Water Quality in Reservoirs under a climate change

The Water Quality Group of GRANDE

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An Introduction of the WQ Group

Our Study Site:

Tuni Reservoir and its Basin

- One of the major water resource of La Paz
- About 30km from La Paz
- Altitude = 4,437m
- Capacity of Reservoir = 24.7×10^6 m^3
- Water Supply = 1m^3/s to La Paz (20%) & El Alto (80%)

A Plan View

Lake Surface

Objectives of the WQ Group

1. Prediction of water quality in Tuni Reservoir

Evaluation of potential increase in

a) algal biomass (eutrophication),
b) turbidity
etc.

in the reservoir

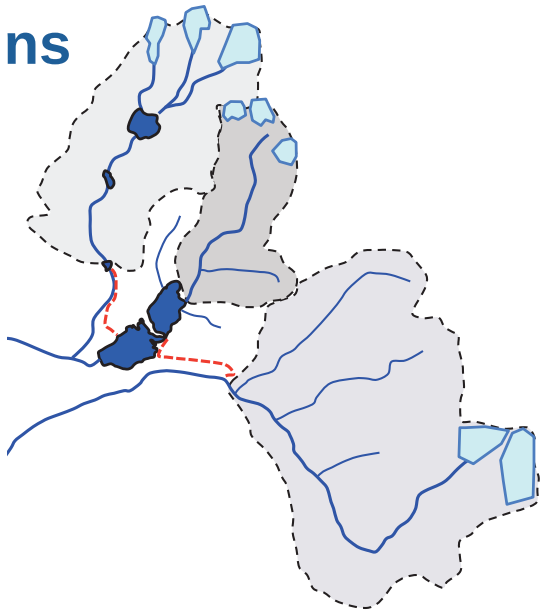
} Factors possibly affecting water treatment and use

2. Elucidation of water quality formation in the basins

Each watershed is composed of

a) glacier,
b) glacier lake,
c) wetland,
d) livestock grazing,
etc.,

which influence on nutrient cycles in the basin,
and finally have influences on inflow WQ of the Tuni Reservoir.



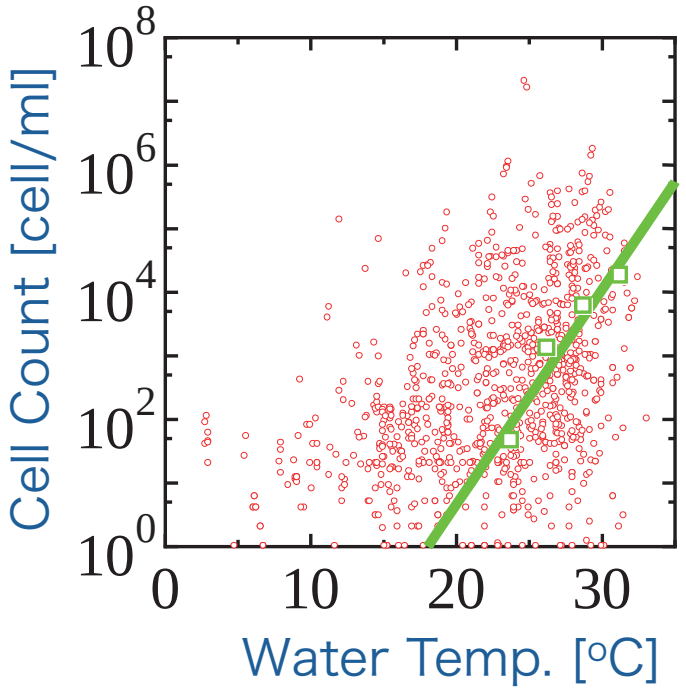
Concerns about WQ in reservoirs

affected by Global Warming

Reservoirs occupy large fractions of water supply in Japan, as well as in La Paz and El Alto.

Typical bloom-forming cyanobacteria *Microcystis aeruginosa* show remarkable increase of biomass with rising water temperature.

