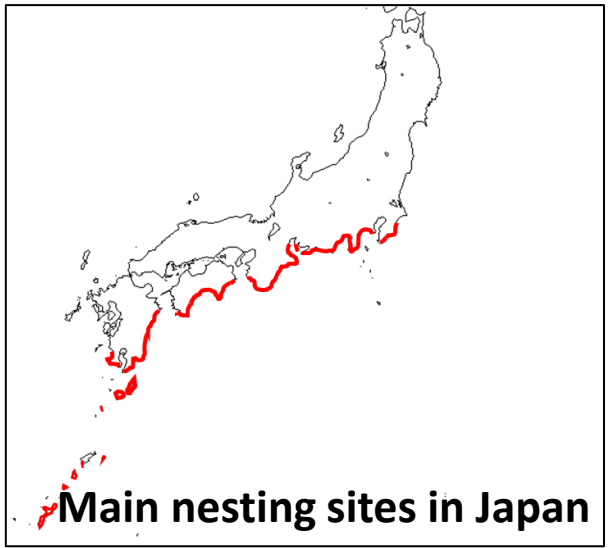
The Features of Nesting Environment of the STRETCH Turtle Birth Beach

○Noah YAMAGUCHI & Tomomi SAITO (Kochi University)

Background information

Loggerhead turtles *Caretta caretta*



Main nesting sites in Japan

- Distribute in subtropical and temperate oceans
- Nest at sandy beaches during nighttime from May to August in Japan
- Japan is the only nesting area for the North Pacific population

(Kamezaki et al., 2003)

Background information

Status of Japanese sandy beaches

Decrease in sand supply and construction of port facilities have progressed beach erosion

(Uda, 2017)

https://www.skr.mlit.go.jp/kochi/work/w_outline.pdf

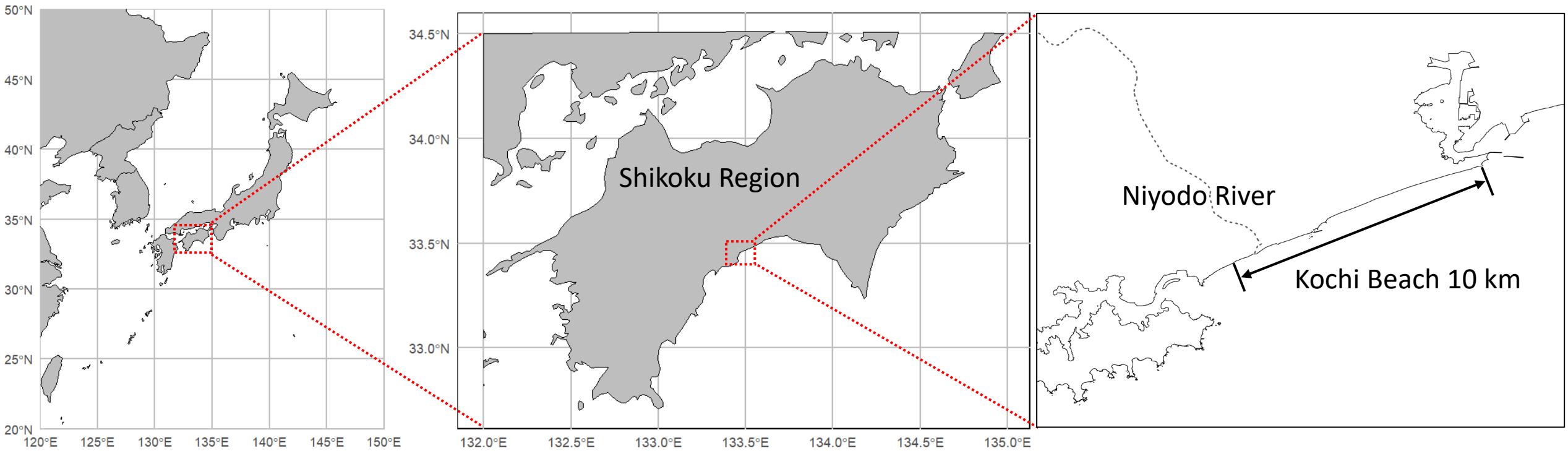
Beach modification to mitigate the damage of natural disasters

(Malloy, 2023)

Degrading beach environment

Materials and Methods

Kochi Beach



- Every early morning we patrolled the beach, searching for loggerhead turtle tracks left behind the night before
- Recently largest number of loggerhead nests have been confirmed in the Shikoku Region
- Various levels of environmental modification have been observed throughout the beach
- Beach environments surveyed at every 500 m

Materials and Methods

Measurement item

To assess the nesting environment and impact of human activity,
We present 4 items below

- **Backshore area**
  This item indicate how large nesting ground in Kochi Beach

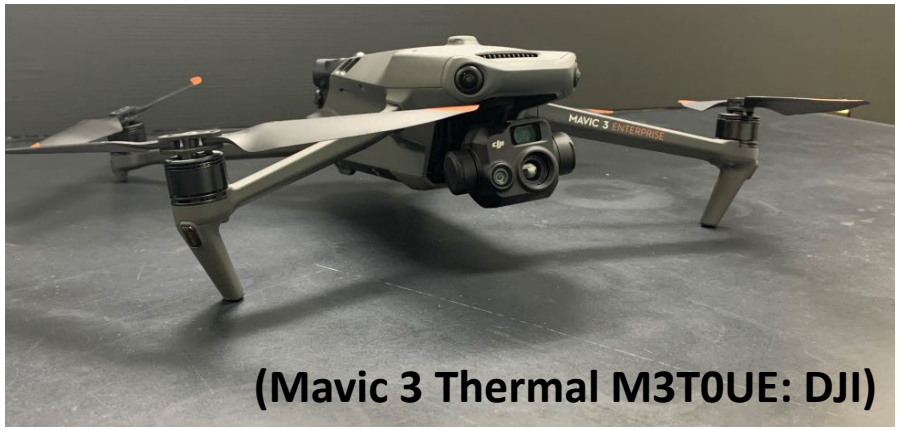
- **Sand particle composition**
  This item indicate sand quality at sea turtle nesting site

