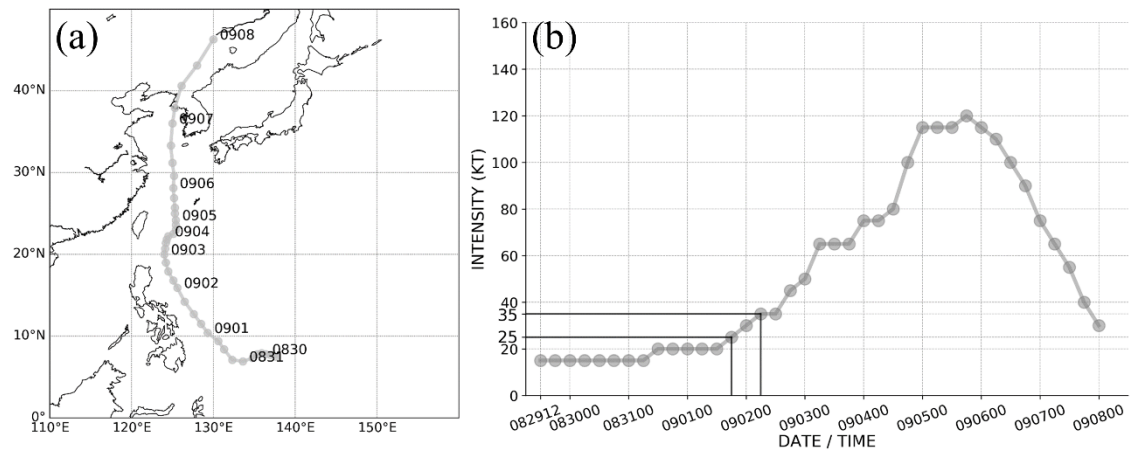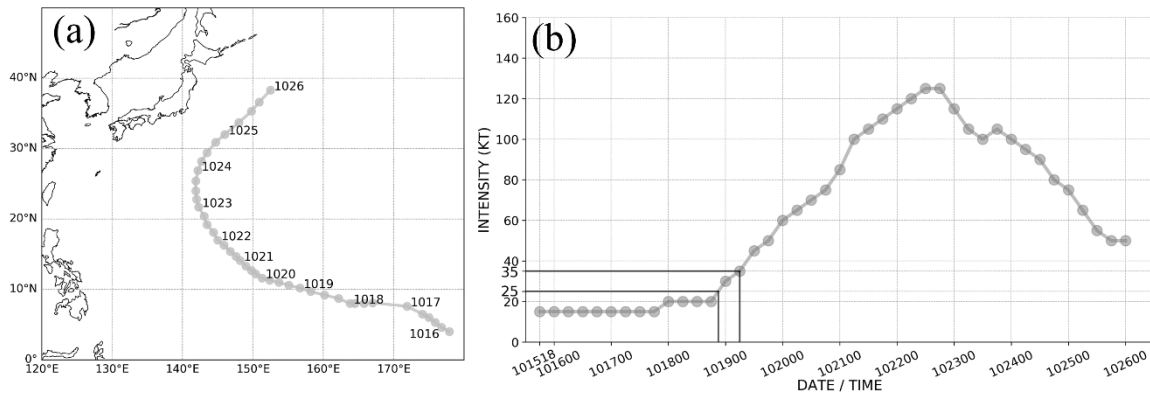**Supplementary Figures**

BT_25kt: 2019090118(Lat:14.2°N, Long:126.5°E); BT_35kt: 2019090206(Lat:16.8°N, Long:125.1°E); BT peak intensity: 120kt (2019090518)

