2nd Field Survey Report for Palu Tsunami 2018

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Survey Members & Itinerary(from Japan)

Taro Arikawa

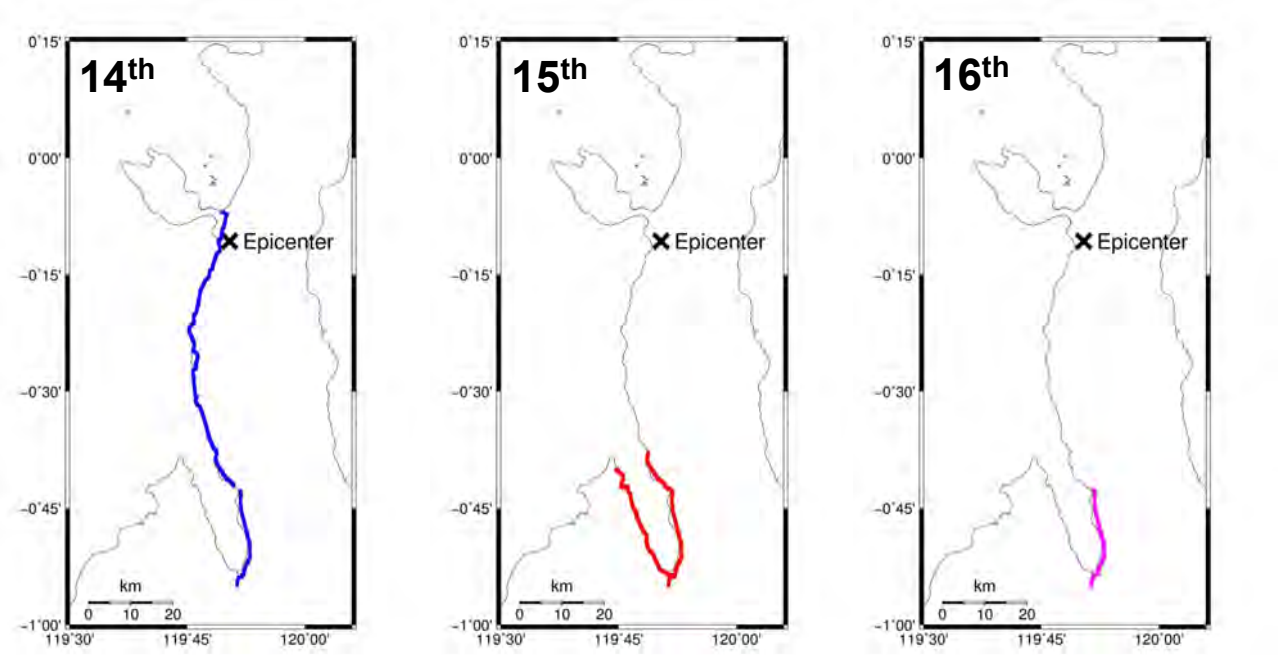
Yoshihiro Okumura

Yuji Dohi

- 12th / Oct, Tokyo (Osaka) to Jakaruta (13th)
- 13th / Oct, Jakaruta to Palu
- 14th~16th / Oct, Field Survey in Palu
- 16th / Oct Palu to Jakaruta
- 16th / Oct Jakaruta to Tokyo (Osaka) (17th)

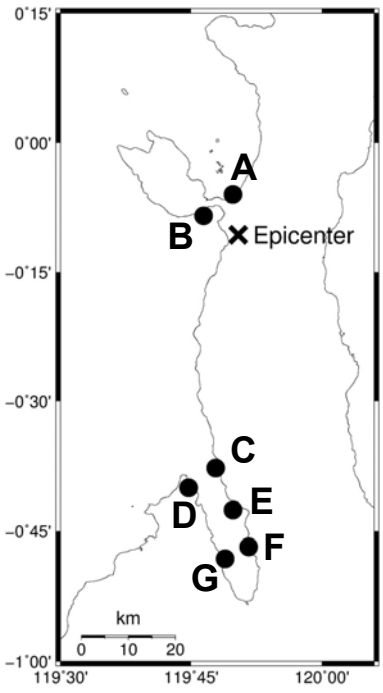
Itinerary (field survey)

14th, East coast of the Bay of Palu
15th, East and west coast of the Bay of Palu
16th, East coast of the Bay of Palu



Possible subsidence areas or tsunami source areas along the coast

Distribution of the Possible subsidence areas or tsunami source areas based on the results of the field survey

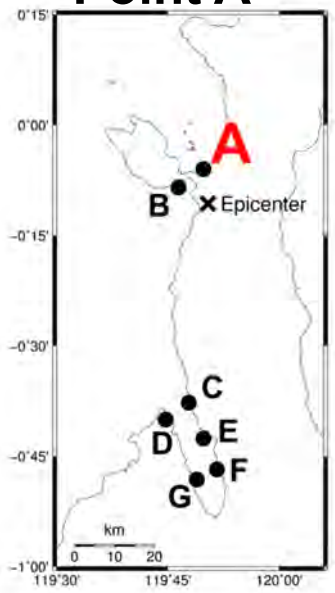


Source	Date of the survey	Lon.*	Lat.*
A	14th / Oct	E 119.821	S 0.117
B	14th / Oct	E 119.810	S 0.140
C	15th / Oct	E 119.812	S 0.629
D	15th / Oct	E 119.745	S 0.667
E	15th / Oct	E 119.859	S 0.711
F	16th / Oct	E 119.870	S 0.797
G	15th / Oct	E 119.806	S 0.803

* Lon. and Lat. indicate the survey points on the land.

Possible subsidence area (Tsunami source)

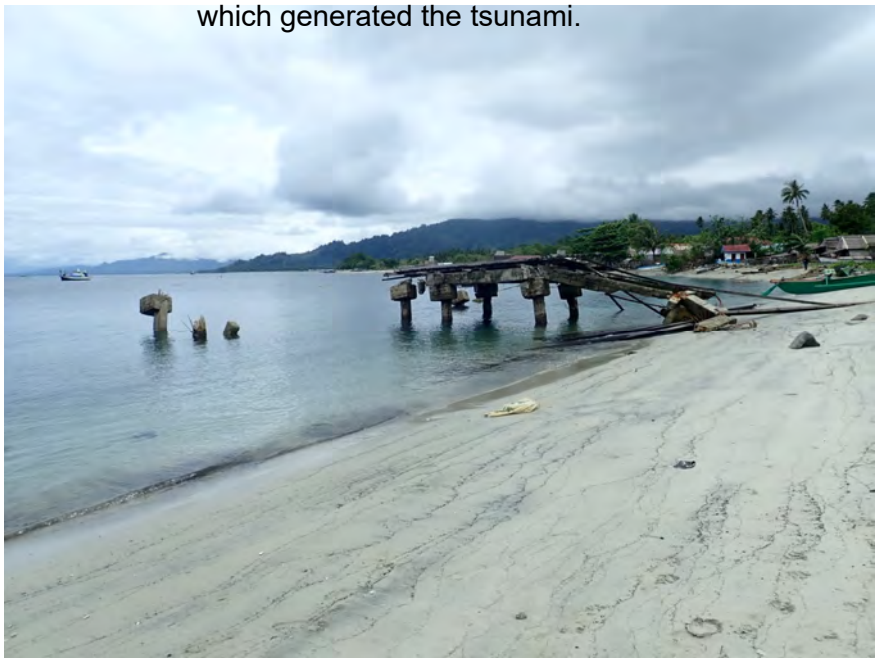
Point A



Lon.*	Lat.*
E 119.821	S 0.117

* Lon. and Lat. Indicate the survey points on the land.

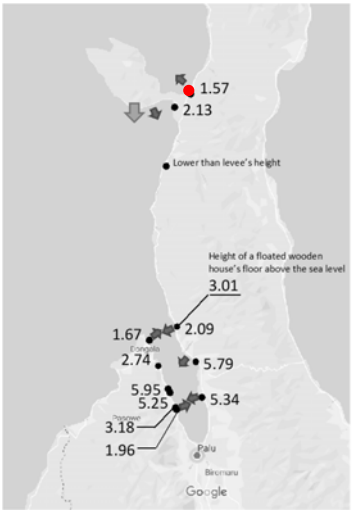
The slope of the beach was so steep because of the subsidence due to the earthquake. Here, the tsunami was generated soon after the earthquake. This eyewitness indicated that the subsidence might be occurred by the submarine landslide which generated the tsunami.



ID1

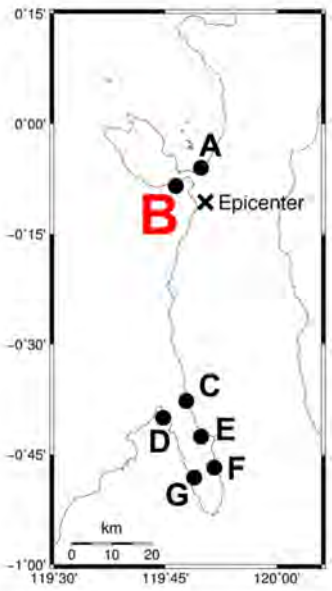
Tsunami Height and Behavior at Point A

- Run up height is 1.57m
- After the earthquake, the sea level fell down and seemed to hit in the offing, after that the tsunami headed for the shore



Possible tsunami sources

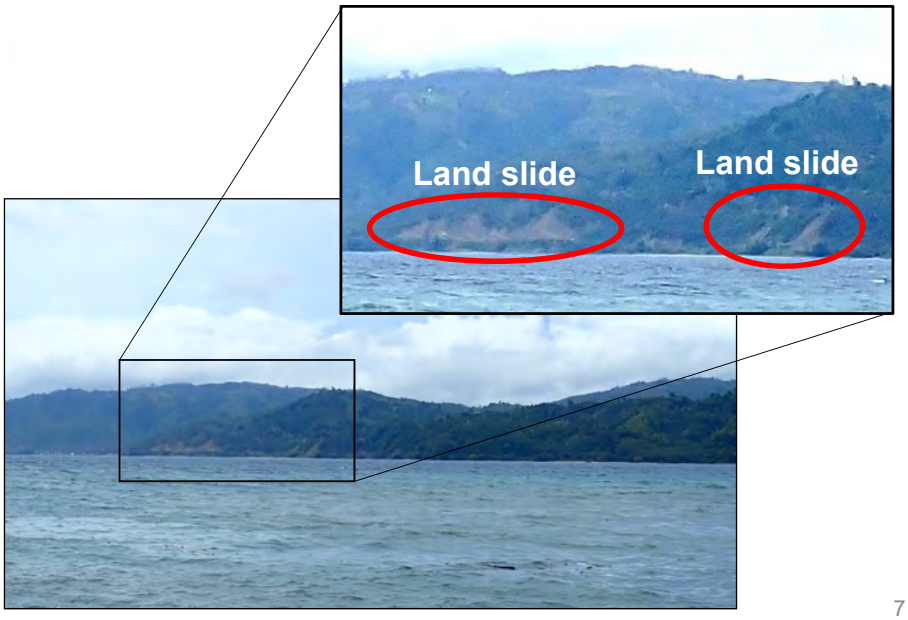
Point B



Lon.*	Lat.*
E 119.810	S 0.140

* Lon. and Lat. Indicate the survey points on the land.

From the interview, there were eyewitness testimony that the tsunami arrival time in the surrounding area was several minutes and the tsunami went to Palu. Also, since a large cliff collapse is observed near point B, it is speculated that a tsunami occurred at point B due to fault displacement and landslide.

