LIFE GoodWater IP International conference Waterside – A Space for Water, Land and People Interactions: Practices and Challenges in River Basin Management, October 8–9, 2025 Riga, Latvia

Similarity between the pesticide cocktails detected using POCIS in Daugava river and the Gulf of Riga waterside in autumn 2024

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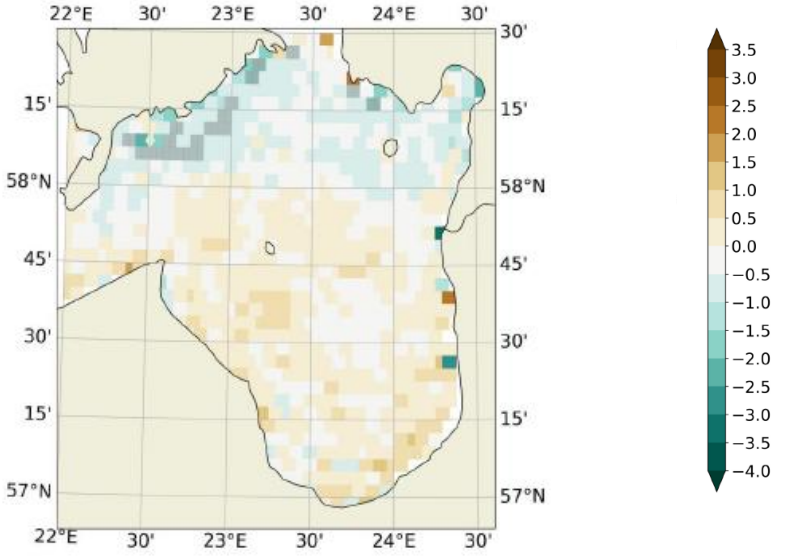
Institute of Numerical Modelling

Background – oceanographic model data analysis

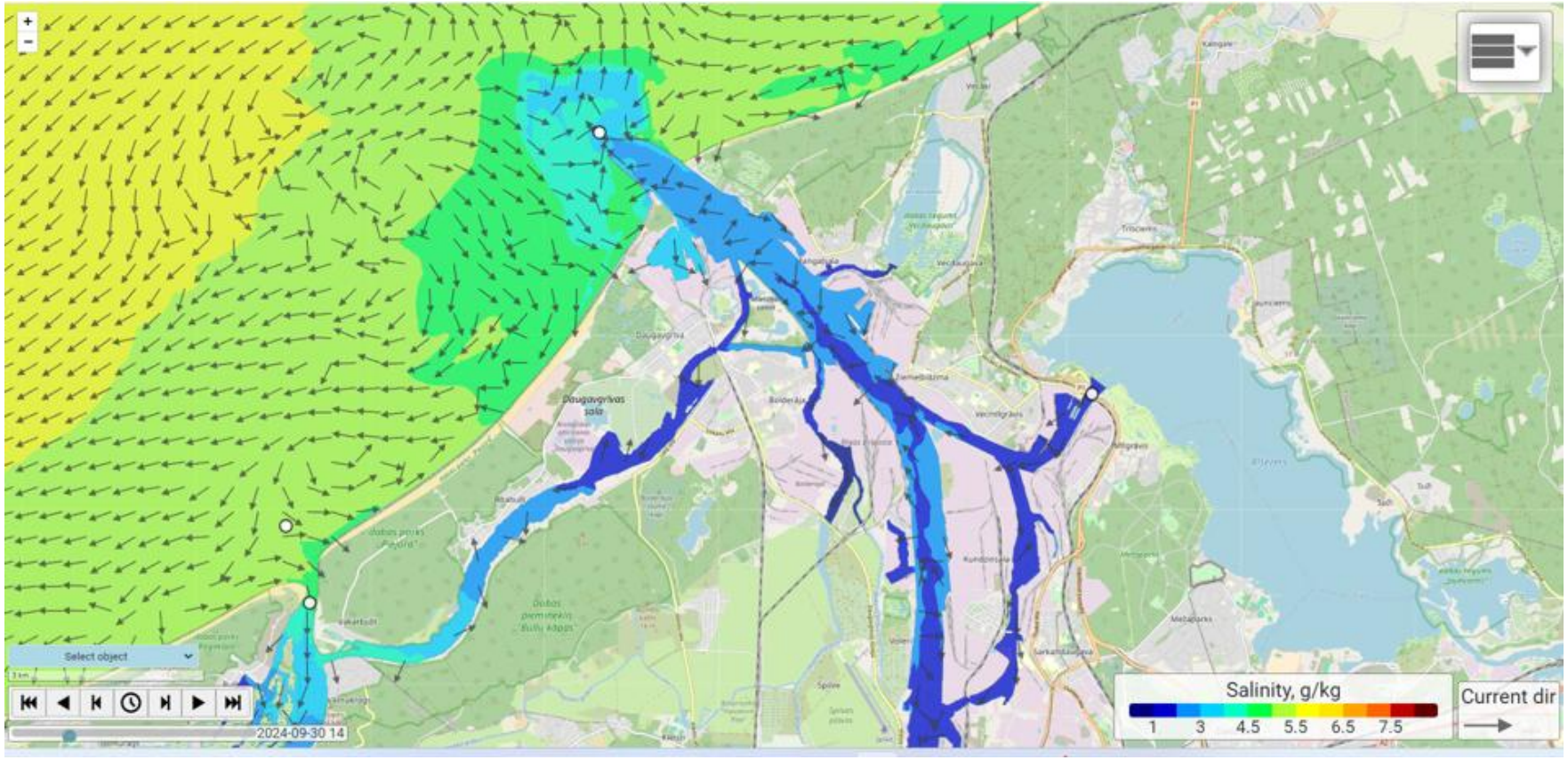
- observed water color in Daugava (cobalt - platinum scale) and in the Gulf of Riga (Forel Ule scale)
- modeled salinity in the Gulf of Riga
- satellite data derived water color products
- observed oxigen concentrations



