

cores

microfluids

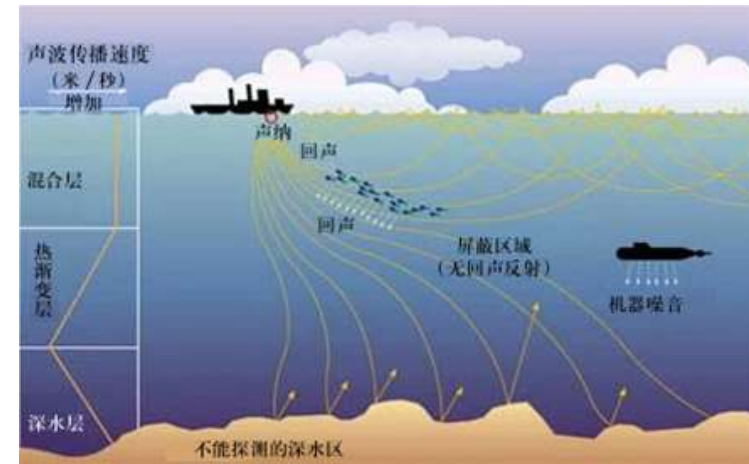
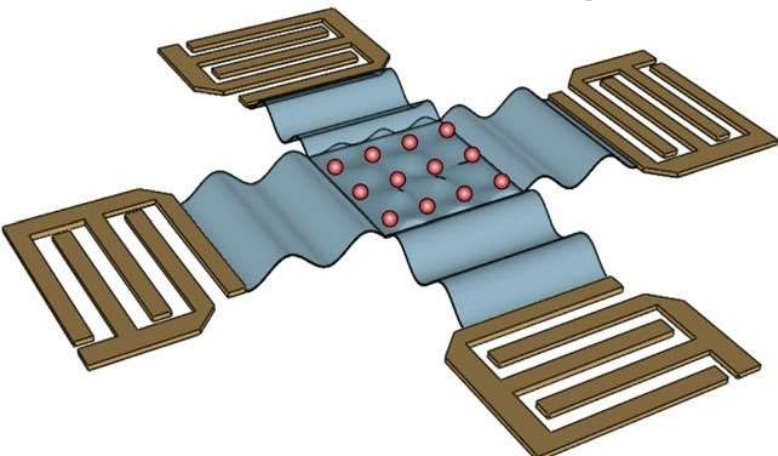
fluids

ocean

Surface acoustic (e.g. acoustic tweezers)

Wave/vibration

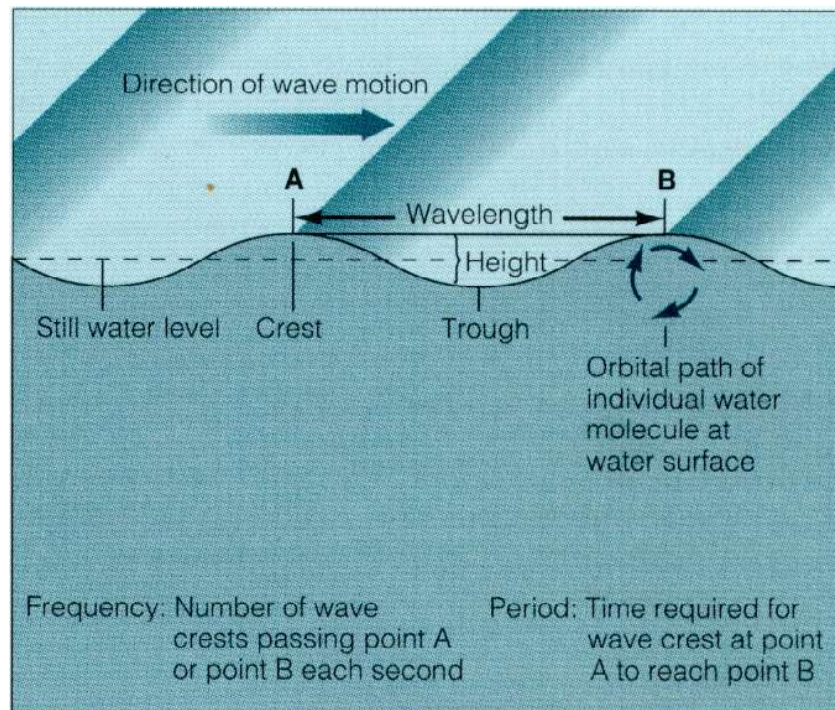
Sea wave (e.g. underwater acoustic)



	Acoustofluidics Lab	Ocean Acoustic Lab
Tool	acoustics	
Frequency	<i>MHz</i>	<i>Hz, KHz</i>
Medium	fluidics	
Size	<i>μm</i>	<i>km</i>