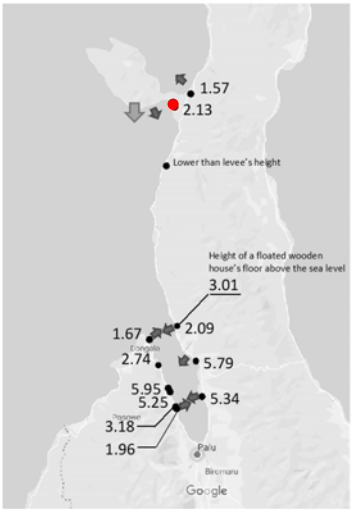


State of Landslide at Point B

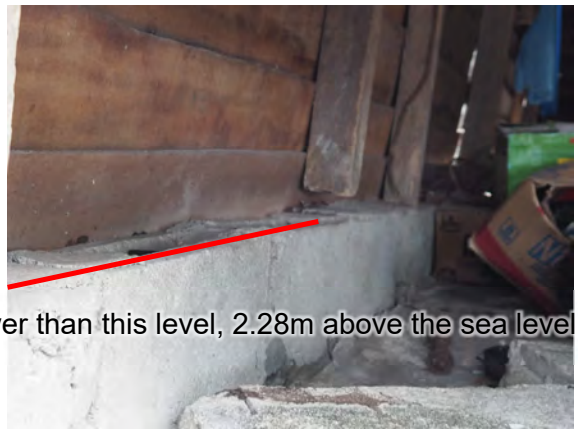
Courtesy to Akihiro Nakajima, Jakarta Shinbun

The height of the tsunami around the point B

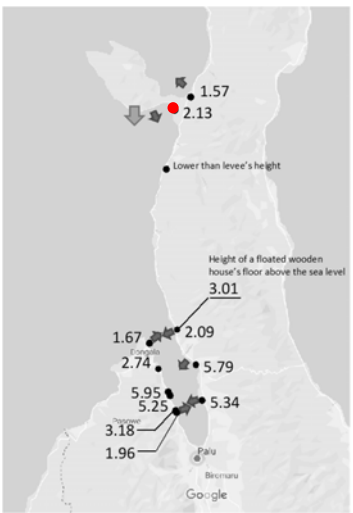
There was no water marks inside a wooden building.
At least, a tsunami height is lower than the upper of the concrete block of the foundation.



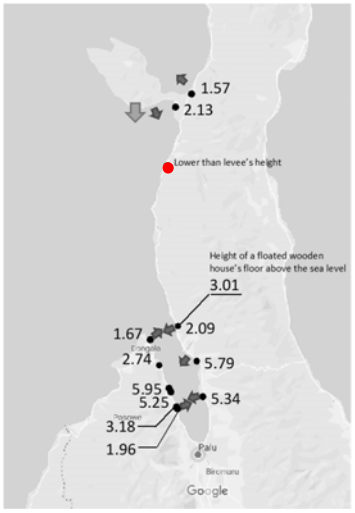
ID2



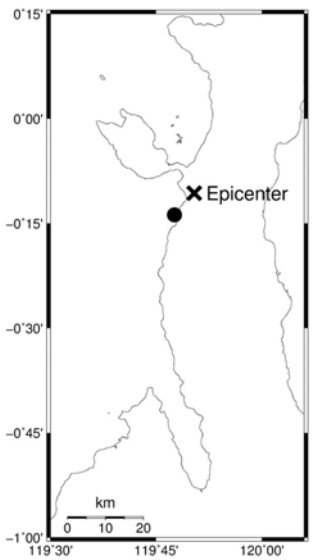
ID3



ID5



More information…



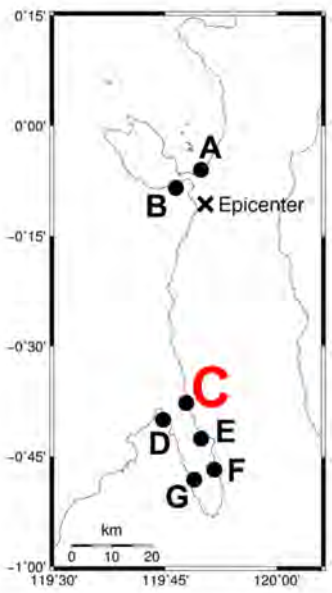
The slope seen at the coast can be considered to be the subsidence?
This subsidence indicates the possibility of the tsunami source resulted from the land slide under the sea?

Date of the survey	Lon.*	Lat.*
14th / Oct	E 119.803	S 0.230

* Lon. and Lat. Indicate the survey points on the land.

Possible subsidence areas

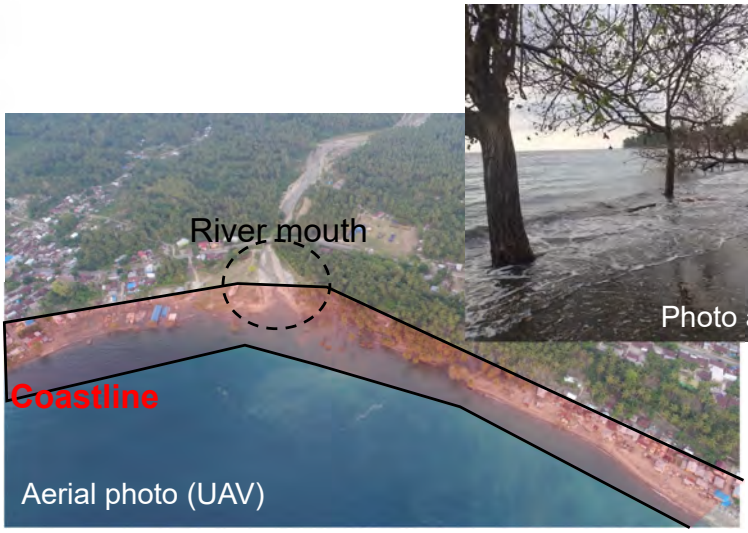
Point C



Lon.*	Lat.*
E 119.812	S 0.629

* Lon. and Lat. Indicate the survey points on the land.

The slope seen at the coast can be considered to be the subsidence.
Additionally, it can be seen that a lot of sediment can be supplied around the river mouth at the aerial photo.



ID14

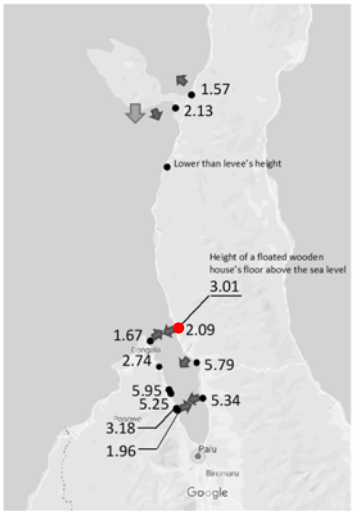
Scene of crack at point C

Sea side

Mountain side

ID13

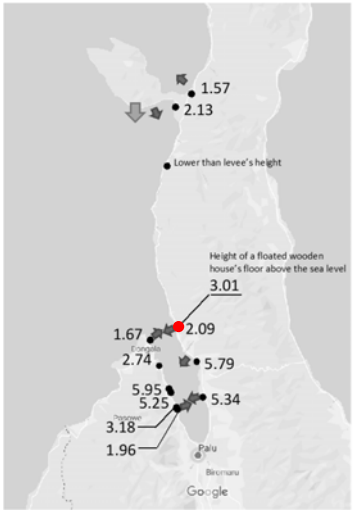
Tsunami Height at Point C

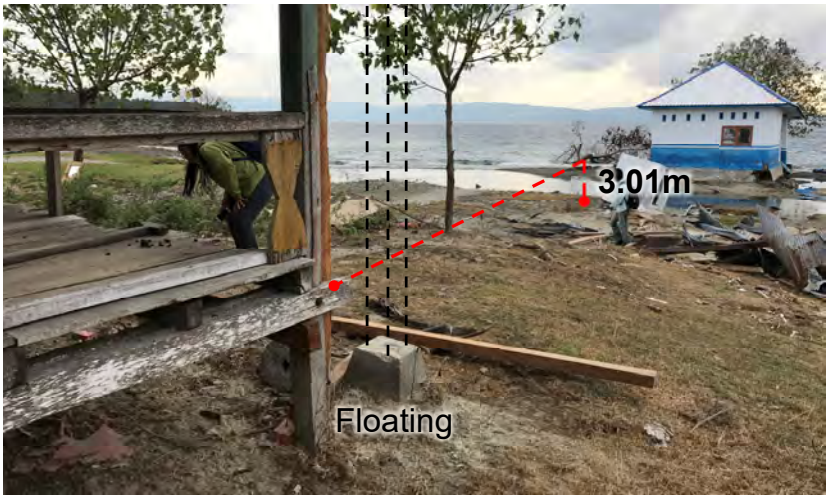


ID14

Tsunami Height at Point C

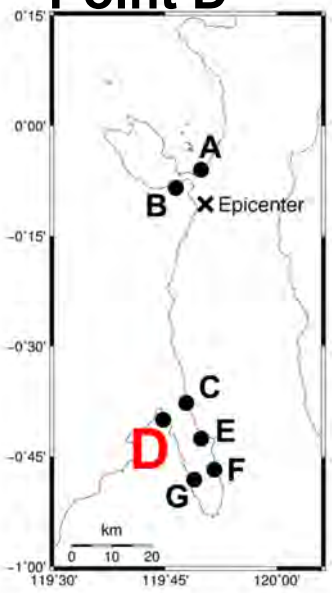
At least 3.01m height of tsunami arrived at this area because of a floating wooden building. Flow depth is 2.09m here.





Possible subsidence area (Tsunami source)

Point D



Lon.*	Lat.*
E 119.745	S 0.667

* Lon. and Lat. Indicate the survey points on the land.

The tilted house can be seen.
Additionally, some houses sank into the sea after the earthquake, base on the testimony by the diver who dived into the sea around here on the day after the earthquake.
These phenomena indicates the possibility of the submarine landslides here.

ID6

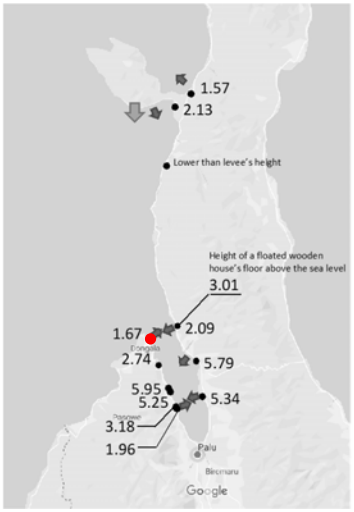
Scene of step at the pier due to subsidence of the ground at point D

Due to the bottom of the offshore side of the pile of the pier might be subsidence, it can be seen that the shore side is raised

ID6

Tsunami Height and Behavior at Point D

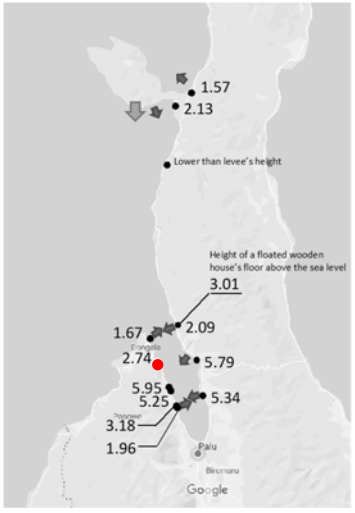
- Inundation height is 1.67m
- Because the sea overflowed soon after the earthquake, they ran away to the hill. On the way to the evacuation, they saw tsunami inundated in the river.



