Testing some hypotheses on the outbreak mechanisms of *Cochlodinium polykrikoides* blooms in the southern coastal waters of Korea

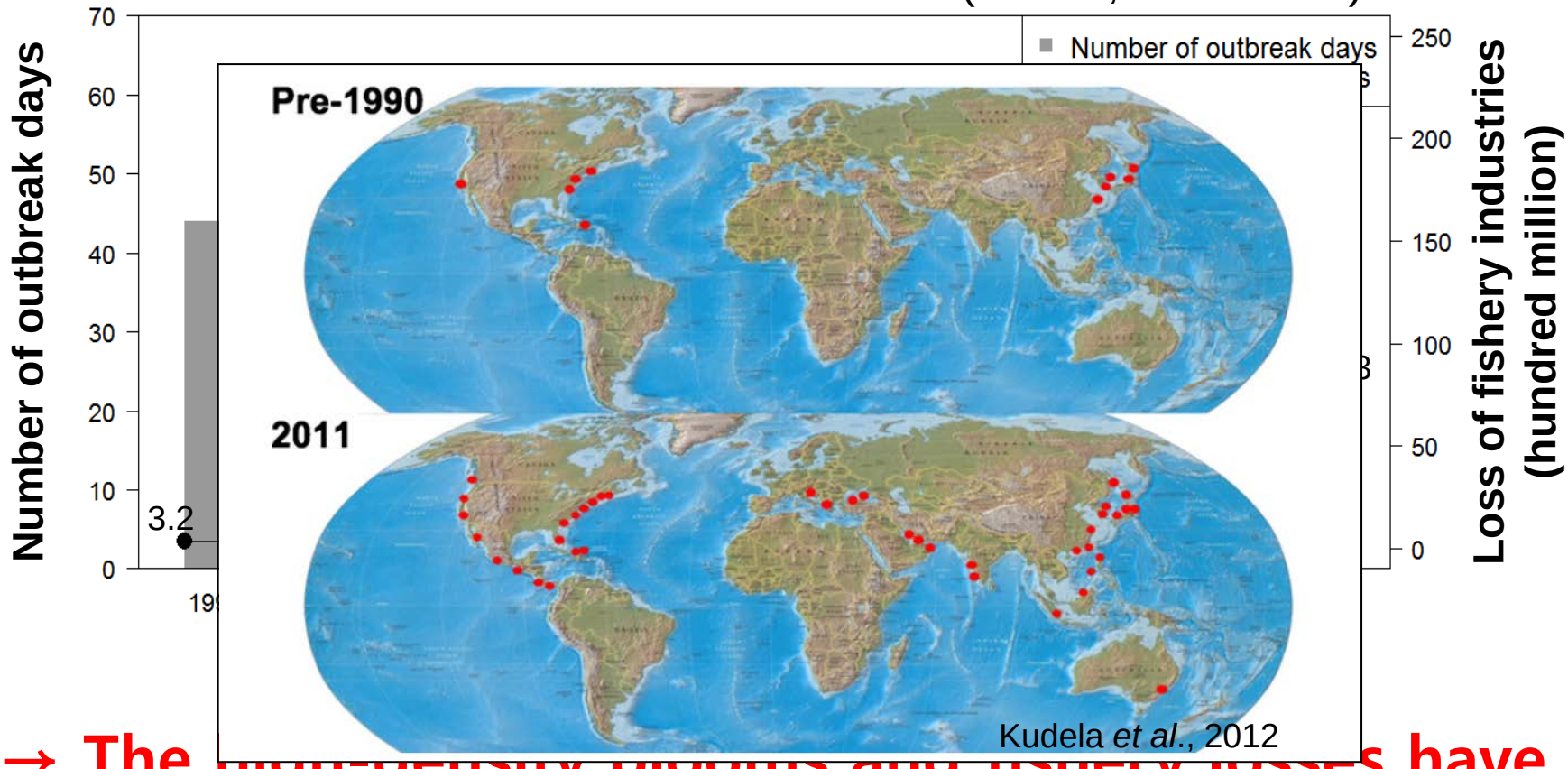
Yeseul Kim[1,2], Sinjae Yoo[1,2], Young baek Son[1], Soonmi Lee[1]

[1] Korea Institute Ocean Science & Technology
[2] Ocean Science & Technology School

Contents

Historical records of *C. polykrikoides* blooms

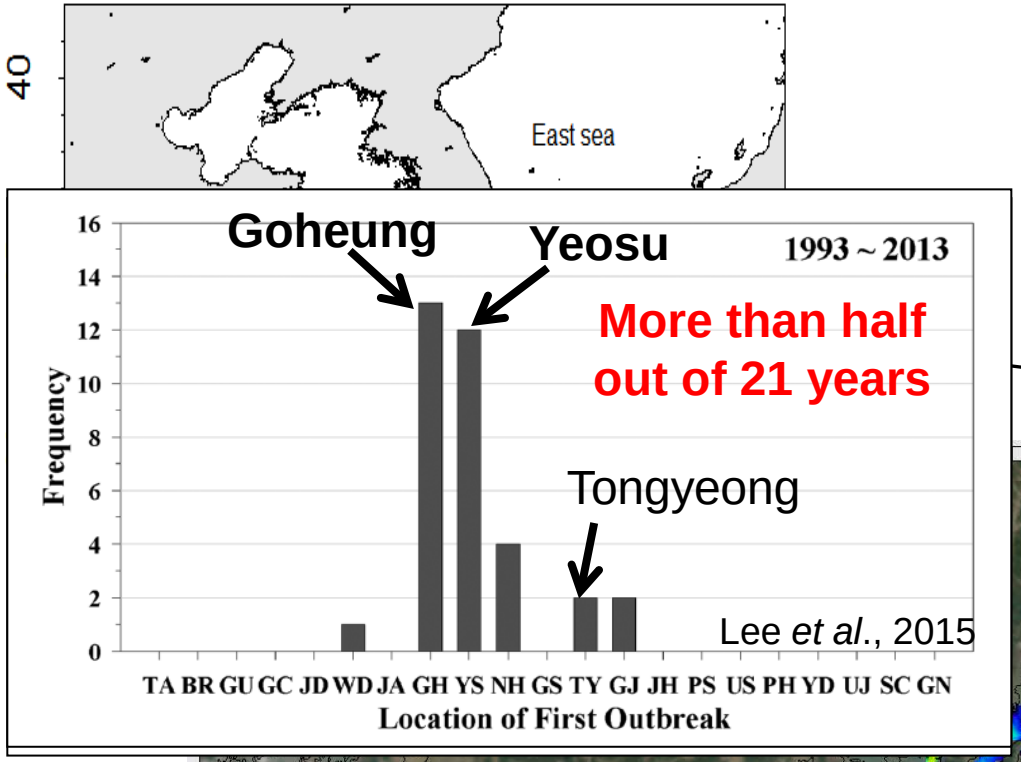
(NFRDI, 1999~2014)



