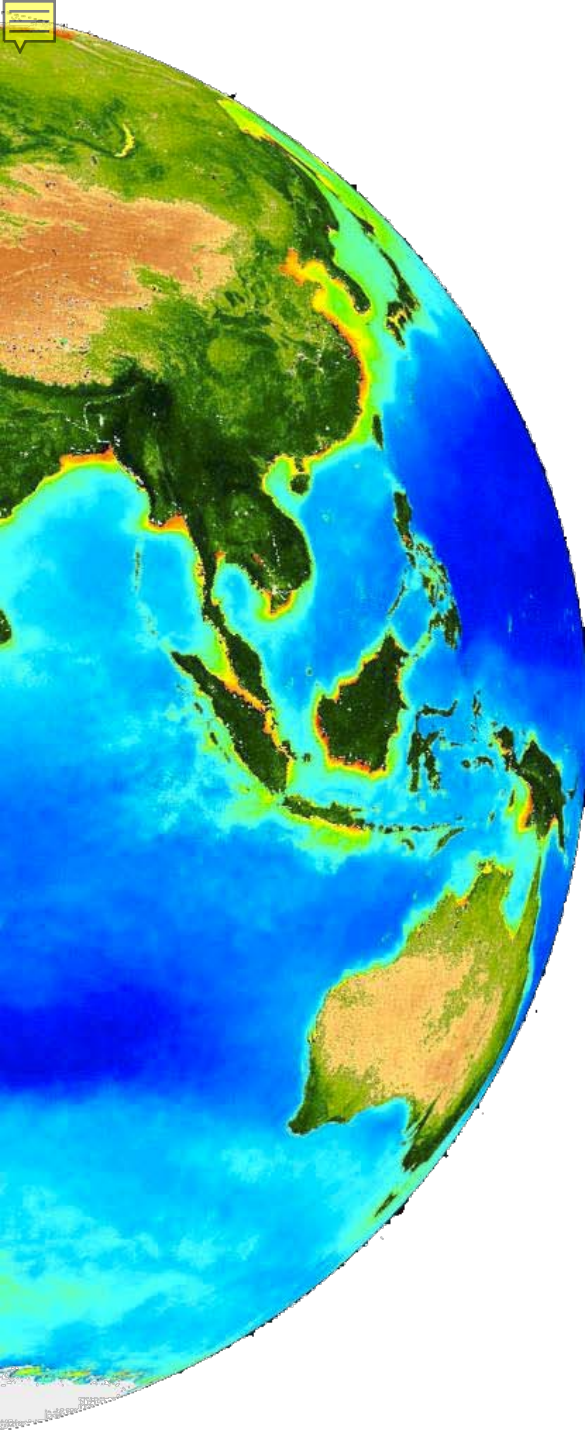




HOKKAIDO UNIVERSITY

Title	Spatial information systems approach toward sustainable aquaculture
Author(s)	Radiarta, I Nyoman; Saitoh, Sei-Ichi
Description	Panel Discussion
Relation	International Symposium on "Sustainability Science on Seafood and Ocean Ecosystem Conservation". 7 November 2009. Hakodate, Japan.
Issue Date	2009-11-07
Doc URL	https://hdl.handle.net/2115/39918
Type	conference presentation
File Information	Nyoman.pdf





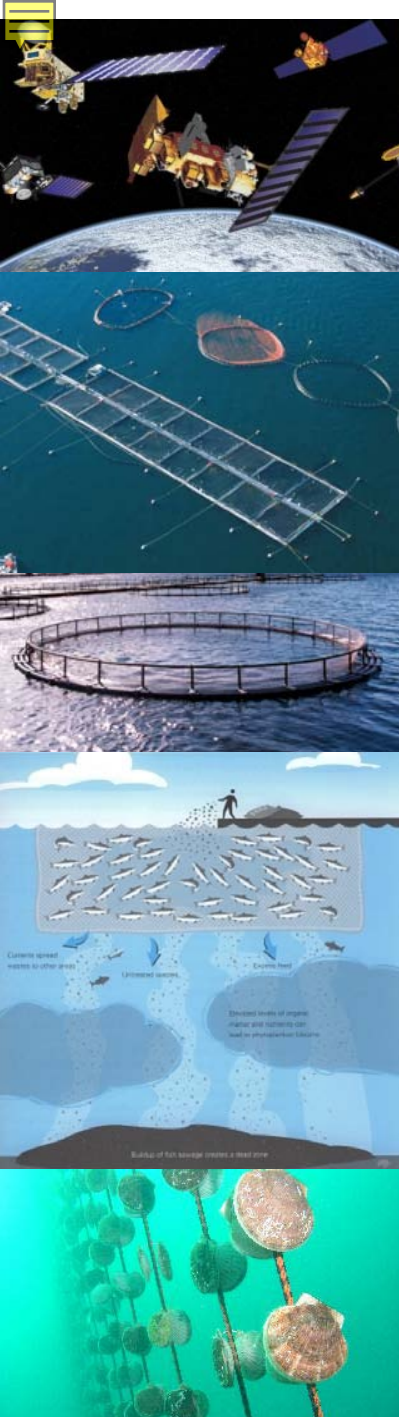
International Symposium on “Sustainability Science on
Seafood and Ocean Ecosystem Conservation”
Hakodate, November 7, 2009

