

REFRESH NEWSLETTER



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www.refresh.ucl.ac.uk

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Introducing REFRESH

Greenhouse gas emissions are expected to rise until at least the middle of this century. Climate modelling studies suggest that even if emissions were stabilised at present levels, future climate change is inevitable.

Given the rate and amount of change predicted, we need to know what steps can be taken to minimise the adverse effects of climate (and other) changes on the natural environment over the next 50 years.

REFRESH is concerned with how these changes might affect freshwater ecosystems, what this means for management and, if there are adverse effects, what can be done to counter them?

REFRESH addresses the question

‘How can the way we manage our freshwater ecosystems today be adapted so that the effects of future global changes (climate, land use, pollution and water demand) can be anticipated and incorporated into management strategies to protect our water resources and conserve freshwater biology?’

This is an important question for policy makers, those that implement policy and other water managers.

Our aims

REFRESH has two main goals. The first is to increase our understanding of how freshwater ecosystems will respond to the environmental changes driven by climate, land use, water use and pollution over the next 50–60 years. These changes can affect water bodies (REFRESH focuses on streams, lakes and wetlands) through increases in temperature, shifts in patterns of drought and flooding, increased levels of nutrients from surrounding land and changes in water level due to the demands of irrigation among others. The second goal is to translate this knowledge into a form that can be used by water managers. This can then feed into the design of cost-effective restoration and management programmes that will account for the projected future impacts of, for example, climate and land use change. In doing so, REFRESH will support efforts to achieve and maintain compliance with the Water Framework Directive (WFD) and Habitats Directive (HD) as part of an adaptive management approach. The Project will highlight specific adaptation measures to minimise the impacts of these global changes.

Our methods

A number of approaches are being used to improve our understanding of how freshwater ecosystems respond to changes in the environment brought about by global change (e.g. temperature, changes in flow or water level, nutrient loading). These include lake, river and wetland experiments (see below) and the analysis of existing datasets including wide ranging survey data and long-term time series analysis. We are then using a combination of modelling techniques socio-economic analysis, which brings together existing knowledge

and the new understanding generated in REFRESH, at a number of case study catchments to assess

- i) how freshwater ecosystems will respond to future change and
- ii) how cost-effective a range of management options will be in maintaining compliance with the WFD and HD under these changing conditions.

Throughout the Project we have been engaged in discussion with stakeholders in each of the case study catchments covering key compliance issues, management approaches and future change. This stakeholder engagement is a key element to our work in these areas and ensures a collaborative understanding between scientists, policy makers and water users (see below).

REFRESH has been running for just over three years now and these activities are now generating results that will be of interest to policy makers and water managers. This is the first in a series of newsletters which will summarise these results and other ongoing research.

REFRESH Experiments

REFRESH ran experiments at a number of lake, stream and riparian wetland sites during the first three years of the project. These have now mostly been concluded and the data are being analysed.

Lakes

In REFRESH we ran tank and pond experiments at two sites, one in Denmark and one in the UK. These are to examine the consequences of changes in temperature and nutrient loading (and the interactions between them) for freshwater organisms. The Danish experiment has been running continuously since 2003. The results of these studies, together with other work during, or preceding, REFRESH indicates that temperature increases driven by climate change already have, and will continue to have, substantial effects on trophic structure and dynamics of lake ecosystems and also on lake metabolism. These changes may compromise the effects of nutrient loading reduction programmes currently implemented to restore degraded lakes.

This calls for much stronger measures to fulfil the objectives of the Water Framework Directive (WFD) than necessary under current conditions. It is therefore of key importance that the planned revision of the River Basin Management Plans includes measures that account for the effect of climate change, in particular the consequences of temperature driven increases in nutrient loading.

A report (www.refresh.ucl.ac.uk/webfm_send/1958) synthesising this work is available on the REFRESH web site.