Acoustofluidics Lab
Duke University

μm

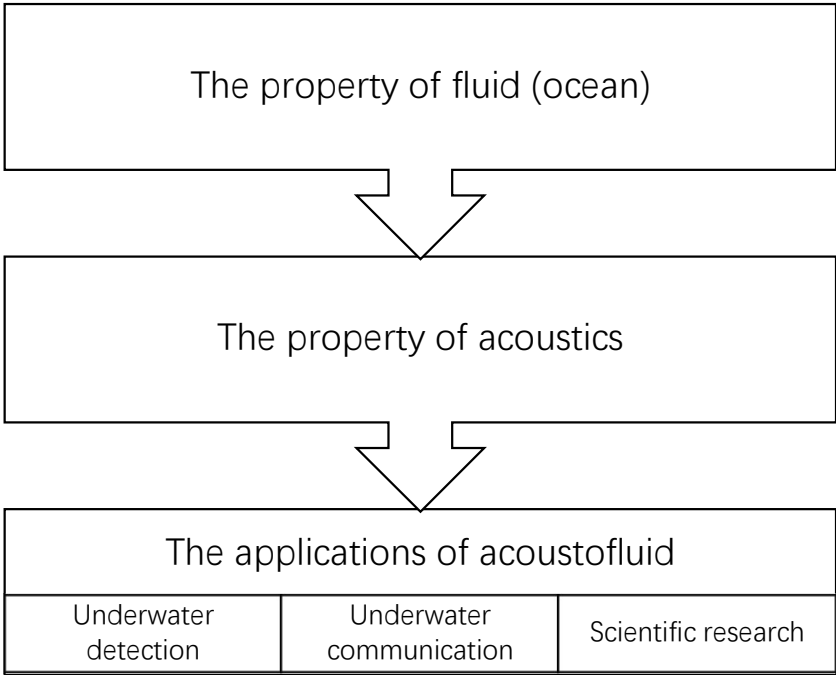
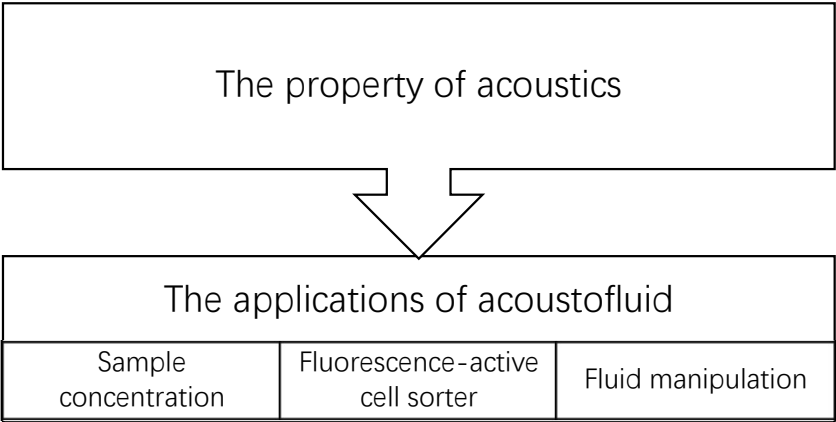


Ocean Acoustic Lab
Ocean University of China

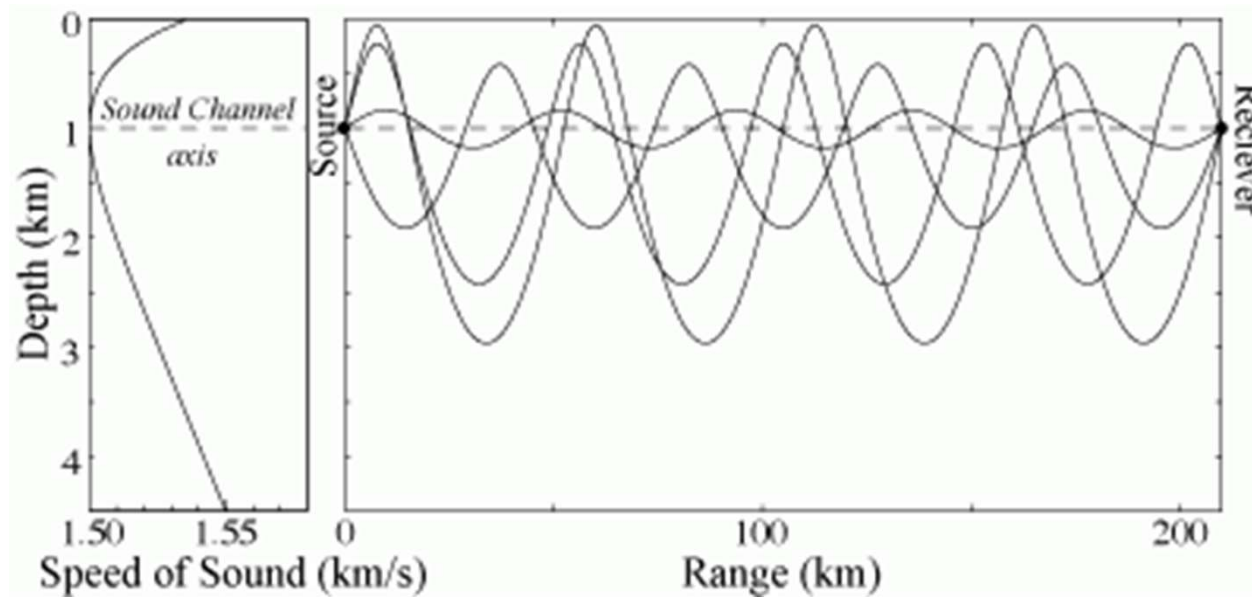
km

Acoustofluidics Lab

Ocean Acoustic Lab



To illustrate the route of **ocean acoustic research** clearly, I take **the Measurement Project of Global Warming as an example.**



