

# SHIPS Predictor Files

Last Updated: 4 May 2022

- Modifications for 2022:** 2021 cases added for AL, CP and EP.
- Modifications for 2021:** 2020 cases added for AL, CP and EP. 2019 cases updated with final best tracks. 7-day files now available.
- Modifications for 2020:** 2018 and 2019 cases added for AL, CP, and EP.  
Preliminary Best Tracks were used for 2019 cases.  
Final Best Tracks were used for 2018 cases.
- Modifications for 2018:** 2017 cases added for AL, EP, and CP  
Daily Reynolds SST variables added (DSST, DSTA)  
Time dependent model TPW variables added  
Subsurface ocean variables added from NCODA analysis  
PHCN variable removed (proxy for ocean heat content)
- Modifications for 2017:** 2016 cases added for AL, EP, CP (preliminary best track data)  
Missing EP cases from 1983 restored  
More IR satellite variables added
- Modifications for 2016:** 2015 cases added for AL, EP, and CP  
TPW variables from GFS analysis added (MTPW)  
Environmental storm-relative helicity (HE07, HE05)  
Large-scale vertical velocity from GFS added (O500, O700)  
“Ocean Age” variables added (OAGE, NAGE)  
Extra time added to IR variables (IRM1)
- Modifications for 2015:** 2014 cases added for AL, EP, and CP.  
Climate Forecast System Reanalysis (CFSR) fields used for 1982- 1999 cases instead of old NCAR/NCEP Reanalysis.  
Three new variables added (G150, G200, and G250)
- Modifications for 2014:** 2013 cases added for AL, EP, and CP
- Modifications for 2013:** 2012 cases added  
New climatological variables added (CD20, CD26, COHC).  
East and Central Pacific data in separate files.  
Starting point for Atlantic, East and Central Pacific files is the new NHC HURDAT2 file. All unnamed cyclones prior to 1989 were eliminated.
- Modifications for 2012:** 2011 cases added  
New fields added to the PSLV line  
West Pacific file added
- Modifications for 2011:** 2010 cases added  
Six new variables added (V000, V850, V500, V300, TGRD, TADV)
- Modifications for 2010:** 2009 cases added  
Modification to the header line (min pressure and ATCF ID added)

TYPE line added (indicates storm type)  
HIST line added (storm age variable)

**Modifications for 2009:** 2008 cases added  
Older climatological ocean variables deleted (D20C, D26C, HCON)  
New climatological heat content variable (PHCN)  
GOES predictors extended back to 1983 (from 1995 in previous ver.)  
Ocean heat content (RHCN) now available for east Pacific (to 1996)  
New experimental predictors added (U20C, V20C, VVAC)

**Modifications for 2008:** 2007 cases added, and two new experimental predictors added for testing (VVAV and VMFX)

**Modifications for 2007:** Several new synoptic variables related to storm vortex removal

**Modifications for 2006:** 2 new synoptic variables (T250, T150)  
6 new GOES IR predictors

**Modifications for 2005:** 12-hour records/data replaced by 6-hour records/data  
4 new synoptic variables (T000, Z000, R000)  
GOES IR data predictors at t=-3 hr (IRM3)

**Currently available files:**

- lsdiaga\_1982\_2020\_sat\_ts.dat –
  - Atlantic data with predictors from CFSR re-analysis
  - Fields 1982-1999 and operational analyses 2000-2019 with satellite variables when available (SAT) and cases are either tropical or subtropical (TS)
- lsdiage\_1982\_2020\_sat\_ts.dat Same as the above file for the East Pacific
- lsdiagc\_1982\_2020\_sat\_ts.dat Same as the above file for the Central Pacific
- lsdiagw\_1990\_2017\_rean\_sat\_nbc\_ts.dat. Same as the above file for the Western North Pacific, but without 2016/2017 additions
- lsdiagi\_1990\_2017\_rean\_sat\_nbc\_ts.dat. Same as the above file for the N. Indian Ocean
- lsdiags\_1998\_2017\_rean\_sat\_nbc\_ts.dat. Same as the above file for the S. Hemisphere

**The SHIPS predictor file** is divided into a set of records for each storm case. Each line of the file ends with a line descriptor, and each set of records starts with HEAD and ends with LAST.

**The current files** include cases at 6-hour intervals. Not all predictors are available for all years (see note below).