- **Darkness**
  This item is index of light pollution

- **Sky openness**
  This item is adopted as index of landscape behind the beach

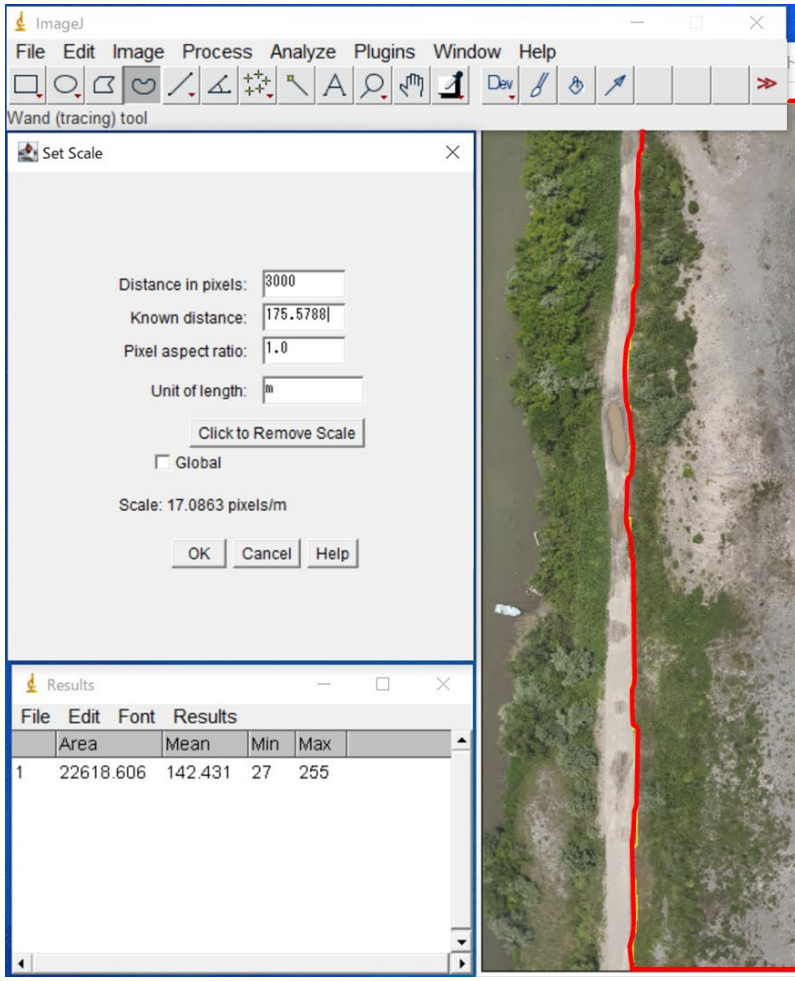
Materials and Methods

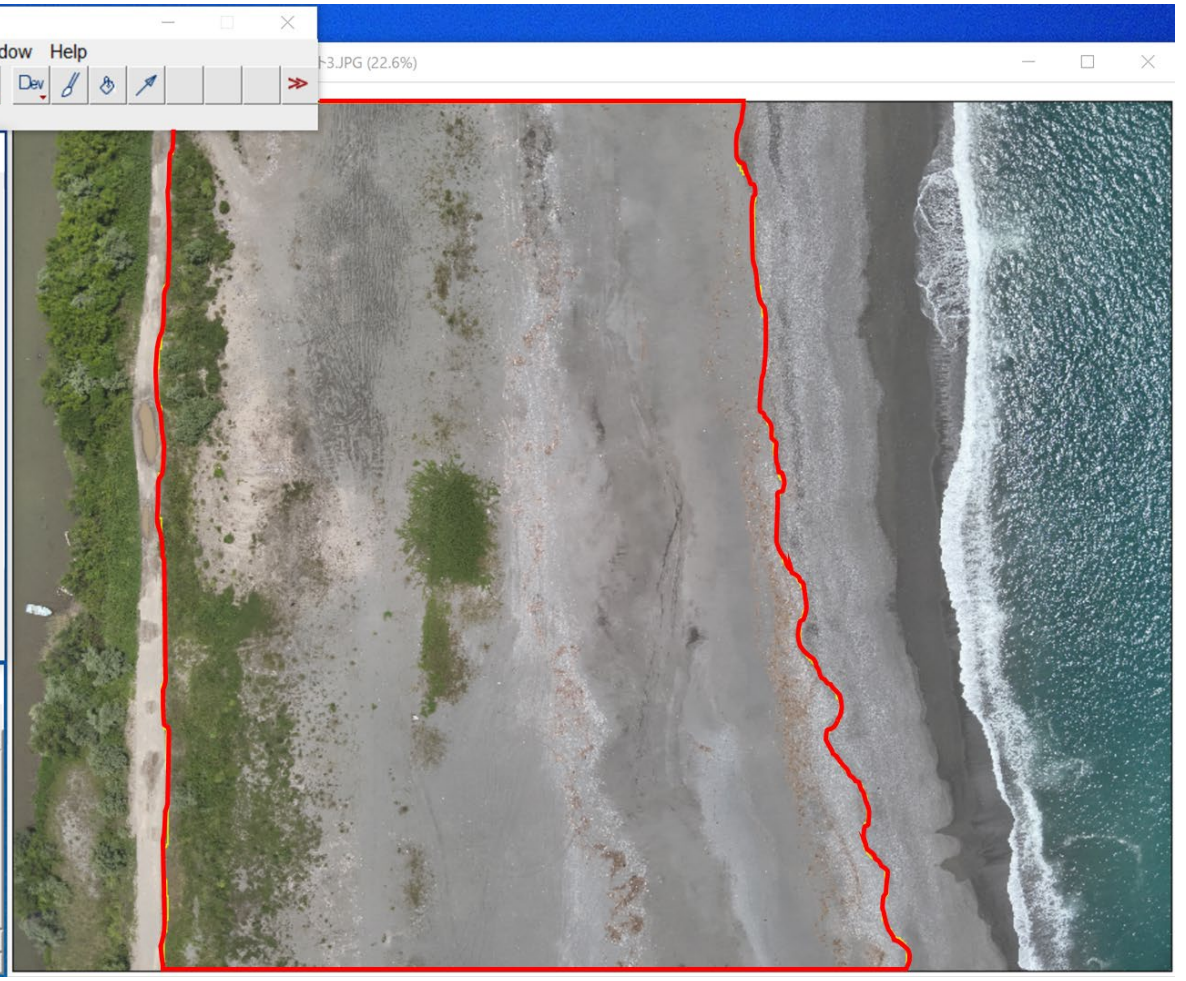
Backshore area



(Mavic 3 Thermal M3T0UE: DJI)

- Drone was operated at low tide during spring tides
- Captured aerial photographs at the center of each section from a height of 130 m





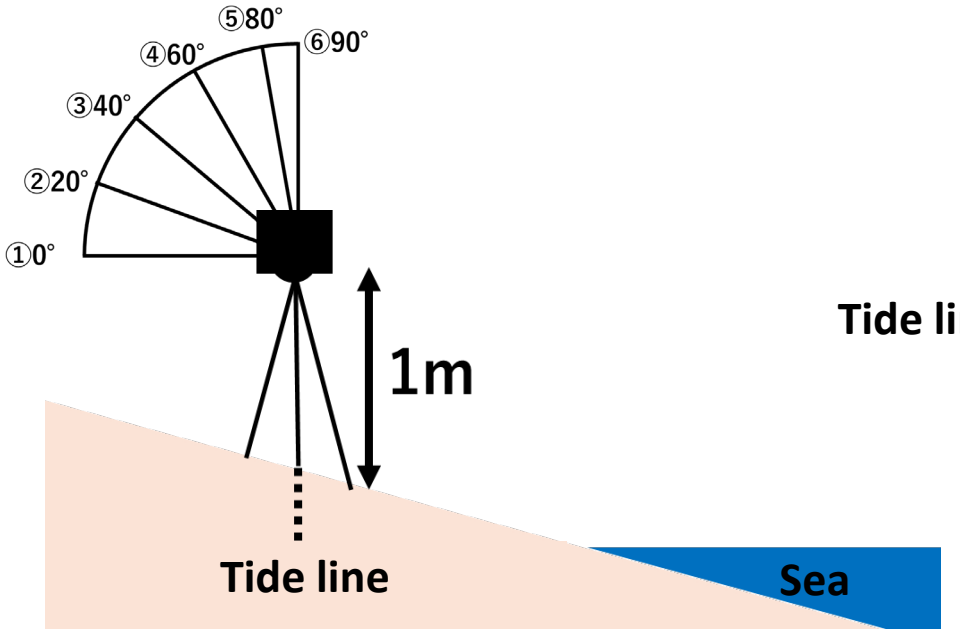
Quantify the backshore area with “Image J”, (vegetation area is included if it exists)

Materials and Methods

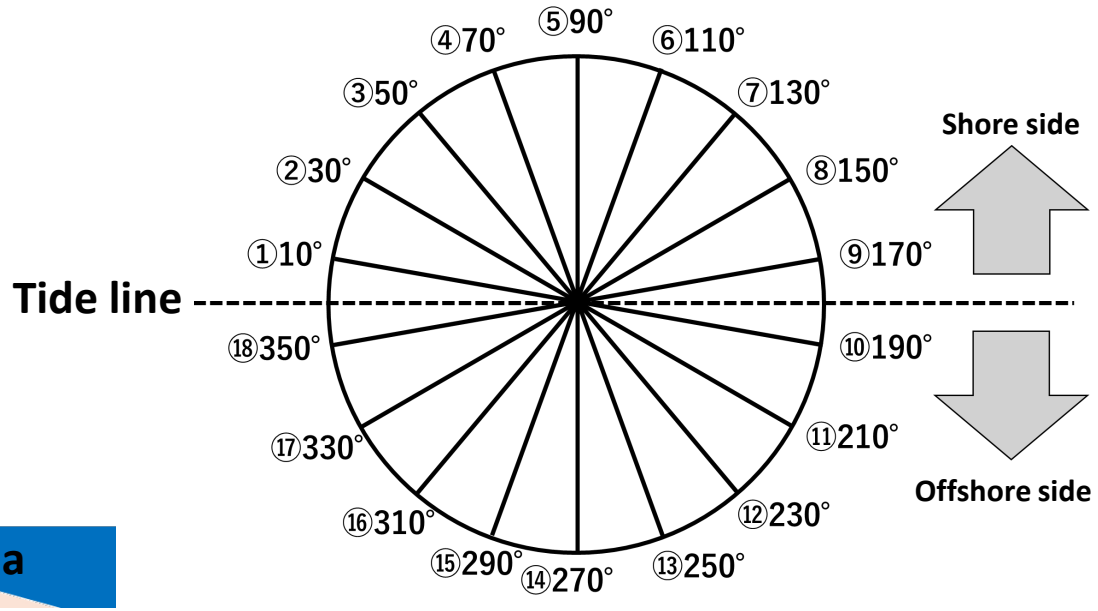
Darkness

Sky Quality Meter

Vertical angle



Horizontal angle



Example of measured values

- Night sky at urban area
  Approx. 18(mags・arcsec^{-2})

