19 October 2016

Research plan of typhoon aircraft observations in Japan for the next four years

T-PARCII
(Tropical cyclones-Pacific Asian Research Campaign for Improvement of Intensity estimations/forecasts)

supertyphoon on Sept. 16, 2076

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2: International Coordination Office of S2S, KMA
3: MRI/JMA
4: University of the Ryukyus

NHK World News, 11 June 2016

Japan

Saturday, June 11, 03:56

Aircraft to be used for typhoon observation

Japanese researchers plan to start observing typhoons using aircraft next year, for the first time in about 30 years.

A research team consisting of members from Nagoya University, University of the Ryukyus and the Meteorological Research Institute will carry out the observation.

At present, data collected by weather satellites, such as the size and shape of clouds, are used to estimate the wind speed and atmospheric pressure of typhoons at sea and to forecast their course and intensity.

The accuracy of the forecast course has been improving, but the forecast of position 3 days later can be off by up to 200 kilometers, and the forecast of the intensity of typhoons has not shown any improvement.
Accurate forecasting has been especially difficult for stronger typhoons.

As part of the government-led research, the team will fly a civilian airplane that has been remodeled for observation close to a typhoon, and drop a device called a dropsonde into it. The probe collects data on the speed and direction of the wind, temperatures and humidity at different altitudes as the typhoon passes.

By observing the typhoon directly, it is expected to help forecast the course and intensity more accurately and reveal the mechanism that causes typhoons to develop.

Aircraft are used to observe typhoons in the United States and Taiwan. In Japan it was done just once as an experiment 8 years ago since continuous observation by the US military ended in 1987.

Grants-in-Aid for Scientific Research
we call this KAKENHI in Japanese

Grants-in-Aid for Scientific Research are competitive funds that are intended to significantly develop all scientific research (research based on the free ideas of the researcher), from basic to applied research in all fields, ranging from the humanities and the social sciences to the natural sciences.

http://www.jsps.go.jp/english/e-grants/index.html

Prof. Kazuhisa Tsuboki at Nagoya University, in collaboration with University of the Ryukyus and MRI/JMA, applied for KAKENHI to conduct typhoon aircraft observation research last year and won the funds!

Prof. Kazuhisa Tsuboki
http://rain.hyarc.nagoya-u.ac.jp/~tsuboki/

Overview

- The period of the research is 5 years from 2016-2020.
- The Gulf Stream II aircraft will be used for dropsonde observation (4 channels) surrounding a typhoon (similar to DOTSTAR in Taiwan).
- A check of equipment implementation and test flight will be made in February 2017.
- Typhoon observations will be made for the next 4 years from 2017-2020.
- The number of flights will be one or two times a year because the budget is limited (approx. 1.7M USD in total).
- The main observation area is the south of Okinawa where a typhoon turns. The aircraft will fly from Naha or Okinawa.

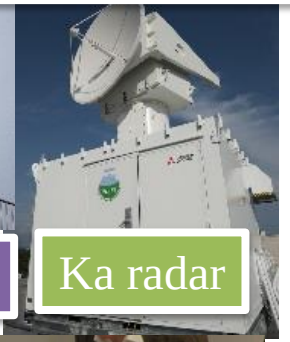
Diamond Air Services (DAS) will operate the Gulfstream II aircraft for the project. DAS is located in the Nagoya City Airport which is close to Nagoya University.

We perform aircraft observation of typhoon to improve intensity estimation, and also in-situ observation of thermodynamical and cloud-microphysical processes of typhoons to improve numerical model.

dropsonde from the aircraft

Using dropsondes dropped from the aircraft, temperature, humidity, pressure, and wind are measured in the surrounding region of the typhoon eyewall.

