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STORM-INDUCED EROSION OF NOTSUKEZAKI SAND SPIT, JAPAN

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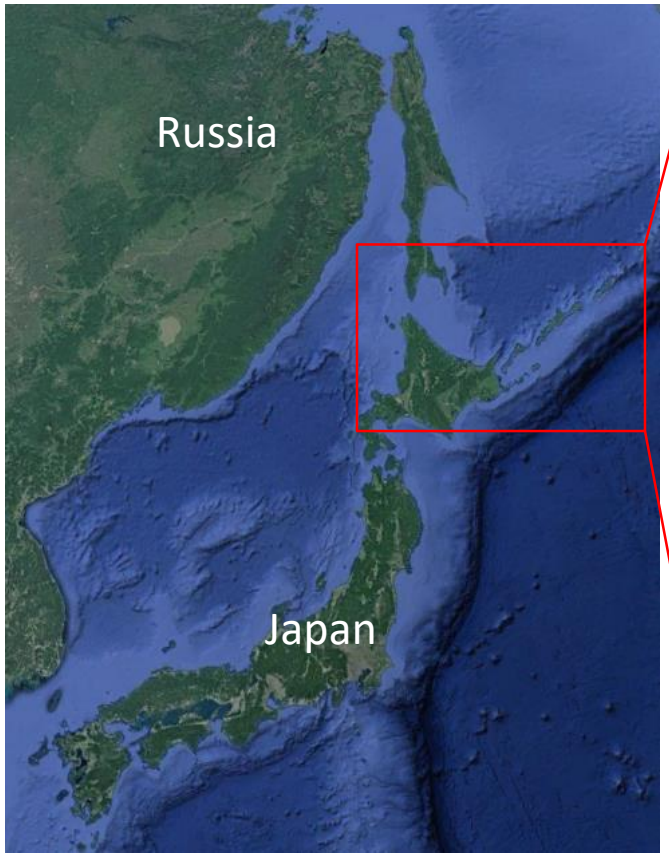
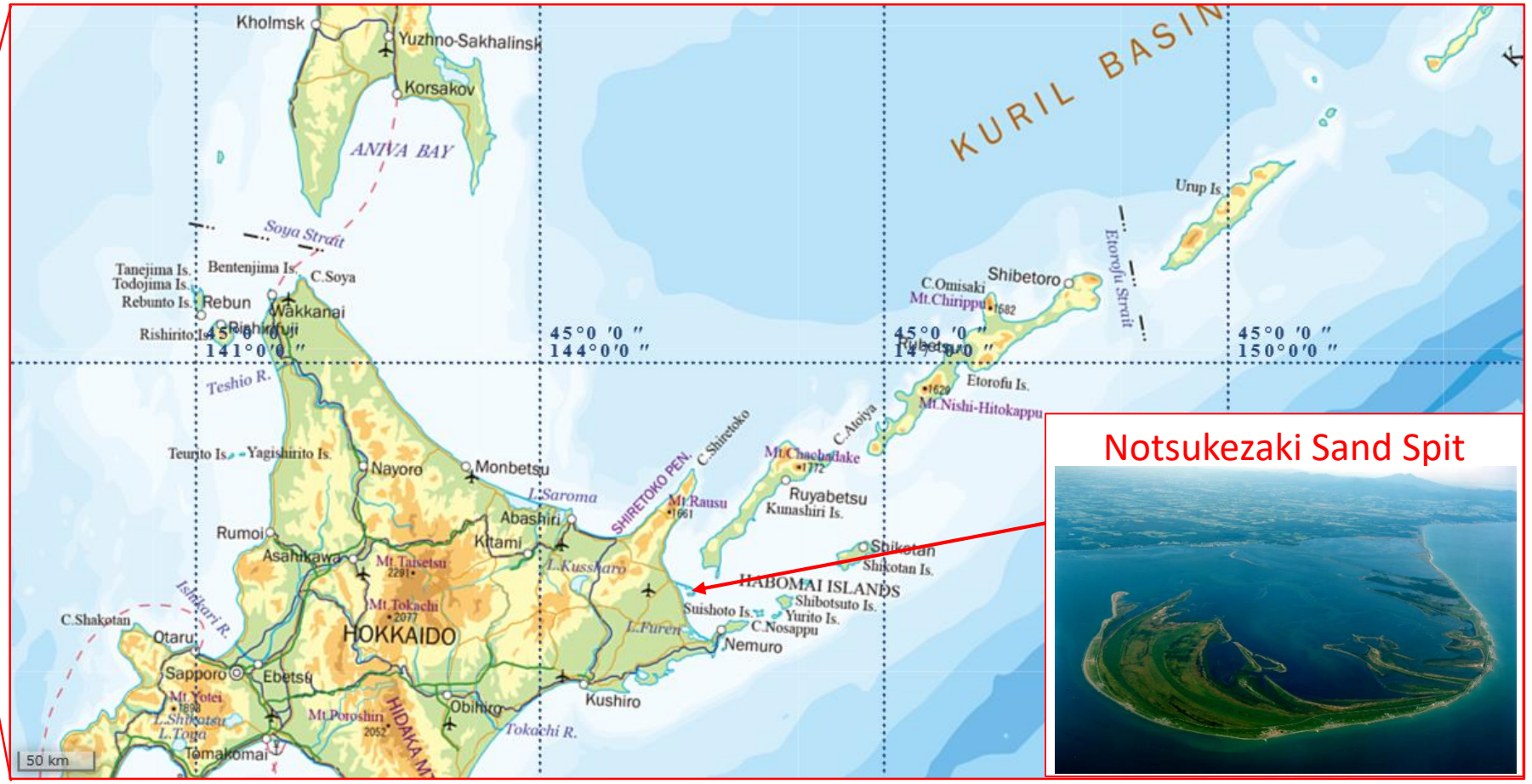
Outline

1. Introduction
2. Field Observation
3. Numerical modeling for Shoreline Changes
4. Storm-Induced Erosion
5. Conclusions

1. Introduction

（1）Location of Notsukezaki Sand Spit



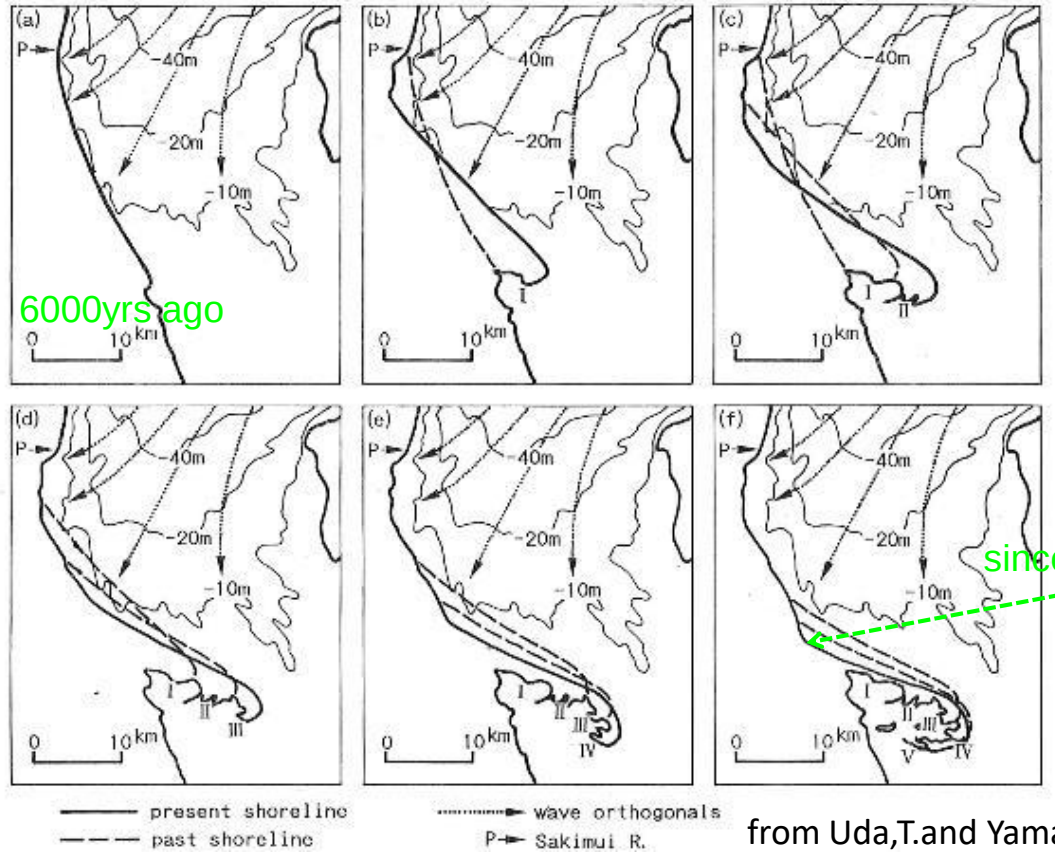


- Notsukezaki Sand Spit is the largest sand spit in Japan, which is located in the eastern Hokkaido, Japan.
- The length of the sand spit is about 26 km from the Shibestu fishing port. Every winter, drift ice floating from the Ohktsuku sea covers the Nemuro Strait. The tidal range is 1.6 m.

