Ecosystem Status Assessment in Korea

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Indicators of Status and Change within North Pacific Marine Ecosystems: A FUTURE Workshop

Honolulu, 2011.04.26-28

Purpose

❖ To introduce monitoring and assessment programs in Korea

Outline

❖Monitoring networks in Korea

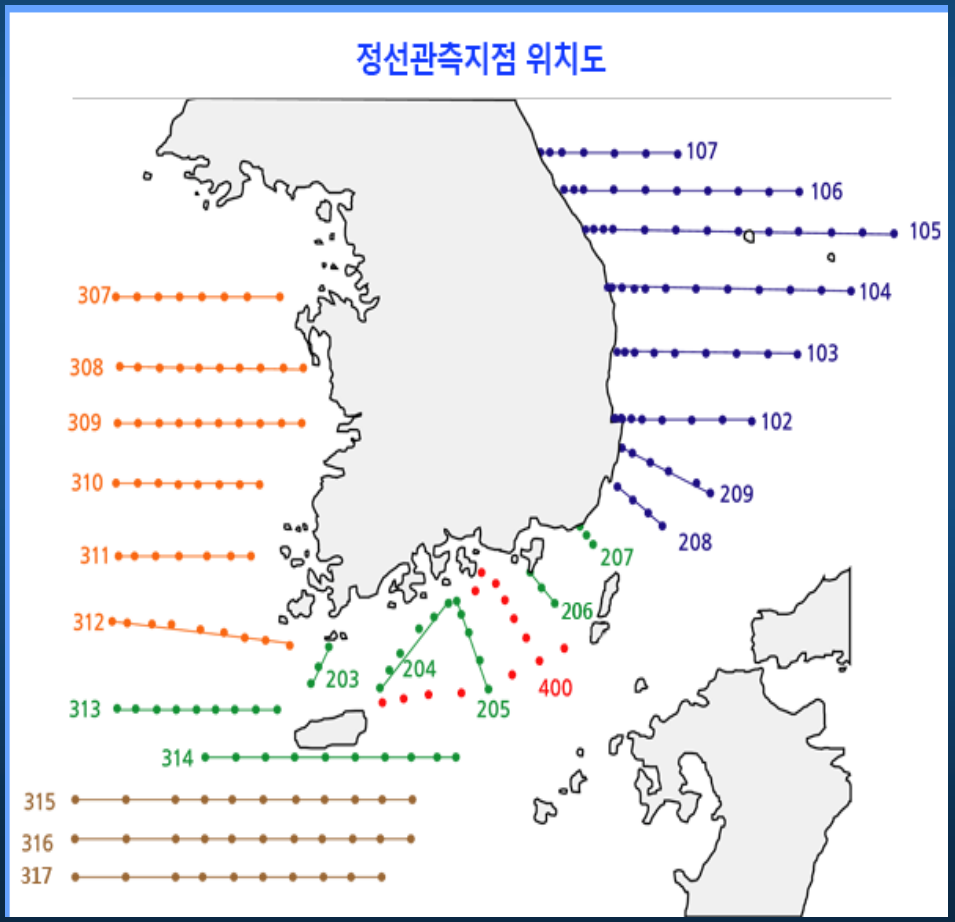
❖National Investigation of Marine Ecosystems

❖Problems in assessment

- Determination of reference conditions
- Sampling problems: Confounding regional and interannual differences

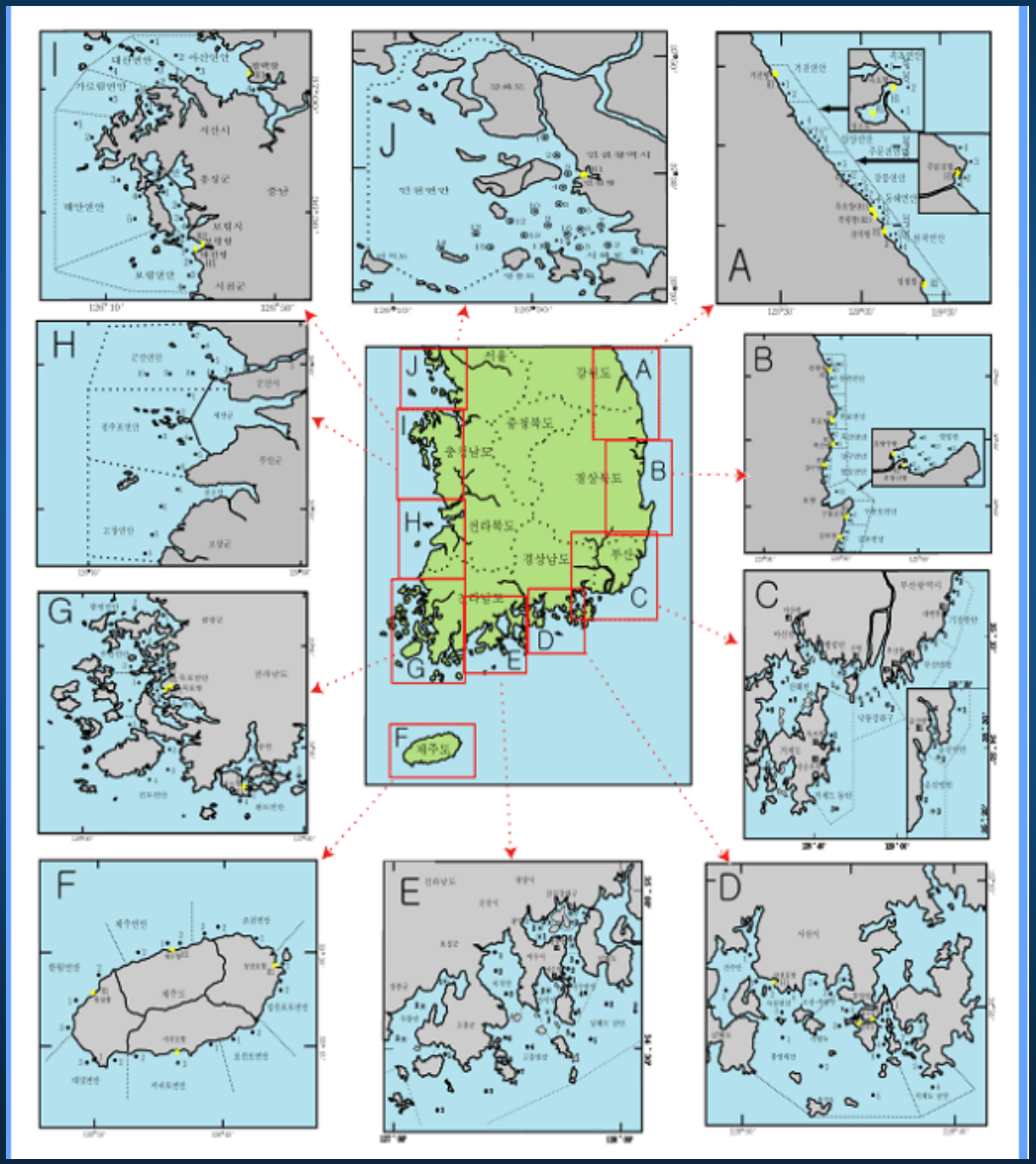
❖On-going and future works

Station-based Monitoring Network (1961~)



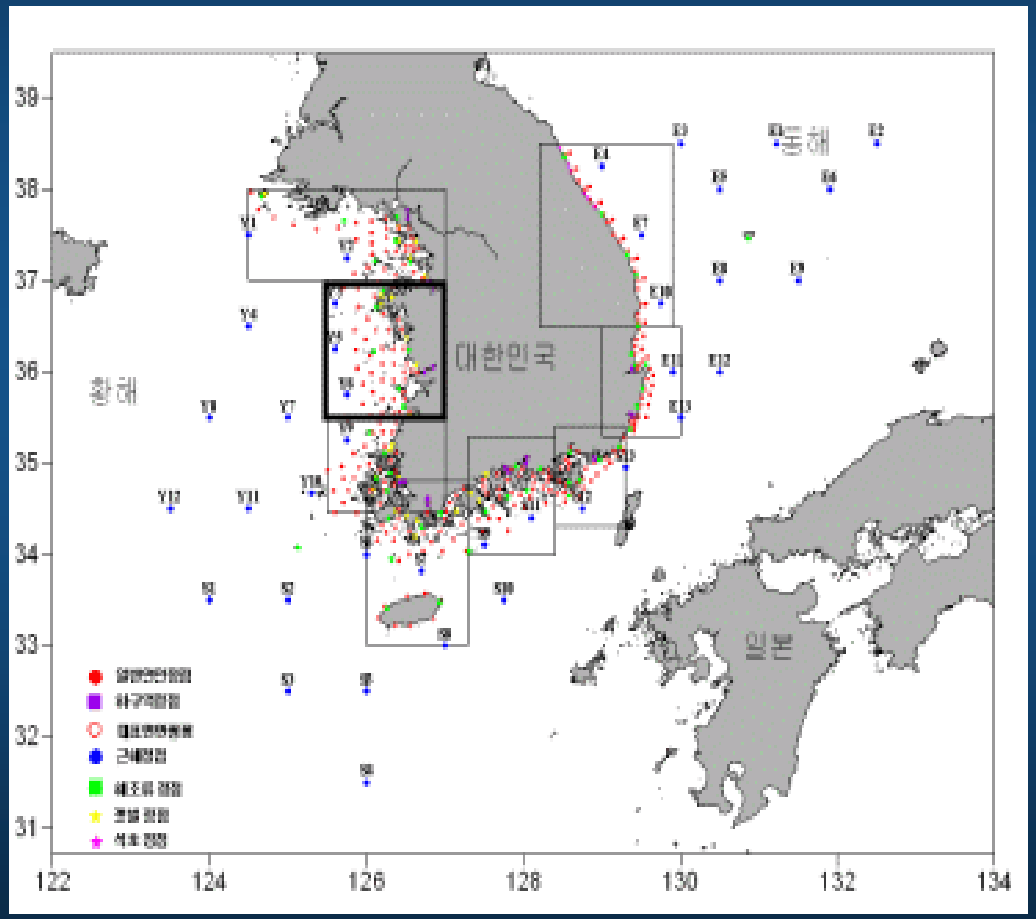
		Variables	Month
1961 ~		•T, S pH, DO, TN, DIN (NO2-N, NH4-N, NO3-N), TP, DIP (PO4-P), SiO2-Si, transparency, zooplankton biomass by groups, phytoplankton	2, 4, 6, 8, 10, 12

National Environmental Monitoring Network (1996~)



