Fukushima derived radionuclides in the ocean

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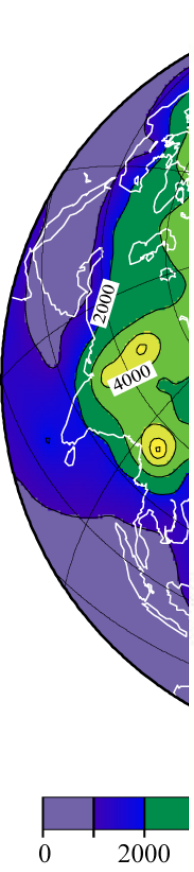
Talk Outline

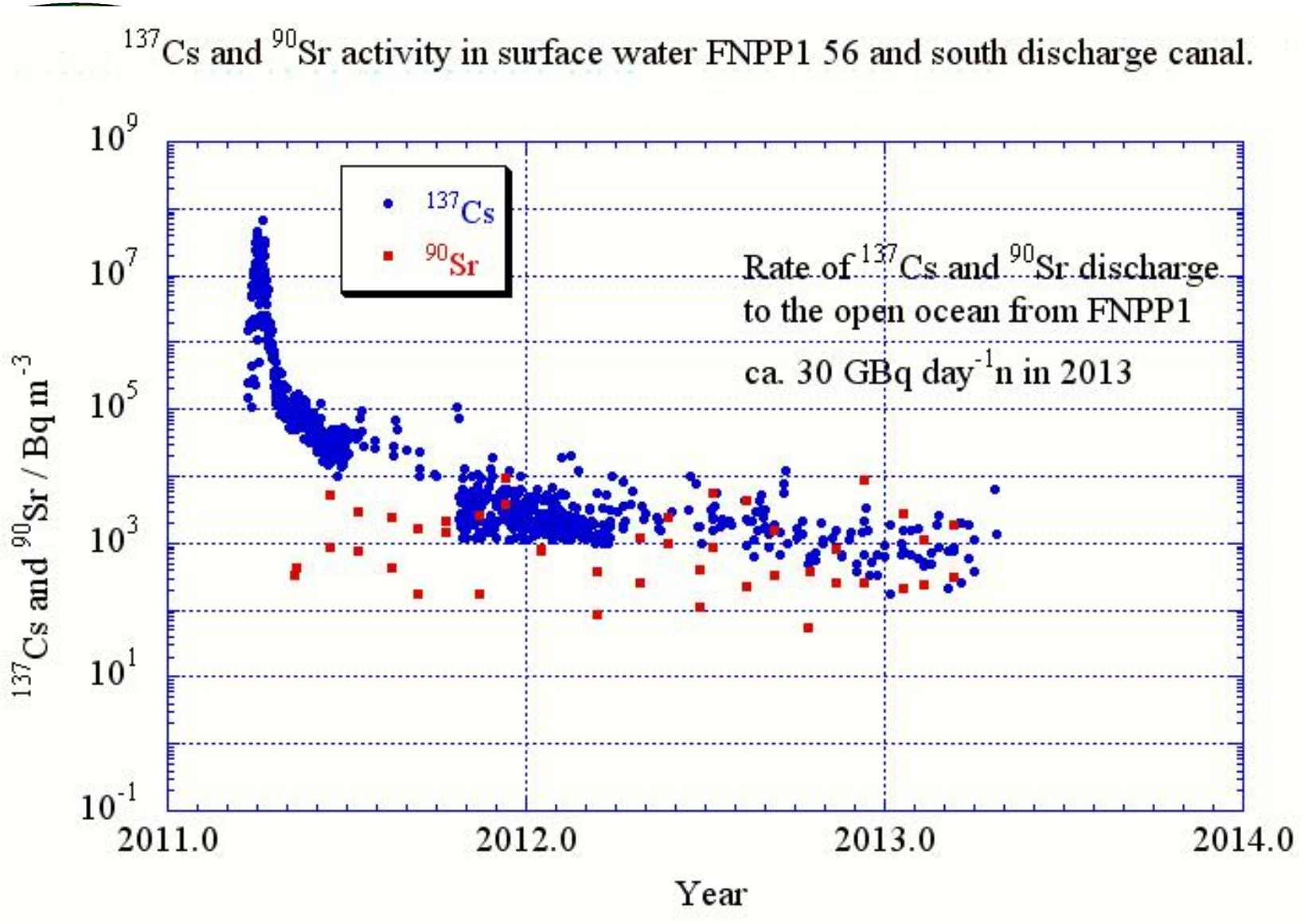
1. Global cesium distribution and mass balance
   - pre Fukushima
2. Fukushima cesium
   - mass balance of ^{137}Cs
   - surface transport and subduction to the ocean interior

