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Environmental Impact Assessment of Squid Fisheries in Japan using RS/GIS

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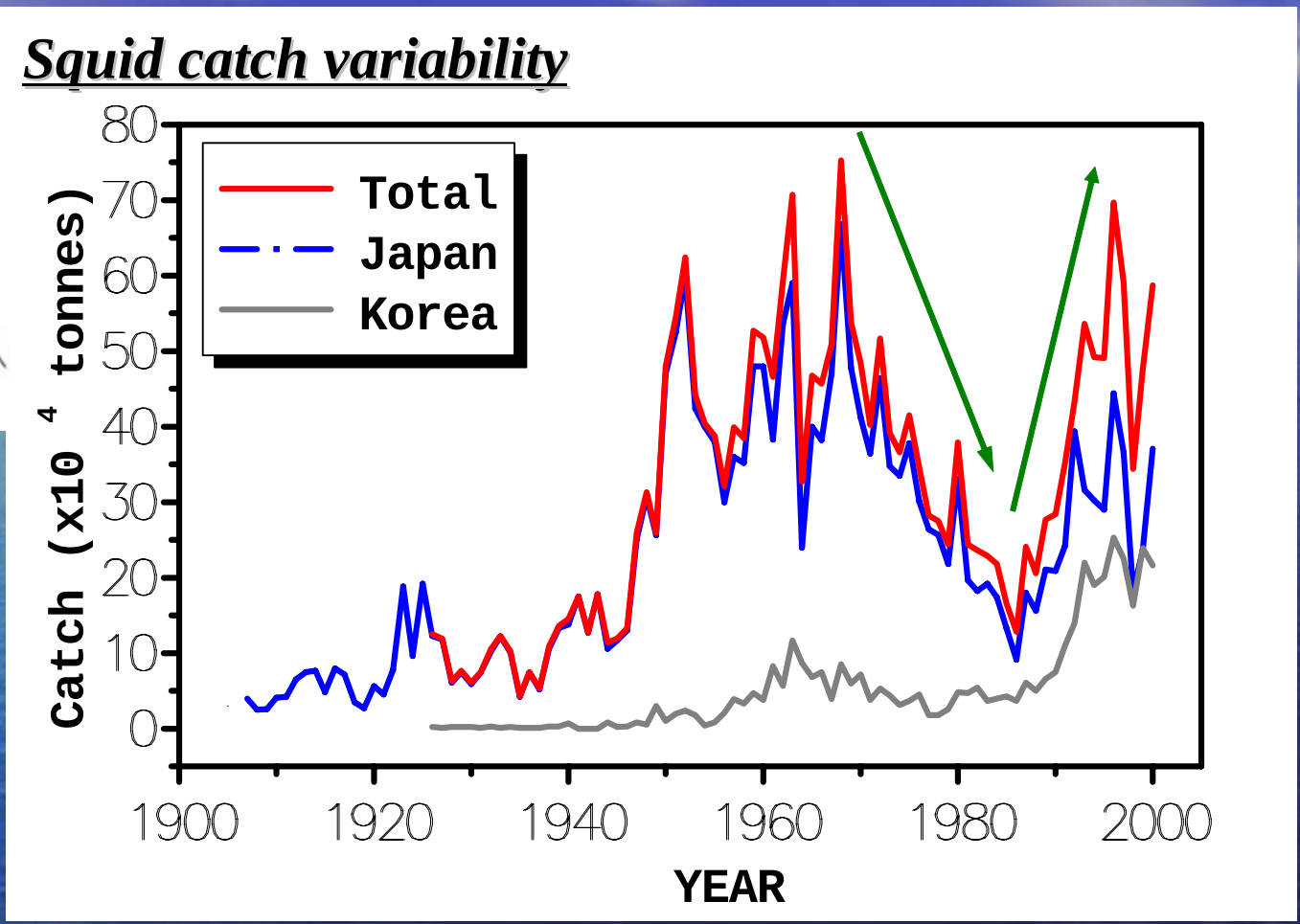
Background



selected one of the target species of Total Allowable Catch (TAC) system

necessities of accurate stock assessment and fisheries management

Motivation

1. Final goal

to develop the squid fisheries support system using RS/GIS

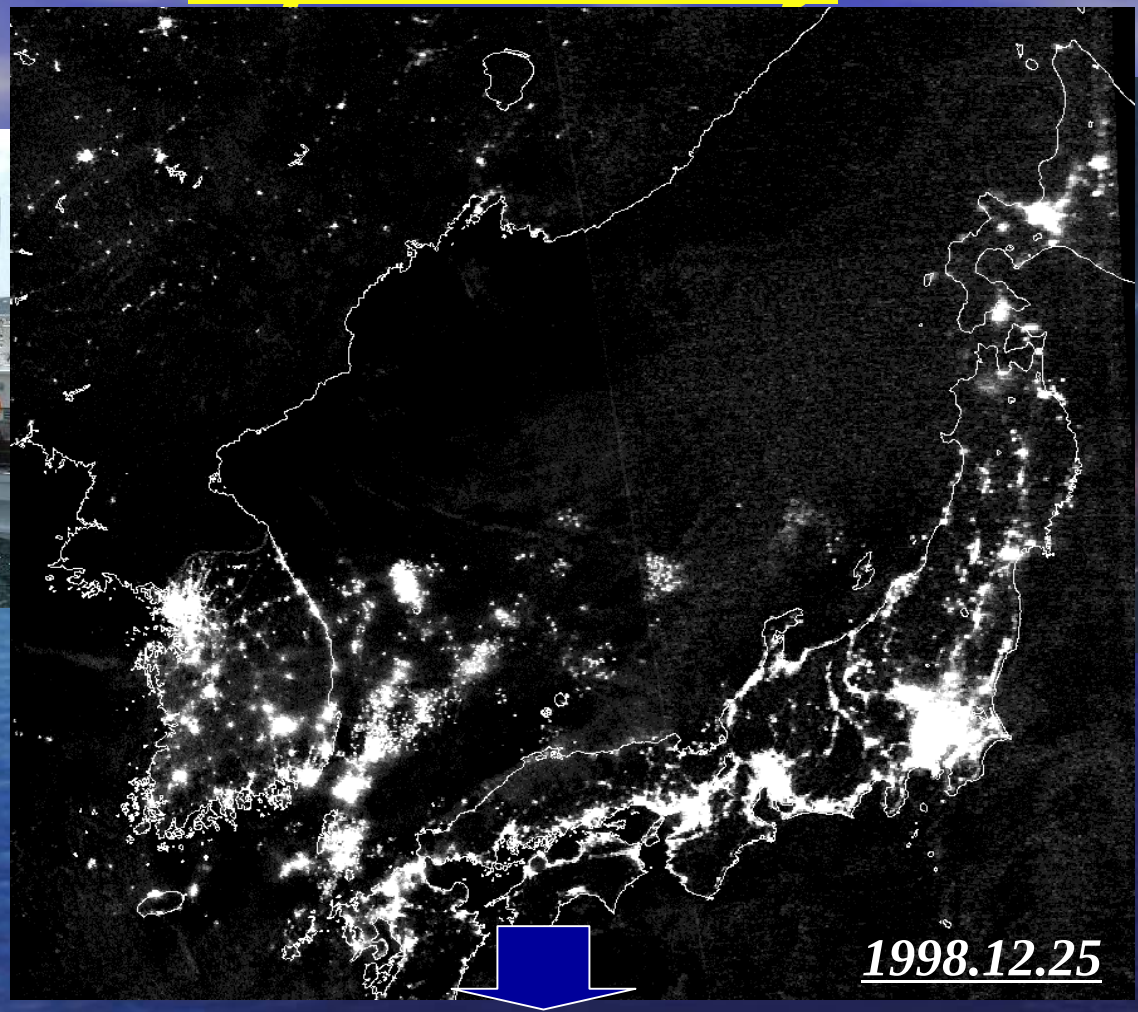
2. previous studies

- many researches of squid biology and ecology
- not so many researches on investigating squid fishing impact on stocks and environment