		Variables	Month
Sea-water	Water quality	•T, S pH, DO, COD, TN, DIN(NO2-N, NH4-N, NO3-N), TP, DIP (PO4-P), SiO2-Si, SS, transparency, hydrocarbon, CHL-a	2, 4, 6, 8, 10
	metals	•Cu, Pb, Zn, Cd, Cr, Hg, As, CN	2
tissue, sediments	metals	•Cu, Pb, Zn, Cd, Cr, Hg, As, CN	2

National Investigation of Marine Ecosystems (NIMO: 2006~)



- 8 domains in coastal areas (>300 stations)
- Seasonal surveys at one domain per year (8 year monitoring cycle)
- Pelagic
  - Water quality
  - Phytoplankton
  - Zooplankton
- Nekton*
  - -- Ichthyoplankton
  - -- Fish
  - -- Crustacean
  - -- Cephalopods
- Benthic
  - Water quality
  - Meiofauna
  - Macrofauna
  - Macro algae

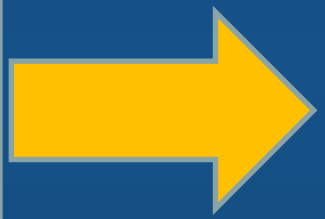
Assessment and thematic maps in NIMO

Purposes

- Scientific summary of massive observational data
  - Spatio-temporal distribution of ecosystem properties
  - Holistic interpretation of ecosystem dynamics
  - Visual presentation of thematic maps
- Assessment of ecosystem status in Korean waters
  - Ecosystem status
  - Impact assessment for stressors
  - Basis for management policy

Stressors and ecosystem properties (Yellow Sea)

- Eutrophication
- Nutrient imbalance
- Overfishing
- Hazardous substances
- NIS
- Habitat disturbance
- Reduction of freshwater input
- Sea warming



- Ecosystem structure
- Biodiversity
- Biomass
- Productivity
- foodwebs

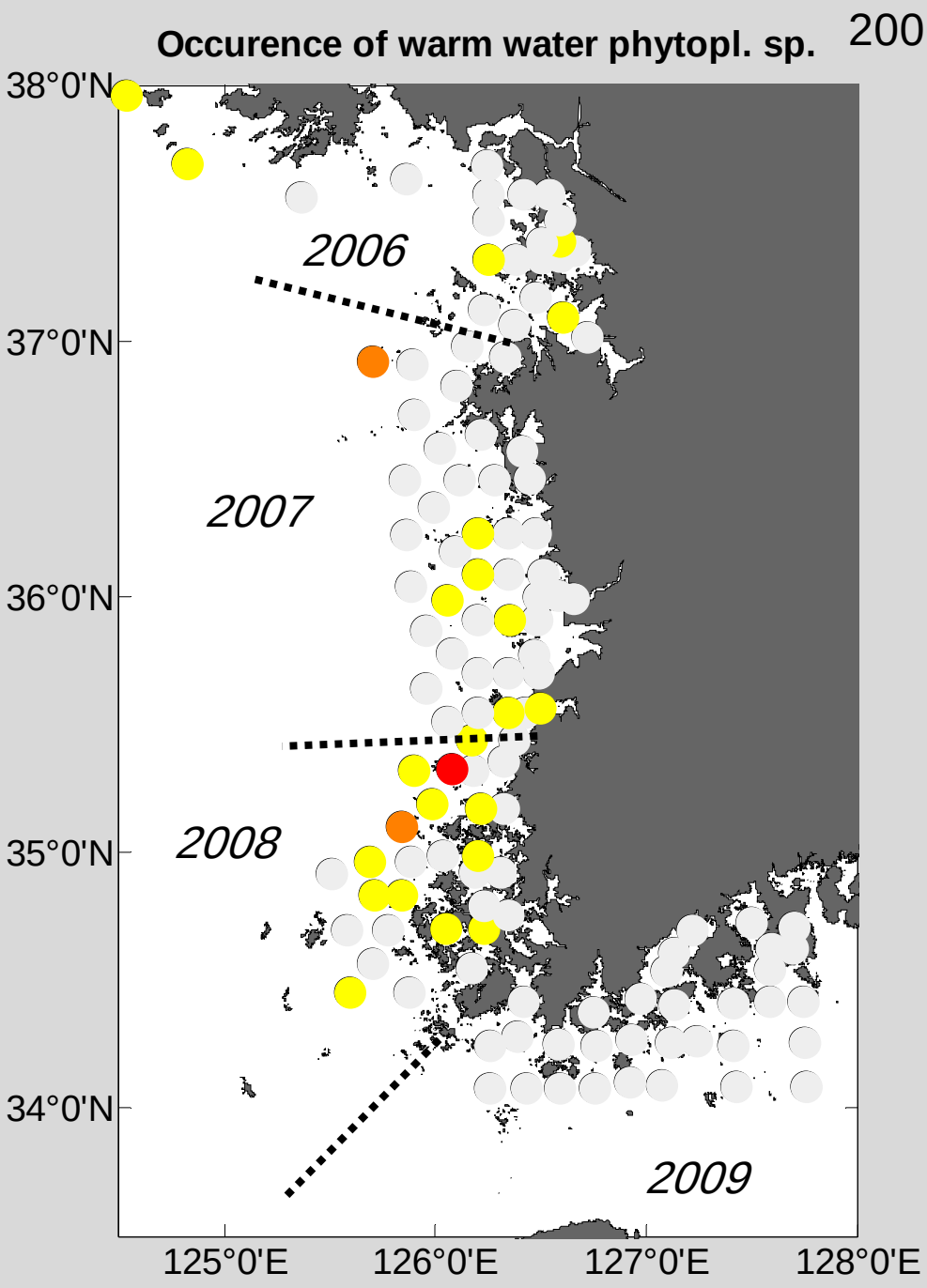
Based on YSLME Transboundary Diagnostic Analysis

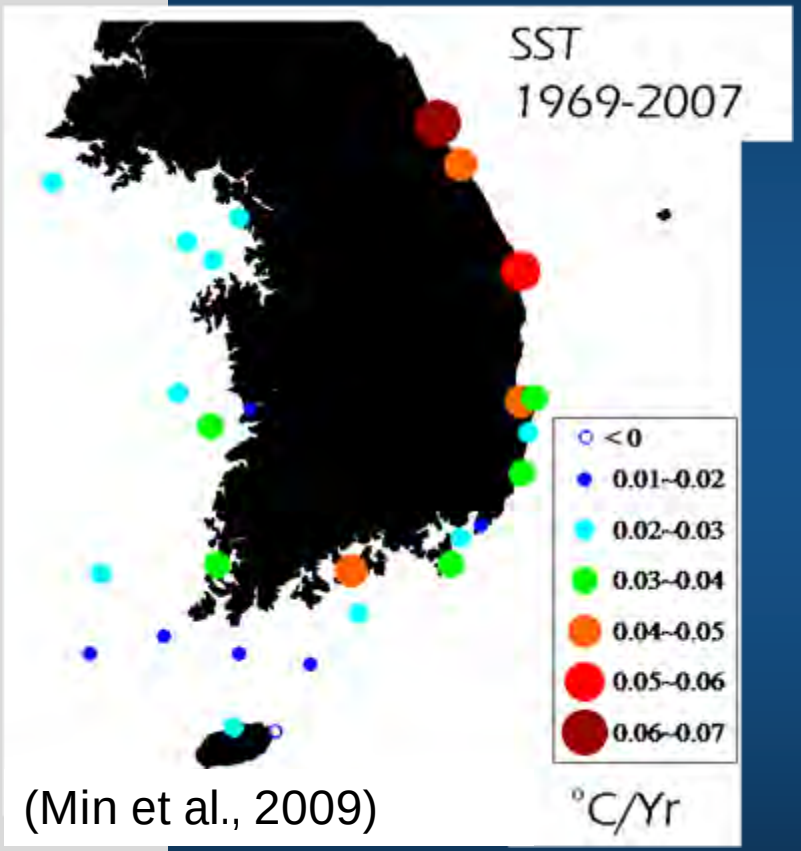
Theme 1: Indicators of Ecosystem Status

	Phyto-plankton	Zoo-plankton	Bethos	Macro-algae	Ichthyo-plankton	Nekton
Structure	Biomass, abundance, Dominant species	Biomass, abundance, Dominant species	Biomass, abundance, Dominant species	Biomass, abundance, Dominant species	Abundan-ce of dominant species	Biomass, abundance, Dominant species
Diversity	Sp. Richness, Sp. Diversity	Sp. Richness, Sp. Diversity	Sp. Richness, Sp. Diversity	Sp. Richness, Sp. Diversity		Sp. Richness, Sp. Diversity
Producti-vity	Should be added		could be estimated	Should be added		could be estimated
Food-web			Trophic linkage			Trophic linkage

Theme 2: Indocators of Ecosystem Stressors

	Benthic environment	Pelagic environment	phytoplankton	zooplankton	benthos	Macro-algae	Ichthyo-plankton	Nekton
Eutrophication	Bottom DO	Nutrients	CHL-a		ISEP, biomass	R/P		
Hazardous substance	metals				Tissue conc.			Tissue conc.
Habitat disturbance								Pelagic/ Demersal
NIS			NIS	NIS		NIS		NIS
Freshwater Input reduction			Fresh-water sp.					
Nutrient balance		N/P/Si	Diatoms/ Dino					
Warming	Temperature change	Temperature change	Tropic/ subtropic Sp.	Tropic/ subtropic Sp.		Warm water Sp.		Tropic/ subtropic Sp.



