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Runoff of particle bound pollutants from urban impervious surfaces studied by analysis of sediments from stormwater traps

Morten Jartun[a,b,*], *Rolf Tore Ottesen*[a], *Eiliv Steinnes*[b], *Tore Volden*[a]

[a]*Geological Survey of Norway, NO-7491 Trondheim, Norway*
[b]*Norwegian University of Science and Technology, NO-7491 Trondheim, Norway*

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ABSTRACT

Runoff sediments from 68 small stormwater traps around the harbor of urban Bergen, Norway, were sampled and the concentrations of polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), heavy metals, and total organic carbon (TOC) were determined in addition to grain size. Our study provides empirical data from a large area in the interface between the urban and marine environment, studying the active transport of pollutants from land-based sources. The results of the analyses clearly demonstrate the importance of the urban environment representing a variety of contamination sources, and that stormwater runoff is an important dispersion mechanism of toxic pollutants. The concentrations of different pollutants in urban runoff sediments show that there are several active pollution sources supplying the sewage systems with PCBs, PAHs and heavy metals such as lead (Pb), zinc (Zn) and cadmium (Cd). The concentration of PCB_7 in the urban runoff sediments ranged between <0.0004 and 0.704 mg/kg. For PAH_{16}, the concentration range was <0.2–80 mg/kg, whereas the concentration ranges of Pb, Zn and Cd were 9–675, 51.3–4670 and 0.02–11.1 mg/kg respectively. Grain size distribution in 21 selected samples varied from a median particle diameter of 13 to 646 μm. However, several samples had very fine-grained particles even up to the 90 percentile of the samples, making them available for stormwater dispersion in suspended form. The sampling approach proposed in this paper will provide environmental authorities with a useful tool to examine ongoing urban contamination of harbors and similar recipients.

1. Introduction

The urban environment is affected by a wide variety of local, anthropogenic activities, and this contamination is a continuous and diffuse process. Road networks, housing, and industrial activities will tend to increase the contents of heavy metals and organic pollutants in urban soils (Kelly et al., 1996; Mielke et al., 1999; Ottesen and Langedal, 2001; Mielke et al., 2004). Various types of soil may be present within the urban environment, ranging from relatively undisturbed soils, similar in some respects to their rural counterparts (Bridges, 1991; Hollis, 1991), to completely man-made soils (Ottesen and Langedal, 2001). The most significant impact of urbanization on soil is the complete loss or burial as a result of construction activities. Assuming that an average proportion of between 50 and 100% of the urban area has been built upon, this represents a considerable volume of buried or displaced soil in addition to an important change in the hydrological

* *Corresponding author*. Tel.: +47 73904309; fax: +47 73921620.
E-mail address: morten.jartun@ngu.no (M. Jartun).

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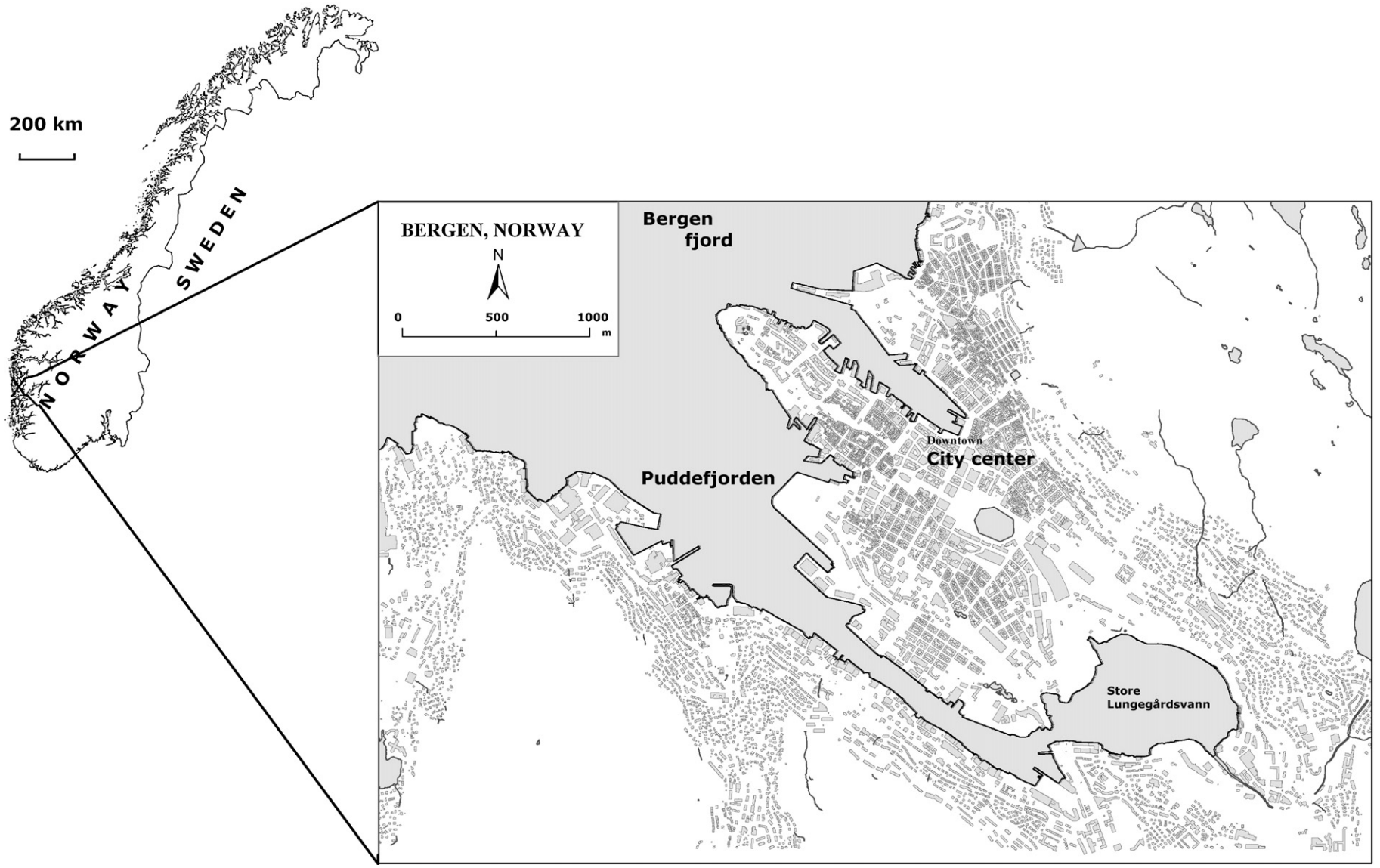

Fig. 1 – Survey area around Bergen harbor, located in the western part of Norway.