IAEA Scientific Forum 17-18 September 2013 Vienna, Austria

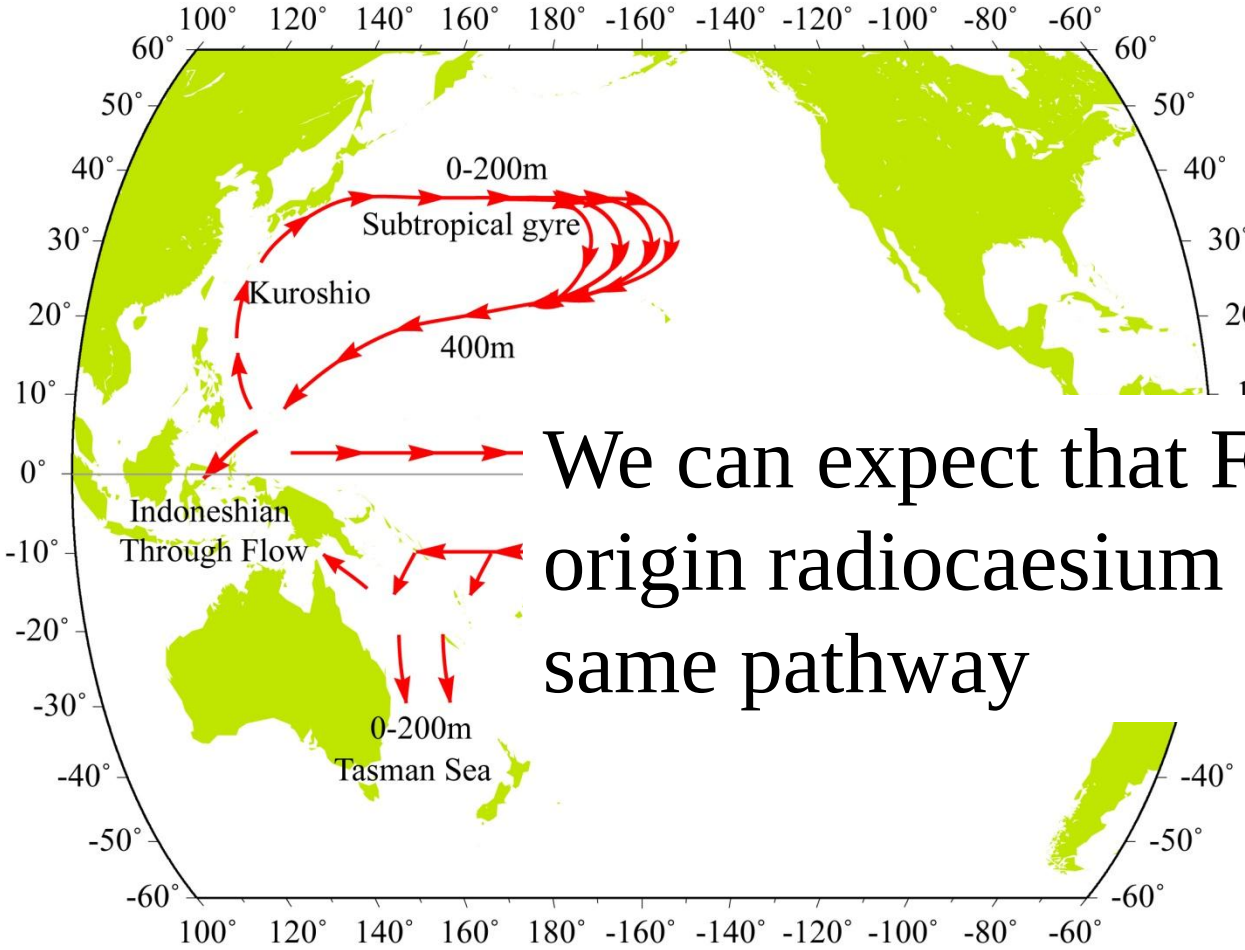
Decay corrected accumulative fallout of ^{137}Cs derived from atmospheric weapons tests as of 1970



Michio Aoya
construction
weapons test
Monitoring, 8



A pathway of weapons tests derived ^{137}Cs in the North Pacific Ocean, tracer of sea water movement

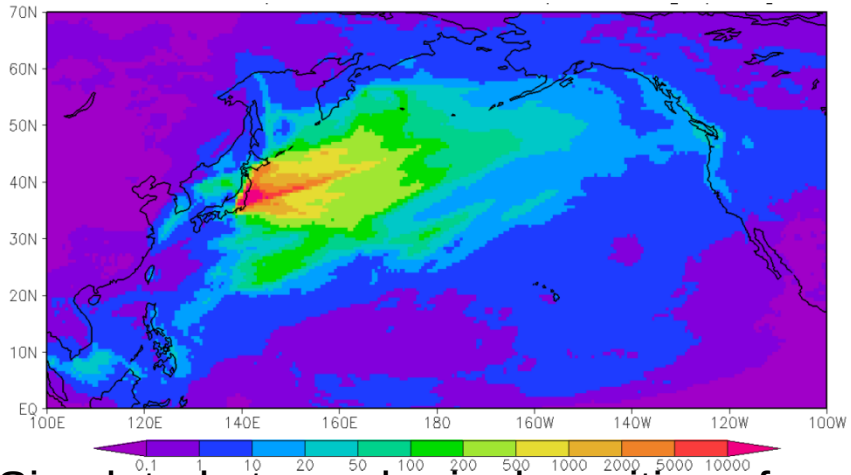


We can expect that Fukushima origin radiocaesium should go same pathway

Fig. S2 Possible pathway of ^{137}Cs in the Pacific Ocean based on 3-D observations of ^{137}Cs in 2000s (Aoyama et al., 2013)

