

# Water Science for Water Communities

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Environmental and Urban Studies (EUS)

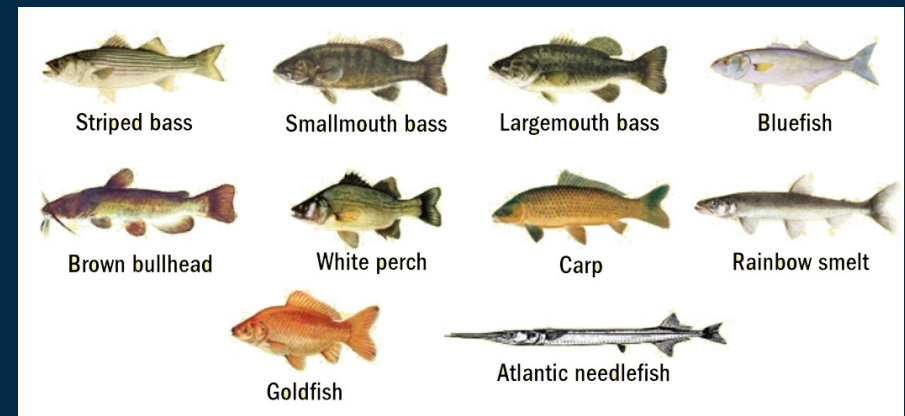
Director, Center for the Study of  
Land, Air, and Water (<https://landairwater.bard.edu>)  
Director, EUS Program (<https://eus.bard.edu>)

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12/10/20

HRWA Omelet Lecture

FIRST: this presentation, like all presentations, represents my interpretation of the work of many, many, many people, including scientists, activists, leaders, community members, family, friends, and complete strangers generously sharing their expertise with me along the way. I thank you for your trust in me and your patience when I so often did not fully understand. I am still trying.



# What is community?

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# Why me?

- Biological Oceanographer
- Environmental Microbiologist
- A Human.....
- I am accountable to: scientific community, watershed community, family, friends, EJ, queer, academia
- My philosophy:  
Healthy People = Healthy Planet
- My strategy:  
water science + water communities =  
**better** science and **better** communities



# What is water?

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# What is science?

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**Science** (from the **Latin** word *scientia*, meaning "knowledge")<sup>[1]</sup> is a systematic enterprise that **builds** and **organizes knowledge** in the form of **testable explanations** and **predictions** about the **universe**.<sup>[2][3][4]</sup>

**Knowledge = Power**

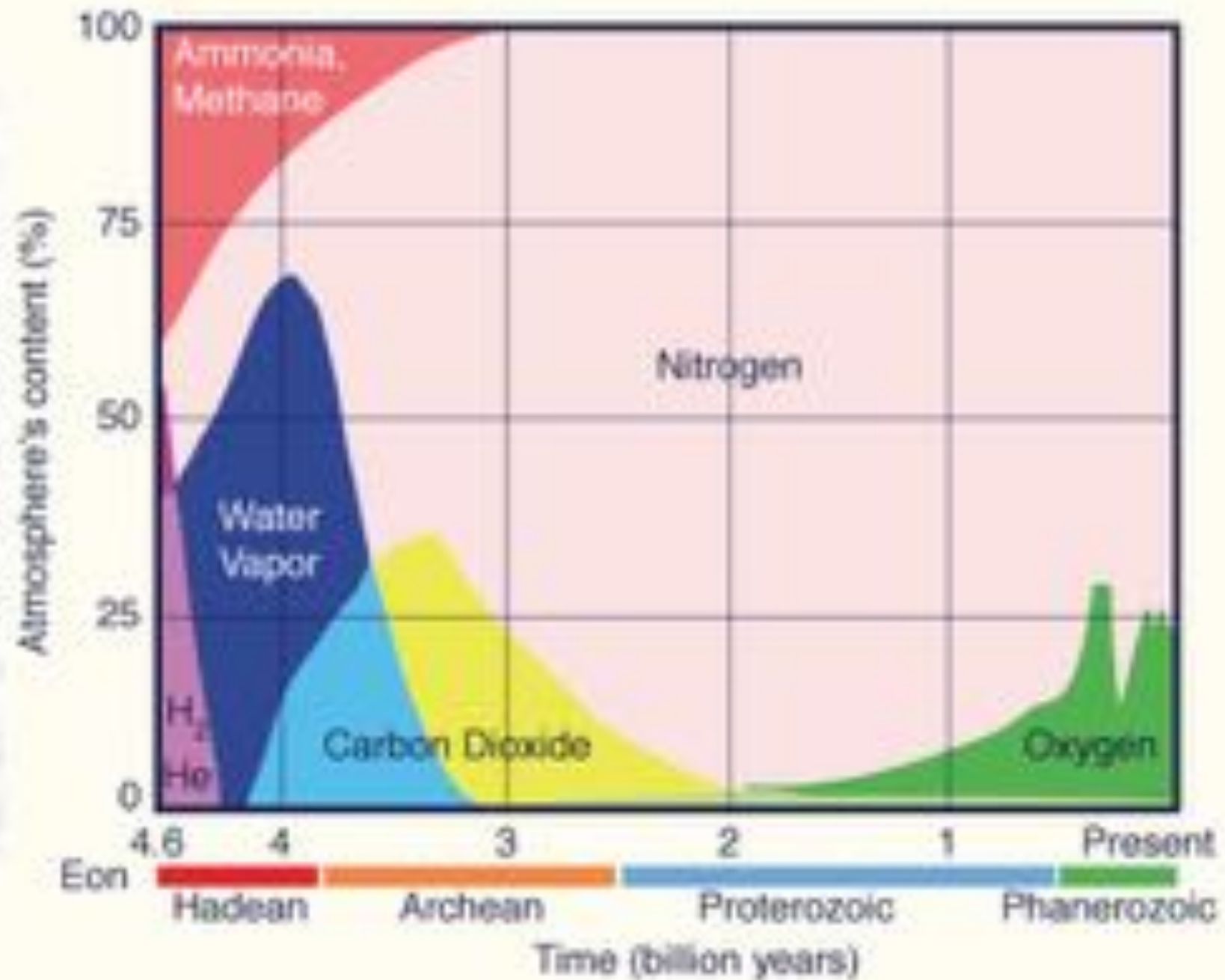
**In this day and age, knowledge/science is POLITICAL.**

**Just ask:**

**Dr. Timnit Gebru**, top AI ethics researcher (<https://ai.stanford.edu/~tgebru/>)

**Rebekah Jones**, data scientist ([https://en.wikipedia.org/wiki/Rebekah\\_Jones](https://en.wikipedia.org/wiki/Rebekah_Jones))

# What is science?





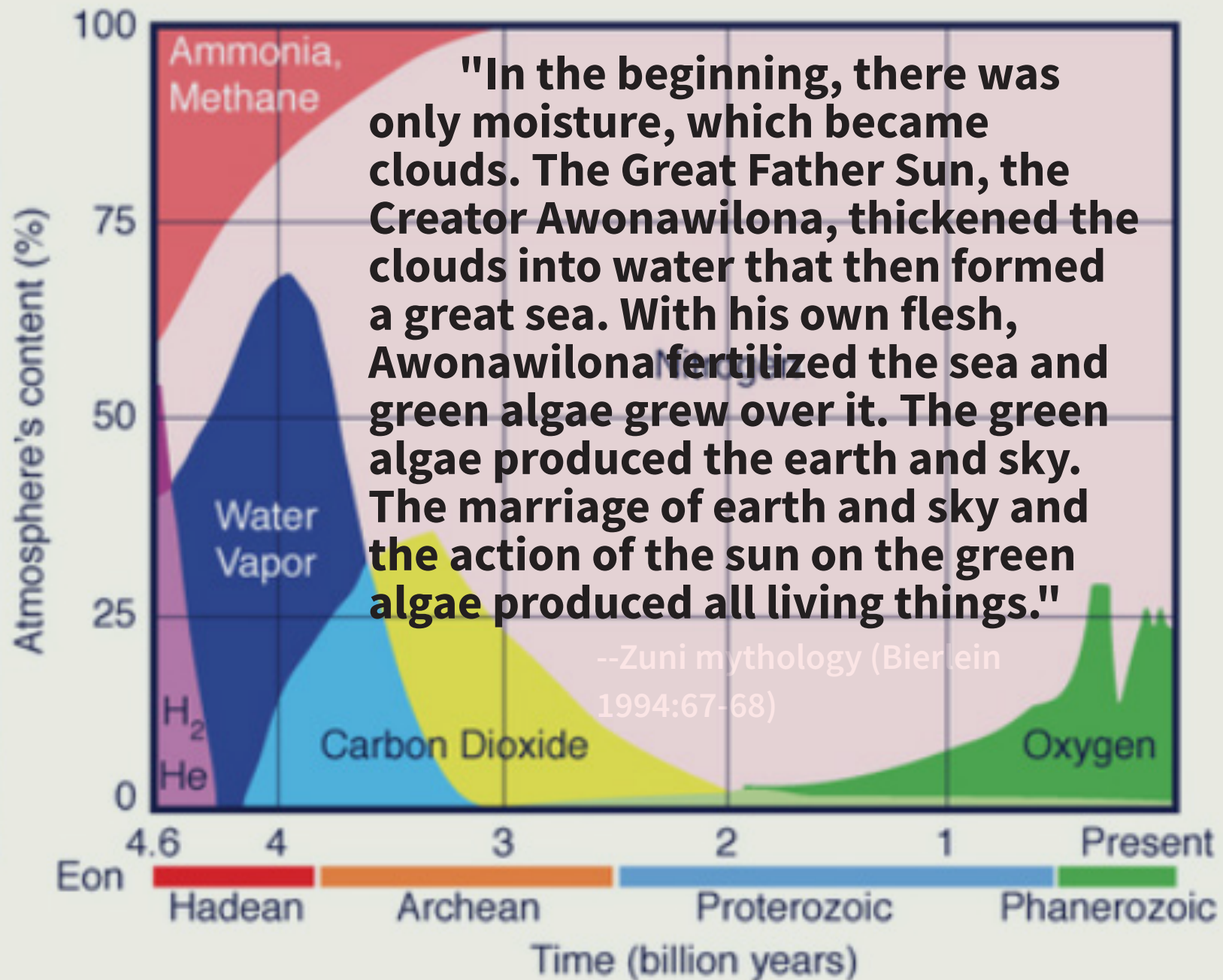
# What is science?

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"In the beginning, there was only moisture, which became clouds. The Great Father Sun, the Creator Awonawilona, thickened the clouds into water that then formed a great sea. With his own flesh, Awonawilona fertilized the sea and green algae grew over it. The green algae produced the earth and sky. The marriage of earth and sky and the action of the sun on the green algae produced all living things."

--Zuni mythology (Bierlein 1994:67-68)  
(<http://www.ashiwi.org/>)

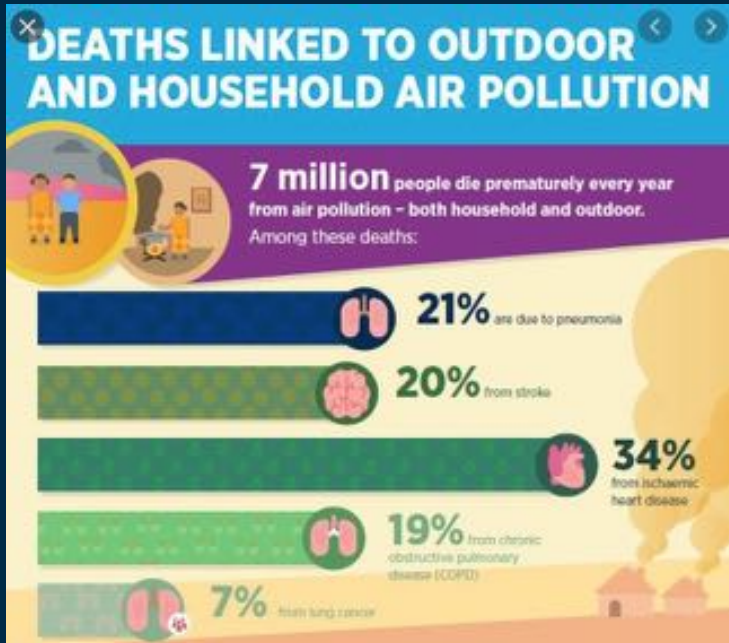
# They are BOTH science.





# Healthy People = Healthy Planet

## Case #1: Air



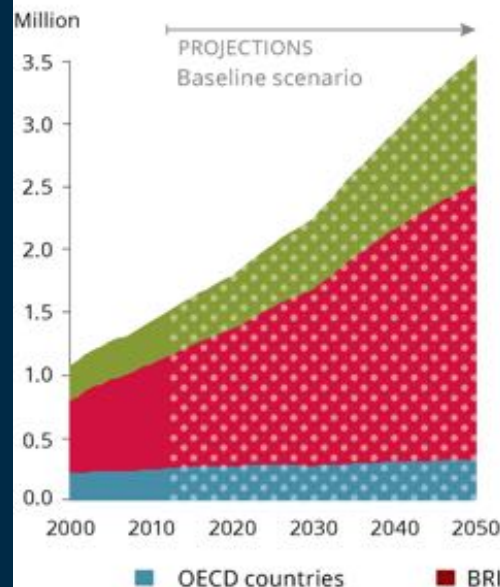
## Study estimates exposure to air pollution increases COVID-19 deaths by 15% worldwide

27 Oct 2020

## Welcome to “Cancer Alley,” Where Toxic Air Is About to Get Worse

Air quality has improved for decades across the U.S., but Louisiana is backsliding. Our analysis found that a crush of new industrial plants will increase concentrations of cancer-causing chemicals in predominantly black and poor communities.

