

# Fluid Dynamics Video of flow around a seismic streamer

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## Abstract

This short article provides background information on a fluid dynamics video made for the Gallery of Fluid Motion. It shows a high Re-number unsteady turbulent boundary layer surrounding a long cylinder that is towed through the ocean. Previous work on flow around long cylinders have often focused on the case where the flow-direction is perfectly aligned with the cylinder. In this work we show that in an ocean environment, a cross-flow components is present. This has a significant influence on the shape and development of the turbulent boundary layer.

## 1 Introduction

Marine seismic exploration is normally done by towing long flexible cables (streamers) filled with hydrophones through the ocean. These streamers record reflections from the subsurface, and are used to acquire graphic representation of the Earth's subsurface geology. The goal is in most cases to explore for hydrocarbons. A problem with data that is recorded from such streamers is noise contamination. A good portion of the recorded noise is produced by the turbulent flow in the boundary layer around the cylinder. This work aims to document how the turbulent boundary layer around a  $d = 5\text{cm}$  seismic streamer looks when the streamer is towed through the ocean at around  $2\text{m/s}$ . To better understand such flow, and then hopefully use this knowledge to reduce the amount of noise that is recorded, is of considerable economic interest.



Figure 1: The dye-release hose and a short part of the seismic streamer.

## 2 Experimental setup

The film was recorded around 200 meter downstream on a seismic streamer towed through the ocean. Normally, such streamers are towed at 5-10m depth, but in order to make a good movie, the streamer was put at 1-3 meters during this experiment. The film was acquired in a fjord on the west-coast of Norway. The weather was calm when the film was made and no currents or waves were visible.

To observe the turbulent boundary layer we pumped an environmentally friendly dye into the boundary layer through a thin hose, see Figure 1. It was hoped that the presence of this hose did not influence the boundary layer too much. The camera was mounted on a pole-system from a work-boat on the surface.

A sample video can be obtained by clicking [here](#) for a large 80Mb video or [here](#) for a smaller 30Mb version.

## 3 Observations and Conclusions

The main observation made from this movie is the 'unsteadiness' of the flow. Two snapshots can be seen in Figure 2. Even though we are towing in very calm conditions, the turbulent boundary layer appears to be unsteady. Due to cross-flow it is unsymmetrical and tend to be washed away from the streamer surface. This behavior makes it difficult to make good computer simulations the noise production in the turbulent boundary layer. Experimental results obtained on nearly perfectly axis-symmetrical boundary layers in laboratories might also have a limited value in explaining features in the real-life flow.

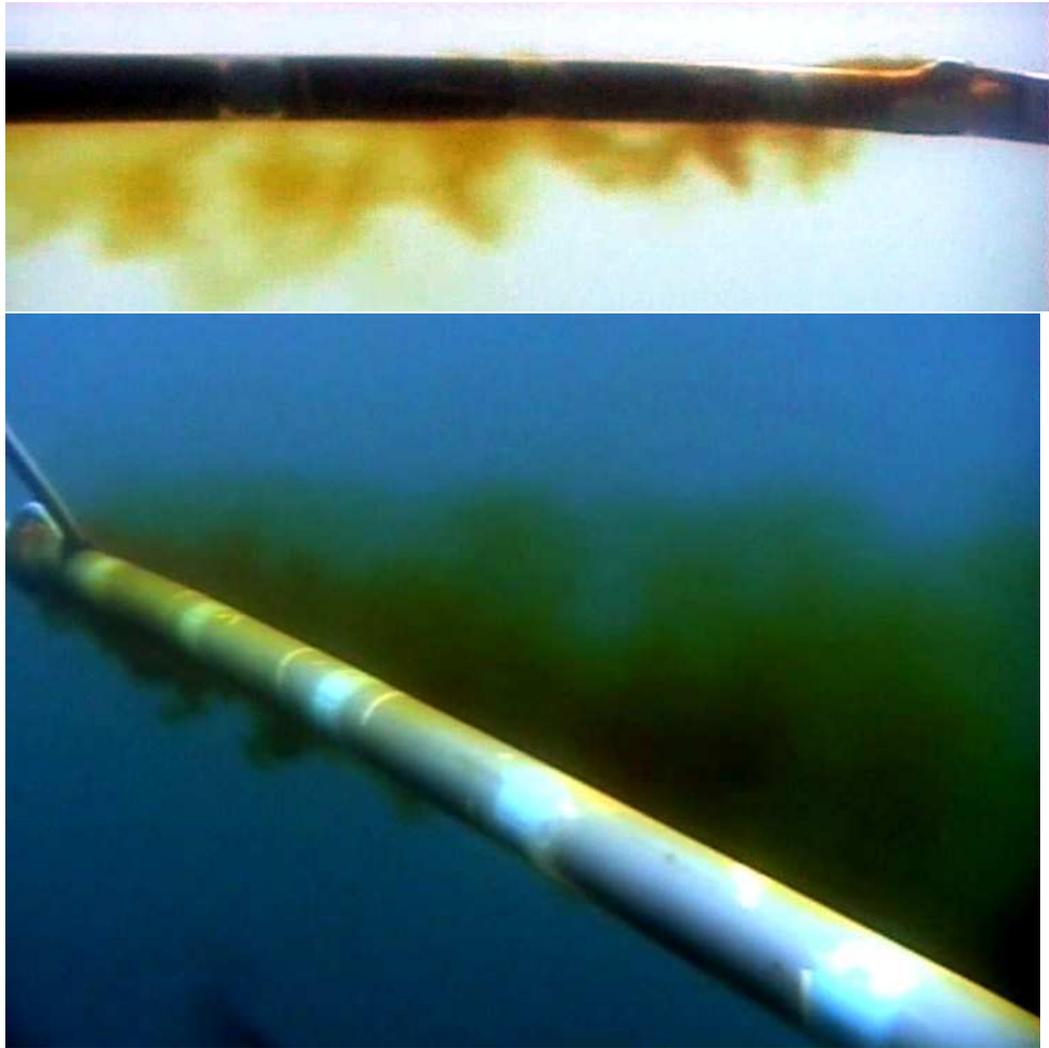


Figure 2: Two snapshots of the turbulent flow around the seismic streamer.