EAS CONGRESS 2018
THE EAST ASIAN SEAS CONGRESS

Nov. 27, 2018
Iloilo, Philippines

Carbon storage in estuarine tidal flat and salt marsh of the west and south coasts of Korea

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BEATHOS
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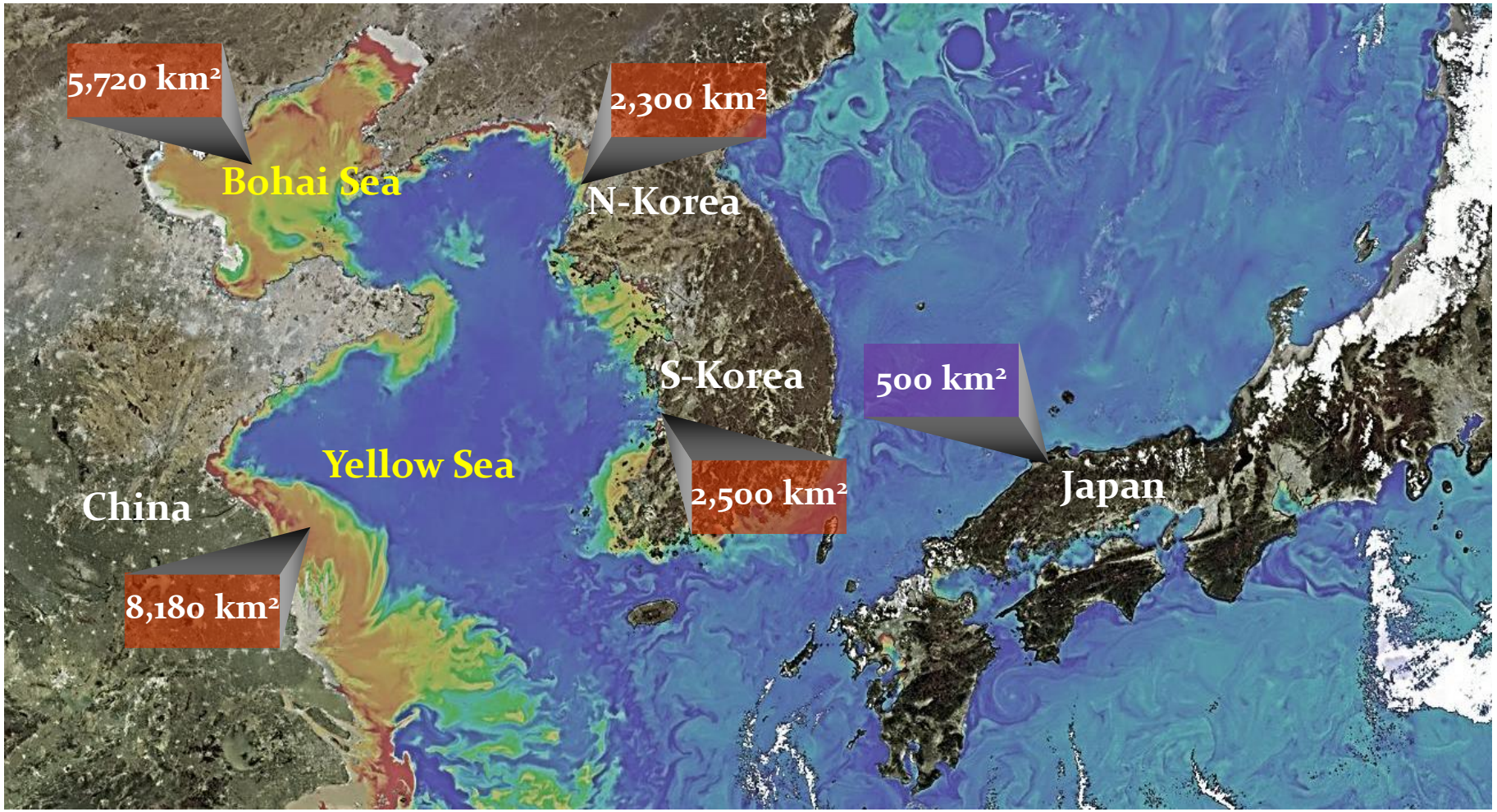
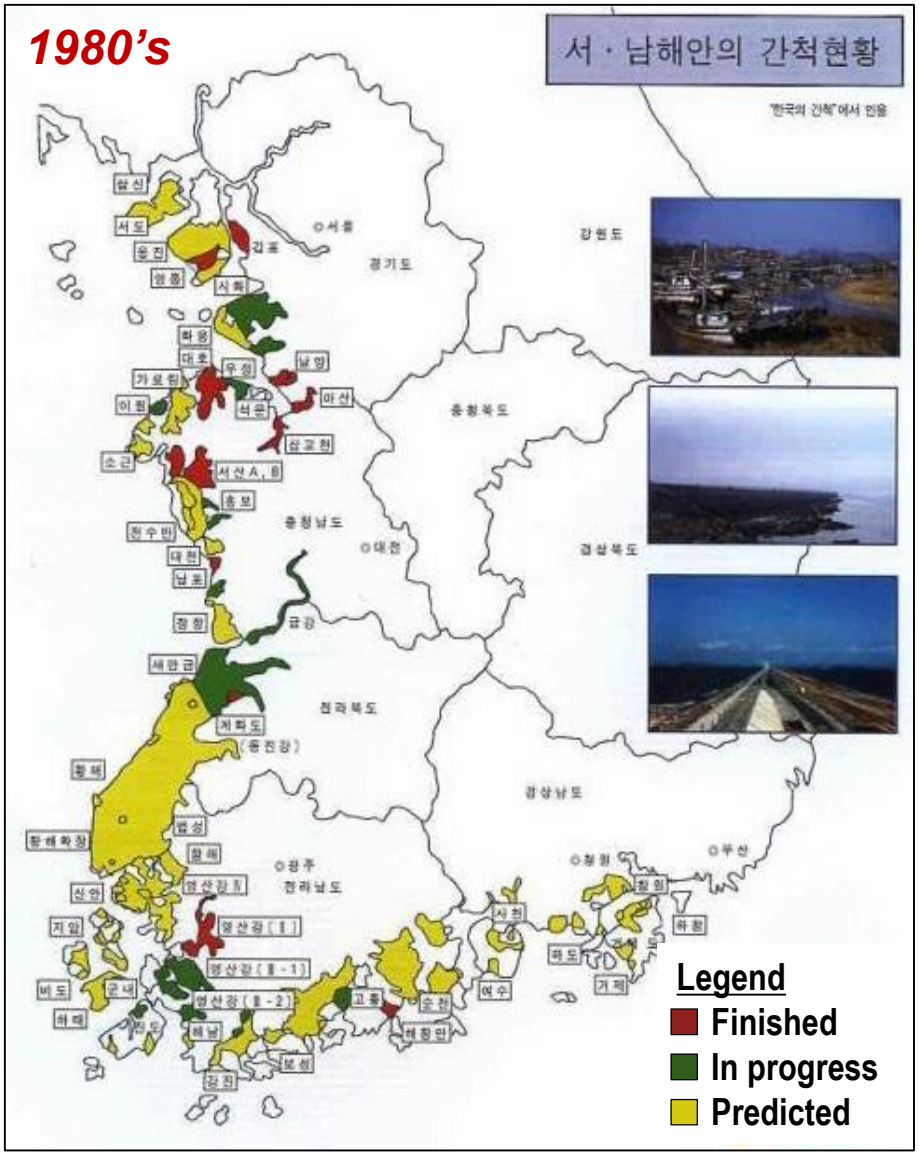
1. Introduction: Tidal flats in Yellow Sea