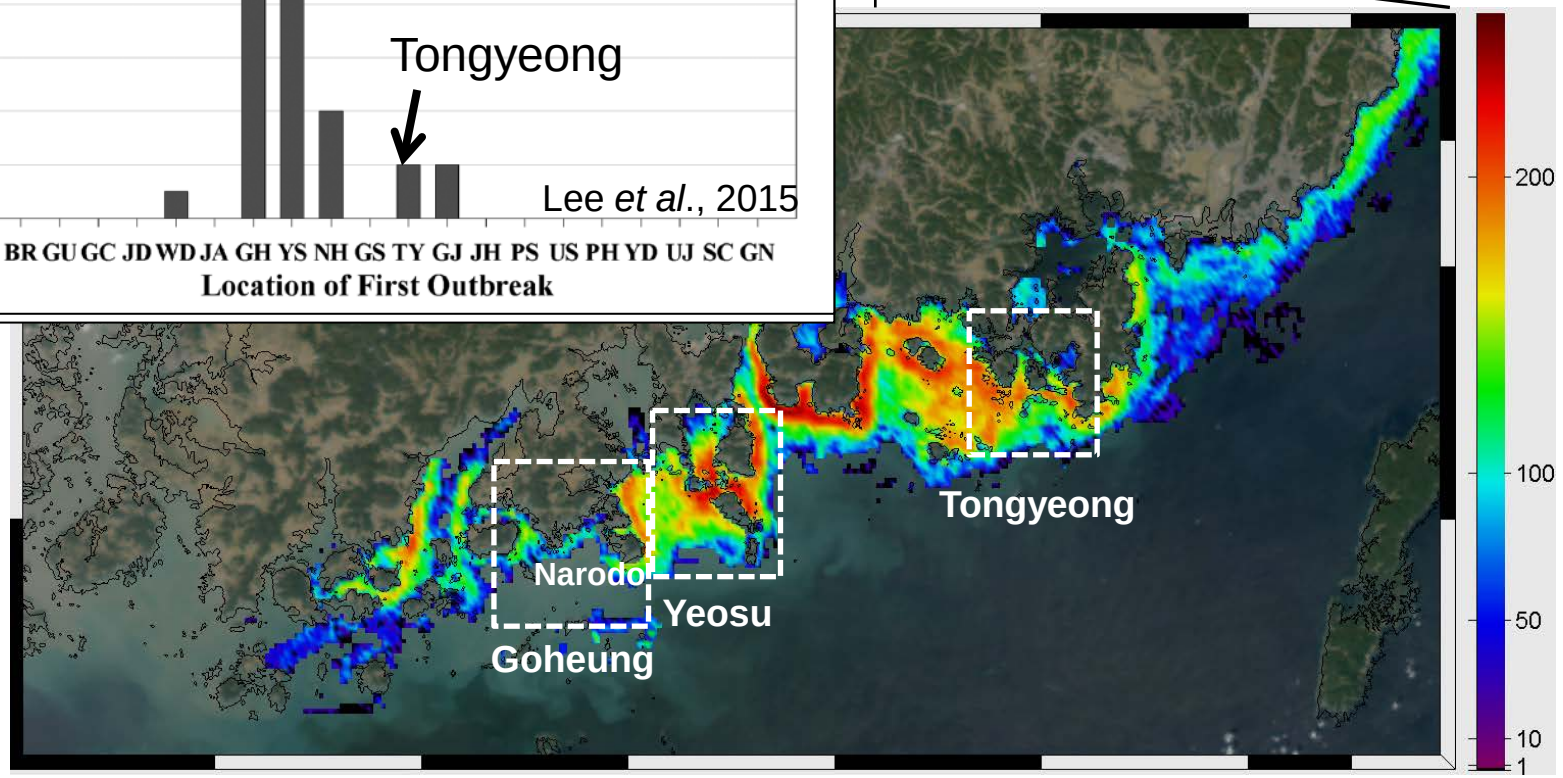
→ The high-density blooms and fishery losses have continuously occurred, except for 2011.

