Polish Geological Institute Special Papers, 11 (2004): 77–82
Proceedings of the Conference "Rapid transgressions into semi-enclosed basins"

THE ROLE OF THE DAY BY DAY BEACH MONITORING IN SHORE TRANSFORMATION

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Abstract. The new method of a detailed morphodynamic registration of sandy beaches has been presented. The digital oriented photograms have been taken from a stabilised point at least once a day. Occasionally also more often, for example every hour during a storm cycle. The analyses of the photograms are performed in digital mode using special computer software. This digital beach monitoring of the Polish Baltic coast was initiated in summer 2002. The test fields in Polanka Redłowska within Gdynia and Chłapowo near Władysławowo were selected. The beach areas of the length of about 200 m along the shore were registered there. Selected examples of short-term changes of the beach relief were presented. A range of spatiotemporal transformations related to different periods (hours, days, months etc.) was demonstrated.

Key words: orthogonal photograms, shore zone, Polish Baltic coast.

INTRODUCTION

The geodetic profiles registration and GPS technology are the most popular methods of shore transformation observations. The data gathered by means of these methods does not show situation from the same moment in the whole area. The time of the data acquisition depends on the examined area and changing weather conditions. Moreover, the space images obtained from the profiles are the result of interpolation, and the condition of the shore between the profiles or points is not taken into account (Fig. 1). Satellite or aerial photos, radar and lidar images cover all regions of our interest at the same time (Fig. 2). The main disadvantages of these methods are the dependence on the weather conditions and the cost. The terrestrial oriented photos show the whole area studied at the same time and with required frequency. Digital techniques and computer software available today make it possible to transform images to the suitable form for precise shore analyses. The photos display arrangement of the nearshore forms which is useful in the interpolation of the registered processes (Musielak, Stolarczuk, 1994).

The oriented digital photo observation was inspired by the research initiated in USA (Holland *et al*., 1997; Stockdon, Holman, 2000; Holland *et al.*, 2001). American researchers have constructed ARGUS monitoring system. They use digital techniques for transformation of the images to the orthogonal pattern. The ARGUS system also takes 10' time exposure photos.

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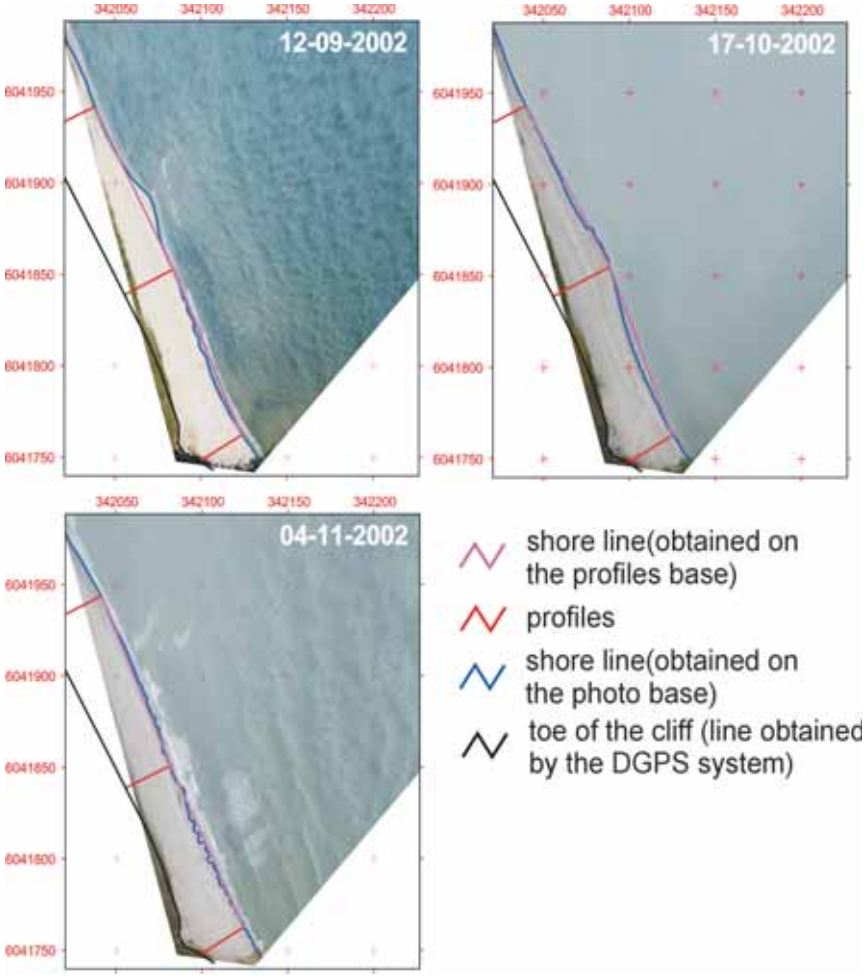

Fig. 1. The comparation of the interpolated and oriented digital photo data

Fig. 2. Satellite image, aerial photo and terrestrial photo — an example from the coast part at Chłapowo

METHODS

In August 2002, the top of the 30 m high cliff in Polanka Redłowska within Gdynia was chosen as an observation point. Three points were established for identical positioning of the camera stand during the day-by-day observation. The points' co-ordinates were determined by the Garmin DGPS system (Garmin GPS12, Garmin GBR23 beacon receiver).

