WHICH CAME FIRST: THE DATA OR THE DECISION?

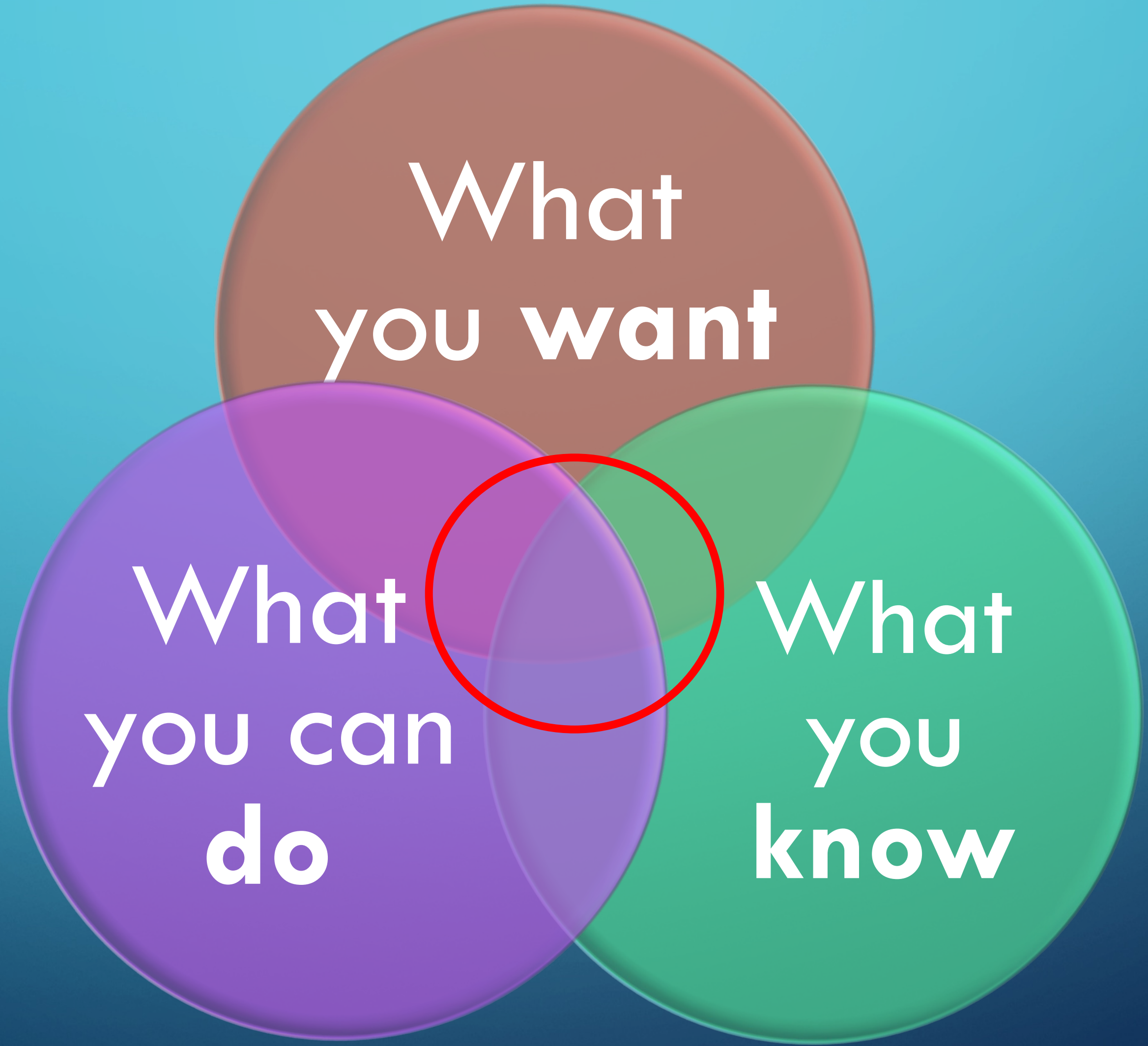
HOW AI/ML HELPS THE USGS DELIVER DECISION-AGNOSTIC WATER DATA THAT INFORMS EVERY LINK IN THE DECISION QUALITY CHAIN

KATRINA ALGER[1], JACOB ZWART[1], JARED SMITH[1], GERICKE COOK[1], JULIEN MARTIN[1], AND LAURA BRANDT[2]

[1]U.S. GEOLOGICAL SURVEY
[2]U.S. FISH AND WILDLIFE SERVICE

2024 SOCIETY FOR DECISION PROFESSIONALS
EFFECTIVE DECISION MAKING IN A DYNAMIC WORLD
ARLINGTON, VA

WHERE IS DATA NORMALLY SLOTTED IN THE DECISION-MAKING PROCESS?



DATA FOR DECISIONS

What you need to know about the system

- Frame
- Trigger
- Alternatives
- Objective Weights
- Value of Additional Information

What you **want**

What you can **do**

What you need to know for the decision

Are there other ways decision-makers use data?

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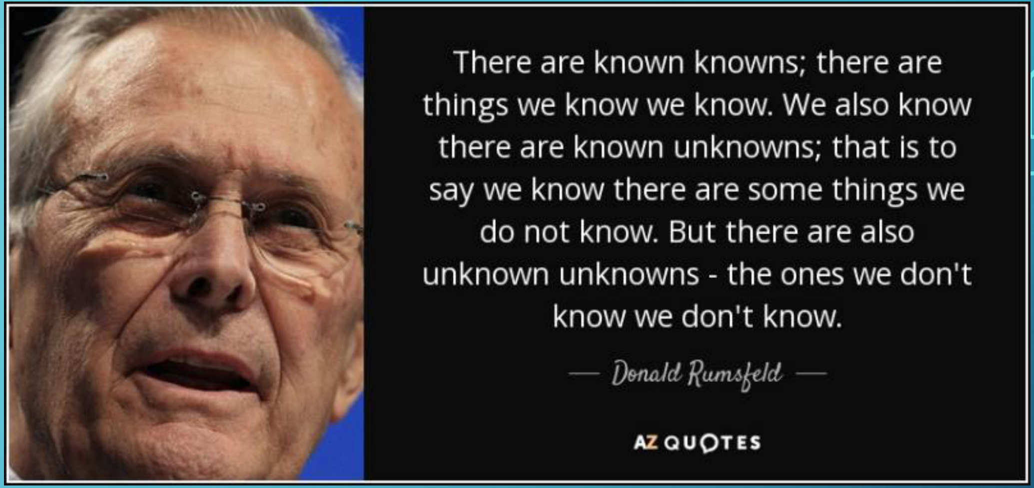
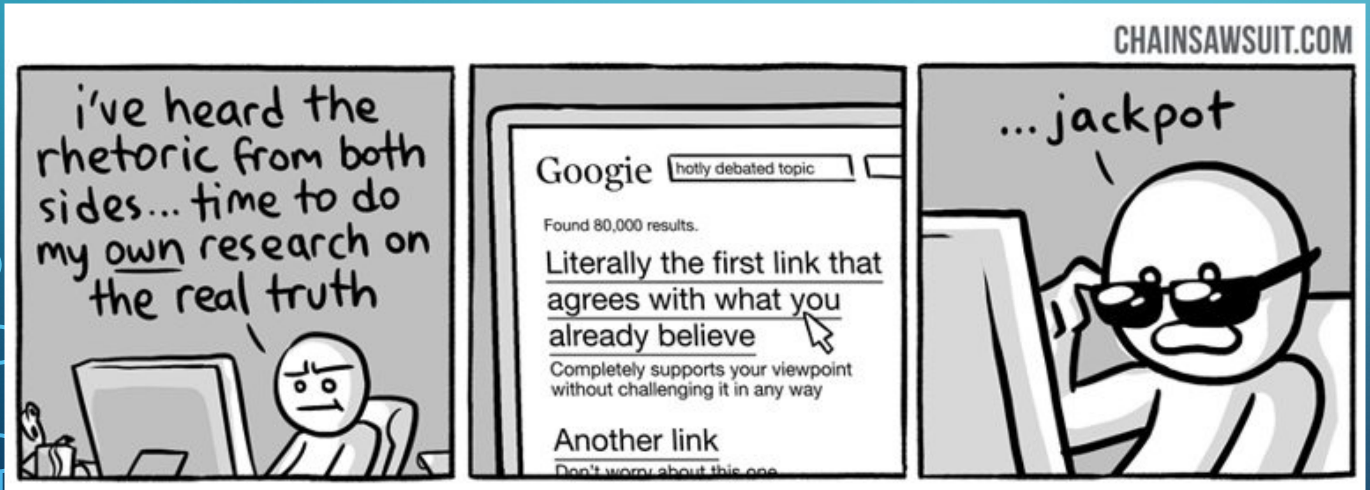
THE CHALLENGE

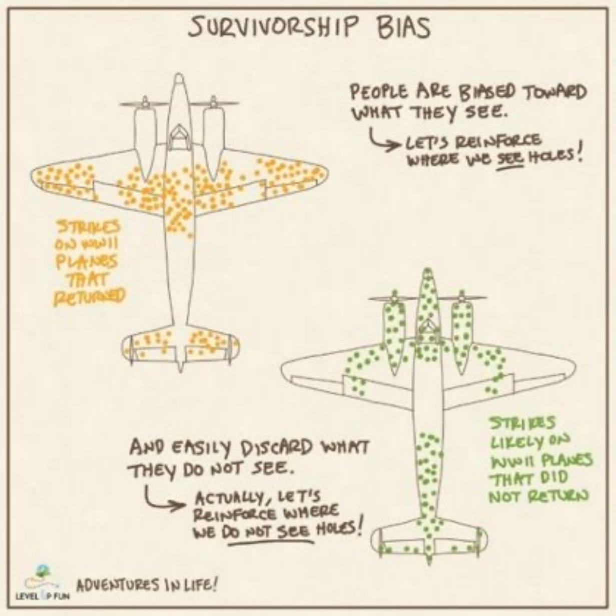
Reiner, Rob. (1984) *This is Spinal Tap*



