

JAMSTEC "Cyber System" Current Status

Ken'ichi Itakura (JAMSTEC)

- JAMSTEC Super-computer system: ES

- Cyber System for Geo- and Oceanographic Information
 - Earth Informatics Cyber System

- Test Case: JAMSTEC "Cyber System"
 - SI-CAT program

- Summary

Global Change

Oceanographic observation and modeling research, to understand the causes of global environmental change and predict the future.



Vessels



HPC

Earth Evolution

Clarifying the dynamics of the Earth's interior, to understand the causes of earthquakes, volcanoes, tsunami, and other natural disasters.

Biogeosciences

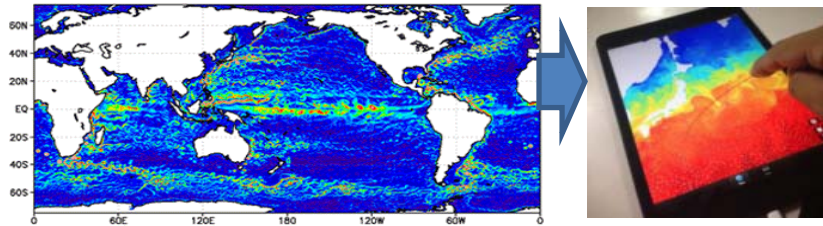
Studying organisms mainly in extreme environments to understand complex ecosystems and make effective use of marine bio resources.

Our Mission at CEIST/JAMSTEC:

contributing towards the safe and secure global society by -

Advance the research of computer simulation

Develop leading-edge mathematical, physical models and simulation methods using large scale computer systems to predict various phenomenon in multiple scales with high accuracy.

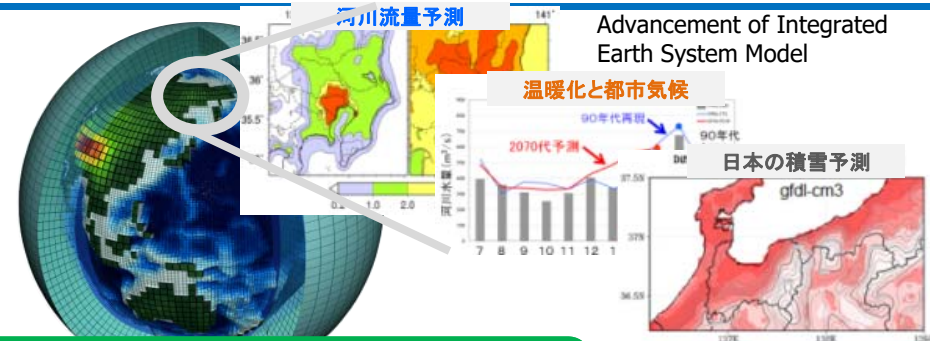


Manage IT infrastructure including Earth Simulator

Manage stable and efficient IT infrastructure including large scale supercomputers for researchers providing advanced user environment with sufficient technical information and support.

Create and disseminate data/information

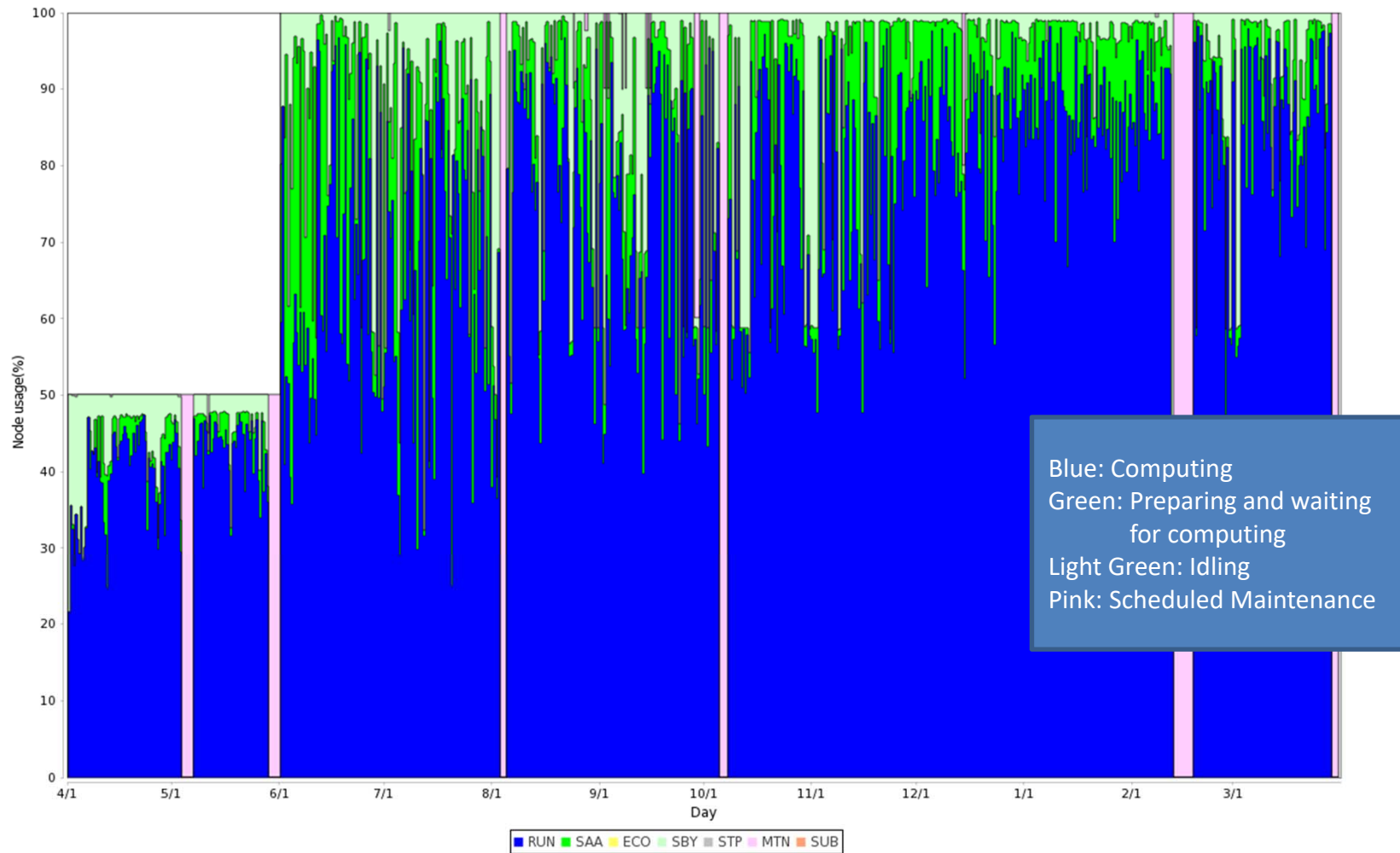
Create information valuable for science and society using massive amount of earth data. Develop data assimilation/synthesis, large scale numerical simulation and visualization.



Earth Simulator Operation (Apr. 2015 – Mar. 2016)