The digital photos have been taken day-by-day since August 2002. Every month there are about three days without registration. The plan is to maintain monitoring registrations for the period of one year. The next stage will be photos taken in shorter series.

There is the maximum view (ca 200 m) of the beach in the photos. The view is limited by trees on the cliff. A Minolta Dimage S304 digital camera was used.

The orthogonal transformation of a digital photo is based on the georeferential net model. The net was constructed on the basis of points marked out and measured in the terrain. The co-ordinates of the georeferential points were determined in UTM zone 34 WGS-84 by DGPS set of Garmin make. The photogrametrical transformation to the orthogonal pattern was made in TNTMips 6.4 program in cooperation with the Department of Operational Oceanography of the Maritime Institute in Gdańsk. The method was retested in a different place of the Polish Baltic coast in the Chłapowo field. A daily monitoring card was created for observation archives (Fig. 3).

Fig. 3. The example of the daily monitoring card

RESULTS

About 4000 photos were taken from 8 August 2002 to 30 April 2003. 247 of these photos were chosen for transformation. There are visible such elements of the beach like: shore line, longshore bar, longshore trough, small beach bay, cuspate foreland, beach cusps, step, beach lagoon, beach scarp, stones (Furmańczyk, 1994).

The shore line changes were detected. The changes were connected with both side movements of cuspate forelands, changes of the beach width (Fig. 4), reconstruction of longshore bars, beach lagoons and beach cusps.

Systematic photographical registration enabled observation of the changing processes on the beach, such as creation and transformation of the beach forms in the nearshore area (Fig. 4). When registration is done more frequently (every 10'), there is an opportunity to observe these processes as they are happening (Fig. 5).

The need for precise planning of the research methods, choice of measuring points, weather and hydrological conditions, and the recognition of the conditions for observation of beach dynamics has been proved (Fig. 1).

