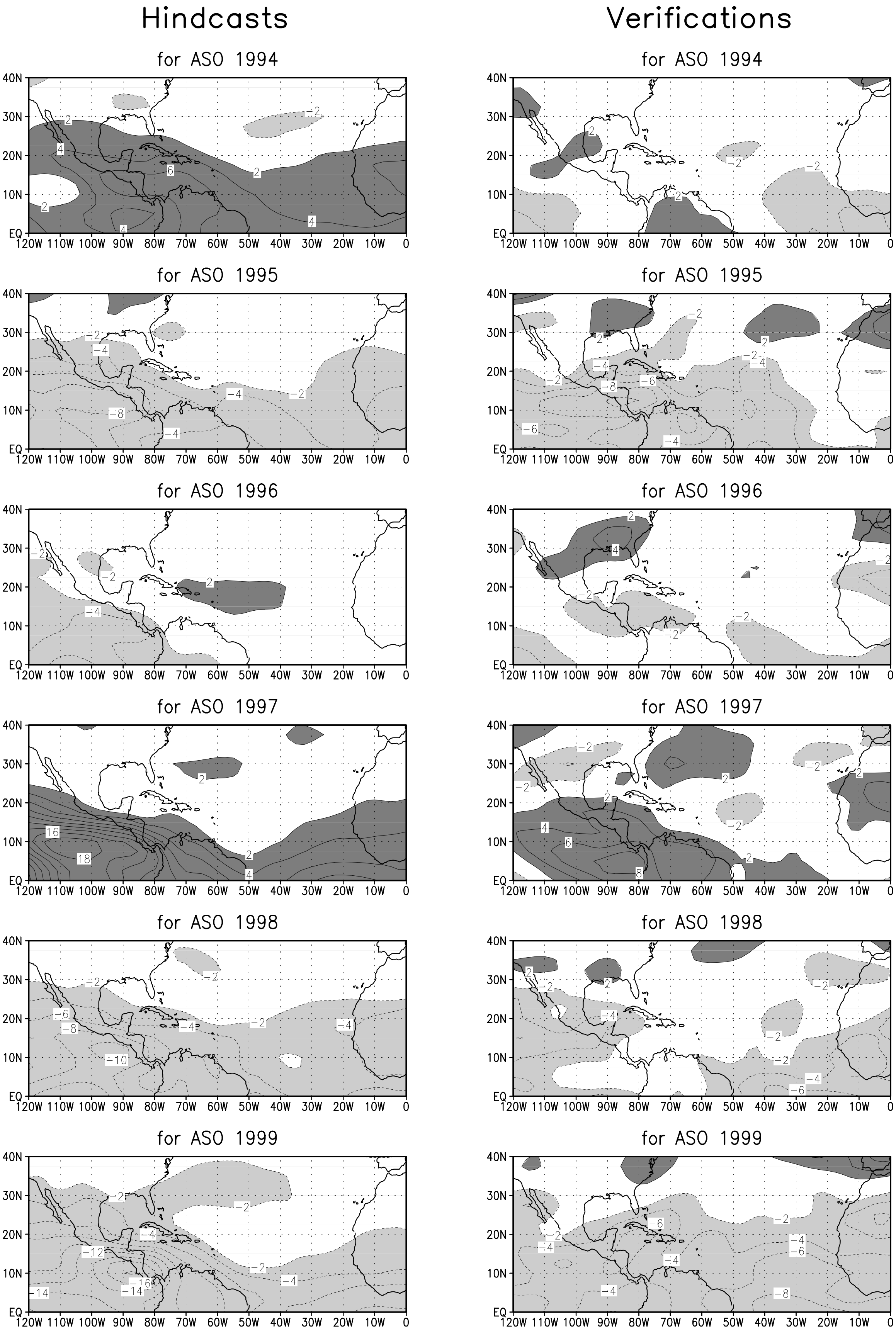

Fig. 6 AC Scores of the Long-lead Windshear Hindcasts
evaluated for the TC prone region of 90-50W & 5-15N
hindcat ensemble runs were initiated in June