Use of ECMWF Model Data in support of Seamless Forecast of High Impact Weather

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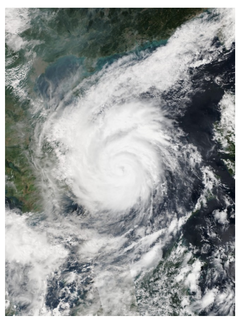
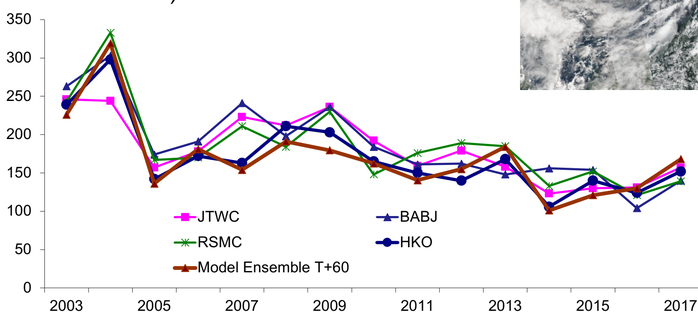
Introduction

- The Hong Kong Observatory (HKO) makes use of ECMWF model data to support weather forecasting and warning services. With advances in data assimilation, model dynamics, physical processes and ensemble forecasting, the ECMWF deterministic model and ensemble prediction system (EPS) demonstrate increasing level of skills in short-range to medium-range forecasts of high impact weather such as that of tropical cyclone (TC).

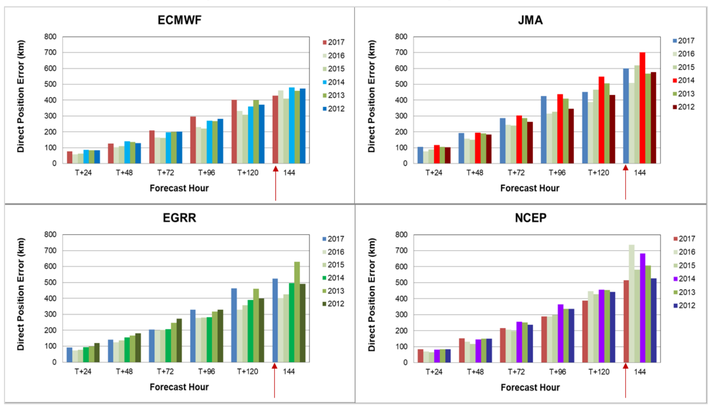
Verification of TC Forecasts

- Verification of 48-h TC track forecasts from HKO, BABJ, RSMC/Tokyo and JTWC against NWP model ensemble (ECMWF + JMA + NCEP + UKMO) from 2003 to 2017:

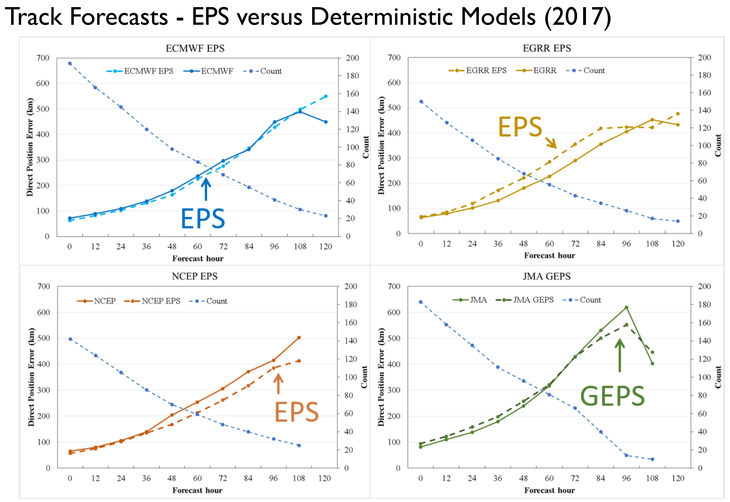




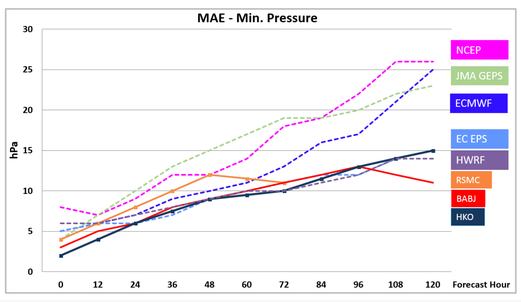
- Global NWP model performance in recent years



