Special Project by the Ministry of Environment (2014-2018)
S13
Development of Coastal Management Method to Realize the Sustainable Coastal Sea

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Development of Coastal Management Method to Realize the Sustainable Coastal Sea (2014-2018)

P.I.; T.Yanagi

Theme 1

1. Seto Inland Sea

Decrease of fish catch
High biodiversity and production
Control of nutrients concentration

Theme 2

2. Sanriku coastal sea

Recovery from Tsunami-damage
Satoumi creation
Material flux from forest to coastal sea

Theme 3

3. Japan Sea coastal area

Intergovernmental management
Spillover effect of MPA
Future forecast of ecosystem

Theme 4

4. Social and Human sciences

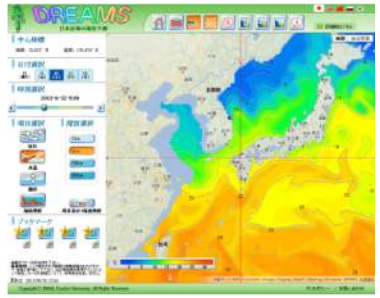
Economic value of ecosystem service
MPA and fisheries
Satoumi story for citizen

Theme 5

Integrated numerical model development

Synthesis

Philosophy for coastal sea management
Measures for establishment of sustainable coastal sea area
Integrated model as a support tool for policy makers



Integrated Coastal Sea Model

visualization

Environmental Policy

Committee（Three types）

1.5 million US$/year

Realize clean, rich and prosperous coastal sea

Global dispatching

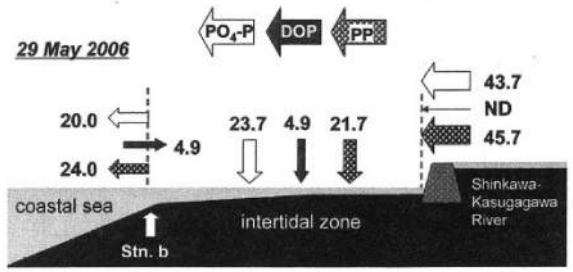
Theme 1; Seto Inland Sea

I. Different production systems in bays and nadas
   - ✓ Nutrients ～small fish/ bivalves
     （Hiroshima Bay～Bisan Strait）
   - ✓ Population dynamics of herbivorous fish

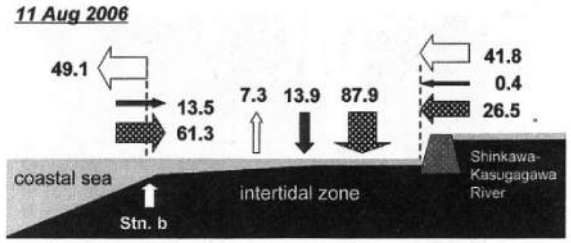
II. Function of tidal flat and sea-weed bed
   - ✓ Water quality and production
   - ✓ Expansion of euphotic layer

III. Suitable nutrient concentration for each bay or nada

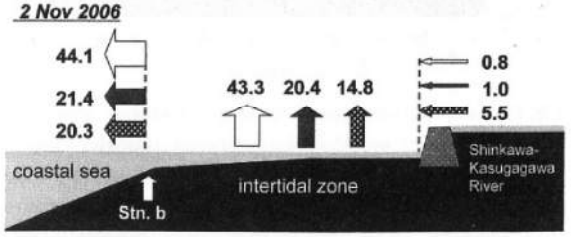
IV. Disappearance mechanism of hypoxia



Spring



Summer



Autumn

Fig. 8 Phosphorus balance in Shinkawa-Kasugagawa River estuary in each survey (kg day^{-1}).

アマモの窒素要求量

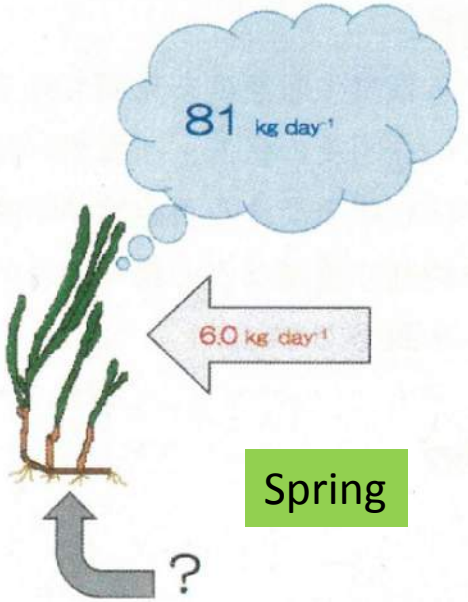
- 生島湾のアマモ現存量 : 0.875 kgDW m^{-2}
- アマモの成長速度 : 0.022 g g^{-1} day^{-1}
- アマモの窒素含有量 : 0.01 g-N gDW^{-1}

⇒ 81 kg-N day^{-1}

アマモ場のDIN Flux

- 水中DIN Flux
  = 3.2 kg-N day^{-1}
- 堆積物からの窒素溶出
  = 2.8 kg-N day^{-1}

⇒ 6.0 kg-N day^{-1}



Spring

Tidal flat: Seasonal variation
input: DIP, POP
output: DIP
spring, summer: deposit
autumn, winter: release

Sea-grass bed: quick material cycling
short-term regeneration of nutrients ?

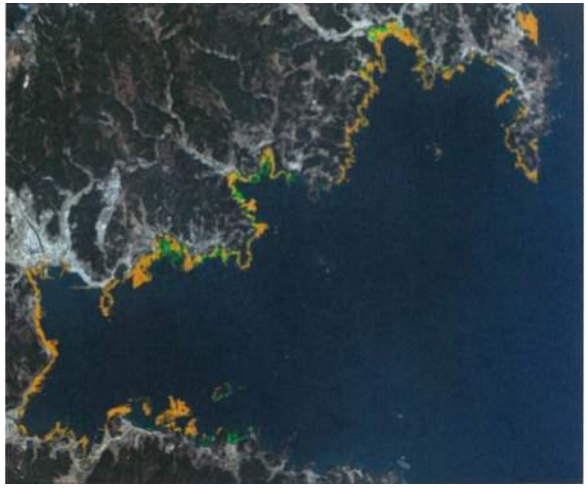
Tada et al. (2014)