Difference between mean watercolors in July of two 12 years groups - the most and least saline years according to modeled yearly volume salinity averages in the GoR 1998-2021. Negative sign of difference in case the watercolor values lower during the years with higher salinity. The grid cells shaded gray in case changes significant ($p<0.05$) according to Mann –Whitney u test.

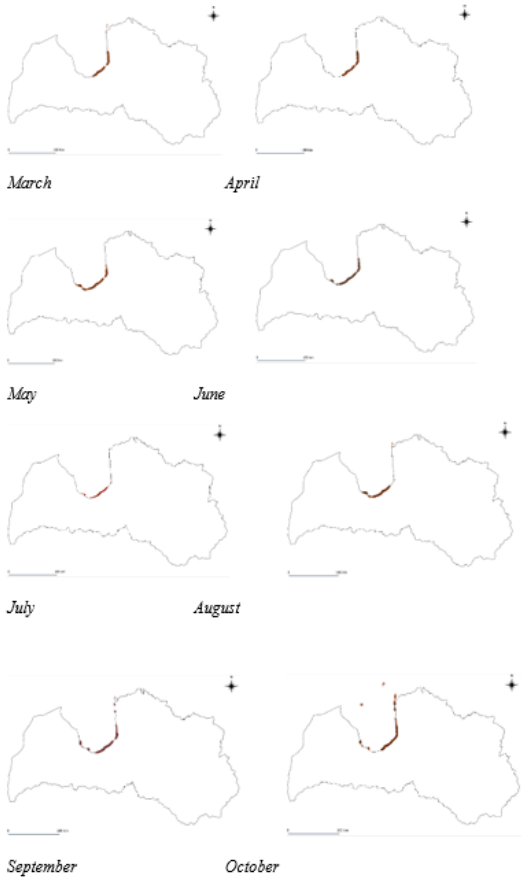
Watercolor along the coast of GoR in Estonian island Saremaa is significantly lower in July in the years with the total volume salinity of the GoR higher

Hywas-Port service Hydrodynamic, wave and siltation modelling for ports



Daugava – the Gulf of Riga system in Hywas-Port
http://www.water.lv/HywasPort/SeamlessTransition/#d=current&v=S&v=V

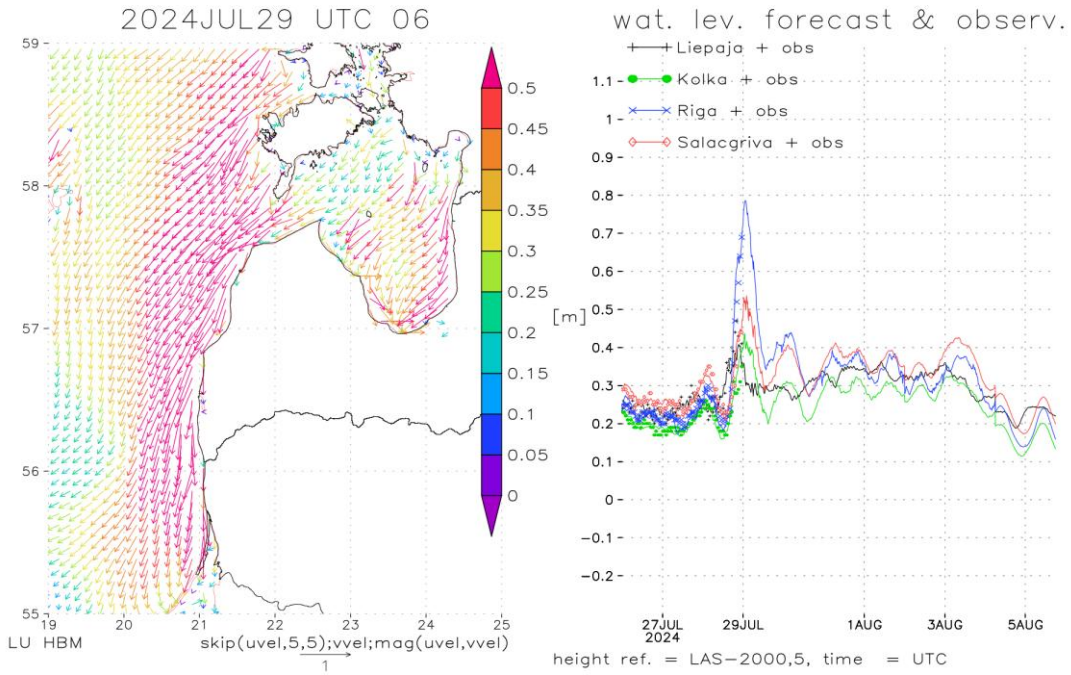
Surface current drift patterns towards the coast from Daugava and Lielupe deltas



