

# PWS Requirements and Opportunities for Probabilistic Products and Services

- *Requirements Analysis*
- *Application Experiences*
- *Comments*

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# 1. Requirements Analysis

- ❑ Weather forecasting has **uncertainties**, not only in large scale system such as typhoon tracking and its intensity, but also in rare events such as tornadoes.
- ❑ Probability is a more direct **expression** of the forecast uncertainty, which can directly express a certain level of confidence that an event will or won't occur. However, people intent to get **information** from the probabilistic forecast through some kinds of application products derived from probabilistic product of forecasting. Then, what's the information?
- ❑ **Communication** of information from forecast uncertainty is a key to assist people to make more effective decisions.
- ❑ **Application process** of probabilistic products is very important for users to decide when, what and how certain actions should be taken.

## 2. Application Experiences of Probabilistic Forecast and Services in PWS

### 2.1 Probabilistic Forecast in the Multi-Hazards Early Warning in Shanghai

#### 2.2 Case Study

##### 2.2.1 Case I

##### 2.2.2 Case II

##### 2.2.3 Case III



## 2.1 Probabilistic Forecast in Multi-Hazards Early Warning

- The mechanism of multi-hazards early warning is one of effective approaches to express, communicate and apply the **uncertainty** of forecasts between NMHSs and other agencies including NGOs related to DPM in the process of probabilistic products application for early warning from meteorological hazards to weather related disasters such as flooding etc. So, the interaction is important, not only between agency and agency, but also between discipline and discipline such as weather and water.

## 2.1 Probabilistic Forecast in Multi-Hazards Early Warning

- The application of probabilistic forecasts products in multi-hazards early warning can identify and link the occurrence possibility of hazards and potential risk to assist **multi-agency preparedness** and **multi-phase response** in DPM, e.g., the emergency management official is one of the most important users of probabilistic products in the multi-hazards early warning and mitigation.
- Probabilistic products are also necessary for **loss and risk pre-assessment** which is one of important elements in multi-hazards early warning.



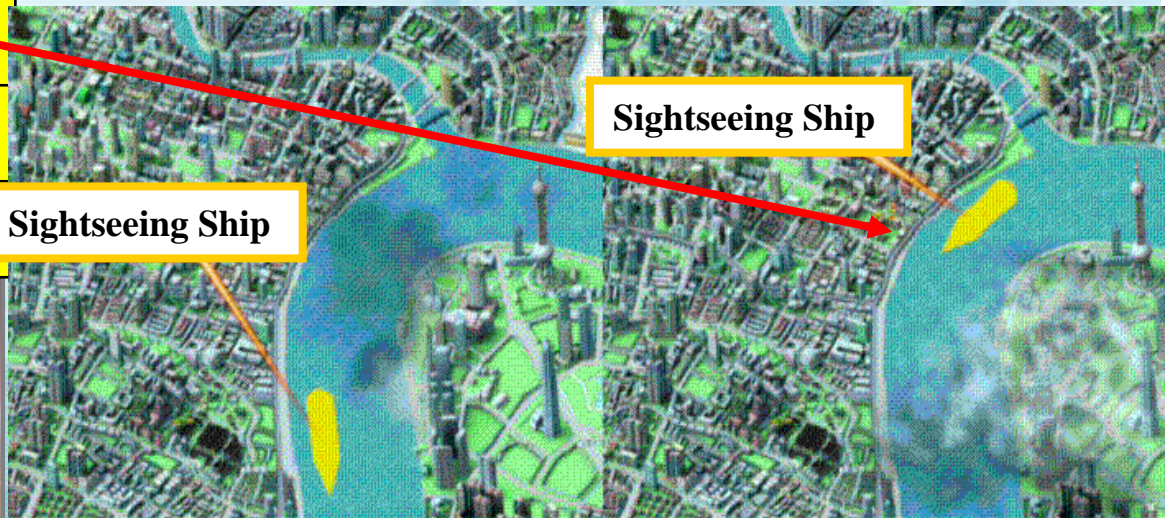
# Case I: Weather Service for Fireworks Display in May 15,2006 Shanghai Cooperation Organization (SCO) Summit

TIME	Probabilities of Wind Direction			
HOURS	North	South	East	West
120	>30%	>30%	<20%	< 20%
72	>40%	>40%	<10%	<10%
48	>70%	<30%	<2%	<2%
24	>80%	<20%	<2%	<2%
12	>90%	<10%	<2%	<2%
6	>98%	<2%	<2%	<2%
2	>98%	<2%	<2%	<2%

Initially **four** different routes of sightseeing ship were prepared based on probabilistic products of wind direction.