Total area of Tidal Flats in the East Asia: ~19,000 km²
(*cf.* Wadden Sea: ~4,700 km² or Australian Mangroves: ~11,500 km²)



1. Introduction: Unthinkable… mistake



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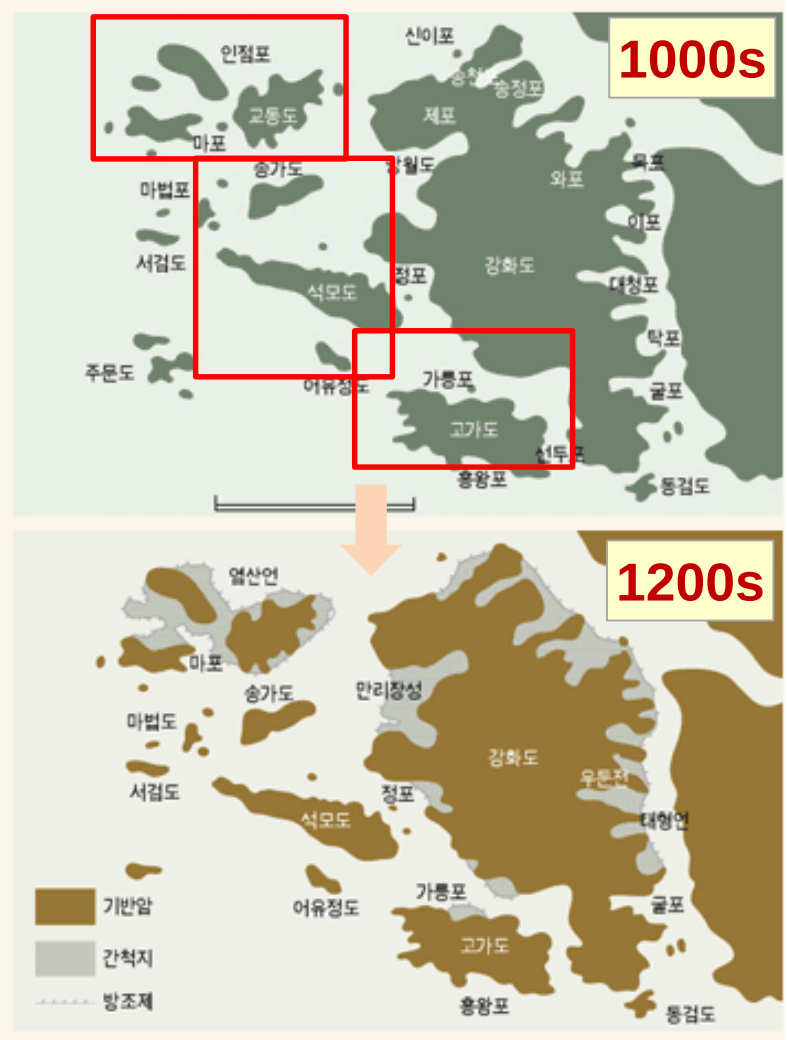


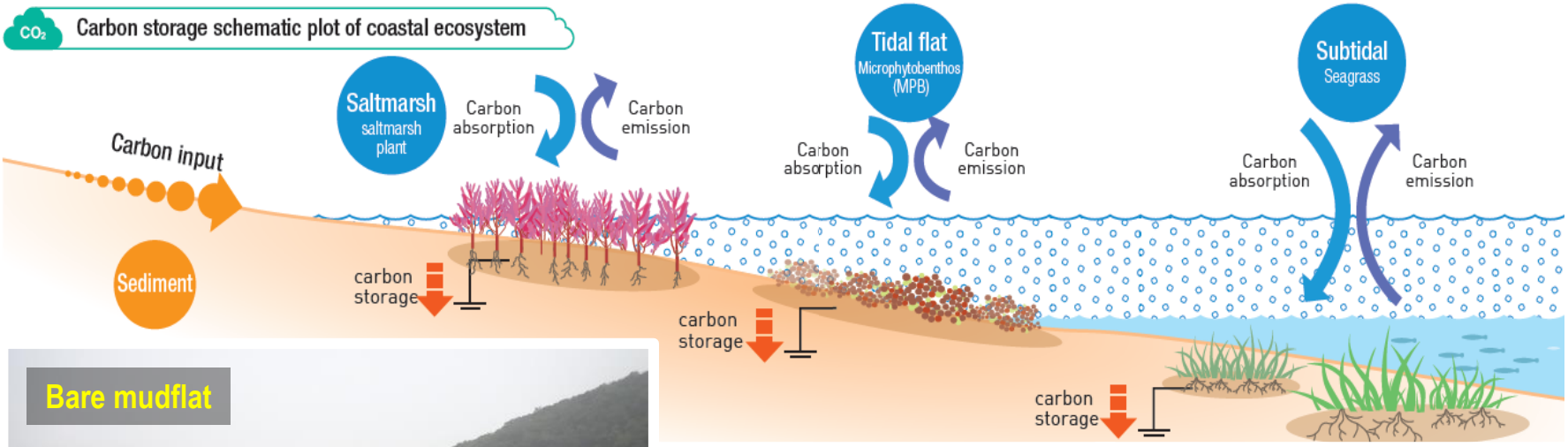
1. Introduction: Research Plan

► Research plan of Korea's Blue Carbon Project (5yr)

Level	Level 1	Level 2		Level 3	
Year budget*	2017 0.3 million USD	2018 2.5 million USD	2019 2.5 million USD	2020 2.5 million USD	2021 2.2 million USD
Database establishment	Spatial database establishment (Ganghwa island)	Spatial database establishment (Western Sea)	Spatial database establishment (Southern Sea)	Spatial database establishment (East Sea, Jeju)	Blue carbon spatial database provision
	saltmarsh plant/sea-grass photosynthesis/ biomass measurement	Yearly/zonal photosynthesis/biomass measurement and analysis ((saltmarsh vegetation (17 total), seagrass (7 total))			
Investigation of carbon cycle	carbon measurement and analysis demonstration	Yearly/Zonal carbon measurement and analysis (tidal flat (25 total), salt marsh vegetation (22 total), seagrass (7 total)			
	Carbon measurement method and standard operating protocol development		Seasonal sedimentation rate survey		
				National emissions constant calculation	
blue carbon management technology	Proposal of MRV boundary concept	Greenhouse gas measurement and report guideline development	Greenhouse gas verification method development	QA/QC, uncertainty method development	QA/QC, uncertainty guideline development
		Marine greenhouse gas statistical system planning and establishment			
	Symposium on blue carbon founding and management			Global network on blue carbon founding and management	