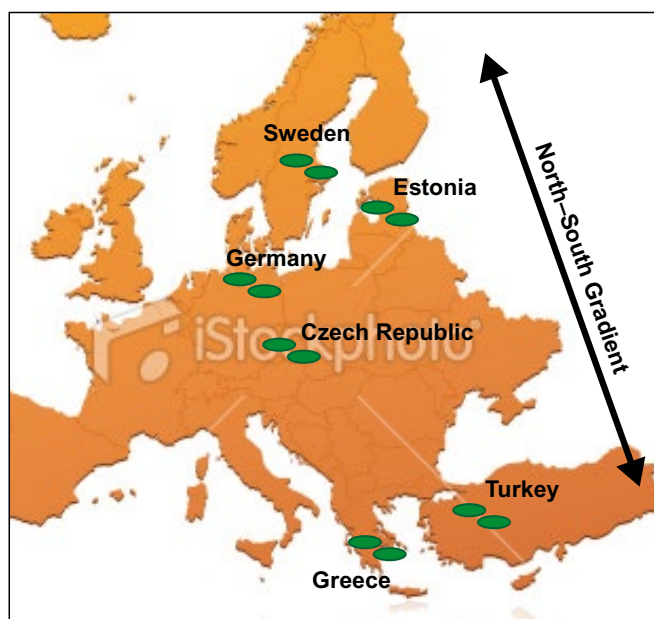


Danish tank mesocosm experiment

A series of lake experiments along a north-south gradient across continental Europe was run to investigate the effects on shallow lake ecology of water level fluctuation accompanied by changes in salinity under high and low nutrient conditions at two different depths.

The experimental design at each site was identical, following precisely a harmonised protocol, to allow comparisons to be made along this climate gradient. The data collected have enormous potential in terms of assessing the effects or climate driven warming and the interactions between this and eutrophication on lake processes and dynamics across Europe.

Results from the analyses of these data will feature in a subsequent edition of the REFRESH newsletter.



Map of REFRESH experimental lake sites



REFRESH in-lake mesocosm experiments – Germany



REFRESH in-lake mesocosm experiments – Czech Republic



REFRESH in-lake mesocosm experiments – Turkey

Stream and riparian wetlands

Field experiments have been conducted at co-located stream and riparian wetland sites along an Atlantic gradient, from Sweden down to Spain.

The work at the stream sites focuses on temperature, drought and nutrient impacts (and combinations of these) on stream ecology. For the riparian wetlands the experiments are designed to look at the impacts of temperature, drought and flooding on how these wetlands function and their biodiversity, together with an assessment of how these impacts interact with nutrient enrichment. At the Spanish site a major flood wiped out the experimental set up. However, this has presented a unique opportunity for REFRESH to monitor recovery at this site and the experiment has been redesigned in order to do this.

Early results from the stream shading experiments demonstrate the importance of wooded buffer strips on ecosystem structure. In addition to providing shading to counteract the effects of increased temperature, they also provide woody debris for the stream which increases the variety of habitats available for aquatic insects.

This highlights the dual benefits of re-vegetating riparian zones as a restoration / adaptation measure.



Map of REFRESH stream and riparian wetland sites



Flooding at Spanish stream / wetlands site. Arbúcies Stream on 14th February (left) and 18th March (right)

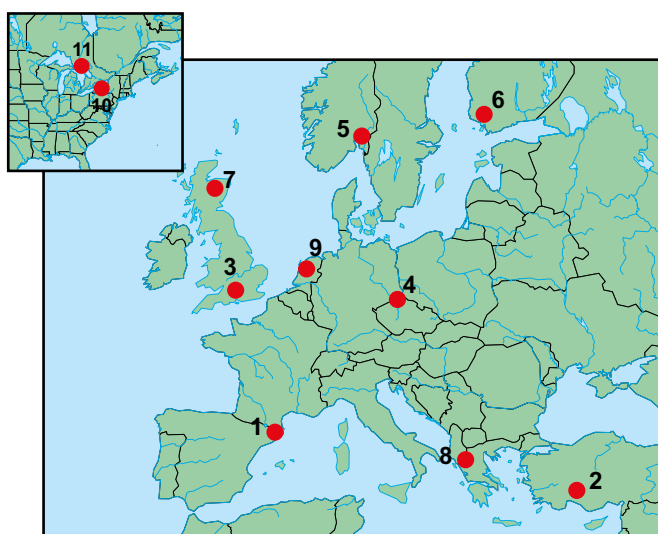
REFRESH Demonstration catchments

At a number of case study catchments across Europe REFRESH has been making use of existing long-term datasets to assess how the surface waters will respond to future environmental change and how management can adapt to accommodate these changes.

There are eleven modelling case studies and at six of these the modelling will incorporate cost effectiveness analysis of measures to achieve compliance with the WFD and HD.

In each catchment REFRESH is;

- (i) generating scenarios (e.g. climate and land use) of change over the next 50–60 years;
- (ii) assessing how projected change will affect the physical and chemical status of surface waters;
- (iii) identifying the ecological response driven by these changes;
- (iv) identifying where this is likely to cause problems reaching prescribed ecological targets (e.g. compliance with the Water Framework Directive and Habitats Directive);
- (v) modelling the response to management measures (in discussion with local stakeholders), adapted to accommodate future global change; and
- (vi) examining the cost-effectiveness of the management response.