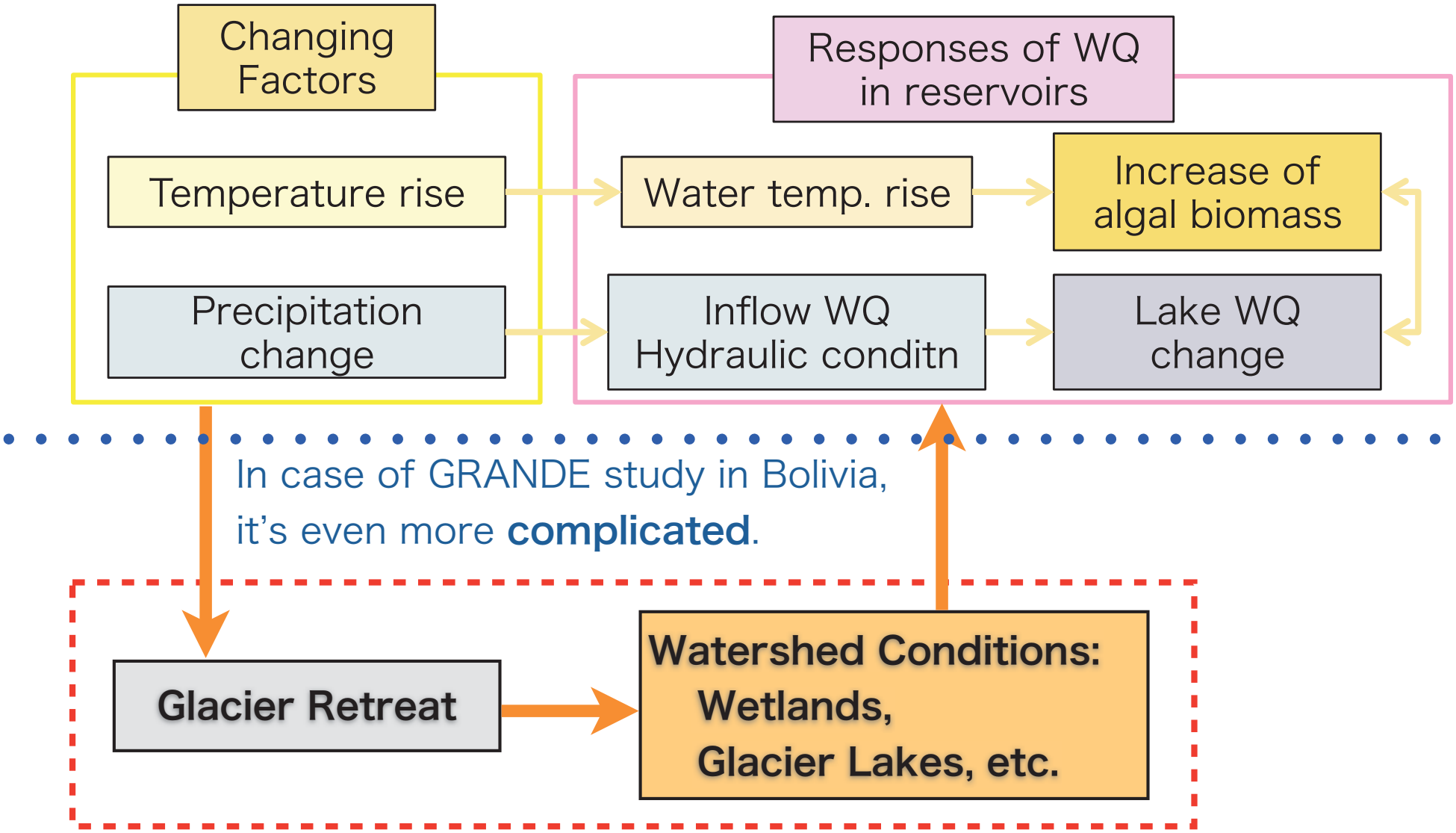
Algal bloom in a reservoir



Data from reservoirs in Japan
(Umeda&Tomioka, 2007)

Expected Mechanisms of WQ Change

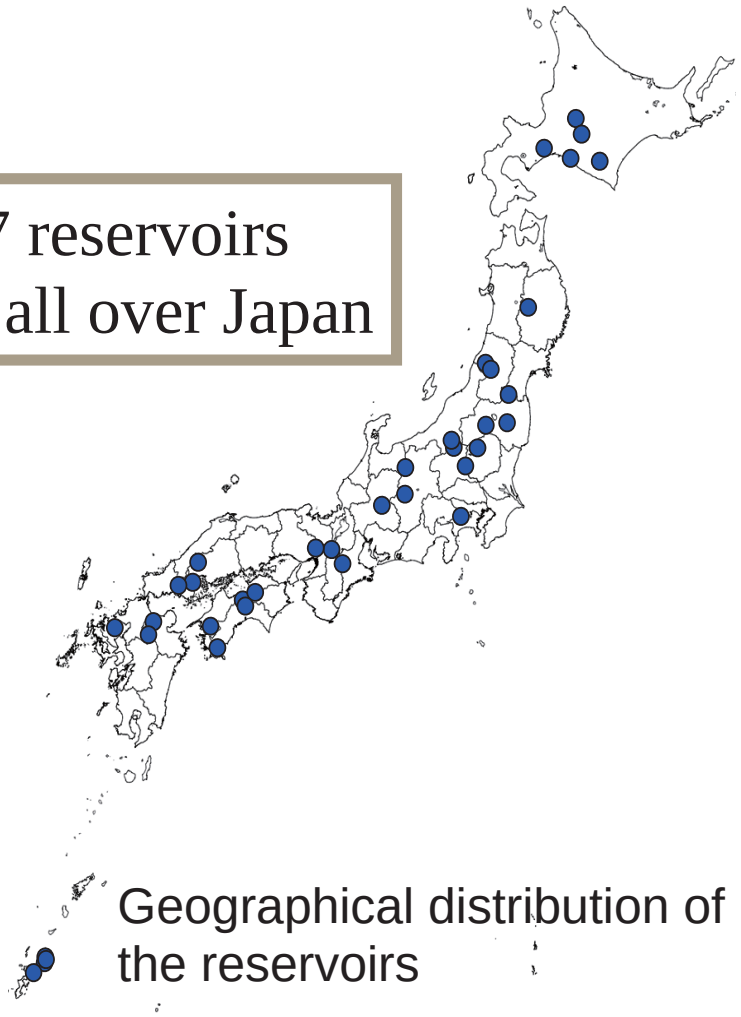
Climate change can influence on Water Quality in reservoirs (in Japan):