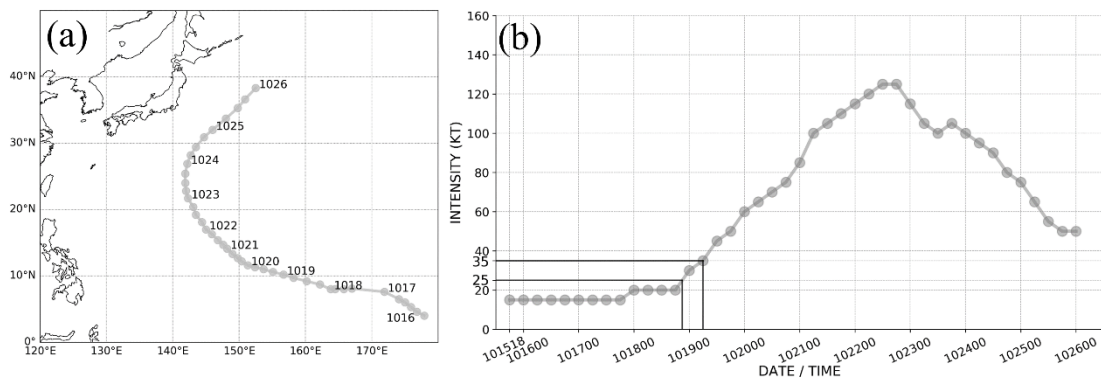| GEFS	Storm No.	Members Start	Members Max	Storm Start GEFS Days	Storm Start Lat(°N)	Storm Start Long(°E)	Warm Core Mag Max	Likely Storm Cat.	T2F(25) GEFS(25) Days	T2F(25) Lat error deg. N	T2F(25) Long error deg. E	T2F(35) WCM(50) Days	T2F(35) Lat error deg. N	T2F(35) Long error deg. E	T2F(35) WCM(55) Days	WAIP GEFS (25)	WAIP WCM (50)	WAIP WCM (55)
083000	3	3	19	0.0	8.7	138.73	136.0	TY	-0.75	-4.83	7.16	-0.5	-4.71	6.5	-0.5	86.0	88.8	88.8
083012	3	5	19	0.0	9.42	134.02	149.33	TY	-1.0	-4.83	6.48	-1.0	-5.48	6.28	-1.0	85.19	101.28	101.28
083100	2	19	20	0.0	7.25	133.92	171.67	TY	0.0	-1.42	2.32	-1.0	-5.83	5.36	-0.5	74.82	83.11	80.51
083112	2	20	21	0.0	8.24	132.66	148.67	TY	-0.25	-2.39	2.24	0.25	-1.42	0.66	0.5	77.47	83.01	81.16
090100	3	19	20	0.0	10.12	130.58	136.0	TY	0.75	2.41	-1.25	0.0	-1.16	0.73	0.5	74.56	75.2	79.48
090112	3	15	17	0.0	12.85	128.36	106.33	TY	1.75	5.91	-2.26	0.75	2.01	-0.75	0.75	49.78	60.1	60.1
090200	3	20	20	0.0	15.85	125.81	124.67	TY	N/A	N/A	N/A	0.25	0.92	-0.5	0.25	N/A	59.32	59.32

Figure S1. Validation summary table for the GEFS forecasts for pre-TY Lingling with (a) Joint Typhoon Warning Center (JTWC) Working Best Track (WBT) positions shown at 00 UTC on the MODA; (b) JTWC WBT intensities (kt) at MODAHR with the times of T2F(25) and T2F(35) as indicated in green and blue boxes below the plots in panels (a) and (b), along with the peak intensity in the red box. The first nine columns are storm characteristics that are repeated from the bottom of each forecast summary (e.g., Line 2 of the table is from the bottom of Figure 3). Columns 10-12 in green are the T2F(25) timing (days) and position errors in latitude and longitude, Columns 13-15 in blue are the T2F(35) timing and position errors for the early T2F(35), Column 16 in blue is the late T2F(35) timing error, and Columns 17-19 are the peak combined WAIP intensity forecasts for each of the three T2Fs.

BT_25kt: 2019101900(Lat:10.2°N, Long:156.7°E); BT_35kt: 2019101906(Lat:10.6°N, Long:155.1°E); BT peak intensity: 125kt (first time:2019102212)

