Introduction to Typhoon Prediction and Climate Research at the Japan Meteorological Agency

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Day 1 Technical Presentations
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Outline of the talk

Research to Operations (R2O) transfer

- Introduction to research outcomes reflected in forecast products
- Example of successful R2O transfer
- WMO/WWRP Tropical Cyclone Probabilistic Forecast Products

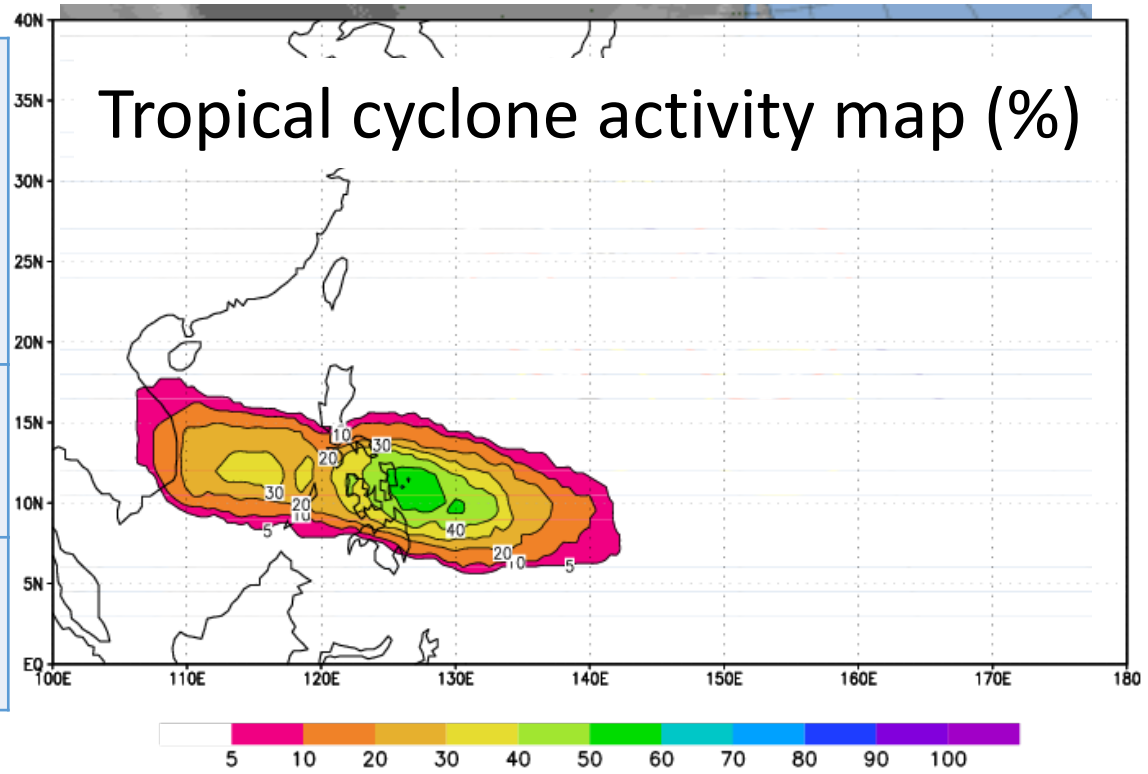
Climate change and tropical cyclones

- 30-year Trend Analysis of Strong Typhoons using Dvorak Reanalysis Data
- Basin-wide evaluation vs local/area-specific evaluation
- Future projection

Summary

Research outcomes reflected in forecast products

Track	• Consensus approach • Use of multiple global ensembles to determine the size of the probability circles
Intensity	Implementation of statistical dynamical model
Genesis	Tropical cyclone activity prediction based on multiple global ensembles



MRI/JMA closely works with RSMC Tokyo to ensure that typhoon forecast products issued by RSMC Tokyo are of global standard or the world's most advanced and accurate.

