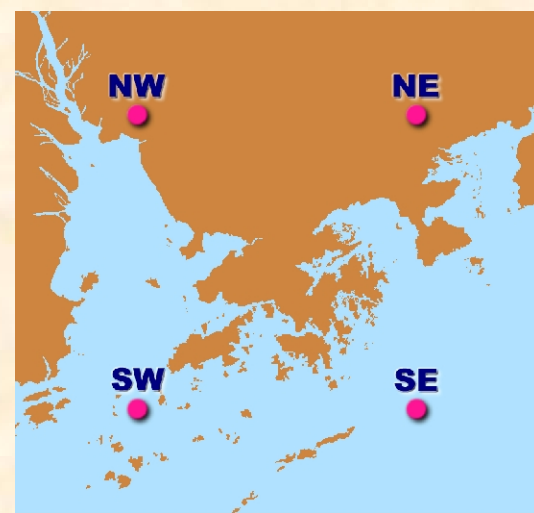


Performance and Application of Ensemble Prediction System (EPS) Forecasts in Hong Kong

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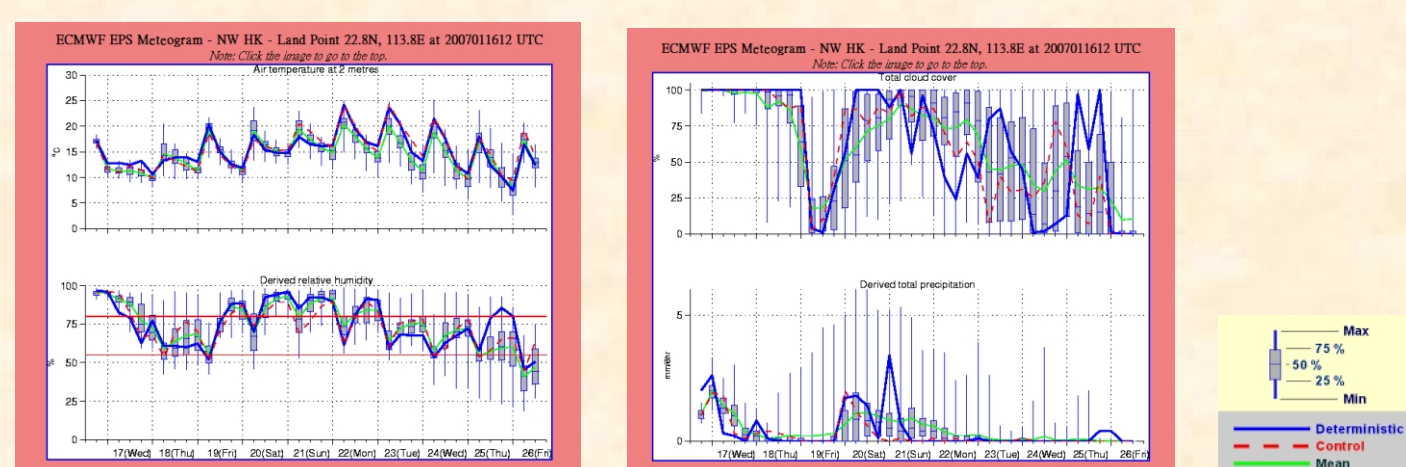
ECMWF EPS Forecasts for Hong Kong

- ECMWF EPS data for 4 grid points in the vicinity of Hong Kong (00 UTC & 12 UTC).
- 50 ensemble members + 1 control, forecasts at 6-hourly intervals, up to 240 hours ahead.
- Forecast elements: MSLP, 10m wind, 2m temperature, 2m dew point, accumulated precipitation & total cloud cover.



Applications of EPS Forecasts in Hong Kong

EPS Meteograms



Extreme Weather Forecast based on ECMWF EPS

Year	Day	Time	Observed	Model	Score	Rank
2004	1	00:00	0.0	0.0	1.0	1
	2	00:00	0.0	0.0	1.0	1
	3	00:00	0.0	0.0	1.0	1
	4	00:00	0.0	0.0	1.0	1
	5	00:00	0.0	0.0	1.0	1
	6	00:00	0.0	0.0	1.0	1
	7	00:00	0.0	0.0	1.0	1
	8	00:00	0.0	0.0	1.0	1
	9	00:00	0.0	0.0	1.0	1
	10	00:00	0.0	0.0	1.0	1
	11	00:00	0.0	0.0	1.0	1
	12	00:00	0.0	0.0	1.0	1
	13	00:00	0.0	0.0	1.0	1
	14	00:00	0.0	0.0	1.0	1
	15	00:00	0.0	0.0	1.0	1
	16	00:00	0.0	0.0	1.0	1
	17	00:00	0.0	0.0	1.0	1
	18	00:00	0.0	0.0	1.0	1
	19	00:00	0.0	0.0	1.0	1
	20	00:00	0.0	0.0	1.0	1

