

# Techniques for quantifying the accumulation of marine debris on beaches

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- 4) Surfrider Foundation, USA
- 5) Oregon State University, USA
- 6) NOAA Marine Debris Program, USA
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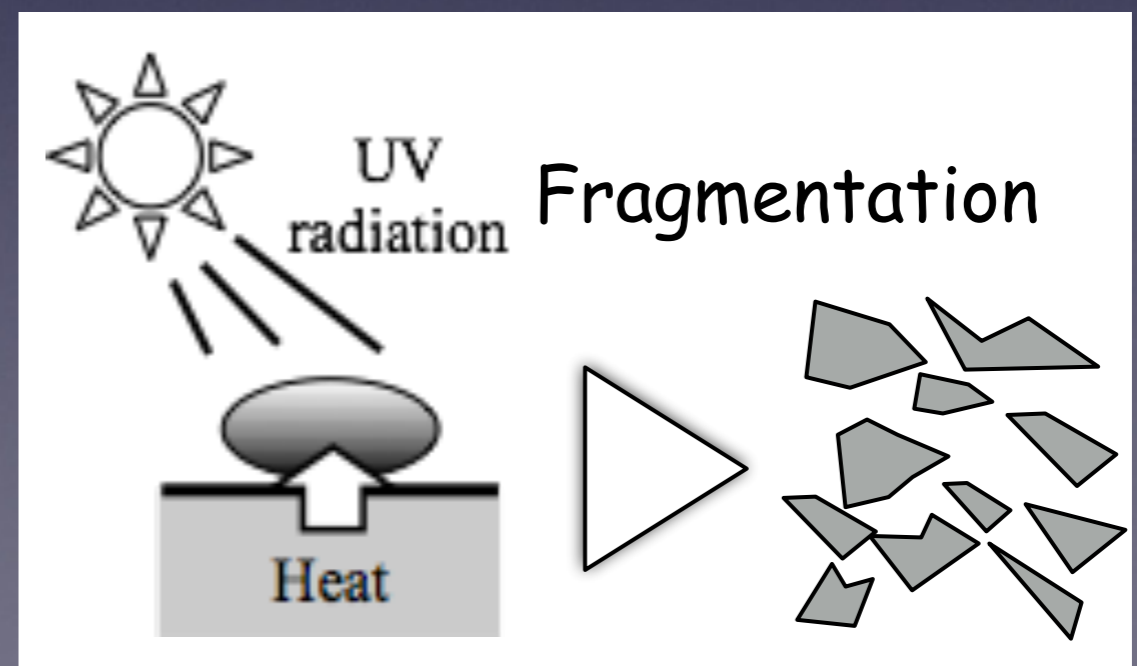
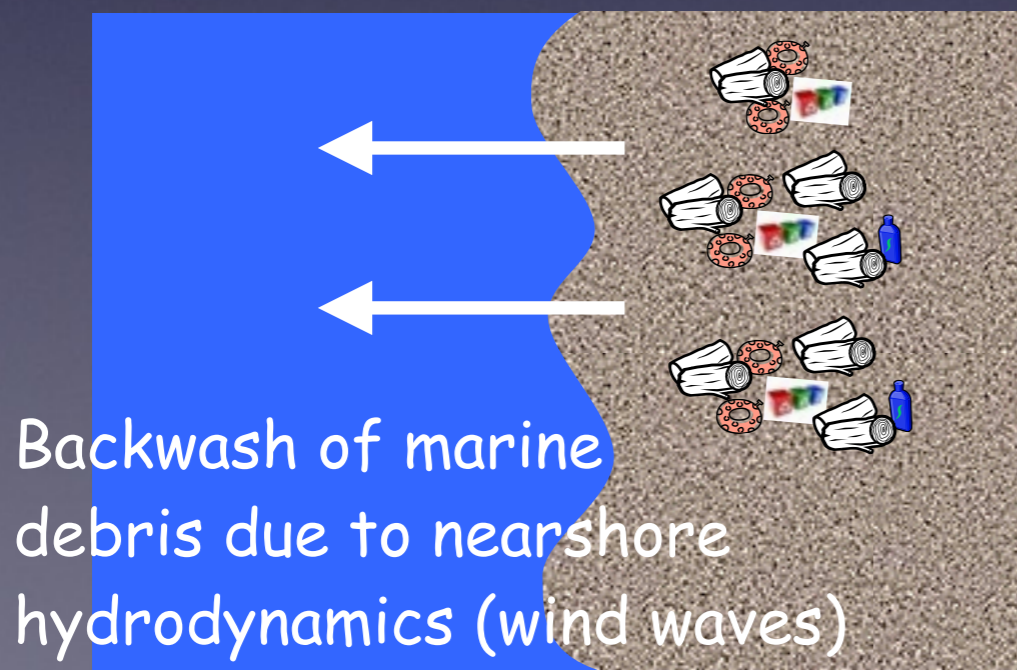
# General background

## Accumulation of marine debris on beaches

→ Important index to understand the behavior of marine debris, and to take measures for reducing the impacts of marine debris on the marine environment.

Beaches would be secondary sources of marine debris in the ocean (Kataoka et al., MPB, 2015)

Beaches would be hot spots for the generation of microplastics (Andrady, MPB, 2011)



# Purpose of our research

Stand stock surveys for marine debris  
(e.g. Ryan et al., 2009)

→ There is a limit of understanding the accumulation of marine debris with a high spatiotemporal resolution.



Purpose: We attempt to quantify the accumulation of marine debris by **aerial photography** and **webcam monitoring** surveys.