1．Introduction

（2） Back Ground

Formation of Notsukezaki Sand Spit



Construction of Shibetsu Fishing Port

from Uda,T.and Yamamoto,K.(1992)

Severe Erosion had started in front of continuous seawall and detached breakwaters

Reduction of Sediment transport in 1990’s

Natural longshore sediment transport toward sand spit≒0

1. Introduction

（3） about Notukezaki Sand Spit

Inner Bay and Land

Coastal Zone

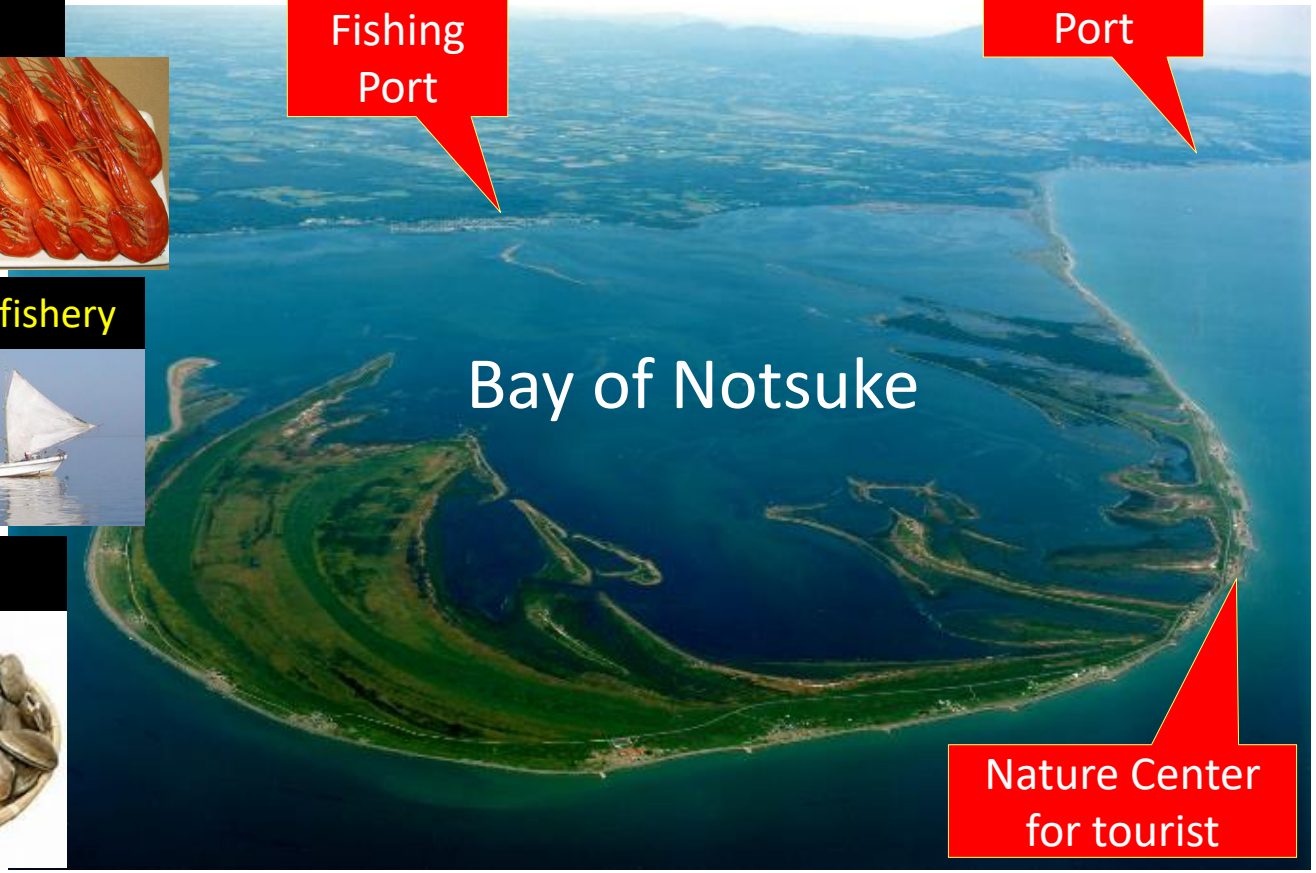
Wild Birds

Wild Animals

shrimp

Traditional fishery

clam



Salmon

Scallops

Other fish for eating

1. Introduction

（4） Shore Protection of Notsukezaki Sand Spit

Development of River

Protection of Coastline

Construction of Shibetsu Fishing Port

1970 1980 1990 2000 2010

Longshore Sediment Transport

27,000 ~86,000 m^3/yr

Decrease to 0 m^3/yr in future

Concept for design of protection in 1999

① Keeping Special Landscape based on Sandy Beach and Lagoon

② Keeping Sustainability of Wild Animal Lives and Fishermen Lives

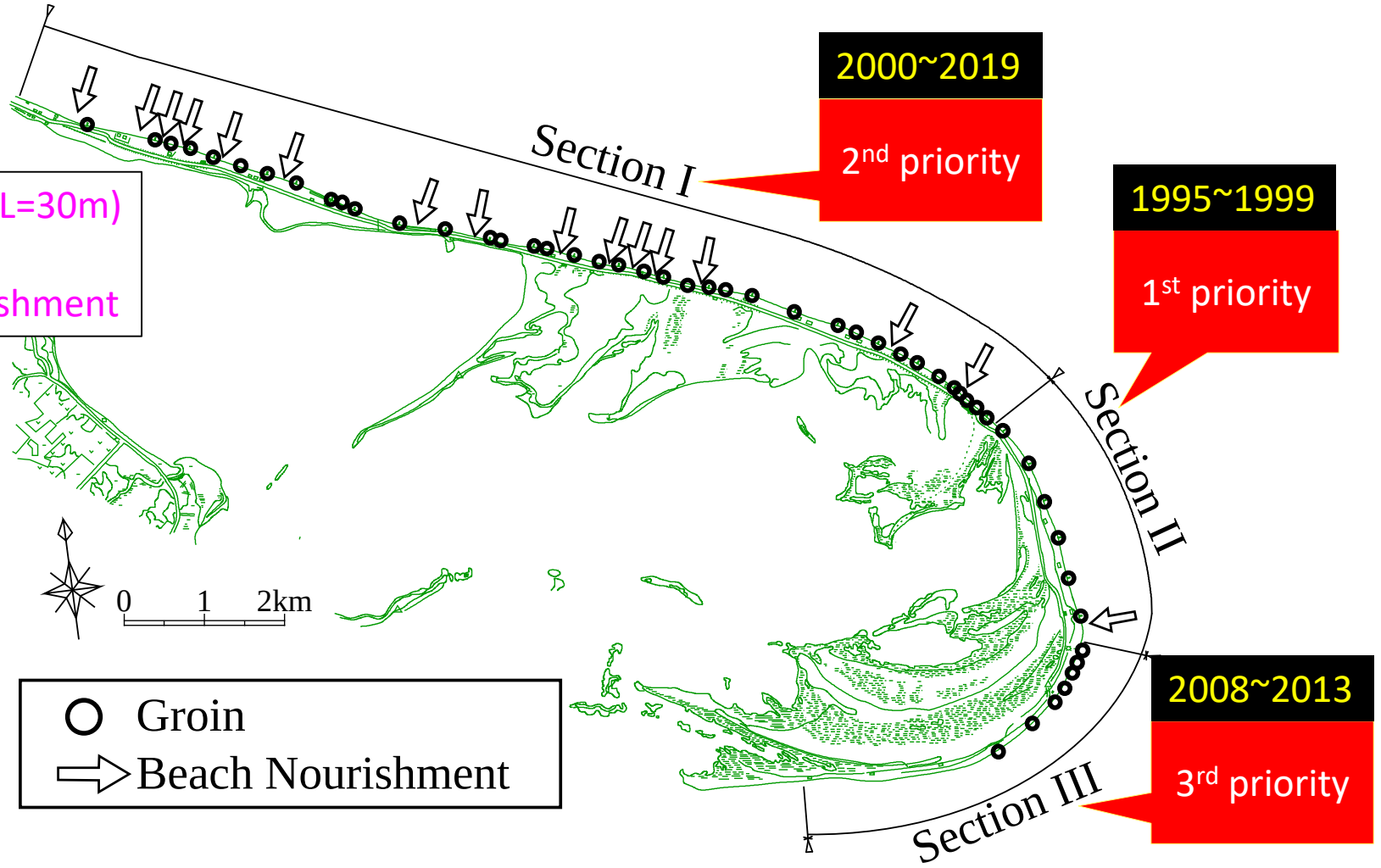
③ There will be less Natural Longshore sediment supply after 2000

④ Sand Management will be more important on Japanese coast

1. Introduction

（4）Shore Protection of Notsukezaki Sand Spit

Total 39 of 51 short groins (L=30m)
＋
Total 263,000 m3 beach nourishment



2000~2019
2nd priority

1995~1999
1st priority

2008~2013
3rd priority

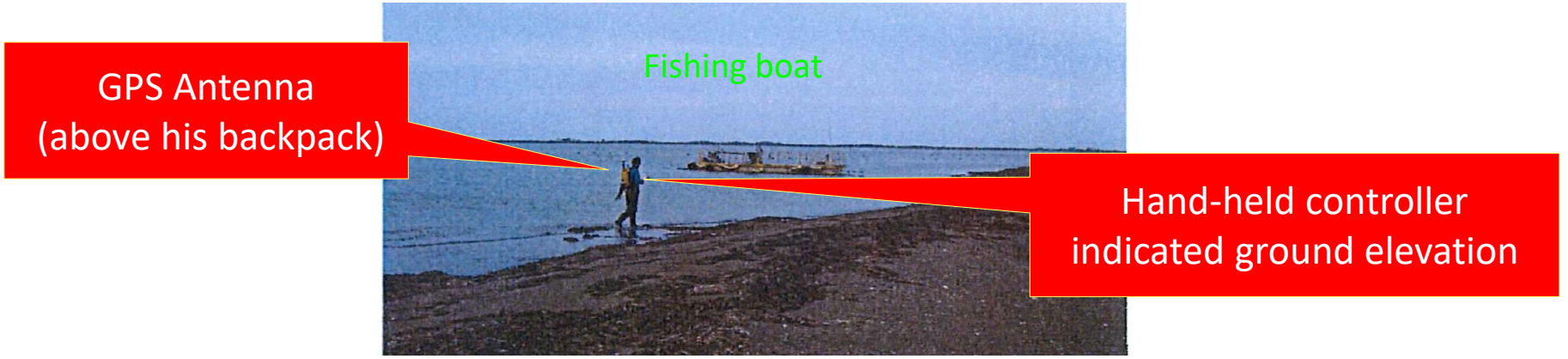
2. Field Observation

（1）Overview of field data

Category	Year	Additional Information
Arial Photograph	1947[1], 1990[2], 1995[2], 2000[2], 2004, 2009, 2015	[1]U.S. Armed Forces [2]Geograhical Survey Institute
Shoreline Position and vegetation boundary	2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015	By a man with Real Time Kinematic-GPS(GNSS)
Beach Profile	1992※, 1999※, 2003, 2004, 2007※, 2009, 2010, 2011, 2012, 2013※, 2014, 2015	Cross—shore profile from shoreline
Beach Materials	2008, 2013	Sieve analysis

data by Hokkaido Government

How do we get shoreline position (ground height ≒ 0m) and boundary of vegetation ?