Pathways of Fukushima derived radionuclides to the Ocean

- Atmospheric deposition
- Direct release
- Groundwater discharge
- River runoff



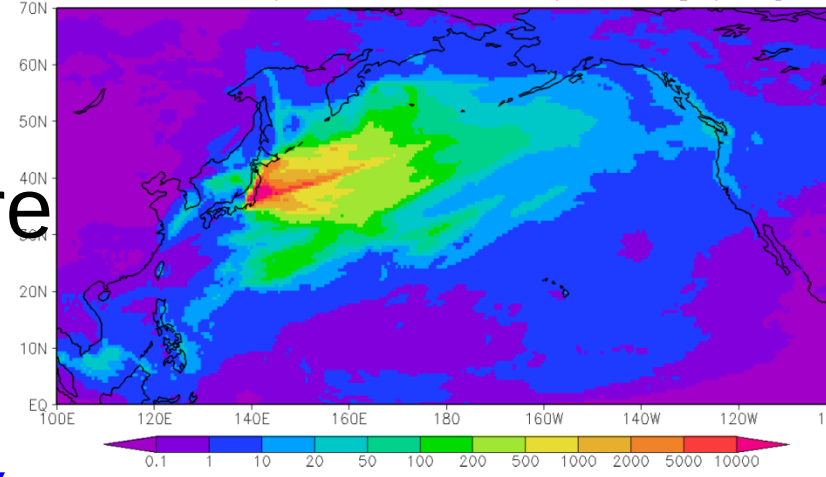
Simulated atmospheric deposition of ^{137}Cs (Bq m^{-2}) (by Masingar II of MRI) (Aoyama et al., in preparation)

