Japan Meteorological Agency

Meteorological Research Institute

Preface

Japan has long experienced frequent natural disaster conditions brought by torrential rainfall, typhoons, earthquakes, volcanic eruptions and other extreme events. Some of the most important issues facing the nation today involve mitigating such disasters and making society safer and more secure. Global warming phenomena and desertification are urgent problems faced by all humanity.

The Japan Meteorological Agency (JMA) works to provide information that will help to mitigate the effects of natural disasters, improve people's lives, support traffic safety and foster industrial development. To achieve these tasks, advanced technology grounded in the latest science is essential.

The Meteorological Research Institute (MRI) is a JMA facility that conducts research to clarify and support the prediction of meteorological, terrestrial and hydrological phenomena and develop associated techniques and technologies. It also contributes to the advancement of fundamental technology for meteorological services.

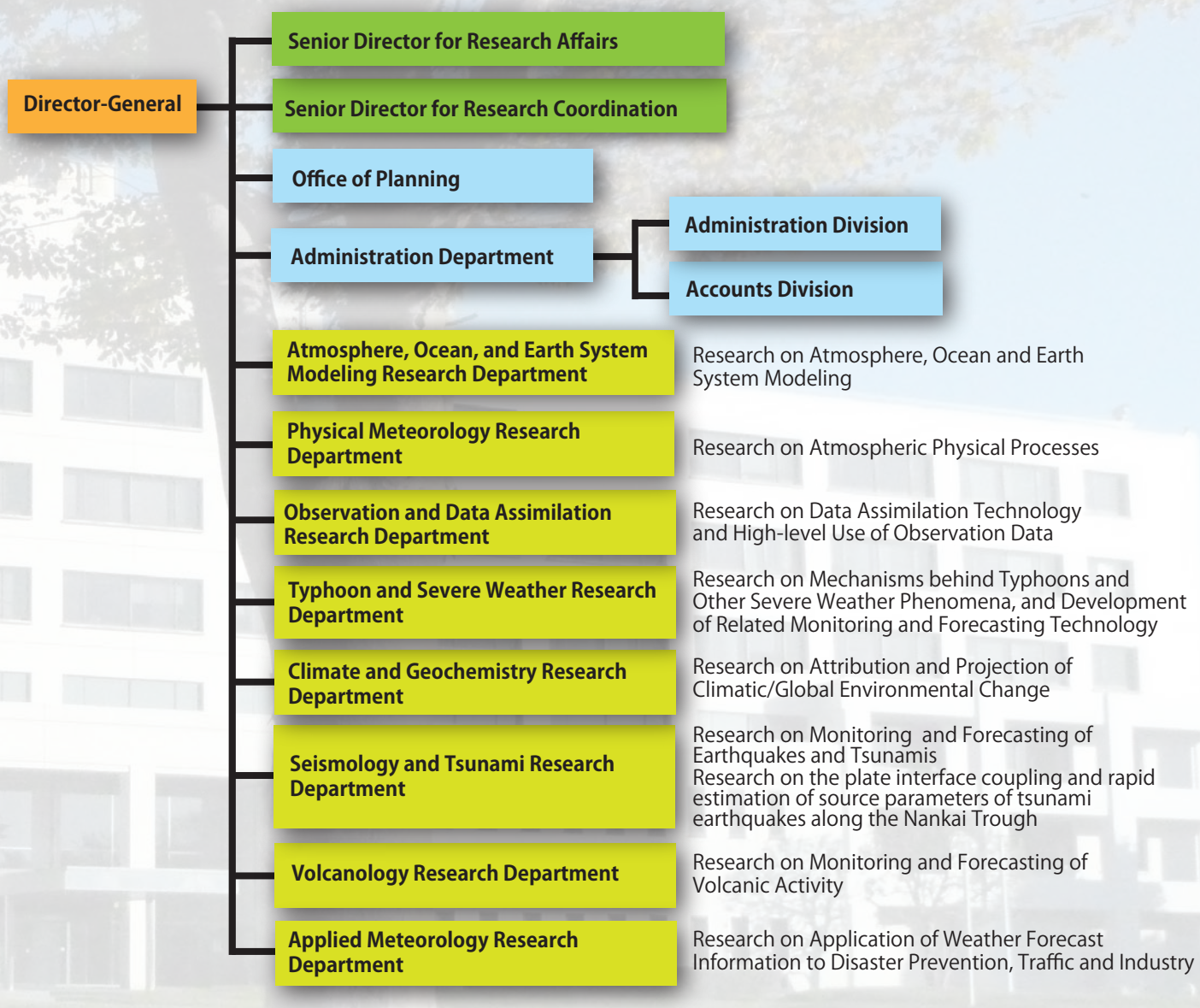
MRI further collaborates with other research organizations in Japan and overseas, and actively contributes to international bodies such as the Intergovernmental Panel on Climate Change (IPCC).

Contents

History

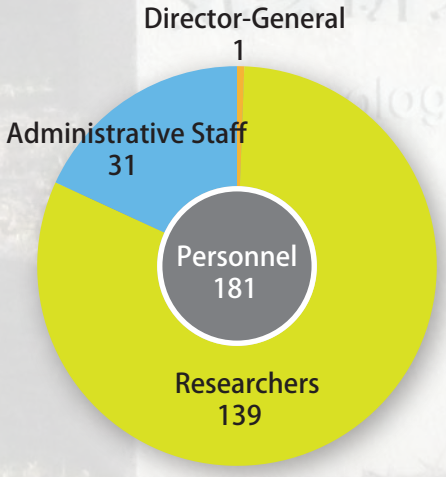
Jan. 1942	Central Meteorological Observatory Research Division established.
Feb. 1946	Regulations on Central Meteorological Observatory clerical device duties promulgated. Central Meteorological Observatory Research Division formally re-established.
Apr. 1947	Meteorological Research Institute reorganized.
Jul. 1956	Reorganization and association with Japan Meteorological Agency implemented with Administrative Department and nine Research Divisions.
Jun. 1980	Transfer of entire Institute to Tsukuba Science City implemented.
May 1987	Climate Research Department and Meteorological Satellite and Observation System Research Department established.
Apr. 1997	Atmospheric Environment and Applied Meteorology Research Department established.
May 2013	Senior Director for Research Affairs/Senior Director for Research Coordination positions and Oceanography and Geochemistry Research Department established.
Apr. 2014	Seismology and Tsunami Research Department and Volcanology Research Department established.
Apr. 2019	Atmosphere, Ocean, and Earth System Modeling Research Department, Physical Meteorology Research Department, Observation and Data Assimilation Research Department, Typhoon and Severe Weather Research Department, Climate and Geochemistry Research Department, Seismology and Tsunami Research Department, Volcanology Research Department and Applied Meteorology Research Department established.