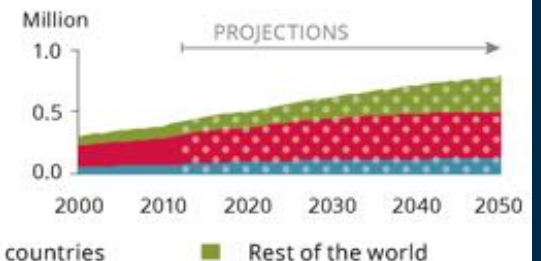
World premature deaths from exposure to particulate matter



Megacities of 2025



World premature deaths due to ozone pollution



# Healthy People = Healthy Planet

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## Case #1: Air



**Can California's Iconic Redwoods Survive  
Climate Change?**



# Healthy People = Healthy Planet

## Case #2: Water

### Update on Newburgh Water Contamination Issue

Apr 24, 2019



Beatrice Harris of Newburgh, who suffers from a host of medical issues from the contaminated water supply in Newburgh, was one of several community residents who spoke about the debilitating and costly human effects of this ongoing issue in Newburgh at a special meeting held Thursday night at the Newburgh Unity Center by the US Air Force.

By Jennifer L. Warren

**NEWBURGH** – Perfluorooctanesulfonic acid, PFOS and Perfluorooctanoic acid, and PFOA have become common language for many in the City of Newburgh and New Windsor.

These synthetic fluorinated organic compounds are applied to numerous industrial and consumer products, including cookware, stain-resistant fabric and carpet as well as fire fighting foam. Falling under the umbrella of Perfluorinated Compounds (PFCs), PFOS and PFOA are the sole two compounds carrying the Environmental



Am. J. Trop. Med. Hyg., 97(5), 2017, pp. 1623–1628

doi:10.4269/ajtmh.17-0396

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### Human Intestinal Parasite Burden and Poor Sanitation in Rural Alabama

Megan L. McKenna,<sup>1</sup>† Shannon McAtee,<sup>1</sup>† Patricia E. Bryan,<sup>1</sup> Rebecca Jeun,<sup>1</sup> Tabitha Ward,<sup>1</sup> Jacob Kraus,<sup>1</sup> Maria E. Bottazzi,<sup>1</sup> Peter J. Hotez,<sup>1</sup> Catherine C. Flowers,<sup>2</sup> and Rojelio Mejia<sup>1\*</sup>

<sup>1</sup>Departments of Pediatrics and Medicine, National School of Tropical Medicine, Baylor College of Medicine, Houston, Texas; <sup>2</sup>Alabama Center for Rural Enterprise, Montgomery, Alabama

# Healthy People = Healthy Planet

## Case #2: Water



Aug 10, 2020

### Stranded whales and dolphins offer a snapshot of ocean contamination

"Many of the chemical profiles that we see in cetaceans are similar to the types of chemical profiles that we see in humans who live in those coastal areas."

*Am. J. Trop. Med. Hyg.*, 97(5), 2017, pp. 1623–1628  
doi:10.4269/ajtmh.17-0396  
Copyright © 2017 by The American Society of Tropical Medicine and Hygiene

### Human Intestinal Parasite Burden and I

Megan L. McKenna,<sup>1</sup>† Shannon McAtee,<sup>1</sup>† Patricia E. Bryan,<sup>1</sup> Reber  
Peter J. Hotez,<sup>1</sup> Catherine C. Flov

<sup>1</sup>Departments of Pediatrics and Medicine, National School of Tropical Medicine  
Rural Enterprise, Montgoi



### Herbicide, Lead, and Other Poisons Found in Bodies of Stranded Dolphins and Whales

George Dvorsky  
8/10/20 2:56PM • Filed to: STRANDED DOLPHINS

2 Save



**A** AL  
Equip Your  
14,000 enclosure  
and accessories  
in stock today  
nVent  
SHOP NOW

Recent Video



# Spoiler Alert! My Punchlines

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We are on the verge of pressing a massive "RESET" button. Science is not enough. Laws are not enough. Trust has been broken on all levels. What is the best strategy for moving forward on water stewardship? Who has the knowledge? Who has the power? If these aren't the same people, we need to make some big changes.

## We need new strategies for these unprecedented times:

- Regulation does not equal stewardship. Institutions like DEC, EPA cannot achieve equitable access to shared resources like water and air on their own. We, the community, must be more involved.
- We need to shift our perspectives from "is it safe to swim?" and "are we protecting the fish?" to "do we ALL have equal access to clean water?"
- Put people first, ALL people -- and the fish and clean swimming beaches must follow!
- We need to move our citizen science into true community science (functional, defensible, active).
- Holistic water stewardship requires paying attention to air, as well.

## A reminder:

We are ALL frontline communities when it comes to water and air. Community science is our early warning system. It is reasonable to demand attention/action from our elected officials and tax-supported institutions when we observe and document an issue. *We should never agree to rules restricting our capacity to make and communicate these observations.*

# We (all of us!) are the front line.



# We (all of us!) are the front line.

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**We (all of us!) are the front line.**

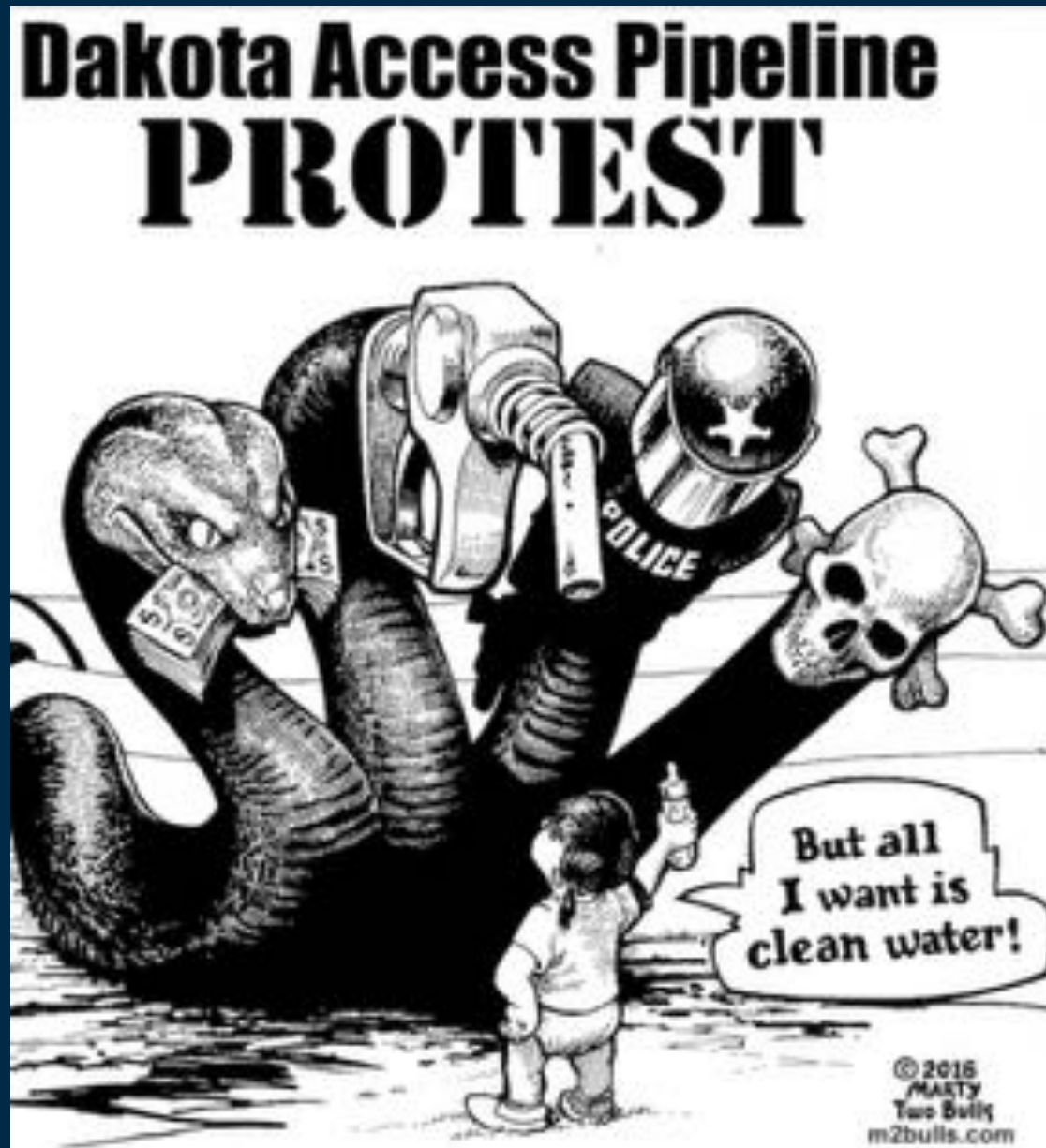
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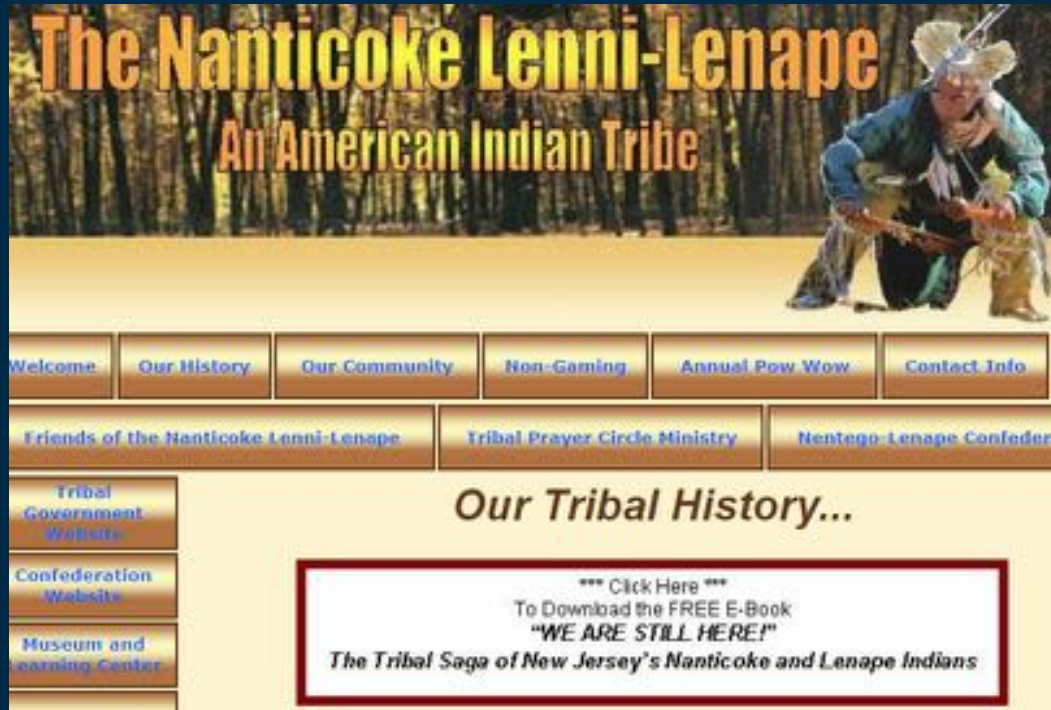


**We (all of us????) are the front line.**

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# The "we" in the Hudson River watershed



We are fighting to protect shared resources on indigenous homelands. Peoples of indigenous nations are integral to our water communities. These nations have scientific and historical knowledge/experience that no US scientist or government official currently has.