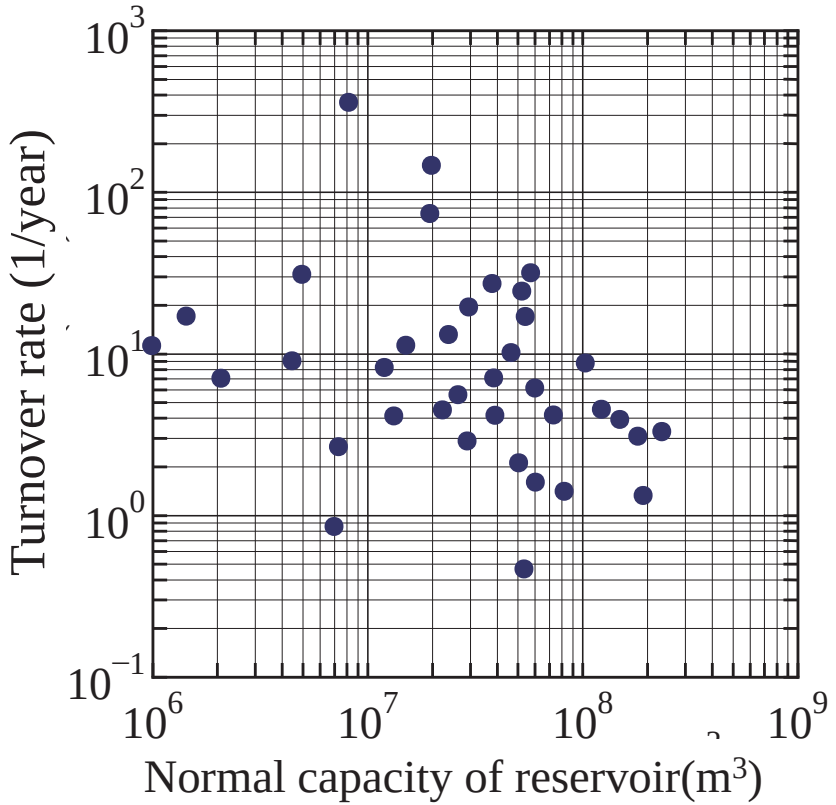
A Case Study in Japan

Multi-purpose reservoirs with a function of domestic water supply:

37 reservoirs
from all over Japan



Geographical distribution of the reservoirs



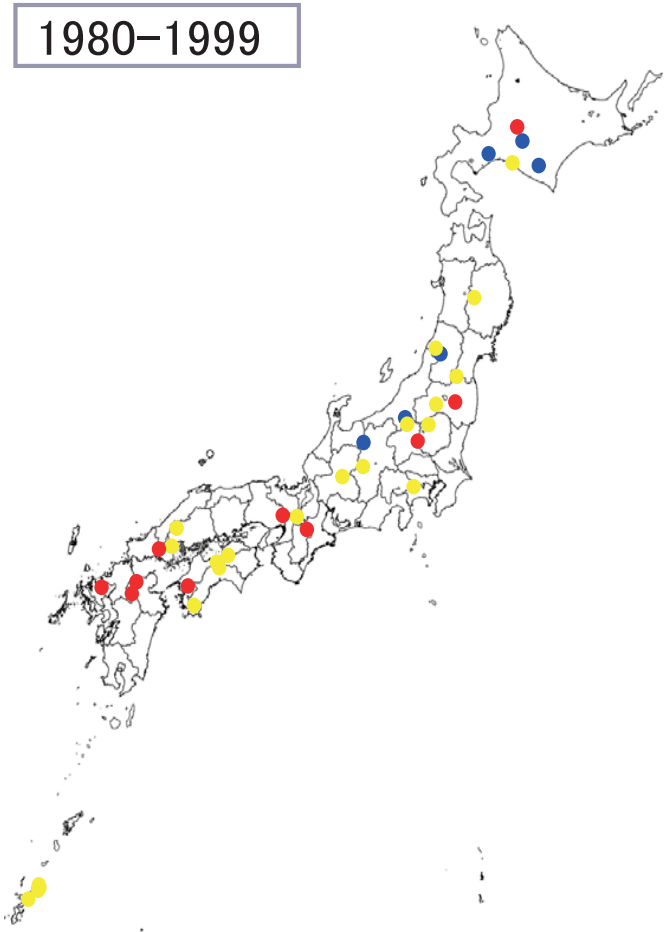
Distribution of hydraulic characteristics

