

Science AMA Series : We're a team of researchers studying where wetlands can be found around the globe, from the arctic to the tropics, and trying to understand how human land use activities and climate change are affecting their distribution.

Where *are* wetlands<sup>1</sup> and *r/ScienceAMAs*<sup>1</sup>

<sup>1</sup>Affiliation not available

April 17, 2023

### Abstract

Hi, we're Drs. Ben Poulter (NASA), Thomas Gumbricht (CIFOR), David Olefeldt (University of Alberta) and Etienne Fluet-Chouinard (University of Wisconsin) — we study techniques to map wetlands around the world, how they change over time, and how this information can be used to understand how wetlands function and provide ecosystem services to people. Wetlands can be mapped using a variety of techniques, from sending people out into the field using inventory techniques to taking advantage of satellites in orbit around the Earth and using the electromagnetic spectrum. Recently, a new map of tropical wetlands was published by Thomas Gumbricht as well as a high-resolution map of global surface inundation by Etienne Fluet-Chouinard, both databases are being used for a variety of purposes, including to understand how wetland affect climate change by emitting methane. Join our AMA to find out how satellites are helping in the quest to learn more about where wetlands are located, how human activities affect wetland area, and how climate change is affecting methane emissions from wetlands. We'll be back at 12 pm ET to answer your questions, AMA! Mapping tropical wetlands <http://onlinelibrary.wiley.com/doi/10.1111/gcb.13689/full> High-resolution global wetland mapping <http://www.sciencedirect.com/science/article/pii/S0034425714004258> Understanding wetlands and methane emissions <http://iopscience.iop.org/article/10.1088/1748-9326/aa8391/pdf>

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## Science AMA Series : We're a team of researchers studying where wetlands can be found around the globe, from the arctic to the tropics, and trying to understand how human land use activities and climate change are affecting their distribution.

WHERE\_ARE\_WETLANDS [R/SCIENCE](#)

Hi, we're Drs. Ben Poulter (NASA), Thomas Gumbricht (CIFOR), David Olefeldt (University of Alberta) and Etienne Fluet-Chouinard (University of Wisconsin) --- we study techniques to map wetlands around the world, how they change over time, and how this information can be used to understand how wetlands function and provide ecosystem services to people. Wetlands can be mapped using a variety of techniques, from sending people out into the field using inventory techniques to taking advantage of satellites in orbit around the Earth and using the electromagnetic spectrum. Recently, a new map of tropical wetlands was published by Thomas Gumbricht as well as a high-resolution map of global surface inundation by Etienne Fluet-Chouinard, both databases are being used for a variety of purposes, including to understand how wetland affect climate change by emitting methane. Join our AMA to find out how satellites are helping in the quest to learn more about where wetlands are located, how human activities affect wetland area, and how climate change is affecting methane emissions from wetlands.

We'll be back at 12 pm ET to answer your questions, AMA!

Mapping tropical wetlands <http://onlinelibrary.wiley.com/doi/10.1111/gcb.13689/full>

High-resolution global wetland mapping <http://www.sciencedirect.com/science/article/pii/S0034425714004258>

Understanding wetlands and methane emissions <http://iopscience.iop.org/article/10.1088/1748-9326/aa8391/pdf>

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Hello! Thank you for this AMA.

I'm interested in your use of satellite imagery. What is it you look for in the returning signal - is it a particular emission spectrum (such as unusual methane concentrations) that indicate wetlands? Does this vary between, say, looking for swamps and looking for fens?

[StonedPhysicist](#)

Hi, Satellites are not able to directly observe methane emissions from wetlands, instead they have the ability to detect different land surfaces based on a combination of wavelengths. Here it is particularly informative to distinguish between open water and different types of vegetation communities. These characteristics will vary between different wetlands types, including how they vary over time - some wetland types have frequent inundation while other are almost never inundated. To estimate methane emissions from different regions, it is necessary to combine wetland mapping of different wetland types with our understanding of how methane is produced and emitted from these wetland types. This data on methane emissions will come from field observations, which then can be used to inform biogeochemical models for estimating methane emissions.

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-David Olefeldt

Spent the better part of my career protecting, preserving and restoring coastal wetlands in Texas. It is interesting to see new methodology being applied. Thank you for your efforts, especially given the current sentiment towards climate change and science in general.