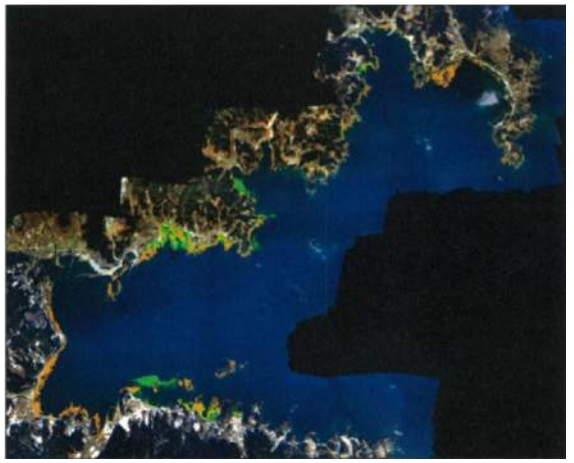
Theme 2; Sanriku coastal sea

1）Management of eco-tone created by big tsunami in 2011

2）Material flux from forest-river to coastal sea

3）Satoumi creation for recovery from tsunami disaster





GeoEye-1

Airplane

2009. 11. 4

2012. 2. 22

2014. 1. 15

2011.3.11 : big tsunami

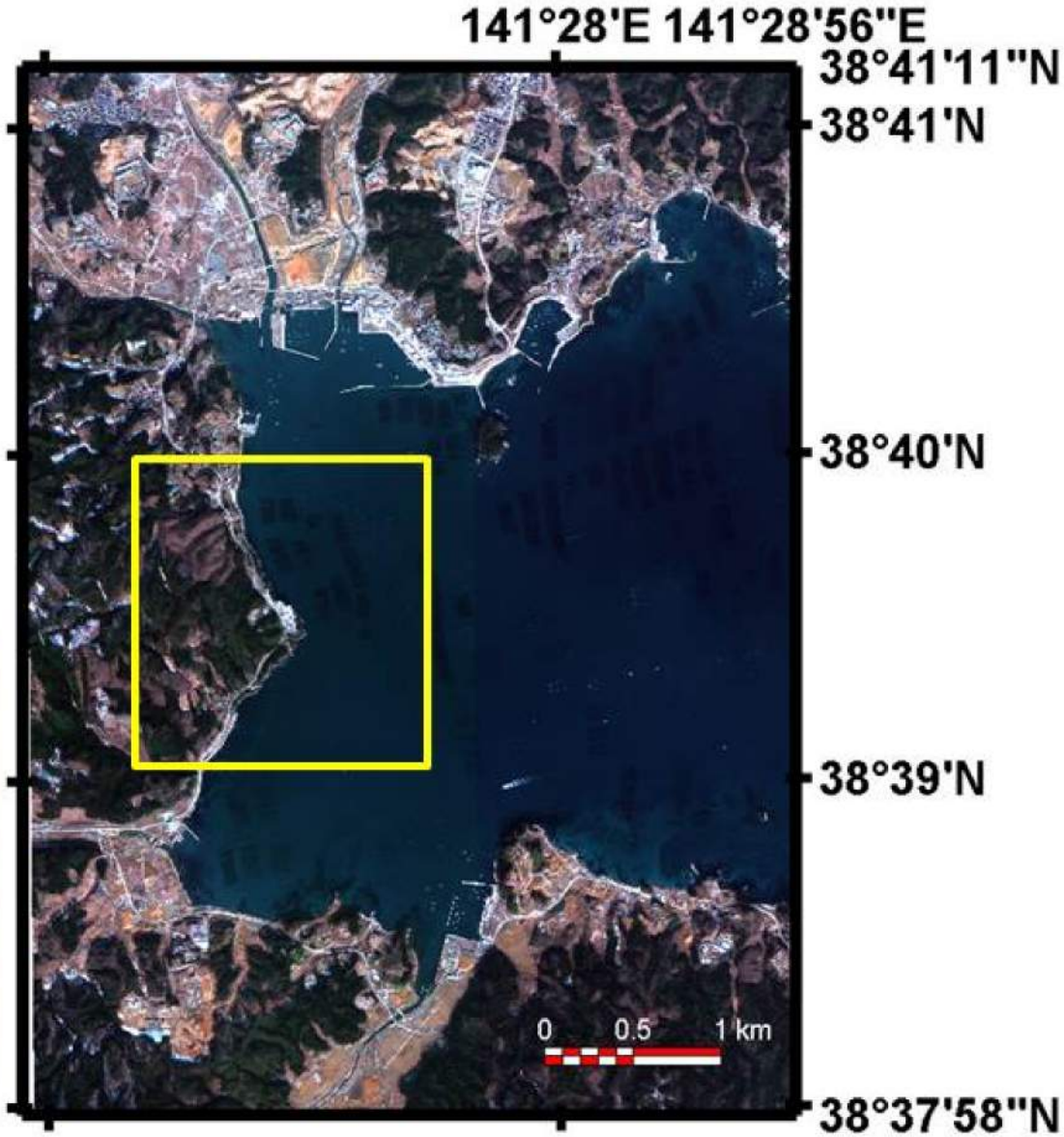
Orange: sea-grass
Yellow-green: sea-weed

What kind of human interaction is useful for recovery of sea-grass and sea-weed beds?

Discussion with local fishermen

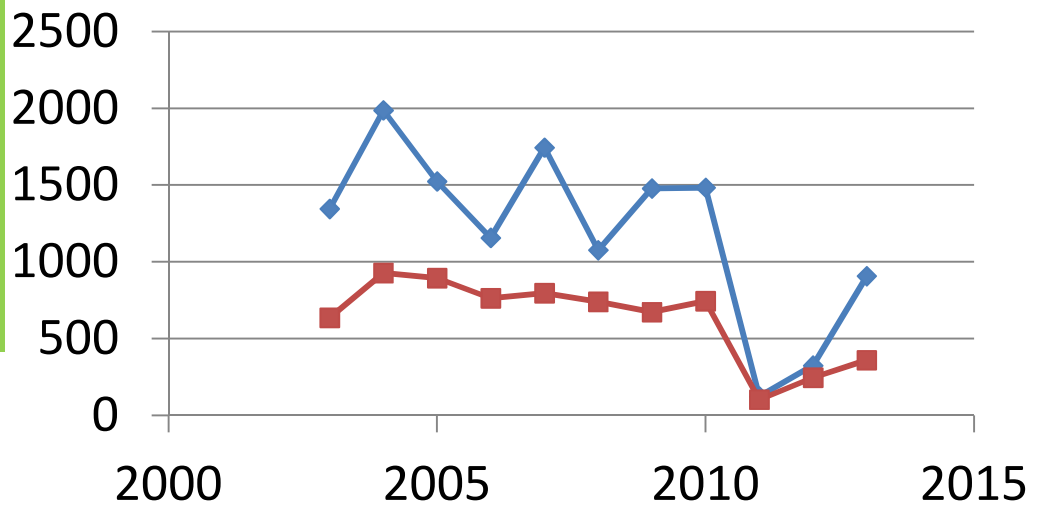
Komatsu et al. (2014)