Site Name

- | | |
|----------------------------|------------------------------------|
| 1 La Tordera | 6 Lake Pyhäjärvi/River Yläneenjoki |
| 2 Lake Beyshir & catchment | 7 River Dee |
| 3 Thames/Kennet | 8 River Lounce |
| 4 Vitava | 9 Jsselmeer |
| 5 Vansjø-Høbol | 10 Plastic |
| | 11 Harp |

Map of REFRESH demonstration catchments

Work in the Thames Catchment

Early results from the UK, Finland and the Czech Republic suggest that changes in land use will have greater impacts on freshwaters (and thus the ecology) than climate alone but that climate can amplify the land-use effects. In the Thames catchment, where the modelling is furthest advanced, the modelling suggests;

1. there are likely to be reduced summer flow as a result of climate change. This could lead to water shortages in drought periods unless some action is taken over the next 20 years (e.g. a new reservoir or reduced demand for water);
2. toxic cyanobacteria may occur more frequently, threatening water supply and recreational activities;
3. phosphorus (P) concentrations will probably increase in the future due to reduced dilution of agricultural and sewage treatment works (STW) discharges following reduced summer flows and increased fertiliser runoff due to more intensive arable production;
4. projected land use change has a very large effect on P concentrations;
5. a combined strategy of treatment for P removal at STWs combined with fertiliser reductions is the best and least cost approach to manage P in the River Thames. It is highly likely that this strategy will apply to other similar UK lowland catchments.

Reference

'Whitehead et al., (2013) 'A Cost Effectiveness Analysis of Water security and Water Quality: Impacts of Climate and Land Use Change on the River Thames System.' Philosophical Transactions of the Royal Society A (in press).



Sewage treatment plant

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Agricultural land

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REFRESH stakeholder engagement

In REFRESH, the stakeholder consultation process began early on in the work programme to ensure a collaborative understanding of water management issues. A number of workshops involving stakeholders at different levels (from policy makers to farmers, including conservation bodies and recreational users) have been organised.

A workshop was organised in London involving policy-makers and practitioners from across Europe, together with scientists from REFRESH. The aims of the meeting were:

- i) to develop links between scientists and policy-makers from across Europe,
- ii) to elicit ideas about how to develop science-policy links in future,
- iii) to introduce REFRESH and its scenarios to policy-makers, and discuss future challenges to managing the water environment,
- iv) to discuss ideas about how to address those challenges (including information needs).

Feedback from the workshop included preferences for dissemination methods to maximise engagement potential. The communication methods most favoured were short policy briefs, presentations at other events (conferences and national workshops), and face to face meetings. Least popular were blogs, unsolicited mailshots, phone calls and tweets.

A report from the workshop is available at:

www.refresh.ucl.ac.uk/Public_News_Page?page=3



Discussions at one of the Dee stakeholder workshop

Two workshops were organised involving local stakeholders acting locally in the River Dee catchment in Scotland and the River Louros catchment in Greece to investigate the potential barriers to implementation of water management legislation. Discussions revealed that money was not the only issue: for example the linked issues of time, social and human capital are all important, as well as environmental, institutional and business contexts.

Output from these workshops are available at:

www.refresh.ucl.ac.uk/barriers_to_action

There has been a continual programme of engagement at the REFRESH case study catchments. These have included workshops held between local stakeholders and REFRESH scientists to discuss possible mitigating, adaptive and restoration options which might enable compliance with WFD and HD obligations in each catchment. Nutrient pollution was the most widely cited problem, while agricultural activity and sewage treatment were identified as the major sources of pollution. The outcomes were summarised in a synthesis report covering all **six catchments**. These were followed by a series of collaborative workshops to inform and consult with local stakeholders to discuss whether the benefits of improving water quality outweigh the costs, and on the existence of an uneven distribution of costs and benefits (Disproportionality Analysis) and whether there were wider benefits to be gained from improving water quality in the demonstration catchments.

Towards the end of the project a number of dissemination workshops are planned where output from REFRESH will be presented to a wide range of stakeholders from EC policy makers to local catchment managers (see below for details).



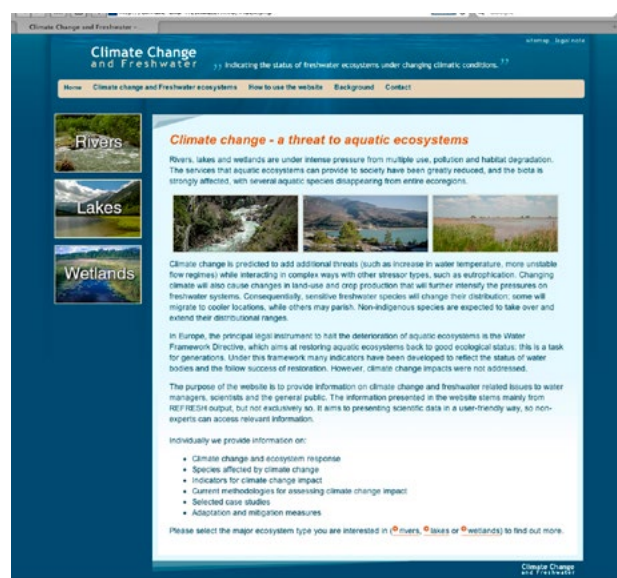
Climate-and-freshwater-info website

The climate-and-freshwater.info web site (www.climate-and-freshwater.info) was initially designed during the EU FP6 project Euro-Limpacs in 2006 and was a first attempt to gather and present knowledge on climate change and freshwaters.

