Summary of professional accomplishments, scientific and educational achievements to qualify for a habilitation degree.

Area: Natural Sciences

Field: Oceanology

dr Magdalena Bełdowska

Gdansk University

Gdynia 2015

1. Name

Magdalena Bełdowska

2. Diplomas and academic degrees with place and year obtained and related thesis.

2004 Doctor of Natural Sciences in the field of Oceanology (9th July 2004), Gdansk University, Department of Biology, Geography and Oceanology, Oceanography Institute, doctoral thesis entitled „*Sea as a storage and source of atmospheric mercury (exemplified by the Gdansk Basin)*" – executed under the supervision of Professor Lucyna Falkowska, PhD.

1998 **M.Sc. degree in Oceanography** (23rd June 1998), Gdansk University, Department of Biology, Geography and Oceanology, Oceanography Institute, thesis entitled: *„Ammonium concentration in the atmosphere of the Southern Baltic"* – executed under the supervision of Professor Lucyna Falkowska, PhD.

3. History of employment in scientific / academic units:

since 2005 **Gdansk University**, Oceanography Institute, The Centre of Marine Chemistry and Marine Environmental Protection, position: Assistant Professor.

1998-2004 **Environmental Doctoral Institute**, Gdansk University, Department of Biology, Geography and Oceanology.

4. Indication of accomplishment as described in Article 16 par. 2 of the Act of the 14th March 2003 on academic degrees and titles (Journal of Laws point 65, item. 595 with amendments):

a) accomplishment title:

Processes influencing the changes in mercury circulation in the area of land and sea contact

b) author(s), title(s), year of publication, name of publisher, reviewers:

4.b I Bełdowska M., Saniewska D., Falkowska L., Lewandowska A. 2012. Mercury in particulate matter over the Polish zone of the Southern Baltic Sea. Atmospheric Environment 46, 397-404. doi: 10.1016/j.atmosenv.2011.09.046. **IF = 3.11**

4.b II Saniewska, D., **Bełdowska, M**., Bełdowski, J., Falkowska, L. 2014. Mercury in Precipitation at an Urbanised Coastal Zone of the Baltic Sea (Poland). AMBIO 43 (7), 871-877. doi: 10.1007/s13280-014-0494-y. **IF = 2.973**

4.b III Saniewska, D., **Bełdowska, M**., Bełdowski, J., Saniewski, M., Szubska, M., Romanowski, A., Falkowska, L. 2014. The impact of land use and season on the riverine transport of mercury into the marine coastal zone. Environmental Monitoring and Assessment 186 (11), 7593-7604. doi: 10.1007/s10661-014-3950-z. **IF = 1.679**

4.b IV Bełdowska M., Saniewska D., Falkowska L. 2014. Factors influencing variability of mercury input to the southern Baltic Sea. Marine Pollution Bulletin 86, 283–290. doi: 10.1016/j.marpolbul.2014.07.004. **IF = 2.793**

4.b V Bełdowska M., Jędruch A., Słupkowska J., Saniewska D., Saniewski M. 2015. Macrophyta as a vector of contemporary and historical mercury from the marine environment to the trophic web. Environmental Science and Pollution Research. doi: 10.1007/s11356-014-4003-4. **IF = 2.757**

4.b VI Saniewska D., **Bełdowska M**., Bełdowski, J., Jędruch A., Saniewski M., Falkowska L. 2014. Mercury loads into the sea associated with extreme flooding. Environmental Pollution 191, 93-100. doi: 10.1016/j.envpol.2014.04.003**. IF = 3.902**

4.b VII Bełdowska M. 2015. The influence of weather anomalies on mercury cycling in the marine coastal zone of the southern Baltic—future perspective. Water Air Soil Pollut 226, 2248. doi: 10.1007/s11270-014-2248-7. **IF = 1.685**

---

total IF: 18.899

total MNiSW (Ministry of Science and Higher Education) points: 230

c) description of the scientific goals of the above-mentioned papers, and the obtained results with an outline of their potential utilisation.

Introduction

Despite its undoubted usability, mercury (Hg) is the most toxic metal and one of the most toxic elements. It is as yet unknown whether there are any beneficial functions performed by mercury in live organisms. It is, however, proven to have neurotoxic, nephrotoxic, immunotoxic, mutagenic, embryotoxic and allergising properties (Zahir et al. 2005; Bose-O'Reilly et al. 2010). It is one of the factors causing a number of disorders, such as Alzheimer's disease, Parkinson's disease, autism, amyotrophic lateral sclerosis or lupus (Wermuth et al. 2005; Zahir et al. 2005; Johnson & Atchison 2009; Salerno 2012; Yassa 2014). The main route of mercury introduction to the human system is the consumption of fish and seafood. Owing to the fact that mercury is capable of penetrating quickly through the placenta – foetus barrier, some countries have introduced recommendations against the consumption of predatory fish by pregnant women (Bose-O'Reilly et al. 2010).

The problem of mercury toxicity was only widely explored in the second half of the 20th century, following cases of fatal poisonings as a result of the consumption of contaminated fish (Takeuchi et al. 1959) and grains preserved with mercury compounds (Rustam & Hamdi 1974). As a consequence, Hg emission and deposition has been monitored in many regions of the world. In the Baltic region the role has been performed by the Baltic Marine Environment Protection Commission, also known as the Helsinki Commission – HELCOM. Out of all the Baltic countries, Poland is indicated as being the main supplier of Hg into the sea, although these reports were developed based on models, without studies into mercury concentrations at Polish coastal stations (Bartnicki et al. 2010, 2011, 2012).

According to HELCOM reports (2004; 2010), Hg emission in the Baltic region at the beginning of the 21st century was about 20% - 30% lower than during the 1980s. The climate warming, particularly in the autumn-winter season (HELCOM 2013), is another factor contributing to the decline in Hg emission from the main source, the burning of fossil fuels, into the coastal zone of the Southern Baltic. On the other hand, however, in the seaside air rich in halides, there are conducive conditions for a quick transformation of gaseous mercury to the aerosol form, which causes Hg to be removed faster to the ground. In the zone where marine and terrestrial air masses meet, this process is aided by high humidity. This results in larger aggregates being formed, which drop out of the atmophere faster (Sommar et al. 1997; Hedgecock & Pirrone 2001; Chand et al. 2008). During warm autumn and winter months

phytoplankton blooms can occur (Wasmund & Uhlig 2003), leading to the bioaccumulation of mercury from atmospheric deposition, the inflow of which is always higher in the home-heating season as opposed to the warm part of the year (Bełdowska et al. 2007). In such cases, mercury compounds do not drop to the bottom of the water basin, but are accumulated by phytoplankton and thus included in the trophic chain (Bełdowska et al. 2013b). Climate changes in the coastal zone of the Southern Baltic point to the shortening of the icing period (Kożuchowski 2009), which affects the circulation of mercury between near-bottom water, sediments and benthic organisms (Bełdowska et al. 2013a). The reason for this is the prolongation of the macrophytobenthic vegetative period and zoobenthic activity, which can in turn increase the absorption of pollutants from near-bottom and pore water and intensify the mixing of surface sediments. In recent years the intensification of extreme natural phenomena has also been observed (HELCOM 2013). More frequent precipitation and floods can contribute to the reemission and remobilisation of mercury transported into the sea from land.

The above observations led to the formulation of the following research goals:

- To measure the mercury concentration in aerosols, rain water, and rivers, and to determine the factors that influence this value in the Southern Baltic region.
- To estimate the degree of Hg inflow via atmospheric precipitation and rivers into the Baltic and determine the factors that influence this value in the Southern Baltic.
- To assess Hg concentration in the Polish coastal zone in the first chain of the marine trophic chain – i.e. macrophytobenthos. To make an attempt to indicate the role of macrophytobenthos as a carrier of mercury, transported to the sea contemporarily as well as in the past, into the trophic chain.
- To determine the tendencies in the changes of Hg circulation in the marine environment under the influence of climate changes occurring in the Southern Baltic region.

Description of the obtained results

– **Hg concentrations in the natural environment of land and sea contact in the Polish coastal zone of the Southern Baltic.**

The research carried out as part of this PhD study has shown that, in the Polish coastal zone, mercury concentrations both in aerosols and in rains (publications 4.b I and 4.b II) were comparable to the values obtained at other stations within the Baltic (Wängberg et al. 2001, 2003; Bartnicki et al. 2010, 2011). The mean annual Hg concentration in aerosols (Hgp) was 1% of total Hg concentration in the air, which is typical of unpolluted areas (publication 4.b I; Lamborg et al. 1995).

Using the annexes of HELCOM reports as reference, it was found, in the study period (2008-2009) (Bartnicki et al. 2010, 2011), that the obtained mean monthly Hg concentrations in rains and their variability at the Gdynia station, were comparable to the values at a Station in Germany (Zingst) and a few times lower than in Lithuania and Estonia (publication 4.b II). Particularly in August, October and November 2008, with the same air masses (SWW, W), Hg concentrations in wet precipitation at the station in Poland were similar to those in Germany. This also indicates the absence of additional mercury sources over North-Eastern Poland.

In the seven studied rivers terminating in the Baltic in the region of the Polish coast, the mean annual Hg concentrations were similar to the value 5 ngHg dm^{-3}, considered to be the global mean concentration in watercourses. Annual medians were lower than 7 ngHg dm^{-3} (publications 4.b III and 4.b IV).

The Hg inflows into the Baltic estimated on the basis of direct measurements at the station in Gdynia (publications 4.b IV and 4.b V) were much lower than those published on the basis of models in the HELCOM reports (HELCOM 2004; Bartnicki et al. 2008, 2010; HELCOM 2010; Bartnicki et al. 2011, 2012). The reports claimed that Poland introduced 3-4 times more mercury into the Baltic than other countries. The Hg inflow measured in the Polish coastal area (in Gdynia) was comparable to data from the same study period on the German coast (in Zingst), while HELCOM reports (Bartnicki et al. 2010, 2011) showed that in this area of Poland the Hg inflow was a few times higher than in the German coastal zone. That discrepancy was particularly significant with respect to mercury inflow via the River Vistula. Estimated on the basis of actual measurements, the mass of Hg introduced yearly into the Baltic was thirty times lower than the value shown in the HELCOM report (2010). Even taking into account the largest ever recorded flood on the River Vistula (in 2010), the value of

Hg inflow suggested by the report was still thirteen times higher (publications 4.b IV and 4.b V). The overestimation of the Hg load introduced from Poland was also indicated by the concentrations of this metal in macrophytobenthos, which is often used as a bioindicator of environmental quality (Filipovic-Trajkovic et al. 2012; Stankovic et al. 2014). Hg concentrations in macroalgae in the Polish coastal zone of the Baltic, particularly in the outlets of the rivers Vistula and Oder, the main rivers of the Baltic drainage area, do not testify to a larger inflow of this metal compared to other regions (publication 4.b VI).

– **Changes of Hg concentration in the atmosphere and rivers of the Southern Baltic region.**

Hg concentrations in the air and rivers varied in the particular months of the year (publications 4.b I, 4.b II, 4.b III, 4.b IV, 4.b VII). In the region of the Polish coastal zone of the Baltic, at the station in Gdynia, the Hg concentration in large aerosols was higher than in small particles (on average 93% of the total Hg in aerosols) (publication 4.b I). The reverse was observed in air masses that had been transported from distant polar and subpolar regions high above the ground, particularly from over volcanos in Iceland. Hg concentrations in aerosols, both large and small, were higher in terms of statistical significance in the heating season than in the non-heating season. Moreover, in the heating season Hg concentration in both large and small aerosols was lower in the marine air masses than in terrestial air masses. This is related to the intensive combustion of fossil fuels for heating purposes in this season. Statistical analyses showed a significant role of individual home furnaces, which are relatively numerous in and around the Tri-city, in the formation of mercury concentrations in aerosols and rains (publication 4.b I and 4.b II). Hg concentration in rains in both seasons (heating and non-heating) were not found to be different in terms of statistical significance (publication 4.b II). In the coastal zone of the sea, a place where the polluted terrestrial air masses meet the cleaner, humid and halide-rich marine air masses, an important factor forming the volume of mercury concentration, both in aerosols and in rains, was found to be that of Hg transformations. In such conditions gaseous mercury Hg(0) can be oxidated to Hg(II) and adsorbed on condensation nuclei, which in consequence can lead to an increase of Hg concentration in rains and in large aerosols in marine sea masses, particularly in the warm season (publications 4.b I and 4.b II). These are significant processes, particularly in the summer, when an increased emission of gaseous mercury from the sea into the air is observed (Marks & Bełdowska 2001). As a consequence, in the non-heating season Hg concentration in large aerosols was higher than in the marine air masses compared to terrestrial air masses

(publication 4.b I), and Hg concentration in rains was the highest in summer (publication 4.b II). Additionally, in summer mercury in dry air evaporated off the aerosol surface, which led to a drop in Hg(p) concentration in terrestrial air masses (publication 4.b I).