- Night sky at mountainous area
  Approx. 21(mags・arcsec^{-2})

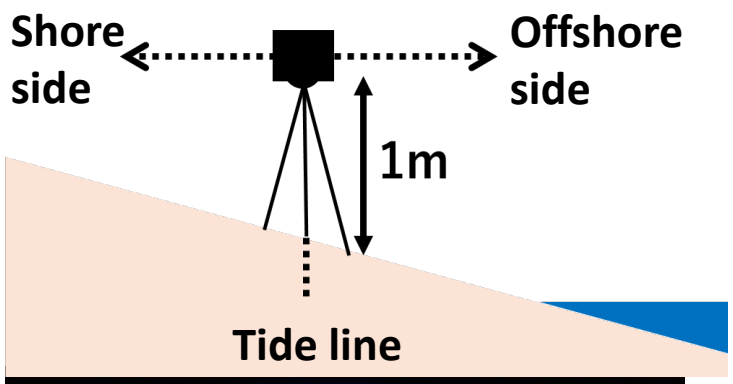
Measured darkness at high tide line during full and new moons

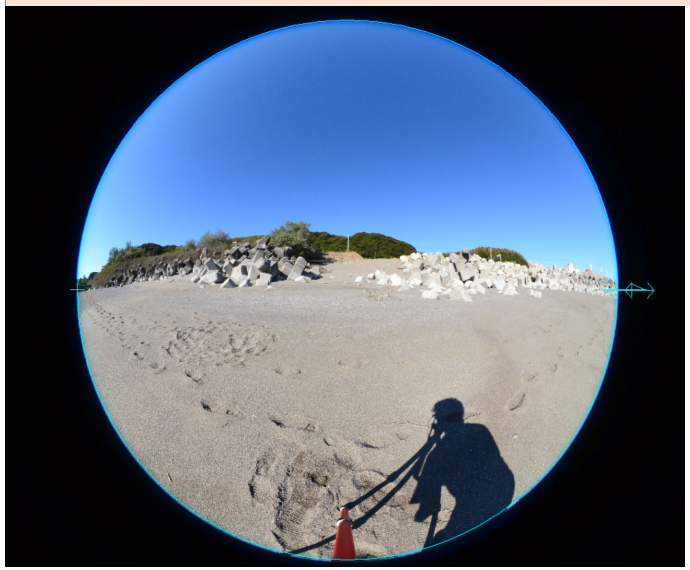
Measured over the entire hemisphere

Sensor's angle of view is 20°

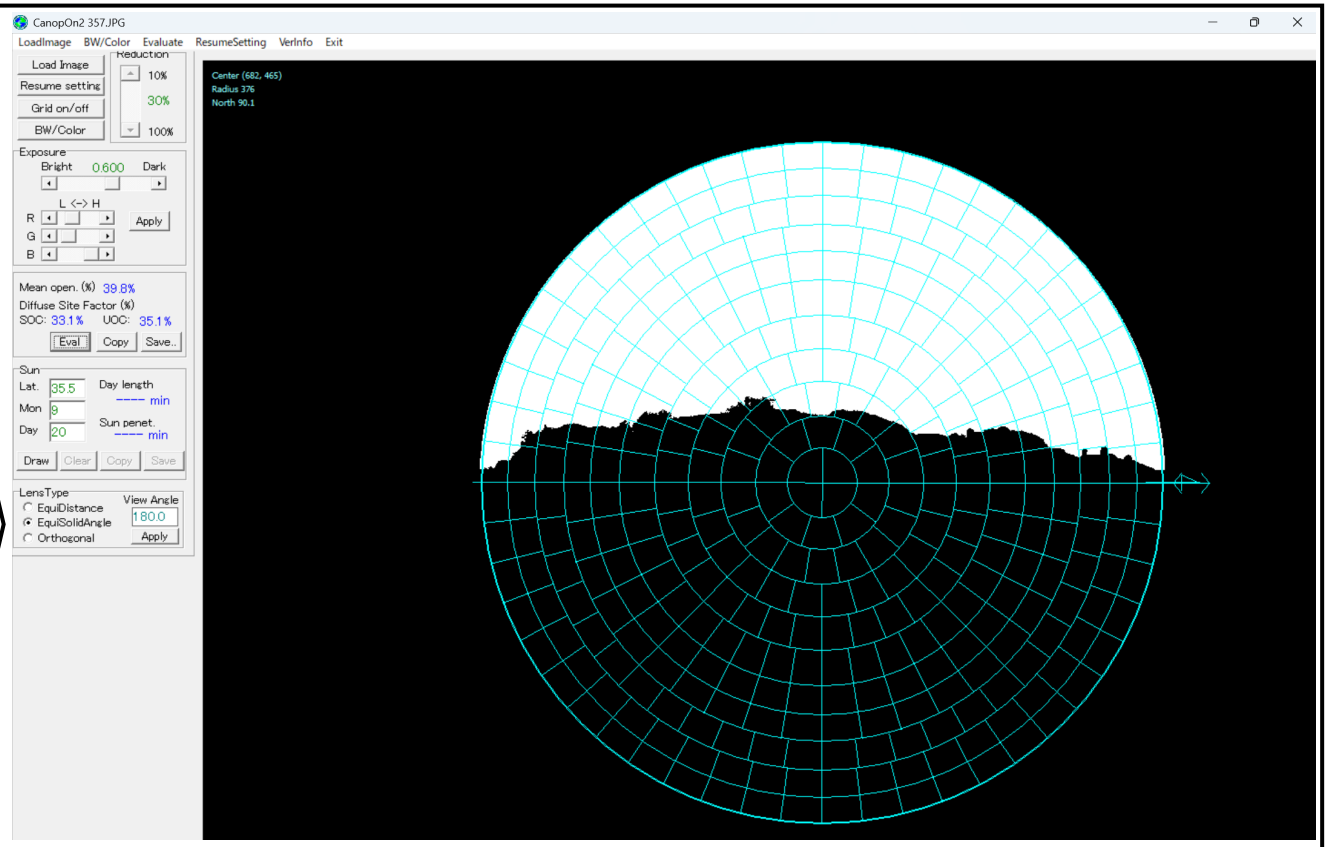
Materials and Methods

Sky openness





Hemispherical photos by fisheye camera



Calculate sky openness

- “Sky openness” calculated as the proportion of sky visible in hemispherical photos
- Software *“CanopOn2”* used for the hemispherical image analysis

