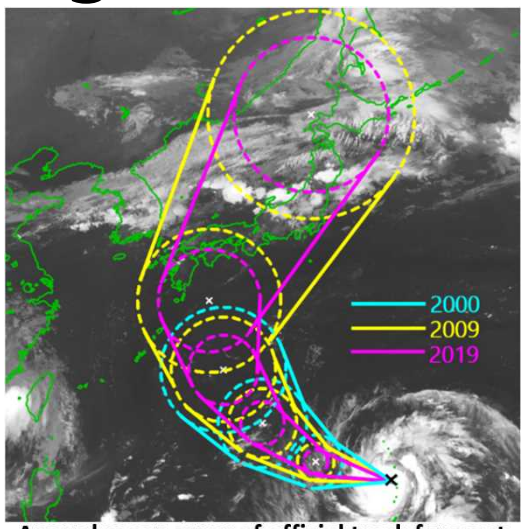
High-level Dialogues on Tropical Cyclones

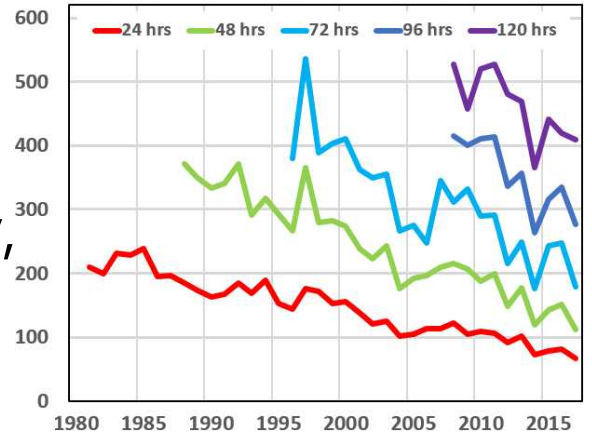
– A 10-year Vision to Protect Life and Property –

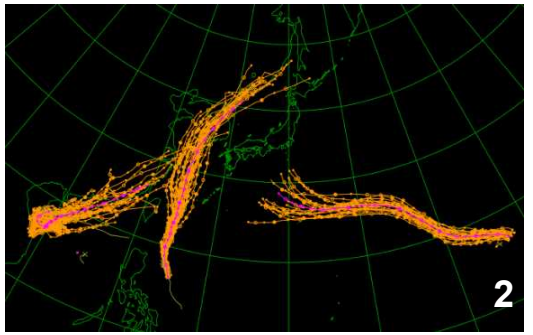
RSMC Tokyo - Typhoon Center's progress in the last 30 years

- forecasts for more than 700 tropical cyclones
- forecast time extended to 120 hours
- annual mean error of official track forecast reduced by half
- probability-circle radii are less than half
- advancements of satellite, super computer, NWP models, observation with more variety, denser network and higher frequency are remarkable
- training for more than 300 forecasters in total and contributed to the technical improvement in many countries



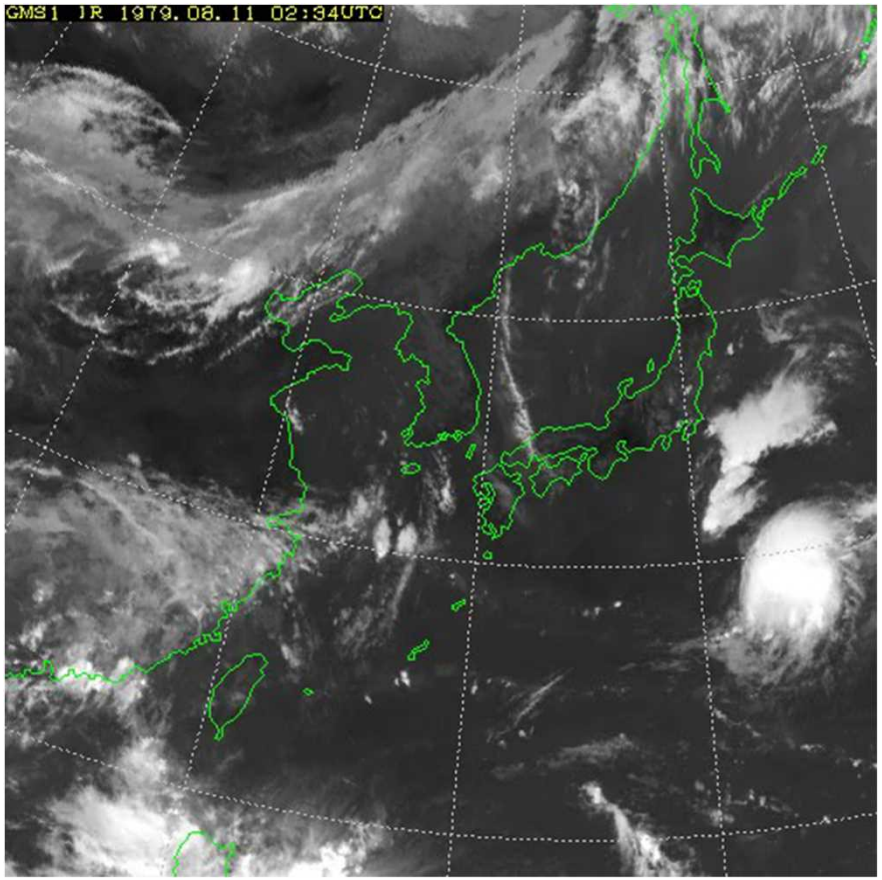
Annual mean error of official track forecast by RSMC Tokyo - Typhoon Center (km)