In rivers flowing into the Baltic along the Polish coast, Hg concentration was much less directly dependent on meteorological parameters than was the case with aerosols and rains. The level of mercury concentration in rivers was indirectly related to the volume and height of precipitation (publication 4.b III). Depending on the type of catchment and the length and height of wet precipitation, Hg concentration was either diluted in a river or increased as a result of the metal being washed off land. An increase in mercury concentration was observed in sections of rivers flowing through urbanised areas. The washing-off of pollutants from street and pavement surfaces, pitches or car parks as a Hg source into rivers is also confirmed by increased metal concentrations in water from storm sewers collected both during and after rain. Hg remobilisation from agricultural areas also increased Hg concentration in rivers compared to the source section. In the 20^{th} century mercury compounds were commonly used in agriculture as fungicides, which is why such areas are currently a potential source of this metal into rivers and the sea (publication 4.b III).

– **Factors influencing Hg inflow into the Southern Baltic**

The inflow of mercury into the Southern Baltic changed over the course of a year (publication 4.b IV). The size of Hg load introduced with dry precipitation mainly depended on air temperature, particularly in the heating season. In that period dry deposition of Hg depended mainly on Hg concentration in aerosols, in both marine and terrestrial air masses. Wet Hg deposition, on the other hand, increased with the height of precipitation. In the non-heating season the size of Hg load introduced in this way depended on both the height of precipitation and on Hg concentration in rains and, analogously, that introduced with dry precipitation: on the concentration of Hg in aerosols and the speed of particle deposition (publication 4.b IV).

In the conducted research it was shown that there is a possible tendency of increasing Hg inflow from the atmosphere, which may reveal itself in the following conditions: in the heating season the inflow of atmospheric Hg will increase with the number of cases where continental air masses from regional and distant sources, with the predominance of coal burning in home furnaces, flow over the coastal zone of the Southern Baltic and with the increasing incidence of rains from marine air masses from distant sources (publication 4.b IV).

The atmospheric Hg load will also increase as air temperature drops and the amount of burnt coal increases, as well as with a rise in the intensity of gaseous mercury transformation into the particulate form (publication 4.b I and 4.b IV). Taking into account the non-heating season, it was estimated that the more frequent the inflows of air masses from regional sources (both marine and terrestrial) and rains from continental regional air masses, the greater the load of mercury coming from the atmosphere will be (publication 4.b II & 4.b IV).

Hg inflow via rivers also fluctuated in the particular months over the course of the study period (publication 4.b IV). A larger load of mercury was introduced in the cold season, when the metal penetrated into rivers directly from increased atmospheric deposition and with the washing-out of pollutants from land – those deposited there both contemporarily and in the past. In addition, meltwater also contributed to the transportation of Hg from land into rivers and the sea. Rains were also a significant factor forming the inflow of Hg via rivers. Changes occurred in various directions – depending on the type of catchment, intensive rains were either conducive to the washing-out of Hg from land or contributed to the thinning down of the metal concentration in the river.

– **Macrophytobenthos as a carrier of Hg into the trophic chain in the coastal zone of the Southern Baltic**

Mercury that reaches the sea is either included in the trophic chain through accumulation by phytoplankton or phytobenthos or becomes sedimented in the seabed, from where it can be reintroduced to the cycle. A good indicator of the size and changes of metal concentrations in water is macrophytobenthos (Filipovic-Trajkovic et al. 2012; Stankovic et al. 2014). It follows from the research on Hg concentration in macrophytobenthos that has been carried out since 2006, that over a long time period the changes in concentrations in the particular seasons are statistically insignificant (publication 4.b V). This is related to the disappearance of stark differences in air and water temperatures between particular seasons (the warming of the autumn-winter-spring season, lack of icing, rainy summer). It has, however, been observed that there are differences in Hg concentration in macrophytobenthos in the particular regions of the Polish Baltic coast (publication 4.b V). Benthic flora in the coastal zone of the open sea was considerably less polluted with mercury than the material from the Bay of Pomerania or the Gulf of Gdansk. The urbanisation of the coastal zone has contributed to the increase in Hg concentration in macroalgae. Surface run-off and the inflow of rain water, e.g. from storm sewers, to the coastal zone of the Gulf, have led to an increase in mercury concentration in macroalgae there compared to regions located far away from

those sources. On the other hand, the inflow of pollutants from river catchment areas contributed to an increase in the concentration of the metal in marine vascular plants. The suspension carried via rivers into the sea, depending on the type of the outlet, was deposited close to the shore to a smaller (e.g Vistula outlet) or greater degree (e.g. Oder outlet), becoming an Hg source into pore water, and, consequently, into vascular plants. The capability of vascular plants to accumulate chemical substances from pore water also contributed to the absorption of mercure that had been deposited in seditemnts in the past. As a consequence, *Potamogeton pectinatus* (a vascular plant) had a 60% higher bioconcentration coefficient than *Furcellaria lumbricalis* (a macroalga) (publication 4.b V).

- **The possible influence of climate changes on the circulation of Hg in the coastal zone of the Southern Baltic**

In recent years, an intensification of extreme natural phenomena has been observed (HELCOM 2013, IMGW PIB 2015). Intensive rains and floods cause increased washing-off of chemical substances from land, which in consequence contributes to the inclusion in the river course of mercury deposited for decades. This is a highly significant problem, as calculations have shown that currently about 50% of mercury deposited into the bottom sediments of the Gdansk Basin, become reintroduced to the water column. If more mercury flows into sediments, e.g. with surface run-off as a result of intensive rains, the streams of mercury emission from sediments may increase by a few to more than 10 per cent above the difference resulting from the change in the inflow (Bełdowski et al. 2009). Thus the bottom sediment will increase its share as a source of Hg into the marine ecosystem.

During the largest flood (2010) on the River Vistula, within a relatively short time (31 days) 1.2 tonnes of Hg penetrated into the Baltic, amounting to 75% of the annual load in 2010 (publication 4.b VI). Such a large mass of mercury introduced was caused not only by the large volume of water (12 km^3 which amounted to 21% of the yearly flow of the Vistula), but also by a several-fold increase in the Hg concentration compared to the time before the flood. During the culmination of the first flood wave, the concentration of total mercury (Hg tot) in the Vistula was over 200 ng dm^{-3}, where the Hg concentration median from before the flood was 6.3 ng dm^{-3}. That was caused by the washing out of pollutants, deposited over years, from the soil, as well as from cemeteries, landfills, farmyards, waste depositories, etc. The high water level, persisting for a long time, apart from washing Hg out of land, contributed to the deposition of suspension (enriched with mercury) close to and in the river

bed. This is of considerable significance as, under the influence of another rise in the water level – either due to a flood, flooding or seasonal meltdown, it is very likely that mercury, in the form of methylmercury (the most toxic form), will be released from the bed and transported into the sea (Jackson 1991; Heaven et al. 2000) (publication 4.b VI). Such a situation w4.b VI was observed in July and September 2010 (publication 4.b V).

The mercury introduced into the coastal zone of the sea during the flood in 2010 was adsorbed by phytoplankton, contributing to a four-fold increase in its concentration in algae in the period between two flood waves reaching the Gdansk Basin, compared to the period before and after the flood (publication 4.b VI). Mercury bound to the fine sediment fraction, to suspension, and in its dissolved form was transported by the strong flood current from the river mouth far into the Southern Baltic. As a consequence, the concentration of Hg in the sediments of the Southern Baltic following the flood increased by as much as 500% compared to the period before the flood, and in relation to the fine fraction content – by as much as 1500%. This state persisted for nearly two years (publication 4.b VI).

The mercury concentrations measured during the flood both in the Vistula and in the Gulf of Gdansk, exceeded the safe values for water organisms. Hg concentrations in herring measured in 2011 by Woroń and Danowska (2012) were the highest, and were found to be 67% higher than in the period 1998-2010, while in mussels they were 60% higher than in that period (publication 4.b VI).

According to HELCOM reports, mercury inflow into the Baltic has decreased since the 1990s thanks to industrial modernisation (HELCOM 2010). Moreover, climate warming (HELCOM 2013) has been contributing to the decrease in the proportion of the main Hg source in the Polish coastal zone, i.e. fossil fuel burning, which reduces the inflow of mercury with atmospheric deposition and rivers (publication 4.b IV). This is of particular importance in regions where emission from individual home furnaces is predominant. The inflow of Hg with dry deposition during a winter when subzero air temperatures were predominant, was eight times higher than in a warm winter, abounding in temperatures above zero (publication 4.b IV). On the other hand, however, a warm winter, as opposed to a frosty one, is conducive to faster mercury transformations in the zone where the marine and terrestrial air masses meet, thus shortening the time of Hg residence and its transportation over long distances (publication 4.b I). As a result of the lengthening of the warm season (winter starting later and ending earlier (HELCOM 2013)) phytoplankton blooms are observed, particularly in the coastal zone, as early as the end of January or the beginning of February (Łysiak-Pastuszak 1996; Witek & Pliński 2000; Wasmund & Uhlig 2003; Błaszczyk et al. 2013). In this

situation Hg from atmospheric deposition, the inflow of which by this route is always greater in the heating season than in the warm season (publication 4.b I and 4.b IV), does not drop to the bottom of the water basin, but is accumulated by phytoplankton. As a consequence, Hg concentration in the phytoplankton of the Puck Bay was found to be higher in the heating season than in the non-heating season (publication 4.b VII). In this way, as a result of the warming of the winter season, taking into account the persistence of raised alga biomass, a higher Hg load is included in the trophic chain over the course of a year. During an abnormally warm autumn (according to the rating introduced by the Institute of Meteorology and Water – the State Research Institute (IMGW-PIB 2015)) raised Hg concentrations were also observed in peryfitone covering stones (publication 4.b VII). Its mean concentration was in that season three times higher than during a thermally normal winter.

As a result of the warming of the winter season in the Southern Baltic region, there are increasingly many winters with no icing even in the coastal zone of the gulfs, or with icing lasting much shorter (Kożuchowski 2009), particularly compared to the years 1946-1991, when the average duration of the icing season in the inner Puck Bay was 90 days (Girjatowicz 1988, Szefler 1993). The lack of icing is conducive to the thriving of macroalgae, which consequently prolongs the period of metal accumulation by fauna. On the one hand the reduction of Hg emission into the environment has led to a drop in the concentration of metal in macrophytobenthos of the Polish coastal zone of the Southern Baltic (publication 4.b V). On the other hand, the prolongation of the vegetative season and the improvement of environmental quality have led to an increasingly intense growth and coverage of the seabed by marine fauna. That has brought about the inclusion into the trophic chain of mercury deposited contemporarily as well as in the past. Sea grass beds are places where animal organisms thrive – they are also the consumers of phytobenthos, directly accumulating mercury. Thriving phytobenthos contributes to the faster inclusion of Hg into the trophic chain and this is of particular importance in areas where the sea grass beds of *Zostera marina* are regrowing, as that is where the highest Hg concentrations were measured. In this way, while macrophytobenthos can be said to clear water and sediments, it also transfers Hg from sediments, which has relatively low bioaccessibility for higher organisms, to the higher trophic levels (publications 4.b V & 4.b VII).

High phytobenthos and zoobenthos biomass persisting during a warm autumn (IMGW-PIB 2015) caused the Hg mass contained in benthic organisms in that season to be five times higher than during a thermally normal winter (IMGW-PIB 2015) (publication 4.b VII). Owing to that, despite the decreasing Hg emission, the warming of the climate in the

Southern Baltic region is conducive to the prolongation of the period within which mercury is included in the food chain. Between 1999 and 2014, there were 12 instances in which autumn was observed to be above the thermal norm (IMGW PIB 2015).

Climate changes are also observed in the summer. In warm, marine air masses there are intensive transformations of gaseous mercury into the particulate form, and rains occurring at that time lead to an increase in the Hg load introduced to the sea with wet precipitation (publication 4.b II). In July and August there is a higher incidence of intensive rains, reaching as much as 220% of the mean total precipitation from the period between 1971 and 2000 (IMGW PIB 2015). This leads to an increase of about 12% to the annual inflow of atmospheric Hg (publication 4.b VII). Intensive rains, particularly after a dry spell, were also favourable for the washing-out of Hg from the catchment area, which also boosted the load of Hg introduced to the sea with rivers (publications 4.b III & 4.b IV). This is of great significance as at such a time phytoplankton biomass in the sea is normally high, presenting conditions conducive to the inclusion of a higher Hg load to the trophic chain, in comparison to a summer without anomalously intensive rains.

Possible utilisation of the results

The presented phenomena and processes are especially significant for marine organisms that thrive in the coastal zone of bays. This is of particular importance as these regions are attractive for tourists and consumers of fish, which are caught in these parts along with occasional seafood.

I.

