# 2006 National Hurricane Center Forecast Verification Report

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ABSTRACT

NHC official track forecasts in the Atlantic basin set records for accuracy from 12-72 h in 2006. They consistently beat the individual dynamical guidance models, but trailed the consensus models slightly. Examination of trends suggests that there has been some increase in skill in recent years for the 24-48 h forecasts. Among the operational consensus models, GUNA performed the best overall. The GFDI, GFSI, and NGPI provided the best dynamical track guidance at various times, while the performance of the UKMI trailed considerably. No routinely-available early dynamical model had skill at 5 days. The ECMWF (a late model) performed extremely well, especially at longer times, but it was rarely available in time to be considered by the forecasters. A small improvement in the timeliness of this model would be of great value.

Atlantic official intensity errors were very near the previous 5-year means, but skill levels in 2006 were down sharply. Official errors trailed the GHMI and ICON (a consensus of the GHMI and DSHP) guidance, and had a significant high forecast bias. For the first time, dynamical intensity guidance (GHMI) in 2006 was superior to the statistical DSHP guidance on average.

Official track errors in 2006 for the eastern North Pacific were slightly lower than the 5-year mean errors, but were slightly higher than in 2005. The official forecast beat the individual dynamical models but not the consensus models. The consensus track models GUNA and CONU in the eastern Pacific were substantially better than their components, indicating a very strong independence of the consensus members. On the other hand, the GFS ensemble mean (AEMI) was inferior to its control run (GFSI). Among the dynamical models, the GFDI and UKMI were the best performers overall.

Eastern North Pacific official intensity errors were near the 5-year averages. There has been no detectible trend in intensity error since 1990, although skill appears to have increased slightly during this time. GHMI beat DSHP after 36 h, but ICON generally was superior to either one. The FSU super-ensemble also performed well.

## 1. Introduction

For all operationally-designated tropical (or subtropical) cyclones in the Atlantic and eastern North Pacific basins, the National Hurricane Center (NHC) issues an "official" forecast of the cyclone's center position and maximum 1-min surface wind speed. Forecasts are issued every 6 hours, and contain projections valid 12, 24, 36, 48, 72, 96, and 120[1] h after the forecast's nominal initial time (0000, 0600, 1200, or 1800 UTC)[2]. At the conclusion of the season, forecasts are evaluated by comparing the projected positions and intensities to the corresponding post-storm derived "best track" positions and intensities for each cyclone. A forecast is included in the verification only if the system is classified in the final best track as a tropical (or subtropical)[3] cyclone at both the forecast's initial time and at the projection's valid time. All other stages of development (e.g., tropical wave, remnant low, extratropical) are excluded. For verification purposes, forecasts associated with special advisories do not supersede the original forecast issued for that synoptic time; rather, the original forecast is retained[4]. Except where noted to the contrary, all verifications in this report include the depression stage.

It is important to distinguish between *forecast error* and *forecast skill*. Track forecast error is defined as the great-circle distance between a cyclone's forecast position and the best track position at the forecast verification time. Skill, on the other hand,

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1 NHC began making 96 and 120 h forecasts in 2001, although they were not released publicly until 2003.
2 The nominal initial time represents the beginning of the forecast process. The actual advisory package is not released until 3 h after the nominal initial time, i.e., at 0300, 0900, 1500, and 2100 UTC.
3 For the remainder of this report, the term "tropical cyclone" shall be understood to also include subtropical cyclones.
4 Special advisories are issued whenever an unexpected significant change has occurred or when watches or warnings are to be issued between regularly scheduled advisories. The treatment of special advisories in forecast databases has not been consistent over the years. The current practice of retaining and verifying the original advisory forecast began in 2005.

represents a normalization of forecast error against some standard or baseline. Skill is positive when the forecast error is smaller than the error from the baseline. Particularly useful standards are those that are independent of operations and can be applied retrospectively to historical data. To assess the degree of skill in a set of track forecasts, the track forecast error can be compared with the error from CLIPER5[5], a climatology and persistence model that contains no information about the current state of the atmosphere (Neumann 1972, Aberson 1998). Errors from the CLIPER5 model are taken to represent a "no-skill"[6] level of accuracy that can be used as a baseline for evaluating other forecasts. If CLIPER5 errors are unusually low during a given season, for example, it indicates that the year's storms were inherently "easier" to forecast than normal or otherwise unusually well-behaved. The current version of CLIPER5 is based on developmental data from 1931-2004 for the Atlantic and from 1949-2004 for the eastern Pacific.

Forecast intensity error is defined as the absolute value of the difference between the forecast and best track intensity at the forecast verifying time. Skill in a set of intensity forecasts is assessed using Decay-SHIFOR5 (DSF5). The DSF5 forecast is obtained by initially running SHIFOR5, the climatology and persistence model for intensity that is analogous to the CLIPER5 model for track (Jarvinen and Neumann 1979, Knaff et al. 2003). The output from SHIFOR5 is then adjusted for land interaction by applying the decay rate of DeMaria et al. (2006). The application of the decay

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[5] CLIPER5 and SHIFOR5 are 5-day versions of the original 3-day CLIPER and SHIFOR models.

[6] To be sure, some "skill", or expertise, is required to properly initialize the CLIPER model.

component requires a forecast track, which here is given by CLIPER5[7]. The use of DSF5 as the intensity skill benchmark is new for 2006. On average, DSF5 errors are about 5-15% lower than SHIFOR5 in the Atlantic basin from 12-72 h, and about the same as SHIFOR5 at 96 and 120 h.

NHC also issues forecasts of the size of tropical cyclones; these "wind radii" forecasts are estimates of the maximum extent of winds of various thresholds (34, 50, and 64 kt) expected in each of four quadrants surrounding the cyclone. Unfortunately, very little surface wind information is available to help the forecaster accurately analyze the current size of a tropical cyclone's wind field. As a result, post-storm best track wind radii are likely to have errors so large as to render a verification of official radii forecasts virtually meaningless. No verifications of NHC wind radii are therefore included in this report.

Numerous objective forecast aids (guidance models) are available to help the NHC in the preparation of official track and intensity forecasts. Guidance models are characterized as either *early* or *late*, depending on whether or not they are available to the forecaster during the forecast cycle. For example, consider the 1200 UTC (12Z) forecast cycle, which begins with the 12Z synoptic time and ends with the release of an official forecast at 15Z. The 12Z run of the National Weather Service/Global Forecast System (GFS) model is not complete and available to the forecaster until about 16Z, or about an hour after the forecast is released - thus the 12Z GFS would be considered a late model since it could not be used to prepare the 12Z official forecast. This report focuses on the verification of early models, although some late model information is included.

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[7] A more accurate and operationally useful version of DSF5 would make use of the official forecast track (OFCI), rather than the CLIPER5 track to determine the likely decay component. A skill benchmark, however, cannot depend on irreproducible (or unavailable) operational forecasts.

Multi-layer dynamical models are generally, if not always, late models. Fortunately, a technique exists to take the most recent available run of a late model and adjust its forecast to apply to the current synoptic time and initial conditions. In the example above, forecast data for hours 6-126 from the previous (06Z) run of the GFS would be smoothed and then adjusted, or shifted, so that the 6-h forecast (valid at 12Z) would match the observed 12Z position and intensity of the tropical cyclone. The adjustment process creates an "early" version of the GFS model for the 12Z forecast cycle that is based on the most current available guidance. The adjusted versions of the late models are known, mostly for historical reasons, as *interpolated* models[8]. The adjustment algorithm is invoked as long as the most recent available late model is not more than 12 h old, e.g., a 00Z late model could be used to form an interpolated model at 12Z, but not at 18Z. Verification procedures here make no distinction between 6 and 12 hr interpolated models.

A list of models is given in Table 1. In addition to their timeliness, models are characterized by their complexity or structure; this information is contained in the table for reference, but a complete description of the various model types is beyond the scope of this report. Briefly, *dynamical* models forecast by solving the physical equations governing motions in the atmosphere. These may treat the atmosphere either as a single layer (two-dimensional) or as having many layers (three-dimensional), and their domains may cover the entire globe or be limited to specific regions. The interpolated versions of dynamical model track and intensity forecasts are also sometimes referred to as

[8] When the technique to create an early model from a late model was first developed, forecast output from the late models was available only at 12 h (or longer) intervals. In order to shift the late model's forecasts forward by 6 hours, it was necessary to first interpolate between the 12 h forecast values of the late model – hence the designation "interpolated".

dynamical models. *Statistical* models, in contrast, do not consider the physics of the atmosphere but instead are based on historical relationships between storm behavior and various other parameters. *Statistical-dynamical* models are statistical in structure but use forecast parameters from dynamical models as predictors. *Consensus* models are not true forecast models per se, but are merely combinations of results from other models. One way to form a consensus model is to simply average the results from a sample of models, but other, more complex techniques can give better results. The FSU super-ensemble, for example, combines its individual components on the basis of past performance in an attempt to correct for biases in those components. A consensus model that considers past error characteristics can be described as a "weighted" or "corrected" consensus[9].

GHMI, CGUN, and CCON (Table 1) are new models (or more accurately, new variants on old models) available to the forecasters in 2006. GHMI is an early (interpolated) version of the GFDL model that uses a special adjustment algorithm to minimize the effect of spin-up instabilities in the early hours of GFDL runs that are irrelevant to longer-range forecasts. An offset between the 6 h GFDL forecast and the observed initial intensity is computed as described above, but applied as follows: the full offset is applied to the 6, 12, and 18 h GFDL forecasts, half of the offset is applied to the 24 h GFDL forecast, and no offset is applied to the GFDL forecasts beyond 24 h. (With respect to track, GHMI and GFDI are identical.) Tests with a multi-year sample show that GHMI intensity forecasts have smaller errors than GFDI forecasts that use the traditional adjustment algorithm. GHMI was implemented mid-season in 2006, but the results

[9] It has been argued that "consensus" is not an appropriate term for a combination of models, since consensus is defined as "a general agreement among all the member of a group". One could imagine however, that if a group of disparate models were to sit down and politely settle their differences, some combination of their collective viewpoints might well be the result. In any event, the term consensus has a long history of use in meteorology for this purpose and will be retained here.

presented here include GHMI forecasts for the full season generated after the fact. Similarly, GHMI replaced GFDI in the generation of the intensity consensus model ICON in mid-season, but early season ICON forecasts that used GFDI have been recalculated using GHMI for evaluation here. CGUN and CCON are models under development through the Joint Hurricane Testbed (JHT) that are "corrected" versions of the GUNA and CONU consensus models, respectively. CGUN and CCON use linear regression on past errors in an attempt to improve model performance.

Verifications for the Atlantic and eastern North Pacific basins are given in Sections 2 and 3 below, respectively. Conclusions are summarized in Section 4.

## 2. Atlantic Basin

### *a. 2006 season overview - Track*

Table 2 presents the results of the NHC official track forecast verification for the 2006 season, along with results averaged for the previous 5-yr period 2001-2005[10]. After the extremely busy 2005 season, tropical cyclone activity (and the number of official forecasts) returned to near normal levels in 2006. Mean track errors ranged from 30 n mi at 12 h to 265 n mi at 120 h. It is seen that mean official track forecast errors were smaller in 2006 than during the previous 5-yr period (by roughly 15%-20% out to 72 h), and in fact, at forecast projections through 72 h the errors established new all-time lows. Since 1990, 24-72 h track forecast errors have been reduced by roughly 50% (Fig. 1). Fairly substantial vector biases at the longer ranges were noted in 2006; at 120 h the

[10] It has been traditional to use a 10-year sample to establish representative NHC official forecast error characteristics. Given the increase in storm activity in recent years, as well as the significant improvements in track forecast accuracy, it is now felt that a 5-year sample is more representative of the state of the science.

official forecast bias was 82 n mi to the west of the verifying position. This bias, about 35% of the mean error magnitude, was about twice as large as the 120 h bias in the GUNA consensus (Table 3b), suggesting a tendency to resist forecast guidance calling for re-curvature.

While the track forecasts at each time period were more accurate in 2006 than they had been over the previous 5 years period, only the forecasts from 12-72 h were also more skillful. The improved skill at 12-72 h occurred despite the fact that CLIPER5 errors during 2006 were also below average from 12-72 h, indicating below average forecast difficulty. It is worth noting that the 96 and 120 h CLIPER5 errors and sample sizes were anomalously low in 2006, so the loss of skill at these time periods is likely not significant. An examination of annual skill trends (Fig. 1) suggests that shorter-range skill continues to trend upward, while no clear trend is apparent for 72 h and beyond.

Table 3a presents a homogeneous[11] verification for a selection of early models for 2006. Vector biases of the guidance models are given in Table 3b. Results in terms of skill are presented in Fig. 2. Figure 2 shows that none of the dynamical models scored consistently high marks throughout the forecast period. On balance the GFDI performed best, although its 5-day forecasts were disappointing. Trailing the other dynamical models by a good margin were GFNI and UKMI. The conceptually simple BAM models were only competitive with the poorer-performing of the three-dimensional dynamical models. It should be noted that the relative performance of the track models in 2006 is broadly consistent with a three-year verification for the period 2004-6 (Fig. 3).

[11] Verifications comparing different forecast models are referred to as *homogeneous* if each model is verified over an identical set of forecast cycles. Only homogeneous model comparisons are presented in this report.

Consensus models on average outperform the individual models from which they are constructed, and this was true again in 2006. Historically, consensus models have also outperformed the official forecast, and this was mostly true again in 2006. Errors from the three multi-model consensus aids (GUNA, CONU, FSSE) were tightly packed, with FSSE best by a small margin through 36 h and GUNA generally best by an equally small margin beyond that time. It is worth noting that FSSE has as one of its components the previous NHC official forecast – blurring the distinction between objective guidance and the Hurricane Specialist's final subjective forecast. It is also worth noting that CONU has significantly higher availability than the other consensus models. Finally, the GFS ensemble mean, AEMI, lagged significantly behind the multi-model ensembles and indeed was mostly not even as good as the control GFSI.

The corrected consensus models CGUN and CCON, although not officially operational, were available and viewed by the Hurricane Specialists in 2006. Each is compared to its uncorrected parent model in Fig. 4. The corrected consensus models were generally better by 1-3%, although the technique did not appear to be effective at 5 days. It is expected that these JHT models will be available again to forecasters in 2007.

While late models are not available to meet forecast deadlines, verification for a selection of these models is given in Table 4. Performance of the late models was largely similar to that of the interpolated-dynamical models discussed above. This particular selection of late models includes the ECMWF (EMX), which has not played a major role in forecast operations because of its limited availability (e.g., the 12Z EMX arrives at NHC too late to be used to generate an interpolated version of the model at 18Z). However, EMX performed very well in 2006, and only a small improvement in its timeliness would be required to allow it to be used effectively by the forecasters. In fact, EMX outperformed a GFDL/UKM/NGPS/GFS consensus at 72, 96, and 120 h.

Atlantic basin 48-h official track error, evaluated for tropical storms and hurricanes only, is a forecast metric tracked under the Government Performance and Results Act of 1993 (GPRA). In 2006, the verification for this GPRA metric was 97 n mi.

*b. 2006 season overview - Intensity*

Table 5 presents the results of the NHC official intensity forecast verification for the 2006 season, along with results averaged for the preceding 5-yr period. Mean forecast errors in 2006 were very close to the 5-year means, with errors ranging from about 7 kt at 12 h to just below 20 kt at 96 and 120 h. Forecast biases, however, were large and positive – near 5 kt at 72 h and over 7 kt at 96 h. In contrast, intensity biases for the period 2001-5 are near zero. It is interesting that these large positive biases occurred in a year for which there were very few instances of rapid strengthening[12] (only 3.3% of all 24 h intensity changes qualified), but which followed a season that featured many such cases (2005 featured a 7.1% occurrence rate), and indeed the 2001-5 period as a whole had numerous strong and rapidly-deepening storms. The lack of such storms in 2006 led to decay-SHIFOR errors that were considerably below-normal, i.e., this year's storms should have been relatively easy to forecast. However, these low decay-SHIFOR errors, coupled with the tendency to over-forecast intensification, resulted in strongly negative official forecast skill in 2006 (Fig. 5).

