Extended Range Forecast for Northwest Pacific Typhoon Activity in 2020

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by Dr Adam Lea and Professor Mark Saunders

Dept. of Space and Climate Physics, UCL (University College London), UK

Forecast Summary

TSR predicts the 2020 Northwest Pacific typhoon season will see activity below the 1965-2019 norm. However, the uncertainties associated with this outlook are large and the forecast skill at this extended range is historically low. We introduce probability of exceedance information to better quantify the forecast uncertainty.

The TSR (Tropical Storm Risk) extended range forecast for Northwest Pacific typhoon activity in 2020 anticipates a season with an ACE index that is 10-15% below norm. The forecast spans the period from 1st January to 31st December 2020 (95% of typhoons occur historically after 1st May) and employs data through to the end of April 2020. The forecast includes deterministic and probabilistic projections for overall basin activity, and deterministic projections for the ACE index and numbers of intense typhoons, typhoons and tropical storms. TSR's main predictor for overall activity is the forecast anomaly in August-September Niño 3.75 (region 5˚S-5˚N, 140˚W-180˚W) sea surface temperature (SST) which we anticipate being 0.14±0.49°C warmer than normal (1965-2019 climatology). This and other forecast weighting factors all point to a season with somewhat below-average activity. However, sizeable uncertainties remain in the ENSO forecast for August-September 2020. Furthermore the precision of TSR's outlooks for upcoming Northwest Pacific typhoon activity issued in early May between 2003 and 2019 is low. In order to better quantify the current large uncertainty in anticipated typhoon activity in 2020 we introduce forecast probability of exceedance information for the benefit of users. Updated seasonal outlooks will be issued in early July and early August 2020 when the forecast skill is historically good.

NW Pacific ACE Index and System Numbers in 2020

		ACE Index	Intense Typhoons	Typhoons	Tropical Storms
TSR Forecast (±FE)	2020	258 (±80)	8 (±2)	15 (±3)	26 (±4)
55yr Climate Norm (±SD)	1965-2019	294 (±100)	9 (±3)	16 (±4)	26 (±4)
Forecast Skill at this Lead	1965-2019	33%	34%	18%	8%

Key:			
ACE Index	=	Accumulated Cyclone Energy Index = Sum of the Squares of 6-hourly Maximum Sustained Wind Speeds (in units of knots) for all Systems while they are at least Tropical Storm Strength. ACE Unit = x10^4 knots^2.	
Intense Typhoon	=	1 Minute Sustained Wind > 95Kts	= Hurricane Category 3 to 5.
Typhoon	=	1 Minute Sustained Wind > 63Kts	= Hurricane Category 1 to 5.
Tropical Storm	=	1 Minute Sustained Winds > 33Kts.	
SD	=	Standard Deviation.	
FE (Forecast Error)	=	Standard Deviation of Errors in Cross-Validated Hindcasts 1965-2019.	
Forecast Skill	=	Percentage Improvement in Mean Square Error Afforded by Cross-Validated Hindcasts 1965-2019 over Hindcasts Made with the 1965-2019 Climate Norm.	
Northwest Pacific	=	Northern Hemisphere Region West of 180°W Including the South China Sea. Any Tropical Cyclone (Irrespective of Where it Forms) Which Reaches Tropical Storm Strength Within this Region Counts as an Event.	

There is a 11% probability that the 2020 NW Pacific typhoon season ACE index will be above-average (defined as an ACE index value in the upper tercile historically (>335)), a 34% likelihood it will be near-normal (defined as an ACE index value in the middle tercile historically (247 to 335) and a 55% chance it

will be below-normal (defined as an ACE index value in the lower tercile historically (<247)). The 55-year period 1965-2019 is used for climatology.

Key: Terciles   =   Data groupings of equal (33.3%) probability corresponding to the upper, middle and lower one-third of values historically (1965-2019).

Forecast Probability of Exceedance Plot for the 2020 Northwest Pacific Typhoon Season

Seasonal outlooks for Northwest Pacific typhoon activity contribute to the anticipation of risk for insurance companies, other weather-sensitive businesses, and local and national governments. However, the uncertainty associated with such forecasts is often unclear. This reduces their benefit and contributes to the perception of forecast 'busts'. The robust assessment of risk requires a full and clear probabilistic quantification of forecast uncertainty with the forecast issued in terms of probability of exceedance (PoE). In this way the chance of each activity outcome occurring is clear for the benefit of users. Going forward TSR will be including robust forecast probability of exceedance (PoE) information based on the recommendation and methodology described in Saunders et al. (2020).