Owing to the high toxicity of mercury, the Baltic countries are obliged to reduce its emission into the environment. The main source of Hg is the burning of fossil fuels, which is why an increase in its inflow to the Baltic may be observed in the heating season compared to the non-heating season. Many restrictions concern the energy sector. The conducted studies showed that not only industrial coal combustion, but also regional individual home furnaces, have an important influence on the deposition of this metal. However, along with the adopted methods of mercury removal from fumes, an important factor influencing the emission of this metal is the warming of the cold season: late autumn-winter, early spring. Anomalously high air temperatures translate to less heating needs, which in turn reduces coal burning. On the other hand, the warming of the winter season prolongs the vegetative season of marine organisms, extending the period within which Hg is included in the food chain. As a consequence, despite the decreasing mercury emission into the natural environment, a larger

load of the metal may be included in the marine trophic chain over the course of a year. This problem obviously requires further studies. There are currently two projects, which I am in charge of, that focus on this problem, both financed by the NCN (2011/01/B/ST10/07697; 2014/13/B/ST10/02807).

The decrease in Hg inflow to the Baltic is not the only result of climate changes. More intense rainfalls also lead to the washing out of Hg from both the atmosphere and from land. The conducted studies showed that the remobilisation and discharge of Hg occurs in most catchments of rivers flowing into the Gulf of Gdansk. This, to a large extent, is the effect of urbanisation. Tarmac-ing or pouring concrete over roads and pavements limits the retention of Hg in the soil. Moreover, intensive rains and floods wash out the metal from agricultural areas where it was widely used in the past as a fungicide. This is why the type of catchment ought to be taken into consideration while drawing up regulations concerning the reduction of Hg emission by particular states. The present studies were conducted in the drainage area of the Gulf of Gdansk, but analogous processes occur in other regions on the same latitude. The choice of suitable methods of drainage area management may significantly regulate the discharge of Hg into the sea.

Chemical substances that reached the sea with the extreme Vistula flood in 2010 were deposited both in the coastal zone as well as being carried far out into the Baltic, contributing to an increase in their concentrations in surface sediments. The research carried out after the flood indicated the need to monitor this process in sediments and, more importantly, in commercially attractive fish at least 2 years after the flood. Moreover, during a flood a large load of polluted suspension drops to the river bed or on the flooded areas, from where it can be washed off and transported to the sea during the next intensive floods or meltdowns.

The increase in rainfalls, particularly in the summer, is of particular importance for the marine environment. This is related to an increased inflow of Hg with wet precipitation but the warm season is also favourable for intensive growth of sea organisms and, consequently, a faster accumulation of chemical substances, including toxic ones. As a result, the concentration of mercury in organism biomass increases.

The conclusions described above should be taken into account while preparing regulations concerning Hg emission by particular countries. Studies have shown that an increase in mercury concentration in marine organisms is not always linked to an increased inflow of anthropogenic Hg, directly influenced by humans, but may also be related to climate changes occurring in a given area, the type of catchment as well as to the predominance of either marine or terrestrial air masses.

II.

The conducted studies show that even if Hg emission remains the same, its inflow into the Baltic will change as conditions, such as air temperature, number and intensity of rains, wind speed and type of atmospheric circulation, change. **The conclusions presented in seven publications may be a basis for models of the volume of mercury inflow into the Baltic depending on the forecast climate changes in the Southern Baltic region.**

III.

The presented conclusions may be a basis for models concerning the inflow of Hg into the Baltic from the Polish territory.

Literature

Bartnicki J., Gusev A., Aas W., Fagerli H., Valiyaveetil S. 2008. Atmospheric Supply of Nitrogen, Lead, Cadmium, Mercury and Dioxines/Furanes to the Baltic Sea in 2006. EMEP Centers Joint Report for HELCOM EMEP/MSC-W TECHNICAL REPORT 3/2008.

Bartnicki J., Gusev A., Aas W., Valiyaveetil S. 2010. Atmospheric Supply of Nitrogen, Lead, Cadmium, Mercury and Dioxins/Furans to the Baltic Sea in 2008. EMEP Centers Joint Report for HELCOM EMEP/MSC-W Technical Report 2/2010. Oslo.

Bartnicki J., Gusev A., Aas W., Valiyaveetil S. 2011. Atmospheric Supply of Nitrogen, Lead, Cadmium, Mercury and Dioxins/Furans to the Baltic Sea in 2009. EMEP Centers Joint Report for HELCOM EMEP/MSC-W Technical Report 2/2011. Oslo.

Bartnicki J., Gusev A., Aas W., Valiyaveetil S. 2012. Atmospheric Supply of Nitrogen, Lead, Cadmium, Mercury and Dioxins/Furans to the Baltic Sea in 2010. EMEP Centers Joint Report for HELCOM EMEP/MSC-W Technical Report 2/2012. Oslo.

Bełdowska M., Falkowska L., Siudek P., Gajecka A., Lewandowska A., Rybka A., Zgrundo A. 2007. Atmospheric mercury over the coastal zone of the Gulf of Gdańsk, Oceanological and Hydrobiological Studies 36, 3/2007, 9-18.

Bełdowska M., Jędruch A., Bełdowski J., Szubska M. 2013a. Mercury concentration in the sediments as a function of changing climate in coastal zone of Southern Baltic Sea – preliminary results. E3S Web of Conferences, Volume 1. DOI: 10.1051/e3sconf/2013016002

Bełdowska M., Jędruch A., Bełdowski J., Szubska M., Kobos J., Mudrak-Cegiołka S., Graca B., Zgrundo A., Ziółkowska M. , Kiełczewska J., Lewandowska E. , Wasowska K., Falkowska L. 2013b. Rtęć w strefie brzegowej Zatoki Puckiej (południowy Bałtyk). IN: Falkowska L. (red.), Rtęć w środowisku Identyfikacja zagrożeń dla zdrowia człowieka. Wydawnictwo Uniwersytetu Gdańskiego, Gdańsk, 97-103.

Bełdowski J., Pempkowiak J., Miotk M. 2009. Mercury fluxes through the sediment water interface and bioavailability of mercury in Southern Baltic Sea sediments. Oceanologia, 51, 263 – 285.

Błaszczyk A., Kobos J., Hohlfeld N., Toruńska A., Hebel A., Mazur-Marzec H. 2013. First report of saxitoxin production by Alexandrium ostenfeldii in Puck Bay (Southern Baltic Sea), 32nd International Conference of Polish Phycologists. Do termophilic species invasion treaten us? Book of abstract 2013. p.12.

Bose-O'Reilly S., McCarty K.M., Steckling N., Lettermeier B. 2010. Mercury exposure and children health. Current Problems in Pediatric and Adolescent Health Care, 40, 186-215.

Chand, D., Jaffe, D., Prestbo, E., Swartzendruber, P.C., Hafner, W., Weiss-Penzias, P., et al., 2008. Reactive and particulate mercury in the Asian marine boundary layer. Atmospheric Environment 42, 7988e7996.

Filipovic-Trajkovic R., Ilic S.Z., Sunic L., Andjelkovic S. 2012. The potential of different plant species for heavy metals accumulation and distribution. J Food Agric Environ 10, 959–964.

Girjatowicz J.P. 1988. Lodowe warunki Zatoki Gdańskiej. Przegląd Geograficzny, 1-2, 93 - 112.

Heaven S., Ilyushchenko M.A., Kamberov I.M., Politikov M.I., Tanton T.W., Ullrich S.M., Yanine E.P., 2000. Mercury in the River Nura and its floodplain, Central Kazakhstan: II. Floodplain soils and riverbank silt deposits. Sci. Total Environ. 260, 45e55. http://dx.doi.org/10.1016/S0048-9697(00)00566-0.

Hedgecock I.M., Pirrone N. 2001. Mercury and photochemistry in the marine boundary layer-modelling studies suggest the in situ production of reactive gas phase mercury. Atmospheric Environment 35, 3055e3062.

HELCOM. 2004. The fourth Baltic Sea pollution load compilation (PLC-4). Baltic Sea Environment Proceedings. No. 93.

HELCOM. 2010. Towards a tool for quantifying anthropogenic pressures and potential impacts on the Baltic Sea marine environment: A background document on the method, data and testing of the Baltic Sea Pressure and Impact Indices. Baltic Sea Environmental Proceedings No. 125.

HELCOM. 2013. Climate change in the Baltic Sea Area: HELCOM thematic assessment in 2013. Baltic Sea Environment Proc. No. 137.

IMGW PIB (Institute of Meteorology and Water Management National Research Institute). 2015. Polish Climate Monitoring Bulletin <http://www.imgw.pl/extcont/biuletyn_monitoringu>.

Jackson T.A. 1991. Biological and environmental control of mercury accumulation by fish in lakes and reservoirs of Northern Manitoba. Can. J. Fish. Aquat. Sci. 48 (12), 2449e2470. http://dx.doi.org/10.1139/f91-287.

Johnson F.O. Atchison W.D. 2009. The role of environmental mercury, lead and pesticide exposure in development of amyotrophic lateral sclerosis. NeuroToxicology 30 (5), 761–765.

Kożuchowski K. 2009. Contemporary climate warming in Poland. Papers on Global Change 16, 41-53.

Lamborg C.H., Fitzgerald W.F., Vandal G.M., Rolfhus R.R. 1995. Atmospheric mercury in northern Wisconsis: sources and species. Water Air and Soil Pollution 80, 198.

Łysiak-Pastuszak E. Oxygen and nutrients in the Southern Baltic Sea. Ocean. Stud. 1996; 1-2: 41-76.

Marks R., Bełdowska M., 2001. Air-sea exchange of mercury vapour over the Gulf of Gdańsk and southern Baltic Sea. Journal of Marine System 27, 315-324.

Rustam H., Hamdi T., 1974. Methyl mercury poisoning in Iraq. Brain 97, 499-510.

Salerno J.P. 2015. System lupus erythematosis and mercury toxicity. Personalised Medicine Universe 1(1), 81–83.

Sommar J., Gårdfeldt K., Strömberg D., Fenga X. 1997. A kinetic study of the gasphase reaction between the hydroxyl radical and atomic mercury. Atmospheric Environment 35, 3049-3054.

Stankovic S., Kalaba P., Stankovic A.P. 2014. Biota as toxic metal indicators. Environmental Chemistry Letters 12, 63–84. doi:10.1007/s10311-013-0430-6

Szefler K. 1993. Zlodzenie. IN: Korzeniewski K. (red.) Zatoka Pucka. Fundacja Rozwoju Uniwerystetu Gdańskiego, Gdańsk, 532 s.

Takeuchi T., Kambara T., Morikawa N., Matsumoto H., Shiraishi Y., Ito O. 1959. Pathological observations of the Minamata disease. Acta Pathol. Japan. 9, 769-776.

Wängberg I., Munthe J., Ebinghaus R., Gardfeidt K., Iverfeldt A., Sommar J. 2003. Distribution of TPM in Northern Europe, The Science of the Total Environment, 304, 53-59.

Wängberg I., Munthea J., Pirroneb N, Iverfeldta Å., Bahlmanc E., et al. 2001. Atmospheric mercury distribution in Northern Europe and in the Mediterranean region. Atmospheric Environment, 35/17, 3019-3025.

Wasmund N., Uhlig S. 2003. Phytoplankton trends in the Baltic Sea. ICES Journal of Marine Science, 60: 177-186.

Wermuth L., Koldkjur, O.G., Bjerregaard P. 2005. Parkinson's disease among Inuit in Greenland: mercury and lead as risk factors. Journal of the Neurological Sciences 238 (1), 375.; doi:10.1016/S0022-510X(05)81449-2

Witek B., Pliński M. 2000. The first recorded bloom of Prorocentrum minimum (Pavillard) Schiller in the coastal zone of the Gulf of Gdańsk. Oceanologia; 42(1): 29-36.

Woroń J., Danowska B. 2012. Heavy metals. IN: Zalewska T., Jakusik E., Łysiak-Pastuszak, E., Krzymiński W. (red.), Bałtyk Południowy w 2010 roku. Charakterystyka wybranych elementów środowiska. Wydawnictwo IMGW-PIB, Warszawa, pp. 158-160.

Yassa H.A. 2014. Autism: A form of lead and mercury toxicity. Environmental toxicology and pharmacology 38, 1016–1024.

Zahir F., Rizwi S.J., Haq S.K., Khan R.H. 2005. Low dose mercury toxicity and human health. Environmental Toxicology and Pharmacology 20, 351-360.