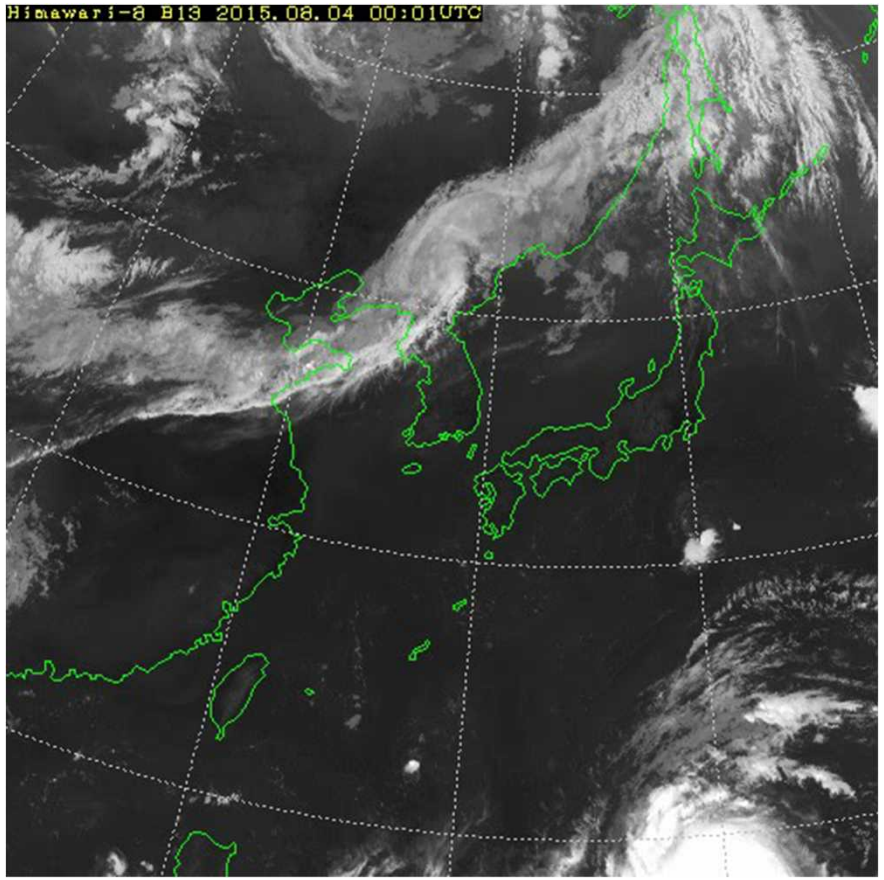


RSMC Tokyo - Typhoon Center's progress in the last 30 years

1st generation



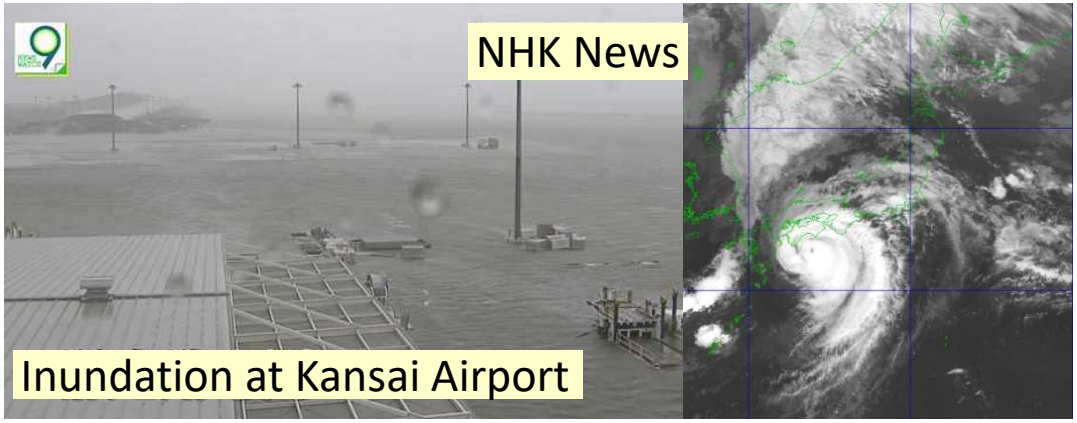
Himawari-8



Remaining risk of tropical cyclones

Typhoon Jebi

brought strong wind, storm surge and heavy rain in western and eastern Japan, having left 14 people dead and more than 900 people injured.

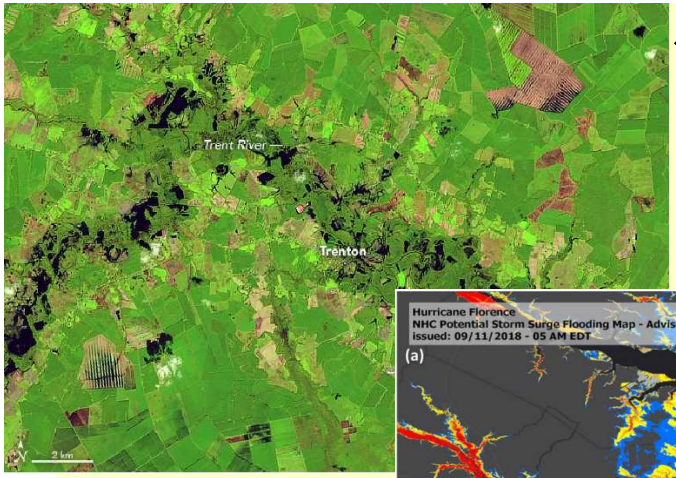


https://www9.nhk.or.jp/nw9/digest/2018/09/0905.html