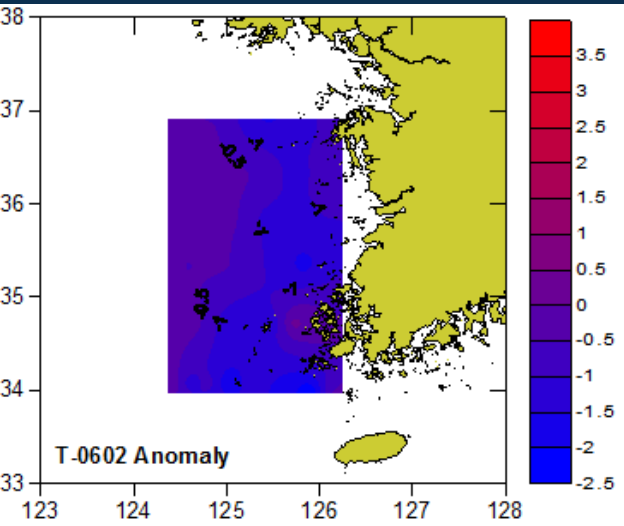


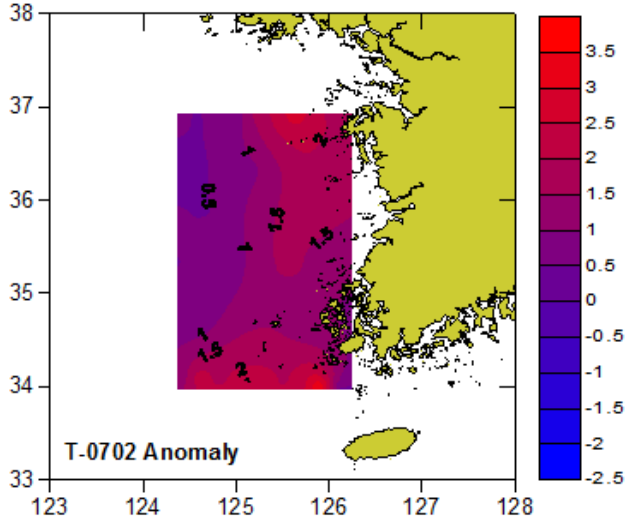
(Min et al., 2009)

Problems with NIMO data

- What would be confounding effects of year-to-year variations and regional differences?
- Reference values
  - Data from pristine conditions are rare.
- Different references for oceanographic conditions?
  - Yellow Sea vs. East Sea
  - Neritic waters vs. open sea

SST anomaly


T-0602 Anomaly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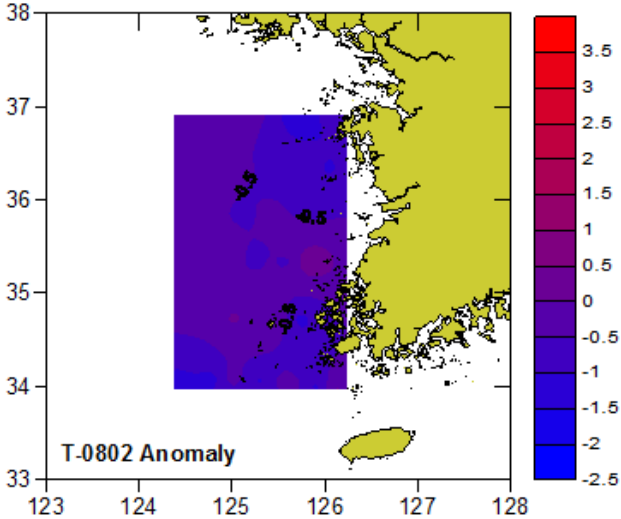
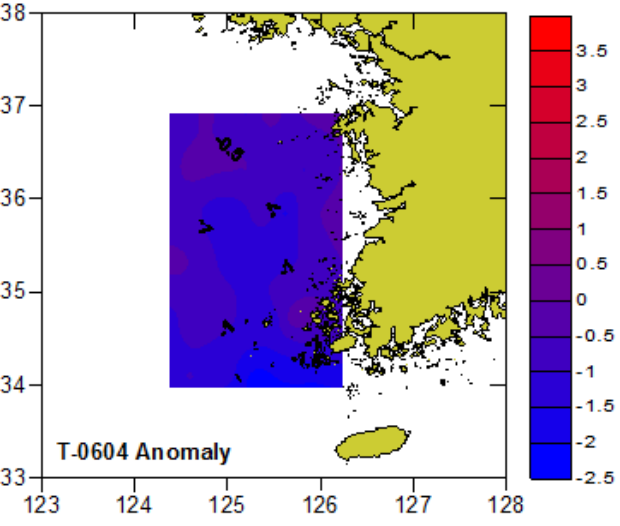
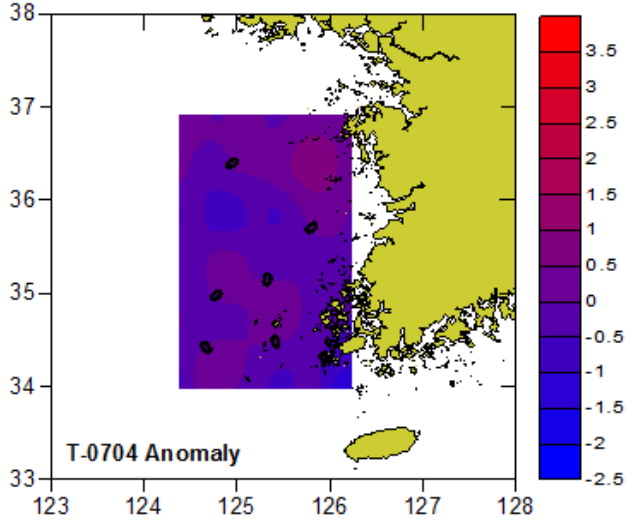
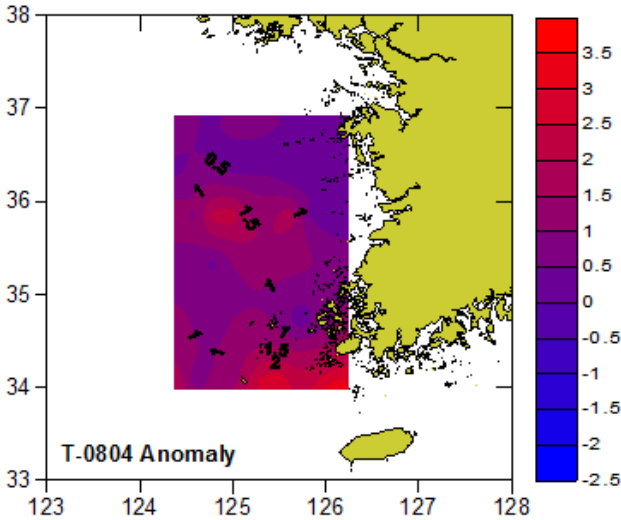

T-0802 Anomaly


T-0604 Anomaly

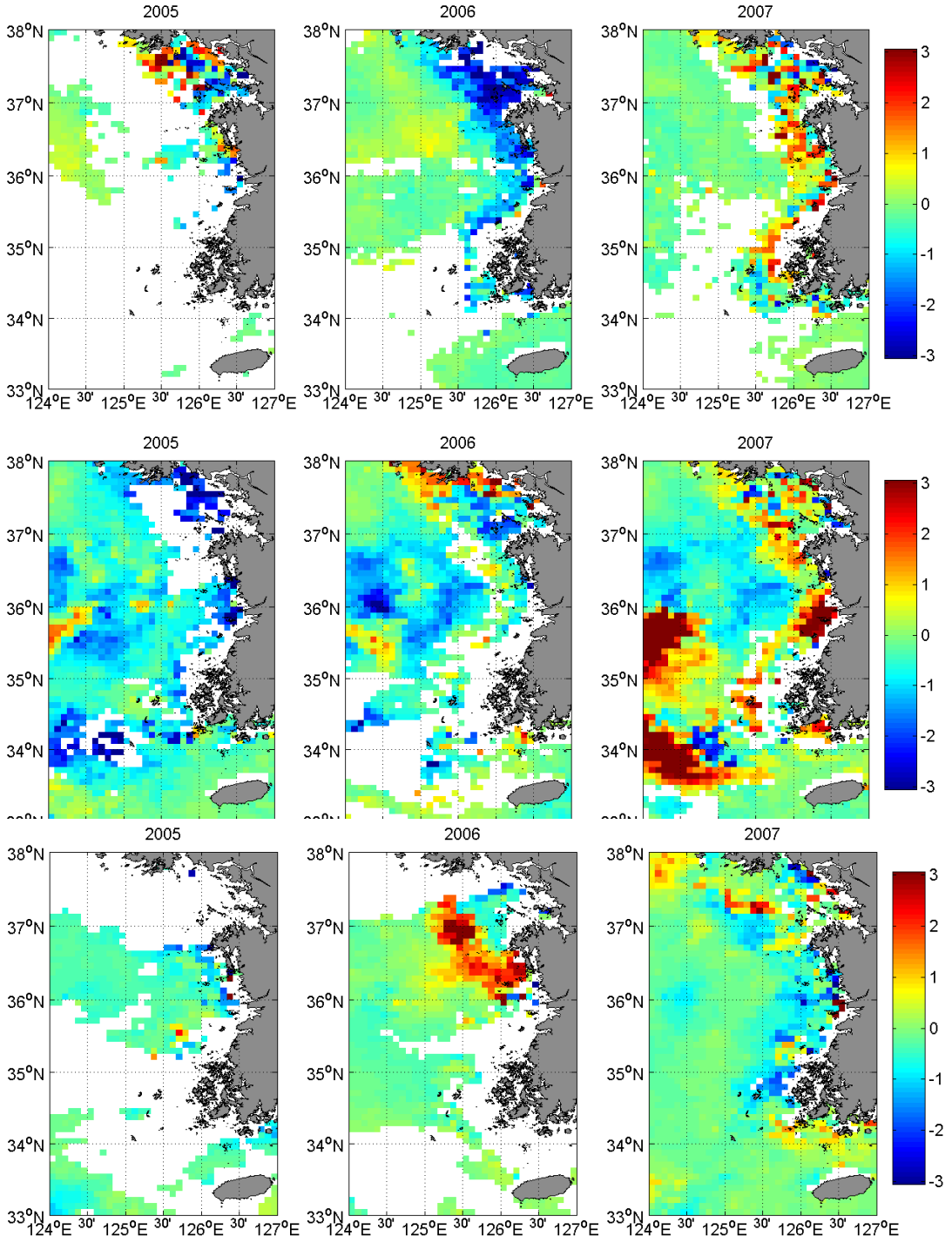

T-0704 Anomaly


T-0804 Anomaly

2/18-25

3/30-4/6

5/25-6/1



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Method for determination of reference conditions