Ocean Acoustic Lab

1. Fluid property

- SOFAR channel

2. Acoustic property

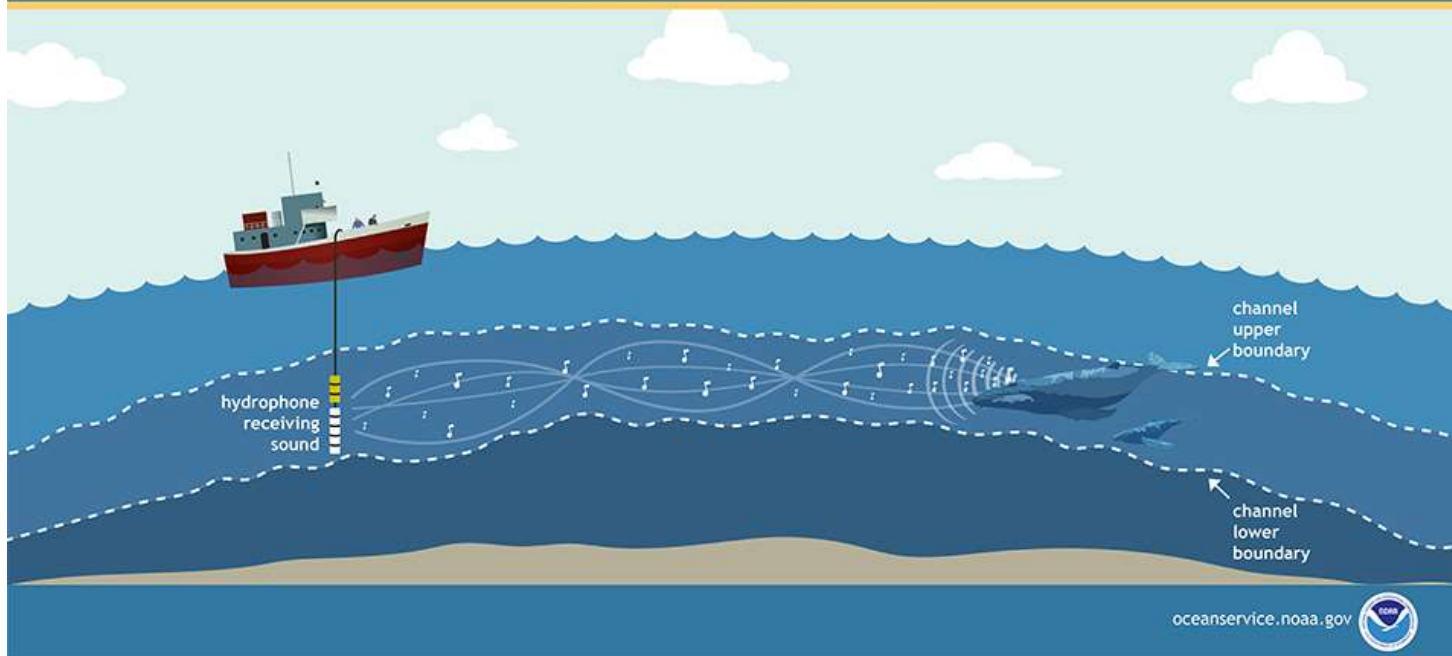
- Low attenuation

3. Application

- Global warming
- Global temperature measurement

What is SOFAR?

SOFAR, or Sound Fixing and Ranging Channel, is a naturally-occurring ocean "channel" that allows sound to carry great distances



Ocean Acoustic Lab

1. Fluid property

- SOFAR channel

2. Acoustic property

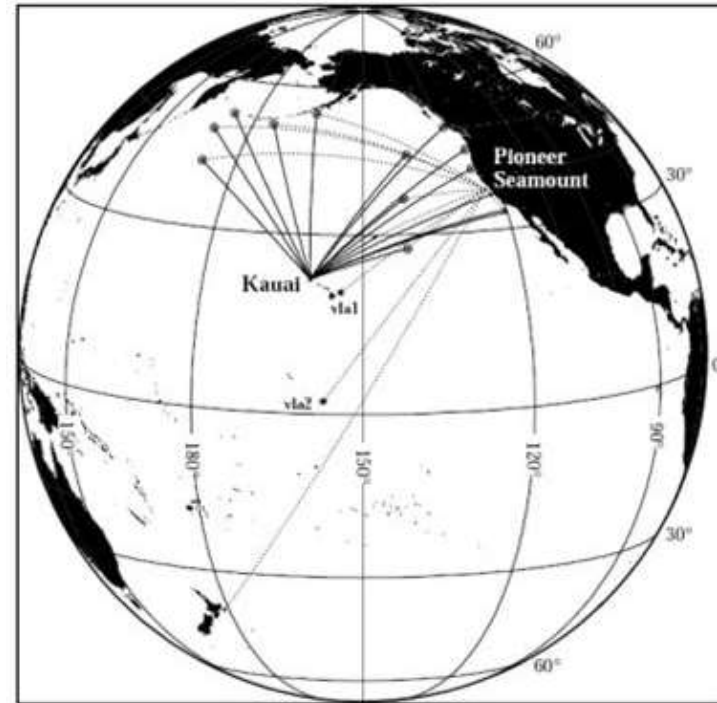
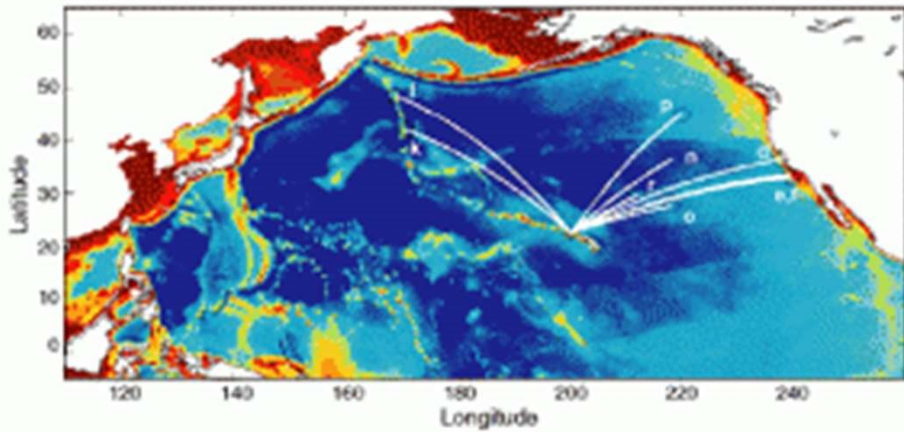
- Low attenuation