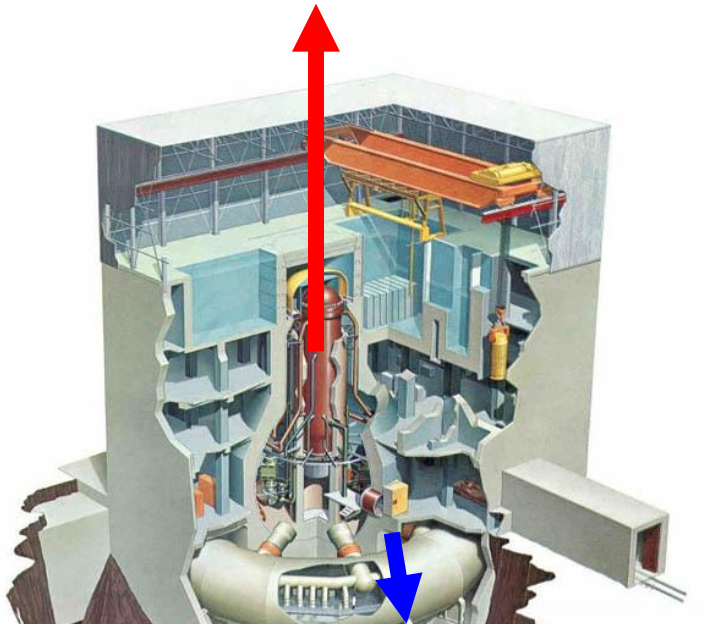
^{137}Cs : 1.8E+12 Bq/m^3

TEPCO Press release

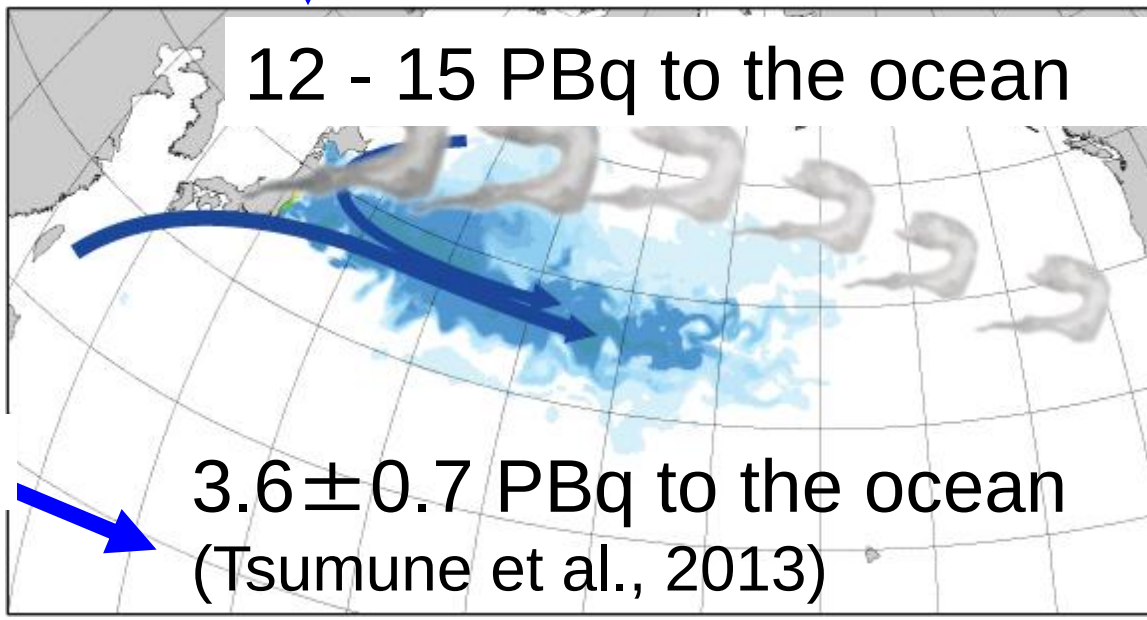
^{137}Cs mass balance

14–17 PBq to the atmosphere





12 - 15 PBq to the ocean



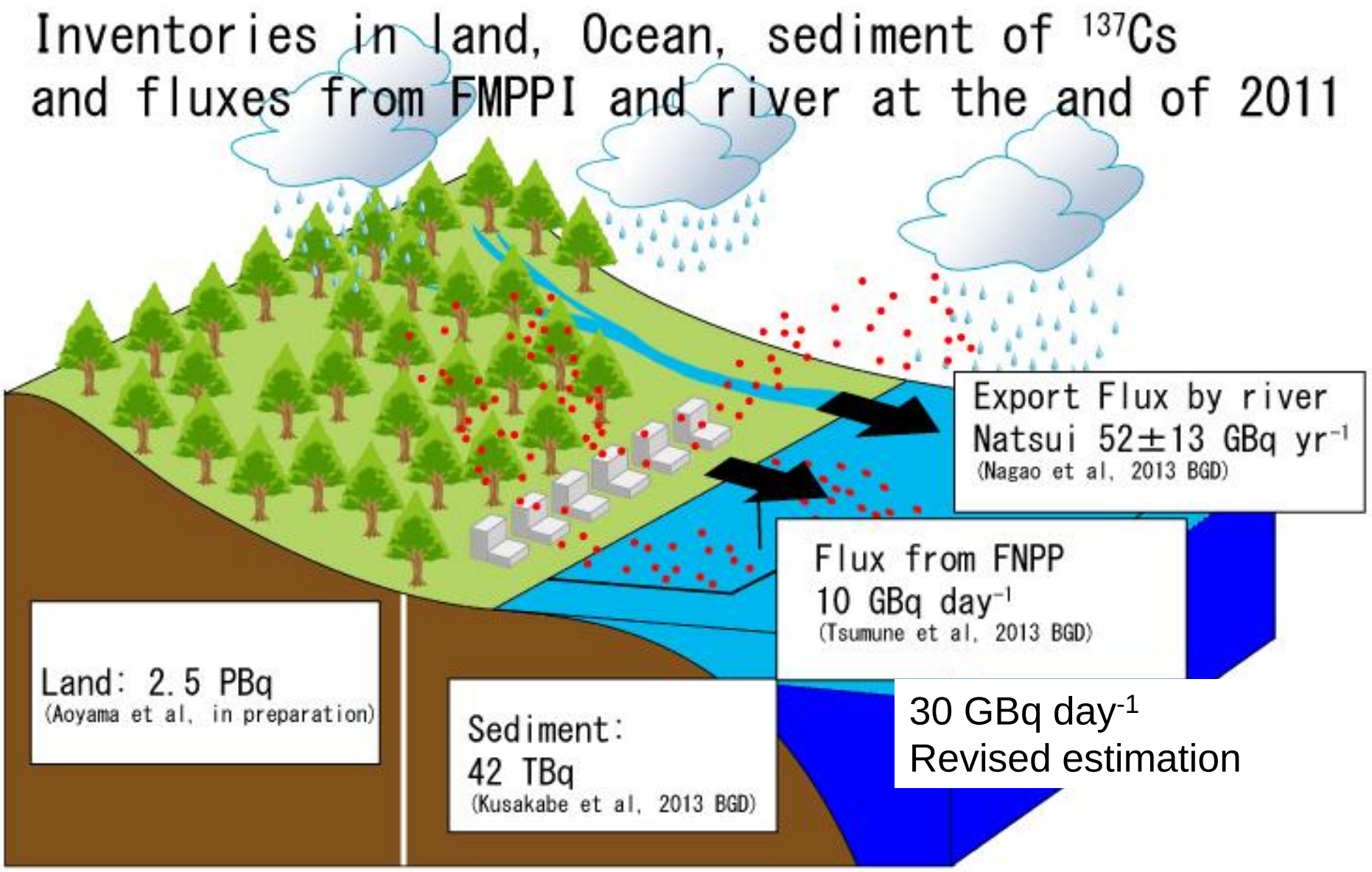
140 PBq in stagnant water

Boiling Water Reactor Systems "Nuclear Reactor Concepts" Workshop Manual, U.S. NRC

3.6±0.7 PBq to the ocean
(Tsumune et al., 2013)

700 PBq was in the three core
(Nishihara et al.,, 2011)

140 PBq in stagnant water
(Nishihara et al., 2011)



More than 99% of released radioaesium to the ocean was transported offshore, then to the ocean interior

