Influencing people

Climate communication

Assignments

~~Brightspace discussion question~~

(Optional) course feedback:
https://nyu.qualtrics.com/jfe/form/SV_73c1EEHPLaJVO62

Written Project Plan

Due Thursday the 23rd by midnight.

Project Plan Presentation

Tuesday the 28th, in class.

Short project plan

~500 words. Provide team members and team name. Describe the problem you are tackling and how it will help mitigate or adapt to climate change and why you chose this problem. Explain the data you intend to use, the methods, and how you will evaluate your results. List anticipated challenges (e.g., data cleaning issues, learning to use new methods/coding packages, etc).

Due March 23. **I will provide feedback on your plan before your presentation.**

Climate change in the news

Climate change in the news

The New York Times

BREAKING NEWS

Earth is likely to cross a critical global warming threshold within the next decade unless drastic changes are made, a major U.N. report said.

Monday, March 20, 2023 9:04 AM ET

The report by the Intergovernmental Panel on Climate Change, a body of experts convened by the United Nations, says it is still possible to hold global warming to relatively safe levels, but doing so will require global cooperation, billions of dollars and big changes.

Read more

"Global average temperatures are estimated to rise 1.5 degrees Celsius (2.7 degrees Fahrenheit) above preindustrial levels sometime around "the first half of the 2030s," as humans continue to burn coal, oil and natural gas."

The report comes as the world's two biggest polluters, China and the United States, continue to approve new fossil fuel projects. Last year, China issued permits for 168 coal-fired power plants of various sizes, according to the Centre for Research on Energy and Clean Air in Finland. Last week, the Biden administration approved an enormous oil drilling project known as Willow that will take place on pristine federal land in Alaska.

Biden Administration Approves Huge Alaska Oil Project

The administration also announced new limits on Arctic drilling in an apparent effort to temper criticism over the $8 billion Willow oil project, which has faced sharp opposition.

Everything is done by people

Leadership & University Administration

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- Office of the President
- President-Designate
- Office of the Provost
- Deans and Directors
- Senior Leadership Team
- University Senate
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Office of the President

Andrew Hamilton, President of NYU

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EXECUTIVE COMMITTEE

The Shell plc Executive Committee operates under the direction of the Chief Executive Officer and is responsible for Shell's overall business and affairs.

The Chief Executive Officer has final authority in all matters of management that are not within the duties and authorities of the Board or of the shareholders' general meeting. The Executive Committee supports the Chief Executive Officer and implements all Board resolutions and supervises all management levels in Shell.

Wael Sawan

Chief Executive Officer.