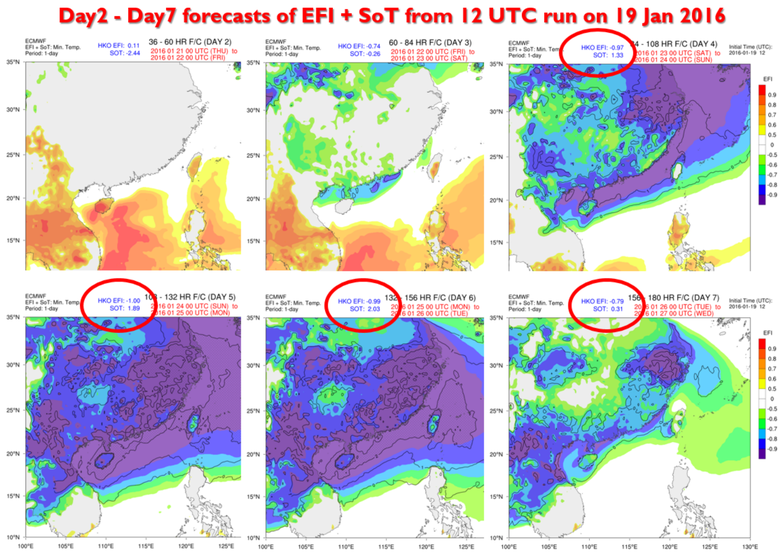
- Track Forecasts - EPS versus Deterministic Models (2017)



- Intensity Forecasts



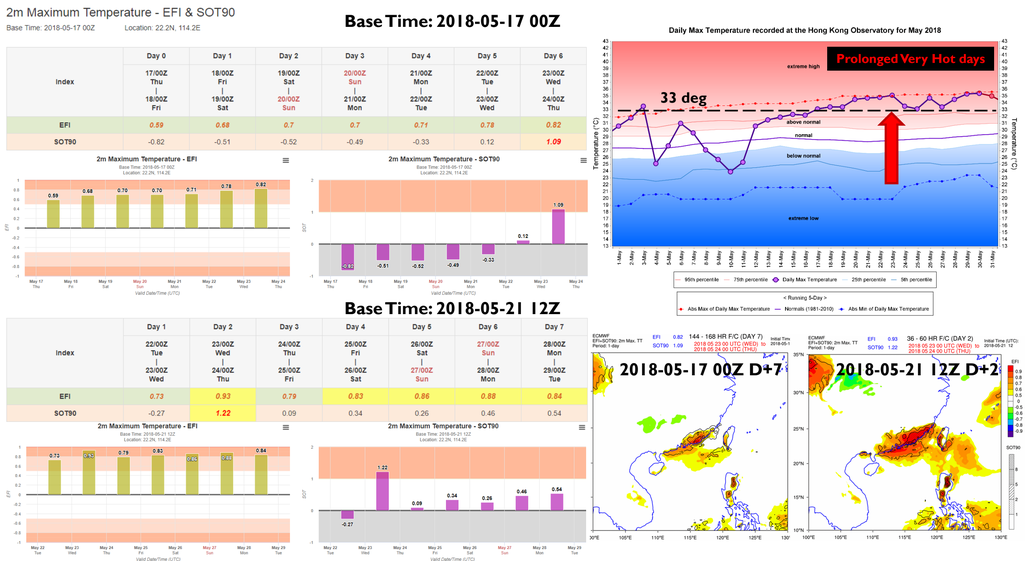
Extreme Weather Forecast



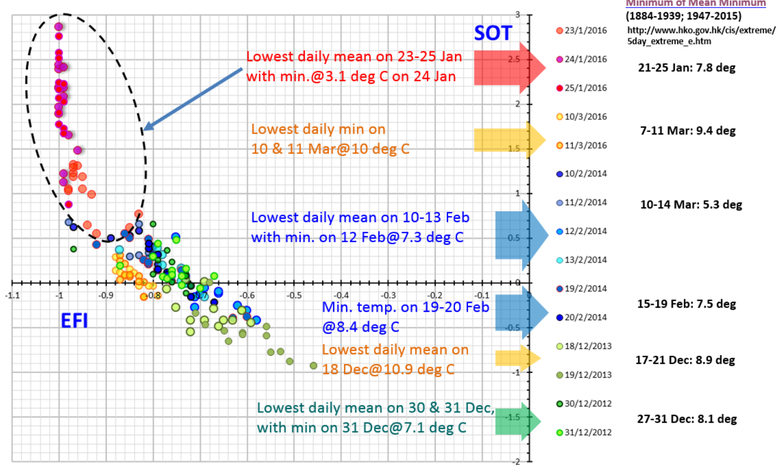
- EFI and SOT of daily maximum temperature indicate potential of prolonged very hot days in Hong Kong and extreme maximum temperature in the coastal areas of southern China during late May 2018.