3. Application

- Global warming
- Global temperature measurement



- ATOC (Acoustic Thermometry of Ocean Climate)
- A project that provides data to measure changes in global temperature
- What to expect? It will provide evidence related to questions as regards to global warming.
- The SOFAR Channel is a beneficial tool to measure the oceanic



Ocean Acoustic Lab

1. Fluid property

- SOFAR channel

2. Acoustic property

- Low attenuation

3. Application

- Global warming
- Global temperature measurement

Acoustofluidics Lab

Ocean Acoustic Lab

The property of acoustics

The property of fluid (ocean)

The property of acoustics

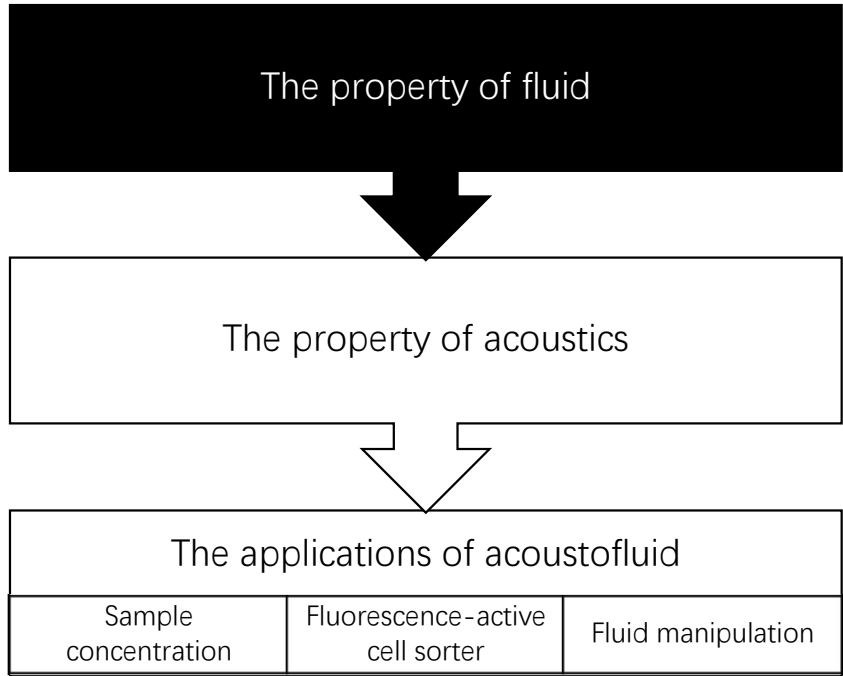
The applications of acoustofluid

Sample concentration	Fluorescence-active cell sorter	Fluid manipulation
----------------------	---------------------------------	--------------------