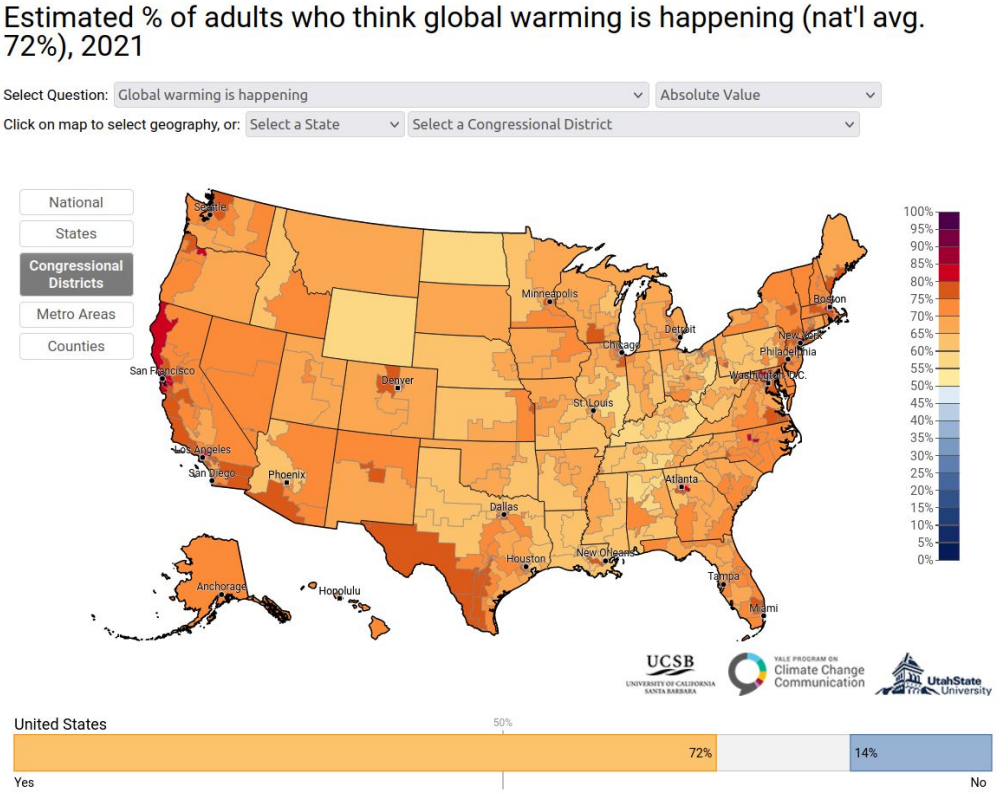
Sinead Gorman

Chief Financial Officer.

Harry Brekelmans

Projects & Technology Director.

What do people think about climate change?



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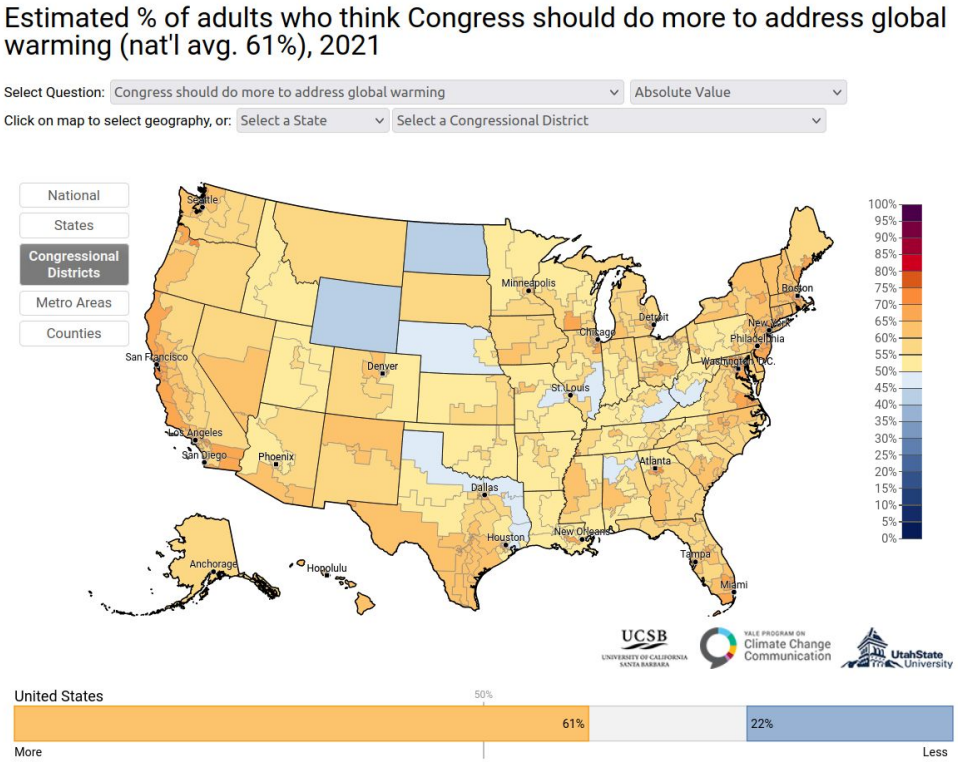