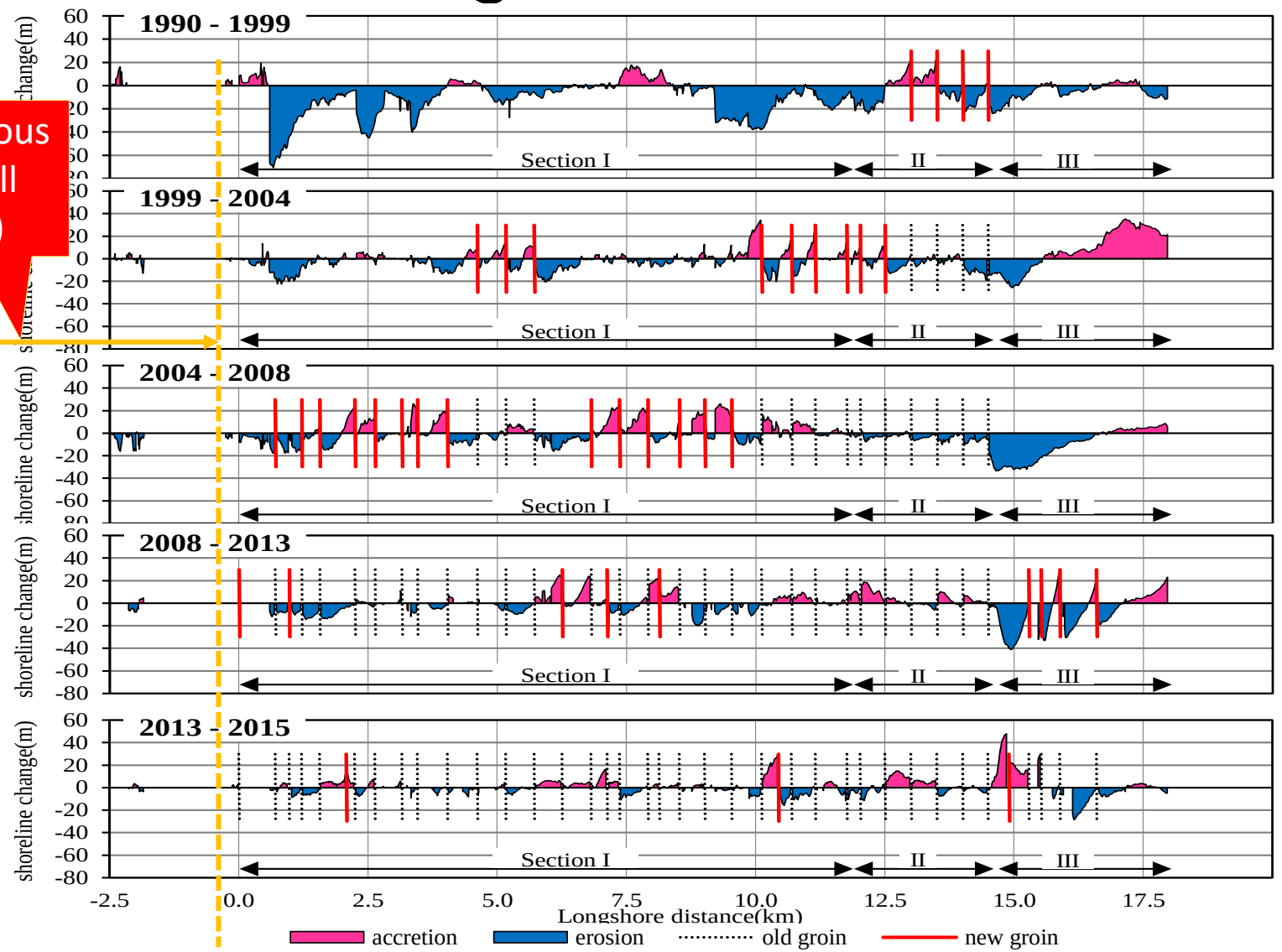


2. Field Observation

（2）Shoreline Changes in each section

Continuous seawall (6km)

Shibestsu Fishing port



1995～2005

-0.6m/year

Average retreat rate has been decreasing

2005～2015

-0.2m/year

2. Field Observation

（3）Wave Climates

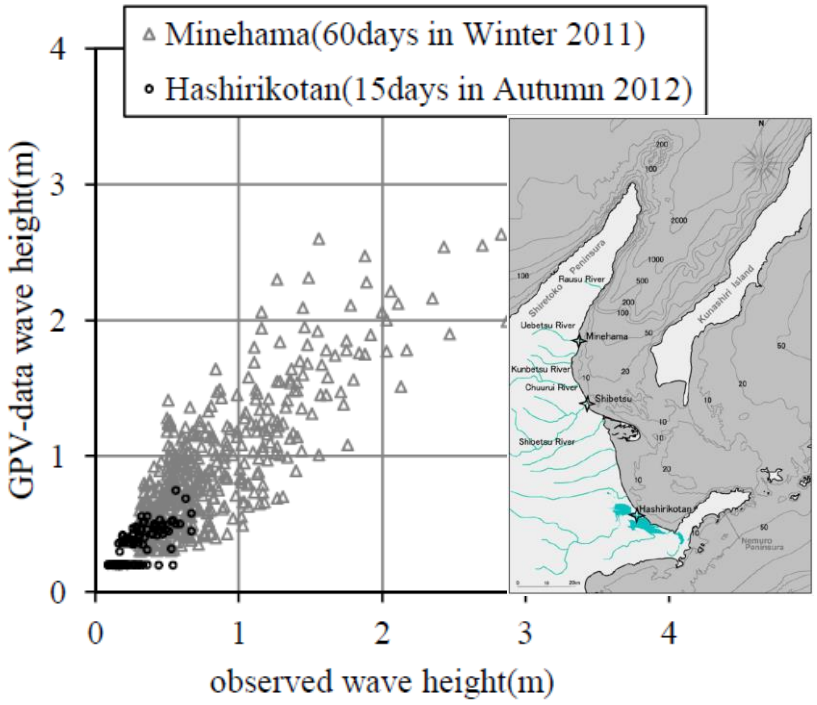
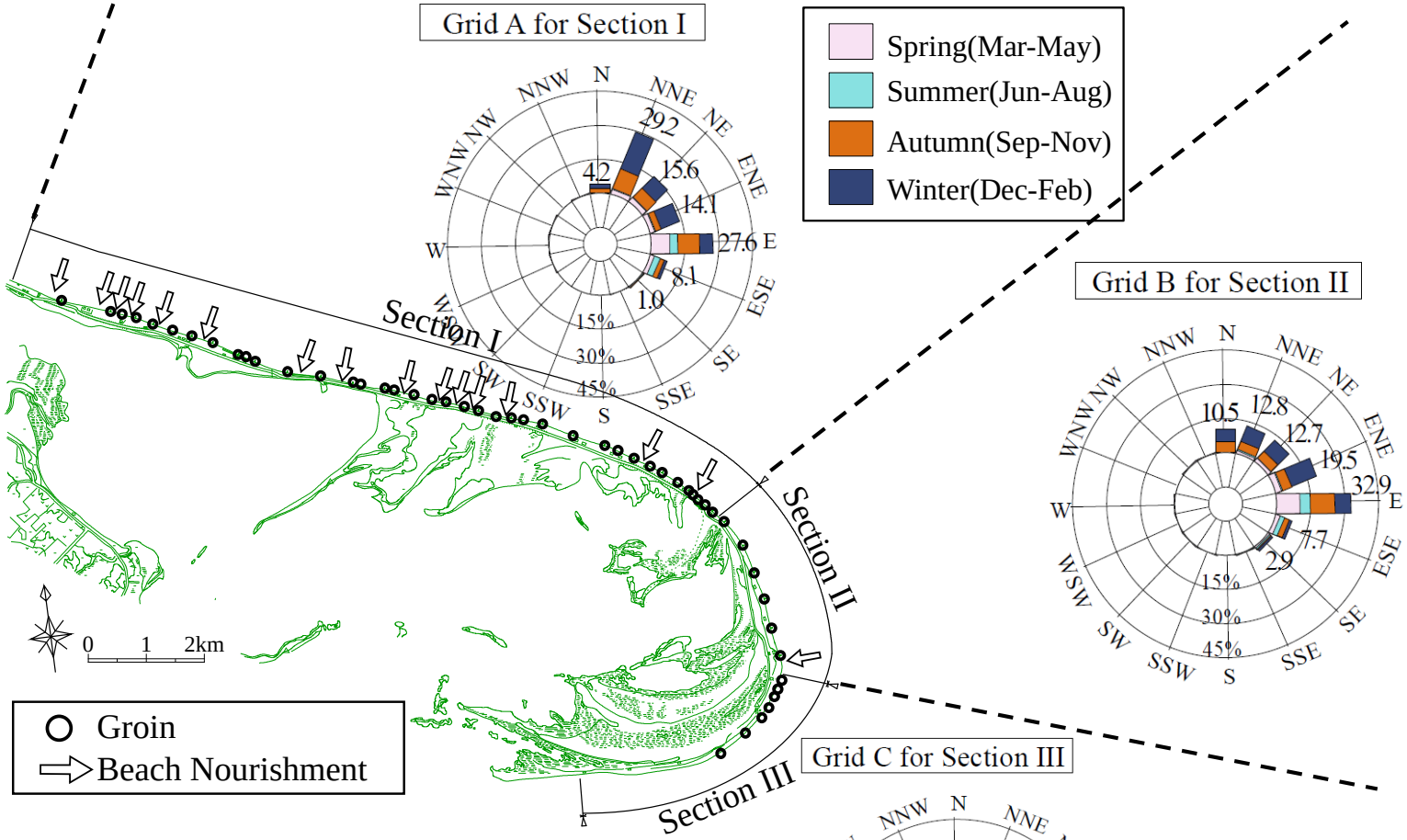