X band radar

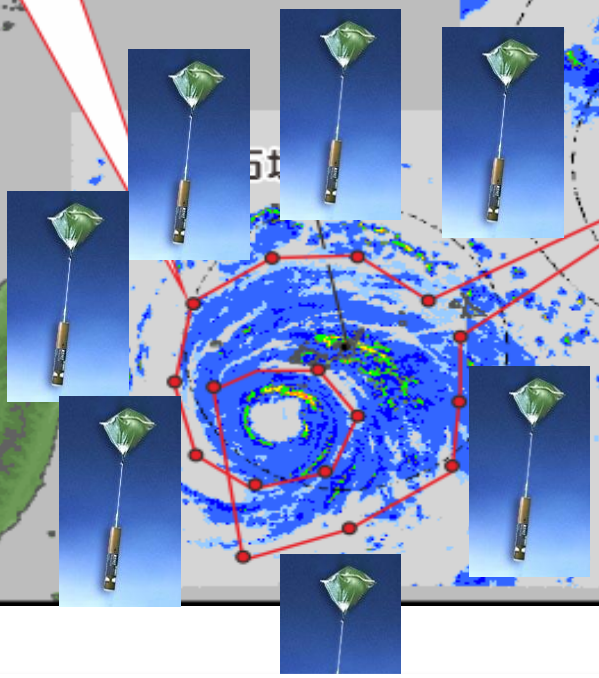


Ka radar

Drone

COBRA

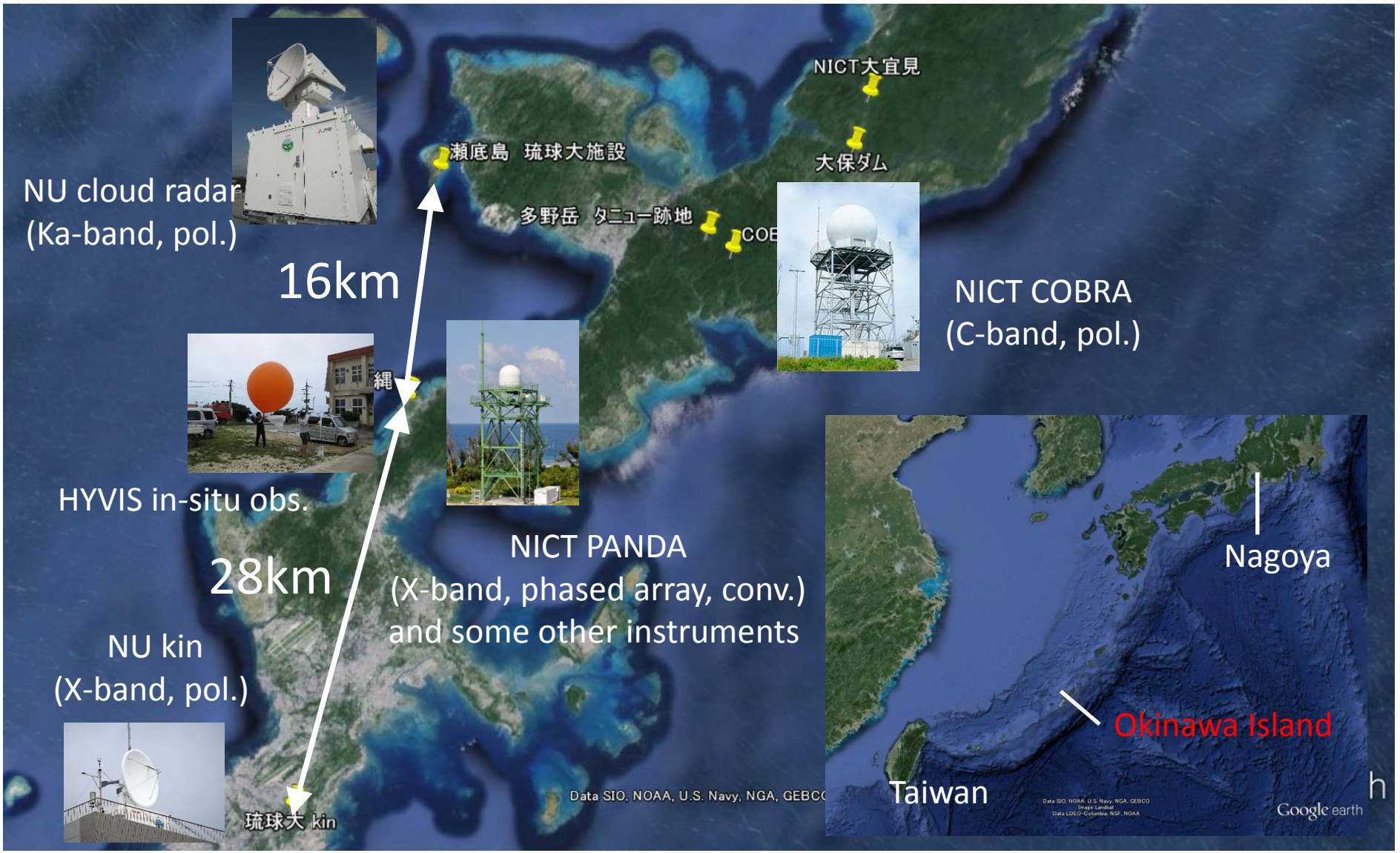
沖縄



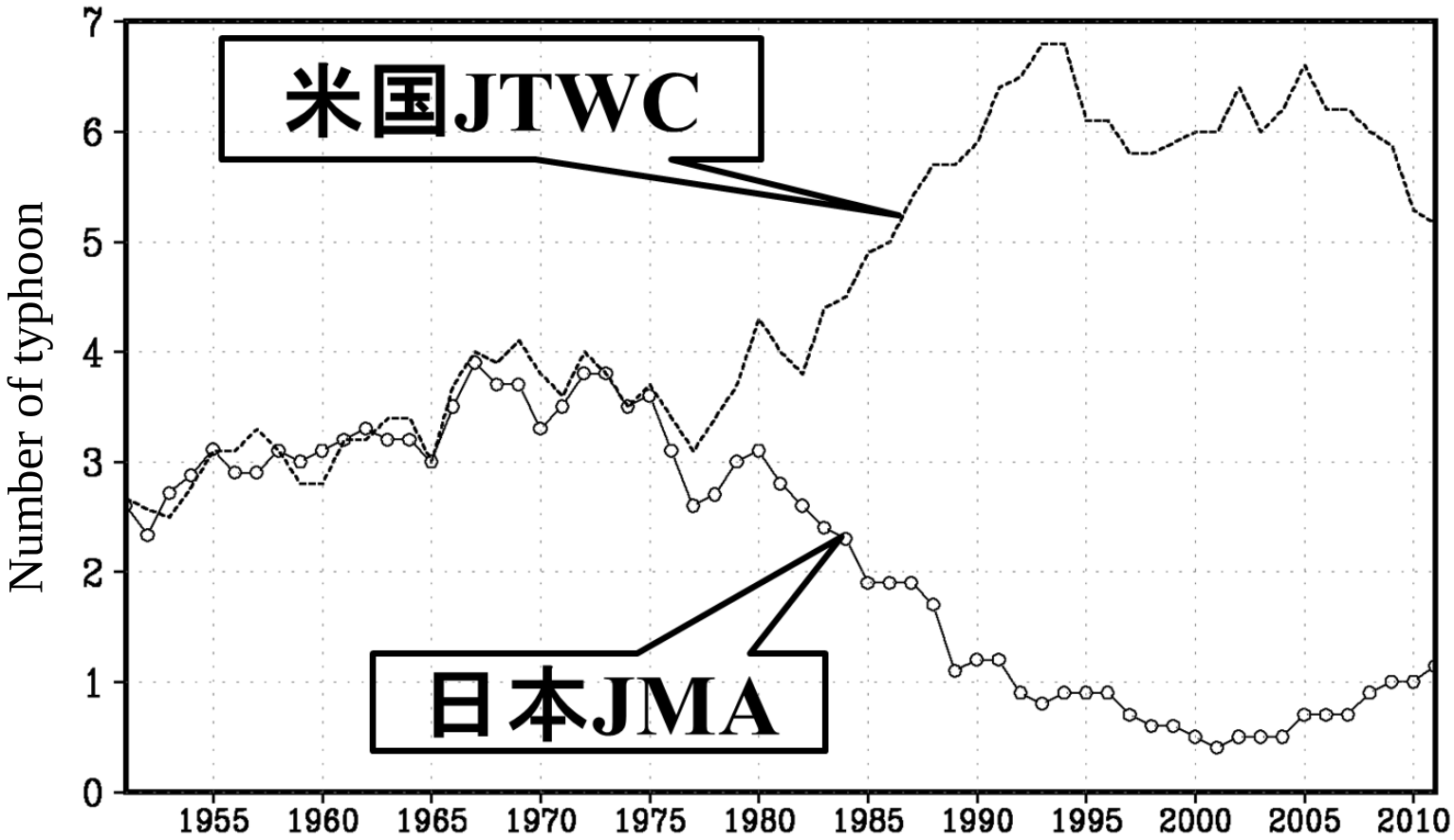
Typhoon prediction using numerical model

The dropsonde data are assimilated to the numerical cloud-resolving model

Okinawa observation plan in 2016 (Collaboration with Nakakita COBRA project)