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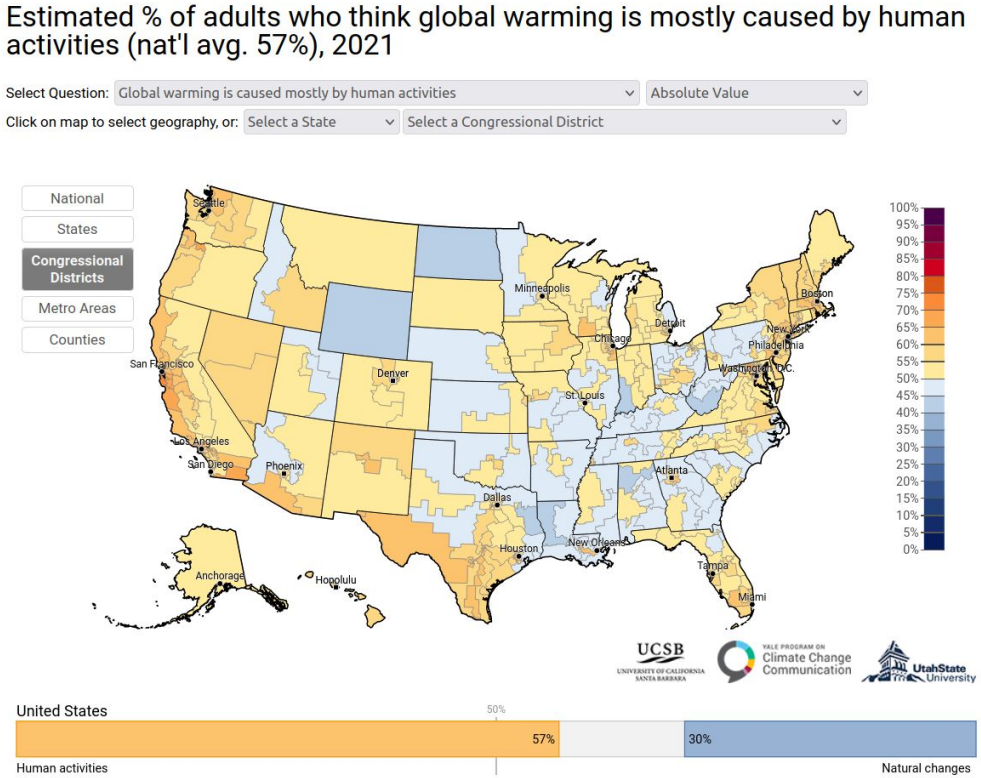

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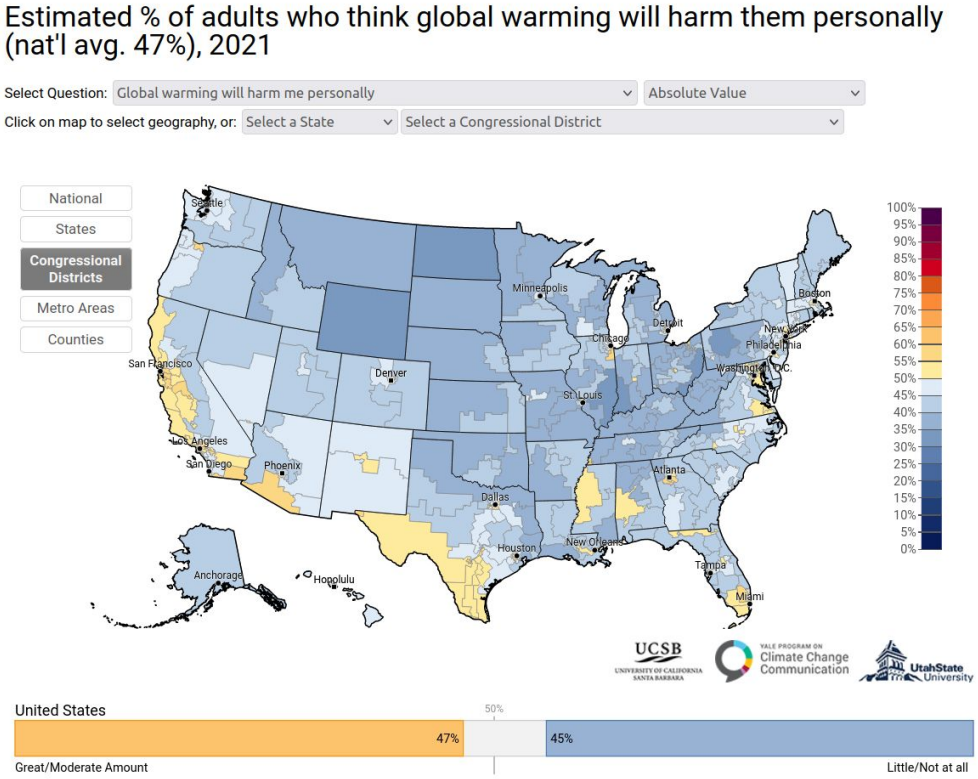