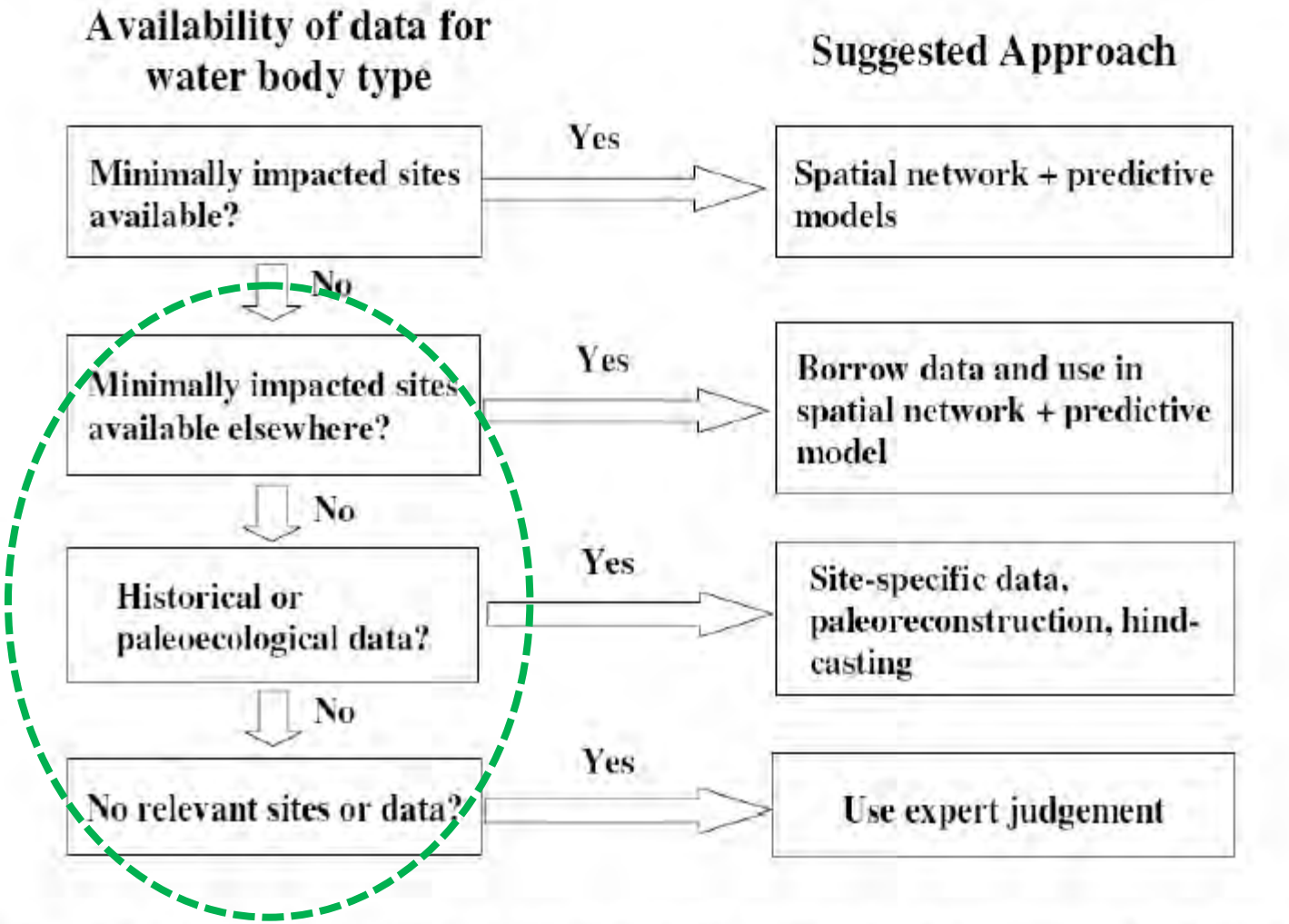


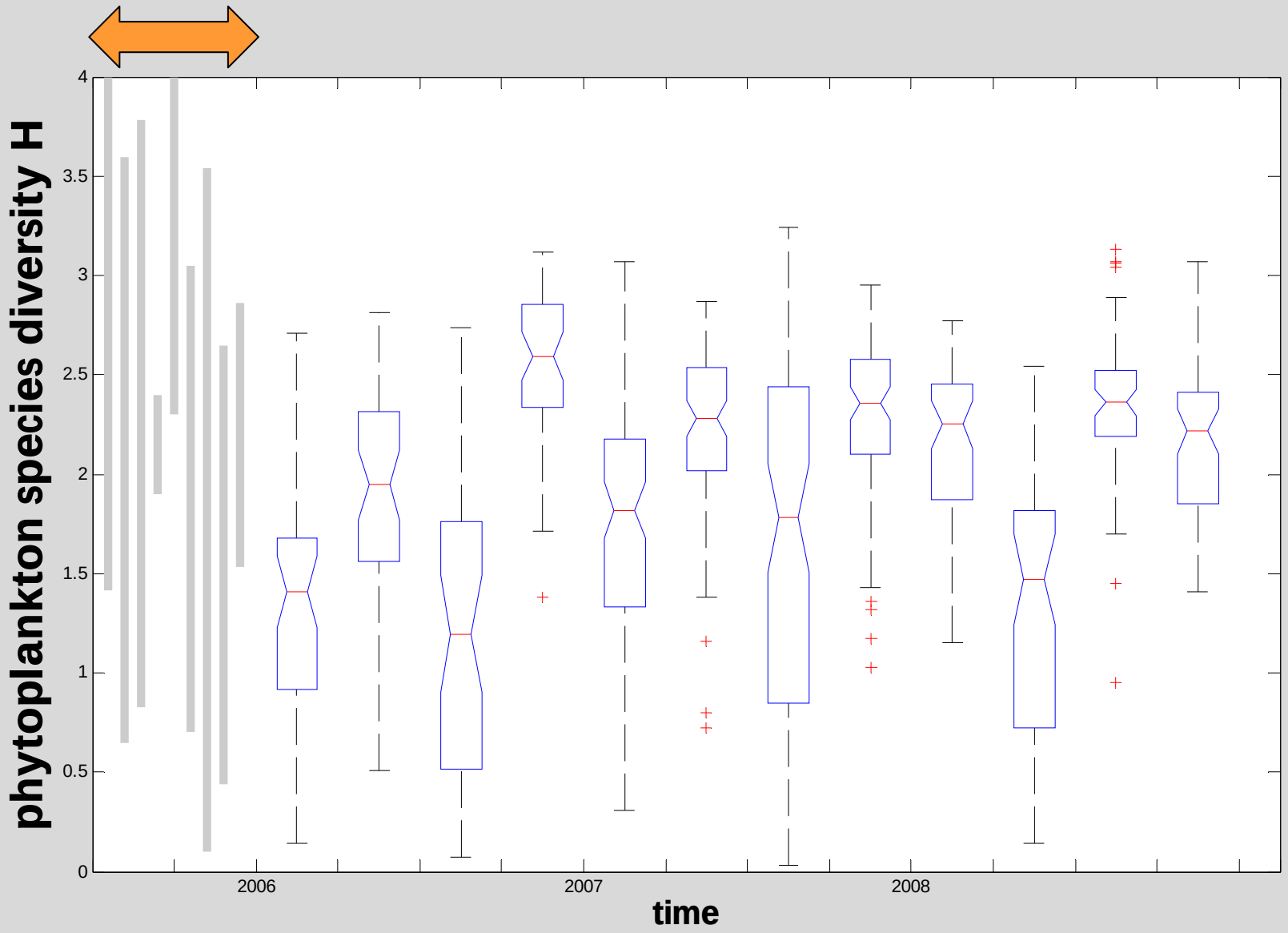
Figure 2.1 step-by-step approach for selection of the method for determination of reference conditions for surface water bodies depending on available information and data (from REFCOND guidance, Anonymous 2003c)

(European Commission, 2007)

Reference conditions (first try)

- Phytoplankton species diversity
  - Literature: 1977~1996
- Macrofauna species diversity
  - European Water Framework Directive
- Nutrients (DO, COD, DIP, DIN, N:P, N:Si)
  - National Env. Monitoring (1996-2007)
- Chlorophyll-a
  - National Env. Monitoring (1996-2007)

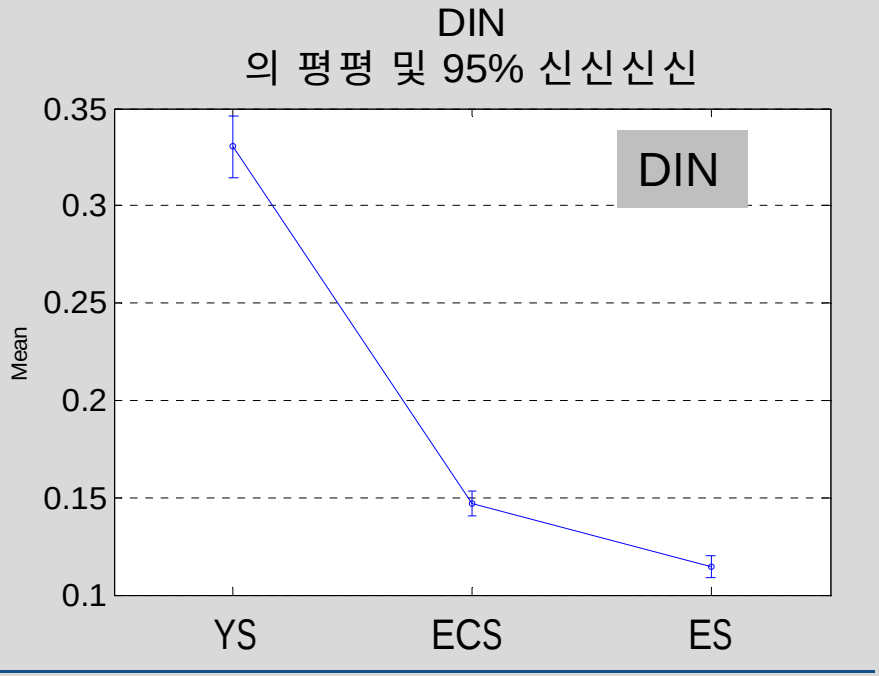
Historical data (1977-1996)