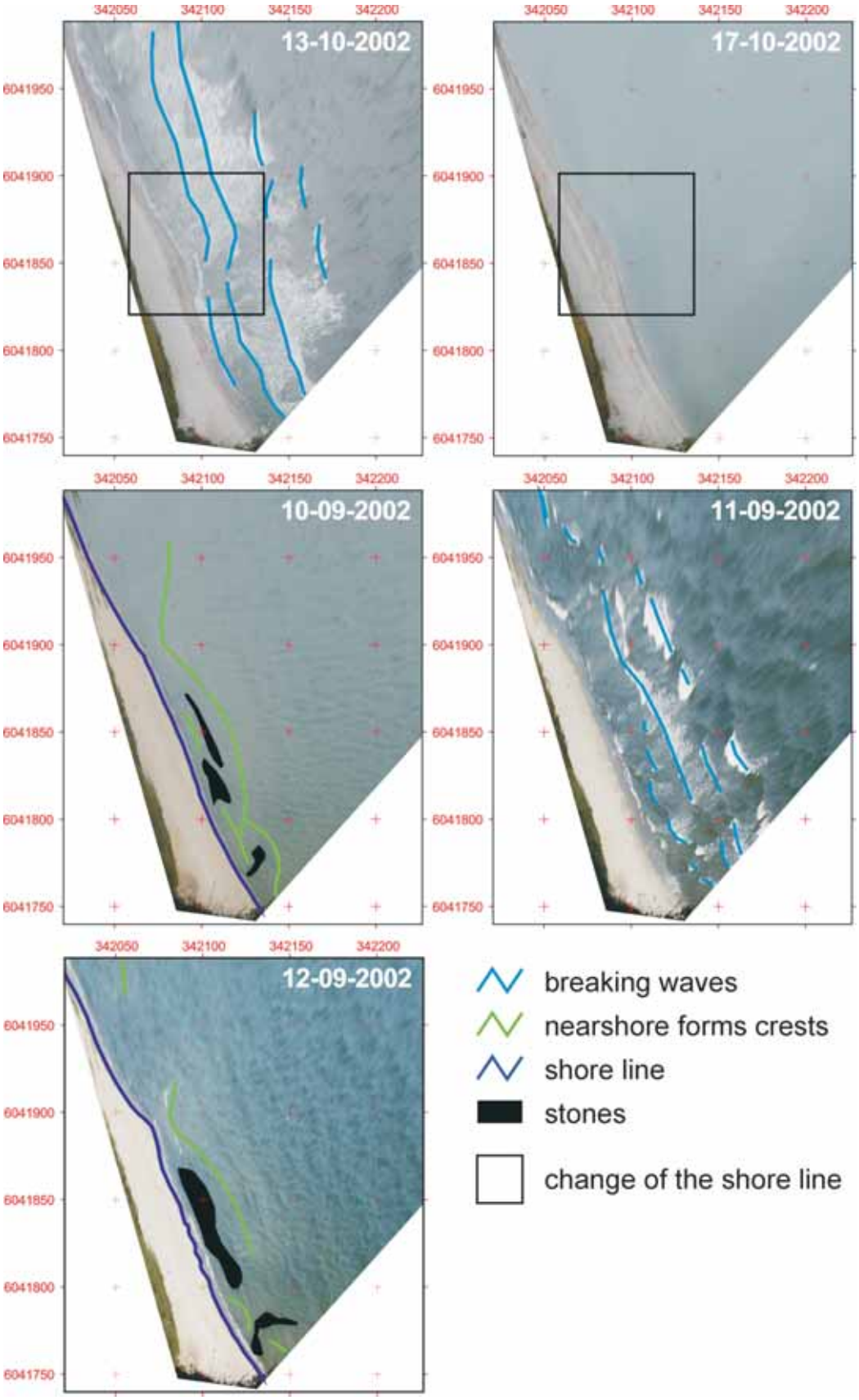

Fig. 4. The examples of the day-by-day observations at Polanka Redłowska field

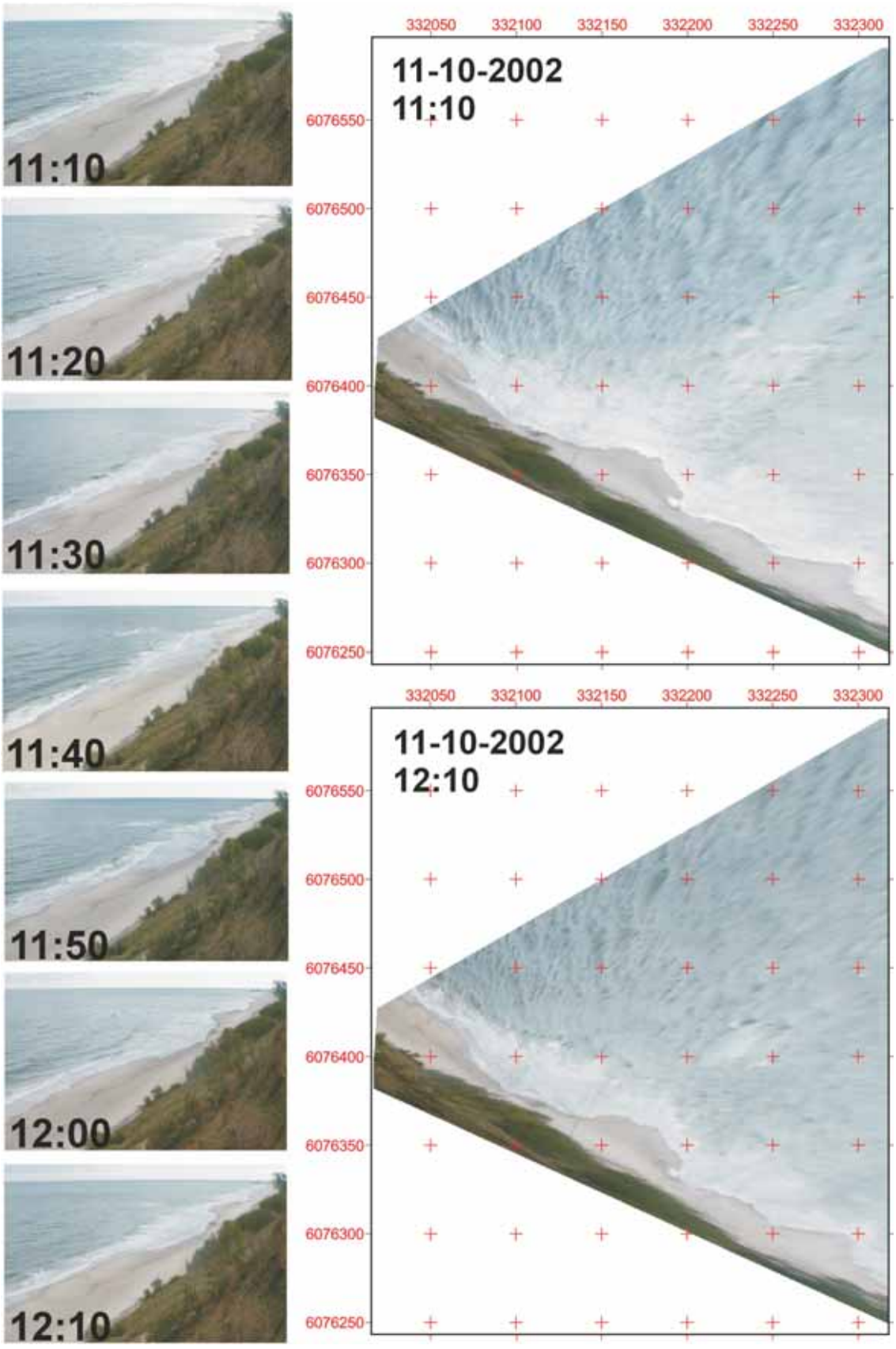

Fig. 5. The hour after hour observation with 10' periods of time — Chłapowo field

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