Node usage in fiscal 2015

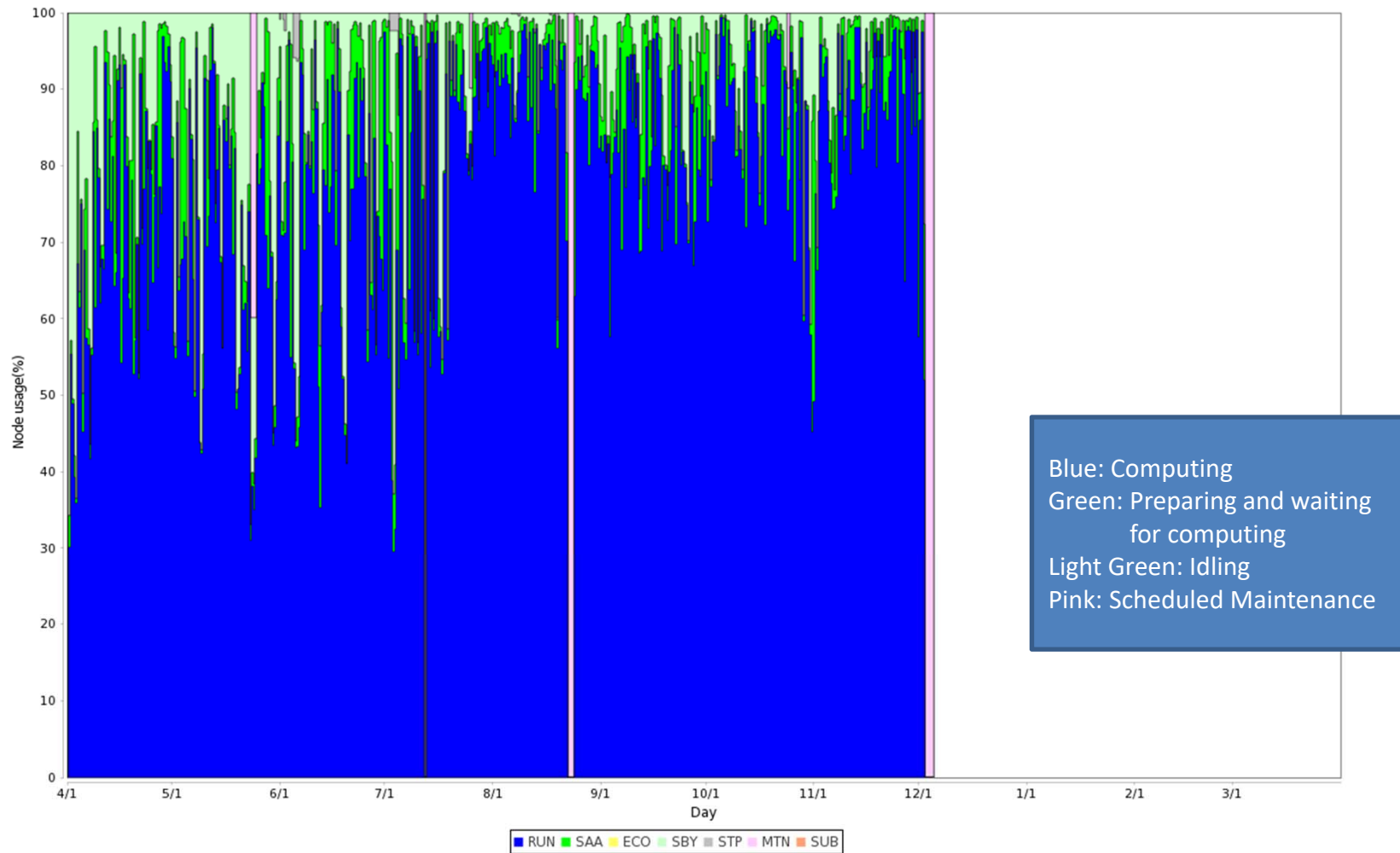
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Earth Simulator Operation (Apr. 2016 – Nov. 2016)

Node usage in fiscal 2016

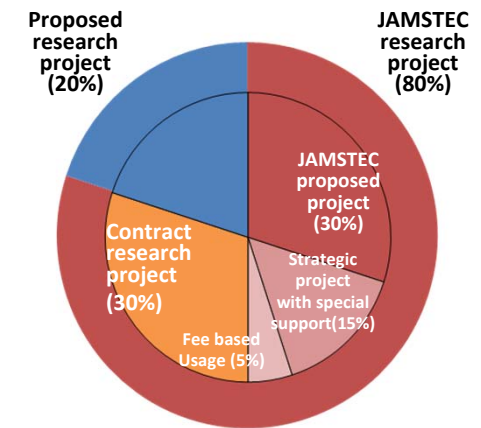
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Earth Simulator Resources allocation

◆ JAMSTEC Research Projects

(1) JAMSTEC Proposed Projects	23
(2) Strategic Project with special support (※1)	4
(3) Contract Research Projects	
Program for Risk Information on Climate Change	1 (3subjects)
HPCI (High Performance Computing Infrastructure)	3
Other project funded by the Government	1
(4) Fee Based Projects	8
◆ Proposed Research Projects	27



FY2016 Allocation

◆ Registered User

ES	Proposed Research	JAMSTEC Proposed	Strategic Project	Contract Research	Total
#user id	214	337	21	204	776

As of Sep. 26, 2016

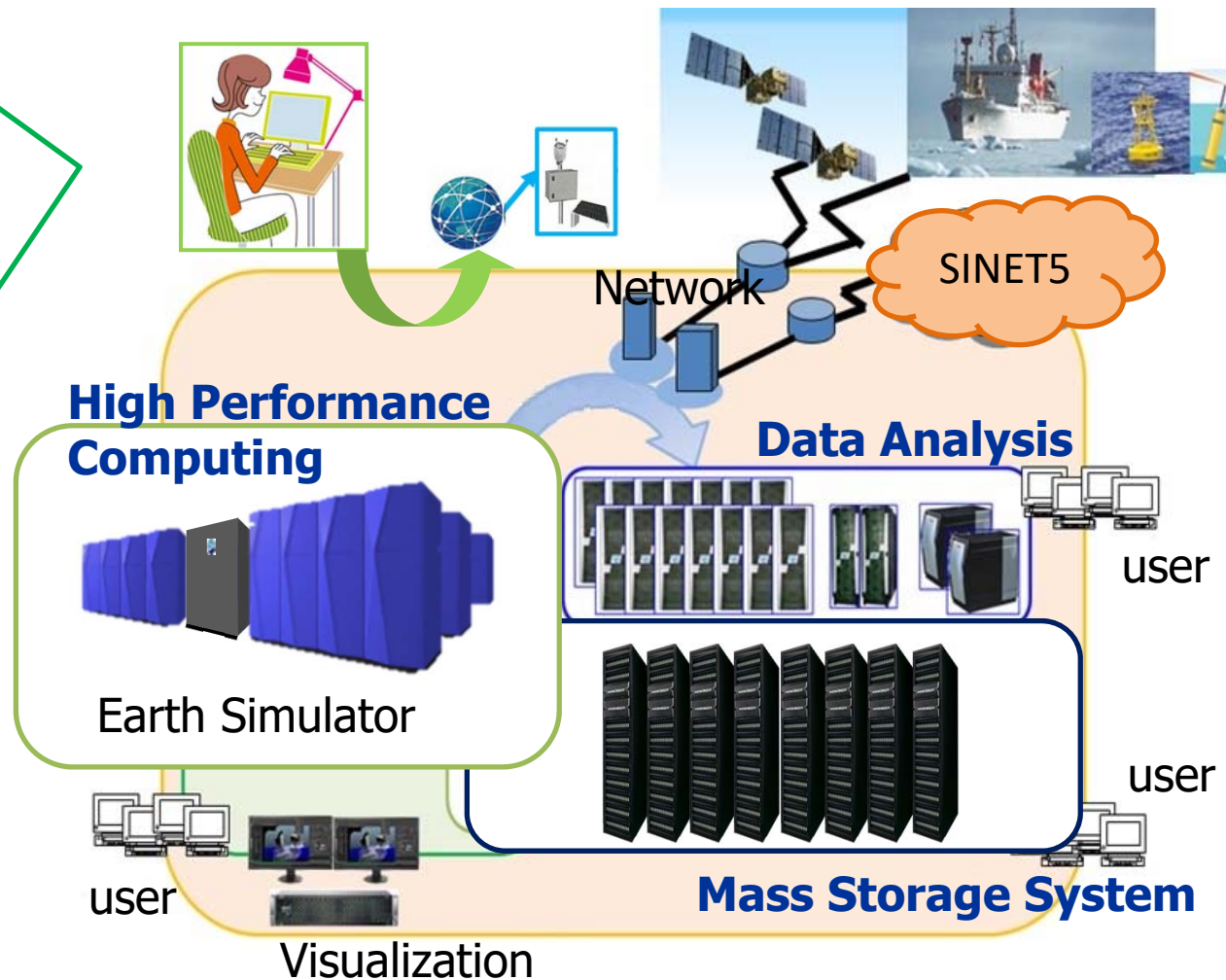
* Number of Strategic Project is the total sum of three terms (Mar-May, Jun-Sep, Oct-Jan)