Spatial information systems approach toward sustainable aquaculture

I Nyoman **Radiarta**^{1,2} and Sei-Ichi Saitoh¹

¹ Faculty of Fisheries Sciences, Hokkaido University

² Research Center for Aquaculture, MMAF, Indonesia

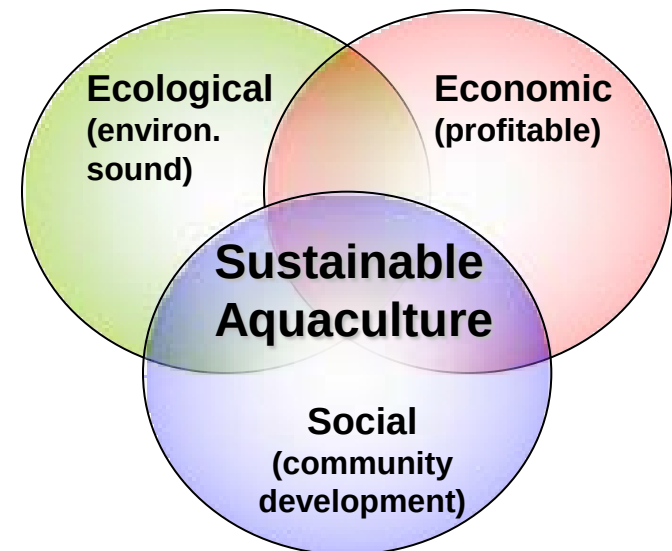
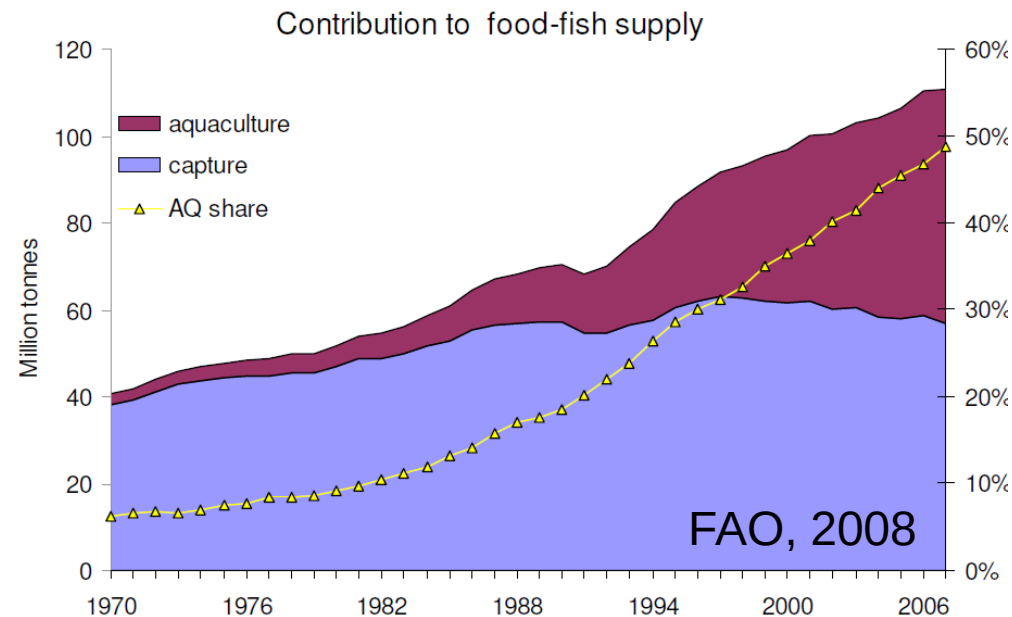


Contents

- 1. Sustainable aquaculture**
- 2. Spatial information systems**
- 3. Case study: Japanese scallop aquaculture development**
- 4. Conclusions**

Sustainable Aquaculture

- Aquaculture, the fastest growing food-producing sector.
- Aquaculture has great potential for alleviation of poverty and generation of wealth for the people living in coastal area.
- Accounts for almost **50%** of the world's food fish.
- Sustainable aquaculture consider the ecological, economic & social aspect





Sustainable Aquaculture

- FAO guideline for supporting sustainable aquaculture development
 - ▣ Ecosystem approach to aquaculture (Soto et al., 2008)
 - ▣ Code of conduct for responsible fisheries (FAO, 1995)
- It is necessary to develop an analytical framework that can incorporate spatial (and temporal) dimensions of parameters that effect sustainability

The main purpose: to promote the use of spatial data for improving the planning and management of aquaculture in order to support sustainable development.

Spatial Information Systems



Spatial Information Systems

the technology of acquiring, managing, analyzing, and displaying information in a spatial context (lat., long. & time)

Examples of the technology in spatial data

- Remote sensing data
- Global Positioning System (GPS)
- Geographic Information Systems (GIS)

Spatial Information Systems

Spatial question integrated in every geographic inventory (COPEMED, 2001)

1. Location: Where is it...?
2. Quantification: How big, How long, How many in...?
3. Routing: What is the best way to...?
4. Condition: What is at...?
5. Trends: What has changed since...?
6. Patterns: What spatial patterns exist...?
7. Modeling: What if...?



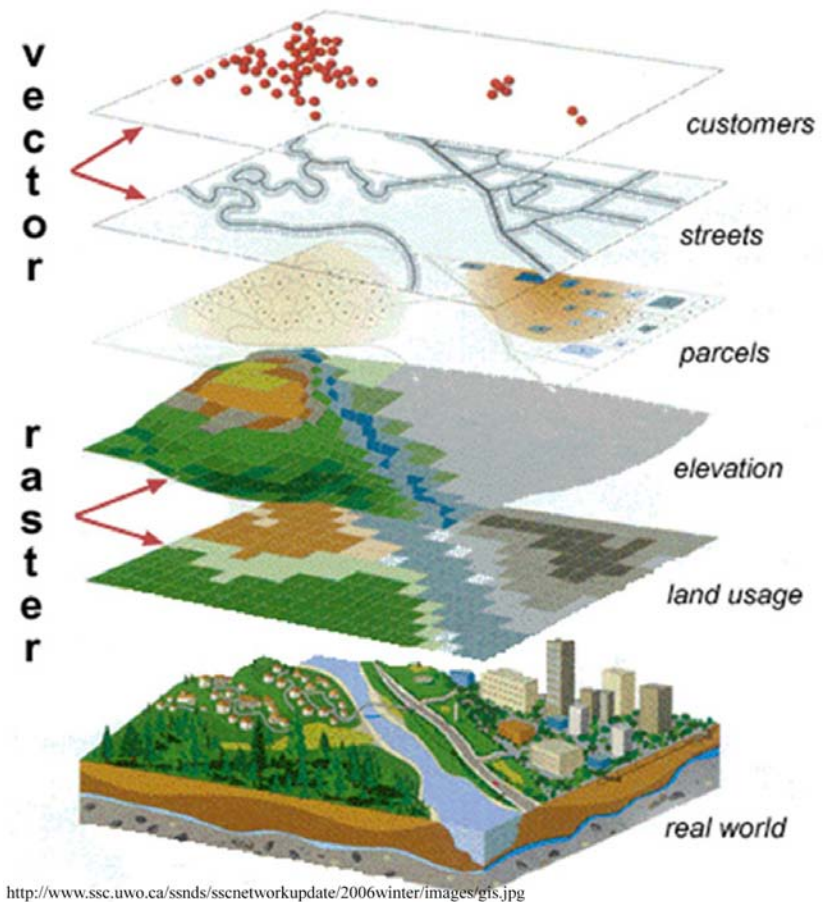
Data types

1. Vector

- Points: Data of water quality measurements (Sea Temperature, Chl-a)
- Lines: Streets, rivers, bathymetry
- Polygons: Settlement, lake