**Each line of the file except** HEAD, HIST, IRXX, IR00, IRM1, IRM3, PSLV, MTPW and LAST contain predictors at 6-hour intervals (-12, -6, 0, 6, 12 ... 120 hr) relative to the time and date of the particular case. The new 7-day files extend to 168 hr. If the value of a predictor is not available, the field contains 9999. All of the fields are relative to the storm center, where the storm center is determined from the NHC Best Track, except where specified. All of the atmospheric predictors are from NCEP global model analyses (either re-analysis or operational). The predictors in the file contain the following:

**HEAD:** Header line (1<sup>st</sup> four letters of storm name, 2-digit year, month, day, and UTC time, maximum winds (kt), lat, lon, minimum sea level pressure (hPa), and ATCF ID number (e.g., AL011982) at t=0 of current case.

**TIME:** Time relative to current case (hr)

**VMAX:** Maximum surface wind (kt)

**MSLP:** Minimum Sea Level Pressure (hPa)

**TYPE:** Storm type (0=wave, remnant low, dissipating low, 1=tropical, 2=subtropical, 3=extra-tropical). Note that the SHIPS variables are set to missing for all cases except type=1 or 2, since these are not included in the SHIPS developmental sample for estimating the model coefficients.

**HIST:** Storm history variable. The no. of 6 hour periods the storm max wind has been above 20, 25, ..., 120 kt.

**DELV:** Intensity change (kt) -12 to 0, -6 to 0, 0 to 0, 0 to 6, ... 0 to 120 hr. If the storm crosses a major land mass during the time interval, value set to 9999

**INCV:** Intensity change (kt) -18 to -12, -12 to -6, ... 114 to 120 hr. INCV is set to 9999 similar to DELV for land cases.

**LAT:** Storm latitude (deg N \*10) vs time

**LON:** Storm longitude (deg W \*10) vs time

**CSST:** Climatological SST (deg C \* 10) vs time

**CD20:** Climatological depth (m) of 20 deg C isotherm from 2005-2010 NCODA analyses

**CD26:** Same as CD20 for the 26 deg C isotherm

**COHC:** Same as above for ocean heat content (kJ/cm<sup>2</sup>)

**DTL:** Distance to nearest major land mass (km) vs time

**OAGE:** Ocean Age (hr\*10), which is the amount of time the area within 100 km of the storm center has been occupied by the storm along its track up to this point in time

**NAGE:** Same as OAGE, but multiplied by the maximum wind/100kt. If the max wind was a constant 100 kt over its past history, NAGE=OAGE.

**RSST:** Reynolds SST (deg C\*10) vs time. Number after SST label is the age in days of the SST analysis used to estimate RSST from the weekly Reynolds SST analyses.

**DSST:** Same as RSST, but from daily Reynolds SST analyses

**DSTA:** Same as DSST, but spatially averaged over 5 points (storm center, + 50 km N, E, S and W of center)

**U200:** 200 hPa zonal wind (kt \*10) vs time (r=200-800 km)

**U20C:** Same as U200 but for r=0-500 km)

**V20C:** Same as U20C, but for the v component of the wind

**E000:** 1000 hPa theta\_e (r=200-800 km) vs. time (deg K\*10)

**EPOS:** The average theta\_e difference between a parcel lifted from the surface and its environment (200-800 km average) versus time (deg C \* 10). Only positive differences are included in the average.

**ENEG:** Same as EPOS, but only negative differences are included. The minus sign is not included.

**EPSS:** Same as EPOS, but the parcel theta\_e is compared with the saturated theta\_e of the environment

**ENSS:** Same as ENEG, but the parcel  $\theta_e$  is compared with the saturated  $\theta_e$  of the environment

**RHLO:** 850-700 hPa relative humidity (%) vs time (200-800 km)

**RHMD:** Same as RHLO for 700-500 hPa

**RHHI:** Same as RHLO for 500-300 hPa

**PSLV:** Pressure of the center of mass (hPa) of the layer where storm motion best matches environmental flow ( $t=0$  only) and the information used to calculate the steering layer pressure. All fields are valid at  $t=0$ , and those in the  $t=6$  to  $t=102$  columns include the following:

- $t=6$  column: The observed zonal storm motion component ( $\text{m/s} * 10$ )
- $t=12$  column: The observed meridional storm motion component ( $\text{m/s} * 10$ )
- $t=18, t=24$  columns: Same as  $t=6, 12$  hr columns but for the 1000 to 100 hPa mass weighted deep layer environmental wind ( $\text{m/s} * 10$ )
- $t=30, t=36$  columns: Same as  $t=6, 12$  columns but for the optimally weighted deep layer mean flow ( $\text{m/s} * 10$ )
- $t=42$  column: The parameter  $\alpha$  that controls the constraint on the weights from being not too “far” from the deep layer mean weights (non-dimensional,  $*100$ )
- $t=48$  to  $t=102$  columns: The optimal vertical weights for  $p=100, 150, 200, 250, 300, 400, 500, 700, 850$  and  $1000$  hPa. (non-dimensional  $*1000$ )