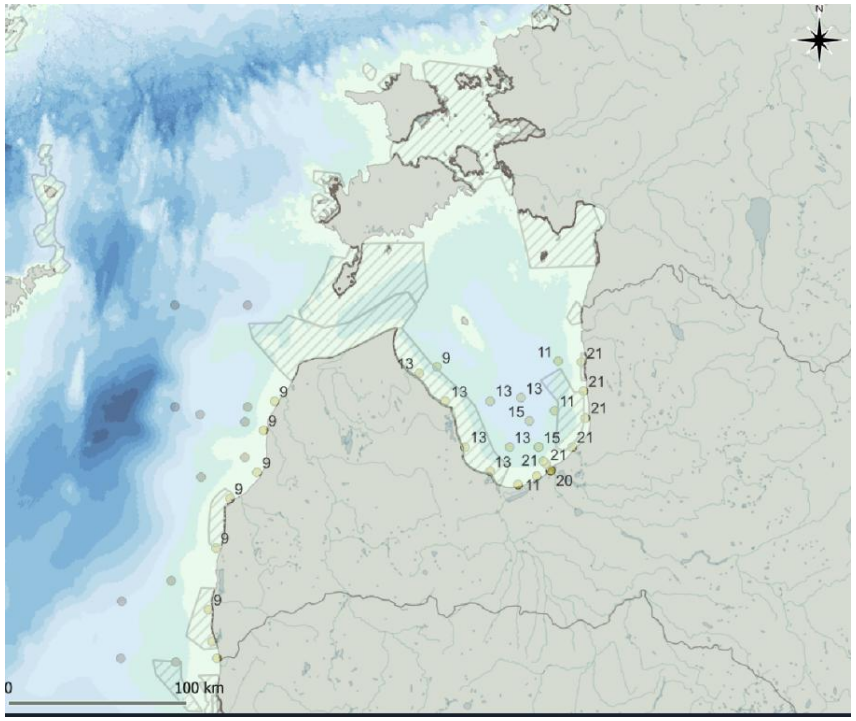
Numerical modelling experiment results using CMEMS oceanographic model data.

Coastal segments receiving passive surface drifters from Lielupe and Daugava deltas in 20 days. Drifters released daily March-October 2008-2018.

Storm in summer 2024

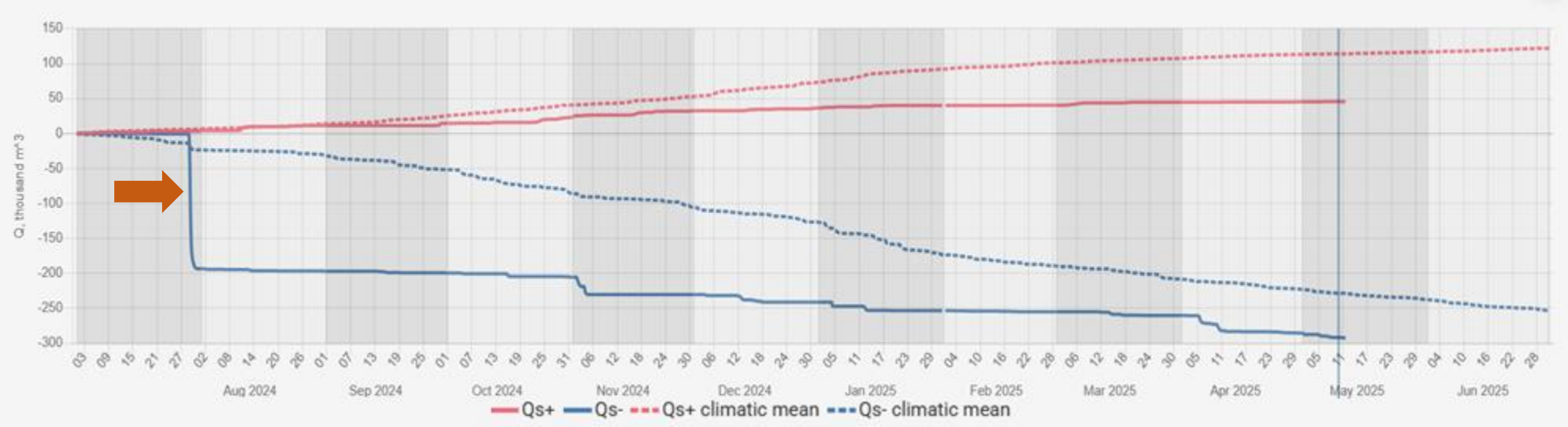


Representation of the extreme event in UL HBM oceanographic model results and waterlevel observations.