1. Introduction: General Background

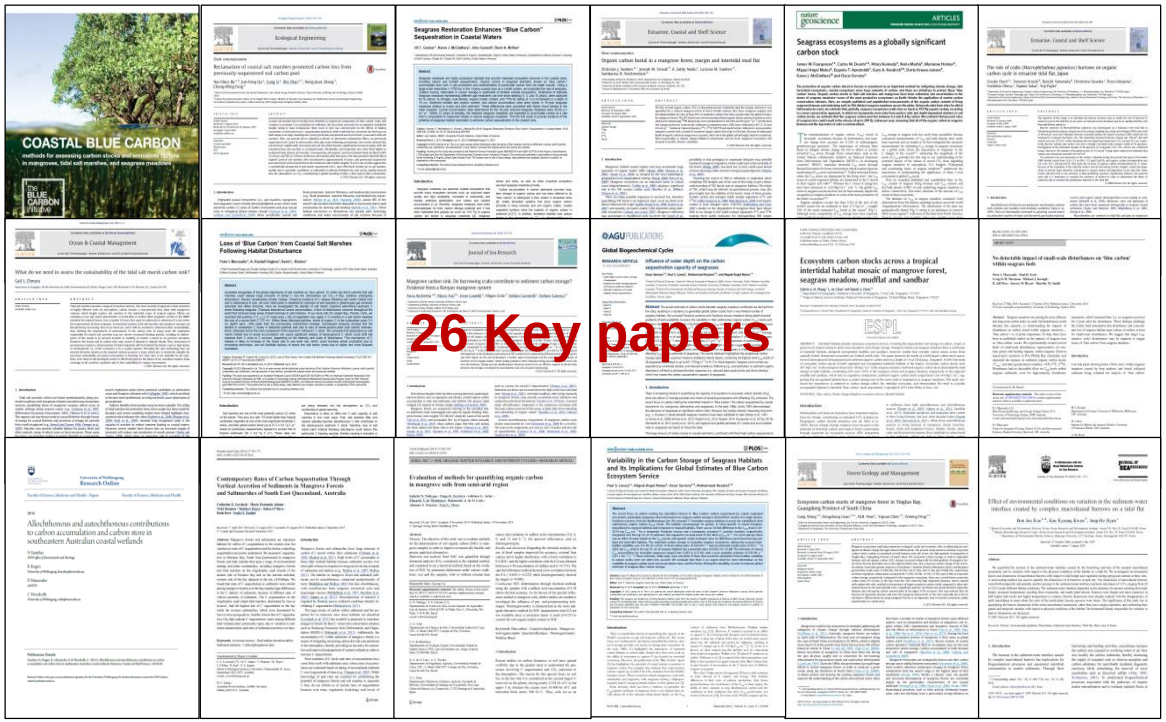
► How does the marine ecosystem absorb carbon?



- Potential carbon sources in coastal area:
  Microphytobenthos, salt marsh plant, and sea grass

2. Materials and Methods

► Reference work



Eff. Date: Replaces SOP:

Seoul National University
School of Earth and Environmental
Laboratory of Marine Benthic Ecology

STANDARD OPERATING PROCEDURE

퇴적물 내 유기탄소 및 총질소의 안정동위원소비 및 농도측정

Version 1.0 February 2017

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SOP

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- Reviewed >300 references: Research articles and international reports
- 26 selected papers used for the development of SOP, with our preliminary data
  → A method for analysis of organic carbon in coastal sediment, Korea

2. Materials and Methods

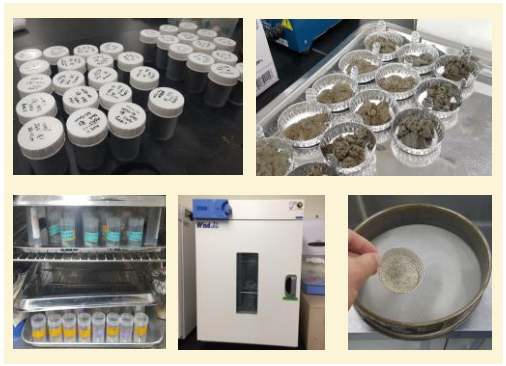
► Sampling method & Sampling area

Multi-Sampler (manpower)

Coring sediment (~ 1 m)

Sub-sampling (5 cm intervals)

Gas-Power Core (gas pressure)



Desiccation

Wet sieve (63 um)

Loss on ignition (550°C , 4h)

Elemental Analyzer

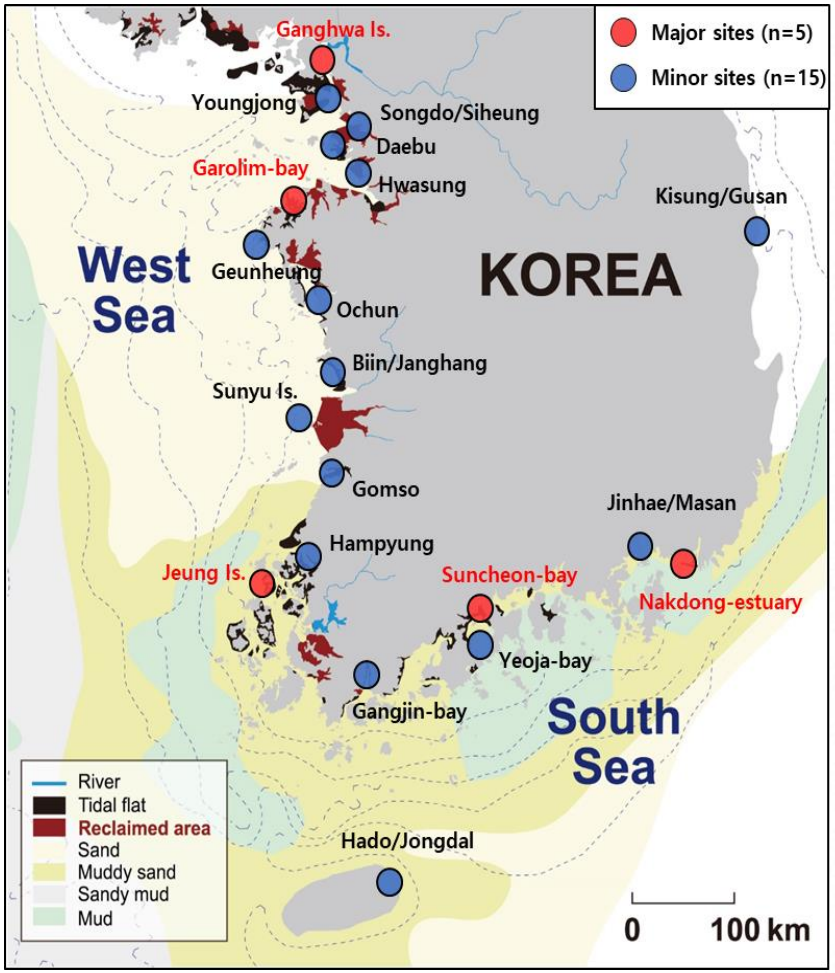
Bulk density (BD)