Figure 7. Correlation of significant wave height

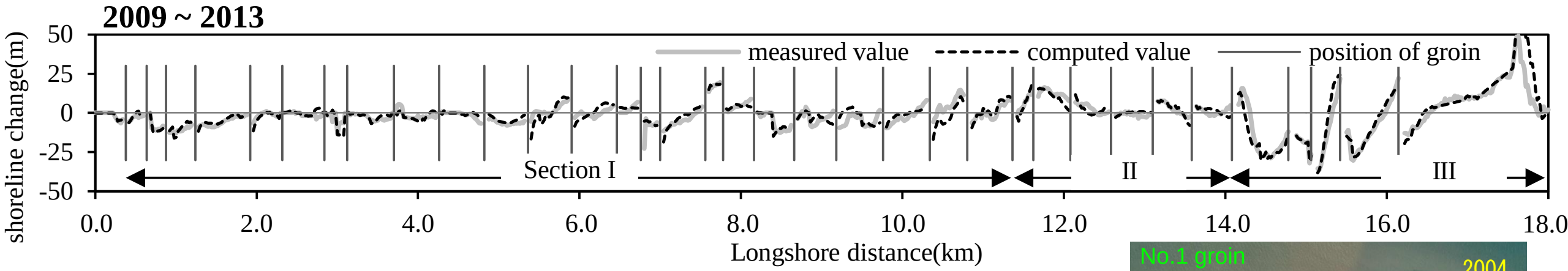


Wave Energy during Winter is the largest

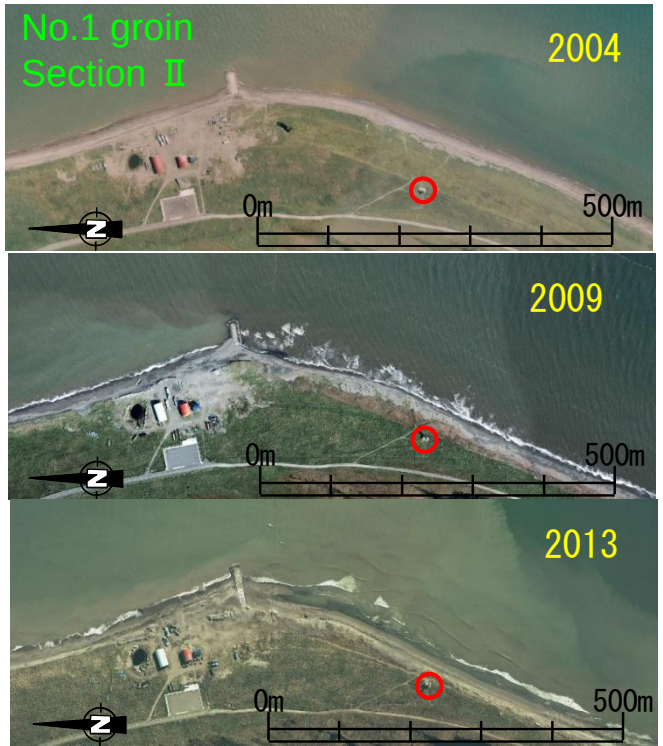
Wave Energy in Spring and Summer is quite different from Winter

3. Numerical modeling for Shoreline Changes

Reproduction of shoreline changes using one-line model



One-line model calibrated using mean tide level does not predict beach profile changes during storms



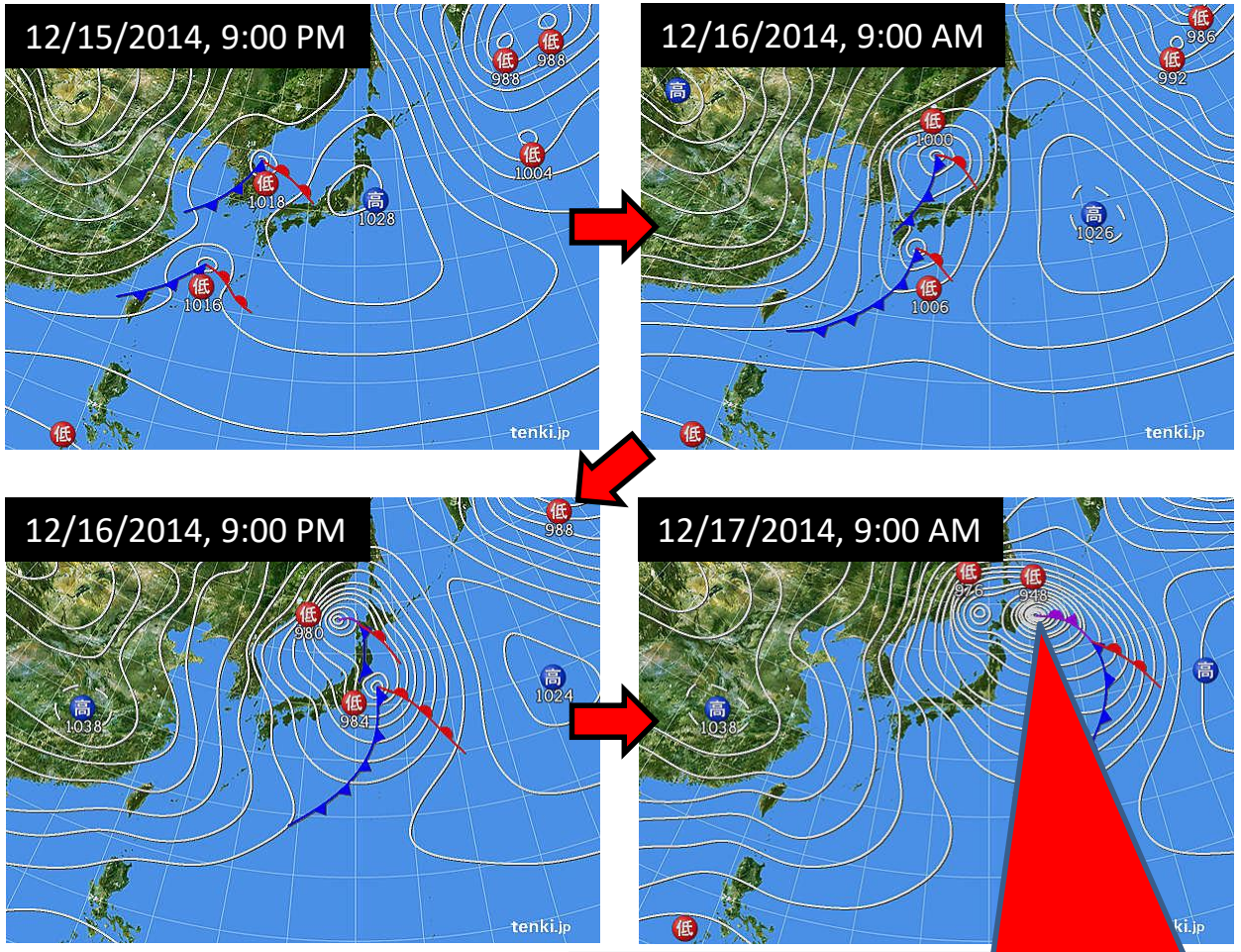
4. Storm-Induced Erosion

（1）Overview of Nemuro Storm Surge in December 2014

- In December 2014, a remarkable high tide occurred in Nemuro region due to the approach of rapidly developing low pressure
- In Nemuro city, total of 95 buildings flooded due to storm surge