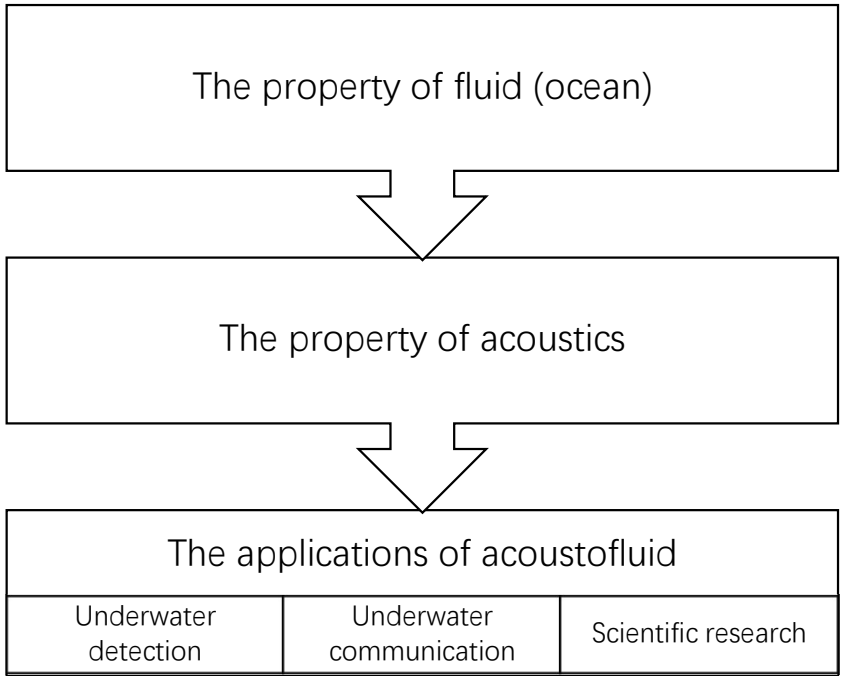
The applications of acoustofluid

Underwater detection	Underwater communication	Scientific research
----------------------	--------------------------	---------------------

Acoustofluidics Lab



Ocean Acoustic Lab

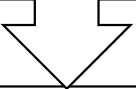


Acoustofluidics Lab

The property of fluid



The property of acoustics



The applications of acoustofluid		
Sample concentration	Fluorescence-active cell sorter	Fluid manipulation

	Fluid (ocean)	Fluid (biomedicine)	variate
Chemical	salinity	Sodium	x_1
	chlorophyll content	Magnesium	x_2
	electric conductivity	Carbon	x_3

physical	Temperature	temperature	y_1
	Density	Density	y_2

P_{fluid} : the property of fluid,
 $P_{acoustics}$: the property of acoustics

$$P_{fluid} = f(x_1, x_2, x_3, \dots, y_1, y_2, \dots)$$

$$P_{acoustics} = F(P_{fluid})$$

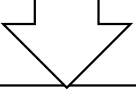
Applications

Acoustofluidics Lab

The property of fluid



The property of acoustics



The applications of acoustofluid		
Sample concentration	Fluorescence-active cell sorter	Fluid manipulation

	Fluid (ocean)	Fluid (biomedicine)	variate
Chemical	salinity	Sodium	x_1
	chlorophyll content	Magnesium	x_2
	electric conductivity	Carbon	x_3

physical	Temperature	temperature	y_1
	Density	Density	y_2

P_{fluid} : the property of fluid,
 $P_{acoustics}$: the property of acoustics

$$P_{fluid} = f(x_1, x_2, x_3, \dots, y_1, y_2, \dots)$$

$$P_{acoustics} = F(P_{fluid})$$

Applications

Acoustofluidics Lab

1. Fluid property

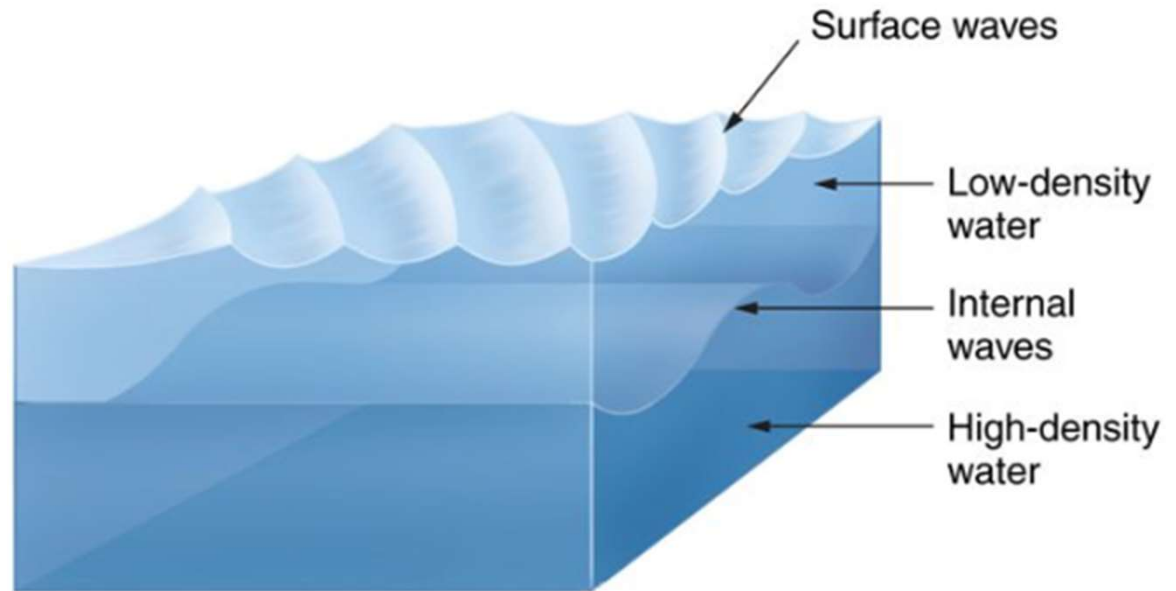
- Layers

2. Acoustic property

- Internal wave
- Bigger amplitude

3. Application

- ?
- ?
- ?