https://www.azquotes.com/quote/254214



Kris Straub (2014), Chainsawsuit



https://www.levelupfun.com/articles/survivorship-bias

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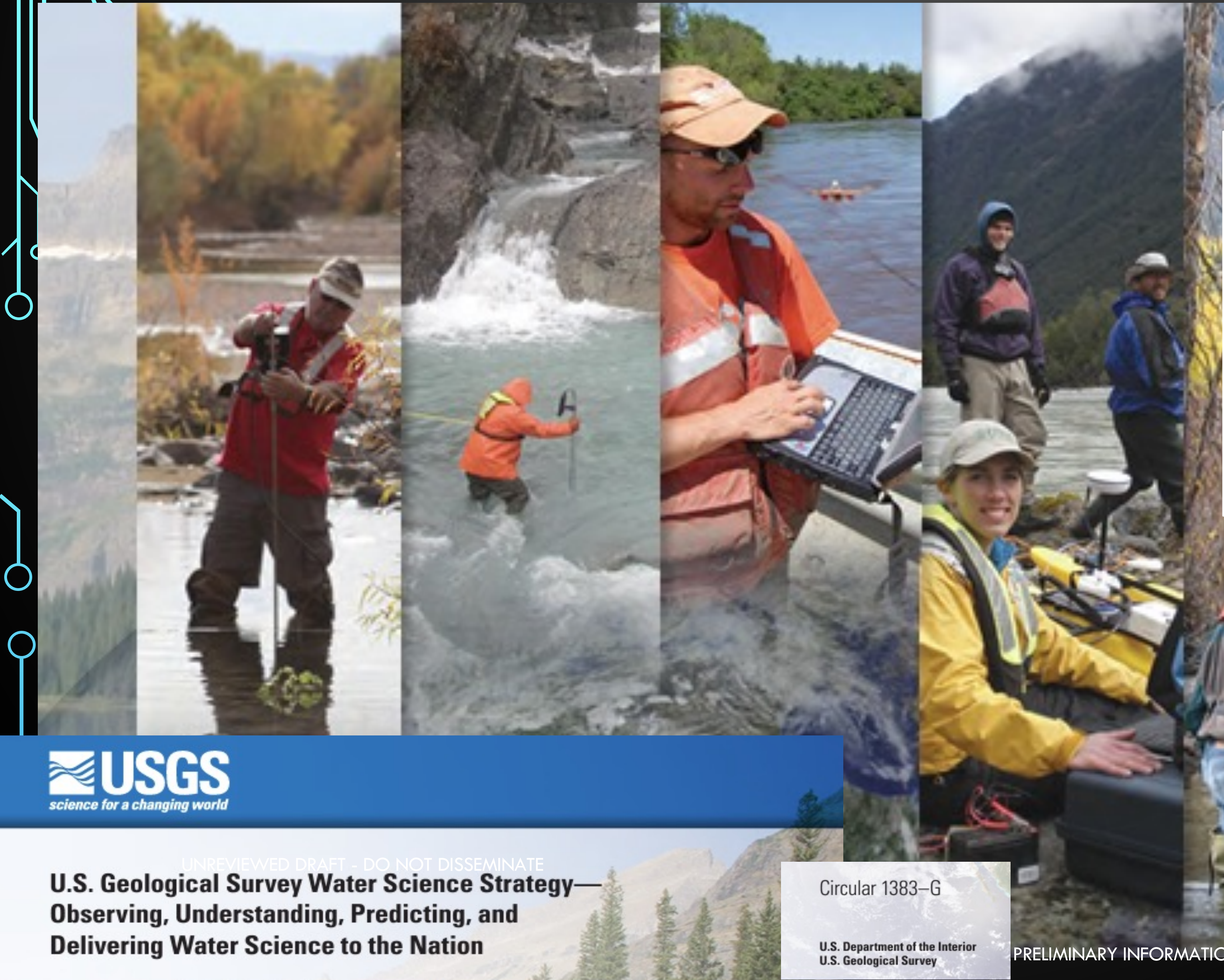
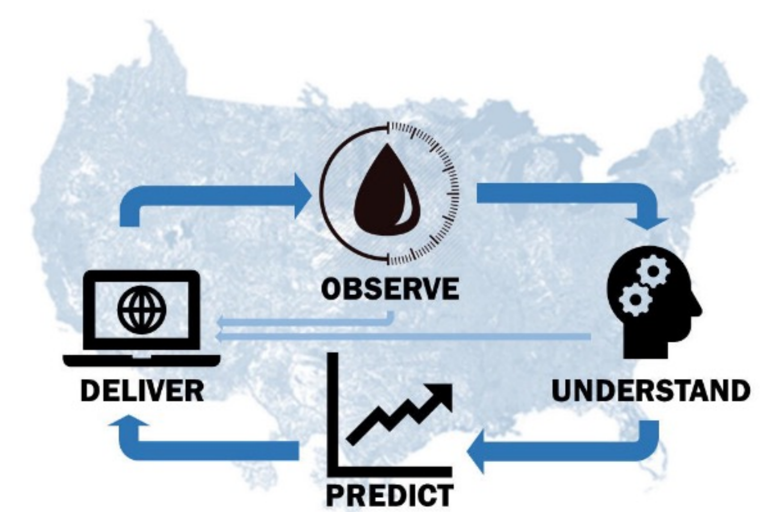
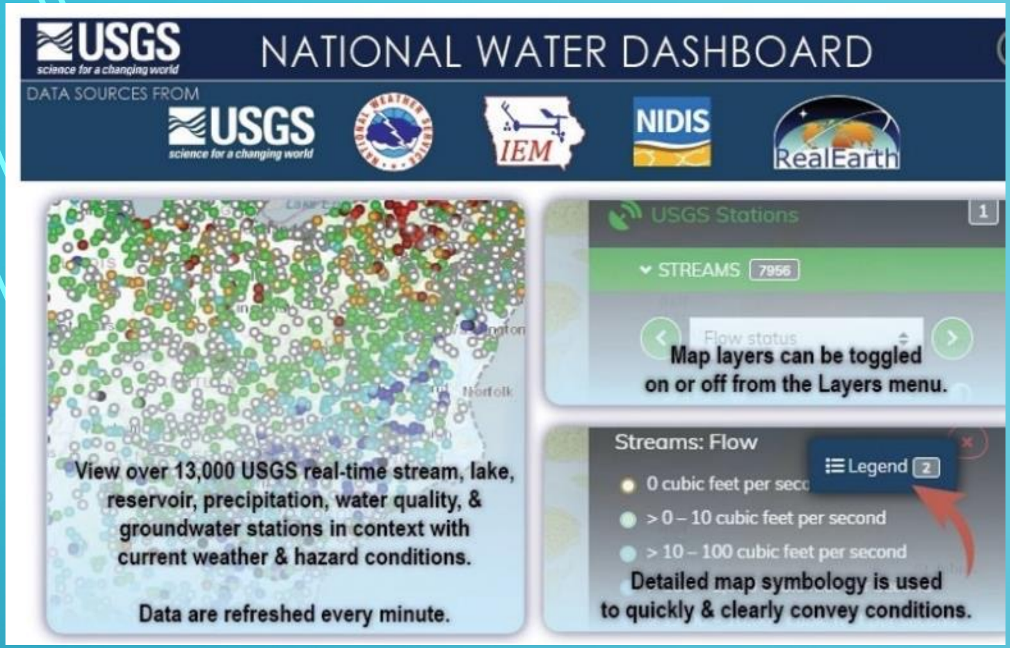
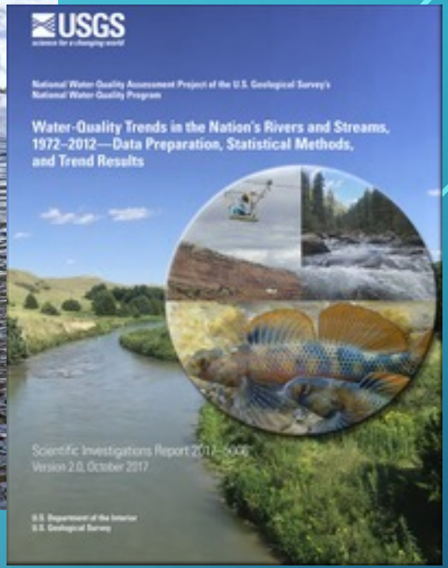




IWS Basins: Observe, Understand, Predict, and Deliver | U.S. Geological Survey (usgs.gov)

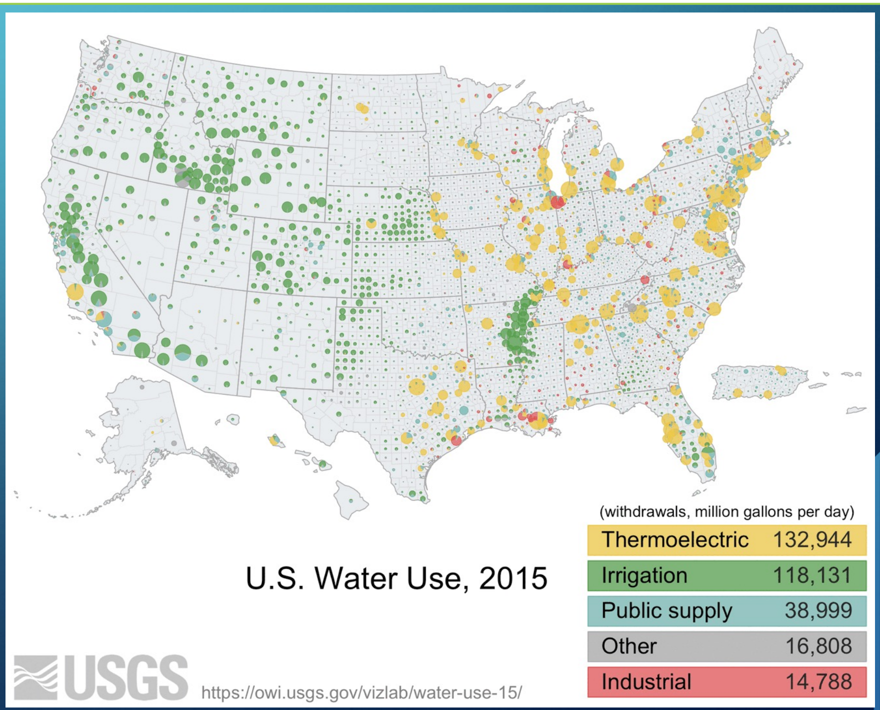


[USGS | National Water Dashboard]



ALL PHOTOS PUBLIC DOMAIN UNLESS OTHERWISE NOTED

https://labs.waterdata.usgs.gov/visualizations/water-use-15



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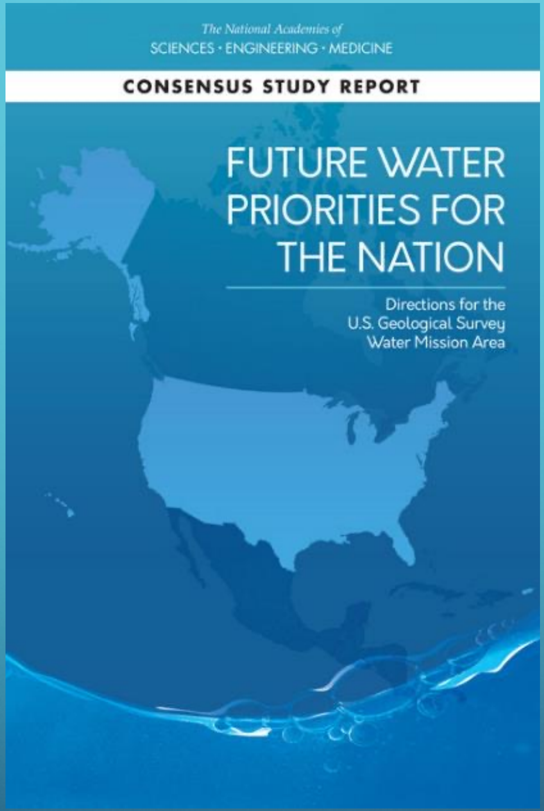
2009 SECURE Water Act
PL 111-11 Section 9508

