Spatio-temporal variation of pCO_2 in shore-reef waters off Arasaki district, Sagami Bay, Japan

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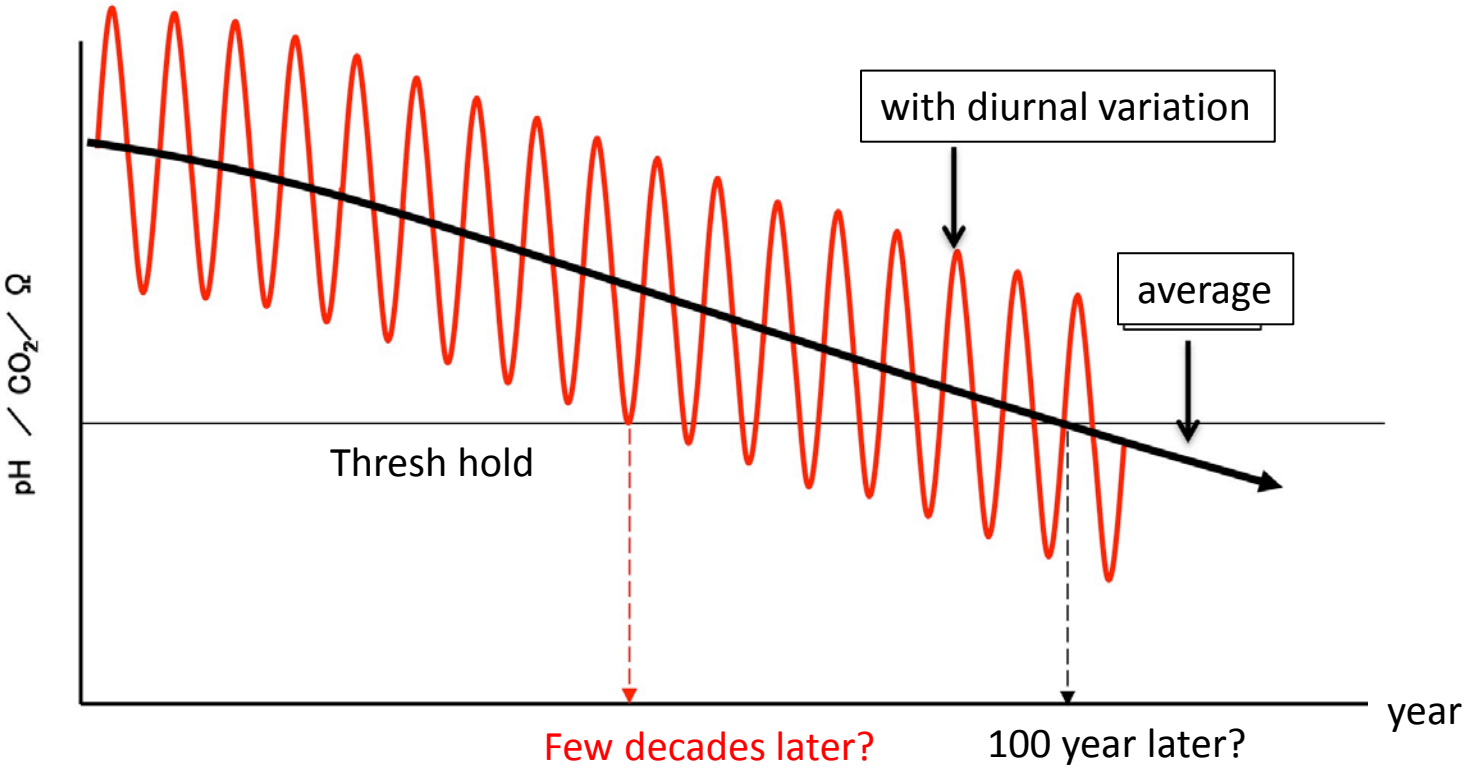
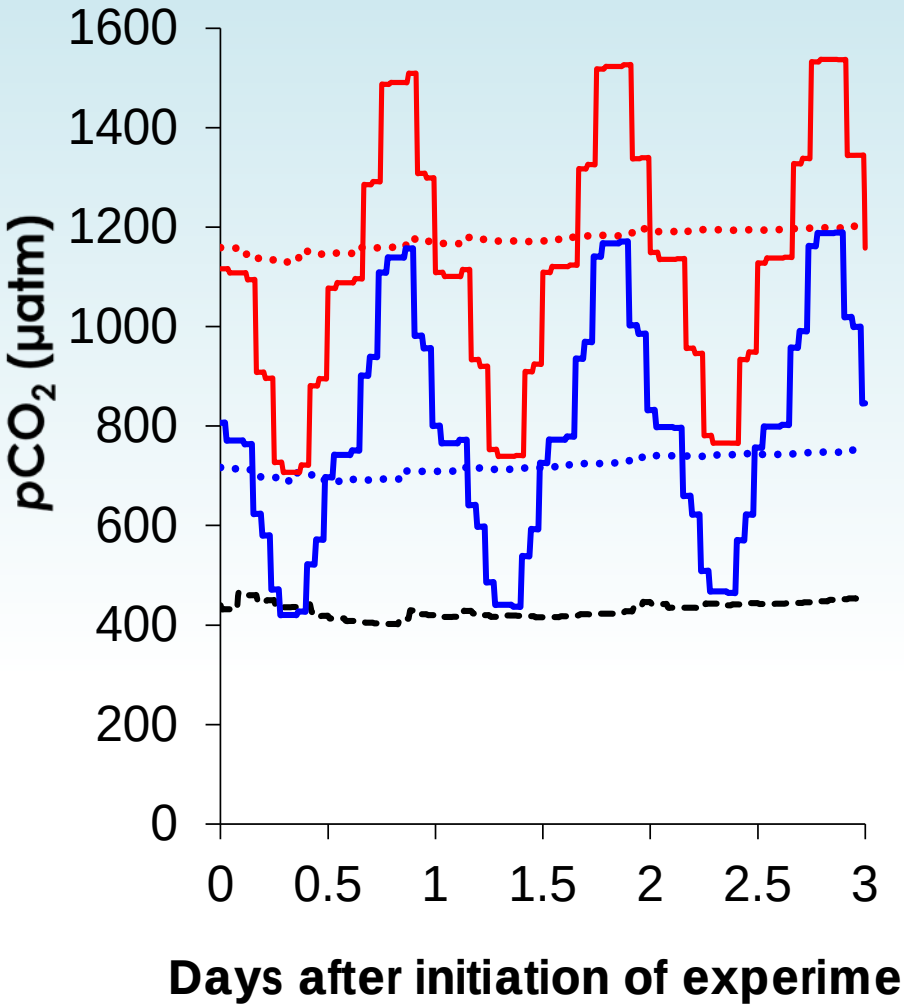