In REFRESH the web site is being completely redesigned. climate-and-freshwater.info will now;

1. Create a platform to present REFRESH results.
2. Focus on climate-related subjects.
3. Present scientific data to the non-scientific community (water managers, stakeholders, etc)
4. Present the data in a more user-friendly way.

The main purpose of the website is to provide information on climate change and freshwater related issues to water managers, scientists and the general public. The information presented in the website stems mainly from REFRESH output, but not exclusively so. It aims to presenting scientific data in a user-friendly way, so non-experts can access relevant information. In addition, the final website version will include a specific section which will present guidelines for the development of adaptation, mitigation and restoration strategies to water managers and stake holders.



The web site is currently a beta version and not the final product. This will ultimately incorporate a wide range of material from ongoing REFRESH work. We welcome any feedback concerning the design and content of the web site.

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Forthcoming REFRESH dissemination events

11th October

Meriton Grand Conference and Spa Hotel, Paldiski mnt 4, Tallinn, Estonia. Lake management needs a professional approach and detailed planning

Joint Interregional dissemination event

REFRESH and LakeAdmin – Regional Administration of Lake Restoration Initiatives (lakeadmin.savonia.fi)

21-22nd October

Vansjø workshop – Stakeholder Meeting in Norway

Meeting organized with REFRESH and managers (local municipalities, Morsa Water District Organisation, County Governor's office, etc.). Day 1 focuses on the state of the lake, today and in the future. The REFRESH consortium will be represented by speakers highlighting the results of work on lakes, scenario settings and modelling undertaken during the project. Day 2 will focus on measures (particularly those related to agriculture and sewage treatment) and their effects and wider benefits.

6-7th November

Royal College of Physicians (DAY 1), UCL (DAY2), London, UK
Freshwater management in a changing world

This two day open meeting will present the results from REFRESH to the project to the scientific community (DAY 1) and highlight the implications for management to those tasked with drawing up and implementing policy and with vested interests in improving and protecting water quality and ecosystem status (DAY 2).

2nd December

METU, Cultural and Covention Centre, Ankara, Turkey
REFRESH Stakeholder Workshop

One day meeting to disseminate the results of REFRESH to managers, conservation agencies, policy makers and implementers in Turkey, Greece and Spain.

29th/30th January

Museum of Natural Sciences, Brussels, Belgium

Water Lives: scientific horizons for biodiversity and water policy

The aim of the joint Science Policy Symposium for Freshwater Life by BioFresh and REFRESH is to bring together policy makers, stakeholders from the water, energy and conservation sector, NGOs, the scientific community and selected experts to discuss challenges in implementation of the 2020 Biodiversity strategy and the EU Water Framework Directive and to come up with clear recommendations for policy making and future research. The goal is to inform and to create synergies across participants with the best recent knowledge on freshwater science and policy.

Project Partners

University College London, UK

Aarhus Universitet – National Environmental Research Institute, DK

The University of Reading, UK

Finnish Environment Institute, FI

Universitaet Duisburg-Essen, DE

Alterra B.V., NL

Natural Environment Research Council, UK

Swedish University of Agricultural Sciences, SE

James Hutton Institue, UK

Utrecht University, NL

Consejo Superior de Investigaciones Científicas, ES

Middle East Technical University, TR

Forschungsverbund Berlin e. V, DE

Institut National de la Recherche Scientifique, (Canada) CA

Commission of the European Communities – Directorate General Joint Research Centre, EU

Stichting Deltares, NL

Universitaet fuer Bodenkultur Wien, AT

Biology Centre AS CR, v.v.i., Institute of Hydrobiology, CZ

Eesti Maaülikool (Estonian University of Life Sciences), EE

Universitat de Barcelona, ES

University of Patras, GR

Centre National de la Recherche Scientifique – UNIVERSITE PAUL SABATIER, FR

Norwegian Institute for Agricultural and Environmental Research, NO

Norwegian Institute for Water Research, NO

Trent University, CA

Australian Rivers Institute (ARI), Griffith University, AU



The REFRESH consortium in Antalya