Performance Evaluation of EPS Forecasts

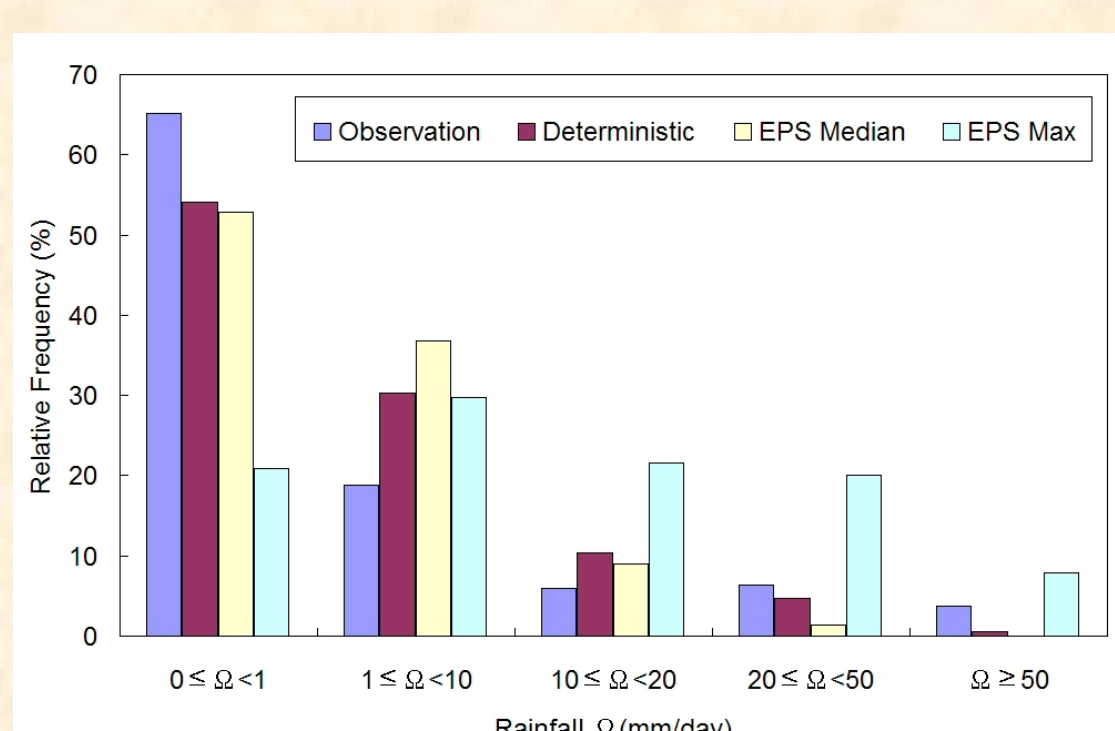
Objectives:

- To review the application of ECMWF EPS in the operational forecasting of rain, high winds and very hot/cold weather in the context of Hong Kong's experience.
- To better understand the usefulness of EPS forecasts in terms of accuracy, bias and relative value for a small region like Hong Kong.

Verification Dataset:

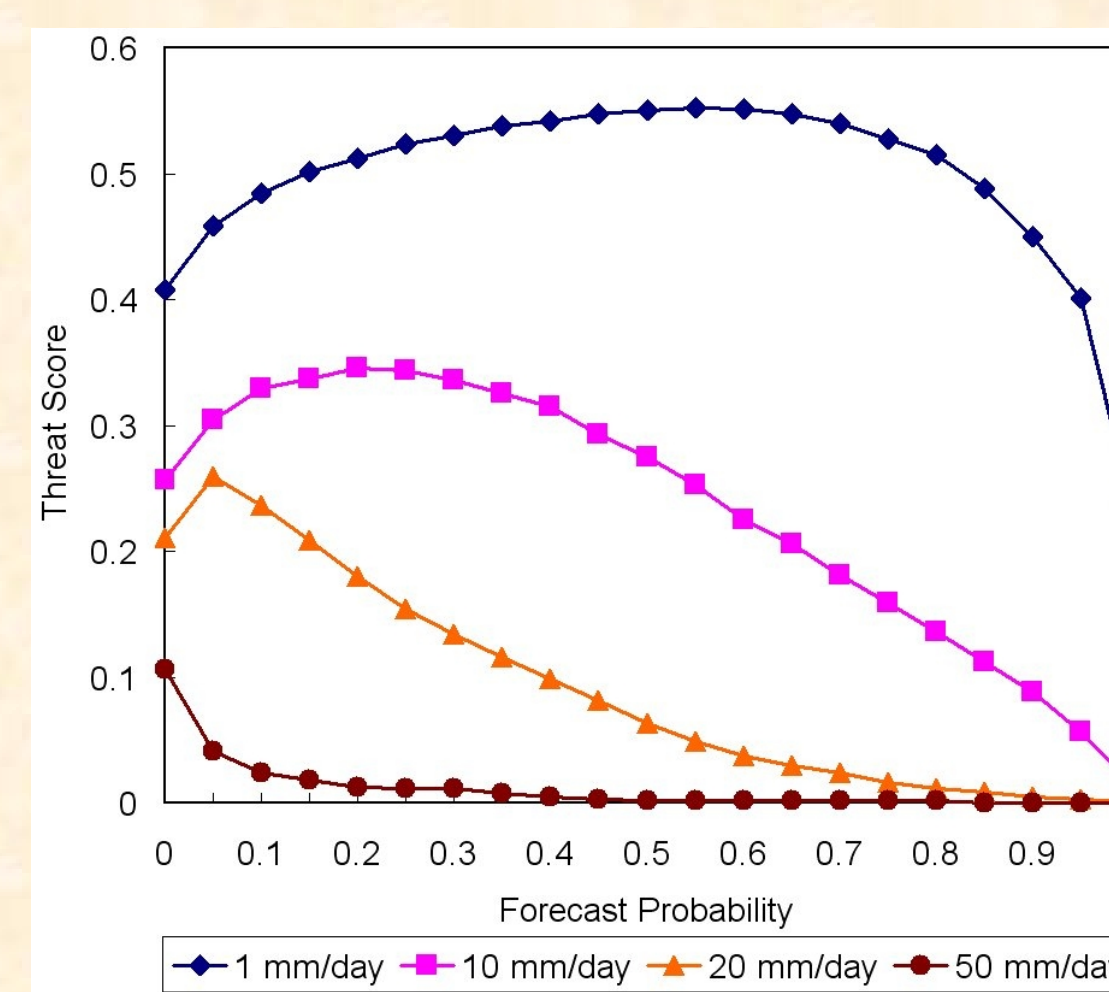
- ECMWF EPS data from June 2004 to November 2006.
- Observed daily rainfall, surface temperatures and wind speeds at selected stations in Hong Kong.