Results: Eutrophication Criteria Analysis

Classification by OECD

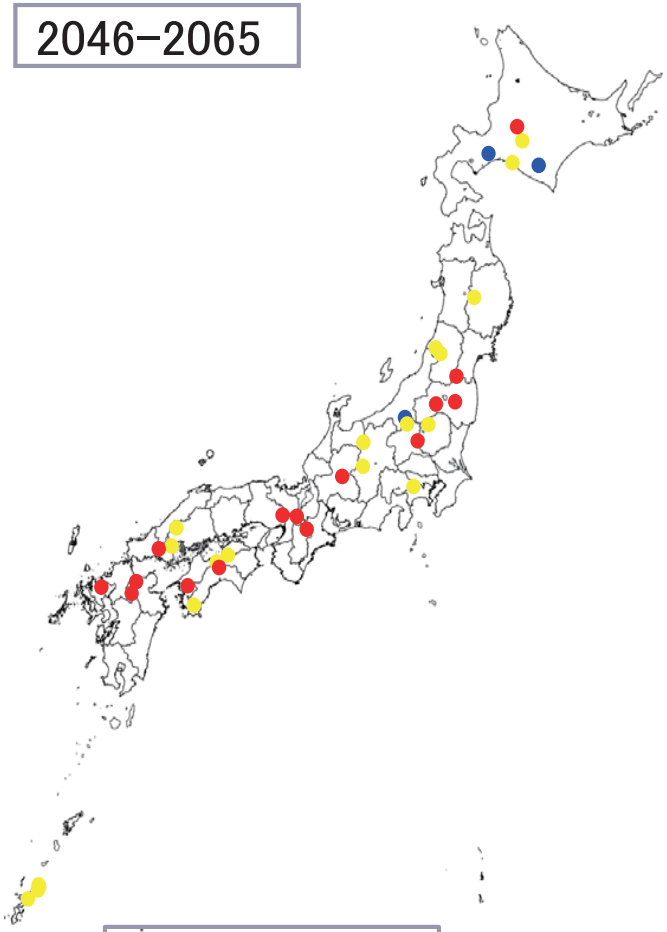
- Oligotrophic （C_a< 2.5μg/l）
- Mesotrophic （2.5μg/l≦ C_a <8.0μg/l）
- Eutrophic （8.0μg/l < C_a）