- Example of Successful R2O Transfer -
Tropical Cyclone Track Forecasts with Multiple Ensembles

Step 1 **Step 2:** Research on new products

- **It may take time, but outcomes of research projects certainly contribute to improving services in the operational forecasts.**
- **One reason for the time required is that the current operational system is so huge and complex that it requires a reasonable amount of human and financial resources to upgrade the system.**
- **Hence, it is important for research bodies and operational centers to keep in close contact with each other on a regular basis and cooperate to improve the services.**

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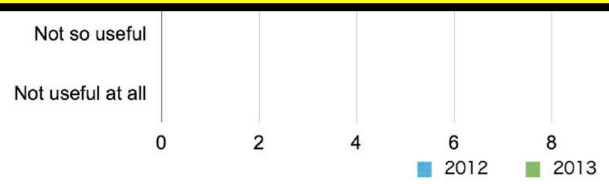
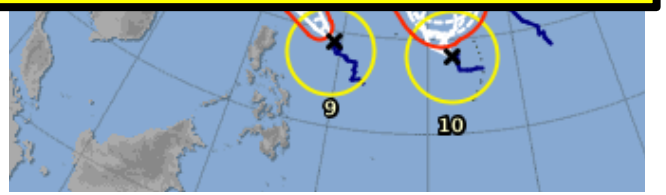




- WMO/WWRP Project -
Tropical Cyclone Probabilistic Forecast Products (TC-PFP)

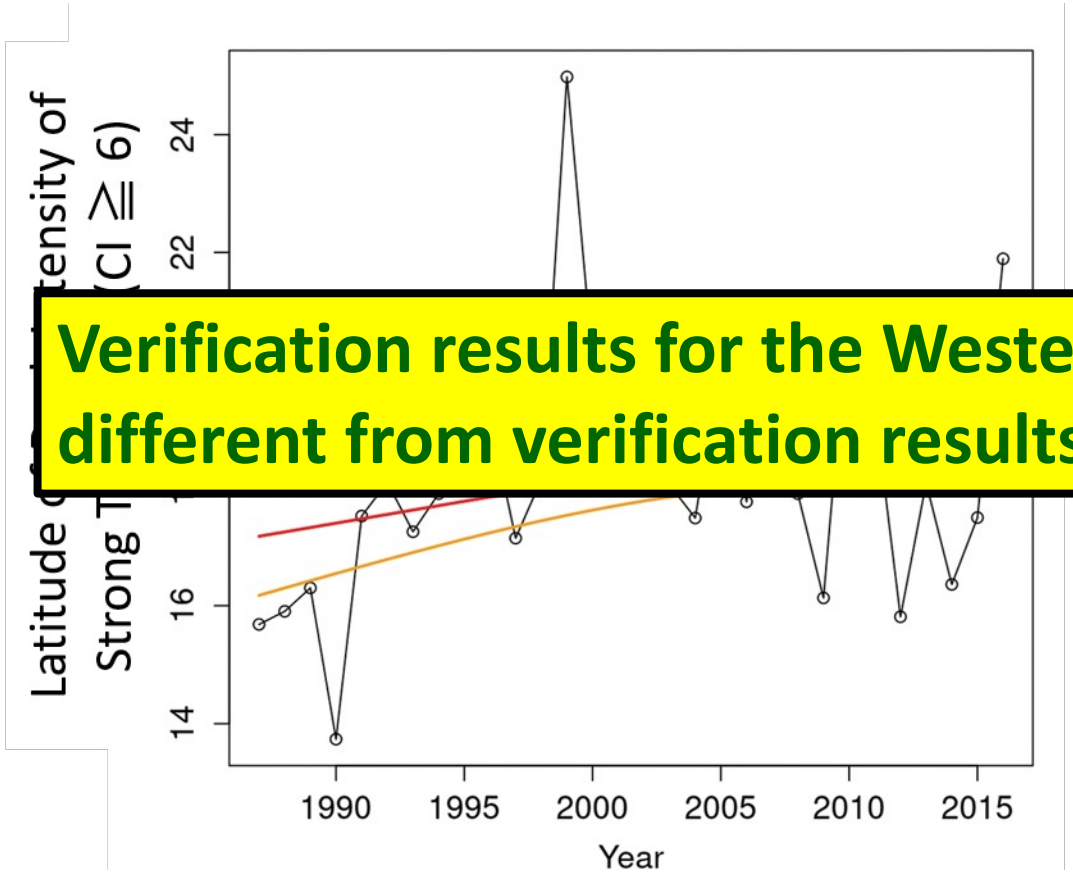
- This WMO/WWRP project was launched in response to recommendations from IWTC-9 held in 2018 on the use of ensemble forecasting at operations.
- The project main goal is to coordinate across TC RSMCs and other forecast centers to **identify best practice guidance for probabilistic tropical cyclone forecasts**.
- The background of this international project was a slower progress in the use of ensembles at operations.