[TXPedaler](#)

Thanks - there are lots of new satellite missions being launched or planning to be launched to help map water resources. Take a look at the planned NASA SWOT mission (<https://swot.jpl.nasa.gov/>) which will provide new information on oceans, rivers, and reservoirs, for example.

Thank you for doing this AMA!

Handling the huge volume of data it sounds like this work generates must be a challenge. Does machine learning play a role in analyzing all the images that come out of your work? Is securing the funding to be able to maintain and update these databases a concern?

[neurobeegirl](#)

Hi, A main source of data for global wetland mapping comes from satellite remote sensing. Data volume and computing needs grow with ever finer pixel size, growing time series and refined algorithm. Machine learning methods, like neural networks, random forests, etc. has been used for a while for remote sensing. To alleviate some of the computing burden, we are seeing the start of a shift to cloud computing whereby data is stored and processed on servers. The Google Earth Engine and its use for mapping water cover over 30 years is a salient example this (you can explore their results here: <https://global-surface-water.appspot.com/>). During the last few years, some of the older satellite sensors (e.g. Landsat) have made their data archive free and accessible to the public which has alleviated the cost of imagery for these large projects. - Etienne Fluet-Chouinard, University of Wisconsin-Madison

Hi guys! Thanks for this AMA. I'm wondering how the public has acted toward your findings. Are you finding acceptance of the research, or are they more skeptical of your findings? How would you suggest scientists interact with the public on this topic? Thanks!

[Austion66](#)

Hi, Almost any communication with the public is better than no communication! This is something we as scientists always can get better at, and finding new ways to communicate our science is important. Often I find that members of the public are open to listen to our findings, but I have had occasions where it has been clear that my findings are evaluated from specific political viewpoints, e.g. with suspicions whether I have a political agenda to push, funded by specific sources. I find that explaining my motivations for my research often helps, on how I want to understand the basic functions of wetlands in order to understand how they will respond to both direct disturbances such as human development, wildfire, permafrost thaw, and indirect disturbances such as climate change. -David Olefeldt

Enhanced methane emissions from Arctic permafrost, such as through thermokarst lakes and such, is often brought up as a risk for rapid climate warming and also an area of huge uncertainty. Is there similar levels of uncertainty with regard to methane emissions from wetlands in more southern

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latitudes?

If you could design an optimal wetland mapping instrument to launch into orbit, how might it look?

Also, how many times do you get stuck in mud on an average field season?

[IceBean](#)

Hi. I work a lot on methane emissions from high-latitude wetlands, and we agree that the uncertainty of arctic methane missions is high. However, having said that we have enough of an understanding to be able to rule out catastrophic scenarios where arctic methane emissions on their own push the climate significantly. While arctic methane emissions are likely to increase in the future due to warming and permafrost thaw, this is more likely to be a nudge to the global climate rather than a big push.

As an high-latitude researcher, I and my students get stuck in mud and peat about 1-2 times per summer. Ranging from our truck being stuck on muddy roads to my graduate student loosing their boots in thick peat deposits. All good fun though. No one has been eaten by a bear yet.

Overall, tropical wetlands have greater methane emissions than wetlands in the high-latitudes. We have much less field data on methane emissions from tropical wetlands, so our uncertainty of tropical wetland methane emissions is likely greater than for high latitude wetlands.

-David Olefeldt, Assistant Professor University of Alberta

Hello and welcome! Thanks for taking the time to come talk with us about your research.

I was wondering how rising sea levels will affect wetlands? Will we see growth in wetlands that are inland as the water table rises?

Also, you mentioned using the EM spectrum to to map wetlands. How does that work since water heavily attenuates *most* EM frequencies?

[PapaNachos](#)

hi, thanks for the question! Sea level rise poses an interesting challenge - most coastal wetlands formed during a time of sea level rise, where the soil surface of a marsh rises to keep pace with sea level rise. For example, dead grasses and root growth build up the soil organic matter, causing it to rise slightly in elevation at a rate of around 1 mm per year. The challenge now is that sea level is rising between 1 to 3 mm per year because of climate change caused ocean warming, and so in many areas, coastal wetlands will be inundated.

