Events

Nutrients, aquatic methane emissions and climate change: 22-27 June 2021

ASLO (Association for the Sciences of Limnology and Oceanography) Special Session (SS06) on **Methane Accumulation in Oxic Aquatic Environments:** Sources, Sinks and Subsequent Fluxes to The Atmosphere. Within the 2021 Aquatic Sciences Meeting (online, 22-27 June 2021). In partnership with the Leibniz Institute of Freshwater Ecology and Inland Fisheries (IGB) and ASLO, ESPP and SPA will follow-up with a webinar to exchange between science, water stakeholders and policy makers on implications of aquatic methane emissions for nutrient management. Proposals for input are welcome.

ASLO special session on methane in oxic aquatic environments: https://www.aslo.org/2021-virtual-meeting/session-list/
Contact Mina Bizic mbizic@igb-berlin.de
To contribute to the ESPP- SPA- IGB webinar: contact info@phosphorusplatform.eu

Future of Phosphorus Removal in Wastewater 2021

7th July 2021, 10h30 - 16h30 CEST. Online conference will look at current status and future developments in phosphorus removal from wastewater, P-stewardship and P-recovery. Speakers include the UK Environment Agency, Isle Utilities, The Rivers Trust, several UK water companies, ESPP.

https://event.wwtonline.co.uk/phosphorus/

Policy

EU Zero Pollution Action Plan published

The European Commission has published its Zero Pollution Action Plan, part of the Green Deal, including proposed actions on nutrient loss reduction, nutrient recycling, sewage reuse, ammonia emissions as well as putting a price to pollution, actioning the polluter-pays principle and incentives for alternatives. The Plan is presented as a "*compass for including pollution prevention in all relevant EU policies*". The Zero Pollution Hierarchy is emphasised: 1) prevent pollution by clean-by-design production and the circular economy, 2) minimise releases and exposure, 3) eliminate and remediate. An emphasis is placed on stricter implementation and enforcement.

The Zero Pollution Targets for 2030 include reducing nutrient losses by 50% (specifying as compared to 2012-2015), as already set in both the Farm-to-Fork and Biodiversity Strategies (see SCOPE Newsletter n°131).

The Plan states that this will be achieved by "*implementing and enforcing the relevant environmental and climate legislation in full, identifying with Member States the nutrient load reductions needed to achieve these goals, applying balanced fertilisation and sustainable nutrient management, stimulating the markets for recovered nutrients and by managing nitrogen and phosphorus better throughout their lifecycle*". It will be promoted by the Mission ' Soil Health and Food', and the agricultural European Innovation Partnership (EIP AGRI). The Mission 'Healthy oceans, seas, coastal and inland waters' will also address nutrients.

In order to make livestock farming more sustainable, the Commission will "*facilitate the placing on the market of alternative feed materials and innovative feed additives*".

The need to further reduce ammonia emissions will be assessed, in particular from intensive livestock, possibly by actions under the Common Agricultural Policy or by "*making manure handling blinding*"

The already engaged reviews of the Urban Waste Water Treatment and Sewage Sludge Directives will "*increase the ambition level to remove nutrients from wastewater and make treated water and sludge ready for reuse, supporting more circular, less polluting farming. It will also address emerging pollutants such as microplastics and micropollutants, including pharmaceuticals*".

The announced Integrated Nutrient Management Action Plan (consultation expected later in 2021 see www.phosphorusplatform.eu/regulatory) will maximise synergies between policies and use "*the green architecture of the new common agricultural policy, especially via conditionality and eco-schemes*".

The annexed list of actions includes, for 2023, to "*Compile and make accessible in a digital format all main obligations on nutrient management stemming from EU law to limit the environmental footprint of farming activities*".

European Commission "Pathway to a Healthy Planet for All. EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil", SWD(2021)140 - SWD(2021)141, 12th May 2021 https://ec.europa.eu/environment/strategy/zero-pollution-action-plan_fr

Amended EU Standards Mandate for fertilising products

Proposed amendments to the mandate to CEN for standards to support the new EU Fertilising Products Regulation include different standards to determine P solubility in inorganic fertilisers, and composition and contaminants in STRUBIAS materials. Standards to assess total P_2O_5 content, water soluble, NAC, formic acid and citrate soluble P_2O_5+ are requested for inorganic, organic and organo-mineral fertilisers. Standards to assess dry matter and contents of organic carbon, P_2O_5, iron, aluminium and several contaminants and pathogens are requested for Precipitated Phosphate Salts or their Derivates, standards for various contaminants (inc. PAH_{16}, $PCDD/F_{-equiv}$ are requested for ashes/ash derived products and for biochars, as well as H/C_{-org} for biochars.