5. **Overview of other academic and scientific achievements**

In the years 1993-1998 I pursued my Masters degree in Oceanography, a course conducted at the Biology, Geography and Oceanography Department of Gdansk University. Having completed my second year of studies, I decided to specialise in Chemical Oceanography. In the years 1997-1998, still as an undergraduate, I took part in an international project entitled Atmospheric Load, BASYS (Baltic Sea System Study), 5th UE Framework Programme MAS3-CT96-0058, which was focused on the examination of e.g. metals, nitrogen forms and macrocomponents in the atmosphere over the Baltic. As part of that project, in 1997 I went on a two-week work placement to a laboratory at the Swedish Environmental Research Institute in Gothenburg, where I participated in preparations for the collection of aerosol and gas samples, and the intercalibration of equipment needed for measurement campaigns. Upon my return to Poland, my tasks consisted of operating and changing denuders and the aerosol collector at the test station in Hel. I also participated in two 2-month research campaigns: one in summer (1997) and one in winter (1998). In the collected samples, I analysed nitrogen compounds in the atmospheric air over the open sea and in the coastal zone of the Gulf of Gdansk. That was my first scientific research task. The collected material enabled me to prepare my Masters thesis: „Ammonium concentration in the atmosphere of the Southern Baltic", under the supervision of Professor Lucyna Falkowska, PhD. Since 1998, I have been pursuing my doctoral degree at the Environmental doctoral Institute of the Biology and Oceanology Department, Gdansk University, under the same supervisor. In the first years I continued researching nitrogen compounds in the atmosphere of the coastal station in Gdynia, as well as at open sea, during a voyage on board the „Kopernik" between 18.05-28.05.1999. The collected results were presented in a publication and at a conference in poster format:

- Lewandowska A., Falkowska L., Bełdowska M. 2004. Ammonia and ammonium over the southern Baltic Sea. Part 2. The origin of ammonia and ammonium over two coastal stations: Gdynia and Hel. Oceanologia, 46 (2), 185–200. (*publication*)
- Błońska K., Kunz R.,. Bełdowska M., Falkowska L., Nadstazik A. 2000. Nitrogen compounds in ambient air over the open sea and the coastal zone of the Gulf of Gdansk. National Scientific Conference Oceanography from knowledge to practice, Gdynia (in polish). *(poster)*

During the BASYS project, Roman Marks, PhD, (an employee at the Oceanology Institute of the Polish Academy of Science in Sopot at that time) offered me the chance to take part in studies into gaseous mercury in the atmospheric air of the coastal zone of the Gulf of Gdansk and over the open sea. I continued those studies during my doctoral studies at a test

station in Sopot and Gdynia. The collected material was published once and presented six times (three oral presentations and three posters) at international and national conferences:

- Marks R., Bełdowska M. 2000. Air-sea exchange of mercury vapor over the Gulf of Gdańsk and southern Baltic Sea. Journal of Marine Systems, 739, 1-10. (*publication*)

- Bełdowska M., Marks R. 1999. Total Gaseous Mercury experimental measurements over the Gulf of Gdańsk. BASYS Atmospheric Load Meeting, Sopot. *(oral presentation)*
- Marks R., Bełdowska M. 1999. Air-sea exchange of mercury vapour over the open Baltic Sea and Gulf of Gdańsk. 2nd EUROTRAC-2 MEPOP, Hamburg. *(oral presentation)*
- Marks R., Kruczalak K., Bełdowska M. 1998. Mercury vapour experimental measurements over the Gulf of Gdańsk. Baltic Sea Conference, Stockholm. *(oral presentation)*

- Bełdowska M., Marks R., Falkowska L. 2001. Total Gaseous Mercury concentrations in the atmosphere in Sopot. 3rd International Symposium on Functioning of Coastal Ecosystems in Various Geographical Regions. Gdynia. *(poster)*
- Bełdowska M., Marks R., Falkowska L. 2001. Sources And Sinks Of Gaseous Mercury In The Polish Coastal Zone. 3rd Baltic Sea Science Congress, Stockholm. *(poster)*
- Schmolke S. R., Bełdowska M., Ebinghaus R., Kock H. H., Kwietkus K., Marks R., Munthe J., Urba A. Wangberg I. 1999. Simultaneous measurments of atmospheric mercury at four coastal stations and in the Central Baltc Sea. Third BASYS Anuual Science Conference, Warnemunde. *(poster)*

The publication (Marks & Bełdowska 2000) was a basis for writing, under the supervision of Professor Falkowska, a project Gdansk University's Own Studies (BW 1380-5-0060-1) within the framework of which an automated gas mercury analyser GARDIS 3a was purchased for the Marine Chemistry and Marine Environmental Protection Institute (where I continued my doctoral studies). The purchased analyser made it possible to conduct research into the daily changes in gaseous mercury concentration in the inhaled air and also to monitor the influence of construction works on Hg emission in an urbanised area. The data was presented in four articles and two oral presentations.

- Bełdowska M., Falkowska L., Lewandowska A. 2006. The level of mercury vapor concentrations in the ambient air in the coastal zone of the Gulf of Gdansk. Air Protection in Theory and Practice, Monograph Institute of Environmental Engineering of Polish Academy of Sciences in Zabrze, pp. 13-22. *(abstract, result summary &tables in English).* (*publication*)
- Bełdowska M., Falkowska L., Marks R. 2003. Total Gaseous Mercury over the coastal zone of the Gulf of Gdańsk, Oceanological and Hydrobiological Studies, 22, no. 3, 3-18. (*publication*)
- Bełdowska M., Falkowska L., Siudek P., Otremba M. 2006. Influence of construction activities and high temperature processes on the level of gaseous mercury concentration in air. Environment Protection Engineering 32(3), 31-38. (*publication*)
- Bełdowska M., Siudek P., Falkowska L., Otremba M. 2006. The impact of construction activities on the level of toxic mercury concentration in the inhaled air. In: (ed.) Musielak-Piotrowska A., Rutkowski J.D., Protecting the Air, achievements in science, energy and industry, Monografia Nr 863, 15-18, (*in polish*). (*publication*)

- Bełdowska M., Falkowska L., Lewandowska A. 2006. The gaseous mercury concentration level in the breathed air of the coastal zone of the Gulf of Gdansk, V International Scientific Conference "Air Protection in Theory and Practice", Zakopane, 18-21 October 2006 *(oral presentation)*
- Bełdowska M., Siudek P., Falkowska L., Otremba M. 2006. Wpływ działań budowlanych na poziom stężenia toksycznej rtęci we wdychanym powietrzu, VIII Konferencja Naukowo - Techniczna Ochrona Powietrza Atmosferycznego, POL-EMIS 2006. Osiągnięcia w nauce, przemyśle i energetyce, Karpacz, 21-24 czerwiec 2006 *(oral presentation)*

Thanks to the purchase of a component for Hg analysis in liquid samples, I developed a set of methods for assaying mercury in water, using a gaseous mercury analyser, on the basis of EPA 1631 methods. That made it possible to broaden the scope of research by including Hg analysis in aerosols, rains, sea water and suspension. Funds from a KBN supervisor

research project (supervised by Professor Falkowska) entitled *Sea as a source of mercury in the atmosphere (exemplified by the coastal zone and open waters of the Gdansk Basin)*, (PO4E 023 22). The conducted research allowed me to write a doctoral thesis, supervised by Professor Falkowska, entitled „Sea as a storage and source of atmospheric mercury (as exemplified by the Gdansk Basin)", which I presented in July 2004. The thesis was merited twice: by the Council of Biology, Geography and Oceanology and with an award from the Gdansk Science Society. A year later, in October 2005, I was employed at the Oceanography Institute of Gdansk University. In the meantime, while taking care of my baby son, I organised international science workshops under Professor Jerzy Bolałek, as part of the OI GU Perfection Centre BALTDER "*Chemical substances transformation in sediments – methodological aspects*". My duties included inviting participants, correspondence as well as organising the workshops themselves. Having started work in October 2005 at the Marine Chemistry and Marine Environmental Protection Institute OI GU as associate professor, I resumed the studies into Hg in the atmosphere and in water. The research and experiments which I conducted attracted interest from students and postgraduate students, whose work I supervised or counselled, and resulted in two doctoral theses and 16 Masters papers. The study results also formed the basis for 10 publications, 2 oral presentations and 12 posters:

- Bełodowska M., Falkowska L. 2007. Exchange of mercury between air and seawater in day/night cycle, during summer and winter. Oceanological and Hydrobiological Studies 36, 3/2007, 51-68. (*publication*)
- Bełdowska M., Falkowska L., Siudek P., Gajecka A., Lewandowska A., Rybka A., Zgrundo A. 2007. Atmospheric mercury over the coastal zone of the Gulf of Gdańsk, Oceanological and Hydrobiological Studies 36, 3/2007, 9-18. (*publication*)
- Bełdowska M., Falkowska L. 2008. Experimental research on mercury exchange between air and seawater. In: L. Falkowska (ed.) Mercury in the environment, Identification of risks to human health, the Foundation for the Development of the University of Gdańsk, 53-64 (*in polish*). (*publication*)
- Bełdowska M., Zawalich K., Falkowska L., Siudek P., Magulski R. 2008. Total gaseous mercury in the area of southern Baltic and in the coastal zone of the Gulf of Gdansk, during spring and autumn. Environment Protection Engineering 4, 139-144. (*publication*)
- Bełdowska M., Zawalich K., Falkowska L., Siudek P., Magulski R. 2008. Mercury in the air above the waters of the southern Baltic Sea and in the coastal zone of the Gulf of Gdansk. In: (ed.) Musielak-Piotrowska A., Rutkowski JD, Current Problems in the Air Protection, Nr. 880, 33-36 *(in polish*). (*publication*)
- Falkowska L., Bełdowska M. 2003Mercury in the air, in sea water and aerosols, IN: Siepak J (ed.), Problems of Analytical determination of mercury and its forms of speciation in environmental samples, BETAGRAF Poznań, 55-74 (*in polish*). (*publication*)
- Falkowska L., Bełdowska M., Lewandowska A. 2007. The impact of anthropogenic sources of mercury seasonal variability in aerosols over Gdynia. In: J. Namieśnik, W. Wardencki, J. Gromadzka (ed.) Air quality in Pomorskie - present condition and prospects, Publishing Gdansk, s. 43-49 (*in polish*). (*publication*)
- Magulski R., Falkowska L., Bełdowska M. 2007. Mercury transformations in the seawater in the presence of *cyclotella meneghiniana* and *nodularia spumigena*. Oceanological and Hydrobiological Studies, 36, 3/2007, 69-81. (*publication*)
- Murawiec D., Gajecka A., Bełdowska M., Falkowska L. 2007. Investigation on mercury concentration levels in coastal and offshore waters of the Gdańsk Basin. Oceanological and Hydrobiological Studies, 36, 3/2007, 83-97. (*publication*)
- Murawiec D., Gajecka A., Bełdowska M., Falkowska L. 2008. Spatial and temporal changes in the concentration of mercury in the coastal zone and the open waters of the Gdansk Basin. In: L. Falkowska (ed.) Mercury in the environment, Identification of risks to human health, the Foundation for the Development of the University of Gdańsk, 79-94 (*in polish*). (*publication*)

- Bełdowska M., Siudek P., Rybka A., Lewandowska A., Falkowska L. 2007. Mercury in the air of the coastal zone of the Gulf of Gdansk. National Scientific Conference, Mercury in the Environment - Identification of Human Health Risks, Gdynia (*in polish*). *(oral presentation)*

- Falkowska L., Bełdowska M., Lewandowska A. 2007. What we know and what we do not know about mercury in the coastal zone of the Pomeranian province. And Pomeranian Air Quality Conference in Pomorskie -stan and prospects, Gdańsk (*in polish*). *(oral presentation)*

- Bełdowska M., Falkowska L., Lewandowska A. 2007. Changes in the concentration of mercury vapor in the air inhaled during renovation and construction. National Scientific Conference, Mercury in the Environment - Identification of Human Health Risks, Gdynia (*in polish*). *(poster)*
- Bełdowska M., Falkowska L., Magulski R. 2006. Fluxes of mercury emissions from seawater into the air. VII Conference Chemistry, Geochemistry and Protection of the Marine Environment, Sopot (*in polish*). *(poster)*
- Bełdowska M., Falkowska L., Magulski R. 2006. Mercury transformations at the water/air interface, VI Intrenational Sympodium on speciation of Elements In Biological, Environmental and Toxicological Sciences, Białowieża. *(poster)*
- Bełdowska M., Falkowska L., Magulski R., Zawalich K. 2007. The sea as a source of atmospheric mercury (for example Basin of Gdansk). National Scientific Conference, Mercury in the Environment - Identification of Human Health Risks, Gdynia (*in polish*). *(poster)*
- Bełdowska M., Zawalich K., Falkowska L., Siudek P., Magulski R. 2008. Mercury in the air above the waters of the southern Baltic Sea and in the coastal zone of the Gulf of Gdansk, IX Conference on Science and Technology, Current Problems in the Air Protection, Karpacz (*in polish*). *(poster)*
- Gajecka A., Bełdowska M., Falkowska L. 2007. Mercury in the Gulf of Gdansk. National Scientific Conference, Mercury in the Environment - Identification of Human Health Risks, Gdynia (*in polish*). *(poster)*
- Magulski R., Falkowska L., Bełdowska M., Kowacz M. 2006. Transformation of dissolved inorganic forms of mercury into the gas with the help of cyanobacteria. VII Conference "Chemistry, Geochemistry and the Protection of the Marine Environment", Sopot (*in polish*). *(poster)*
- Magulski R., Falkowska L., Bełdowska M., Saniewski M. 2007. The transformation of mercury in the marine environment involving algae (based on experimental studies). National Scientific Conference, Mercury in the Environment - Identification of Human Health Risks, Gdynia (*in polish*). *(poster)*
- Magulski R., Falkowska L., Bełdowska M., Saniewski M. 2008. The transformation of mercury in the marine environment involving algae (based on experimental studies). Chemistry, geochemistry and Protection of the Marine Environment, Sopot (*in polish*). *(poster)*
- Murawiec D., Bełdowska M., Falkowska L. 2007. Mercury in the open waters of the Baltic Sea. National Scientific Conference, Mercury in the Environment - Identification of Human Health Risks, Gdynia (*in polish*). *(poster)*
- Murawiec D., Bełdowska M., Falkowska L. 2008. Mercury in the open waters of the Baltic Sea. Chemistry, geochemistry and Protection of the Marine Environment ", Sopot (*in polish*). *(poster)*
- Siudek P., Rybka A., Bełdowska M., Falkowska L. 2007. Mercury in aerosols over the coastal zone of the Gulf of Gdansk. National Scientific Conference, Mercury in the Environment - Identification of Human Health Risks, Gdynia (*in polish*). *(poster)*

In 2006, Professor Falkowska made a decision to organise an event in 2007: the 1st National Scientific Conference entitled *Mercury in the Environment – Identifying Threats to Human Health*. My duties involved raising as much interest as possible among Polish scientists dealing with mercury studies in the marine and terrestrial environment (including studies in the atmosphere, soil, freshwater and plants), as well as among doctors and vets. The conference brought together about 70 Polish scientists in total. I also managed to obtain sponsorship for the conference and planned it. I corresponded with the participants and sponsors prior to the conference, as well as after with authors and reviewers of the publication that was being prepared. At the same time, while performing the functions of secretary and Member of the Organisers' Committee, I prepared a paper and two posters, and helped with the preparation of 6 other posters.