Organization



Personnel

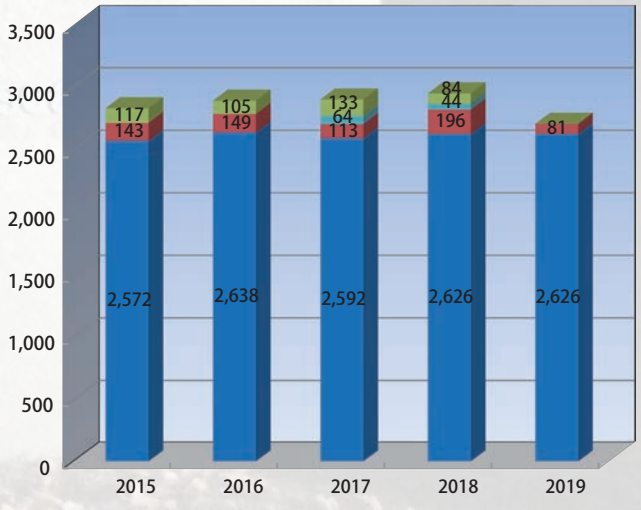
As of May 2019



Budget

(Unit：Million Yen)

As of May 2019



Work of the Meteorological Research Institute

MRI conducts research to support the quality of information issued by JMA on weather, earthquakes, volcanic activity, climatic conditions and other phenomena.
Research Projects of MRI involving evaluation by external experts is intensively implemented for public safety under the classifications of Fundamental Technology Research, Problem-Solving Research, Earthquake-Tsunami-Volcanic Research and Applied Meteorology Research.

The results are used by JMA for the provision and enhancement of related services, and are additionally supplied to various organizations both domestically and internationally through IPCC reports and other channels. Publicity work is also implemented to maximize public awareness of the results and associated information.

Japan Meteorological Agency

Research based on external funding Co-research with other institutions

Utilization of achievements

Meteorological Research Institute

Applied Meteorology Research

- Research on Application of Weather Forecast Information to Disaster Prevention, Traffic and Industry

Problem-Solving Research

- Research on Mechanisms behind Typhoons and Other Severe Weather Phenomena, and Development of Related Monitoring and Forecasting Technology
- Research on Attribution and Projection of Climatic/Global Environmental Change

Earthquake-Tsunami-Volcanic Research

- Research on Monitoring and Forecasting of Earthquakes and Tsunamis
- Research on the plate interface coupling and rapid estimation of source parameters of tsunami earthquakes along the Nankai Trough
- Research on Monitoring and Forecasting of Volcanic Activity

Fundamental Technology Research

- Research on Atmosphere, Ocean and Earth System Modeling
- Research on Atmospheric Physical Processes
- Research on Data Assimilation Technology and High-level Use of Observation Data

Utilization of achievemen

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Academia

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Reflection of evaluation results

Assignment

The progress and achievements of research activities are evaluated by external experts and reflected in research plans

✓ External evaluation by Board of Regents (priority research)

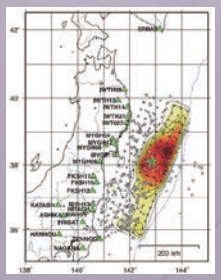
open to the public

Outreach and PR activities

- ✓ Publication of Papers in Meteorology and Geophysics
- ✓ Publication of Technical Reports of the Meteorological Research Institute
- ✓ Open institute (during Science and Technology Week and the summer vacation)
- ✓ Facility tours for groups
- ✓ Press release on outstanding achievements

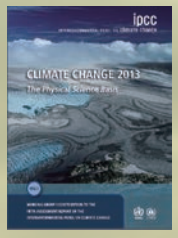
Improvements in JMA's services

- ✓ Start of a new Volcanic Ash Fall Forecast (Mar.2015)
- ✓ Introduction of the dual-polarized radar (Mar.2016)
- ✓ Contribution to Global Warming Projecition Vol.9 (Mar.2017)
- ✓ Improvement of Earthquake Early Warning system for Huge earthquake (Mar.2018)
- ✓ Introduction of five-day typhoon intensity forecast (Mar.2019)



Various types of contribution to society

- ✓ contribution to IPCC (Intergovernmental Panel on Climate Change) etc.
- ✓ international contribution by participating in Science and Technology Research Partnership of JICA etc
- ✓ contribution by academic conference presentations

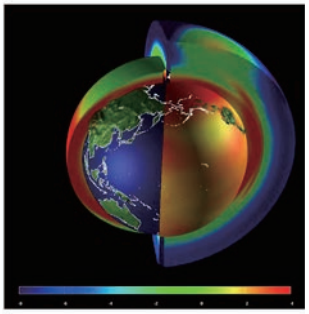


Research Projects of MRI

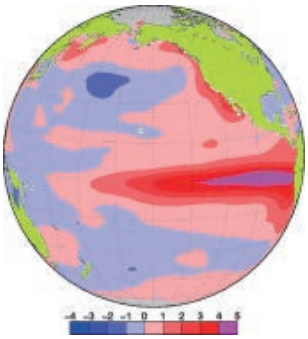
Research on Atmosphere, Ocean and Earth System Modeling

The organization conducts comprehensive studies on numerical modeling of earth system components such as the atmosphere, oceans, land, snow/ice, trace gases and aerosols toward the construction of an earth-system model with hierarchical descriptions supporting highly accurate monitoring and forecasting of meteorological phenomena on various spatio-temporal scales, as well as providing ideas for next-generation operational weather forecast systems and climate models.