1980–1999



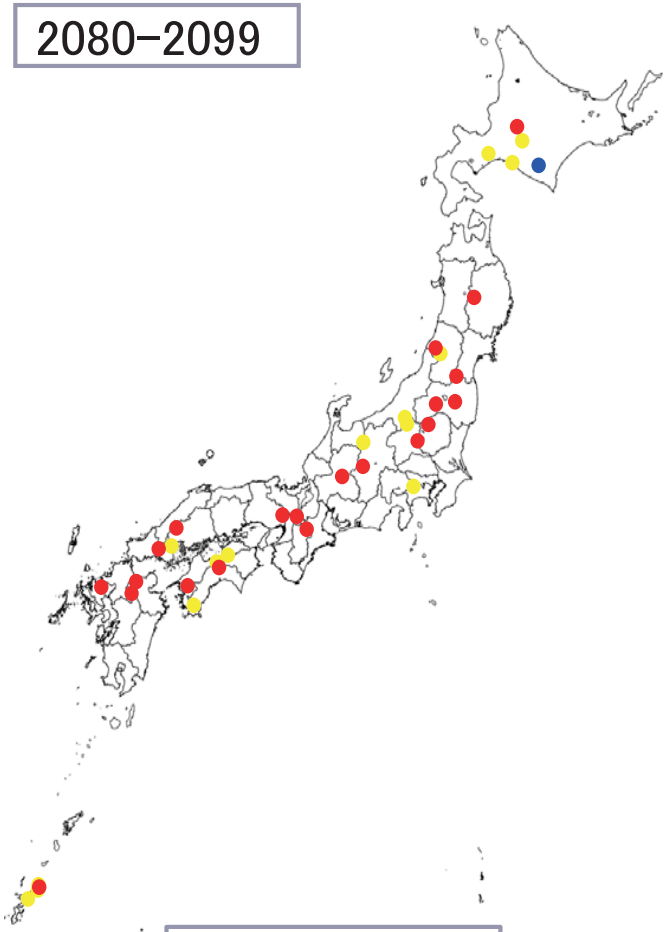
10 eutrophic

2046–2065



15 eutrophic

2080–2099



21 eutrophic

An Application to Tuni Reservoir

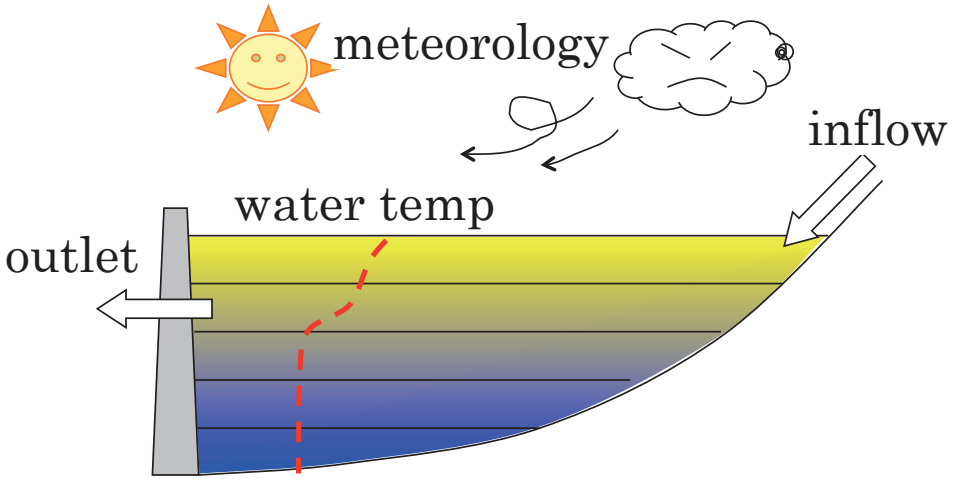
Methodology:

Vertical 1-dimensional computation modeling:

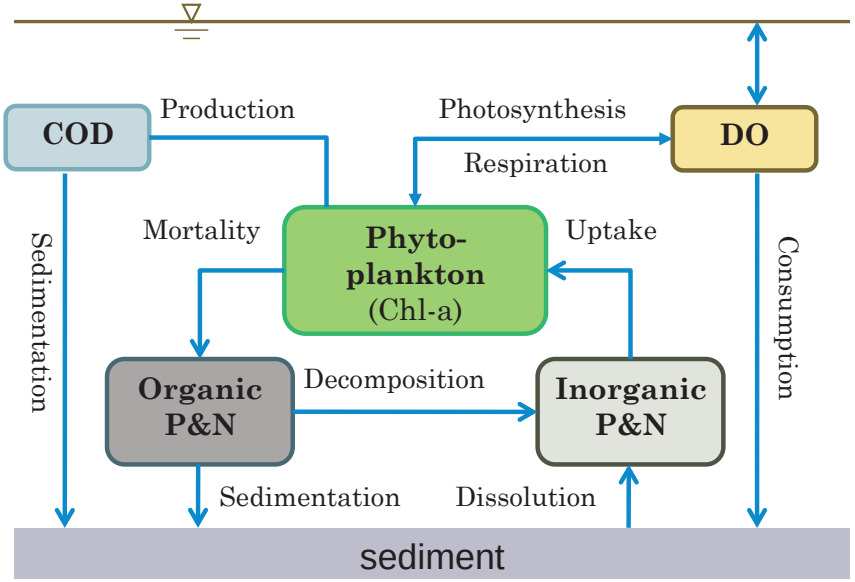
Hydrodynamic-based simulations considering
- Heat balance from meteorological conditions,
- Density current structure, and
- Water quality and ecological processes

in the reservoir.

Schematic of 1-D modeling



Structure of WQ-Eco modeling



Data Acquisition in the Field

Results of modeling only exist in computers,
neglecting lots of raw information that appear in actual fields.

Field data is precious for technical works.
Therefore, we elaborate the field campaign.

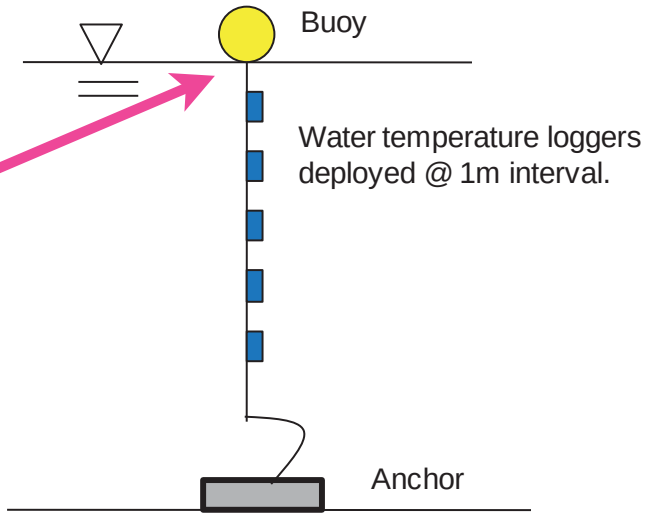
Data Acquisition in the Field

Facing frequent difficulties....