Watercolor monitoring results (in FU scale) in August, September 2024 by Latvian Institute of Aquatic Ecology; bathymetry of the Baltic Sea with 20m step; shading in Marine protected areas.

Integral sediment load transport dynamics in Daugavgriva in July 2024



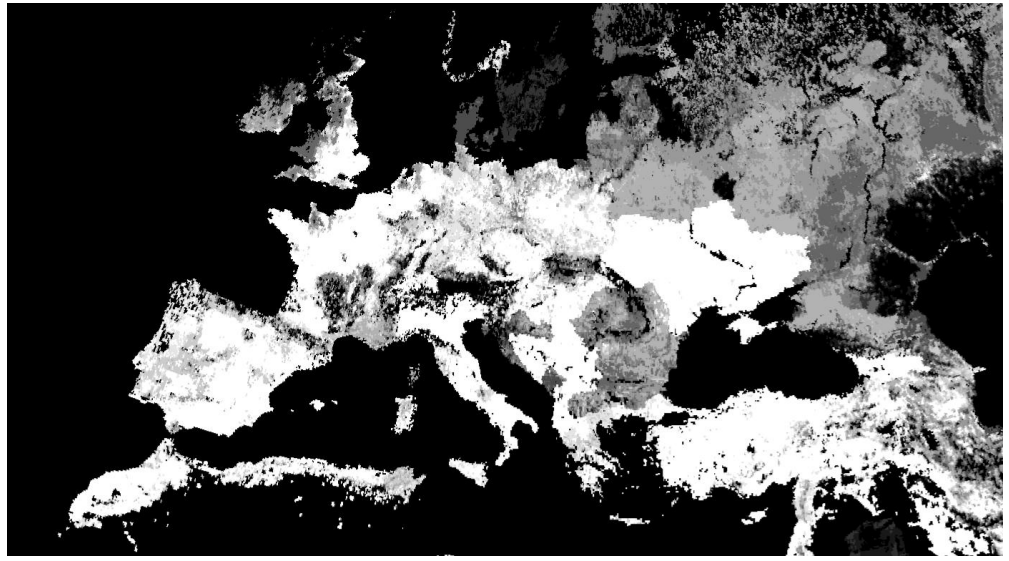
Integral longshore sediment load transport since 1st of July 2024 in Hywasport system in **Daugavgrīva, Riga city.** Dashed line – climatic average, solid line – current year. Arrow – outline the extreme weather condition impact in July 29th 2024.

Qs- and Qs+ denote the integral sediment load transport since 1st of July in leftward and rightward direction along the coast.

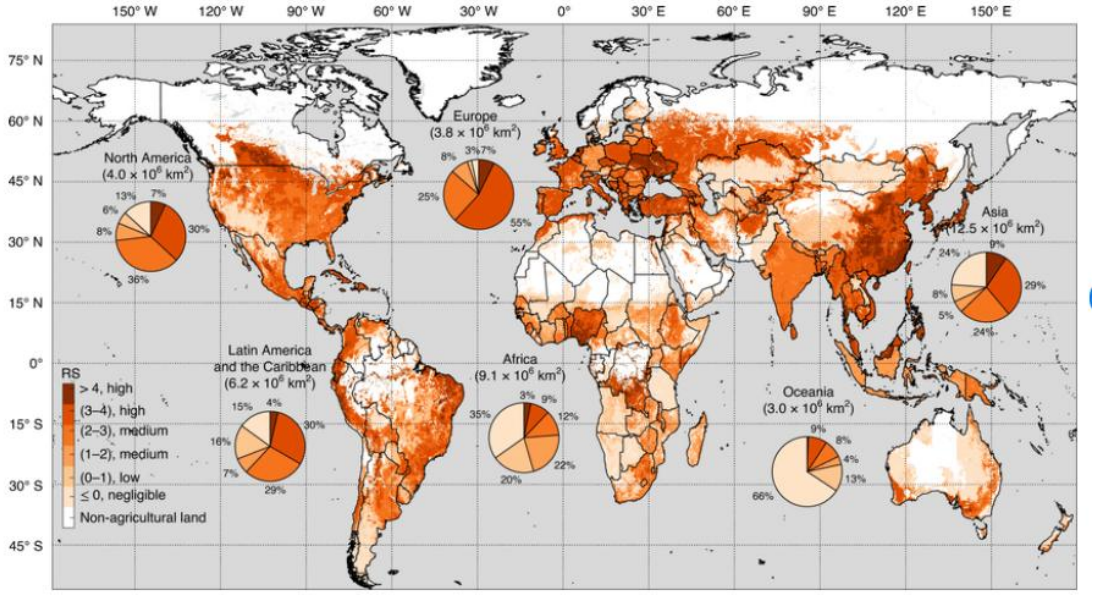
It had been the most important sediment disturbing event in the recent year.