ID7

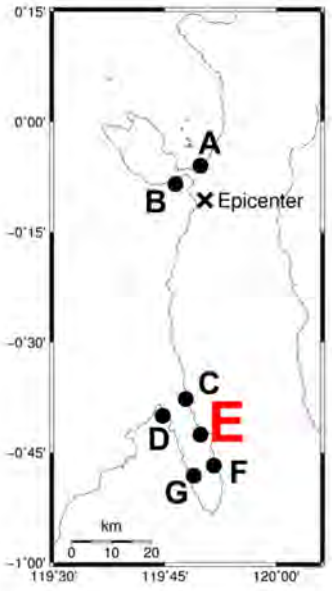
Tsunami Height and Behavior near by Point D

- There was no evidence of the subsidence here.
- The tsunami arrived in 10 minutes after the earthquake



Possibility of Subsidence at Point E

Point E

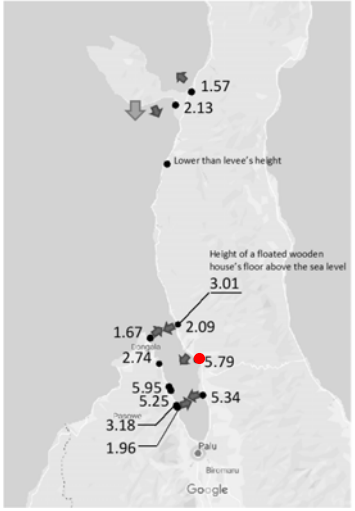


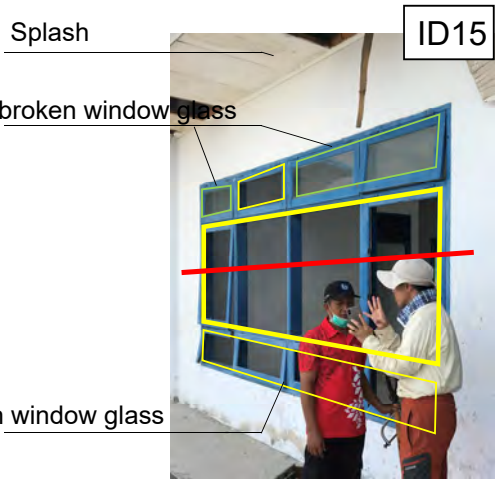
Lon.*	Lat.*
E 119.859	S 0.711

* Lon. and Lat. Indicate the survey points on the land.

At the Pantoloan Port, the settlement could not be seen from the land. On the other hand, in Wani 2 village just to the north of it, there was a possibility of the subsidence (see the result of the first survey)

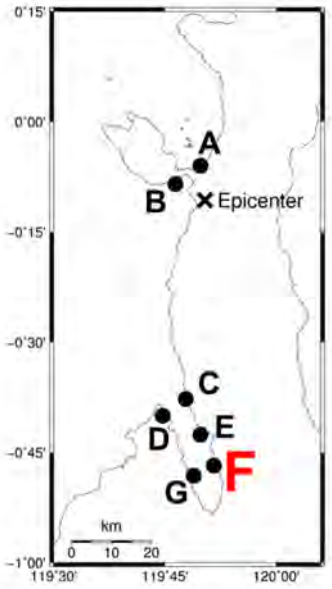
Tsunami Height at Point E





Possible subsidence area

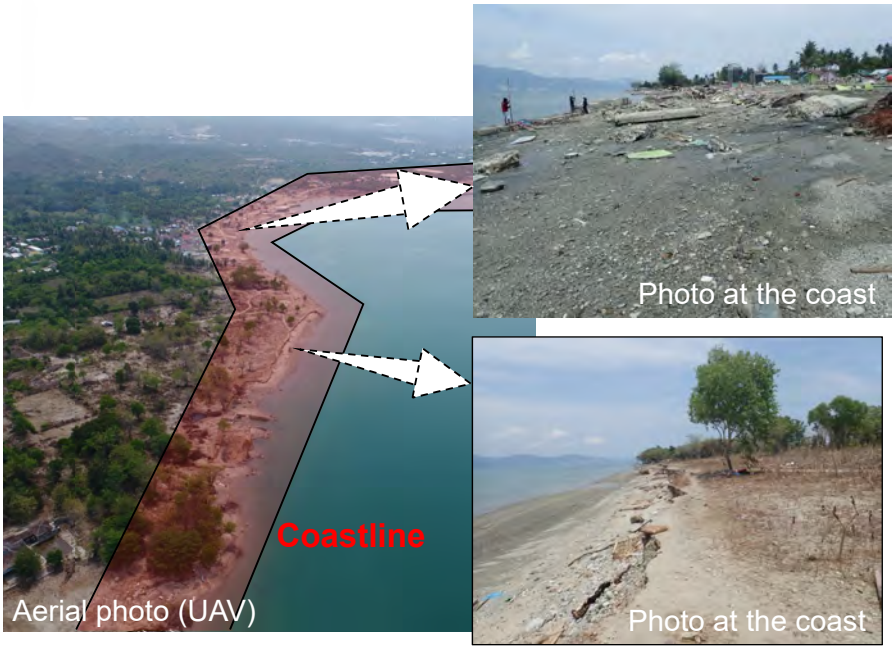
Point F



Lon.*	Lat.*
E 119.870	S 0.797

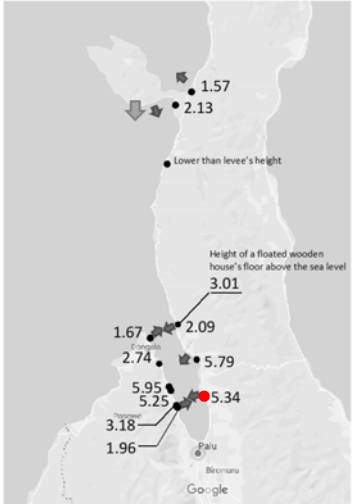
* Lon. and Lat. Indicate the survey points on the land.

The area around here seems to have subsided entirely. A comparison by Google Earth is also shown in the subsequent slides. On the other hand, the possibility that there was a step on the sand beach before the earthquake occurred can not be denied



ID16

Tsunami Height and Behavior at Point E



Google Earth

20180927

20181002

Google Earth

20180927

20181002

Google Earth

20180927

20181002

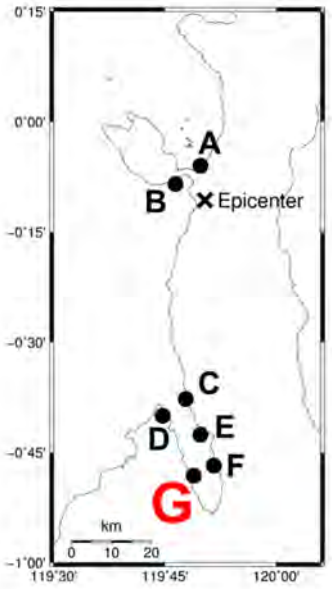
Google Earth

20180927

20181002

Possible subsidence area (Tsunami source)

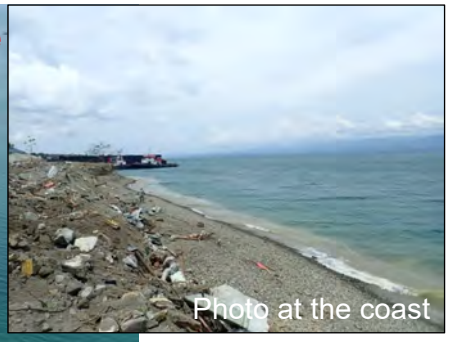
Point G



Lon.*	Lat.*
E 119.806	S 0.803

* Lon. and Lat. Indicate the survey points on the land.

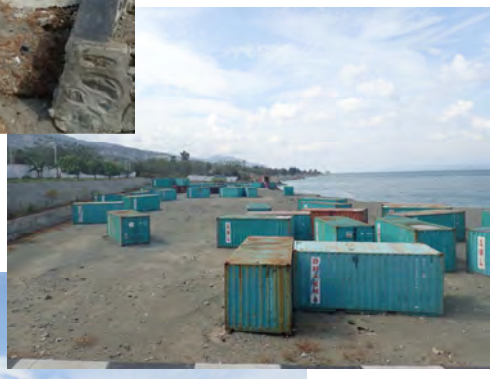
The steep slope seen at the coast can be considered to be the subsidence.
Additionally, change in the color at the sea surface near the coastline can be seen.
These phenomena indicates the possibility of the tsunami source resulted from the land slide under the sea.

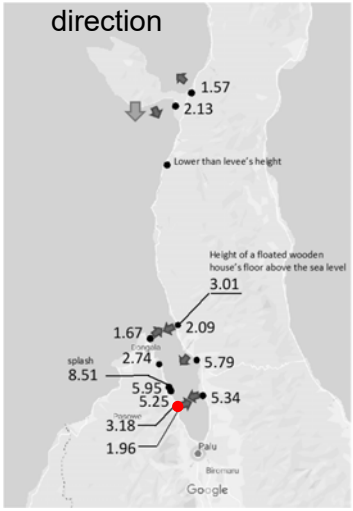


ID12

Subsidence and Tsunami behavior at Point G

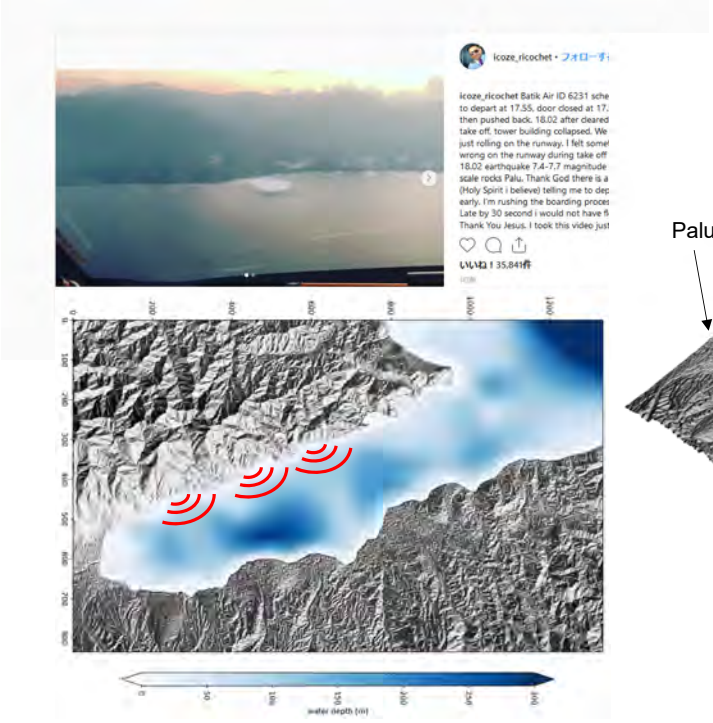
- There were drifted containers on the ground 3.18m from the sea level.
- Container yard disappeared about 100 meters in the cross-shore direction

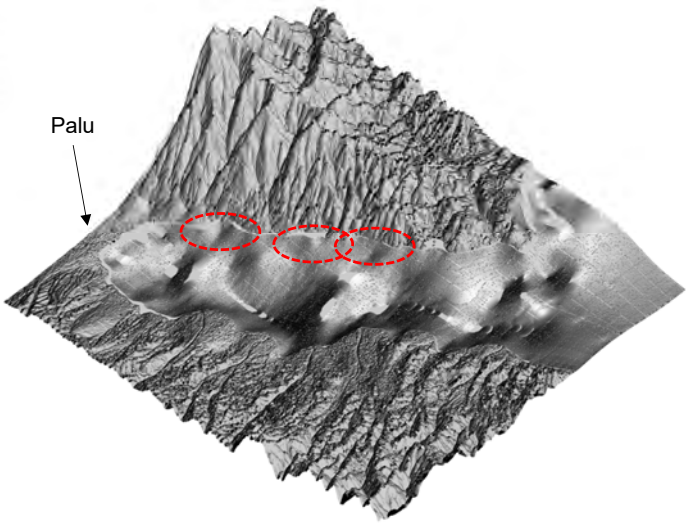




From the First Survey

Hydrographic Survey Results



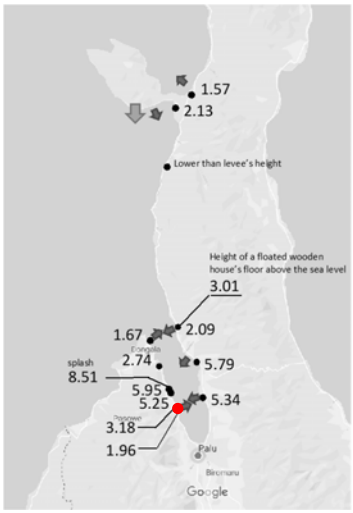


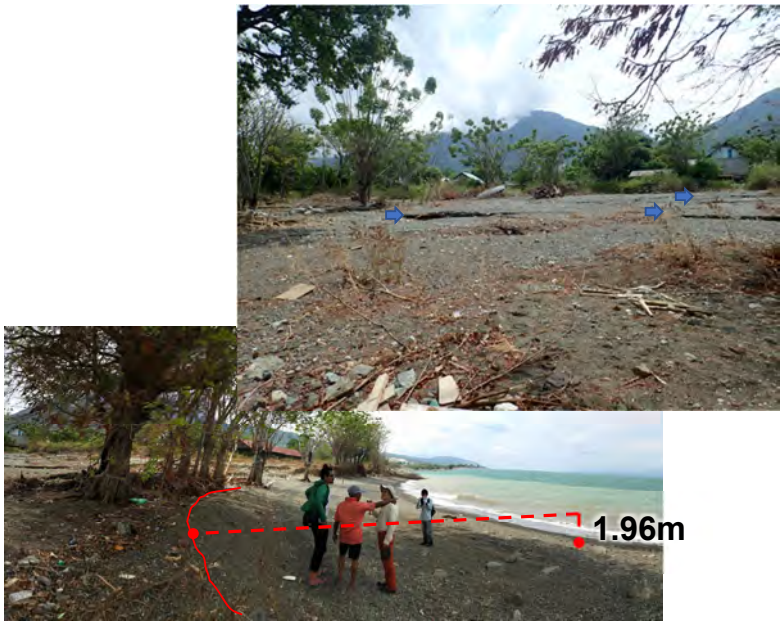
Bathymetry data (dx=30m)

