

Why is high environmental persistence a problem? Considering trifluoroacetic acid (TFA) and other examples.

Ian T. Cousins

Department of Environmental Science
Stockholm University, Sweden

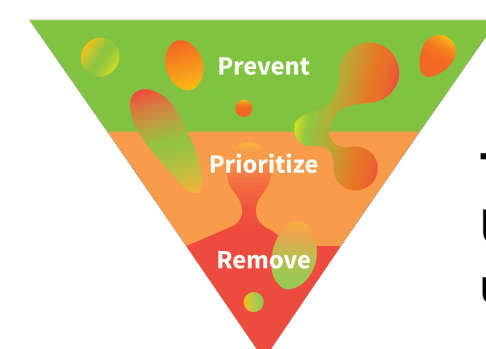
Contact:

ian.cousins@aces.su.se



Stockholms
universitet

ZerO⁺PM

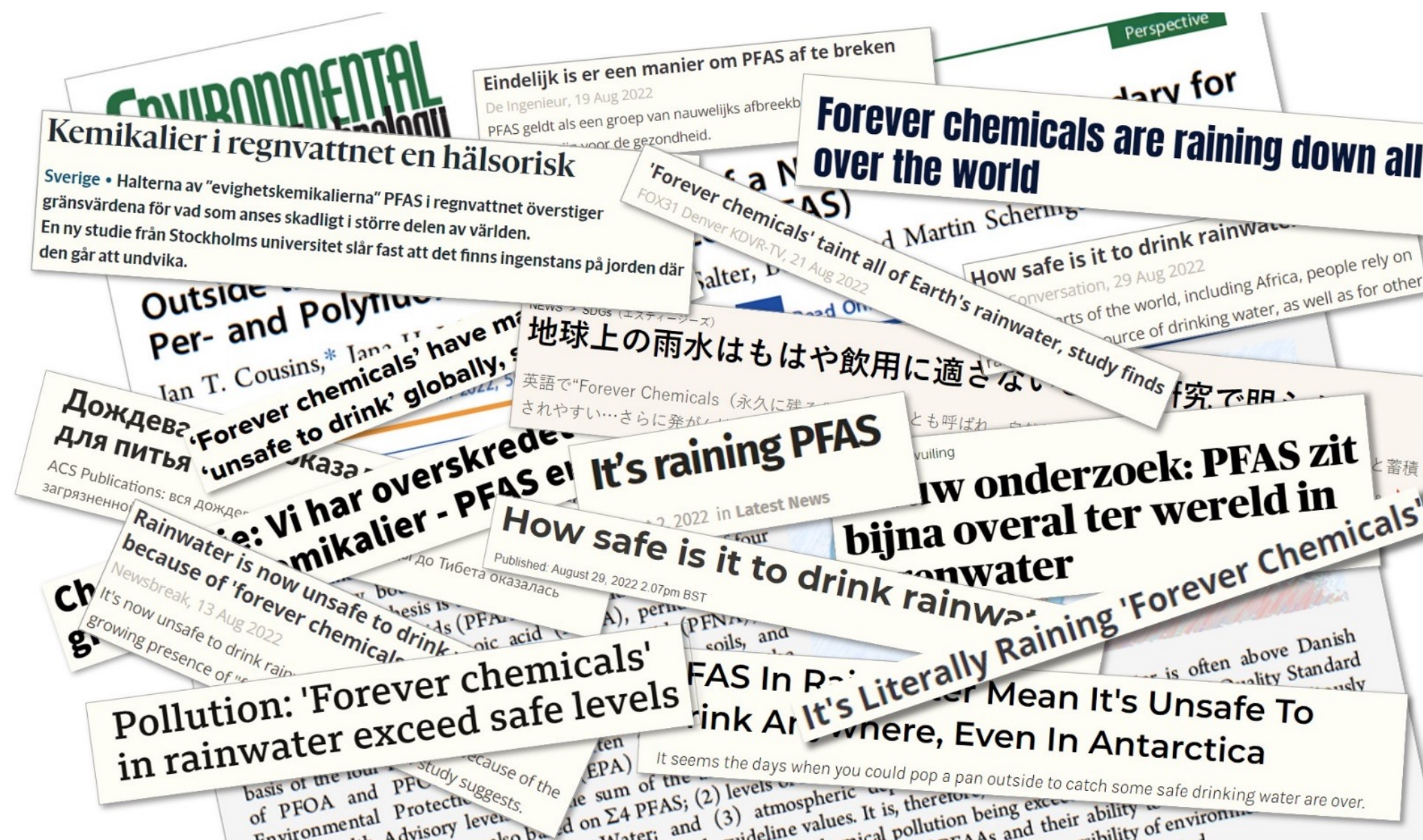


This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101036756

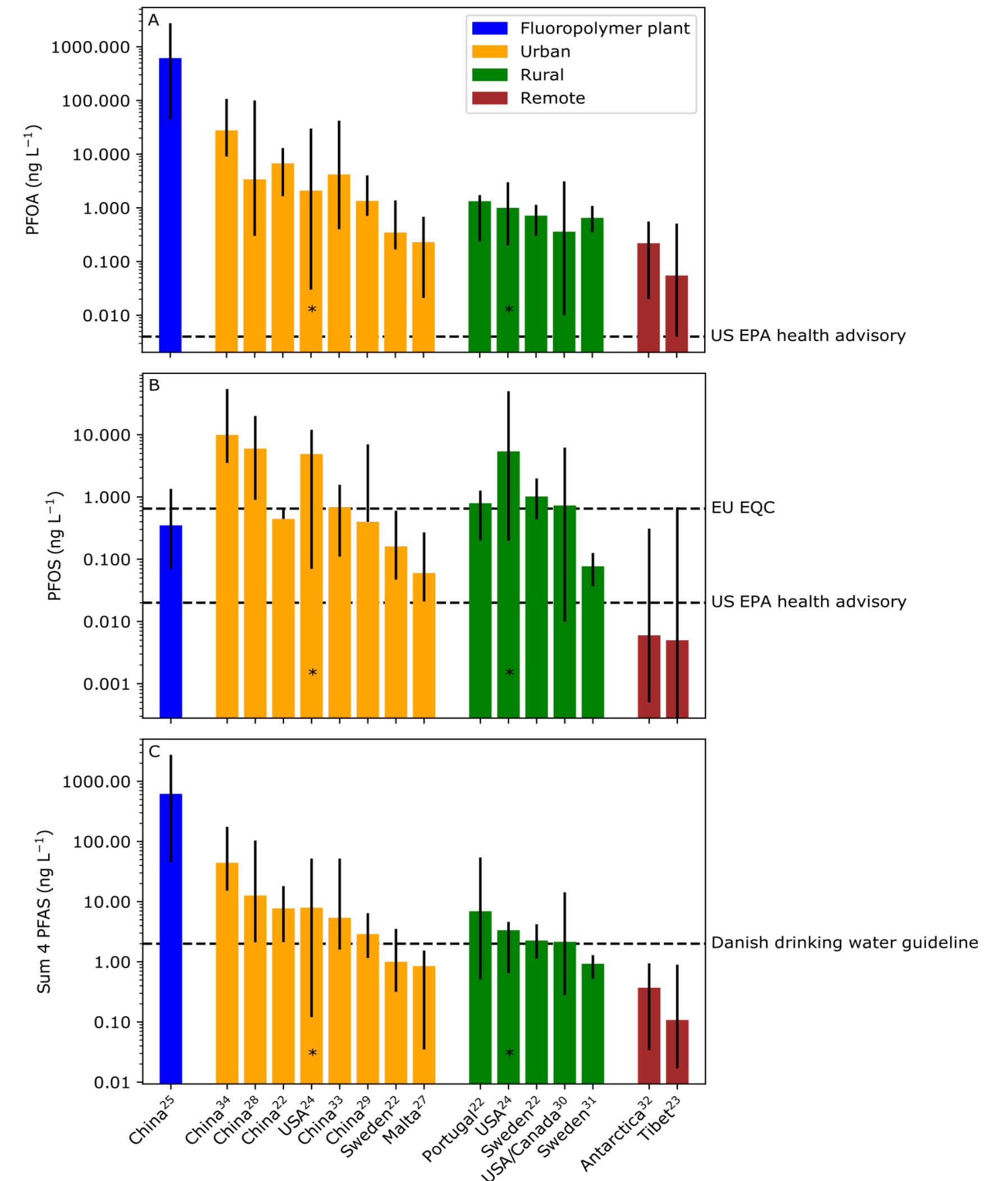
Outside the Safe Operating Space of a New Planetary Boundary for Per- and Polyfluoroalkyl Substances (PFAS)