**Remember:** While the drivers may be different this time, *climate change has occurred in the Hudson Valley before. These communities have expert knowledge.*

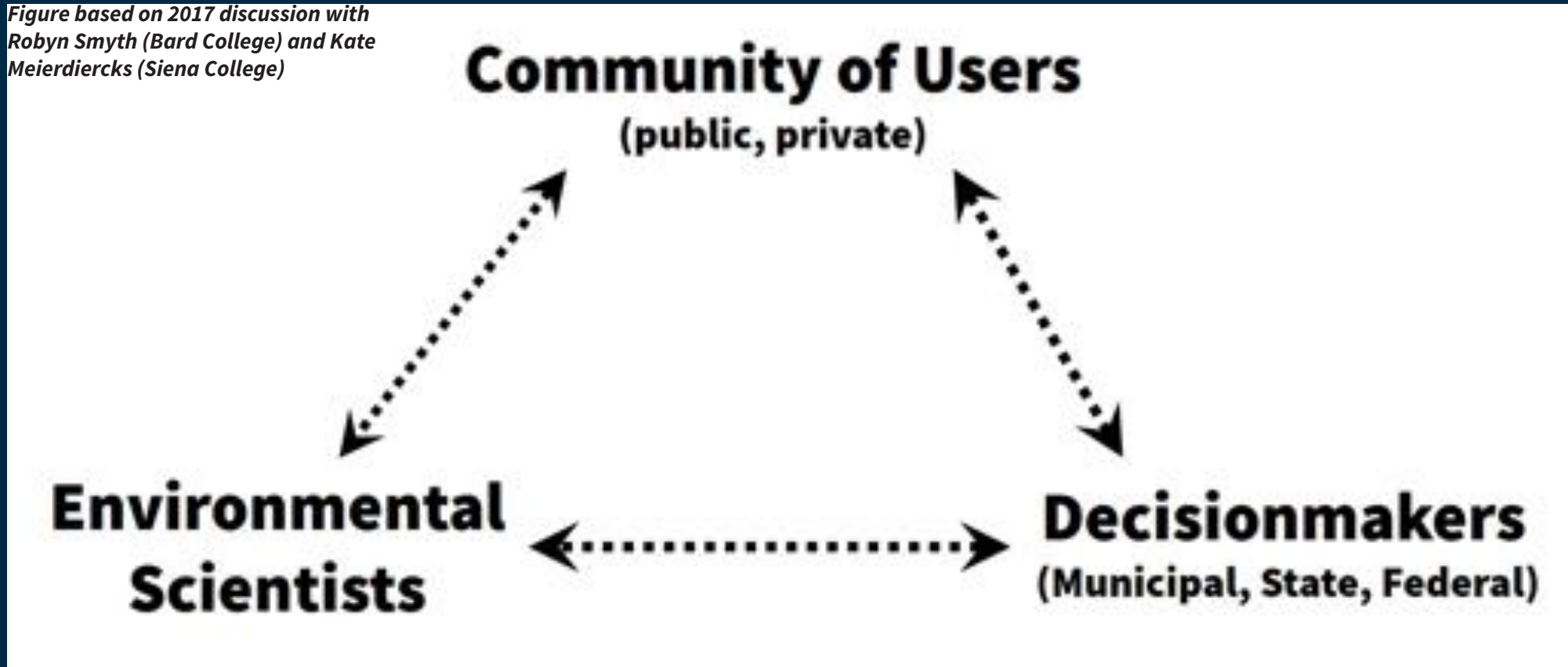
## Stockbridge-Munsee Community Band of Mohican Indians



"People of the waters that are never still"

# Protecting Shared Resources

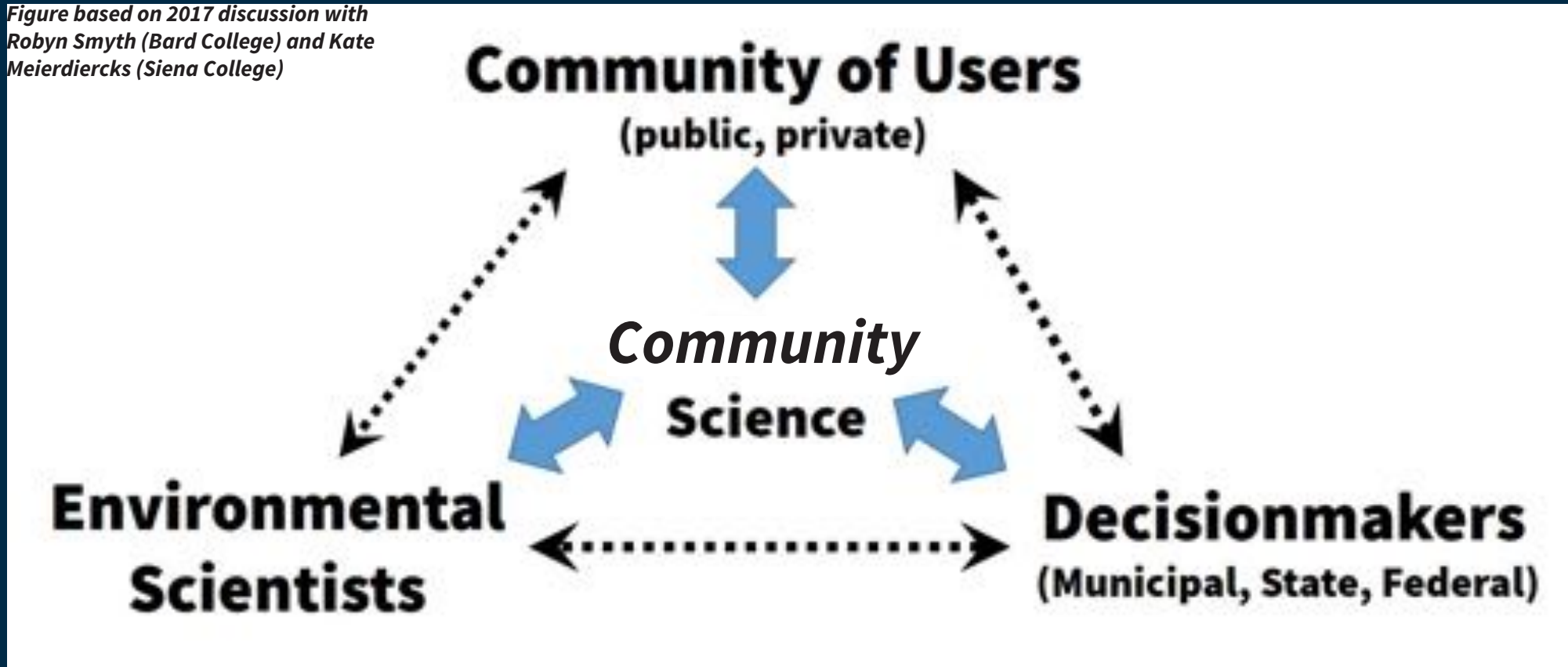
*Figure based on 2017 discussion with Robyn Smyth (Bard College) and Kate Meierdiercks (Siena College)*



- We have limited capacity to make meaningful change with current avenues of communication and distribution of resources/power.
- Recent actions by Feds, EPA, NY DEC have reduced/delegitimized community voices in water stewardship.

# Protecting Shared Resources

*Figure based on 2017 discussion with Robyn Smyth (Bard College) and Kate Meierdiercks (Siena College)*



- Regulation does not equal stewardship. Institutions like DEC, EPA cannot cannot achieve equitable access alone.
- Need a shared forum where different ways of knowing and community connections to these are re-centered -- community science (beyond citizen science)?



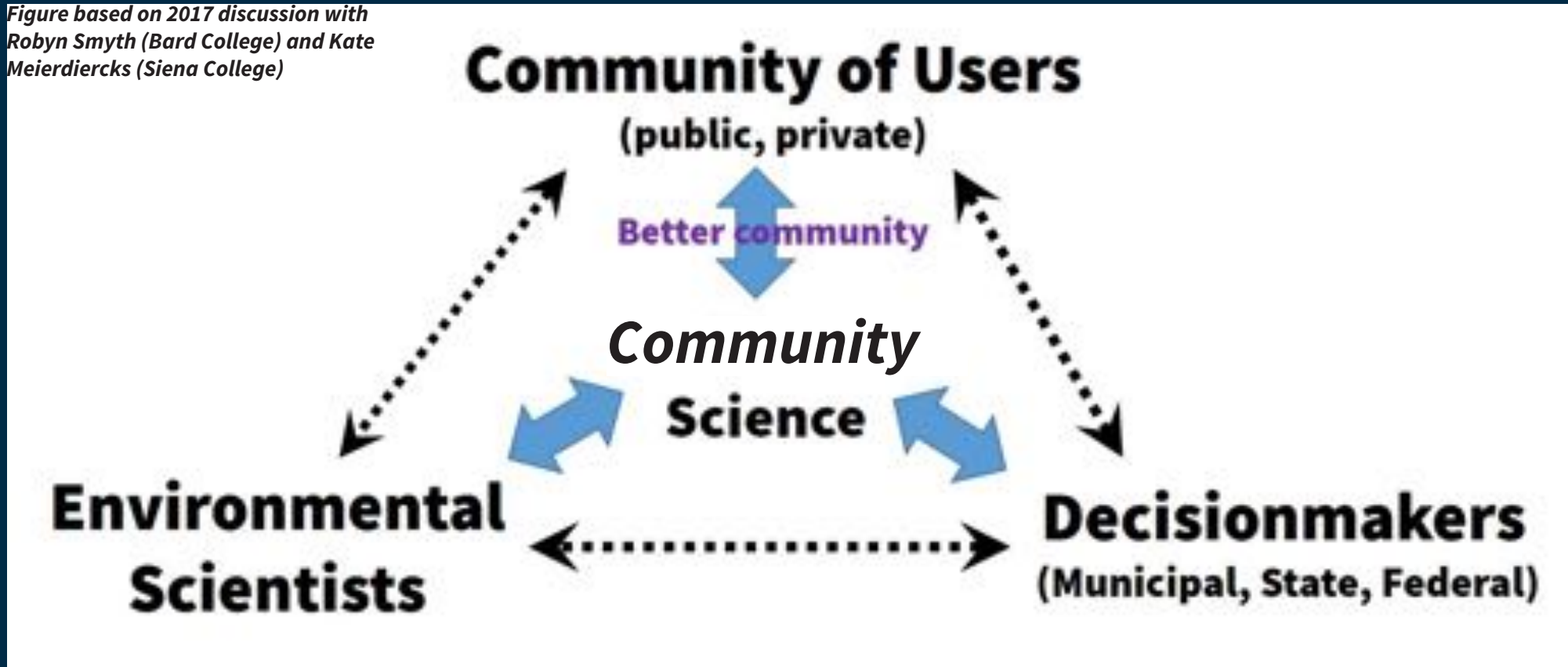
# Community Science (Common Sense)

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# Protecting Shared Resources

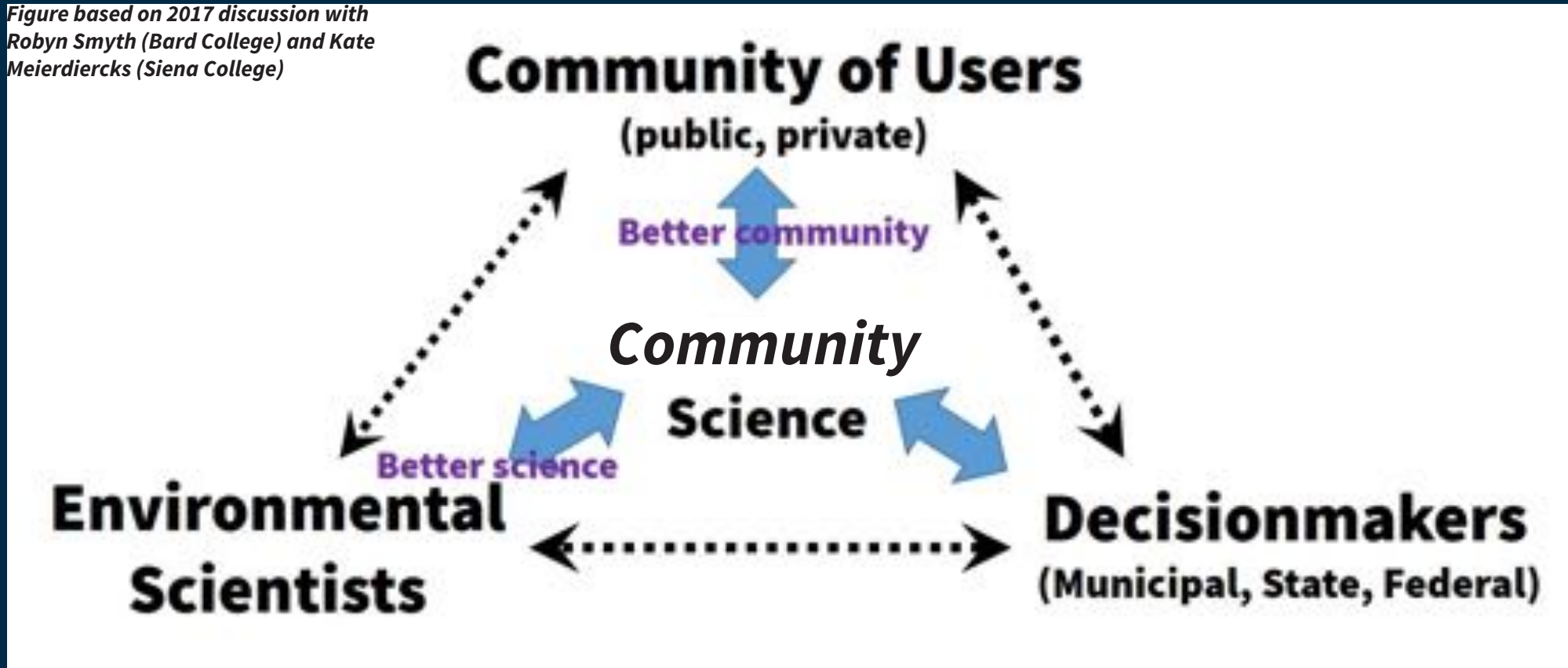
*Figure based on 2017 discussion with Robyn Smyth (Bard College) and Kate Meierdiercks (Siena College)*



- Organized communities are better equipped to advocate for shared resource management
- Organized communities can collectively shift culture, addressing sources of inequity

# Protecting Shared Resources

*Figure based on 2017 discussion with Robyn Smyth (Bard College) and Kate Meierdiercks (Siena College)*



- Science informed by community interest and fueled by community participation will help to shift cultural norms
- Communities ask the best scientific questions, bringing creativity to the process

# Science + Communities

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**Eli Dueker** 🏳️‍🌈🔬🧠🚢 @ed71\_h2o · Dec 5

...