Acoustofluidics Lab

1. Fluid property

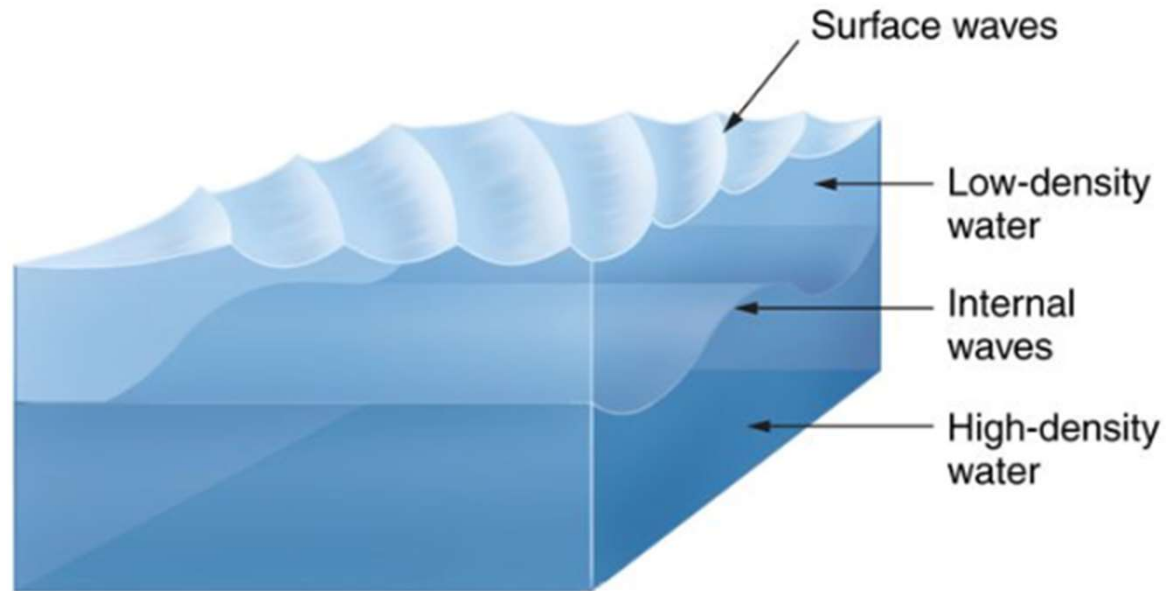
- Layers

2. Acoustic property

- Internal wave
- Bigger amplitude

3. Application

- ?
- ?
- ?



Introduction to internal wave – from the perspective of oceanography

Acoustofluidics Lab

1. Fluid property

- Layers

2. Acoustic property

- Internal wave
- Bigger amplitude

3. Application

- ?
- ?
- ?

- On 10 April 1963, ***Thresher* (Nuclear Submarine)** sank during deep-diving tests about 220 miles (350 km) east of Boston, Massachusetts, killing all **129 crew** and shipyard personnel aboard in the deadliest submarine disaster except for the French submarine *Surcouf* (130 crew lost).
- Upon now, this is the biggest submarine accident.
- Why?



