

## ORD CLEARANCE FORM

Initiator Information		Product Category	
First Name:	Leah	<input type="checkbox"/> HISA (Highly Influential Scientific Assessment) <input type="checkbox"/> ISI (Influential Scientific Information) <input checked="" type="checkbox"/> Not HISA or ISI <input type="checkbox"/> Requires Advance Notification <input checked="" type="checkbox"/> Does not Require Advance Notification	
Last Name:	Fowler		
E-mail Address:	Fowler.Leah@epa.gov		
Organization:	ORD, CEMM, WECD		
Principal Investigator / Project Officer Information		Product Information	
First Name:	Jake	Clearance Tracking #:	ORD-065971
Middle Initial:	J	EPA Publication #:	
Last Name:	Beaulieu	Product Type:	Journal Article
Email:	Beaulieu.Jake@epa.gov	Product Subtype:	Peer Reviewed
Phone #:	513-569-7842	Records Schedule:	Permanent
Product Title			
Pervasive nitrous oxide undersaturation in U.S. lakes and reservoirs			
Author(s), Affiliation, and Address			
EPA Author		EPA Author	
First Name: Jake		First Name: Roy	
Last Name: Beaulieu		Last Name: Martin	
Organization: ORD, CEMM, WECD, WMB		Organization: ORD, CEMM, WECD, ECB	
Address:		Address:	
Telephone: 513-569-7842		Telephone: 513-569-7074	
Email: Beaulieu.Jake@epa.gov		Email: Martin.Roy@epa.gov	
Percentage Contribution %:		Percentage Contribution %:	
Impact / Purpose Statement			
Note: The Impact / Purpose Statement information for this work product will be displayed on the additional pages.			
Product Description / Abstract			
Note: All Product Description / Abstract information for this work product will be displayed on the additional pages.			
Tracking and Planning			
Note: All Tracking and Planning Field data for this work product will be displayed on the additional pages.			
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## Additional Authors

Author # 3 - EPA Author

First Name: Michael

Last Name: McManus

Organization: ORD, CEMM, WECD, WMB

Address:

Phone: 513-569-7994

Email: McManus.Michael@epa.gov

Percentage Contribution:

## Sub-Product ID and Title

SSWR.1.1.2.16: Pervasive nitrous oxide undersaturation in U.S. lakes and reservoirs

## Tracking and Planning 2019 Forward Field Set(s)

Research Area ID: SSWR.1

Research Area: Assessment, Monitoring and Management of Aquatic Resources

Product Title: Nationally consistent NARS indicator methods and assessment thresholds

Brief Description and Use: NARS requires indicators that can be collected, reported and interpreted in a consistent way across the country that are scientifically defensible and that can be adopted and implemented by States. ORD research will fill gaps in current core indicators and evaluate the potential for new approaches and emerging technologies to enhance NARS capability. Ongoing milestones: 1) Indicator of hydrological alteration in lakes and reservoirs. Hydrological alteration is a key stressor in lakes for which we currently have no indicators.&nbsp; &nbsp;(Brooks) 2) Techniques for interpreting the role of critical gases in lakes and reservoirs (methane, carbon dioxide and nitrous oxide) using data from NLA 2017 pilot studies. (Beaulieu) 3) Refining ORD&rsquo;s approach to use of DNA technologies in NARS: DNA applications for a) primary NARS taxa (fish, macroinvertebrates, algae), b) microbial communities, and c) eDNA approaches. The first stage will be a strategy to focus the work (in partnership with OW and States) and ensure the most effective use of samples and staff time. (Pilgrim, Keely, Trebitz) New milestones: 4) Trophic State Index for estuaries (Pelletier) 5) Indicators for nutrient enhanced coastal acidification and hypoxia in estuaries (Gear)

Topic(s):

Watersheds

Research Program Area: Safe and Sustainable Water Resources

## Impact / Purpose Statement

Excessive nitrogen loading to surface waters can stimulate the production of nitrous oxide, a contributor to stratospheric ozone destruction, and it is generally believed that surface waters are a globally significant source of N<sub>2</sub>O to the atmosphere. This study found that most US lakes and reservoirs function as a sink for nitrous oxide rather than a source. This finding suggests that the role of surface waters in the global N<sub>2</sub>O budget may be overestimated.