[12] Following Kaplan and DeMaria (2003), rapid intensification is defined as a 30 kt increase in maximum winds in a 24 h period, and corresponds to the 5th percentile of all intensity changes in the Atlantic basin.

Table 6a presents a homogeneous verification for a selection of early intensity models for 2006. To increase the sample size, a smaller collection of the better-performing models is given in Table 6b, and results in terms of skill for the second grouping are presented in Fig. 6. Intensity biases are given in Table 6c. The figure includes the intensity consensus ICON, an arithmetic average of GHMI and DSHP that is a useful simple consensus against which to measure the FSU super-ensemble. Historically, ICON outperforms either of its components, although in 2006 GHMI was as good as or better than the consensus. It was a very good year for GHMI, and in fact 2006 was the first year that a dynamical intensity model beat the statistical-dynamical DSHP. However, it was not a good year for the intensity guidance generally, with none of the models showing skill beyond 48 h. Nor was it a good year for the official intensity forecasts, which generally beat the objective guidance, but failed to do so in 2006. The high bias in the official forecasts mirrored a high bias in the GHMI and FSSE models. Curiously, DSHP had a near-zero bias but significantly higher mean errors than GHMI.

*c. Verifications for individual storms*

Forecast verifications for individual storms are given for reference in Table 7. Relative to the seasonal averages, low track forecast errors occurred for Debby, Florence, and Helene, while Beryl, Gordon, and Isaac were less well-forecast. The 4- and 5-day track forecasts for Ernesto had a significant westward bias. For intensity, forecast errors with Chris and Ernesto were particularly unsatisfying. Florence, a long-lived storm with very low decay-SHIFOR5 errors, also was largely responsible for the lack of intensity forecast skill in 2006. Additional discussion on forecast performance for individual storms can be found in NHC Tropical Cyclone Reports available at http://www.nhc.noaa.gov/2006atlan.shtml.

## 3. Eastern North Pacific Basin

### *a. 2006 season overview – Track*

Table 8 presents the NHC official track forecast verification for the 2006 season, along with results averaged for the previous 5-yr period 2001-5. Mean track errors range from 30 n mi at 12 h to 228 n mi at 120 h. Mean official track forecast errors in 2006 were slightly smaller than the 5-year means, but mostly larger than the record low errors of 2005. The 12 h error of 30 n mi, however, did establish a new record. Figure 7 (top panel) shows recent trends in track forecast accuracy for the eastern Pacific. Errors are down by roughly 20-40% for the 24-72 h forecasts since 1990, a somewhat smaller improvement than what has occurred in the Atlantic over this period, but still substantial. Forecast skill in 2006 was very close to 5-year mean values (Table 8), but not as skillful as in 2005. Recent large year-to-year variations in skill make it difficult to discern trends (Fig. 7), although the trend in skill still appears to be generally upward. Track forecast biases were small.

Track guidance errors for the early models are given in Table 9a, and skill comparisons of selected models are shown in Fig. 8. Vector biases of the guidance models are given in Table 9b. Among the dynamical models, the GFDI performed best overall, with the UKMI close behind. For the second year in a row, however, the simple BAMM was as good as or better than any of the dynamical models, and indeed many of the more primitive aids beat the dynamical models at 5 days. The single-model consensus

AEMI did not provide value over the GFS control, but the multi-model consensus GUNA and FSSE performed very well. The official forecast trailed the performance of the consensus models by a modest margin. Also for the second year in a row, there was a large separation between the consensus models (GUNA and CONU) and their constituent members, indicating substantial value in a multi-model consensus approach. Figure 9 shows 72 h model biases for the GUNA consensus and its components. Biases for the individual models are seen to have a large azimuthal spread, which led to a small bias for the GUNA consensus. In particular, the GFDI and UKMI appear to have had rather different dominant error mechanisms during the past two seasons.

It would be incorrect, however, to draw the conclusion from Fig. 9 that the low *mean error* of the GUNA consensus is due to compensating biases. In fact, it can be shown (Goerss, personal communication) that removal of seasonal biases from each individual model forecast has a negligible impact on the 2006 72 h mean GUNA forecast error. Rather, what lowers mean consensus error is the tendency of the consensus to have few large errors when the component models are highly independent – i.e., when one model "goes bad" the other independent models mitigate the damage to the consensus. Put more formally, the mean track error is proportional to the track error standard deviation (Goerss 2000, Sampson et al., 2006). This effect is illustrated in Fig. 10, which shows the cumulative error distribution of GUNA and its members at 72 h for the last two seasons of eastern North Pacific track forecasts. The figure shows, for example, that roughly 35% of the individual model forecasts are in error by at least 200 n mi but only 10% of the GUNA forecasts are. Following Goerss, one can estimate the effective degrees of freedom in a consensus as $n_e = (s_i/s_c)^2$, where $s_i$ is the average standard deviation of the individual component model errors, and $s_c$ is the standard deviation of the consensus error. Error standard deviations are estimated separately using the along and cross track model errors. For the east Pacific errors of Fig 10, this calculation yields $n_e = 2.4$ for both the along- and cross-track directions, while a comparable calculation for the Atlantic gives $n_e = 1.7$ (along-track) and 1.6 (cross-track). In other words, the Atlantic track models are less independent of each other. One can speculate that Atlantic forecasts are dominated by relatively strong, variable, and well-measured steering currents that are largely similar from model to model, while in the eastern North Pacific, simpler steering flows and the lack of upstream data tend to make forecasts more dependent on the vagaries of individual model initializations. Whatever the reasons, the consensus approach appears to be somewhat more useful in the eastern North Pacific than it is in the Atlantic.

A verification of late track models is given in Table 10. The GFDL was the most consistently strong model. As noted above, the GFS ensemble mean in the eastern North Pacific did not provide value over the standard GFS run.

*b. 2006 season overview – Intensity*

Table 11 presents the results of the NHC eastern North Pacific intensity forecast verification for the 2006 season, along with results averaged for the preceding 5-yr period. Mean forecast errors started near 7 kt at 12 h and leveled off near 19 kt by 96 h. These errors were all within 10% of the 5-year means. Decay-SHIFOR5 forecast errors in 2006 were mostly larger than their 5-year means, indicating that the season’s storms were slightly more difficult to forecast than average. A review of annual errors and skill scores

(Fig. 11) indicates little net change in intensity error since 1990, although there has been a slight increase in forecast skill. Eastern North Pacific intensity forecasts have traditionally had a high bias, and this was true again in 2006, although this year's bias was a little smaller than the 5-year mean bias.

Table 12a and Fig. 12 present a homogeneous verification for the primary early intensity models for 2006. Model biases are given in Table 12b. The official forecast generally beat all the guidance, including the consensus guidance, through 48 h. FSSE provided the best guidance through 48 h (perhaps because of the excellent official forecasts it used), while ICON and GHMI performed best at the longer lead times. It was not a good year for DSHP, which showed skill only through 48 h. Conversely, GHMI only had skill at 48 h and beyond. A similar relative performance of the DSHP and GHMI/GFDI occurred for the eastern North Pacific in 2005 (but not 2004).

### *c. Verifications for individual storms*

Forecast verifications for individual storms are given for reference in Table 13. Additional discussion on forecast performance for individual storms can be found in NHC Tropical Cyclone Reports available at http://www.nhc.noaa.gov/2006epac.shtml.

## 4. Summary

### *a. Atlantic*

- OFCL track forecasts established new records for accuracy from 12-72 h. OFCL track forecasts were better than all the dynamical guidance models, but trailed the consensus models slightly.

- Among the operational consensus models, GUNA performed the best overall. The GFDI, GFSI, and NGPI provided the best dynamical track guidance at various times, while the performance of the UKMI trailed considerably. No early dynamical model had skill at 5 days.
- The ECMWF performed extremely well, especially at longer times, but it was rarely available to the forecasters. A small improvement in the timeliness of this model would be of great value.
- Atlantic official intensity errors were very near the 5-year means, but skill levels in 2006 were down sharply. Official errors trailed the GHMI and ICON guidance, and had a significant high forecast bias.
- For the first time, dynamical intensity guidance (GHMI) was superior to the statistical DSHP guidance on a seasonal basis.

*b.* *Eastern North Pacific*

- Official track errors in the eastern North Pacific were slightly smaller than the 5-year means, but were up slightly in 2006 compared to 2005. The official forecast beat the individual dynamical models but not the consensus models.
- The consensus track models GUNA and CONU in the eastern North Pacific were substantially better than their components, although the GFS ensemble mean (AEMI) was inferior to the control run (GFSI). Among the dynamical models, the GFDI and UKMI were the best performers overall.

- Eastern North Pacific official intensity errors were near their 5-year averages. There has been no detectible trend in intensity error since 1990 in this basin, although skill appears to have increased slightly during this time. GHMI beat DSHP after 36 h, but ICON generally was superior to either one.

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Table 1. National Hurricane Center forecasts and models.

| ID | Name/Description | Type | Timeliness (E/L) | Parameters forecast |
|---|---|---|---|---|
| OFCL | Official NHC forecast | | | Trk, Int |
| GFDL | NWS/Geophysical Fluid Dynamics Laboratory model | Multi-layer regional dynamical | L | Trk, Int |
| GFSO | NWS/Global Forecast System (formerly Aviation) | Multi-layer global dynamical | L | Trk, Int |
| AEMN | GFS ensemble mean | Consensus | L | Trk, Int |
| UKM | United Kingdom Met Office model | Multi-layer global dynamical | L | Trk, Int |
| NGPS | Navy Operational Global Prediction System | Multi-layer global dynamical | L | Trk, Int |
| GFDN | Navy version of GFDL | Multi-layer regional dynamical | L | Trk, Int |
| CMC | Environment Canada global model | Multi-level global dynamical | L | Trk, Int |
| NAM | NWS/NAM | Multi-level regional dynamical | L | Trk, Int |
| AFW1 | Air Force MM5 | Multi-layer regional dynamical | L | Trk, Int |
| EMX | ECMWF global model | Multi-layer global dynamical | L | Trk, Int |
| BAMS | Beta and advection model (shallow layer) | Single-layer trajectory | E | Trk |
| BAMM | Beta and advection model (medium layer) | Single-layer trajectory | E | Trk |
| BAMD | Beta and advection model (deep layer) | Single-layer trajectory | E | Trk |
| LBAR | Limited area barotropic model | Single-layer regional dynamical | E | Trk |
| A98E | NHC98 (Atlantic) | Statistical-dynamical | E | Trk |
| P91E | NHC91 (Pacific) | Statistical-dynamical | E | Trk |
| CLP5 | CLIPER5 (Climatology and Persistence model) | Statistical (baseline) | E | Trk |
| SHF5 | SHIFOR5 (Climatology and Persistence model) | Statistical (baseline) | E | Int |
| DSF5 | Decay-SHIFOR5 (Climatology and Persistence model) | Statistical (baseline) | E | Int |

| ID | Name/Description | Type | Timeliness (E/L) | Parameters forecast |
|---|---|---|---|---|
| OCD5 | CLP5 (track) and DSF5 (intensity) models merged | Statistical (baseline) | E | Trk, Int |
| SHIP | Statistical Hurricane Intensity Prediction Scheme (SHIPS) | Statistical-dynamical | E | Int |
| DSHP | SHIPS with inland decay | Statistical-dynamical | E | Int |
| OFCI | Previous cycle OFCL, adjusted | Interpolated | E | Trk, Int |
| GFDI | Previous cycle GFDL, adjusted | Interpolated-dynamical | E | Trk, Int |
| GHMI | Previous cycle GFDL, adjusted using a variable intensity offset correction that is a function of forecast time. | Interpolated-dynamical | E | Trk, Int |
| GFSI | Previous cycle GFS, adjusted | Interpolated-dynamical | E | Trk, Int |
| UKMI | Previous cycle UKM, adjusted | Interpolated-dynamical | E | Trk, Int |
| NGPI | Previous cycle NGPS, adjusted | Interpolated-dynamical | E | Trk, Int |
| GFNI | Previous cycle GFDN, adjusted | Interpolated-dynamical | E | Trk, Int |
| EMXI | Previous cycle EMX, adjusted | Interpolated-dynamical | E | Trk, Int |
| GUNA | Average of GFDI, UKMI, NGPI, and GFSI | Consensus | E | Trk |
| CGUN | Version of GUNA corrected for model biases | Corrected consensus | E | Trk |
| AEMI | Previous cycle AEMN, adjusted | Consensus | E | Trk, Int |
| CONU | Average of at least 2 of GFDI, UKMI, NGPI, GFSI, and GFNI | Consensus | E | Trk |
| CCON | Version of CONU corrected for model biases | Corrected consensus | E | Trk |
| ICON | Average of GHMI and DSHP | Consensus | E | Int |
| FSSE | FSU Super-ensemble | Corrected consensus | E | Trk, Int |

Table 2. Homogenous comparison of official and CLIPER5 track forecast errors in the Atlantic basin for the 2006 season for all tropical cyclones. Averages for the previous 5-year period are shown for comparison.

| | Forecast Period (h) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 2006 mean OFCL error (n mi) | 29.7 | 50.8 | 71.9 | 97.0 | 148.7 | 205.5 | 265.3 |
| 2006 mean CLIPER5 error (n mi) | 43.4 | 90.0 | 144.6 | 203.3 | 299.1 | 331.6 | 333.7 |
| 2006 mean OFCL error relative to CLIPER5 (%) | -32 | -44 | -50 | -52 | -50 | -38 | -21 |
| 2006 mean OFCL bias vector (°/n mi) | 314/5 | 310/9 | 319/14 | 335/19 | 352/28 | 311/17 | 257/82 |
| 2006 number of cases | 223 | 205 | 187 | 169 | 132 | 100 | 78 |
| 2001-2005 mean OFCL error (n mi) | 37.3 | 64.5 | 91.3 | 118.3 | 171.4 | 231.1 | 303.3 |
| 2001-2005 mean CLIPER5 error (n mi) | 49.8 | 103.9 | 164.7 | 222.0 | 327.7 | 441.9 | 548.1 |
| 2001-2005 mean OFCL error relative to CLIPER5 (%) | -25 | -38 | -45 | -47 | -48 | -48 | -45 |
| 2001-2005 mean OFCL bias vector (°/n mi) | 305/6 | 315/13 | 320/21 | 322/27 | 310/24 | 344/19 | 034/36 |
| 2001-2005 number of cases | 1930 | 1743 | 1569 | 1410 | 1138 | 913 | 742 |
| 2006 OFCL error relative to 2001-2005 mean (%) | -20 | -21 | -21 | -18 | -13 | -11 | -13 |
| 2006 CLIPER5 error relative to 2001-2005 mean (%) | -13 | -13 | -12 | -8 | -9 | -25 | -39 |

Table 3a. Homogenous comparison of Atlantic basin early track guidance model errors (n mi) for 2006. Errors smaller than the NHC official forecast are shown in bold-face.