Sampling locations during the period from March 2011 to Oct. 2012

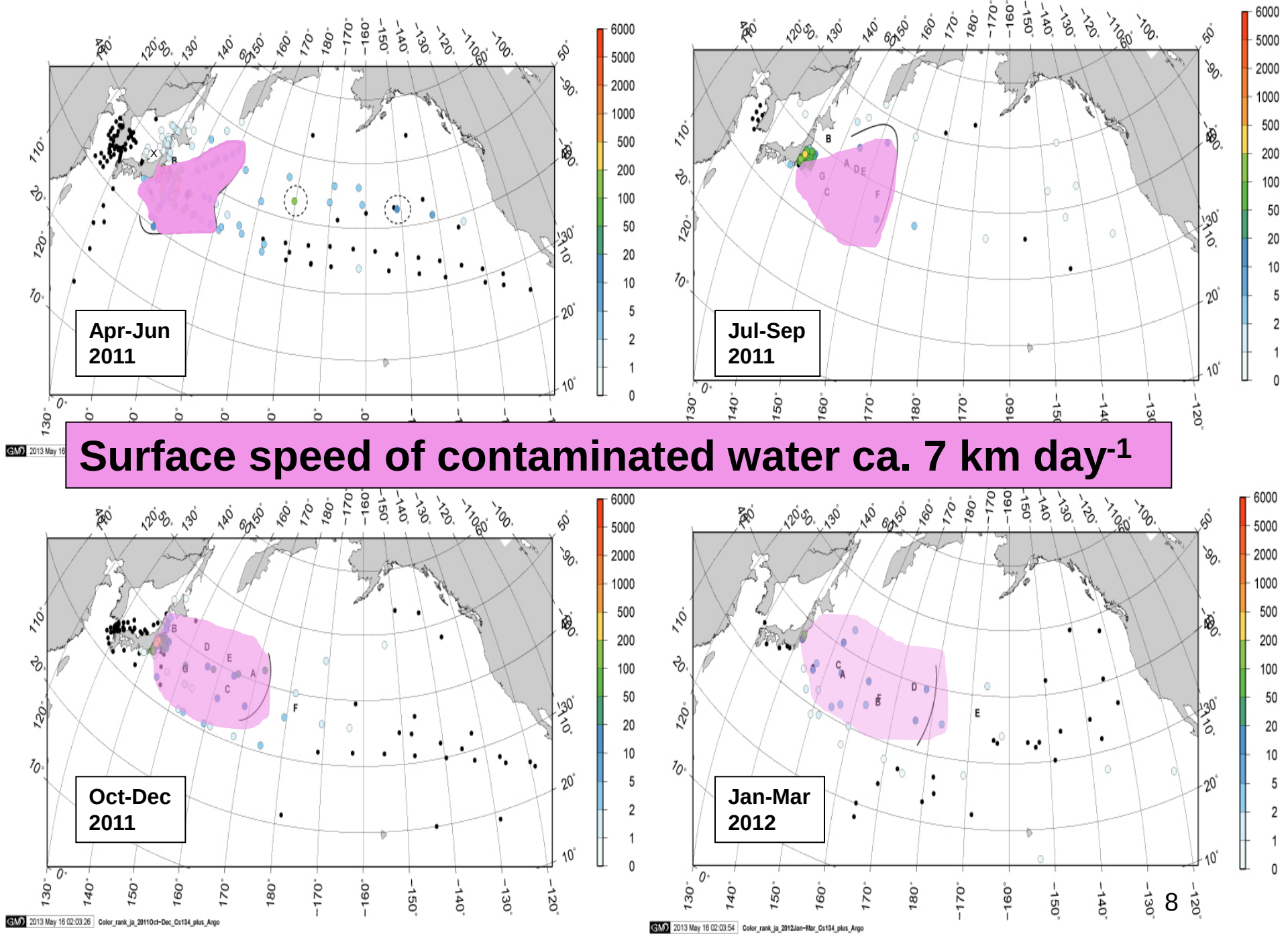
R/V Mirai

NYK AQUARIUS

R/V Hakuho Maru

凌風丸