“Cyber System” for Geo- and Oceanographic Information

where, HPC is a indispensable part of the intensively networked whole system

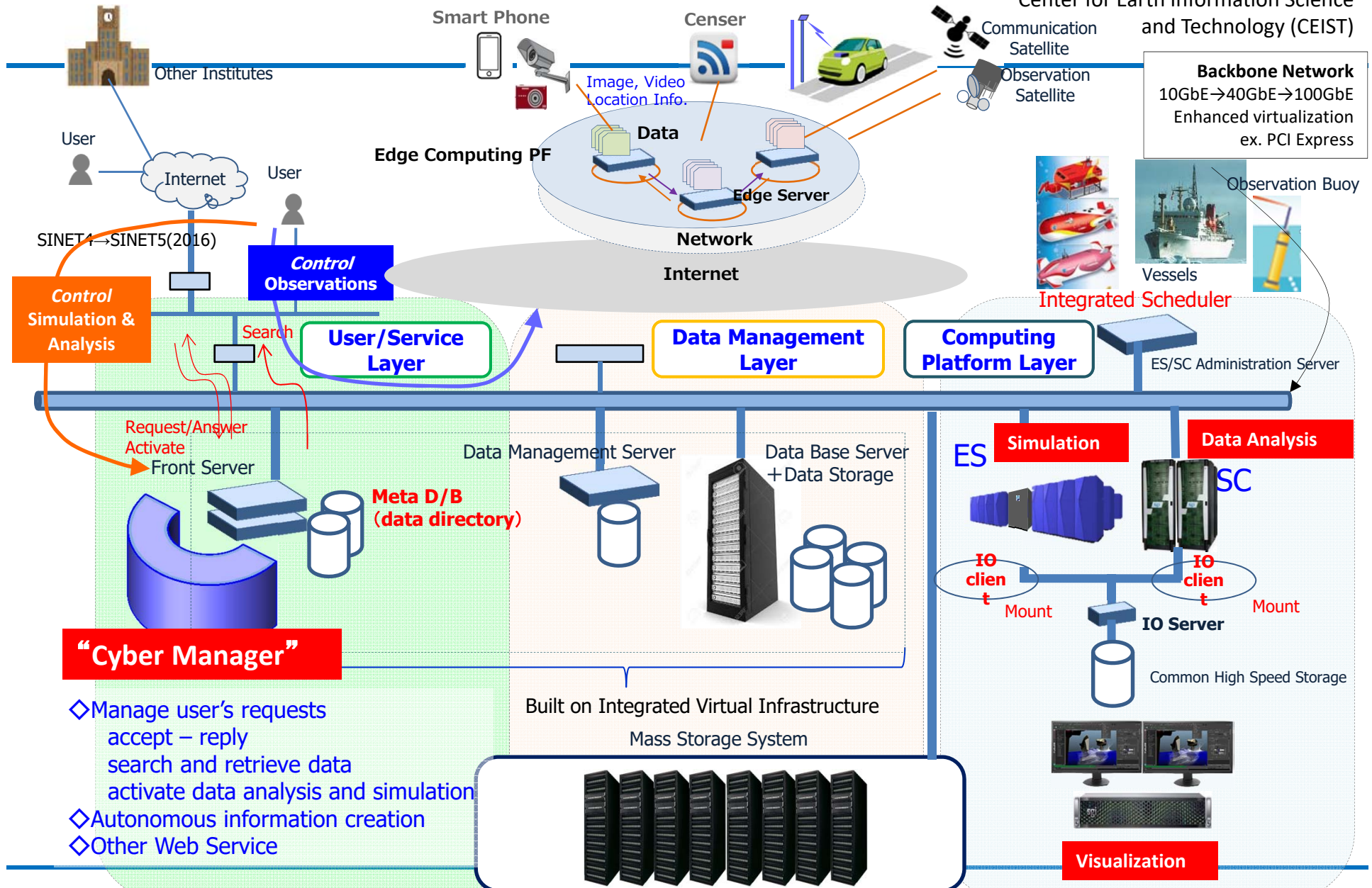
- Users control observation facilities and vessels remotely.
- As soon as receiving 3D observation, users proceed quality control, visualization or launch simulation and analysis.
- The results of simulation and analysis are sent to observation facilities and vessels immediately.

It will change the style of research !



Earth Informatics Cyber System

Center for Earth Information Science and Technology (CEIST)



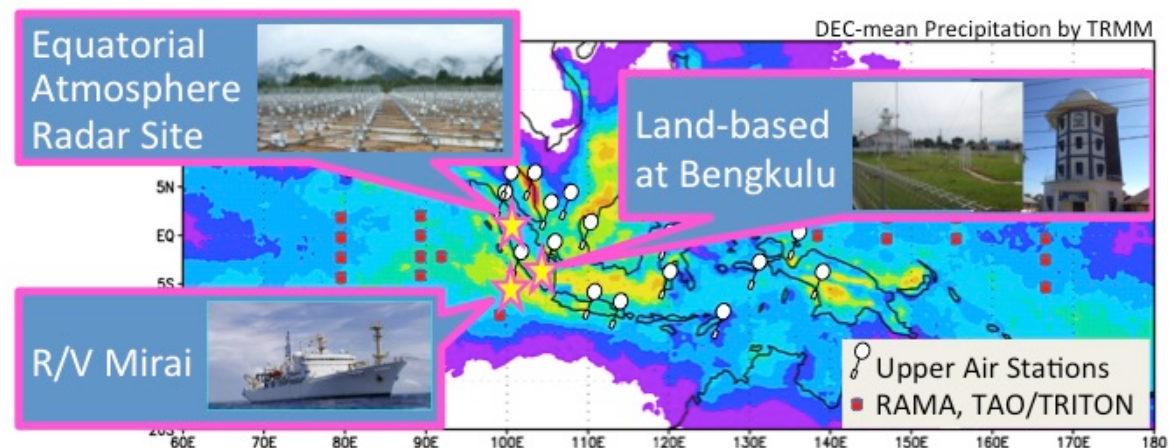
Test Case: JAMSTEC "Cyber System" Pre-YMC campaign

YMC : “Years of the Maritime Continent”

The goal of the "Years of the Maritime Continent (YMC)" is to expedite the progress of improving understanding and prediction of local multi-scale variability of the MC weather-climate system and its global impact through observations and modeling exercises.

Pre-YMC Observations in 2015

- Purpose:** Precipitation mechanism off and on Sumatra, with focus on the relationship with
1) local atmospheric circulation vs. MJO
2) IOD (SST condition over the oceanic upwelling region).
- Period:** Nov – Dec 2015
- Location:** Eastern Indian Ocean ~ Sumatra
- Observations:** R/V Mirai C-band Polarimetric Doppler radar, Radiosonde, CTD, etc.
Bengkulu X-band Polarimetric Doppler radar, Radiosonde, Surface Met, etc.
Kototabang Equatorial Atmosphere Radar, Water vapor + Ozone sonde



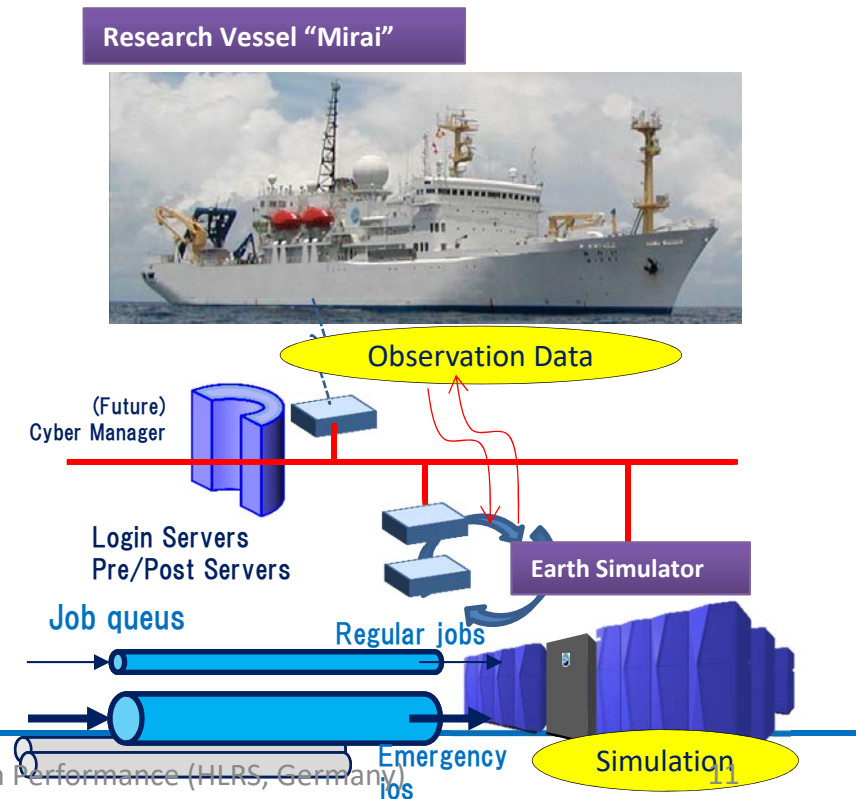
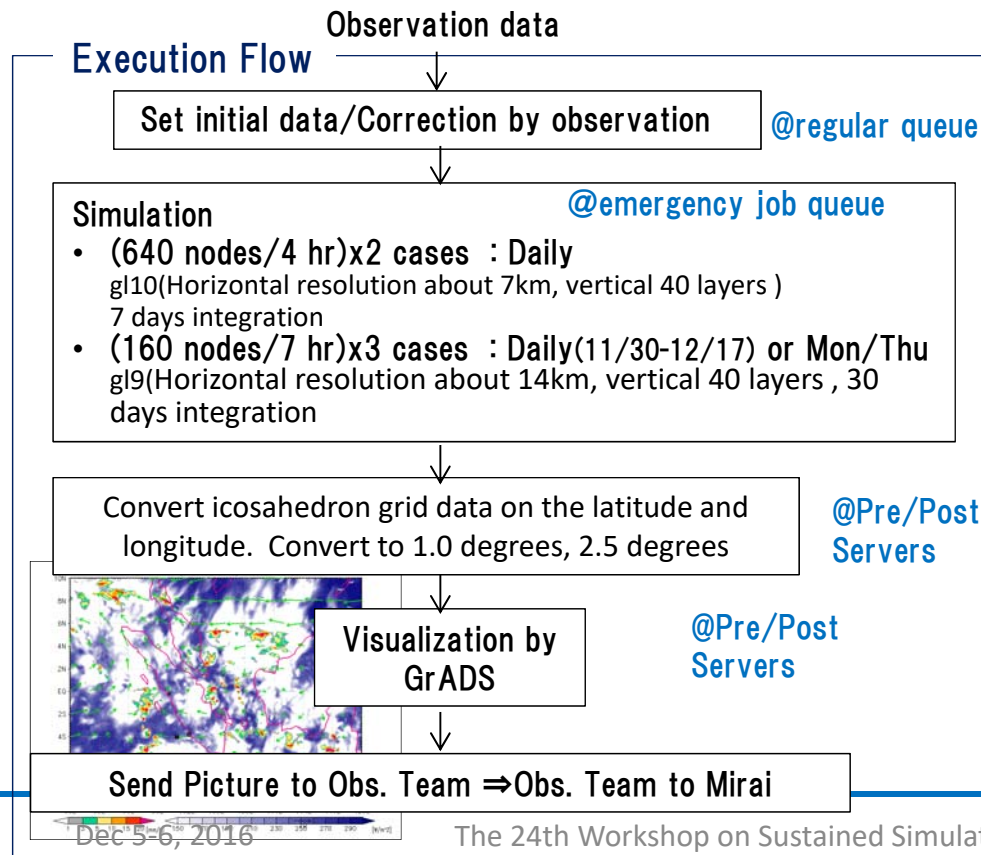
Daily Prediction by Numerical Model for research vessel MIRAI