Sediment load transport had been taking place leftwards – in negative direction dominantly during the event.

Global pesticide contamination acording to modeled data



Global active ingredients count. Black-white scale (0-21).



TANG, Fiona HM, et al. Risk of pesticide pollution at the global scale. *Nature geoscience*, 2021, 14.4: 206-210.
Global pesticide pollution risk data sets. figshare. Dataset. https://doi.org/10.6084/m9.figshare.10302218.v1

There have not been medium and high risks and concerns regarding the pesticides acquired in Baltics until recently.

POCIS (polar organic chemical integrative sampler) experiment

Received: packed in foil.
Storage: frozen before and after the experiment.
Quality control: 1 POCIS used as field blank – exposed to the air in the sampling sites without immersion in water.
Deployment: 0.5 or 4 m deep for 10 days in Sept./Oct. 2024.

Additional requirements:

- POCIS fully immersed in water during the experiment.
- Intense pollution – oil spot on the water etc. must be avoided since high sensitivity.

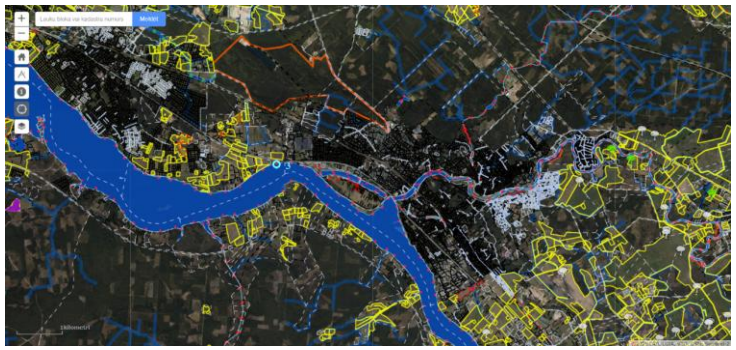
POCIS experiment in autumn 2024 – POCIS disk after retrieval (left), retrieval in site ID4 (right).

Analysis: by CENAKVA/Czech republic in May 2025
Results: detected list of pesticides above the limit of quantification expressed in **ng/POCIS** from the 157 chemicals including 60 pesticides in total; (background information for identical analysis done for the field blank and instruments).

Sampling sites & agricultural activity

Lake Engure and Berzciems

Daugava and Bullupe in Riga city

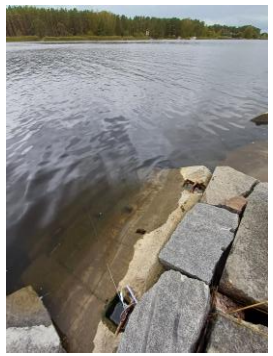


Daugava in Ogre Municipality

Agricultural activity (yellow polygons), nature protection status (red polygons), organic crops (violet shading)
Source: The map of field blocks Rural support service Republics of Latvia http://karte.lad.gov.lv/.

Organic farming takes place in 18 % of the farmland in Latvia (2023).

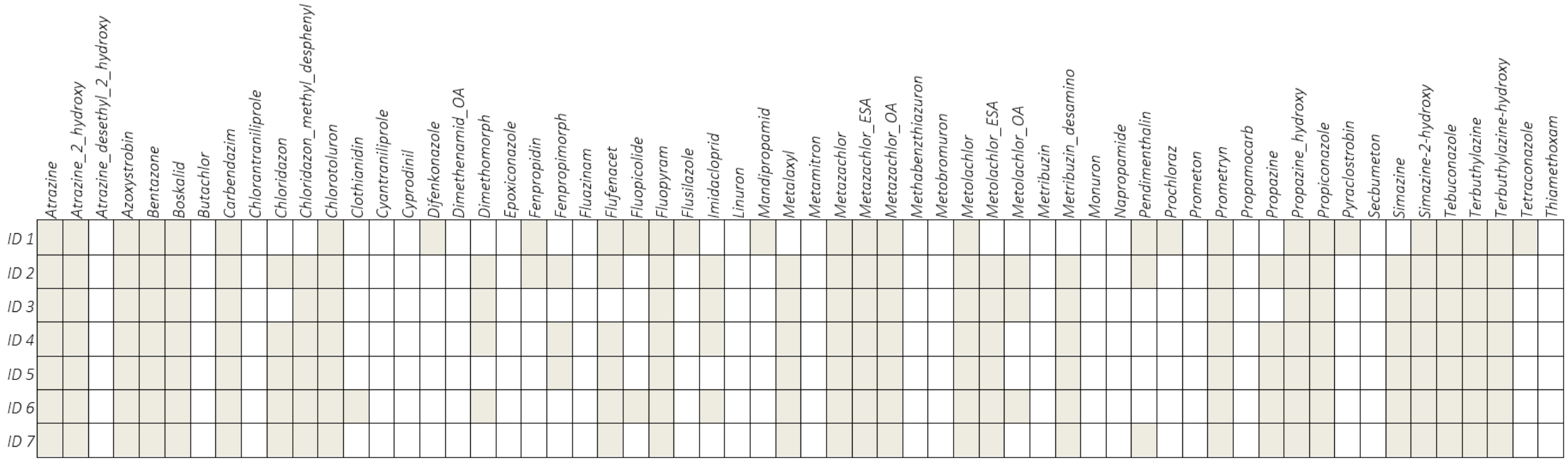
There had been almost no organic field blocks in the vicinity of the sampling sites.