EPS Daily Accumulated Rainfall Forecasts

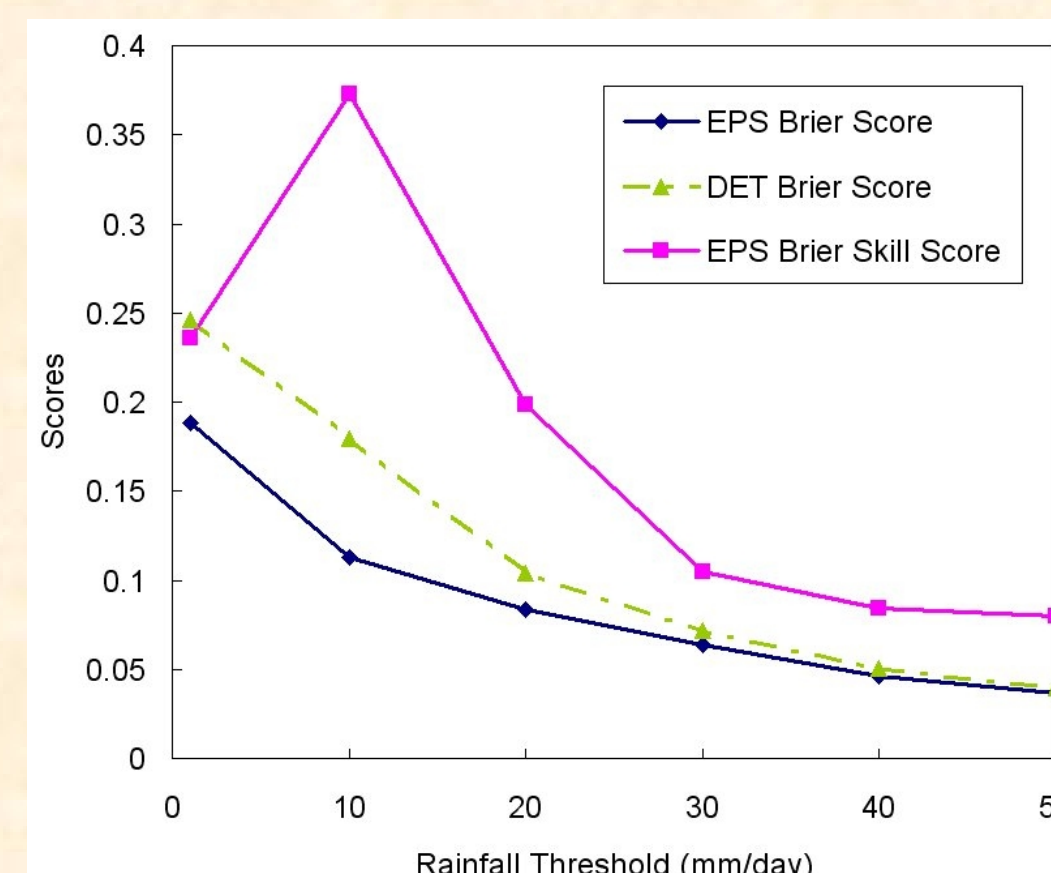


Frequency distribution of EPS median is reasonably close to observations of rainfall at 20 mm/day or below, but dies out quickly in higher rainfall regimes. Frequency for EPS maxima is too high for intense rainfall.