2. Raster

- Pixels: DEM, satellite data



Satellite remote sensing



Passive sensors

- ❑ High resolution: IKONOS (1m), Quickbird (60cm), ALOS (10m), SPOT (10m)
- ❑ Medium resolution: Landsat (30m), IRS (23.5m), ASTER (15m)
- ❑ Low resolution: NOAA-AVHRR , SeaWiFS, MODIS $\approx$ 1km

Active sensors

- ❑ Radarsat (SAR); ALOS-PALSAR

GISFish

FAO Home > Fisheries & Aquaculture > GISFish >

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
helping to build a world without hunger

العربية | 中文 | Español | Français

search... more»

Home About us Activities Statistics **GeoInfo** Meetings and News Publications Fact Sheets

Global Gateway to Geographic Information Systems (GIS), Remote Sensing and Mapping for Fisheries and Aquaculture

search GISFish... more»
Search hints

Welcome to GISFish!

The Fisheries and Aquaculture Management Division at FAO is actively promoting the use of spatial analytical tools and geo-referenced information for the analysis of Fisheries and Aquaculture data and in the development of Fisheries and Aquaculture management.

GISFish is a "one stop" site from which to obtain the global experience on **Geographic Information Systems (GIS), Remote Sensing and Mapping** as applied to Fisheries and Aquaculture.

GISFish sets out the issues in Fisheries and Aquaculture, and demonstrates the benefits of using GIS, remote sensing and mapping to resolve them. The global experience provided by GISFish is captured in **Issues, Publications, Activities, Training, Data and Tools, Contacts, Discussions, News and events.**

GISFish is broadly divided into two domains, **GISFish Aquaculture** and **GISFish Capture Fisheries** with a wide range of material and information that is shared between the two domains to address the role of GIS to support the **Ecosystem Approach to Fisheries (EAF)** and the **Ecosystem Approach to Aquaculture (EAF)**.

Contribute to and participate in the growing GISFish community by becoming an active **Member of GISFish** today.

Recently added content

Aquaculture

- [SuperGIS Desktop \(Commercial Software\)](#)
- [Occurrence and potential risks of harmful algal blooms in the East China Sea](#)

Capture Fisheries

- [Estimating reef habitat coverage suitable for the humphead wrasse, *Cheilinus undulatus*, using remote sensing](#)
- [Species distribution models and ecological theory: a critical assessment and some possible new approaches](#)

Newsletters

May 2009
December 2008
April 2008
November 2007

Events

December 20, 2009: The Fourth Session Of The International...

November 21, 2009: 24th International Cartographic Conference

October 29, 2009: AfricaGIS 2009

GISFish Home

- About GISFish
- GISFish Contacts
- GISFish Partners
- GISFish Members
- Visitors Map
- GISFish Glossary
- Discussions
- GISFish Help: FAQ

Aquaculture

Capture Fisheries

63 Topics - 1466 Knowledge Objects - 224 Members - 6 Editors Site Map Disclaimer ©FAO, 2000-2009



SAFARI
societal applications in fisheries and aquaculture using remotely-sensed imagery

Main About Us Events Publications Links Sponsors Contact

News

SAFARI Symposium

SAFARI will be hosting a symposium on remote sensing and fisheries in February 2010, to be held in Kochi, India [More...](#)

IOCCG Monograph

IOCCG Report 9, entitled "Remote Sensing in Fisheries and Aquaculture", has been published and is now available for distribution. A digital copy can be found [here](#).

PICES Symposium

There will be an international symposium on Climate Change Effects on Fish and Fisheries: Forecasting Impacts, Assessing Ecosystem Responses, and Evaluating Management Strategies, to be held in April 2010 in Sendai, Japan [More...](#)

Welcome to SAFARI

The SAFARI Project was launched in November 2007 after receiving funding from the Canadian Space Agency (CSA). SAFARI falls under [GEO's](#) task AG-06-02, which calls for consultation at the international level to identify opportunities for enhanced utilization of Earth observation data in fisheries and aquaculture.

SAFARI aims to accelerate the assimilation of Earth Observation (EO) into fisheries research and ecosystem-based fisheries management on a global scale. This will be accomplished by facilitating the application of rapidly evolving satellite technology to fisheries management questions.

Download the SAFARI brochure in [English](#) or [French](#).