ID11

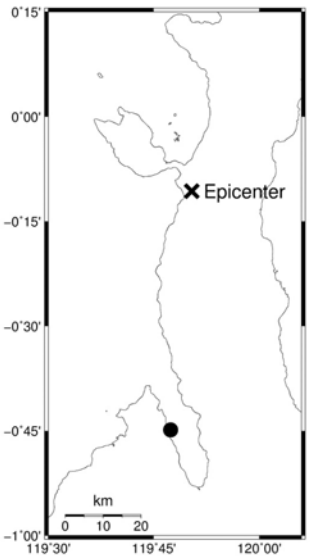
Tsunami height around point G

- Cracks were found at this place
- The tsunami height was seems to be small





More information…



The small cliff was seen at the coast of north part of Point G.
It resulted from the subsidence by **1968 earthquake** based on the testimony by the inhabitant.
It indicates that the earthquakes repeatedly occur in this region.

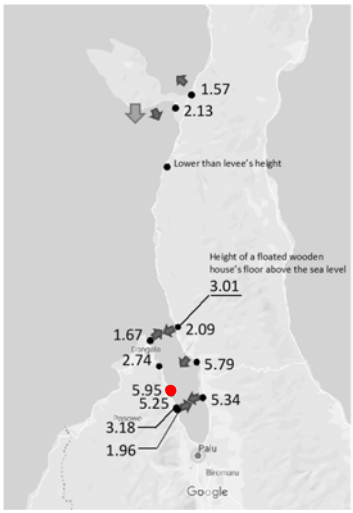
Date of the survey	Lon.*	Lat.*
15th / Oct	E 119.790	S 0.748

* Lon. and Lat. Indicate the survey points on the land.

ID8

Tsunami height

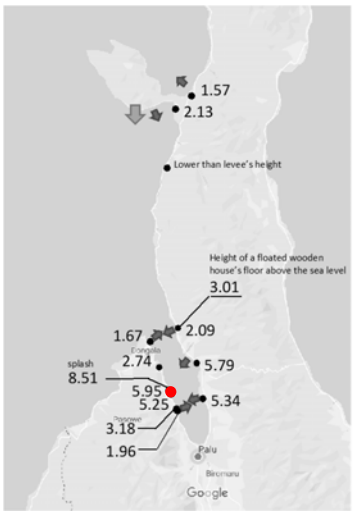
A tsunami overflowed the road.



ID9

Tsunami height

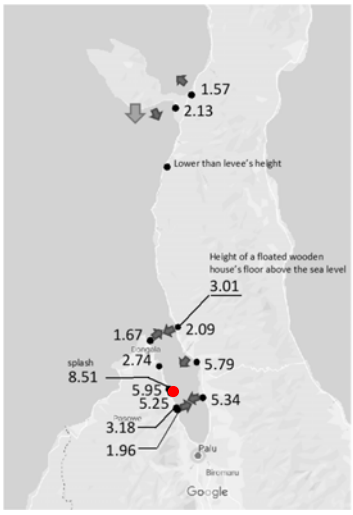
Splash mark on the ceiling.
The height of the mark above the sea level is 8.51m.



ID10

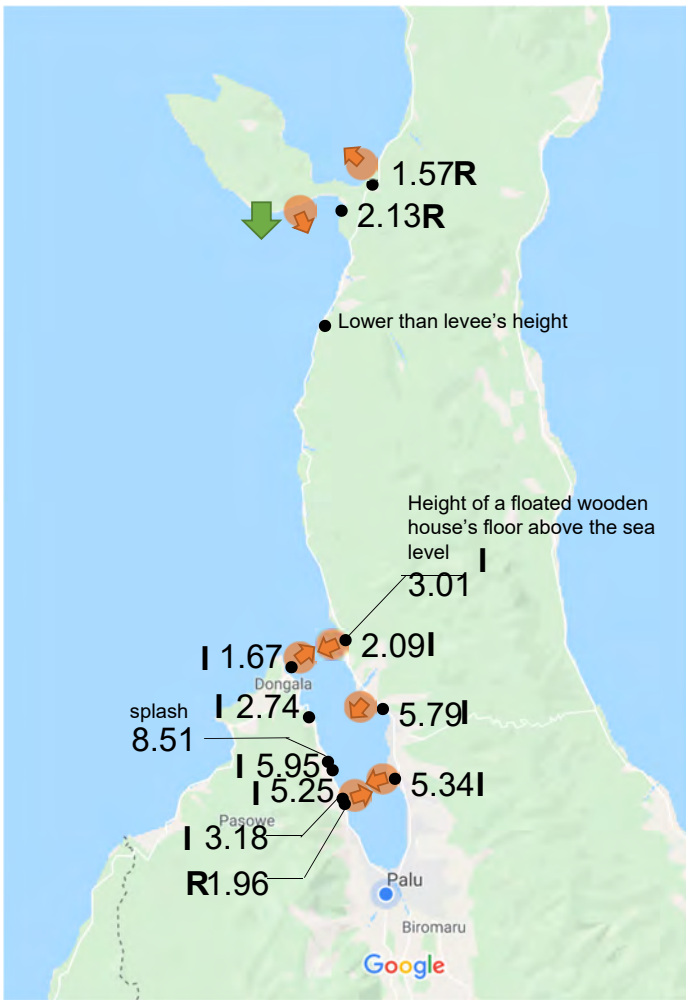
Tsunami height

- Flow depth was a knee level at the place of the drifted boat.
- Inundation height was 5.25m



Summary

- The survey was conducted from 12th -17th October 2018.
- The purpose of this survey is to collect the evidence of the subsidence area along the coast, and the information of the tsunami height and behavior from interviews and so on.
- Findings from the field survey data lead to the possibility of some tsunami sources due to the landslides at the almost same time after the earthquake motion.



R : run-up height
I : inundation height

From Prof. Haraguchi

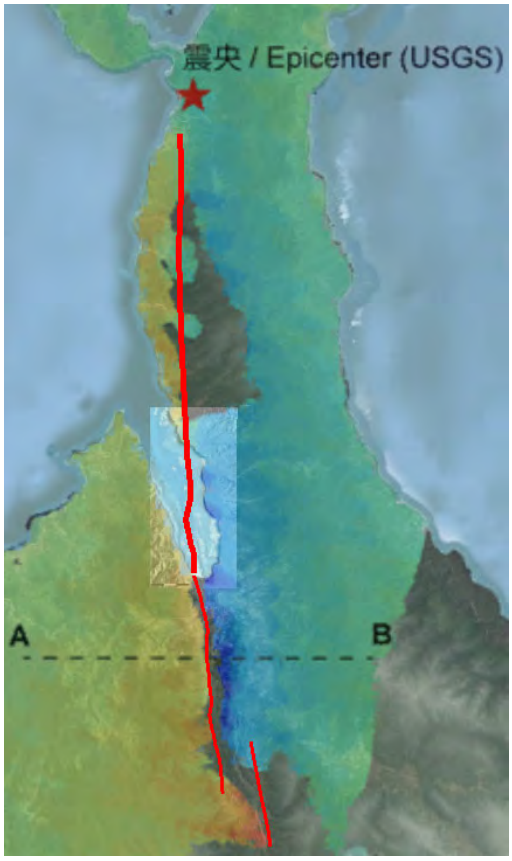
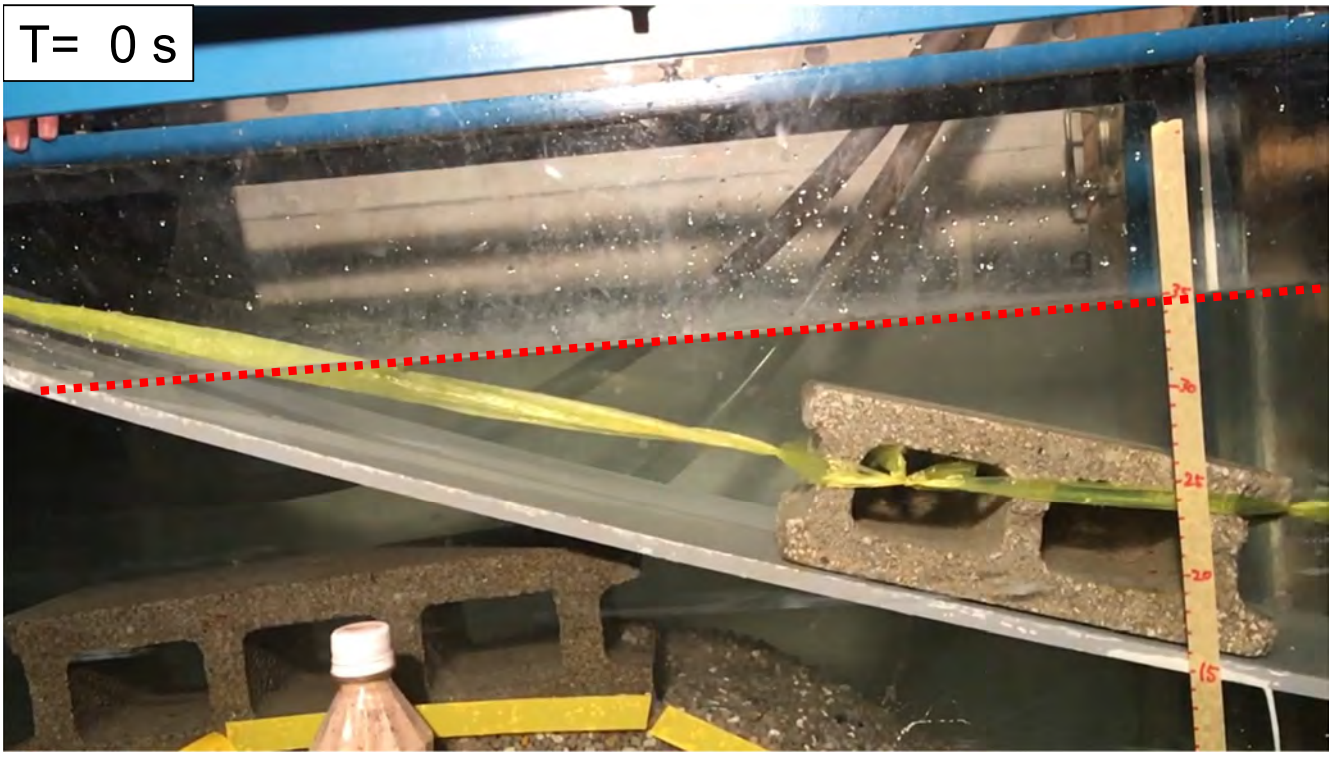
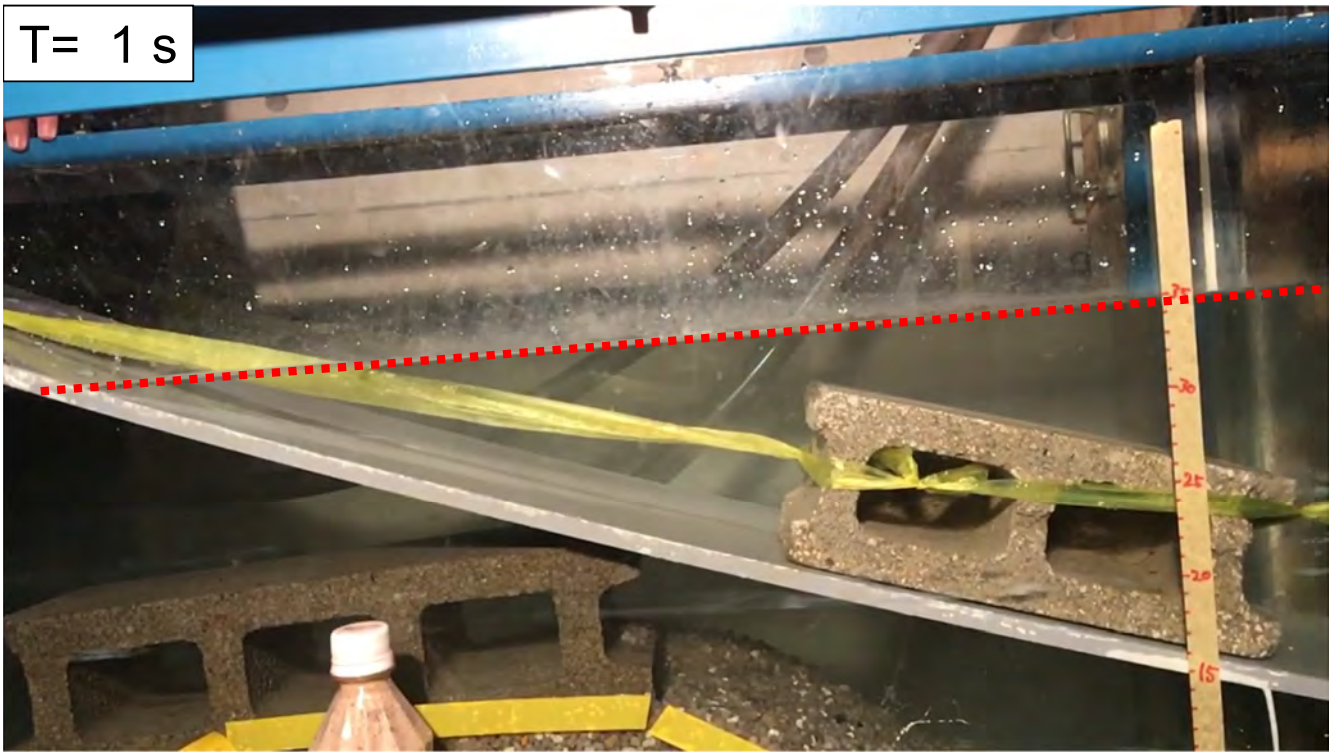