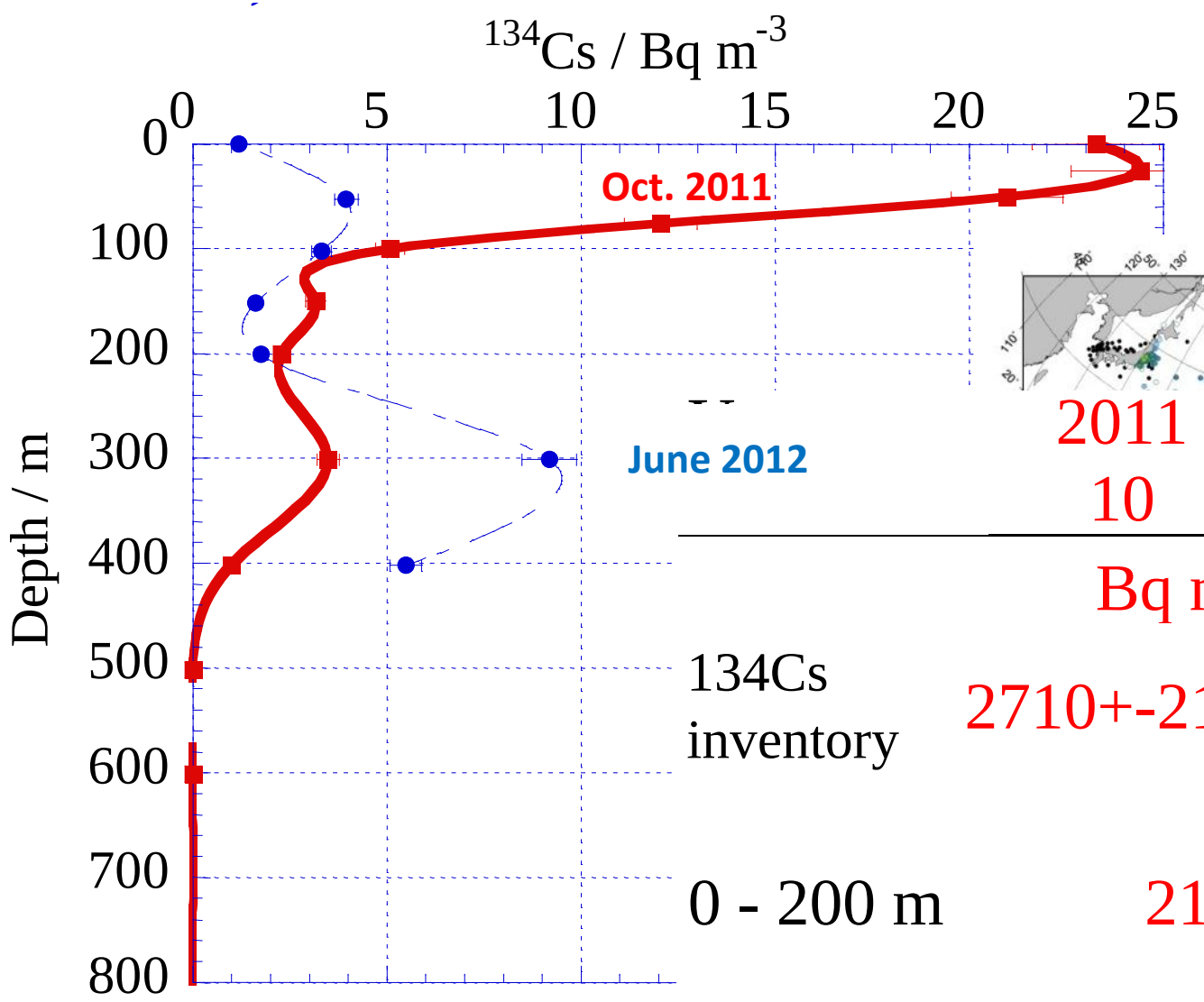
NYK Heijin

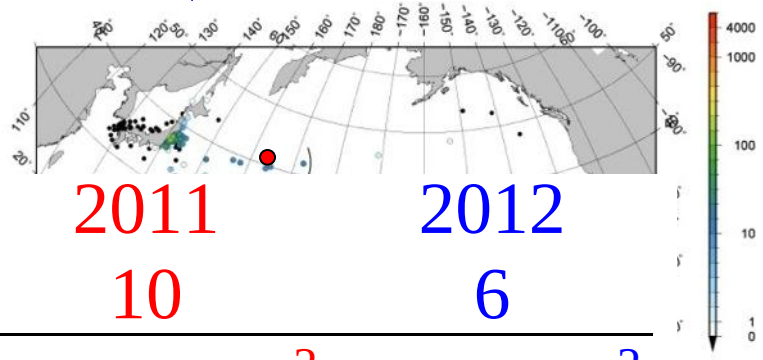


Surface speed of contaminated water ca. 7 km day^{-1}

(Aoyama et al., BG 10 3067-3078, 2013)