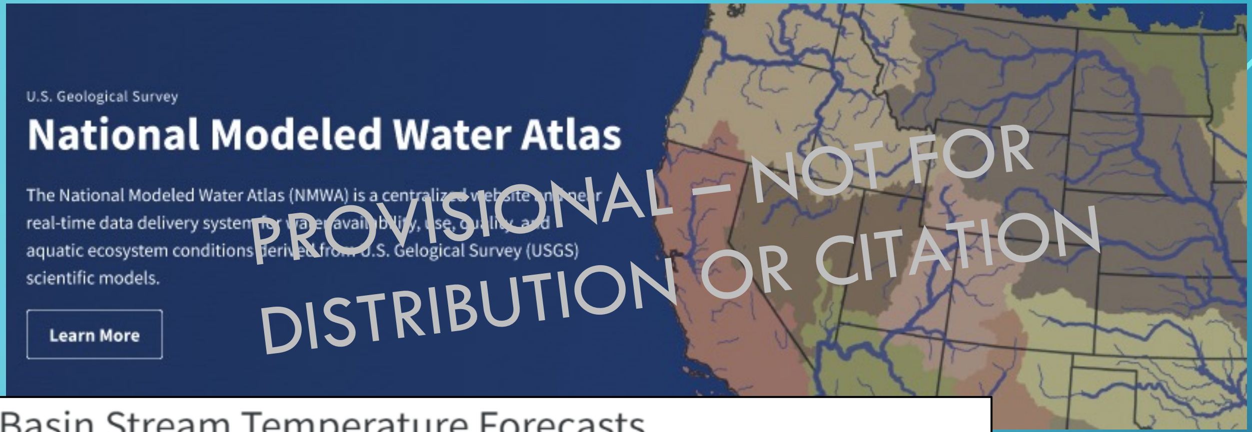
https://bobdylancenter.com/about/biography/

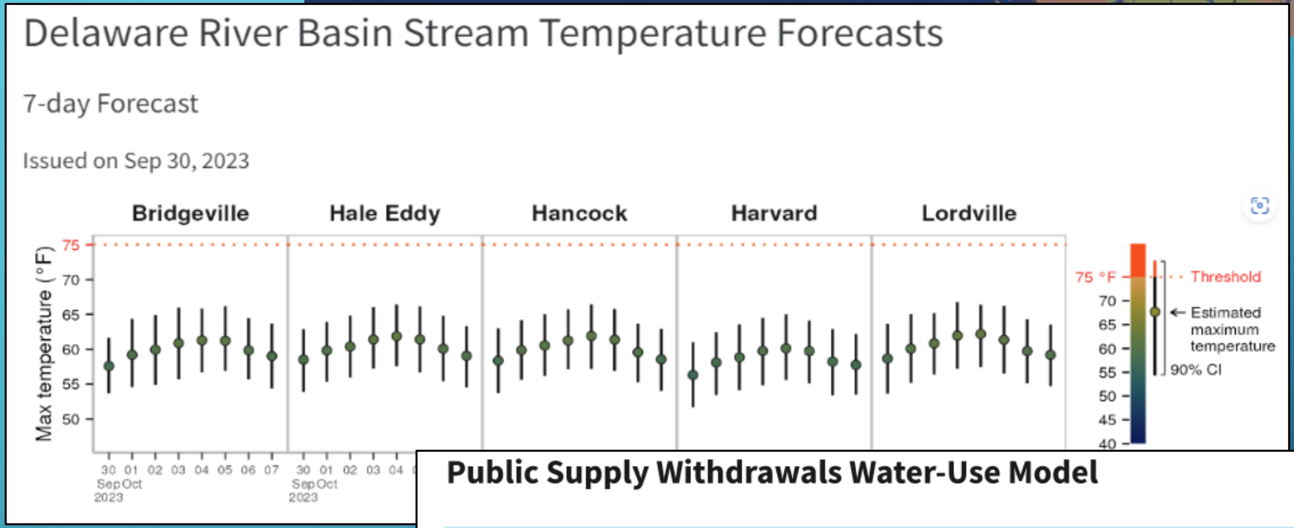


To evaluate:

- The *status* of water resources in the United States
- The *quantity* of water available
- The *quality* of water available
- Long-term *trends* in water availability

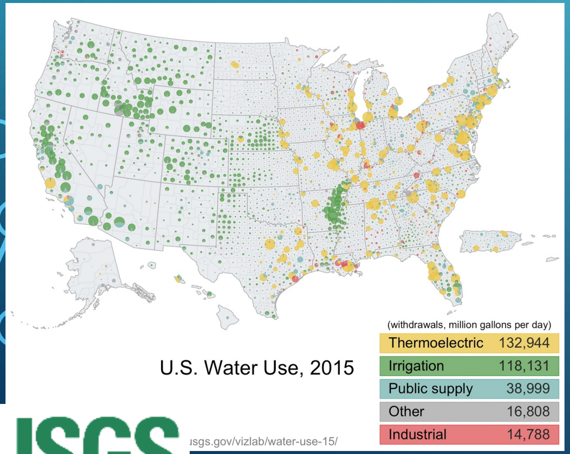
And ultimately, to *forecast* water availability for future economic, energy, and environmental uses

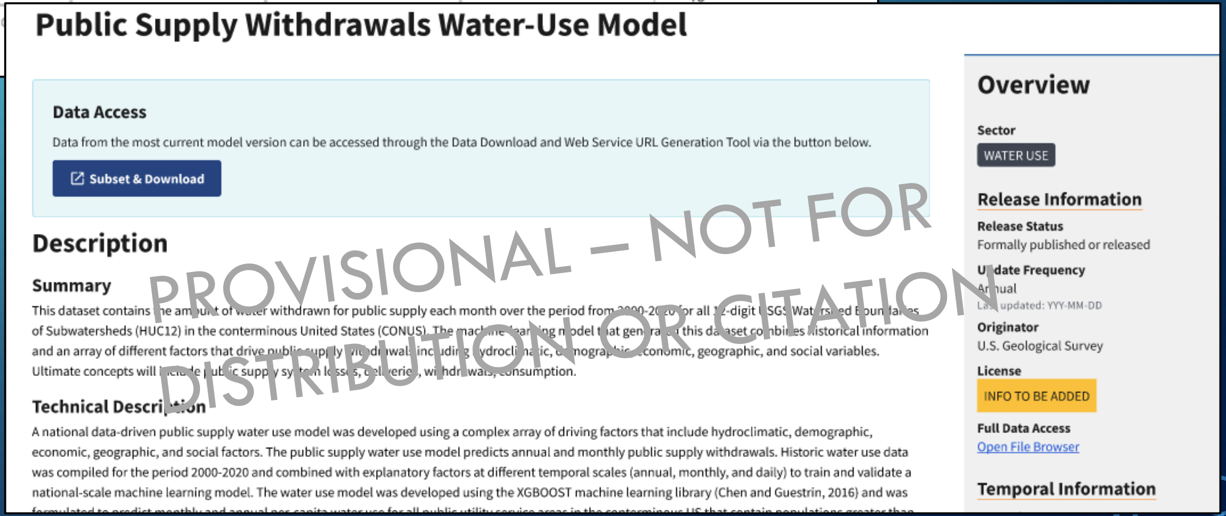




[Using Artificial Intelligence to Help Protect Trout and Drinking Water Supplies | U.S. Geological Survey (usgs.gov)]

[Stream Temperature Forecasts for Sites in the Delaware River Basin - Delaware River Basin Stream Temperature Forecasts (usgs.gov)]





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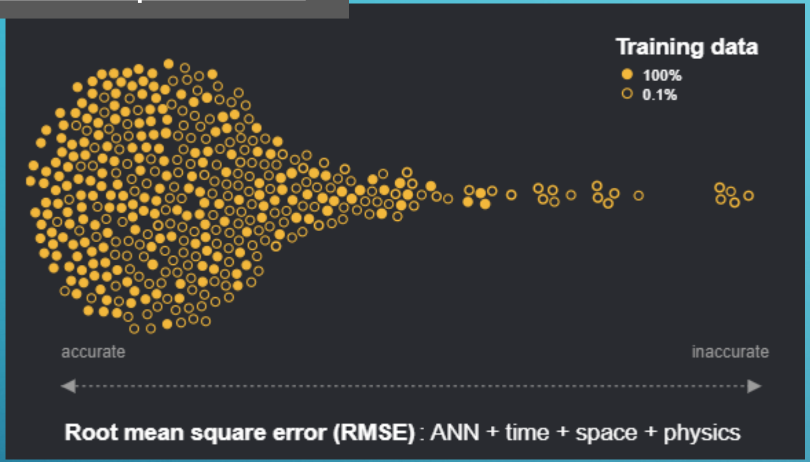
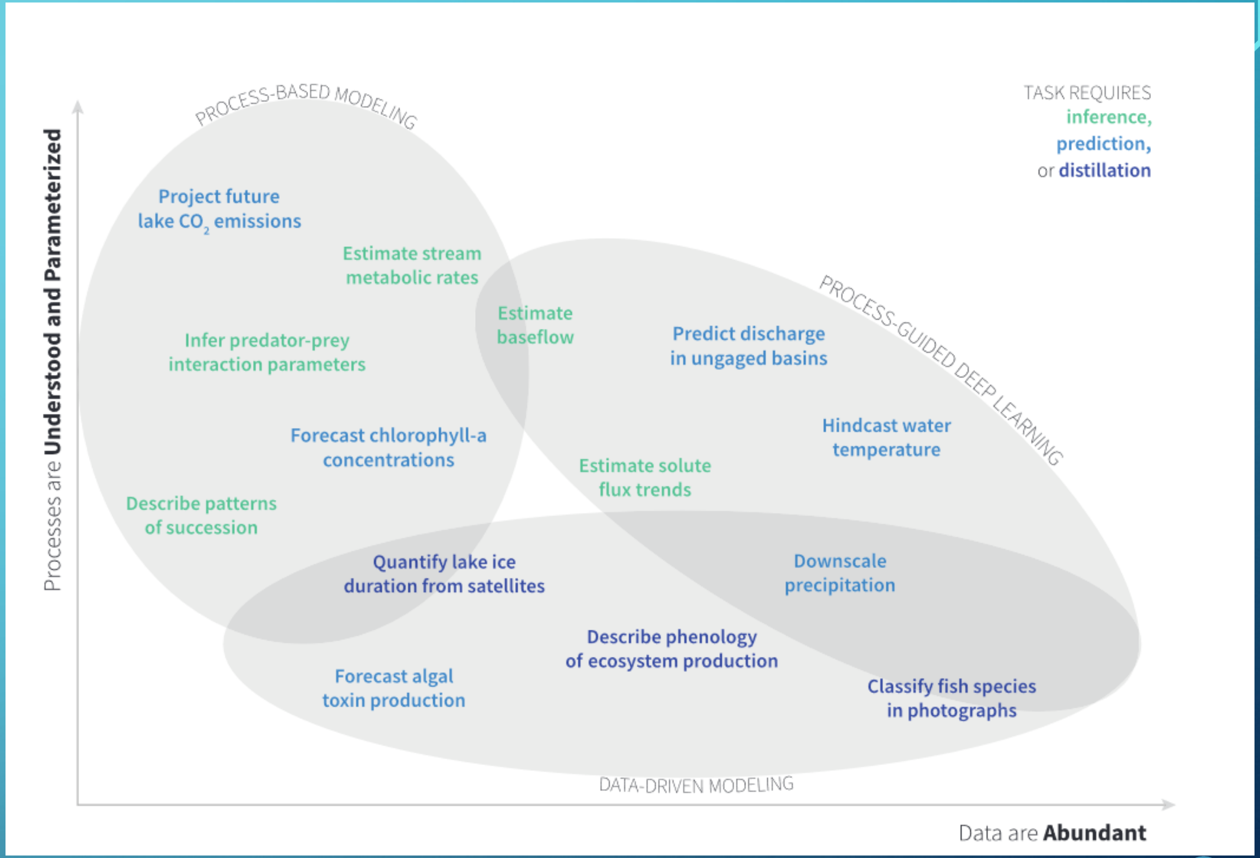
AI/ML COMPLIMENTS OTHER MODELING FRAMEWORKS