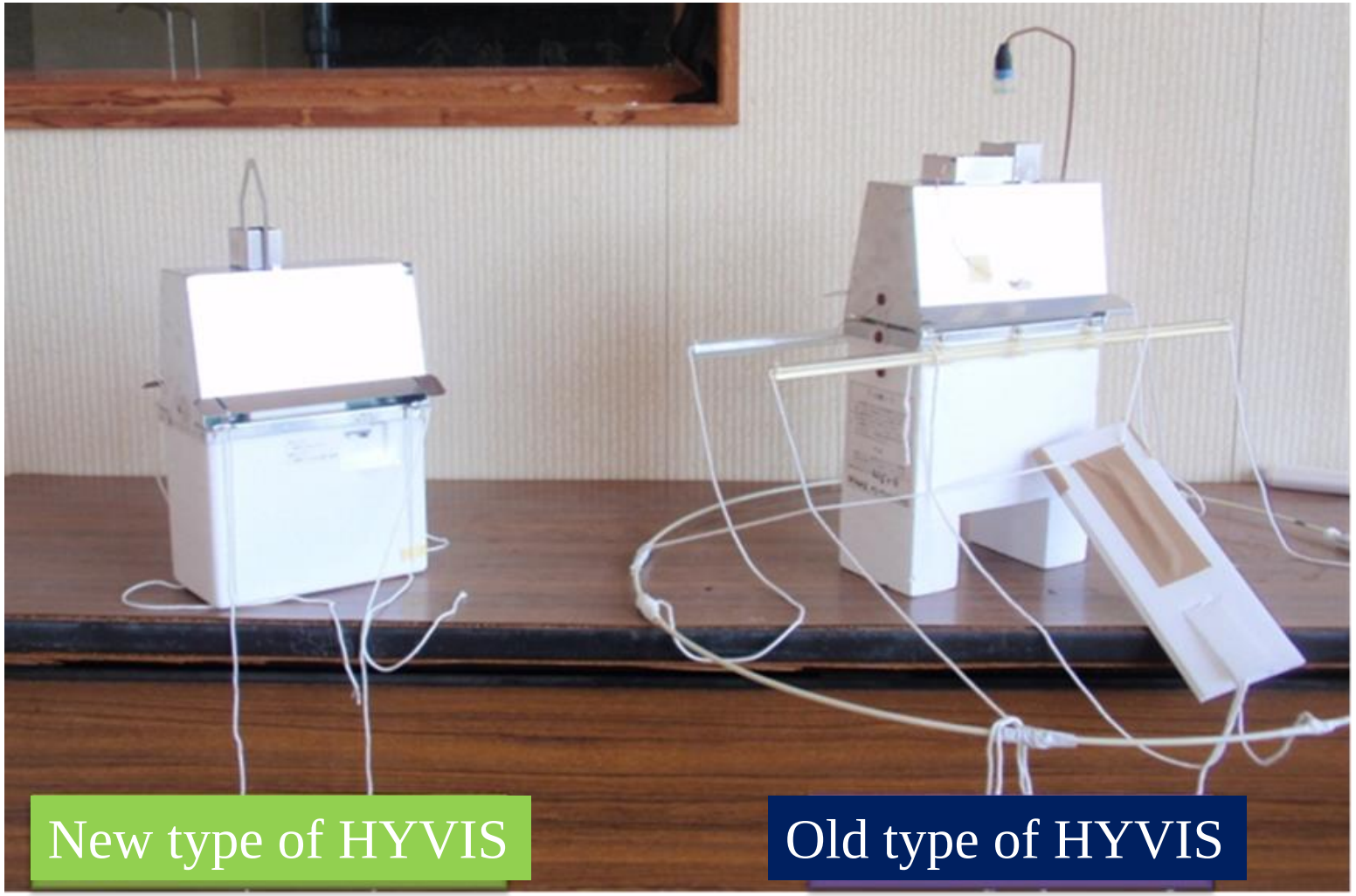


- These results raise great concern regarding future change in typhoon intensity in the western North Pacific.
- However, the historical data of typhoon include large uncertainty.
- In particular, intensity of intense typhoons seems to include large error after the termination of the typhoon reconnaissance by the US aircraft in 1987.
- In fact, the annual number of the JMA-strongest category of typhoon (10 min. averaged sustained wind is 54 m/s or more) shows large difference between JMA and JTWC.