Over time, Cs moves east and subducted in the ocean interior

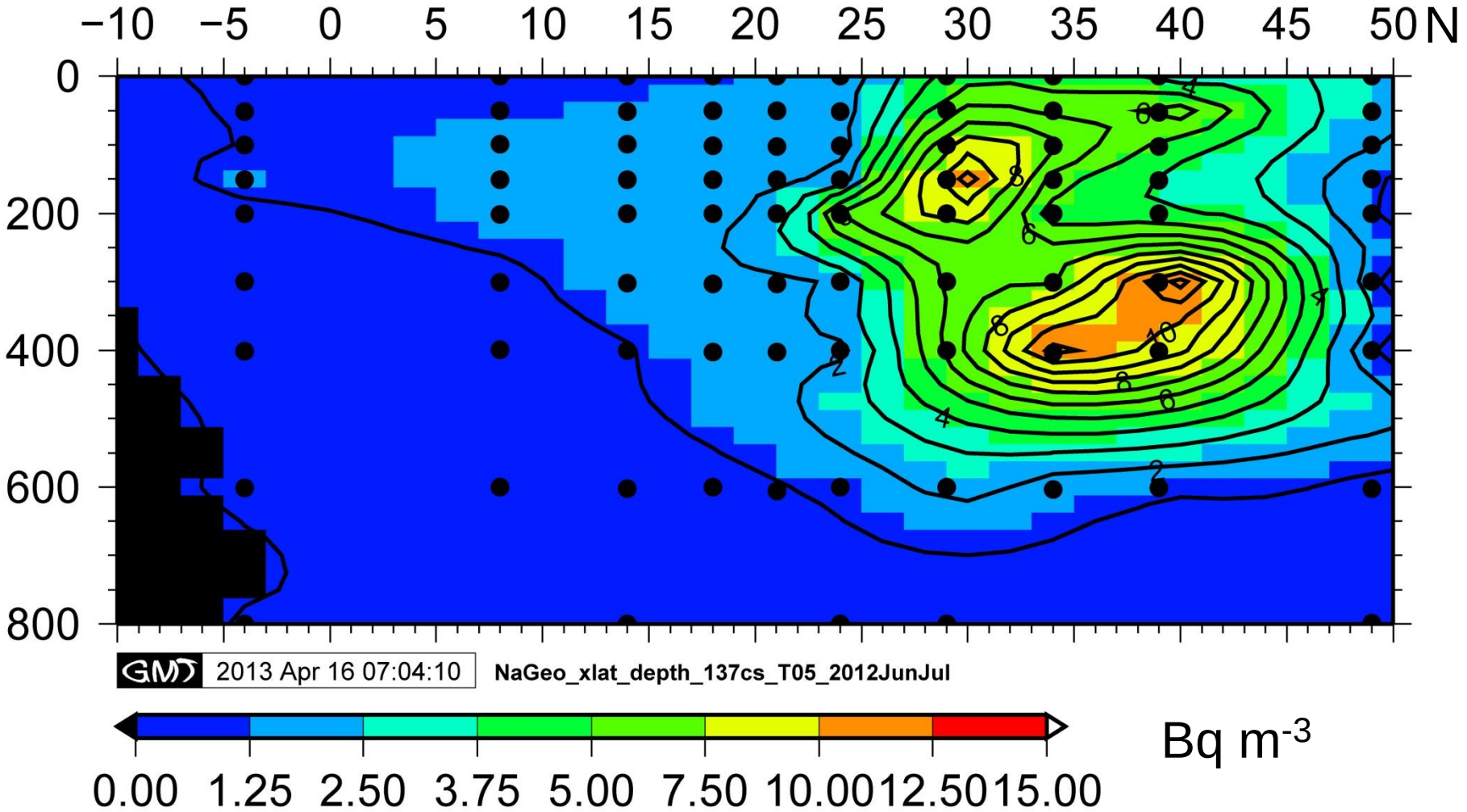




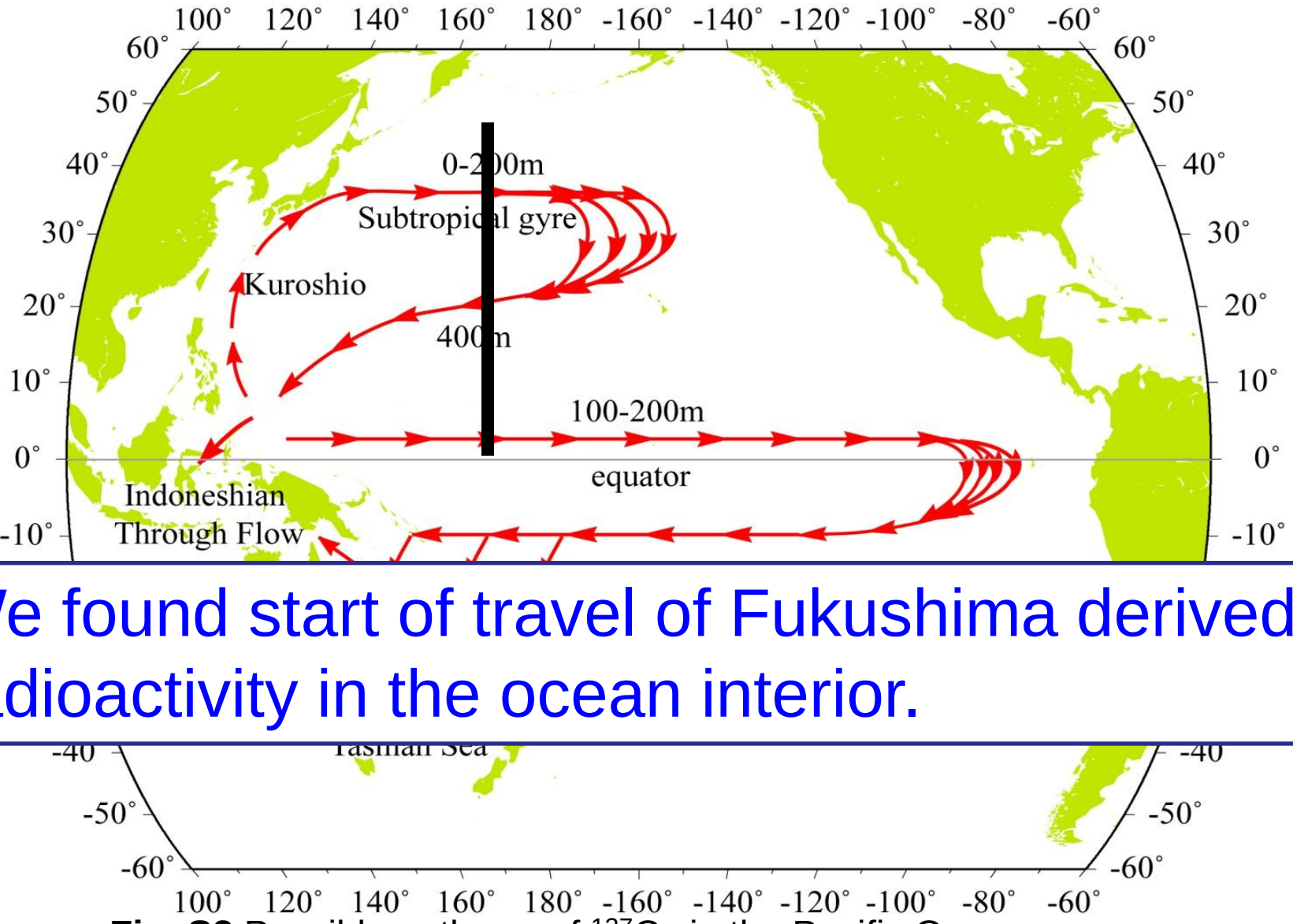
	2011 10 Bq m^{-2}	2012 6 Bq m^{-2}
134Cs inventory	2710+-210	2350+-190
0 - 200 m	2150	520
Deeper than 200 m	520	1830