# Aerial photography surveys



# Aerial photography surveys

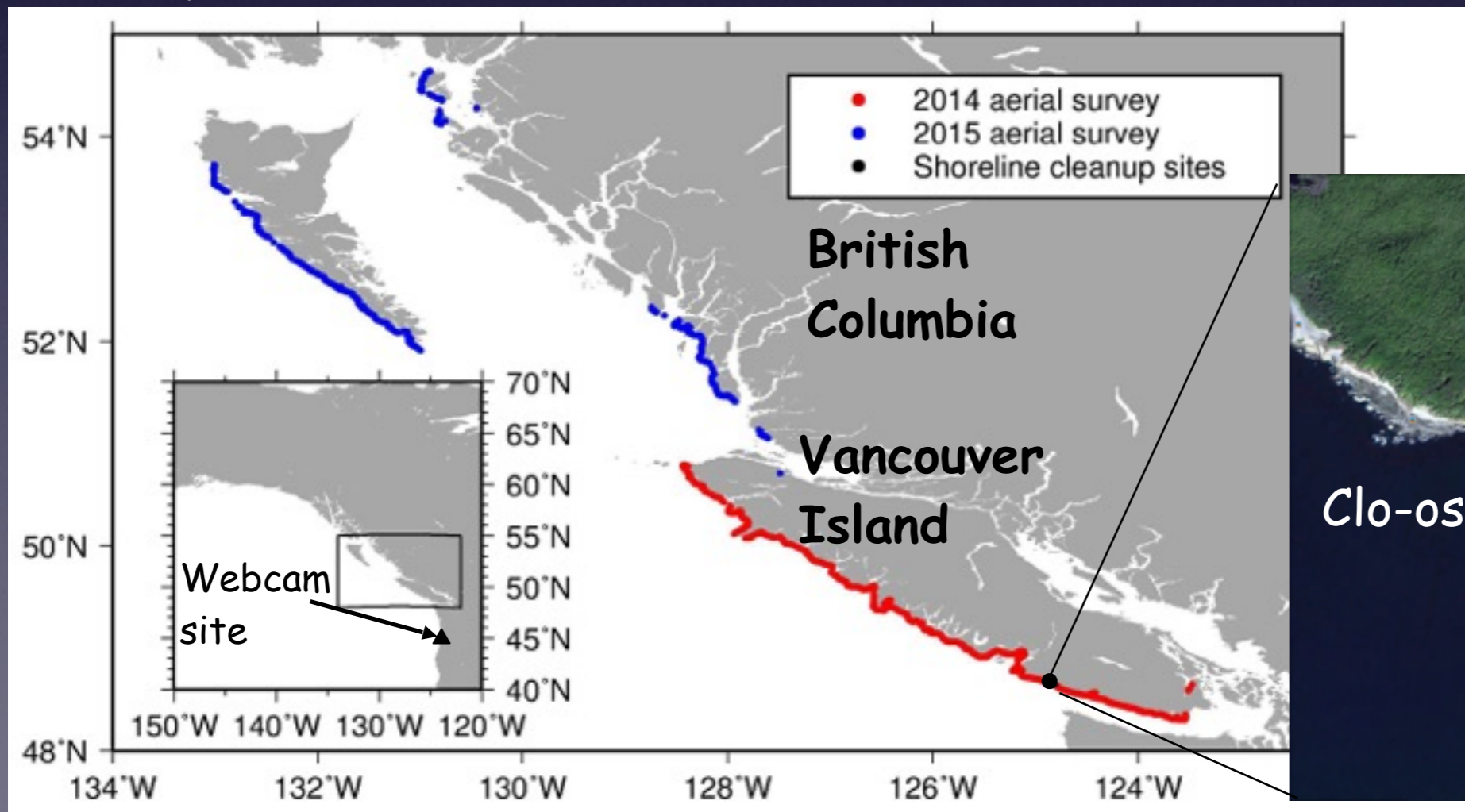
## Survey organization

- North Pacific Marine Science Organization (PICES)

## Date:

- Aerial photography survey: 2014 surveys (Oct. 7 and Dec. 3, 2014)  
2015 surveys (Jan. 30, Mar. 2 and Jul 28, 2015)
- Shoreline cleanup surveys: Jul. 28, 2015

## Study sites:



Data for this study



# Aerial photos on Cheewat Beach



Beach length: 1897 m long  
Beach width: 98 m wide (on average)  
Num. of photos: sixteen photos



# Aerial photos on Clo-ose Beach



Beach length: 188 m long  
Beach width: 49 m wide (on average)  
Num. of photos: four photos

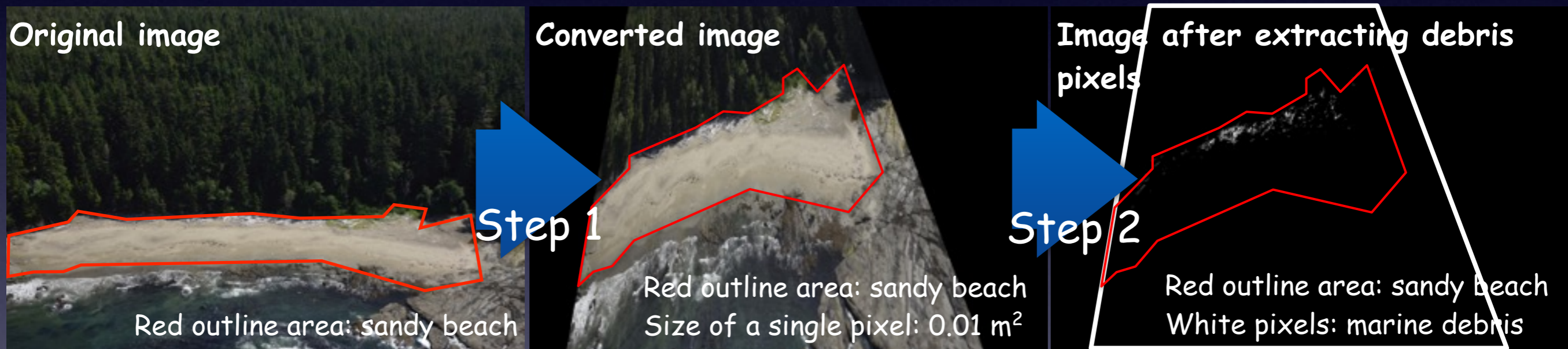


# Procedure of image analysis for quantifying the accumulation

## Accumulation of marine debris

### ▶ percent cover of marine debris

(a ratio of an area covered by marine debris to an area of sandy beach)



Step 1: Removing the distortion of the original image (Magome et al., 2007)

Step 2: Extracting pixels of marine debris (debris pixels)

Step 3: Calculating the percent cover

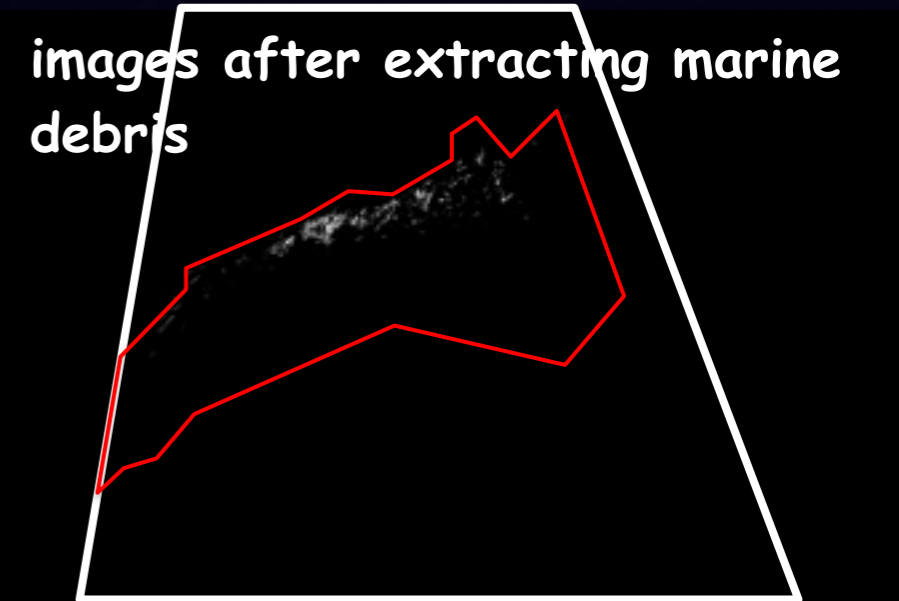
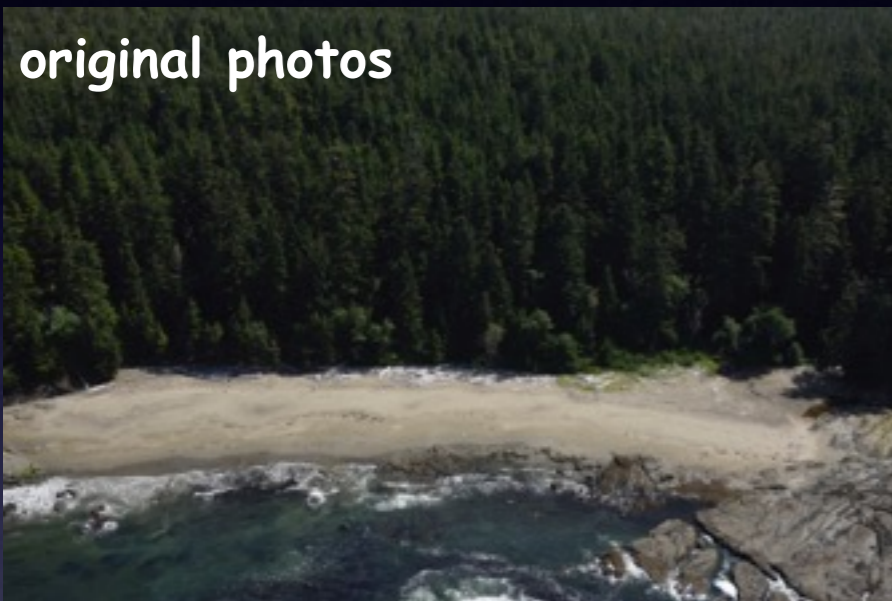
$$\text{Percent cover} = A_{\text{debris}} / A_{\text{beach}}$$