| | Forecast Period (h) | | | | | | |
|---|---|---|---|---|---|---|---|
| Model ID | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| OFCL | 25.9 | 46.3 | 69.4 | 90.2 | 130.1 | 176.9 | 237.5 |
| CLP5 | 42.0 | 95.0 | 159.8 | 227.6 | 295.5 | 303.9 | 269.2 |
| GFSI | 32.7 | 52.9 | 74.3 | **89.2** | 145.0 | 211.5 | 306.1 |
| GFDI | 29.1 | 49.3 | 71.7 | 94.3 | 143.4 | 196.6 | 344.0 |
| GFNI | 31.7 | 57.6 | 88.8 | 114.7 | 169.2 | 221.5 | 323.5 |
| UKMI | 37.7 | 68.2 | 97.8 | 127.7 | 244.0 | 279.2 | 298.1 |
| NGPI | 31.2 | 54.9 | 82.0 | 105.5 | 145.4 | 187.3 | 281.9 |
| GUNA | 26.4 | **43.6** | **63.6** | **79.6** | 132.9 | **165.6** | **227.1** |
| CONU | 26.4 | **44.0** | **65.1** | **82.5** | 132.6 | **169.6** | **236.5** |
| FSSE | **25.7** | **41.6** | **62.6** | **82.3** | 143.1 | **174.0** | **228.7** |
| AEMI | 36.0 | 60.1 | 83.7 | 102.0 | 151.2 | 205.1 | 303.8 |
| BAMS | 47.5 | 88.3 | 123.4 | 148.8 | 192.6 | 237.2 | 341.5 |
| BAMM | 37.6 | 69.5 | 102.9 | 133.5 | 183.0 | 228.0 | 349.6 |
| BAMD | 36.8 | 67.3 | 103.0 | 139.5 | 214.4 | 267.9 | 383.3 |
| LBAR | 32.2 | 61.5 | 94.0 | 134.7 | 196.7 | 252.0 | 359.9 |
| A98E | 36.8 | 67.7 | 103.9 | 144.5 | 223.4 | 308.5 | 453.3 |
| # Cases | 159 | 139 | 124 | 107 | 75 | 56 | 41 |

Table 3b. Homogenous comparison of Atlantic basin early track guidance model bias vectors (º/n mi) for 2006.

| | Forecast Period (h) | | | | | | |
|---|---|---|---|---|---|---|---|
| Model ID | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| OFCL | 309/6 | 310/13 | 323/19 | 356/27 | 012/37 | 330/14 | 255/65 |
| CLP5 | 261/7 | 251/19 | 257/37 | 257/56 | 279/37 | 005/39 | 323/53 |
| GFSI | 286/13 | 290/18 | 313/19 | 009/29 | 034/37 | 110/18 | 217/63 |
| GFDI | 263/3 | 319/9 | 337/20 | 014/33 | 015/66 | 016/93 | 021/210 |
| GFNI | 254/8 | 261/20 | 266/34 | 269/41 | 265/53 | 242/67 | 241/73 |
| UKMI | 329/7 | 323/15 | 334/23 | 359/37 | 030/10 | 041/96 | 023/28 |
| NGPI | 306/10 | 296/22 | 283/35 | 271/38 | 265/49 | 259/73 | 252/122 |
| GUNA | 299/8 | 305/15 | 313/22 | 346/25 | 014/48 | 015/37 | 335/37 |
| CONU | 288/7 | 295/15 | 300/23 | 326/24 | 358/37 | 351/23 | 308/32 |
| FSSE | 307/2 | 352/3 | 024/9 | 048/25 | 043/55 | 041/18 | 279/46 |
| AEMI | 284/18 | 300/28 | 319/33 | 001/45 | 022/56 | 039/38 | 277/12 |
| BAMS | 251/29 | 245/50 | 240/64 | 232/66 | 229/60 | 230/106 | 225/205 |
| BAMM | 236/15 | 227/27 | 213/35 | 191/36 | 177/46 | 202/65 | 217/151 |
| BAMD | 197/0 | 121/4 | 122/14 | 098/26 | 095/42 | 103/041 | 200/38 |
| LBAR | 274/3 | 286/13 | 288/24 | 273/24 | 235/60 | 220/91 | 209/159 |
| A98E | 243/9 | 221/16 | 233/028 | 235/045 | 226/089 | 218/110 | 207/185 |
| # Cases | 159 | 139 | 124 | 107 | 75 | 56 | 41 |

Table 4. Homogenous comparison of Atlantic basin late track guidance model errors (n mi) for 2006. Errors from CLP5, an early model, are shown for comparison. The smallest error at each time period is displayed in bold-face.

| | Forecast Period (h) | | | | | | |
|---|---|---|---|---|---|---|---|
| Model ID | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| GFDL | **33.8** | **51.6** | **65.6** | 80.1 | 141.6 | 142.9 | 234.0 |
| GFDN | 37.5 | 61.4 | 84.9 | 108.2 | 177.4 | 224.0 | 304.0 |
| UKM | 41.3 | 66.0 | 89.8 | 115.1 | 215.0 | 295.6 | 296.1 |
| NGPS | 38.4 | 61.3 | 87.0 | 101.9 | 151.6 | 184.6 | 250.2 |
| GFSO | 34.3 | 56.1 | 70.4 | **75.9** | 134.8 | 179.9 | 250.1 |
| AEMN | 37.4 | 61.8 | 75.1 | 83.8 | 132.0 | 163.9 | 230.2 |
| EMX | 43.8 | 58.5 | 70.6 | 80.6 | **96.3** | **119.7** | **162.7** |
| CMC | 56.9 | 74.7 | 97.0 | 130.0 | 204.3 | 297.6 | 463.0 |
| CLP5 | 43.3 | 93.1 | 147.9 | 208.7 | 273.9 | 277.8 | 258.9 |
| # Cases | 82 | 72 | 60 | 50 | 35 | 25 | 22 |

Table 5. Homogenous comparison of official and Decay-SHIFOR5 intensity forecast errors in the Atlantic basin for the 2006 season for all tropical cyclones. Averages for the previous 5-year period are shown for comparison.

| | Forecast Period (h) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 2006 mean OFCL error (kt) | 6.5 | 10.0 | 12.4 | 14.3 | 18.1 | 19.6 | 19.0 |
| 2006 mean Decay-SHIFOR5 error (kt) | 6.7 | 9.3 | 11.4 | 12.9 | 13.8 | 14.4 | 13.1 |
| 2006 mean OFCL error relative to Decay-SHIFOR5 (%) | -3 | 8 | 9 | 11 | 31 | 36 | 45 |
| 2006 OFCL bias (kt) | 0.7 | 2.2 | 2.7 | 3.4 | 5.0 | 7.3 | 6.1 |
| 2006 number of cases | 223 | 205 | 187 | 169 | 132 | 100 | 78 |
| 2001-5 mean OFCL error (kt) | 6.3 | 9.8 | 12.1 | 14.3 | 18.4 | 19.8 | 21.8 |
| 2001-5 mean Decay-SHIFOR5 error (kt) | 7.8 | 11.7 | 15.0 | 18.1 | 22.1 | 24.8 | 25.5 |
| 2001-5 mean OFCL error relative to Decay-SHIFOR5 (%) | -19 | -16 | -19 | -21 | -17 | -20 | -15 |
| 2001-5 OFCL bias (kt) | 0.2 | 0.3 | 0.1 | -0.4 | -0.7 | -1.8 | -1.6 |
| 2001-5 number of cases | 1930 | 1743 | 1569 | 1410 | 1138 | 913 | 742 |
| 2006 OFCL error relative to 2001-5 mean (%) | 3 | 2 | 2 | 0 | -2 | -1 | -13 |
| 2006 Decay-SHIFOR5 error relative to 2001-5 mean (%) | -14 | -21 | -24 | -29 | -38 | -42 | -49 |

Table 6a. Homogenous comparison of Atlantic basin early intensity guidance model errors (kt) for 2006. Errors smaller than the NHC official forecast are shown in bold-face.

| | Forecast Period (h) | | | | | | |
|---|---|---|---|---|---|---|---|
| Model ID | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| OFCL | 6.7 | 10.8 | 13.9 | 15.6 | 17.1 | 16.4 | 14.8 |
| DSF5 | 7.1 | **10.2** | **13.0** | **13.7** | **12.9** | **13.5** | **8.1** |
| GFDI | 7.2 | **9.4** | **11.2** | **13.4** | **14.5** | **12.8** | **12.0** |
| GHMI | 7.1 | **9.5** | **11.3** | **12.5** | **14.4** | **13.9** | **12.1** |
| SHIP | 7.6 | 11.7 | 15.1 | 18.2 | 21.9 | 20.4 | 15.2 |
| DSHP | 6.9 | 10.7 | **13.8** | 16.5 | 19.2 | 19.1 | **13.3** |
| ICON | 6.8 | **9.4** | **11.4** | **13.5** | **15.1** | **15.1** | **12.1** |
| FSSE | 7.0 | **10.2** | **12.7** | **15.1** | 18.4 | 20.2 | 16.3 |
| GFSI | 8.9 | 12.7 | 15.2 | 18.4 | 23.2 | 24.6 | 24.1 |
| GFNI | 7.8 | **10.4** | **13.7** | **15.4** | 19.2 | 20.4 | 21.4 |
| UKMI | 9.2 | 13.1 | 16.3 | 19.3 | 22.6 | 23.8 | 24.8 |
| NGPI | 8.7 | 12.8 | 15.5 | 18.9 | 23.1 | 23.5 | 22.9 |
| # Cases | 158 | 139 | 125 | 108 | 77 | 57 | 43 |

Table 6b. Homogenous comparison of a selected subset of Atlantic basin early intensity guidance model errors (kt) for 2006. Errors smaller than the NHC official forecast are shown in bold-face.

| | Forecast Period (h) | | | | | | |
|---|---|---|---|---|---|---|---|
| Model ID | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| OFCL | 6.7 | 10.8 | 13.7 | 15.8 | 18.3 | 18.4 | 19.0 |
| DSF5 | 7.1 | **10.1** | **12.6** | **14.2** | **13.7** | **13.3** | **10.4** |
| GFDI | 7.3 | **9.9** | **11.7** | **13.1** | **14.7** | **14.4** | **15.7** |
| GHMI | 7.3 | **9.8** | **11.7** | **13.0** | **15.4** | **16.1** | **17.3** |
| SHIP | 7.5 | 11.7 | 14.9 | 18.7 | 23.2 | 22.8 | 21.2 |
| DSHP | 6.9 | **10.7** | **13.5** | 16.7 | 20.4 | 20.2 | **18.6** |
| ICON | 6.8 | **9.7** | **11.6** | **14.0** | **16.1** | **17.0** | **17.6** |
| FSSE | 7.1 | **10.5** | **12.8** | **15.7** | 19.7 | 21.3 | 22.1 |
| # Cases | 181 | 164 | 147 | 129 | 97 | 73 | 56 |

Table 6c. Homogenous comparison of a selected subset of Atlantic basin early intensity guidance model biases (kt) for 2006.

| | Forecast Period (h) | | | | | | |
|---|---|---|---|---|---|---|---|
| Model ID | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| OFCL | 1.3 | 3.4 | 4.4 | 5.2 | 5.9 | 7.1 | 6.3 |
| DSF5 | -.1 | 0.2 | -0.3 | -1.0 | -5.2 | -7.4 | -4.4 |
| GFDI | 0.9 | 2.2 | 3.0 | 3.7 | 6.1 | 5.5 | 8.1 |
| GHMI | 0.9 | 2.9 | 4.8 | 6.0 | 8.6 | 7.7 | 10.0 |
| SHIP | 0.9 | 3.0 | 4.9 | 6.9 | 7.2 | 6.3 | 3.2 |
| DSHP | 0.3 | 1.5 | 2.6 | 3.8 | 2.9 | 1.9 | 0.6 |
| ICON | 0.9 | 2.5 | 4.0 | 5.1 | 60 | 5.0 | 5.6 |
| FSSE | 1.2 | 2.6 | 4.2 | 5.6 | 7.0 | 7.7 | 5.6 |
| # Cases | 181 | 164 | 147 | 129 | 97 | 73 | 56 |

Table 7. Official Atlantic track and intensity forecast verifications (OFCL) for 2006 by storm. CLIPER5 and Decay-SHIFOR5 forecast errors are given for comparison and indicated collectively as OCD5. Number of track and intensity forecasts are given by NT and NI, respectively. Units for track and intensity errors are n mi and kt, respectively.

Verification statistics for: AL012006 ALBERTO

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 17 | 7.0 | 11.2 | 17 | 0.9 | 1.8 |
| 012 | 15 | 33.9 | 52.0 | 15 | 6.3 | 6.9 |
| 024 | 13 | 63.1 | 99.6 | 13 | 8.1 | 6.5 |
| 036 | 11 | 69.6 | 136.1 | 11 | 11.4 | 8.1 |
| 048 | 9 | 92.7 | 181.5 | 9 | 10.6 | 14.1 |
| 072 | 5 | 217.1 | 203.0 | 5 | 5.0 | 9.8 |
| 096 | 1 | 255.8 | 174.2 | 1 | 15.0 | 3.0 |
| 120 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |

Verification statistics for: AL022006 UNNAMED

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 012 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 024 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 036 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 048 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 072 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 096 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 120 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |

Verification statistics for: AL032006 BERYL

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 13 | 3.1 | 3.7 | 13 | 0.4 | 0.4 |
| 012 | 11 | 19.3 | 32.8 | 11 | 3.6 | 5.8 |
| 024 | 9 | 45.3 | 65.3 | 9 | 3.9 | 7.6 |
| 036 | 7 | 68.9 | 102.1 | 7 | 3.6 | 10.0 |
| 048 | 5 | 107.4 | 160.9 | 5 | 6.0 | 10.8 |
| 072 | 1 | 440.0 | 288.6 | 1 | 15.0 | 17.0 |
| 096 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 120 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |

Verification statistics for: AL042006 CHRIS

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 13 | 7.1 | 7.0 | 13 | 2.3 | 3.1 |
| 012 | 11 | 26.6 | 26.1 | 11 | 8.2 | 8.5 |
| 024 | 9 | 47.6 | 46.8 | 9 | 17.8 | 15.4 |
| 036 | 7 | 63.2 | 71.5 | 7 | 19.3 | 16.6 |
| 048 | 5 | 88.4 | 89.5 | 5 | 20.0 | 19.8 |
| 072 | 1 | 163.9 | 203.5 | 1 | 5.0 | 25.0 |
| 096 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 120 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |

Verification statistics for: AL052006 DEBBY

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 19 | 10.1 | 10.1 | 19 | 1.1 | 1.1 |
| 012 | 17 | 32.4 | 37.3 | 17 | 3.8 | 4.8 |
| 024 | 15 | 54.4 | 67.6 | 15 | 6.0 | 8.4 |
| 036 | 13 | 72.9 | 116.0 | 13 | 7.7 | 8.8 |
| 048 | 11 | 87.3 | 176.9 | 11 | 10.5 | 9.8 |
| 072 | 7 | 110.6 | 278.3 | 7 | 17.9 | 13.7 |
| 096 | 3 | 92.9 | 371.5 | 3 | 30.0 | 24.7 |
| 120 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |

Verification statistics for: AL062006 ERNESTO

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 32 | 7.5 | 9.2 | 32 | 2.5 | 3.3 |
| 012 | 30 | 27.3 | 35.5 | 30 | 8.7 | 7.9 |
| 024 | 28 | 47.2 | 73.1 | 28 | 14.5 | 11.8 |
| 036 | 26 | 72.3 | 121.3 | 26 | 16.9 | 15.2 |
| 048 | 24 | 102.2 | 170.7 | 24 | 18.3 | 15.0 |
| 072 | 20 | 159.8 | 232.7 | 20 | 27.8 | 16.9 |
| 096 | 16 | 260.4 | 306.9 | 16 | 34.1 | 19.6 |
| 120 | 12 | 414.9 | 416.0 | 12 | 35.4 | 24.3 |