Pre-YMC 2015 campaign

As a collaboration of CEIST and a research group*, semi-real time simulation by Global Cloud Resolving Model “NICAM” on Earth Simulator provided daily prediction for “MIRAI”, which was performing a fixed-point observation in the eastern Indian Ocean Sumatra coast from 11/1 to 12/25, 2015.

* Department of Seamless Environmental Prediction Research (DSEP)

- Established the collaboration immediately upon the request from the research group.
- To secure the completion of daily prediction, Pre-YMC simulation had priority on 40% of ES computing resource and used the emergency job queue.
- The code was developed on ES and performed in high efficiency. (15% of peak)





Social Implementation Program on Climate Change Adaptation Technology

Social Implementation Organizations

As core organizations, social implementation organizations manage the Program and bridge the gap between the seeds of technologies and the needs of local governments. This section contains the organizations responsible for the roles.

Model Municipalities

This section introduces municipalities that are involved in research and development as members of technological development organizations.

Technological Development Organizations



Near-term climate change projections

Technological Development Organizations



Downscaling

Technological Development Organizations



Impact Assessments

Ministry of Education, Culture, Sports, Science and Technology

- Managing the operation of the overall Program
- Coordinating with related government ministries and agencies, social implementation organizations, and those who need climate change adaptation measures

Social Implementation Organizations

Social Implementation Organizations

-Producing socioeconomic scenarios for local governments by collecting and analyzing their needs, utilizing knowledge from researchers of social science and humanities

-Providing needs information to technological development organizations and reflecting it in the achievements

-Disseminating the achievements obtained from the project to local governments

-Managing the progress of the overall Program

Others including support for holding the Program general meetings

Program Director

Management Meeting
Composed of external experts

Disseminating achievements

Providing needs

Local Governments in Japan and etc.

- Providing needs of local governments and research institutions that have a high level of interest in climate change adaptation, and those of private enterprises that are interested in adaptation businesses, to social implementation organizations
- Offering the information such as future prospects of local governments around 2030
- Implementing the achievements of the Program provided by social implementation organizations

Municipalities

Enterprises

Municipalities

Research institutes

Providing instructions to technological development while considering needs

Program General Meeting

Municipalities, which voluntarily make efforts to cope with climate change adaptation or which are taking the initiative to engage in the efforts, join model municipalities while cooperating with R&D.

Technological Development Organizations

Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

1. Near-term climate change projections

-Providing the information of near-term climate change projections, which is versatile and precise in temporal scales (around 2030), and in which uncertainties are reduced.

Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

2. Super high-resolution downscaling techniques

-Providing the information of super-high-resolution projection by spatial scale, which enables local governments to formulate adaptation measures

National Institute for Environmental Studies (NIES)

3. Assessment techniques for effectiveness of adaptation measures

-Developing applications for climate change impact assessments for local communities, effectiveness assessments when adopting multiple adaptation measure and utilization of the achievements.

Model Municipalities and etc.

Municipalities

Research Institutions

Regional universities

Local governments (including regional universities that work in coordination with municipalities) and research institutions have needs of climate change adaptations in the fields of agriculture and disaster prevention. On the other hand, private enterprises have a strong interest in adaptation businesses. People from the local governments, the research institutions, and the private enterprises can actively participate in R&D as members of technological development organizations from the conception phase. They conduct provisions of observational data, trials of development achievements, and dissemination of said achievements.



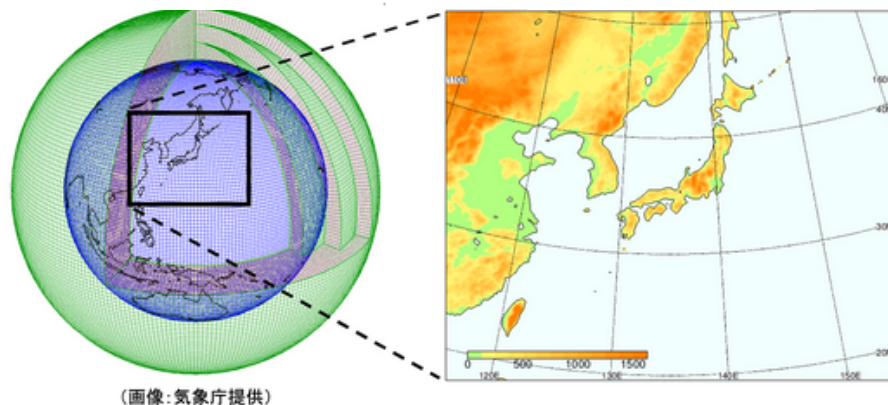
Welcome to d4PDF

Planning for adaptation to global warming will be based on impact assessments of disasters, agriculture, water resources, ecosystems, human health, and so on, in each region. For each impact assessment, detailed projections of extreme events such as heavy rainfall, heat wave, drought, and strong wind are required at the regional scale as well as projections of climatological temperature and precipitation. An unprecedentedly large ensemble of climate simulations with a 60 km atmospheric general circulation model and dynamical downscaling with a 20 km regional climate model have been performed to obtain probabilistic future projections of low-frequency local-scale events. The simulation outputs are open to the public as a database called “Database for Policy Decision-Making for Future Climate Change” (d4PDF), which is intended to be utilized for impact assessment studies and adaptation planning for global warming.

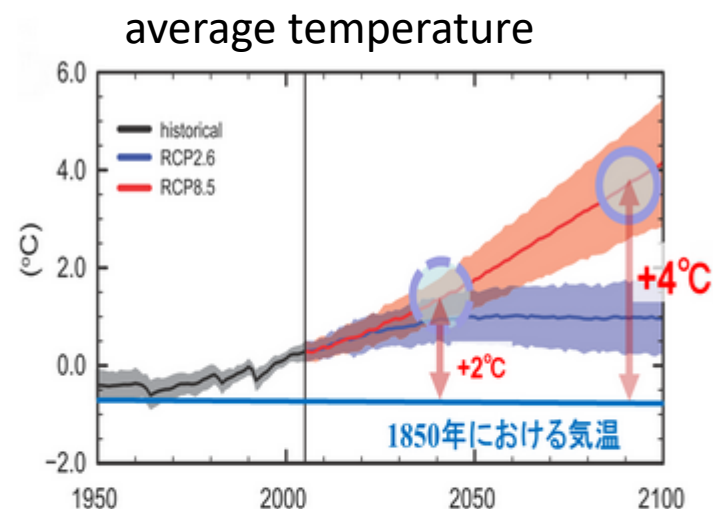
Database of d4PDF

AGCM
60km mesh

NHRCM
20km mesh



Total data size : 2PB
Stored in DIAS
(the Data Integration and Analysis System)