$$\text{Area of marine debris } A_{\text{debris}} = N_{\text{debris}} \times a$$

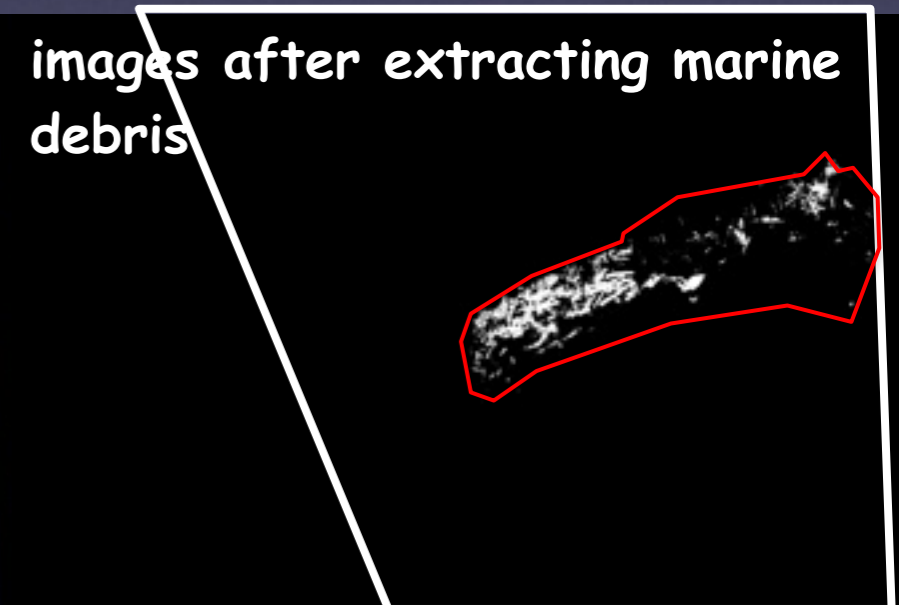
$$\text{Area of sandy beach } A_{\text{beach}} = N_{\text{beach}} \times a$$

# Results of the estimate of the percent cover of marine debris

Cheewat Beach → Percent cover of marine debris: 4.0%



Clo-ose Beach → Percent cover of marine debris: 14.0%



Red outline area: sandy beach, White pixels: marine debris

# Results of the shoreline cleanup survey

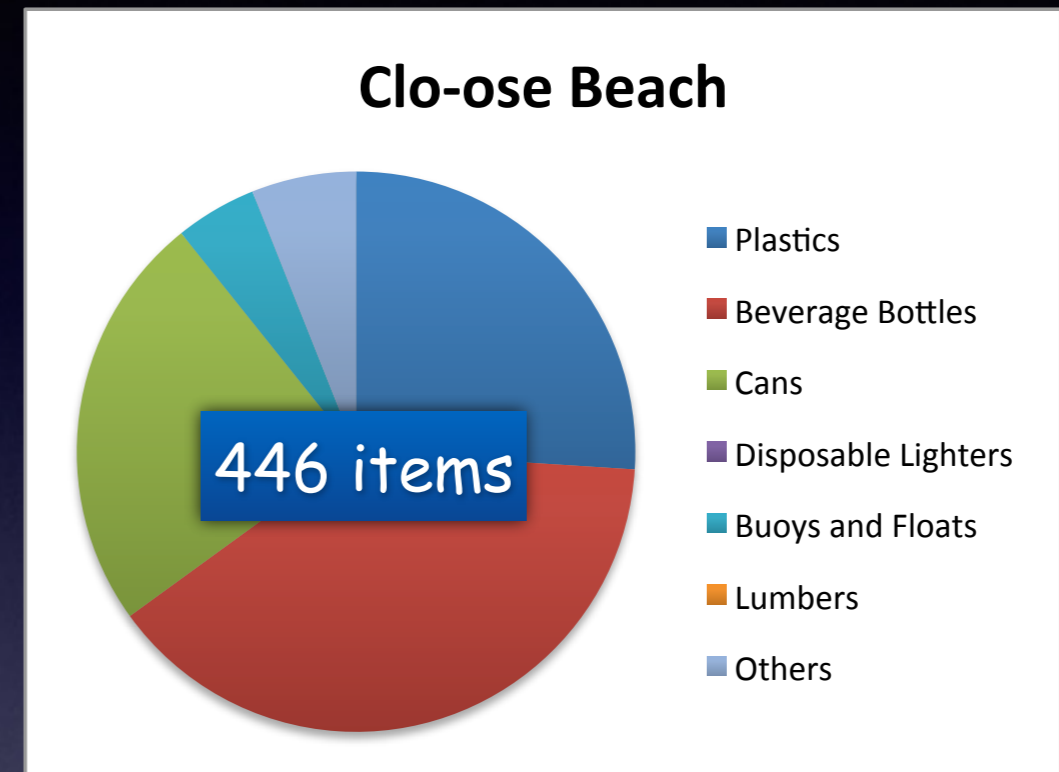
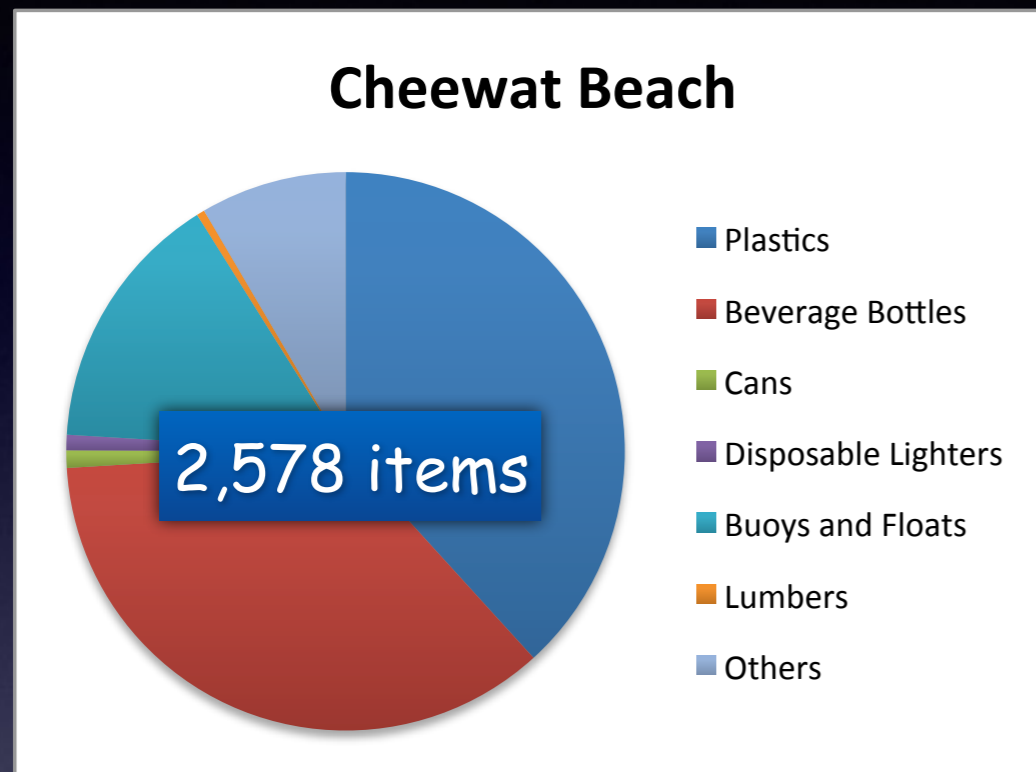
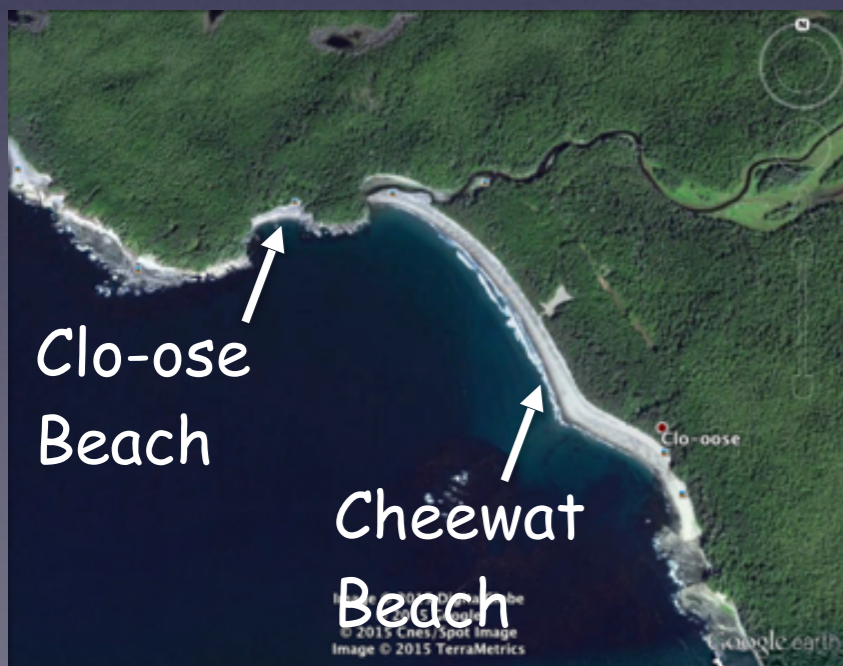