modified from Yamamoto-Kawai et al.

Effects of diurnally-variable pCO_2 on ezo-abalone larvae by culture experiment *[Takami et al., in prep.]*



Constant treatments

Targeted pCO_2

400 µatm, 800 µatm, 1200 µatm

Results of monitoring

(Dotted lines)

430±15, 732±19, 1175±20 µatm

Diel cycle treatments

Targeted pCO_2

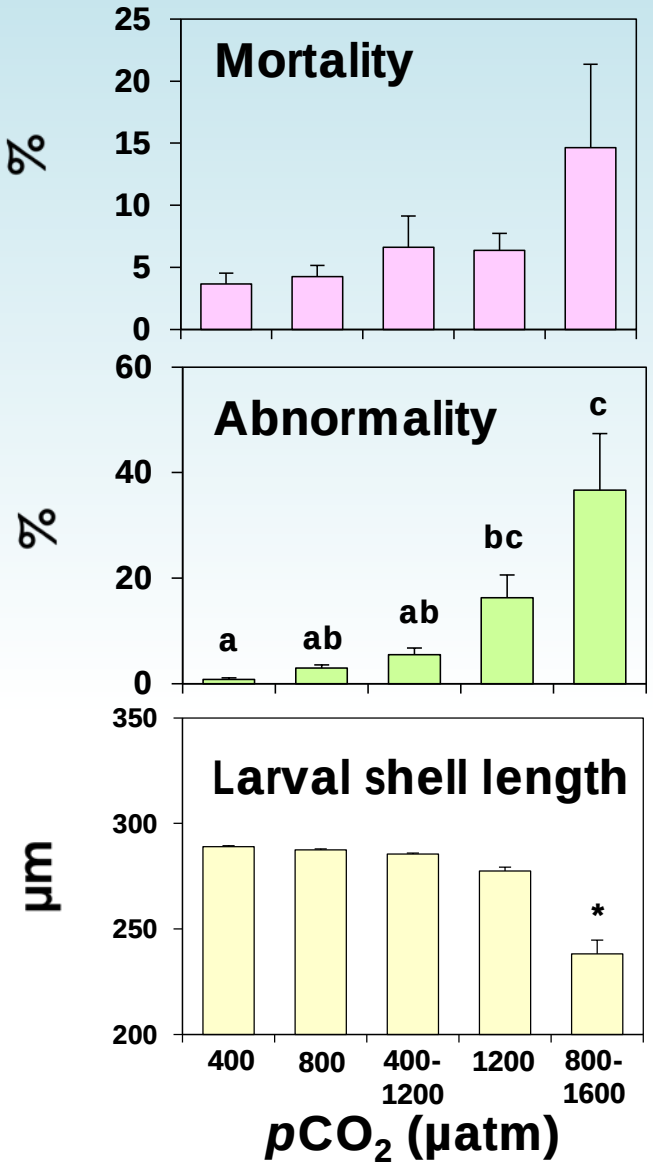
400-1200 µatm, 800-1600 µatm

Results of monitoring

(Solid lines)

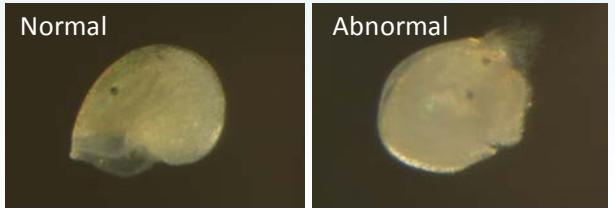
420-1189 µatm, 739-1537 µatm

Results : Effects on larval fitness

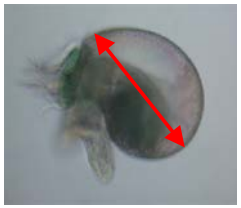


There were no significant differences in mortality rate among all the pCO_2 treatments.

Abnormality rate was significantly higher in the 1200µatm, and more in 800-1600 µatm