Water content (WC)

Mud content (MC)

Organic matter (OM)

Total organic matter (TOC)
Total nitrogen (TN)



2. Materials and Methods

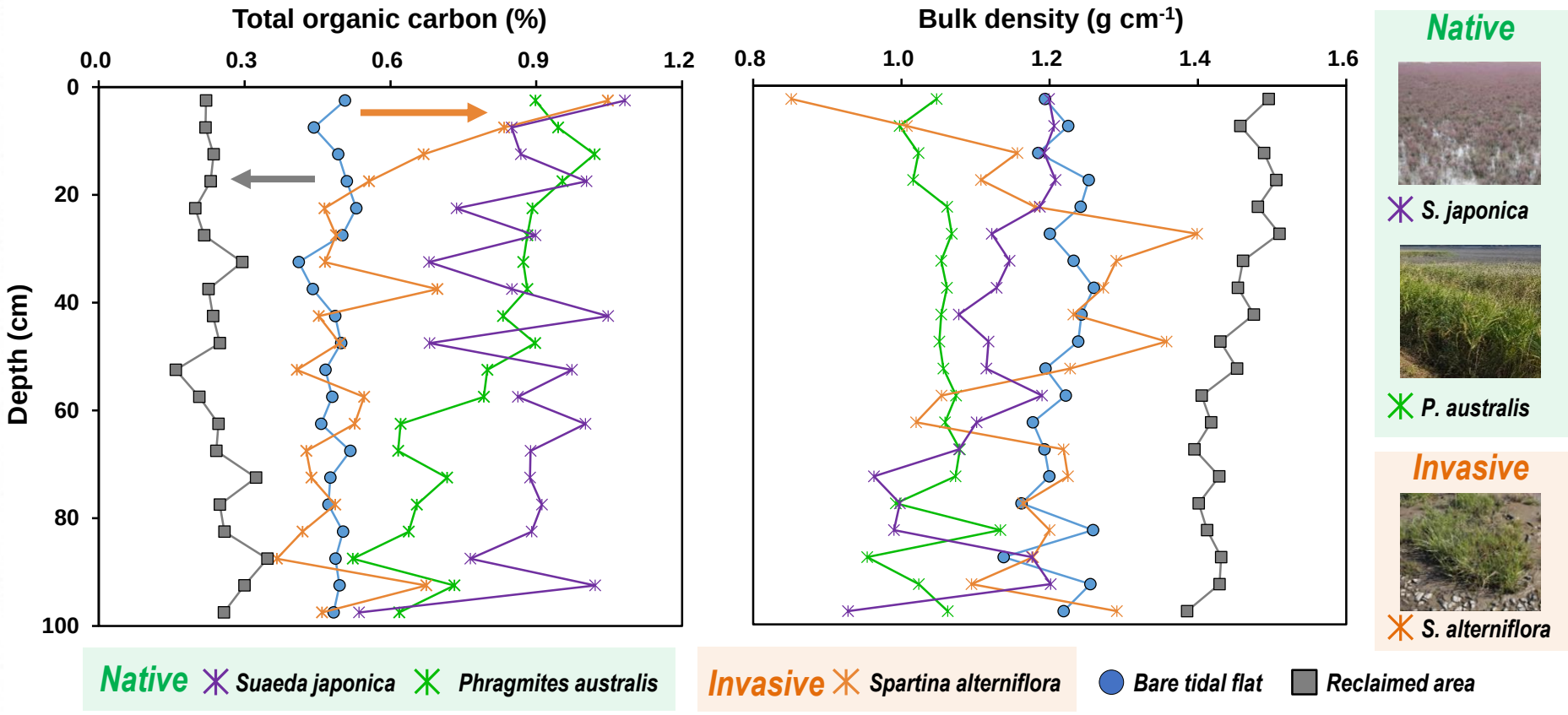
► Sediment core sampling






3. Results and discussion

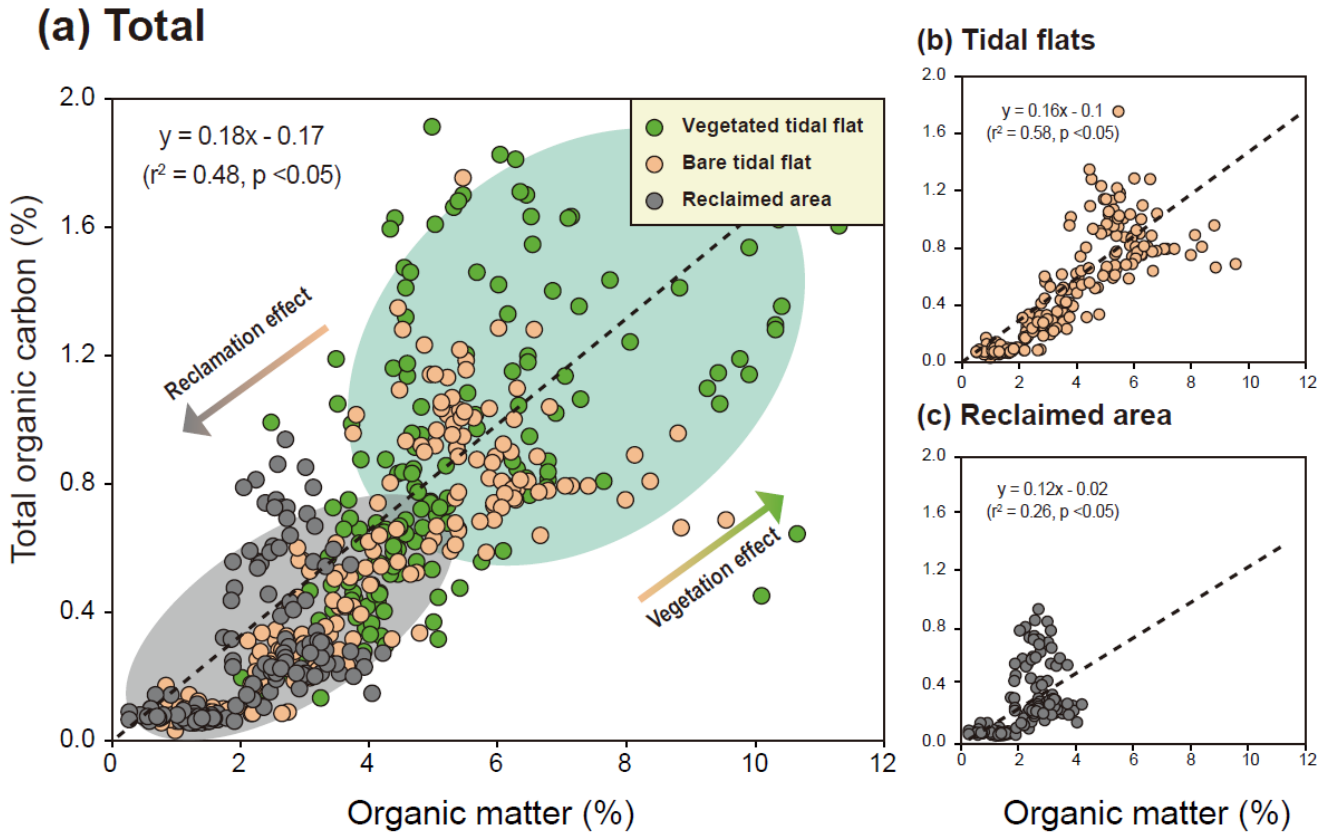
► Comparison of organic carbon & bulk density, by sediment depth