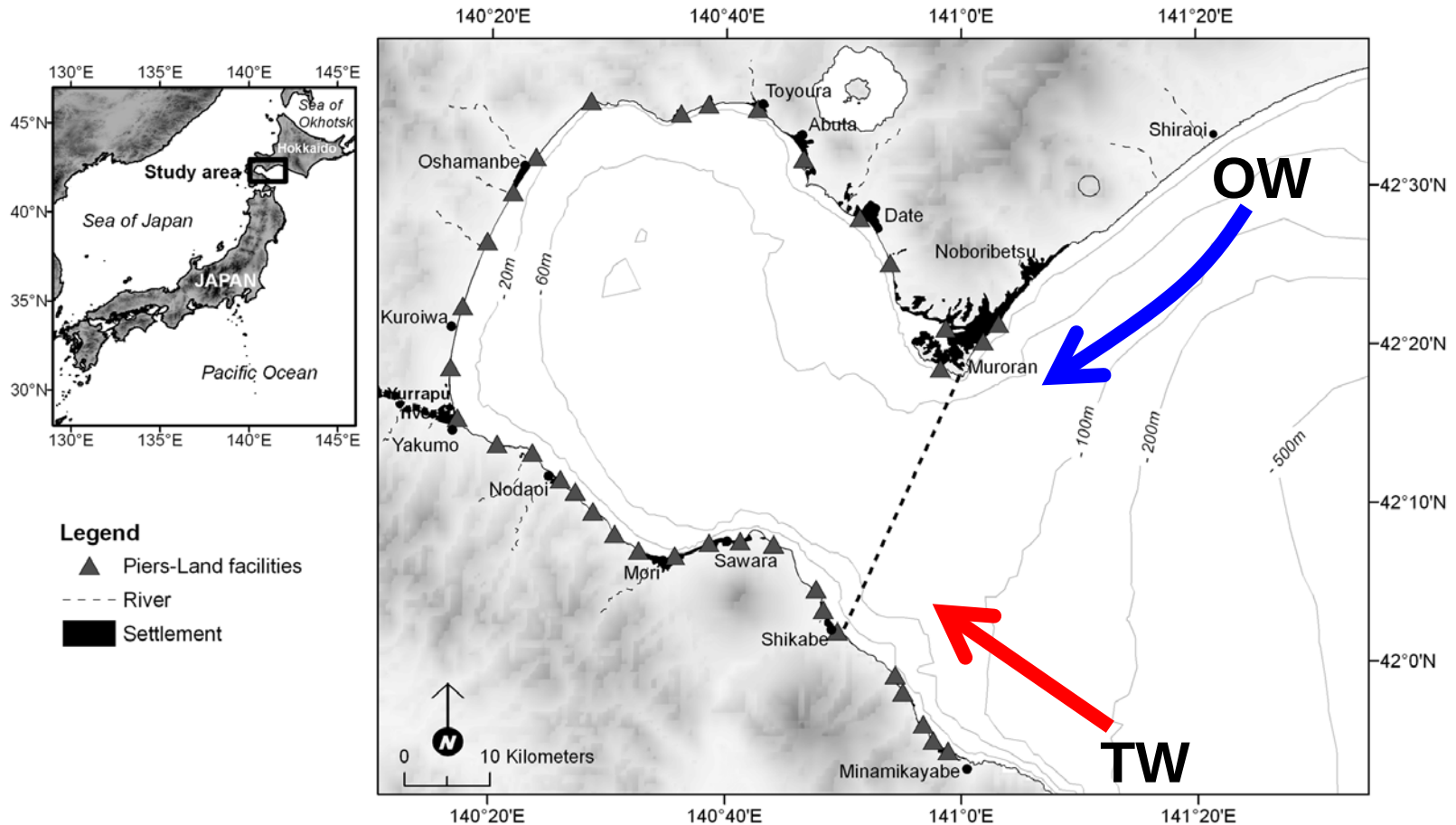
Case study

Japanese scallop aquaculture development

Objectives

1. To identify the most suitable sites for hanging culture of Japanese scallop development.
2. To examine the potential impact of climate change on the development of scallop aquaculture
 - indirect impact of climate change on **suitable sites** of scallop aquaculture

Study area



- Depth, maximum 107 m and mean 38 m
- 2315 km² surface area, and a 195 km coastline
- Water replace 2 time a year : OW & TW



SS model construction

- Built on hierarchical structure
- Scoring: 1 (least suitable) - 8 (most suitable)
(Radiarta et al., 2008)

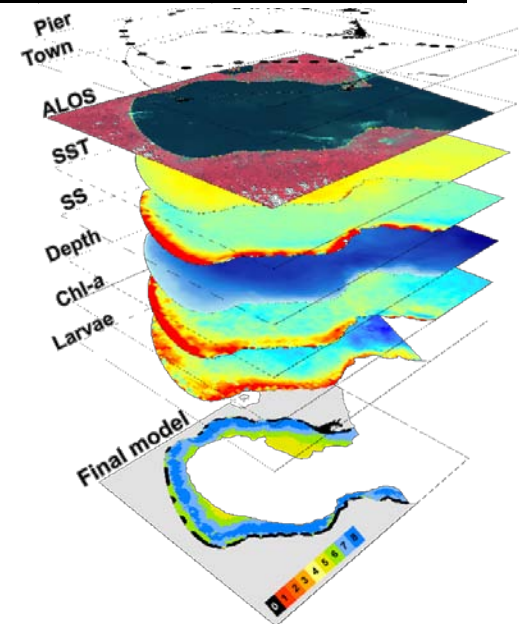
Parameters	Suitability score							
	8	7	6	5	4	3	2	1
Bathymetry (m)	> 20.0	17.5-20.0	15.0-17.5	12.5-15.0	10.0-12.5	7.5-10.0	5.0-7.5	<5.0
Larvae level (No./ton)	>1000	850-1000	700-850	550-700	400-550	250-400	100-250	<100
Distance to town (km)	<3	3-4	4-5	5-6	6-7	7-8	8-9	>9

$$V(x_i) = \sum_j w_j r_{ij}$$

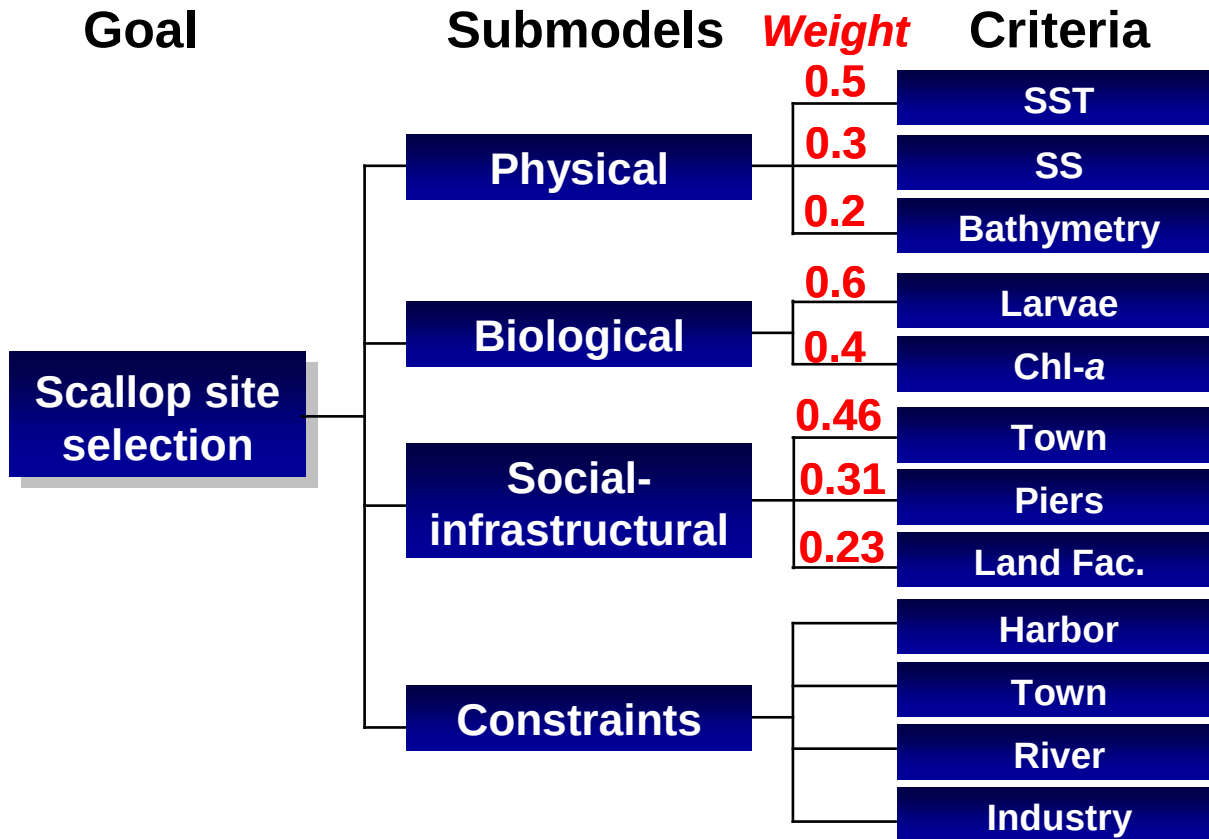
w_j = weight, $\sum w_j = 1$,

r_{ij} = the attribute transformed into score (1-8)