* The number of outbreak days: the days on which cell density was ≥1000 cells/ml

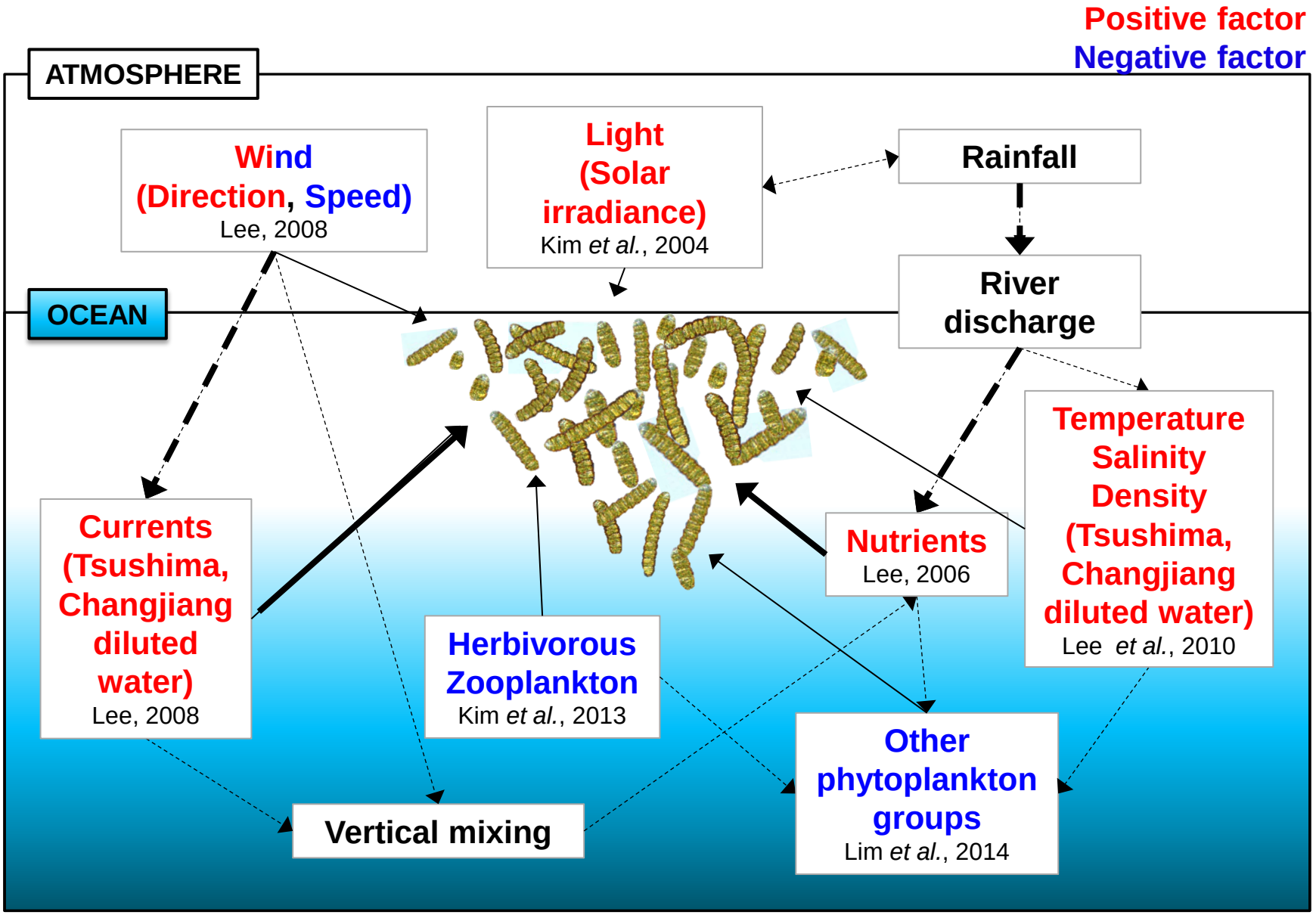
Study area

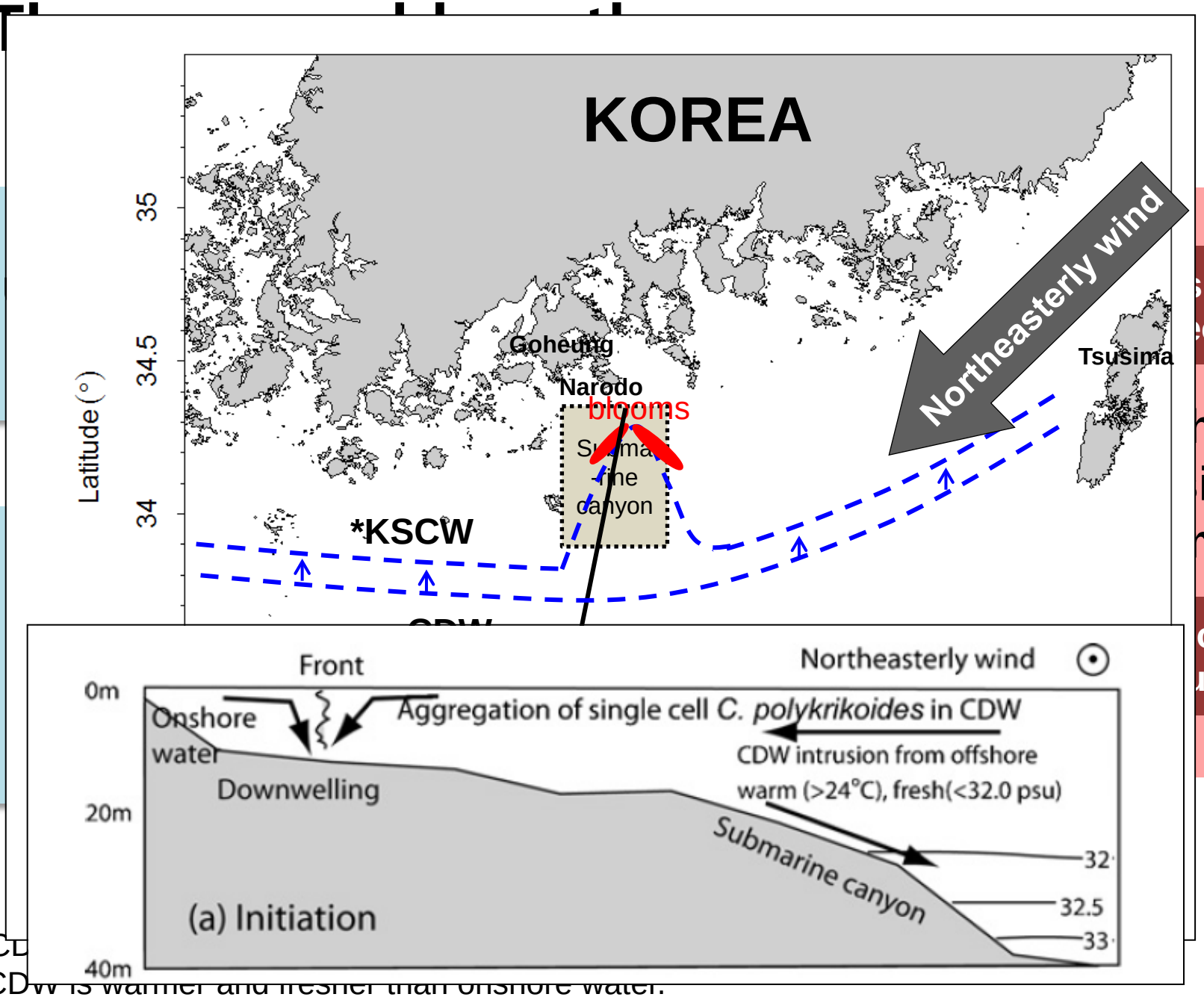


The cumulative frequency of *C. polykrikoides* blooms in 1999-2013



Possible processes of bloom formation

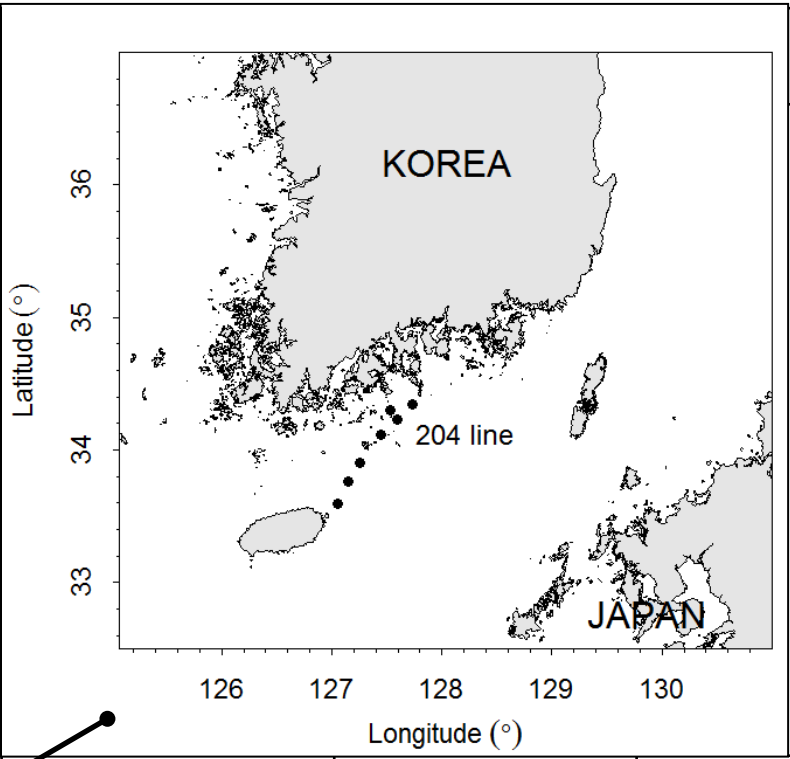




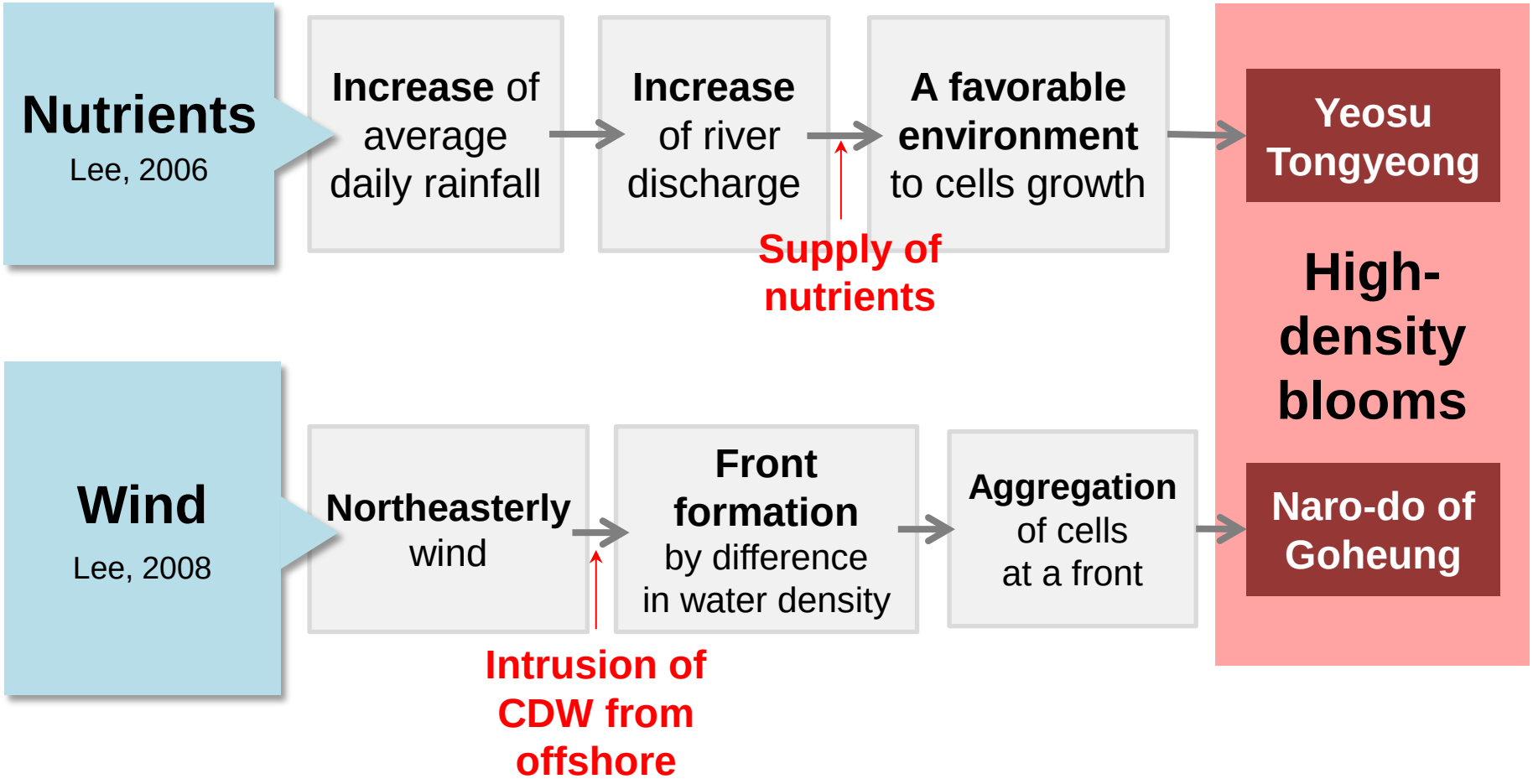
* CD
CDW is warmer and fresher than onshore water.

Data list

Category	Variable	Area covered			
Red tide information	Cell density	Goheung Yeosu Tongyeong			
	Duration of blooms				
	Outbreak days of blooms				
Nutrients-related	Rainfall	Yeosu, Jinju			
	River discharge	Seomjin river (Songjeong, Hadong2)			
Wind-related	Temperature	204 line (Around Goheung)	Bi-monthly	KODC (Korea Oceanic Data Center)	2000~2014
	Salinity				
	Wind direction	Southern coastal water	Daily	QuikSCAT (ASCAT)	
	Wind speed				