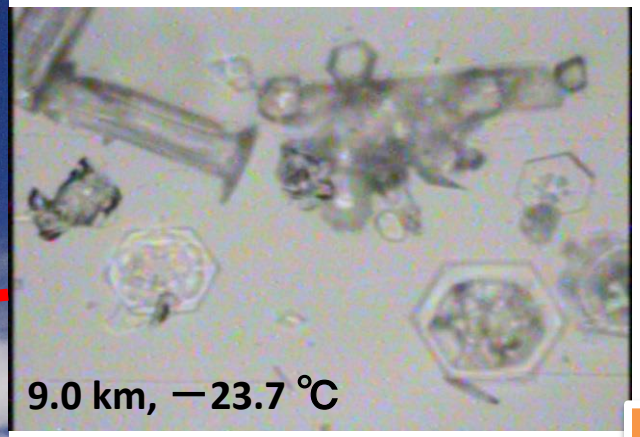


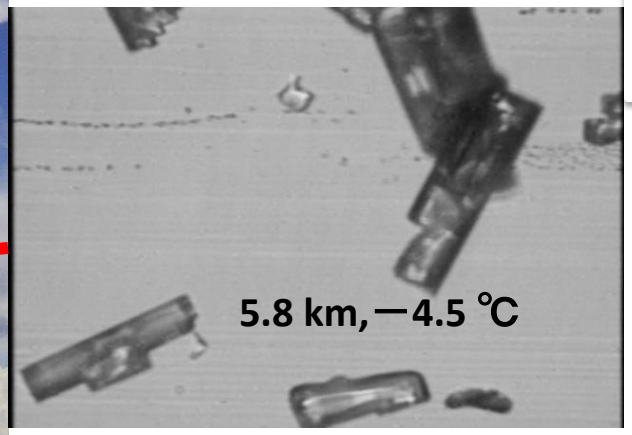
No in-situ observation by an aircraft makes it unknown which is better estimation of intensity; JMA or JTWC.

Hydorometeor Video Sonde (HYVIS)



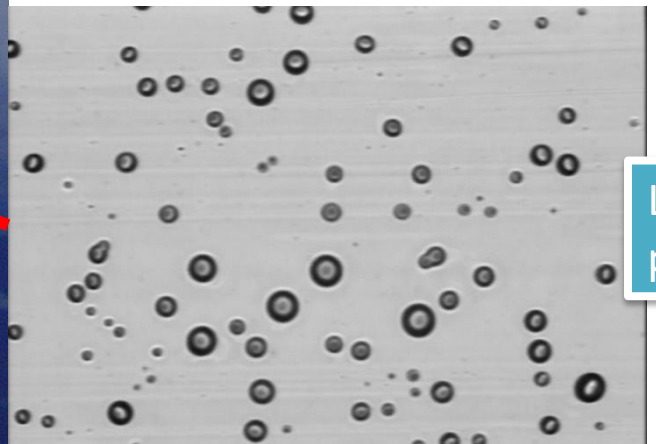
Weight of new HYVIS: 1270g
Weight of old type : 1700g, 2200g





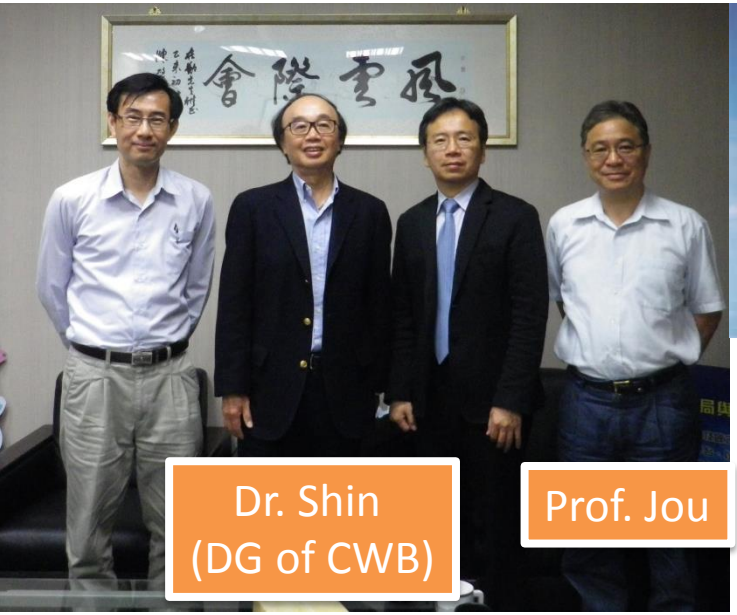
Solid particles

0°C



Liquid particles

Collaboration with DOTSTAR



Prof. Tsuboki visited Taiwan to discuss collaboration with DOTSTAR (12 April 2016)

Typhoons tend to make a recurvature around these areas -> Large uncertainty in TC prediction.