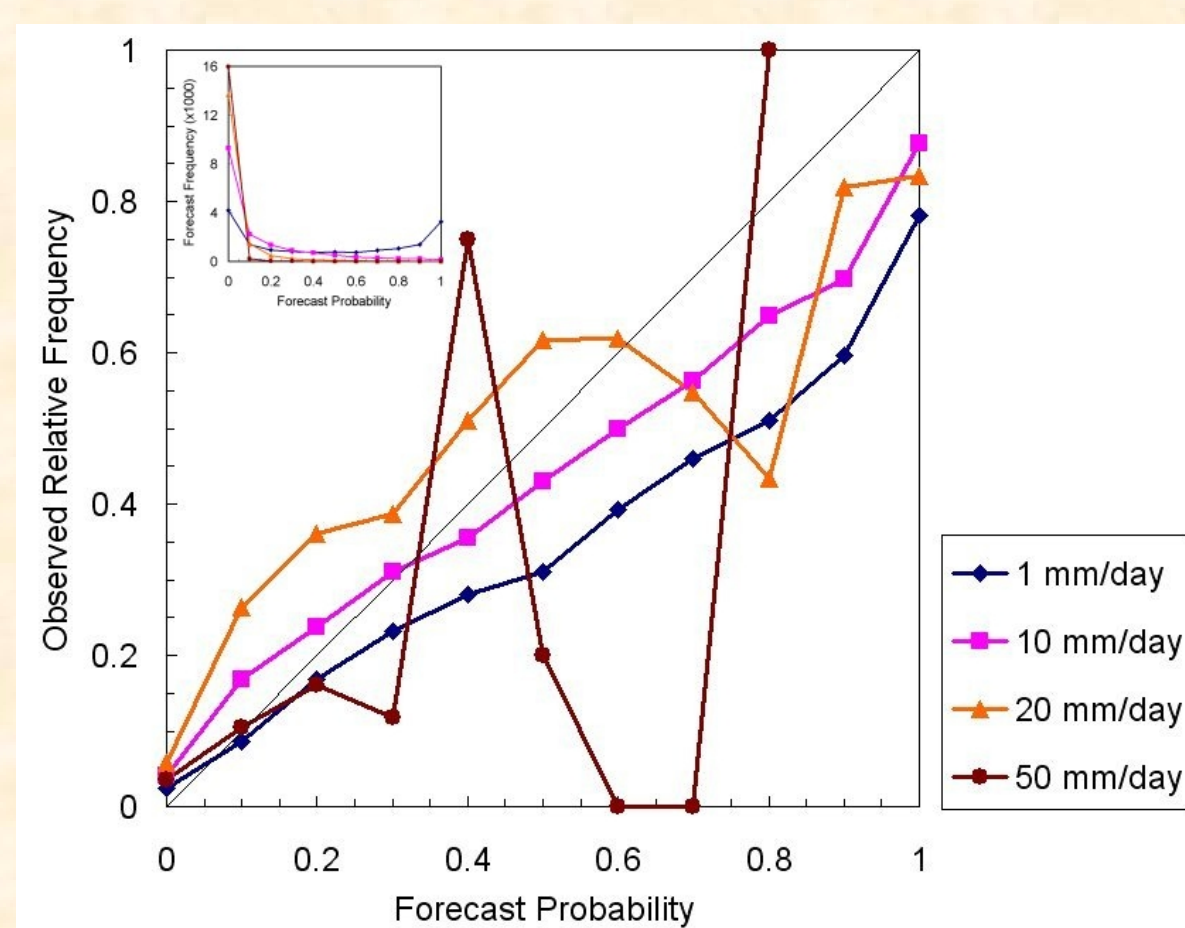
Verification of EPS Rainfall Forecasts



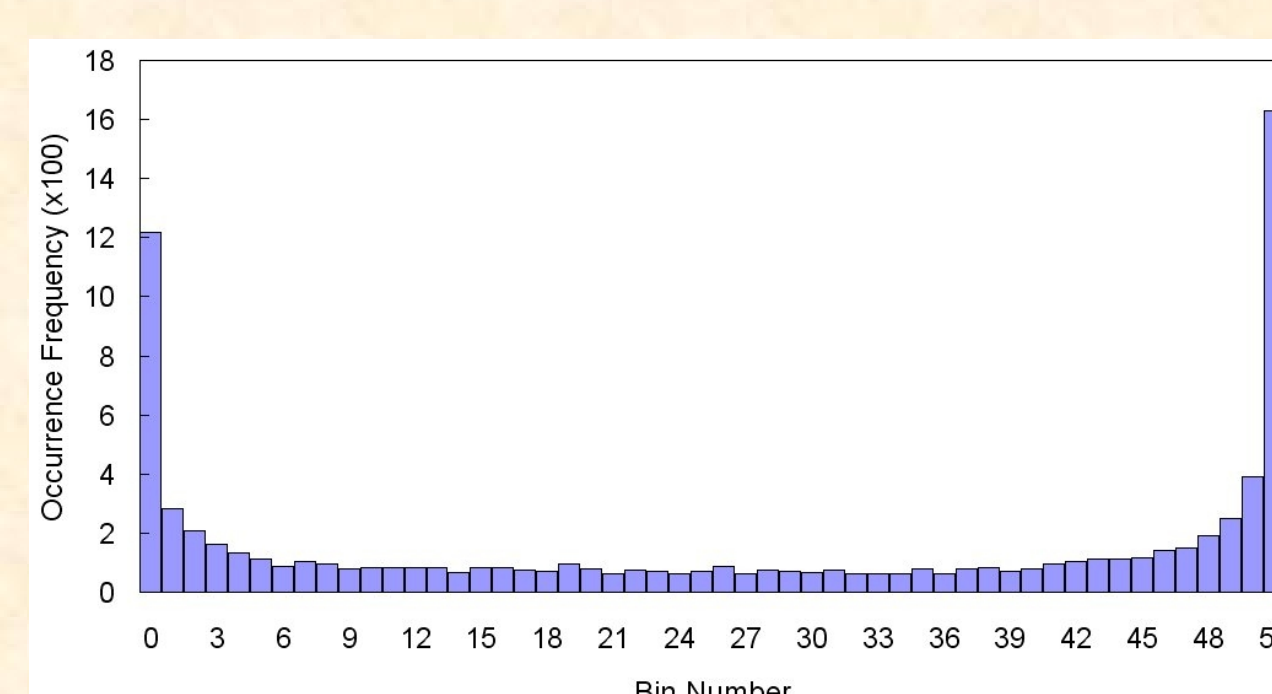
Under all rainfall thresholds, the useful decision probability range is skewed towards the lower end. For intense rainfall, the EPS Max offers the most valuable information.



