

SUMMARY

The doctoral dissertation discusses the problem of atmospheric pollution with carbon compounds in aerosols and precipitation in the urbanized coastal zone of the Gulf of Gdańsk. In the work presented for the evaluation, an attempt was made to determine the factors that determine the seasonal variability of the concentration of suspended organic carbon (WIOC) and soluble organic carbon (WSOC) and elemental carbon (EC) in aerosols of various sizes (PM1, PM2.5, PM10) and factors influencing the size of the load of these compounds introduced into the coastal zone of the sea with aerosols of various sizes and with wet deposition in various forms of its occurrence (rain, snow and mixed precipitation).

Based on the conducted environmental research, the analysis of the obtained results and on the basis of the existing world literature on the problem discussed in the paper, the following conclusions were formulated:

- Regardless of the form of organic carbon in aerosols (WSOC, WIOC), the most effective process of removing this compound from the atmosphere turned out to be mixed precipitation and rain in the first day of their occurrence. Elemental carbon in aerosols is most effectively removed from the atmosphere with snow, and this process requires an episode of rainfall for several days.

- In the urbanized coastal zone of the Gulf of Gdańsk, the concentration of carbon compounds in wet precipitation is subject to seasonal changes. It is mainly determined by the volume of precipitation and the form of its occurrence, as well as by the chemical properties of individual carbon compounds. The seasonal variability of the concentration of organic forms of carbon (WIOC, WSOC) in precipitation is more influenced by natural, and elementary carbon (EC) by anthropogenic sources of their origin in atmospheric aerosols. In turn, the dispersion of aerosols, regardless of their origin, is shaped by the force of the wind and its direction

- The annual load of coal introduced to the coastal zone of the Gulf of Gdańsk with wet and dry atmospheric deposition was estimated at the third part of the CO₂ load. At the same time, the carbon load in all forms of its occurrence (WIOC, WSOC, EC) is one to two orders of magnitude higher with wet than dry deposition (Fig. 1). The size of the coal load introduced into the coastal zone of the Gulf of Gdańsk changes seasonally and is determined by the overlapping sea and land masses of air. In the growing season with wet precipitation, a high

load of bioavailable soluble organic carbon (WSOC) is brought in. This may be important for the functioning of the Baltic flora and fauna. In addition to the direct negative impact on living organisms, organic substances introduced into the sea may determine the increase in the thickness of the sea surface microlayer, limitation of gas exchange at the water and atmosphere boundary, and the rate of CO₂ transfer. Taking into account that in the South Baltic region, during the growing season, there is a systematic increase in rainfall volume as a result of a changing climate, the processes described above may be permanent. Similar trends should also be expected in urbanized regions of other mid-latitude shelf seas.

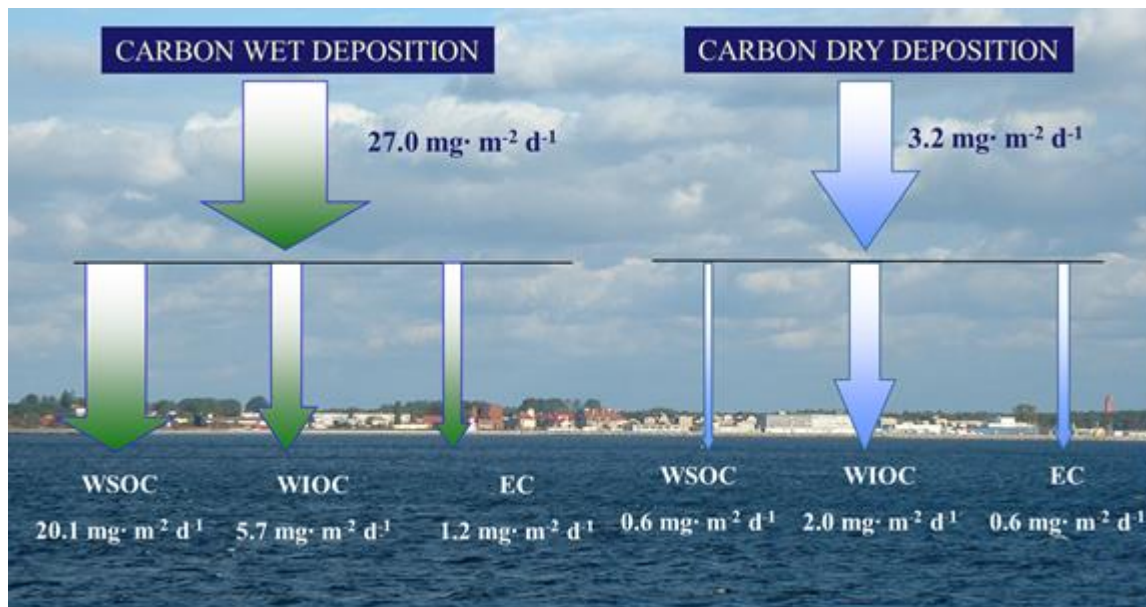


Fig. 1 Fluxes of carbon in its various forms of occurrence with wet and dry deposition into Gulf of Gdansk (own drawing, Article II)

- The high concentrations of mercury and benzo(a)pyrene (B(a)P), which is an indicator of the degree of air pollution with polycyclic aromatic hydrocarbons (PAH), obtained in the aerosols of the coastal zone of the Gdańsk Bay, are worrying for the quality of the environment, the health of the inhabitants of the Tri-City and other living organisms. In the research area, atmospheric deposition is an important carrier of both compounds to the coastal zone of the sea, especially during the heating season. At that time, their main source of origin are coal and wood combustion processes for heating purposes in the municipal and housing sector. During the non-heating period, when the above source is limited, B (a) P mainly comes from transport. In turn, mercury at this time is not present in aerosols or reaches very low concentrations. Exceptions are when air masses flow from the port, rich in elemental carbon and primary organic carbon emitted by ships. Then, gaseous mercury is adsorbed on the carbon, which leads to an increase in its concentration in aerosols.