The south, east and west wind were excluded successively, and the **north** route was selected for the optimal sightseeing ship.

Probabilistic products longer than 12 hour were provided by EPS (T63 model), others obtained from radar data.



## Case I: Weather Service for Fireworks Display in May 15,2006 Shanghai Cooperation Organization (SCO) Summit

The case shows:

- Based on climatic probability of the wind direction in the day, **multi-action plans** should be prepared;
- The different outcomes of probabilistic forecasts with different time scales are essential for the decision procedure to select the optimal plan from different initial plans;
- Therefore, the application of variation of probability with different lead time is very important.

## Case II: Weather Service of the Typhoon “Ewiniar” (0603) for Evacuation of workers in the Offshore Oil Platform “Pinghu”

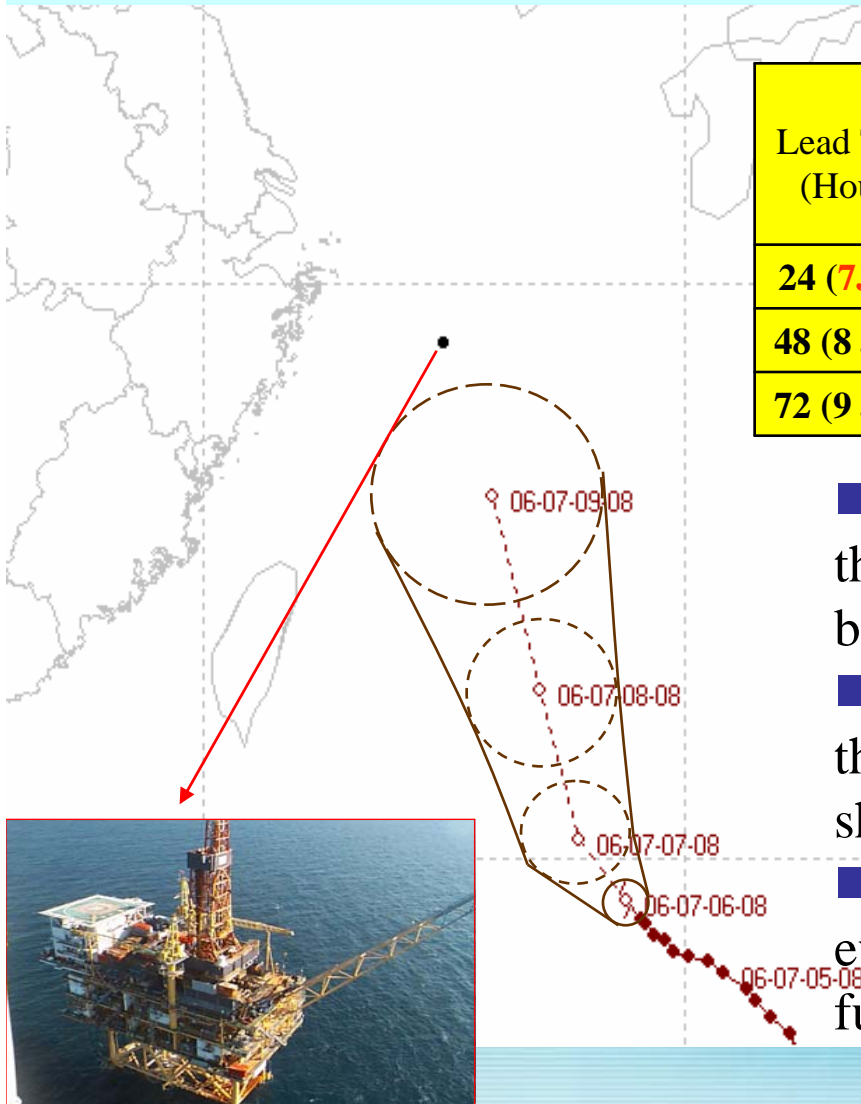
This case shows that application of probabilistic forecast and the variation of the probability with different lead time is also important to start the **multi-phase** response and decide priorities.