Document for consultation https://ec.europa.eu/docsroom/documents/45687 (Draft amendment to Commission Implementing Decision C(2020) 612 final of 10.2.2020 on a standardisation request to the European Committee for Standardisation as regards the EU fertilising products in support of Regulation (EU) 2019/1009). Comments by 16/6/2021 to GROW-FERTILISING-PRODUCTS@ec.europa.eu

EU sewage and sludge Directives update process

A European Commission stakeholder workshop emphasised the need to address contaminants in sewage sludge (especially pharmaceuticals, microplastics, heavy metals and PFAS/PFOS) and showed support for regulatory mechanisms to support phosphorus recycling (blending obligation or % recycling requirement). The Urban Waste Water Treatment Directive (UWWTD) was evaluated in 2018, concluding "fit for purpose" but possibilities for improvements. The Sewage Sludge Directive (SSD) is currently undergoing evaluation. DG ENVI highlighted that the SSD is part of the Green Deal agenda, with objectives of climate neutrality, zero pollution and circular economy, and is cited in the EU Methane Strategy. A 2014 evaluation of the SSD concluded that it is "fit for purpose". An aim of the current evaluation is to strengthen regulation of pollutants in sewage sludge. Two EU JRC projects were presented: modelling impacts of micropollutants in sewage sludge, assessing climate emissions impacts of UWWTD and SSD policies. Studies presented suggested that micropollutants present in sewage sludge may not pose adverse risk to soil, but that long term sludge use in agriculture led to levels of PFAS which could impact earthworms. The lack of information on microplastics was noted. The importance of source control, reducing or preventing input of contaminants into sewage where possible, was emphasised. Phosphorus and nitrogen recovery from sewage were discussed, with much stakeholder support expressed for phosphorus recycling policies such as a blending obligation (including a certain level of recycled P in fertilisers) or a % P-recycling requirement.

Trinomics, for European Commission DG Environment "Evaluation of the Sewage Sludge Directive 86/278/EEC" http://trinomics.eu/project/6515-sewage-sludge-directive-86-278-eec/

EU consultation on Urban Wastewater Treatment Directive (UWWT)

Open to 21 July 2021. This is a general public questionnaire, plus additional questions for experts and operators – you do not have to answer all questions. Questions ask what should be priorities for action (nutrients are one of seven proposed priorities), how to improve protection of nutrient "Sensitive Areas", addressing micropollutants, circularity (proposals include recovery obligations for phosphorus and other materials).

"Water pollution – EU rules on urban wastewater treatment", EU public consultation open to 21 July 2021.

EU consultation on Algae Sector

Open to 11 August 2021. Environmental footprint of algae and environmental benefits of algae products are addressed, as are impact on CO2, nutrients capture and bioremediation. The use of algae for waste treatment (e.g. nutrient removal from wastewater, CO_2 or NO_x abatement), and regulatory questions around such waste-fed algae (e.g. End-of-Waste) are not addressed, but can be added in the comments boxes.

"Public consultation on the EU Algae initiative", EU public consultation open 11 August 2021.

EU policies could reduce phosphorus losses by 20%

A modelling study concludes that ambitious but technically feasible policy actions on municipal waste water treatment and on agricultural fertilisation could reduce total EU nitrogen and phosphorus losses to surface waters by -14% and -20% respectively. The study was led by the European Commission's Joint Research Centre. This ambitious but technically feasible scenario (MTFR = High Technically Feasible Reduction) considers that all municipal sewage works are upgraded to the highest nutrient removal level (tertiary treatment with "enhanced" phosphorus removal) and agricultural fertilisation is set to limit nitrogen surplus to 10% of N in output, and P is reduced correspondingly. The study concludes that this would "only slightly" increase proportion of surface waters in good ecological status (as defined by the Water Framework Directive). The study notes that the resulting differential reductions in N and P losses could worsen nutrient unbalances in coastal waters. ESPP considers that the study shows that technically feasible actions on sewage treatment and agricultural fertilisation can significantly reduce nutrient losses, but that this reduction is much less than the -50% nutrient loss reduction target fixed by the EU Farm-to-Fork strategy (see SCOPE Newsletter n°139) and that a combination of other measures not assessed in this study will be needed for higher nutrient loss reductions and to achieve Water Framework Directive ecological quality objectives, for example: phosphorus traps and buffer strips in fields, morphological restauration of rivers, recreation of wetlands, treatment of discharges from small settlements and isolated households, treatment of stormwaters …

"How EU policies could reduce nutrient pollution in European inland and coastal waters?", B. Grizzetti et al., Global Environmental Change Volume 69, July 2021, 102281 DOI.