Destruction of sea weed beds by increase of sea-urchin

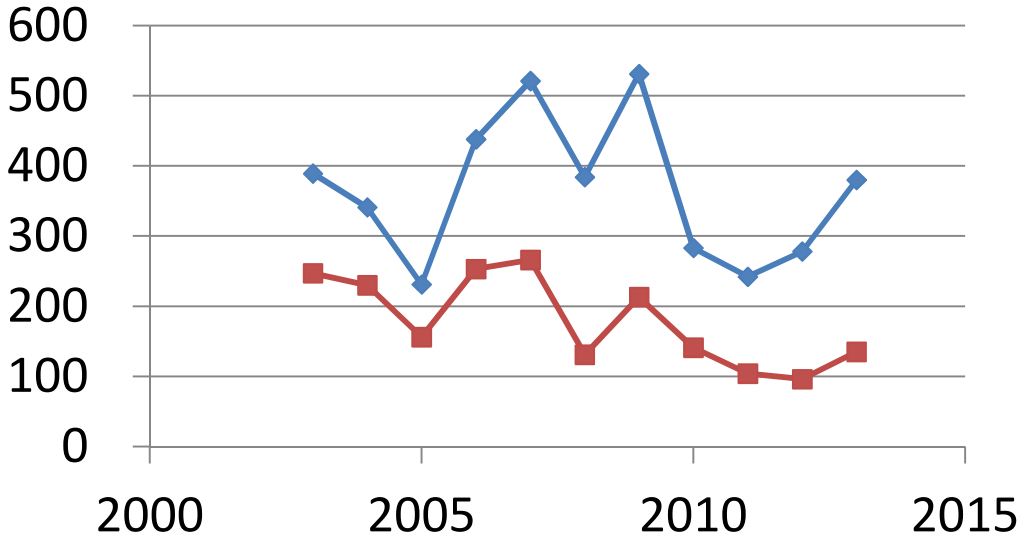


Destruction of sea-weed beds from 2014 to 2015

Decrease of harvest → increase of sea-urchin



Sea-urchin



abalone

Year-to-year variations in sea-urchin and abalone harvest

Theme 3; Japan Sea coastal area

Topic 1：Mechanism of environment variation in the Japan Sea

Numerical hydrodynamic model and ecosystem model

Topic 2：Future projection of the Tsushima Warm Current

Effects of global warming and human activities in the East China Sea

Topic 3：Effects of environmental change to higher trophic level ecosystem in the Japan Sea

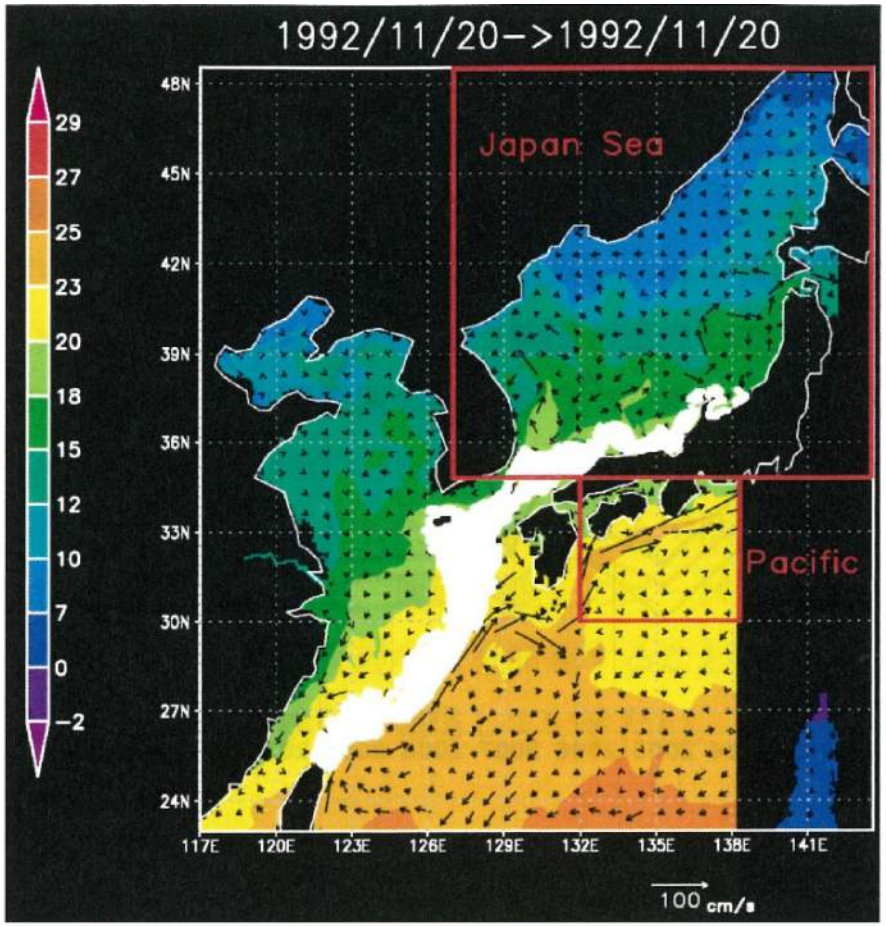
Environmental change in the Japan Sea → Higher trophic level ecosystem

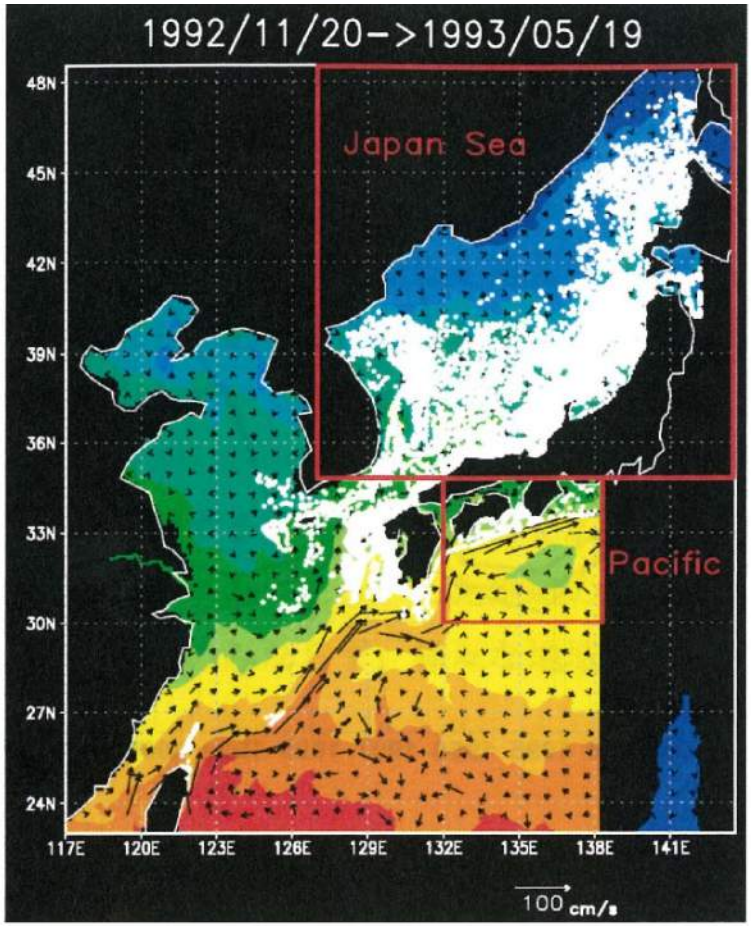
Topic 4：Spillover effect of MPA for biodiversity

MPA designation and its effects to biodiversity

Topic 5：International management system of the Japan Sea

Cooperation with NOWPAP (NOrthWest Pacific Action Plan)





Spawning ground of squid
(water depth and water temperature)

Larvae distribution (water temperature and chl.a)

Where and when is the most effective for MPA ?