Verification statistics for: AL072006 FLORENCE

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 37 | 17.6 | 17.5 | 37 | 2.2 | 2.6 |
| 012 | 35 | 39.7 | 46.0 | 35 | 6.1 | 5.9 |
| 024 | 33 | 58.9 | 76.3 | 33 | 9.2 | 6.6 |
| 036 | 31 | 71.9 | 111.2 | 31 | 12.4 | 8.5 |
| 048 | 29 | 69.9 | 150.8 | 29 | 15.3 | 9.5 |
| 072 | 25 | 61.3 | 228.3 | 25 | 19.4 | 10.6 |
| 096 | 21 | 93.9 | 304.8 | 21 | 21.4 | 10.3 |
| 120 | 17 | 159.9 | 395.0 | 17 | 21.8 | 6.6 |

Verification statistics for: AL082006 GORDON

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 40 | 5.9 | 6.2 | 40 | 2.0 | 2.6 |
| 012 | 38 | 27.5 | 52.8 | 38 | 6.8 | 7.2 |
| 024 | 36 | 53.6 | 128.1 | 36 | 10.7 | 11.4 |
| 036 | 34 | 86.0 | 219.6 | 34 | 14.7 | 14.8 |
| 048 | 32 | 128.7 | 318.6 | 32 | 17.2 | 17.7 |
| 072 | 27 | 226.9 | 458.1 | 27 | 22.6 | 20.1 |
| 096 | 21 | 331.7 | 410.1 | 21 | 21.4 | 20.0 |
| 120 | 19 | 360.7 | 395.3 | 19 | 21.1 | 11.0 |

Verification statistics for: AL092006 HELENE

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 49 | 10.8 | 10.9 | 49 | 3.4 | 3.3 |
| 012 | 47 | 27.0 | 41.4 | 47 | 7.4 | 7.3 |
| 024 | 45 | 42.1 | 84.9 | 45 | 10.4 | 9.2 |
| 036 | 43 | 61.5 | 131.3 | 43 | 11.6 | 9.9 |
| 048 | 41 | 85.8 | 177.1 | 41 | 11.8 | 10.6 |
| 072 | 37 | 123.7 | 261.4 | 37 | 11.2 | 10.4 |
| 096 | 33 | 161.3 | 299.3 | 33 | 10.6 | 11.8 |
| 120 | 29 | 192.1 | 219.3 | 29 | 9.8 | 13.8 |

Verification statistics for: AL102006 ISAAC

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 21 | 9.4 | 9.7 | 21 | 1.7 | 1.2 |
| 012 | 19 | 28.6 | 52.2 | 19 | 3.7 | 4.7 |
| 024 | 17 | 50.6 | 125.3 | 17 | 5.9 | 6.9 |
| 036 | 15 | 75.9 | 207.1 | 15 | 7.7 | 10.3 |
| 048 | 13 | 115.5 | 277.1 | 13 | 11.5 | 11.8 |
| 072 | 9 | 193.2 | 402.6 | 9 | 16.7 | 11.7 |
| 096 | 5 | 317.3 | 415.2 | 5 | 13.0 | 4.8 |
| 120 | 1 | 574.4 | 449.6 | 1 | 5.0 | 4.0 |

Table 8. Homogenous comparison of official and CLIPER5 track forecast errors in the eastern North Pacific basin for the 2006 season for all tropical cyclones. Averages for the previous 5-year period are shown for comparison.

| | Forecast Period (h) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 2006 mean OFCL error (n mi) | 30.2 | 54.5 | 77.4 | 99.7 | 142.3 | 186.1 | 227.5 |
| 2006 mean CLIPER5 error (n mi) | 36.2 | 72.7 | 112.1 | 152.3 | 220.5 | 260.1 | 300.8 |
| 2006 mean OFCL error relative to CLIPER5 (%) | -17 | -25 | -31 | -35 | -36 | -29 | -24 |
| 2006 mean OFCL bias vector (°/n mi) | 326/5 | 339/8 | 348/10 | 336/11 | 334/01 | 105/10 | 041/11 |
| 2006 number of cases | 341 | 302 | 264 | 228 | 159 | 107 | 71 |
| 2001-5 mean OFCL error (n mi)[a] | 35.1 | 60.1 | 82.5 | 102.6 | 144.6 | 191.8 | 231.1 |
| 2001-5 mean CLIPER5 error (n mi) | 42.2 | 81.2 | 122.5 | 159.0 | 224.4 | 281.8 | 341.0 |
| 2001-5 mean OFCL error relative to CLIPER5 (%) | -17 | -26 | -33 | -36 | -36 | -32 | -32 |
| 2001-5 mean OFCL bias vector (°/n mi) | 323/1 | 290/1 | 267/3 | 287/7 | 233/5 | 183/13 | 211/25 |
| 2001-5 number of cases | 1300 | 1152 | 1009 | 877 | 652 | 465 | 313 |
| 2006 OFCL error relative to 2001-5 mean (%) | -14 | -9 | -6 | -3 | -2 | -3 | -2 |
| 2006 CLIPER5 error relative to 2001-5 mean (%) | -14 | -10 | -8 | -4 | -2 | -8 | -12 |

Table 9a. Homogenous comparison of eastern North Pacific basin early track guidance model errors (n mi) for 2006. Errors smaller than the NHC official forecast are shown in bold-face.

| | Forecast Period (h) | | | | | | |
|---|---|---|---|---|---|---|---|
| Model ID | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| OFCL | 27.8 | 50.5 | 72.5 | 95.8 | 131.1 | 169.6 | 202.0 |
| CLP5 | 32.4 | 67.5 | 105.8 | 140.8 | 177.4 | 208.9 | **199.0** |
| GFSI | 38.8 | 68.3 | 100.3 | 127.6 | 181.4 | 218.4 | 266.8 |
| GFDI | 33.0 | 58.5 | 84.3 | 115.0 | 167.6 | 212.5 | 310.5 |
| GFNI | 38.5 | 74.6 | 116.6 | 155.5 | 215.6 | 275.9 | 333.1 |
| UKMI | 35.6 | 62.2 | 87.5 | 113.7 | 162.0 | 221.9 | 286.4 |
| NGPI | 37.9 | 71.4 | 108.9 | 142.6 | 191.6 | 212.9 | 227.9 |
| GUNA | **27.5** | **47.3** | **66.8** | **84.2** | **121.0** | **167.5** | 209.3 |
| CONU | **27.7** | **49.1** | **71.0** | **91.4** | **129.7** | 176.0 | 221.0 |
| FSSE | 28.0 | **48.4** | **69.0** | **88.8** | **119.8** | **154.7** | **187.5** |
| AEMI | 37.6 | 69.6 | 105.8 | 141.0 | 198.8 | 243.0 | 263.3 |
| BAMS | 40.9 | 69.8 | 100.1 | 132.5 | 183.4 | 214.5 | 215.4 |
| BAMM | 34.8 | 60.1 | 85.8 | 109.2 | 158.9 | 214.0 | 225.0 |
| BAMD | 46.8 | 81.9 | 119.6 | 151.6 | 181.9 | 253.4 | 303.4 |
| LBAR | 35.8 | 71.5 | 110.5 | 140.9 | 184.0 | 239.1 | 263.6 |
| P91E | 32.0 | 62.2 | 93.1 | 127.9 | 171.1 | 210.1 | 274.0 |
| # Cases | 232 | 213 | 174 | 159 | 123 | 72 | 47 |

Table 9b. Homogenous comparison of eastern North Pacific basin early track guidance model bias vectors (º/n mi) for 2006.

| | Forecast Period (h) | | | | | | |
|---|---|---|---|---|---|---|---|
| Model ID | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| OFCL | 349/7 | 356/12 | 002/13 | 349/15 | 074/14 | 086/58 | 081/128 |
| CLP5 | 334/7 | 328/13 | 313/16 | 280/33 | 259/45 | 228/27 | 202/15 |
| GFSI | 280/8 | 224/12 | 202/27 | 199/37 | 180/54 | 137/58 | 082/174 |
| GFDI | 017/10 | 026/22 | 028/31 | 029/49 | 033/87 | 055/137 | 071/276 |
| GFNI | 067/5 | 093/16 | 092/35 | 079/40 | 029/65 | 053/125 | 062/225 |
| UKMI | 325/9 | 334/11 | 313/7 | 214/13 | 189/58 | 158/114 | 153/131 |
| NGPI | 045/15 | 059/31 | 065/49 | 056/50 | 053/58 | 065/79 | 055/90 |
| GUNA | 000/7 | 032/11 | 058/13 | 061/13 | 091/21 | 098/68 | 085/142 |
| CONU | 009/6 | 046/11 | 071/17 | 068/18 | 064/25 | 084/73 | 078/156 |
| FSSE | 357/6 | 036/10 | 056/14 | 041/16 | 046/21 | 093/55 | 092/113 |
| AEMI | 262/10 | 227/15 | 200/31 | 193/47 | 176/55 | 135/73 | 094/158 |
| BAMS | 326/22 | 315/32 | 300/42 | 281/06 | 263/72 | 252/59 | 097/75 |
| BAMM | 345/18 | 333/25 | 323/32 | 301/38 | 273/31 | 253/17 | 072/103 |
| BAMD | 017/22 | 011/34 | 013/48 | 012/48 | 027/25 | 098/44 | 080/187 |
| LBAR | 009/17 | 346/44 | 338/76 | 326/96 | 320/119 | 321/109 | 352/80 |
| P91E | 318/6 | 299/14 | 299/23 | 291/38 | 259/35 | 209/73 | 179/199 |
| # Cases | 232 | 213 | 174 | 159 | 123 | 72 | 47 |

Table 10. Homogenous comparison of eastern North Pacific basin late track guidance model errors (n mi) for 2006. Errors from CLP5, an early model, are shown for comparison. The smallest errors at each time period are displayed in bold-face.

| | Forecast Period (h) | | | | | | |
|---|---|---|---|---|---|---|---|
| Model ID | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| GFDL | 33.4 | 54.7 | 75.7 | **95.1** | **138.6** | **176.5** | 285.2 |
| GFDN | 39.3 | 66.5 | 96.4 | 136.0 | 204.9 | 255.7 | 332.1 |
| UKM | 40.8 | **54.0** | **75.0** | 100.3 | 139.3 | 196.7 | 243.5 |
| NGPS | 39.2 | 65.2 | 93.1 | 133.7 | 192.8 | 222.1 | 257.7 |
| GFSO | 44.2 | 65.2 | 92.3 | 110.4 | 149.4 | 178.1 | 210.5 |
| AEMN | 46.9 | 69.1 | 97.9 | 127.5 | 191.3 | 212.1 | 204.0 |
| EMX | 54.6 | 72.7 | 92.1 | 105.0 | 146.5 | 199.2 | **199.7** |
| CLP5 | **33.3** | 67.0 | 103.5 | 129.2 | 156.1 | 197.6 | 205.6 |
| # Cases | 113 | 89 | 67 | 48 | 24 | 16 | 9 |

Table 11. Homogenous comparison of official and Decay-SHIFOR5 intensity forecast errors in the eastern North Pacific basin for the 2006 season for all tropical cyclones. Averages for the previous 5-year period are shown for comparison.

| | Forecast Period (h) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 2006 mean OFCL error (kt) | 6.8 | 11.2 | 14.6 | 16.1 | 17.8 | 19.3 | 18.3 |
| 2006 mean Decay-SHIFOR5 error (kt) | 7.9 | 12.7 | 15.9 | 18.3 | 19.8 | 23.4 | 23.6 |
| 2006 mean OFCL error relative to Decay-SHIFOR5 (%) | -14 | -12 | -8 | -12 | -10 | -18 | -23 |
| 2006 OFCL bias (kt) | 1.0 | 1.5 | 1.5 | 1.4 | 4.4 | 3.0 | -0.4 |
| 2006 number of cases | 341 | 302 | 264 | 228 | 159 | 107 | 71 |
| 2001-5 mean OFCL error (kt) | 6.2 | 10.8 | 14.3 | 16.5 | 18.7 | 18.3 | 19.3 |
| 2001-5 mean Decay-SHIFOR5 error (kt) | 7.0 | 11.6 | 15.2 | 17.7 | 21.3 | 20.4 | 19.1 |
| 2001-5 mean OFCL error relative to Decay-SHIFOR5 (%) | -11 | -7 | -6 | -7 | -12 | -10 | +1 |
| 2001-5 OFCL bias (kt) | 0.9 | 2.2 | 3.2 | 3.1 | 4.4 | 5.5 | 4.9 |
| 2001-5 number of cases | 1300 | 1151 | 1009 | 876 | 652 | 465 | 313 |
| 2006 OFCL error relative to 2001-5 mean (%) | +10 | +4 | +2 | -2 | -5 | +5 | -5 |
| 2006 Decay-SHIFOR5 error relative to 2001-5 mean (%) | +13 | +10 | +5 | +3 | -7 | -15 | +24 |

Table 12a. Homogenous comparison of eastern North Pacific basin early intensity guidance model errors (kt) for 2006. Errors smaller than the NHC official forecast are shown in bold-face.

| | Forecast Period (h) | | | | | | |
|---|---|---|---|---|---|---|---|
| Model ID | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| OFCL | 7.5 | 11.5 | 14.4 | 15.6 | 19.3 | 20.2 | 17.4 |
| DSF5 | 8.9 | 13.7 | 16.6 | 18.4 | 20.2 | 24.2 | 24.5 |
| GFDI | 9.5 | 14.7 | 18.2 | 19.8 | 21.6 | **19.9** | 17.7 |
| GHMI | 9.5 | 14.2 | 17.3 | 18.0 | **18.7** | **17.2** | **12.3** |
| SHIP | 8.9 | 13.1 | 16.7 | 18.9 | 21.8 | 24.3 | 25.1 |
| DSHP | 8.4 | 12.6 | 16.0 | 18.0 | 21.4 | 23.9 | 25.1 |
| ICON | 8.4 | 12.3 | 15.0 | 16.0 | **16.5** | **16.5** | **15.6** |
| FSSE | 8.2 | 11.9 | **14.3** | 15.8 | **18.1** | **18.6** | 17.7 |
| # Cases | 266 | 236 | 207 | 178 | 125 | 88 | 52 |

Table 12b. Homogenous comparison of eastern North Pacific basin early intensity guidance model biases (kt) for 2006.

| | Forecast Period (h) | | | | | | |
|---|---|---|---|---|---|---|---|
| Model ID | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| OFCL | 1.3 | 2.1 | 2.4 | 2.6 | 7.1 | 4.8 | 0.5 |
| DSF5 | 1.0 | 2.0 | 3.1 | 4.8 | 8.7 | 9.1 | 8.1 |
| GFDI | -2.1 | -2.9 | -2.6 | -1.2 | -0.2 | -3.1 | -5.5 |
| GHMI | -2.1 | -3.7 | -4.3 | -3.0 | -1.7 | -4.1 | -5.6 |
| SHIP | 0.7 | 0.6 | 1.0 | 2.2 | 4.7 | 4.0 | -0.3 |
| DSHP | 0.1 | 0.0 | 0.4 | 1.3 | 4.3 | 3.7 | -0.3 |
| ICON | -0.7 | -1.6 | -1.7 | -0.6 | 1.5 | 0.0 | -2.7 |
| FSSE | -0.8 | -1.8 | -1.7 | -0.5 | 1.8 | -1.3 | -7.5 |
| # Cases | 266 | 236 | 207 | 178 | 125 | 88 | 52 |

Table 13. Official eastern North Pacific track and intensity forecast verifications (OFCL) for 2005 by storm. CLIPER5 (CLP5) and SHIFOR5 (SHF5) forecast errors are given for comparison and indicated collectively as OCD5. Number of track and intensity forecasts are given by NT and NI, respectively. Units for track and intensity errors are n mi and kt, respectively.