POCIS experiment sites in autumn 2024.

***ID and sampling depth*:**
Lake Engures (ID1, 0.5m); Daugava in Voleri near LHEI (ID2, 0.5m and ID5, 4m); Elksni near Ogre city (ID3, 0.5m); Winter port (ID4, 4m); Bullupe near P.Jaunzems Stone sculpture park (ID6, 4m), GoR waterside in Berzciems (ID7, 0.5m).

Pesticide detected (shaded), not detected (white)

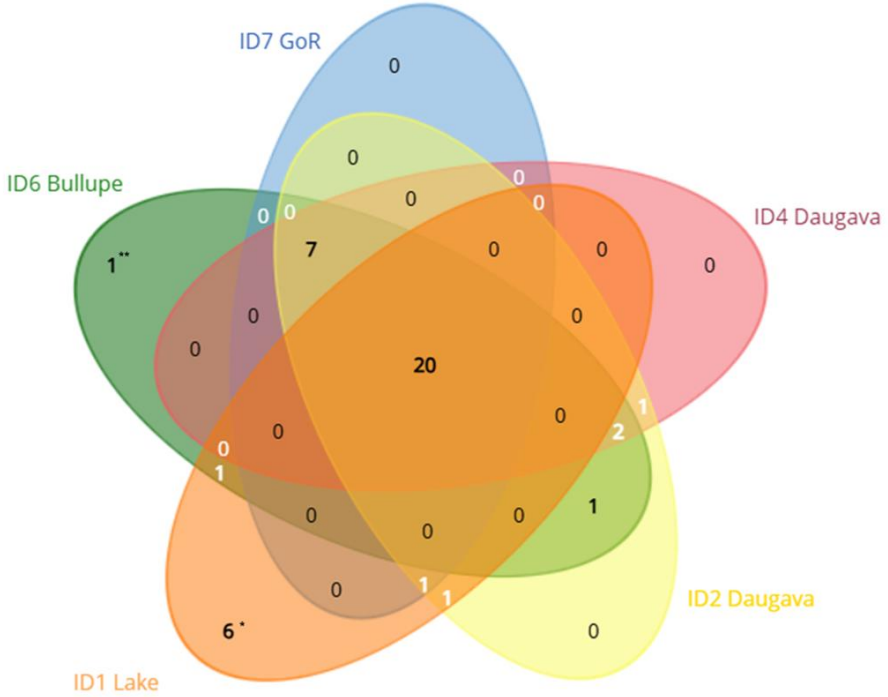


Experiment results for the Gulf of Riga waterside in Berzciems do not provide any unique pesticides among 60 tested that have not been detected in Daugava, Bullupe or Engures ezers.

The highest obtained value – 130 ng/POCIS for propiconazole in ID2.

Broadly detected pesticides that are not currently in use - carbendazim, chloridazon, chlothianidin, fenpropimoph etc. show longterm contamination pattern.

Similarity between the sampling sites



Number of pesticides detected in sites ID1, 2, 4, 6, 7.
*Lake Engure: difenkonazole, flusilazole, mandipropamid, prochloraz, pyraclostrobin, tetraconazole. **Bullupe – chlotianidin.
Visualisation https://biotools.fr/misc/venny.

High similarity in the lists of detected pesticides between the measured sites.

The pesticides detected in GoR waterside in Berzciems (ID7) are the same detected in inland surface water sampling sites ID-ID6 in Daugava, Bullupe or Engures ezers.

Pesticide contamination of the field blank

5 pesticides – metazachlor, metolachlor, propiconazole, simazine-2-hydroxy, terbuthylazine (out of 60 in total tested) had been detected above the quantification limit in the field blank – POCIS that had been exposed to the air in the test site during deployment and retrieval but not immersed in the water.