3. Problems

- large-scale squid distribution and fishing ground
  → difficult to determine
- number of vessels, fuel consumptions and CO_2 emissions
  → still remain

Squid Fishery



Squid were caught in areas where fishing vessels gathered

Possible to clarify the squid distribution, squid fishing area formation

What We Did in Present Work

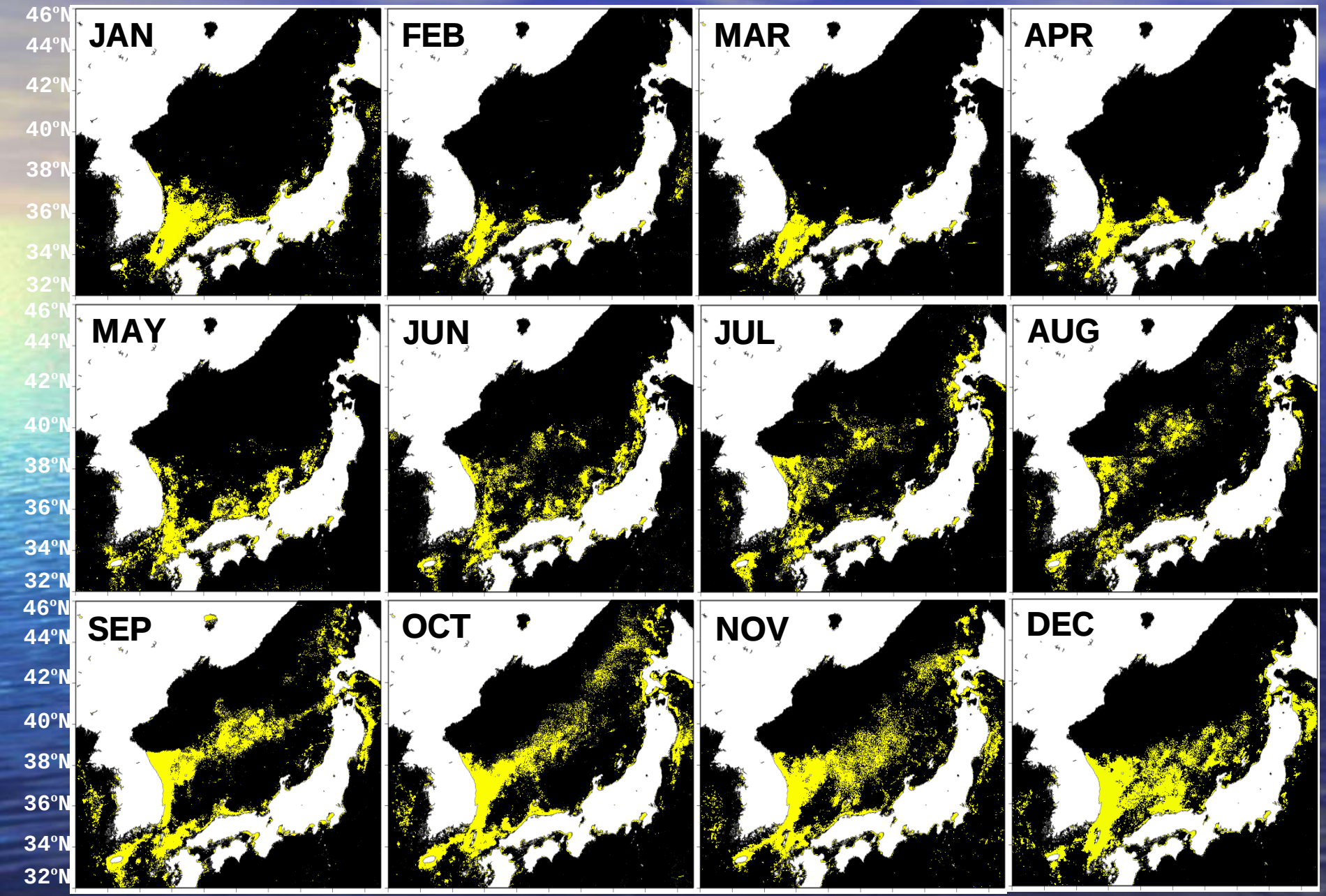
Using remotely-sensed nighttime image…

- **To examine spatial and temporal variability of *T.pacificus* fishing area**
- **To estimate the number of squid fishing vessels**
- **To estimate fuel consumption and CO_2 emissions**