Verification statistics for: EP012006 ALETTA

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 15 | 10.5 | 10.5 | 15 | 1.0 | 1.7 |
| 012 | 13 | 31.5 | 37.8 | 13 | 4.6 | 4.2 |
| 024 | 11 | 40.3 | 64.0 | 11 | 11.4 | 8.8 |
| 036 | 9 | 58.9 | 99.3 | 9 | 17.2 | 12.1 |
| 048 | 7 | 73.5 | 118.5 | 7 | 19.3 | 11.4 |
| 072 | 3 | 82.3 | 239.4 | 3 | 16.7 | 6.7 |
| 096 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 120 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |

Verification statistics for: EP022006 TWO

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 7 | 13.4 | 15.1 | 7 | 0.0 | 0.0 |
| 012 | 5 | 65.1 | 87.6 | 5 | 3.0 | 3.2 |
| 024 | 3 | 94.4 | 151.3 | 3 | 3.3 | 3.0 |
| 036 | 1 | 95.4 | 249.5 | 1 | 5.0 | 2.0 |
| 048 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 072 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 096 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 120 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |

Verification statistics for: EP032006 BUD

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 20 | 8.5 | 8.5 | 20 | 4.3 | 5.0 |
| 012 | 20 | 22.9 | 26.2 | 20 | 11.0 | 13.4 |
| 024 | 18 | 49.3 | 53.9 | 18 | 15.6 | 20.4 |
| 036 | 16 | 77.1 | 91.1 | 16 | 17.8 | 24.3 |
| 048 | 14 | 99.5 | 137.0 | 14 | 18.6 | 31.8 |
| 072 | 10 | 209.3 | 281.4 | 10 | 15.5 | 25.7 |
| 096 | 6 | 398.9 | 430.1 | 6 | 20.8 | 27.7 |
| 120 | 2 | 628.6 | 608.0 | 2 | 20.0 | 27.0 |

Verification statistics for: EP042006 CARLOTTA

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 20 | 11.7 | 12.1 | 20 | 1.8 | 1.8 |
| 012 | 18 | 31.3 | 33.6 | 18 | 6.4 | 8.0 |
| 024 | 16 | 49.9 | 64.8 | 16 | 10.3 | 12.3 |
| 036 | 14 | 58.9 | 86.0 | 14 | 10.7 | 11.6 |
| 048 | 12 | 70.1 | 101.9 | 12 | 9.6 | 9.3 |
| 072 | 8 | 106.1 | 109.0 | 8 | 18.1 | 14.4 |
| 096 | 4 | 140.4 | 123.5 | 4 | 21.3 | 18.5 |
| 120 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |

Verification statistics for: EP052006 DANIEL

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 30 | 4.9 | 5.1 | 30 | 1.2 | 1.3 |
| 012 | 30 | 21.7 | 23.7 | 30 | 4.2 | 5.2 |
| 024 | 30 | 46.4 | 51.7 | 30 | 7.8 | 10.5 |
| 036 | 30 | 71.4 | 82.2 | 30 | 13.5 | 16.6 |
| 048 | 30 | 96.0 | 117.6 | 30 | 20.0 | 21.6 |
| 072 | 28 | 125.9 | 167.5 | 28 | 27.9 | 29.5 |
| 096 | 24 | 169.4 | 195.8 | 24 | 28.3 | 35.7 |
| 120 | 20 | 222.2 | 192.8 | 20 | 23.8 | 37.2 |

Verification statistics for: EP062006 EMILIA

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 27 | 5.1 | 5.1 | 27 | 3.3 | 3.5 |
| 012 | 25 | 40.0 | 49.8 | 25 | 6.6 | 7.2 |
| 024 | 23 | 75.1 | 107.5 | 23 | 11.3 | 8.5 |
| 036 | 21 | 103.3 | 167.6 | 21 | 14.3 | 7.9 |
| 048 | 19 | 116.7 | 204.8 | 19 | 12.6 | 7.6 |
| 072 | 15 | 125.7 | 210.4 | 15 | 6.7 | 12.7 |
| 096 | 11 | 144.5 | 223.8 | 11 | 4.1 | 11.5 |
| 120 | 7 | 156.6 | 358.9 | 7 | 7.9 | 8.6 |

Verification statistics for: EP072006 FABIO

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 10 | 9.3 | 9.3 | 10 | 0.5 | 0.5 |
| 012 | 8 | 23.3 | 35.6 | 8 | 5.0 | 5.9 |
| 024 | 6 | 44.5 | 70.2 | 6 | 7.5 | 9.8 |
| 036 | 4 | 66.7 | 114.5 | 4 | 8.8 | 11.8 |
| 048 | 2 | 96.7 | 147.0 | 2 | 10.0 | 16.0 |
| 072 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 096 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 120 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |

Verification statistics for: EP082006 GILMA

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 12 | 11.4 | 11.2 | 12 | 1.3 | 1.3 |
| 012 | 10 | 24.2 | 29.2 | 10 | 2.5 | 7.6 |
| 024 | 8 | 47.8 | 61.7 | 8 | 8.1 | 17.5 |
| 036 | 6 | 85.6 | 101.8 | 6 | 15.8 | 26.8 |
| 048 | 4 | 141.7 | 129.2 | 4 | 25.0 | 37.0 |
| 072 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 096 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 120 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |

Verification statistics for: EP092006 HECTOR

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 30 | 7.0 | 6.9 | 30 | 3.3 | 3.7 |
| 012 | 28 | 24.7 | 27.3 | 28 | 6.8 | 7.5 |
| 024 | 26 | 41.1 | 52.1 | 26 | 8.7 | 9.5 |
| 036 | 24 | 55.9 | 75.0 | 24 | 11.9 | 10.5 |
| 048 | 22 | 72.4 | 106.4 | 22 | 13.2 | 13.0 |
| 072 | 18 | 96.8 | 165.6 | 18 | 13.3 | 15.2 |
| 096 | 14 | 85.5 | 201.3 | 14 | 13.6 | 16.4 |
| 120 | 10 | 64.4 | 206.2 | 10 | 14.0 | 17.0 |

Verification statistics for: EP102006 ILEANA

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 25 | 5.9 | 6.5 | 25 | 2.4 | 3.2 |
| 012 | 23 | 20.4 | 27.7 | 23 | 8.0 | 9.2 |
| 024 | 21 | 36.0 | 59.0 | 21 | 12.1 | 15.2 |
| 036 | 19 | 47.8 | 91.6 | 19 | 11.1 | 17.9 |
| 048 | 17 | 57.0 | 124.1 | 17 | 11.2 | 17.4 |
| 072 | 13 | 51.9 | 181.3 | 13 | 10.0 | 15.0 |
| 096 | 9 | 55.8 | 204.0 | 9 | 12.8 | 15.4 |
| 120 | 5 | 121.3 | 221.9 | 5 | 6.0 | 19.0 |

Verification statistics for: EP112006 JOHN

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 29 | 5.7 | 5.7 | 29 | 1.9 | 2.6 |
| 012 | 27 | 23.4 | 31.1 | 27 | 9.6 | 9.0 |
| 024 | 25 | 36.0 | 56.7 | 25 | 14.8 | 14.5 |
| 036 | 23 | 50.1 | 89.2 | 23 | 18.7 | 17.2 |
| 048 | 21 | 68.9 | 121.3 | 21 | 19.8 | 17.0 |
| 072 | 17 | 141.7 | 197.7 | 17 | 25.3 | 15.3 |
| 096 | 13 | 241.8 | 281.7 | 13 | 33.5 | 28.9 |
| 120 | 9 | 345.5 | 357.0 | 9 | 32.2 | 26.3 |

Verification statistics for: EP122006 KRISTY

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 37 | 8.4 | 8.4 | 37 | 0.7 | 1.5 |
| 012 | 35 | 35.7 | 39.9 | 35 | 5.0 | 5.4 |
| 024 | 33 | 66.1 | 82.6 | 33 | 9.7 | 8.6 |
| 036 | 31 | 95.8 | 126.4 | 31 | 12.3 | 11.9 |
| 048 | 28 | 122.4 | 177.6 | 28 | 13.4 | 13.0 |
| 072 | 18 | 195.5 | 309.0 | 18 | 11.1 | 21.9 |
| 096 | 10 | 283.9 | 434.3 | 10 | 8.5 | 21.9 |
| 120 | 10 | 317.2 | 521.0 | 10 | 8.0 | 15.3 |

Verification statistics for: EP132006 LANE

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 16 | 8.4 | 8.4 | 16 | 2.5 | 4.7 |
| 012 | 14 | 19.5 | 31.0 | 14 | 11.8 | 14.6 |
| 024 | 12 | 39.8 | 63.3 | 12 | 18.8 | 21.7 |
| 036 | 10 | 87.1 | 114.5 | 10 | 28.5 | 26.0 |
| 048 | 8 | 136.9 | 196.2 | 8 | 29.4 | 33.5 |
| 072 | 4 | 260.1 | 288.0 | 4 | 33.8 | 29.8 |
| 096 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 120 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |

Verification statistics for: EP142006 MIRIAM

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 9 | 13.6 | 13.6 | 9 | 0.6 | 1.1 |
| 012 | 7 | 30.1 | 32.1 | 7 | 2.9 | 3.7 |
| 024 | 5 | 54.8 | 47.0 | 5 | 3.0 | 6.0 |
| 036 | 3 | 98.0 | 46.4 | 3 | 8.3 | 8.7 |
| 048 | 1 | 93.0 | 98.3 | 1 | 10.0 | 13.0 |
| 072 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 096 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 120 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |

Verification statistics for: EP152006 NORMAN

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 12 | 21.3 | 19.8 | 12 | 1.7 | 1.3 |
| 012 | 10 | 41.4 | 49.4 | 10 | 5.5 | 6.4 |
| 024 | 7 | 93.8 | 108.0 | 7 | 11.4 | 11.9 |
| 036 | 5 | 143.0 | 169.8 | 5 | 13.0 | 12.2 |
| 048 | 3 | 174.1 | 239.2 | 3 | 11.7 | 11.0 |
| 072 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 096 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 120 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |

Verification statistics for: EP162006 OLIVIA

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 13 | 7.1 | 7.1 | 13 | 1.5 | 1.2 |
| 012 | 11 | 39.9 | 58.1 | 11 | 3.6 | 4.9 |
| 024 | 9 | 77.6 | 143.2 | 9 | 4.4 | 7.9 |
| 036 | 7 | 104.8 | 240.4 | 7 | 7.1 | 7.7 |
| 048 | 5 | 88.9 | 369.7 | 5 | 9.0 | 11.8 |
| 072 | 1 | 83.5 | 669.0 | 1 | 10.0 | 23.0 |
| 096 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 120 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |

Verification statistics for: EP172006 PAUL

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 20 | 12.7 | 14.3 | 20 | 0.8 | 2.0 |
| 012 | 18 | 37.5 | 35.0 | 18 | 10.8 | 11.7 |
| 024 | 16 | 70.7 | 75.4 | 16 | 16.9 | 17.7 |
| 036 | 14 | 95.6 | 139.5 | 14 | 21.1 | 24.9 |
| 048 | 12 | 143.7 | 200.8 | 12 | 15.8 | 27.8 |
| 072 | 8 | 200.7 | 349.4 | 8 | 13.8 | 15.4 |
| 096 | 4 | 231.2 | 490.1 | 4 | 11.3 | 12.3 |
| 120 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |

Verification statistics for: EP182006 EIGHTEEN

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 6 | 18.1 | 18.1 | 6 | 0.0 | 0.0 |
| 012 | 4 | 87.4 | 92.8 | 4 | 8.8 | 4.8 |
| 024 | 2 | 129.9 | 157.7 | 2 | 17.5 | 11.5 |
| 036 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 048 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 072 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 096 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 120 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |

Verification statistics for: EP192006 ROSA

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 11 | 14.7 | 14.7 | 11 | 0.5 | 0.5 |
| 012 | 9 | 30.0 | 39.0 | 9 | 3.9 | 5.1 |
| 024 | 7 | 46.5 | 69.3 | 7 | 5.7 | 8.9 |
| 036 | 5 | 58.3 | 87.9 | 5 | 9.0 | 13.0 |
| 048 | 3 | 81.4 | 108.7 | 3 | 15.0 | 21.3 |
| 072 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 096 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 120 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |

Verification statistics for: EP202006 TWENTY

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 2 | 33.9 | 23.7 | 2 | 0.0 | 0.0 |
| 012 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 024 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 036 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 048 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 072 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 096 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |
| 120 | 0 | -999.0 | -999.0 | 0 | -999.0 | -999.0 |

Verification statistics for: EP212006 SERGIO

| VT (h) | NT | OFCL | OCD5 | NI | OFCL | OCD5 |
|---|---|---|---|---|---|---|
| 000 | 28 | 4.9 | 5.1 | 28 | 1.1 | 2.0 |
| 012 | 26 | 30.7 | 37.9 | 26 | 7.9 | 10.6 |
| 024 | 24 | 65.1 | 86.5 | 24 | 12.9 | 17.8 |
| 036 | 22 | 93.1 | 136.4 | 22 | 15.7 | 21.9 |
| 048 | 20 | 127.7 | 179.8 | 20 | 18.3 | 24.9 |
| 072 | 16 | 184.3 | 246.0 | 16 | 21.9 | 22.4 |
| 096 | 12 | 224.4 | 248.0 | 12 | 22.1 | 22.5 |
| 120 | 8 | 227.7 | 272.3 | 8 | 23.8 | 20.8 |

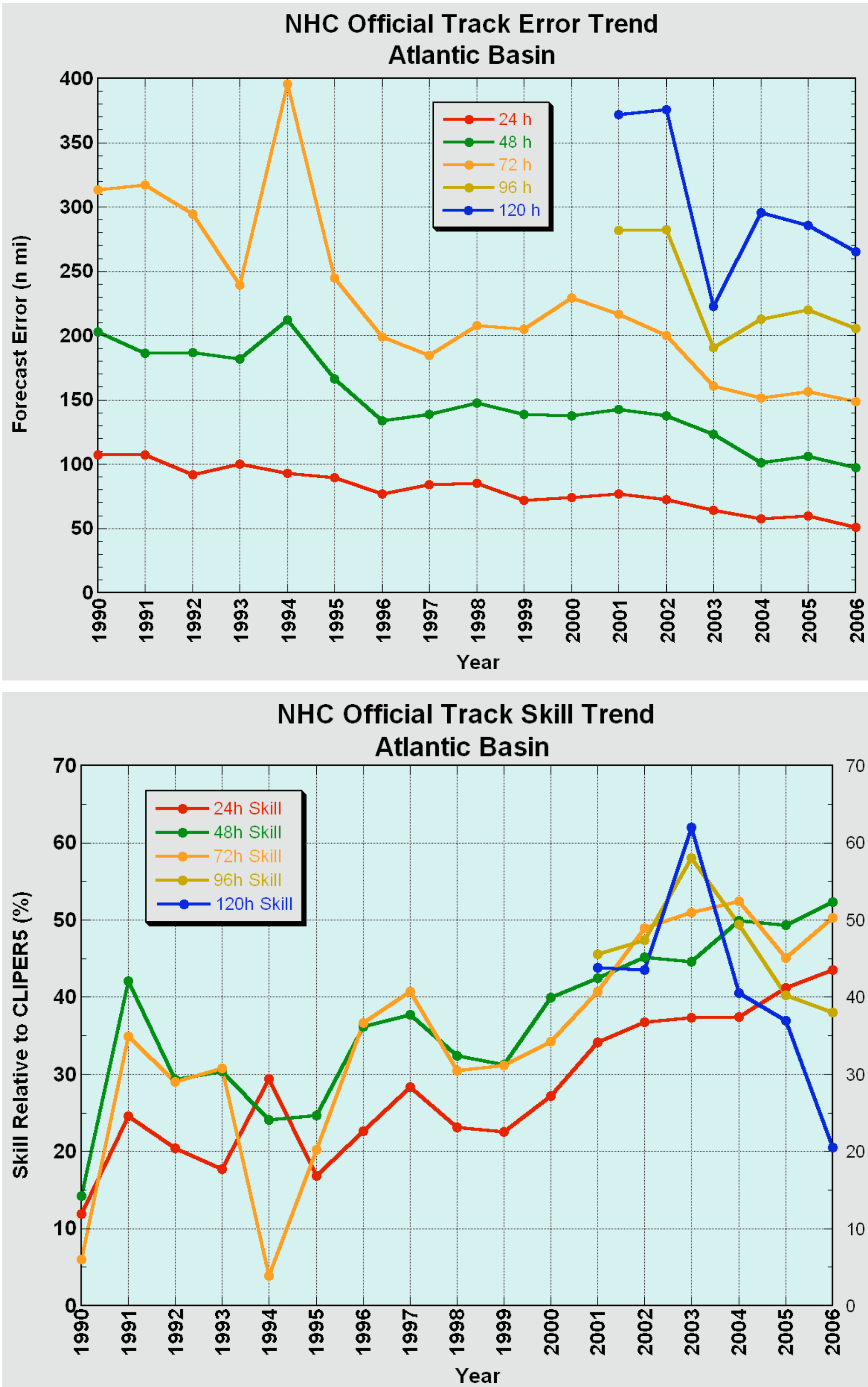



Figure 1. Recent trends in NHC official track forecast error (top) and skill (bottom) for the Atlantic basin.