Image analysis

Shoreline cleanup

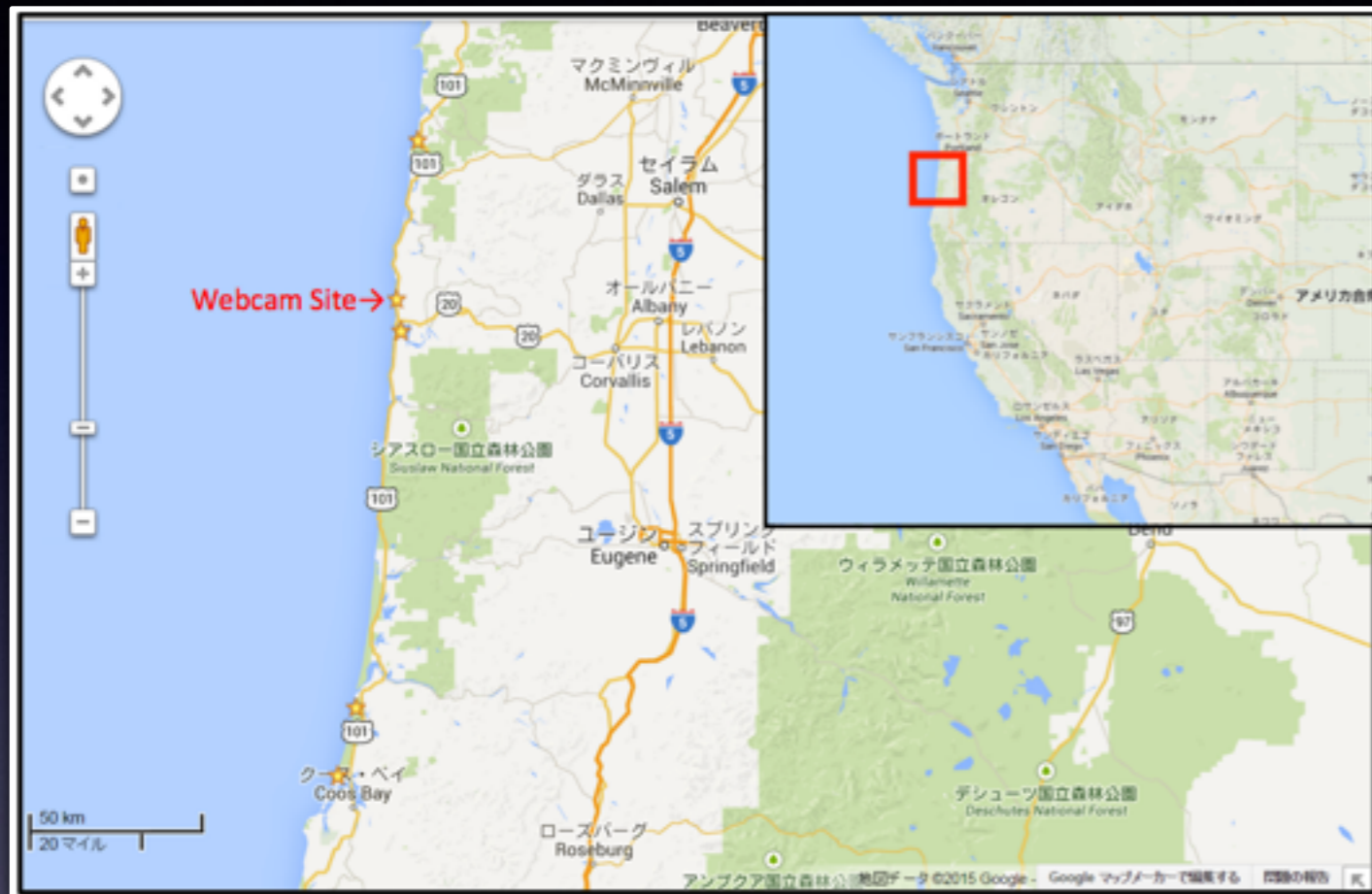


Beach	Percent cover of marine debris (%)	Density of marine debris (items/100m <sup>2</sup> )
Cheewat Beach	4.0	1.4
Clo-ose Beach	14.0	4.9
Clo-ose / Cheewat	3.5	3.5