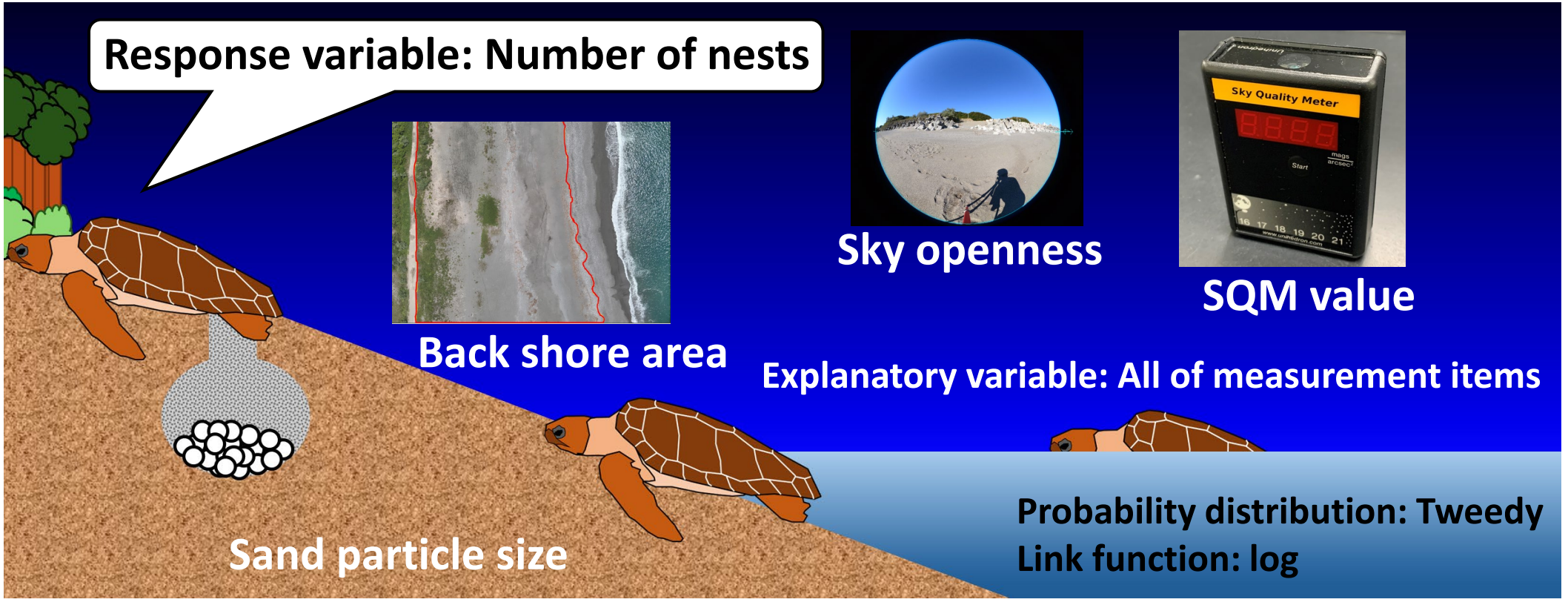
Materials and Methods

Statistic analysis

Generalized additive model

- The changes in each environmental factor are evaluated with the distance from the western edge of Kochi Beach as horizontal axis

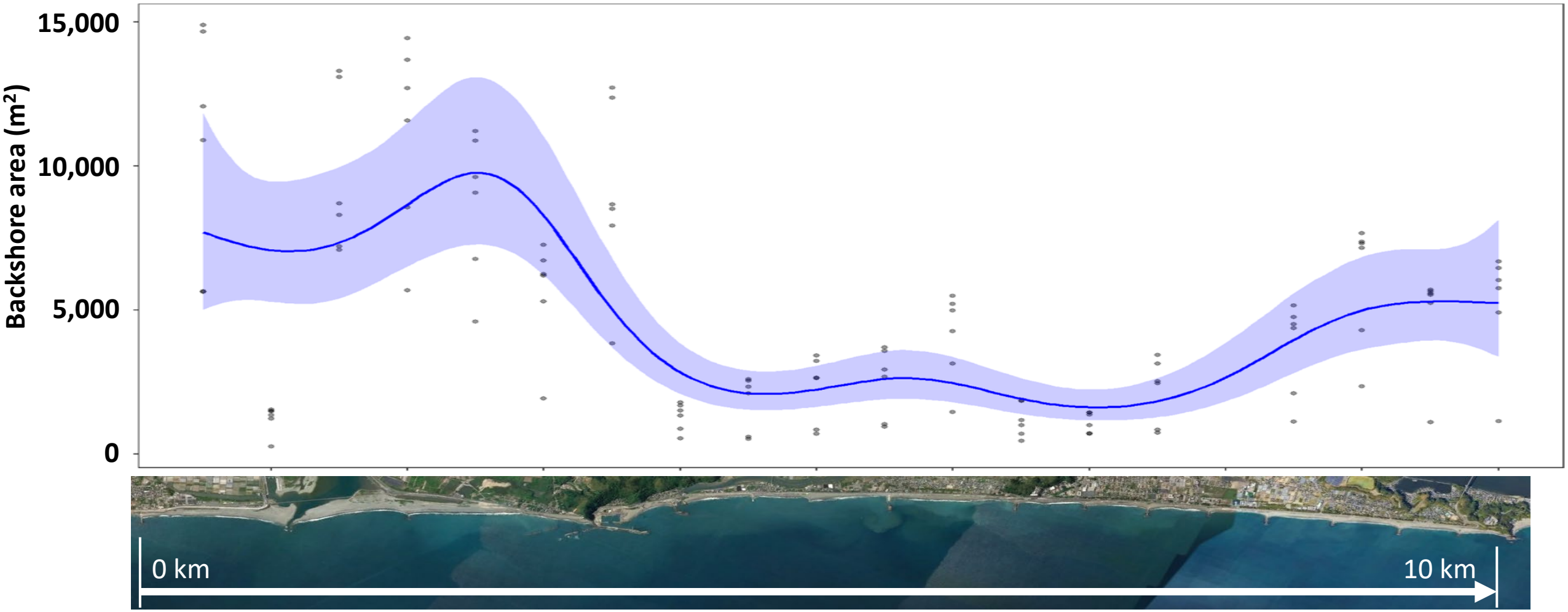
- The environmental factors that significantly influenced number of nests were identified