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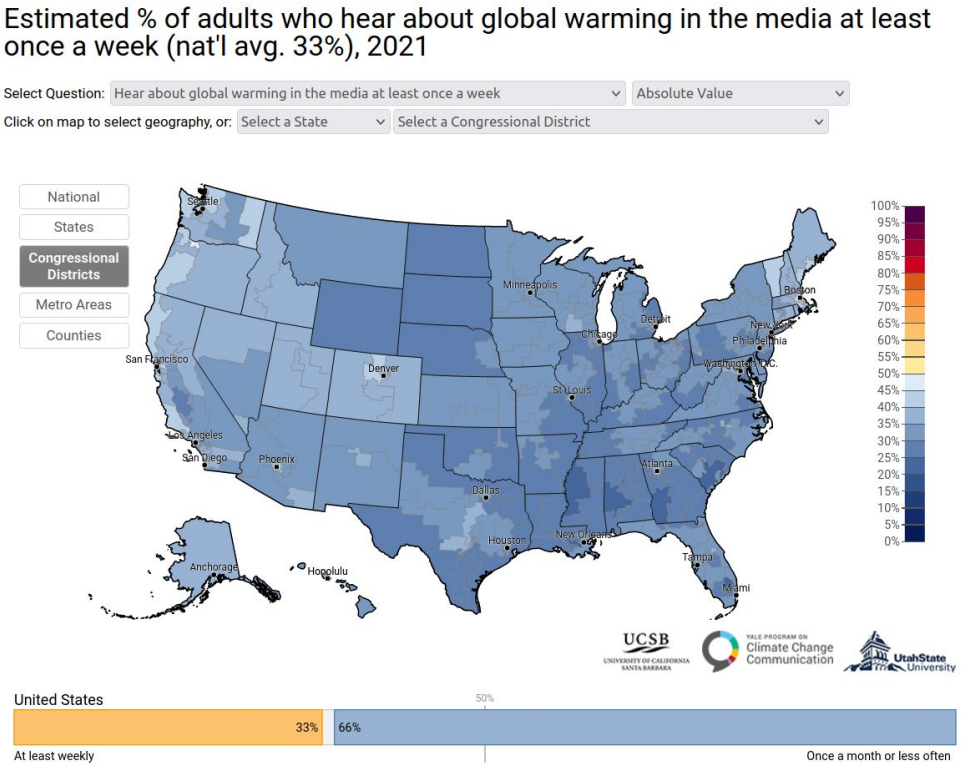