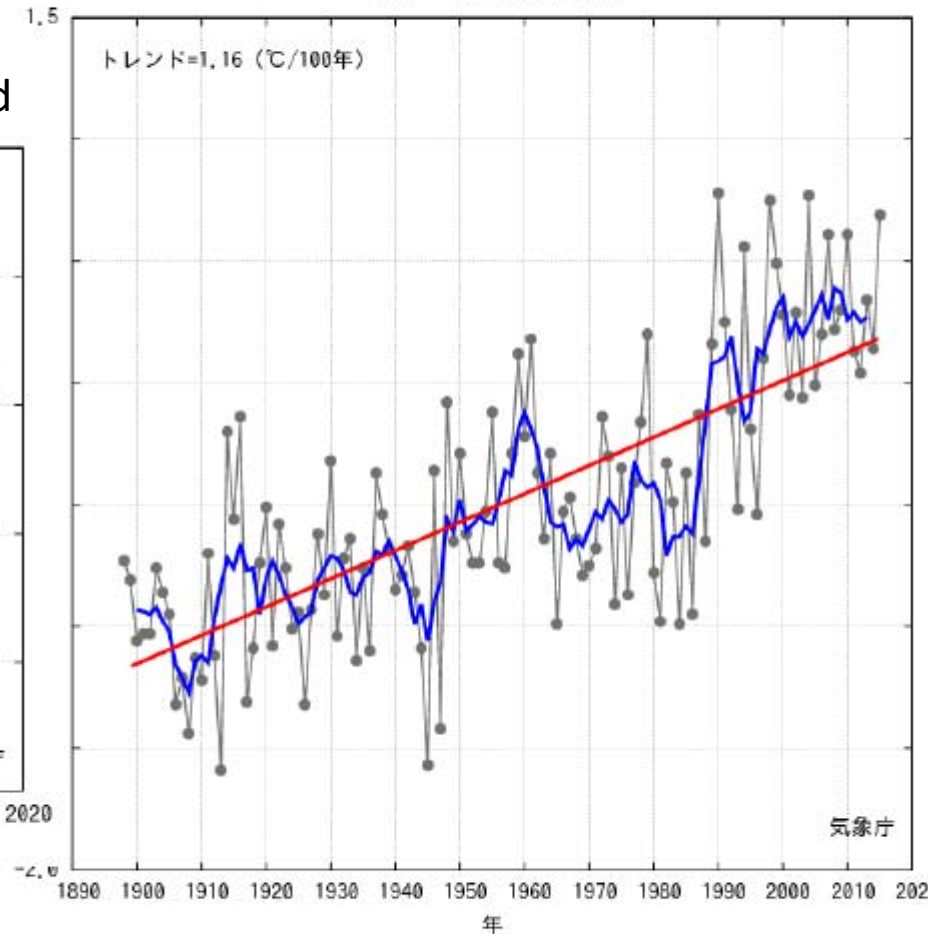
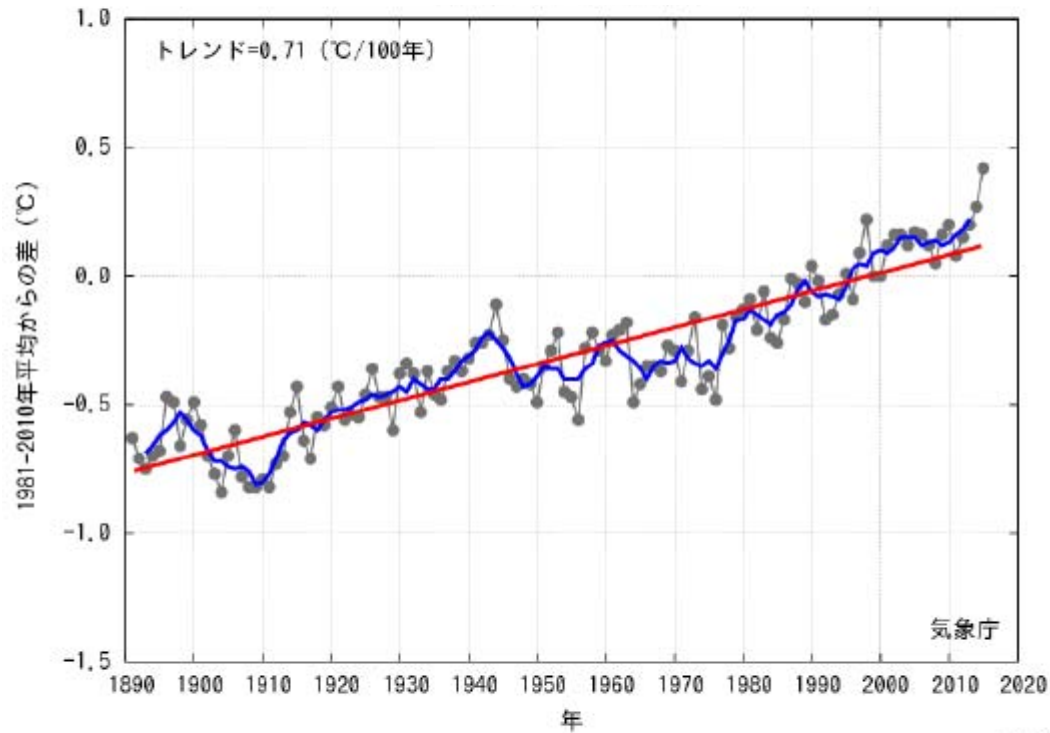
60km mesh AGCM
[1951-2010]
100 members
100 members (non warming)
[2010-2070]
90 members (6 Δ T \times 15 σ T)

20km mesh Japan Region
[1951-2010]
50 members
[2010-2070]
90 members

Model Municipalite Example : Nagano Prefecture

The average temperature deviation in Japan

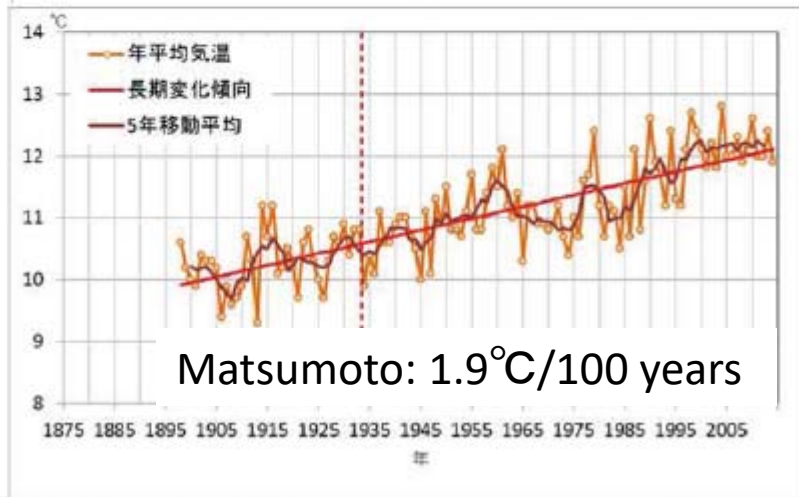
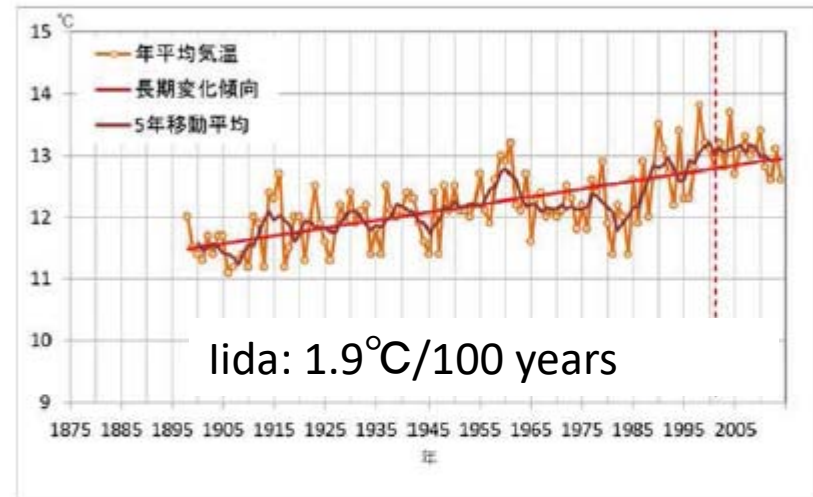
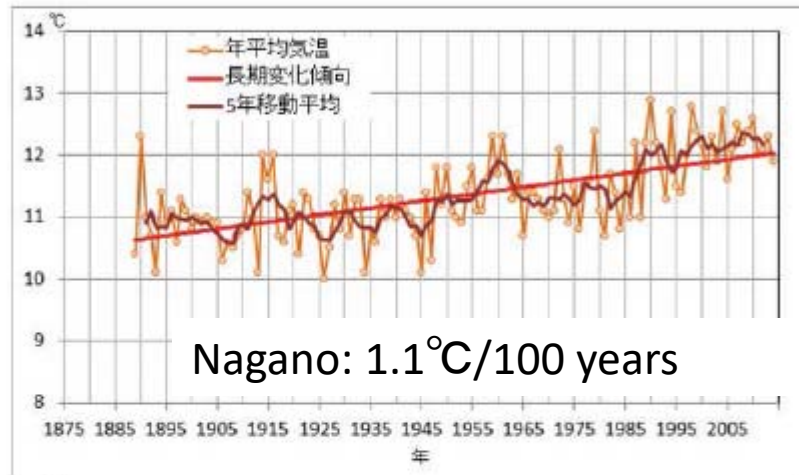
The average temperature deviation in the world