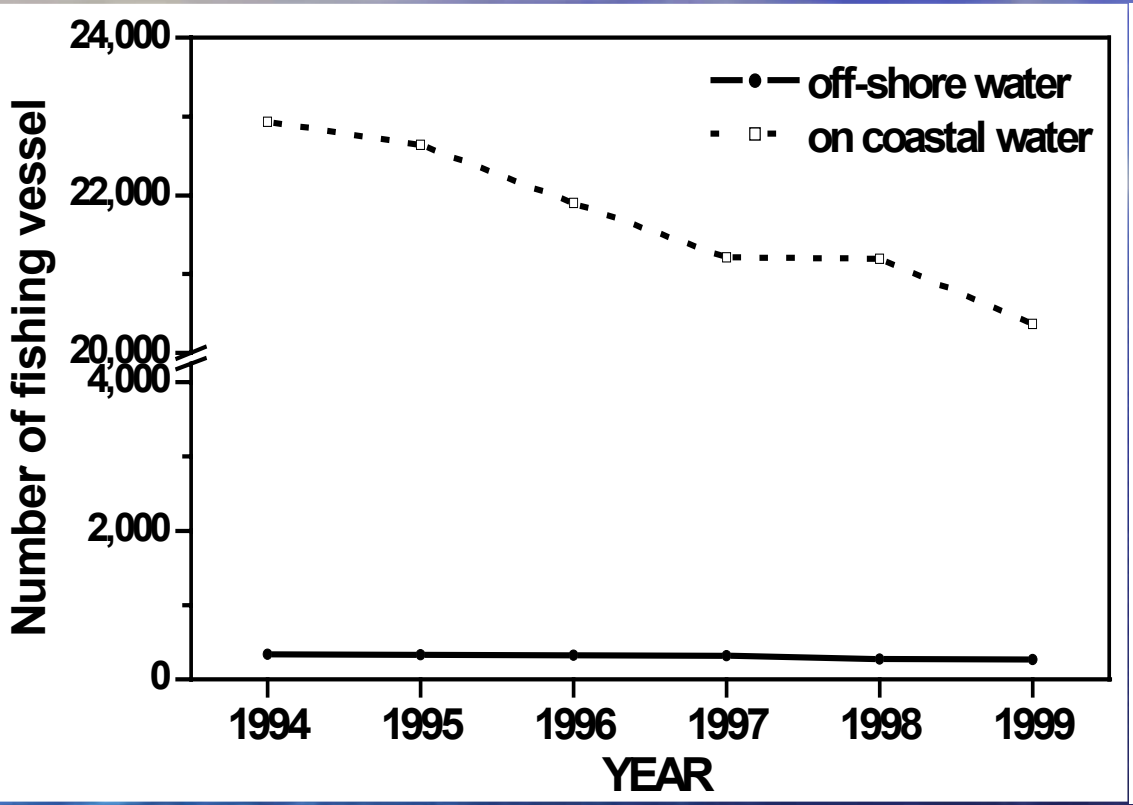
What's New in the Present Work

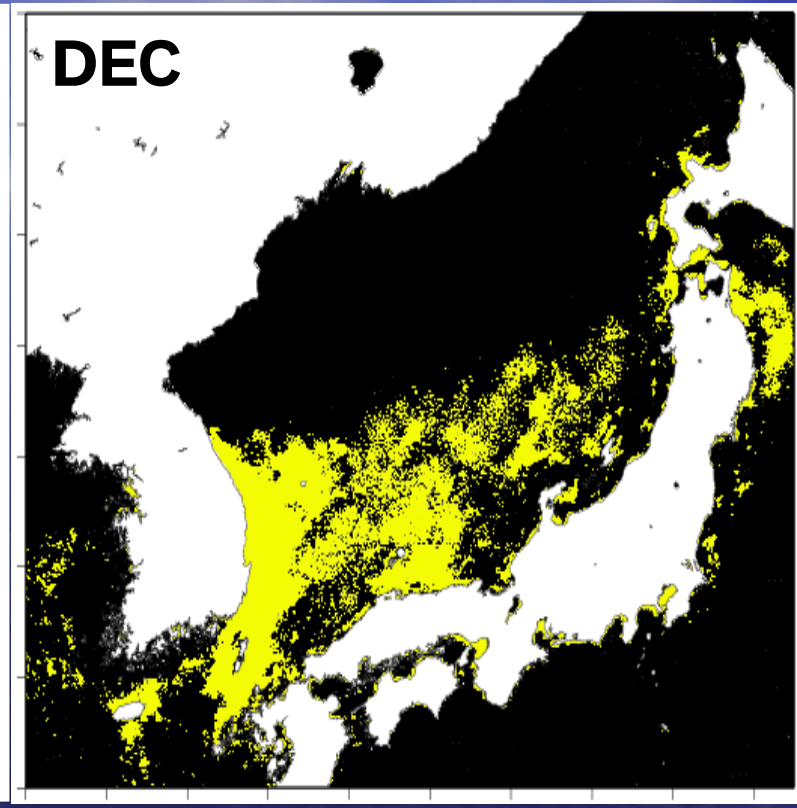
Integrated (RS + GIS) method

DMSP/OLS monthly composite images from 1994 to 1999



Number of fishing vessels in Japan off-shore water and on coastal water





Over 20,000 vessels

Number of vessels
Fishing locations
Fishing seasons

are still unknown

Method

Step 1

investigate position of squid vessels by radar observation and calculate distances between each vessels

Step 2

determine a threshold of digital number values of DMSP/OLS nighttime visible images thought to be fishing vessels

Step 3

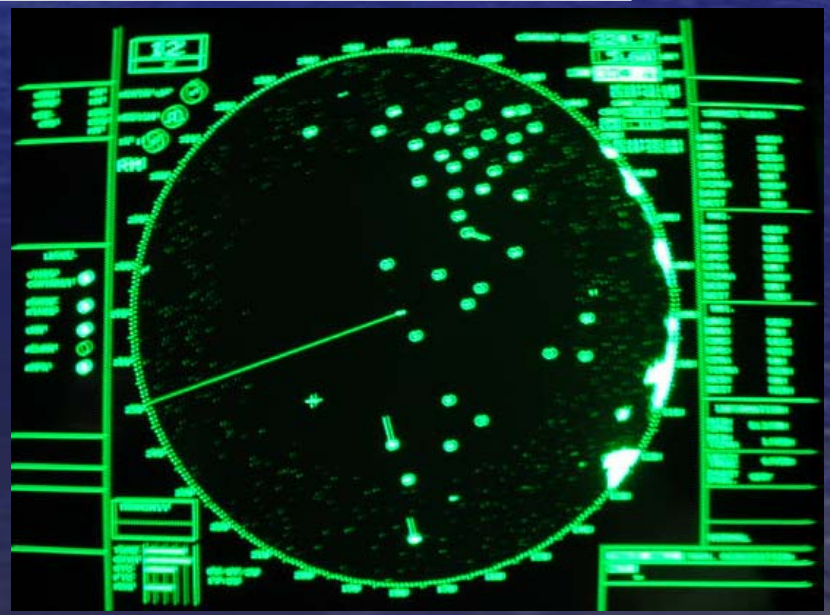
estimate number of vessels from DMSP/OLS images