Lead Time (Hours)	Probabilities (%) of Wind Gusts Prediction for the Offshore Oil Platform				
	<20.7m/s	20.7~24.4m/s	24.5~28.4m/s	28.5~32.6m/s	≥ 32.7m/s
24 (7 July)	>98%	<2%	<2%	<2%	<2%
48 (8 July)	<10%	60%	<10%	<2%	<2%
72 (9 July)	<2%	<10%	30%	60%	<10%

■ Probabilistic products show that the workers in the oil platform should evacuate **completely** before 9 July, 2006.

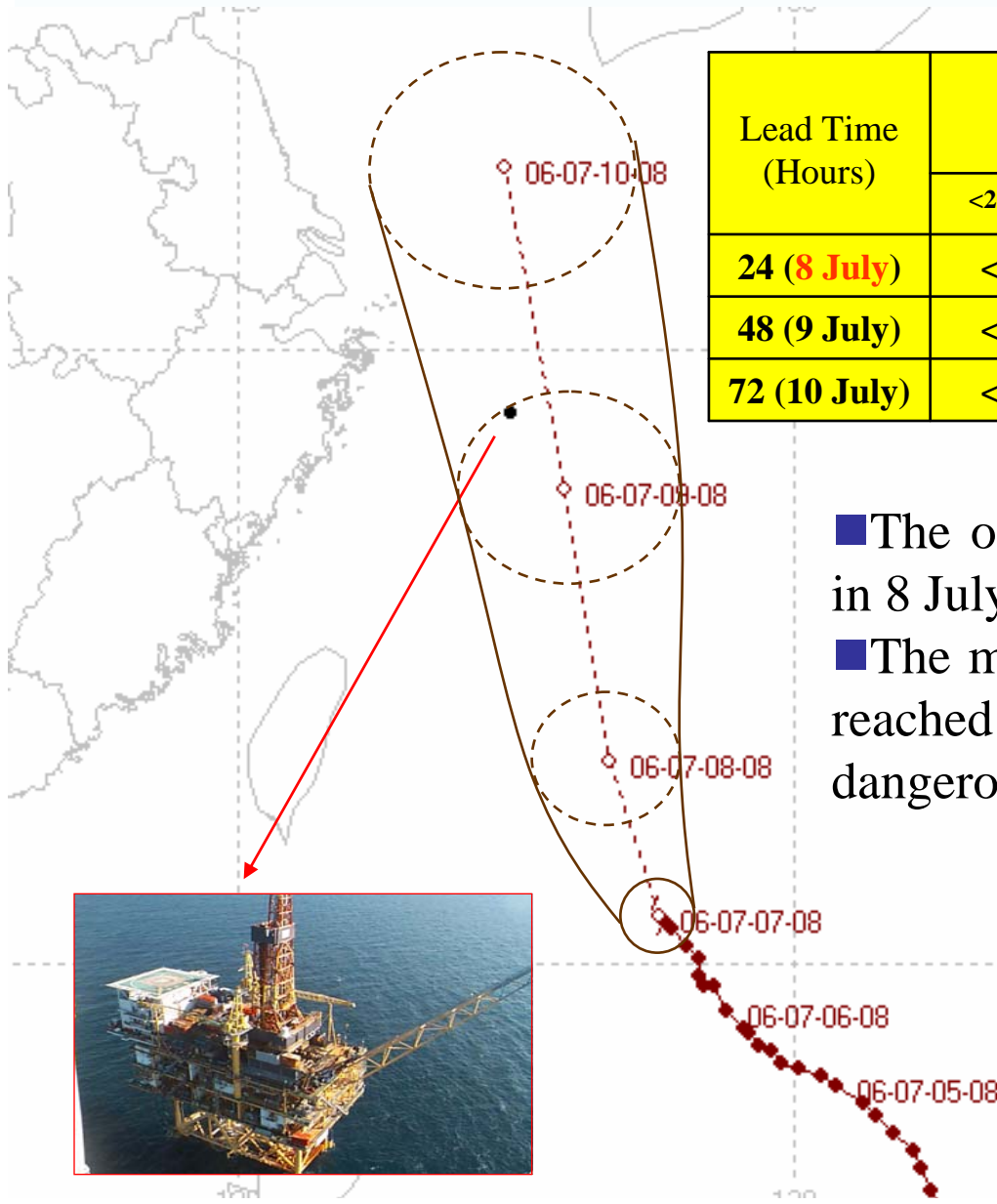
■ In order to maintain operation, the workers in the oil platform began to evacuate **partially** by ship in 7 July.