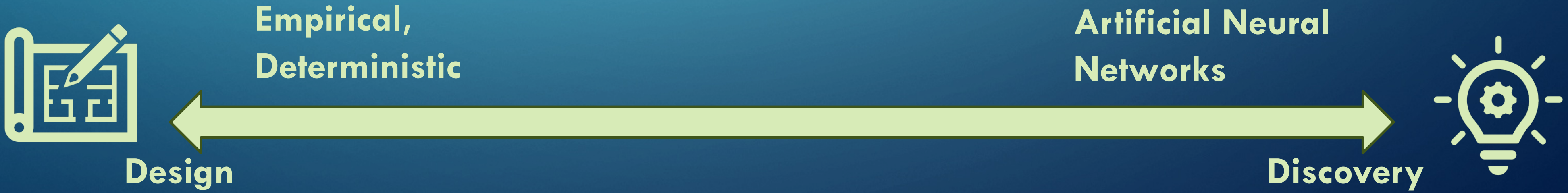
https://labs.waterdata.usgs.gov/visualizations/temperature-prediction



Figures by H. Corson-Dosch; data from Jia et al. 2021



From Appling et al. 2022



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PRELIMINARY INFORMATION – SUBJECT TO REVISION. NOT FOR CITATION OR DISTRIBUTION

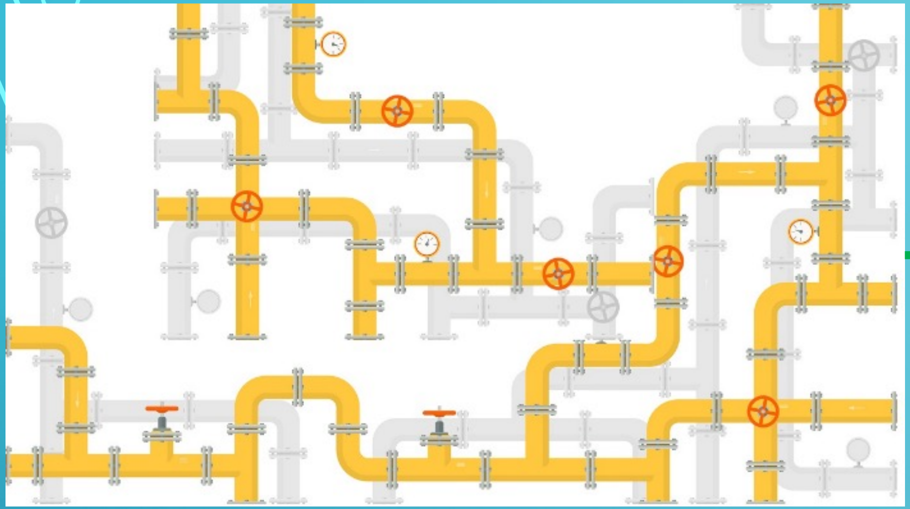
From Appling et al. 2022

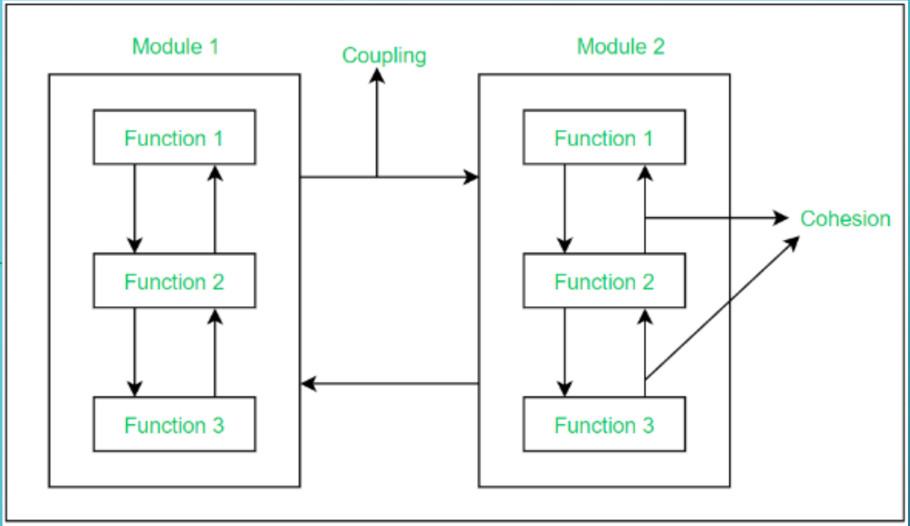

istockphoto.com

3 KEY QUALITIES OF DECISION-AGNOSTIC DATA

1. RELIABLE
2. USEFUL
3. ENHANCE UNDERSTANDING

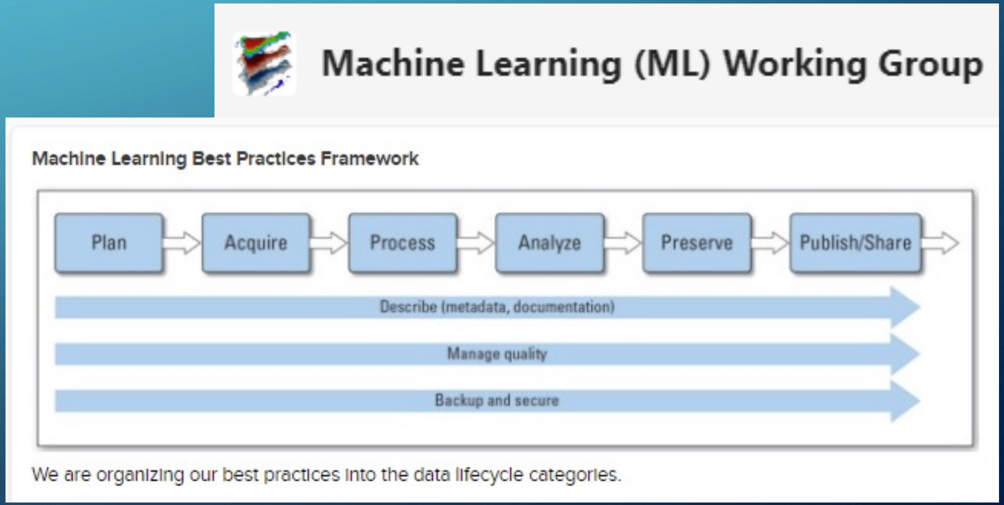
ENSURING BEST PRACTICES FROM DEVELOPMENT TO DELIVERY

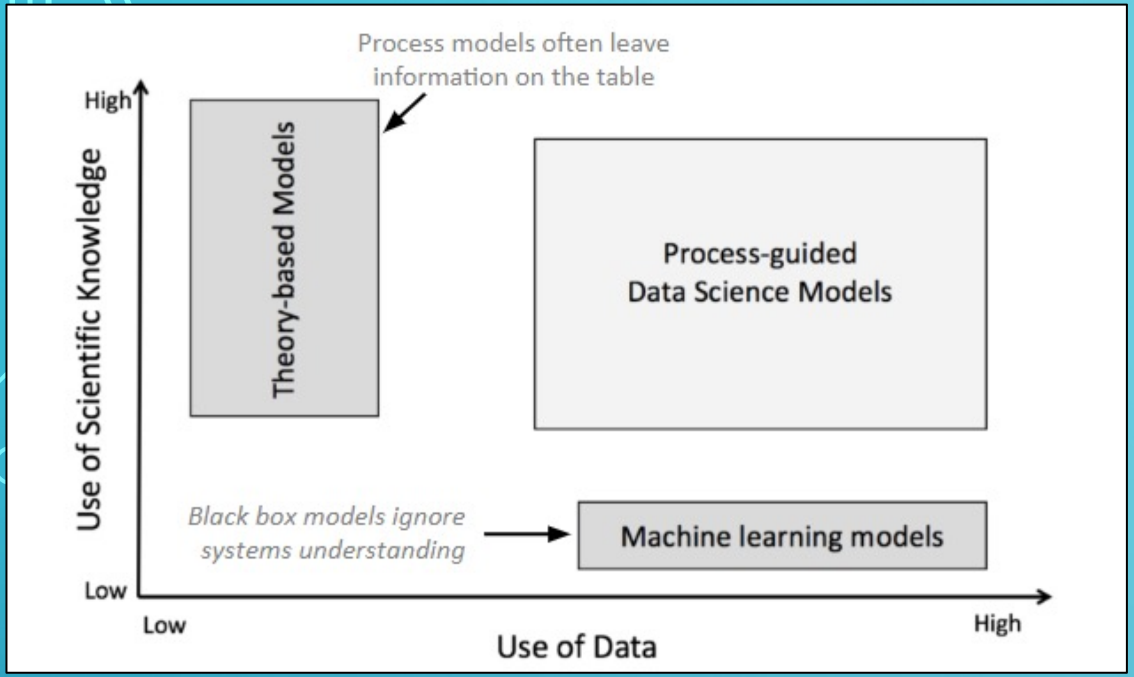




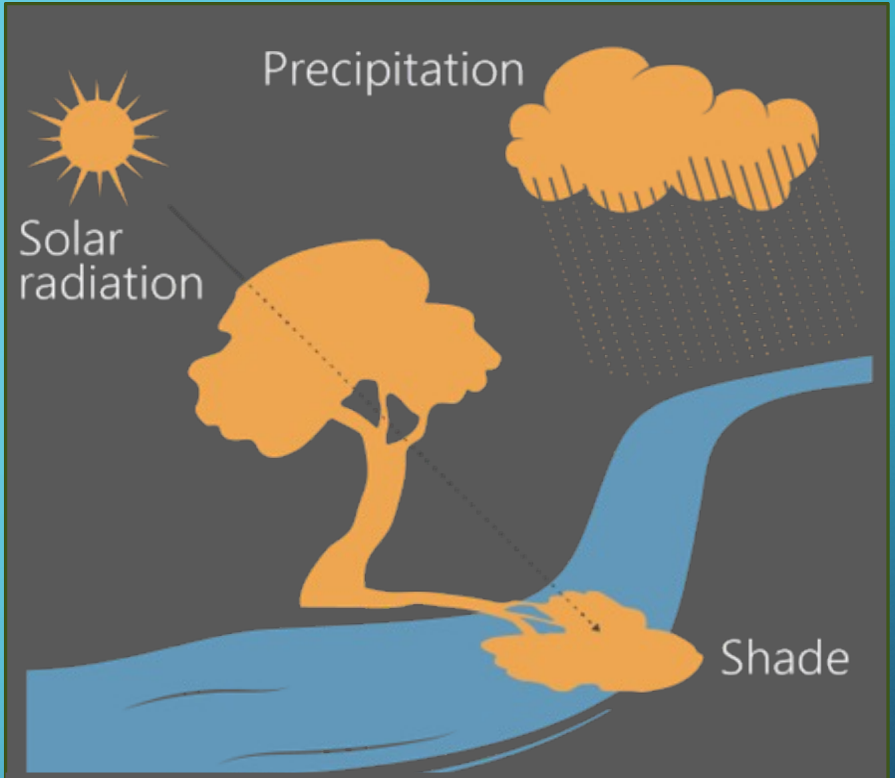
GitLab

GitHub



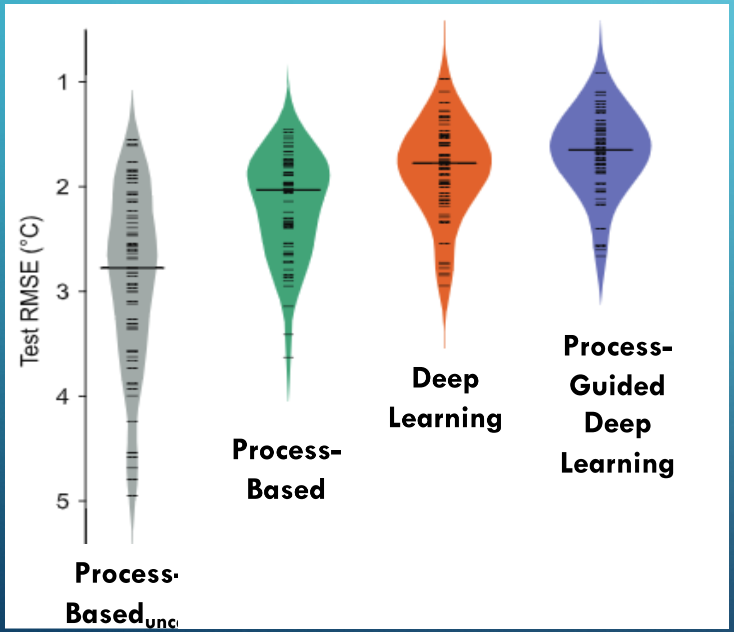


[Data Science for Water Resources | U.S. Geological Survey (usgs.gov)]