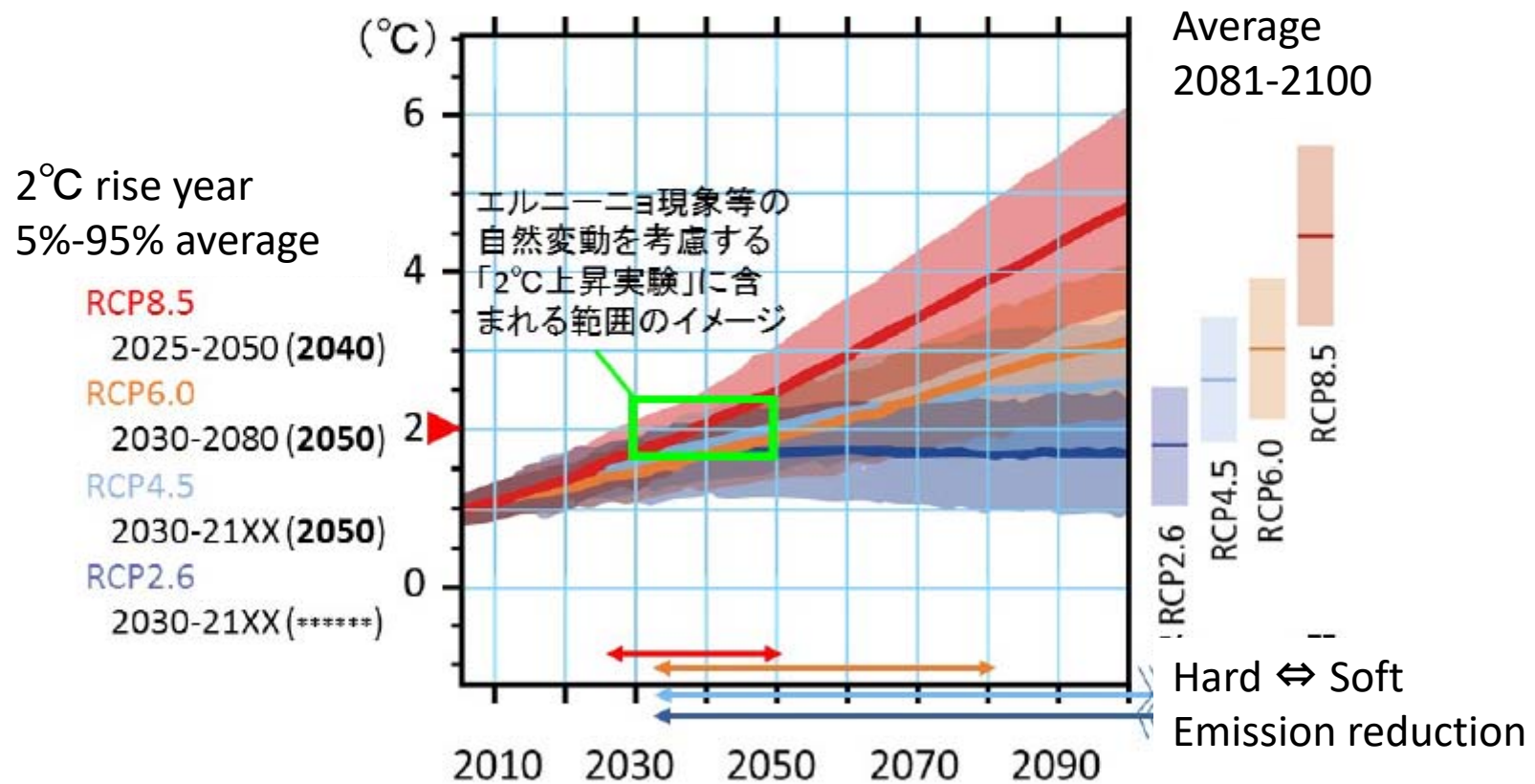
気象庁ホームページより

How about Nagano Prefecture?

- Observation Report

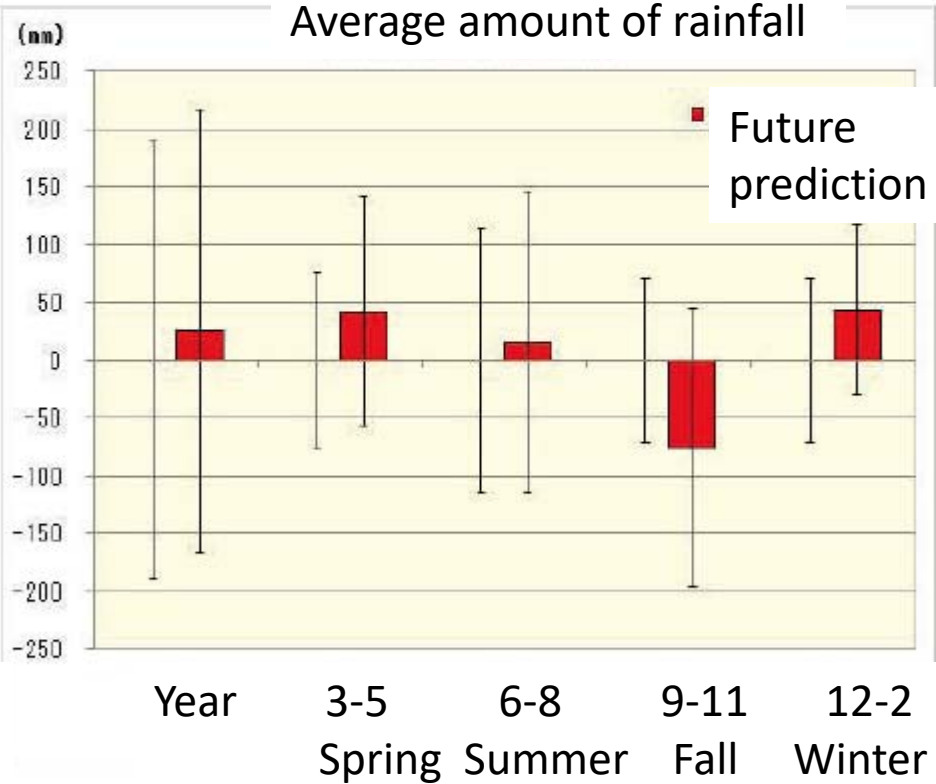
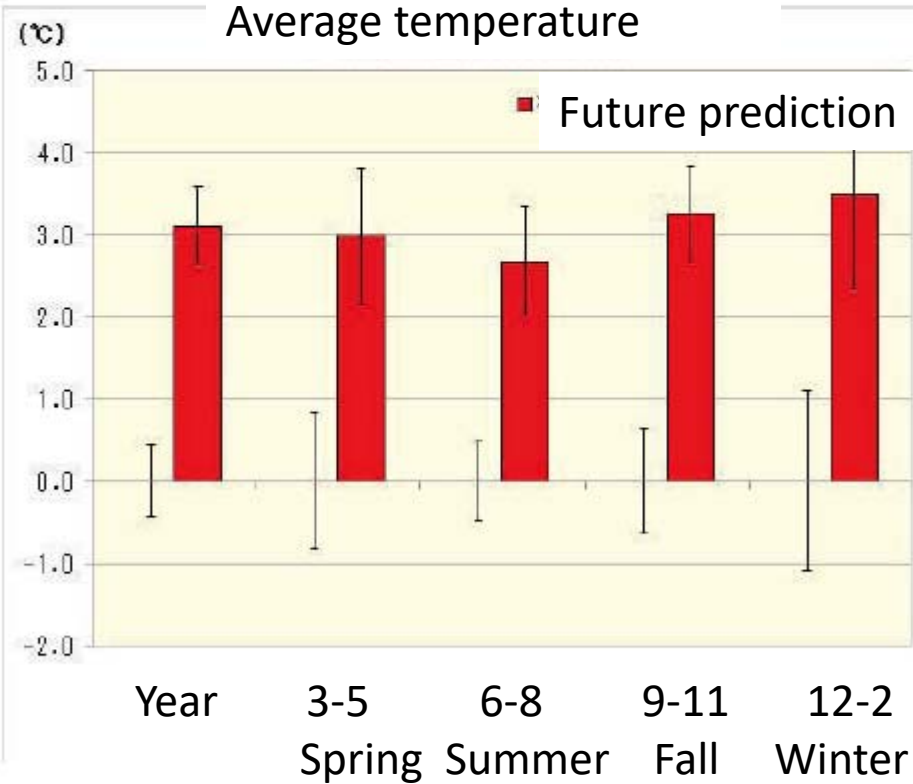