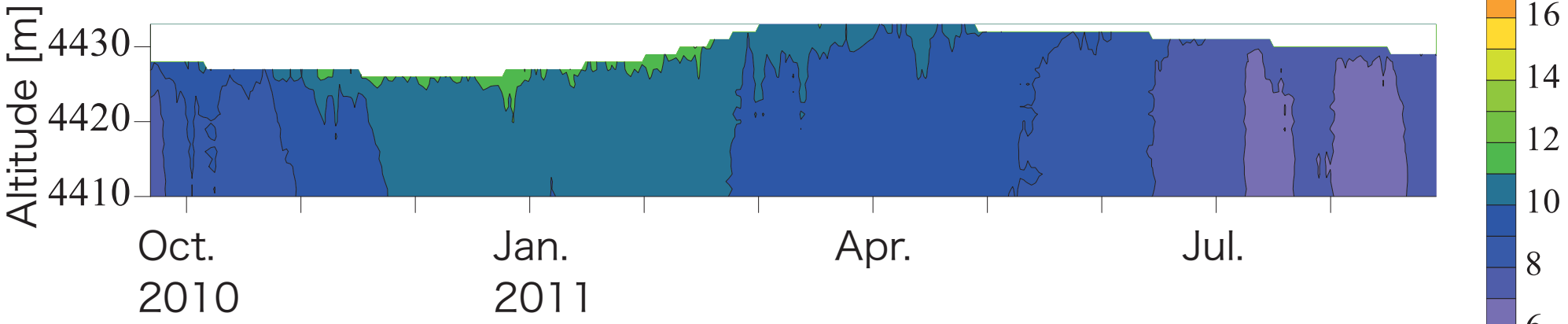
And overcoming them with our friendship and cooperations.

Thermal Stratification in Tuni R.

Location of deployment

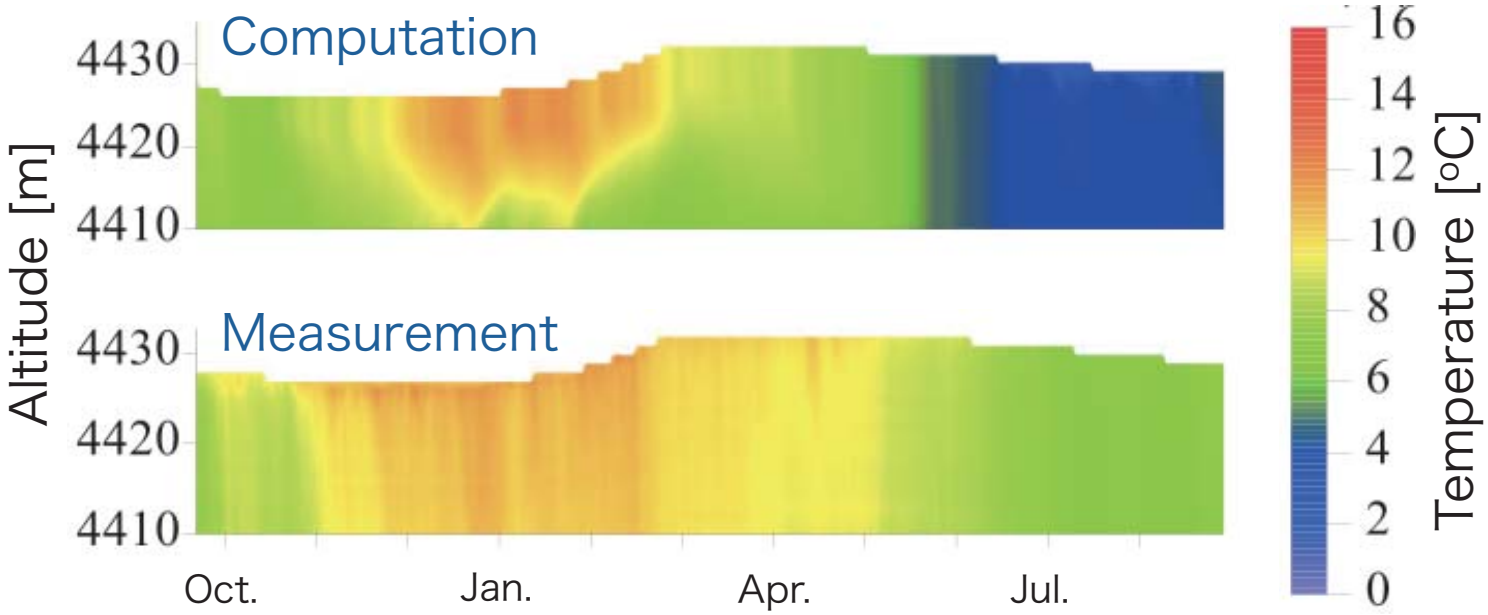


Results of continuous measurement of water temperature.
From October 2010 through August 2011.