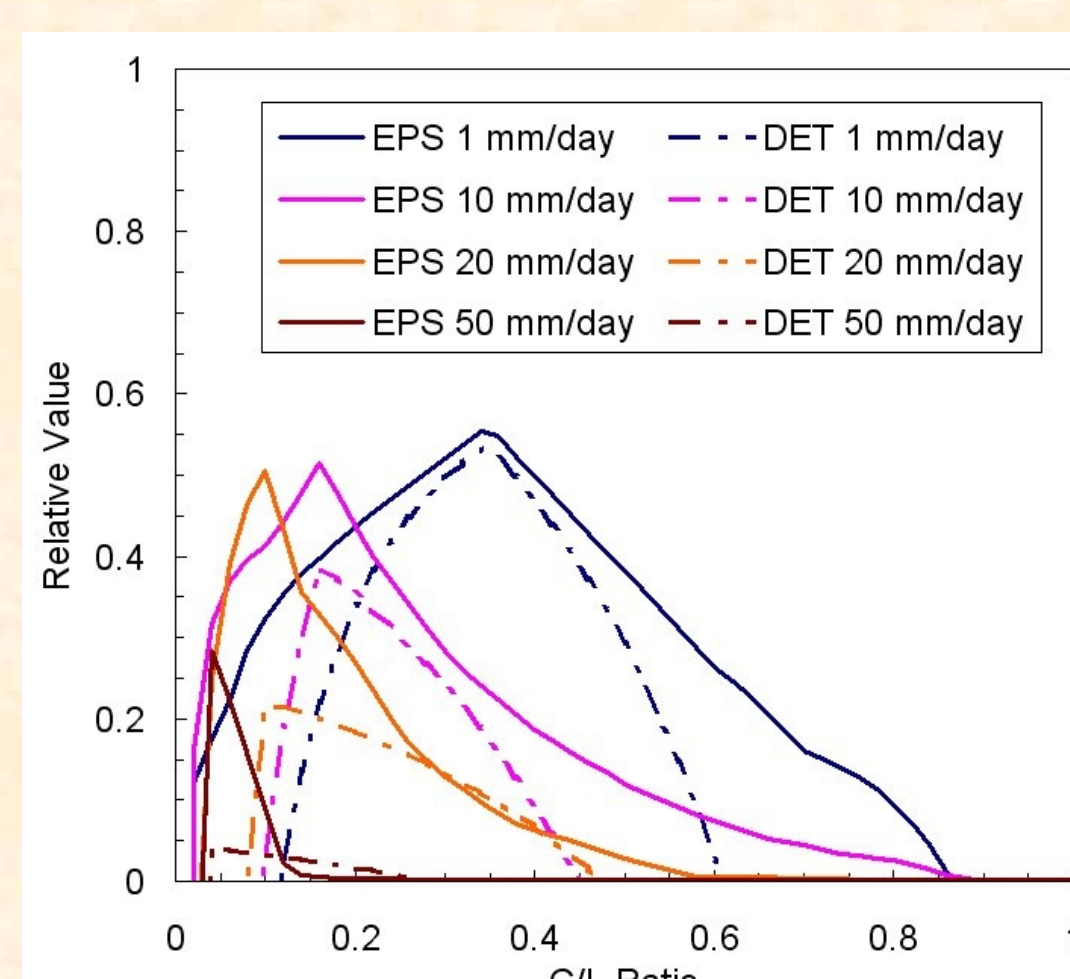
EPS rainfall forecasts are in general more skilful than the deterministic (DET) counterparts for small amount of precipitation up to the 30 mm/day threshold.



Reliability diagram shows that EPS systematically over-predicts the probability of occurrence for rainfall threshold of 1 mm/day.

