Video imaging in turbid water

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1 Introduction

In order to describe seabed habitats and to identify and quantify spatial patterns information is needed at different scales. Whereas ground-truthing techniques are used to gain point information, remote sensing techniques are used to obtain information on a larger scale. To link seabed samples taken with grabs and cores to a wider patterns remote sensing techniques as side scan sonar, multibeam and video imaging are often used. For the latter, however, the Dutch waters are often too turbid to obtain good images.
In order to improve information obtained by photography and video a “water lens” system was developed and tested.

2 Methodology

2.1 Water lens

The water lens system consists of a video camera which is mounted in a aluminium frame (Figure 1a) that can be filled with fresh water. In the prototype a adjustable light is attached to the side. The bottom of the frame is made of a glass plate of 50 x 50 cm, resulting in a field of view of 0.25m^2. Bars of lead are attached to give the system enough weight. A wing at one side assures that the system is positioned relatively stable into the current.

The system was lowered to the sea bed or was kept just above the seabed. An online monitor made it possible to follow the actions. A recording system was later combined with the camera and the monitor.

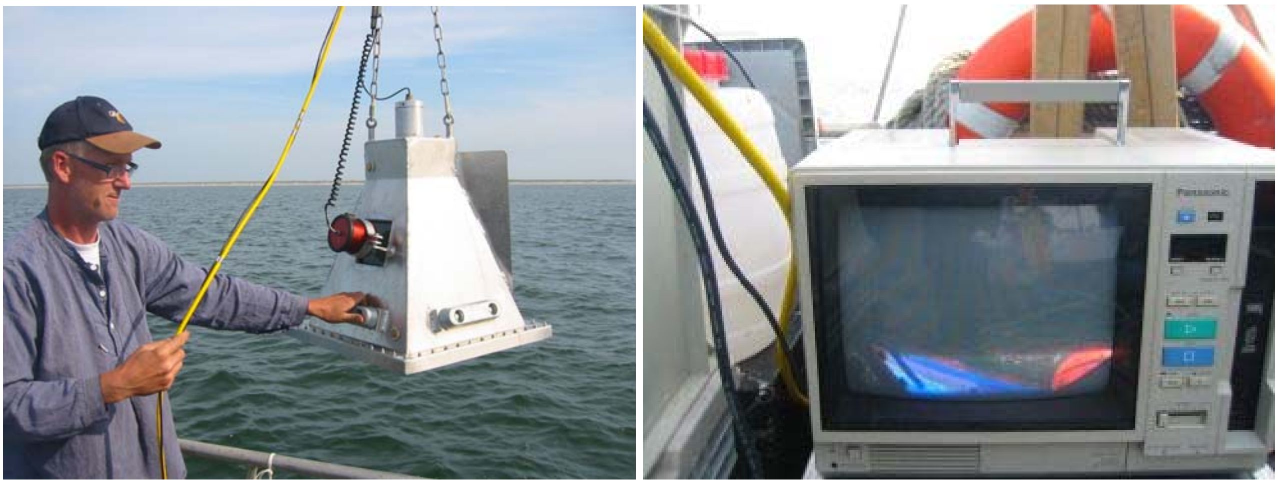

Figure 1 a: The "water lens" video system as developed by TNO-IMARES. A light is attached to the side. Visible are the wing and the bars of led. b: the monitor on deck.

2.2 Sediment and ground-truthing

In addition to the video observations samples of the seabed were taken with a 0.1 m^2 Van Veen grab (Figure 2) for the analysis of the sediment composition and macrobenthos community. Geographical position (DGPS) and depth relative to NAP (Dutch Ordnance level) were recorded. Macrobenthos samples were washed over a sieve with a 1 mm mesh size.

Figure 2 *Van Veen grab used to ground truth the seabed (0.1 m^2).*

In addition also epifauna and fish was sampled using a 2 m beam trawl net. Hauls were made of app. 200-300 m length.

Figure 3 *2 m beam trawl net used to fish on epifauna and juvenile fish (mesh size 1 cm^2).*

3 Results

3.1 Side scan sonar

The side scan sonar images taken at Ameland are combined with depth data in a mosaic chart (Figure 4). Due to failures in the system and due to the sea state no full coverage map could be obtained. This resulted in side scan sonar in suboptimal images.
The mosaic chart indicates a rather uniform sonar signal of the seabed at Ameland. Only at a few areas some divergent spots are observed. The reflections did not reveal clearly structures presence at the sea bed or areas of irregularity.