Guo et al. (2014)

Theme 4; Social and Human sciences

1）Economic value of ecosystem service

2）Sustainability evaluation and ICM (Integrated Coastal Management)

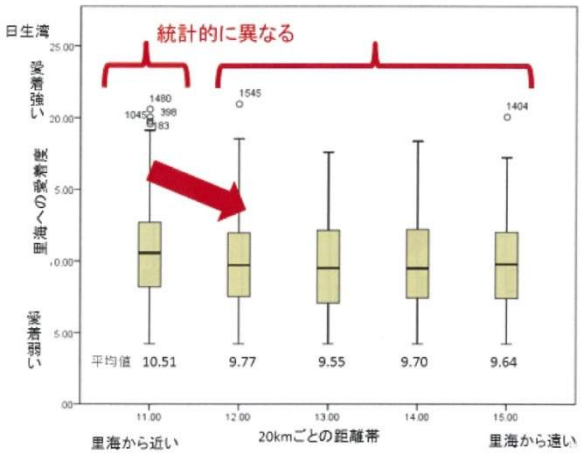
3) MPA and fisheries

4）Three-step management strategy

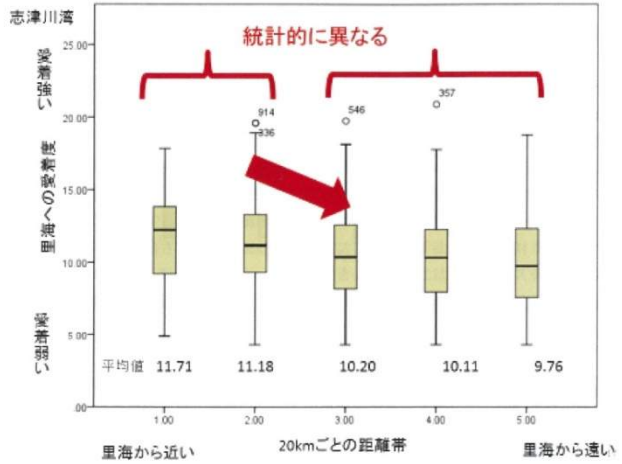
5）Satoumi story for involvement of citizen

- **Integrated numerical model development as a support tool for policy makers with Theme 5**