Industry and technology

Ragn-Sells and Kemira join forces in phosphorus recycling from sewage sludge

Kemira and Ragn-Sells' daughter company EasyMining (both ESPP members) have announced a collaboration to recover phosphorus from sewage sludge at Kemira's industrial site in Helsingborg. This means that EasyMining takes the next step and continues with the plans to build a plant for phosphorus recycling from 30,000 t/y of sewage sludge incineration ash to be operational in 2025. The patented Ash2Phos technology from EasyMining attacks the ash with hydrochloric acid, then uses purification processes to separate out a high-grade calcium phosphate which can technically be used in fertiliser production, animal feed (see ESPP eNews n°52), or the chemicals industry, recovering more than 90% of the phosphorus contained in the ash. The process can also recover iron and aluminium present in the ash separately for e.g. recycling by Kemira as a coagulant for chemical P-removal in sewage works. The new plant will create 30 jobs within Kemira's Helsingborg industrial park, South West Sweden. Sewage sludge ash is expected to come from Sweden but also to be imported via the site's maritime access. The project has been granted 5 M€ from Sweden's climate fund (Klimatklivet).

"Ragn-Sells and Kemira jointly engage in phosphorus recycling from sewage sludge" - Kemira and Ragn-Sells Newsroom

Nitrate and other nutrient recycling from drinking water to fertigation

Agua DB has demonstrated a process to recover nitrate from drinking water nitrate removal, and recycle with K, S, Ca and Mg to local agriculture via fertigation. Ion-exchange is today widely used to remove nitrates from drinking water, but uses salt for regeneration. This generates a phytotoxic sodium nitrate brine, which has to be disposed, often via expensive truck transport. The Agua DB process uses water quality potash (KCl) for regeneration, instead of salt, in significantly lower quantities, so generating liquors rich in sulphate, nitrate and potassium, which can be used for fertigation in local agriculture. These can partially replace synthetic fertilisers and reduce use of potash by farmers, so reducing salination (Cl input) to farmland. A three months pilot project with Affinity Water (a UK drinking water company supplying 3.6 million people), showed effective nitrate removal down to 5 mgN/l. Red Russian Kale was grown hydroponically with the fertigation liquor providing 60% of the required nutrients, showing performance comparable to synthetic nutrients and good nutrient density in the crop. Fertigation and application of N to soil as nitrate is suggested to have agronomic benefits including improved yields with reduced fertiliser application and run-off, more efficient use of water and the potential to link irrigation water storage schemes into flood mitigation measures. The technology could also be adapted for tertiary N-removal from sewage works and can be used in industry or desalination plants.

See presentation by Mike Waite at the AquaEnviro conference "The Art of the Possible: Resource Recovery from Wastewater and Bioresources", May 18th 2021 and presentation here from 38 minutes.

Research

"Legacy P" and field slope

A study of an 8 ha field in SW Ontario, Canada, under maize – soy – alfalfa rotation shows that phosphorus accumulates over time in the lower parts of the field ("toe-slope" and "foot"). Soil was sampled once, in October (after harvest) at 50 sites, 10 in each of the slope classification areas (toe, foot, back, shoulder, summit). Toe and foot zones made up nearly 60% of the field area. Elevation of the field varied by about 4 m between the lowest point and the highest summit with slopes up to 15%. Results show topsoil thickness 40 - 50 % greater in foot and toe zones than in back, shoulder and summit, and mean organic carbon stock also 30 – 80 % higher. Soil Olsen-P stock showed even more pronounced accumulation in the lower parts of the field, at around 50 kg-OlsenP/ha in toe and foot zones, compared to around 20 kg/ha in summit zones. The authors conclude that soil erosion over time moves legacy P to the lower zones of the field, along with top soil, smaller soil particles and organic carbon. The study does not provide any indication as to how this local accumulation of P within the field might impact P losses to surface water.

"Spatial decoupling of legacy phosphorus in cropland: Soil erosion and deposition as a mechanism for storage", A. VandenBygaart et al., Soil & Tillage Research 211 (2021) 105050 DOI.