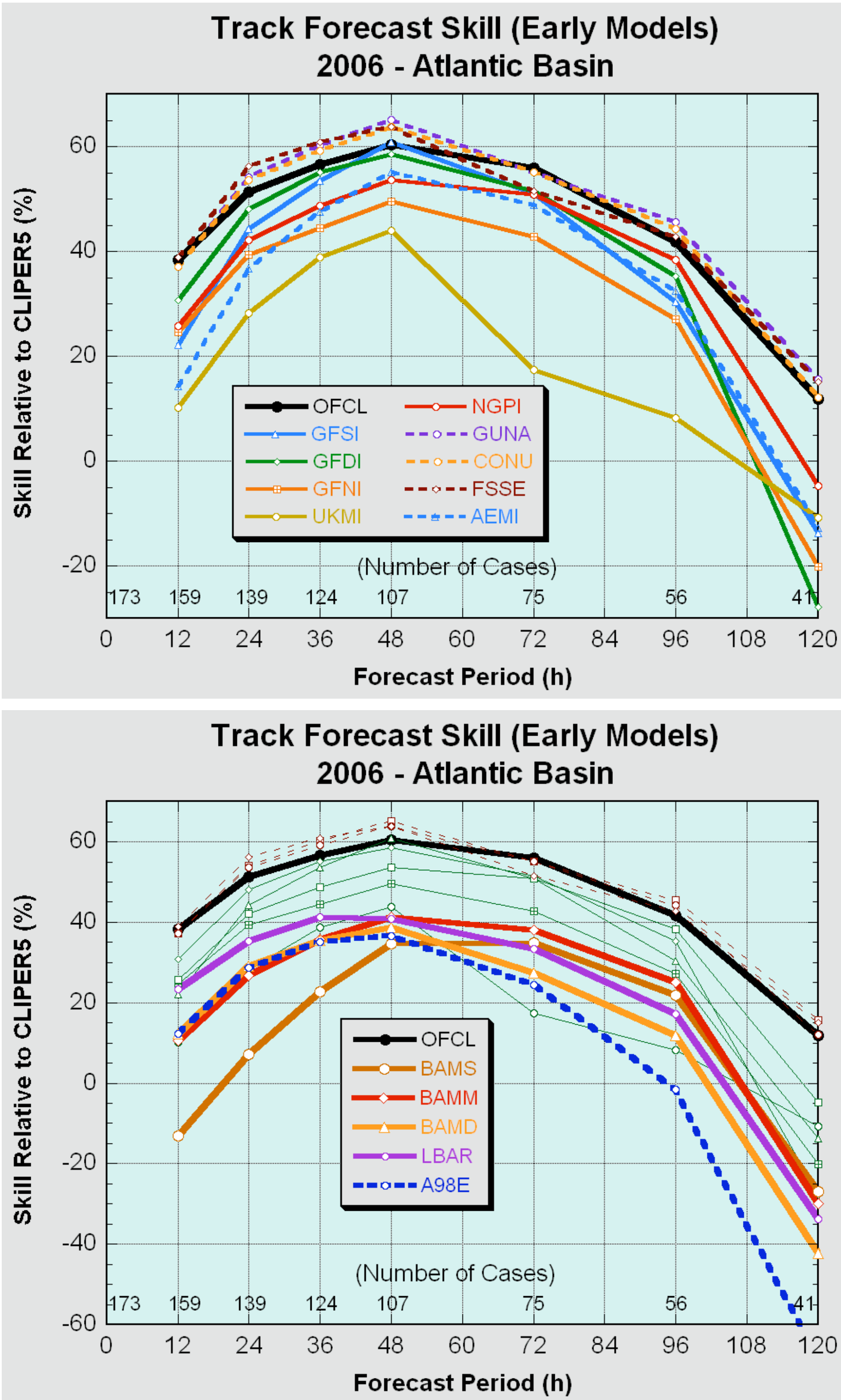



Figure. 2. Homogenous comparison for selected Atlantic basin early track guidance models for 2006. The top panel shows just the more advanced models (which also appear in the bottom panel as thin lines). Simpler models are highlighted in the bottom panel.

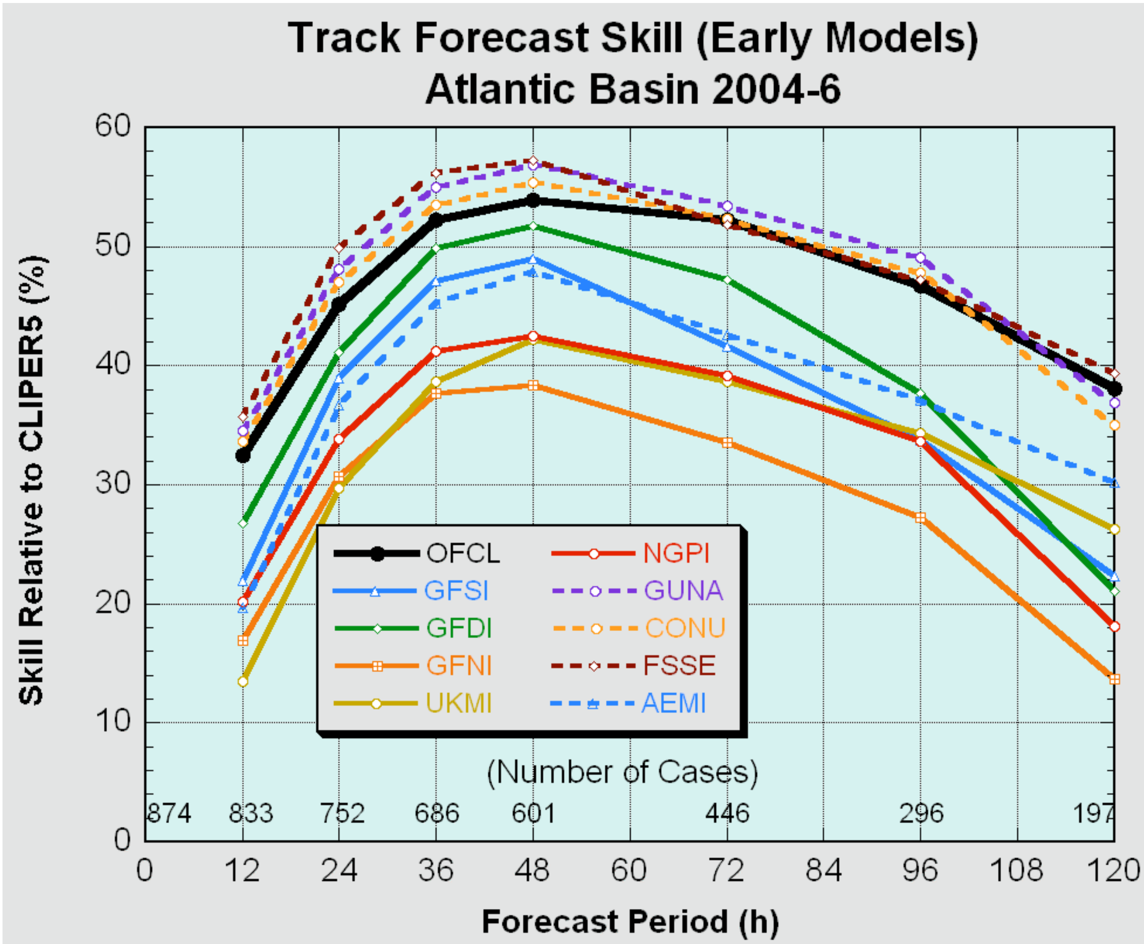
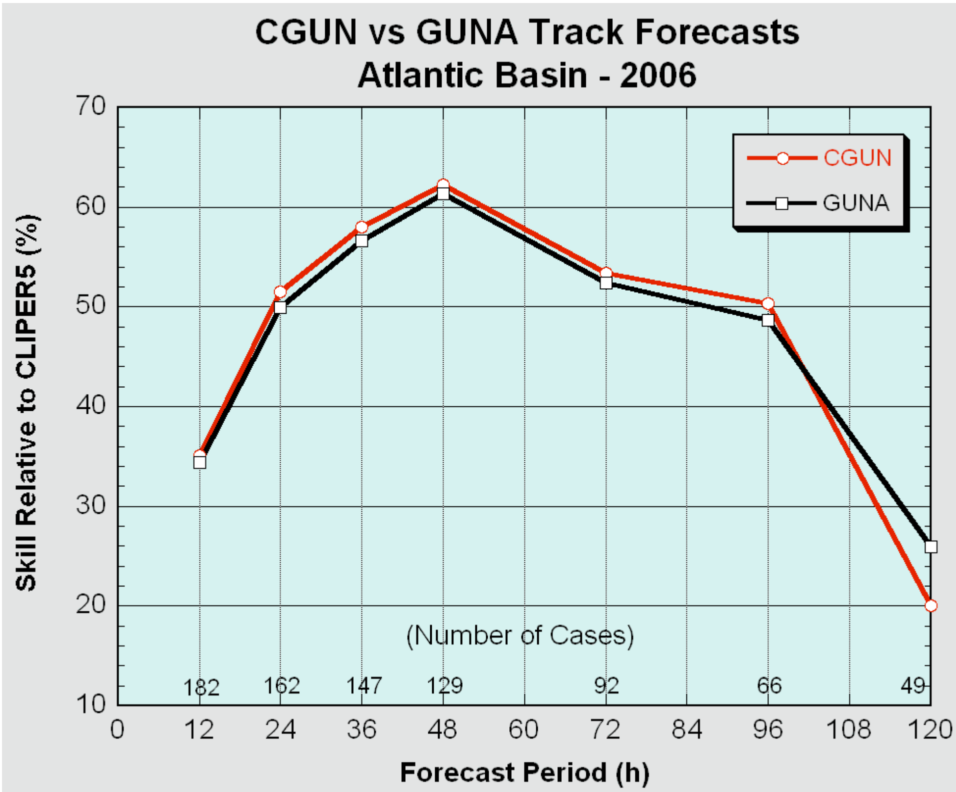



Figure. 3. Homogenous comparison for selected Atlantic basin early track guidance models for the three-year period 2004-2006.



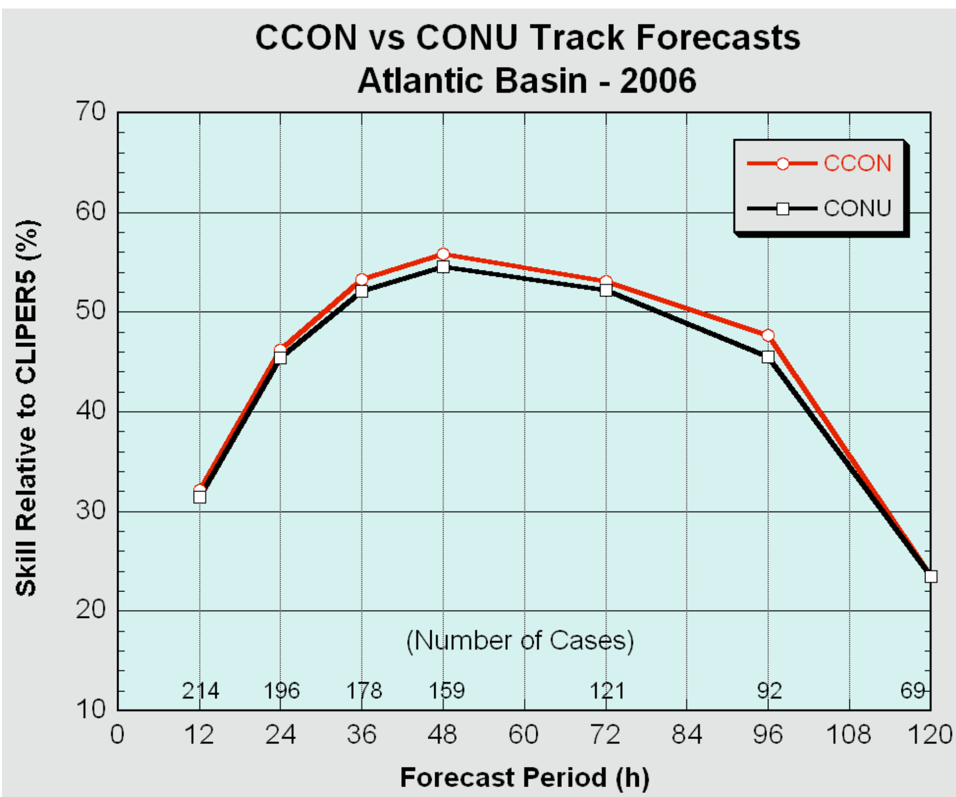
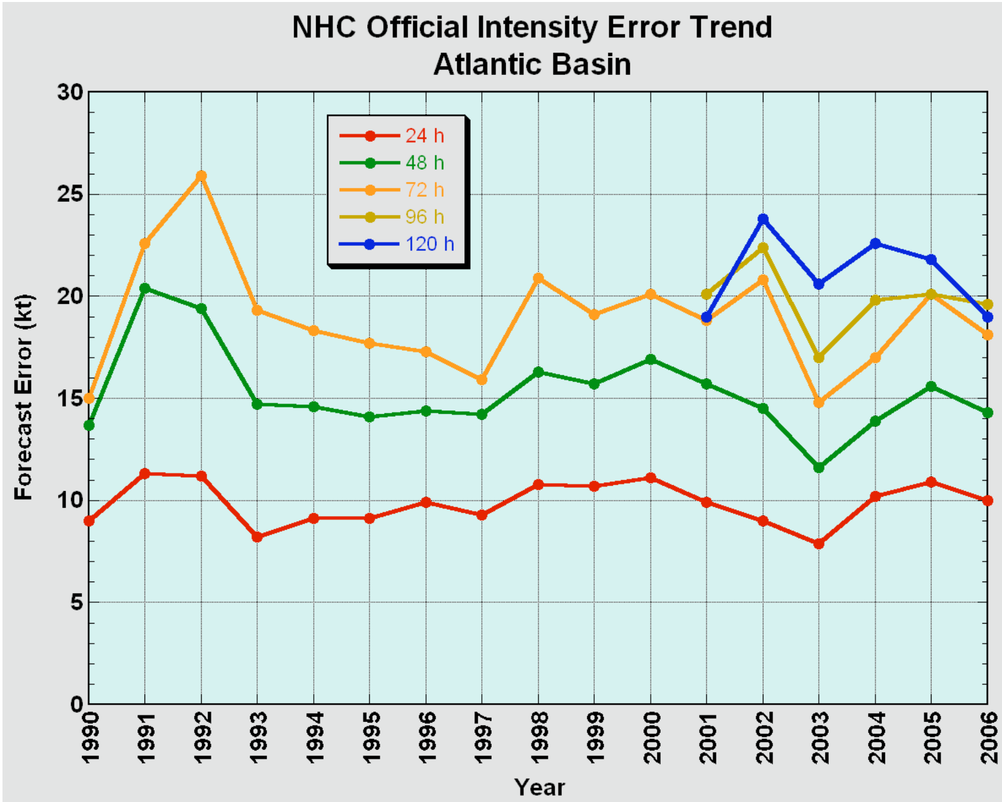




Figure. 4. Homogenous comparison of CGUN vs GUNA (top) and CCON vs CONU (bottom) for 2006.