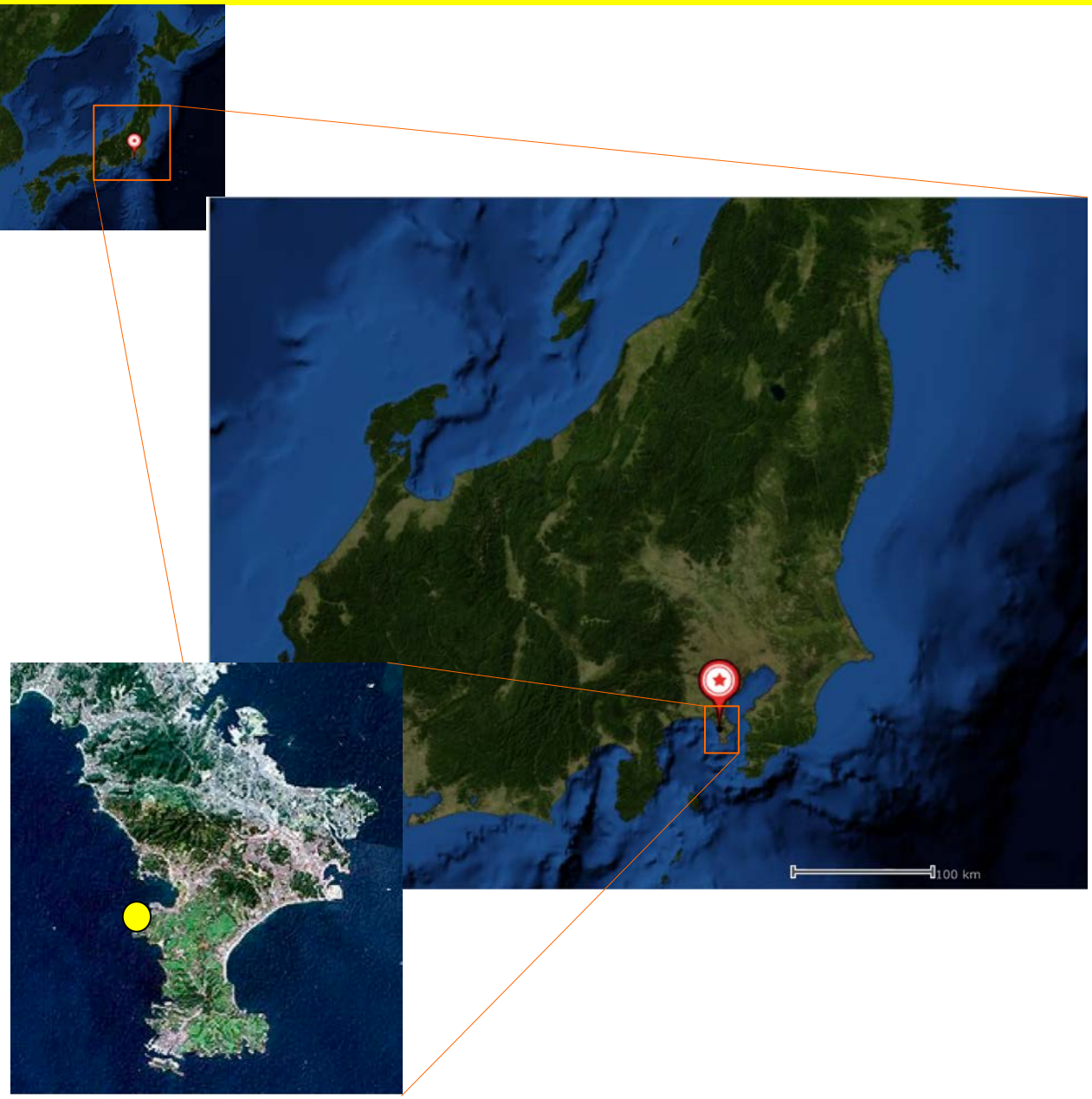


Shell length in the 800-1600 µatm was significantly shorter but not in the 1200µatm.



[Takami et al., in prep.]