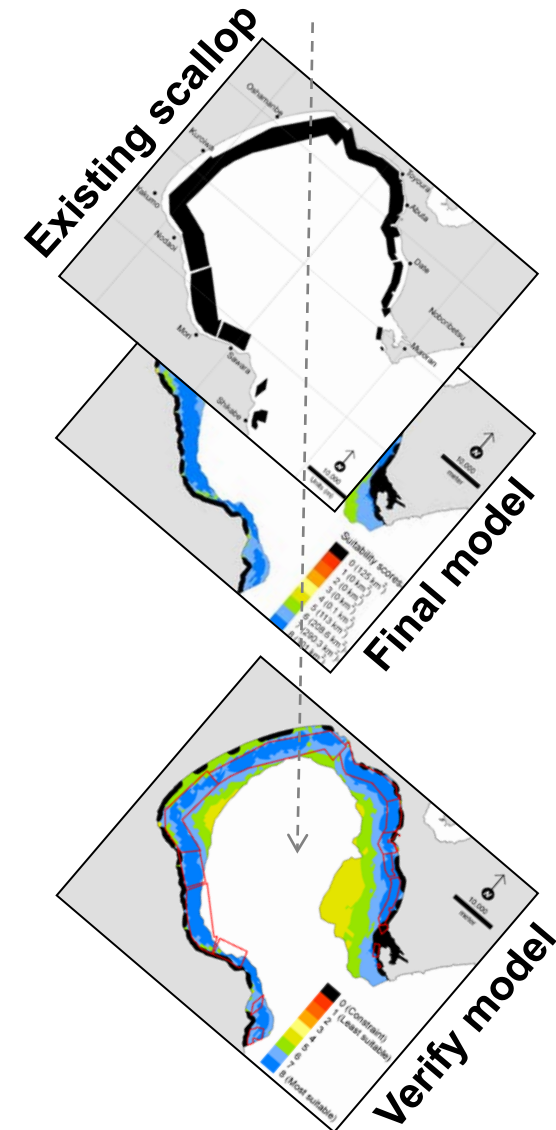
The most preferred alternative is the maximum $V(x_i)$ value



