LCQ2: Improving weather forecast operation

Following is a question by the Hon Chan Chun-ying and a reply by the Secretary for Environment and Ecology, Mr Tse Chin-wan, in the Legislative Council today (November 8):

Question:

It has been reported that the Hong Kong Observatory (HKO) plans to introduce new measures to enhance the accuracy of weather forecasts, including the development of new weather radars and the introduction of artificial intelligence (AI) in weather forecasting. In this connection, will the Government inform this Council:

(1) as the HKO has pointed out that it attained a weather forecast accuracy of 92 per cent last year, but a public opinion survey conducted last year indicated that the percentage of the HKO's weather forecasts considered accurate by the public was 77 per cent, whether the HKO has examined the reasons for the discrepancy between these two figures; if so, of the details; if not, the reasons for that;

(2) of the progress of introducing AI in weather forecasting, and whether it has studied how AI enhances the accuracy of weather forecasts; if so, of the details; if not, the reasons for that; and

(3) as some members of the public are of the view that, in respect of the issuance of weather warnings linked to the arrangements for the suspension of work and classes (e.g. Black Rainstorm Warning Signal and Tropical Cyclone Warning Signal No. 8 or higher), the advance notice given by the HKO is too short, and they are dissatisfied with the timing of issuing such signals, whether the HKO has studied the room for using technology for further improving the issuance of weather warnings; if so, of the details; if not, the reasons for that?

Reply:

President,

(1) As a scientific department dedicated to serving the public, the Hong Kong Observatory (HKO) has always adhered to rigorous and objective scientific methods in developing weather forecast products and regularly evaluates its service quality.

To assess the accuracy of weather forecasts, the HKO calculates the "percentage of accurate weather forecasts" using an objective verification method. This objective method takes into account the differences between the Local Weather Forecast and actual observations for each day of the year,

including weather elements such as temperature, wind speed, cloud cover, visibility and rainfall, etc, to objectively calculate the accuracy of weather forecasts. In 2022, the "percentage of accurate weather forecasts" was 92 per cent, with the average percentage for the past 10 years (2013 to 2022) exceeding 90 per cent.

To collect feedback from users and to understand their needs regarding weather services, the HKO has been commissioning independent survey companies to conduct annual opinion surveys. Survey results show that, over the past five years (2018 to 2022), the average percentage of forecasts perceived as accurate by the public was 78 per cent, which is a slight increase compared to the average of 76 per cent in the previous five-year period (2013 to 2017). In addition, the HKO also conducts opinion surveys among frequent users of its forecast services, such as airlines and ship captains. The results show that the accuracy of weather forecasts as perceived by these users was over 95 per cent, which is even higher than the "percentage of accurate weather forecasts" calculated from the HKO's objective verification method.

We note that the accuracy of the HKO's forecast services as perceived by frequent users was over 95 per cent. On the other hand, the results of public opinion surveys also reflect to a certain extent public concern about changes in weather conditions. Furthermore, as weather information becomes more widely available, the expectations of the public about weather forecast services continue to rise. The HKO will strive to enhance service levels and develop new services with reference to public opinion. Such efforts include the continuous introduction of new instruments and technologies, such as the deployment of a new and more advanced radar system at Tai Mo Shan next year, and active participation in the World Meteorological Organization (WMO) of the United Nations to enhance knowledge exchange with members with advanced forecasting technology to keep the overall service quality up to date.

(2) As regards the provision of rainfall nowcast, the HKO has started to apply artificial intelligence in recent years to optimise its rainfall nowcasting system. This system can generally provide alerts at ten to several tens of minutes before the rainfall amount reaches the rainstorm warning criteria. However, the development of rainstorms is highly random and can change drastically within a short period of time, making the prediction of rainstorms a major challenge for the global scientific community. The HKO, with its internationally recognised technical capabilities, has been designated by the WMO as one of the three Regional Specialised Meteorological Centres for nowcasting. Nevertheless, we will continue to strive to identify ways to improve the effectiveness of rainfall nowcasting.

As for tropical cyclone warnings, global numerical weather prediction models are important forecasting tools. As regards the application of artificial intelligence, the HKO has been conducting trials of an artificial intelligence weather prediction model since the middle of this year to provide forecasts for wind direction, wind speed, temperature and sea-level pressure to provide references for compiling the 9-Day Weather Forecast and

the forecast track of tropical cyclones. In October this year, the HKO also launched the weather forecast charts of the "Pangu Computer Model" on its website to provide users with more information about future weather changes. However, the application of artificial intelligence in this area is still in the preliminary stage, and further accumulation of data is necessary before we can ascertain its effectiveness in improving forecast accuracy.

(3) Tropical cyclones and rainstorms are two different weather systems. Tropical cyclones generally have a larger geographical coverage compared to that of rainstorms. The HKO closely monitors each tropical cyclone when it is relatively far away from Hong Kong and issues the Tropical Cyclone Warning Signals No.1, No.3, and No.8, etc, as appropriate. The HKO typically issues an advance notice two hours before the issuance of the Tropical Cyclone Warning Signal No.8 to allow the public to make preparations.

However, it is important for the public to understand that, when a tropical cyclone edges closer to Hong Kong, even slight changes in its position and intensity can result in different wind conditions from the previous forecast. If these changes lead to a rapid increase in local wind strength, it may be necessary to upgrade the warning signal from No.8 to No.9 or higher within a short period of time. The HKO will make every effort to provide advance notices to the public whenever feasible.

In recent years, the HKO has actively employed more reliable computer forecast models to predict tropical cyclones. However, there are still limitations in the world-leading computer forecast models in predicting the subtle changes of tropical cyclones as they approach Hong Kong, including insufficient spatial resolution, etc. When a tropical cyclone gets close to the territory, it is often necessary to continuously assess the latest storm situation based on actual observations and the latest forecasts to issue warnings.

Compared to tropical cyclones, the geographical coverage of rainstorms is usually smaller. The average lead time for issuing rainstorm warnings has increased in the past few years. However, the development of rainstorms is highly random, and significant changes can occur within a short period of time. There are still technological limitations that prevent further extension of the lead time for issuing rainstorm warnings. The HKO will continue to utilise the latest technologies and actively collaborate with meteorological agencies, including those within the Greater Bay Area, to enhance forecasting capacities. In addition, the HKO will actively follow up the measures proposed in this year's Policy Address to develop a risk-based decision support system. By utilising artificial intelligence and big data technology to analyse historical and real-time rainfall and flooding data, a flood risk alert system will be established to assist relevant departments in taking prompt response actions.

Thank you, President.