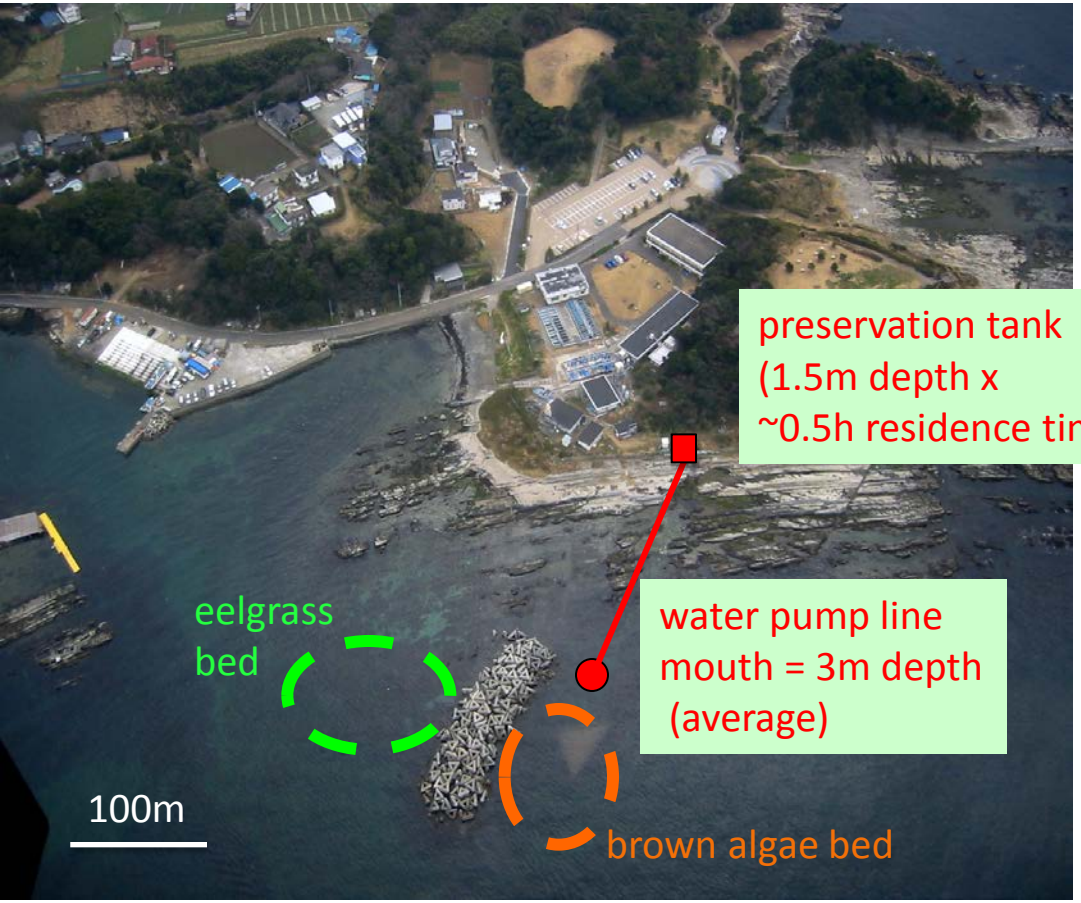
evaluation of pCO_2 diurnal cycle on typical Japanese coast: Arasaki district, Sagami-Bay (summer 2009 ~ spring 2011)