Introduction to internal wave – from the perspective of oceanography

Acoustofluidics Lab

1. Fluid property

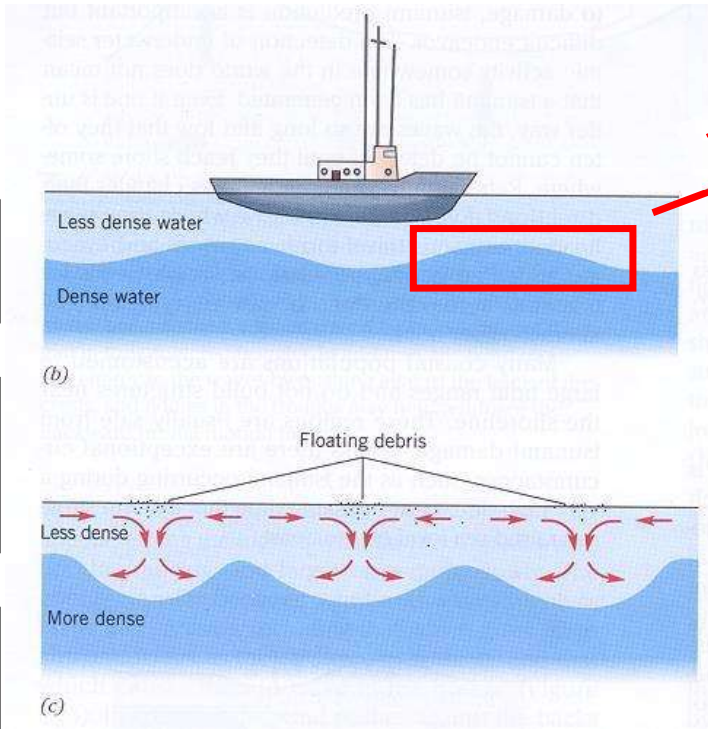
- Layers

2. Acoustic property

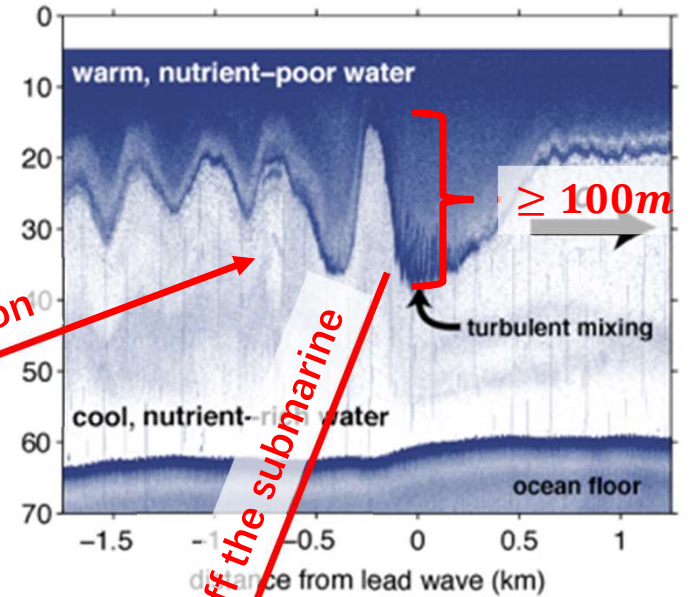
- Internal wave
- Bigger amplitude

3. Application

- ?
- ?
- ?



investigation



Cut off the submarine

Acoustofluidics Lab

1. Fluid property

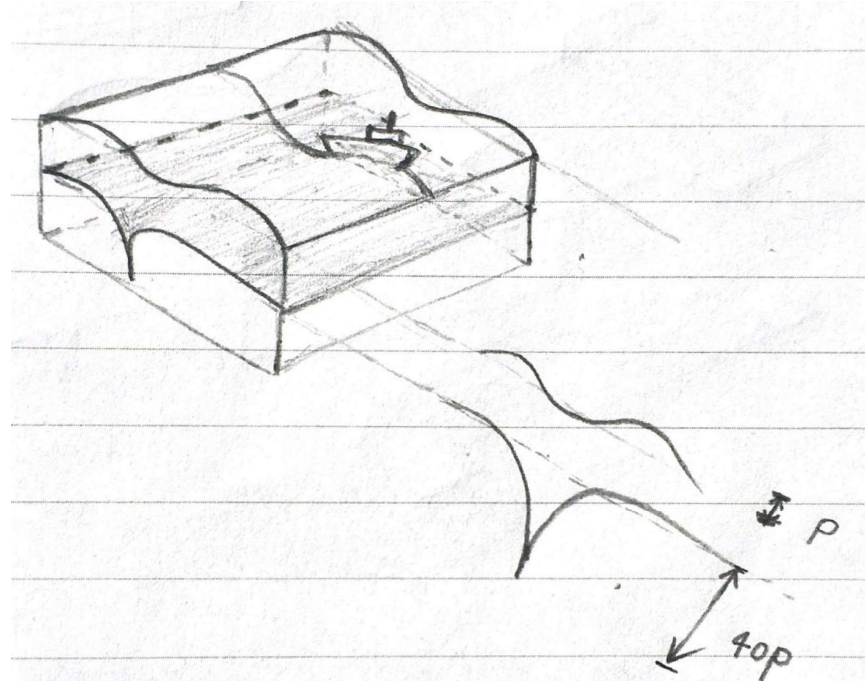
- Layers

2. Acoustic property

- Internal wave
- Bigger amplitude

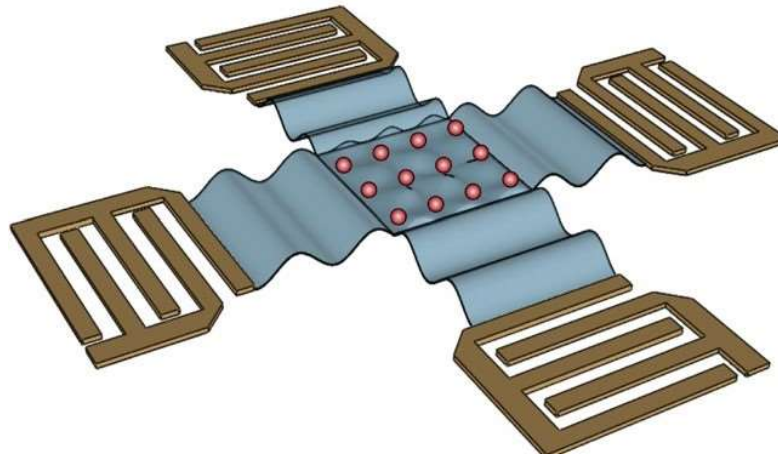
3. Application

- ?
- ?
- ?



- The most important difference between surface waves and internal waves is the amplitude with **the same inputting energy**.
- Generally speaking, with the same inputting energy, the amplitude of internal waves are roughly **40 times bigger** than that of surface waves.