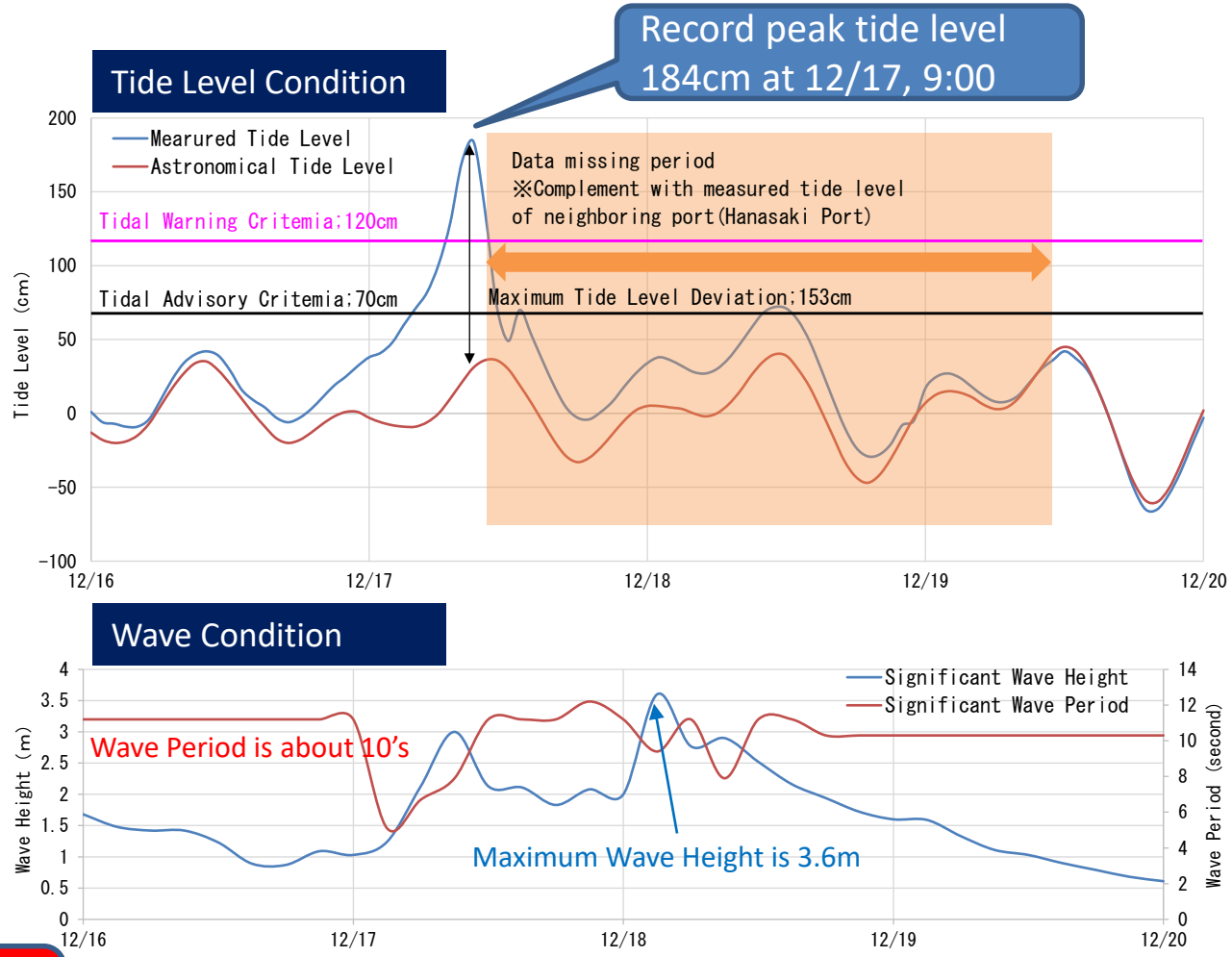
4. Storm-Induced Erosion

（1）Overview of Nemuro Storm Surge in December 2014



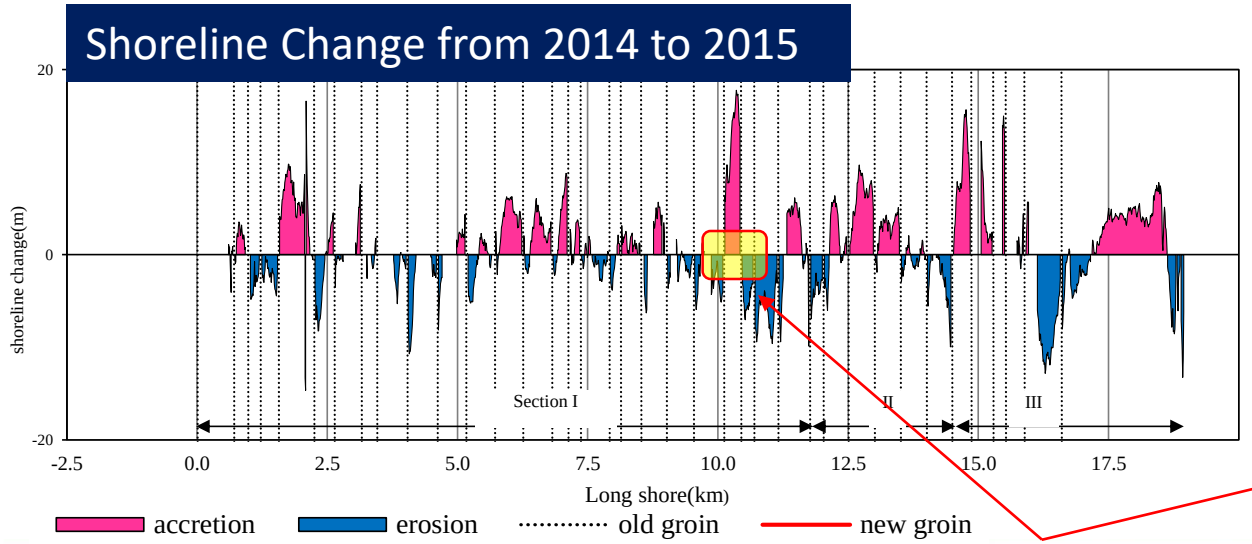
from Japan Weather Association

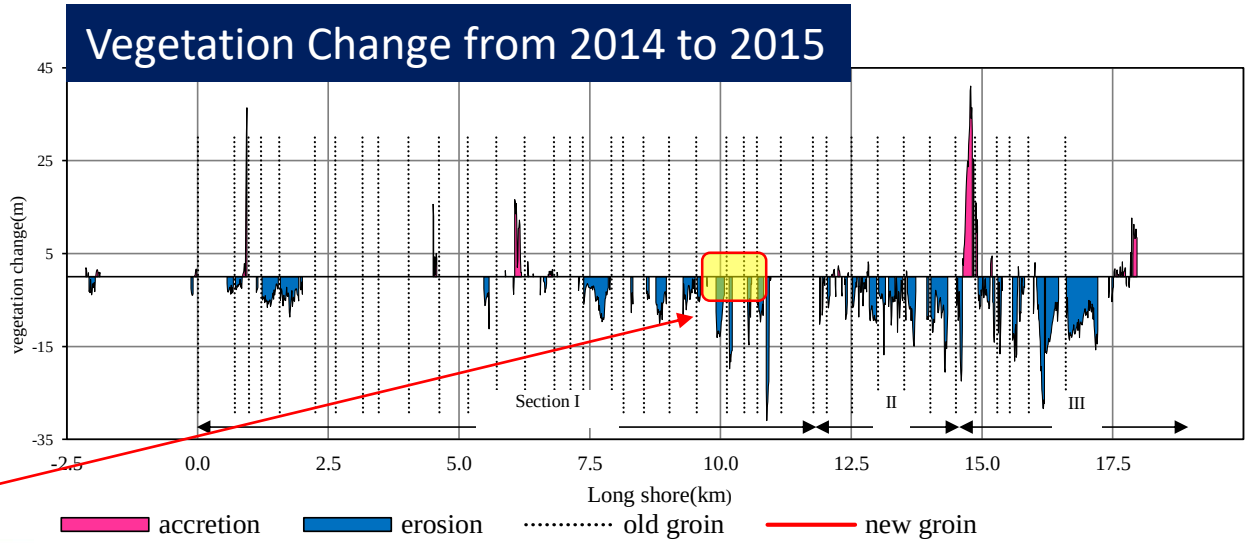
Record peak Atmospheric Pressure
948hPa at 12/17, 9:00 AM