## Product Description / Abstract

Lakes, ponds, and reservoirs are estimated to be globally important sources of nitrous oxide (N<sub>2</sub>O) to the atmosphere but recent evidence of N<sub>2</sub>O uptake across a broad range of lakes have called the accuracy of emission estimates into question. Here we use a new national-scale dataset on dissolved N<sub>2</sub>O and a Bayesian hierarchical model to predict N<sub>2</sub>O concentration and emission rates in 465,896 waterbodies in the conterminous U.S. (CONUS). We found that N<sub>2</sub>O undersaturation was widespread through the CONUS, with an estimated 72.9% (95% credible interval: 68.9 - 76.6%) of lakes functioning as N<sub>2</sub>O sinks. The model predicts dissolved N<sub>2</sub>O concentrations reasonably well based partly on interactions between nitrate concentration, waterbody surface area, and water temperature. Despite working with the largest aquatic N<sub>2</sub>O dataset to date, our national-scale estimate of N<sub>2</sub>O emissions from CONUS lakes is poorly constrained, with a 95% credible interval ranging from net uptake to net emission (-849 - 1453 metric tons N<sub>2</sub>O year<sup>-1</sup>). Widespread N<sub>2</sub>O undersaturation in CONUS waterbodies and a national-scale emission estimate that is too uncertain to determine if CONUS lakes are a net source or sink of N<sub>2</sub>O highlight the need to revisit N<sub>2</sub>O models which presume surface waters are a N<sub>2</sub>O source.

## Does this journal article have data associated with it?

Yes: EPA Data

## Data Description:

Primary/secondary data 'owned' by EPA through in-house or EPA-funded efforts (ScienceHub full entry)

## CCs

Thurston.Hale@epa.gov

Latham.Michelle@epa.gov

Cole.Caroline@epa.gov

vanDrunick.Suzanne@epa.gov

Williams.Joe@epa.gov  
McManus.Michael@epa.gov  
Rea.Anne@epa.gov  
Martin.Roy@epa.gov  
Parshionikar.Sandhya@epa.gov  
Daniel.Jessica@epa.gov  
Schneider.Marie@epa.gov  
Beaulieu.Jake@epa.gov  
Hagler.Gayle@epa.gov  
Azzam.Kathleen@epa.gov  
Benton.Breanne@epa.gov  
Oshima.Kevin@epa.gov  
Johnson.Brent@epa.gov  
Grimm.Ann@epa.gov

## Comments

Author: Fowler, Leah      Date: 03/13/2025 2:26 PM      System Source: RAPID

I spoke with Margie Vazquez regarding the cited QAPP (J-WECD-0033074) not being selectable in RAPID, and she states that she will provide additional explanation via a comment in STICS.

Author: Margie Vazquez      Date: 03/14/2025 11:31 AM      System Source: STICS

This journal article manuscript needs to have the standard EPA disclaimer and authors added. ORD did not have the QA lead on this national project which is why there is no ORD QAPP cited. However, the EPA requirement for QA documentation for project planning is fulfilled with the Office of Water planning documents: an overall QAPP, a field operations manual, and a lab operations manual. Dr. Beaulieu was included in the QAPP. The field sampling design was described. Dissolved gas sampling, including nitrous oxide, was listed under analytes of interest thus all field and lab activities seem well covered. ORD addendums describing data analysis and uses in modeling could benefit project planning for future uses of data. This QA product review was filed under QA Track #J-WECD-0033074-JA-1-0 and limited to confirmation of project planning documentation in an approved QAPP.

Author: Matthew Heberling      Date: 03/17/2025 9:07 AM      System Source: STICS

I am approving as support for WMB supervisor. My minor revisions and Jake's responses can be found in the file "Beaulieu Paper Clean NatGeo N2O 20200307\_mth\_JB.pdf." I also added the new clean manuscript file along with three Supporting Information files that were missing with the initial submission.

Author: Susan Cormier      Date: 03/18/2025 2:41 PM      System Source: STICS

no technical or policy issues. well written manuscript