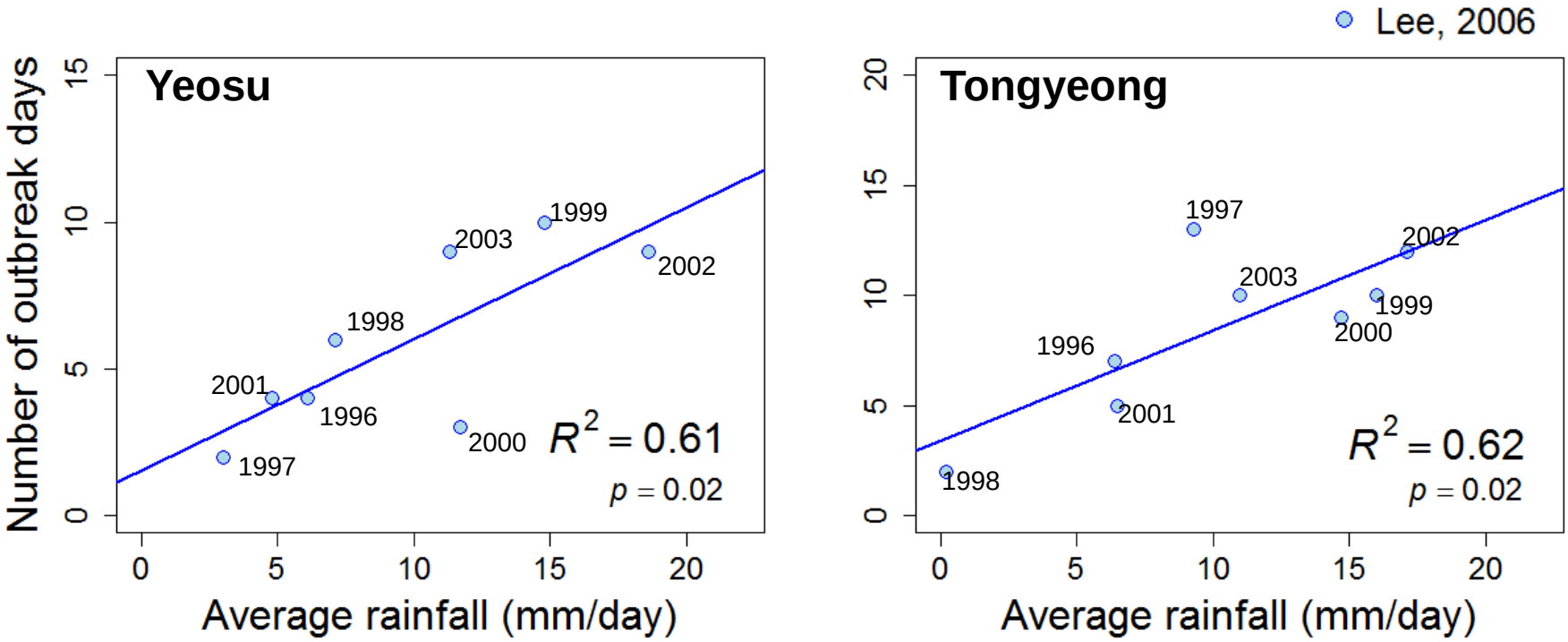


1. Nutrients



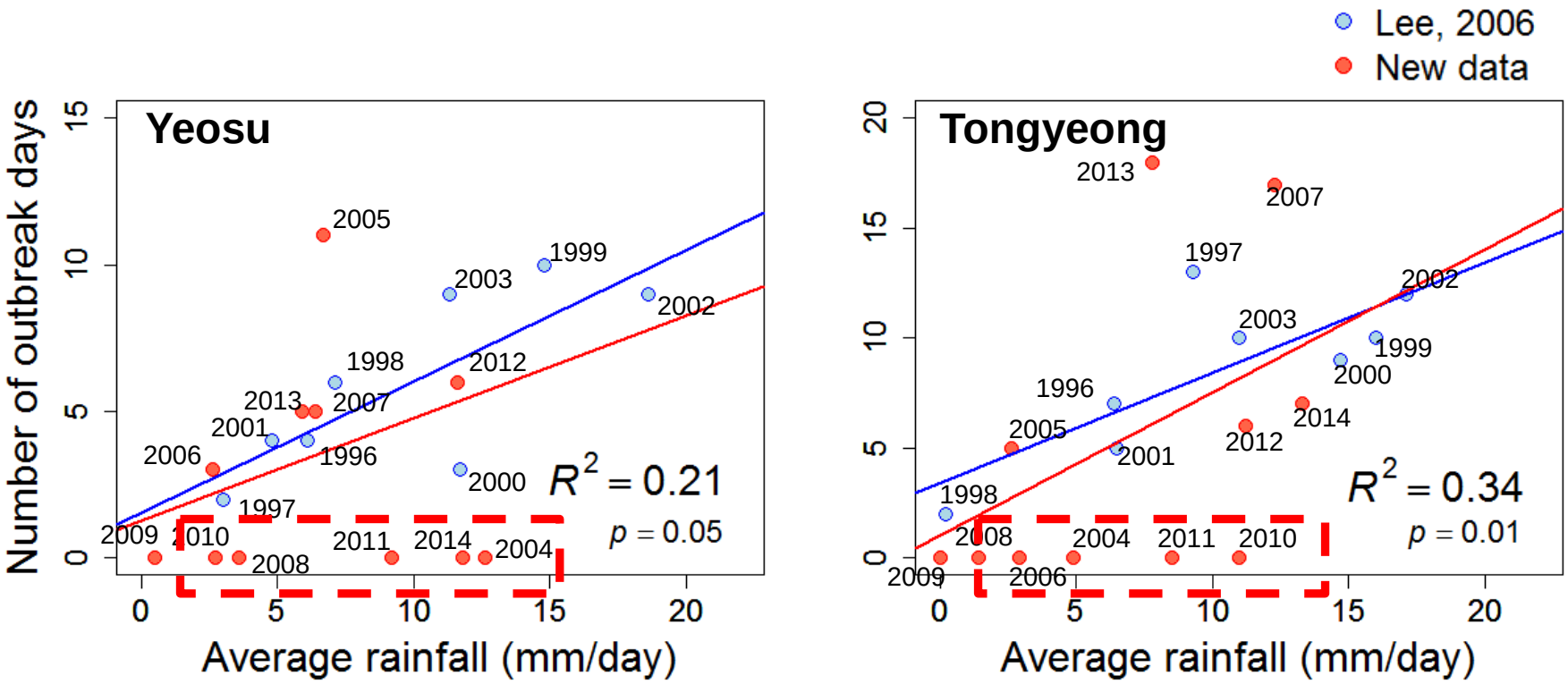
* CDW: Changjiang Diluted Water
  CDW is warmer and fresher than onshore water.