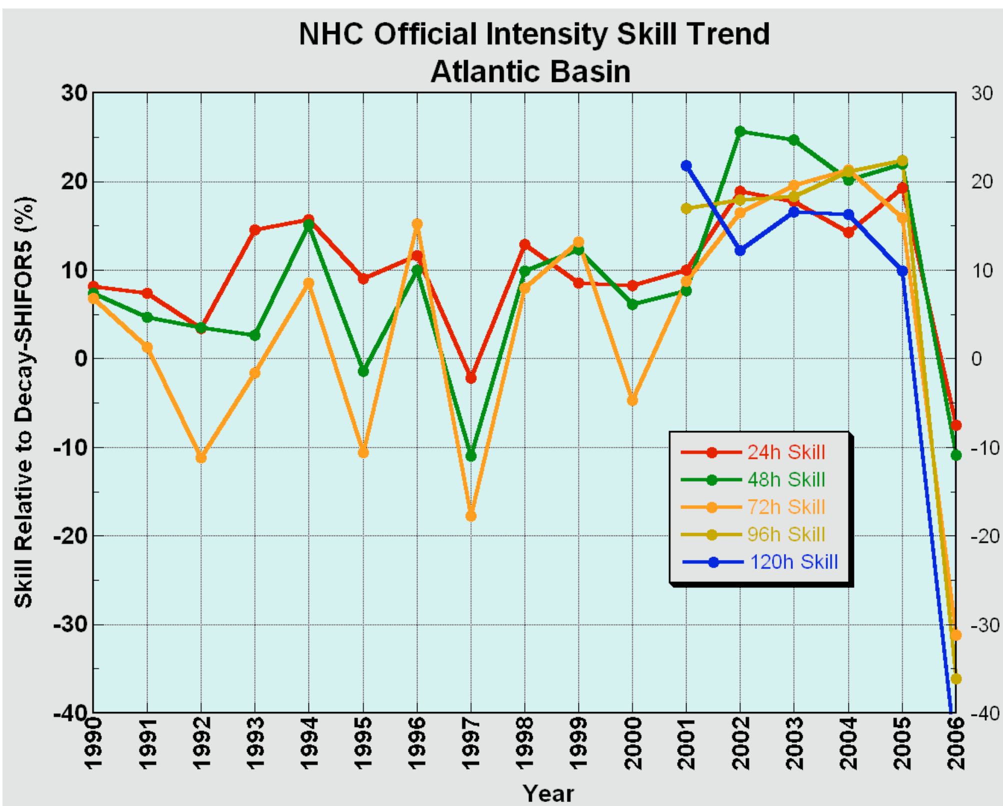




Figure 5. Recent trends in NHC official intensity forecast error (top) and skill (bottom) for the Atlantic basin.

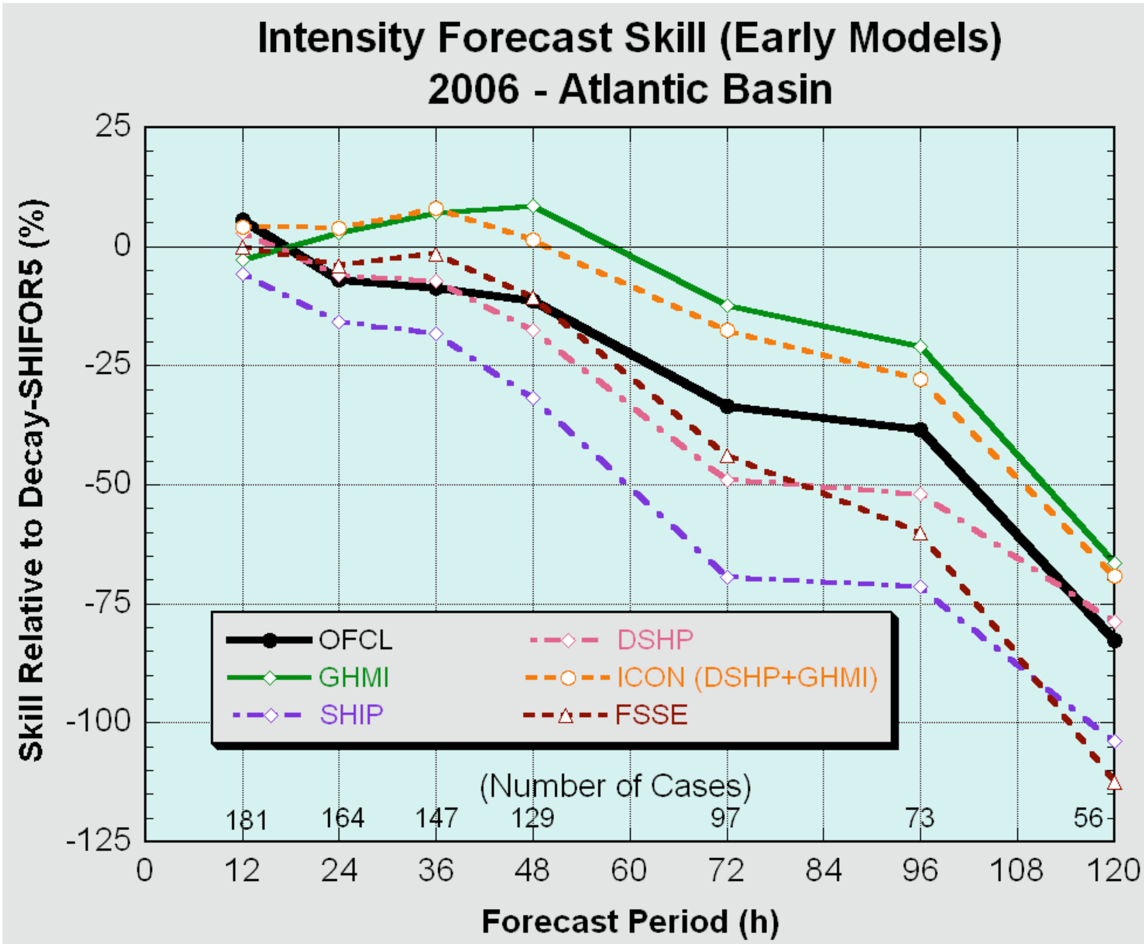
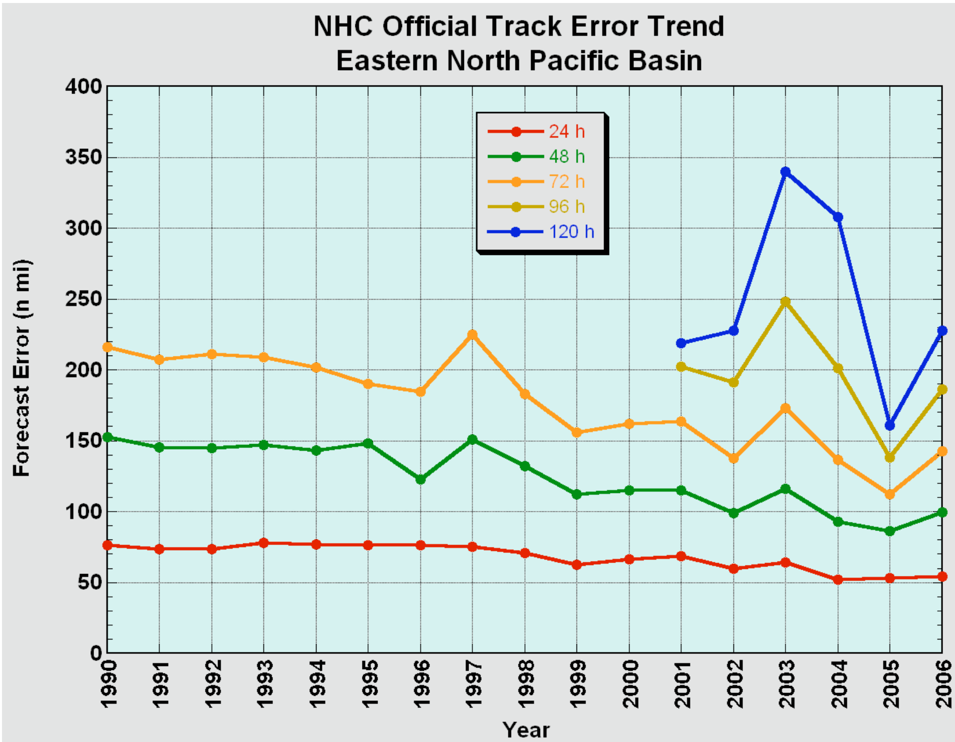



Figure. 6. Homogenous comparison for selected Atlantic basin early intensity guidance models for 2006.



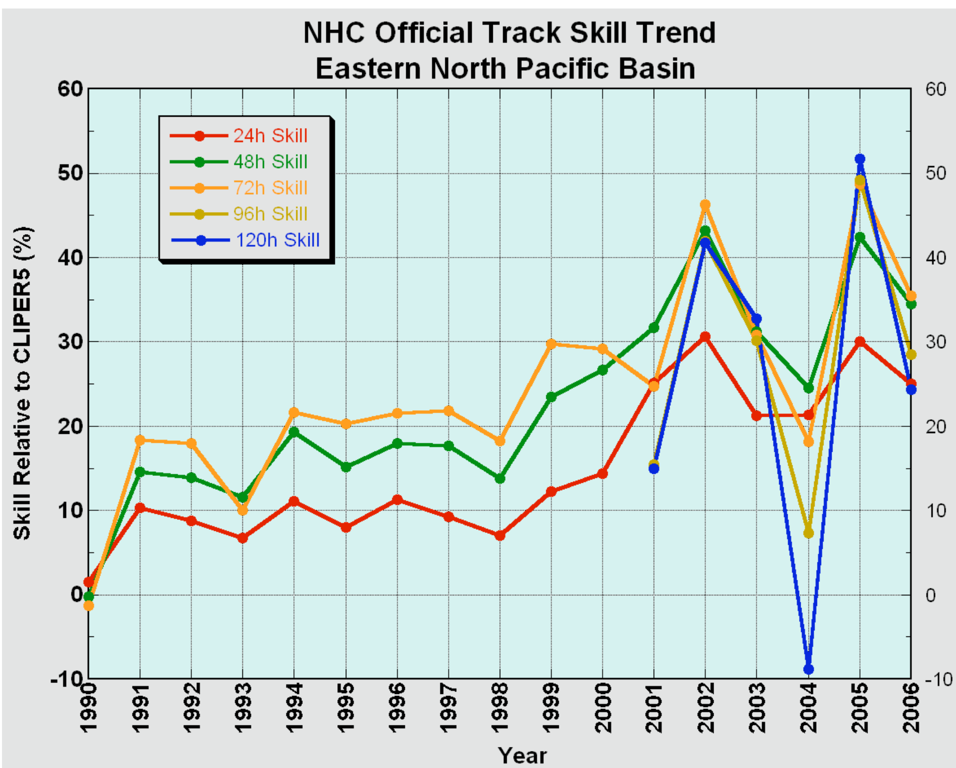
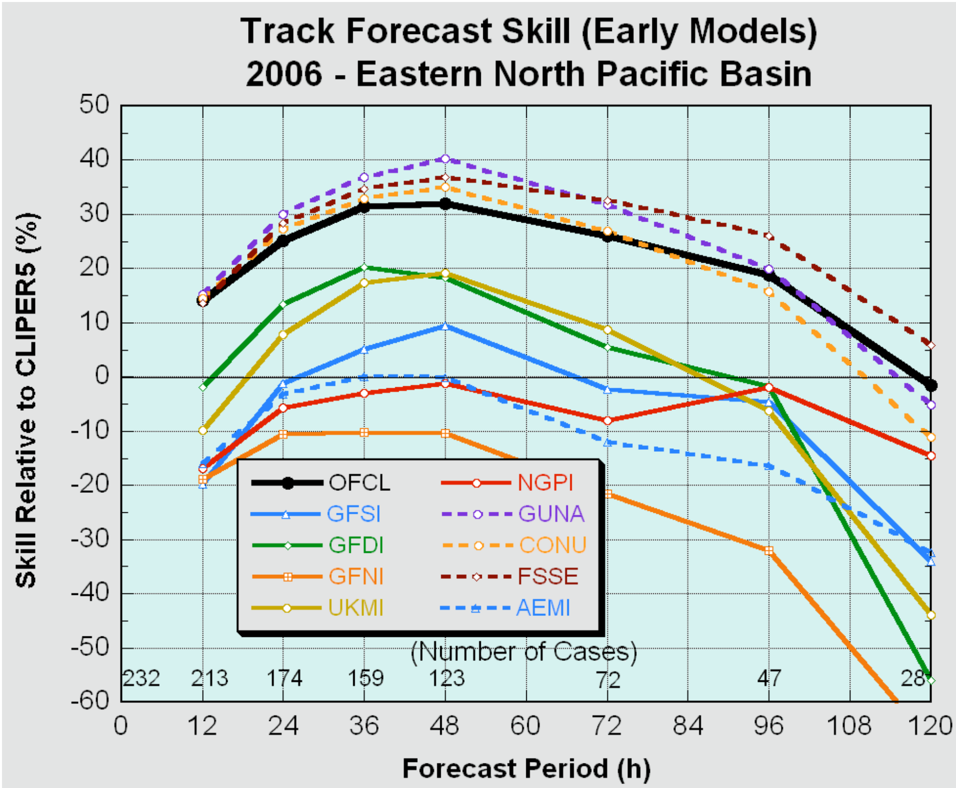




Figure 7. Recent trends in NHC official track forecast error (top) and skill (bottom) for the eastern North Pacific basin.



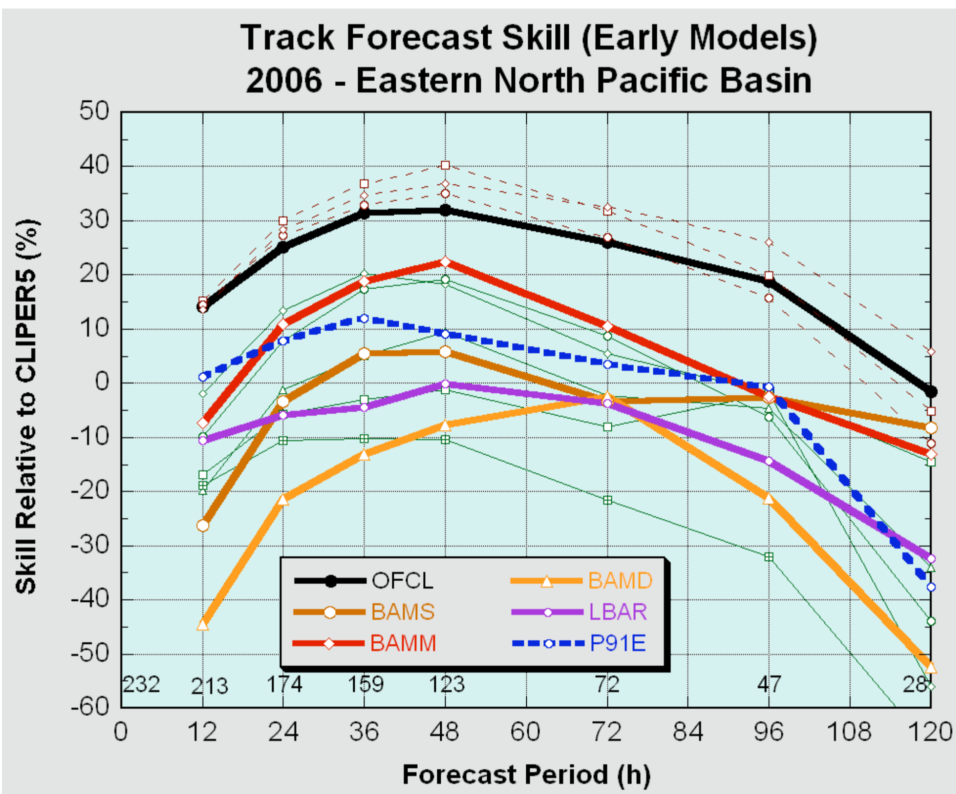




Figure. 8. Homogenous comparison for selected eastern North Pacific early track models for 2006. The top panel shows just the more advanced models (which also appear in the bottom panel as thin lines). Simpler models are highlighted in the bottom panel.