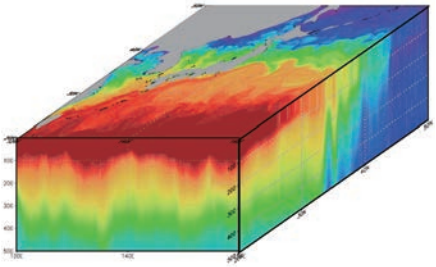
Climate Prediction Model



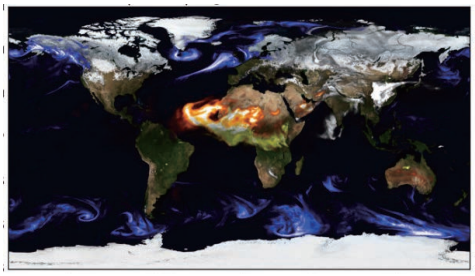
Coupled Atmosphere-Ocean Model
Seasonal Prediction System



Ocean-Sea Ice Model
Coupled Atmosphere-Ocean-Surface-Wave Model
Ocean Data Assimilation
Coupled Atmosphere-Ocean Data Assimilation

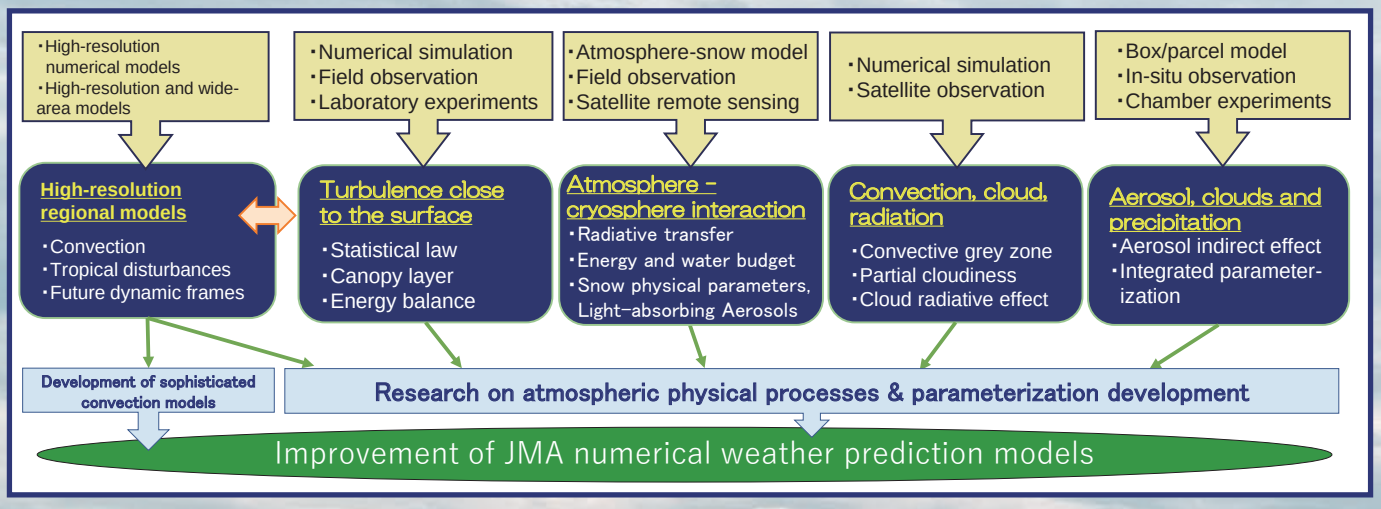


Chemical Transport Model &
Data Assimilation



Research on Atmospheric Physical Processes

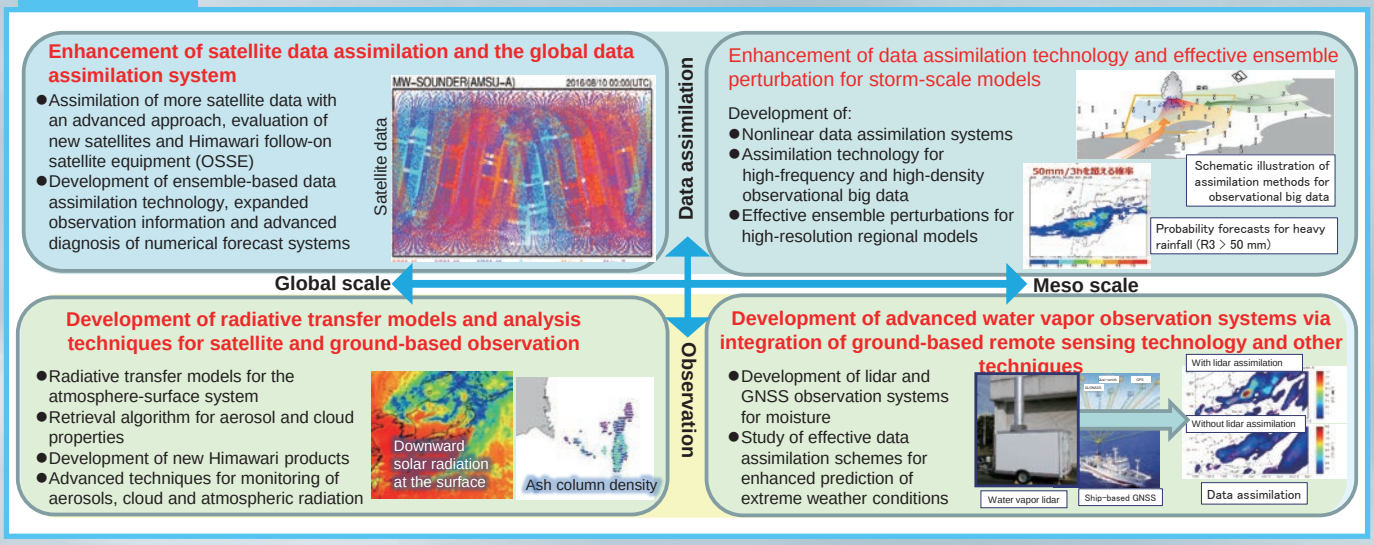
This research is conducted to improve the accuracy of numerical prediction models used in forecasting local heavy rain and typhoons, seasonal forecasts, and global climate projections. We perform observational and experimental studies as well as numerical studies on atmospheric physical processes to incorporate new insights from this research into numerical prediction models.