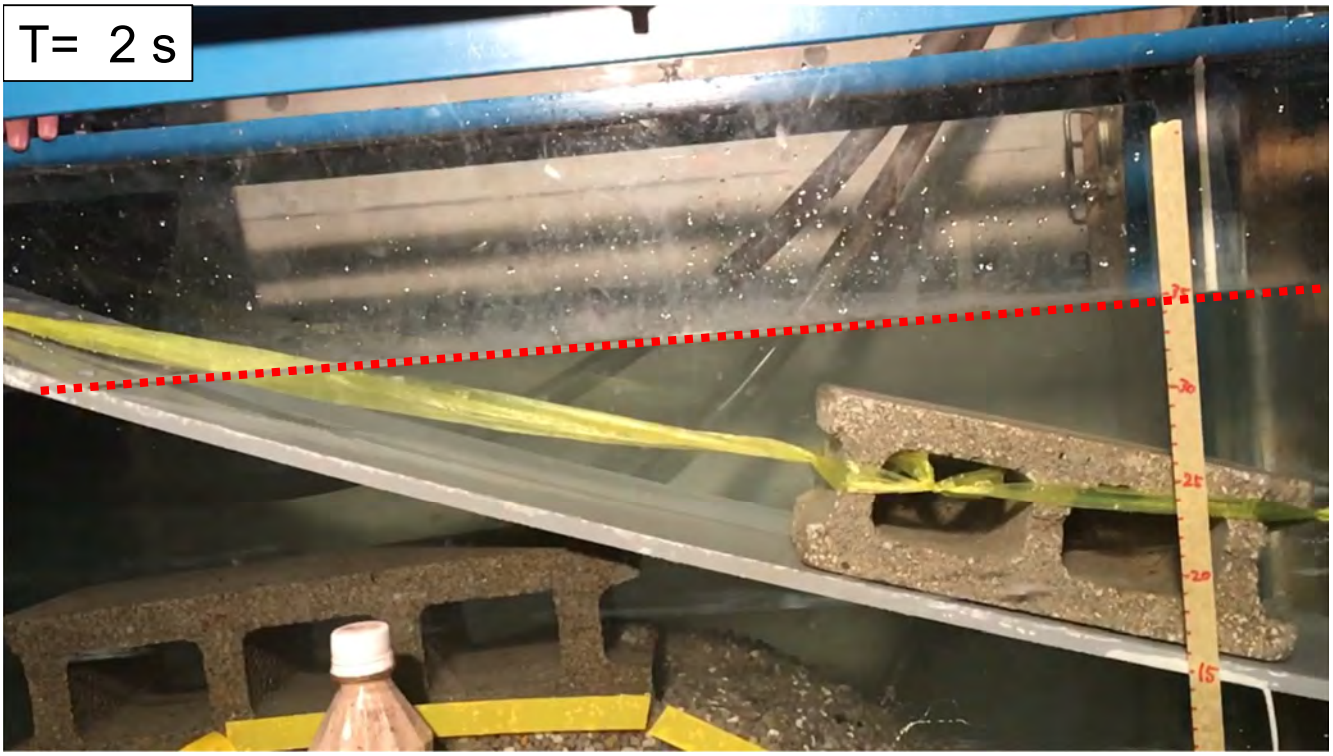
Image of the submarine landslide tsunami