https://labs.waterdata.usgs.gov/visualizations/temperature-prediction

Figures by H. Corson-Dosch; data from Jia et al. 2021



[Process-Guided Deep Learning Predictions of Lake Water Temperature - Read - 2019 - Water Resources Research - Wiley Online Library]

Deep Learning model "learns" physics through pre-training with thermodynamic model predictions

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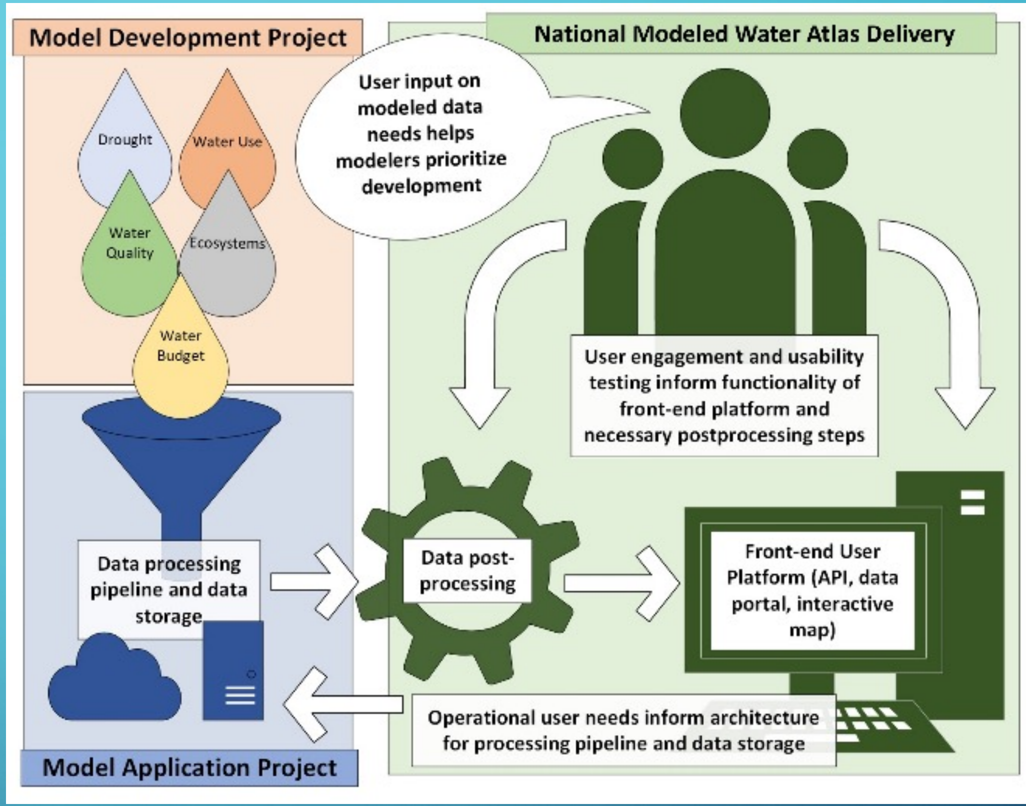
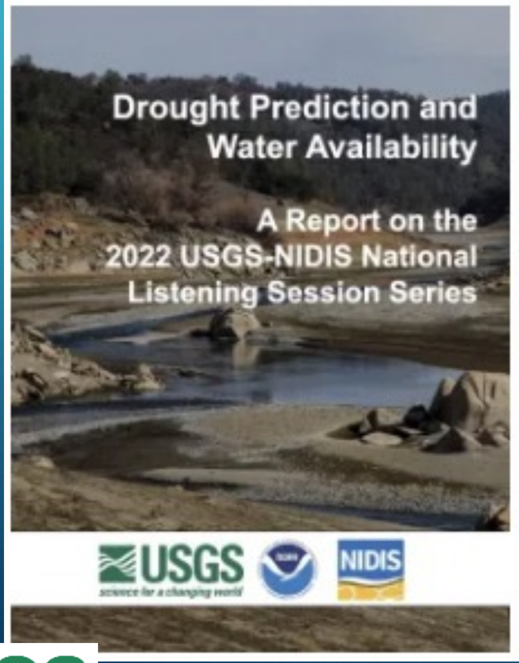
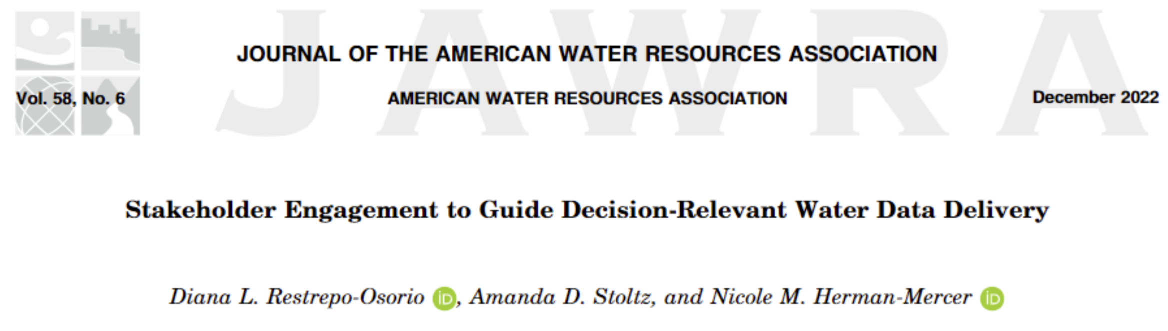
WHO NEEDS *WHAT DATA* IN *WHAT FORMAT* TO MAKE *WHAT DECISION*?

National Modeled Water Atlas | U.S. Geological Survey (usgs.gov)





Drought Prediction and Water Availability: A Report on the 2022 USGS-NIDIS National Listening Session Series | Drought.gov


JOURNAL OF THE AMERICAN WATER RESOURCES ASSOCIATION

Vol. 58, No. 6 AMERICAN WATER RESOURCES ASSOCIATION December 2022

Stakeholder Engagement to Guide Decision-Relevant Water Data Delivery

Diana L. Restrepo-Osorio, Amanda D. Stoltz, and Nicole M. Herman-Mercer

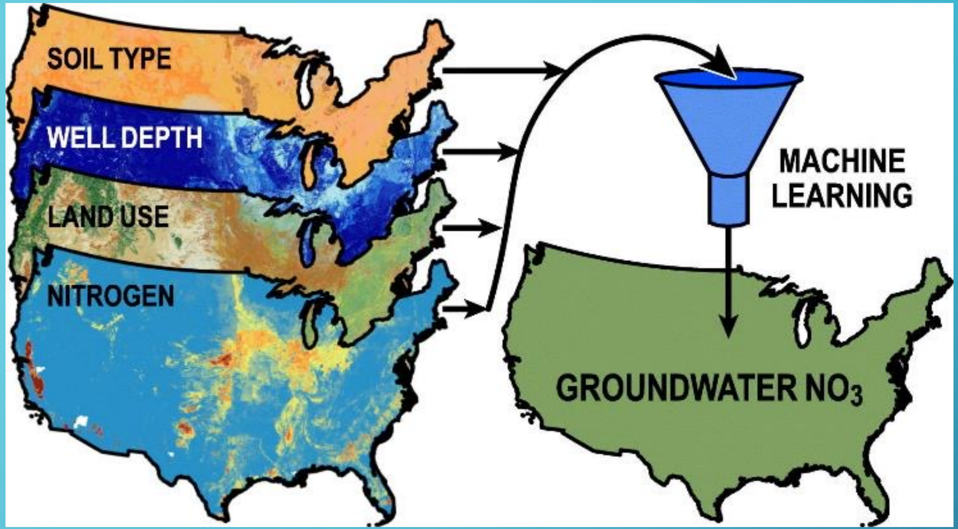
Stakeholder Engagement to Guide Decision-Relevant Water Data Delivery (wiley.com)

USGS science for a changing world

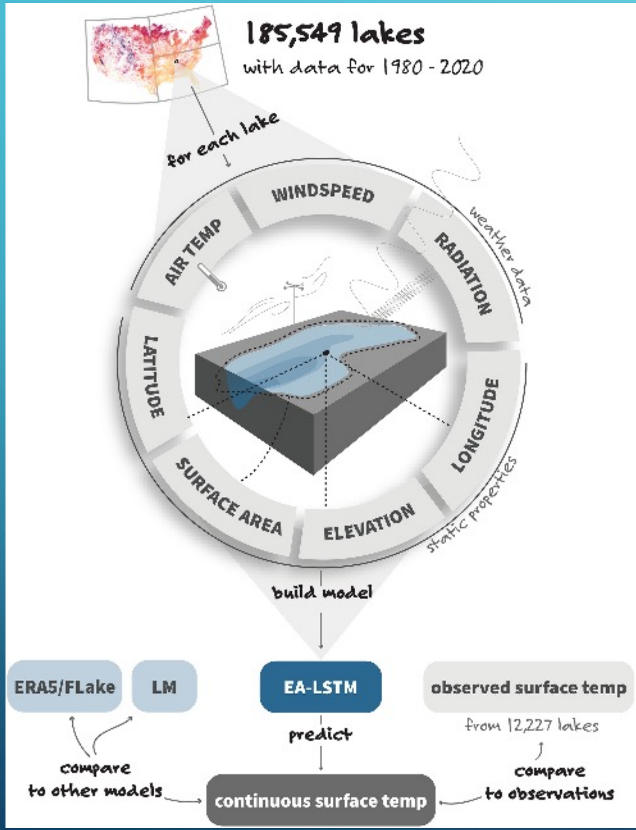
Science of The Total Environment
Volume 807, Part 3, 10 February 2022, 151065

Machine learning predictions of nitrate in groundwater used for drinking supply in the conterminous United States