Step 1
investigate position of squid vessels by radar observation

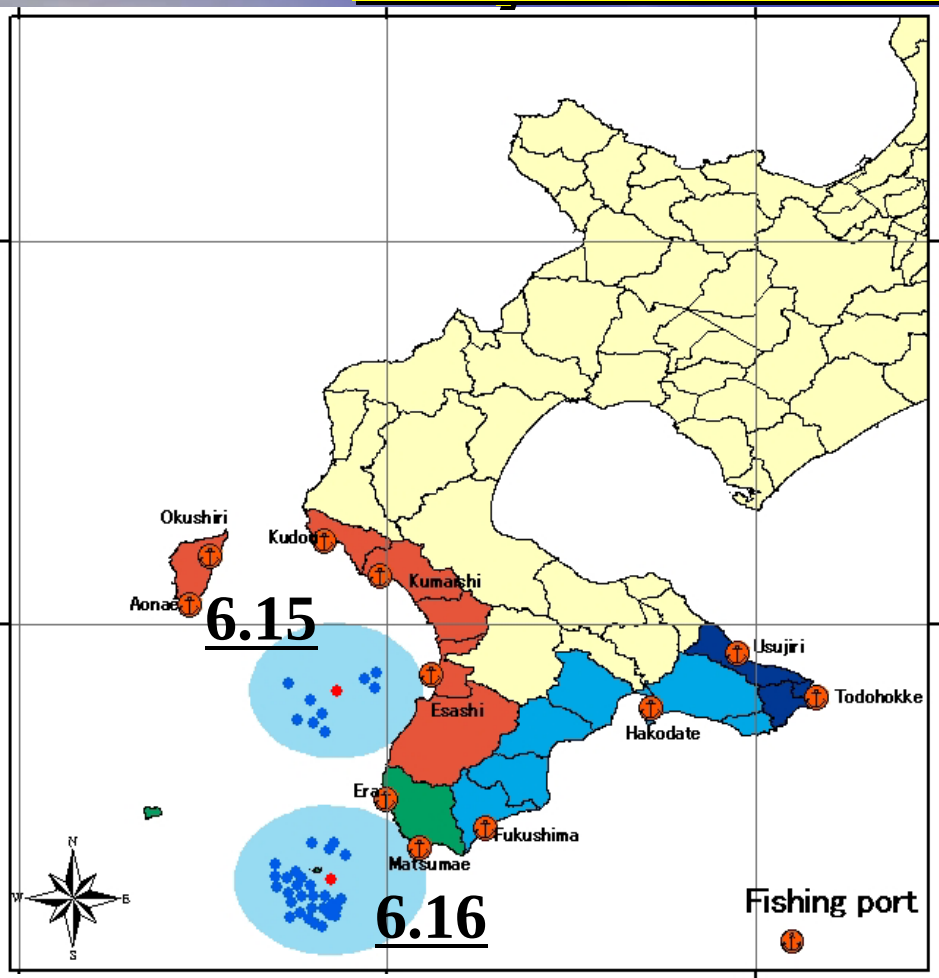
1. Radar images on T/S Ushio-maru

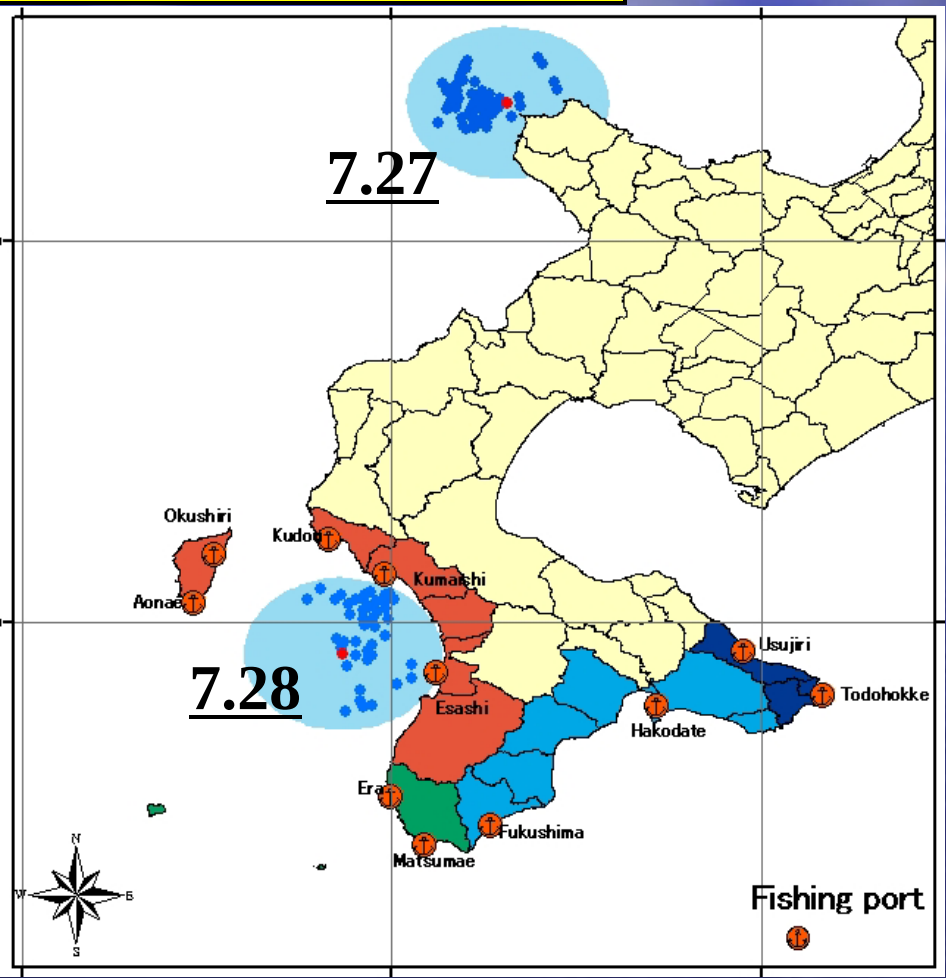
Radar observation

Date	radar range	number of observed vessels
2003.6.15	12 miles	9
2003.6.16	12 miles	30
2003.7.27	12 miles	55
2003.7.28	12 miles	43