■ It was planned that the other workers would evacuate by helicopters in 8 July according to further prediction.



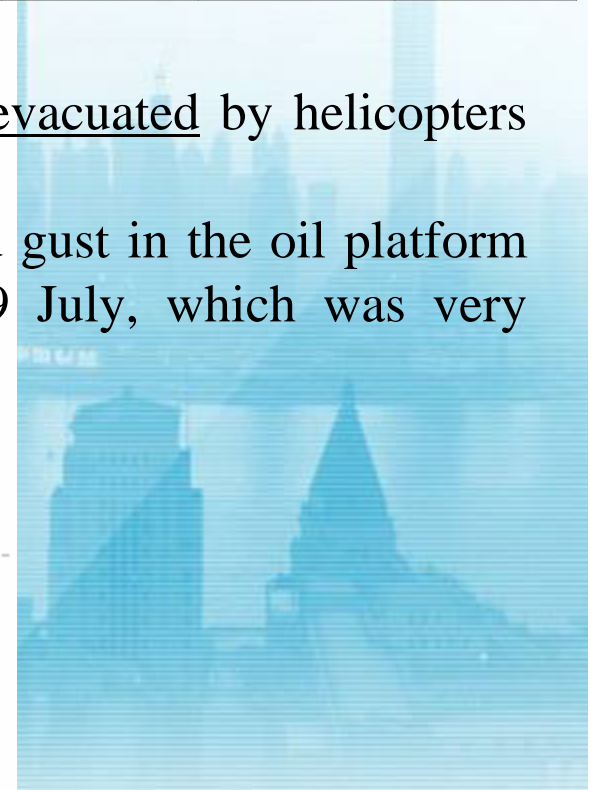


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- The other workers evacuated by helicopters in 8 July, 2006.
- The maximum wind gust in the oil platform reached **32.7m/s** in 9 July, which was very dangerous to workers.