Hierarchical structure



Model verification



CC model construction

- Consider only change of SST values
- Assume other variables constant

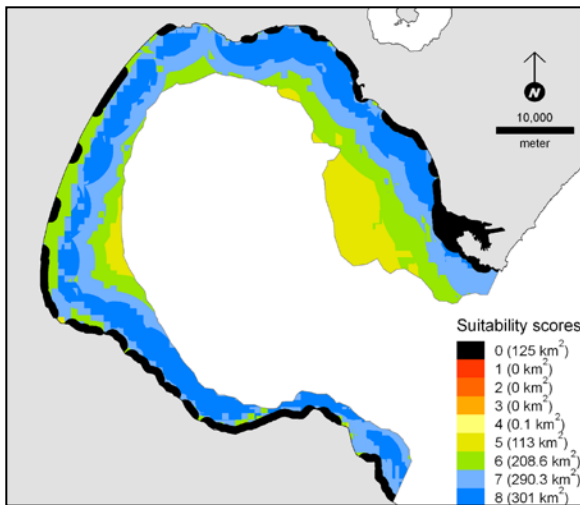
Predicted models

**SST
Increased
4 °C**

**SST
Increased
2 °C**

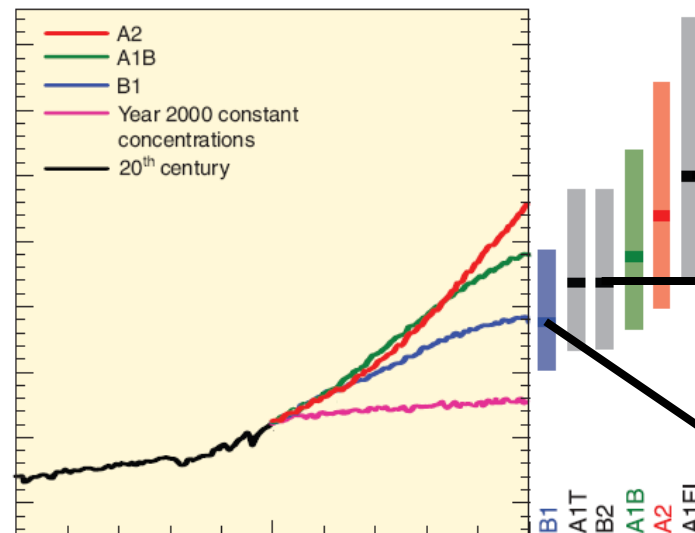
**SST
Increased
1 °C**

Original model



Suitable sites

Reanalyzed



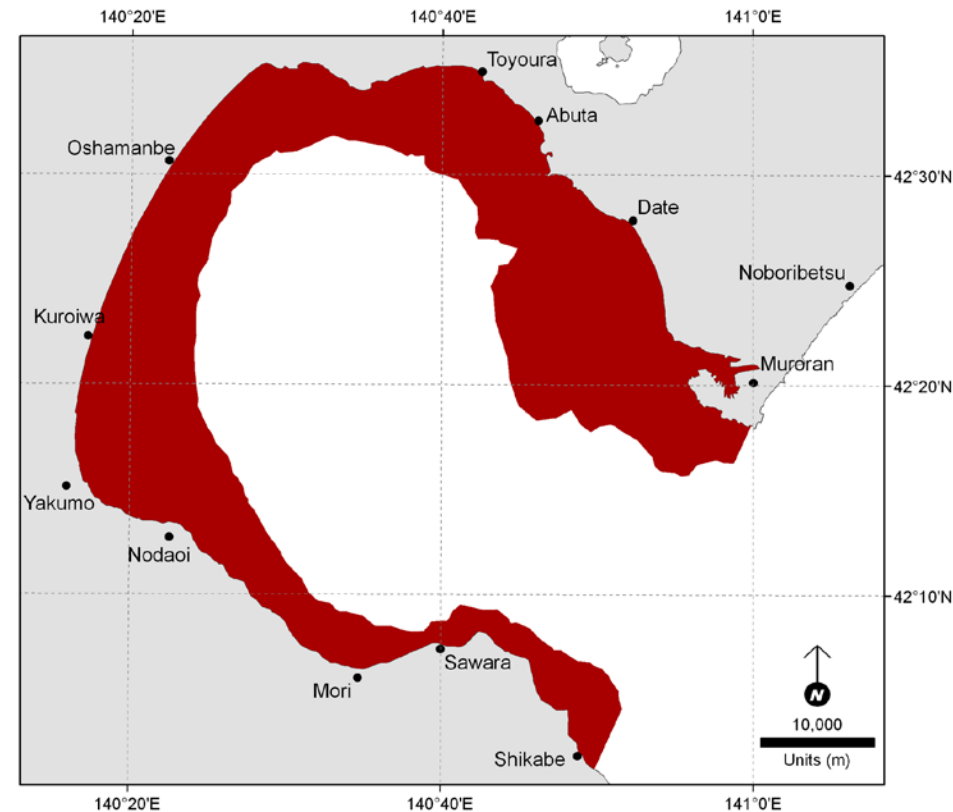
(IPCC, 2007)



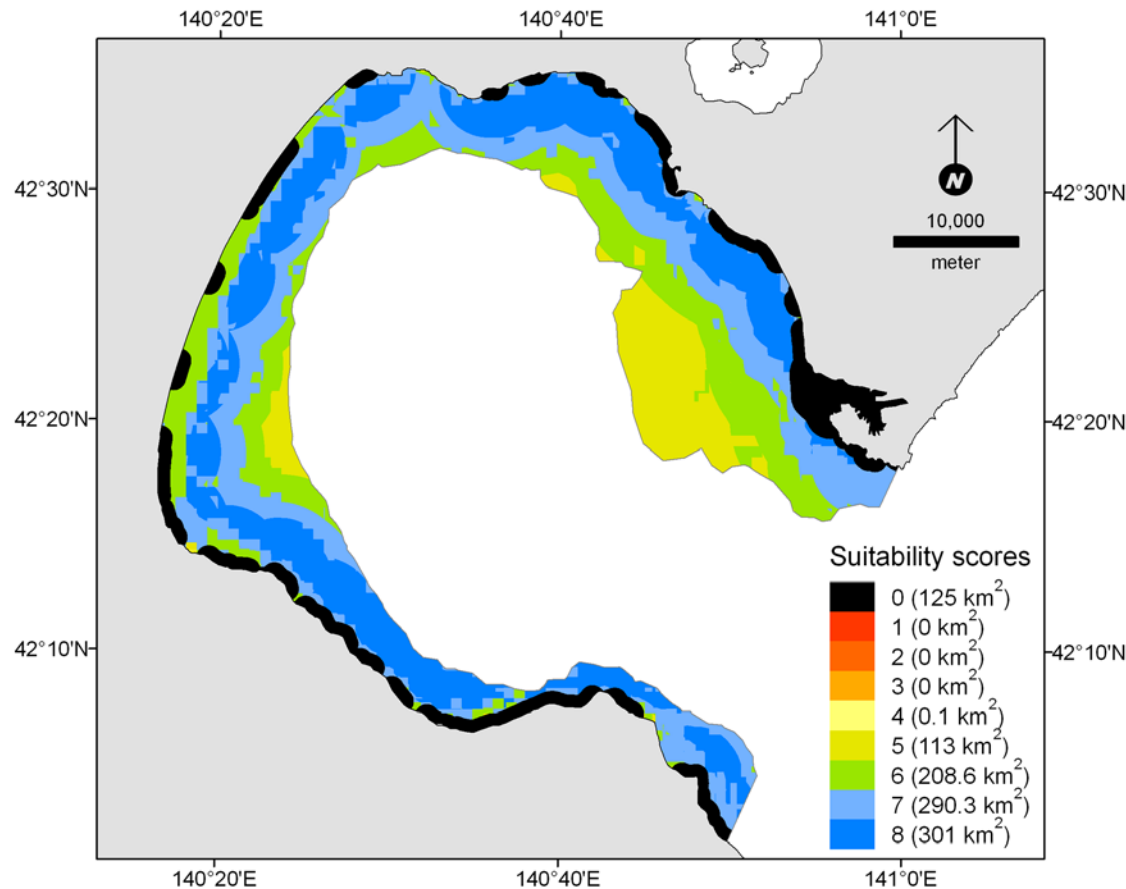
Results

Area of interest

- Suitable area based on 60 m depth
→ to minimize operation costs and difficulty in mooring systems
- Potential area about 1038 km² (45%)



Final suitable site model



Scores and proportional area (%)