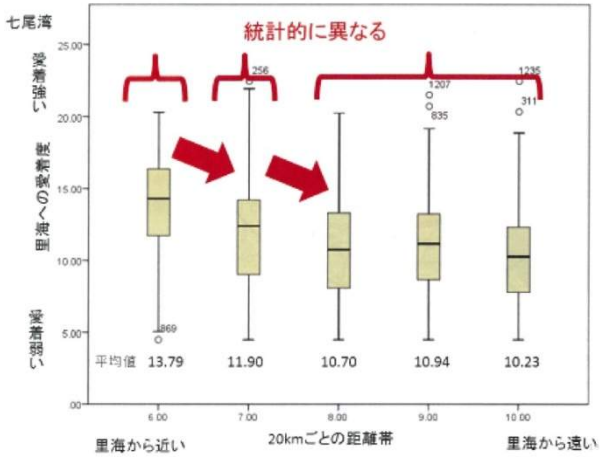
Seto Inland Sea

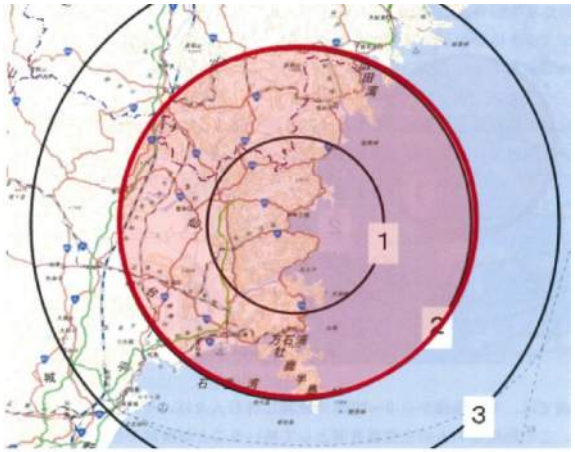


Sanriku coast



Japan Sea





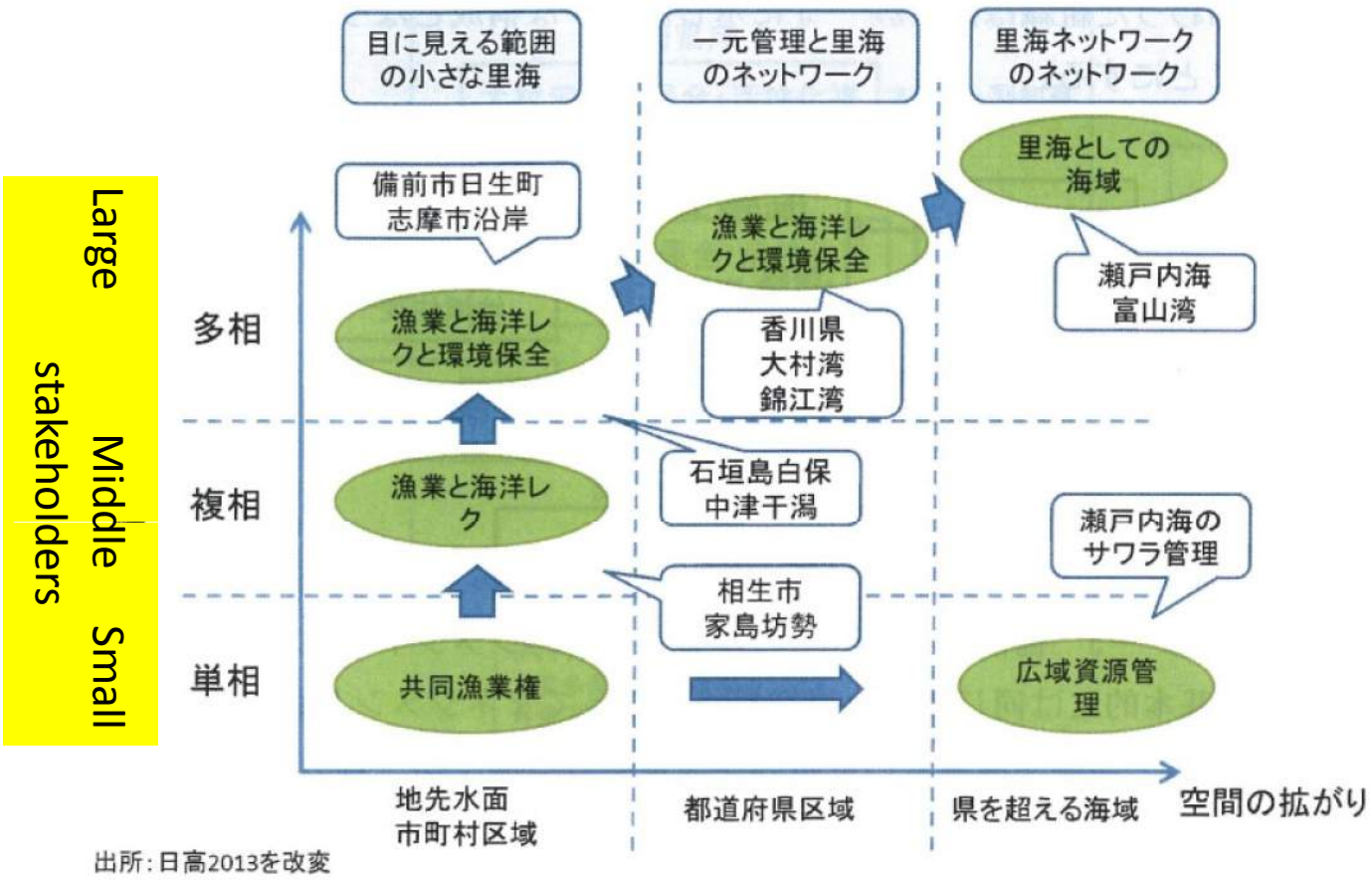
Answer	1,689	1,284	1,449

Questionnaire; Is this coastal sea important for you?

We will clarify the reason on such different results.

We can use such information to define the suitable scale of ICM committee.

Nakagami et al. (2014)



Large Middle Small stakeholders

Small Middle Large space scale

Three-steps Committee System for ICM

Hidaka (2014)

Synthesis including numerical model

- Philosophy for coastal management（Human and sea, use and conservation, food security…）

  Natural, social and human sciences
- Measures for the sustainable coastal sea area（transparency, bottom DO, area of tidal flat and sea weed, nutrients concentration……）