- Higher TOC and lower bulk density found in vegetated area
- Similar trend observed for surface TOC b.t. *S. alterniflora* habitat & vegetated area
- However, TOC showed higher value under 30 cm depth in vegetated area

3. Results and discussion

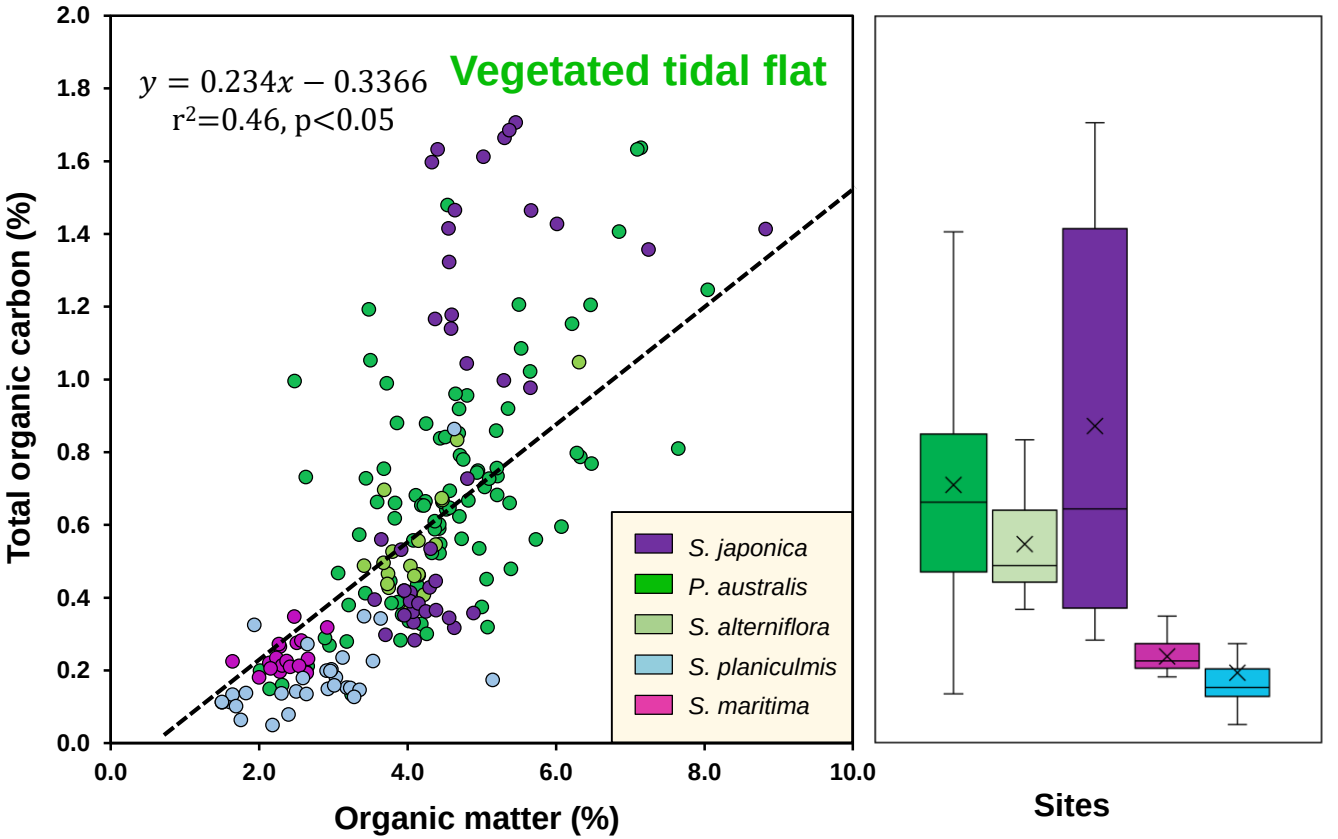
► Relationship between organic matter & organic carbon

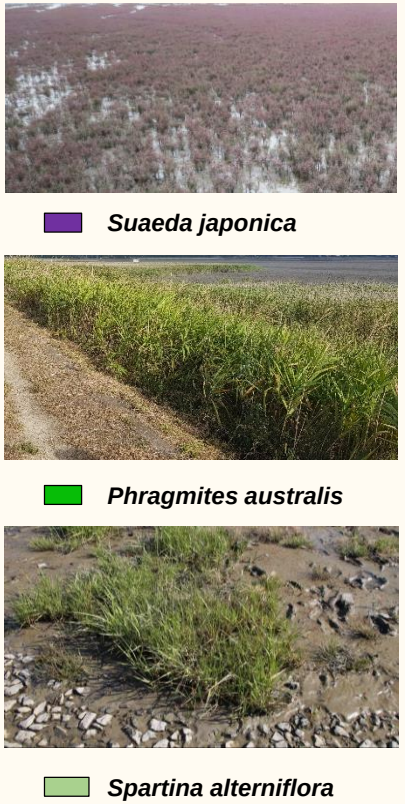


- TOC & OC: Vegetated tidal flat >> Bare tidal flat (unvegetated) > Reclaimed area
- Significant relationship: 0.18*OM=TOC (ref.: Nobrega et al., 2015, 0.27*OM=TOC)