the best models were selected using AIC

Results

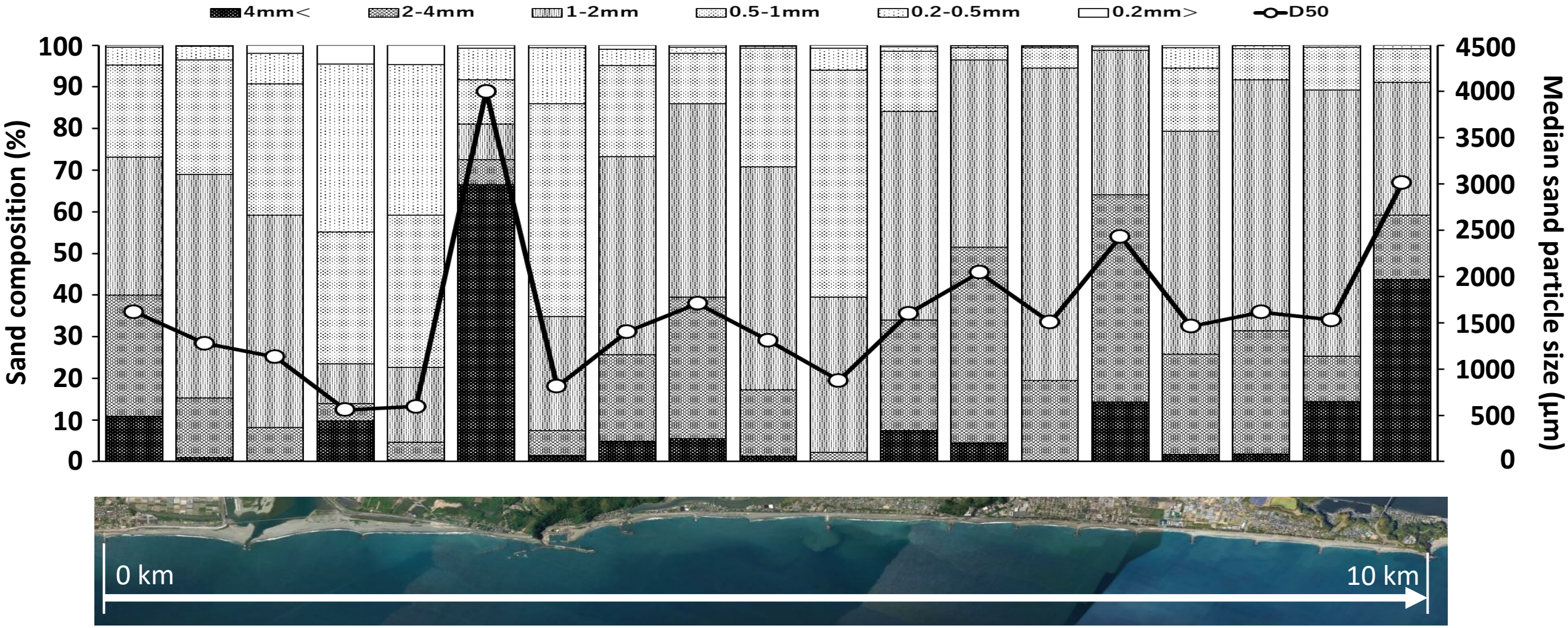
Backshore area



Backshore area tended to decrease with increasing distance from west edge

Results

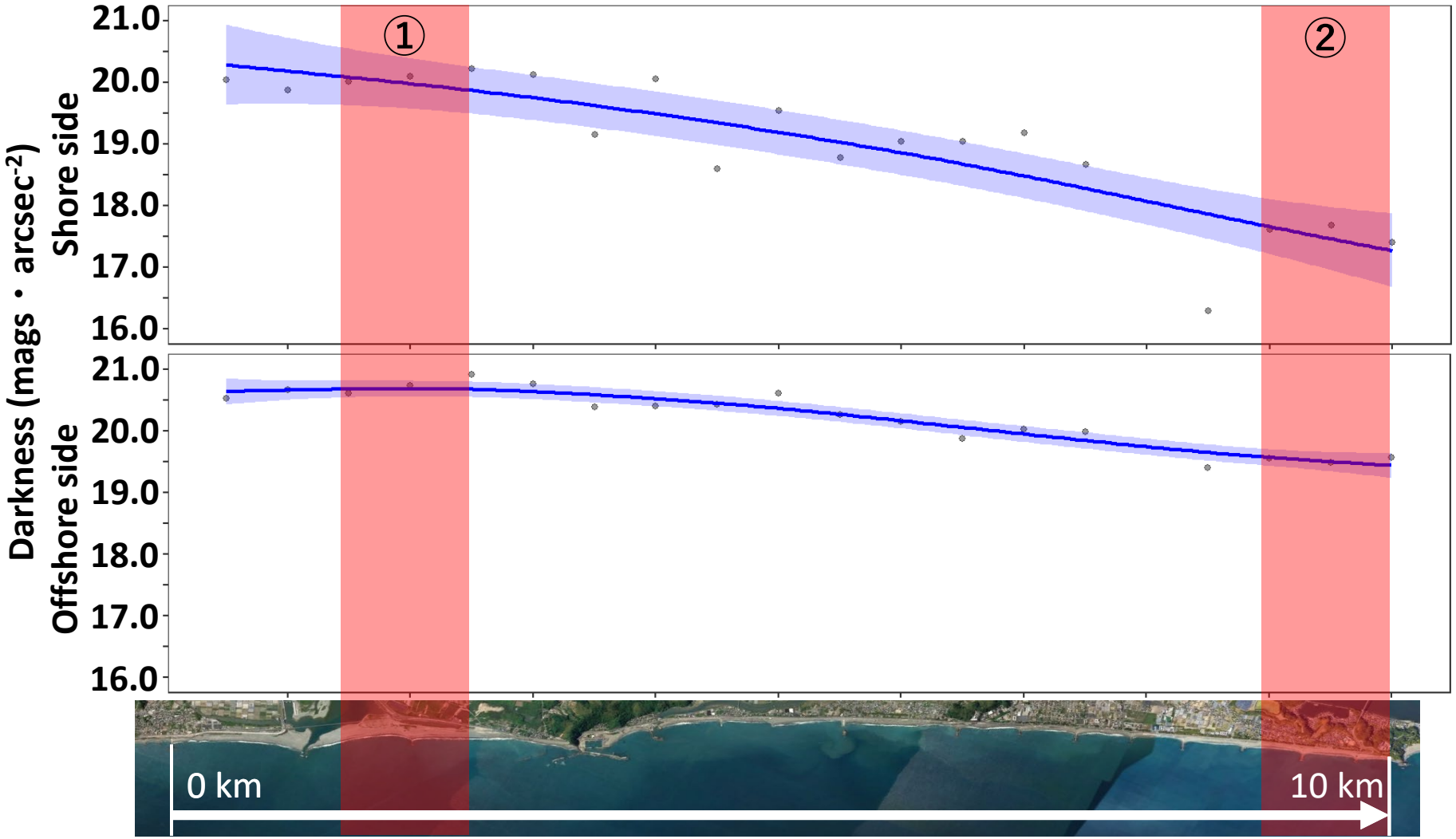
Sand particle size



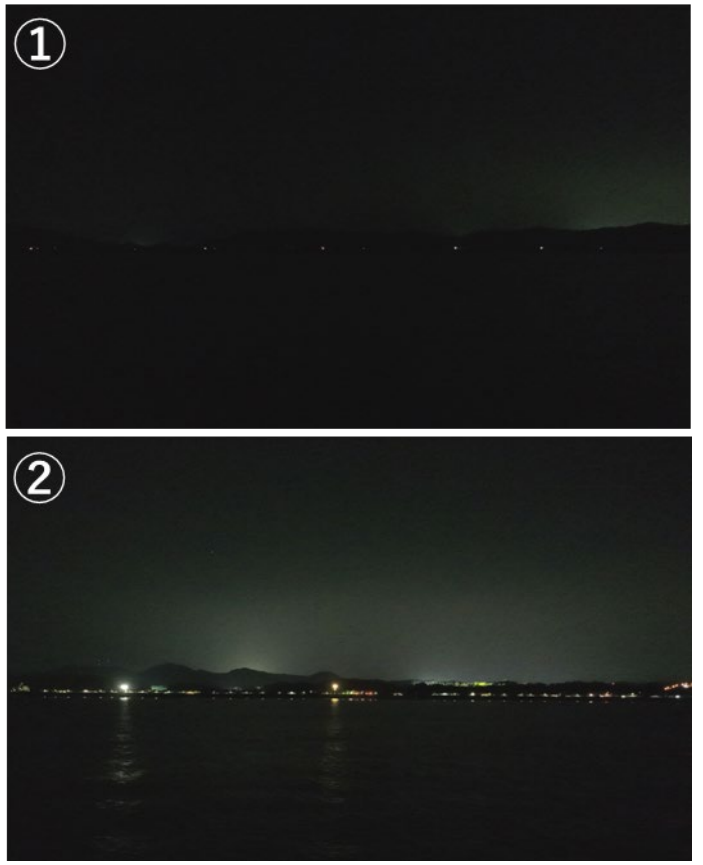
Sand particle size tended to increase with distance from west edge