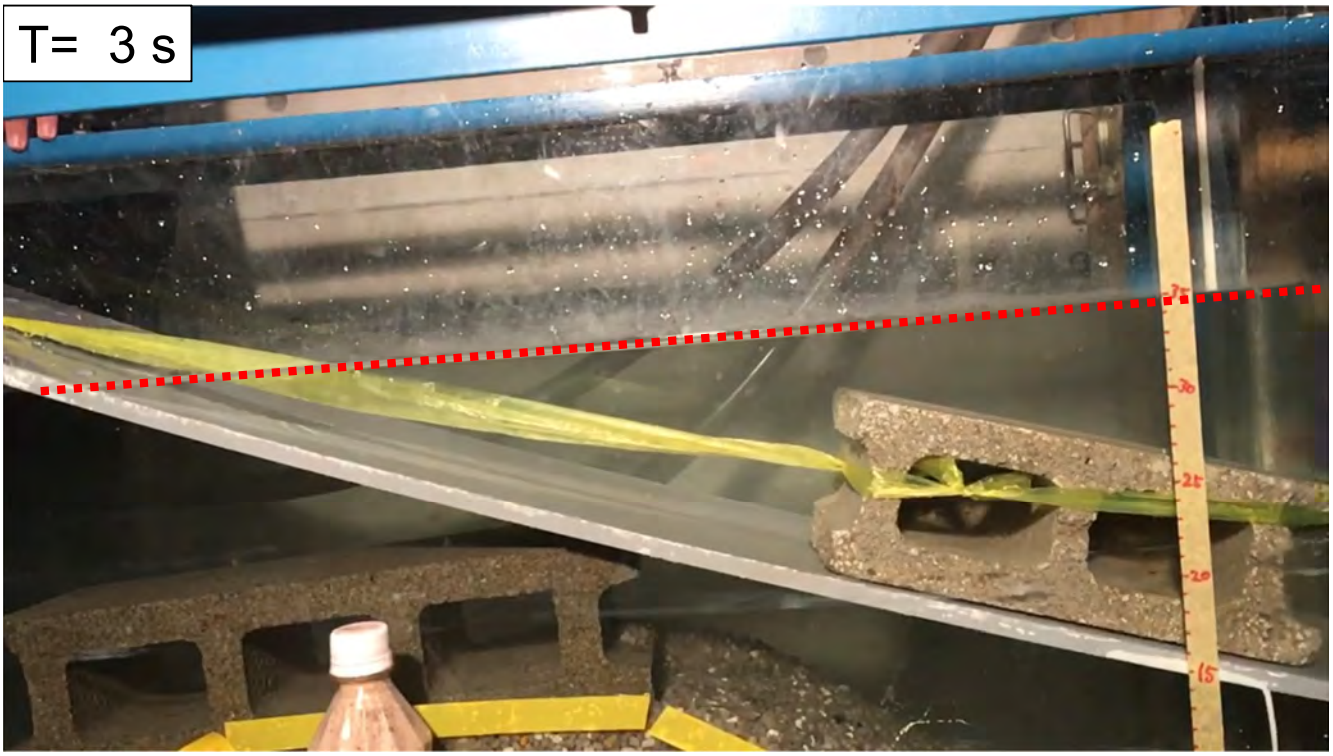
T= 1 s



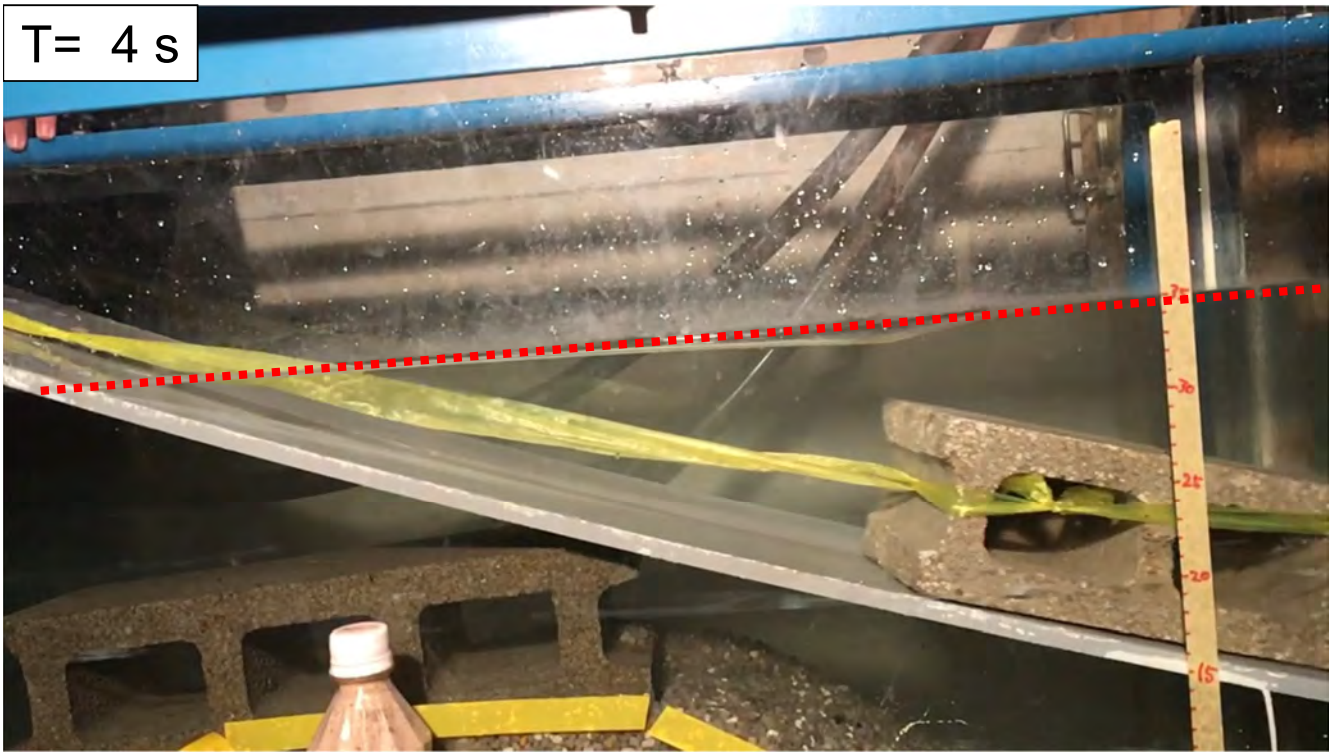
T= 2 s



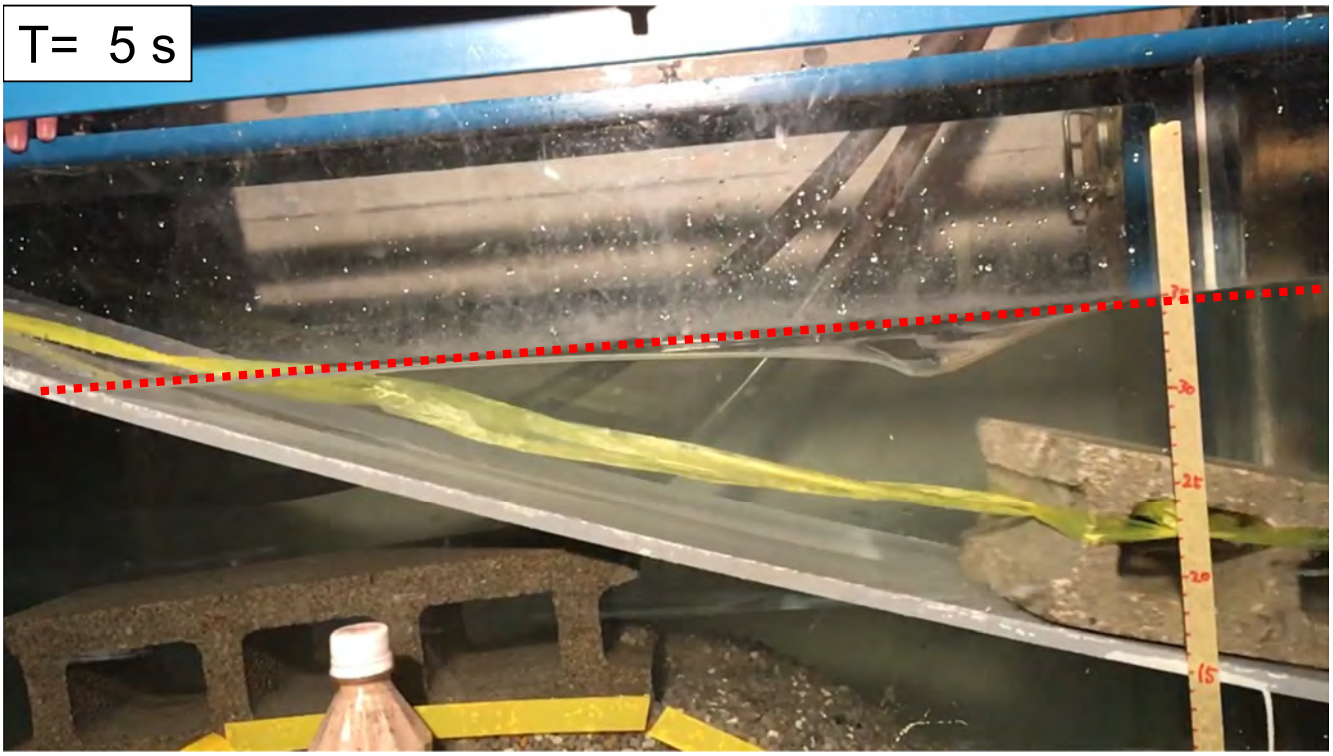
T= 3 s



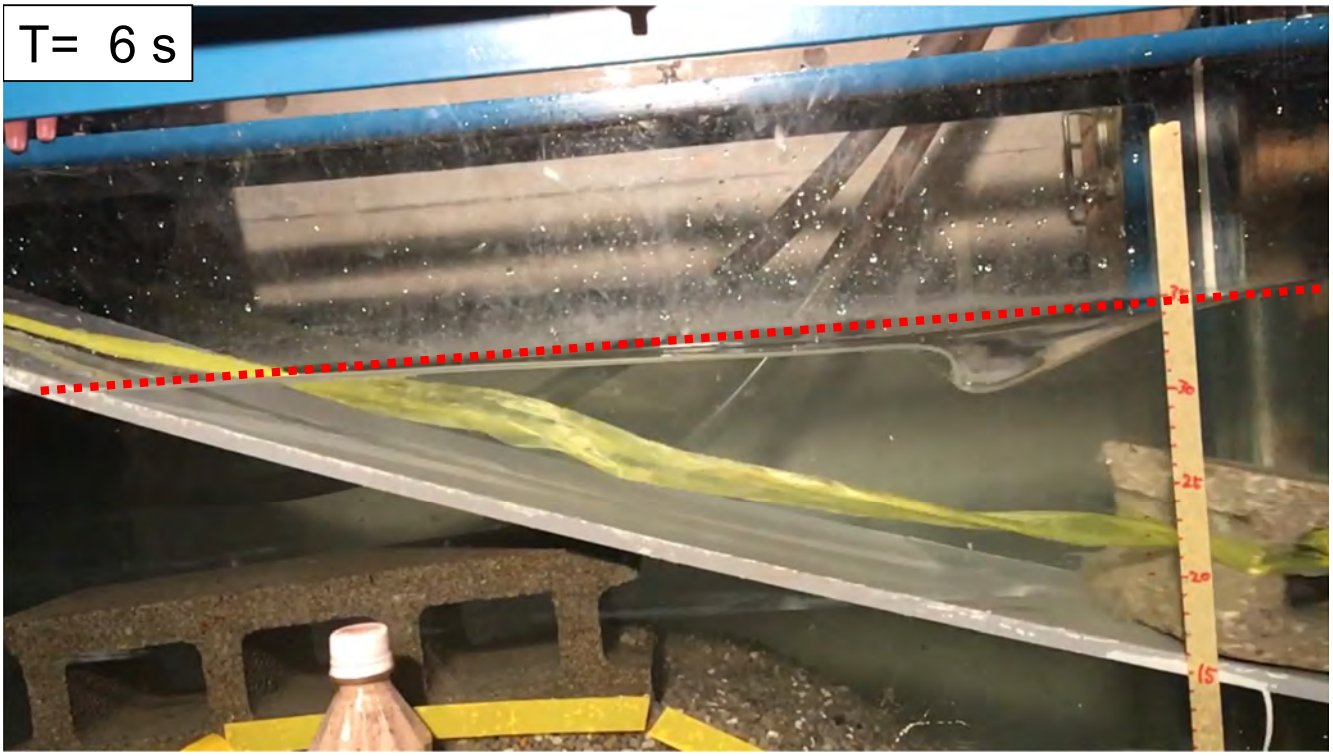
T= 4 s