Map of radar observation



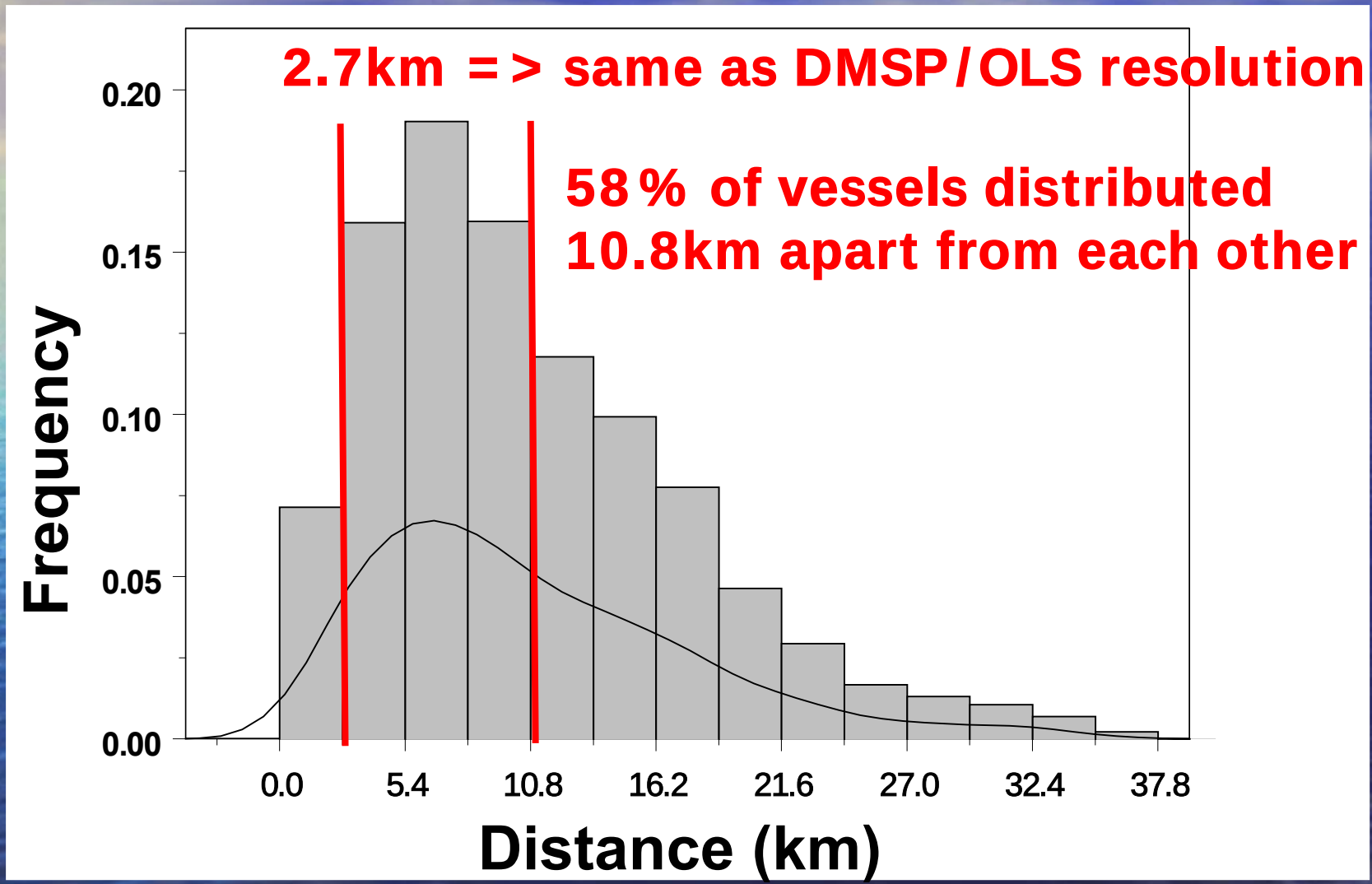


- T/S Ushio-maru
- observed vessels

Radar range (12 miles)

calculate distances between each vessels

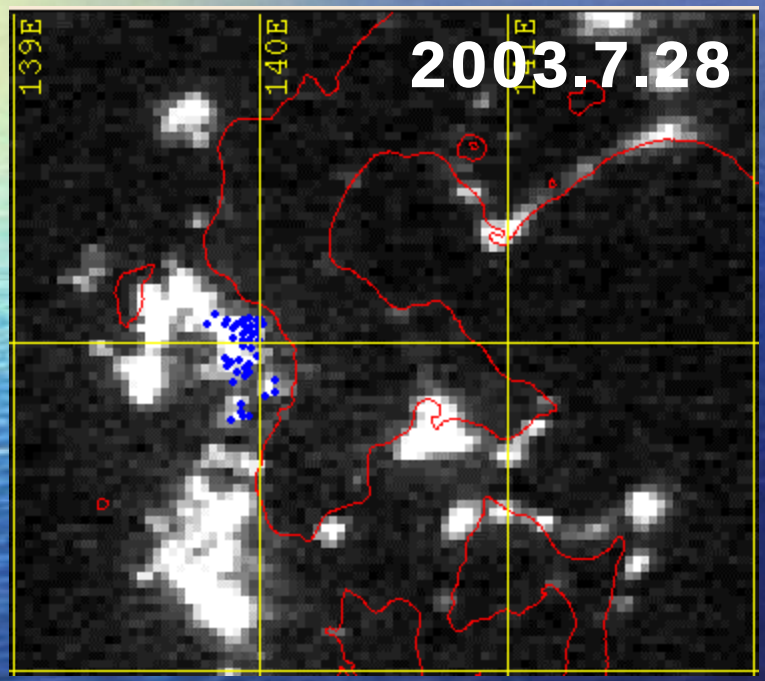
Frequency distribution of distances of each vessels

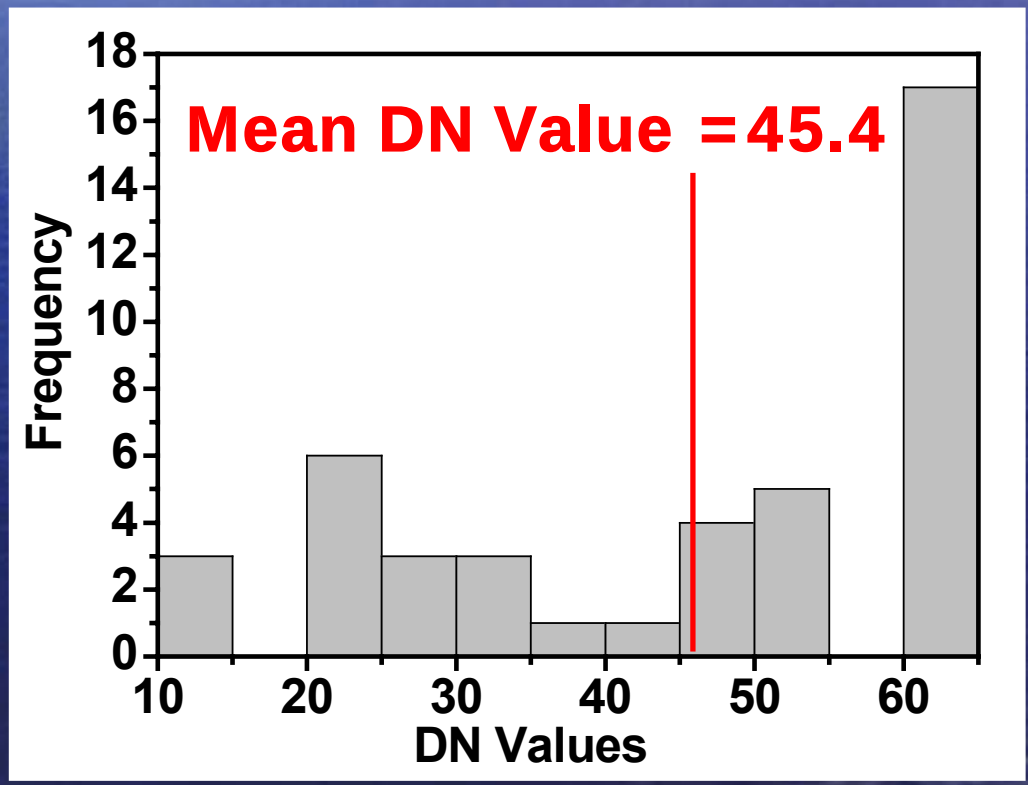


One vessel in one pixel of DMSP/OLS image

Step 2
determine a threshold of digital number values thought to be fishing vessels