K.M. Ransom [a], B.T. Nolan [b], P.E. Stackelberg [c], K. Belitz [d], M.S. Fram [a]



[Machine learning predictions of nitrate in groundwater used for drinking supply in the conterminous United States - ScienceDirect]



LIMNOLOGY AND OCEANOGRAPHY LETTERS
ASLO
Open Access

Data Article | Open Access

Daily surface temperatures for 185,549 lakes in the conterminous United States estimated using deep learning (1980–2020)

Jared D. Willard, Jordan S. Read, Simon Topp, Gretchen J. A. Hansen, Vipin Kumar

First published: 17 March 2022 | https://doi.org/10.1002/lol2.10249 | Citations: 5

[Daily surface temperatures for 185,549 lakes in the conterminous United States estimated using deep learning (1980–2020) - Willard - 2022 - Limnology and Oceanography Letters - Wiley Online Library]

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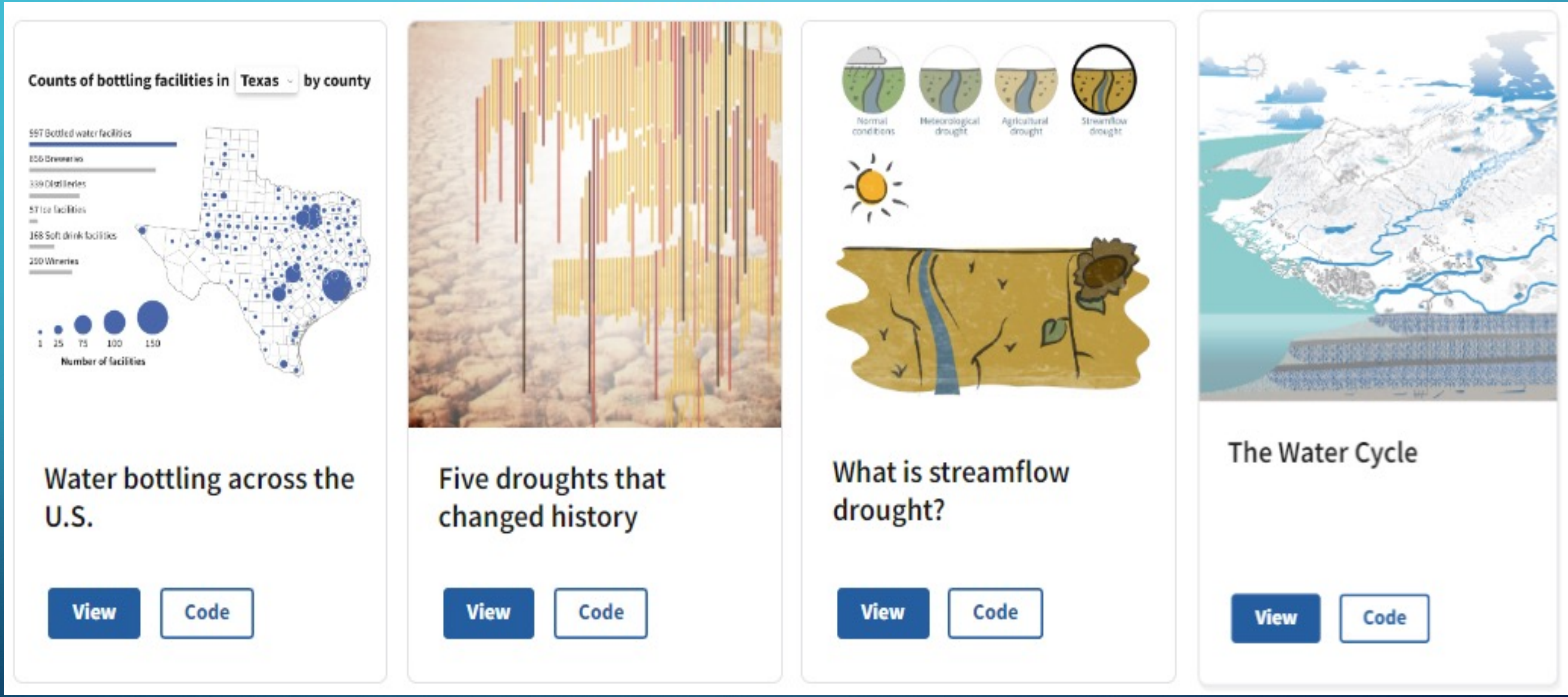
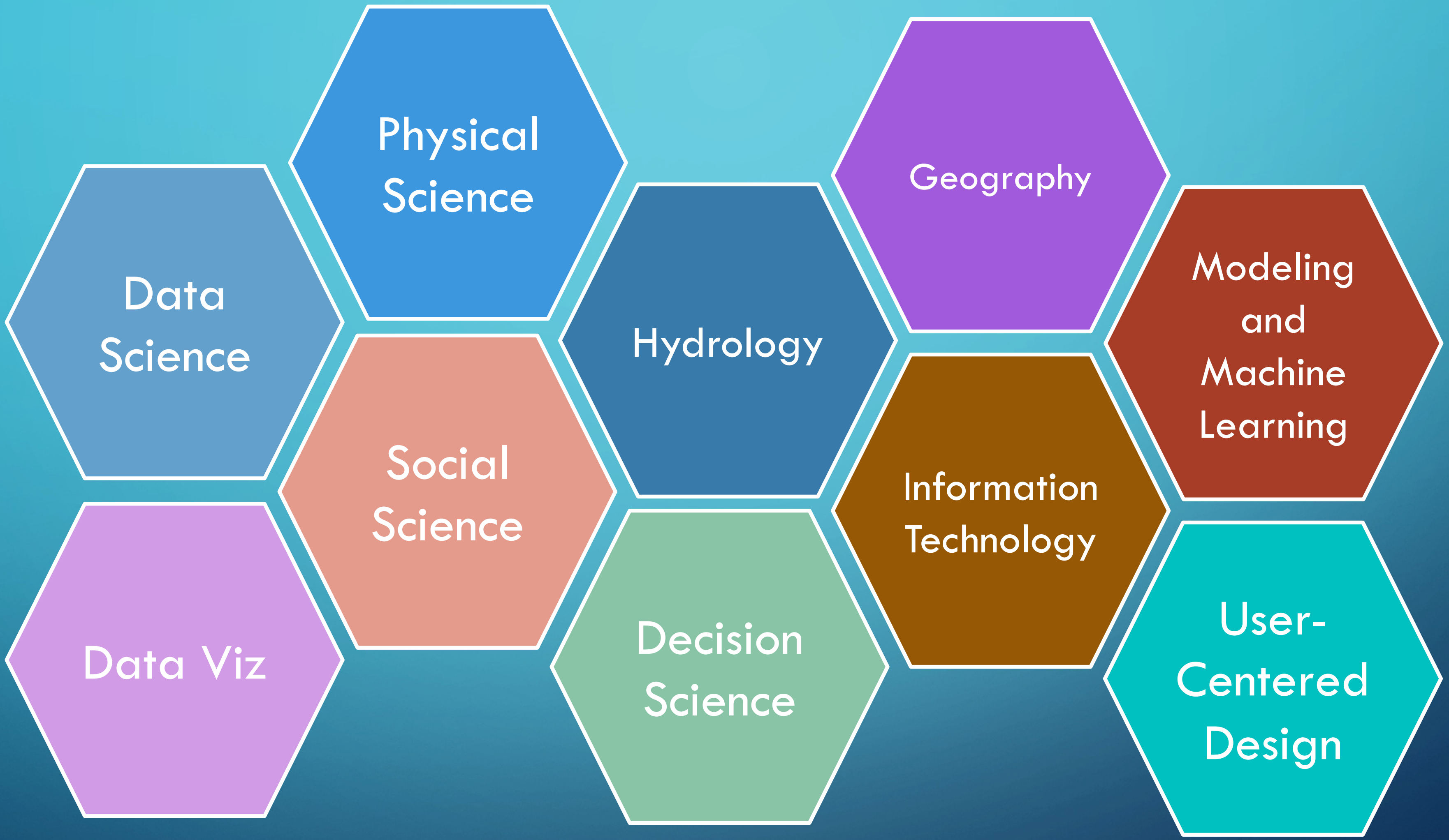
USGS Vizlab
water data visualizations



https://labs.waterdata.usgs.gov/visualiations

INTERDISCIPLINARY APPROACHES TO COMPLEX SYSTEMS



SOPHISTICATED MODELING APPROACHES TO COMPLEX SYSTEMS

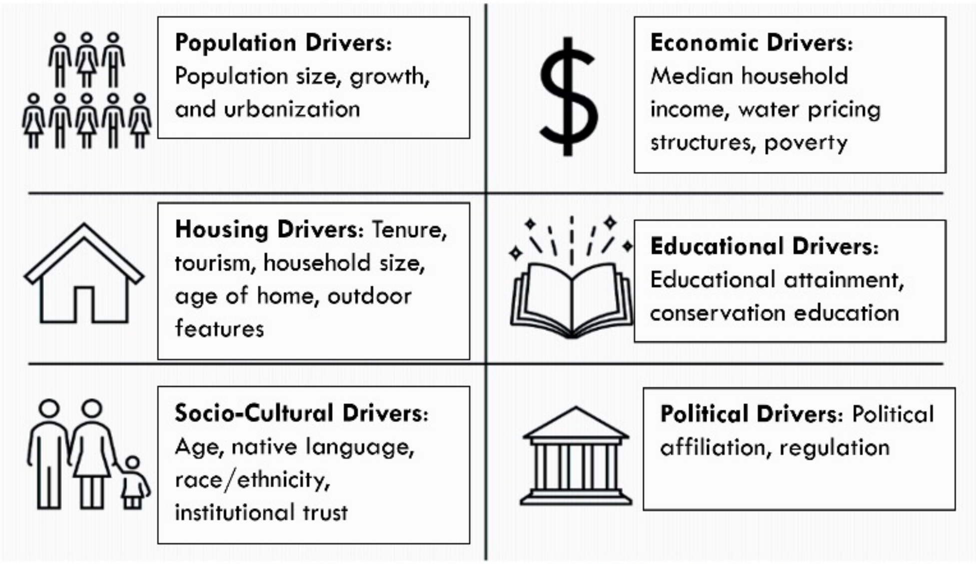
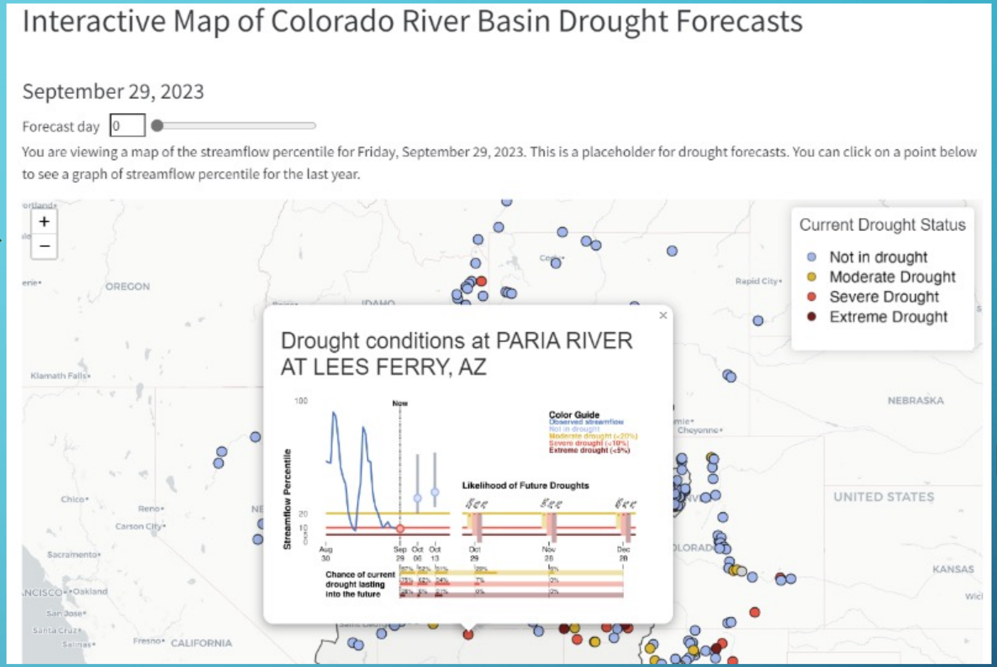