Too funny! I hear you, @DepressedDarth and will work harder to meet the real needs of real people with my science.....:))...



**Darth Vader** @DepressedDarth · Dec 5

Dear Scientists,

It's almost 2021 and you still haven't invented real lightsabers, please get to work.

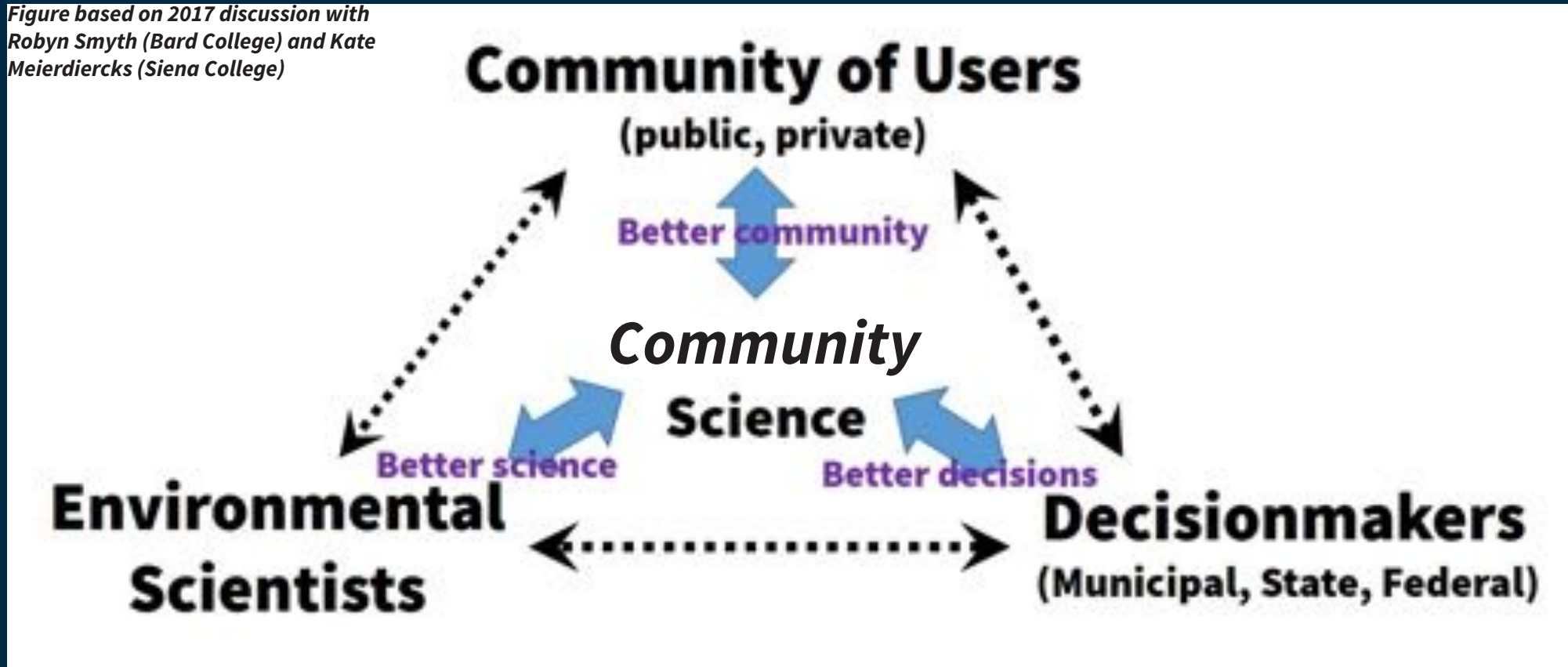
Sincerely,

Every Star Wars Fan.



# Protecting Shared Resources

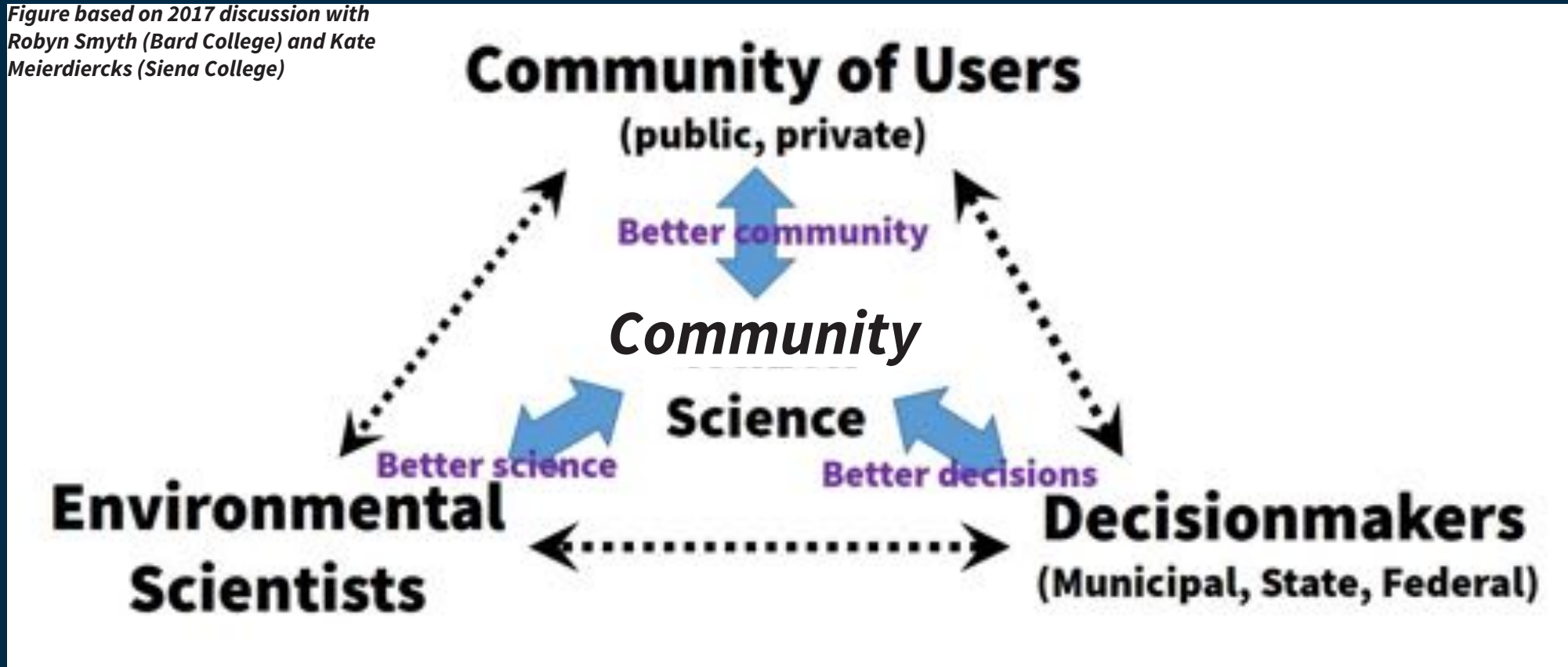
*Figure based on 2017 discussion with Robyn Smyth (Bard College) and Kate Meierdiercks (Siena College)*



- Supported by better science that is widely understood by (and performed by) the community, decisionmakers can be better informed and more agile in addressing water threats. Plus, they have the power of community (voters, taxpayers) behind them, and a real sense of accountability.

# Protecting Shared Resources

Figure based on 2017 discussion with  
Robyn Smyth (Bard College) and Kate  
Meierdiercks (Siena College)



- True stewardship requires everyone to be part of the scientific process and communication. We need science that is generated by and used by a full *community* of stakeholders.
- *Challenge: how do we (all of us, here, now) collaborate to make this real?*

# **I don't know for sure, but.....?**

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**What about fundamentally reorienting our science, our regulatory work, our stewardship efforts, to address issues of environmental racism specifically? How about centralizing and supporting environmental justice as opposed to environmental conservation? This will require having ALL voices at the table. The end result would potentially be far better and, more importantly, defensible in the long-term.**

***Also. There is already a comprehensive roadmap --***



# Jemez Principles (<https://www.ejnet.org/ej/jemez.pdf>)

- **Be Inclusive** (who is our leadership? are we including all stewards?)
- **Bottom-up Organizing** (what are priorities/needs of the people?)
- **Let People Speak for Themselves** (more knowledge!)
- **Work Together in Solidarity and Mutuality** (sharing power)
- **Build Just Relationships Among Ourselves** (becoming whole selves)
- **Commitment to Transformation** (change is tough but required)



Dr. Barbara J. Love

# Bard: Community + Science



# Bard Water Quality Collaborations

As a community member

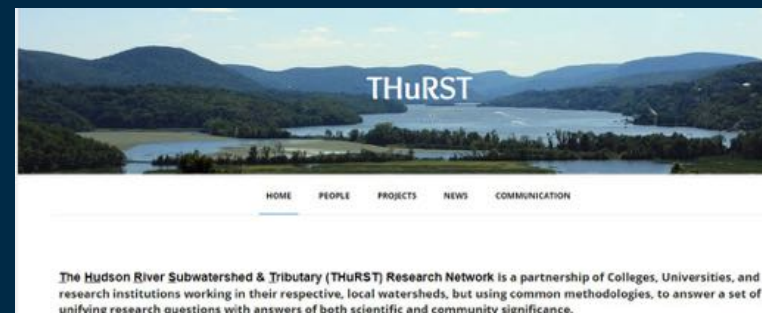
## SKWC: Saw Kill Watershed Community

Protecting the Saw Kill watershed and its ecological, recreational, and historic resources through hands-on science, education, and advocacy.



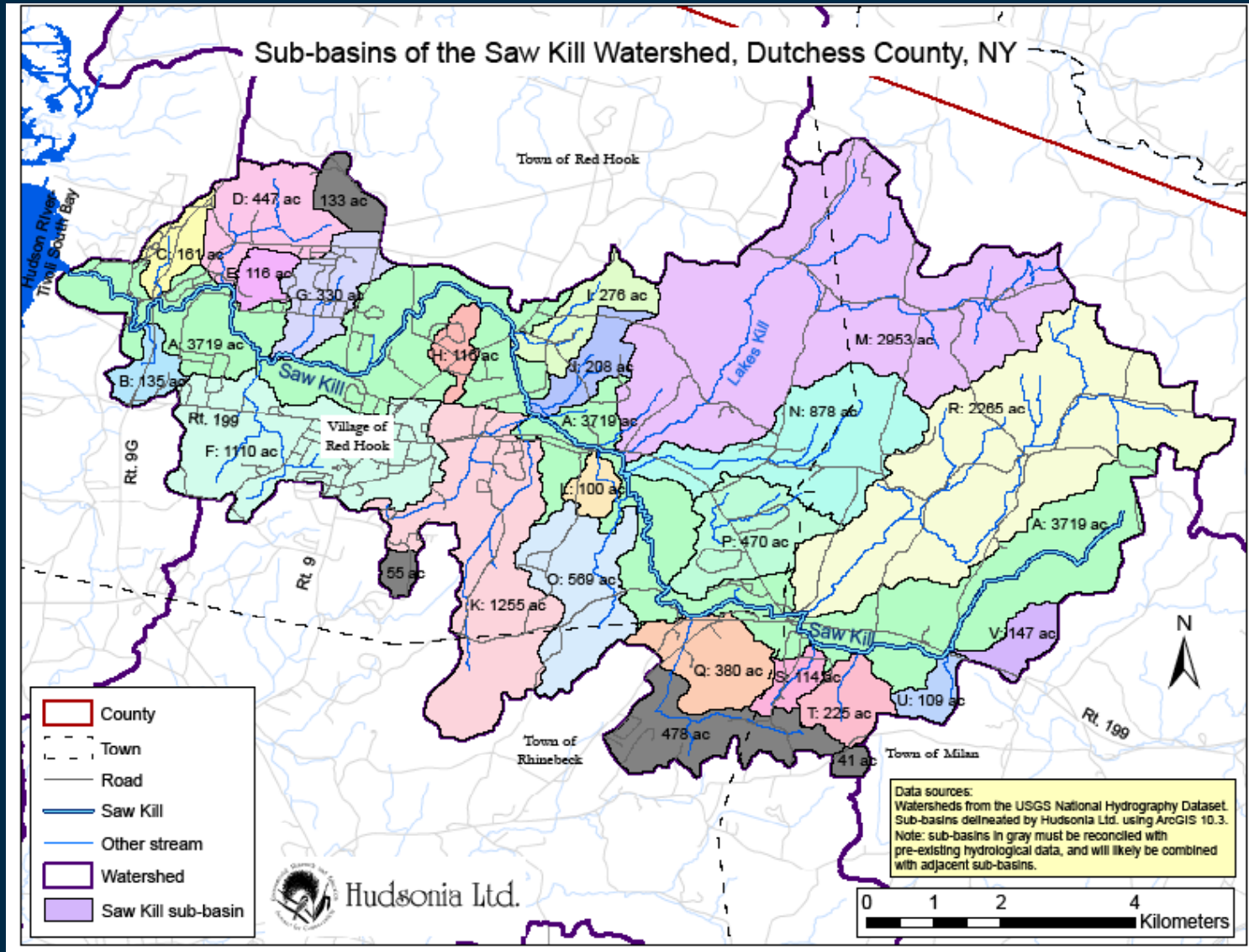
As a resource  
(tools, time,  
people, experts,  
access to  
funding)

As an academic  
community-  
builder





# Saw Kill Watershed Community



Are watersheds a new way to think about neighborhoods?