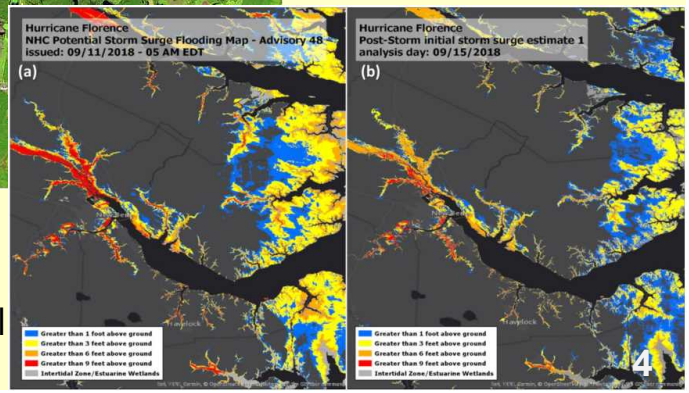
Hurricane Florence

produced extensive wind damage, record breaking storm surge and devastating rainfall that caused catastrophic and life-threatening flooding.
It caused 22 direct deaths and 30 indirect fatalities in the U.S.

(reference: https://www.weather.gov/mhx/Florence2018, https://www.nhc.noaa.gov/data/tcr/AL062018_Florence.pdf)



← Flooded area
from NASA Earth Observatory using Landsat data from the U.S. Geological Survey