CO2 discharge scenario and 2°C rise year



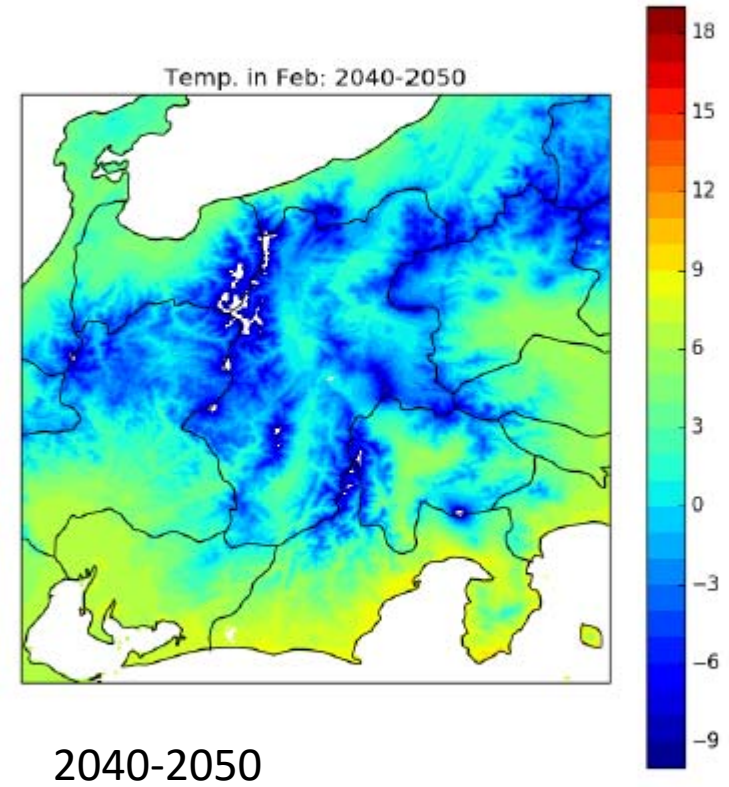
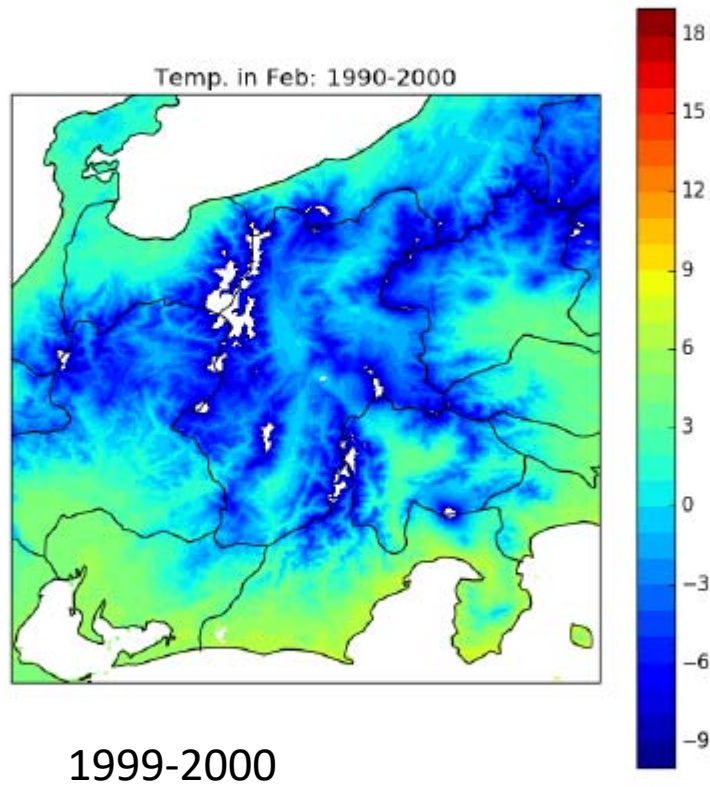
※IPCC-AR5-WG1 (2013) (Fig.12.5 & Fig.SPM06-01)に基づいて作成したもの