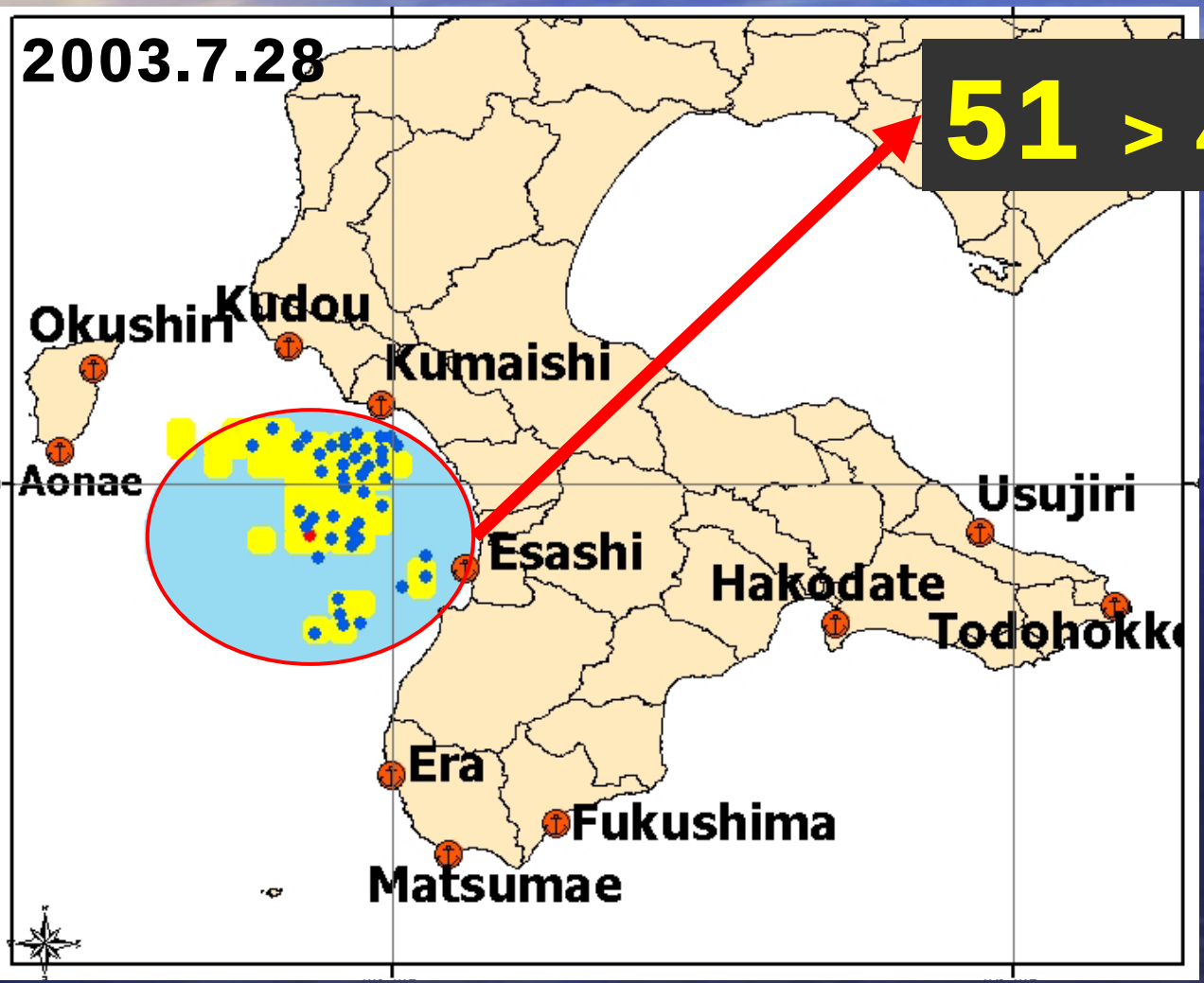
Extract DN values from DMSP/OLS





threshold for extracting fishing vessels ➡ **DN Value = 46**

Step 3
estimate number of vessels from DMSP/OLS images



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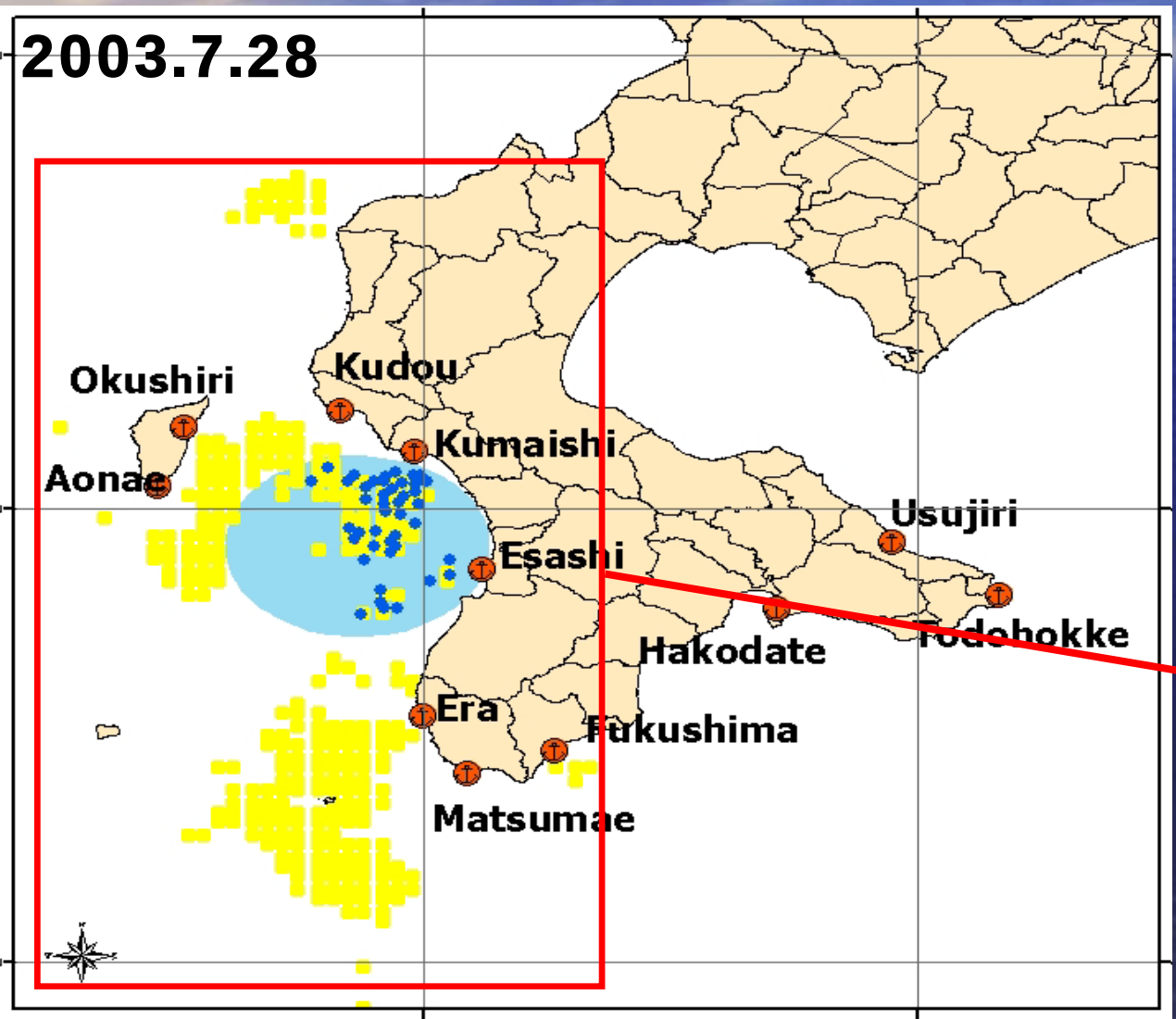
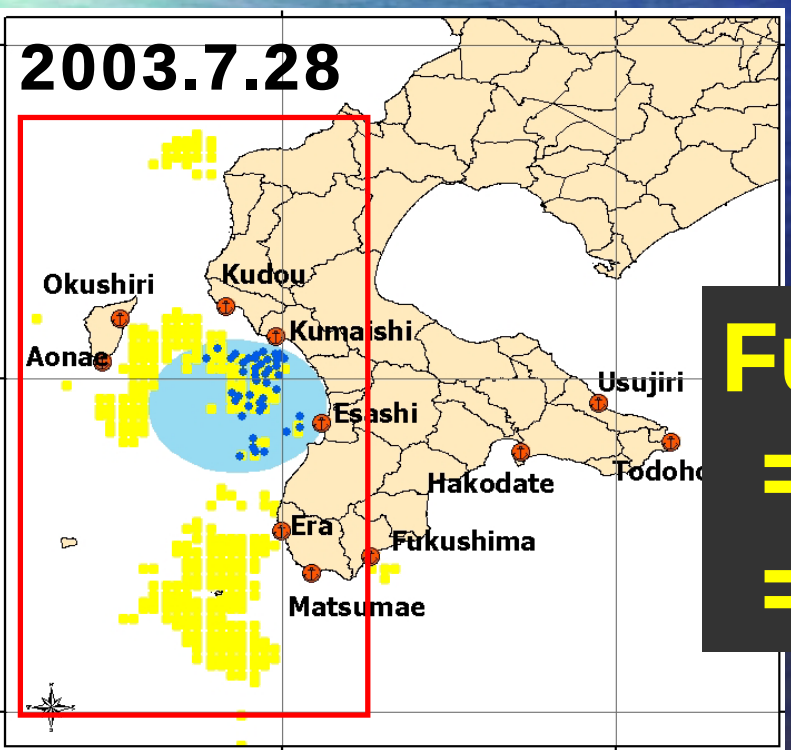