Results of the Modeling

Verification:
Comparison with Measurements

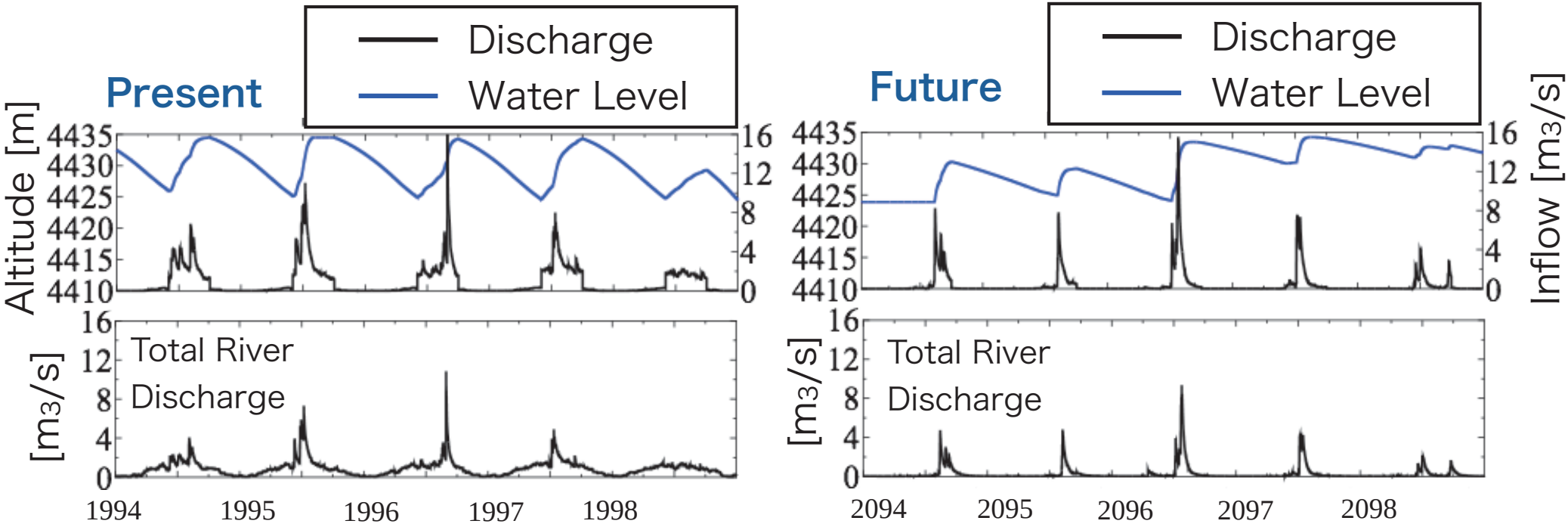


Complete agreement has not been yet achieved.

More detailed examination on the model and the data is necessary.

Future Prediction

Hydrological Conditions obtained from the Runoff Group
based on the model developed by Kinouchi et al. (2012)

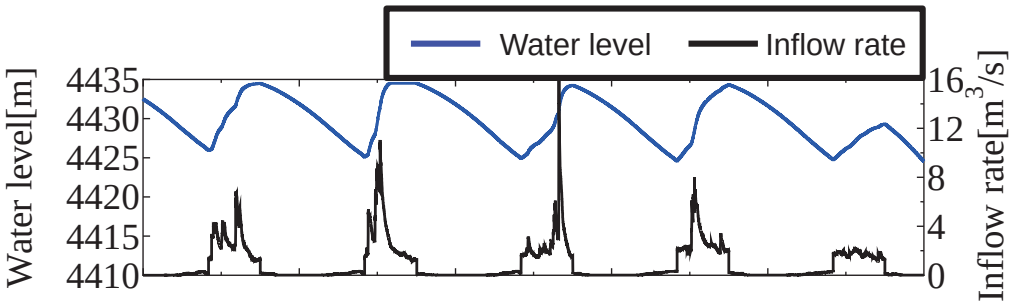


In the future, 100 years later,
annual total inflow is predicted to decrease to only **40%** of present condition.

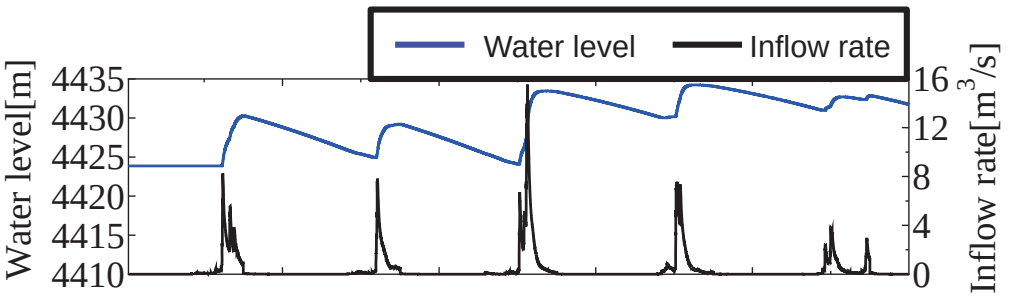
Future Prediction

Computation results of Water Temperature & Chlorophyll (algal biomass)