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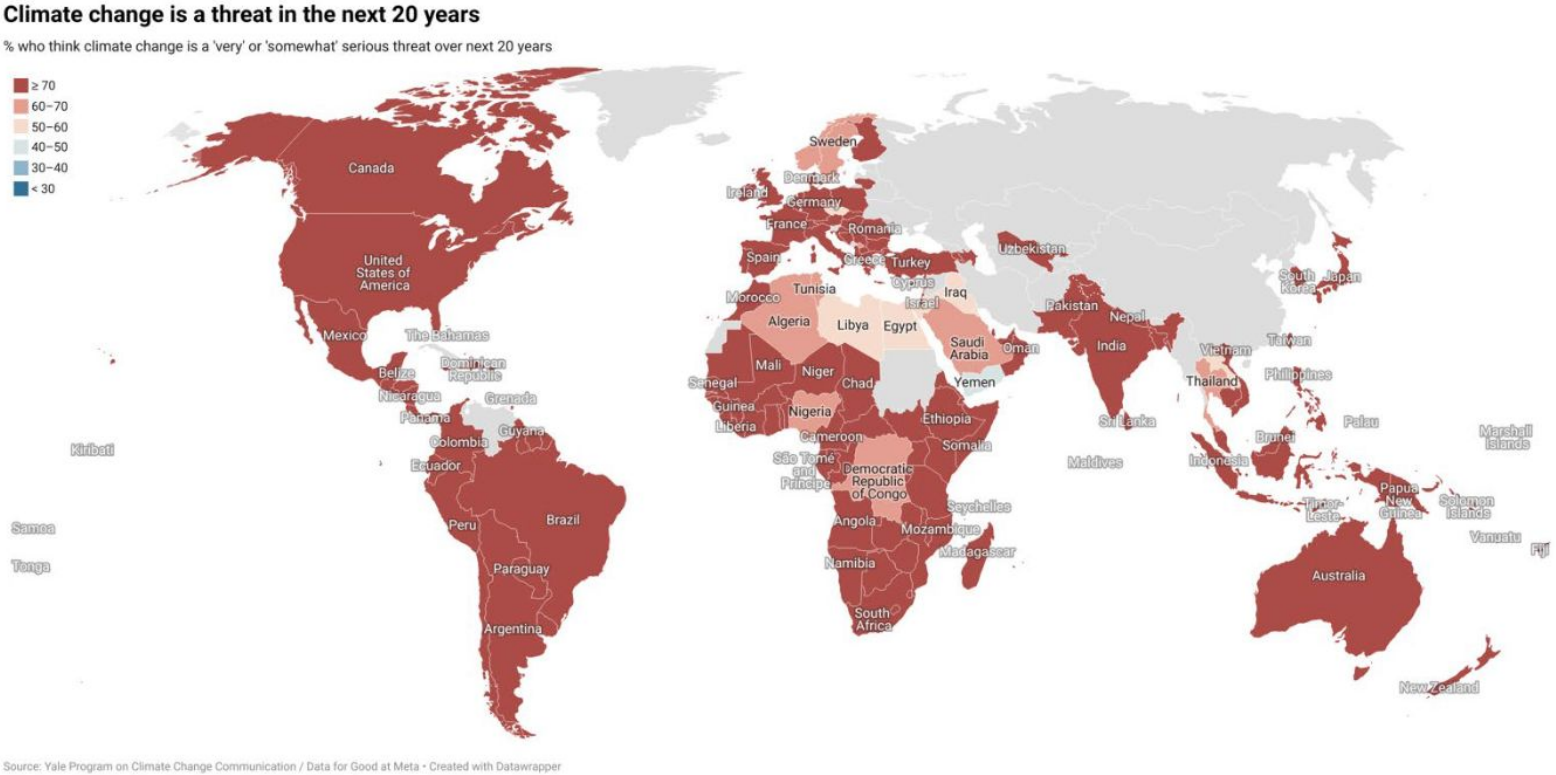