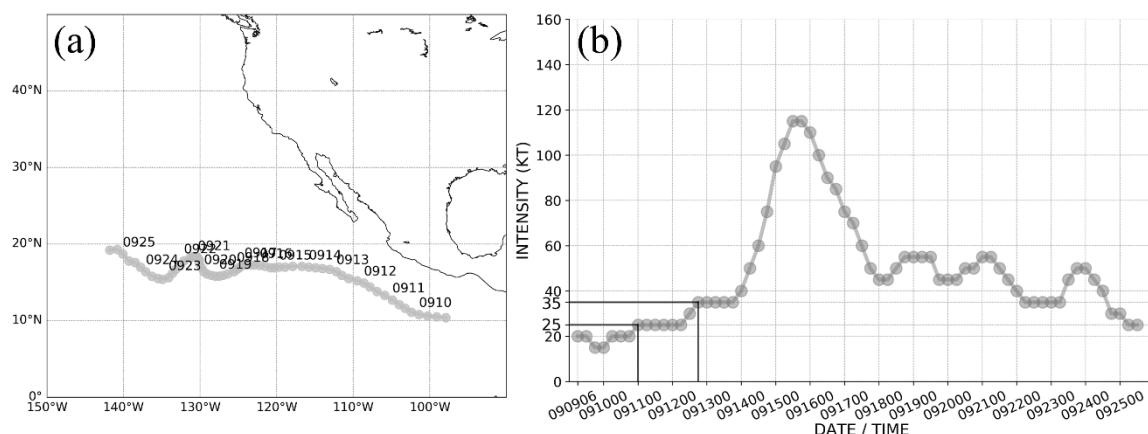| ECEPS	Storm No.	Members		Storm Start			Warm Core Mag Max	Likely Storm Cat.	T2F(25)			T2F(35)				WAIP max intensity		
		Start	Max	ECEPS Days	Lat(°N)	Long(°E)			ECEPS(22.51) Days	Lat error deg. N	Long error deg. E	WCM(25) Days	Lat error deg. N	Long error deg. E	WCM(30) Days	ECEPS (22.51)	WCM (25)	WCM (30)
101212	11	3	21	4.5	6.44	172.21	88.3	TY	-0.5	-0.77	6.49	0.25	1.79	3.46	0.75	77.13	77.74	76.88
101300	7	3	18	4.25	6.49	169.64	165.0	TY	-0.5	-2.0	5.2	0.75	1.59	-0.22	1.75	72.47	82.35	87.27
101312	5	4	12	5.0	7.31	161.6	93.0	TY	-0.25	-2.18	3.44	1.5	2.25	-4.22	2.0	68.48	76.34	77.89
101400	5	3	28	3.5	5.38	167.7	107.0	TY	0.0	-1.41	1.82	2.0	2.38	-7.19	2.25	71.51	82.75	81.73
101500	4	4	19	2.5	6.76	168.37	58.0	TY	0.0	-0.54	2.63	1.5	3.11	-1.8	2.0	70.58	88.71	84.37
101512	3	3	35	0.5	5.96	178.2	122.0	TY	-1.0	-2.16	8.31	0.5	1.48	0.21	1.0	75.62	78.5	79.32
101612	2	14	16	0.0	5.78	174.96	90.7	TY	0.25	-1.2	0.81	2.0	2.84	-4.43	2.0	69.03	75.48	75.48
101700	2	9	32	0.25	6.23	168.93	126.0	TY	-0.5	-2.11	3.34	1.75	2.85	-7.05	3.0	70.09	81.01	86.81
101712	2	9	23	0.0	7.72	167.34	45.7	TS	0.0	0.36	1.42	2.0	5.61	-4.13	2.75	59.92	62.14	N/A
101812	2	52	52	0.0	8.37	159.7	53.3	TY	-0.5	-1.83	3.0	0.5	1.05	-2.56	1.0	72.35	80.74	75.76
101900	2	51	53	0.0	9.67	156.7	76.3	TY	N/A	N/A	N/A	0.5	0.85	-2.49	1.0	N/A	80.58	72.5

Figure S2. Validation summary table for the ECEPS forecasts for pre-TY Bualoi with (a) Joint Typhoon Warning Center (JTWC) Working Best Track (WBT) positions shown at 00 UTC on the MODA; (b) JTWC WBT intensities (kt) at MODAHR with the times of T2F(25) and T2F(35) as indicated in green and blue boxes below the plots in panels (a) and (b), along with the peak intensity in the red box. The first nine columns are storm characteristics that are repeated from the bottom of each forecast summary (e.g., Line 1 of the table is from the bottom of Figure 8). Columns 10-12 in green are the T2F(25) timing (days) and position errors in latitude and longitude, Columns 13-15 in blue are the T2F(35) timing and position errors for the early T2F(35), Column 16 in blue is the late T2F(35) timing error, and Columns 17-19 are the peak combined WAIP intensity forecasts for each of the three T2Fs.

BT_25kt: 2019101900(Lat:10.2°N, Long:156.7°E); BT_35kt: 2019101906(Lat:10.6°N, Long:155.1°E);
BT peak intensity: 125kt (first time:2019102212)