Results

Darkness at new moon



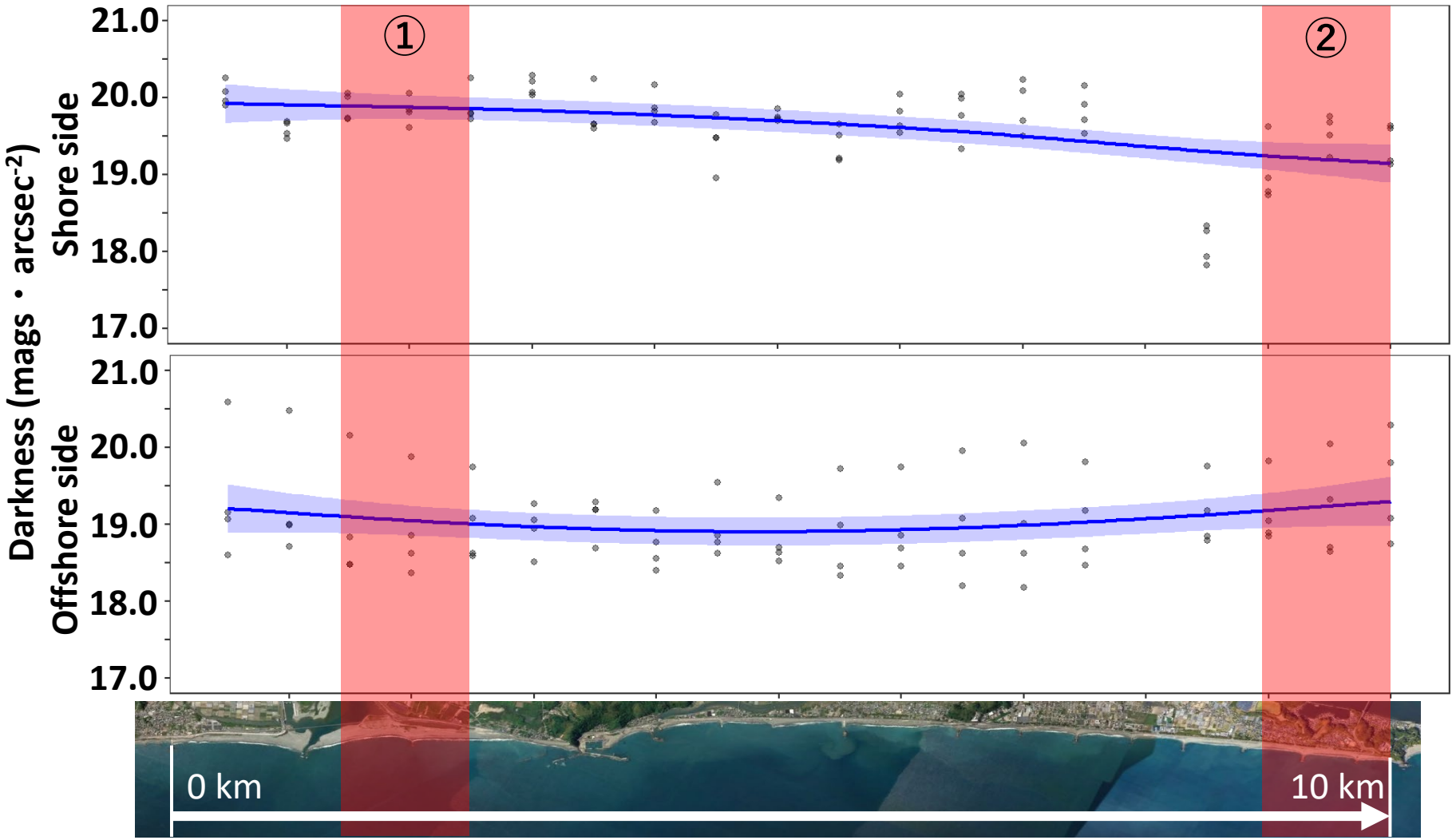
Landscape
from nighttime sea surface



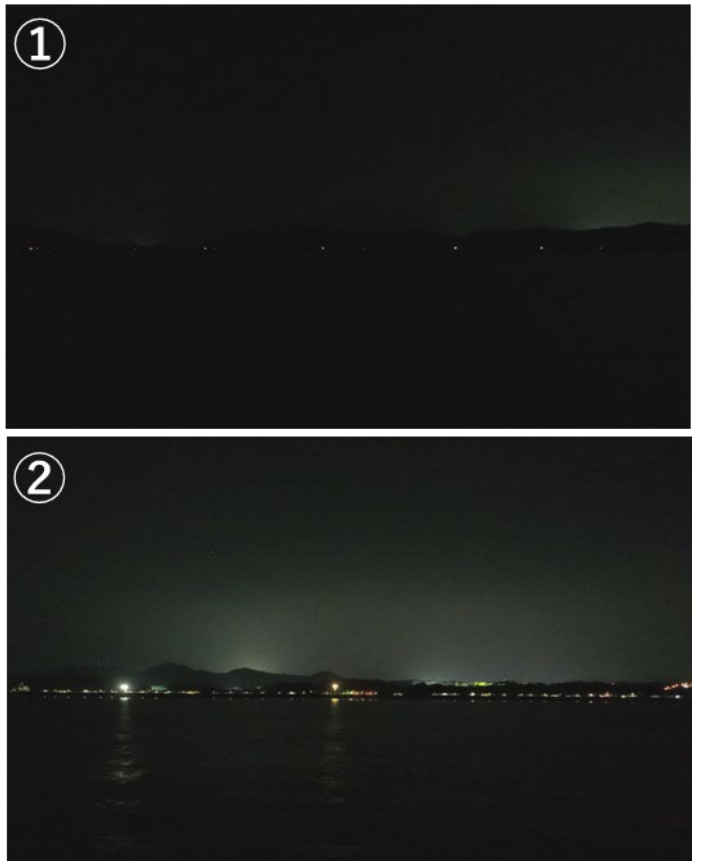
Darkness tended to decrease from west to east