# Webcam monitoring survey



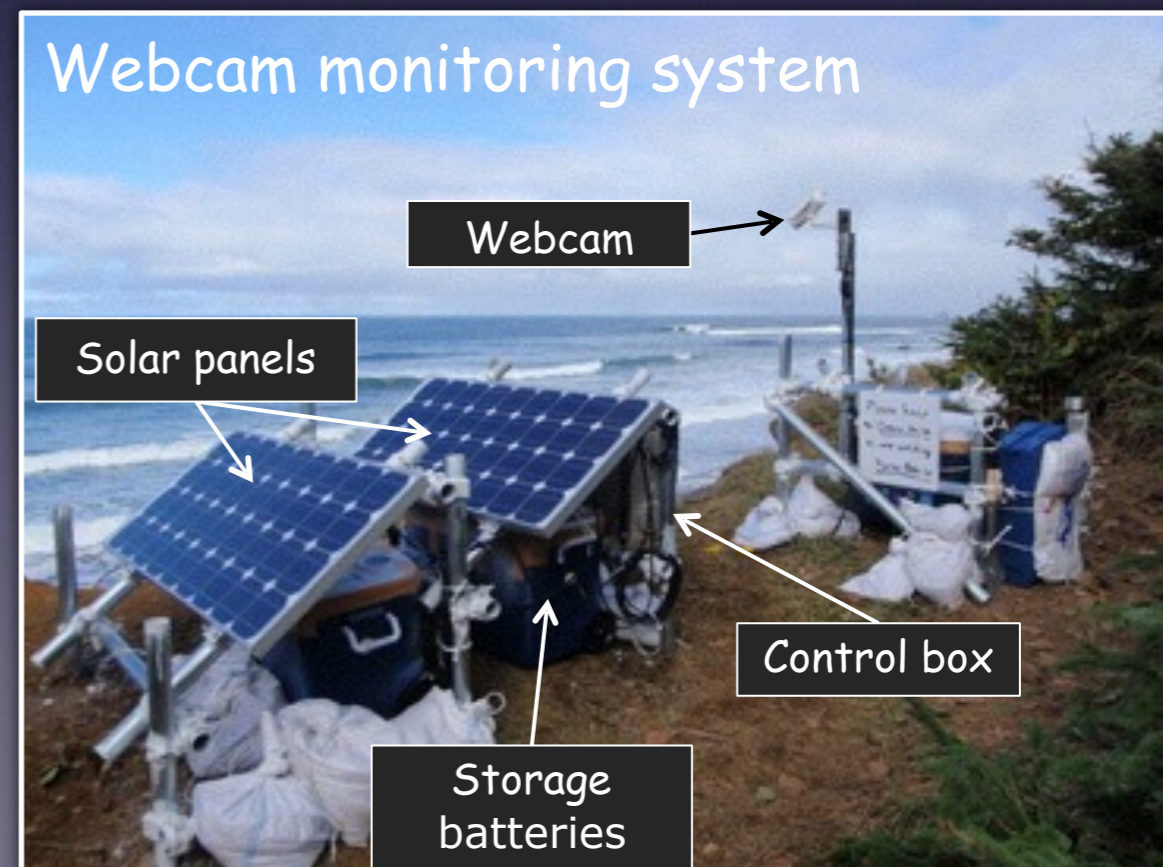
# Study site of webcam monitoring



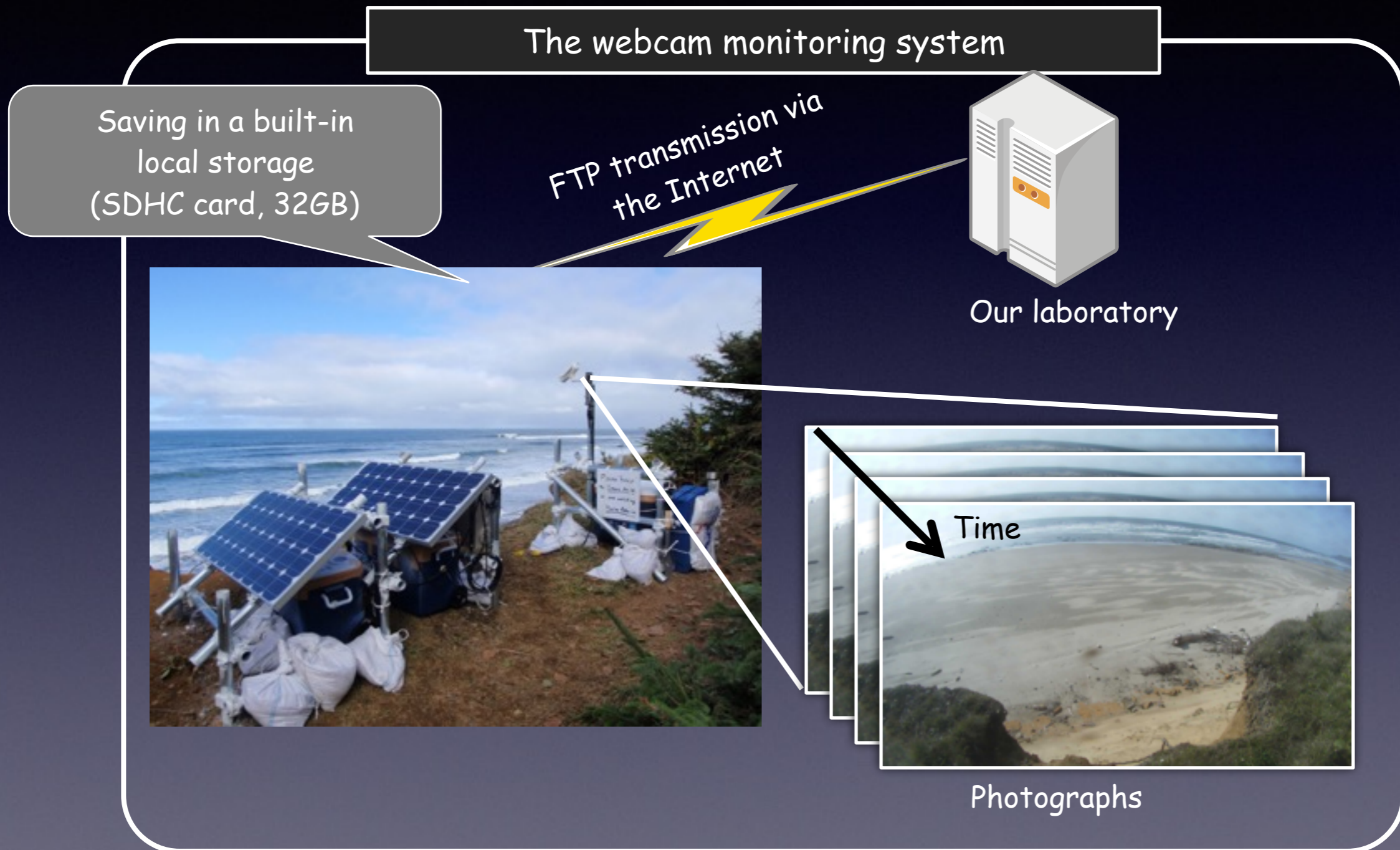
Site: Newport, OR  
Period: Since April 2015- present



Webcam image



# Our webcam monitoring system



Operation time →  
every one hour from 9:00 to 18:00 PST (i.e., ten times every day)

# Webcam site

Webcam website

<http://nilim-camera.eco.coocan.jp/webcam/index.html>

Top page

Webcam image page


Webcam monitoring  
PICES project on "Effects of marine debris caused by the great tsunami of 2011"

[TOP](#) [Webcam images](#) [Research](#)


### About webcam monitoring

Thank you for visiting our website and your interest in our research

We are monitoring tsunami debris using a webcam installed on a beach in the Oregon Coast. We will provide quantities of marine debris littered on beaches using the webcam data (Kako et al., *Mar. Pol. Bull.*, 2010; Kataoka et al., *Mar. Pol. Bull.*, 2012). The webcam is operated every one hour for 9:00 to 18:00 (PST), and the webcam data is sent to our server via the Internet. We will put the last webcam data on this website.



Our webcam site



Our webcam system

The webcam monitoring is supported by the research project "Effect of Marine Debris Caused by the Great Tsunami of 2011" funded by the Ministry of the Environment of Japan through the North Pacific Marine Science Organization (PICES). The website of the research project is [here](#).  
This webcam monitoring project is done by Prof. Atsuhiko Isobe (Kyushu University, Japan), Prof. Hirofumi Hinata (Ehime University, Japan), Dr. Shin'ichiro Kako (Kagoshima University, Japan) and Dr. Tomoya Kataoka (National Institute for Land and Infrastructure


Webcam monitoring  
PICES project on "Effects of marine debris caused by the great tsunami of 2011"

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### Webcam image archive

We have started webcam monitoring since April 4, 2015. If you'd like to see webcam images in the past, please select bellow.