**Z850:** 850 hPa vorticity ( $\text{sec}^{-1} * 10^{**7}$ ) vs time ( $r=0-1000$  km)

**D200:** Same as above for 200 hPa divergence

**REFC:** Relative eddy momentum flux convergence ( $\text{m/sec/day}$ , 100-600 km avg) vs time

**PEFC:** Planetary eddy momentum flux convergence ( $\text{m/sec/day}$ , 100-600 km avg) vs time

**T000:** 1000 hPa temperature ( $\text{deg C} * 10$ ) (200-800 km average)

**R000:** 1000 hPa relative humidity (200-800 km average)

**Z000:** 1000 hPa height deviation (m) from the U.S. standard atmosphere

**TLAT:** Latitude of 850 hPa vortex center in NCEP analysis ( $\text{deg N} * 10$ )

**TLON:** Longitude of 850 hPa vortex center in NCEP analysis ( $\text{deg W} * 10$ )

**TWAC:** 0-600 km average symmetric tangential wind at 850 hPa from NCEP analysis ( $\text{m/sec} * 10$ )

**TWXC:** Maximum 850 hPa symmetric tangential wind at 850 hPa from NCEP analysis ( $\text{m/sec} * 10$ )

**G150:** Temperature perturbation at 150 hPa due to the symmetric vortex calculated from the gradient thermal wind. Averaged from  $r=200$  to 800 km centered on input lat/lon (not always the model/analysis vortex position). ( $\text{deg C} * 10$ )

**G200:** Same as G150 at 200 hPa

**G250:** Same as G150 at 250 hPa

**V000:** The tangential wind ( $\text{m/sec} * 10$ ) azimuthally averaged at  $r=500$  km from (TLAT, TLON) If TLAT, TLON are not available, (LAT, LON) are used.

**V850:** Same as V000 at 850 hPa

**V500:** Same as V000 at 500 hPa

**V300:** Same as V000 at 300 hPa

**TGRD:** The magnitude of the temperature gradient between 850 and 700 hPa averaged from 0 to 500 km estimated from the geostrophic thermal wind ( $\text{deg C per m} * 10^7$ )

**TADV:** The temperature advection between 850 and 700 hPa averaged from 0 to 500 km Estimated from the geostrophic thermal wind ( $\text{deg per sec} * 10^6$ )

**PENC:** Azimuthally averaged surface pressure at outer edge of vortex ( $(\text{hPa}-1000) * 10$ )

**SHDC:** Same as SHRD but with vortex removed and averaged from 0-500 km relative to 850 hPa vortex center

**SDDC:** Heading ( $\text{deg}$ ) of above shear vector. Westerly shear has a value of 90 deg.

**SHGC:** Same as SHRG but with vortex removed and averaged from 0-500 km relative to 850 hPa vortex center

**DIVC:** Same as D200, but centered at 850 hPa vortex location

**T150:** 200 to 800 km area average 150 hPa temperature (deg C \*10) versus time

**T200:** Same as above for 200 hPa temperature (deg C \*10)

**T250:** Same as above for 250 hPa temperature (deg C \*10)

**SHRD:** 850-200 hPa shear magnitude (kt \*10) vs time (200-800 km)

**SHTD:** Heading (deg) of above shear vector. Westerly shear has a value of 90 deg.

**SHRS:** 850-500 hPa shear magnitude (kt \*10) vs time

**SHTS:** Heading of above shear vector

**SHRG:** Generalized 850-200 hPa shear magnitude (kt \*10) vs time (takes into account all levels from 1000 to 100 hPa)

**PENV:** 200 to 800 km average surface pressure ((hPa-1000)\*10)

**VMPI:** Maximum potential intensity from Kerry Emanuel equation (kt)

**VVAV:** Average (0 to 15 km) vertical velocity (m/s \* 100) of a parcel lifted from the surface where entrainment, the ice phase and the condensate weight are accounted for.  
Note: Moisture and temperature biases between the operational and reanalysis files make this variable inconsistent in the 2001-2007 sample, compared 2000 and before.

**VMFX:** Same as VVAV, but a density weighted vertical average.

**VVAC:** Same as VVAV but with soundings from 0-500 km with GFS vortex removed

**HE07:** Storm motion relative helicity ( $m^2/s^2$ )\*10 for p=1000 to 700 hPa, r=200 to 800 km

**HE05:** Same as HE05, for P=1000 to 500 hPa

**O500:** Pressure vertical velocity (hPa/day) at 500 hPa, averaged from r=0 to 1000 km

**O700:** Same as O500 at 700 hPa

**CFLX:** Dry air predictor based on the difference in surface moisture flux between air with the observed (GFS) RH value, and with RH of air mixed from 500 hPa to the surface.