FRA Arasaki experimental station

- located at mouth of Sagami-Bay
  (low eutrophication, frequent intrusion of Kuroshio water)
- Cyclic occurrence of natural coastline & artifacts (ca, fishing port) every ~1 km
- typical "Sato-umi" coast in Japan

Location & observation degsin



24-h monitoring of pCO_2

- a portable membrane-type gas equilibrator was soaked into the preservation tank
  from 11:00 Aug. 24
  to 15:00 Aug. 25
- gas from the equilibrator was measured once an hour by NDIR
- water samples were taken from the tank every 3hour and measured DIC and Talk.

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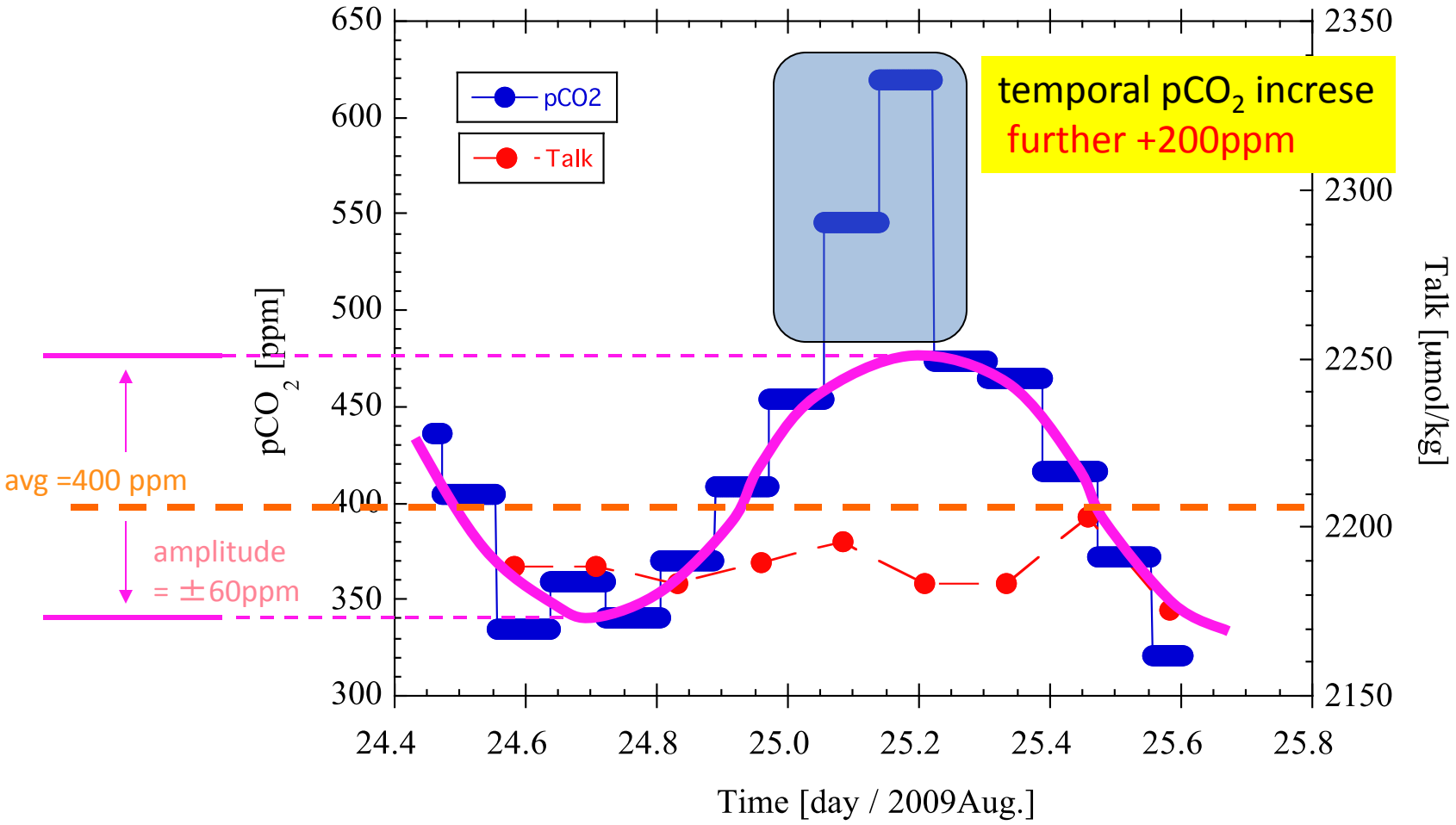
1-year composite pCO_2 variation

similar pCO_2 monitoring (without water sampling) was continued intermittently until Mar. 2011 to obtain composite 1-year monitoring data.