3. Results and discussion

► TOC varied depending on the coverage of halophyte community

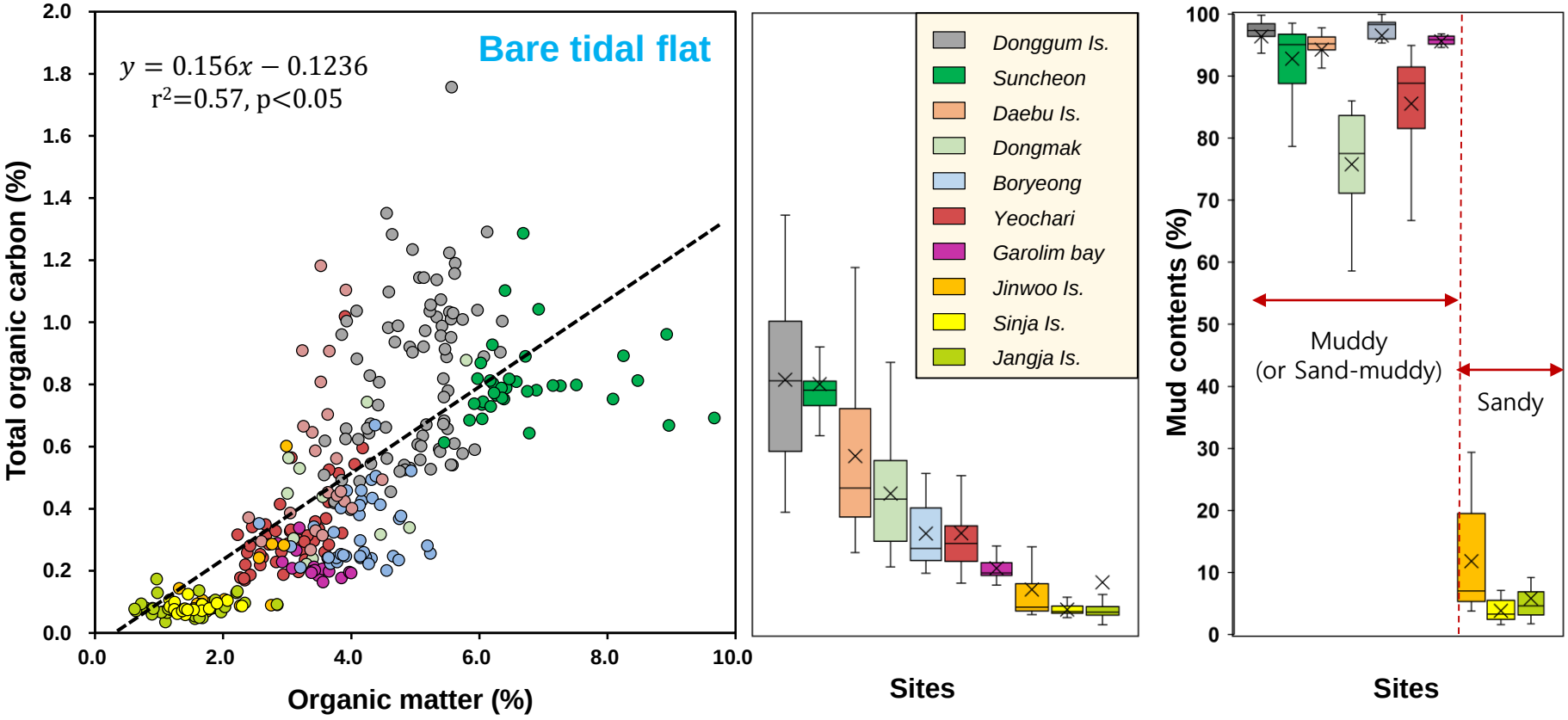




- Vegetation dependent variation of TOC: *S. japonica* > *P. australis* > *S. alterniflora*
- Significant relationship: 0.23*OM=TOC (ref.: Nobrega et al., 2015, 0.27*OM=TOC)

3. Results and discussion

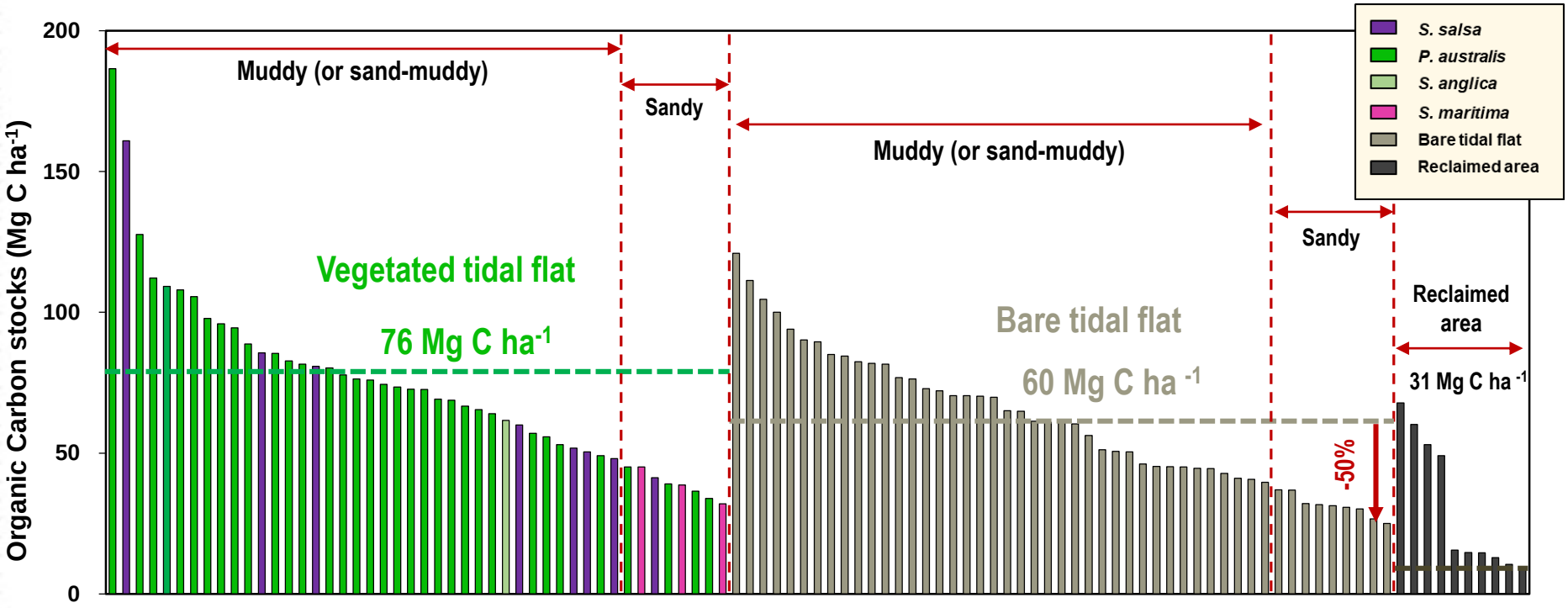
► TOC varied depending on spatial distribution



- Regional variations of TOC & OM among unvegetated areas
- Significant relationship: 0.16*OM=TOC (ref.: Nobrega et al., 2015, 0.27*OM=TOC)

3. Results and discussion

► *Average organic carbon stock in Korean sediments*



- Vegetated tidal flats showed relatively high TOC than bare tidal flats
- The lowest carbon stock was found in reclaimed area (>2 folds compared to bare tidal flat tidal flats)