Results

Darkness at full moon



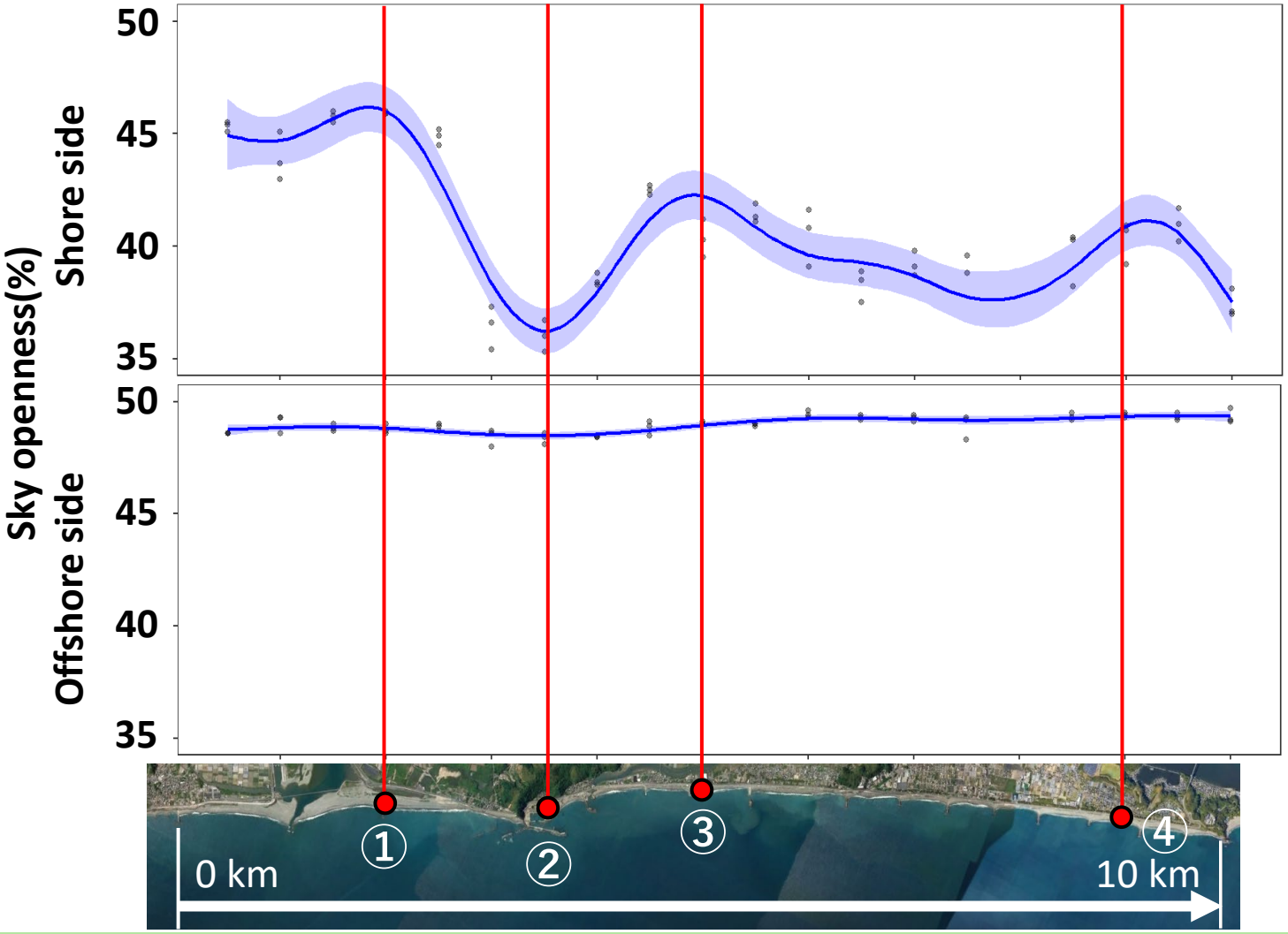
Landscape
from nighttime sea surface

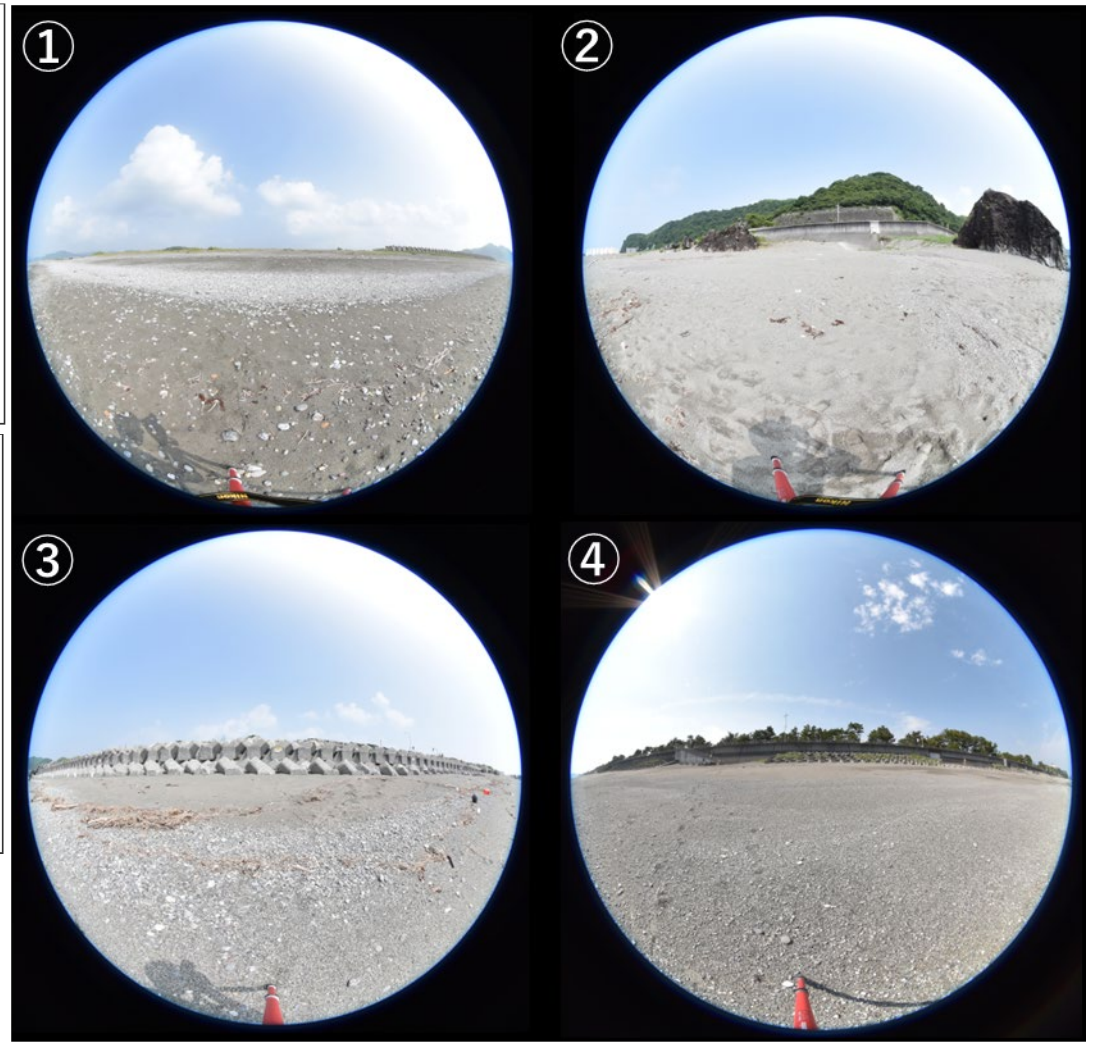


Darkness tended to decrease from west to east

Results

Sky openness measurement





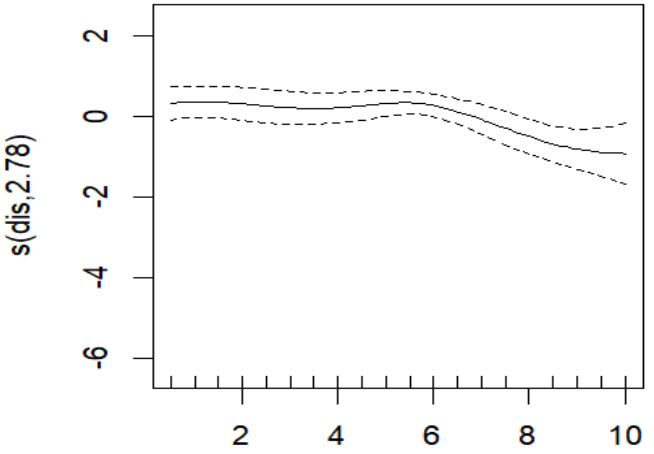
Sky openness tended to decrease at beach modification area

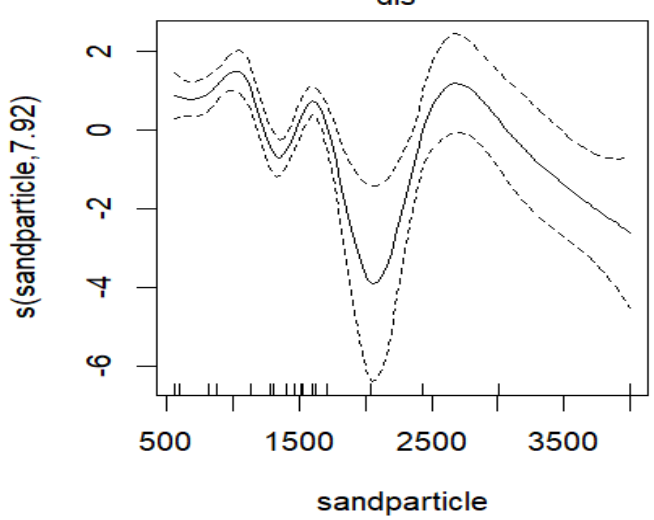
Results

Modelling 1

Term	Estimate	SE	t-value	p-value
Intercept	0.11	0.12	0.95	0.34

Term	edf	Ref. df	F-value	p-value
s(distance)	2.79	9	1.58	P < 0.001
s(sand particle)	7.92	9	6.99	P < 0.001





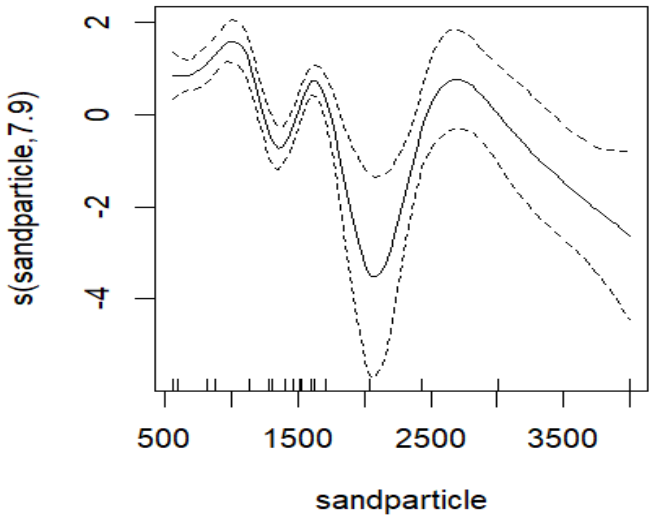
A significant effect of sand particle size was observed

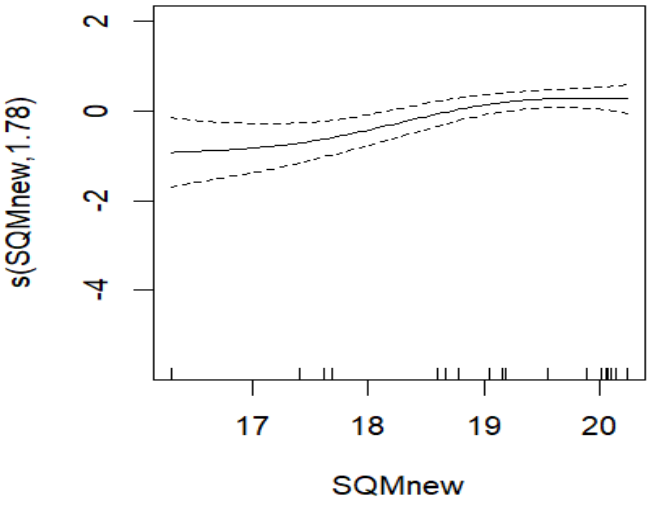
Results

Modelling 2

Term	Estimate	SE	t-value	p-value
Intercept	0.14	0.11	1.23	0.22

Term	edf	Ref. df	F-value	p-value
s(distance)	3.24×10^{-4}	9	0	0.48
s(sand particle)	7.90	9	8.51	P < 0.001
s(SQM value)	1.78	9	1.26	P < 0.001