T= 5 s



T= 6 s



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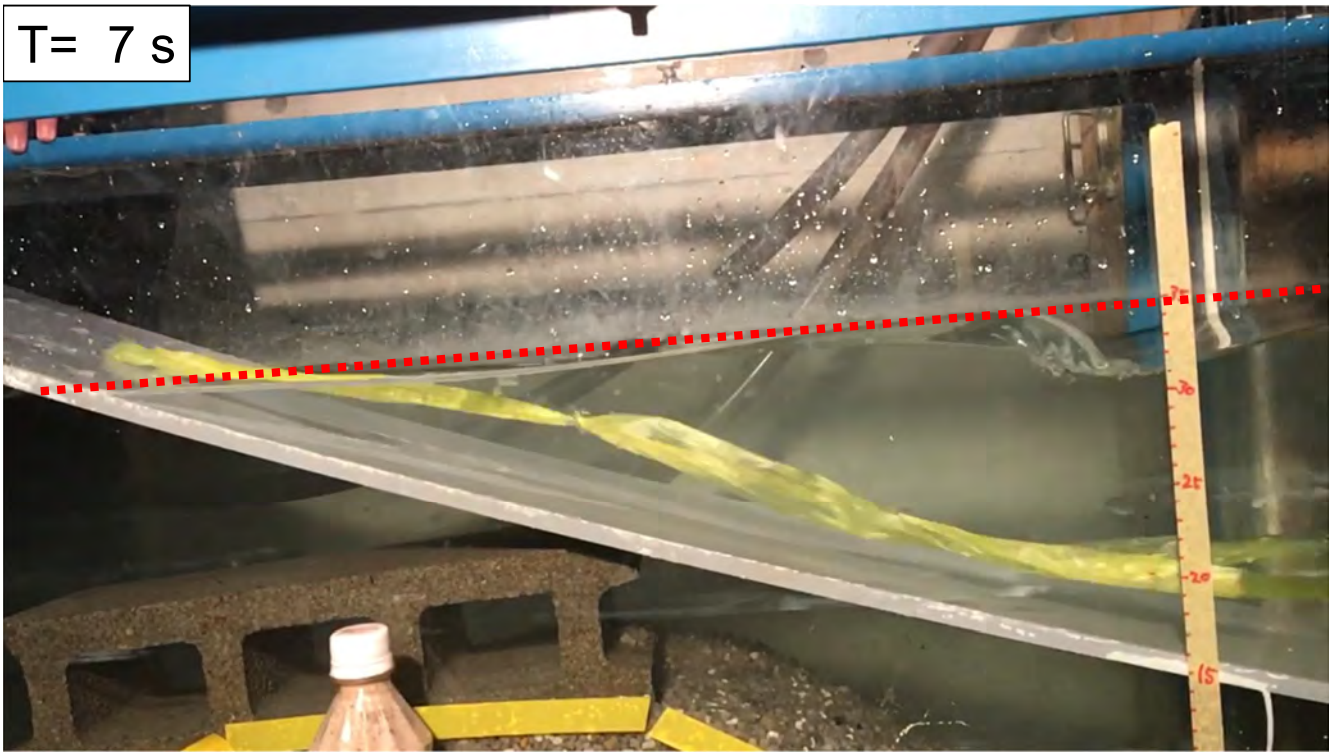
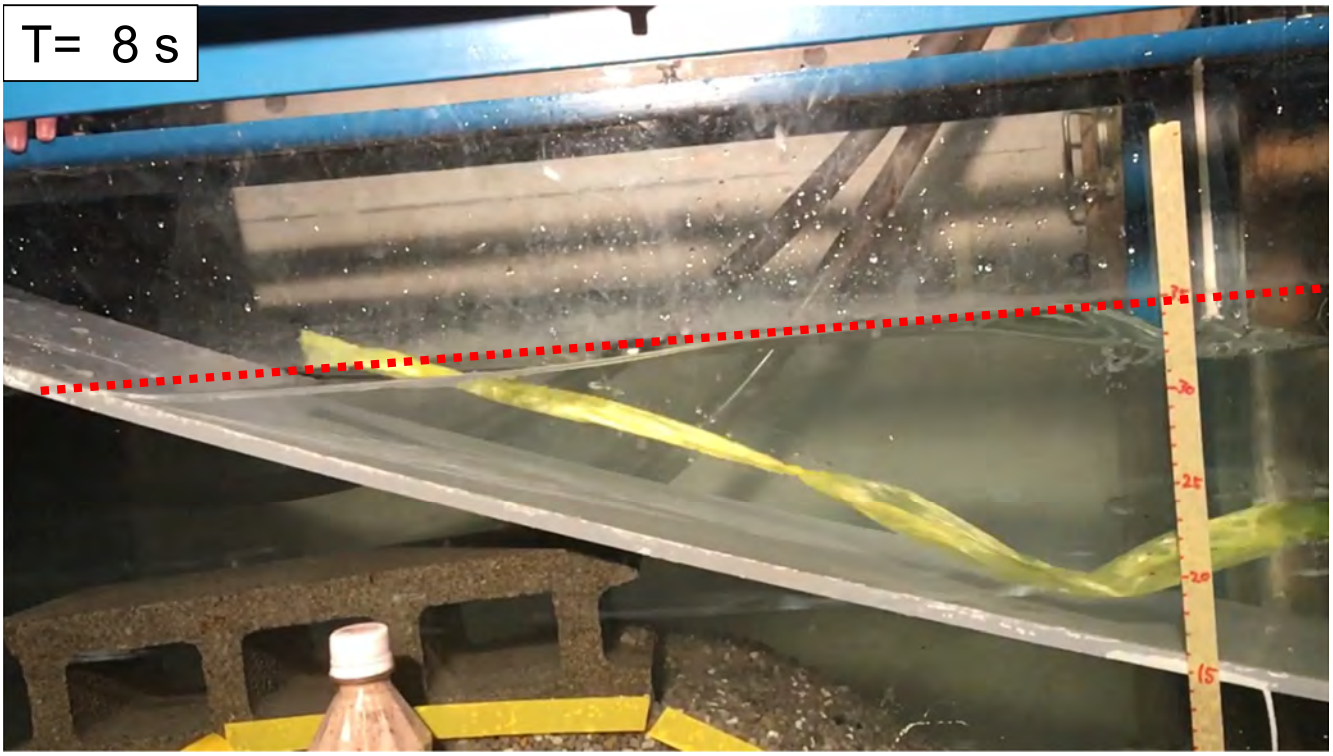
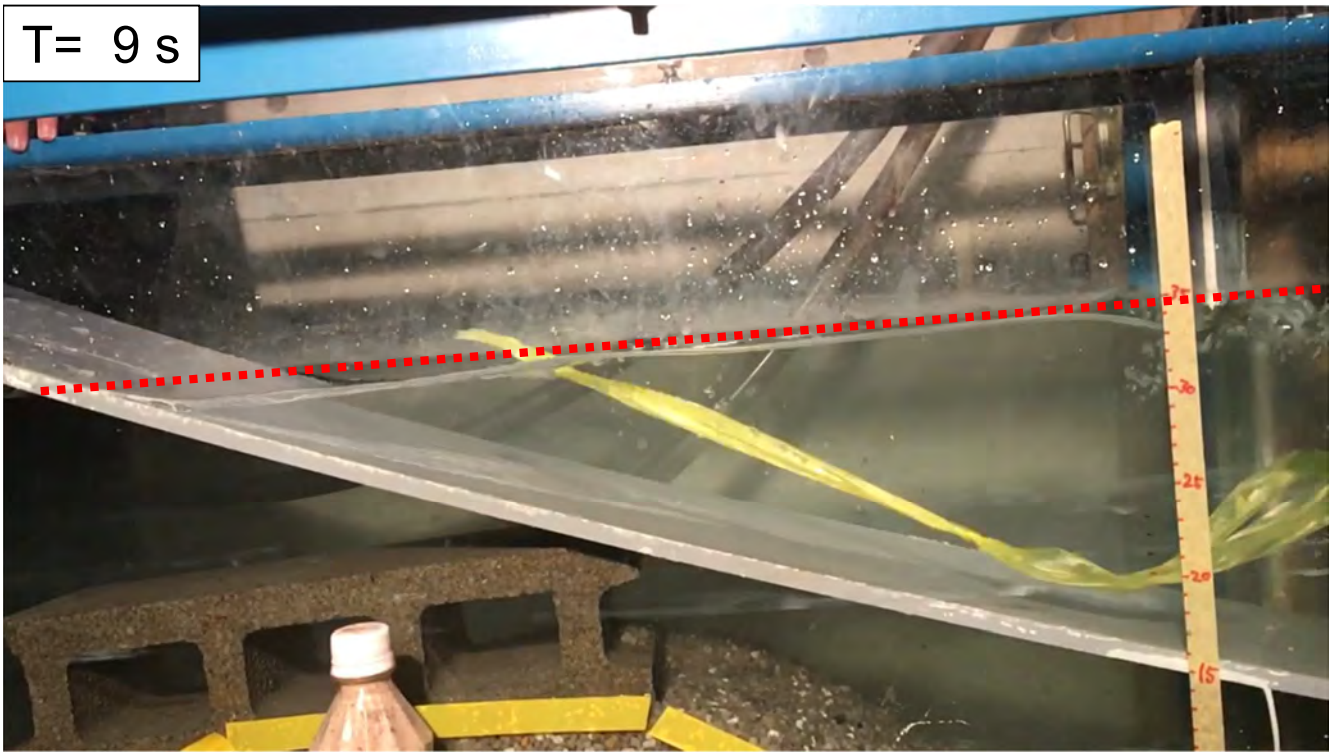


