

Water motion in seas and oceans is generated by waves and currents. For big water depths, the influence of waves and currents on the sea bed is very weak while in the regions with the limited depth the impact of waves and currents on the bottom can be significant. If the sea bed is built of loose material (e.g. sand) it is vulnerable to water flow. In such a case, sand grains also move which frequently results in displacement of sand to remote locations. This phenomenon is accompanied by appearance of depressions and protrusions of the bottom. Such physical processes are most intensive at small water depths, in the shoreline vicinity, where breaking waves generate extremely strong currents. Carried out for tens of years, observations show that the sea bottom changes are smaller further from the shore. At depths of tens of meters motion of water does not reach the nearbed layer and the sea bottom sediments do not move.

In the south Baltic coastal zone, having the sea bed mostly built of fine sand, numerous shoals occur (called bars). It has been found out that the bars appear and move at the depths not bigger than several metres. At the depths amounting to 10-15 m and more (usually corresponding to the distance of at least 1 km from the shoreline), the sea bed forms of this type are basically absent. However, there are some scarce presumptions, mostly having a character of concise notes in materials unavailable in public (reports elaborated within commercial projects) or oral accounts, against this statement. In literature, the author of the present application has encountered few scientific publications describing the sea bed forms at the depth of 18 m near Ustka and at depths of 23-30 m at a distance of about 20 km northwards of Rozewie. Short notes on natural sedimentation in underwater excavations northwards of Cape Rozewie at the depth exceeding 20 m can be found in unpublished documents of the Maritime Institute in Gdańsk. Only a small piece of information on this topic has been revealed in a scientific paper. In recent years, presence and migration of sandy bed forms have been detected at the depth of about 18 m in the region of the IBW PAN Coastal Research Station in Lubiatowo. The above data constitute a premise that there can be relatively strong nearbed currents at the respective depths, satisfactory to cause the sand motion.

The considerations presented above lead to formulation of the project objective: research and description of rates of sandy sediment in the sea at moderate distances from the shore, at depths of 15-20 m, where the influence of water motion on the sea bed is very weak in view of classical theories. Within a hypothesis assumed by the applicant, motion of sediments may appear in this area and can take place only in specific cases of joint occurrence of stormy waves and the currents typical for the open sea.

The project objective will be achieved in a multifaceted and a multi-stage way. Aside from the in-depth analytical studies, the theoretical (numerical) modelling is planned, as well as field investigations. Within the theoretical analysis, particular attention will be paid to characteristics of the currents typical for offshore regions of a non-tidal sea. These studies will be focused on clarification which kind of hydrodynamic conditions typical for the shelf sea like the Baltic can be a source of bed shear stresses higher than the critical values defining incipient motion of grains constituting the sea bed. Theoretical description (computer modelling) of the investigated phenomena will comprise the water flow velocities and rates of motion of sand grains in the bed boundary layer under influence of waves, as well as joint existence of waves and currents. To this end, a three-layer model will be adapted, developed previously at IBW PAN. The field campaign at the IBW PAN Coastal Research Station in Lubiatowo, engaging equipment for measurements of waves and currents will be a crucial component of the proposed project. The measuring device will be installed at a distance of about 2800 m from the shore, at location where water depth amounts to 18 m. Digital bathymetry maps will be made before and after a stormy period typical for the Polish coast. Besides, along with observations of the sea bottom dedicated to identification of appearance and displacement of sea bed forms, the sea bottom soil samples will be collected and analysed.

The motion of water and sandy sediments at depths of 15-20 has rarely been studied and the respective investigations are therefore desirable, at least from a purely scientific point of view. Assessment of conditions in which this motion can occur and what intensity it can have, will provide a new scientific quality, yielding a considerable progress in marine research. In the long run, this progress will presumably lead to innovative solutions of marine engineering problems, particularly in the domain of coastal engineering. One can expect, for instance, utilisation of results of the proposed project in optimisation of activities associated with coastal protection against erosion and flooding by use of artificial shore nourishment with sand dredged from the sea bed. It will be possible to obtain the reliable forecasts of silting up of the excavations and assessment of possibility of subsequent use of these sites as sources of sediment for the engineering needs.