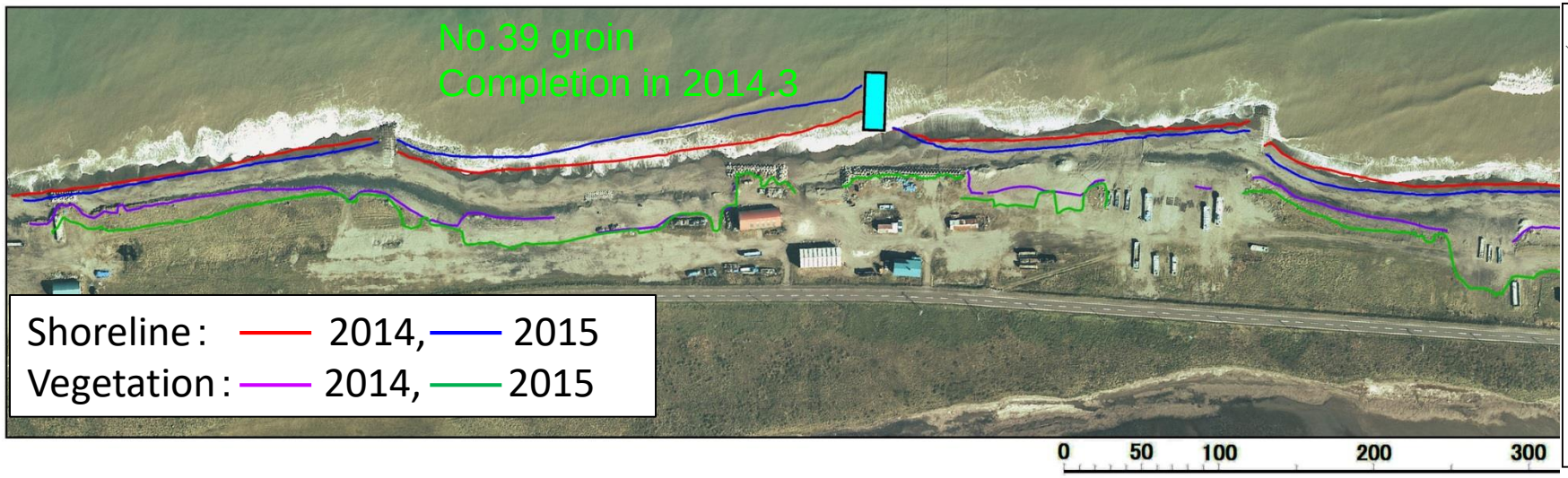


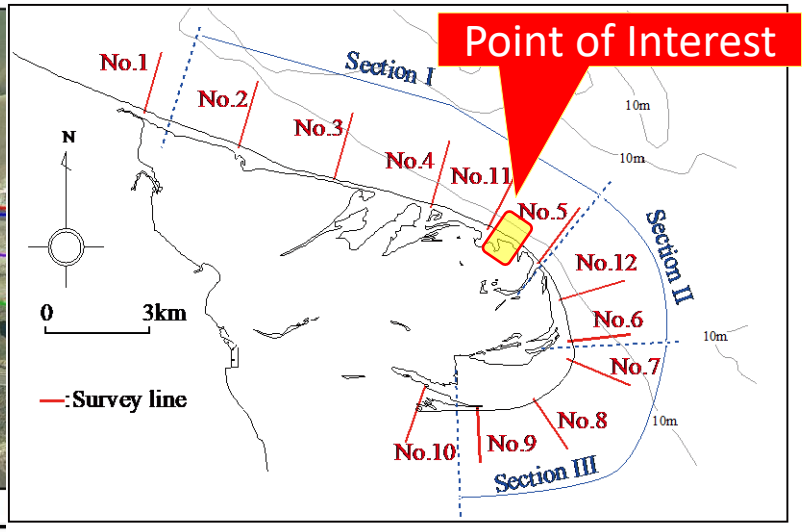
4. Storm-Induced Erosion

（2）Shoreline and Vegetation Boundary Changes Before and After Storm Surge





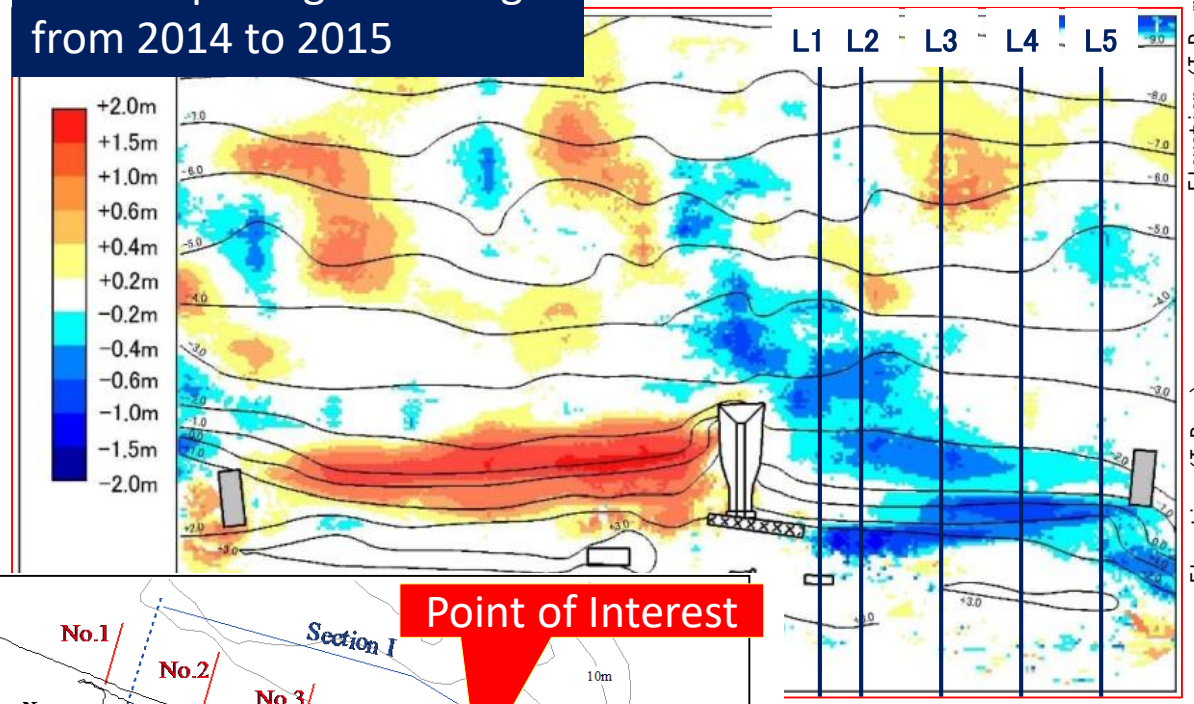


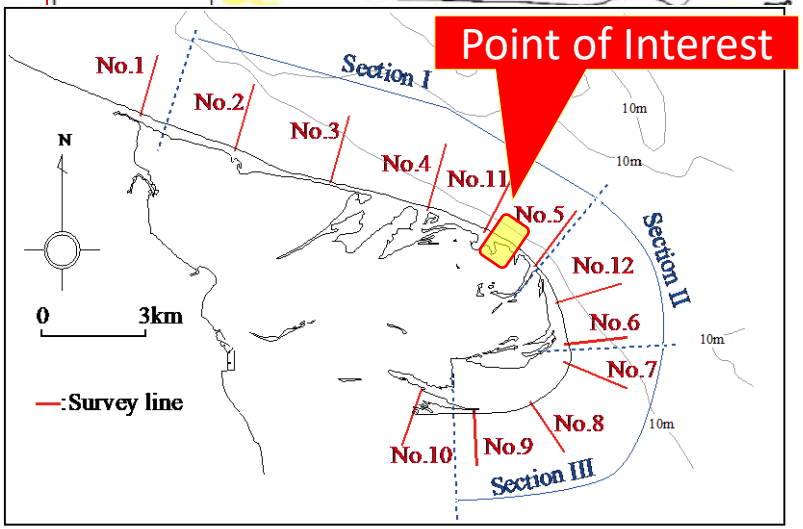


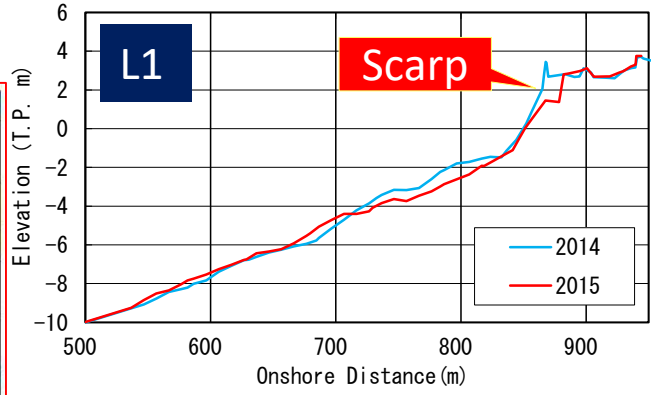
4. Storm-Induced Erosion

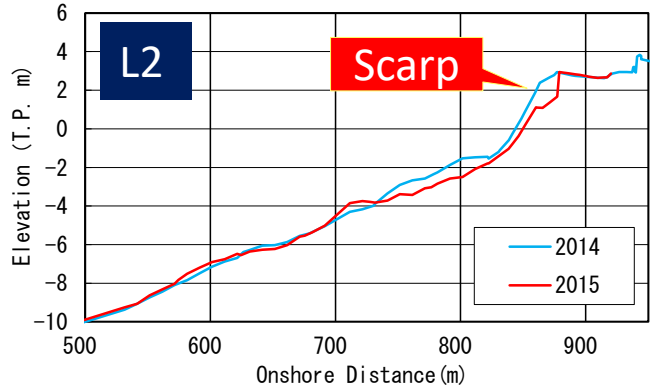
（3）Beach Profiles Before and After Storm Surge

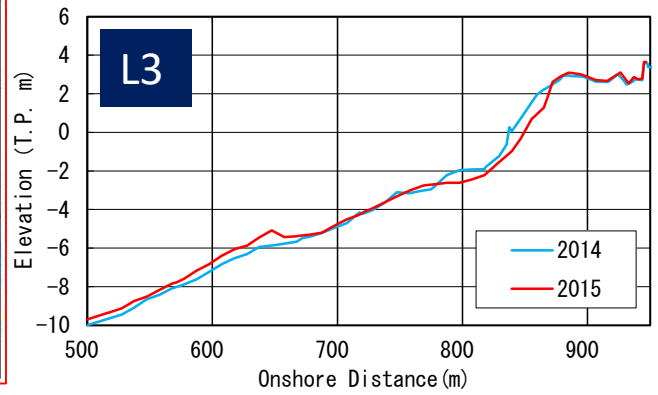
Geomorphological Change from 2014 to 2015