201601




2016/01/18 18:00




2016/01/18 17:00




2016/01/18 16:00




2016/01/18 15:00




2016/01/18 14:00




2016/01/18 13:00




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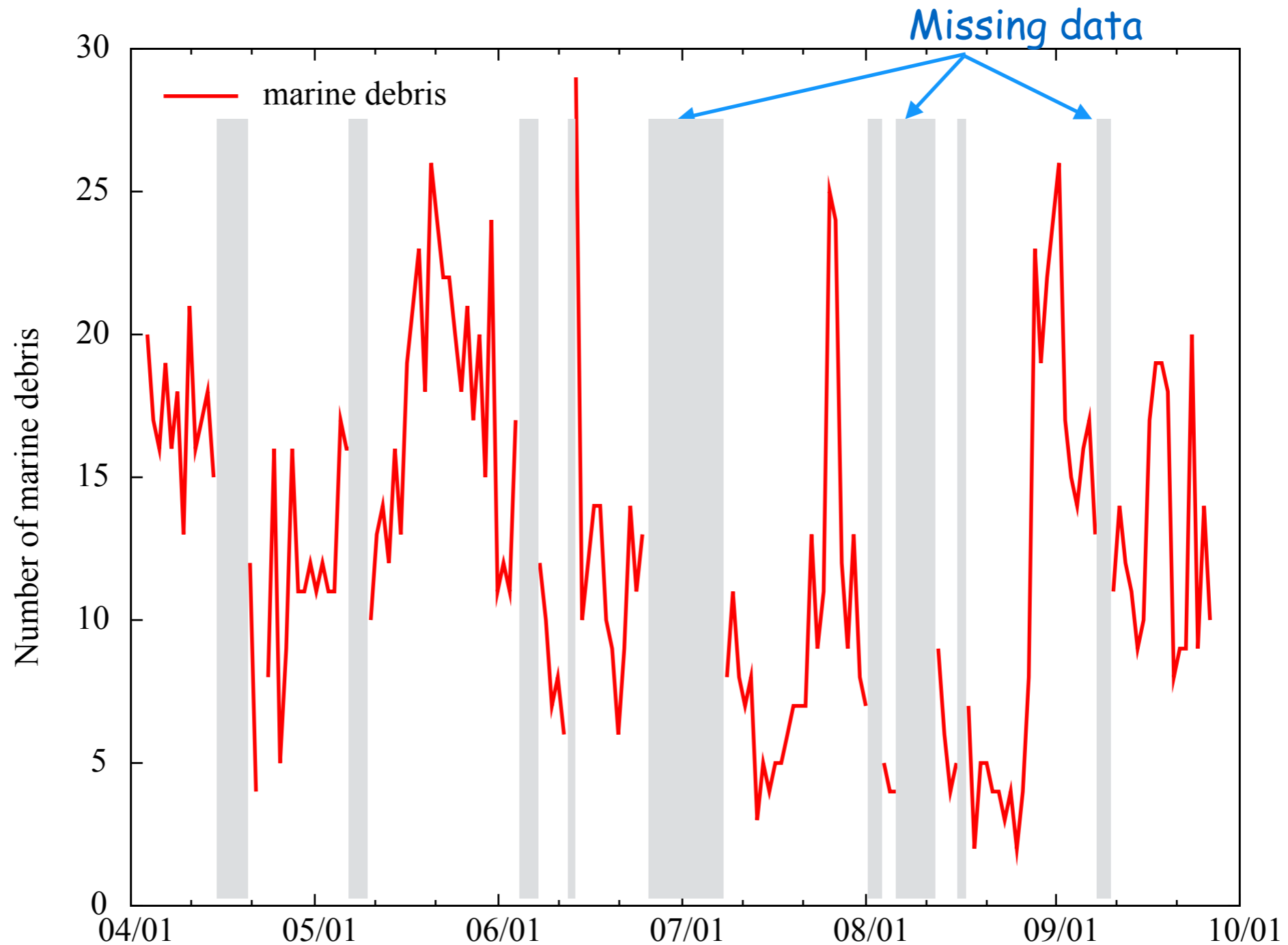