[ng/POCIS]	Blank field	ID 1	ID 2	ID 3	ID 4	ID 5	ID 6	ID 7
Metazachlor	0.26	2.2	3.3	2	1.1	1.1	4.3	0.82
Metolachlor	0.39	0.67	3.3	2.5	1.2	0.58	0.47	0.36
Propiconazole	0.34	7.1	130	1.2	15	9.6	0.54	1.8
Simazine-2-hydroxy	6.7	17	31	19	15	5.4	15	9.4
Terbuthylazine	0.39	0.68	5.7	4.1	1.5	1.3	1.2	1

Correlation coefficient between the pairs of pesticides detected

	Atrazine	Atrazine_2_hydroxy	Azoxystrobin	Bentazone	Boskalid	Carbendazim	Chlorotoluron	Fluopyram	Metazachlor	Metazachlor_ESA	Metazachlor_OA	Metolachlor	Prometryn	Propazine_hydroxy	Propiconazole	Simazine-2-hydroxy	Tebuconazole	Terbuthylazine	Terbuthylazine-hydroxy
Atrazine		0.92	0.53	0.00	0.25	0.71	0.83	-0.01	0.07	0.34	0.24	0.32	0.50	0.51	0.62	0.33	0.59	0.42	0.70
Atrazine_2_hydroxy	0.92		0.66	0.36	0.52	0.79	0.88	0.30	0.42	0.58	0.49	0.35	0.62	0.72	0.64	0.42	0.73	0.48	0.81
Azoxystrobin	0.53	0.66		0.23	0.81	0.92	0.60	0.31	0.56	0.17	0.04	0.88	0.94	0.88	0.91	0.89	0.95	0.91	0.88
Bentazone	0.00	0.36	0.23		0.60	0.18	0.17	0.79	0.82	0.81	0.87	-0.05	0.22	0.52	-0.08	0.10	0.33	0.04	0.24
Boskalid	0.25	0.52	0.81	0.60		0.64	0.55	0.80	0.91	0.56	0.44	0.53	0.65	0.72	0.67	0.79	0.90	0.55	0.58
Carbendazim	0.71	0.79	0.92	0.18	0.64		0.62	0.20	0.45	0.21	0.06	0.84	0.95	0.91	0.83	0.82	0.86	0.90	0.98
Chlorotoluron	0.83	0.88	0.60	0.17	0.55	0.62		0.33	0.38	0.52	0.39	0.22	0.42	0.46	0.75	0.40	0.74	0.32	0.60
Fluopyram	-0.01	0.30	0.31	0.79	0.80	0.20	0.33		0.93	0.83	0.75	-0.02	0.17	0.38	0.15	0.40	0.51	0.01	0.15
Metazachlor	0.07	0.42	0.56	0.82	0.91	0.45	0.38	0.93		0.73	0.65	0.27	0.47	0.65	0.35	0.57	0.67	0.32	0.43
Metazachlor_ESA	0.34	0.58	0.17	0.81	0.56	0.21	0.52	0.83	0.73		0.96	-0.24	0.07	0.35	0.04	0.10	0.39	-0.15	0.21
Metazachlor_OA	0.24	0.49	0.04	0.87	0.44	0.06	0.39	0.75	0.65	0.96		-0.35	-0.04	0.28	-0.13	-0.09	0.25	-0.25	0.10
Metolachlor	0.32	0.35	0.88	-0.05	0.53	0.84	0.22	-0.02	0.27	-0.24	-0.35		0.93	0.77	0.76	0.85	0.71	0.98	0.80
Prometryn	0.50	0.62	0.94	0.22	0.65	0.95	0.42	0.17	0.47	0.07	-0.04	0.93		0.94	0.77	0.83	0.81	0.98	0.95
Propazine_hydroxy	0.51	0.72	0.88	0.52	0.72	0.91	0.46	0.38	0.65	0.35	0.28	0.77	0.94		0.64	0.72	0.81	0.85	0.94
Propiconazole	0.62	0.64	0.91	-0.08	0.67	0.83	0.75	0.15	0.35	0.04	-0.13	0.76	0.77	0.64		0.80	0.89	0.78	0.77
Simazine-2-hydroxy	0.33	0.42	0.89	0.10	0.79	0.82	0.40	0.40	0.57	0.10	-0.09	0.85	0.83	0.72	0.80		0.86	0.82	0.71
Tebuconazole	0.59	0.73	0.95	0.33	0.90	0.86	0.74	0.51	0.67	0.39	0.25	0.71	0.81	0.81	0.89	0.86		0.74	0.80
Terbuthylazine	0.42	0.48	0.91	0.04	0.55	0.90	0.32	0.01	0.32	-0.15	-0.25	0.98	0.98	0.85	0.78	0.82	0.74		0.89
Terbuthylazine-hydroxy	0.70	0.81	0.88	0.24	0.58	0.98	0.60	0.15	0.43	0.21	0.10	0.80	0.95	0.94	0.77	0.71	0.80	0.89	

Pairs of the pesticides with correlation coefficients>0.9 between measured values in all 7 sites found.