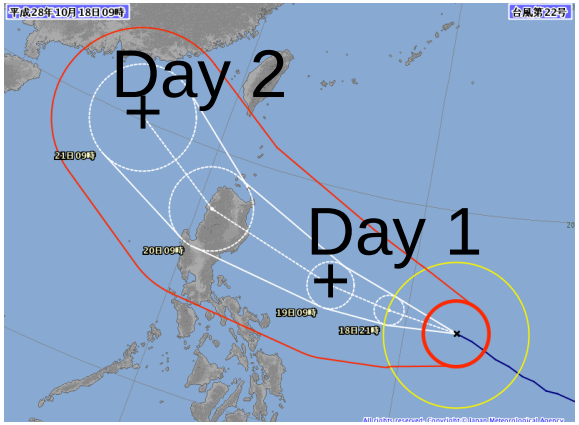
International Collaboration for Typhoon Sensitivity Analysis

The name of organizations/contact points that have agreed to provide the Sensitivity Product for T-PARC II

- AOML (S. Aberson)
- NTU (C.-C. Wu)
- ECMWF (D. Richardson)
- NRL (J. Doyle)
- U. of Miami (S. Majumdar)

Typhoon Targeting System Home Page

Verification Areas:



2017	8/23	8/24	8/25
Hong Kong	-	Plan	-
Taiwan	-	-	-
Korea	-	-	-
Japan	-	-	-

Verification Time (VT):

Year Month **2017 08**

Day **25**

● 00Z ○ 03Z ○ 06Z

○ 09Z ○ 12Z

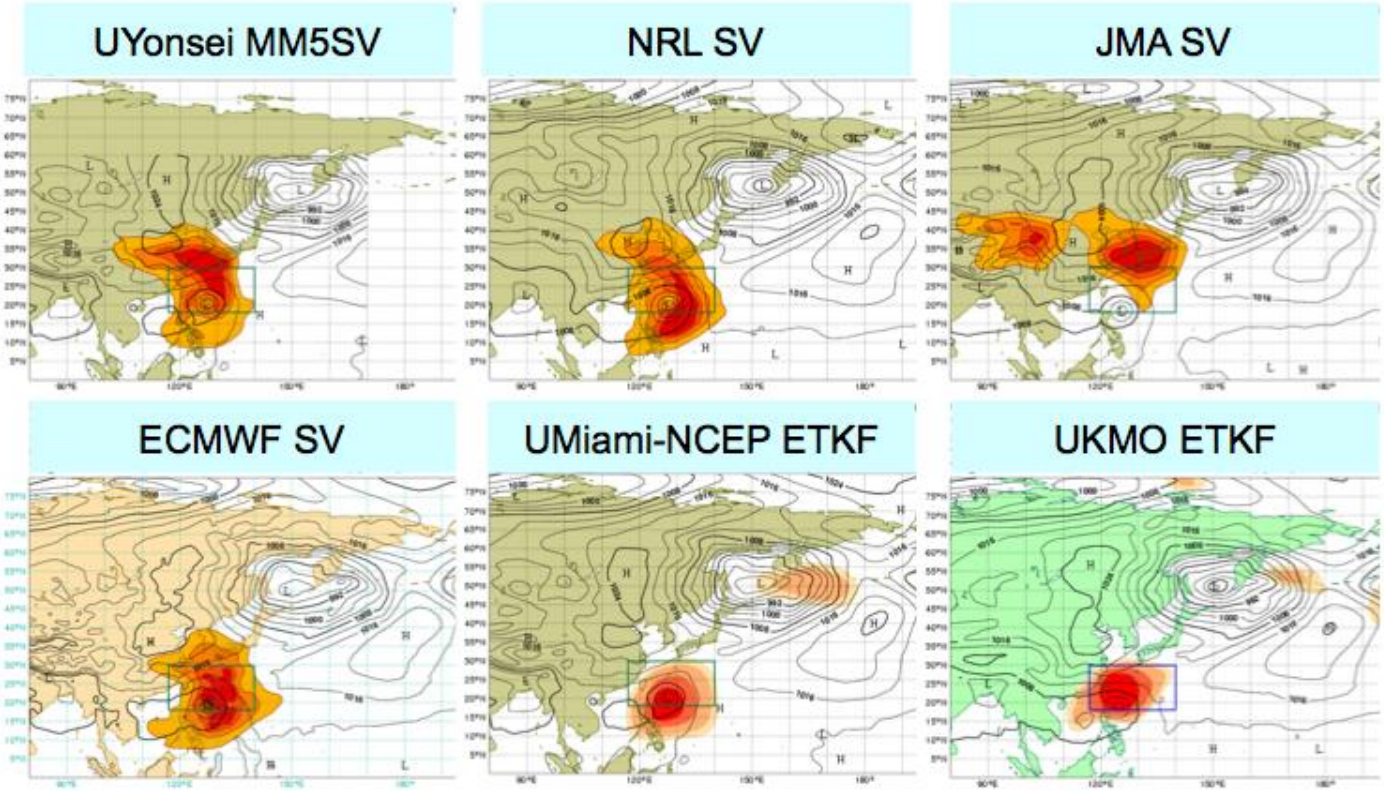
Target Obs. Time:

○ 12 hour before VT

● 1day before VT

○ 1.5 day before VT

○ 2day before VT



Efforts to be endorsed by the Science Council of Japan

The Meteorological Society of Japan, in collaboration with other academic societies, have submitted a research proposal titled “Promotion of Research on Climate and Earth System Science by Advanced Aircraft Observations” to the Science Council of Japan. Research areas range from Tropical Cyclones to Aerosols-Could Interaction, Greenhous gases and so on, and we plan to use Mitsubishi Regional Jet (MRI) for aircraft observations. Larger research funds can be obtained if the Science Council of Japan endorses the research plan. Unfortunately we failed to get the endorsement two times in a row. The next chance will come in 2020.

Promotion of Research on Climate and Earth System Science by Advanced Aircraft Observations: Plans for the New Aircraft Program of Japan

Summary of the report of the Aircraft Observation Planning Committee of the Meteorological Society of Japan (MSJ)

Hiroshi Niino (President of MSJ) and Makoto Koike (Chair of the Committee)

October 1, 2015

1. Background

The Earth’s environment has been changing rapidly, particularly as manifested by global warming, and the changes are imposing large impacts on the fundamental structures of our lives, including socio-economic activities and supplies of water and food. It is critically important to fully understand the current status of the changes and to investigate the controlling processes, in order to predict future changes and protect human society and ecosystems from serious damage. At present, direct atmospheric observations by aircraft are lacking in important geographical regions; they are needed for understanding greenhouse gases, aerosol-cloud interactions, and the hydrologic cycle, including predictions of typhoons and torrential downpours. Japan lacks an aircraft dedicated to scientific measurements, so Japanese scientists have been obliged to charter commercial aircraft for

MRJ: Mitsubishi Regional Jet

http://www.metsoc.jp/default/wp-content/uploads/2015/10/1eb0dc5d7ff364599db9d8d921296ccc.pdf

See pages 185 to 188.

R&TD on High Altitude Long Endurance UAS

Kenya HARADA

UAS Technology Group
Technology Demonstration Research Unit
Aeronautical Technology Directorate(ATD) /
JAXA (Japan Aerospace Exploration Agency)

UAS R&D Program in JAXA

Courtesy of Kenya Harada
(JAXA, Japan Aerospace Exploration Agency)

2003 - 2007	2008 - 2012	2013 - 2017	2018 - 2022

Disaster Monitoring UAS

Weather Observation UAS

Remote Sensing UAS

Unmanned Aerial Radiation Monitoring System

UARMS

HALE-UAS

Unmanned Aircrafts for aerospace technology demonstration ;