Rank	Tmax	Date
1	35.5	1963-05-31
2	35.4	2018-05-30
3	35.3	2018-05-29
4	35.2	1976-05-26
5	35.1	1963-05-30
5	35.1	2018-05-23

Top 5 daily maximum temperature at HKO for May (up to 2018-05-30)

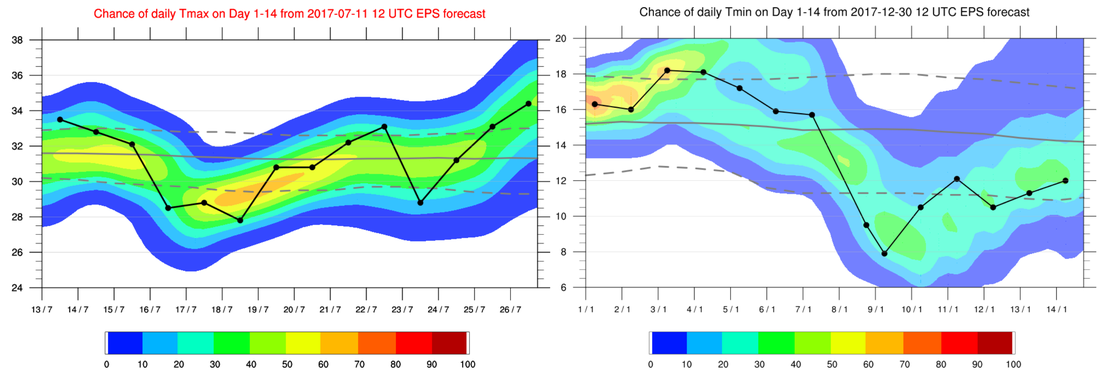


- A study of the extreme cold weather in southern China occurred in late Jan 2016 suggests that EFI and SOT can provide forecast signals on the extremity in short to medium term. Past cold surge cases are then investigated to develop a guidance of extreme cold weather in Hong Kong using EFI and SOT10 of daily minimum temperature.



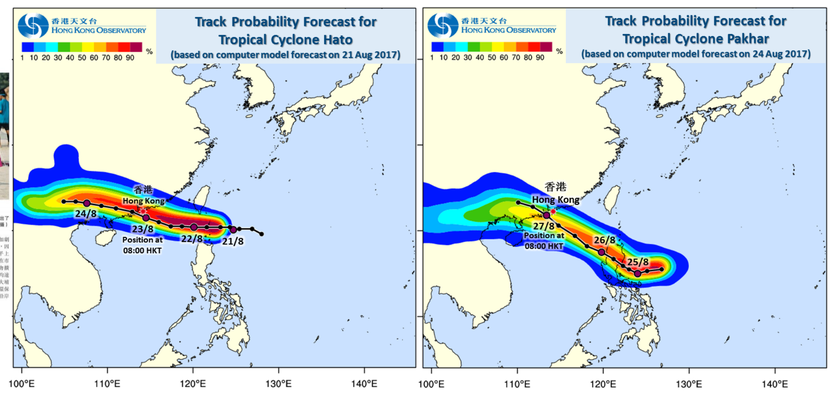
Probabilistic Forecast and Extended Outlook Forecast Service

- In 2017, HKO launched the Extended Outlook forecast service to provide probability forecasts of daily minimum and maximum temperatures for the next 2 weeks.
- The products are generated by using non-homogeneous Gaussian regression to adjust ECMWF EPS forecasts for HK grids.
- The new forecast service allows the public (e.g. elderly and vulnerable groups) or supports power companies to get prepared for the temperature changes.



- The Extended Outlook also features a new "Tropical Cyclone Track Probability Forecast" service to provide the probability of TC track in coming 9 days. This enables members of public to appraise the trend of TC movement and be better prepared as early as possible.
- The forecast strike probability map is based on TC tracks from all available EPS members of ECMWF, NCEP and UKMO.

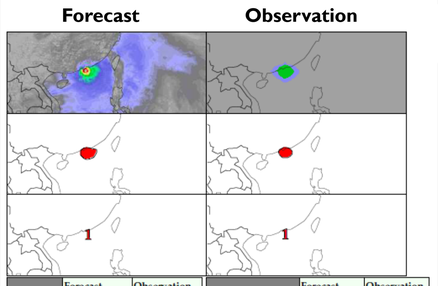
Local press on the chance of TC Hato hitting Hong Kong



Recent Developments

Object-based Verification of TC Wind Structure

- Study is underway on object-based verification methods to assess model forecast of TC wind structure.
- Using MODE (Method for Object-based Diagnostic Evaluation), the metric is shown to be able to identify relative performance of wind structure forecasts from different global NWP models in similar to forecasters' subjective assessments.