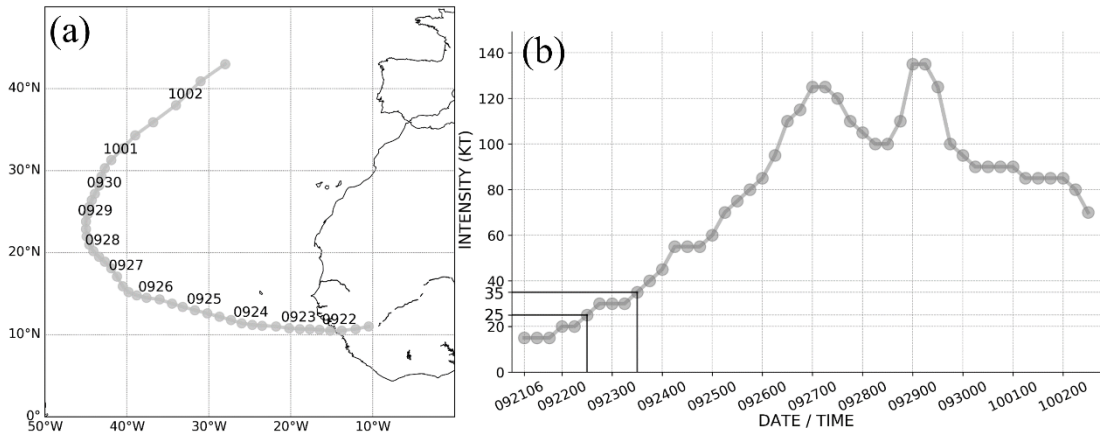| GEFS	Storm No.	Members Start	Members Max	Storm Start GEFS Days	Storm Start Lat(°N)	Storm Start Long(°E)	Warm Core Mag Max	Likely Storm Cat.	T2F(25) GEFS(25) Days	T2F(25) Lat error deg. N	T2F(25) Long error deg. E	T2F(35) WCM(50) Days	T2F(35) Lat error deg. N	T2F(35) Long error deg. E	T2F(35) WCM(55) Days	WAIP max intensity GEFS(25)	WAIP max intensity WCM(50)	WAIP max intensity WCM(55)
101300	6	3	12	5.75	6.68	159.94	153.7	TY	0.75	-1.37	-1.33	1.0	-0.52	-1.93	1.25	70.7	84.28	82.62
101512	2	4	15	0.25	5.4	178.7	173.7	TY	-2.0	-3.27	15.41	0.5	2.35	0.78	0.5	70.78	79.56	79.56
101600	3	3	13	2.5	8.92	160.9	117.0	TY	0.25	-0.19	-0.23	-0.25	-0.98	2.71	-0.25	70.62	73.64	73.64
101612	3	5	10	3.0	9.85	155.04	131.7	TY	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
101700	2	6	18	0.5	7.45	166.27	167.3	TY	1.0	-0.18	-6.46	1.0	-0.28	-6.08	1.5	70.88	82.86	87.56
101712	2	3	17	0.5	7.46	162.28	161.7	TY	1.0	-0.38	-6.84	1.5	0.17	-8.62	1.75	71.19	85.46	85.76
101812	2	5	19	0.0	8.44	159.5	141.3	TY	0.5	0.5	-3.47	1.0	1.0	-5.59	1.75	72.94	77.97	77.49
101900	2	20	20	0.0	9.41	156.46	83.7	TY	N/A	N/A	N/A	1.5	1.9	-6.88	1.75	N/A	63.71	64.48

Figure S3. Validation summary table for the GEFS forecasts for pre-TY Bualoi with (a) Joint Typhoon Warning Center (JTWC) Working Best Track (WBT) positions shown at 00 UTC on the MODA; (b) JTWC WBT intensities (kt) at MODAHR with the times of T2F(25) and T2F(35) as indicated in green and blue boxes below the plots in panels (a) and (b), along with the peak intensity in the red box. The first nine columns are storm characteristics that are repeated from the bottom of each forecast summary (e.g., Line 1 of the table is from the bottom of Figure 10). Columns 10-12 in green are the T2F(25) timing (days) and position errors in latitude and longitude, Columns 13-15 in blue are the T2F(35) timing and position errors for the early T2F(35), Column 16 in blue is the late T2F(35) timing error, and Columns 17-19 are the peak combined WAIP intensity forecasts for each of the three T2Fs.

BT_25kt: 2019091100 (Lat:12.7°N, Long:104.9°W); BT_35kt: 2019091218 (Lat: 15.9°N, Long: 111.5°W); BT peak intensity: 115kt (first time:2019091512)

GEFS	Storm No.	Members		Storm Start			Warm Core Mag Max	Likely Storm Cat.	T2F(25)			T2F(35)			
		Start	Max	GEFS Days	Lat(°N)	Long(°W)			GEFS(25) Days	Lat error deg. N	Long error deg. E	WCM(45) Days	Lat error deg. N	Long error deg. E	WCM(50) Days
090712	5	7	9	2.0	10.15	98.66	85.3	HU	0.25	-1.45	-1.32	0.75	-1.47	2.39	1.0
090800	4	7	14	0.5	9.34	96.49	85.3	HU	0.5	-0.93	0.11	0.25	-1.88	0.39	0.5
090812	4	7	17	0.0	9.17	96.06	98.3	HU	0.25	-1.1	-1.21	0.25	-1.53	-0.3	0.5
090900	4	5	16	0.0	9.42	97.42	100.3	HU	-1.5	-2.59	-5.98	-0.5	-2.37	-2.12	-0.25