2016/01/17 14:00

# Webcam images (May, 2015)

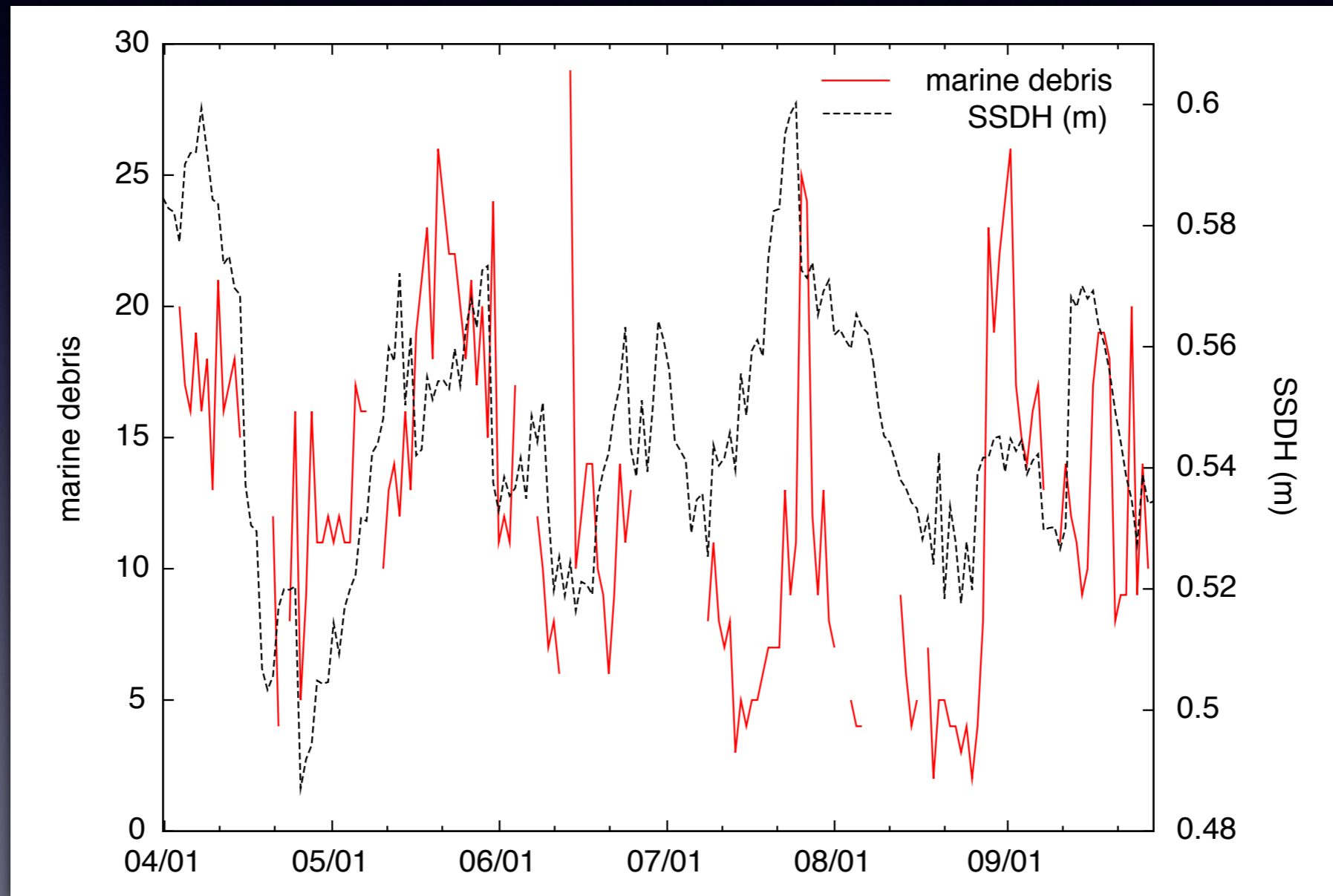


# Time series of the number of marine debris



# Comparison with sea surface dynamic height (SSDH)

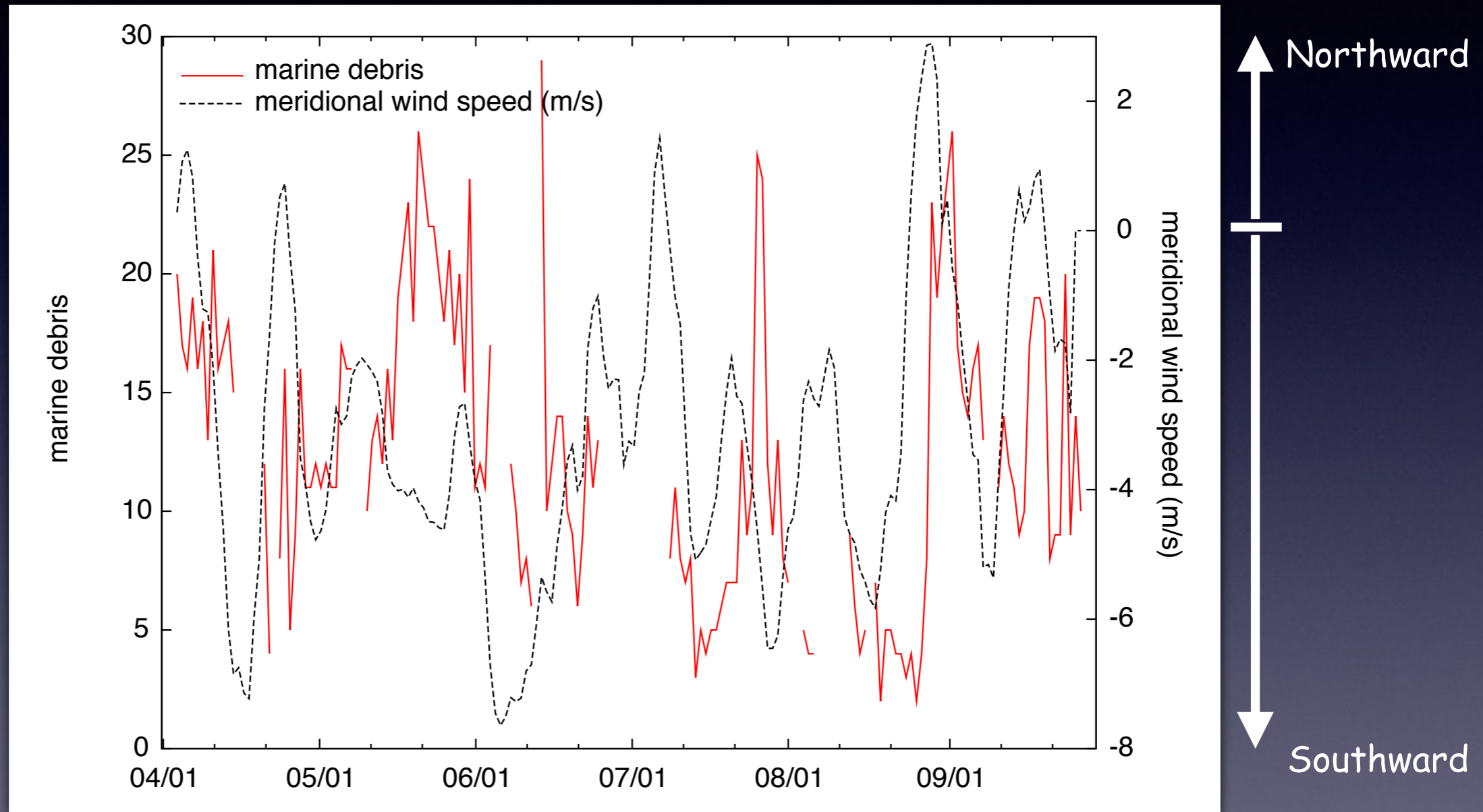
NOTE: SSDH was produced by Archiving, Validation and interpretation of Satellite Oceanographic data (AVISO)



The number of marine debris decreased (increased) when SSDH was low (high).

# Comparison with sea surface wind (SSW)

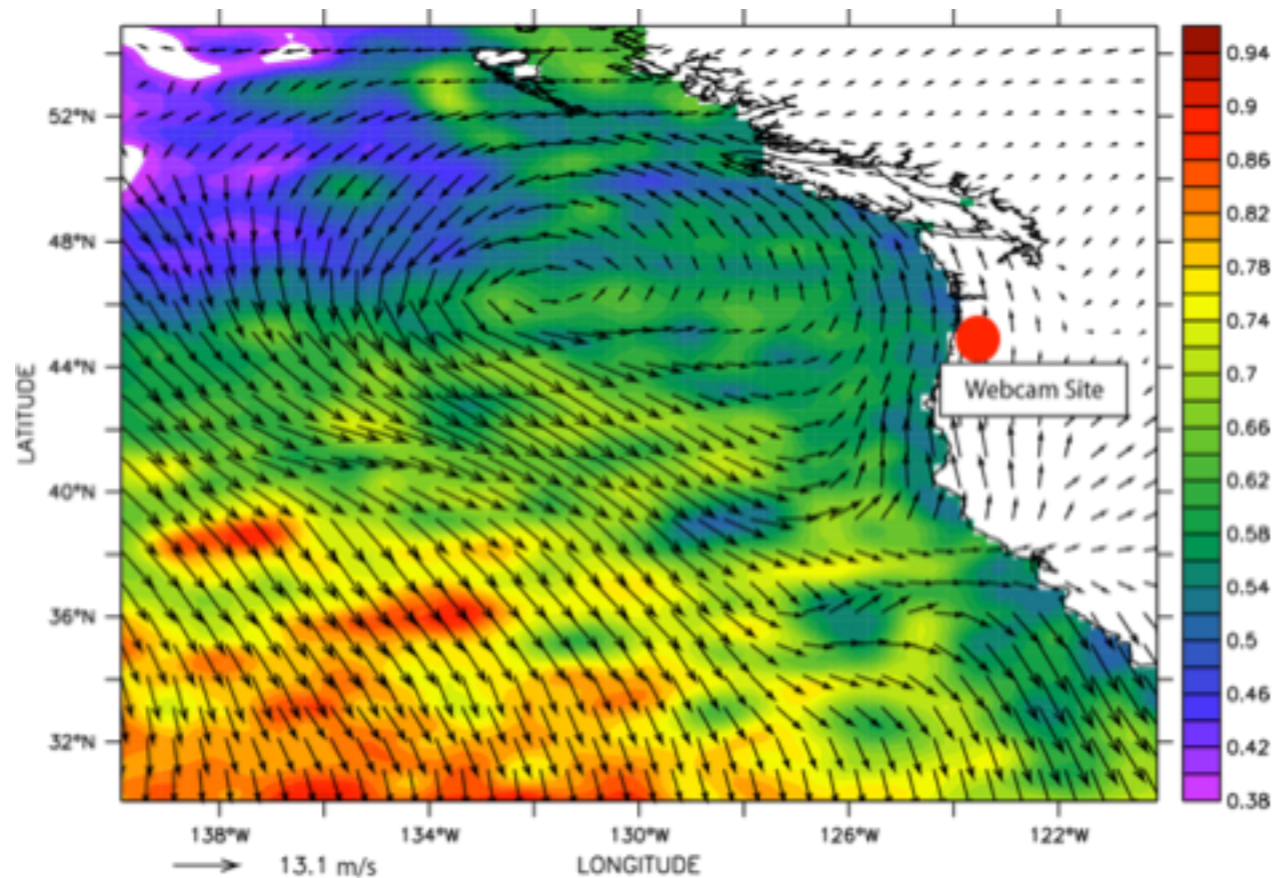
NOTE: SSW was observed by Advanced scatterometer (ASCAT; Kako et al., JGR, 2011)