Figure 2. Socioeconomic drivers found in the data-gap analysis that may improve the assessment of the public-supply water-use category

From "Water-Use Data Gap Analysis," USGS GeoNarrative



Colorado River Basin Drought Forecasts - Interactive Map of Colorado River Basin Drought Forecasts (usgs.gov), Internal Only

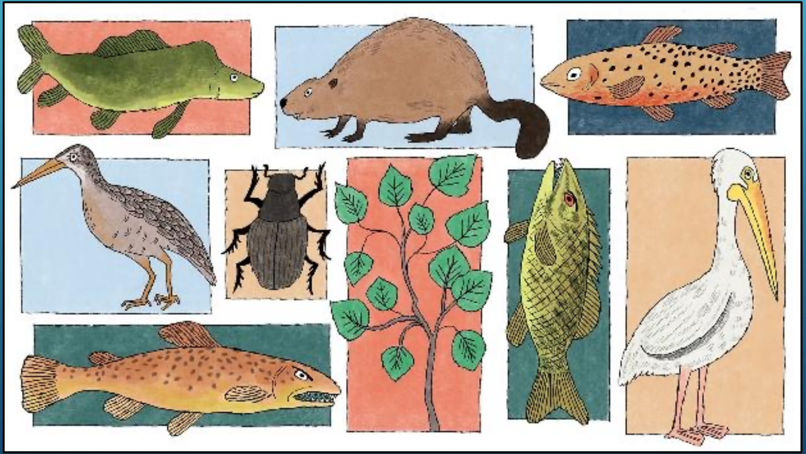
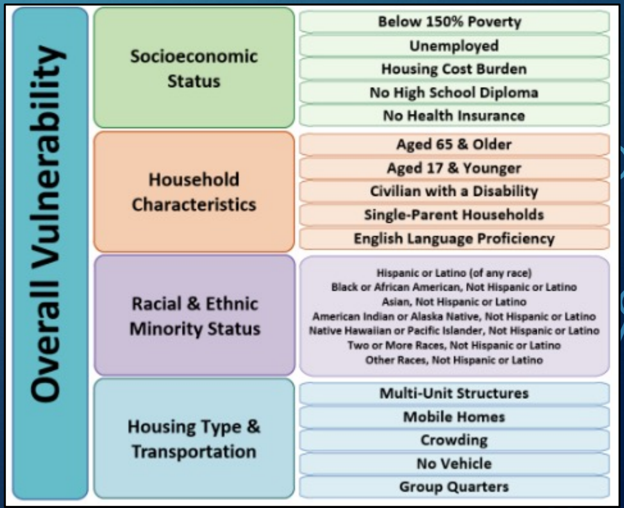
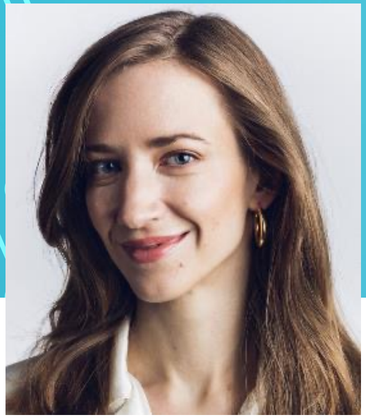


Illustration by Millie von Platen, Vox 2023

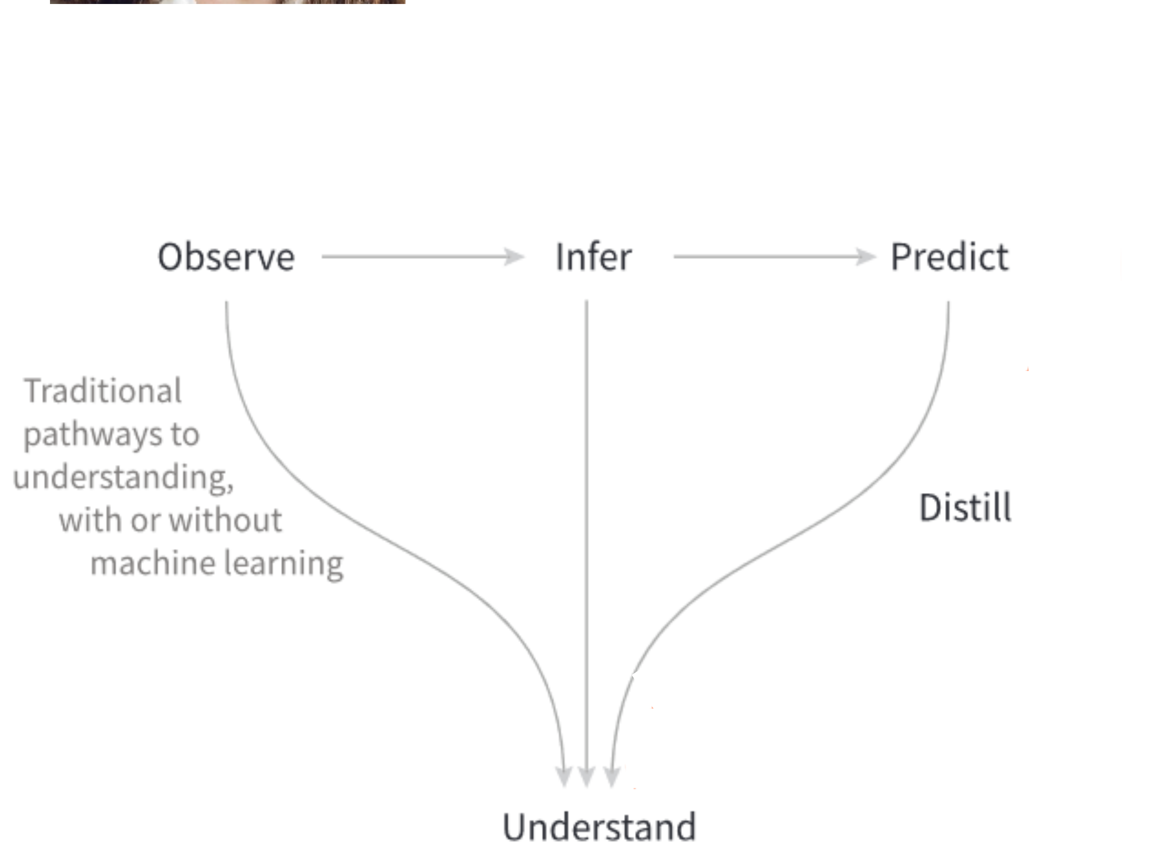


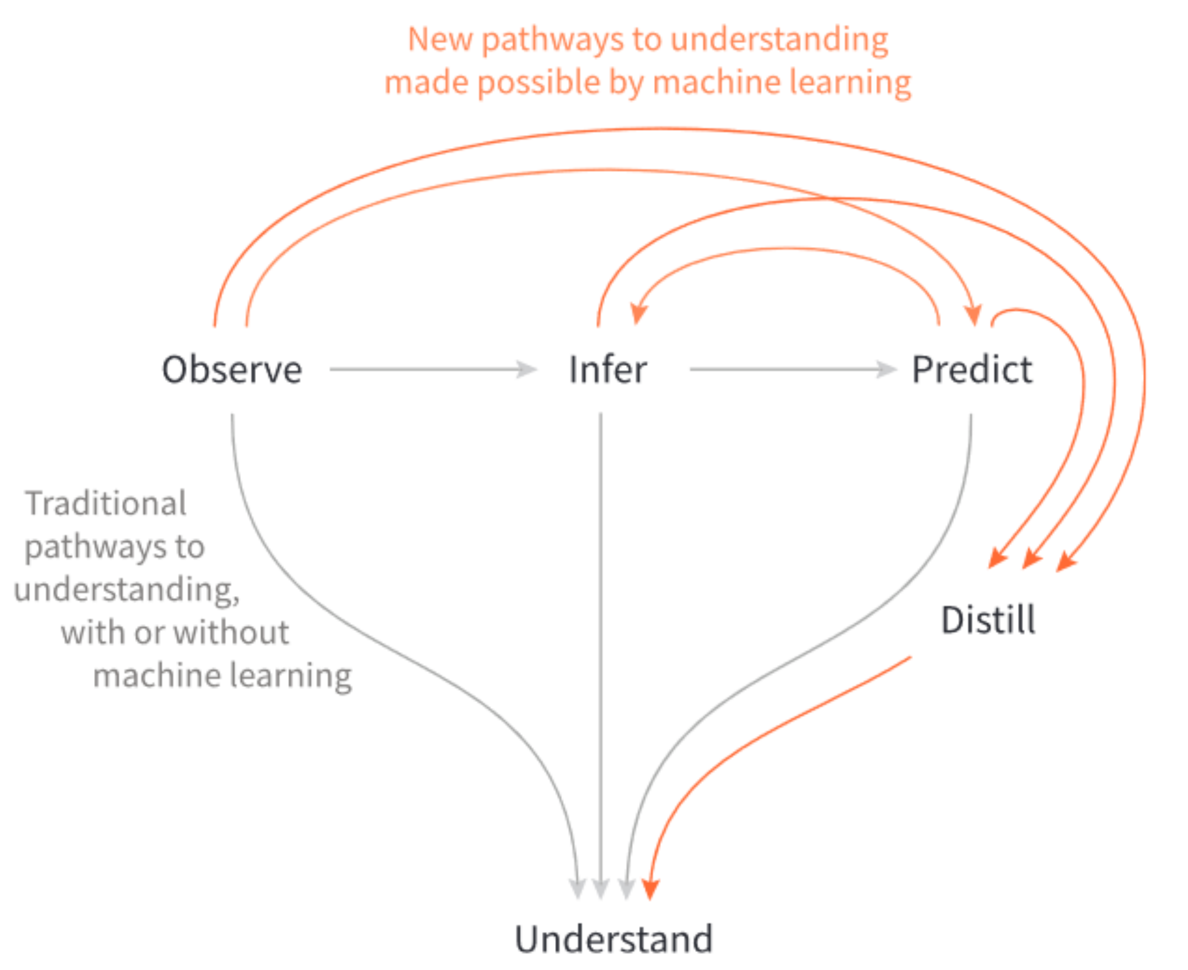
CDC Social Vulnerability Index, 2020



Cassie Kozyrkov,
Decision Scientist

AI = "AUTOMATED INSPIRATION"