Research on Data Assimilation Technology and High-level Use of Observation Data

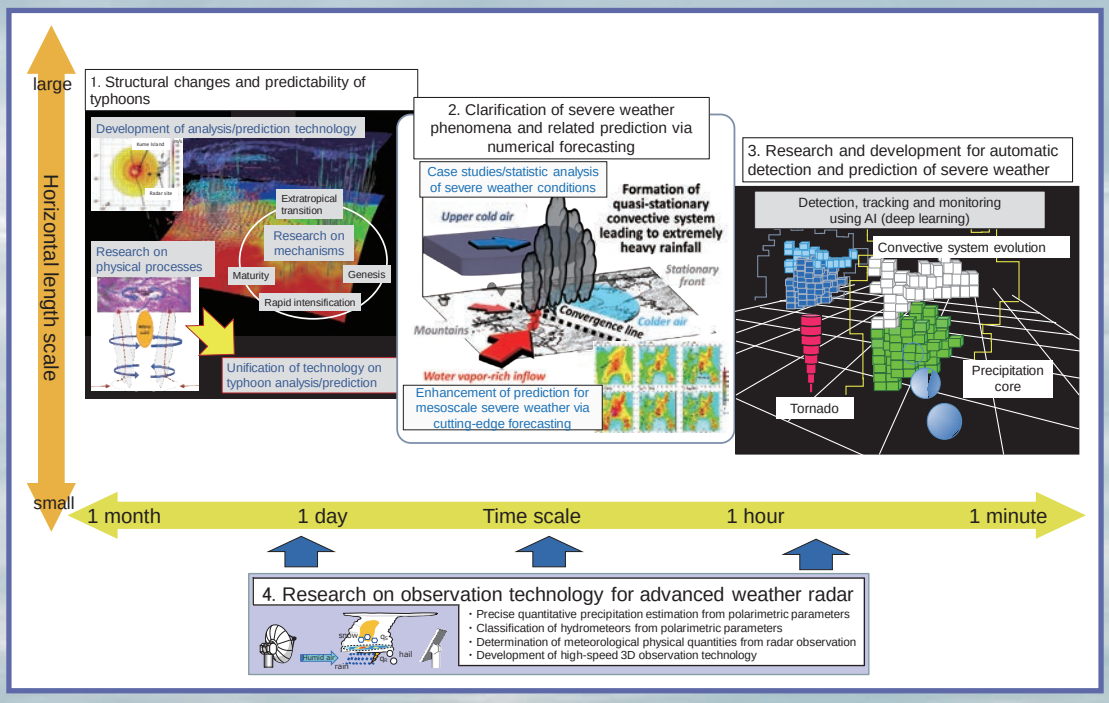
This work is conducted to enhance the accuracy of monitoring and prediction for typhoons and torrential rain, and involves the advancement of data assimilation technology for global-to-mesoscale spatial fields. Focus is also placed on the development of monitoring and forecasting technology for integrated use of satellite- and ground-based remote sensing together with in-situ data.

Overview



Research on Mechanisms behind Typhoons and Other Severe Weather Phenomena, and Development of Related Monitoring and Forecasting Technology

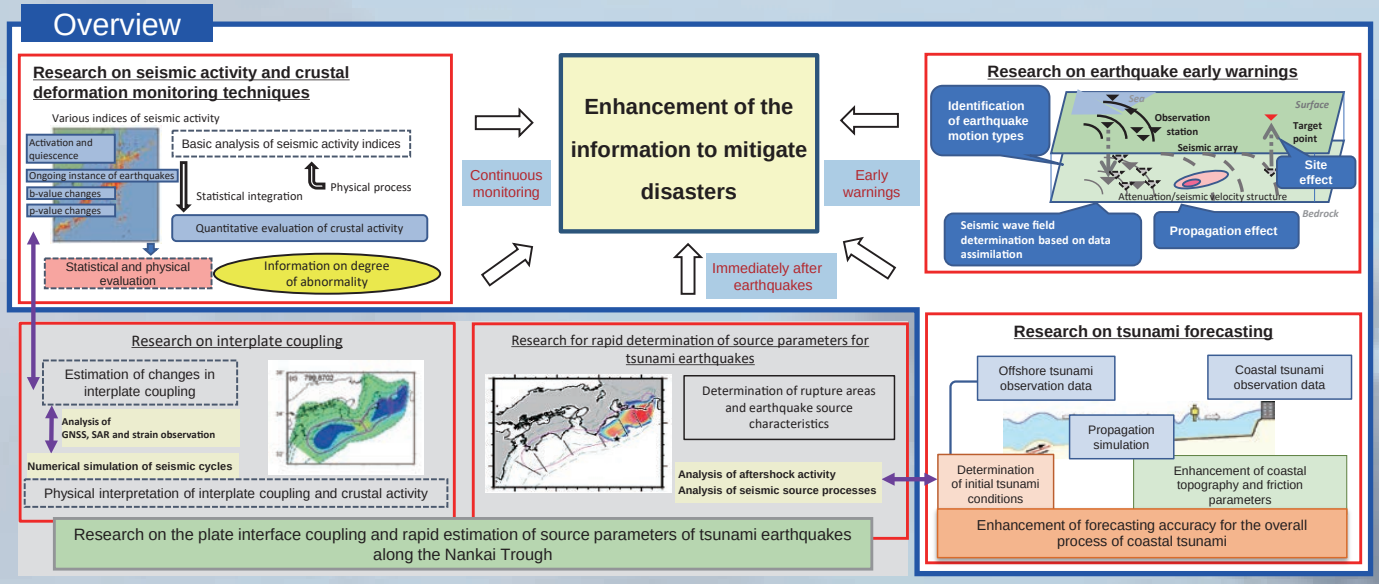
Mechanism elucidation and development of high-level monitoring and prediction technology for severe weather phenomena such as typhoons, torrential rain, heavy snowfall, tornadoes and damaging wind are conducted using state-of-the-art observation and analysis along with high-accuracy numerical prediction. This helps to mitigate the effects of disasters related to such meteorological conditions.