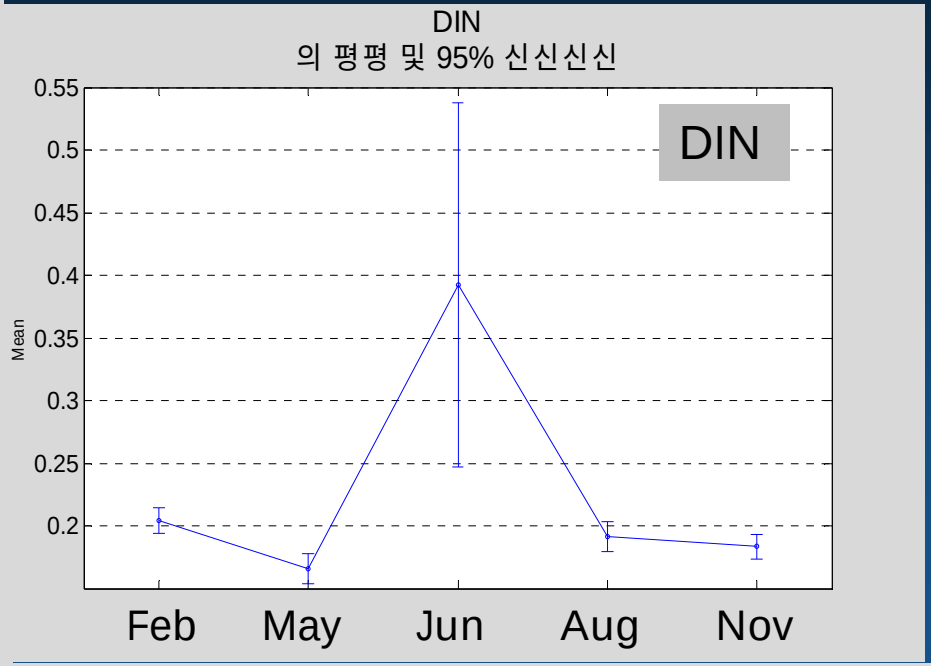


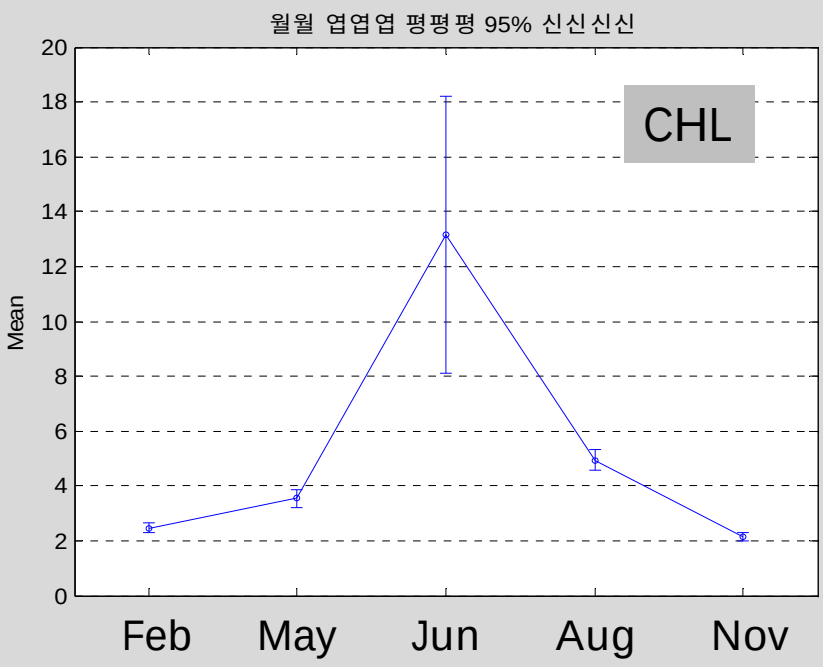
National Environmental Monitoring Network data

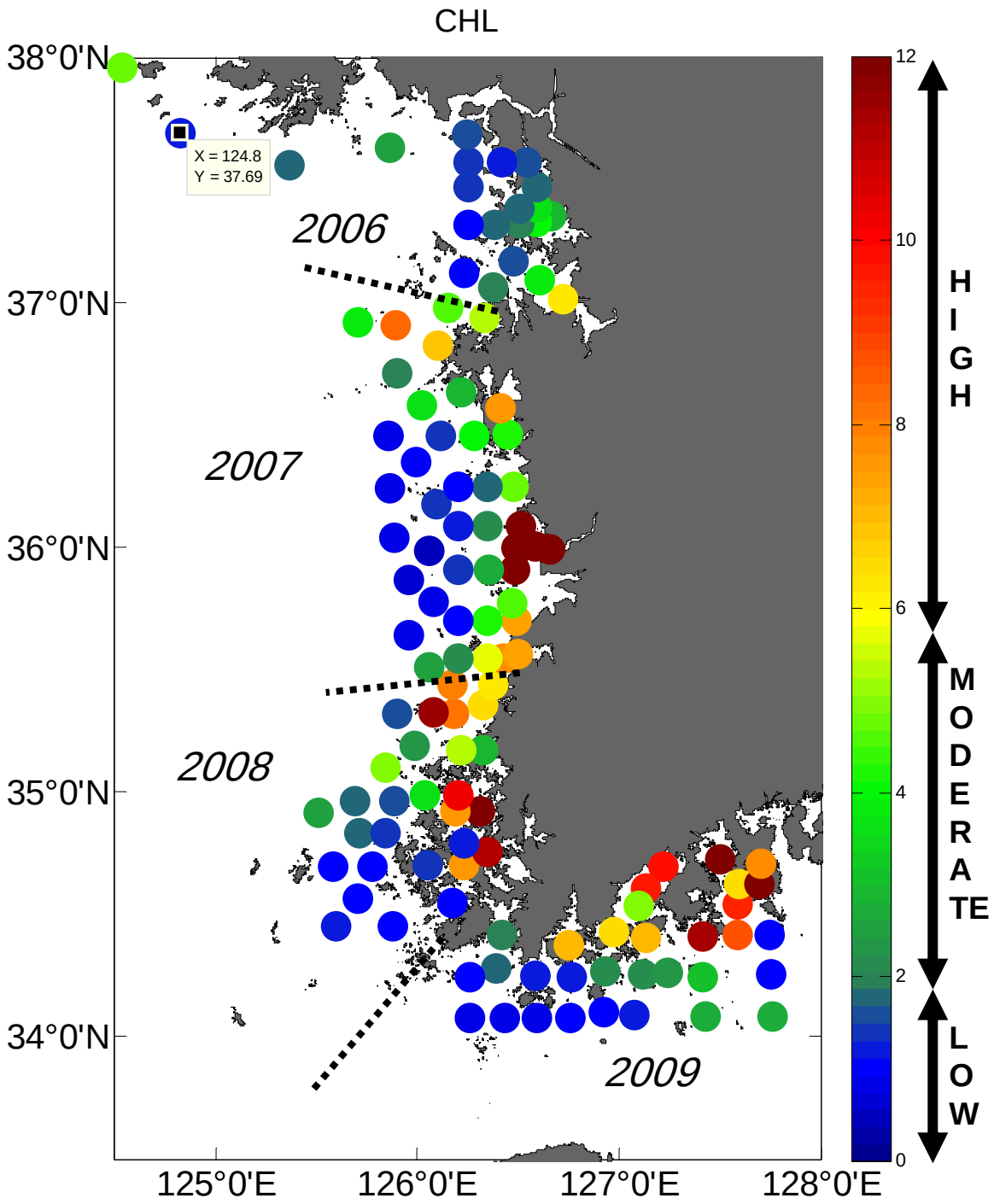
- 1996~2007
- Coastal areas: 14 st. (Yellow Sea), 34 st. (East China Sea), 14 st. (East Sea)
- 7,300 records
- 14 oceanographic and env. variables
  - Temp, Salinity, pH, DO, COD
  - NH_4, Nitrite, Nitrate, TN
  - DIP, TP
  - SiO_2
  - SS
  - Chlorophyll-a

Seasonal, regional distribution









Compared to NEMN datasets

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Ecological Quality Ratio (EQR)