  Field survey, model
- Governance for realizing the measures

  Committee, visualization of model results
- Measures of sustainability

  population dynamics in the coastal sea

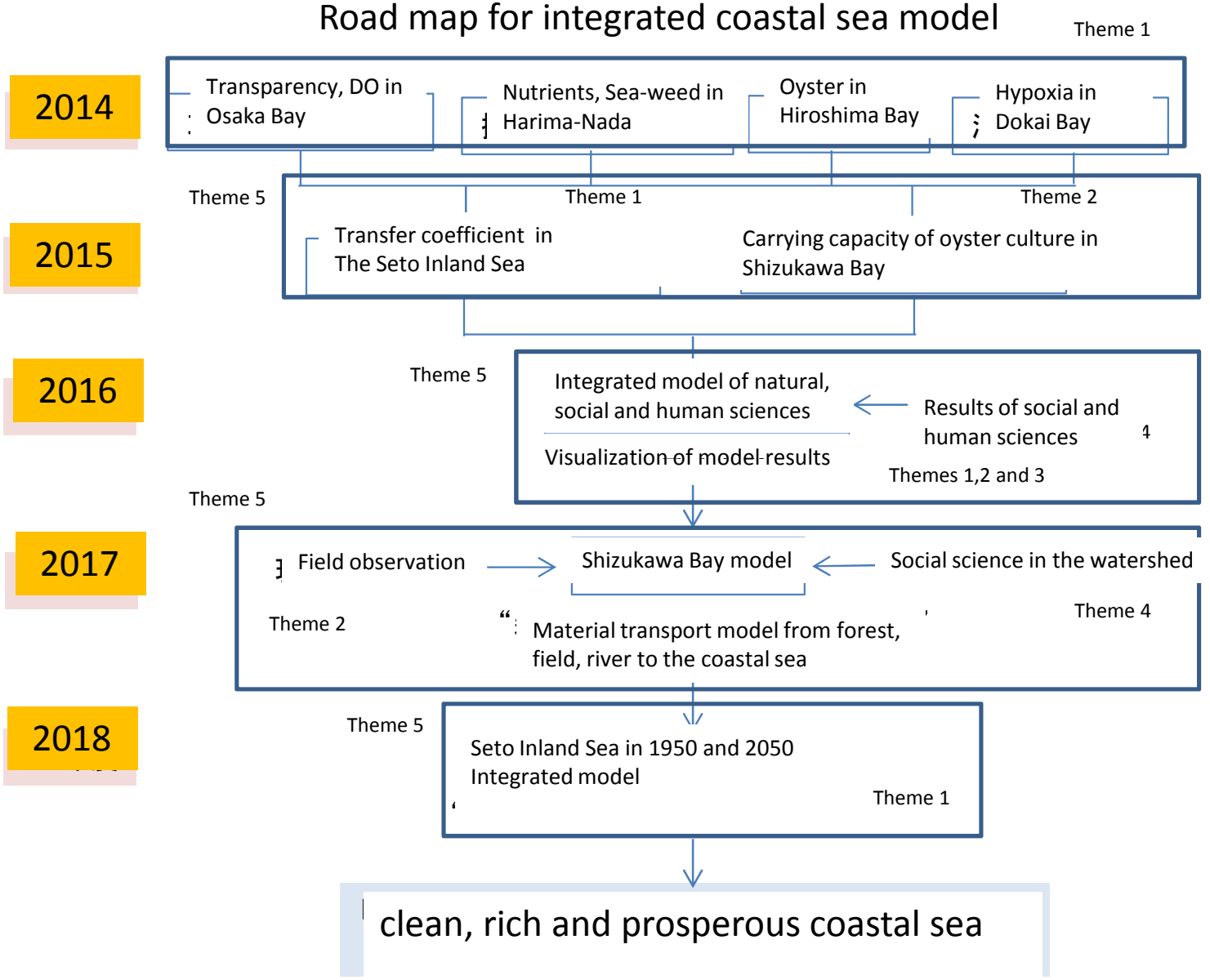
  area

- Integrated numerical model as a support tool for policy makers

  Natural, social and human sciences model

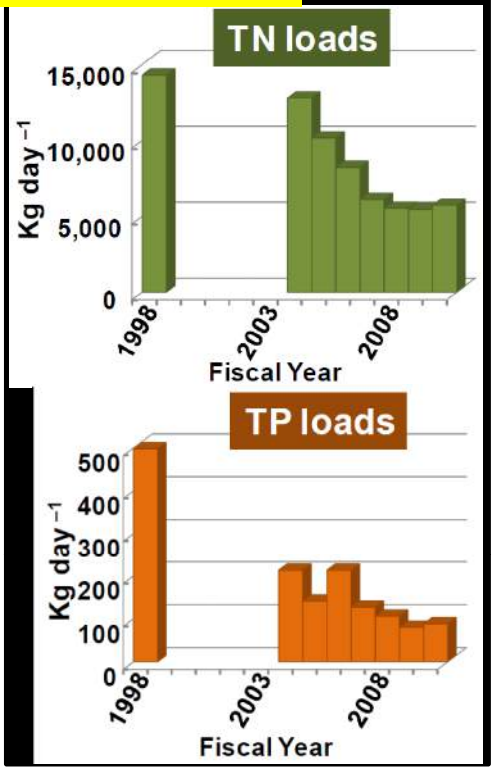
Theme 5

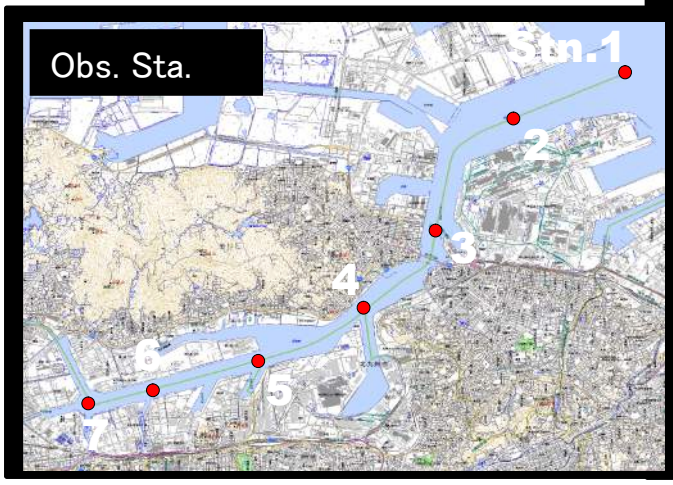
Road map for integrated coastal sea model