The abovementioned scientific achievements were recognised in 2007 with a Rector's Group Award of the first degree, „For a series of articles presenting original and unique study results concerning gas aerosols in the atmosphere of the coastal zone of the Gulf of Gdansk and over the open sea", and in 2008 with a Rector's Group Award of the third degree: „For a

series of 9 original publications devoted to the circulation and transformation of mercury in the atmosphere, water, and on the border or air and water phases."

The gained experience made it possible to obtain funding for an MNiSW (Ministry of Science and Higher Education) research project (N305 2270 33), entitled „Carcinogenic and neurotoxic compounds in aerosols in the inhaled air close to and at a distance from emission sources", which I was in charge of 2007-2009. As part of this project we purchased, among other things, an AMA 254 automatic mercury analyser for solid samples. This piece of equipment does not require previous mineralisation of samples, which greatly accelerated Hg analysis. Thanks to this I was able to undertake short-term changes in Hg concentration in aerosols and broaden the scope of research to include Hg analysis in bird guano, macrophytobenthos, fish and seals. I was granted funding for my last research as part of the Self Studies of Gdansk University in 2008: „Fish as mercury carriers in the ecosystem, as exemplified by the Gdansk Basin" (1380 5 0262 8); and in 2009: „Seals as the main receiver of mercury" (G235 5 0230 9). I was in charge of each of these projects. I took an active part in sample collection and developed a method of Hg assay in samples of fish, guano, suspension, plankton, aerosols, macrophytobenthos and sediments using the AMA analyser. I was joined by 3 doctoral students and 21 MSc students, whom I was supervising or counselling. We determined the range of Hg concentrations in bird guano and seal excrement, changes in Hg concentration (and the reasons for them) in macrophytobenthos, suspension, plankton and particular organs of fish and seals.

Within the framework of the above mentioned MNiSW project N305 2270 33, I undertook studies into the concentration of cadmium, zinc, lead and benzo(a)pyrene in aerosols. The expertise needed to analyse benzo(a)pyrene had been gained during a 2-year placement (2002-2004) work placement at the Biogeochemistry Workshop at the Polish Oceanology Institute of the Polish Science Academy in Sopot. There, under the supervision of Professor IO PAN Ksenia Pazdro, I dealt mainly with the analysis of hydrophobic organic pollutants in the environment as part of a personal research project KBN 3 P04E 022 22.

In the period 2009-2010 I was once again the secretary and a member of the Organisers' Committee for the 2nd Scientific Conference *Mercury in the Environment – Identifying Threats for Human Health*, with an analogical scope of duties. Additionally I prepared one paper for this conference and participated in the preparation of three other papers and one poster. The conference was followed by a publication of a monography, during the preparation of which I coordinated the work of authors and reviewers. I was also a

member of the Organisers' Committee organising the 3rd Scientific Conference, *Mercury in the Environment – Identifying Threats for Human Health*, in 2013. This cyclical conference has resulted in my cooperation with, among others, Dr Halina Pyta from the PAN Institute of Environmental Engineering and Dr Anna Degórska from the Complex Environmental Monitoring Station at Puszcza Borecka. The presented studies were presented in 13 articles, 12 oral presentations and 15 posters.

- Bełdowska M., Murawiec D., Kwaśniak J., Bełdowski J., Saniewski M., Falkowska L. 2010. Mercury In Environmental Compartments In The Polish Part Of Southern Baltic Sea, In: Ż. Bargańska, A. Beyer, K. Klimaszewska, J Namieśnik, M. Tobiszewski, I. Rutkiewicz (red.) Proceedings Of 15th International Conference On Heavy Metals In The Environment, Chemical Faculty, Gdansk University of Technology, Gdańsk, 636-639. (*publication*)
- Bełdowska M., Saniewska D., Falkowska L., Lewandowska A., Bruszewski H., Degórska A., Śnieżek T., Sienicka P. 2010. Mercury in aerosols in the area of forest and coastal zone. The mercury in the environment Identification of risks to human health, L Falkowska (ed.), Foundation for the Development of the University of Gdansk, Gdańsk, 11-21 (*in polish*), *(abstract, result summary & tables in English).* (*publication*)
- Bełdowska M., Murawiec D., Falkowska L., Lewandowska A. Toxic metals in aerosols of the coastal zone of the Gulf of Gdansk in the heating season. In: Konieczyński J. (red), Ochrona Powietrza w Teorii i Praktyce, tom 1, 217-228 (*in polish*), *(abstract, result summary & tables in English).* (*publication*)
- Bełdowska M., Zawalich K., Kwaśniak J., Falkowska L. 2007. Rtęć w rybach w polskiej strefie brzegowej Bałtyku. Environmental Protection and Natural Resources 31, 394-403 *(abstract in English*). (*publication*)
- Falkowska L., Bełdowska M., Kwaśniak J., Zawalich K., Miotk M. 2007. Mercury in guano from the coast of the Gulf of Gdańsk. Oceanological and Hydrobiological Studies, 36, 3/2007, 99-106. (*publication*)
- Falkowska L., Bełdowska M., Kwaśniak J., Zawalich K., Miotk M. 2008. Guano as a carrier of mercury as an example of the coastal zone of the Gulf of Gdansk. In: L. Falkowska (ed.) Mercury in the environment, Identification of risks to human health, the Foundation for the Development of the University of Gdańsk, 95-102 (*in polish*). *(abstract, result summary & tables in English).* (*publication*)
- Falkowska L., Kwaśniak J., Bełdowska M. 2010. The impact of changes in the trophic level for mercury concentrations in fish from the coastal area of the southern Baltic. The mercury in the environment Identification of risks to human health, L Falkowska (ed.), Foundation for the Development of the University of Gdansk, Gdańsk, 115-123 (*in polish*), *(abstract, result summary & tables in English).* (*publication*)
- Saniewska D., Bełdowska M., Bełdowski J., Saniewski M., Kwaśniak J., Falkowska L. 2010. Distribution of mercury in different environmental compartments in the aquatic ecosystem of the coastal zone of Southern Baltic Sea. Journal of Environmental Science 22 (8): 1-7. (*publication*)
- Saniewska D., Bełdowska M., Bełdowski J., Falkowska L. 2010. Atmospheric deposition of mercury to the coastal zone of the southern Baltic Sea. In: Konieczyński J. (ed), Air Protection in Theory and Practice, Volume 2, the Institute of Environmental Engineering of Polish Academy of Sciences, 303-310 (*in polish*), *(abstract, result summary & tables in English).* (*publication*)
- Saniewska D., Bełdowska M., Bełdowski J., Saniewski M., Szubska M., Romanowski A., Kwaśniak J., Falkowska L. 2010. Concentrations of mercury in selected elements of the ecosystem of the coastal zone of the southern Baltic. [In]: Mercury in the environment Identification of risks to human health, L Falkowska (ed.), Foundation for the Development of the University of Gdansk, Gdańsk, 73-79 (*in polish*). *(abstract, result summary & tables in English).* (*publication*)
- Staniszewska M., Bełdowska M., Murawiec D., Porożyńska J. 2008. Benzo(a)pyrene in aerosols during heating season in Gdynia. IN: Konieczyński J. (ed.), Air Protection in Theory and Practice, Volume 2, the Institute of Environmental Engineering of Polish Academy of Sciences, 259-268 (*in polish*). (*publication*)
- Staniszewska M., Bełdowska M., Murawiec D., Porożynska J. 2009. Benzo (a) pyrene in aerosols in Gdynia. In: J. Namieśnik, IN: J. Namieśnik, W.Wardencki, J. Gromadzka (ed.) Second cycle Pomeranian Conference Indoor Air Quality, Department of Chemistry, Technical University of Gdansk, Gdańsk, 174-183 (*in polish*). (*publication*)
- Staniszewska M., Graca B., Bełdowska M., Saniewska D. 2013. Factors controlling benzo(a)pyrene concentration in aerosols in the urbanised coastal zone. A case study: Gdynia, Poland (Southern Baltic Sea). Environ Sci Pollut Res. 20:4154–4163 doi: 10.1007/s11356-012-1315-0. (*publication*)

- Bełdowska M., Falkowska L., Lewandowska A. 2012. The impact of fluctuations in meteorological conditions on the concentrations and the transformation of gaseous mercury and bound in fine particle in an urban area of the Gulf of Gdansk. Conference on Air Protection in Theory and Practice, Zakopane *(in polish*). *(oral presentation)*
- Bełdowska M., A. Lewandowska, A. Witkowska, L. Falkowska. The concentration of mercury in fine particles PM1, in an urban area on the Bay of Gdansk, IV Pomeranian Conference "Air Quality", 05-07.06.2013, Gdańsk (*in polish*). *(oral presentation)*
- Bełdowska M., Murawiec D., Falkowska L. 2009. Seasonal changes in the concentration of toxic metals in aerosols over Gdynia. Conference materials, Pomeranian II Conference cycle Air Quality, Gdańsk- Sobieszewo (*in polish*). *(oral presentation)*

- Lewandowska A., Bełdowska M., Falkowska L., Witkowska A. 2013. The impact of land-based and marine sources of mercury emissions and concentrations of carbon in the smallest fractions of aerosols. Third National Scientific Conference "Mercury in the environment - Identification of risks to human health", Gdynia (*in polish). (oral presentation)*
- Bełdowska M., Saniewska D., Falkowska L., Lewandowska A., Bruszewski H., Degórska A., Śnieżek T., Sienicka P. 2010. Mercury in aerosols in the area of forest and coastal zone, the Second Scientific Conference on Mercury in the Environment - Identification of risks to human health, Gdynia *(in polish)*. *(oral presentation)*
- Bełdowska M, Saniewska D., Lewandowska A., Bruszewski H., Degórska A., Snieżek T., Falkowska L., Sienicka P.2011. Mercury in fine and corse aerosol particles coastal zone of the sea and wooded areas of northern Polish, III Pomeranian Conference of Air Quality cycle, Gdańsk (*in polish*). *(oral presentation)*
- Falkowska L., Kwaśniak J., Bełdowska M. 2010. The impact of changes in the trophic level for mercury concentrations in fish from the coastal area of the southern Baltic. Second Scientific Conference on Mercury in the Environment - Identification of risks to human health, Gdynia (*in polish*). *(oral presentation)*
- Kwaśniak J., Bełdowska M., Falkowska L., 2008. The organs of fish as indicators of environmental contamination with mercury. Chemistry, geochemistry and Protection of the Marine Environment ", Sopot (*in polish*). *(oral presentation)*
- Murawiec D., Bełdowska M., Kwaśniak J., Bełdowski J., Falkowska L., Saniewski M. 2009. Mercury in aerosols of the coastal zone of the Gulf of Gdansk. 9th International Conference on Mercury as a Global Pollutant, Guizhou China. *(oral presentation)*
- Lewandowska A., Staniszewska M., Falkowska L., Bełdowska M., Machuta M., Mróz D. 2012. Elemental and organic carbon, benzo(a)pyrene and alkylphenols a function of the size of aerosol particles in urbanized coastal zone of the Gulf of Gdańskiej- Conference on Air Protection in Theory and Practice, Zakopane (*in polish*). *(oral presentation)*
- Saniewska D., Bełdowska M., Bełdowski J., Saniewski M., Szubska M., Romanowski A., Kwaśniak J., Falkowska L. 2010. Concentrations of mercury in selected elements of the ecosystem of the coastal zone of the southern Baltic. Second Scientific Conference on Mercury in the Environment - Identification of risks to human health, Gdynia (*in polish*). *(oral presentation)*
- Staniszewska M., Bełdowska M., Falkowska L., Bolałek J. 2011. Chemical hazards in the Baltic Sea. Seminar COHIBA: Control of hazardous substances in the Baltic Sea region ", Gdańsk (*in polish*). *(oral presentation)*