1. Nutrients: ① previous study (1996-2003)



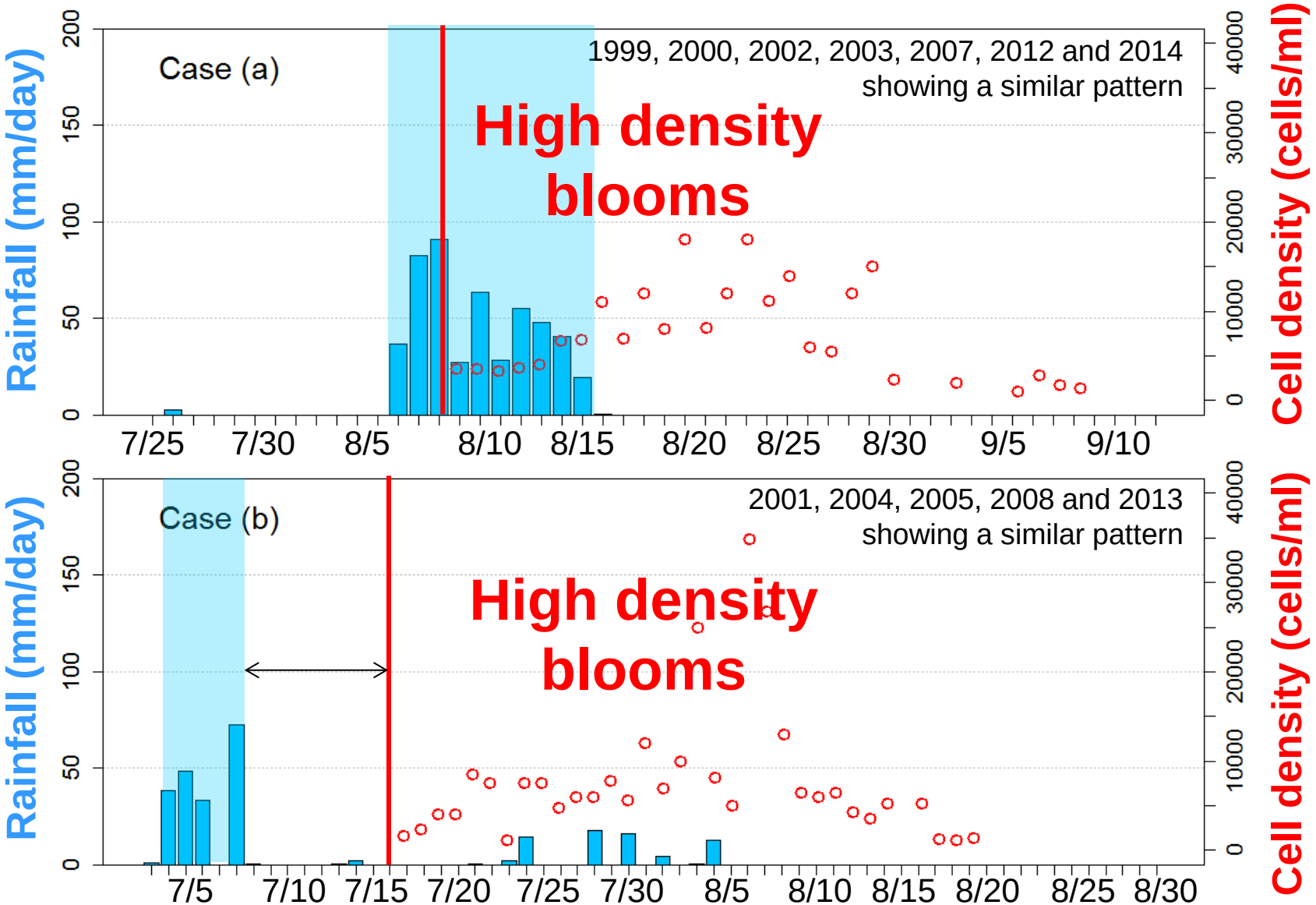
→ **Significant correlation between the average rainfall and the number of outbreak days (≥6000 cells/ml)**

1. Nutrients: ① previous study (1996-2003) + New data (2004-2014)

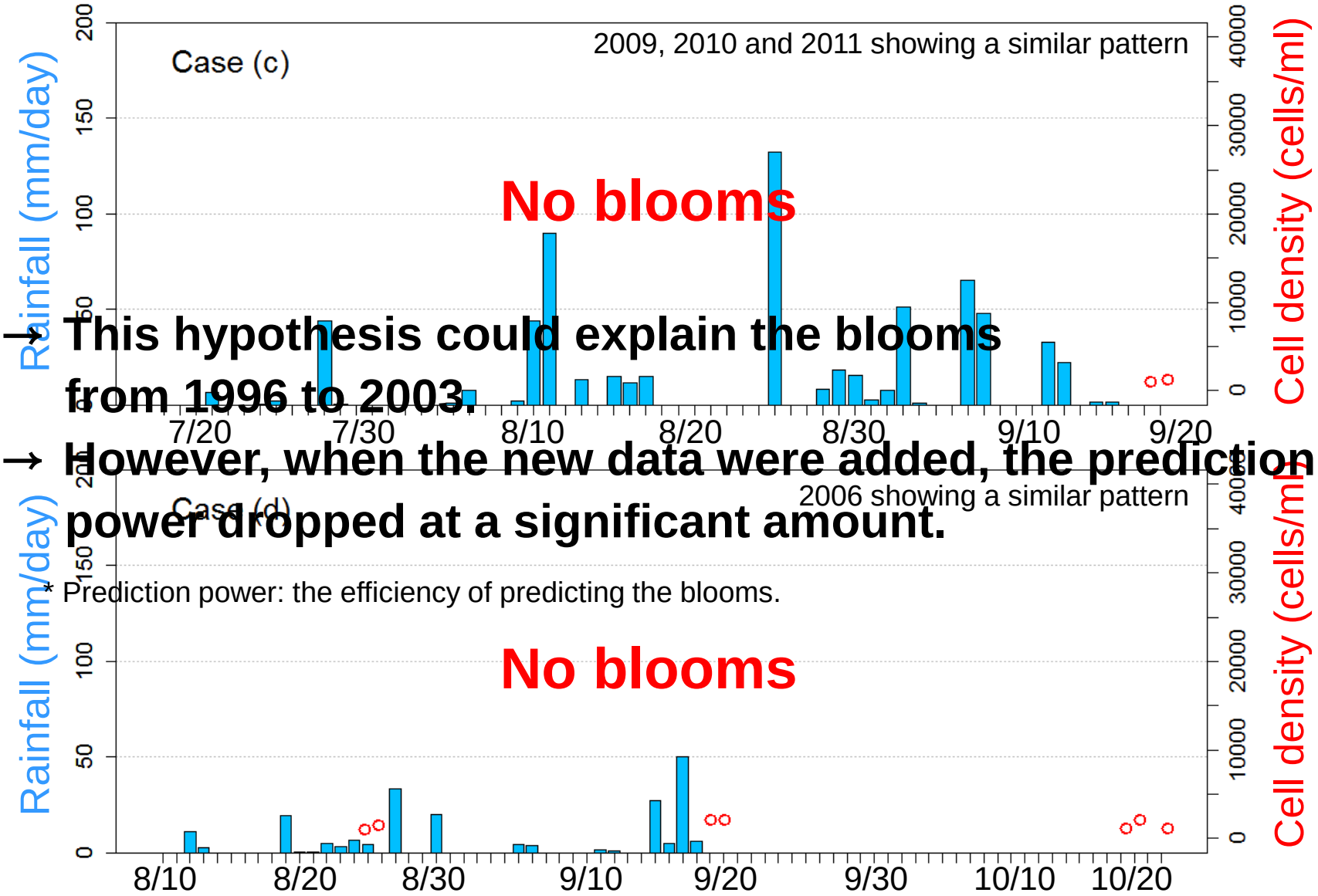


→ **When new data were added, this relationship is not useful in predicting occurrence of blooms.**