- Reference value and slope

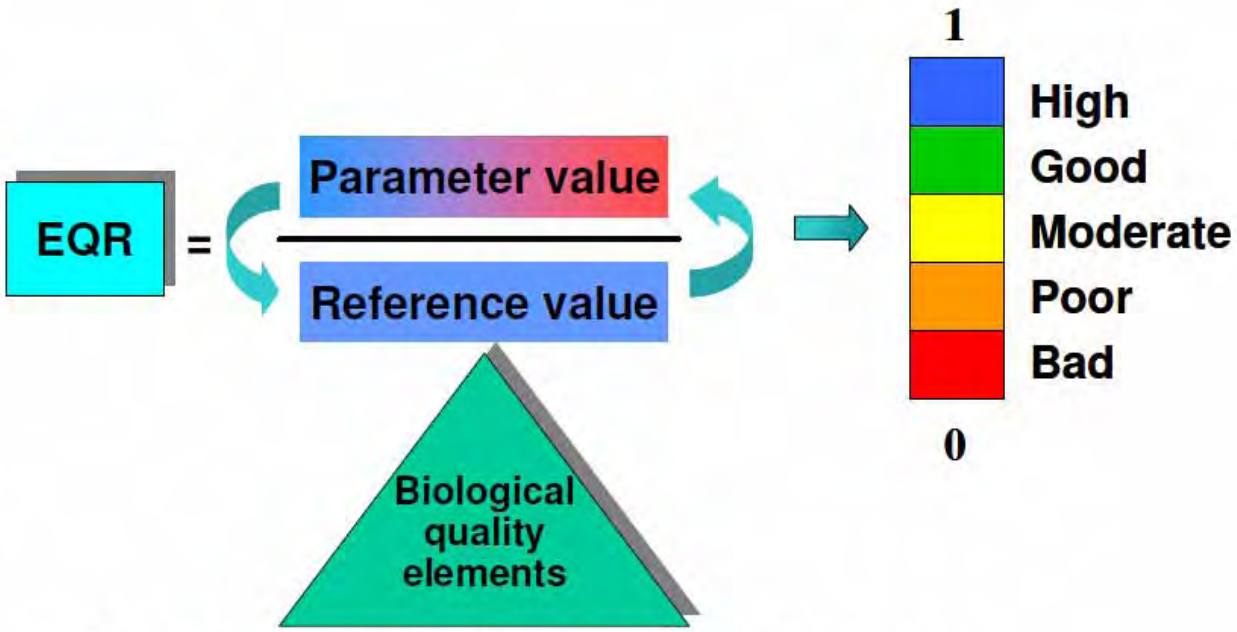
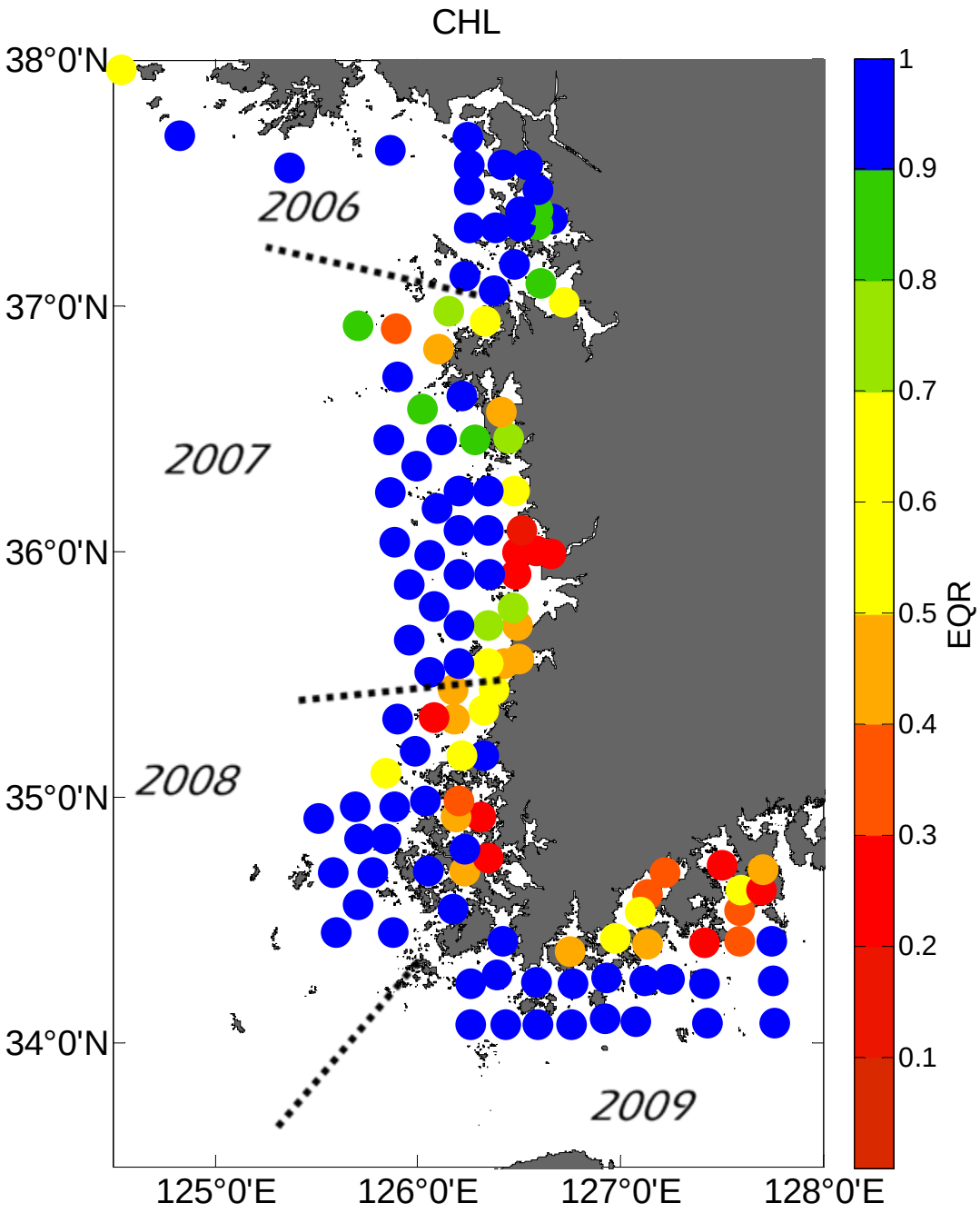
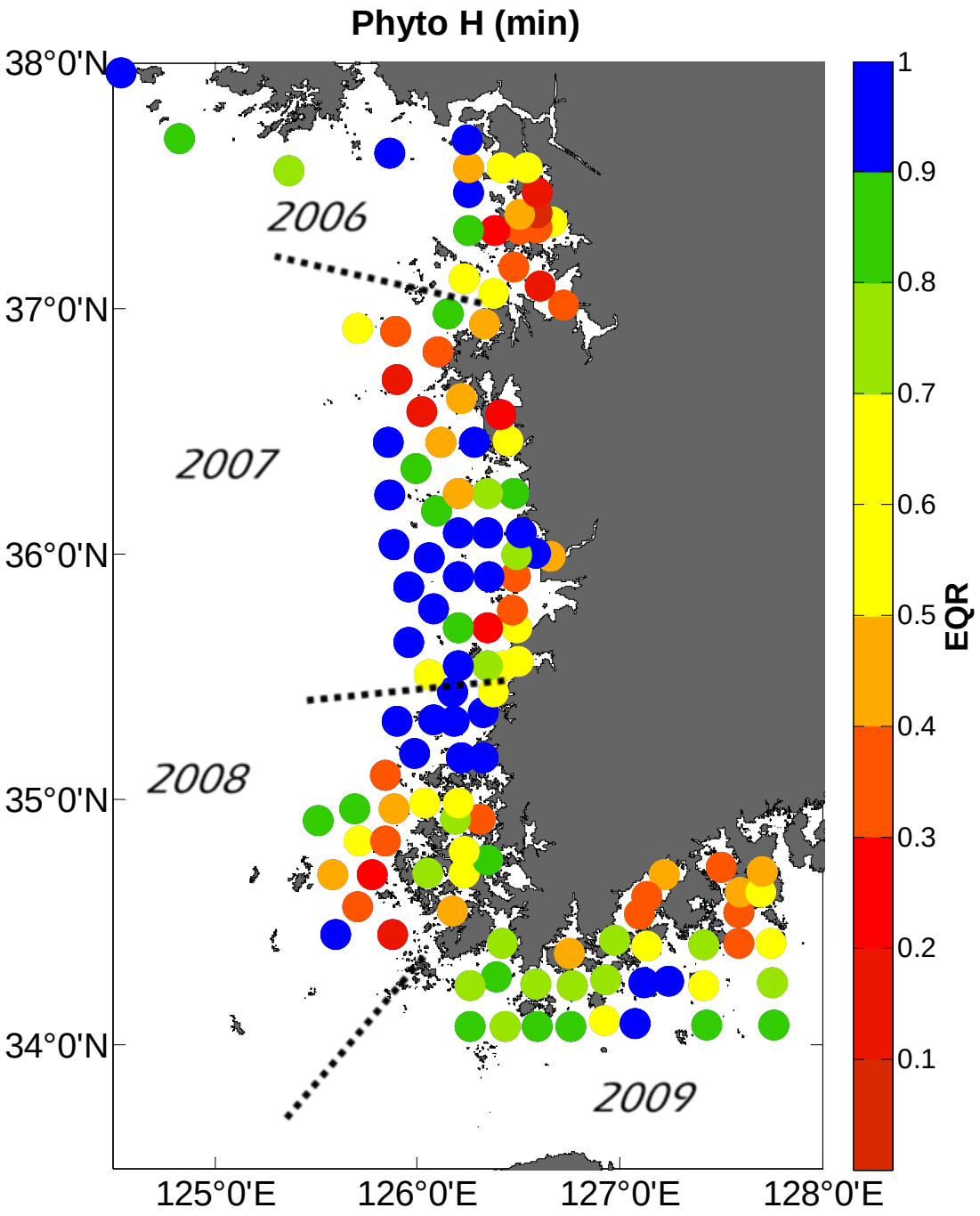


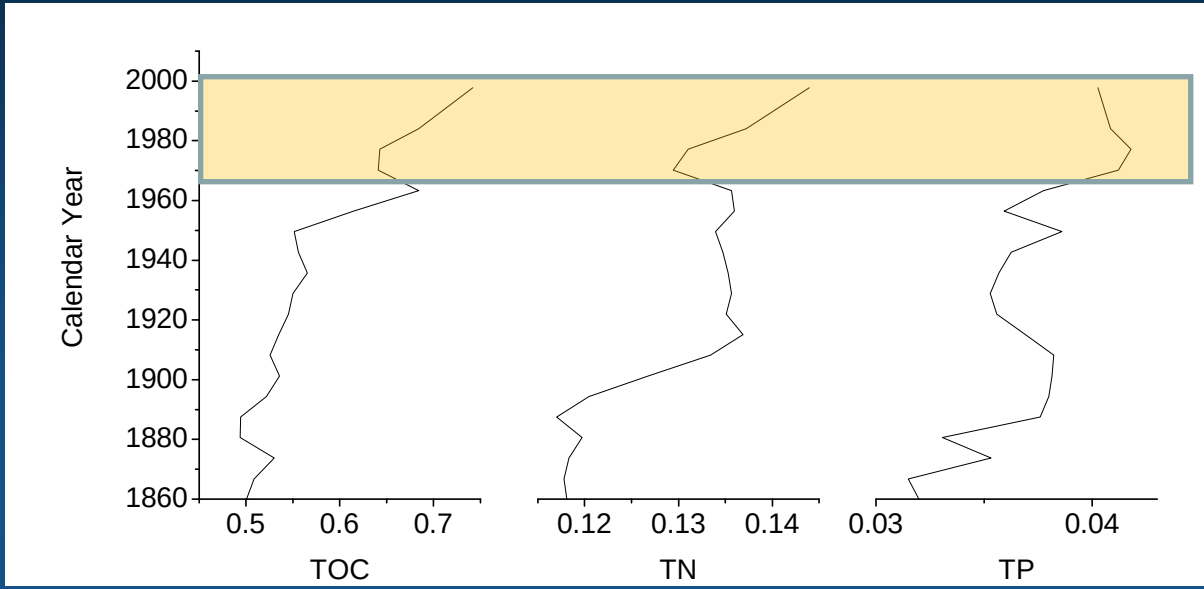
Figure 1.1 – Graphical representation of the concept of the Ecological Quality Ratio

(European Commission, 2007)

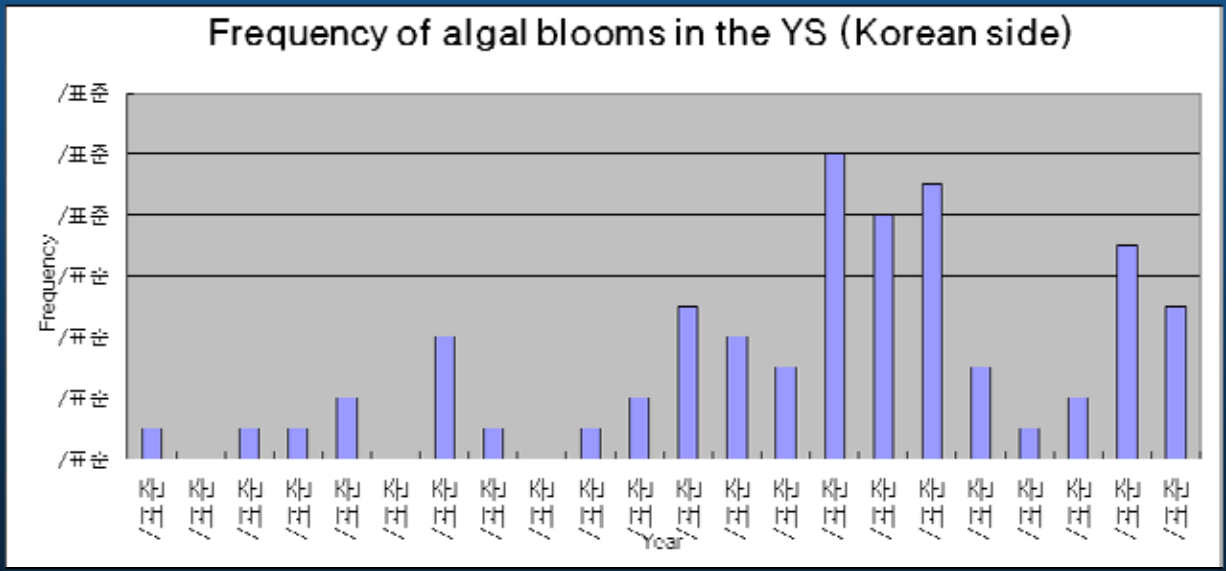

CHL
38°0'N
37°0'N
36°0'N
35°0'N
34°0'N
125°0'E
126°0'E
127°0'E
128°0'E
2006
2007
2008
2009
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
EQR