0	1	2	3	4	5	6	7	8
12	0.0	0.0	0.0	0.01	10.89	20.1	28	29

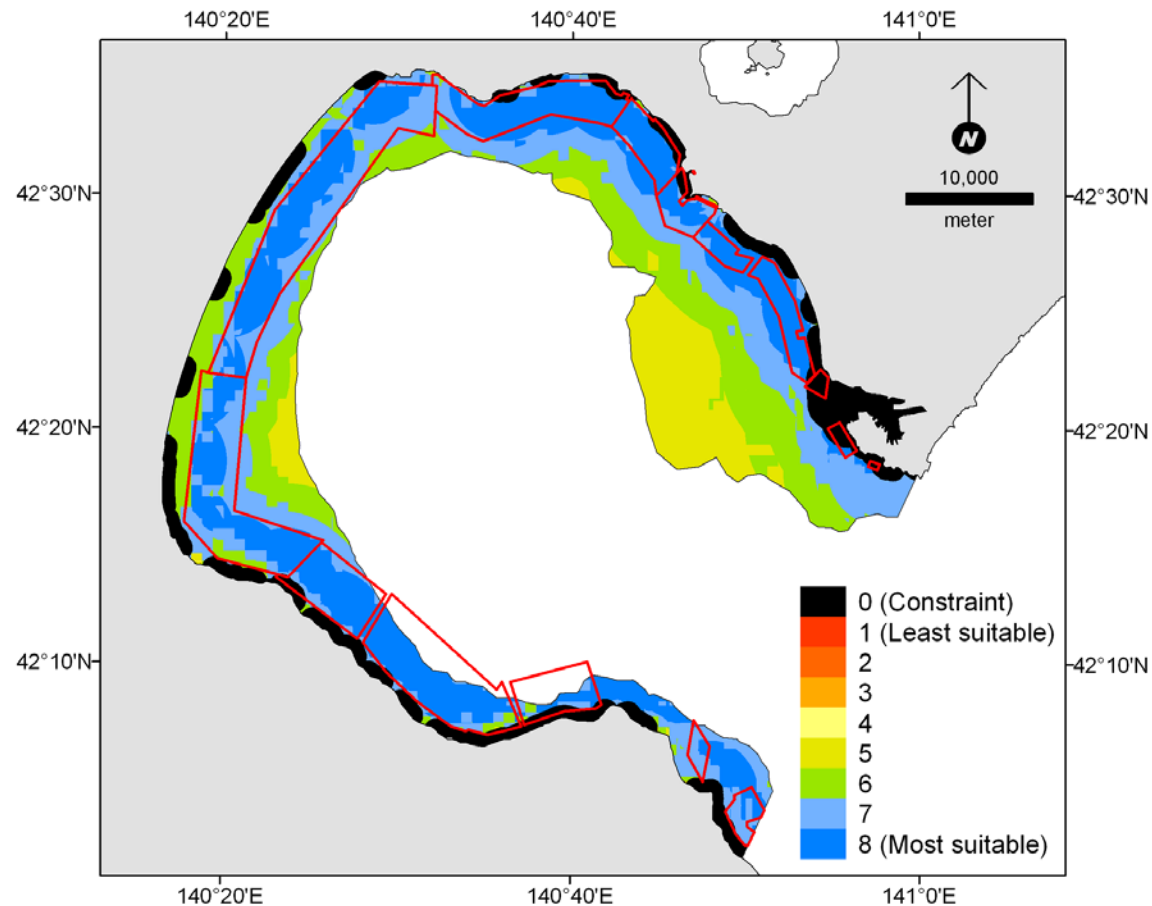


Constraint

Low

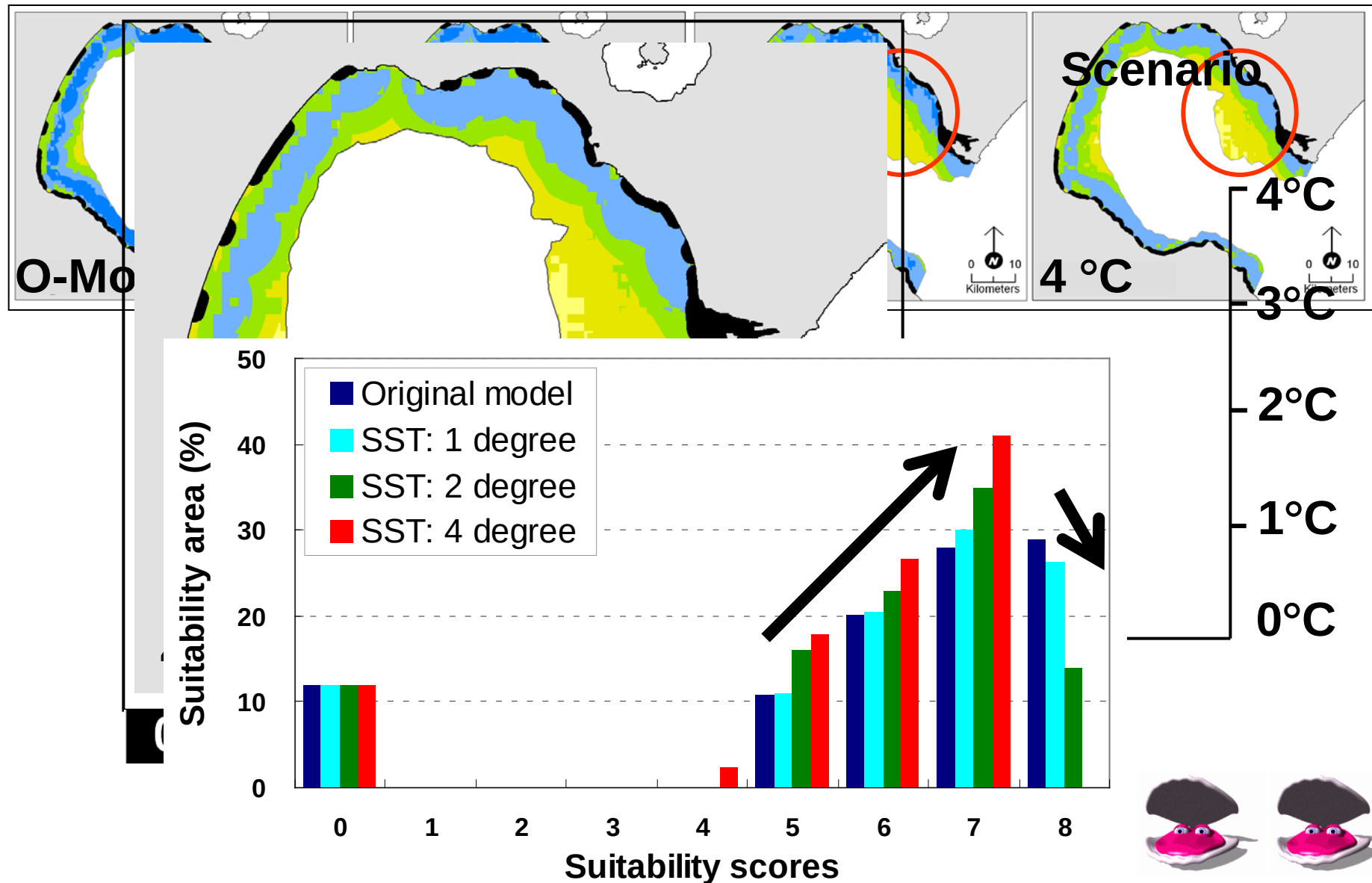
High

SS model verification

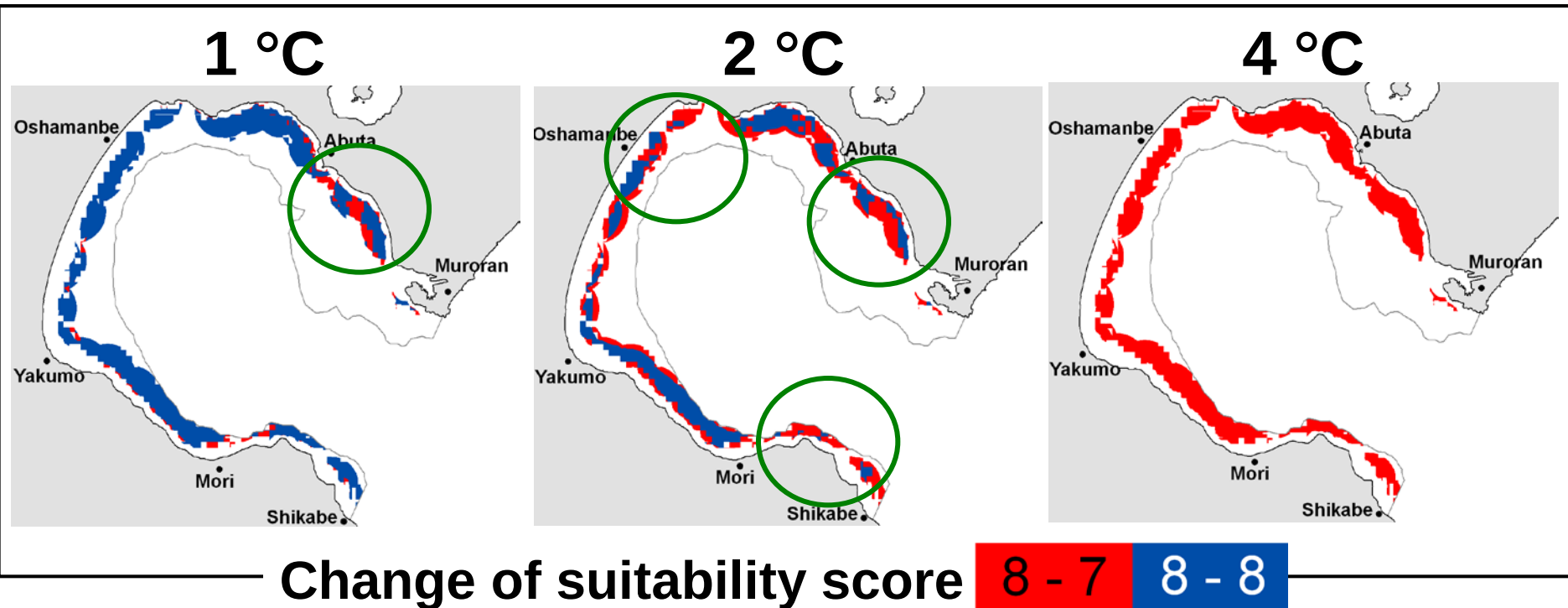


Scores and proportional area (%)									Outside > 60m
0	1	2	3	4	5	6	7	8	
4.0	0.0	0.0	0.0	0.0	0.2	3.0	24.8	60.0	8.0

CC – Prediction model



CC – Prediction model

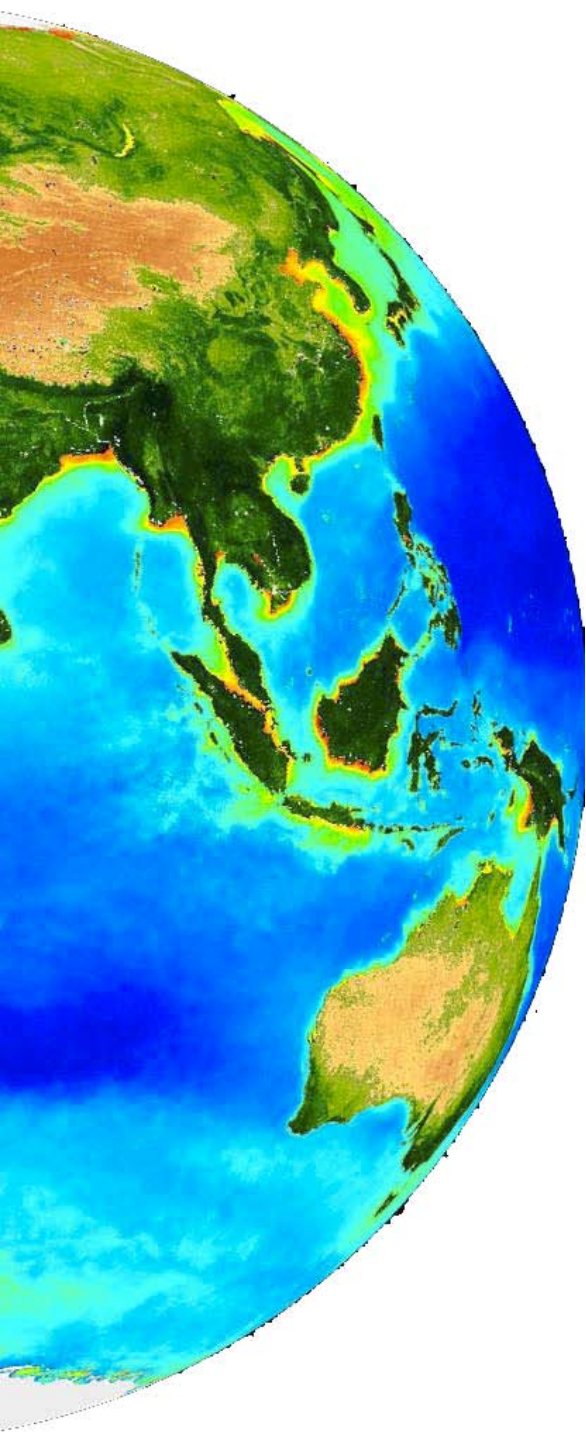


- Prediction models showed CC impact on development of scallop culture
- Continues study on the impact of climate change on the scallop aquaculture development are challenging and need further research

Conclusions

- Spatial information systems has an excellent future to address many issues facing the development and management of aquaculture.
- Spatial data are becoming increasingly available. Those data can be integrated into spatial analyses in order to update and enhance the final outcome.
- Given IT trends, the future spatial tools will provide a range of functions embedded in various component that can be used for specific analyses to support sustainable aquaculture.

International Symposium on “Sustainability Science on
Seafood and Ocean Ecosystem Conservation”
Hakodate, November 7, 2009



Thank you

I Nyoman **Radiarta**^{1,2} and Sei-Ichi Saitoh¹

¹ Faculty of Fisheries Sciences, Hokkaido University

² Research Center for Aquaculture, MMAF, Indonesia