As for the EM spectrum, this is correct that many wavelengths are not reflected by water. Remote sensing specialists take advantage of this to map surface water. For example, scientists have produced 32 years of surface water trends using Landsat optical data - you can visualize the data here <https://global-surface-water.appspot.com/> (BP)

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[PapaNachos](#)

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Hi, Just adding to my colleagues response in the issue of new wetlands further inland due to sea level rise. This is a possibility, but in many regions we now have human settlements along coasts and then we are likely to have w situation of "coastal squeeze" where new wetland formation is prohibited by human developments. -David Olefeldt

Thank you for doing this AMA. My questions might be a little off topic and away from the particular specifics of the research being discussed, but I'm hoping you could shed some light on anyways.

Are the maps and information that you are gathering being made available to organizations and entities that are responsible for maintaining/overseeing the wetland areas that you are mapping? If so, it would seem that if they have historical data from those areas they could compare it to present day data, including your findings. This could be valuable for wetland restoration projects. This leads to my second question, which is to what point would you suggest a wetland area be restored to? For example, would we want to aim for what the area was like 500 years ago, 100 years ago, 50 years ago? What is ideal versus feasible?

Thank you!

[chupacabrasaurus1](#)

Good questions!

Yes, in most cases the data are all publicly and freely available to be analyzed. The 'users' may need some skills in handling files types and working with geospatial data using a GIS software. Lake and river data can be accessed from geoportals like the following <https://global-surface-water.appspot.com/> - and static wetland maps available from the National Wetlands Inventory maintained by the USGS. Scientists often host public workshops or trainings, or may be required to identify stakeholders and users prior to receiving funding.

To the second question, this is a difficult one and would partly depend on what the management objectives are. For example, to protect biodiversity, to sequester or store carbon, to help with water storage or quality issues. In addition, we need to keep in mind that the climate today is a lot different to the climate 500, 100, 50 years ago, in addition to other changes in local hydrology that might have been caused by drainage, paving of surfaces, or habitat fragmentation

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Thank you!

[chupacabrasaurus1](#)

Hi, There are many different wetland mapping products that have been created, often at different scales or for different purposes. Many of the global wetland maps have either relatively coarse spatial resolution, or limited information on the specific wetland types for the local scale. Hence, for many land

management purposes, these global wetland maps are not always the most suitable product to use. That said, many of them are freely available. At the local scale there are often local wetland mapping efforts that have been made, which may be more suitable for land management and restoration issues.

The aims for restoration will vary between jurisdictions, and ultimately be linked to public awareness and opinion. The awareness of wetlands as important ecosystems in the landscape has increased over the last few decades, and thus restoration efforts and legislation has been put in place to varying degrees in different jurisdictions. But it is not only how much of the wetlands that is aimed at restoring, but also whether restoration efforts are required to bring back the same type of wetland that was impacted. In many cases it is not feasible to restore e.g. a bog on a relevant time-scale. Those ecosystems has developed naturally over 1000s of years and will thus be very difficult to quickly restore. On the other hand, many smaller marshes (pot holes, sloughs) in agricultural areas may be technically relatively easy to restore. However, primate land-ownership and the loss of income when restoring a wetland in an agricultural setting often hinders wetland restoration goals to be achieved. - David Olefeldt

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Thank you!

[chupacabrasaurus1](#)

Hi, National governments collect their own field data and map wetlands over their territories, and make decisions based on these data. Going beyond one single nation, wetland area data are assembled to generate global maps and can be used to inform decision makers operating at that scale. International agreements that operate on the global scale, for instance Aichi for biodiversity or Kyoto Protocol / Paris Agreement for climate, have their own mechanisms for periodic assessment. Both these global assessments rely on databases, like the global wetland maps that we are working on generating by the scientific community. Beyond informing organizations, I find that global maps are great tools for awareness raising with the public. Everyone recognizes the globe no matter where you are from!

Historical wetland cover is generally known through soil maps, and those vary in quality across the world. We do know that most of the world's wetlands, due to their location and soil fertility, have mostly been converted to agriculture. Understanding historical extent helps to set restoration targets for wetland ecosystems, but global maps are not sufficiently precise to target management practices.

- Etienne Fluet-Chouinard, University of Wisconsin-Madison