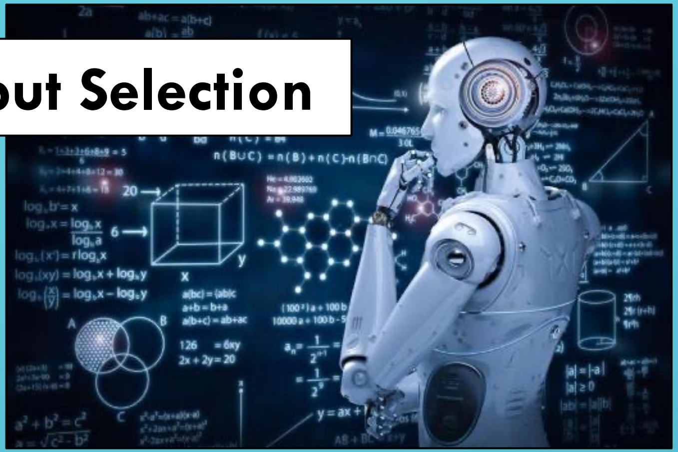
Figures from Appling et al. 2022

AI/ML IS NOT "ONE-SIZE-FITS-ALL"

Preprocessing

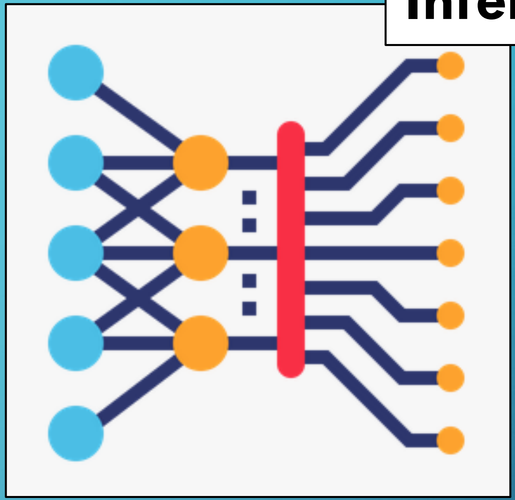
Icon designed by Ida Desi Mariana for FlatIcon.com

Input Selection



https://viso.ai/deep-learning/data-preprocessing-techniques-for-machine-learning-with-python/

Inference

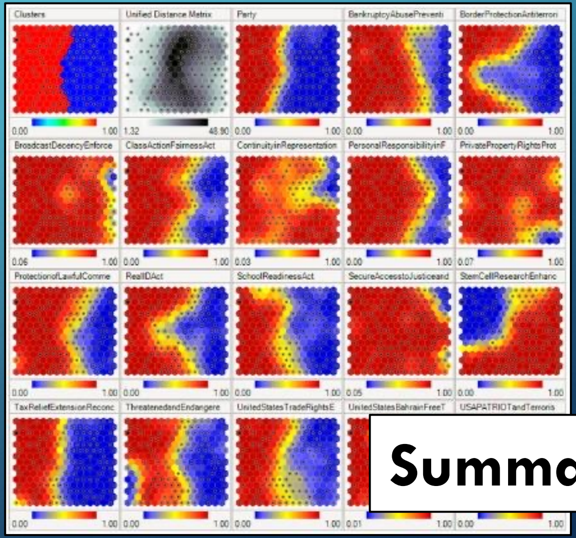


Icon designed by Becris for FlatIcon.com

Forecasting

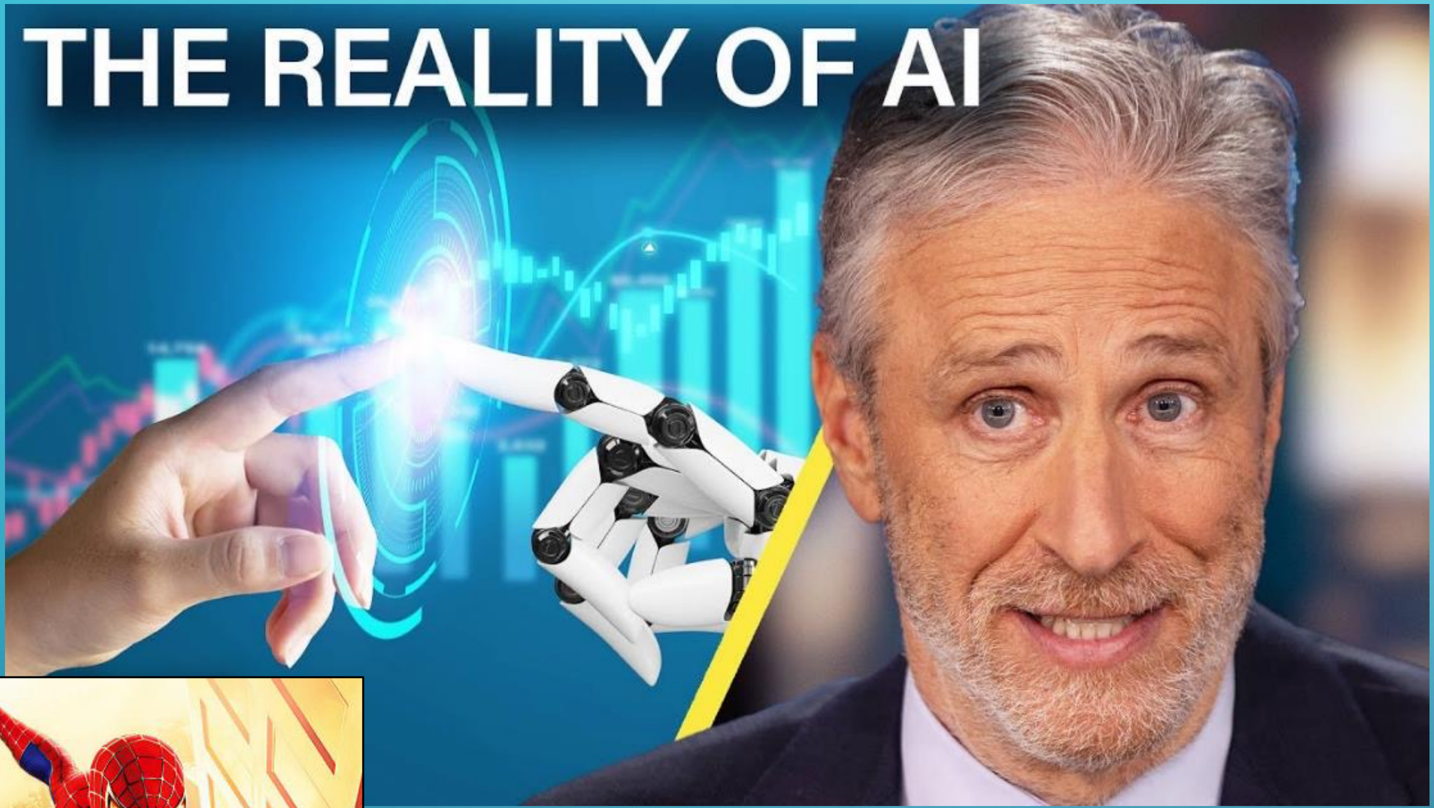
Icon designed by Parzival' 1997 for FlatIcon.com

Summarization



https://en.wikipedia.org/wiki/Self-organizing_map

From Appling et al. 2022

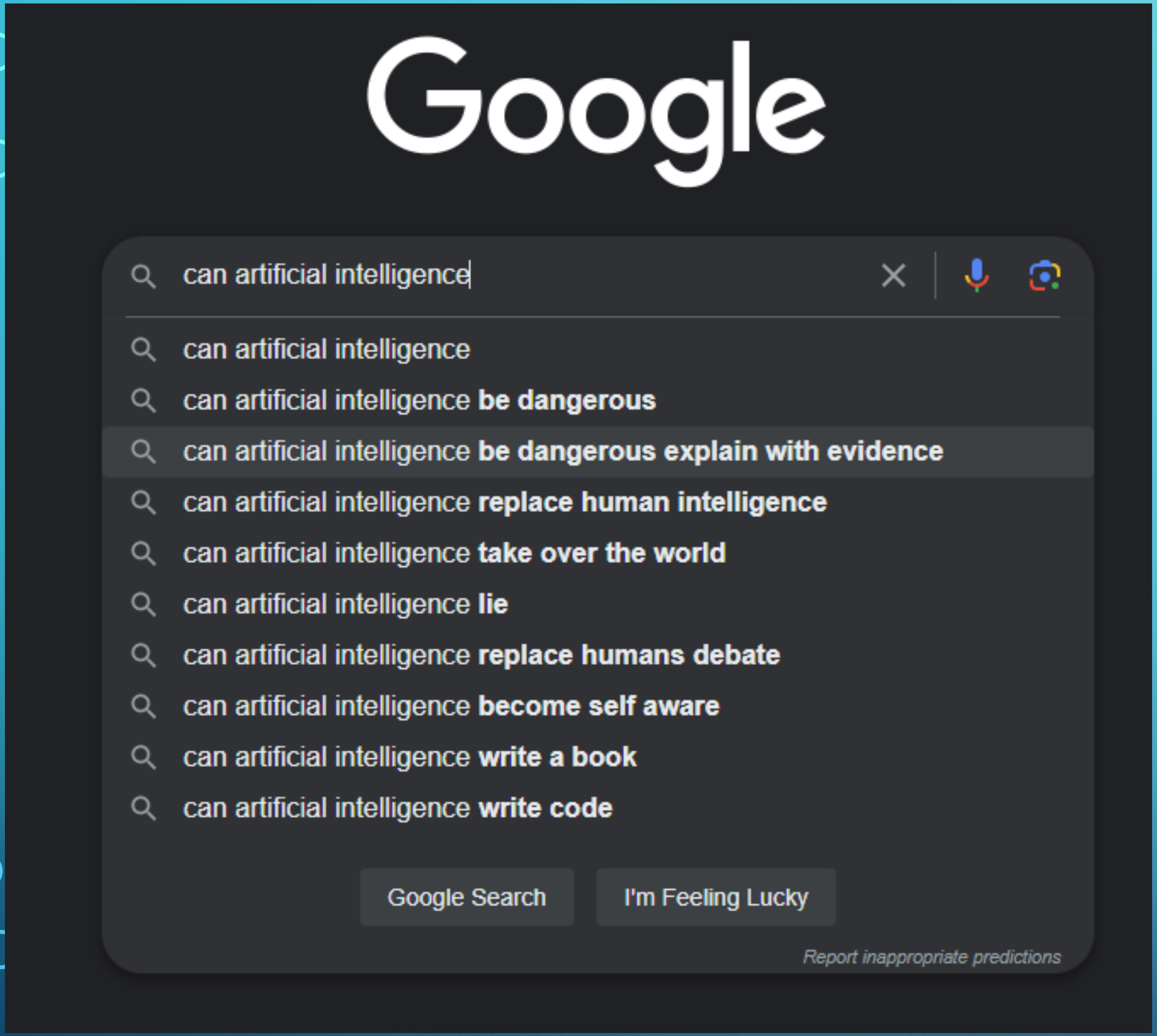


The Daily Show, **April 1, 2024**

"As a society, we've been through technological advances before. And they've all promised a utopian life without the drudgery, but the reality is they come for our jobs…Whether it's globalization or industrialization or now artificial intelligence, the way of life that you are accustomed to is no match for the promise of more profits and new markets…at least those other disruptions took place over a century or decades. AI is gonna be ready to take over by Thursday…"

Jon Stewart


THANK YOU!



QUESTIONS?

Katrina Alger
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Integrated Information
Dissemination Division
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