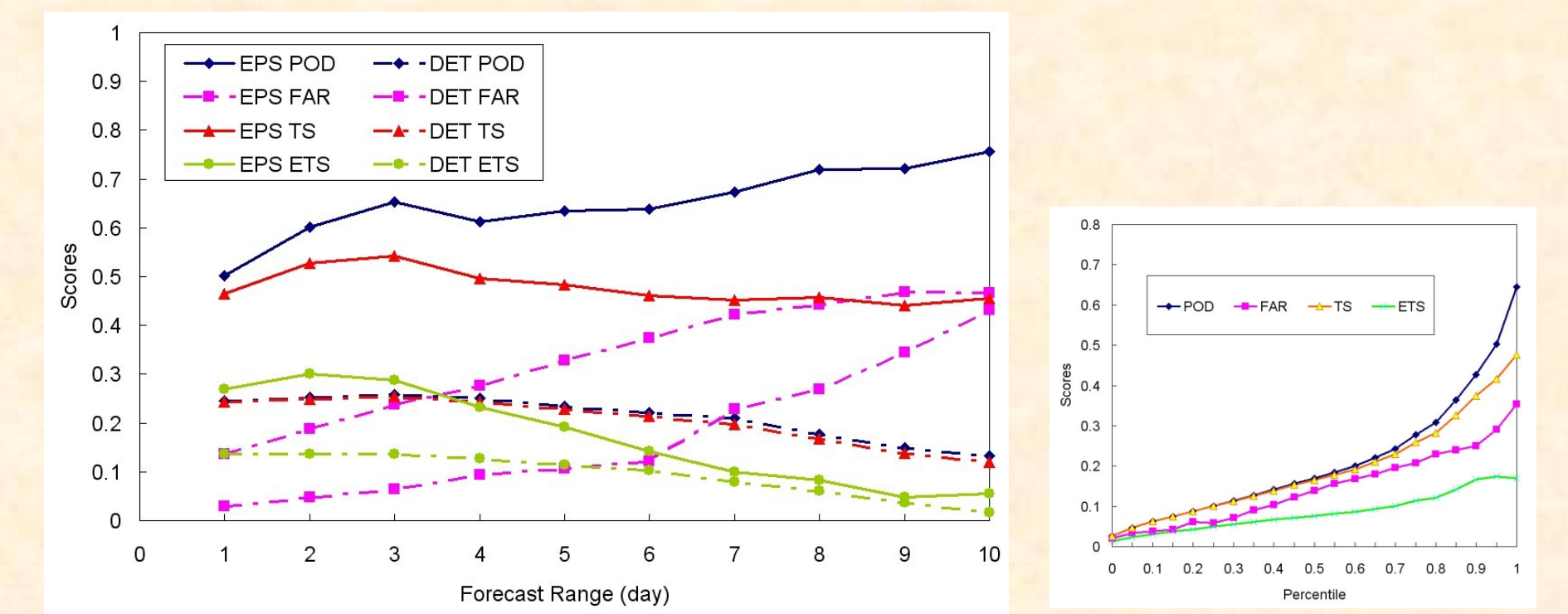


There is a substantial number of cases falling into the last bin of the Talagrand diagram, indicating that the EPS under-estimates rainfall amount in extreme events.



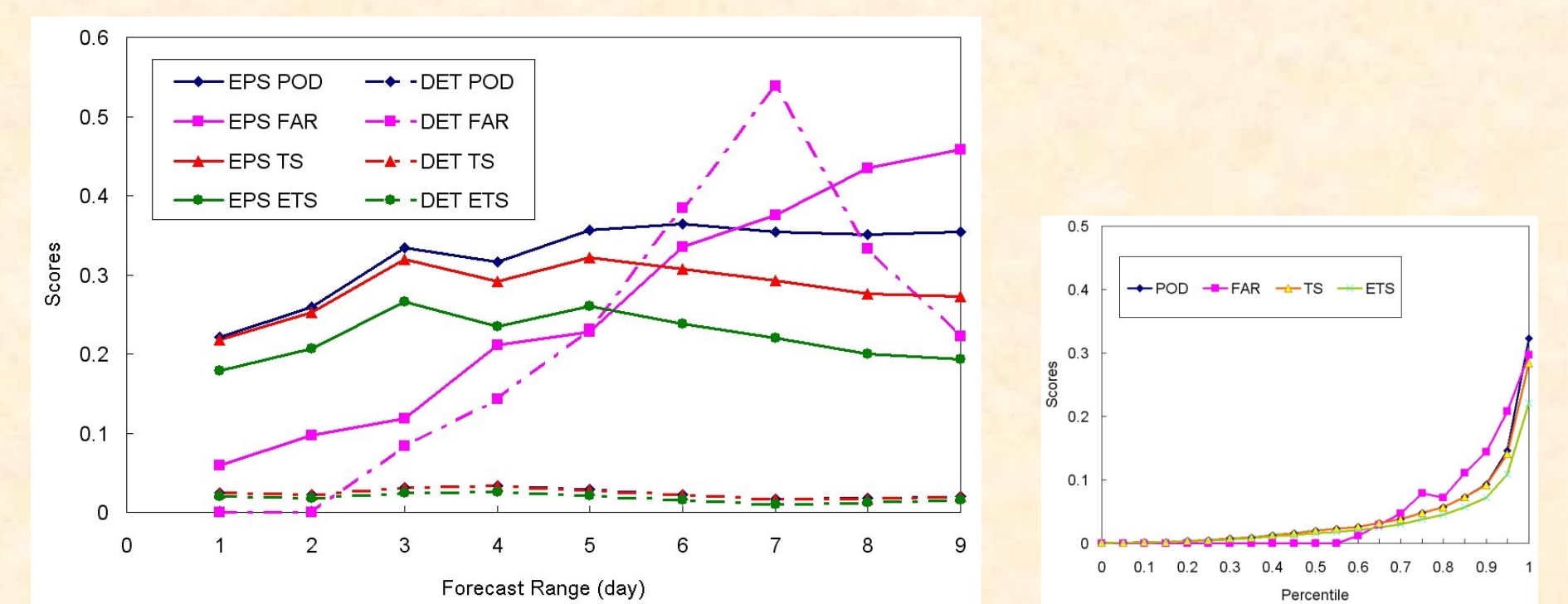
In general, the optimal relative values of EPS rainfall forecasts are higher than those of deterministic (DET) forecasts in all C/L regimes.