^{137}Cs cross section along 165 ºE in June 2012

Start of travel into ocean interior



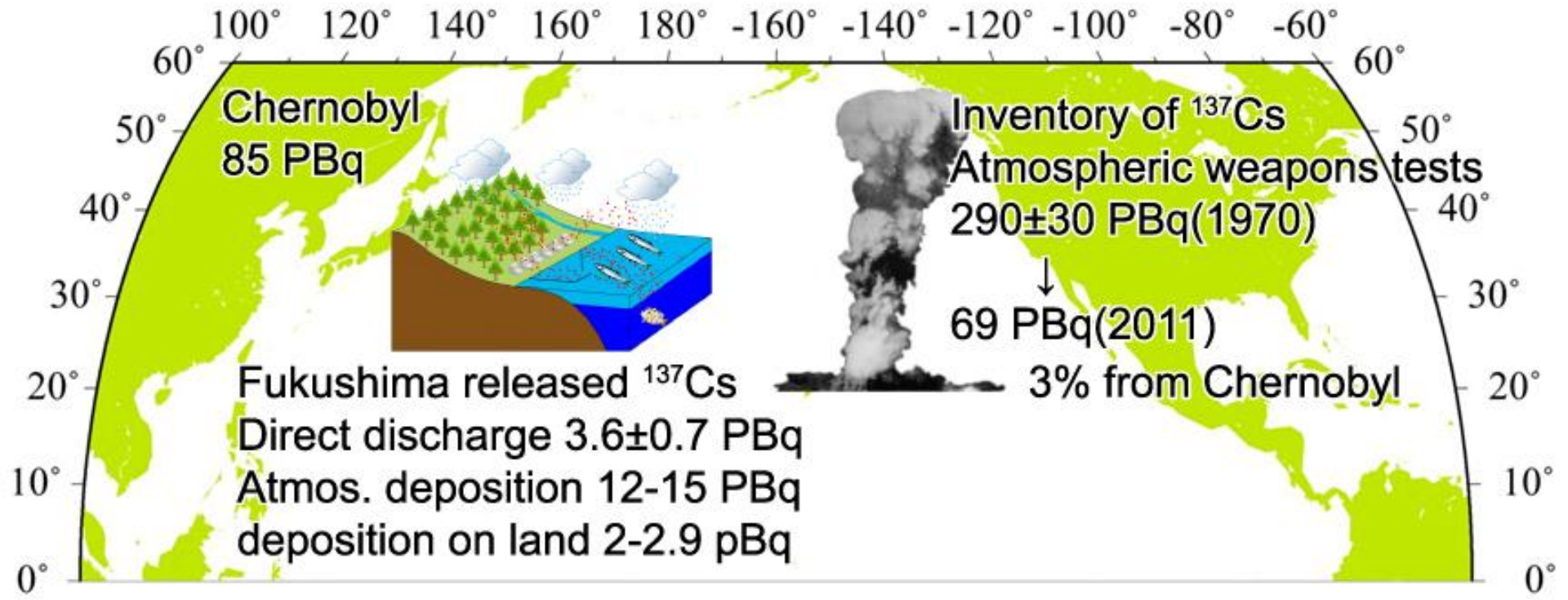
Possible pathway of Fukushima derived radionuclides in the North Pacific Ocean



We found start of travel of Fukushima derived radioactivity in the ocean interior.

Fig. S2 Possible pathway of ^{137}Cs in the Pacific Ocean

Summary of budget of ^{137}Cs for pre- and after the Fukushima accident



Main portion of Fukushima derived radioactivity already subducted into the ocean interior and is moving to southwest ward.