**MTPW:** Total Precipitable Water (TPW) predictors at t=0 from the GFS analysis. The 21 values in this record are as follows:

- 1) 0-200 km average TPW (mm \* 10)
- 2) 0-200 km TPW standard deviation (mm \* 10)
- 3) 200-400 km average TPW (mm \* 10)
- 4) 200-400 km TPW standard deviation (mm \* 10)
- 5) 400-600 km average TPW (mm \* 10)
- 6) 400-600 km TPW standard deviation (mm \* 10)
- 7) 600-800 km average TPW (mm \* 10)
- 8) 600-800 km TPW standard deviation (mm \* 10)
- 9) 800-1000 km average TPW (mm \* 10)
- 10) 800-1000 km TPW standard deviation (mm \* 10)
- 11) 0-400 km average TPW (mm \* 10)
- 12) 0-400 km TPW standard deviation (mm \* 10)
- 13) 0-600 km average TPW (mm \* 10)
- 14) 0-600 km TPW standard deviation (mm \* 10)
- 15) 0-800 km average TPW (mm \* 10)
- 16) 0-800 km TPW standard deviation (mm \* 10)
- 17) 0-1000 km average TPW (mm \* 10)
- 18) 0-1000 km TPW standard deviation (mm \* 10)
- 19) %TPW less than 45 mm, r=0 to 500 km in 90 deg azimuthal quadrant centered on up-shear direction
- 20) 0-500 km averaged TPW (mm \* 10) in 90 deg up-shear quadrant
- 21) 0-500 km average TPW (mm \* 10)

**PW01-PW19:** Time dependent versions of the 21 TPW variables listed above.

**IRXX:** Same as IR00 below but generated from other predictors (not satellite data). These should only be used to fill in for missing IR00 if needed.

**XDST:** Climatological value of the daily Reynolds SST (deg C\*10)

**XNST-XO20:** Climatological values of the NCODA variables listed below (NSST through NO20, except there is no X version of NSTA).

**NSST:** SST from the NCODA analysis (deg C\*10)

**NSTA:** Same as NSST, but spatially averaged over 5 points (storm center, + 50 km N, E, S and W of center)

**NTMX:** Max ocean temperature in the NCODA vertical profile (deg C\*10)

**NDMX:** Depth of the max ocean temperature in the profile (m)

**NDML:** Depth of the mixed layer, defined as the depth where the T is 0.5 colder than at the surface (m). In rare cases, this is the depth where the T is 0.5 warmer than at the surface. In those cases, NDML is negative.

**ND30-ND16:** Depth of the 30, 28, ..., 16 deg C isotherms (m)

**NDFR:** Depth of the lowest model level in the NCODA analysis (m).

**NTFR:** Ocean T at the lowest level in the NCODA analysis (deg C\*10)

**NOHC:** Ocean heat content from the NCODA analysis (kJ/cm<sup>2</sup>) relative to the 26 C isotherm

**NO20:** Same as NOHC with respect to the 20 deg C isotherm

**IR00:** Predictors from GOES data (not time dependent). The 20 values in this record are as follows:

- 1) Time (hhmm) of the GOES image, relative to this case
- 2) Average GOES ch 4 brightness temp (deg C \*10), r=0-200 km
- 3) Stan. Dev. of GOES BT (deg C\*10), r=0-200 km
- 4) Same as 2) for r=100-300 km
- 5) Same as 3) for r=100-300 km
- 6) Percent area r=50-200 km of GOES ch 4 BT < -10 C
- 7) Same as 6 for BT < -20 C
- 8) Same as 6 for BT < -30 C
- 9) Same as 6 for BT < -40 C
- 10) Same as 6 for BT < -50 C
- 11) Same as 6 for BT < -60 C
- 12) max BT from 0 to 30 km radius (deg C\*10)
- 13) avg BT from 0 to 30 km radius (deg C\*10)
- 14) radius of max BT (km)
- 15) min BT from 20 to 120 km radius (deg C\*10)
- 16) avg BT from 20 to 120 km radius (deg C\*10)
- 17) radius of min BT (km)
- 18-20) Variables need for storm size estimation

**IRM1:** Same as IR00 but at 1.5 hours before initial time

**IRM3:** Same as IR00 but at three hours before initial time

**PC00:** Principal components and related variables from IR imagery at t=0

**PCM1:** Same as PC00 but for 1.5 hours before initial time

**PCM3:** Same as PC00 but for three hours before initial time

**LAST:** The last line for this case