First steps towards a new approach for interpretation of ecotoxicological data for sediment and dredged material classification

Susanne Heise[1], Lieven Bervoets[2], Ward deCooman[3], Sonja Faetsch[1], Katharina Heitmann[4], Hanne Hetjens[2], Sebastian Höss[5], Annette Kramer[6], Johannes Teuchies[2], Paul Walker[7]

[1]Hamburg University of Applied Sciences, Ulmenliet 20, 21033 Hamburg, Germany
[2]University of Antwerp, Groenenborgerlaan 171, 2020 Antwerp, Belgium
[3]Vlaamse Milieumaatschappij, Gasthuisstraat 42, 9300 Aalst, Belgium
[4]Institut Dr. Nowak, Mayenbrook 1, 28870 Ottersberg, Germany
[5]ECOSSA, Giselastr. 6, 82319 Starnberg, Germany
[6]Hamburg Port Authority, Neuer Wandrahm 4, 20457 Hamburg, Germany
[7]Sokotec, Ashby Road, Burton on Trent, DE15 0YZ

Phone: +49-(0)-40-42875-6217
E-mail: susanne.heise@haw-hamburg.de

Introduction: The integration of ecotoxicological data in sediment and dredged material assessment frameworks is often controversially discussed: Pro: Sediments contain many more contaminants than detected by chemical analysis. Only those can be compared to sediment quality criteria (SQC) indicating a potential risk. Moreover, SQC do not necessarily predict the ecological risk, because environmental factors as well as the sediment's history modify bioavailability of contaminants. Bioassays in contrast to chemical data are supposed to show an integrated effect of bioavailable substances.
Contra: - From bioassay responses, the underlying causes for toxicity cannot be identified. - A limited battery of different test organisms is used for sediment risk assessment which is not necessarily representative of the whole biological community. - Standardized laboratory test conditions might change sediment properties, which reduces the ecological relevance. - Confounding factors (e.g. sediment properties, ammonium concentration) could result in false positive results. Furthermore, many stakeholders claim that inclusion of ecotoxicological in addition to chemical data into dredged material assessment results in contrary outcomes and increases costs unnecessarily. Also some struggle with the reproducibility of test results in practice.
The Interreg Project "Sullied Sediments" addresses these challenges, trying to achieve a "better" sediment/dredged material assessment that is less costly, but still environmentally safe. Half way through the project, this presentation will suggest an adaptable assessment framework based on the compiled project data.

Methods: Three river catchments in Belgium (Schelde), UK (Humber) and Germany (Elbe), were sampled 3 times at 3 sites each to obtain a variety of different chemical stressors and hydrological conditions. Altogether 6 sampling surveys at different seasons and years are planned. Each sediment sample is analysed for more than 130 contaminants, 10 different ecotoxicological endpoints and composition of macrozoobenthos and meiobenthos communities.

Results and discussion: At the time of abstract submission, 3 sampling surveys have been completed (Oct 2017, March and July 2018). Data will be discussed and presented with regard to (a) characterization of all sites; (b) comparison of dredged material management decisions following a "traditional" framework and a triad approach; c) reproducibility and reliability of chemical and ecotoxicological data (d) environmental safety and cost efficiency; (e) a new approach for adaptable and individual integration of ecotoxicological data in management decision frameworks.
Preliminary results for site characterization are exemplarily shown below for four biotests (in % inhibition) and two chemicals (Cd in mg/kg and Dioxin in TEQ ng/kg) for the sites in UK (Fig. 1). These samples showed strong seasonal differences in ecotoxicological responses with elevated responses in Oct 2017.

		ECOTOX					Chemistry	
Event ID	Suse Sample ID	Nematode (Rep	BKT	LBT	Algae		Cd	2378-TCDD
SuSe-1 (1)	UK_1.1	20.07	87.69	37.14	8.35		1.60	0.35
SuSe-1	UK_1.2	-8.20	82.26	21.78	9.54		0.43	0.35
SuSe-1	UK_1.3	27.05	93.68	43.55	98.83		0.49	0.35
SuSe-2 (2)	UK_2.1	-13.86	0.76	30.98	8.84		1.20	0.50
SuSe-2	UK_2.2	4.40	1.29	22.70	-13.48		0.85	0.40
SuSe-2	UK_2.3	-33.10	0.53	13.21	-14.46		0.59	0.50
Suse-3 (3)	UK_3.1	-15.86	34.52	23.63	-22.64		0.64	0.40
Suse-3	UK_3.2	-5.94	44.52	29.47	-2.38		0.50	0.40
Suse-3	UK_3.3	69.80	52.82	30.04	-9.47		0.71	0.40

Fig. 1: Data from 4 ecotox tests and 2 chemical contaminants shown exemparily for UK samples, organized according to sampling events.

Acknowledgement: Thanks to all Sullied Sediment partners and to the Interreg North Sea Program for funding this study.