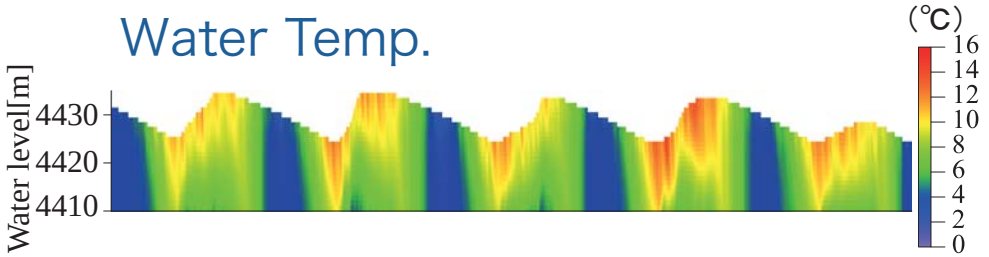
Present



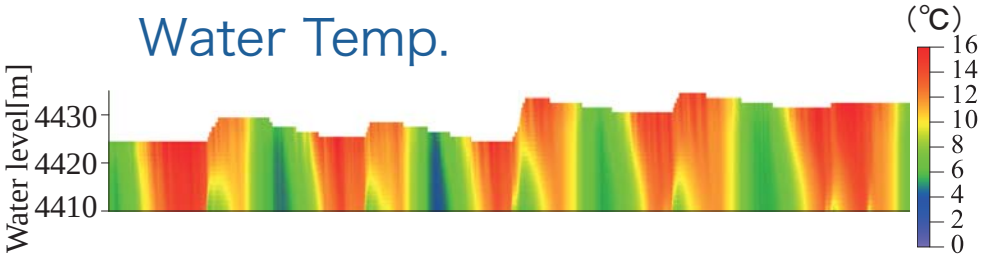
Future



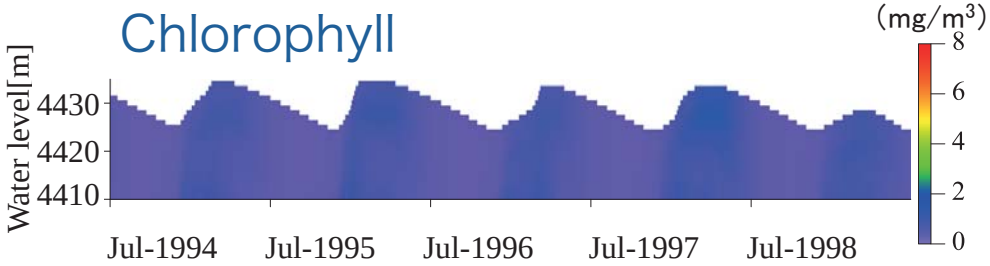
Water Temp.



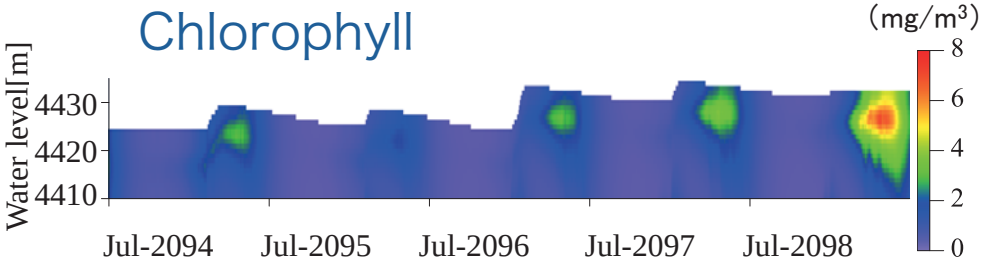
Water Temp.



Chlorophyll



Chlorophyll



According to the predictions up to now,
WT will become about 2 ℃ higher than present;
Phytoplankton can grow more than triple depending on conditions.

Summaries and Conclusions

- A model to predict water temperature and algal growth in Tuni Reservoir has already been developed. However, improvements are still necessary to obtain better agreements.
- Field data acquisition has been being successfully and continuously conducted in Tuni Reservoir and its catchment on water temperature, turbidity and water quality.
- Coupling the achievement by the Runoff Group, lack of water in the reservoir is forecasted.
  Water temperature and eutrophication process is also predicted, whose results suggest increase of algal biomass in the reservoir, as well as that of water temperature.

SATREPS
Science and Technology Research Partnership for Sustainable Development Program

Acknowledgement:
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If you have any questions on our latest research topics, please ask **MY STUDENTS** during the POSTER SESSION:

Keisuke Tani,
Future Prediction of Water Quality in Tuni Reservoir.

Evelin Humerez,
Impact of Climate Change and Glaciter Retreat in Water Quality Formation in the Condoriri Basin.