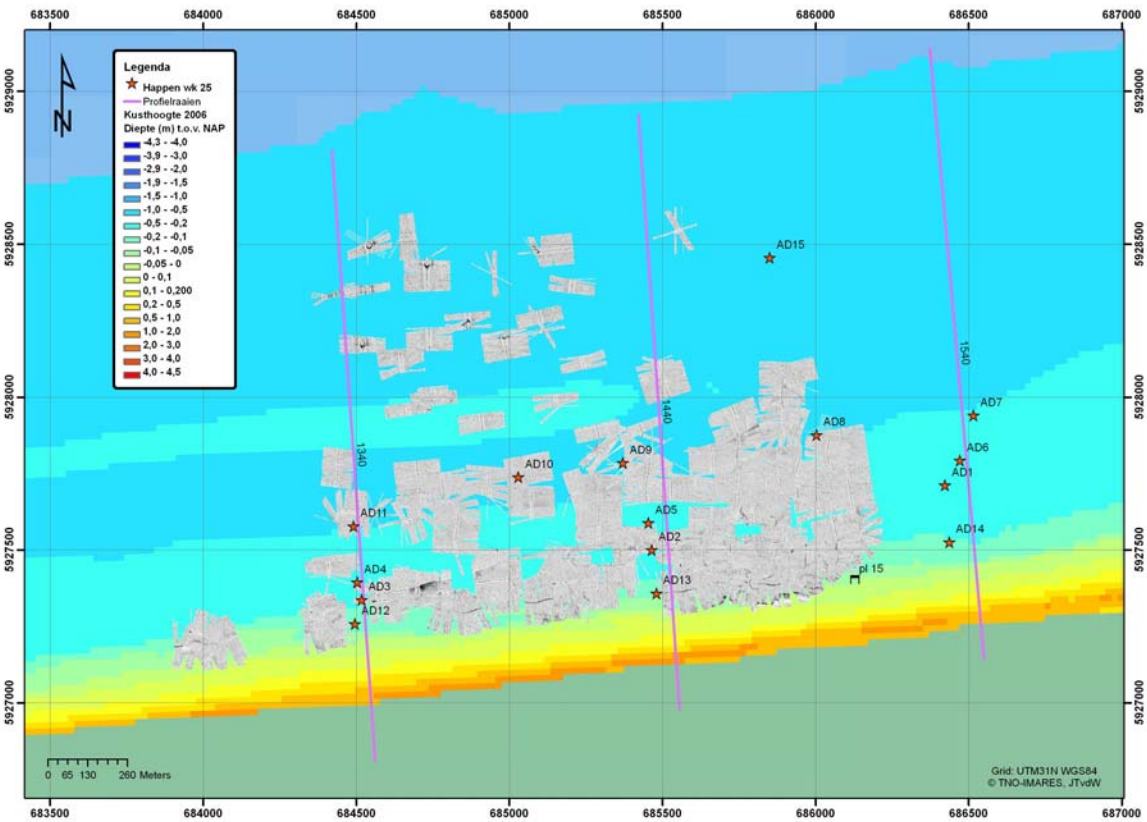

Figure 4 Sonar mosaic in front of the beach of Ameland and sampling stations for sediment and macrofauna .

3.2 Water lens video system

On the images small ripples on the sea bed are visible. Next to debris and shell fragments shrimps, crabs and small fish were seen on the sea bed (Figure 5).
The video images showed clearly that the Sand mason *L. conchilega* may occur in patches of different sizes ranging from centimetres to meters. In the shallow fore shore individuals or small patches of were observed.