Comparison the sites detected amounts

The maximal amounts among all sites acquired for:
• **18** pesticides in Daugava river delta in Voleri, 0.5 m (ID 2) Atrazine, Atrazine_2_hydroxy, Azoxystrobin, Boskalid, Carbendazim, Chlorotoluron, Fenpropimorph, Metolachlor, Metolachlor_ESA, Pendimenthalin, Prometryn, Propazine_hydroxy, Propiconazole, Terbuthylazine-hydroxy; Simazine, Simazine-2-hydroxy, Tebuconazole, Terbuthylazine.

- **9** pesticides in Bullupe, 4 m (ID 6) Bentazone, Chloridazon, Chloridazon_methyl_desphenyl, Clothianidin, Fluopicolide, Fluopyram, Metazachlor, Metazachlor_ESA, Metazachlor_OA.
- **8** pesticides in Lake Engures, 0.5 m (ID 1) Difenkonazole, Fenpropidin, Flufenacet, Flusilazole, Mandipropamid, Prochloraz, Pyraclostrobin, Tetraconazole.
- **5** pesticides in Daugava donwstream Ogre city, 0.5 m (ID 3) Dimethomorph, Imidacloprid, Metalaxyl, Metolachlor_OA, Metribuzin_desamino.
- **1** pesticide in Daugava river delta, Winter port, 4 m (ID 4) Propazine.

Pesticides below the limit of quantification in all sampling sites

Petsicide	Information on usage [1]*
Atrazine_desethyl_2_hydroxy	
Butachlor	
Chlorantraniliprole	reported in use since 2021
Cyantraniliprole	reported in use since 2023
Cyprodinil	
Dimethenamid_OA	
Epoxiconazole	reported in use 2011-2020
Fluazinam	reported in use 2011-2023
Linuron	reported in use until 2017
Metamitron	reported in use 2011-2023
Methabenzthiazuron	
Metobromuron	reported in use 2019-2020
Metribuzin	reported in use 2011-2023
Monuron	
Napropamide	reported in use 2011-2023
Prometon	
Propamocarb	reported in use 2011-2022
Secbumeton	
Thiamethoxam	reported in use 2011-2019

*[1] State Plant Protection Service of the Republic of Latvia (2025). *Report on plant protection products usage in Latvia 2011-2023 Latvijas teritorijā izplatīto AAL darbīgo vielu apjomi* https://www.vaad.gov.lv/lv/augu-aizsardzibas-lidzeklu-statistika.

Discussion

Regarding **ecosystem – farmland interaction**…keeping in mind the pesticide sources (and opportunities in reduction in its use) in urban areas also exist

- herbicides used/not used for weed control in public and private space;
- wood preservation and building industry – fungicides used/not used.

Acknowledgements

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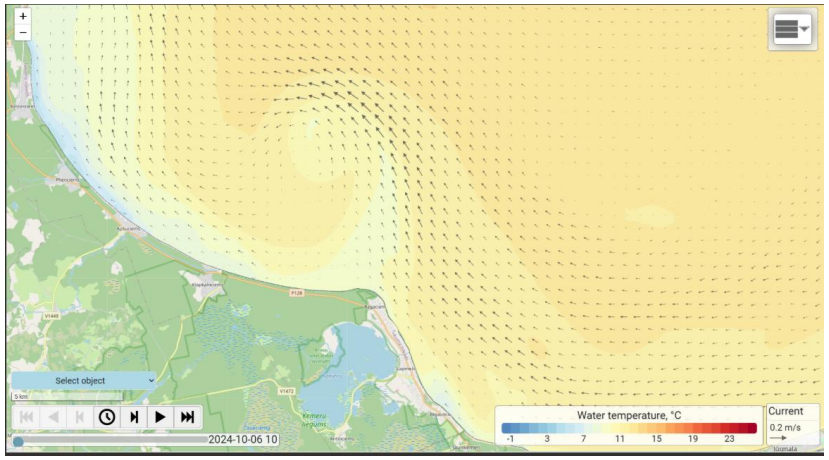

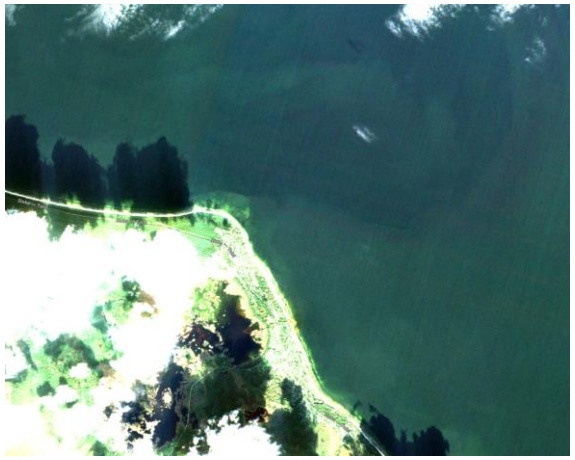

The results of the POCIS experiment or its part can be cited with the reference to its funding sources.

Thank you for your attention!

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