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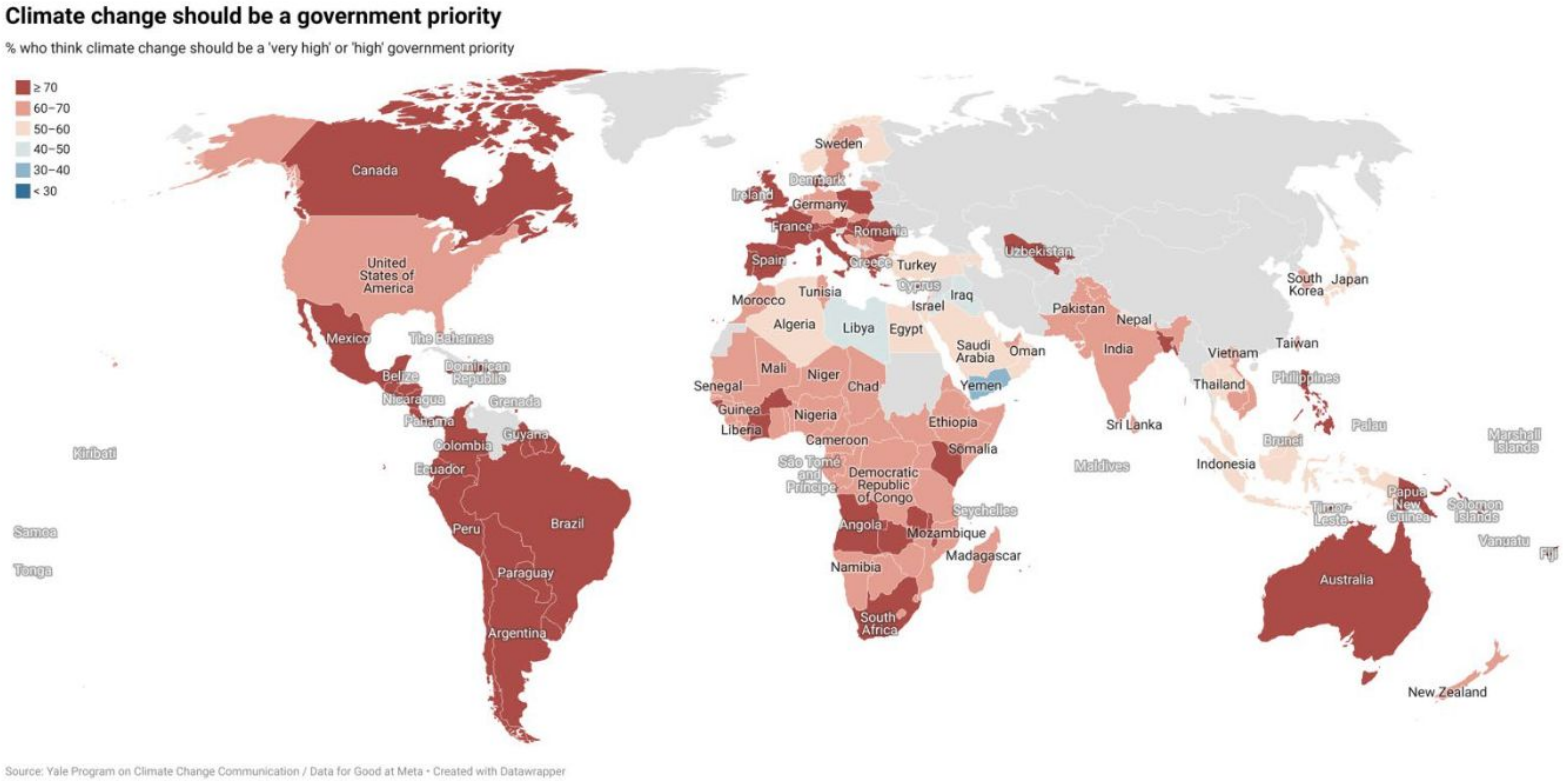