Research on Monitoring and Forecasting of Earthquakes and Tsunamis

To mitigate the disasters by earthquakes and tsunamis, work is being performed to develop monitoring and forecasting techniques for seismic activity, earthquake ground motion and tsunamis, and to elucidate the fundamental physics of related phenomena.

Overview

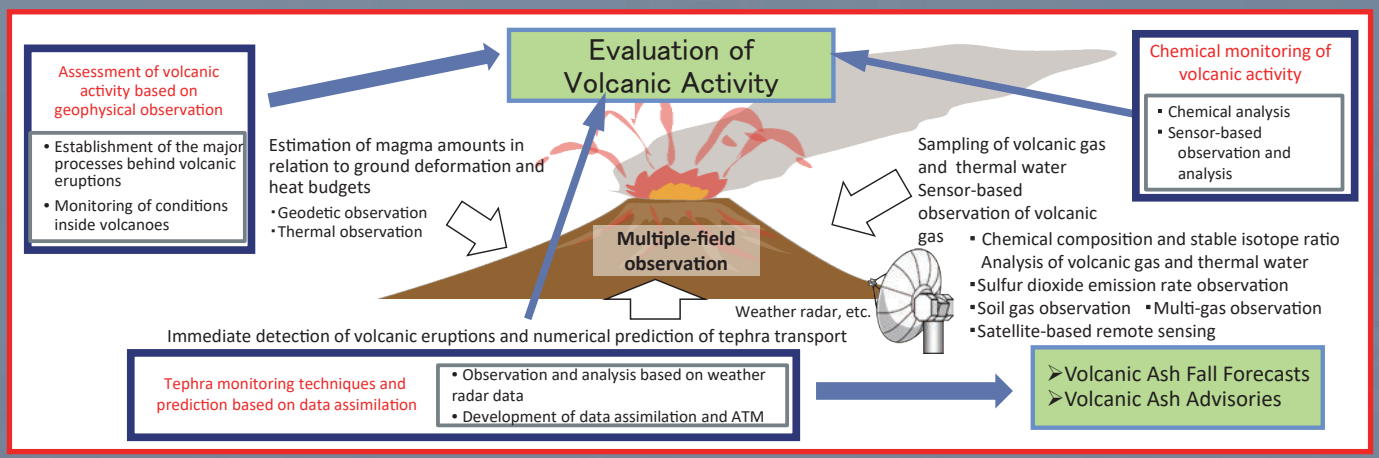


Research on the plate interface coupling and rapid estimation of source parameters of tsunami earthquakes along the Nankai Trough

To support the potential for prediction of major earthquakes along the Nankai Trough, research is performed to enhance detection and analytical capability relating to changes in interplate coupling and precursory slips, and to enable accurate determination of magnitude and slip distribution for various types of earthquakes.

Research on Monitoring and Forecasting of Volcanic Activity

The Department of Volcanology Research works to advance scientific understanding of volcanic activity and to enhance related evaluation and prediction.
The department contributes to the accuracy and reliability of JMA volcanic risk information, such as Volcanic Warnings, Volcanic Alert Levels, Volcanic Ash Fall Forecasts and Volcanic Ash Advisories.

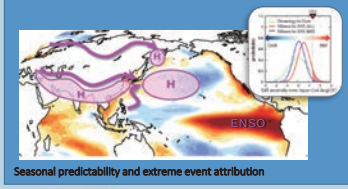


Research on Attribution and Projection of Climatic/Global Environmental Change

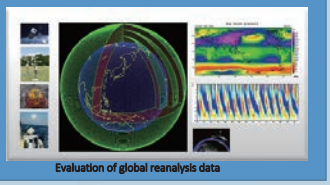
We analyze various observational data related to physical and biogeochemical phenomena in the atmosphere and oceans, such as greenhouse gas variations and numerical model simulation representing and predicting climate change based on various perspectives. The goals are to elucidate the mechanisms behind climatic and global environmental change, improve projection reliability and promote the development of observation and numerical models.