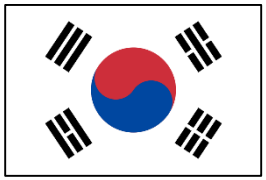
3. Results and discussion

► Blue carbon study along the Yellow Sea: Korea (this study) vs. China

China Carbon Stocks (Mg/ha)	
Salt marsh	Mudflat
92.0	45.2

VS

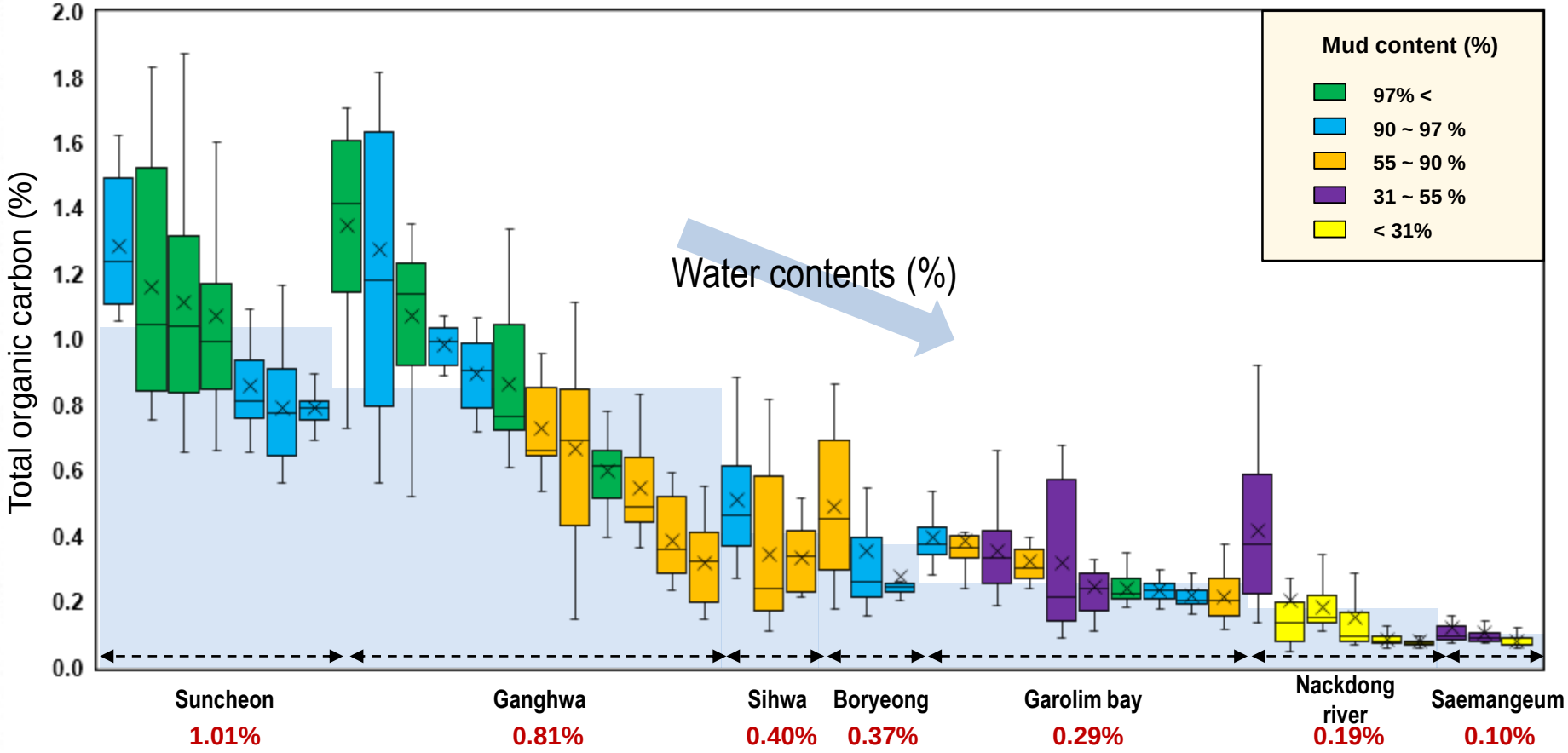
Korea Carbon Stocks (Mg/ha)	
Salt marsh	Mudflat
77.9	56.8



Nation	Sampling region	Vegetation Species	Core depth (cm)	Year	TOC (%)	TOC (g/m^2)	Sediment Carbon stock (Mg/ha) Mean	Sediment Carbon stock (Mg/ha) 1 m corrected	Reference
China	Yancheng Wetland National Nature Reserve, Jiangsu	*S. alterniflora*	30	2012	-	5086	50.9	**169.5**	Yang W et al.,2016
China	Yancheng Wetland National Nature Reserve, Jiangsu	*S. alterniflora*	30	2012	-	4292	42.9	**143.1**	Yang W et al.,2016
China	Yangcheng Coastal wetland, Jiangsu province	*S. alterniflora*	20	2005	0.520	-	-	**-**	Mao Z et al.,2010
China	Yangcheng Coastal wetland, Jiangsu	*S. salsa*	20	2005	0.321	-	-	**-**	Mao Z et al.,2010
China	Jiangsu Coastal area, Rudong County	*S. alterniflora*	20	2002	0.398	-	12.1	**60.3**	Zhou HX et al.,2008
China	Yangcheng National Nature Reserce	*S. alterniflora*	30	2005	-	1600	16.0	**53.4**	Zhou C et al., 2015
China	Yangcheng National Nature Reserce	*S. salsa*	30	2005	-	1250	12.5	**41.7**	Zhou C et al., 2015
China	Yangcheng National Nature Reserce	*P. communis*	30	2005	-	1500	15.0	**50.0**	Zhou C et al., 2015
China	Xinyanggang coastal wetland, North Jiangsu	*S. alterniflora*	20	2011	-	-	3.8	**19.1**	Wang G et al.,2013
China	Liaohe delta, Liadong	None	20	2012	-	-	25.5	**127.5**	Zhao G et al., 2017
China	Shuangtai Estuary, Liadong	None	30	2011	0.594	-	-	**-**	Mao R et al.,2014
China	Dongying port, Shandong	None	30	2013	0.395	910	9.1	**30.3**	Zhao Q et al., 2017
China	Yellow river delta, Shandong	None	50	2015	-	2440	24.4	**48.8**	Zhao Q et al.,2018
China	Yangcheng Natural Reserve, Jiangsu	None	30	2005	-	629	6.3	**21.0**	Zhou C et al., 2015
China	Yangcheng Natural Reserve, Jiangsu	None	20	2005	0.228	-	-	**-**	Mao Z et al.,2010