Figure S4. Validation summary table for the GEFS forecasts for pre-HU Kiko with (a) National Hurricane Center (NHC) Working Best Track (WBT) positions shown at 00 UTC on the MODA; (b) NHC WBT intensities (kt) at MODAHR with the times of T2F(25) and T2F(35) as indicated in green and blue boxes below the plots in panels (a) and (b), along with the peak intensity in the red box. The first nine columns are storm characteristics that are repeated from the bottom of each forecast summary (e.g., Line 2 of the table is from the bottom of Figure 13). Columns 10-12 in green are the T2F(25) timing (days) and position errors in latitude and longitude, Columns 13-15 in blue are the T2F(35) timing and position errors for the early T2F(35), and Column 16 in blue is the late T2F(35) timing error.

BT_25kt: 2019092212 (Lat:10.7°N, Long:17.7°W); BT_35kt: 2019092312 (Lat: 11.1°N, Long: 23.5°W);

BT peak intensity: 135kt (first time:2019092900)

GEFS	Storm No.	Members		Storm Start			Warm Core Mag Max	Likely Storm Cat.	T2F(25)			T2F(35)			
		Start	Max	GEFS Days	Lat(°N)	Long(°W)			GEFS(25) Days	Lat error deg. N	Long error deg. E	WCM(35) Days	Lat error deg. N	Long error deg. E	WCM(40) Days
091612	7	3	9	4.75	10.13	12.53	170.0	HU	-0.5	0.57	-0.86	-1.75	-0.21	-8.13	-1.25
091700	8	3	14	3.75	8.91	11.23	113.0	HU	-1.0	-1.04	-2.14	-2.0	-1.44	-7.94	-1.0
091712	7	3	10	5.0	10.46	18.01	136.7	HU	0.0	-0.24	0.31	-1.0	-0.64	-5.49	-1.0
091800	5	5	13	4.0	10.33	16.19	89.7	HU	-0.25	-0.17	-0.09	-1.25	-0.57	-5.89	-1.25
091900	4	3	19	2.5	8.17	12.16	152.7	HU	-0.25	-1.58	-0.96	0.5	-1.3	3.73	0.5
091912	5	4	20	2.0	8.75	12.71	161.7	HU	-0.5	-1.56	-2.09	-1.0	-1.99	-4.66	-0.5
092000	5	4	20	2.0	9.93	15.06	171.7	HU	0.0	-0.73	0.42	0.0	-0.93	0.68	0.0
092012	4	16	20	1.75	10.08	16.45	136.7	HU	1.5	-0.43	9.43	0.25	-1.03	2.12	0.5
092100	4	8	20	1.25	10.7	17.01	91.7	HU	1.0	0.32	6.15	-0.75	-0.31	-3.59	-0.25
092112	5	3	15	0.75	10.33	16.53	132.3	HU	1.0	0.36	6.24	-0.25	-0.17	-1.17	0.25
092200	2	15	20	0.0	10.94	15.12	183.0	HU	0.25	1.15	1.93	0.25	1.17	2.07	0.75
092212	3	5	21	0.0	10.76	18.38	235.0	HU	0.75	-0.07	4.25	0.0	-0.24	-0.25	0.25
092300	3	19	22	0.0	10.92	20.34	203.0	HU	N/A	N/A	N/A	0.5	0.54	2.43	0.5
092312	3	20	20	0.0	11.08	23.08	248.0	HU	N/A	N/A	N/A	0.25	0.13	0.94	0.25

Figure S5. Validation summary table for the GEFS forecasts for pre-TY Lorenzo with (a) National Hurricane Center (NHC) Working Best Track (WBT) positions shown at 00 UTC on the MODA; (b) NHC WBT intensities (kt) at MODAHR with the times of T2F(25) and T2F(35) as indicated in green and blue boxes below the plots in panels (a) and (b), along with the peak intensity in the red box.   The first nine columns are storm characteristics that are repeated from the bottom of each forecast summary (e.g., Line 1 of the table is from the bottom of Figure 15). Columns 10-12 in green are the T2F(25) timing (days) and position errors in latitude and longitude, Columns 13-15 in blue are the T2F(35) timing and position errors for the early T2F(35), and Column 16 in blue is the late T2F(35) timing error.