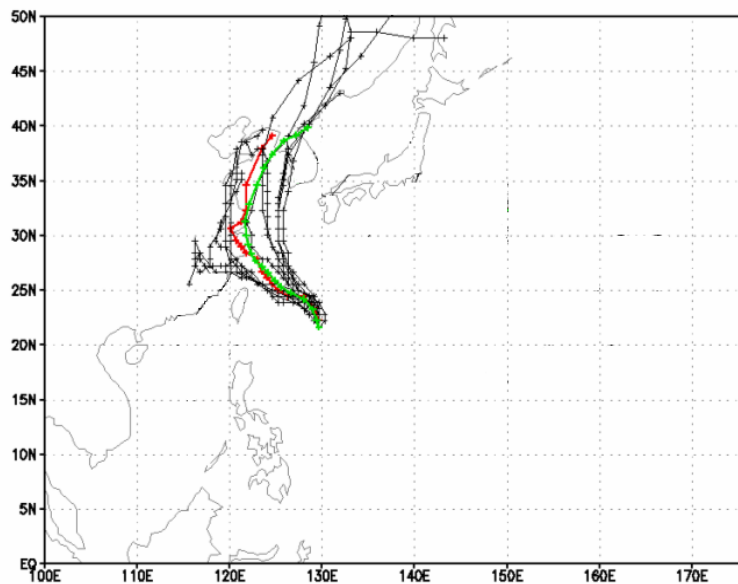


## Case III: Prediction of the Typhoon “Weipha” (0713)

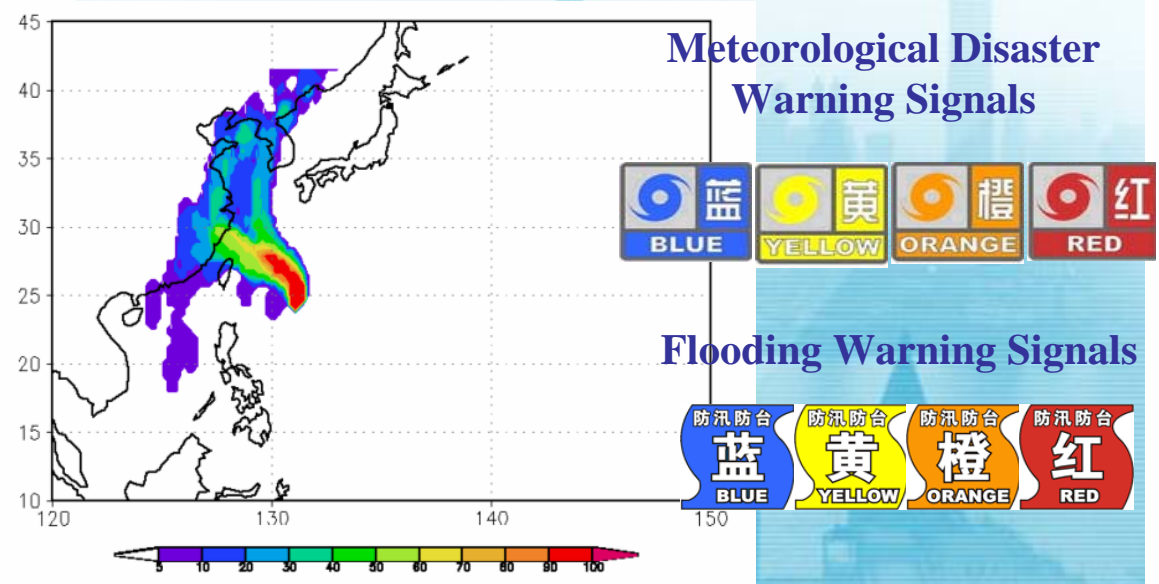
This case shows that application of probabilistic forecast and the variation of the probability with different lead time is effective to start multi-area, multi-agency and multi-level responses.

■ Based on probabilistic forecast of TC track, **Shanghai Meteorology Center** issued the yellow signal of TC warning in the morning of 18 Sep. **Shanghai Water Affairs Authority** issued the yellow signal of flooding warning simultaneously. Later on, Shanghai Meteorology Center and Water Affairs Authority **upgraded** the yellow signal to orange signal in the afternoon of 18 Sep. when the intensity of WEIPHA increased to a super typhoon before its landfall.

■ According to the probability prediction of WEIPHA’s track within 120km radius, different areas adopted different level of response action. For example: **300,000** people in dangerous area were evacuated in Shanghai (1,790,000 people in Zhejiang province), this TC causes no death in Shanghai (5 death in Zhejiang province).



TC tracks of 120h prediction from EPS initiated from 2007091612 UTC (Black-EPS members, **Red**-Control, **Green**-Mean)



Probability that TC would pass within 120km radius during 120h prediction from EPS initiated from 2007091612 UTC

# Comments

- **Application** of probabilistic forecast and deterministic forecast are equally important in PWS. However, what people concerned is not probabilistic product itself, but information from the product.
- The probabilistic products and services should meet **user-oriented** requirements. Additional products based on probabilistic forecast should be developed, i.e. **UV index, cloth dressing index and fire risk index**. However, the application of the variation of probabilistic products with different time is important for making choice by decision-makers

# Comments

- Partnership mechanism should be developed to form application thresholds of probabilistic products for different users. **END-to-END** mechanism (provider-user) should be emphasized in the application of probabilistic forecasts.
- **Evaluation measurements**, including objective evaluation from forecasters and users, should be established for probabilistic products.
- To exploit the advance in NWP and EPS.



A nighttime photograph of the Shanghai skyline, featuring the Oriental Pearl Tower and other illuminated skyscrapers. The lights are reflected in the water in the foreground. The text "Thanks for your attention !" is overlaid in red.

**Thanks for your attention !**

**Welcome to Shanghai !**