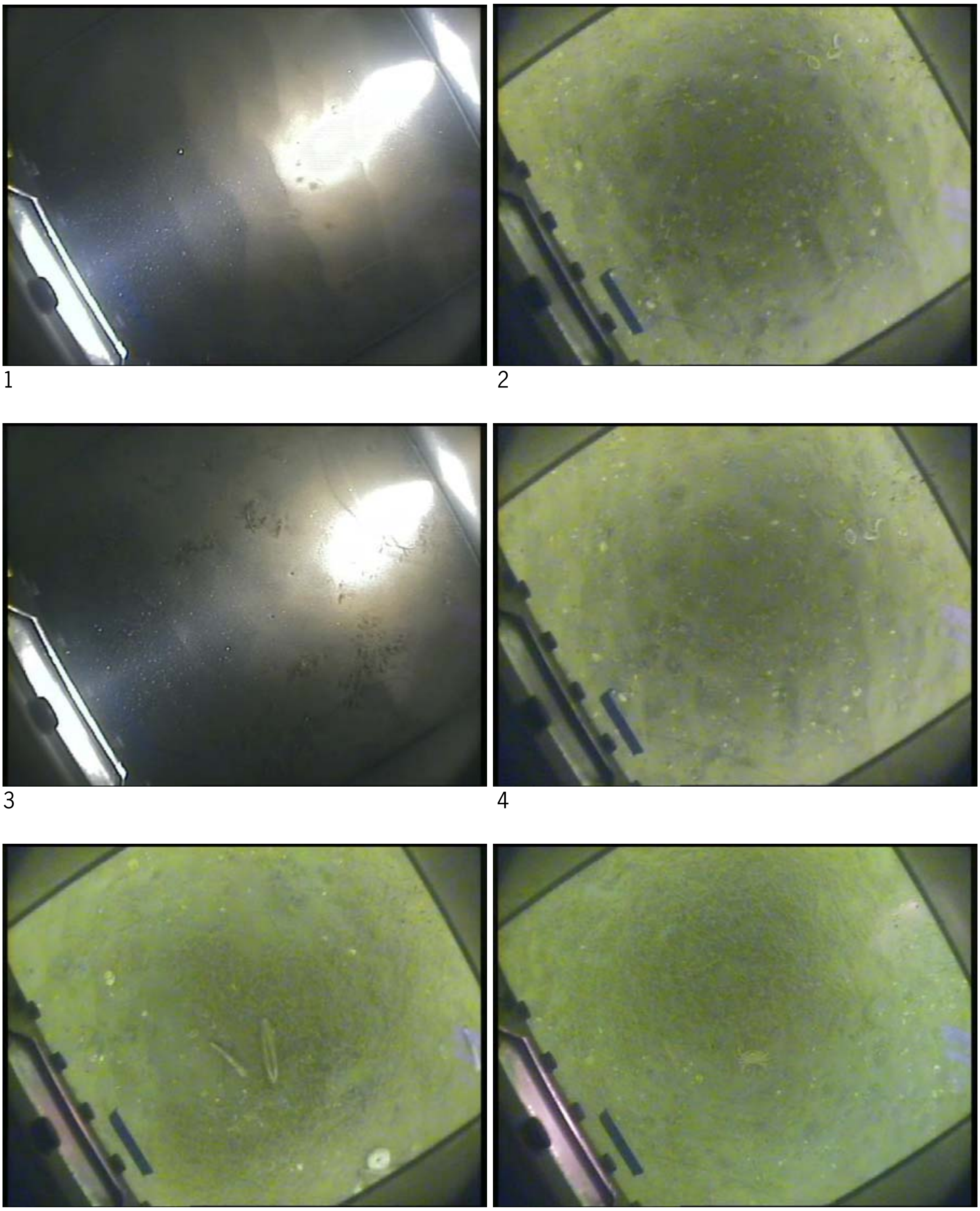

Figure 5 *Screenshots made with the "water lens" video system at Ameland. A scale bar of 10 cm is fixed to the glass plate (left under corner)Visible is a concentration of bed forms (sand ripples, nrs 1, 2), low and high concentrations (patches) of tube dwelling worms (Lanice conchilega, nrs 3, 4 and 5, 6 respectively).*

3.3 Ground truthing (benthos and epifauna)

The macrobenthos samples taken at the different locations showed large differences in the presence and abundance of tube dwelling polychaetes in the area investigated (Figure 6). Especially the tube building Sand mason *Lanice conchilega* occurred sometimes at high numbers at certain locations in the deeper foreshore.

The results of the 2-m beam trawl fishing supported the video recordings and the results of the macrofauna sampling (Figure 7). In certain areas in front of the coast of the island Ameland high concentrations of the Sand mason *L. conchilega* were found.

Date: 19-6-2007
Station 1A, deeper foreshore.
High density of the Sand mason *L. conchilega, Some Sea urchins Echinocardium cordatum and a few Ensis spec.*

Date : 21-6-2007
Station AD-10 Shell debris, a few tube worms and a juvenile sole

Figure 6 Macrobenthos samples at Ameland.

Date : 21-6-2007
Beam trawl catch

Date : 21-6-2007
Detail of beam trawl catch.
Visible next to shrimp and crabs is the large amount of tubes of *L. conchilega*

Figure 7 Beam trawl catch.

4 Discussion

4.1 The "water lens" system as technique

The system proved to be able to take video images of the sea bed in water with a medium and high turbidity. With this method additional information was obtained on the sea bed and especially the spatial distribution of tube building worms. This is important and can be used in the interpretation of the ground truthing samples. The system is capable of collection data over a relative large area in an efficient way. The use of the system as a additional technique to remote sensing using side scan sonar and ground truthing increases the ability to describe the sea bed efficiently and more accurate.

However, it became evident that in this prototype the placing of the light source outside the water lens was sub optimal and caused a reflection on the sheet of glass. Also due to the size and the relative light weights the system was still sensitive to water current. Not all observations were recorded but this prototype of the "water lens" proved to be a valuable tool to make observations of the seabed in waters with low visibility.

A second prototype is currently under development. Improvements are foreseen in the positioning of the light source and in making the system less dependent to wave and hydrodynamic conditions. Also a system of reference is needed, such as multiple laser lights, to provide a reference scale when the water lens is not placed on the seabed. It is also discussed to mount the water lens system on a towed sledge in order to be able to describe transects. The video recordings also will need a direct GPS positioning logging.