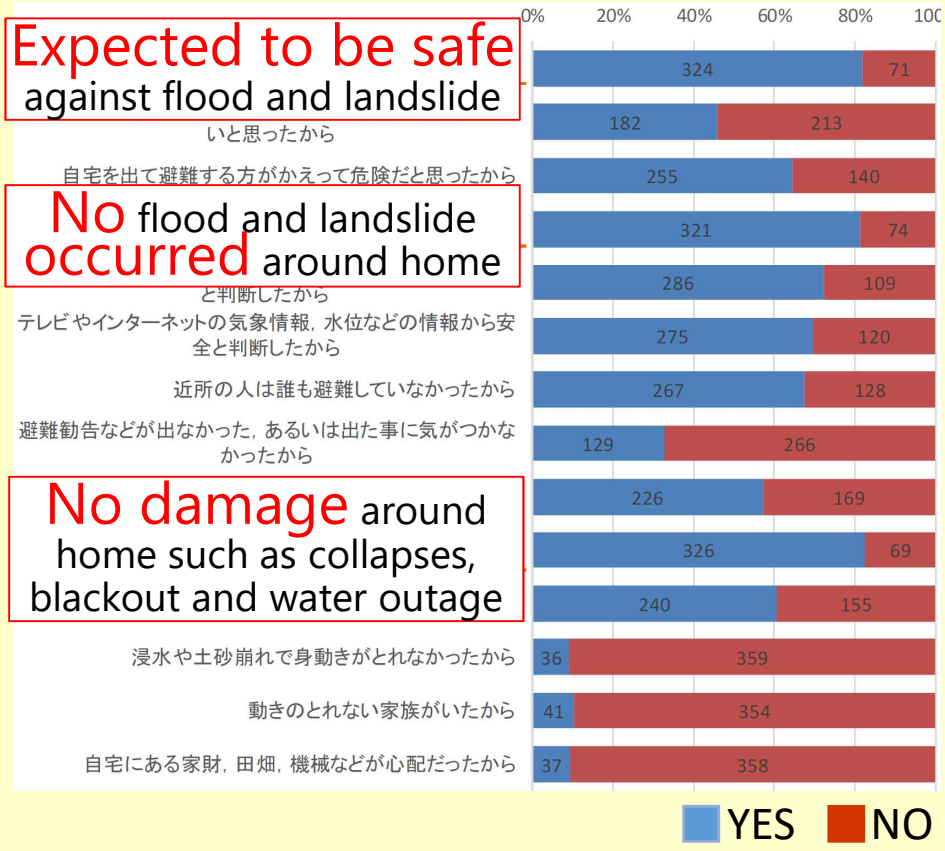
Storm surge estimation →
by the U.S. National Hurricane Center

Challenges to overcome to make meteorological information being used appropriately

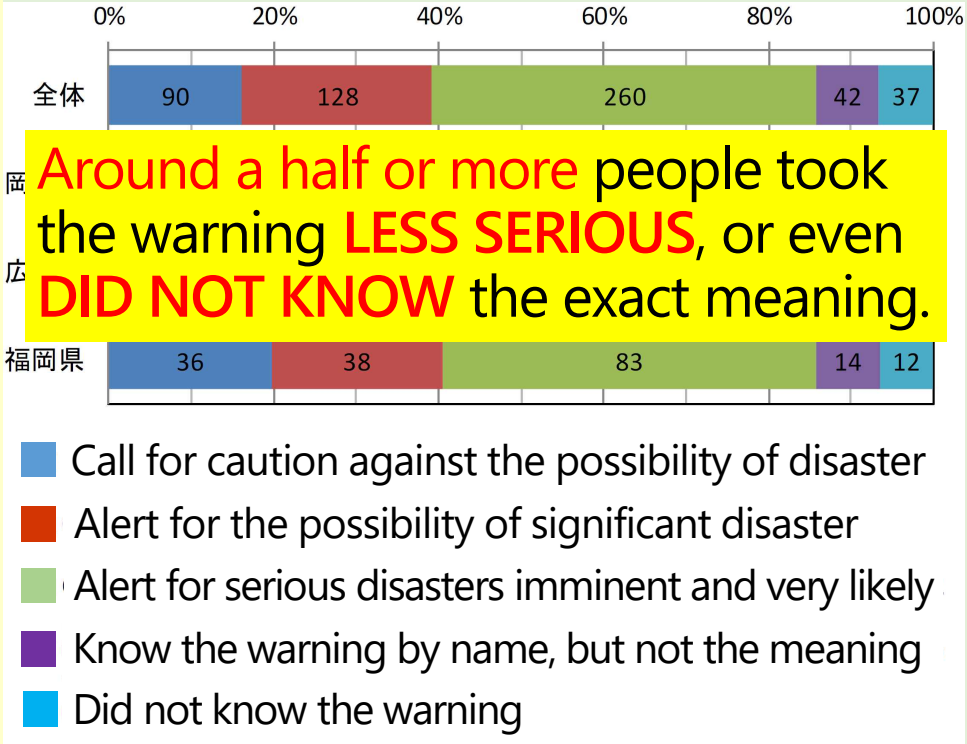
Recent event in Japan (the Heavy Rain Event of July 2018)

- Timely warnings and calls for caution, but some did not evacuate.

Reason for people living in lowland not having evacuated



People's recognition for Emergency Warning for Heavy Rain



Challenges to overcome to make meteorological information being used appropriately

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Recent event in a foreign country

- Hurricane Florence caused severe damage due to flood inland. Evacuation in coastal region was successful but it was more difficult to convey storm surge impacts well in inland along rivers.
- When its intensity category was downgraded from 4 to 1, some people's sense of risk also became lower, though the risk of storm surge and rain did not change.