Ian T. Cousins,* Jana H. Johansson, Matthew E. Salter, Bo Sha, and Martin Scheringer

It's raining PFAS!



- Approaching 250 000 downloads
- More than 300 news articles



It's raining PFAS!

- PFOS and PFOA in low nanograms per liter level
- Mean monthly TFA concentrations in Germany up to 4.87 micrograms per liter
- TFA concentrations are increasing in rainwater, groundwater, ocean water, human blood, and vegetation worldwide
- German drinking water concentrations occasionally >10 micrograms per liter “action level”
- TFA water concentrations are poorly reversible

- Highly predictable and avoidable problem related to high persistence!

What we often hear regarding persistence from industry:

- Persistence indicates the mere presence of a chemical.
- Rocks, sand and many other harmless things are highly persistent.

But others have long thought differently:

Stephenson (1977): On the face of it there appears little reason to be concerned about a material which, even though present in the environment, [is] not causing any detectable damage.

On the other hand, **persistent materials, because of this property, will accumulate in the environment for as long as they are released.** Since the environment is not effective at cleansing itself of these materials, they will remain for indefinite periods which were not recognized at the time of their original release. The problem could become entirely out of control **and it would be extremely difficult if not impossible to do anything about it.** Materials which are strongly persistent can accumulate to rather high levels in the environment and **effects which would not otherwise be important could become so.**

Stephenson ME. 1977. Ecotoxicol Environ Saf 1, 39–48.

Persistence indicates an impactful causal relationship that extends far into the future.

→The continuous release of highly persistent chemicals will lead to widespread, long-lasting, and increasing contamination.

→Increasing concentrations will result in increasing probabilities that known and unknown effects occur, be it by a single chemical and/or in a mixture with other substances.

→Once adverse effects are identified, it will be technically challenging, energy intensive, and thus costly, to reverse the contamination and therefore the effects.

All PFAS are either persistent themselves or degrade into persistent transformation products.

→Basis for the PFAS restriction proposal.

The cover of the journal "Environmental Science Processes & Impacts" from the Royal Society of Chemistry. It features the journal title and logo at the top. Below, it says "PERSPECTIVE" and "View Article Online". The article title is "Why is high persistence alone a major cause of concern?" and the authors are listed as Ian T. Cousins, Carla A. Ng, Zhanyun Wang, and Martin Scheringer.