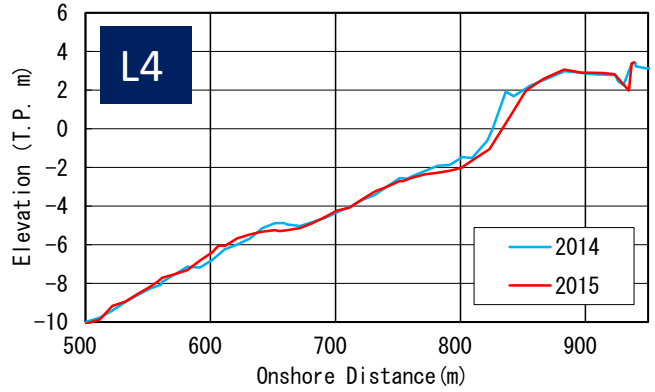


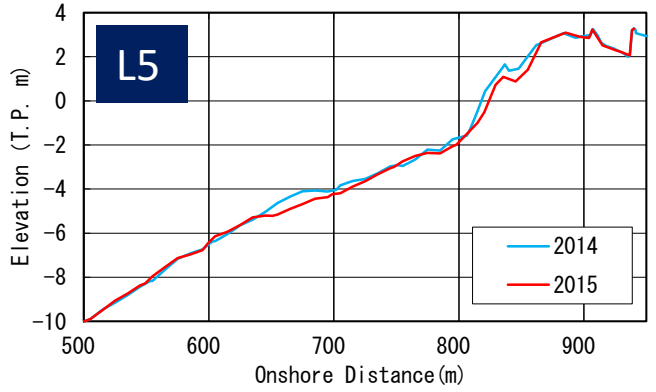






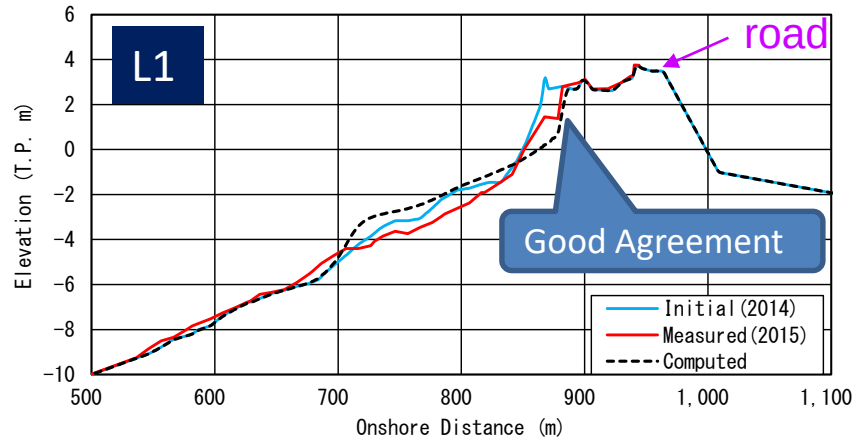


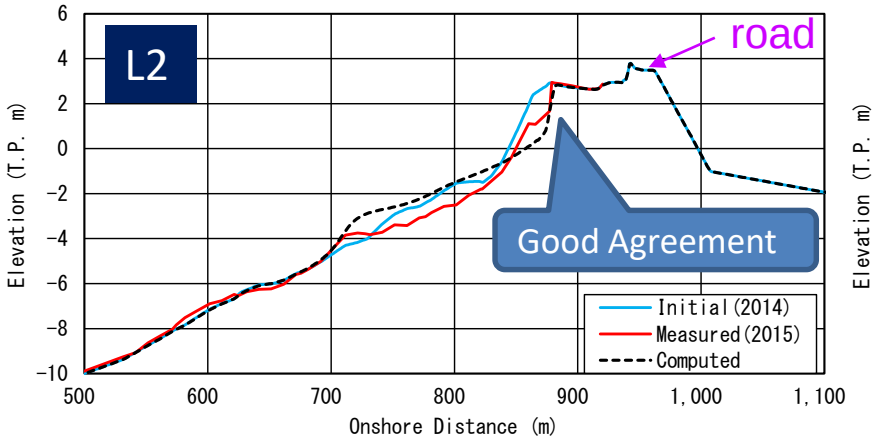


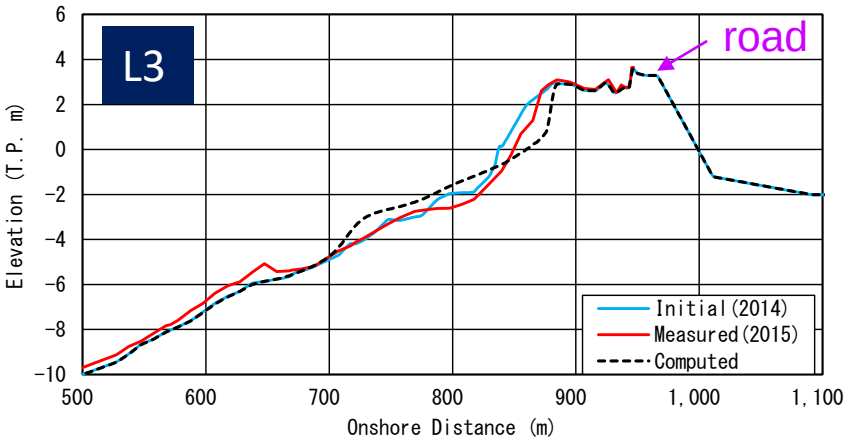


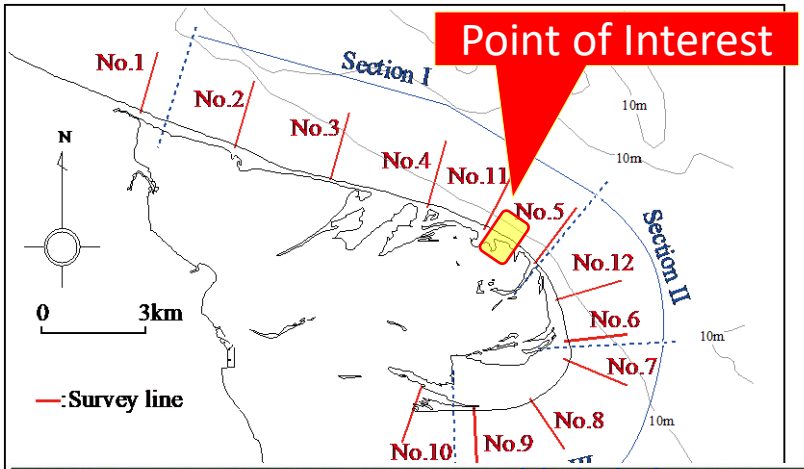
4. Storm-Induced Erosion

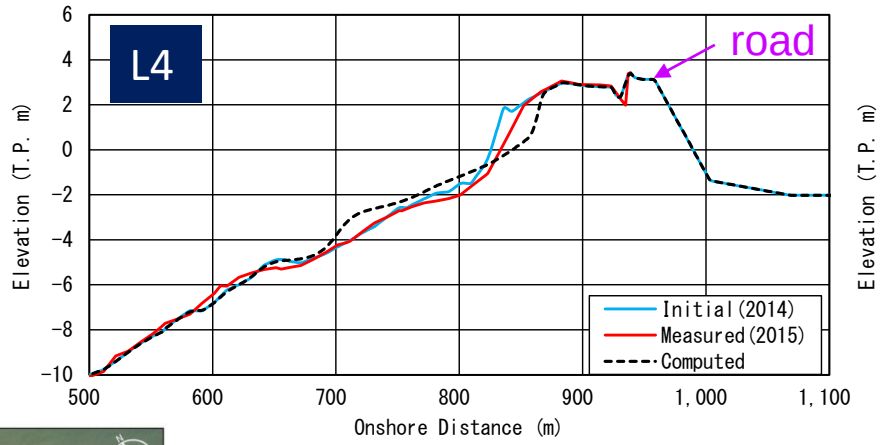
（4）Computed (using CSHORE) Beach Profile Evolution