The figure below displays our current outlook for the Northwest Pacific ACE index in terms of PoE. The plot displays two PoE curves comprising the forecast PoE curve and the 1950-2019 climatology PoE curve. The forecast PoE curve is computed using a method similar to that described in section 3.3 of Saunders et al. (2020) while the climatology PoE curve is computed directly from observations. The figure specifies the current chance that a given ACE index will be reached in 2020 and how this chance compares to climatology.
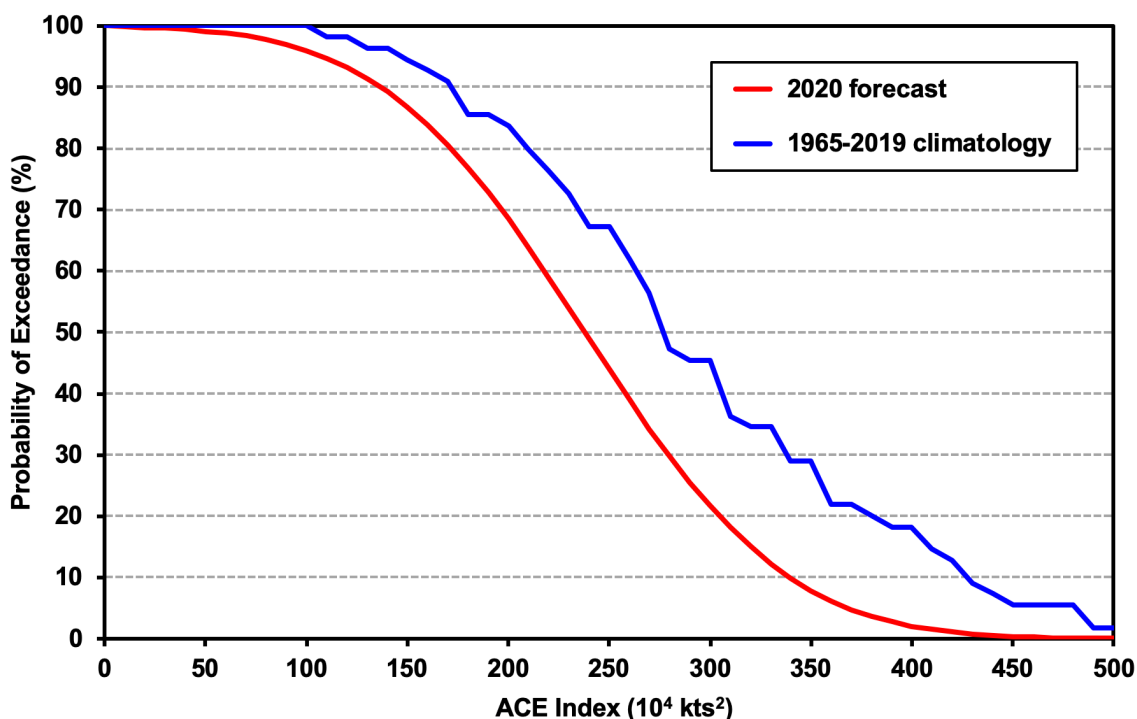
Reference: Saunders, M. A., Klotzbach, P. J., Lea, A. S. R., Schreck, C. J., & Bell, M. M. (2020). Quantifying the probability and causes of the surprisingly active 2018 North Atlantic hurricane season. *Earth and Space Science*, 7, e2019EA000852. https://doi.org/10.1029/2019EA000852

Predictors for 2020

The TSR predictors are as follows. Intense typhoon numbers and the ACE index are predicted from the forecast value for the August-September Niño 3.75 index. Tropical storm and typhoon numbers are forecast using an ensemble of two models: the Niño 3 SST from the prior September and the forecast number of intense typhoons in 2020. Our prediction of the August-September Niño 3.75 index includes the current (19th May 2020) consensus ENSO outlook for the August-September 2020 Niño 3.4 index issued by the International Research Institute for Climate and Society.

The TSR forecasts are weighted by the observed ACE activity up to the date of forecast issue (which is below-norm as of 21st May 2020) and by the current outlook issued by ECMWF for the Indian Ocean Dipole (IOD) in August-September-October 2020 (which anticipates a negative IOD value).