result of 24-hour pCO_2 monitoring

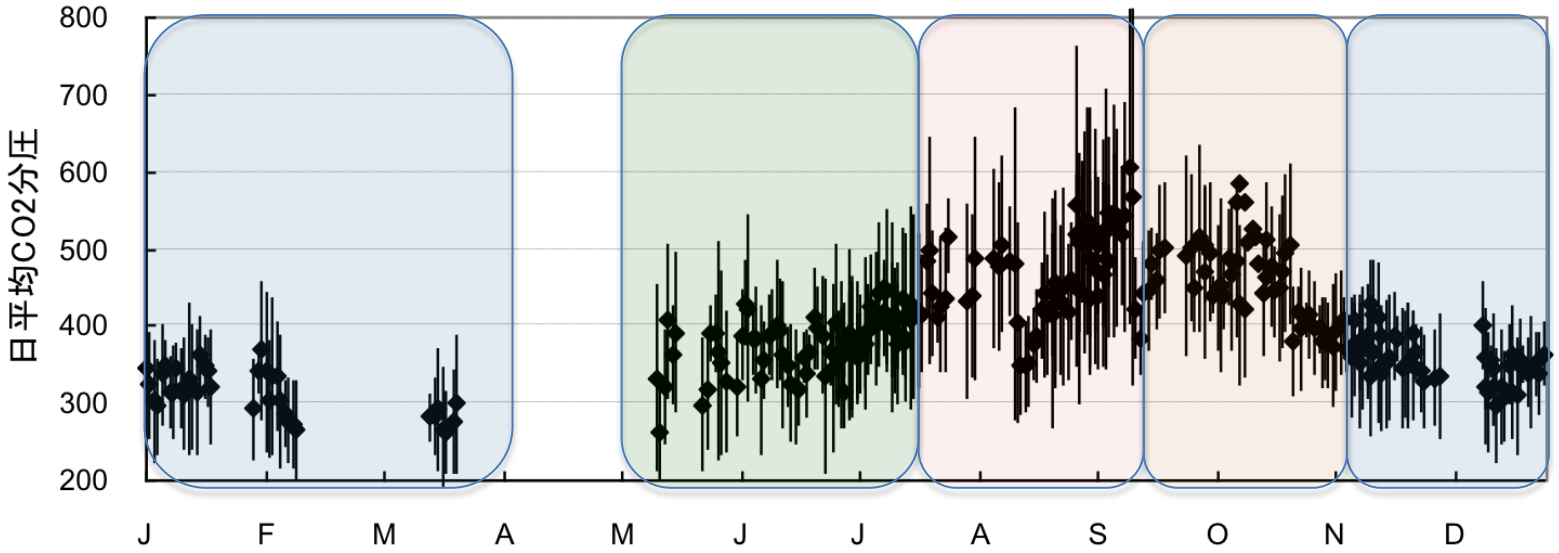


total diurnal pCO_2 variation.....about 300 ppm

where the high-pCO_2 water comes from?

- possible reason.....lateral transport of water from
  - # small fishing ports
  - # stagnant pool caused by artifacts