--Bob Wills, Dutchess County

# Community Questions:

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1. Is nutrient loading an issue on the waterway?
2. Are leaky septic tanks contaminating the waterway and aquifer?
3. How do we better manage floodwaters during extreme weather events?
4. Are road salts a problem for our waterway and/or drinking water?
5. **Is our drinking water protected sufficiently?**

# Community Science

- Long history of community/science on the Saw Kill (as early as 1976) and connection with Bard College resources

PARAMETER	UNITS	1	2	3	4	5	6	7	8	9A	9B	9C	9D	10	11	12A	12B	12C
Time	Hours	1100	1135	1205	1245		1305	1330	1345		1500	1535	1520	1555	1545	1600		
Air Temperature	Deg. C.	-3	-2	-2	1		3	0	2		2	-2	1	-4	0	-5		
Water Temperature	Deg. C.	6	5	5	3		4	4	4		4	4	3.5	3.5	3	3		
pH	Units	7.8	7.7	7.7	7.5		7.5	7.9	7.5		7.6	7.2	7.6	7.6	7.6	7.4		
Dissolved Oxygen	MG/L	8	7	13	10		14	10	5		13	11	14	13	14	13		
Hardness(CaCO <sub>3</sub> )	MG/L	188	222	205	103		188	171	171		171	171	171	171	205	256		
Total Alkalinity	MG/L	239	274	291	105		222	239	223		222	222	222	256	256	342		
Chloride(NaCl)	MG/L	51	38	38	38		38	38	38		38	48	38	40	63	100		
Phosphate, total	MG/L																	
Nitrate	MG/L																	
Ammonium N(N)	MG/L	.36	.36	.36	.36		.36	.36	.12		.24	.36	.24	.36	.48	.34		
Iron	MG/L	All Iron tests zero within limits of method																
Fecal Strep	Col/MG	24	8	28	12		20	40	20		24	<4	20	16	28	38		
Fecal Coliform	Col/MG	28	12	16	8		16	4	24		4	<4	<4	8	12	140		
Total Coliform	No/100 ML	100	16	60	16		28	88	60		200	20	60	84	100	*		
Ratio, FC:PS	Unitless	.86	1.5	.57	.67		.80	.10	1.2		.17	.21	<.20	.50	.43	3.7		

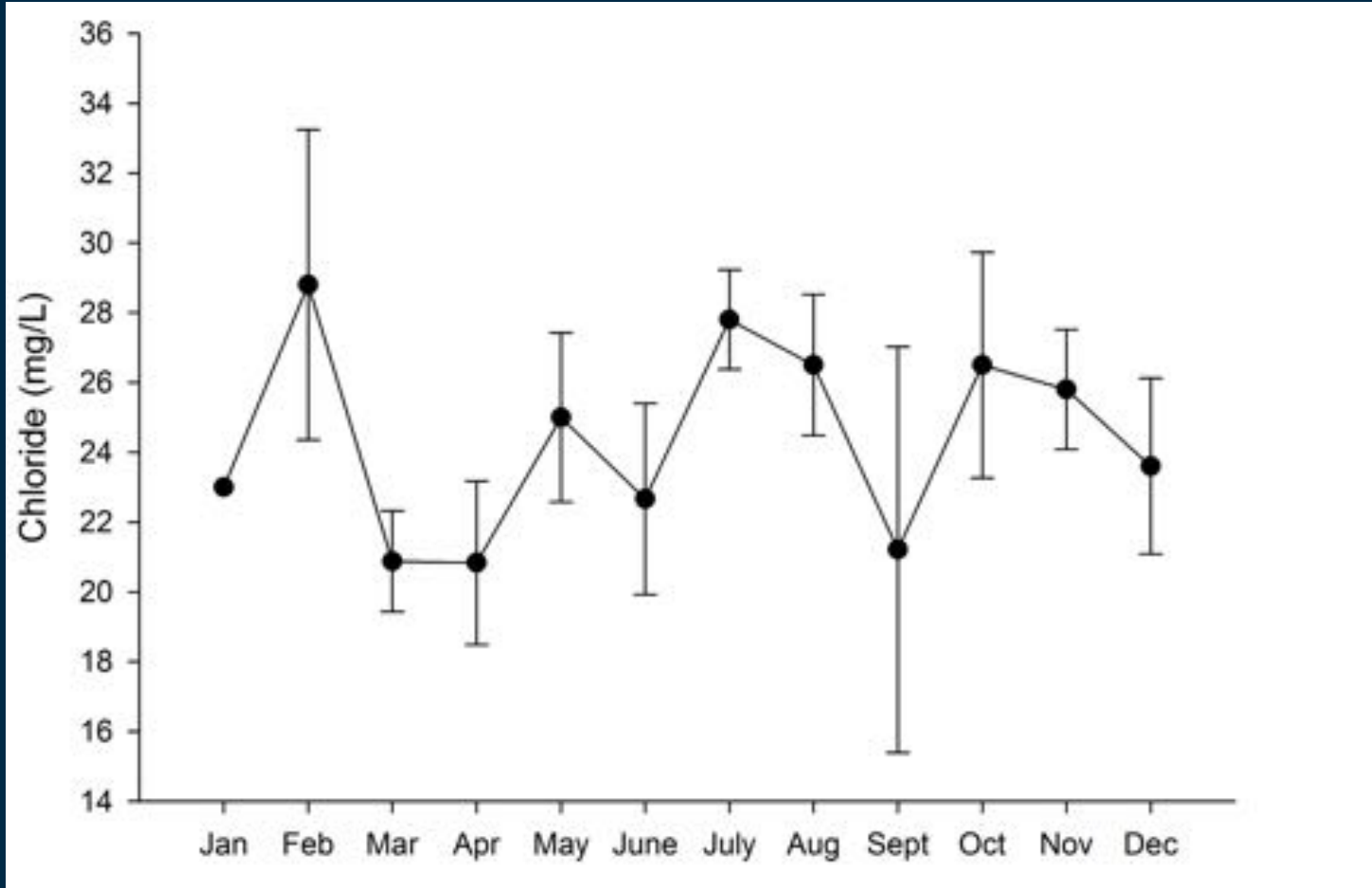
Dates: 12-7-75 Max. Air Temp.: 20° C. Test Day Rainfall:



# Community Science: baseline

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- Students and community members digitized and analyzed these data (1976-1982) to begin to answer the road salts question



# Community Science: monitoring

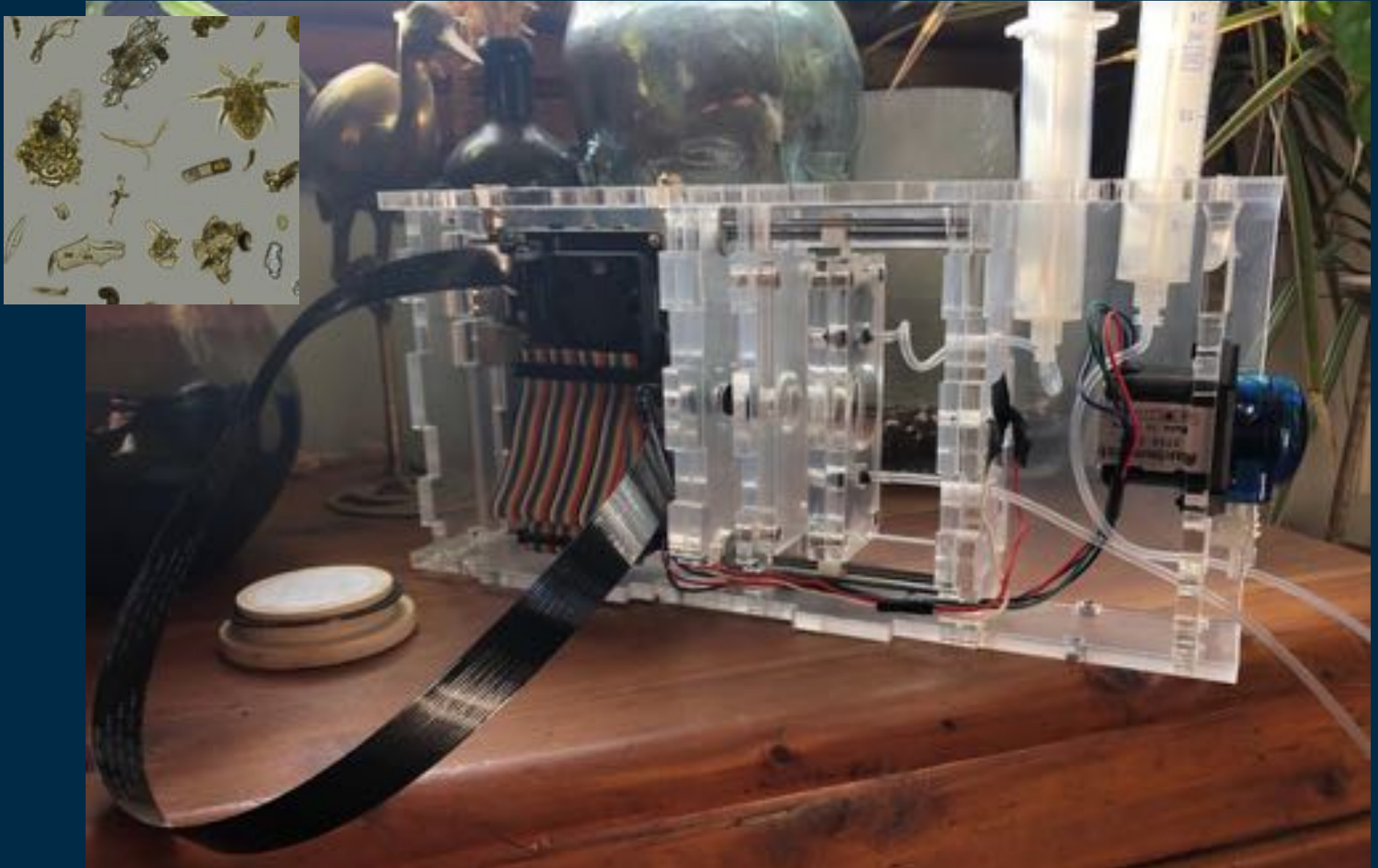
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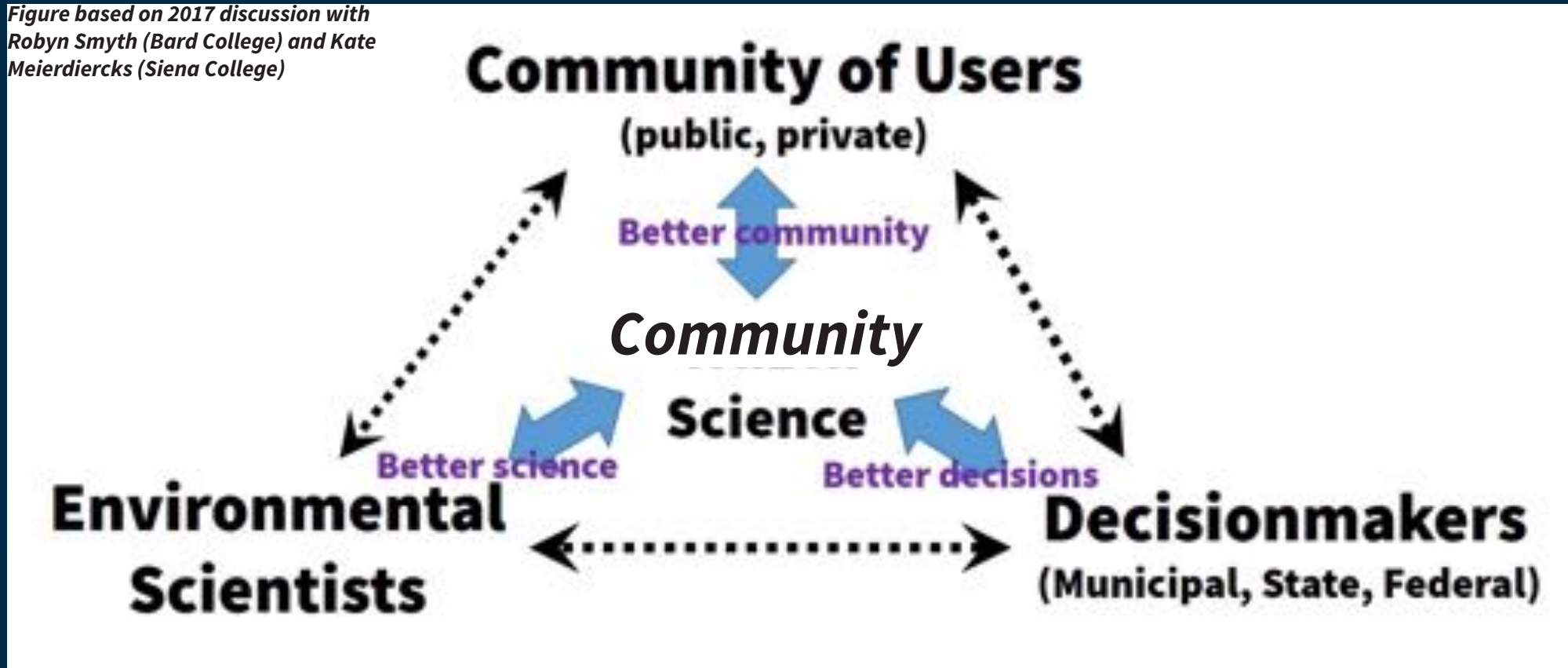
# Community Science: water monitoring

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# Protecting Water Resources

*Figure based on 2017 discussion with Robyn Smyth (Bard College) and Kate Meierdiercks (Siena College)*



- We are realizing the difference between citizen science and community science.....but we need to take the next step -- reconceptualizing the utility of monitoring, centralizing people and their concerns. Because there is no other option.