- Bełdowska M., Murawiec D., Falkowska L., Lewandowska A. 2008. Toxic metals in aerosols of the coastal zone of the Gulf of Gdansk in the heating season, VI International Scientific Conference "Air Protection in Theory and Practice", Zakopane (*in polish*). *(poster)*
- Bełdowska M., Murawiec D., Kwaśniak J., Bełdowski J., Saniewski M., Falkowska L. 2009. Mercury cycle in the southern Baltic Sea ecosystem. 9th International Conference on Mercury as a Global Pollutant, Guizhou, China. *(poster)*
- Kłostowska Ż., Jędruch A., Bełdowska M., Bolałek J. 2014. Seasonal variability of concentrations of selected metals in surface sediments of Gdansk Basin. VI Sopot Youth Forum, Sopot (*in polish*) *(poster)*
- Kłostowska Ż., Jędruch A., Bełdowska M., Bolałek J. 2014. Toxic metals in surface sediments of the Gdansk Basin (Southern Baltic Sea). 17th International Conference on Heavy Metals in the Environment, ICHMET, Guiyang, Chiny, *(poster)*
- Kwaśniak J., Zawalich K., Bełdowska M., Falkowska L., Miotk M., Melzer A. 2007. Guano as a carrier of mercury. National Scientific Conference, Mercury in the Environment - Identification of Human Health Risks, Gdynia (*in poli*sh). *(poster)*
- Kwaśniak J., Zawalich K., Bełdowska M., Falkowska L. 2008. Guano as a carrier of mercury, chemistry, geochemistry and Protection of the Marine Environment ", Sopot *(in polish*). *(poster)*
- Murawiec D., Bełdowska M., Kwaśniak J., Bełdowski J., Falkowska L., Saniewski M. 2009. Mercury in aerosols of the coastal zone of the Gulf of Gdansk. 9th International Conference on Mercury as a Global Pollutant, Guizhou, China. *(poster)*
- Saniewska D., Beldowska, M., Beldowski J., Saniewski M., Szubska, M., Romanowski A., Fila G., Falkowska L. 2011. Input pathways of mercury in the coastal zone of the Gulf of Gdansk, the southern Baltic Sea, The 10th International Conference on Mercury as a Global Pollutant (ICMGP), Halifax, Kanada. *(poster)*
- Witkowska A., Lewandowska A., Bełdowska M., Jędruch A., Falkowska L. 2014. Seasonal variability of mercury concentration. 17th International Conference on Heavy Metals in the Environment, ICHMET, Guiyang, Chiny. *(poster)*
- Saniewska D., Bełdowska M., Jędruch A., Bełdowski J., Falkowska L., 2014. Factors influencing mercury concentration in precipitation in the coastal zone of the Southern Baltic (Poland). Nordic Environmental Chemistry Conference – NECC, Reykjavik, Islandia *(poster)*
- Staniszewska M., Bełdowska M., Murawiec D., Porożyńska J. 2008. Benzo(a)pyrene in aerosols during heating season in Gdynia, VI International Scientific Conference "Air Protection in Theory and Practice", Zakopane, (*in polish*). *(poster)*
- Staniszewska M., Bełdowska M., Murawiec D., Porożynska J. 2009. Benzo (a) pyrene in aerosols in Gdynia. Conference materials, Pomeranian II Conference cycle Air Quality, Gdańsk- Sobieszewo (*in polish*). *(poster)*
- Saniewska D., Bełdowska M., Falkowska L. 2010. The concentration of mercury in aerosols over Gdynia. IX Conference of chemistry, geochemistry and Protection of the Marine Environment, Sopot (*in polish*). *(poster)*
- Staniszewska M., Bełdowska M., Murawiec D., Porożynska J. 2010. Seasonal variability of concentrations of benzo(a)pyrene in the coastal zone of the Gulf of Gdansk. IX Conference of chemistry, geochemistry and Protection of the Marine Environment, Sopot *(in polish*). *(poster)*

- Zawalich K., Kwaśniak J., Bełdowska M., Falkowska L., Ciszewska M., Kardasz D., Kosecka M., Maszka M., Dudzińska-Huczuk B. 2007. Mercury in Fish Bay of Gdansk, Poland Scientific Conference, Mercury in Environment - Identification of Human Health Risks, Gdynia (*in polish*). *(poster)*

In 2009 Professor Falkowska was granted funding for a personal research project MNiSW (N N304 1616 37) „Mercury and Permanent Organic Pollutants in guano from areas of water and land interaction". As part of that project, I developed a method of sample preparation for analysis and a method of analysing Hg concentration in particular tissues and organs of birds (heart, liver, muscles, larynx, feathers, bones etc). I also aced as adviser to Master's students and doctoral students performing these tests. The results made it possible to determine the removal and distribution of Hg in the organisms of sea birds at the top of the trophic chain. They were presented in 6 articles, 3 oral presentations and 3 posters:

- Falkowska L., Reindl A.R., Szumiło E., Kwaśniak J., Staniszewska M., Bełdowska M., Lewandowska A., Krause I. 2013. Mercury and Chlorinated Pesticides on the Highest Level of the Food Web as Exemplified by Herring from the Southern Baltic and African Penguins from the Zoo. Water Air Soil Pollut 224, 1549. doi: 10.1007/s11270-013-1549-6. (*publication*)
- Falkowska L., Szumilo E., Hajdryh, J., Grajewska A. Beldowska M., Krause I. 2013. Effect of diet on the capacity to remove mercury from the body of a penguin (Spheniscus demersus) living in the ZOO. E3S Web of Conferences, Volume 1, DOI: 10.1051/e3sconf/20130112002. (*publication*)
- Grajewska A., Falkowska L., Szumiło-Pilarska E., Hajdrych J., Szubska M., Frączek T., Meissner W., Bzoma Sz., Bełdowska M., Przystalski A., Brauze T. 2015. Mercury in the eggs of aquatic birds from the Gulf of Gdansk and Wloclawek Dam (Poland). Environmental Science and Pollution Research, doi: 10.1007/s11356-015-4154-y. (*publication*)
- Grajewska A., Szumiło E., Falkowska L., Hajdrych J., Bełdowska M., Meissner W., Bzoma Sz. 2013. Rtęć w jajach rybitw (*Sternidae*) gniazdujących w rezerwacie Mewia Łacha (Zatoka Gdańska) IN: L Falkowska (red.), Rtęć w środowisku Identyfikacja zagrożeń dla zdrowia człowieka, Wydawnictwo Uniwersytetu Gdańskiego, Gdańsk, 131-137. (*publication*)
- Szumiło E., Falkowska L., Hajdrych J., Grajewska A., Meissner W., Bełdowska M., Bzoma Sz. 2013. Mercury in the tissues and organs of the genus Larus gulls staying on the Gulf of Gdansk in 2009-2012. In: L Falkowska (ed.), Mercury in the environment Identification of risks to human health, University of Gdansk, Gdańsk, 155-163 (*in polish*). (*publication*)
- Szumiło E., M. Szubska, W. Meissner, M. Bełdowska, L. Falkowska. 2013. Mercury in immature and adults Herring Gulls (*Larus argentatus*) wintering on the Gulf of Gdańsk area. Oceanological and Hydrobiological Studiese 42/3, 260-267. (*publication*)

- Grajewska, E. Szumiło, Falkowska L., Hajdrych J., Bełdowska M., Meissner W., Bzoma Sz. 2013. Mercury in tern's eggs (*Sternidae*) hesting in Mewia Łacha reserve (Gulf of Gdansk), III National Scientific Conference "Mercury in the environment - Identification of risks to human health", Gdynia *(in polish)*. *(oral presentation)*
- Szumilo E., Falkowska L., Hajdryh, J., Grajewska A. Beldowska M., Krause I. 2013. Effect of diet on the capacity to remove mercury from the body of a penguin (Spheniscus demersus) living in the ZOO. The 16th International Conference on Heavy Metals in the Environment, 23-27 wrzesień. Rzym, Włochy. *(oral presentation)*
- Szumiło E., Falkowska L., Hajdrych J., Grajewska A., Meissner W., Bełdowska M., Bzoma Sz. 2013. Mercury levels in organs and tissues of seabirds of genre Larus living on the Gulf of Gdansk in 2009–2012. III National Scientific Conference "Mercury in the environment - Identification of risks to human health", Gdynia *(in polish)*. *(oral presentation)*

- Falkowska L., Szumiło E., Szubska, M., Fila G., Beldowska M., Meisner W., Bzoma Sz. 2011. Mercury in feathers, claws, eggs and guano of birds wintering in the Gulf of Gdansk area (Southern Baltic) as a detoxication proxy. The 10th International Conference on Mercury as a Global Pollutant (ICMGP), Halifax, Kanada *(poster)*
- Grajewska A., Szumiło-Pilarska E., Falkowska L., Hajdrych J., Szubska M., Bełdowska M., Jędruch A., Meissner W., Bzoma S., Przystalski A., Brauze T. 2014. Maternal transfer of mercury in eggs of waterbirds from coastal and inland breeding colony (Poland). 17th International Conference on Heavy Metals in the Environment, ICHMET, Guiyang, Chiny, *(poster)*
- Szumiło E., Falkowska L., Fila G., Szubska M., Bełdowska M., Kwaśniak J., Meisner W., Krauze I. 2011. The influence of diet on mercury levels in muscles and liver of seagulls (*larus argentatus, larus marinus*) and penguin (*spheniscus demersus*) The 10th International Conference on Mercury as a Global Pollutant (ICMGP), Halifax, Kanada. *(poster)*

The elaboration of the Hg analysis method in multiple matrixes using the AMA 254 analyser, led to my collaboration with the Department of Chemistry and Biochemistry of the Sea at the Oceanology Institute of the Polish Academy of Science in Sopot. In the years 2009-2012 I participated in the realisation of a personal research project MNiSW N N306 392936, entitled *The role of water stratification in the removal of toxic metals from the Baltic*. As part of the projects: UE Baltic Sea Regional Program, Priority 3, CHEMSEA (Chemical Munitions Search & Assessment) between 2011 and 2014, and the NATO Science for Peace and Security Grant, MODUM (Towards Monitoring of Dumped Munitions Threat) 2013-2016, I performed analyses of Hg concentrations in sediments in an area of ammunition dumping. This cooperation resulted in 4 articles, 5 oral presentations and 3 posters:

- Bełdowski J., Bełdowska M., Kuliński K., Darecki M. 2010. Vertical mercury, cadmium and lead distribution at two stratified stations in the southern Baltic Sea. In: Ż. Bargańska, A. Beyer, K. Klimaszewska, J Namieśnik, M. Tobiszewski, I. Rutkiewicz (red.), Proceedings Of 15th International Conference On Heavy Metals In The Environment, Chemical Faculty, Gdansk University of Technology, Gdańsk, 537-540. (*publication*)
- Bełdowski J., Bełdowska M., Kuliński K., Darecki M. 2010. Mercury in the area of occurrence piknokliny in the southern Baltic. In: Mercury in the environment Identification of risks to human health, L Falkowska (ed.), Gdansk University Development Foundation, Gdańsk, 67-72 (*in polish*), (*abstract, result summary & tables in English*). (*publication*)
- Bełdowski J., Bełdowska M., Kuliński K., Darecki M. 2012. Vertical Mercury, Cadmium, and Lead Distribution at Two Stratified Stations in the Southern Baltic Sea. In: Heavy Metals in the Environment (red.) J. Nriagu, J. Pacyna, P. Szefer, B. Markert, S. Wuenschmann, J. Namieśnik., Maralte, str. 237-252. (*publication*)
- Bełdowski J., Szubska M., Emelyanov E., Garnaga G., Drzewińska A., Bełdowska M., Vanninen P., Östing A., Fabisiak J. 2015. Arsenic concentrations in Baltic Sea sediments close to Chemical Munitions dumpsites. Deep-Sea Research doi: 10.1016/j.dsr2.2015.03.001. (*publication*)

- Bełdowski J., Bełdowska M., Darecki M. 2009. Particulate mercury mobilisation in the water stratification areas in southern Baltic. 9th International Conference on Mercury as a Global Pollutant, Guizhou China. (*oral presentation*)
- Bełdowski J., Bełdowska M., Kuliński K., Darecki M. 2010. Mercury in the area of occurrence piknokliny in the southern Baltic. Second Scientific Conference on Mercury in the Environment - Identification of risks to human health, Gdynia (*in polish*). (*oral presentation*)
- Bełdowski J., Bełdowska M., Kuliński K., Darecki M. 2010. Vertical mercury, cadmium and lead distribution at two stratified stations in the southern Baltic Sea, 15th International Conference On Heavy Metals In The Environment, Gdańsk. (*oral presentation*)
- Bełdowski J., Bełdowska M., Kuliński K., Miotk M., Sagan S., Massel S. 2011. Mercury vertical transport in the stratified water column, The 10th International Conference on Mercury as a Global Pollutant (ICMGP), 24-29.07., Halifax, Kanada. (*oral presentation*)
- Bełdowski J., Szubska M., Bełdowska M., Emelyanow E., Garnaga G., Drzewińska A., Vanninen P., Ostin A., Fabisiak J. 2014. Arsenic concentration in Baltis Sea sediments close to chemical munitions dumpsites. IASWS 2014 Symposium, July 15-18, Grahamstown, South Africa. (*oral presentation*)