Challenges to overcome to make meteorological information being used appropriately

It was found that the meteorological information for disaster mitigation was/is not actually functioning as an action initiator:

- the sense of risk was not conveyed to the public in an appropriate manner
- people were not quite aware of the meaning of the information and its usage

Then, what should we do?

More reliable meteorological information

Requirements to NMSs (Technical functions)

- Improvement of accuracy in observation and forecasting
  - Tropical cyclones track, intensity and generation forecasts
  - Observation and calculation of various data such as precipitation amount in river basin, precipitation amount distribution and storm surge
  - Use of AI and IoT to forecasts
- Improvement of presenting uncertainty
  - Quantification of uncertainty and visualization of reliability
- International cooperation to achieve the above improvements
  - Promoting the use and sharing of satellite data and products in each region
  - Promoting the use and sharing of radar data and analysis results in each region
  - Introduction and use of advanced analysis techniques

Meteorological information for disaster response - NMSs' roles -

Roles

- Provide information with recognition of NMSs' role as a trigger of a series of disaster response.

  - Designing information in coordination with various users

- promote the use of such information

Meteorological information for disaster response - NMSs' roles -

Requirement to NMSs (Link to disaster response)

- Providing information that takes into consideration related organizations' and residents' responses based on the provided meteorological information, and evacuation and preparation actions.
  - Issuing information in consideration of "timeline" for each sector.
    # Operations of river and port management, hospitals, schools, and public transportation
  - Reconfirming and strengthening the ideal balance of self-, mutual- and public-help with related organizations.
- Enhancing mutual understanding on the awareness of related organs and the public on the meteorological information provided on a regular basis and on their actions taken in response to the information.
- Being flexible to enhance the meteorological information design and delivery according to user feedback, lessons learned from disasters and to adapt to changing circumstances.

1. Information design and delivery

- NMSs promote **risk-based information** provision which conveys the sense of risk appropriately.
- NMSs provide information **in appropriate amount and time intervals**, avoiding overloading/lack of information.
- NMSs deliver information **in steady and various methods**.
  - providing information via variety of delivery methods such as website, SNS and mobile applications according to the characteristics of information, communication circumstances and users needs.
  - delivering information without fail under emergency by disseminating in diversified yet sustainable methods.
- NMSs **contribute to news reports** that help audiences understand the risk appropriately and initiate necessary actions.
  - communicating with media well so that media can deepen the knowledge on meteorological disaster mitigation.

Improvement in information design and delivery is effective with users understanding

2. Public awareness and education campaign

- Meteorologist for Society -

- NMSs need to enhance **understanding of disaster responses** and their skills in communicating meteorological information to disaster management authorities with understanding of disaster response procedures.
- NMSs promote activities to have **disaster management authorities understand meteorological information**.
  - supporting disaster management authorities in enhancing the understanding of meteorological information as well as to raise work-ready experts of meteorological disaster mitigation through various events such as lecture meetings and drills.
- NMSs **diversify public awareness raising activities** and expand a target.
  - developing skills of leaders in disaster management in each region.
  - in cooperation with various organizations, training experts who will play a key role in education campaign.
  - conducting public awareness raising through active learning.

Roles of RSMCs

In addition to the existing roles*, RSMCs will promote the below activities, regarding the support of NMSs with roles in the next 10-year as also RSMCs' roles.

* monitoring, analyses and forecasts of tropical cyclones as well as training activities

- Sharing of observation data and analysis results in the region in a real-time
  - satellite, aircraft, ground and marine observation data and analyses results
- Providing technical support and technology transfer
  - promoting projects and encouraging experience sharing in technology development among regions
- Information sharing related to disasters and responses from social scientific perspectives within and among regions
- Enhancement of training activities to increase forecasters skills to conduct operations based on enough understanding of disaster responses

With these activities, RSMCs work on the enhancement of technical capabilities and disaster risk reduction in the region.

10-year Vision to protect life and property

We, National Meteorological Services, **recognizing our role as a trigger for disaster response in our own country or territory**, will **co-operate** with other areas in physical science, including hydrology, as well as social science, and emergency response and civil protection sectors, will **provide information that support decision making and initiate disaster response** of relevant organizations and individuals for protecting life and property from disasters caused by tropical cyclones and minimizing loss and damage, and **promote the use of such information**. By doing so, we will **realize a tropical cyclone resilient society**.