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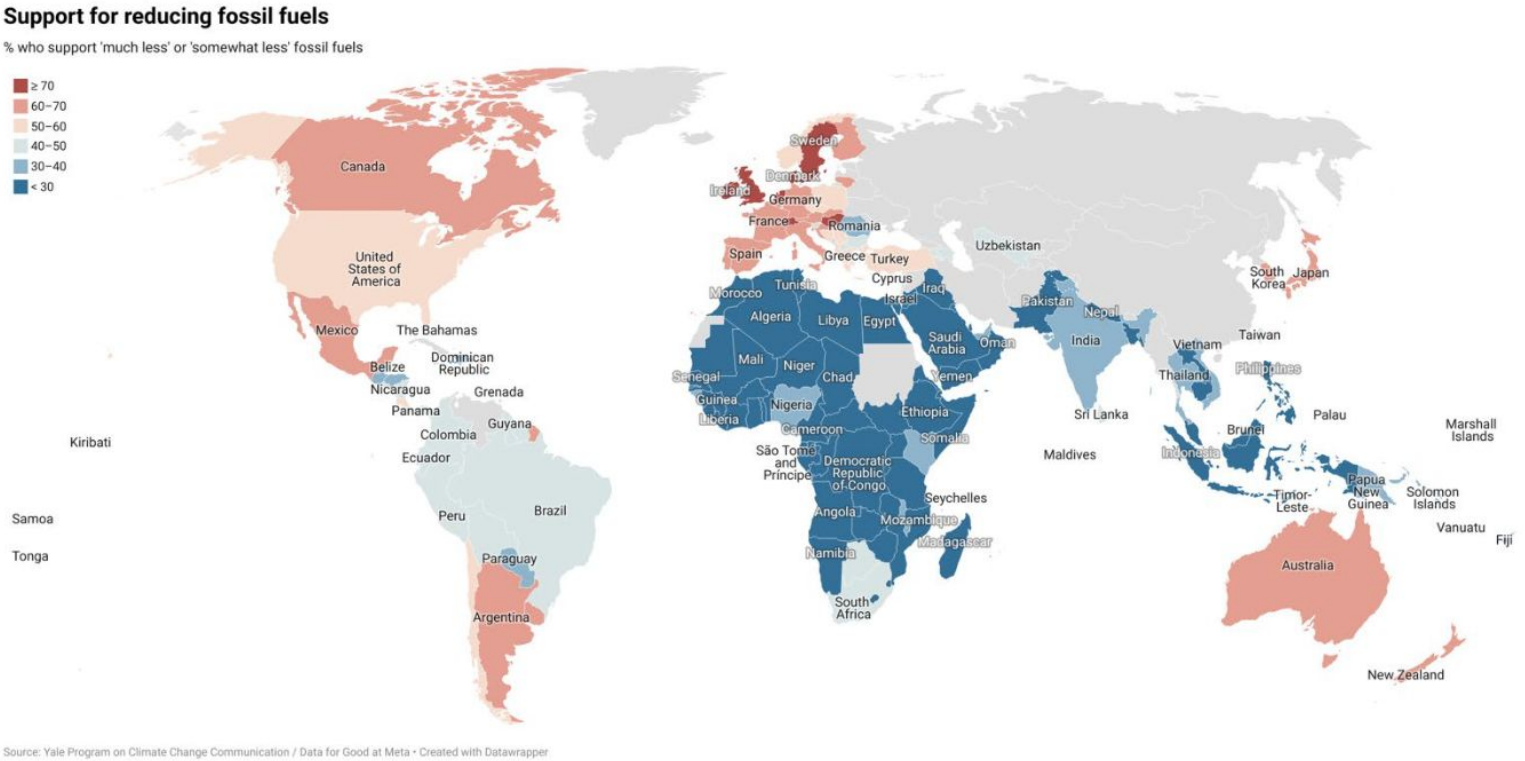


Can we change people's minds?