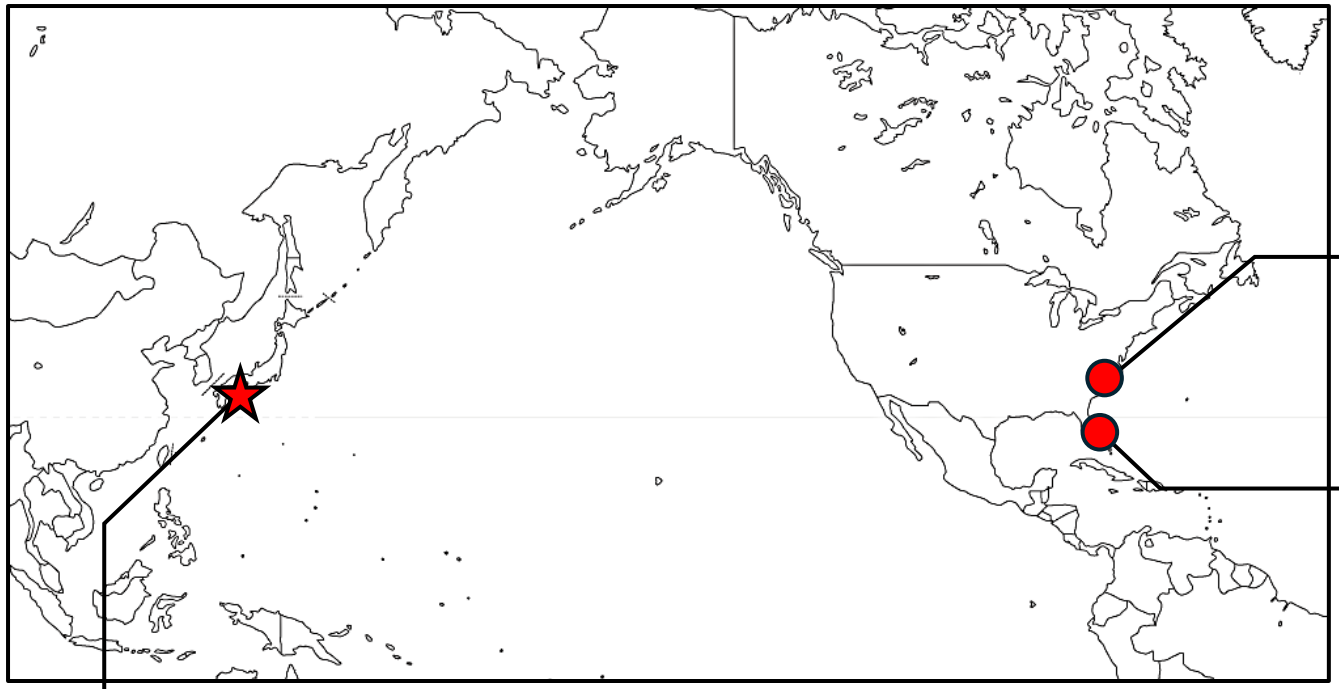




Significant effects of sand particle size and SQM value were observed

Brief Discussion

Comparison darkness with other populations' nesting site



North Atlantic population's nesting site

- **Atlantic Beach: 16.29 ± 2.21 mags・arcsec^{-2}**
  (Windle et al., 2018)
- **Delray Beach: 17.50 ± 0.91 mags・arcsec^{-2}**
  (Hirama et al., 2022)

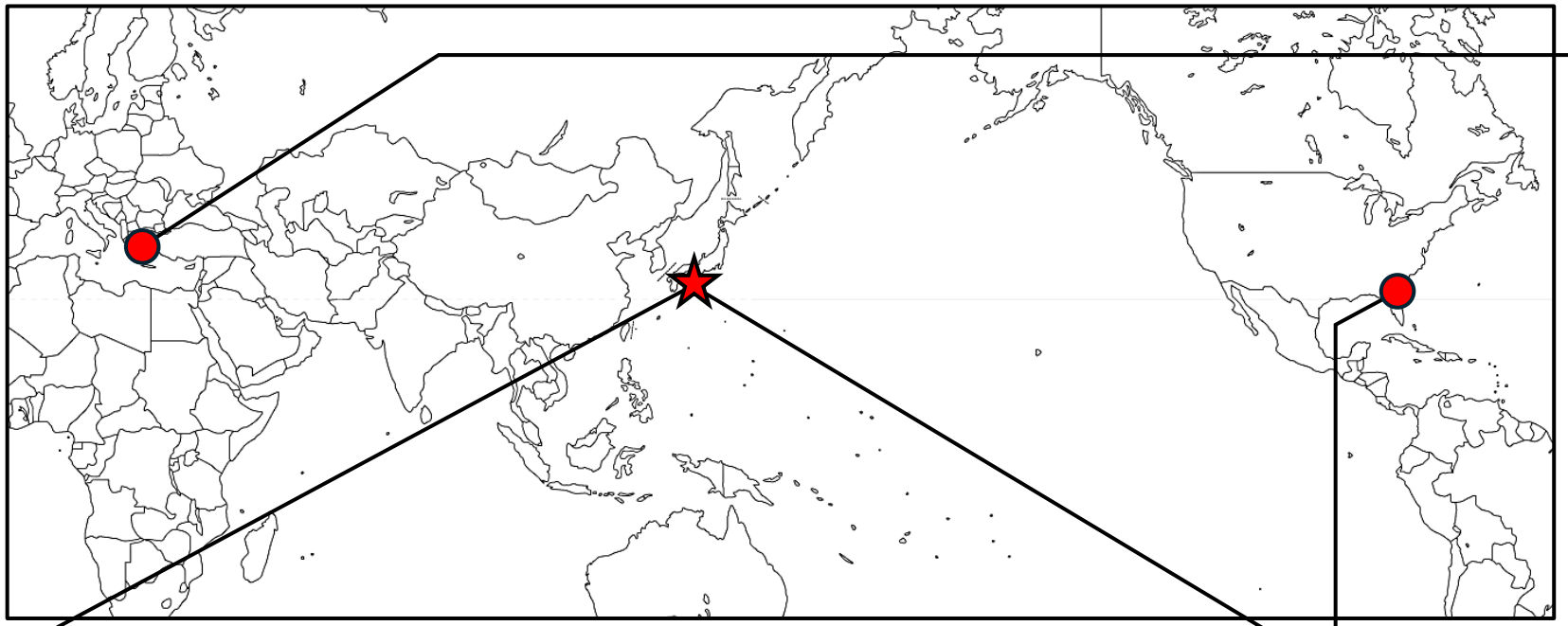
Kochi Beach

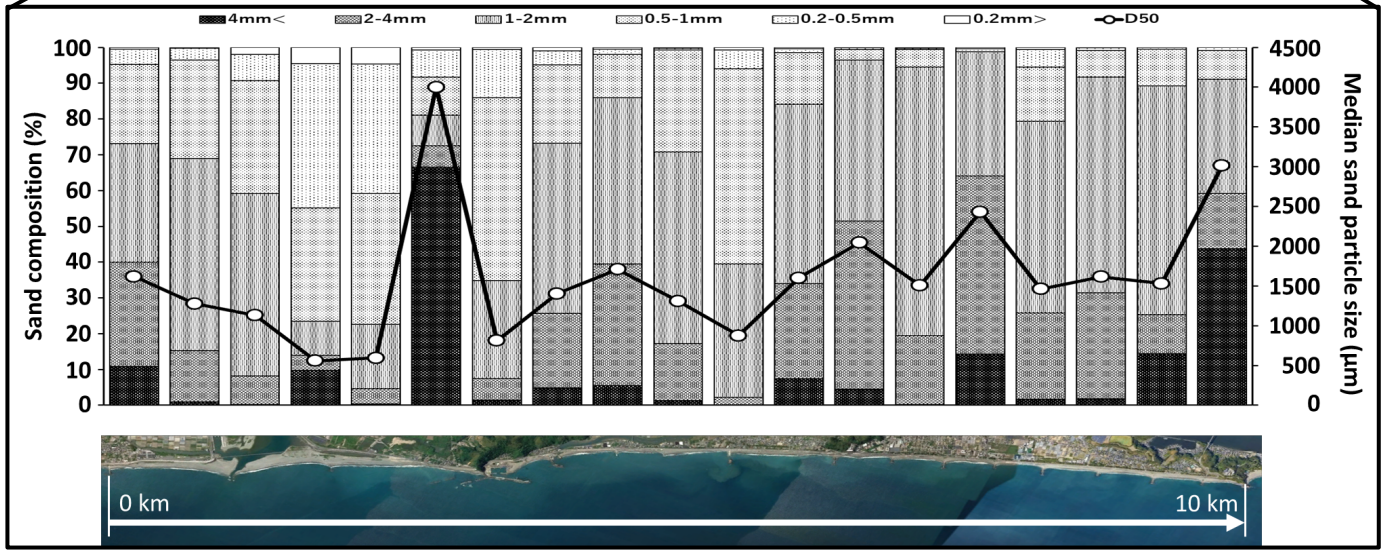
16.96–19.61 (Minimum–Maximum) mags・arcsec^{-2}

Both low and similar levels of light pollution areas exist compared to other regions

Brief Discussion

Sand particle size





The nesting success was higher with finer sand particles

(Mazaris et al., 2006)

The results of our study support the previous findings

The sand particle size at the sandy beach treated for coastal erosion 520.9–1519.6 μm (Shamblott et al., 2021)

The sand particle size is similar to those of other regions

Conclusion

Key Features of Kochi Beach Nesting Environment

- **Gradient in beach environment:**
  Backshore area decrease, and sand particle size increases from west to east

- **Critical nesting factors:**
  Sand particle size and darkness (light environment) are the most significant drivers for loggerhead nesting success

- **Human impact:**
  Beach modification reduces sky openness and may negatively affect nesting habitats

- **Conservation implication:**
  These findings highlight the importance of managing coastal development and light pollution to sustain nesting beaches in Japan and worldwide