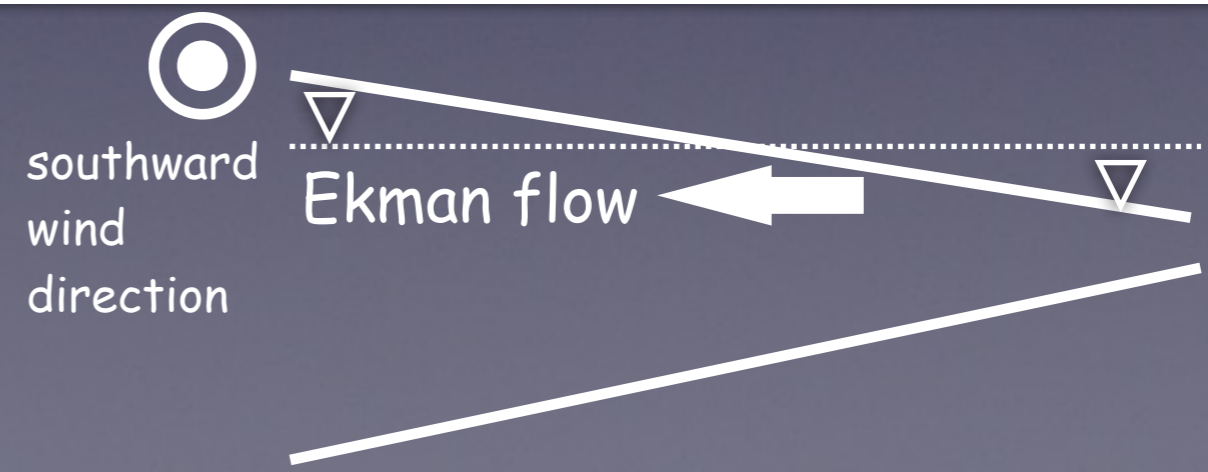
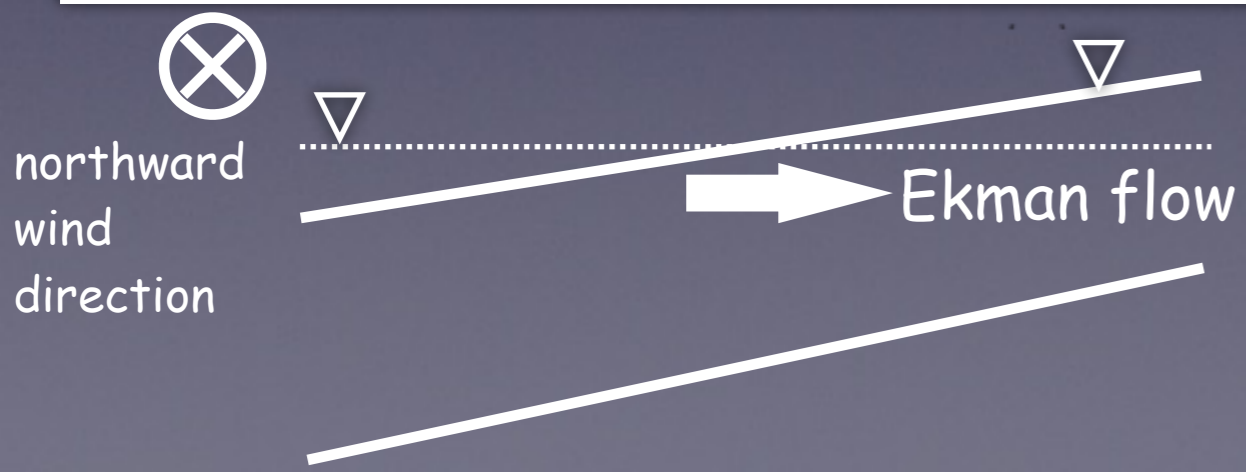
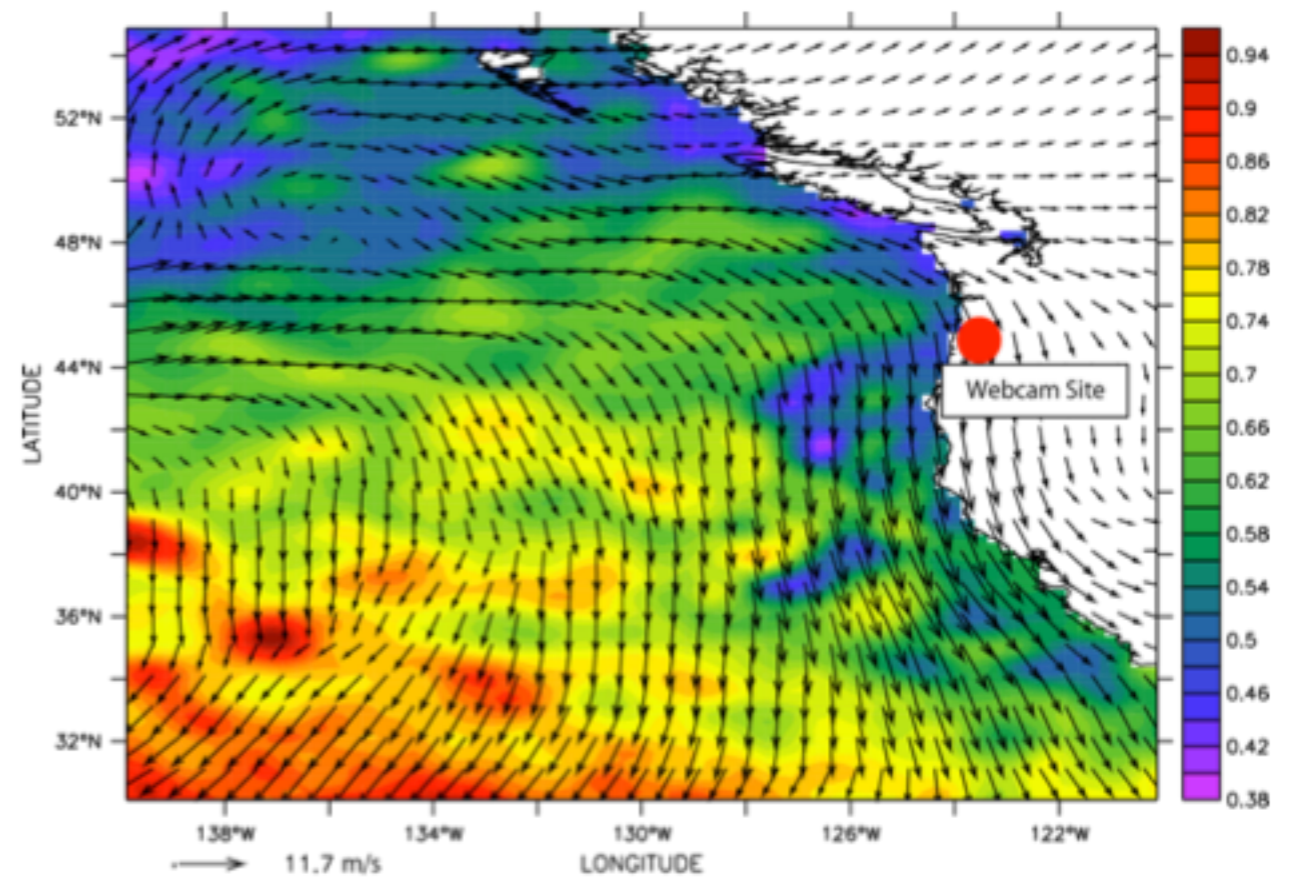
The number of marine debris decreased (increased) when southward winds intensified (weakened or northward winds blowed).

# Horizontal distribution of SSDH and SSW

When the quantity of marine debris increased (on April 5, 2015)



When the quantity of marine debris decreased (on July 15, 2015)



# Summary

## Aerial photography surveys:

- The percent cover estimated from the aerial photographs was consistent with the density of marine debris measured by the shoreline cleanup surveys.
- The estimation of the percent cover would enable us to understand the accumulation of marine debris on multiple beaches.

## Webcam monitoring surveys:

- The quantity of marine debris varied corresponding to SSDH and SSW.
- Wind-driven currents might contribute to the variability of the quantity of marine debris on the Oregon coast.

# Acknowledgement

This research was funded by the Ministry of the Environment of Japan through the North Pacific Marine Science Organization (PICES), and also was supported by JSPS KAKENHI Grant Numbers 25820234, 26630231.



Thank you very much for your attention.