Environmental Science Processes & Impacts

PERSPECTIVE

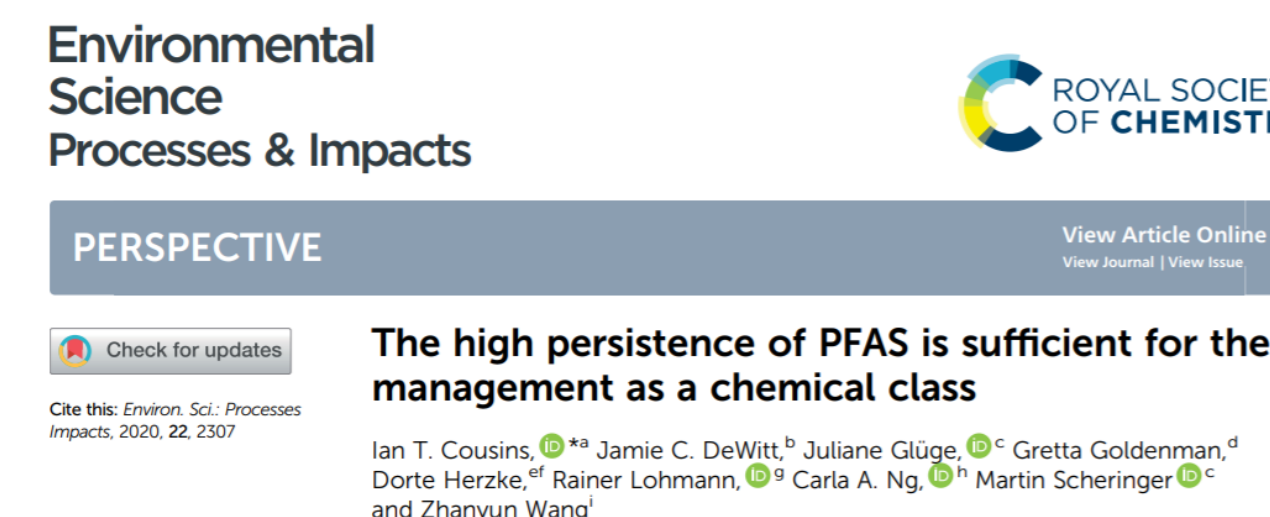
View Article Online

Check for updates

Cite this: *Environ. Sci.: Processes Impacts*, 2019, 21, 781

Why is high persistence alone a major cause of concern?

Ian T. Cousins,^a Carla A. Ng,^b Zhanyun Wang^{b,c} and Martin Scheringer^{b,d}

The cover of the journal "Environmental Science Processes & Impacts" from the Royal Society of Chemistry. It features the journal title and logo at the top. Below, it says "PERSPECTIVE" and "View Article Online". The article title is "The high persistence of PFAS is sufficient for their management as a chemical class" and the authors are listed as Ian T. Cousins, Jamie C. DeWitt, Juliane Glüge, Greta Goldenman, Dorte Herzke, Rainer Lohmann, Carla A. Ng, Martin Scheringer, and Zhanyun Wang.