# This is NOT rocket science. It's often common science/sense.

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The Effects of Sewage Discharge on Streams

Author(s): H. W. Streeter

Source: *Sewage Works Journal*, Oct., 1931, Vol. 3, No. 4 (Oct., 1931), pp. 713-723

Published by: {wef}

Stable URL: <https://www.jstor.org/stable/25028101>

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1. Excessive bacterial pollution, notably by organisms of human intestinal origin.
2. Over-depletion of the normal dissolved oxygen content of stream waters.
3. The presence of specific substances in stream waters which may exercise toxic effects on human or domestic animal consumers of the water; may render it unfit for industrial or general domestic use; or may cause damage to bridges, dams and other structures in or along the stream.

# Water + Air: Historical Context

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- Miasma Theory

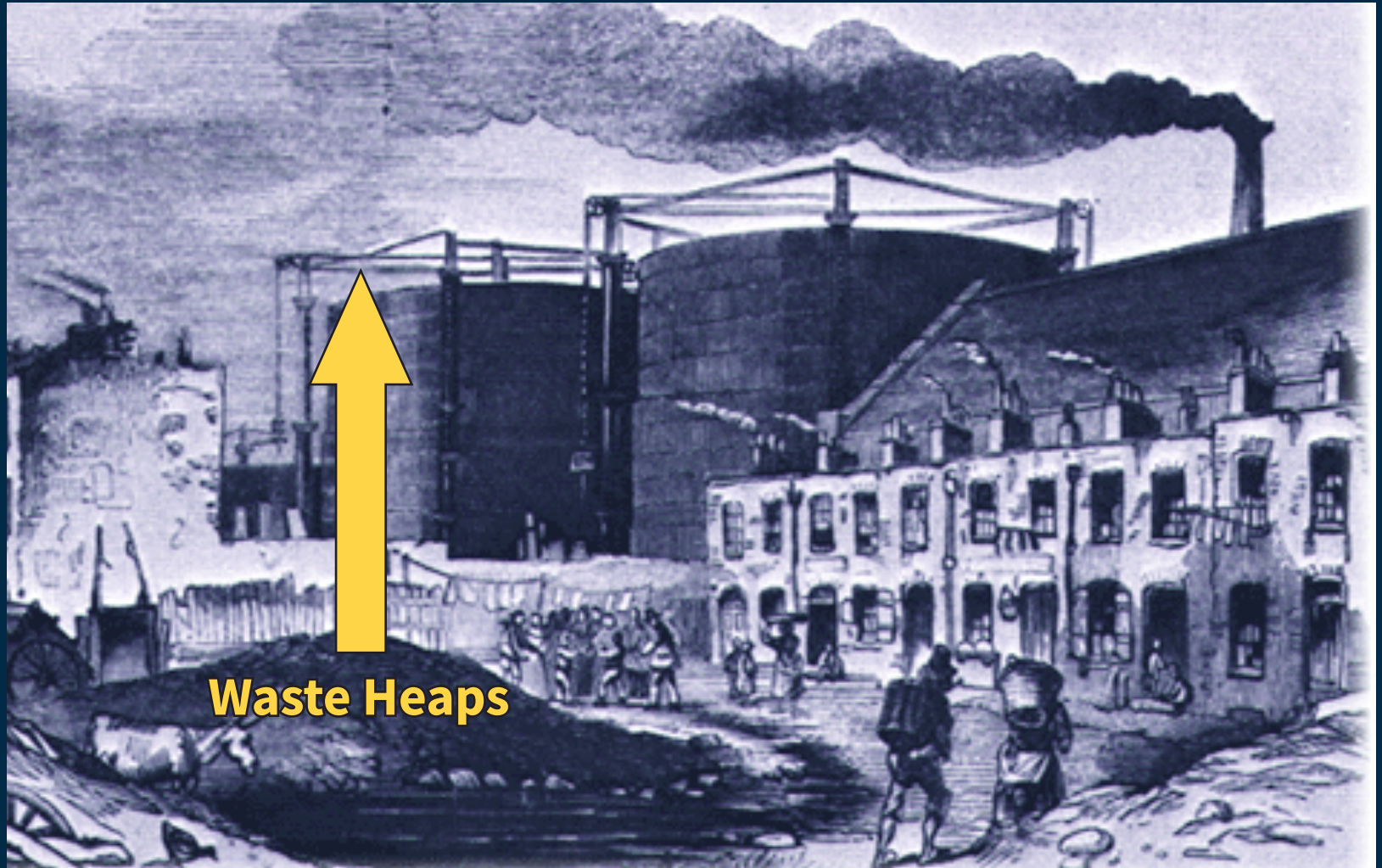




# Historical Water + Air Quality

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- Miasma Theory

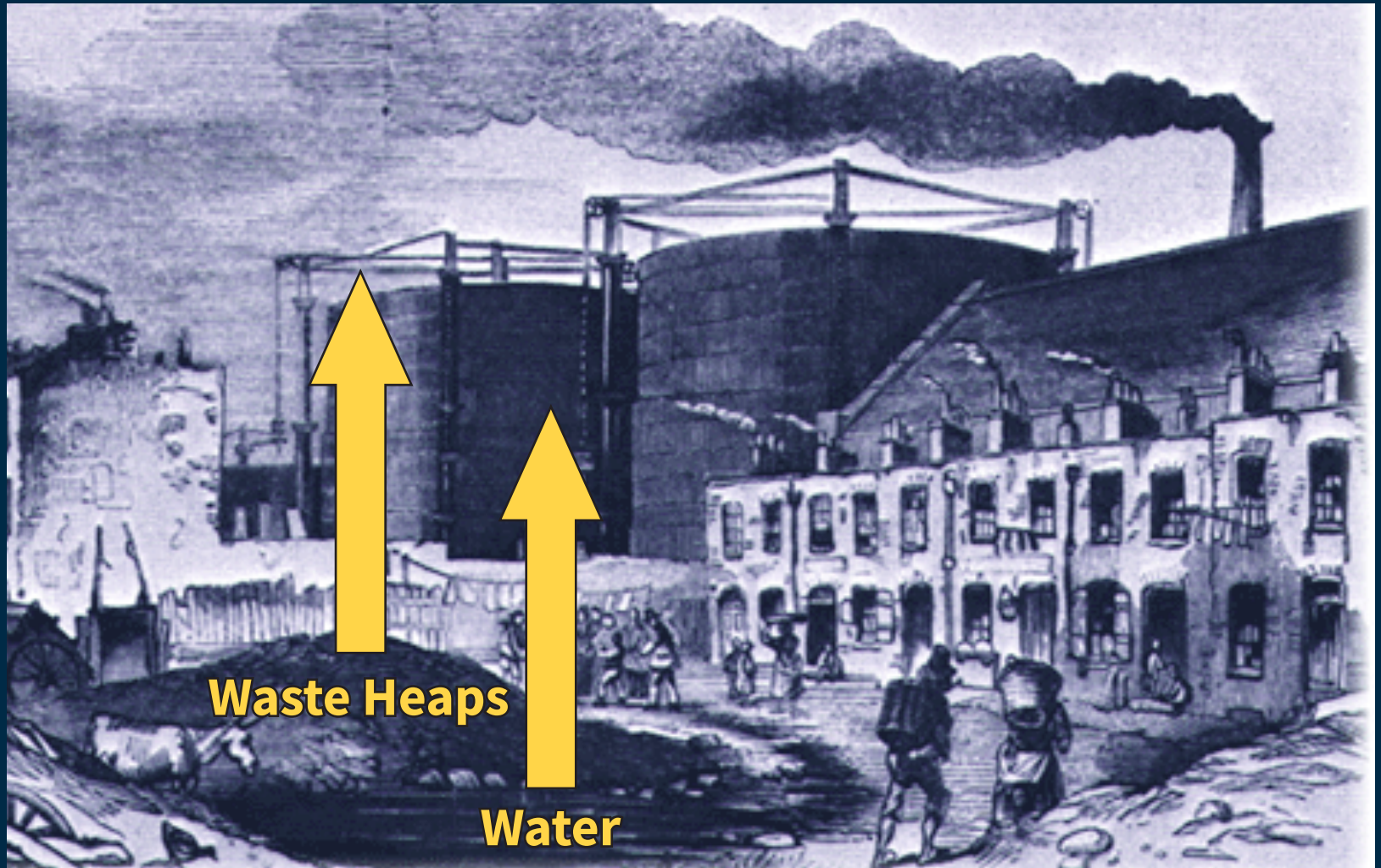




# Historical Water + Air Quality

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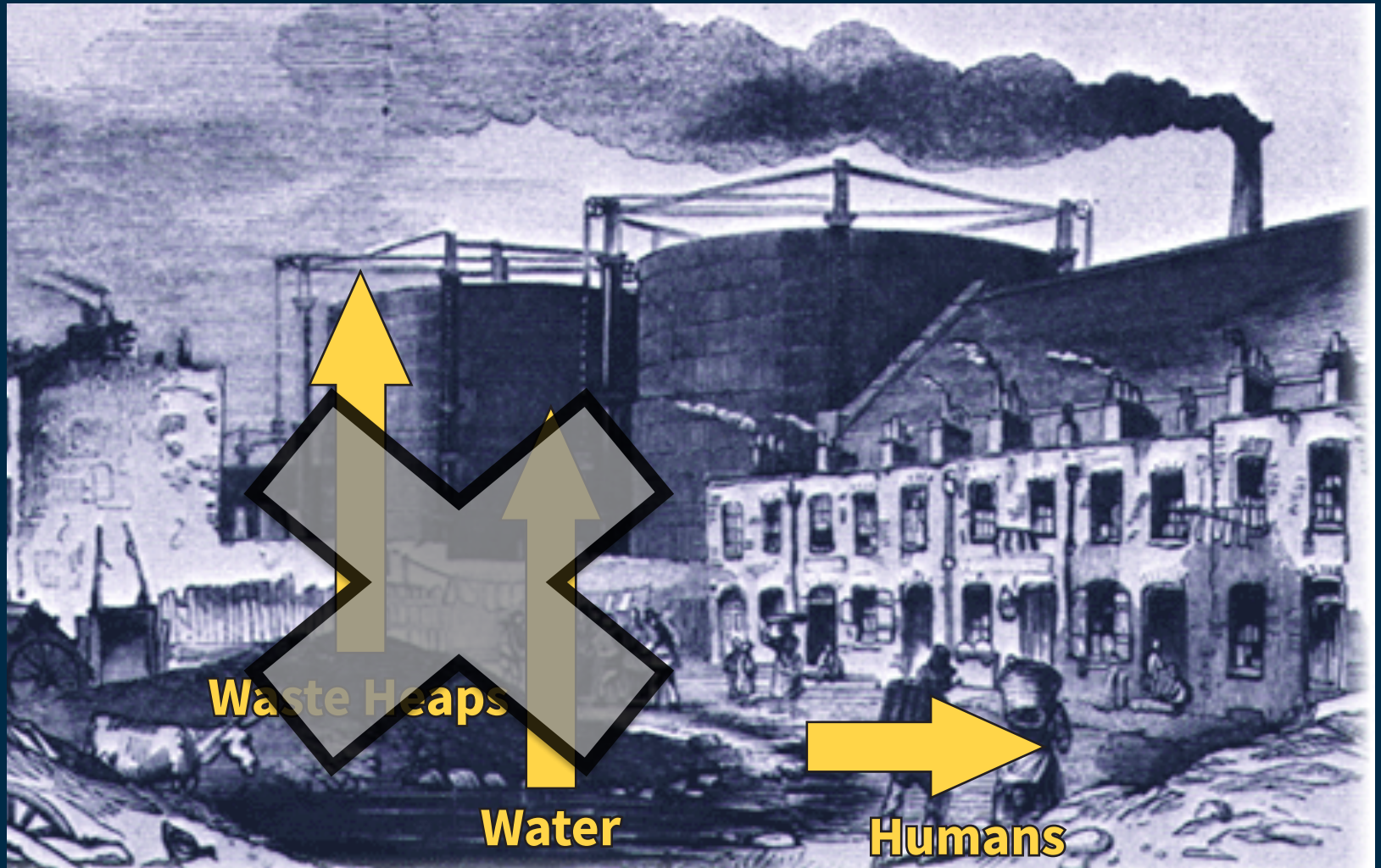
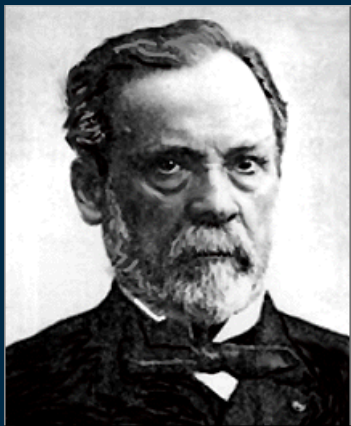
- Miasma Theory