The forecast value for the Niño 3.75 SST anomaly, the forecast values for the IOD, and the current level of ACE activity are all consistent with a below-normal Northwest Pacific typhoon season in 2020. These factors all point to the trade wind speed over the region 2.5°N-12.5°N, 120°E-180°E being stronger than normal during August-September 2020. This in turn would lead to decreased cyclonic vorticity over the Northwest Pacific region where intense typhoons form and thus to fewer intense typhoons and to a below-normal ACE.

It should be stressed that sizeable uncertainties remain in the forecasts for August-September ENSO and for August-September-October IOD, and thus in the current TSR seasonal typhoon outlook. Indeed the precision of TSR's seasonal typhoon outlooks issued in early May between 2003 and 2019 is low as shown below.

The Precision of TSR Seasonal Forecasts 2003-2019

The figure below shows the skill of the TSR-publicly-released seasonal outlooks for Northwest Pacific ACE (left panel) and intense typhoon numbers (right panel) assessed for the 17-year period 2003-2019. Skill is shown as the Pearson correlation r between the forecast values (issued separately in early May, early July and early August) and the observed values. The figure shows low prediction skill from early May but good prediction skill ($r = 0.63$ to 0.75) by early July. The correlation skill for typhoon numbers for the 2003-2019 period (not shown) is lower reaching 0.34 by early August.

(a) WNP ACE Index (2003-2019)

(b) WNP Intense Typhoon Numbers (2003-2019)
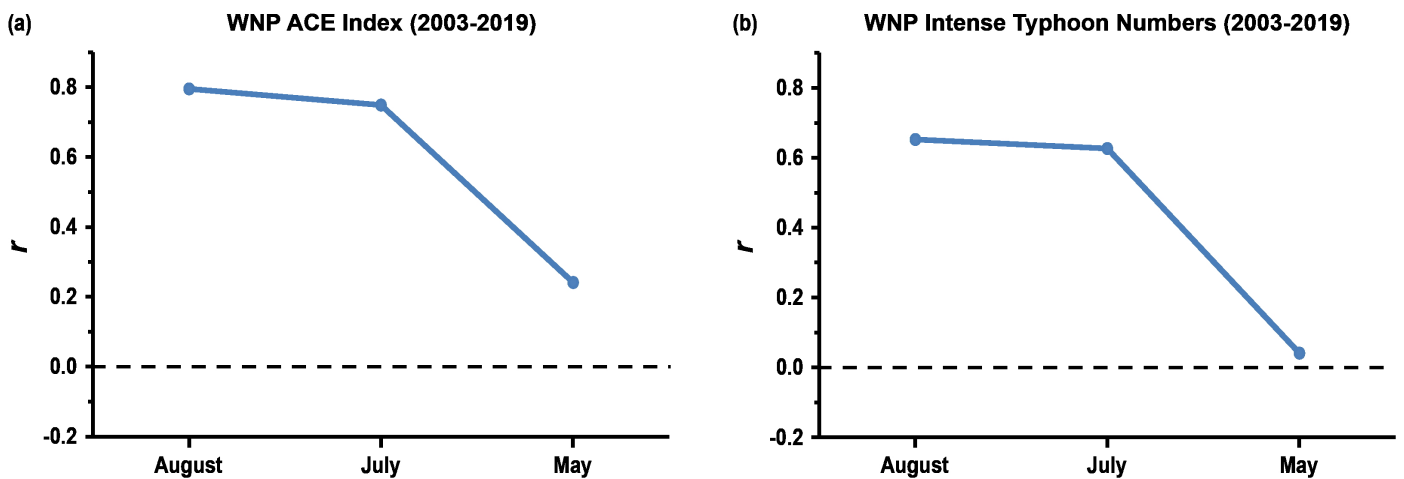
Further Information

For more information about the TSR forecasts and their verifications for Northwest Pacific typhoon activity please see *http://www.tropicalstormrisk.com/for_typh.html*. The first TSR forecast update for the 2020 Northwest Pacific typhoon season will be issued on Thursday 9th July 2020.

Appendix – Predictions from Previous Months

a) Deterministic forecast

NW Pacific ACE Index and System Numbers 2020		ACE Index (x10⁴ knots²)	Intense Typhoons	Typhoons	Tropical Storms
Average Number (±SD) (1965-2019)		294 (±100)	9 (±3)	16 (±4)	26 (±4)
TSR Forecast (±FE)	21 May 2020	258 (±80)	8 (±2)	15 (±3)	26 (±4)

b) Probabilistic forecast

NW Pacific ACE Index 2020				
		Tercile Probabilities		
		below normal	normal	above normal
Climatology 1965-2019		33.3	33.3	33.3
TSR Forecast	21 May 2020	55	34	11