1. Extreme events, seasonal predictability and long-term reanalysis

- Clarification of extreme events
- Validation of long-term global reanalysis
- Evaluation of predictability on intra-seasonal to interannual scales



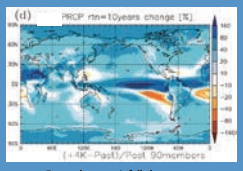
Seasonal predictability and extreme event attribution



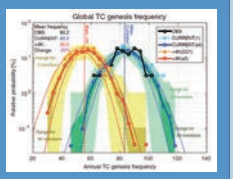
Evaluation of global reanalysis data

2. Reduction of uncertainty in global warming projection

- Predictability on decadal to centurial scales
- Development of a decadal prediction & time-slice experiment system
- Clarification of historical climate change from observation and simulation



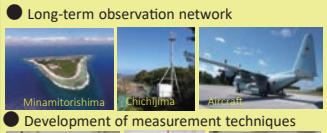
Future heavy rainfall change (with a 10-year return period) for the end of the current century



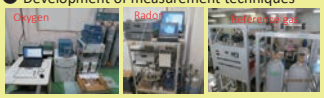
Annual tropical cyclone genesis frequency Present vs. future (+4K)

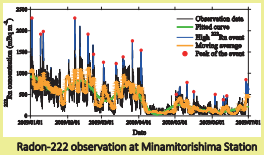
3. Clarification of atmospheric greenhouse gas variations and the carbon cycle

- Long-term observation network
- Analysis of observed variations



- Development of measurement techniques



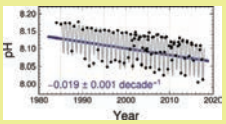


Radon-222 observation at Minamitorishima Station

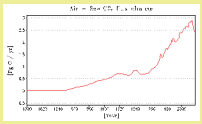
- Detection of continental transport events
- Source categorization and quantification

4. Investigation of ocean biogeochemical cycles and acidification

- Development of long-term and high-precision observation/measurement techniques
- Analysis of observation and measurement data in combination with numerical model simulation



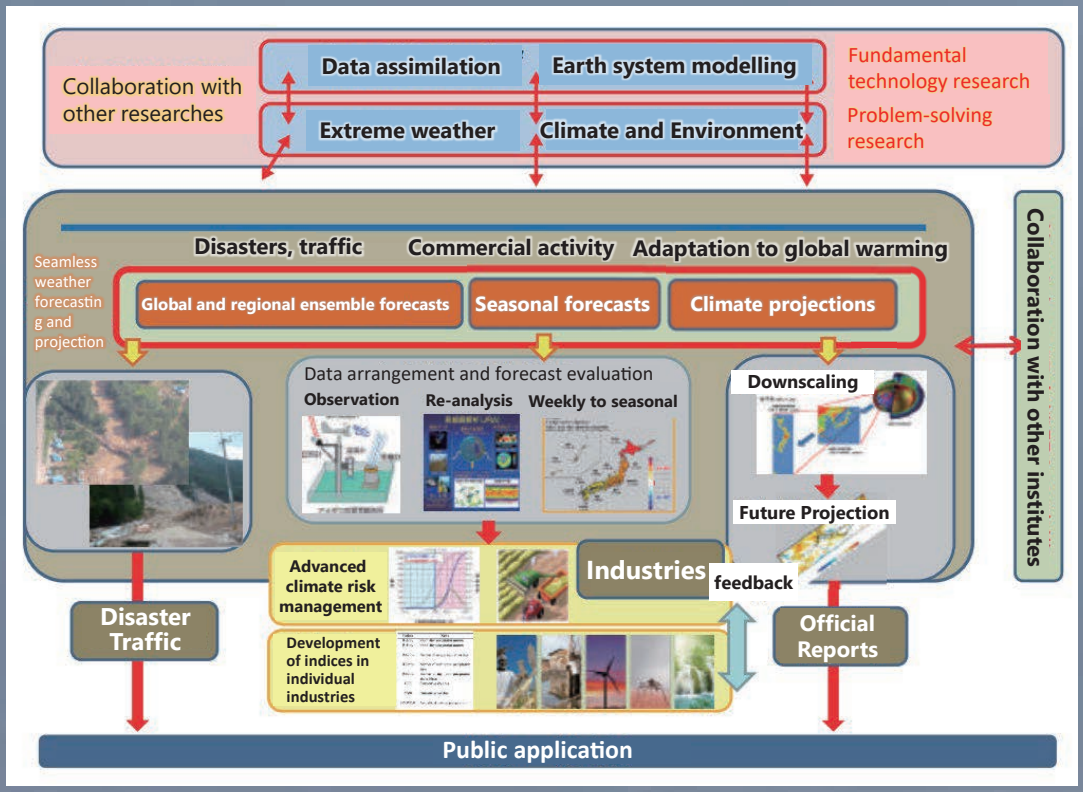
Observed trend of ocean acidification



Simulated trend of ocean CO_2 uptake

Research on Application of Weather Forecast Information to Disaster Prevention, Traffic and Industry

Focus is placed on the worldwide provision of meteorological information for public safety and security. In addition to enhancing weather forecast accuracy, the organization collaborates and interacts with experts in various fields for appropriate utilization of meteorological information in consideration of forecast uncertainty.



Guide to MRI instrumentation

Radiation Observation Building

Aerosols and clouds are monitored in the Radiation Observation Building to help clarify the radiative effects of aerosols and clouds and the properties of greenhouse gases.

Aerological Observatory
Meteorological Instrument Center

Cold Environment Simulator Facility

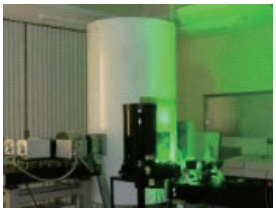
This facility is widely used for experiments to elucidate cloud formation processes and meteorological phenomena occurring in low-temperature environments and to develop/test measuring devices.

It consists of two cold rooms in which the air temperature can be lowered to -40 and -90°C, respectively, and a cloud simulation chamber in which atmospheric environments for cloud formation can be reproduced with a temperature range of +30 to -100°C, a pressure range of 1,013 to 30 hPa, and an updraft velocity range of up to 30 m/sec.

Cloud simulation chamber

Cold room for -90°C experiments

LIDAR



Lidar (Light Detection and Ranging) involves the use of a
that transmits laser light pulses into the atmosphere and
atmospheric molecules, aerosols and clouds. The vertical
constituents such as water vapor, ozone, aerosols and clo
with temperature, using lasers with various wavelengths.
direction can also be derived in consideration of the Dopp
backscattered signals.