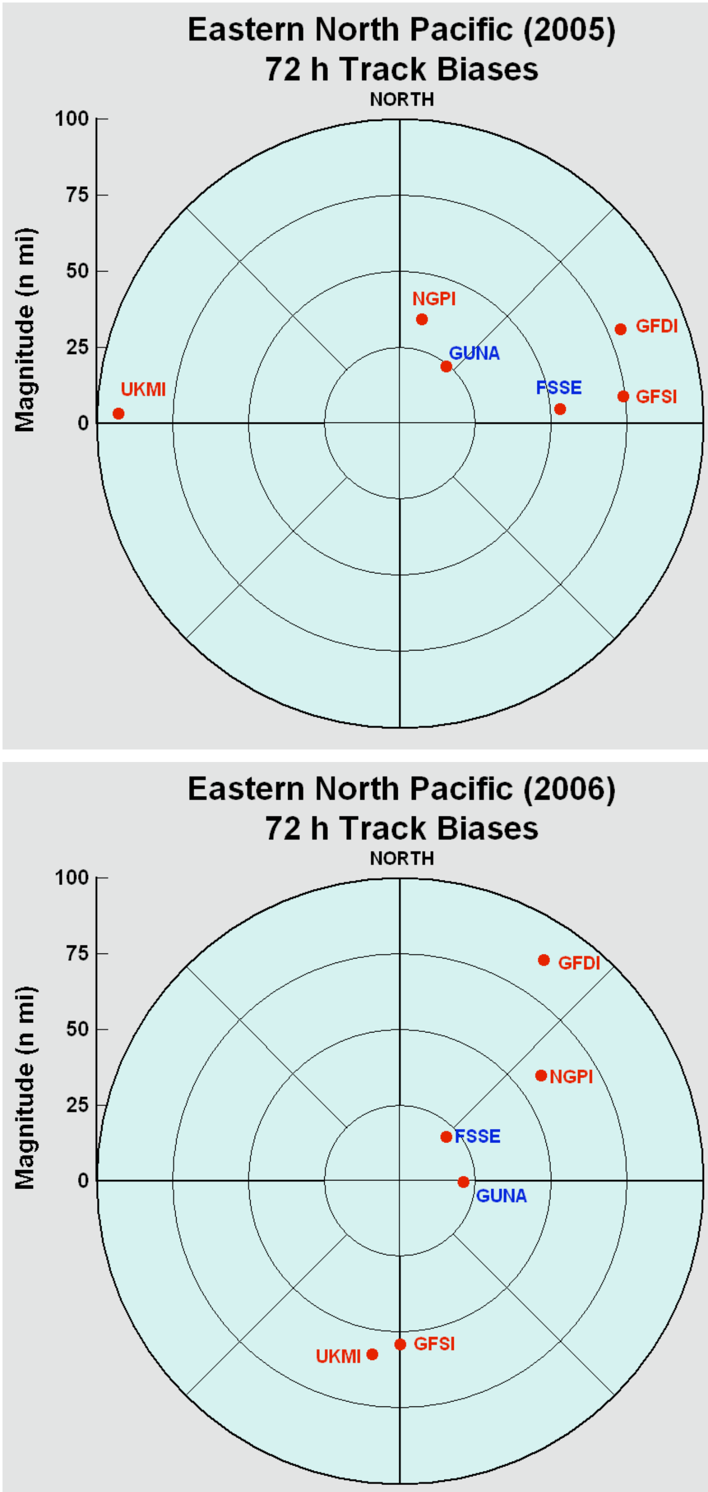



Figure 9. Biases for selected eastern North Pacific early track models for 2005 (top) and 2006 (bottom).

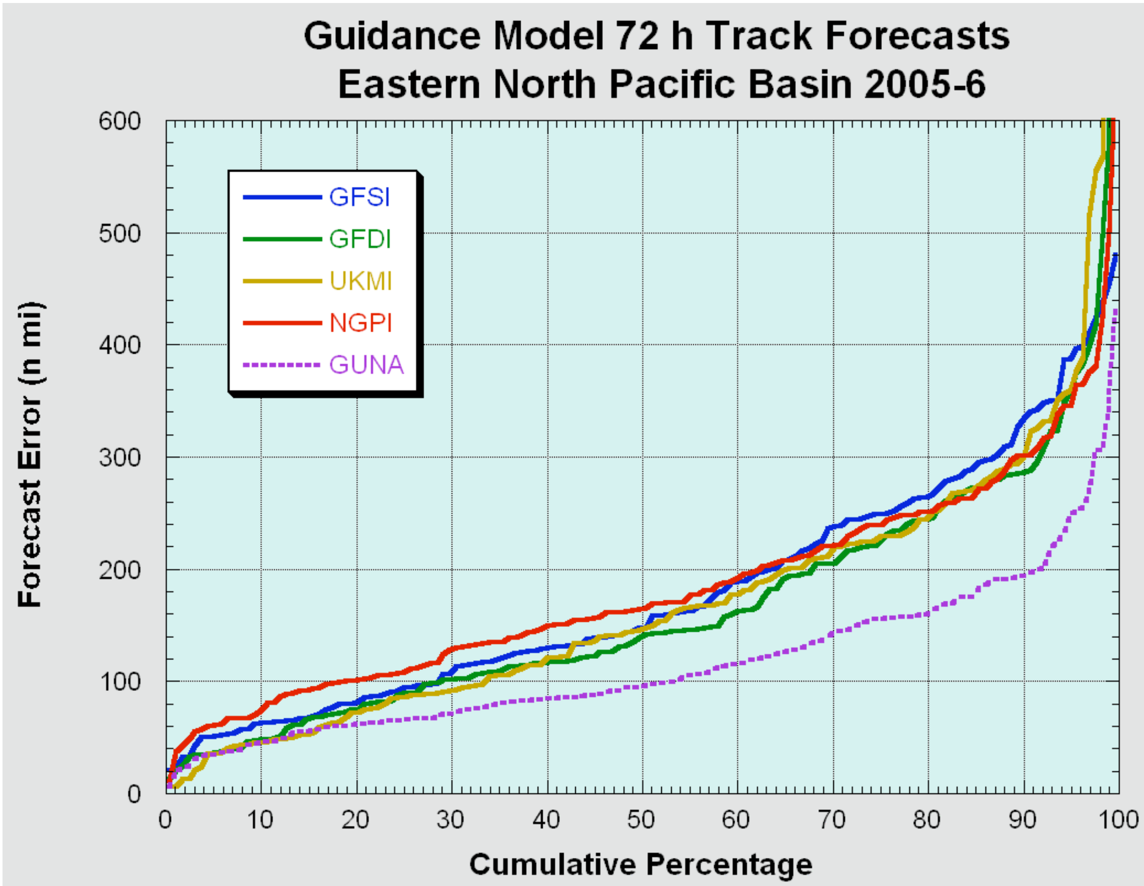



Figure 10. Cumulative distribution of eastern North Pacific 72 h track errors for 2005-2006, for the GUNA consensus and its component models. For example, to determine the percentage of GUNA forecasts having an error smaller than 200 n mi, find 200 n mi on the y-axis, and read across the diagram until this value intersects the GUNA curve. Then read down to obtain the percentage (91%, in this case).

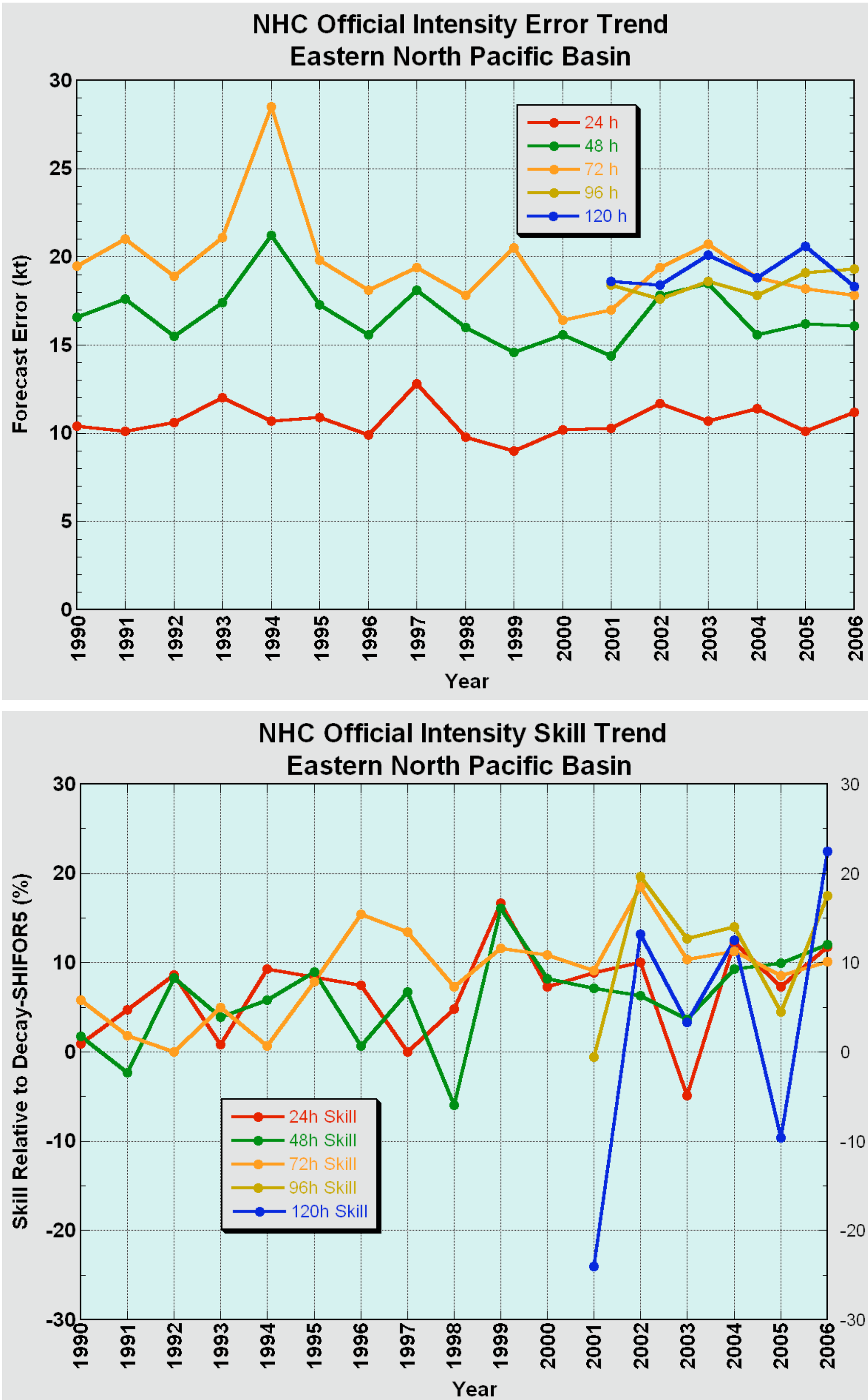



Figure 11. Recent trends in NHC official intensity forecast error (top) and skill (bottom) for the eastern North Pacific basin.

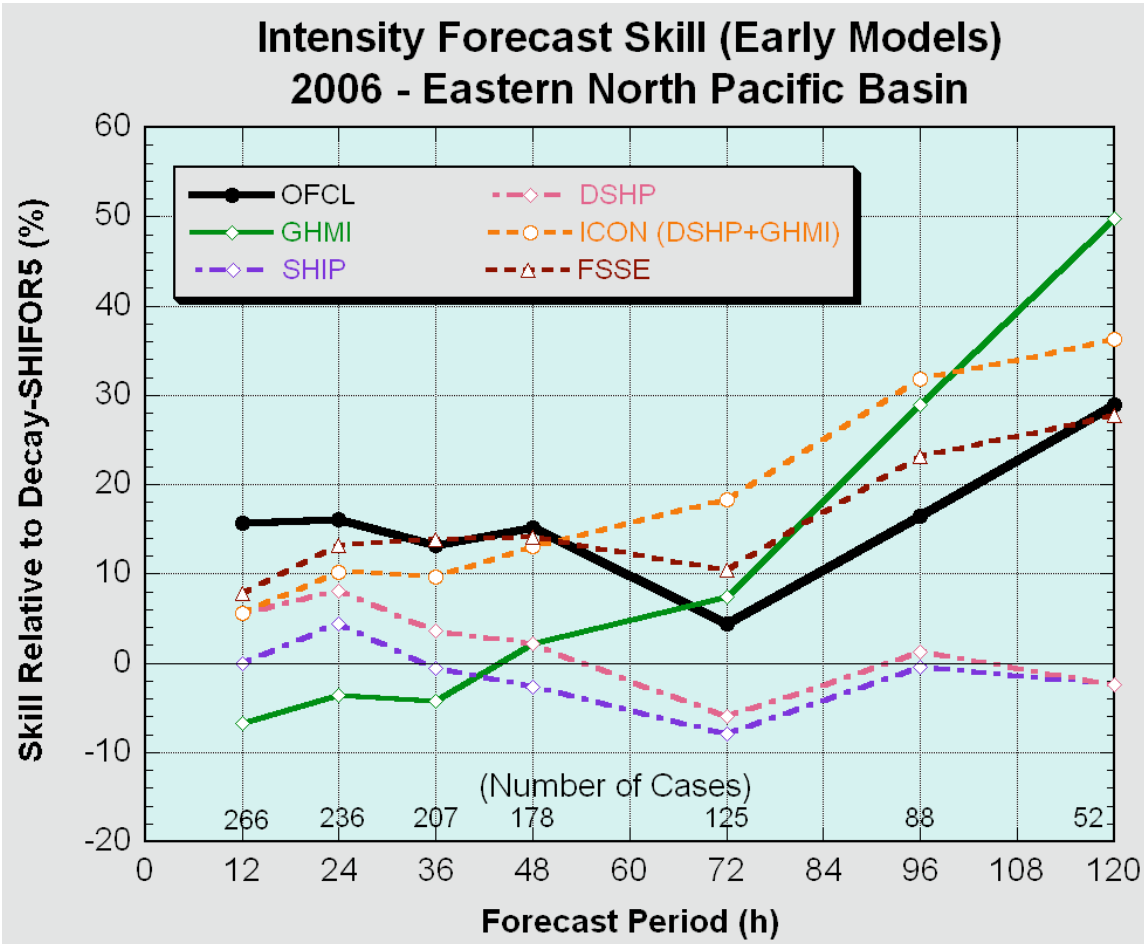



Figure. 12. Homogenous comparison for selected eastern North Pacific basin early intensity guidance models for 2006.