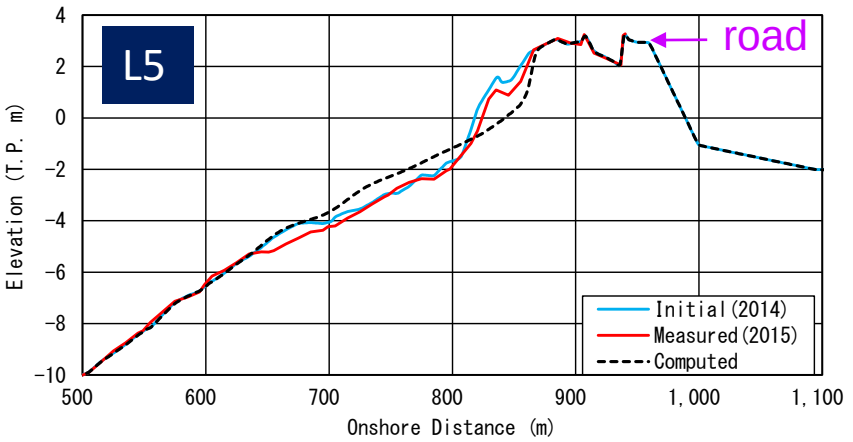


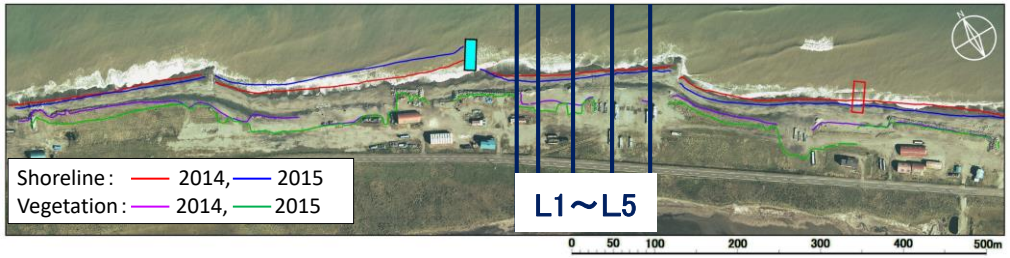








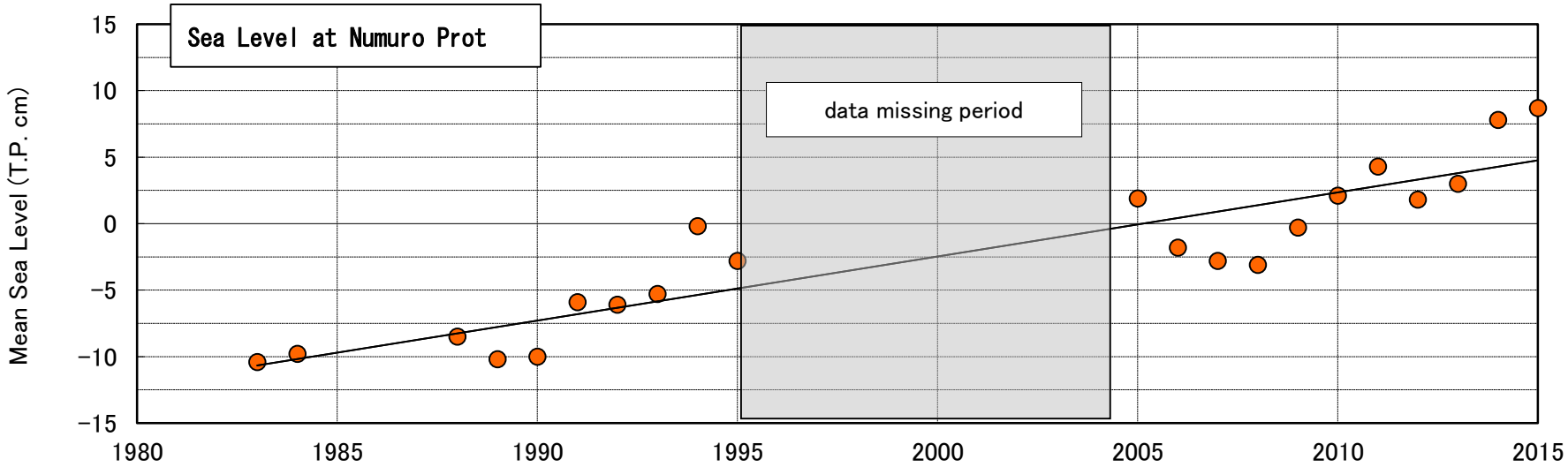


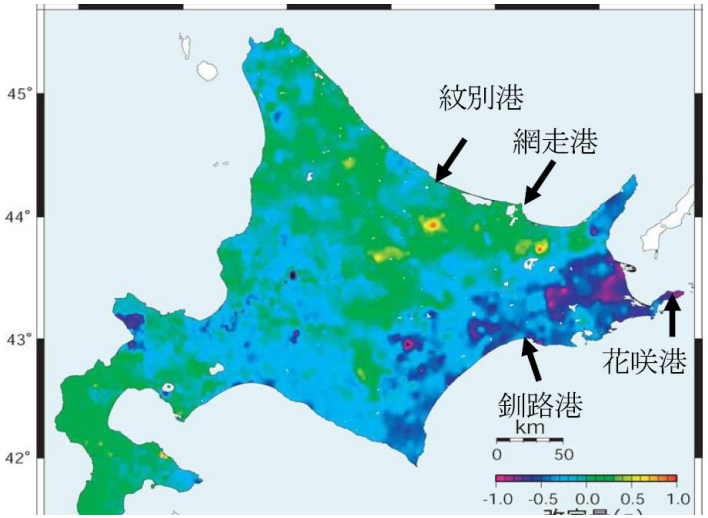


Measured 6 months after Nemuro Storm Surge

4. Storm-Induced Erosion

（５）Risk Assessment of Sand Spit Breach





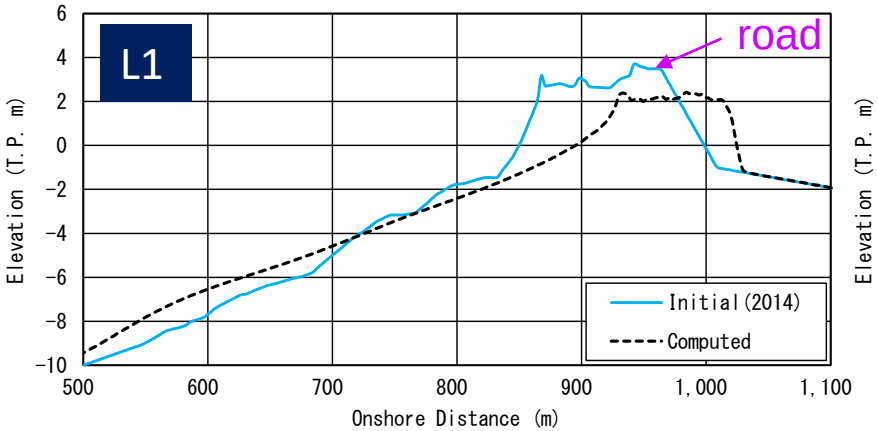
from Technical Report of Geospatial Information Authority of Japan

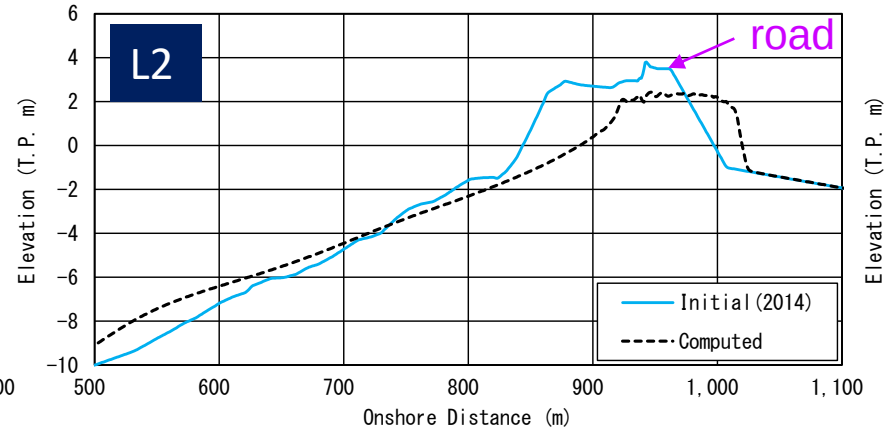
An average of 1.36cm/year of land subsidence has occurred

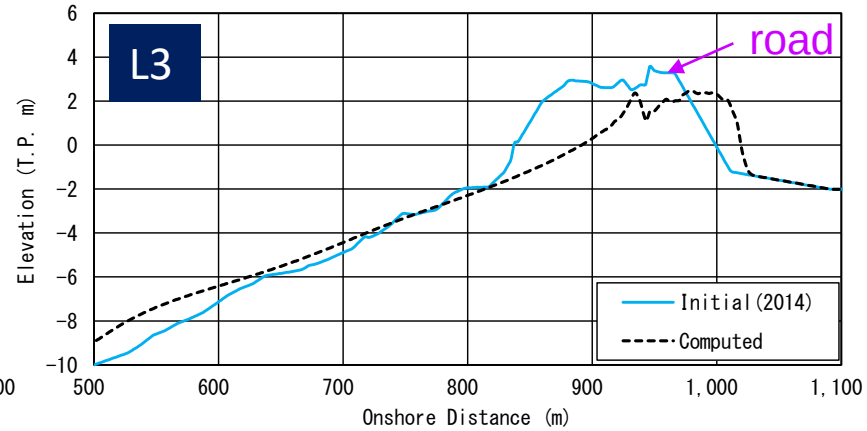
4. Storm-Induced Erosion

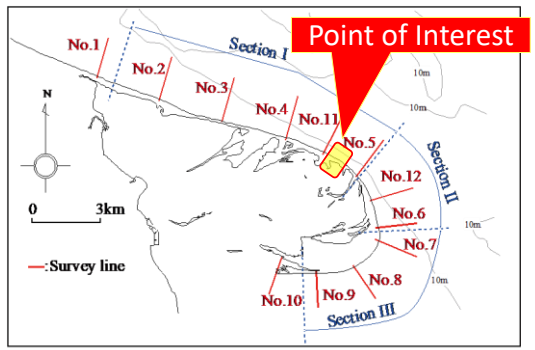
（５）Risk Assessment of Sand Spit Breach

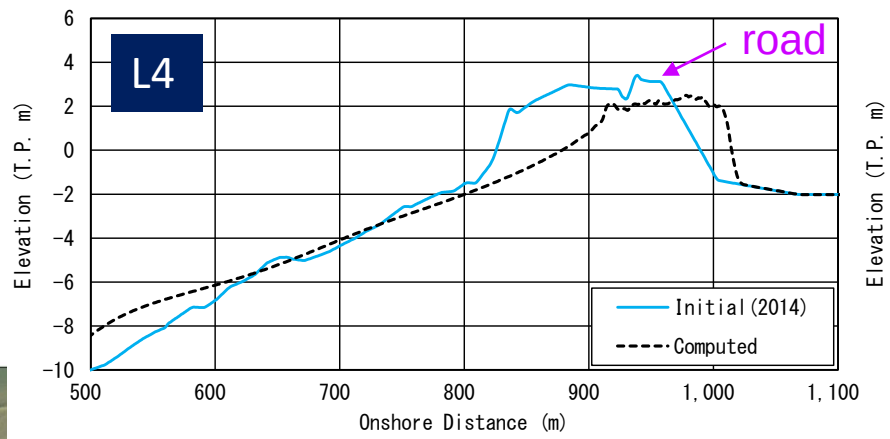
【Tide Level Condition】Nemuro Storm Surge + 0.7m（1.36cm/year × 50year）
【Wave Condition】50 year Storm Wave（Significant wave height：5.4m，Significant wave period：11.4s）

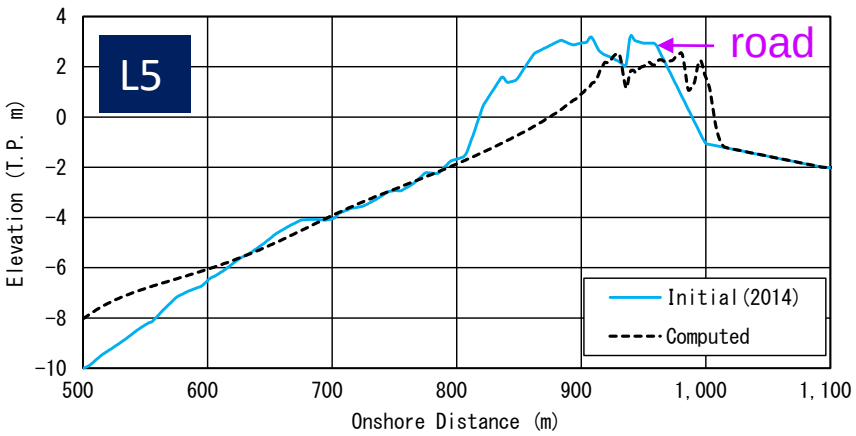


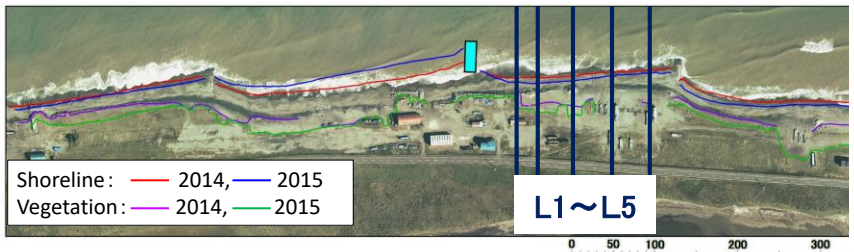






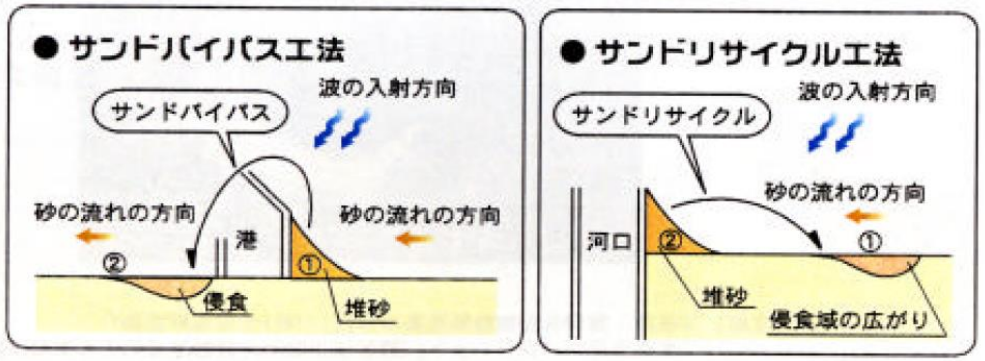






4. Conclusion

① Sand recycle system or extension of groins will be required for management of longshore sediment transport to sustain Notsukezaki sand spit.



By Ministry of Land, Infrastructure, Transport and Tourism (JAPAN)

Beach materials offshore of the 4-m closure depth should be included in sediment analysis

②The beach scarping countermeasure against storm surge will need to be devised.

③Monitoring must be continued

1995

2004

2013

To 2025