Prediction of Nagano Prefecture



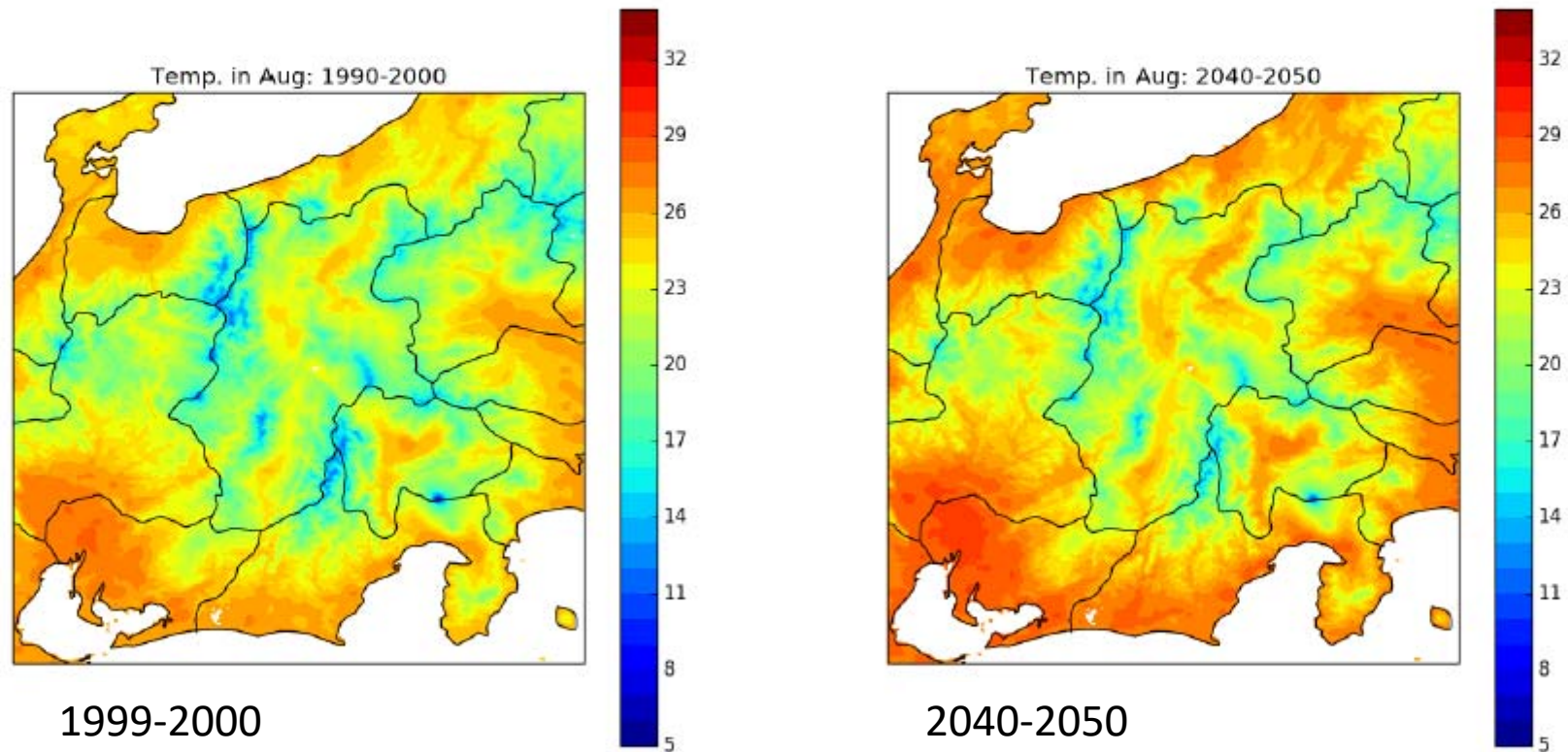
Statistical down scaling

February average temperature

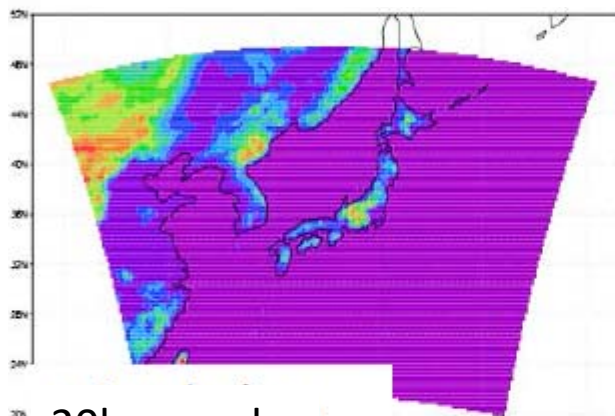


Statistical down scaling

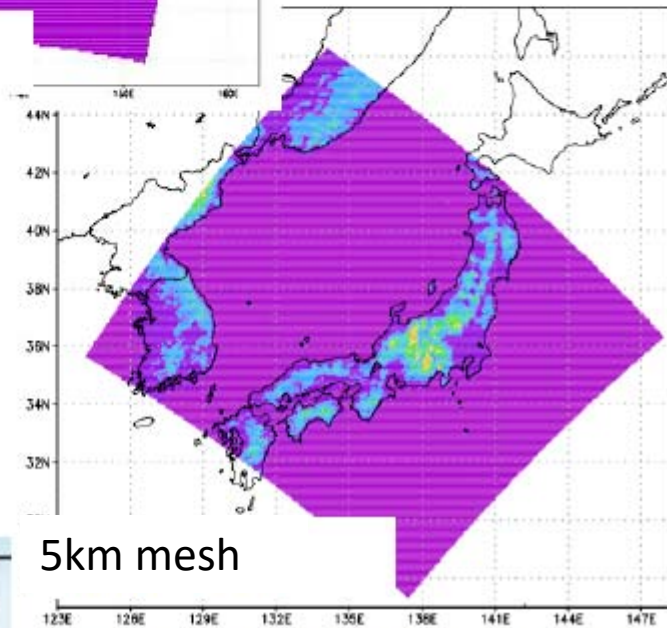
August average temperature



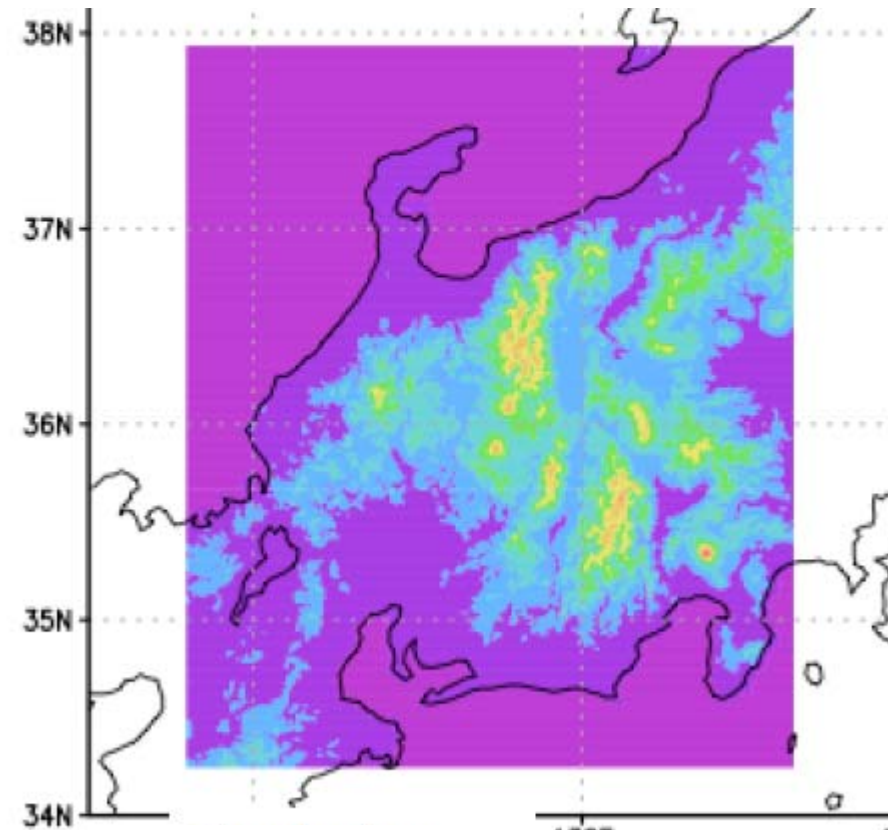
Mechanics down scaling



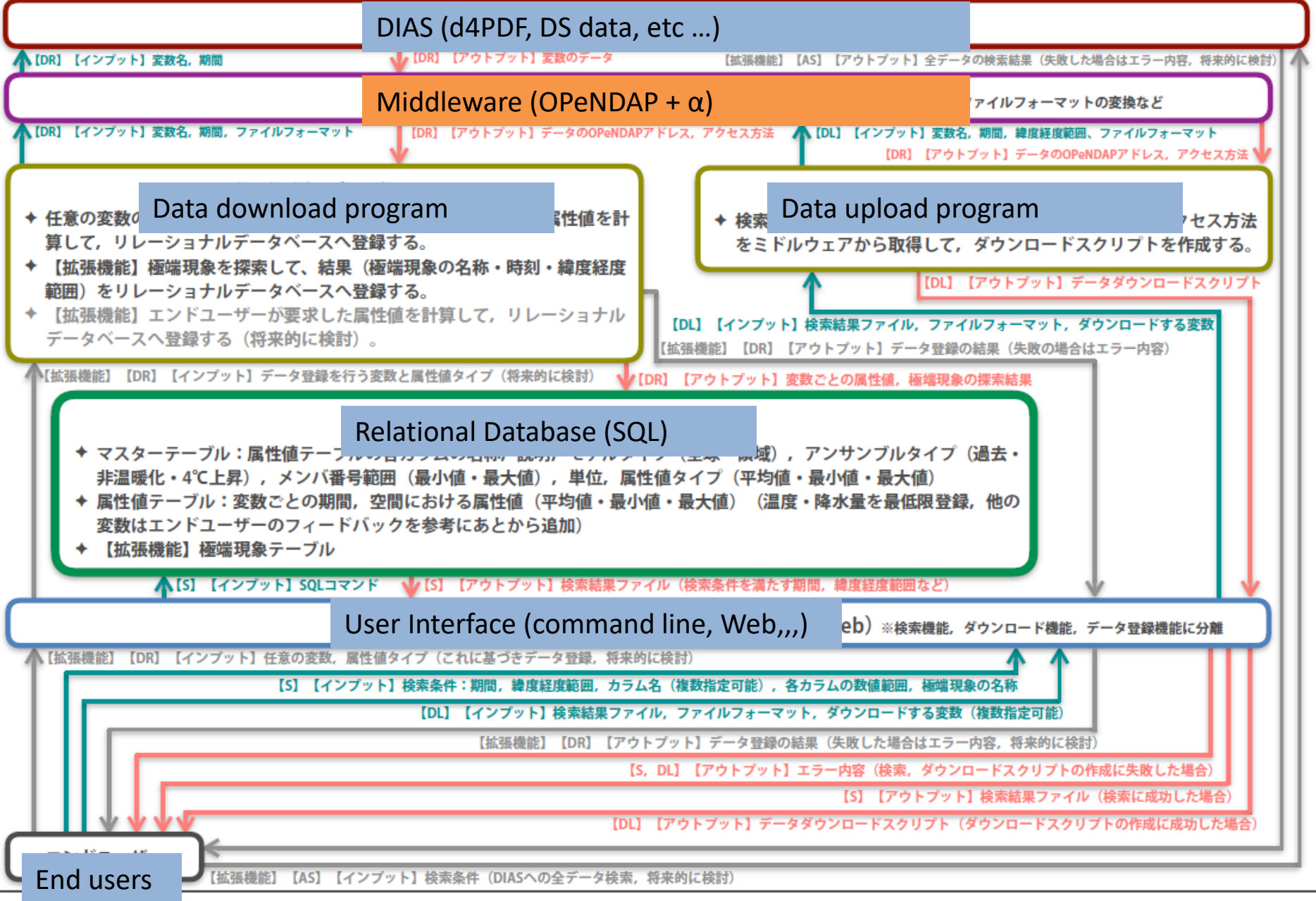
20km mesh



5km mesh



1km mesh



Developing Middleware

■ Common API to access the data on DIAS

- OPeNDAP + OPeNDAP plugin
- The plugins support the future data format. (Flexibility)



■ Functions of Middleware

- Specific Latitude, longitude and time (with changing the coordinate system)
- Specific variables
- Output format (ASCII, binary, binary with metadata, CSV, etc ...)

■ JAMSTEC Super-computer system: ES

- Running user applications : about 75% - 78%.
- User utilization including staging : about 85%
- There are 67 projects and the number users is 776.

■ Cyber System for Geo- and Oceanographic Information

■ Test Case: JAMSTEC "Cyber System" : SI-CAT program

- Big Data base : d4PDF
- Down scaling : Input/Output, Computing, Database Management
- We are developing Middleware :
 OPeNDAP + OPeNDAP plugin

Thank you for attention.