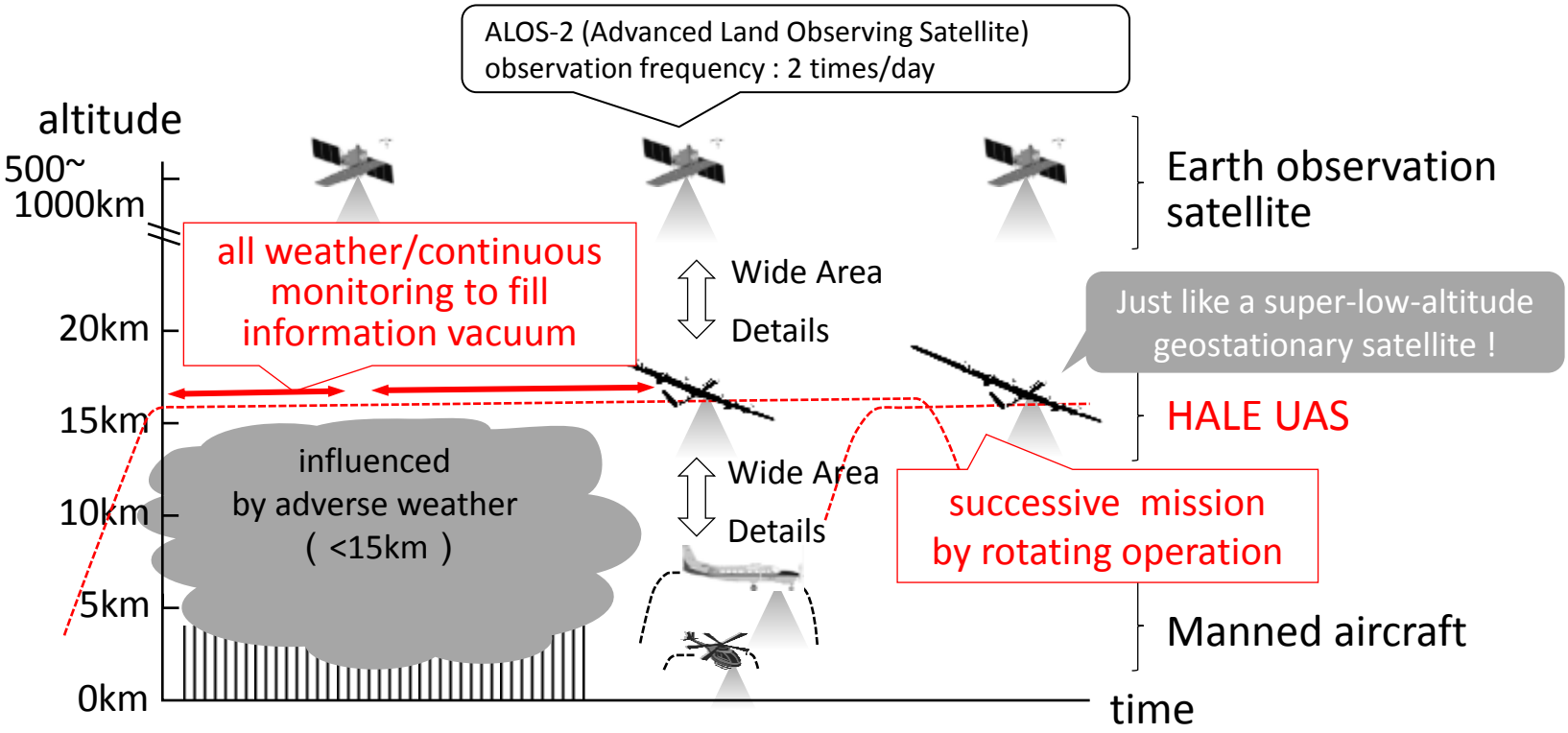
Reentry Vehicle Technology
(ALFLEX, HSFD)

Tiltwing VTOL

Aerodynamics for Supersonic Transport
(NEXST-1, D-SEND)

Objectives / Outline

R&D of High Altitude Long Endurance (HALE) UAS
to get all-weather continuous mission capability
as an observation / communication platform



Possible Applications

- **Disaster Monitoring**
  Continuous monitoring of ongoing disaster ; landslide or flood by storm, seismic fire or tsunami by earthquake, volcanic eruption, etc.
- **Weather Observation**
  Meteorological observation for weather forecasting and environment monitoring
- **Communication Relay for Disaster Area**
  providing high-speed communication service for both disaster-relief activities and disaster victims
- **Maritime Surveillance (Maritime Domain Awareness)**
  Frequent observation of illegal maritime activities (invasion to the territorial waters, unidentified ship, illegal fishing boat, illegal investigative action, etc), marine accident, marine pollution, etc.

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- Government use for land management
- Industrial use for agriculture, forestry, fisheries, and resource mapping
- Academic use for scientific and engineering research