3. Results and discussion

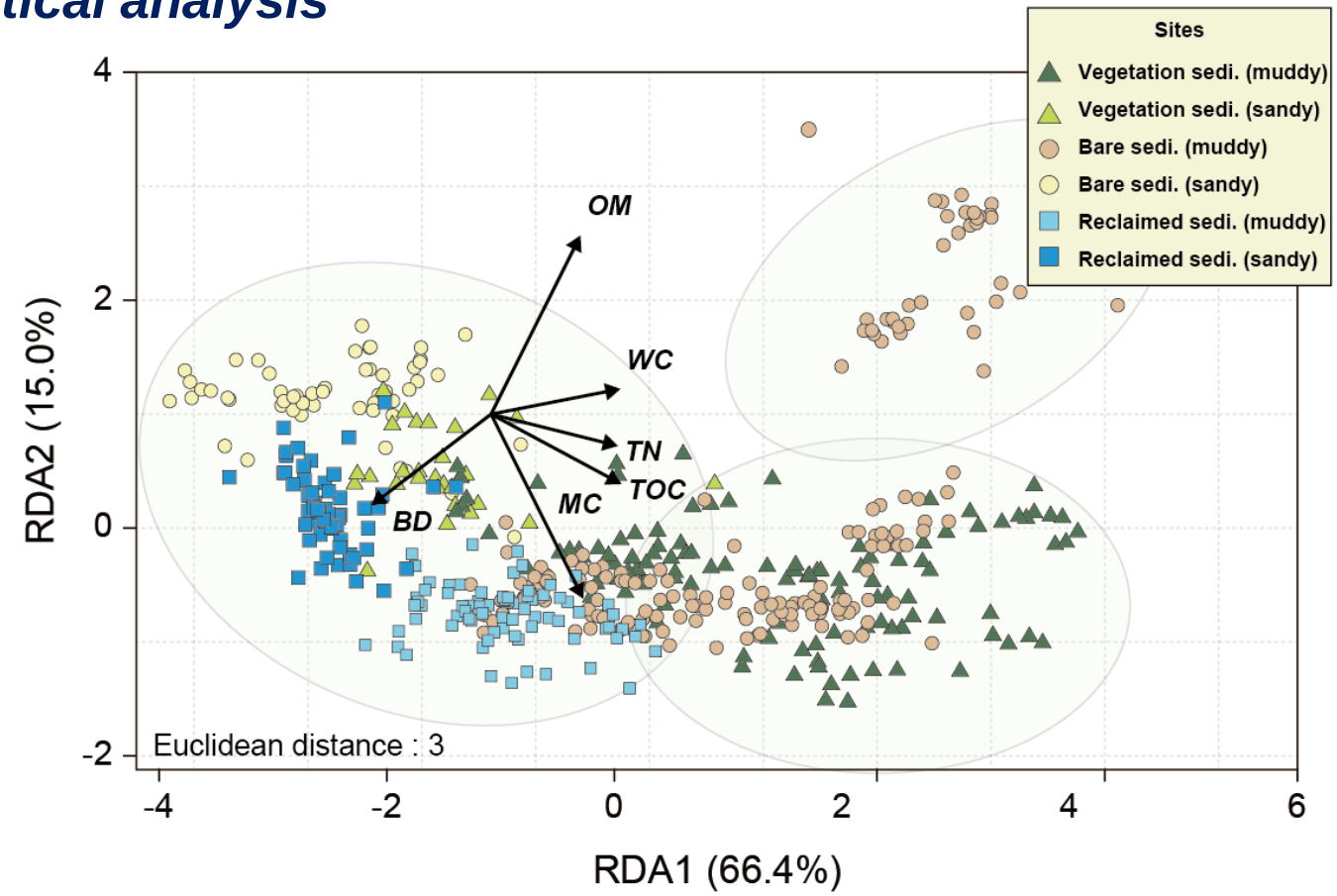
► *Environmental FACTORS?*



- Mud contents were significant with TOC in sediment, scale at 1 m depth
- Water contents also followed with grain size (TOC in MUD > SAND)

3. Results and discussion

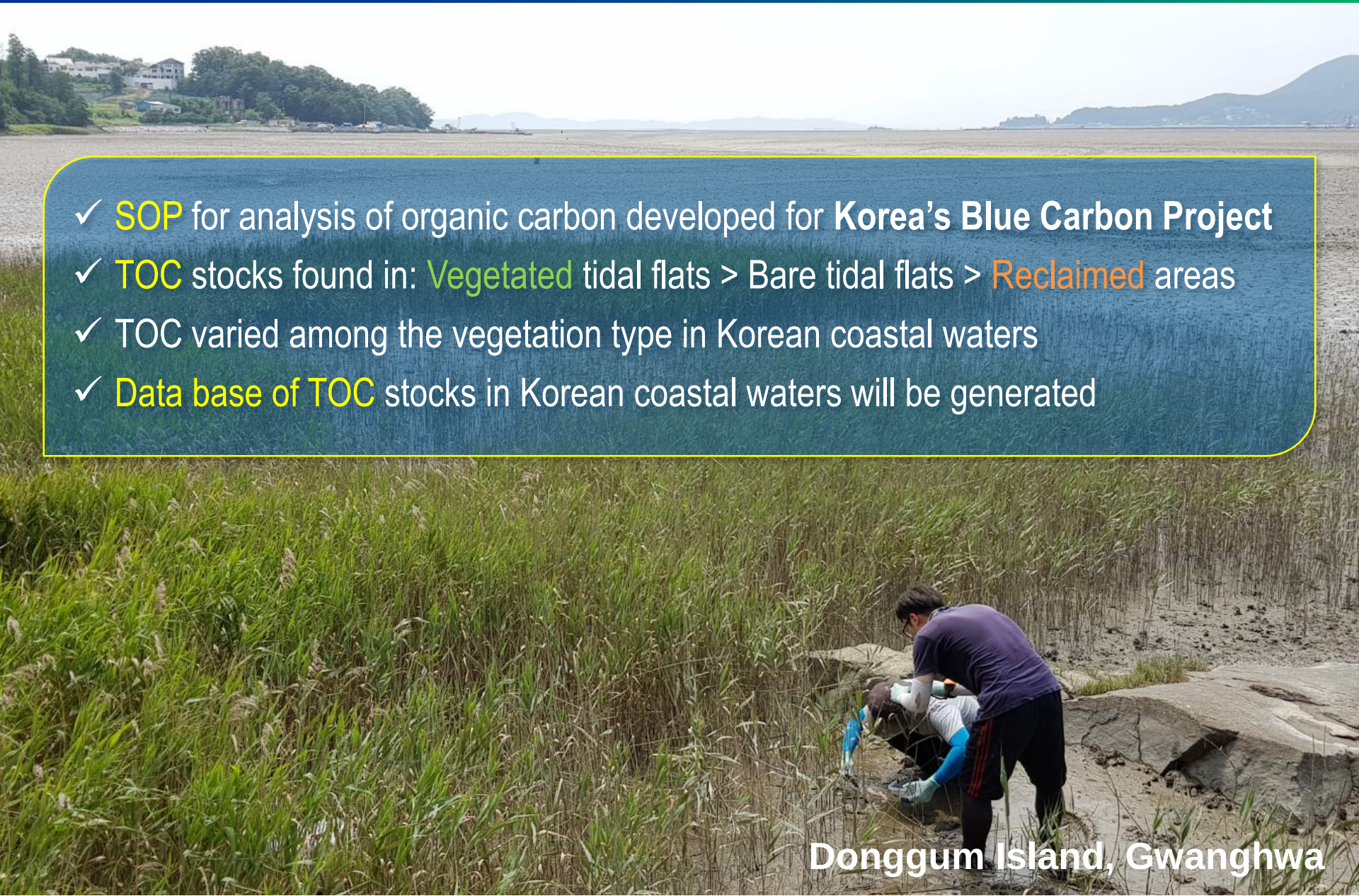
► Statistical analysis



- Salt marshes, bare tidal flats, and reclaimed areas were grouped each in RDA
- TOC with MC showed positive significance, while BD was negatively significant

4. Summary

- ✓ SOP for analysis of organic carbon developed for **Korea's Blue Carbon Project**
- ✓ TOC stocks found in: Vegetated tidal flats > Bare tidal flats > Reclaimed areas
- ✓ TOC varied among the vegetation type in Korean coastal waters
- ✓ Data base of TOC stocks in Korean coastal waters will be generated



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THANK YOU
for your attention

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Acknowledgement

This work was supported by the project entitle **"Development of Blue Carbon Information System and its Assessment for Management (20170318)"** funded by the *Ministry of Oceans and Fisheries of Korea*