Acoustofluidics Lab



1. Fluid property

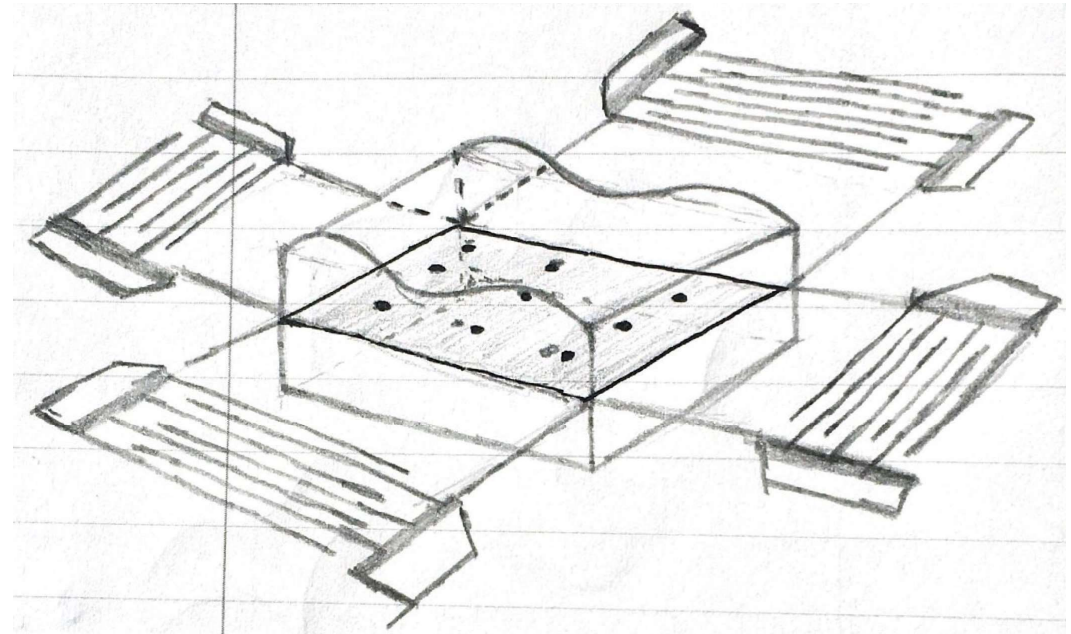
- Layers

2. Acoustic property

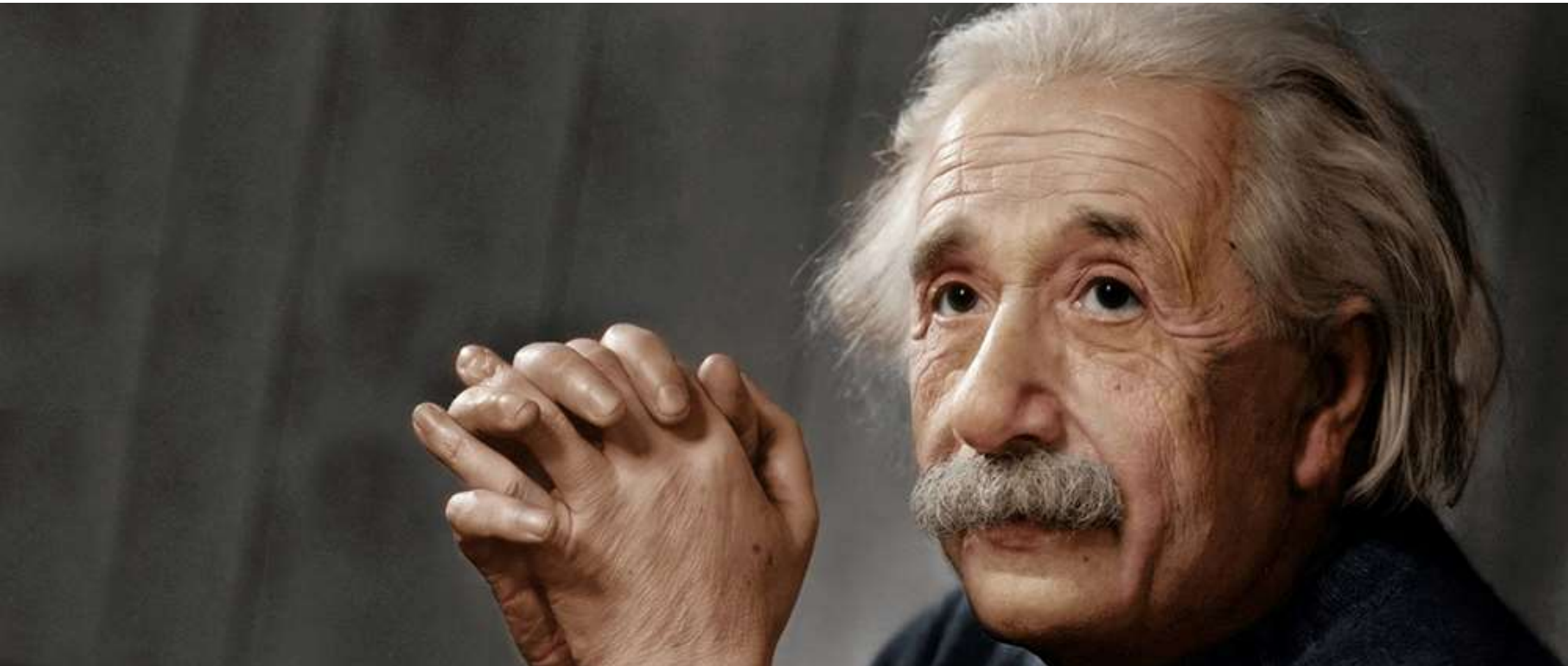
- Internal wave
- Bigger amplitude

3. Application

- ?
- ?
- ?



Internal waves



- Truth Is From Nature.
 - 道法自然
- Albert Einstein: imagination is more important than knowledge.



Thank you for being here!

- Truth Is From Nature.
 - 道法自然
- Albert Einstein: imagination is more important than knowledge.