Joint Research to Establish High-Precision Weather Forecasting Technology in the Osaka Bay Area

– Aiming to Contribute to Disaster Prevention and Environmental Issues in Coastal and Urban Areas –

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Kyoto University
Osaka Gas Co., Ltd.

The Kyoto University Disaster Prevention Research Institute (Director: Eiichi Nakakita, hereinafter "DPRI") and Osaka Gas Co., Ltd. (President: Masataka Fujiwara, hereinafter "Osaka Gas") have recently started a joint research project (hereinafter the "Joint Research") to establish a highly accurate weather forecasting technology (hereinafter the "Technology") in the Osaka Bay area.

Generally, localized winds called land-sea breezes[*1] occur in coastal areas. In addition, at the boundary between the sea and the land, temperature and wind behave in unique ways, resulting in complex phenomena. According to Osaka Gas meteorological observation system installed in the Osaka Bay area, temperatures tend to be lower and winds are stronger compared to inland areas, suggesting that characteristic meteorological phenomena may be developing in the bay area.

Tetsuya Takemi, a professor of the Research Section of Severe Storm and Atmospheric Environment at the DPRI, and his colleagues have made research achievements in the field of mesoscale meteorology (small and medium-sized atmospheric phenomena ranging from a few kilometers to several hundreds kilometers), including understanding and predictability for development and organization process of cumulonimbus clouds that cause local heavy rainfall and their occurrence conditions, the elucidation of the physical mechanisms of heavy rainfall and typhoons, and problems of local air flow and atmospheric diffusion in urban area.

Osaka Gas began weather forecasting using its proprietary method[*2] in 2008 and has been utilizing the forecast results in its own practical operations since 2013. In 2018, we obtained a weather forecasting business license and prepared to provide weather forecast services outside the company.

In this Joint Research, we will observe and analyze local meteorological phenomena in the Osaka Bay area by combining Professor Takemi's knowledge of mesoscale meteorological phenomena with Osaka Gas's own knowledge of weather forecasts and meteorological data in the Osaka Bay area. We will also evaluate the accuracy of Osaka Gas's current weather forecasts, increase the resolution of the simulations[*3], and improve the physical models (simplified mathematical expressions of phenomena in the atmosphere, such as the process of cloud formation) to establish highly accurate weather forecasting technology in the area.

We would like to use the results obtained this time to clarify the relationship between meteorological phenomena in coastal areas and weather and climate in urban areas and to contribute to disaster prevention and solving environmental problems in coastal and urban areas. We also envision its use in smart cities, where various data services are linked. As an example, we will develop "AI Weather Forecasting," which combines this achievement with higher accuracy and automation through AI, and deploy it in the Yumeshima district of Osaka City, which has been selected as a super city[*4]. In addition, we plan to utilize it within the Daigas Group, such as forecasting the area where their facilities are located on the coast of Osaka Bay.

Since December 2021, the DPRI and Osaka Gas have also been conducting joint research[*5] to forecast phenomena such as extreme cold and heat waves over the medium to long term.

*1: Local wind circulation in coastal areas caused by the difference in temperature between land and sea. The direction of the wind changes from sea to land during the day and from land to sea at night.

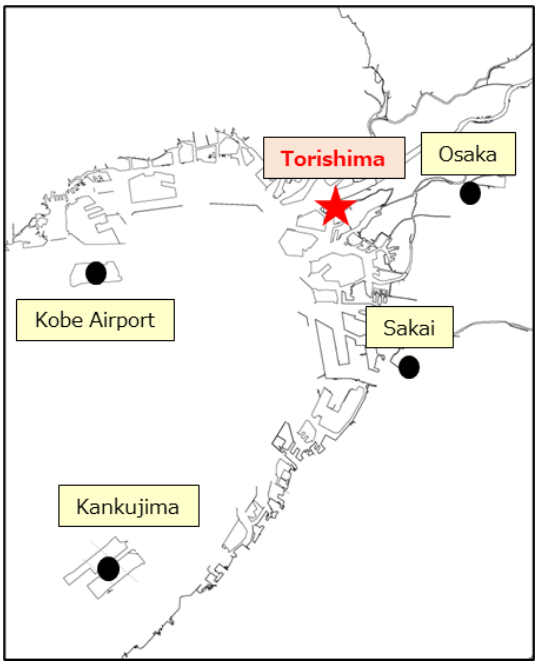
*2: This technology enables detailed forecasting that takes topographical effects into consideration by dividing the forecast area into small high-resolution meshes and performing data analysis. Machine learning based on observation data is combined for an even higher accuracy.

*3: The forecast target area is assumed to be divided into small meshes of 500 m to 1 km square. Under Osaka Gas's conventional weather forecast model, the area was divided into 2.2 km square meshes.

*4: “Construction of the Yumeshima Platform” was adopted by the Cabinet Office as a research project on the development and construction of cutting-edge services in super cities and digital rural health special zones. Osaka Gas is considering AI weather forecasting as a member of the Yumeshima Platform Review Council, which has been entrusted with the project.
（https://www.chisou.go.jp/tiiki/kokusentoc/supercity/pdf/supercity_220715_FlontLine.pdf）
*5: Announced on December 14, 2021, “Commencement of Joint Research and Mid- and Long-Term Weather Forecasting – Providing Early Predictions of Heat Waves and Cold Waves and Contributing to Stable Energy Supply –”
（https://www.osakagas.co.jp/company/press/pr2021/1301824_46443.html）

1. Observation sites (wind conditions and temperature)

<Location of observation site>



<Observation site in the Torishima district>

* Torishima is an independent observation site by Osaka Gas. Others are observation sites by the Japan Meteorological Agency.

2. Image of weather forecast in the bay area

・Predicting how different land conditions, such as sea levels, flat landfills, and built-up areas, affect atmospheric behavior, such as wind friction and heat transfer