Phyto H (min)
38°0'N
37°0'N
36°0'N
35°0'N
34°0'N
125°0'E
126°0'E
127°0'E
128°0'E
2006
2007
2008
2009
EQR
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1

Eutrophication in the Yellow Sea

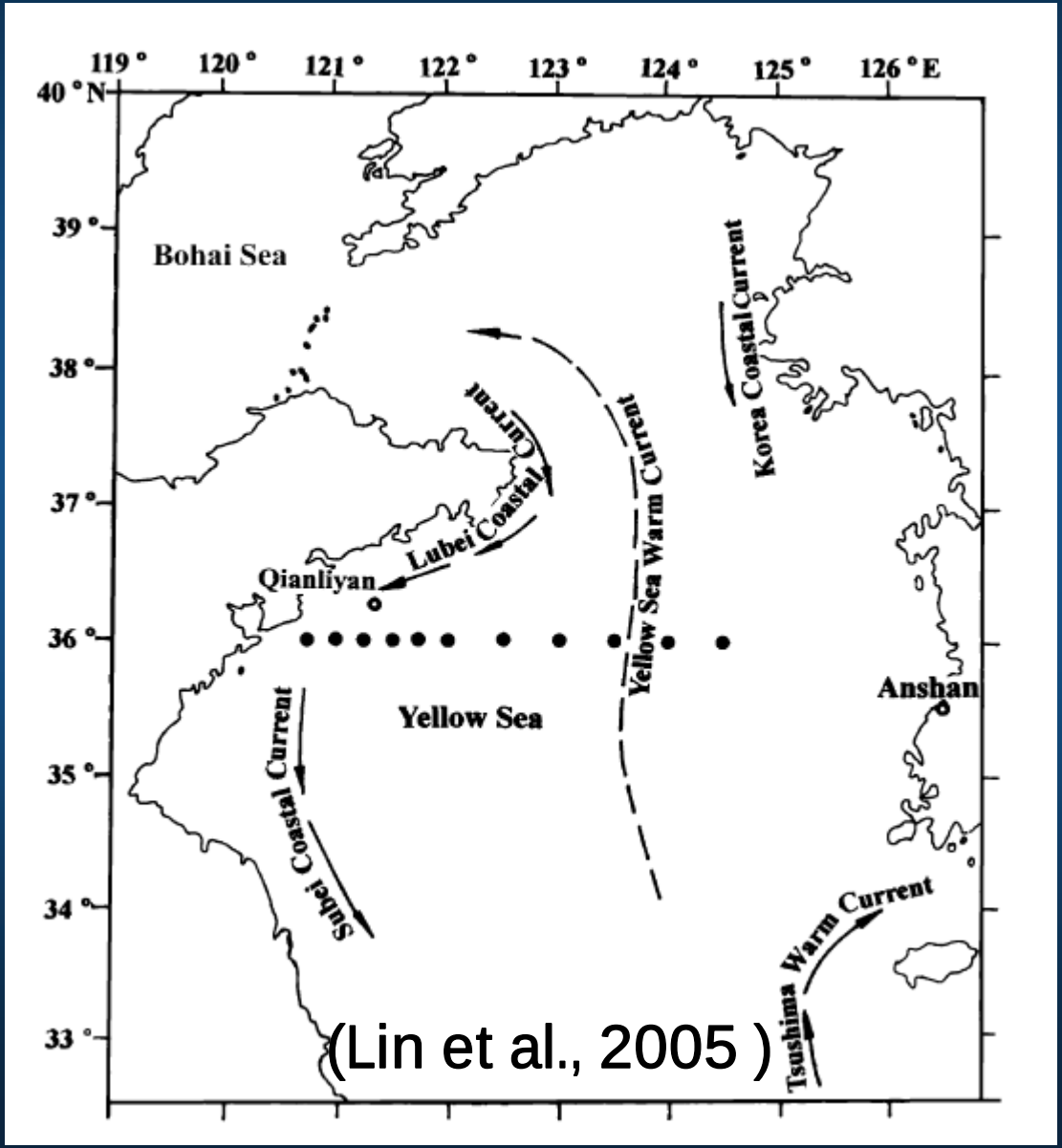


Element chronographs of the Yellow Sea sediment (123.5oE, 35oN): total organic carbon (TOC), nitrogen (TN), phosphorus (TP) content (w/w%)



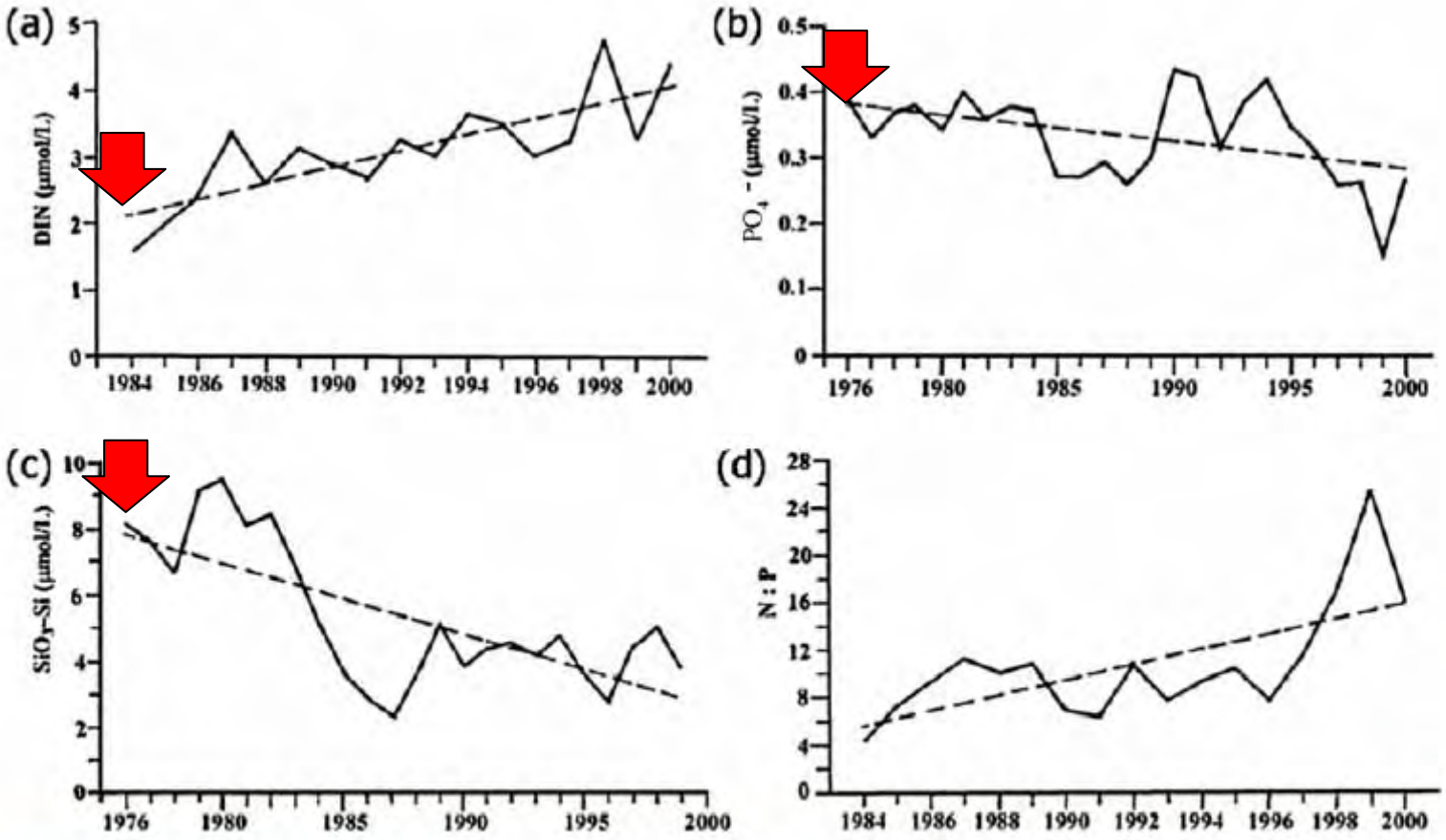
Mostly harmless diatom blooms (> 1,000 ml^{-1}). *Cochlodinium* blooms in 1998 and 2000. No significant economic damages have been reported.

Reference values: historical data (DIN:1984; DIP:1976; Si:1976)