T= 8 s



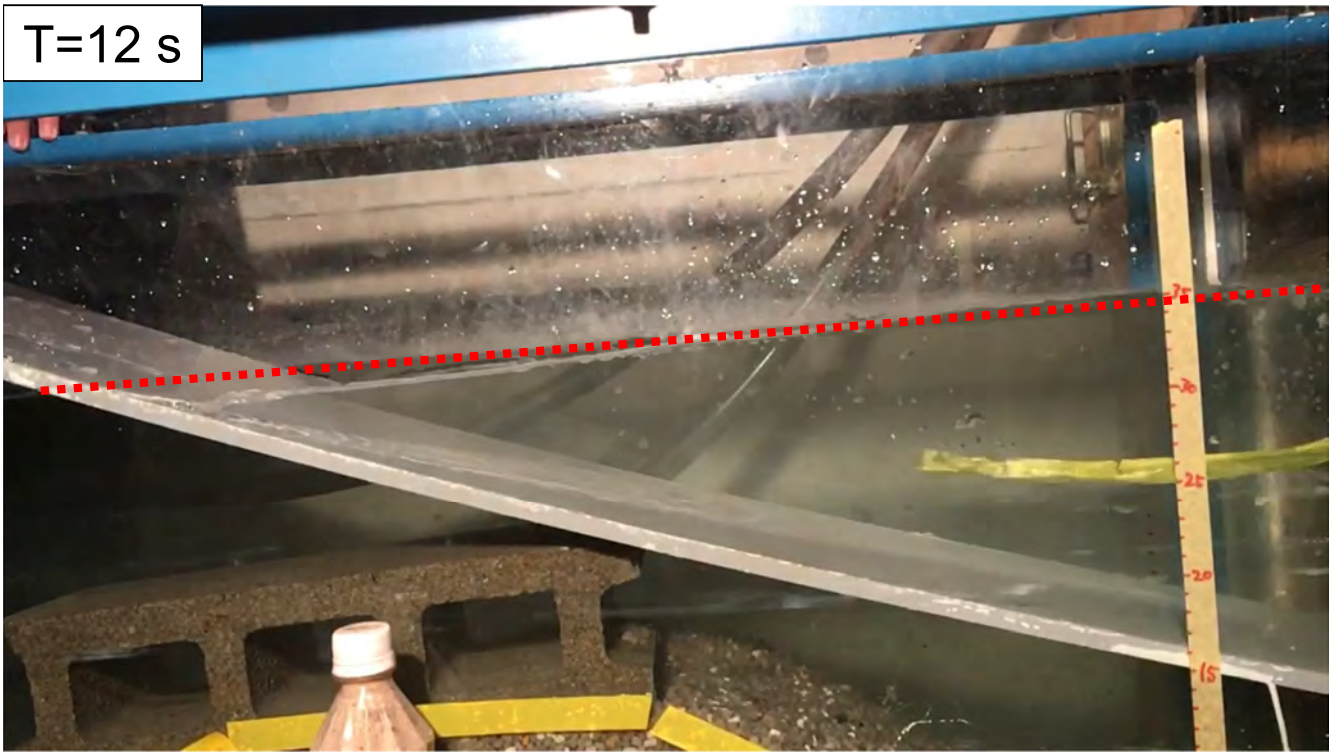
T= 9 s



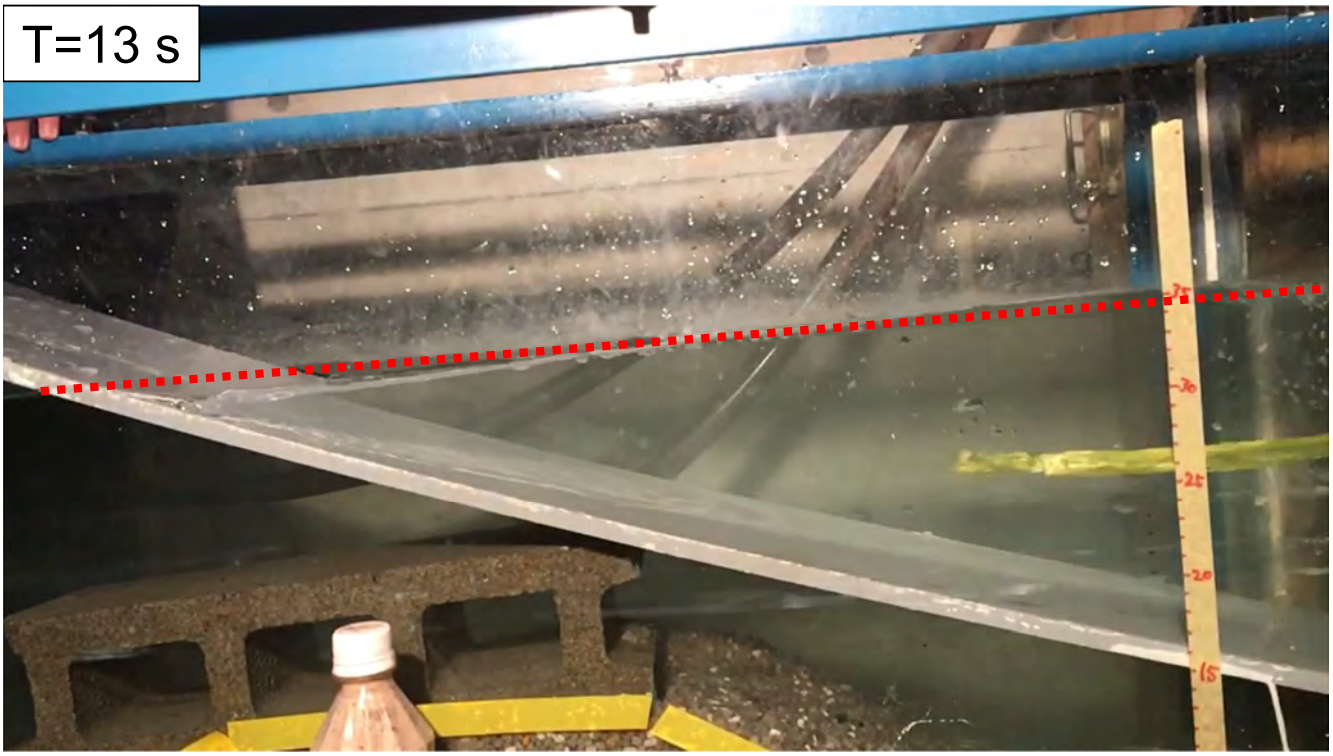
T=10 s

T=11 s

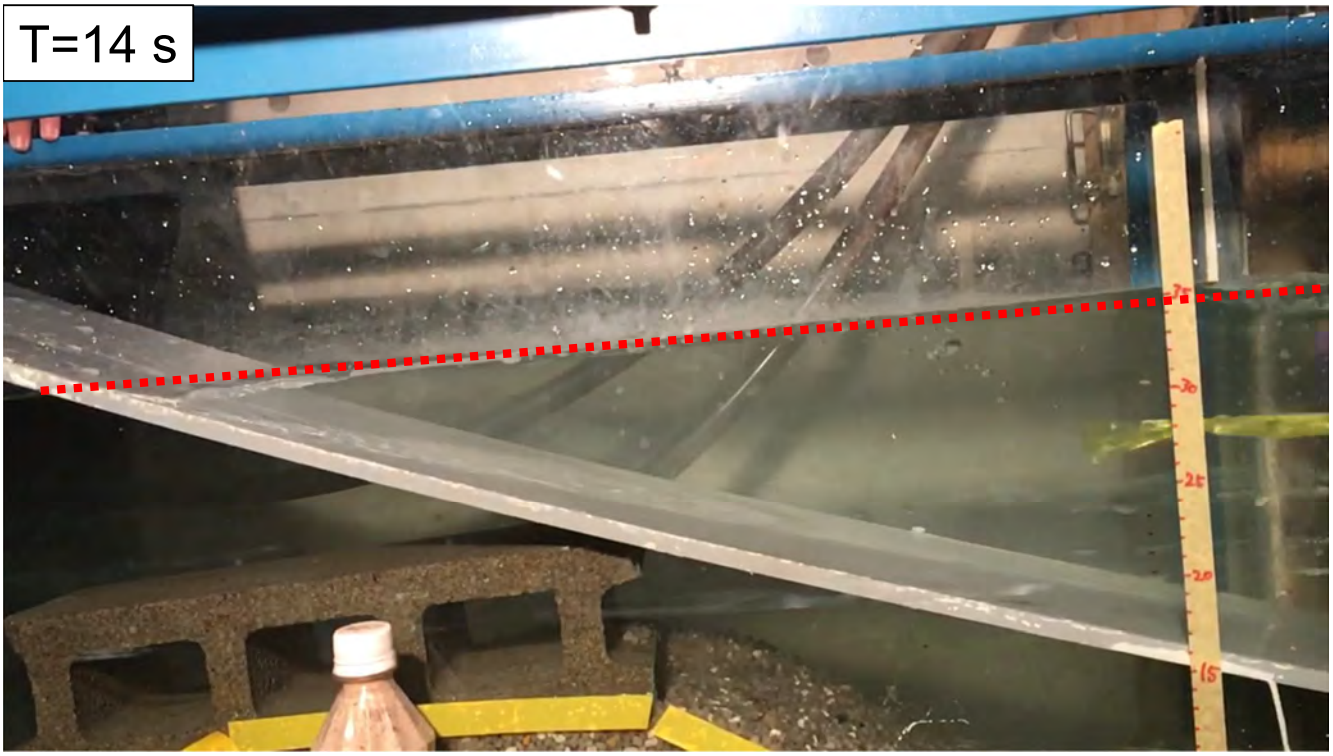
T=12 s



T=13 s



T=14 s



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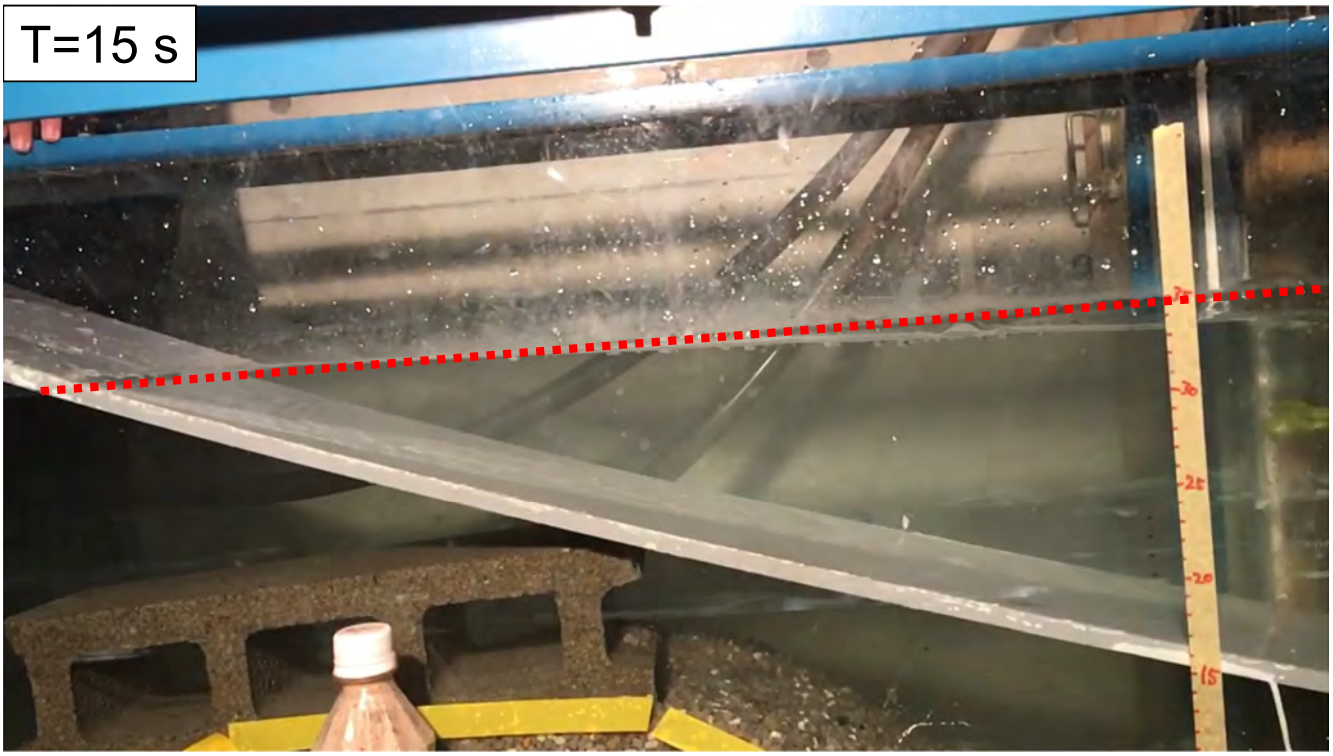
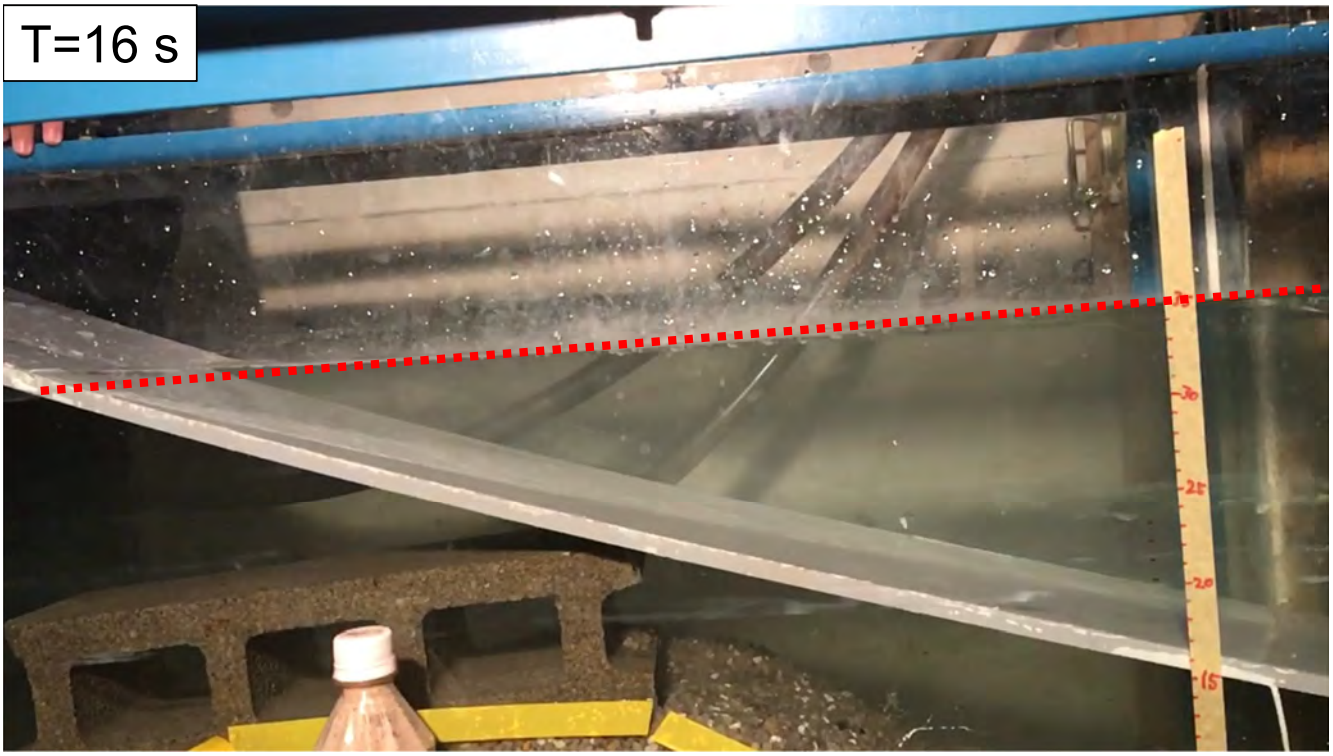
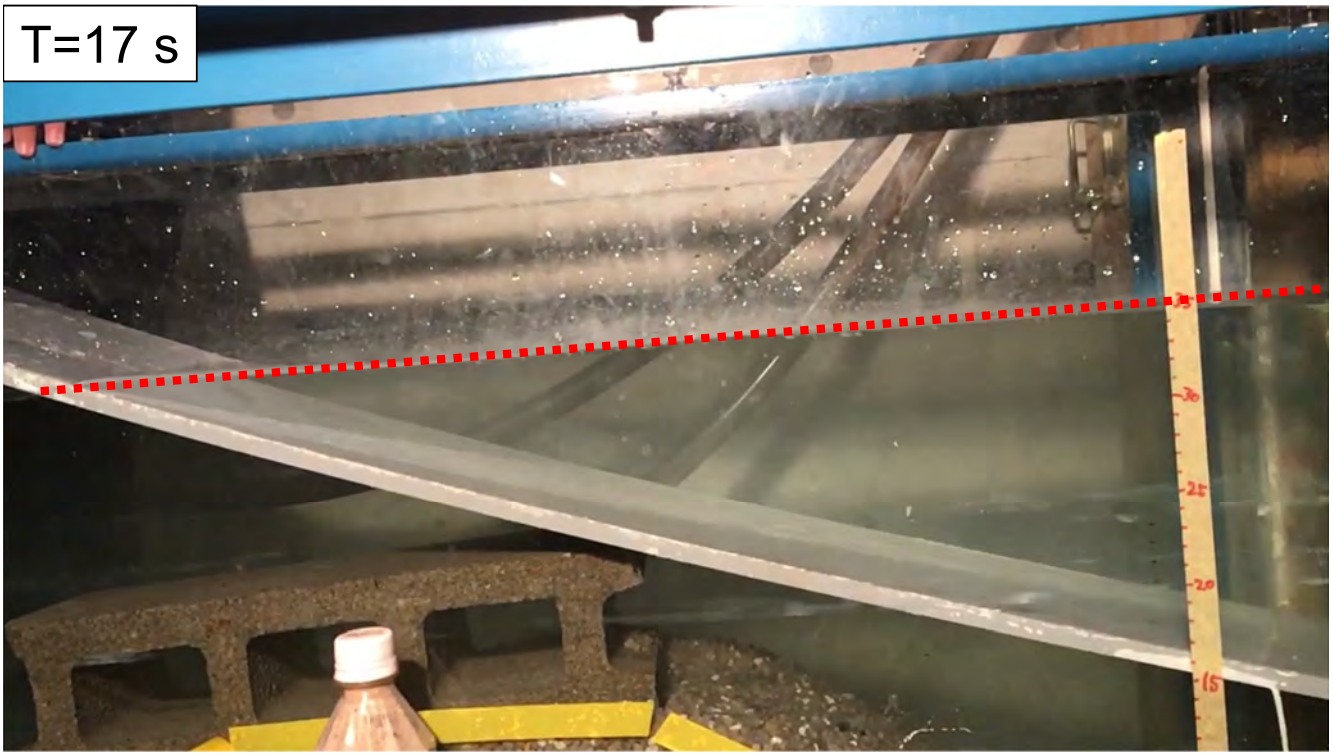


T=16 s





Video (slow motion)