The research community can/should take full advantage of this newly available data to develop new products, etc.

- A new task team was formed under WMO/INFCOM for the purpose of **more stable and timely exchange of tropical cyclone track products by global ensembles**.

30-year (1987–2016) Trend Analysis of Strong Typhoons using Dvorak Reanalysis Data

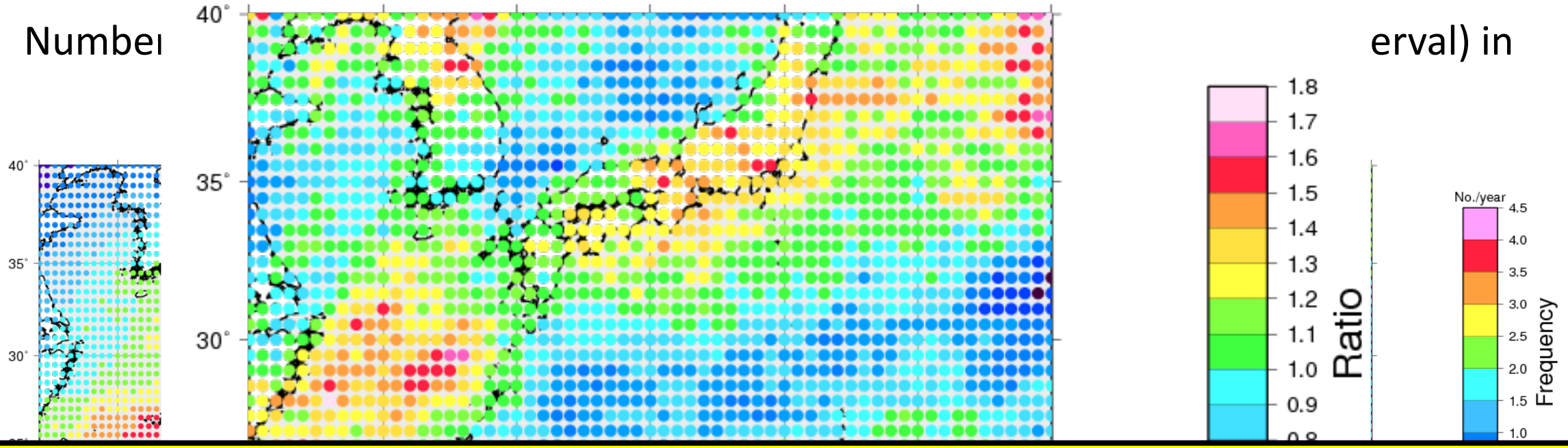
The need for homogeneous TC analysis data over long periods provided the background for JMA to initiate the Dvorak reanalysis at the 43rd Session of the Typhoon Committee. (Nishimura et al. 2023, Technical Review of RSMC Tokyo)



Verification results for the Western North Pacific basin as a whole can be different from verification results that focus on a particular location or region.

The linear regression and the 90 % confidence interval around the linear regression line are shown in red and orange, respectively.

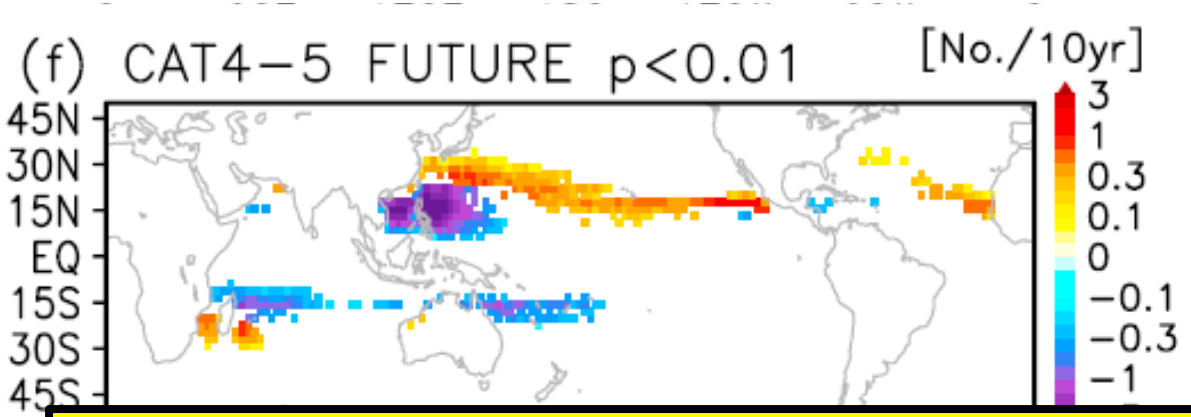
Basin-wide evaluation vs local/area-specific evaluation