High-wind Forecasts in Winter Monsoon



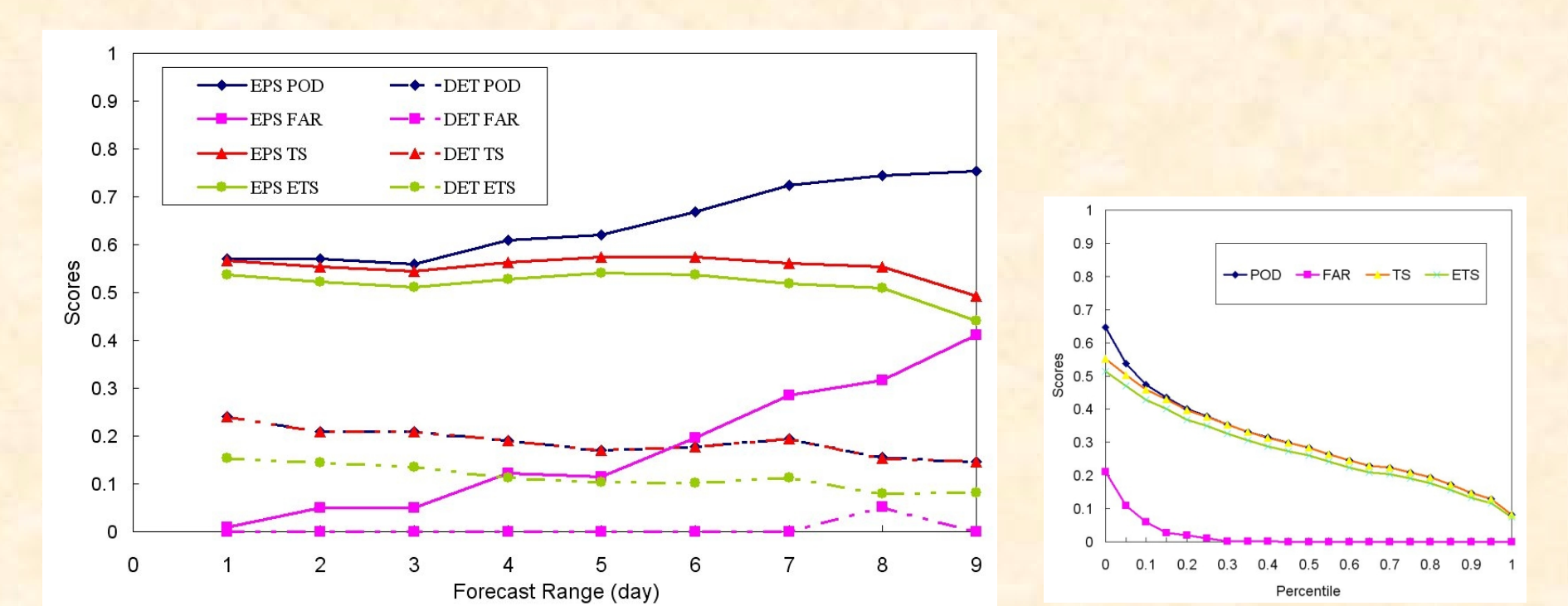
- EPS wind speed forecasts are verified against the strong winds recorded at any one of the reference stations in winter monsoon situation.
- EPS high-wind forecasts are more skilful than the deterministic (DET) counterparts.
- For high-wind forecasts, EPS Max offers the most valuable information.

Very Hot Weather Forecasts



- In this study, very hot weather is defined as the daily max temperature $\geq 33^{\circ}\text{C}$ at any one of the reference stations.
- For very hot weather forecasts, EPS Max offers the most valuable information and is more skilful than the deterministic (DET) counterparts

Very Cold Weather Forecasts



- In this study, very cold weather is defined as the daily min temperature $\leq 12^{\circ}\text{C}$ at any one of the reference stations.
- For very cold weather forecasts, EPS Min offers the most valuable information and is more skilful than the deterministic (DET) counterparts

Conclusions

- The EPS daily rainfall forecasts are in general more skilful and useful than the high-resolution deterministic forecasts.
- EPS forecasts tend to over-forecast the occurrence of rainy days and under-estimate rainfall amount in extreme events.
- The extreme members of the EPS offer the most valuable information for forecasting of extreme rainfall, high-wind and very hot/cold weathers in Hong Kong.
- Development of post-processing techniques (such as ensemble MOS, probability calibration, etc) for EPS forecasts is underway.