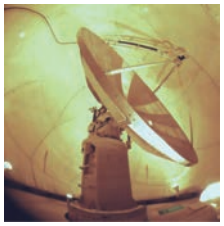
MRI

Electron microscope

By using electron microscopy we can see what far smaller than those visible by the optical microscope. We are conducting studies for chemical composition and morphology of the aerosol (tiny liquid or solid particles suspended in the atmosphere) that have basic effects on weather and climate.

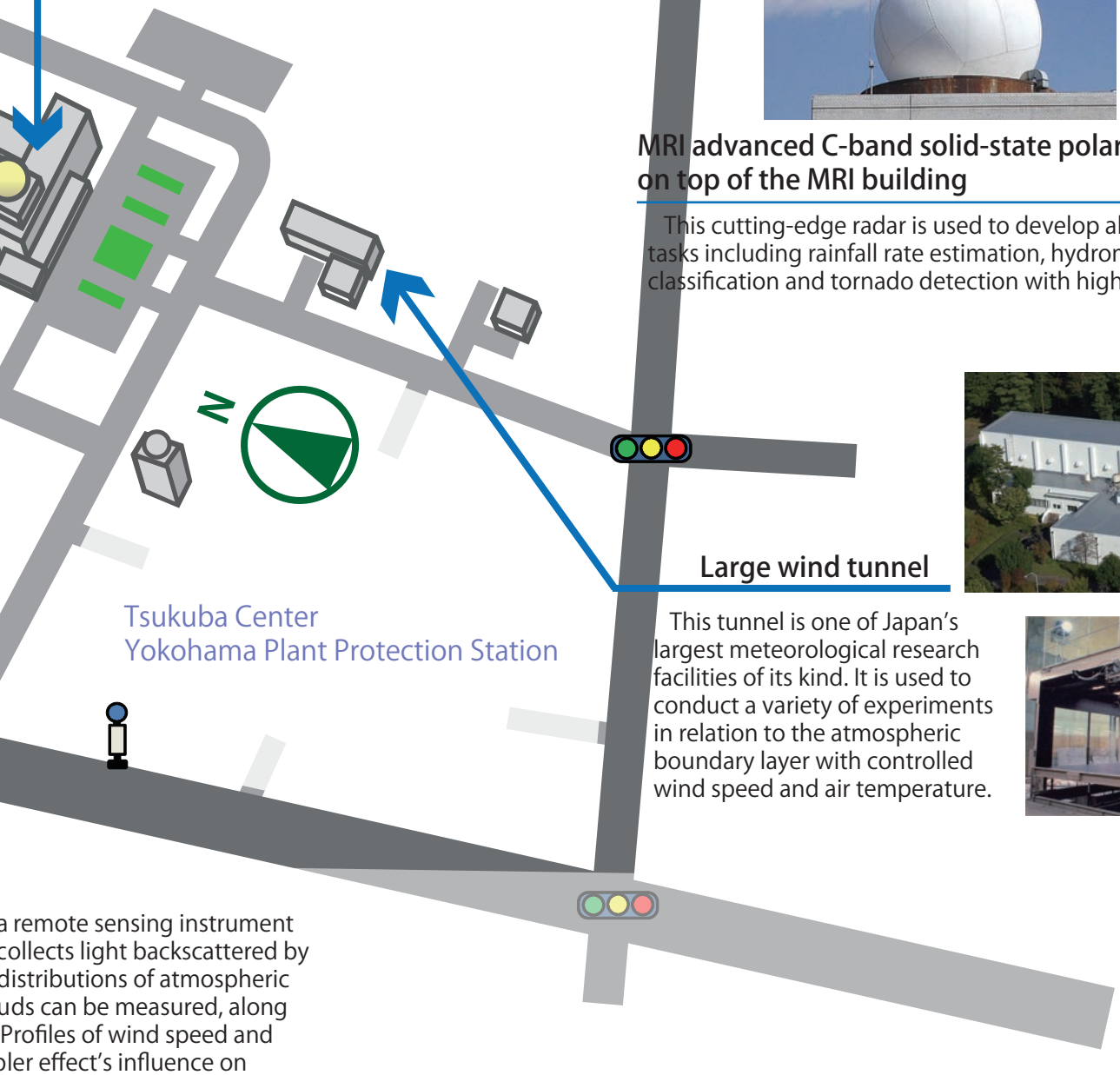
Supercomputer

The Meteorological Research Institute (MRI) supercomputer system is currently operated for numerical studies on atmospheric, oceanic, seismic and volcanic phenomena using various numerical models/systems.



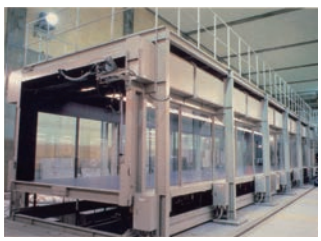
MRI advanced C-band solid-state polarimetric radar on top of the MRI building

This cutting-edge radar is used to develop algorithms for tasks including rainfall rate estimation, hydrometor classification and tornado detection with high reliability.