- Bełdowski J., Bełdowska M., Darecki M. 2009. Particulate mercury mobilisation in the water stratification areas in southern Baltic, 9th International Conference on Mercury as a Global Pollutant, Guizhou, China. (*poster*)
- Bełdowski J., Bełdowska M., Kuliński K., Darecki M. 2009. Selected toxic metals profiles in the water stratification areas in the Southern Baltic. Baltic Sea Science Congress, Tallinn, Estonia. (*poster*)
- Bełdowski J., Bełdowska M., Pryputniewicz D., Burska D., Magulski R., Pryputniewicz D., Falkowska L. 2007. Mercury partitioning between solid and suspended phases in the southern Baltic Sea. Baltic Sea Science Congress Rostock. (*poster*)

Studies carried out since the beginning of 2006 inclined me to put forward the following hypothesis: *Climate changes in the Southern Baltic region effect an uncontrolled increase in the concentration of bioaccessible mercury in water*. In order to verify this hypothesis, I filed an application and in 2010 I received a grant for a GU Self Studies project (G235-5-0496-0), entitled *The influence of climate changes on the bioavailability of mercury in the Gulf of*

Gdansk., of which I was in charge. Preliminary results enabled me to submit another research project and receive a grant from NCN in the years 2011-2014 (NCN 2011/01/B/ST10/07697) entitled „Mercury in the marine environment against the backdrop of weather anomalies", of which I was again in charge. The main aims and results are presented in the „Academic achievements" section. In addition to what has already been mentioned, we specified the role of plankton and benthos organisms in mercury circulation in the coastal zone, and estimated the short- and long-term changes in Hg concentration in marine surface sediments. Not all of the results obtained within this project (which ended on 20th December 2014), have been published as yet, but preliminary observations have made it possible for us to be granted yet another NCN research project (2014/13/B/ST10/02807), entitled „Mercury remobilisation from land to the sea under the influence of intensive meteorological-hydrological phenomena", of which I am in charge. The project commenced in February 2015, granting Dr Dominika Saniewska full-time employment. The results obtained so far with respect to Hg concentration changes against the backdrop of climate changes (apart from the publications constituting academic achievement) have so far been presented in 6 articles, 8 oral presentations and 15 posters. 4 articles are currently under review.

- Bełdowska M., Jędruch A., Bełdowski J., Szubska M. 2013. Mercury concentration in the sediments as a function of changing climate in coastal zone of Southern Baltic Sea – preliminary results. E3S Web of Conferences, Volume 1. doi: 10.1051/e3sconf/2013016002. (*publication*)
- Bełdowska M., Jedruch A., Bełdowski J., Szubska M., Kobos J., Mudrak-Cegiołka S., Graca B., Zgrundo A., Ziółkowska M. , Kiełczewska J., Lewandowska E. , Wasowska K., Falkowska L. 2013. Mercury in the coastal zone of the Gulf of Puck (southern Baltic Sea), In: Mercury in the environment Identification of risks to human health, L Falkowska (ed.), University of Gdansk, Gdańsk, 97-103 (*in polish*). (*publication*)
- Beldowski, J., Miotk, M., Beldowska, M., Pempkowiak, J. 2014. Total, methyl and organic mercury in sediments of the Southern Baltic Sea. Marine Pollution Bulletin 87 (1-2), 388-395. (*publication*)
- Jędruch A., Bełdowska M., Falkowska L. 2013. Total mercury in surface sediments of Gdansk Basin. [In]: Mercury in the environment Identification of risks to human health, L Falkowska (ed.), University of Gdansk, Gdańsk, 105-110 (*in polish*). (*publication*)
- Mudrak-Cegiołka S., Bełdowska M., Jedruch A. 2013. Zooplankton in the study of mercury in the coastal zone of the Gulf of Gdansk. In: Mercury in the environment, identification of hazards to human health, L Falkowska (ed.), University of Gdansk, Gdańsk, 165-170, (*in polish*). (*publication*)

- Bełdowska M., Jędruch A., Bełdowski J., M. Szubska. 2012. Mercury concentration in the sediments as a function of changing climate in coastal zone of Southern Baltic Sea -preliminary results, The 16th International Conference on Heavy Metals in the Environment, 23-27.09. Roma, Italy. *(oral presentation)*
- Bełdowska M., Jędruch A., Bełdowski J., Szubska M., Kobos J., Mudrak-Cegiołka S, Graca B., Zgrundo A., Ziółkowska M., Kiełczewska J., Lewandowska E. , Wasowska K., Falkowska L. 2013. Mercury at coastal zone of Puck Bay (southern Baltic), III National Scientific Conference "Mercury in the environment - Identification of risks to human health", Gdynia (*in polish*). *(oral presentation)*
- Bełdowska M., Bełdowski J., Jędruch A., Zgrundo A. , Ziółkowska M. , Szubska M., Graca B, Jankowska K., Kotlarska E. 2014. Influence of weather anomalies on Hg remobilisation from sediments in the southern Baltic Sea region. IASWS 2014 Symposium, July 15-18, Grahamstown, South Africa. *(oral presentation)*
- Bełdowski J., Bełdowska M., Jędruch A., Szubska M., Kobos J., Zgrundo A., Graca B., Mudrak-Cegiołka S., Ziółkowska M., Kiełczewska J., Jankowska K., Kotlarska E. 2013. Mercury in the coastal zone of Southern Baltic Sea as a function\of changing climate - preliminary results, The 11th International Conference on Mercury as a Global Pollutant, Edinburgh, Scotland. *(oral presentation)*

- Jędruch A., Bełdowska M. 2014. Coastal erosion as a source of mercury in the marine environment on example of the Southern Baltic Sea. 17th International Conference on Heavy Metals in the Environment, ICHMET, Guiyang, Chiny. *(oral presentation)*
- Jędruch A. Bełdowska M., Falkowska L. 2013. Seasonal variability of mercury concentration in the coastal water and sediment of the Gulf of Gdańsk, 2nd Young Scientist Conference World Water Day, Poznań. *(oral presentation)*
- Jędruch A., Bełdowska M., Falkowska L. 2013. Total mercury in surface sediments of the Gdansk Basin, III National Scientific Conference "Mercury in the environment - Identification of risks to human health", Gdynia (*in polish*). *(oral presentation)*
- Saniewska D., Bełdowska M., Bełdowski J., Falkowska L. 2013. The impact of flooding in charge and form of mercury enters the Gulf of Gdansk in 2010. [In]: Mercury in the environment Identification of risks to human health, L Falkowska (ed.), University of Gdansk, Gdańsk, 65-70 (*in polish*). *(oral presentation)*
- Saniewska D., Bełdowska M., Bełdowski J., Falkowska L. 2013. The impact of the flood on the load and the form of mercury flow into the Gulf of Gdansk in 2010, III National Scientific Conference "Mercury in the environment - Identification of risks to human health", Gdynia (in polish). *(oral presentation)*

- Bełdowska M., Bełdowski J., Jędruch A., Szubska M., Kobos J., Mudrak-Cegiołka S, Zgrundo A., Ziółkowska M., Graca B., Jankowska K., Kotlarska E., Kiełczewska J. 2013. Mercury concentration in the coastal zone of Gulf of Gdansk as a function of changing climate– preliminary results. The 9th Baltic Sea Science Congress, Kłajpeda, Litwa. *(poster)*
- Bełdowska M., Jędruch A., Bełdowski J., Kobos J., Mudrak-Cegiołka S., Zgrundo A., Ziółkowska M., Jankowska K., Kotlarska E., Szubska M., Graca B., Kiełczewska J. 2013. Variability of mercury concentrations in plankton and benthos of the coastal zone of Southern Baltic Sea through the year. The 11th International Conference on Mercury as a Global Pollutant, Edinburgh, Scotland. *(poster)*
- Bełdowska M., Jędruch A., Bełdowski J., Ziółkowska M. 2014. Hg in sediments and zoobenthos as a function of thermally anomal winter, in the southern Baltic Sea region. IASWS 2014 Symposium, July 15-18, Grahamstown, South Africa. *(poster)*
- Bełdowska M., Jędruch A., Kobos J., Mudrak-Cegiołka S. 2014. Seasonal variability of mercury concentration in planktonic organisms of the coastal zone of the Gulf of Gdansk (Southern Baltic Sea). 17th International Conference on Heavy Metals in the Environment, ICHMET, Guiyang, Chiny. *(poster)*
- Bełdowska M., Jędruch A., Kobos J., Mudrak-Cegiołka S., Bełdowski J., Szubska M., Lewandowska A., Falkowska L. 2013. Mercury concentrations in phytoplankton and zooplankton in the coastal zone of Gulf of Gdansk, through the year. The 9th Baltic Sea Science Congress, Kłajpeda, Litwa. *(poster)*
- Grajewska A., Szumiło-Pilarska E., Falkowska M., Hajdrych J., Szubska M., Bełdowska M., Jędruch A., Meissner W., Bzoma S., Przystalski A., Brauze T. 2014. Maternal transfer of mercury in eggs of waterbirds from coastal and inland breeding colony (Poland). 17th International Conference on Heavy Metals in the Environment, ICHMET, Guiyang, Chiny. *(poster)*
- Jędruch A., Bełdowska M., Bełdowski J., Zgrundo A., Ziółkowska M. , Szubska M., Graca B., Jankowska K., Kotlarska E., Kiełczewska J. 2013. Variability of mercury concentrations in sediments and benthos of the coastal zone of Puck Bay (southern Baltic Sea), through the year. The 9th Baltic Sea Science Congress, Kłajpeda, Litwa. *(poster)*
- Jędruch A., Bełdowska M., Falkowska L. 2013. Total mercury in surface sediments of the coastal zone of the Gulf of Gdansk scientific conference "Geological processes of the coastal zone of the sea", Gdynia, (*in polish*). *(poster)*
- Jędruch A., Bełdowska M., Falkowska L.2014. Total mercury in surface sediments of the Gdansk Basin. 3rd Young Scientists Conference, World Water Day, Poznań. *(poster)*
- Jędruch A., Bełdowska M., Falkowska L. 2012. Macrophytobenthos ability to absorb of Hg at the coastal zone of the Gulf of Gdansk, the Conference Fri. "Chemistry, geochemistry and marine protection" Sopot, (*in polish*). *(poster)*
- Jędruch A., Bełdowska M., Falkowska L., Perec M., Grzesińska K. 2013. The impact of coastal erosion processes cliff on the flow of mercury into the Bay of Gdansk, scientific conference "Geological processes of the coastal zone of the sea", Gdynia (*in polish*). *(poster)*
- Jędruch A., Bełdowska M., Saniewska D., Falkowska L. 2013. The impact of extreme natural phenomena on the flow of mercury into the Gulf of Gdansk. Aspects of water research in the twentieth and twenty-first century, Gdańsk, (*in polish*). *(poster)*
- Jędruch A., Bełdowska M., Ziółkowska M., Falkowska L. 2014. Mercury in benthic fauna inhabiting the coastal zone of the Gulf of Gdansk (Baltic Sea). Nordic Environmental Chemistry Conference – NECC, Reykjavik, Islandia. *(poster)*
- Mudrak-Cegiołka S., Bełdowska M., Jędruch A. 2013. Mercury in zooplankton in the nearshore zone of the Gulf of Gdańsk (Southern Baltic). 48th European Marine Biology Symposium, National University of Ireland, Galway, Ireland. *(poster)*
- Mudrak-Cegiołka S., Bełdowska M., Jedruch A. 2013. Zooplankton in the investigations of mercury in the nearshore waters the Gulf of Gdansk. III National Scientific Conference "Mercury in the environment - Identification of risks to human health", Gdynia (*in polish*). *(poster)*

– Saniewska D., Bełdowska M., Jędruch A., Bełdowski J., Saniewski M., Falkowska L. 2014. The effect of extreme Vistula flood on mercury loads into the Baltic Sea. Nordic Environmental Chemistry Conference – NECC, Reykjavik, Islandia. *(poster)*

During the construction of the football stadium in Gdansk for the European Championships in 2012, an underground dump site containing mercury compounds was uncovered. Professor Falkowska became actively involved in the studies on the reemission of mercury from the freshly uncovered site. I participated in the measurement campaigns to test the concentrations of gaseous mercury there, as well as in laboratory studies on the potential emission of Hg from soil, debris and the watercourse near the dump. These studies enabled us to determine the parameters stimulating Hg reemission and to estimate the potential risk resulting from such illegal dumps. The results were presented in two publications and in one oral presentation:

- Falkowska L., Bełdowska M., Witkowska A. 2010. Remission of total gaseous mercury from the tomb in Gdansk Letnica. In: Konieczyński J. (eds), Air Protection in Theory and Practice, Volume 2, the Institute of Environmental Engineering of Polish Academy of Sciences, 67-74 (*in polish*). (*publication*)
- Falkowska L; Witkowska A; Beldowska M; Lewandowska A. 2013. Waste disposal sites as sources of mercury in the atmosphere in the coastal zone of the Gulf of Gdansk (southern Baltic Sea). Oceanological nd Hydrobiological Studies 42/1, 99-109. (*publication*)

- Falkowska L., Bełdowska M., Witkowska A. 2010. Remission of total gaseous mercury from the tomb in Gdansk Letnica. VII International Scientific Conference on Air Protection in Theory and Practice, Zakopane (*in polish)*. (*oral presentation)*

Another research task, in which I was involved together with GU Professor Bożena Graca, was the recognition of the role of styrofoam, commonly used in construction, in the circulation of Hg and its inclusion in the marine trophic chain. Studies showed that styrofoam has accumulative properties towards mercury, particularly when covered in biofilm. As, reaching the marine environment, it becomes accidentally consumed by sea organisms, toxic mercury becomes introduced to the food chain. The collected results have been presented in 2 articles and 2 posters:

- Graca B., Bełdowska M., Wrzesień P., Zgrundo A. 2013. Accumulation of mercury in the waste styrofoam In: Mercury in the environment Identification of risks to human health, L Falkowska (ed.), University of Gdansk,Gdańsk, 197-204, *(in polish)*. (*publication*)
- Graca B., Bełdowska M., Wrzesień P. Zgrundo A. 2014. Styrofoam debris as a potential carrier of mercury within ecosystems. Environmental Science and Pollution Research 21(3), 2263-2271. (*publication*)

- Graca, M. Bełdowska, P. Wrzesień, A. Zgrundo. Mercury accumulation in styrofoam Derbis, III Ogólnopolska Konferencja Naukowa "Rtęć w środowisku – Identyfikacja zagrożeń dla zdrowia człowieka", 08-10.05.2013, Gdynia. *(poster)*
- Graca B., Bełdowska M. 2011. The mercury content in the waste polystyrene (Styrofoam) in the area of the Triciti. III Pomeranian Conference cycle Air Quality, Gdańsk *(in polish). (poster)*

Our achievements were once again recognised with a Rector's Group Award of the first degree in 2014 for „A series of publications dealing with the issue of endocrine substances influencing the condition and health of both marine and land organisms".

The experience gained through the BASYS project and work on my doctoral thesis on atmospheric chemistry also aided me in research work after obtaining my doctoral degree. I participated in studies into the concentration of carbon, macrocomponents and nitrogen compounds in the aerosols of the coastal zone of the Gulf of Gdansk and at the reference station in Puszcza Borecka. The results made it possible to determine the role of the sea and land in the formation of the chemical compostition of aerosols. In the years 2006-2011 I was an executor in the UE EUSAAR project (European Supersites for Atmospheric Aerosol Research) as part of the integrated Infrastructures Intitiatives / Structuring the European Research Area – Support for Research Infrastructures. In the years 2007-2010 I represented Gdansk University as a partner in the EU ACCENT programme (Atmospheric Composition Change The European Network of Excellence). The experience helped me to conduct lectures and workshops in Atmospheric Chemistry during Professor Falkowska's sick leave and Professor Anita Lewandowska's maternity leave. The results obtained through those studies were presented in 6 articles and three oral presentations.

- Falkowska L., Lewandowska A., Sikorowicz G., Bełdowska M., Madeja J.H. 2008. The role of air masses in forming of iron concentrations in wet atmospheric deposition over urbanised coastal zone of the Gulf of Gdańsk. Oceanological and Hydrobiological Studies, Vol. 37, No2, 21-37. (*publication*)
- Lewandowska A., Falkowska L., Bełdowska M., Szymańska K. 2006. Inorganic nitrogen and sulfur compounds in the air above urbanized Gdynia and Sopot, Air Protection in Theory and Practice, Monograph, Institute of Environmental Engineering of Polish Academy of Sciences in Zabrze, *(in polish)* s. 177-186. (*publication*)
- Lewandowska A., Falkowska L., Murawiec D., Pryputniewicz D., Burska D., Bełdowska M. 2010. Elemental and organic carbon in aerosols over urbanised coastal region (southern Baltic Sea, Gdynia). Science of the Total Environment 408, 4761–4769. (*publication*)
- Lewandowska A., Falkowska L., Witkowska A., Bełdowska M. 2013. Fluoride in aerosols coastal zone of the sea. In: Air quality: the impact on the environment (ed.) W. Wardencki. Gdańsk Gdansk University of Technology, 112-119, *(in polish)*. (*publication*)
- Lewandowska A., Murawiec D., Falkowska L., Bełdowska M. 2009. The role of land and sea in the formation of the chemical composition of PM 10 in Gdynia. In: J. Namieśnik, W. Wardencki, J. Gromadzka (ed.) II Pomeranian Conference Indoor Air Quality, Department of Chemistry, Gdansk University of Technology, Gdańsk, 45-49, *(in polish)*. (*publication*)
- Siudek P., Falkowska L., Lewandowska A., Pryputniewicz D., Bełdowska M., Gic P. 2006. Chosen anions and cations in the precipitation over coastal zone of the Gulf of Gdańsk. Oceanological and Hydrobiological Studies, 35(1), 39–53. (*publication*)

- Lewandowska A., Falkowska L., Bełdowska M., Szymańska K. 2006. Inorganic nitrogen and sulphur species in the air over urbanised Gdynia and health resort of Sopot, V International Scientific Conference Air Protection in Theory and Practice, Zakopane, *(in polish)*. *(oral presentation)*
- Lewandowska A., Falkowska L., Witkowska A., Bełdowska M. 2013. Fluorki w aerozolach strefy brzegowej morza. IV Pomeranian Conference Air Quality, *(in polish)*. *(oral presentation)*
- Lewandowska A., Murawiec D., Falkowska L., Bełdowska M. 2009. The role of land and sea in the formation of the chemical composition of PM 10 in Gdynia. Conference materials, Pomeranian II Conference cycle Air Quality, Gdańsk-Sobieszewo, *(in polish)*. *(oral presentation)*

Summary of academic activity after obtaining the doctoral degree

Since I obtained the doctoral degree, I have been in charge of seven scientific research projects, which were granted by the MNiSW (Ministry of Science and Higher Education), the National Science Centre and the Dean of Biology, Geography and Oceanology at Gdansk University (Annex 4, point II, item I). I have received funding to the total value of PLN 1,687,143. Part of the grant was used to purchase the automated mercury analyser and other pieces of equipment such as e.g. an automated collector of wet precipitation, a microwave analyser, and a ball mill. This equipment is used by the employees of the Marine Chemistry and Marine Environmental protection institute of GU and is often a laboratory foundation for new projects. As an executor I participated in the implementation of two projects financed by the Ministry of Science and Higher Education. I also took part in research within two international projects: EU Baltic Sea Regional Program, Priority 3, CHEMSEA (Chemical Munitions Search & Assessment) and the NATO Science for Peace and Security Grant, MODUM (Towards Monitoring of Dumped Munitions Threat). I also participated in the European Supersites for Atmospheric Aerosol Research project (EUSAAR) as part of the Integrated Infrastructures Initiatives - Structuring the European Research Area, Support for Research Infrastructures (2006-2011) and in the Atmospheric Composition Change The European Network of Excellence programme (UE ACCENT) (2007-2010).

Implementing the projects enabled me to: give 38 oral presentations, present 57 posters at international and Polish conferences (Annex 4: point II, item K), write 67 publications in English and Polish, including 33 original papers published in English, 28 of which were published in magazines currently indexed by the Philadelphia Institute of Scientific Information (ISI) (Annex 4: point I, item B, and point II, items A and D). The total **number of MNiSW points for publications after obtaining the doctoral degree amounts to 720 points, and the summary impact factor (IF) from the year of publication amounts to 41,121.** Owing to the fact that not in all cases was a given magazine indexed in the year of my publication in it, I provide my **IF for 5 years** as being **50,782**. Details are shown in Table 1.

According to the Web of Science base I have obtained Hirsh Index: 5, and my articles have been quoted in 71 publications. I would also like to point out that my first published articles were not included in the Web of Science list as the respective magazines did not feature on the list at that time, and that the latest 2 articles from 2015 have not yet been taken into consideration in the ranking. According to the Scopus list, my Hirsh index is 6.

Table 1. Publications written by me alone or in collaboration with other authors between 2001 and May 2015.

	Total number of publications	Publications in English		Number of publications in Polish	MNiSW points	IF in the year of publication
		with IF	without IF			
In total	**71**	**31**	**5**	**35**	**767**	**43,776**
Before doctoral degree	4	3	0	1	47	2,655
In total after doctoral degree	**67**	**28**	**5**	**34**	**720**	**41,121**
Scientific accomplishment	7	7	0	0	230	18,899
Academic accomplishment (*not including the scientific accomplishment*)	60	21	5	34	490	22,222

My scientific achievement after obtaining the doctoral degree has been recognised four times by the Gdansk University Rector: three times with a Group Award of the first degree (2007, 2013, 2014) and once with a Group Award of the third degree (2008) (Annex 4, point II, item J).

Summary of teaching activity after obtaining the doctoral degree

The knowledge obtained during the studies made it possible for me to create a curriculum of my own subjects, which instructs Oceanography and Environmental Protection students at the Oceanography and Geography Department in:

- Metals in the marine environment (30 h lectures and 30 h workshops)
- Harmful substances in the drainage area of the Baltic Sea (15 h lectures and 15 h workshops)
- Civilisational problems resulting from the condition of marine environment (30 h workshops)
- Sea water chemistry (15 h workshops)

Additionally, I participated in the preparation of the curriculum and conducted classes in English on the subject of:

- Chemical processes in and between the atmosphere, seawater and sediment of the marine environment (9 h lectures and 10 h workshops).

I have also conducted classes in Chemical Oceanography (60-75h), specialist workshops at sea and in the coastal zone (6h per group), diploma tutorials, MA tutorials and, as a substitute teacher, lectures and classes in Atmospheric Chemistry.

I was also able to use my teaching and academic experience nine times during the Baltic Science Festival and the Science Picnic, in the years 2006-2001 (Annex 4: point III, item A). In the period 2009-2012 I participated in the EU project „Growth through competences" WND-POKL.03.03.04-00-155/09. As part of that project, I prepared 13 presentations and carried out 25 four-hour demo lectures in Environmental Chemistry, as well as mentoring for lower high school pupils from the Pomeranian Voivodship.

I used my ability to work with young people on the seven occasions when I was student guardian in the years 2006-2012 (Annex 4: point III, item Q) and supervised over 20 Masters 2 Bachelor dissertations. In addition to that, I was the academic counsellor for 16 Masters students and five doctoral students (Annex 4: point III, items J, K).

In the years 2009-2013 I was responsible for the preparation of an „Application for the grant of funding for the basis statutory activity" and „Report of scientific-research activity". I was also able to use my organisation skills as:

- Syllabus coordinator
- Member of a team for the preparation of Intelligent Specialisation of Pomerania
- Member of the Bachelor Exams Committee (in 2014)
- Head of the Admissions Committee (in 2014)
- Organiser and Secretary of international science workshops entitled „*Chemical substances transformation in sediments – methodological aspects*" (in 2005)
- Twice the organiser and secretary of the Organisers' Committee of the „Polish National Scientific Conference Mercury in the Environment – identifying threats for Human Health" (in 2007 and 2010)
- Secretary of the Organisers' Committee of the „Polish National Scientific Conference Mercury in the Environment – identifying threats for Human Health" (in 2013)

(Annex 4, point III, item C)

Since 2012 I have reviewed 13 articles, 11 of these in English (annex 4), for publications including Science of the Total Environment (IF 3,2), AMBIO (IF 2,97), Journal of Geochemical Exploration (IF 2,4), and Water, Air, & Soil Pollution (IF 1,7) (Annex 4: point III, item P).

Planned future research

Currently I am implementing a research project financed by the NCN, entitled „Mercury remobilisation from land to the sea under the influence of intense meteorological-hydrological phenomena" (NCN 2014/13/B/ST10/02807, in the years 2015 – 2018), of which I am in charge. I am assisted in this task by one assistant professor and two doctoral students. I estimate that it will result in six publications in impacted magazines.

The new mercury analyser purchased as part of the project will make it possible to implement a new, faster and more sensitive method of analysing mercury speciation. I will use it to recognise Hg speciation in the marine environment: most importantly in phytoplankton and zooplankton. To continue my studies on the influence of climate changes on Hg circulation in the marine environment, I am planning to broaden the research by including the changes of particular mercury forms and other toxic metals. I am planning to invite both young scientists and experts experienced in biological and physical oceanography to participate in these studies.

M. Beldowska