Poland: climate change will impede water quality objectives

A study of 18 surface water bodies in Upper Sileasia, Southern Poland, climate change will both increase nutrient losses from soils and accentuate the impact on water quality of P and N loads because of longer low-flow periods. Upper Silesia is an urbanised (4 million population) and industrialised region, with many coal mines pumping mine water into rivers. Nutrient removal is already largely installed in sewage works, and mine discharge water is expected to be reduced in the future, which will result is less dilution of nutrients. Nutrient loss from farmland was estimated as 20% of P and 50% of N in manure (based on livestock numbers) and 20% of and 88% of N applied in mineral fertilisers. Estimates of current nutrient load to the water bodies suggest that reductions of up to 90% for both P and N are needed to achieve water quality objectives, with most P and N inputs coming from agriculture in the majority of the catchments. The authors conclude that climate change will worsen nutrient-related water quality problems, by increasing agricultural losses because of extreme precipitation events and longer low-flow periods (reduced dilution). The level of nutrient removal in sewage works will not be significantly further improved, so that other measures will be necessary, targeting agriculture, treatment of fish pond discharge, landscaping and water management (which could include use of mine water to increase flows during low-flow periods).

"Impacts of nitrogen and phosphorus loads from various sources on the quality of surface water bodies in the context of climate change – case study in Poland", A. Hamerla & B. Konczak, APP Ecology and Env Res 19(2) 1033-1048, 2021 DOI

UNESCO report on Harmful Algal Blooms (HABs)

A first-ever UN report shows that nearly 10 000 ocean Harmful Algal Blooms were recorded worldwide over 33 years, and that impacts are increasing with rising seafood demand and coastal development. 109 scientists from 35 countries analysed over 9 500 HAB events including 7 million microalgae data points, of which nearly 290 000 toxic algae species occurrences, using the Harmful Algal Event Database (HAEDAT). The widely suggested idea that blooms are increasing with climate change is not confirmed, with blooms increasing in some areas of the world and decreasing or steady in others. Increases in reported HAB events are correlated to increased monitoring and increases in perception are probably related to increased aquacultural production and coastal development. Both Europe and the Mediterranean regions show an increase trend in reported HAB events over the study period (from 1985 to 2018), but possibly with an apparent peak around the year 2000 and after that a decrease in HAB events in the Mediterranean region and fluctuations without a clear increase in Europe (see Hallegraeff et al. Fig. 3 p. 5). A large proportion of the societal impact of blooms was resulting closure of shellfish harvesting, with only rare cases of human poisoning. Economic losses caused by HABs to aquaculture are considerable, whereas in the open ocean wild fish can simply swim away from HABs. The number of recorded HABs over time was strongly correlated with intensification of aquaculture, but this is probably largely due to more intense monitoring. Data on nutrient pollution is considered inadequate to reach conclusions as what extent aquaculture contributes to causing HABs.

Report published by UNESCO (United Nations) and the Intergovernmental Panel on Harmful Algal Blooms (IOC-IPHAB, part of UNESCO's Intergovernmental Oceanographic Commission), 8 June 2021 http://hab.ioc-unesco.org/index.php
Harmful Agal Bloom Information Portal: https://data.hais.ioc-unesco.org/
"Perceived global increase in algal blooms is attributable to intensified monitoring and emerging bloom impacts", G. Hallegraeff et al., Nature Communications Earth & Environment (2021) 2:117 https://doi.org/10.1038/s43247-021-00178-8

Aquatic methane emissions cost society 0.2 – 2.3 trillion US$/year globally

Methane emissions are estimated to represent c. 20% of greenhouse impact of fossil fuels and ¾ of climate change impact of lakes and reservoirs, and are increased by eutrophication (see SCOPE Newsletter n°137). Increasing eutrophication globally could increase lake and reservoir methane emissions to 38 – 58 % of current fossil fuel greenhouse impact by 2100. Societal costs of lake and reservoir methane emissions are estimated at 7 – 80 trillion US$ (total for the years 2015 – 2050), using US Government Interagency Working Group methodology. This does not include methane emissions from rivers, coastal waters and oceans, nor does it include other aquatic greenhouse gas emissions (CO_2, N_2O). The methodology was applied to Lake Erie, North America, to compare estimated societal costs of eutrophication impacts on leisure fishing or on beach closures (due to harmful algae blooms). The conclusion is that societal costs of eutrophication-driven methane emissions are an order of magnitude higher than either of these local societal costs, and also higher than the estimated cost of reducing nutrient inputs to the lake by 40% by changing agricultural practices. The study notes that are not here considered other local societal costs of eutrophication, in particular loss to property value and possible health risks from toxic algae blooms, but that the climate costs of methane emissions are nonetheless a very significant societal cost of eutrophication.