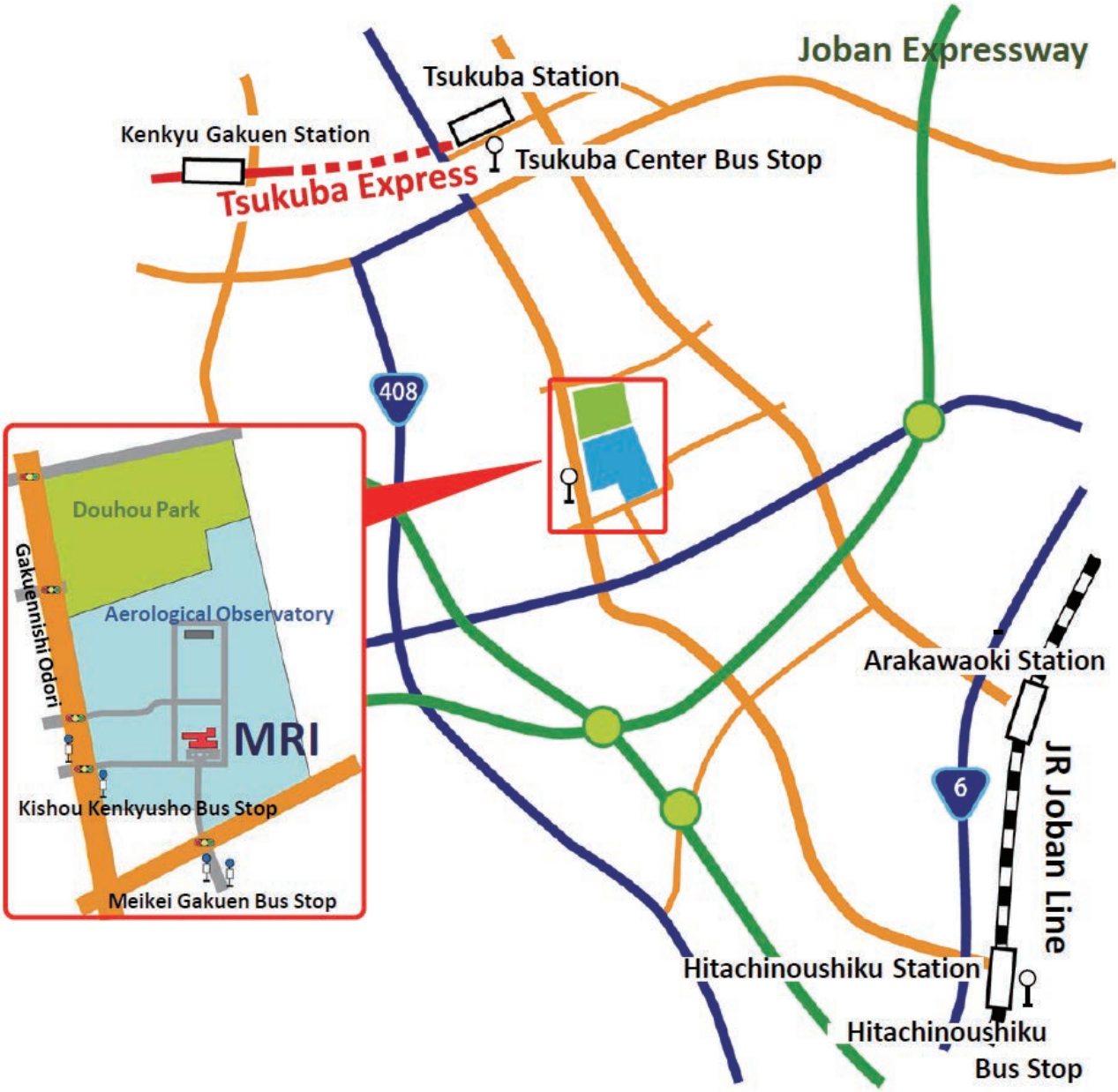


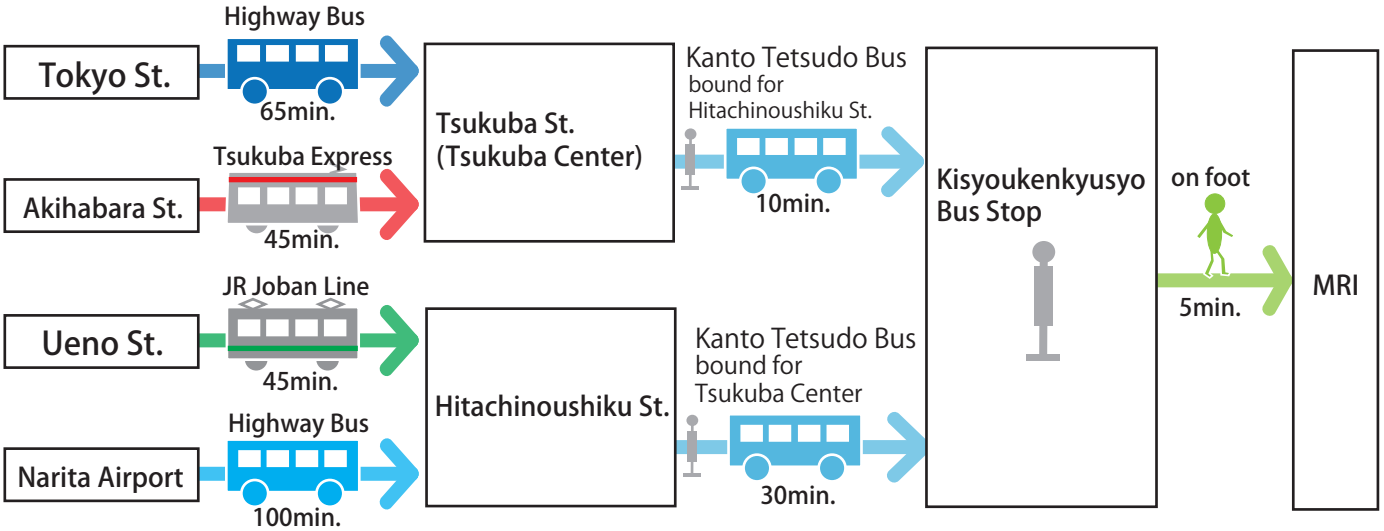
Large wind tunnel

This tunnel is one of Japan's largest meteorological research facilities of its kind. It is used to conduct a variety of experiments in relation to the atmospheric boundary layer with controlled wind speed and air temperature.



a remote sensing instrument
collects light backscattered by
distributions of atmospheric
uds can be measured, along
Profiles of wind speed and
bler effect's influence on





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Mar. 2020