1. Nutrients: ② Case studies (Tongyeong)



1. Nutrients: ② Case studies (Tongyeong)

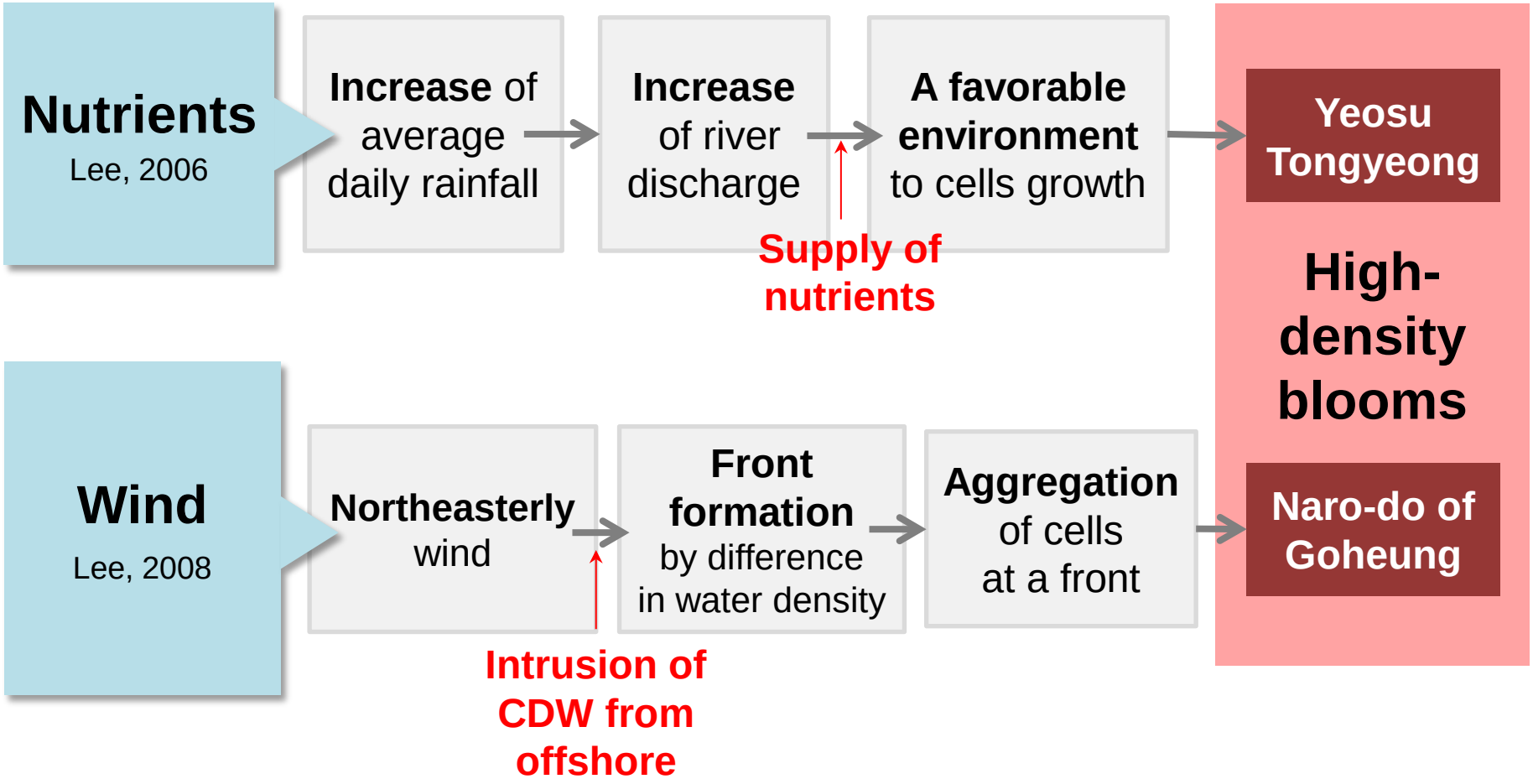


→ **This hypothesis could explain the blooms from 1996 to 2003.**

→ **However, when the new data were added, the prediction power dropped at a significant amount.**

* Prediction power: the efficiency of predicting the blooms.