1-year composite data

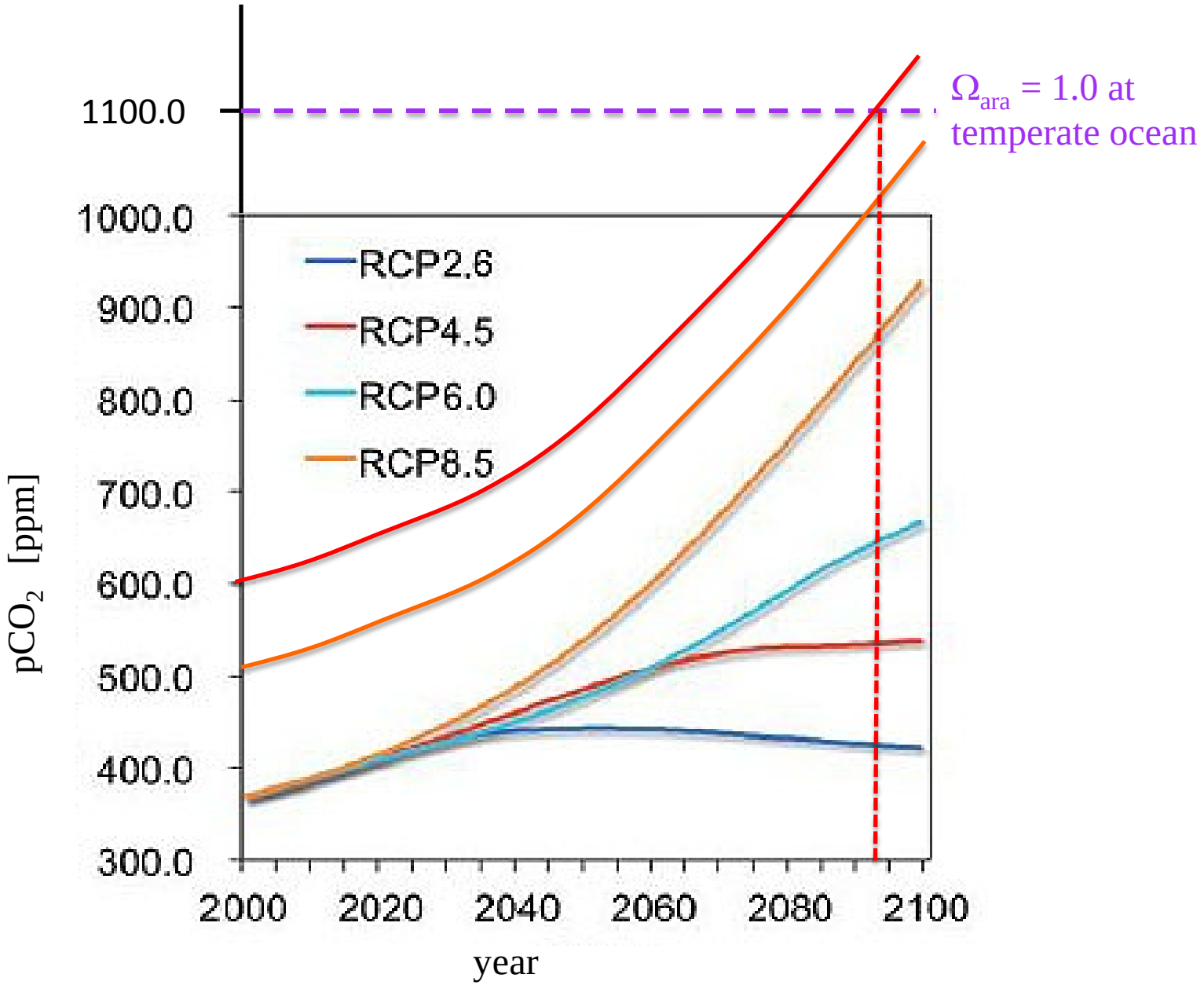


・significant seasonal dependence in the amplitude of diurnal pCO_2 variation

#winter (Nov. – Mar.)	~150 ppm
#spring (May –mid July)	~200ppm
#summer (mid July – early Sept.)	>300ppm (max. 400)
#autumn(mid Sept.-Oct.)	~200ppm