Environmental Science Processes & Impacts

PERSPECTIVE

View Article Online

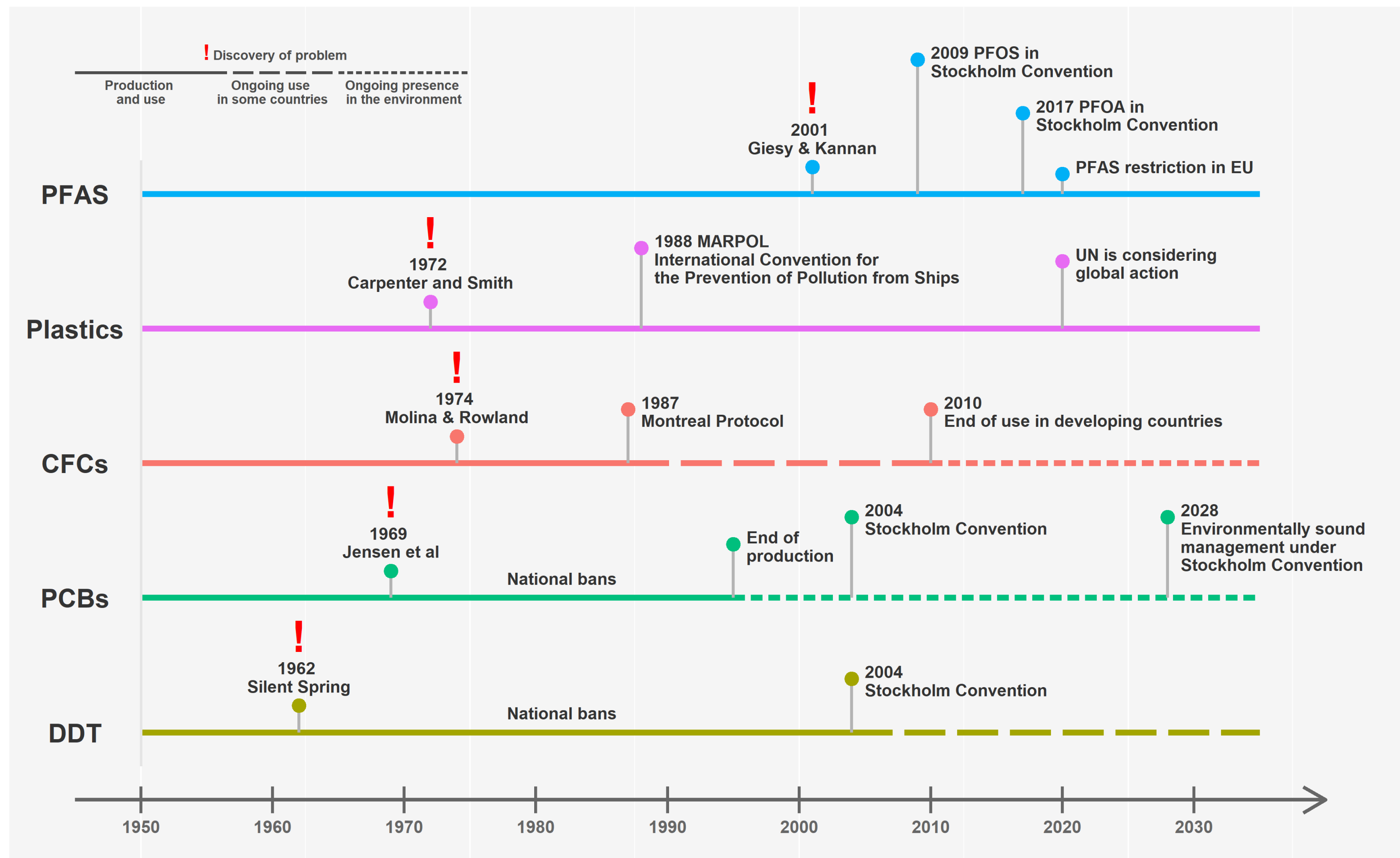
Check for updates

Cite this: *Environ. Sci.: Processes Impacts*, 2020, 22, 2307

The high persistence of PFAS is sufficient for their management as a chemical class

Ian T. Cousins,^{a,*} Jamie C. DeWitt,^b Juliane Glüge,^{b,c} Greta Goldenman,^d Dorte Herzke,^{e,f} Rainer Lohmann,^{b,g} Carla A. Ng,^{b,h} Martin Scheringer^{b,c} and Zhanyun Wangⁱ

Persistent problems! History repeating itself.



Conclusions

- Some fluorinated gases (R-134a, R-143a, R-1234yf, R-1234ze or R-1233zd) completely or partially degrade to TFA.
- The high persistence of TFA means that continuous use of these fluorinated gases results in increasing levels of TFA.
- Eventually, health advisories will be breached and it will be extremely costly for society to reverse the contamination.
- Where possible to prevent a serious problem, it would be sensible to rapidly substitute these fluorinated gases with natural refrigerants.



ATMO Network



Ian Cousins

Department of Environmental Science, Stockholm University, Sweden
Contact: ian.cousins@aces.su.se



Stockholms
universitet

Thank you for listening.



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101036756.

Zero PPM