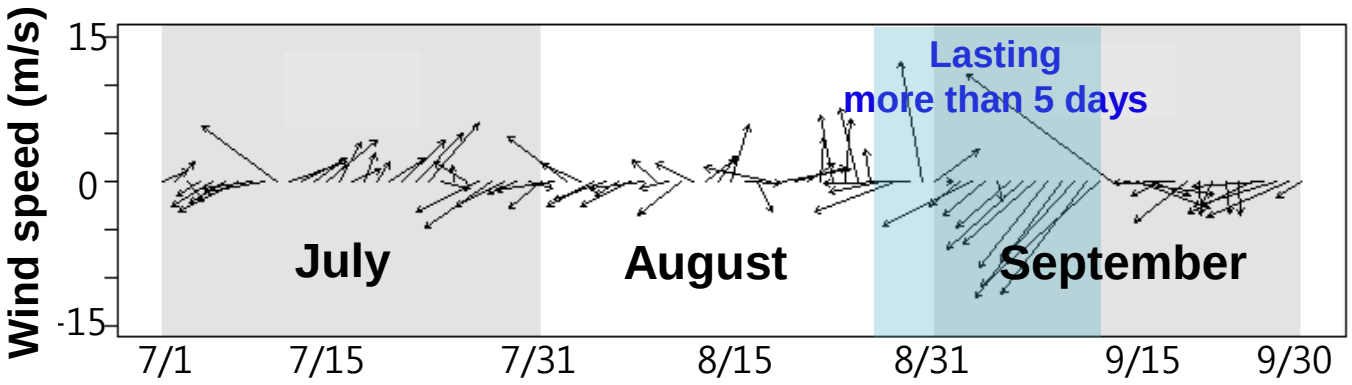
2. Wind direction



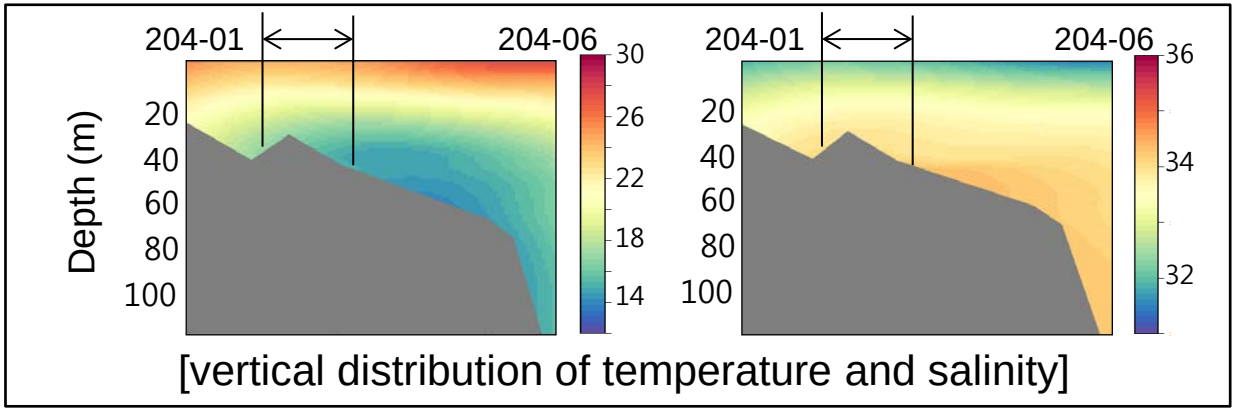
* CDW: Changjiang Diluted Water
  CDW is warmer and fresher than onshore water.

2. Wind direction: Case study (2000)

① Northeasterly wind



② Front formation



2. Wind direction: Prediction vs. actual blooms

	①	②	③	④	
Year	Northeasterly wind	Front formation	Prediction (IF ① And ②)	Actual blooms in Narodo	Verification (time matching of ③ and ④)
2000	+	+	+	+	+
2001	+	+	+	+	+
2002	+	-	-	+	-
2003	+	-	-	+	-
2004	+	-	-	-	-
2005	+	+	+	+	-
2006	+	+	+	+	+
2007	+	+	+	+	-
2008	+	+	+	-	-
2009	+	-	-	-	-
2010	+	+	+	-	-
2011	+	+	+	-	-
2012	+	-	-	+	-
2013	+	+	+	-	-
2014	+	-	-	+	-

1/3 matched

Rainfall hypothesis

Lee, 2006 suggested a causal relationship between the rainfall and the number of outbreak days of blooms and showed a significant relationship between the two from 1996 to 2003 at Yeosu and Tongyeong. However, when new data were added, the relationship degraded. Furthermore, it could not explain **1/4 of the outbreak cases** in about 20 years.

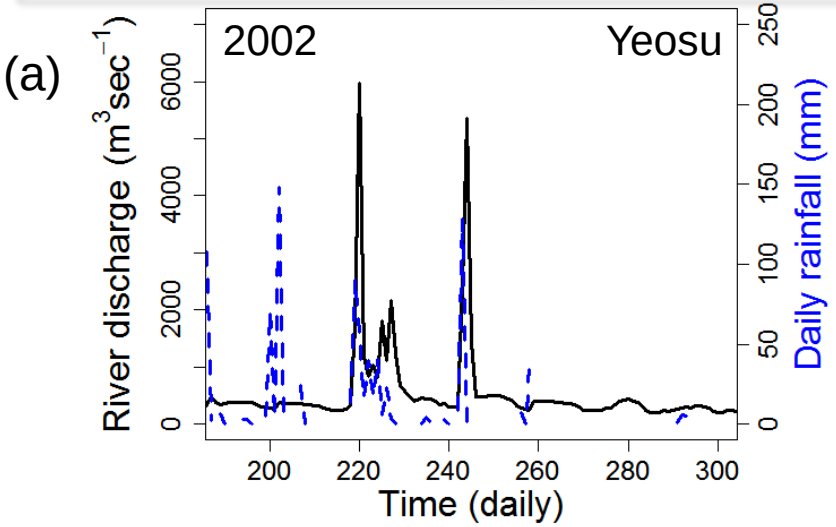
Aggregation-at-front hypothesis

Lee, 2008 proposed a hypothesis on aggregation of cells at front by northeasterly wind near Narodo.

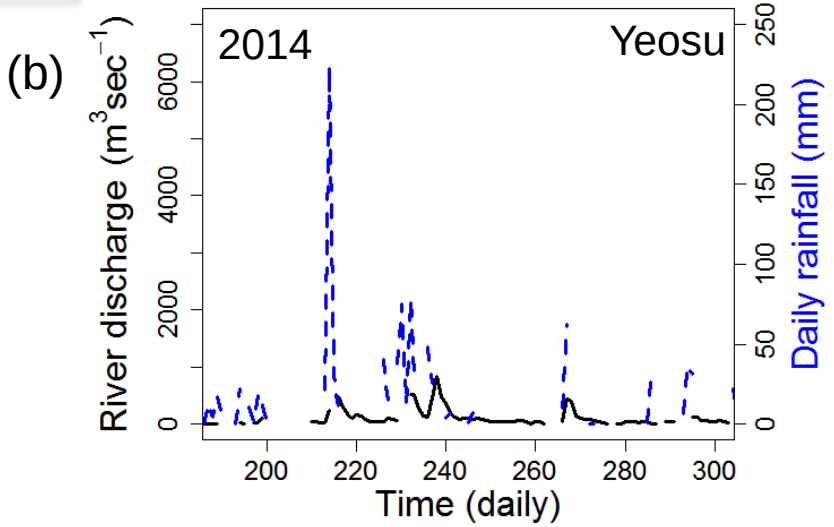
The match-mismatch test for this hypothesis showed that it could not explain about **2/3 of the blooms** near Naro-do during the past 15 years .

Possible limitations of the tests

Rainfall hypothesis



Rainfall↑→River discharge↑



Rainfall↑→River discharge ?

Aggregation-at-front hypothesis

- The observation time interval of the used data is once every two months. It was possible that some short-term front formation was not detected.

Conclusion

- *Cochlodinium polykrikoides* blooms have plagued the southern coastal region of Korea for more than 20 years.
- A few areas show high frequency of bloom initiation.
- We tested two hypotheses why these areas are prone to the outbreaks.
- The two hypotheses did not stand up against the new data.

Thank you for your attention!