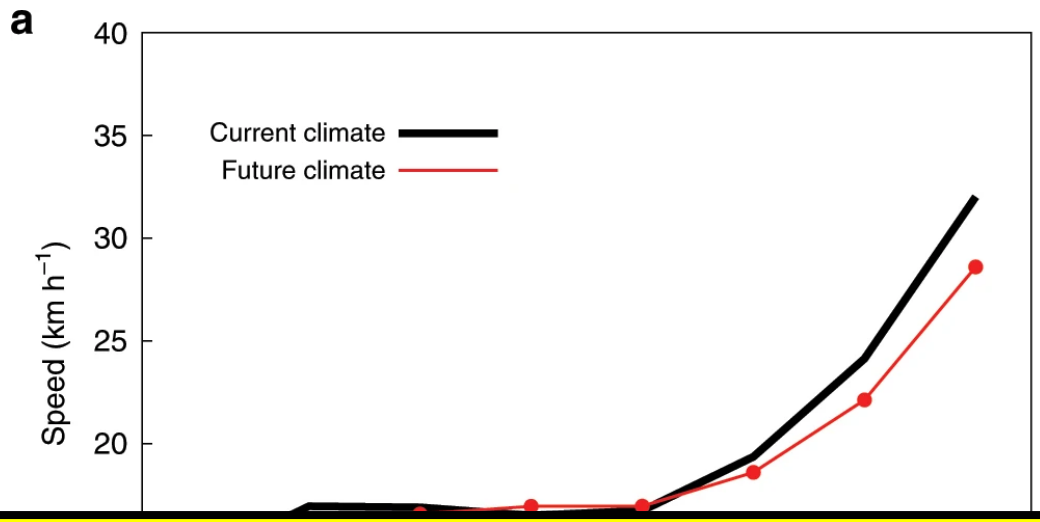
- **A clean spatial distribution can be observed, and TCs are increasingly approaching the Pacific side of Honshu and the East China Sea.**
- **The Pacific High extended more west and north in 2000-2019 than in 1980-1999.**
- **Similar spatial patterns can be seen even when the samples are limited to strong typhoons.**
- **It could happen that the number of strong typhoons is increasing at some locations due to changes in the path of typhoons.**

Future projection of typhoons (RCP8.5 scenario)
Results of high-resolution large ensemble climate simulation

Future change of occurrence frequency of strong typhoons



Future change of translation speed



Working Group on Meteorology (WGM) plans to compile an assessment report on the impacts of climate change on TCs in the Typhoon Committee region (AOP11). These studies will contribute to this report.

It was shown that the frequency of strong TCs increases over the southern ocean of Japan, and that the translation speed of TCs slow down in the mid-latitudes at the end of 21 century.

Summary

Research achievements in the areas of typhoon track, intensity, and genesis predictions have been regularly transferred to RSMC Tokyo products.

Research and development efforts will continue to ensure that the typhoon forecasting products issued by RSMC Tokyo are the world's most advanced and accurate.

Research outcomes on the impact that climate change has had or will have on typhoons will also continue to be shared with the Typhoon Committee members.

These activities (R&D, data utilization, creation of new datasets, climate simulations, etc.) will not only benefit the Typhoon Committee, but will also contribute to the EW4All initiative.

Thank you for your attention

All the content I presented today is in scientific papers/documents.
So if you are interested, please see the references in the following slides.

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