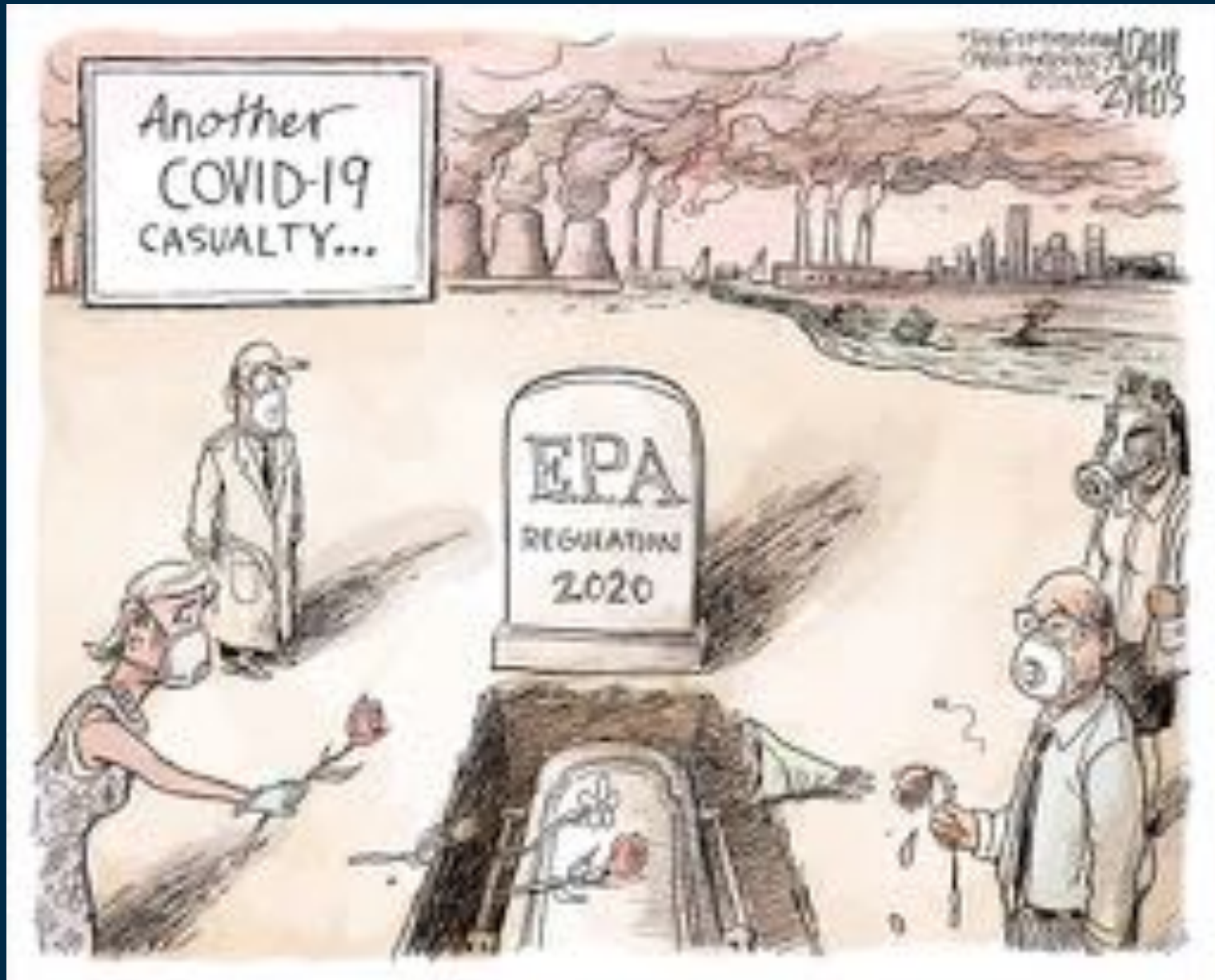
# Historical Water + Air Quality

- Miasma Theory → Germ Theory



# We (all of us!) are the front line.

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# We (all of us??) are the front line.



## Sacoby Wilson

Associate Professor, Applied Environmental Health (MIAEH)

Other Affiliations: UMD Prevention Research Center

Campus: UMD | Building: School of Public Health | Room: 2234D

Phone: 301-405-3136 | Email: [swilson2@umd.edu](mailto:swilson2@umd.edu)

Laboratory Website:

Community Engagement, Environmental Justice and Health (CEEJH)

Website:

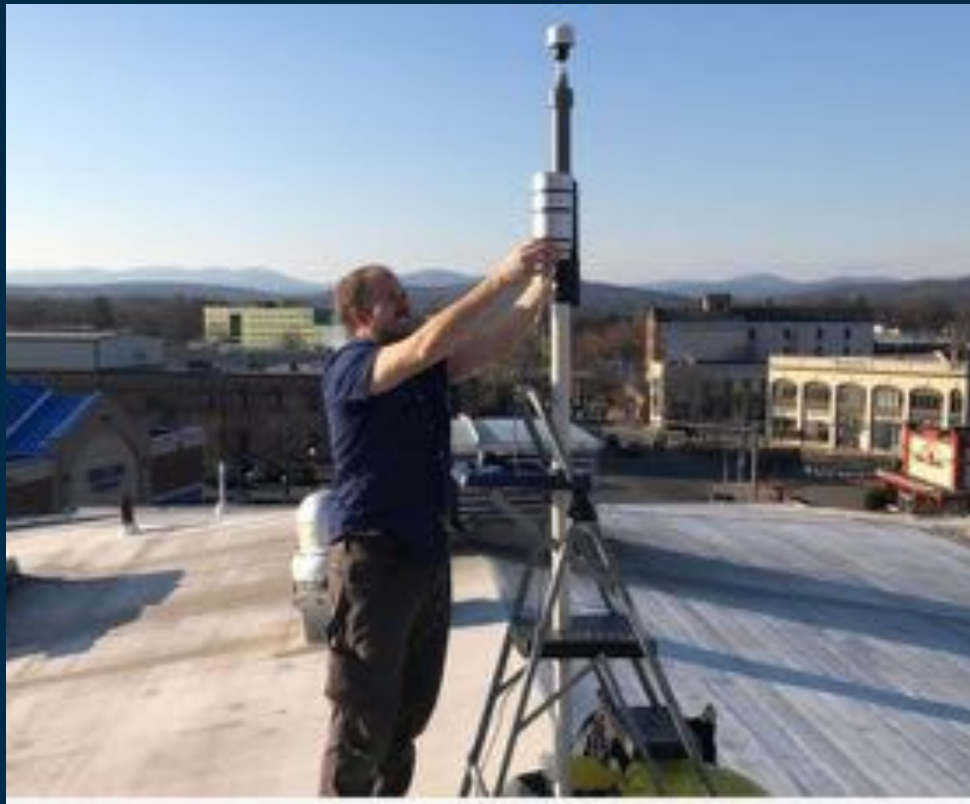
Community Engagement, Environmental Justice and Health lab



One thing that Covid-19 has done, it has made a lot of populations we made invisible, visible. Nursing home populations. The meatpacking industry. Prisons. Communities impacted by environmental injustice. These are communities that we've thrown away. We've made them invisible, but Covid-19 has made them visible.



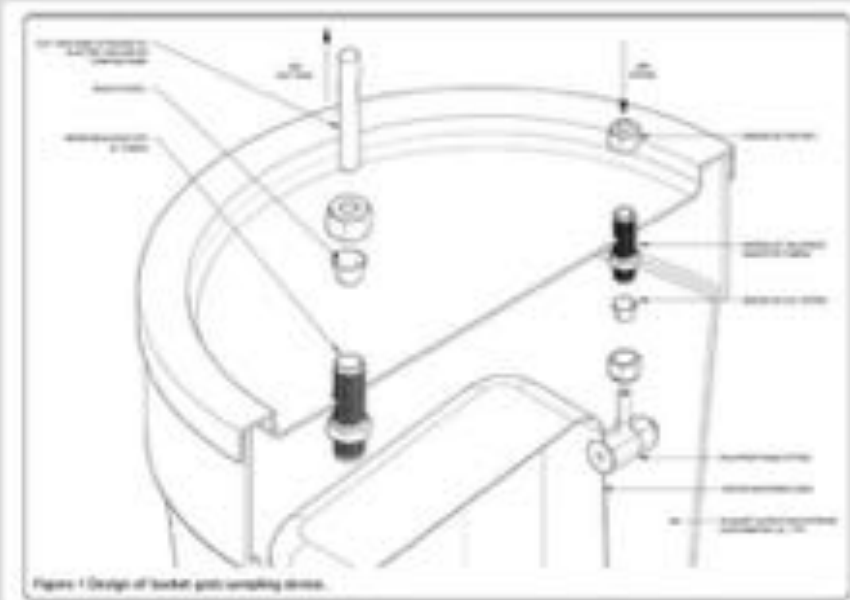
# Community Science: air monitoring





# Community Science: air monitoring

## Community Air Sampling

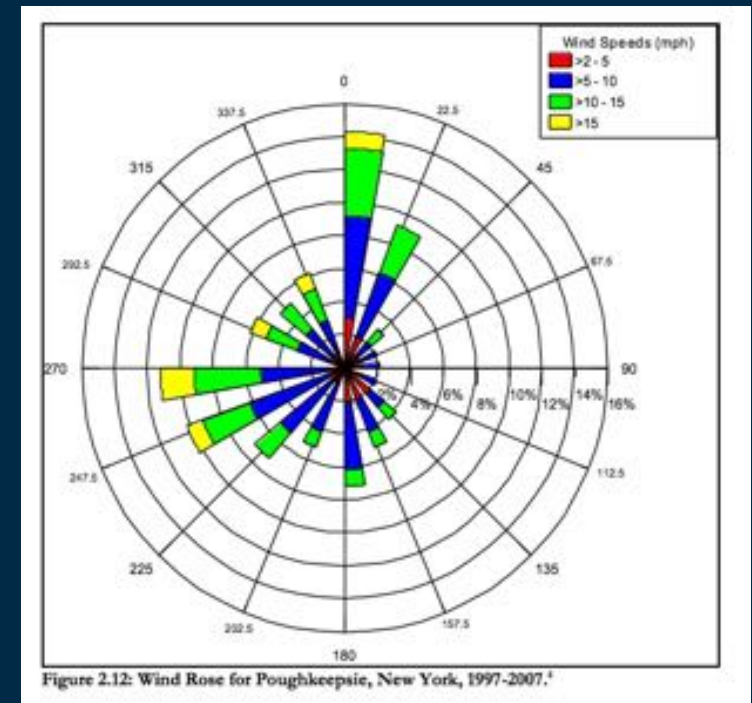
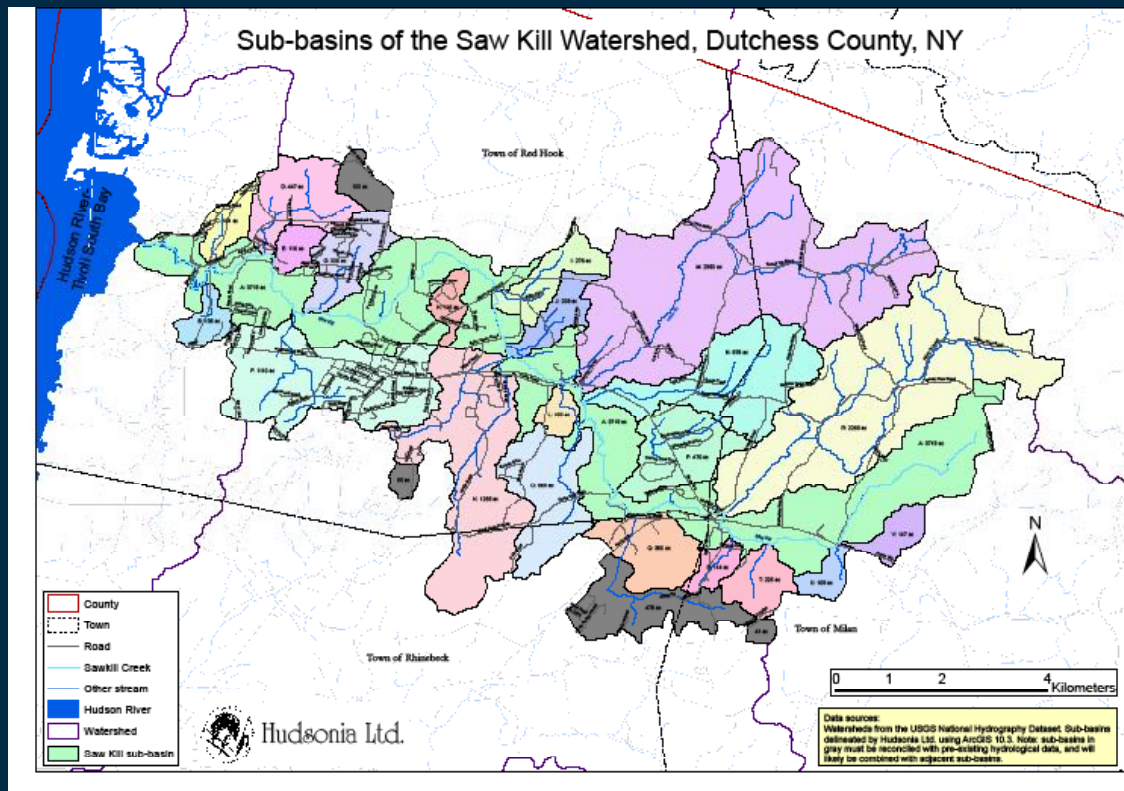