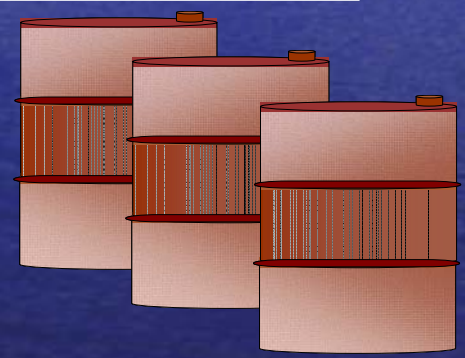
309

Fuel consumptions

Day squid fishing operation

Operation period	9 – 10 hours
Light power	120 kw
Travel distance	0.5 – 3.9 miles
Fuel consumption	600 /

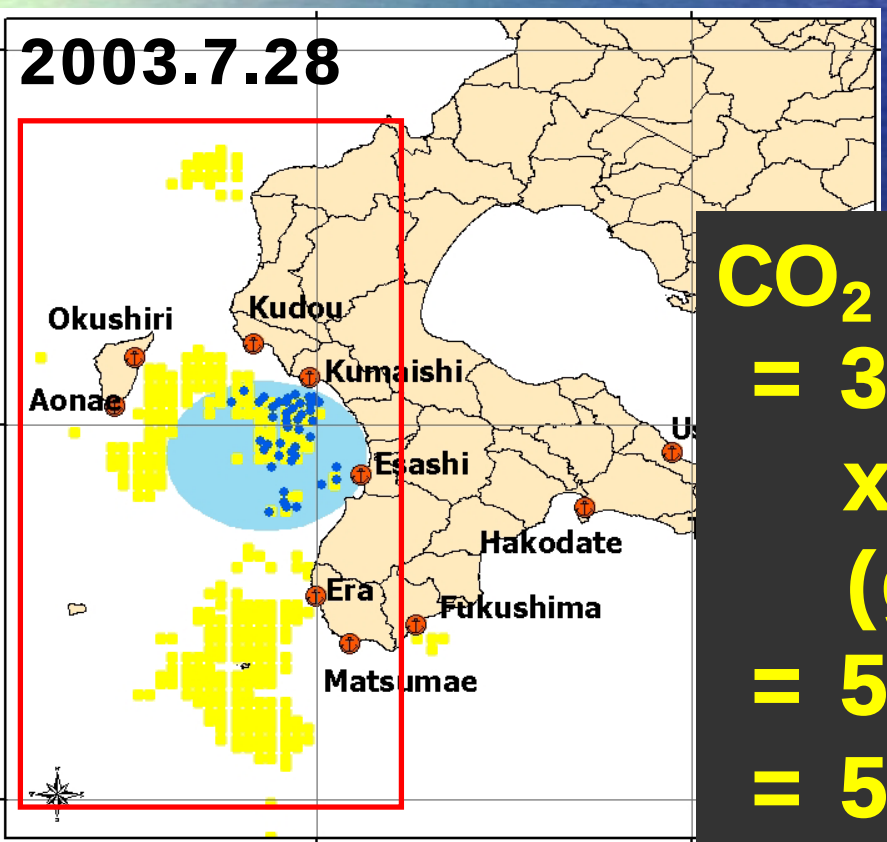


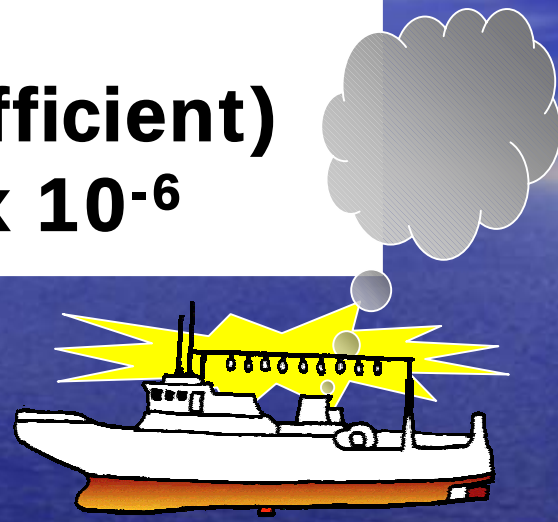


Fuel consumption
= 309(vessels) x 600(/)
= 185,400 (/)