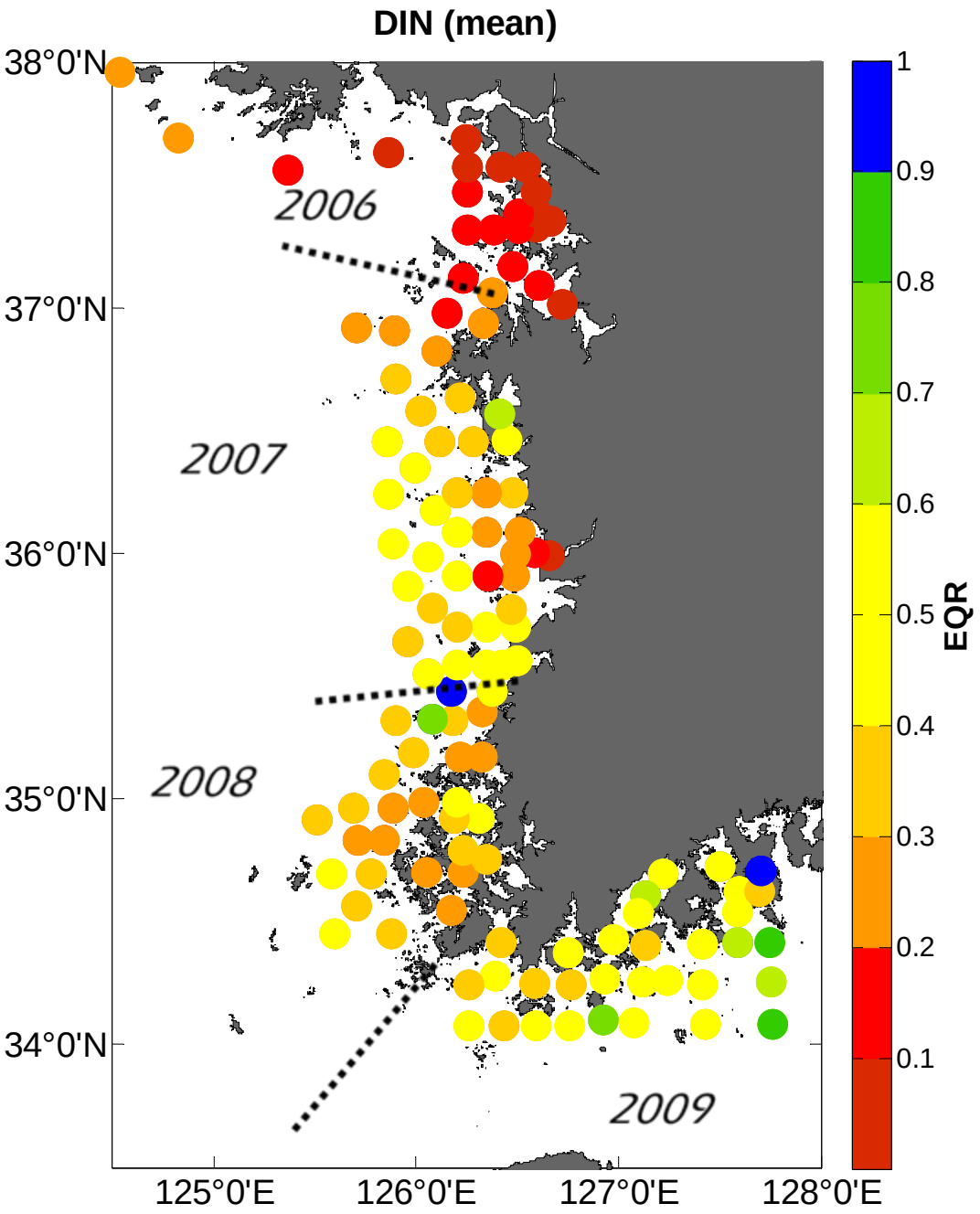


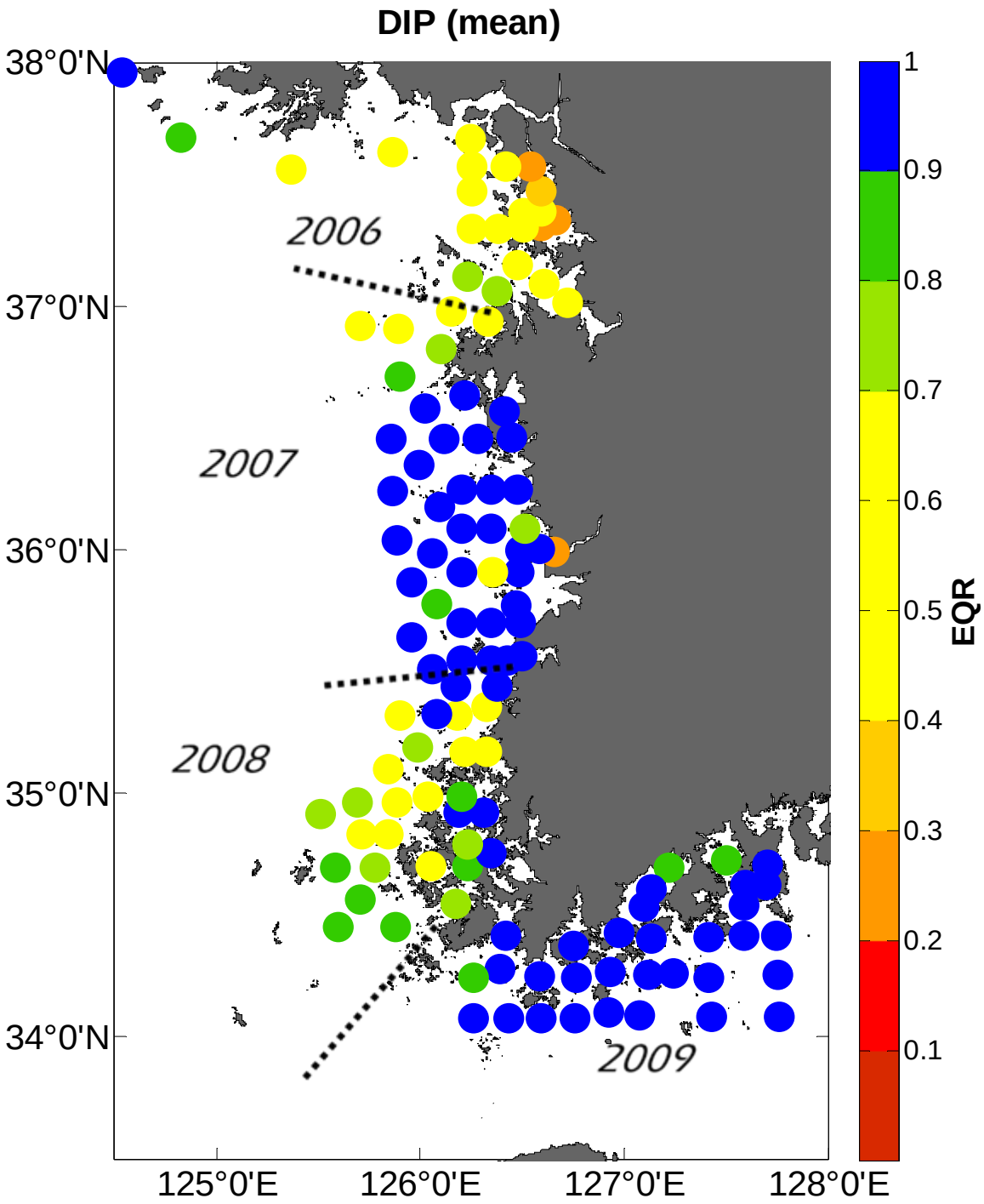
(Lin et al., 2005)

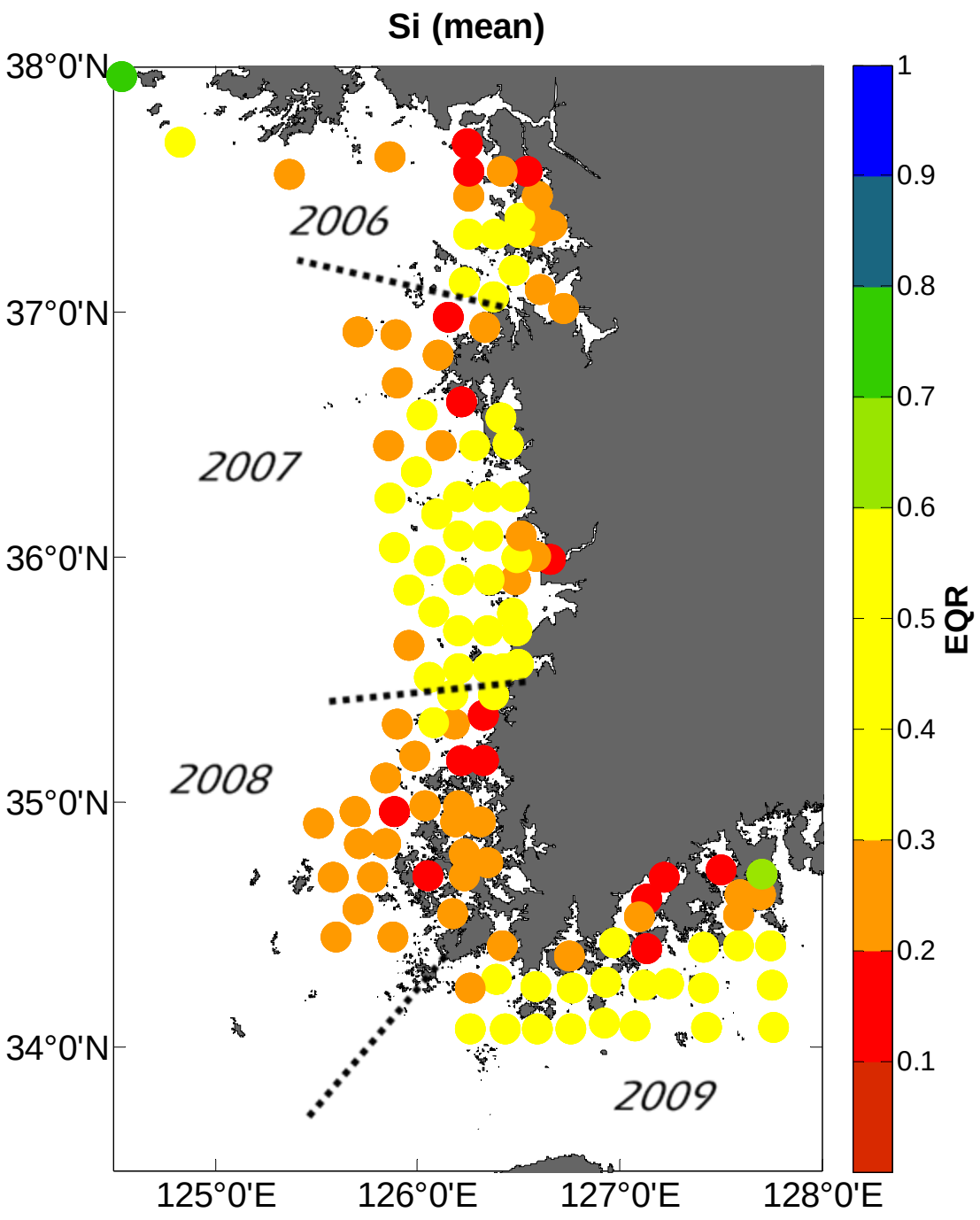
Reference values: historical data (DIN:1984; DIP:1976; Si:1976)



[Figure YS-12] Long-term trend of the nutrients along a transect across 36°N in the Yellow Sea. (a) Dissolved Inorganic Nitrate (DIN), (b) phosphates, (c) silicates, (d) N:P ratio. Modified from Lin et al. (2005).


DIN (mean)
38°0'N
37°0'N
36°0'N
35°0'N
34°0'N
125°0'E
126°0'E
127°0'E
128°0'E
2006
2007
2008
2009
EQR
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1


DIP (mean)
38°0'N
37°0'N
36°0'N
35°0'N
34°0'N
125°0'E
126°0'E
127°0'E
128°0'E
2006
2007
2008
2009
EQR
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1


Si (mean)
38°0'N
37°0'N
36°0'N
35°0'N
34°0'N
125°0'E
126°0'E
127°0'E
128°0'E
2006
2007
2008
2009
EQR
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1

On-going and future works

- Improvement of reference conditions
- Tuning of grades
  - Relationship between stressor indicators and status indicators
  - Statistical analysis of community structure in reference to indicator space
    - ✓Ordination techniques, e. g., CCA
- Integration of indicators

Thank you!

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