

OUTLINE

OF

THE OPERATIONAL NUMERICAL WEATHER PREDICTION

AT

THE JAPAN METEOROLOGICAL AGENCY

March 2026

JAPAN METEOROLOGICAL AGENCY

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Preface

The Japan Meteorological Agency (JMA) began numerical weather prediction (NWP) in June 1959 after years of extensive research by Japan's Numerical Weather Prediction Group, following similar pioneering efforts by the Swedish Meteorological and Hydrological Institute (SMHI) in September 1954 and the US Weather Bureau in May 1955. Subsequent NWP development has progressed steadily, with JMA and other NWP centers benefiting from enhanced understanding of meteorological phenomena, improved modeling, increased computing capacity, efficient telecommunications, and advanced observing systems (especially in the fields of meteorology and satellite-based Earth observation). NWP lends itself to a wide range of applications within JMA's scope of operations.

This annual report presents technical details of JMA's NWP systems as of March 2025. Past reports published every five to six years from 2002 to 2022 served as appendices to the *WMO Technical Progress Report on the Global Data-processing and Forecasting System (GDPFS) and Numerical Weather Prediction (NWP) Research*. Publication has been annual since the 2023 edition as independent output covering the main content of the previous (now-discontinued) WMO Technical Progress Report.

The first chapter summarizes the configurations and specifications of the current JMA computer systems, followed by descriptions of the related operational suite and job management system.

The second chapter describes a) Global Analysis, Meso-scale Analysis and Local Analysis as major data assimilation systems for atmospheric fields incorporating observation data, b) data assimilation systems for snow depth and soil moisture, and c) the JMA Climate Data Assimilation System.

The third chapter describes NWP models used for very short-range prediction of meso-scale disturbances and short-/medium-range prediction of synoptic-scale disturbances. The regional deterministic and ensemble prediction system is used especially for heavy rainfall associated with mesoscale convective systems, which cause extreme disaster conditions in Japan. The global model is used in ensemble prediction systems for typhoon forecasts and weekly/monthly predictions, and the coupled ocean-atmosphere model is employed for seasonal and El Niño forecasts. Atmospheric transport models are applied to predictions of the transport of trace elements such as radioactive materials, Kosa (Aeolian Dust), ozone and volcanic ash for the output of environmental information.

The fourth chapter outlines various applications of NWP products such as weather charts, gridded data, very-short-range precipitation forecasting, half-hourly analysis of wind and temperature, guidance for short-range forecasting, and data relating to aviation services, ensemble prediction and atmospheric angular momentum functions.

The final chapter discusses modeling for ocean waves, storm surges, and oil spill prediction along with systems for sea-surface temperature analysis and ocean data assimilation.

JMA remains committed to its efforts toward enhanced NWP accuracy. Against this background, the Numerical Prediction Development Center was established in 2020 in Tsukuba (the location of the Meteorological Research Institute) for integrated promotion. JMA's NWP Strategic Plan Toward 2030, established in 2018 (https://www.jma.go.jp/jma/en/Publications/JMA_NWP_Strategic_Plan_Toward_2030.pdf), also promotes NWP technology within the context of recent intensification of natural disasters and public demand, defining the direction of NWP development at JMA over the coming years. Updates are provided at <https://www.jma.go.jp/jma/en/Activities/nwp.html>.

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