CO_2 emissions

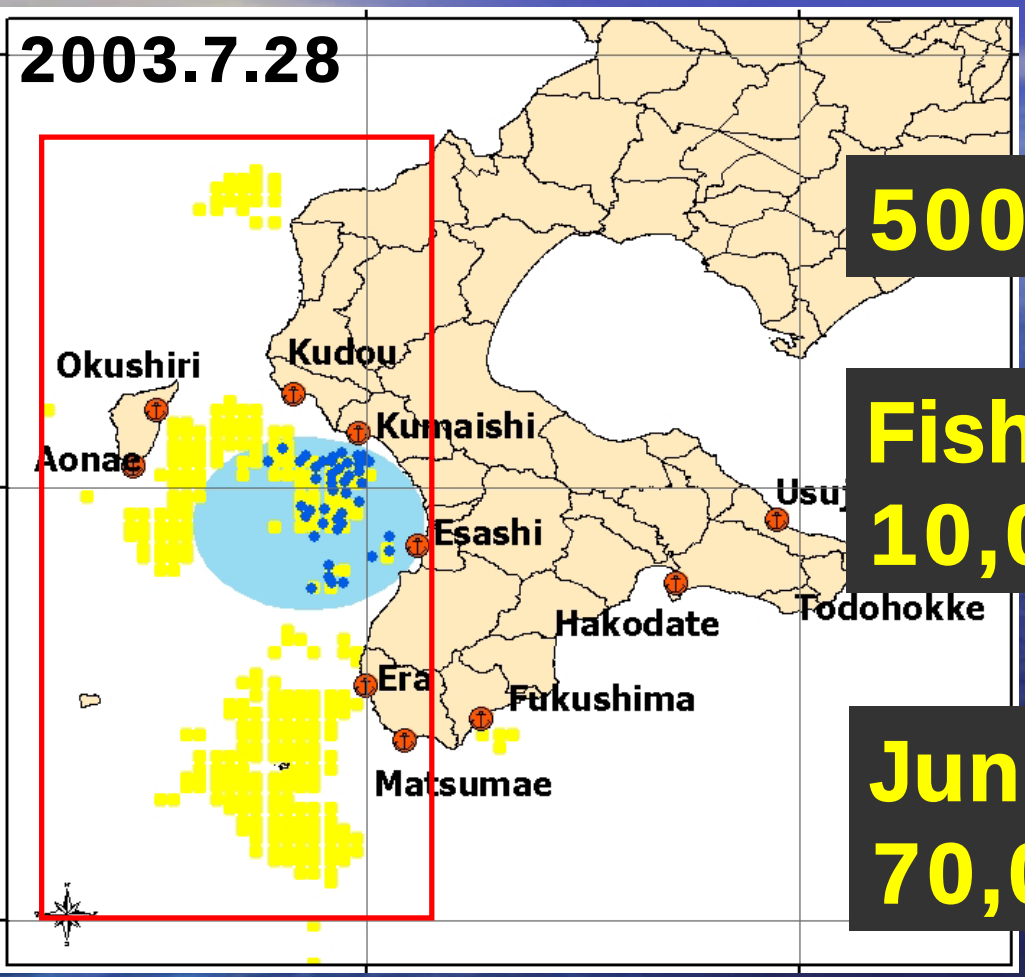
CO_2 emission
= (Fuel consumption) x (heat coefficient)
x (CO_2 emission coefficient) x 10^{-6}





CO_2 emission
= 309(vessels) x 600(*l*)
x 9300 (kcal/l) x 290.1
(g-CO2/1000kcal) x 10^{-6}
= 500196.2 (Kg)
= 500.2 (tonnes)

CO_2 emissions



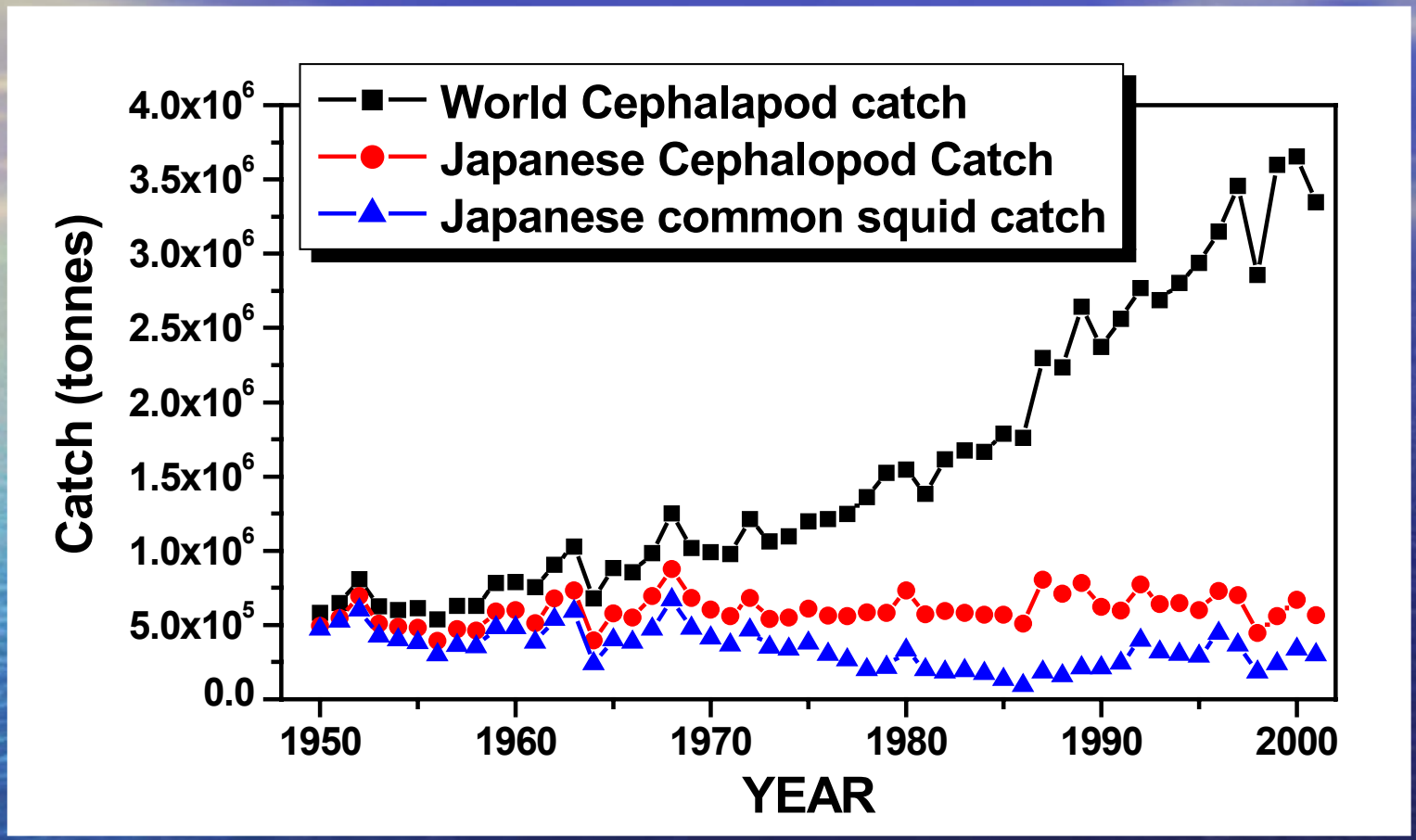
500.2 (tonnes) / day

Fishing period = 20days
10,000 (tonnes) / month

June – December
70,000 (tonnes) / year

0.02 % of CO_2 emissions in Japanese industrial sector

Cephalopod catch



Japanese cephalopod catch – 1/6 of world catch
Japanese common squid – 40% of the total catch in Japan

important to the human food supply

Summary

- **enable to detect fishing vessel lights from DMSP/OLS nighttime visible images**

  ⇒ **provide innovative methodology**

  ⇒ **provide useful information**

- **enable to estimate number of fishing vessels, fuel consumptions and CO_2 emissions from DMSP/OLS night time visible images**

  ⇒ **remind squid fishery may impact on environment**