TN・TP負荷量と貧酸素水塊の経年変動

TN・TP loads





DO

1994 8/31

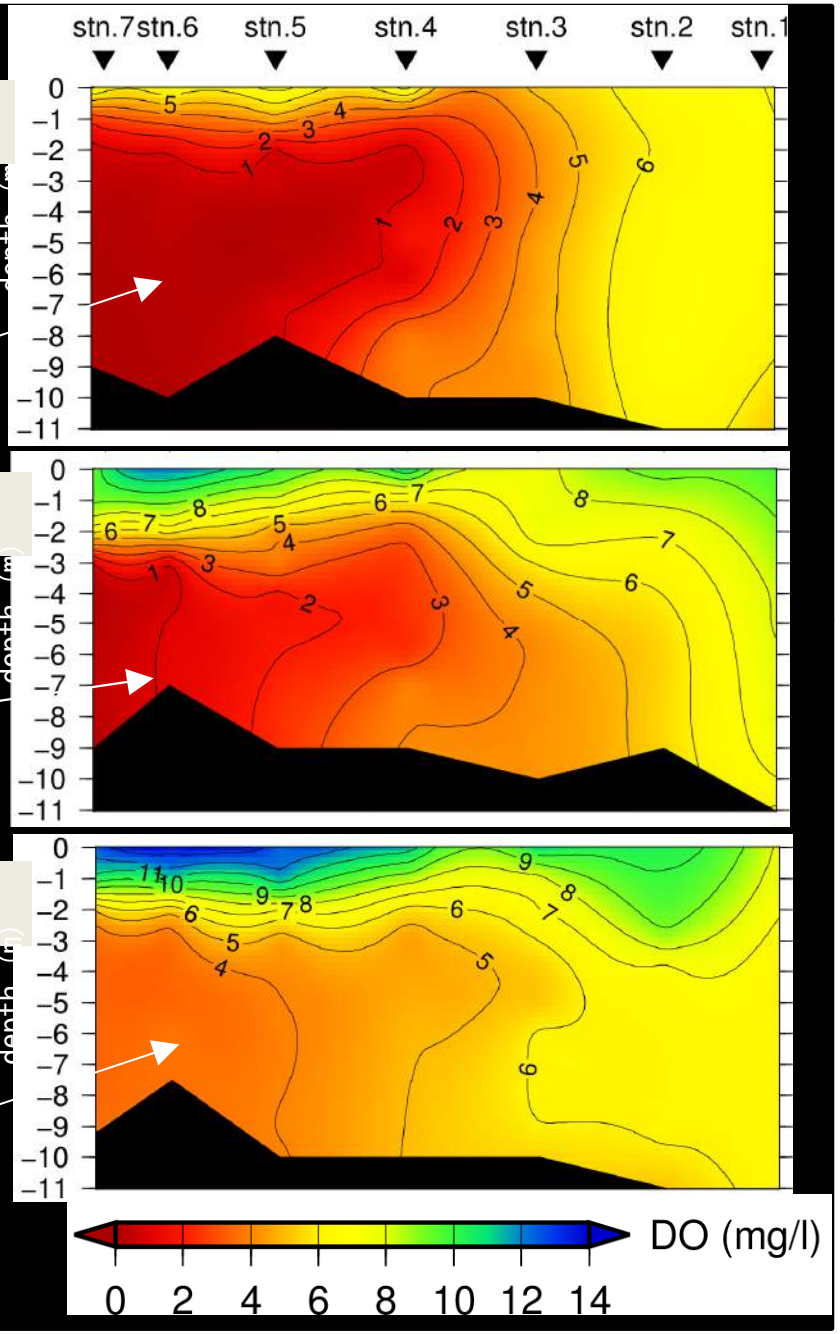
Hypoxia

2006 9/5

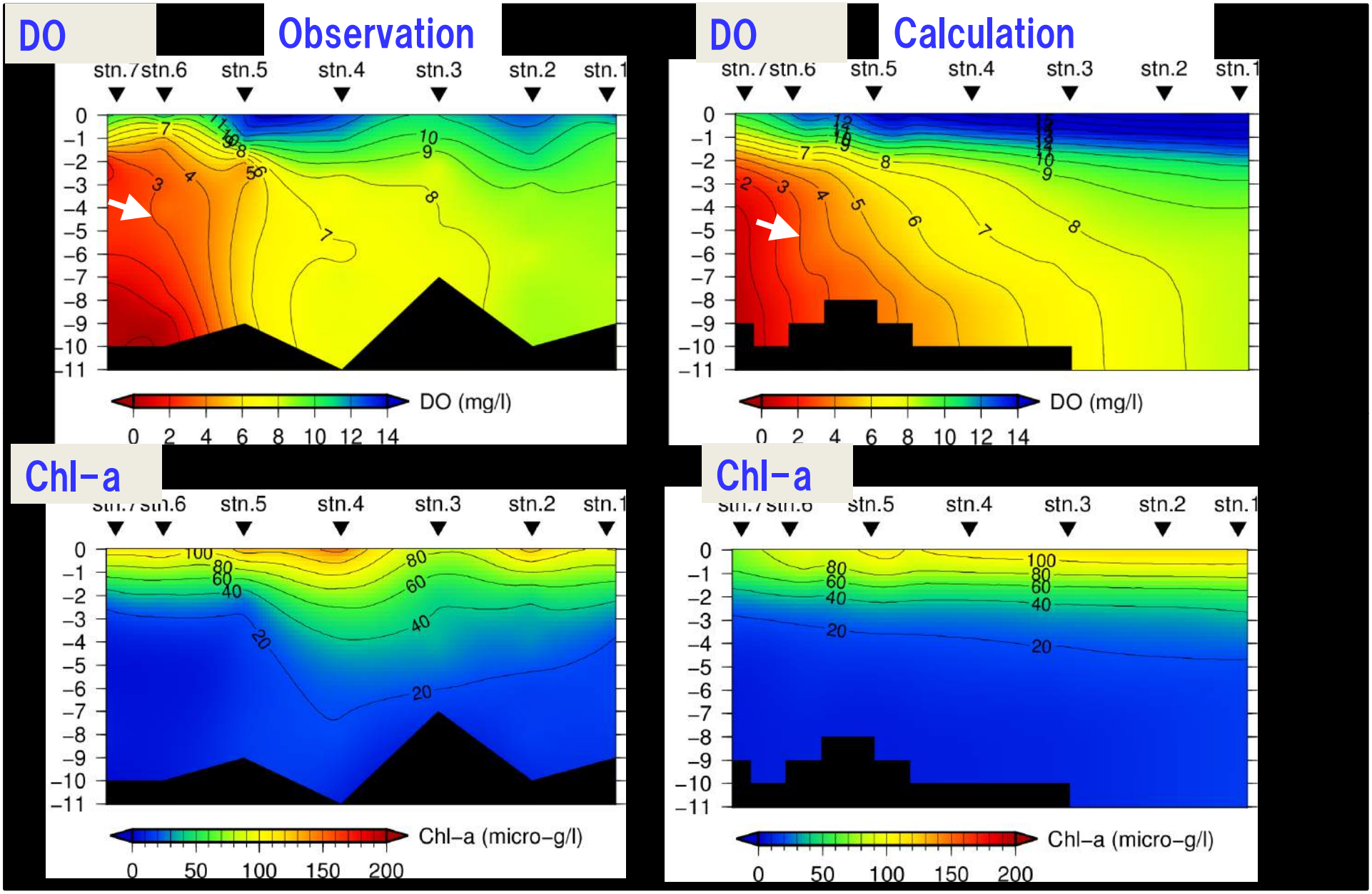
Shrink

2011 9/8

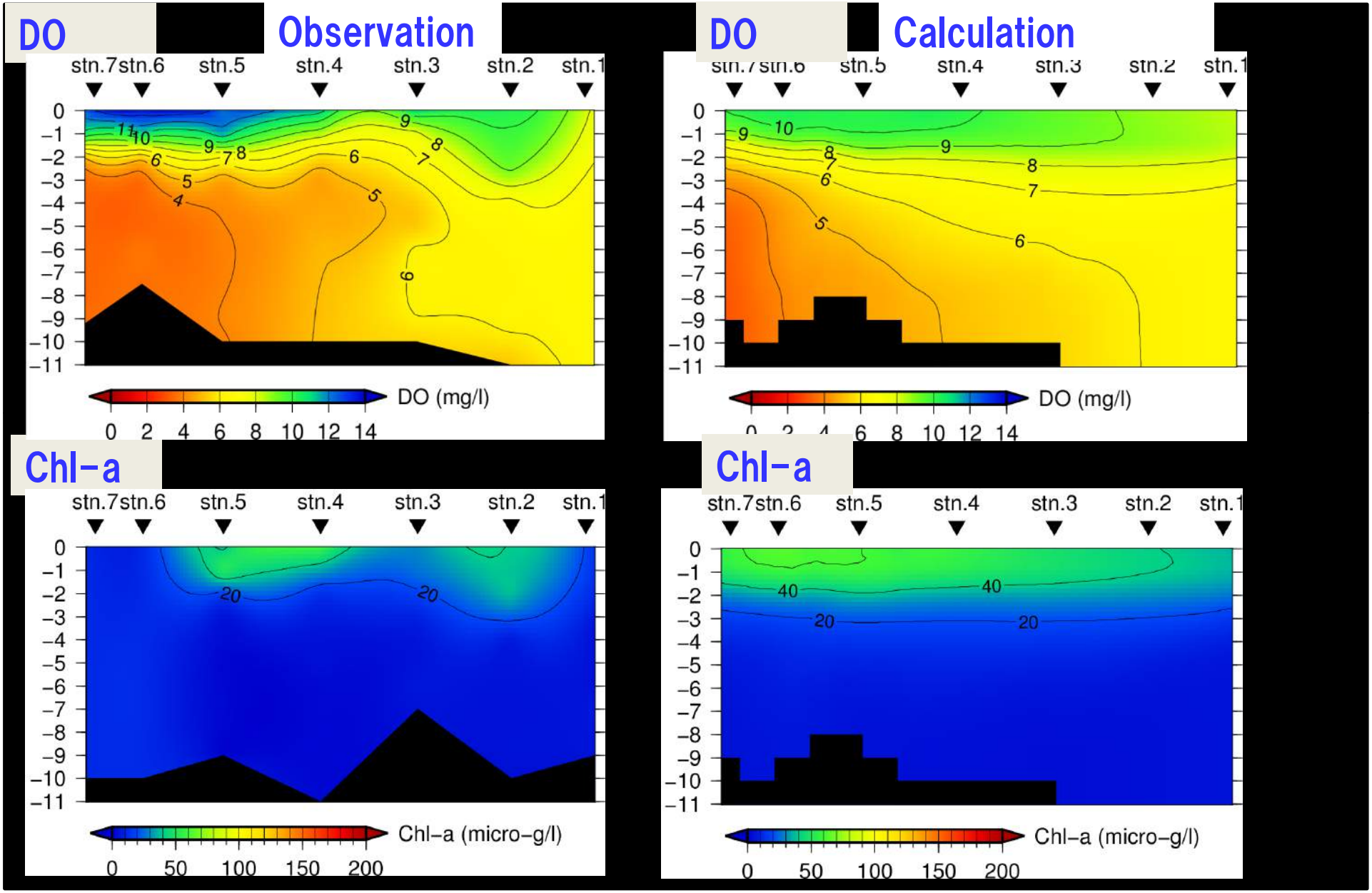
Disappear



1997.8.21（DO、Chl-a）



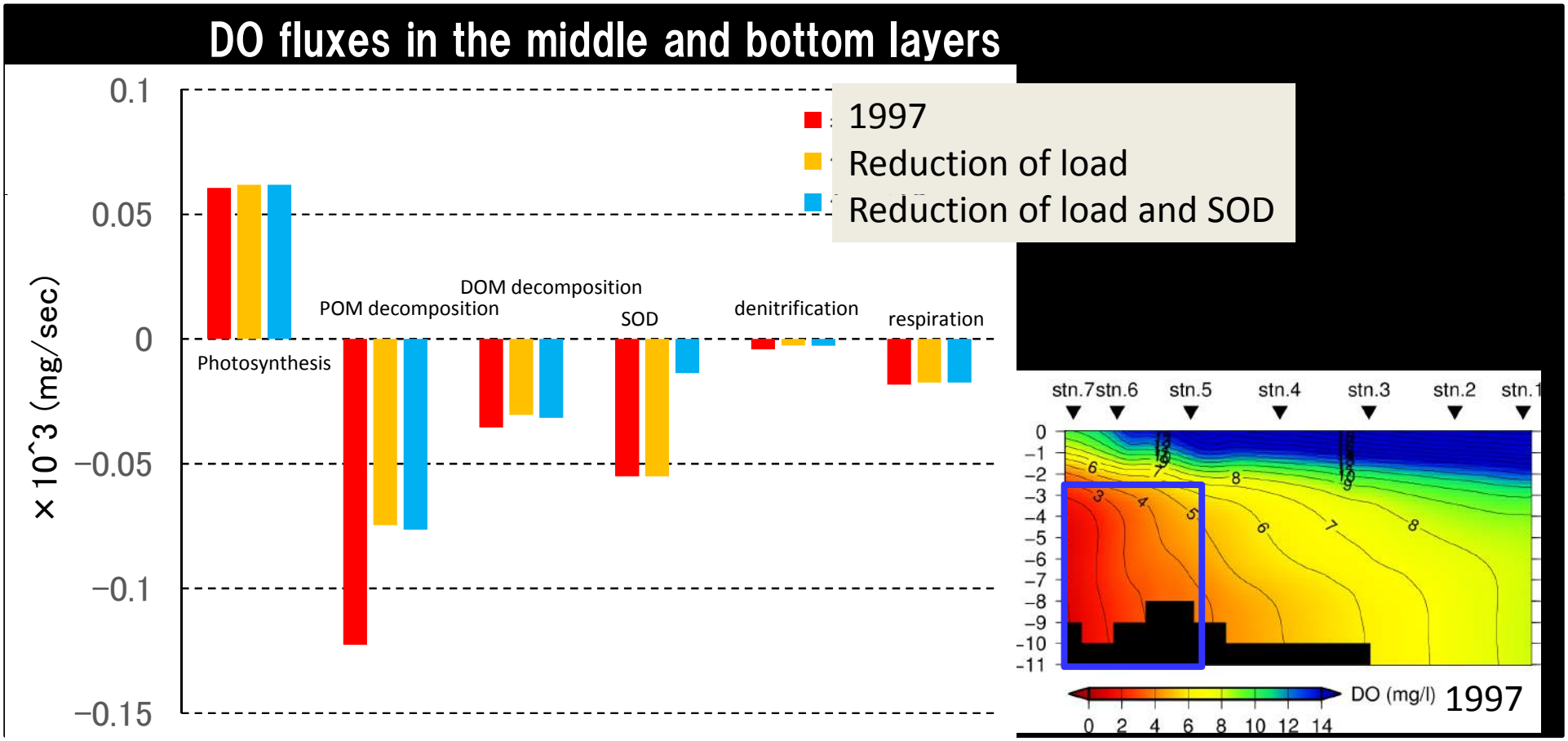
2011.9.8（DO、Chl-a）



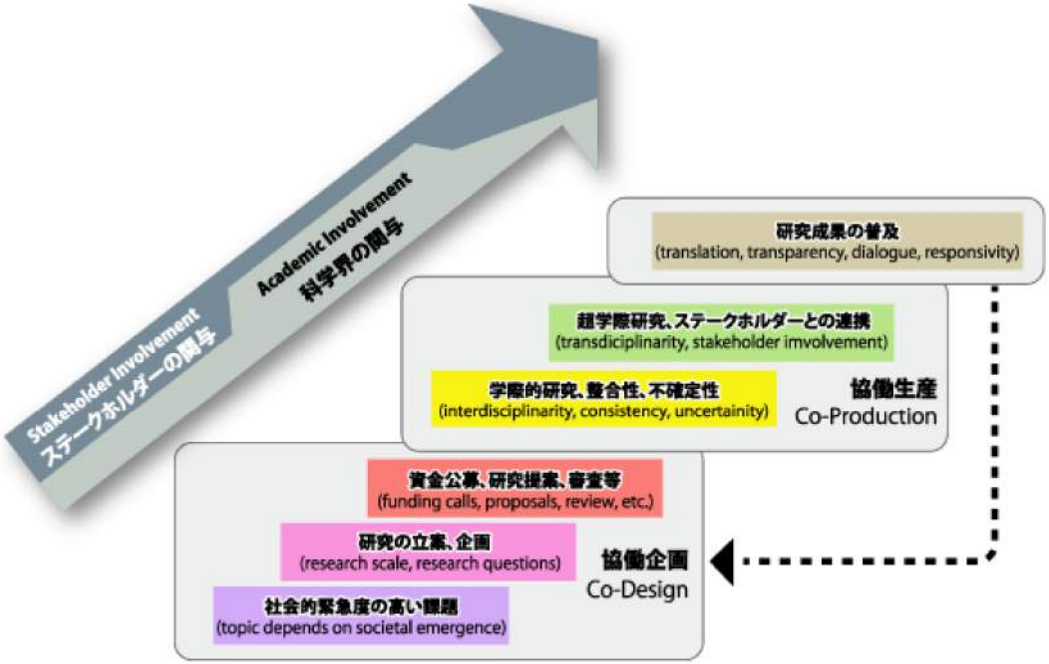
貧酸素が消滅するプロセスとして、以下が考えられる。

① 有機物負荷量の削減 → 底層への有機物フラックスの抑制
（分解の抑制、底質浄化）

② 栄養塩負荷量の削減 → 赤潮の抑制 → 底層への有機物フラックスの抑制
（分解の抑制、底質浄化）



Future Earth (2015-2024) by ICSU



- Sustainability → Future-ability
- Natural, Social and Cultural Sciences → Trans-disciplinary Science → Design Science

"What is the future earth?, future coastal sea?"

- Integrated knowledge scientists, policy makers, stakeholders….

Special session in EMECS 11 (2016)

- Transdisciplinary Study for successful ICM in Japan (Satoumi)

- Theme 1: Seto Inland Sea
- Theme 2: Sanriku coastal area
- Theme 3: Japan Sea
- Theme 4: Social and Human Sciences
- Theme 5: Integrated Numerical Model

- Comments from foreign viewpoints

  Menasveta, Ducroty, Eric,……..