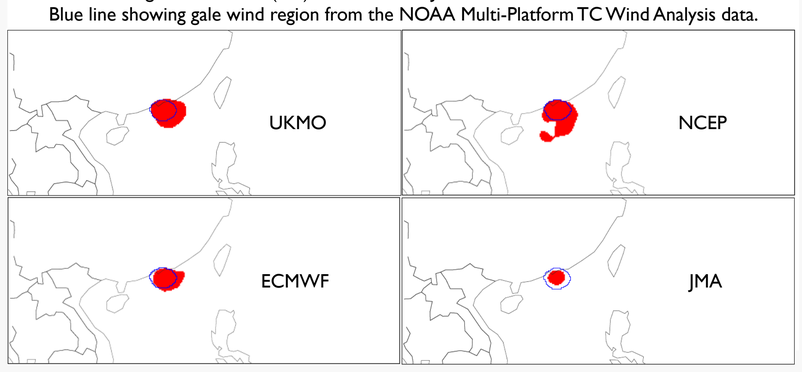


	Forecast	Observation
Model	TrialModel	
Field	wind_speed	wind_speed
Level	*.*	*.*
Units	m/s	m/s
Initial	1970 01 01 00:00:00	1970 01 01 00:00:00
Valid	1970 01 01 00:00:00	1970 01 01 00:00:00
Accum	00:00:00	00:00:00

Centroid/Boundary	2.00	4.00
Convex Hull/Angle	0.00	1.00
Area/Intersection Area	1.00	2.00
Complexity/Intensity	0.00	0.00
Total Interest Thresh	0.70	

	Forecast	Observation
Mask M/G/P	on/off/off	on/off/off
Raw Thresh	>=0.0	>=0.0
Conv Radius	5	5
Conv Thresh	>=17.5	>=17.5
Area Thresh	>=0.0	>=0.0
Inten Thresh	p100>=0.0	p100>=0.0
Merge Thresh	>=16.5	>=16.5
Merging	thresh	thresh
Matching	match/merge	
Simple/M/U	1/1/0	1/1/0
Area	389	293
Area M/U	389/0	293/0
Cluster	1	1
MMI	0.9564	0.9564
MMI (F+O)	0.9564	

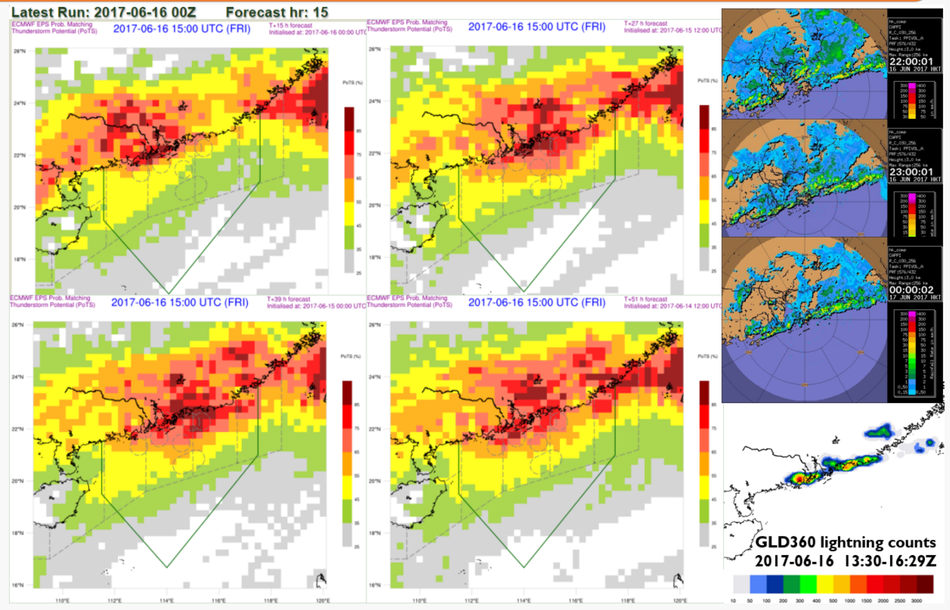
36-h forecast of gale wind areas (red) from ECMWF, JMA, NCEP and UKMO deterministic models. Blue line showing gale wind region from the NOAA Multi-Platform TC Wind Analysis data.



EPS for Significant Thunderstorm Forecast and Convective Weather Diagnostics

- New post-processing techniques are being developed for EPS data to generate thunderstorm potential (PoTS) and convective diagnostics using ingredient-based approach, which enable forecasters to better assess the possible scenarios and chance of severe convection in short range to medium range.

Factors of thunderstorm potential (PoTS)	
Stability	K-index CAPE
Dynamics	U,V (850 hPa) W (700 and 500 hPa) DIV (850 and 200 hPa) VOR (850, 700 and 500 hPa)
Moisture	Q (850 hPa)



- ECMWF EPS convective diagnostics for heavy rain occurred in HK and southern China on 24 May 2017