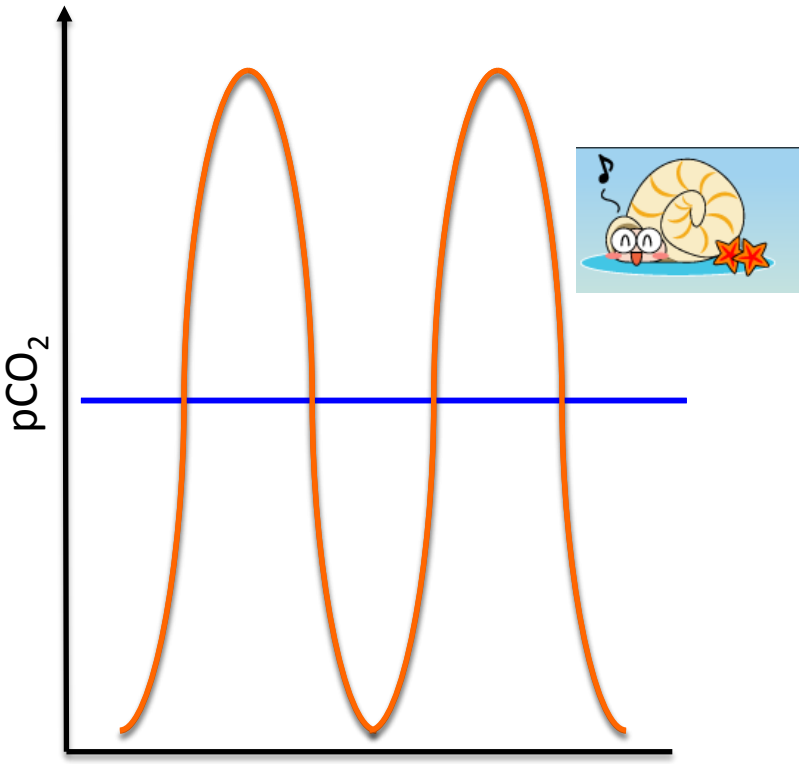
・Annual pCO_2 maximum: daily avg. 600ppm
with diurnal variation: >800ppm

future projection of ezo abarone in Arasaki coat:
with & without diurnal / seasonal variation

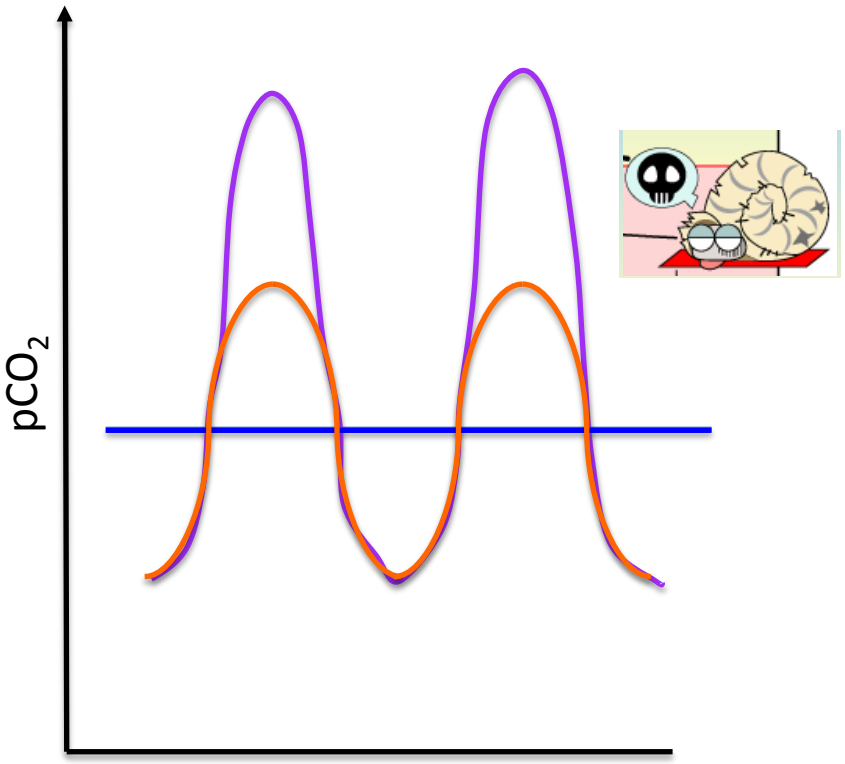


different biotic response between "natural eutrophication" and "polluted eutrophication"

natural eutrophication
(inner-Bay, estuary etc.)



polluted eutrophication
(arasaki district)



summary

- pCO_2 in shore-reef waters off Arasaki district shows significant seasonal variation (300 – 560 ppm) and diurnal variation (~150 ppm in winter and >300ppm in summer). As the combination of these two variation, annual pCO_2 maximum reaches over 800ppm even in present environment.

- Among >300ppm of diurnal pCO_2 variation in summer water, ca. 200ppm is considered to be due to lateral transport of CO_2 - polluted water from adjacent fisheries port.

- This type of acidification caused by "polluted eutrophication" is especially dangerous, as biota has not been adopted to high-CO_2.

- "Polluted eutrophication" process is thought to be typical in most of Japan coast, where natural and artificial coastline alternates frequently in small geographical scale. To assess this type of acidification, high-resolution coastal monitoring network of pCO_2 must be developed ASAP.