Macey et al., 2014



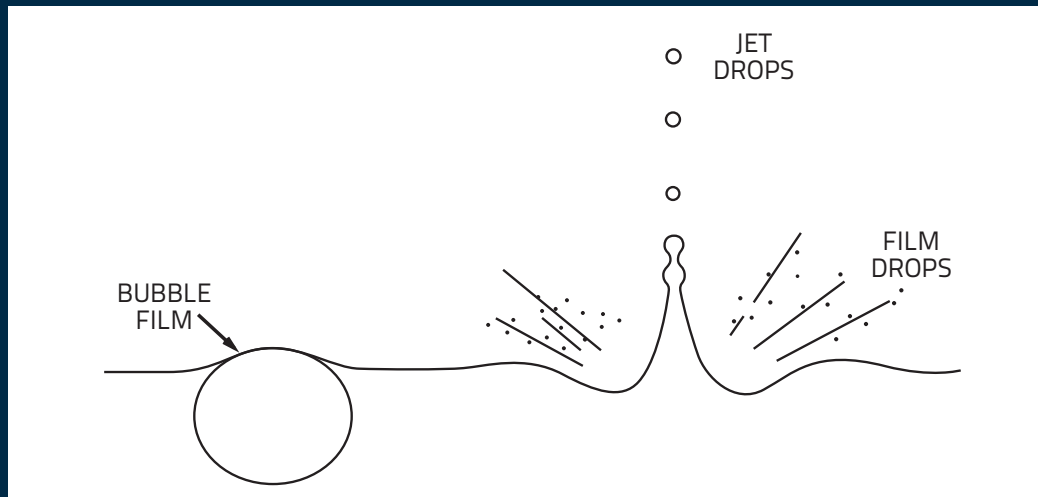
# Watersheds + Airsheds = Better Management of water?

- Airshed:
  - a part of the atmosphere that behaves in a coherent way with respect to dispersion of emissions; geographic area where local topography and meteorology limit dispersion of pollutants away from area



# Extreme Case: Aeration Remediation

- Aeration remediation in Newtown Creek: bubbling since 2010



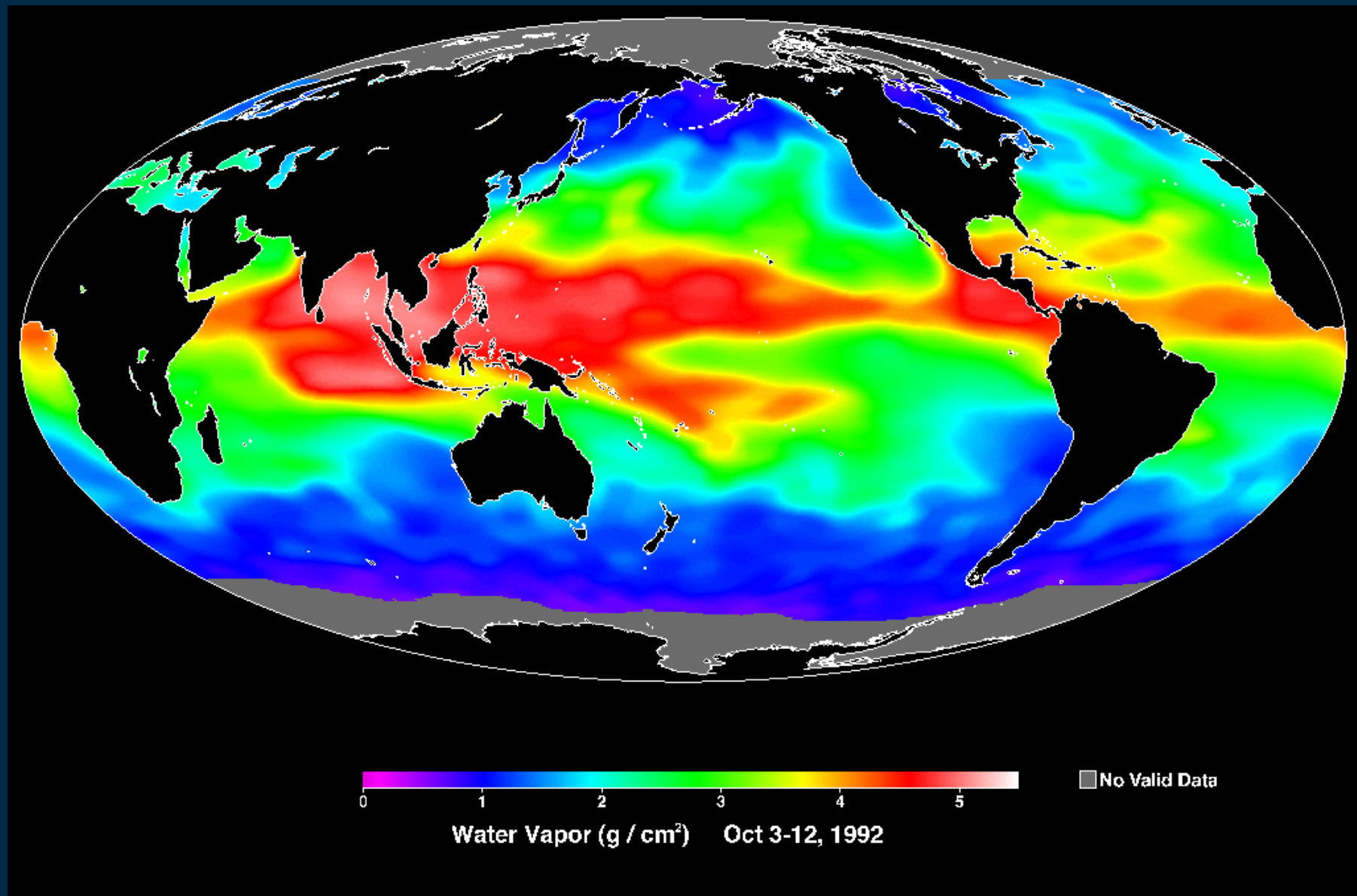
**NCA**  
NEWTOWN CREEK ALLIANCE

RESTORE  
REVEAL  
REVITALIZE



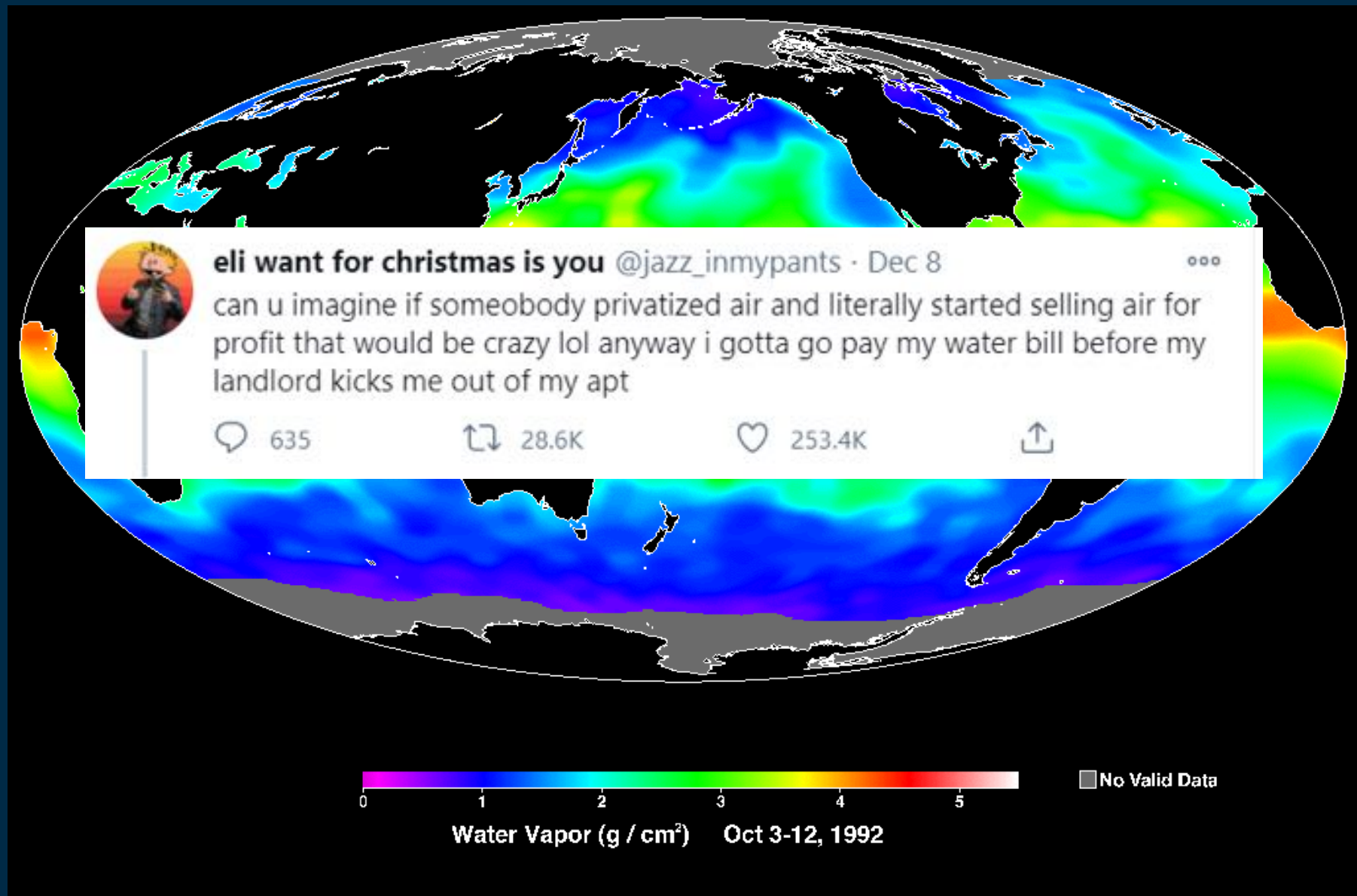
# Water Planet: Rivers everywhere!

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# Water Planet: Rivers everywhere!



# Let's do this.

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## Next Steps:

- Holistic approach to water stewardship -- water *and* air.
- Reconceptualizing and reanalyzing existing environmental data -- it's out there!
- Consolidating and sharing resources.
- Power analyses: who has the power? How do we influence them?
- Diversifying funding streams: community members and local governments, private foundations (but be careful!).
- Affiliating all monitoring efforts with nearest academic institutions.
- Building community science capacity.
  - Gathering community, building resilience
  - Identifying questions
  - Building tools to answer them
  - Reminding governmental institutions that regulations do not equal stewardship

# Thank you! And more info --

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- Eli Dueker: [edueker@bard.edu](mailto:edueker@bard.edu)
- Bard Community Science Lab: [ldrew@bard.edu](mailto:ldrew@bard.edu),  
<https://landairwater.bard.edu/projects/community-science-lab/>
- Saw Kill Watershed Community:  
<https://sawkillwatershed.wordpress.com/>

## Resources for learning more:

- <https://www.reimaginerpe.org/ejprinciples>
- <https://www.ienearth.org/>
- <https://climatejusticealliance.org/workgroup/it-takes-roots/>
- <https://www.weact.org/>
- Hudson Valley Environmental Justice Coalition