"Protecting local water quality has global benefits", J. Downing et al., Nature Communications (2021), 12:2709, DOI.
*NOTE: **ASLO Special Session (SS06) on Methane Accumulation in Oxic Aquatic Environments,** part of the ASLO 2021 Aquatic Sciences Meeting 22-27 June 2021 online - Website*

Economic policy instruments for P sustainability

A research paper suggests that fossil fuel and livestock cap-and-trade tools, combined with a livestock / land area ratio cap, would largely ensure sustainable phosphorus use. It is suggested that resulting energy price increases would reduce P fertiliser use, despite recognising that P-fertiliser production can have negative energy consumption, because of energy used to transport and spread fertilisers. It is not however considered that transport and application of organic and recycled fertilisers may use more energy (higher bulk, decentralised logistics). Cap-and-trade of livestock products would increase price and reduce consumption, so reducing need for P-fertiliser to produce animal feeds, including imported animal feed crops. These two tools would not however address regional livestock concentration, which results in regional nutrient excesses, and geographical distribution obstacles to recycling of manure nutrients. Limiting livestock numbers per land area would avoid regional livestock concentrations and could also be used to limit total national or EU livestock production. The paper also considers limiting total P-fertiliser consumption, e.g. by a certificate trading system for mineral P fertilisers placed on the EU market.

"Economic policy instruments for sustainable phosphorus management: taking into account climate and biodiversity targets", B. Garske & F. Ekardt, Environ Sci Eur (2021) 33-56 DOI.

English Channel: Atmospheric P deposition not biologically significant

A study at a site on in the UK concludes that atmospheric phosphorus deposition to coastal water in the region is "unlikely to be biologically significant". Aerosol-derived P deposition at the study site, on Cornwall coast, South UK, between the North Atlantic and the English Channel, was estimated at 0.16 – 1.6 µ-moles-P/m^2/day, estimated to be consistently below 0.1% of water P standing stock. Atmospheric nitrogen deposition, on the other hand, was estimated to be significant, at 3 – 620 µ-moles-N/m^2/day, contributing up to 20% of water DIN (dissolved inorganic nitrogen) in Spring, when water DIN levels are depleted by biological uptake. The atmospheric nitrogen input is estimated to contribute to up to 22% of primary algal growth at times in Spring. The study is based on aerosol samples collected at Penlee Point Atmospheric Observatory over six months, February to July 2015, corresponding to spring algal growth.

"Inorganic nitrogen and phosphorus in Western European aerosol and the significance of dry deposition flux into stratified shelf waters", C. White et al., Atmospheric Environment, in print 2021, DOI.

Biochar improves soil P availability but only in some soils

A meta-analysis of published data suggests that biochar application improves soil P availability and on plant P uptake respectively +65% and +55% on average. This is not input of P in the biochar but an impact of the biochar on the soil – crop system. The study identified 516 data pairs (from 86 studies) comparing soil P availability or crop P uptake with or without biochar application. P availability data was mostly from laboratory soil incubation tests (175 data points) and pot trials (157) with also 106 field trials, whereas crop P uptake data was mostly from field trials (80) versus 72 pot trials. The most frequently tested biochars were from crop residue and wood (total 321 P availability data points), that is biochars which would contain relatively low levels of phosphorus, versus 98 for manure biochar and only 7 for sewage sludge biochar. The mean effects of biochar on soil P availability and on plant P uptake were respectively +65% and +55%, that is higher than biochar effects on N or C reported elsewhere from biochar application. However, the data suggested that biochar showed considerably greater effects on P availability and uptake in very low phosphorus soils, acid soils (pH < 5) and in heavy textured soils. Also, effects were greater for biochars pyrolysed below 300°C. ESPP note: this temperature limit poses questions in that other studies suggest that temperatures >400°C may be necessary to remove organic pollutants and antibiotic resistance genes in pyrolysis (see ESPP eNews n°s 52 and 54)

"Could biochar amendment be a tool to improve soil availability and plant uptake of phosphorus? A meta-analysis of published experiments", F. Tesfaye et al., Environmental Science and Pollution Research 2021 DOI.

Stay informed

SCOPE newsletter: www.phosphorusplatform.eu/SCOPEnewsletter   eNews newsletter: www.phosphorusplatform.eu/eNewshome
If you do not already receive SCOPE and eNews (same emailing list), subscribe at www.phosphorusplatform.eu/subscribe
LinkedIn: https://www.linkedin.com/company/european-sustainable-phosphorus-platform/   Twitter: @phosphorusfacts
Slideshare presentations: www.slideshare.net/NutrientPlatform

ESPP members