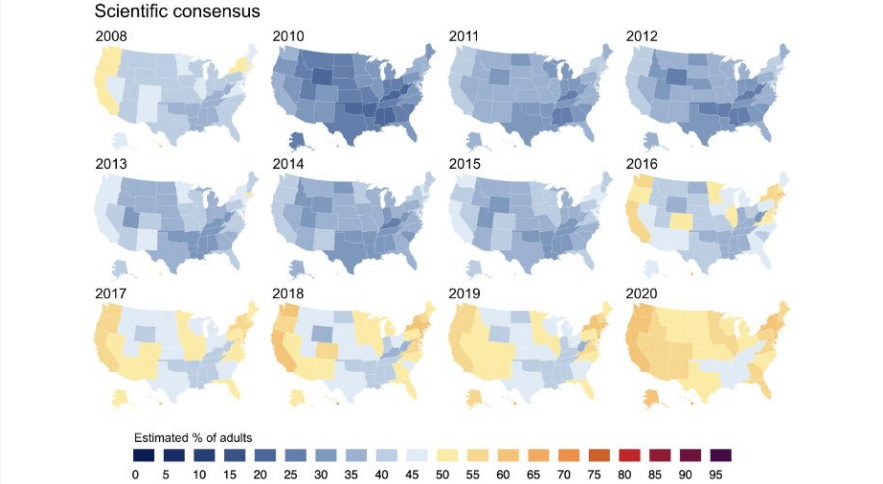


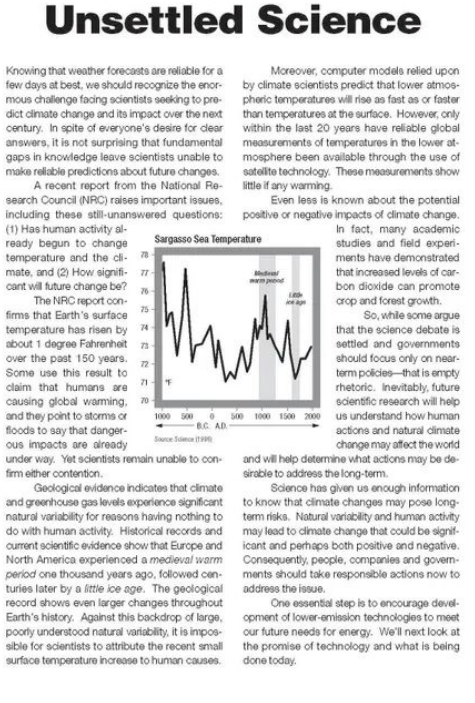
Figure 1. Variations in percentage of Americans by state and over time who think that most scientists think that global warming is happening, 2008–2020.

It's already been happening

https://iopscience.iop.org/article/10.1088/1748-9326/aca702/meta

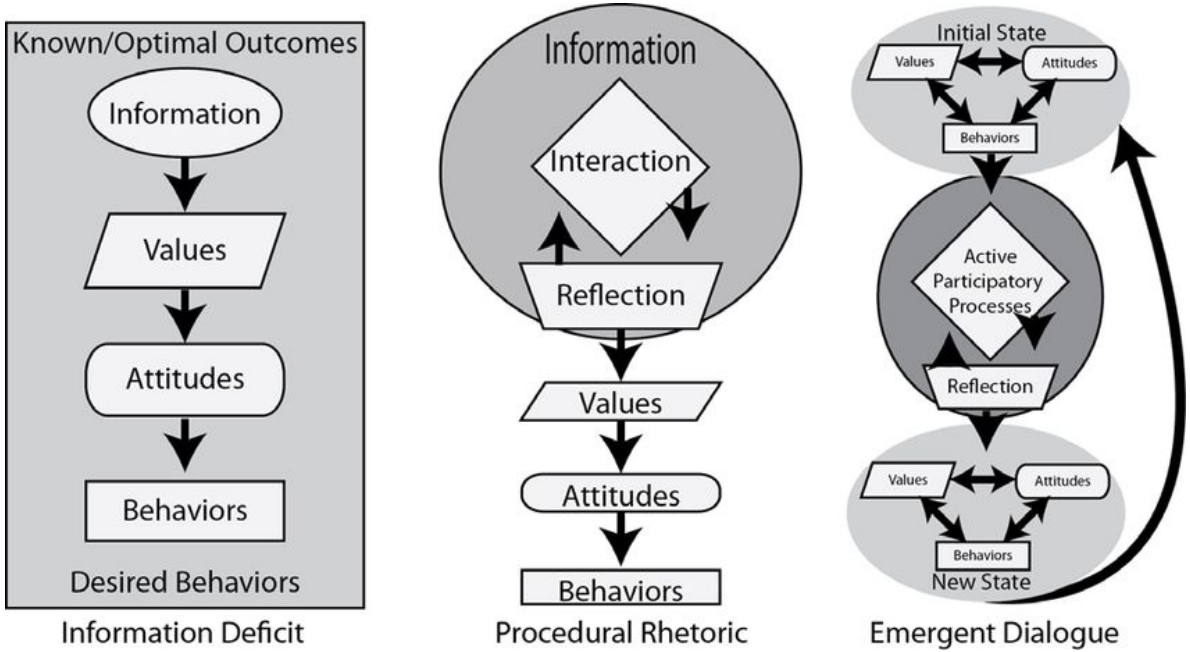
Can we change people's minds?

Oil companies have done it (in the wrong way)



'ExxonMobil's climate "advertorials" – advertisements disguised as editorials – appeared in the op-ed page of the New York Times and other newspapers and were part of what scholars have called "the longest, regular (weekly) use of media to influence public and elite opinion in contemporary America".'

What is effective at changing minds?



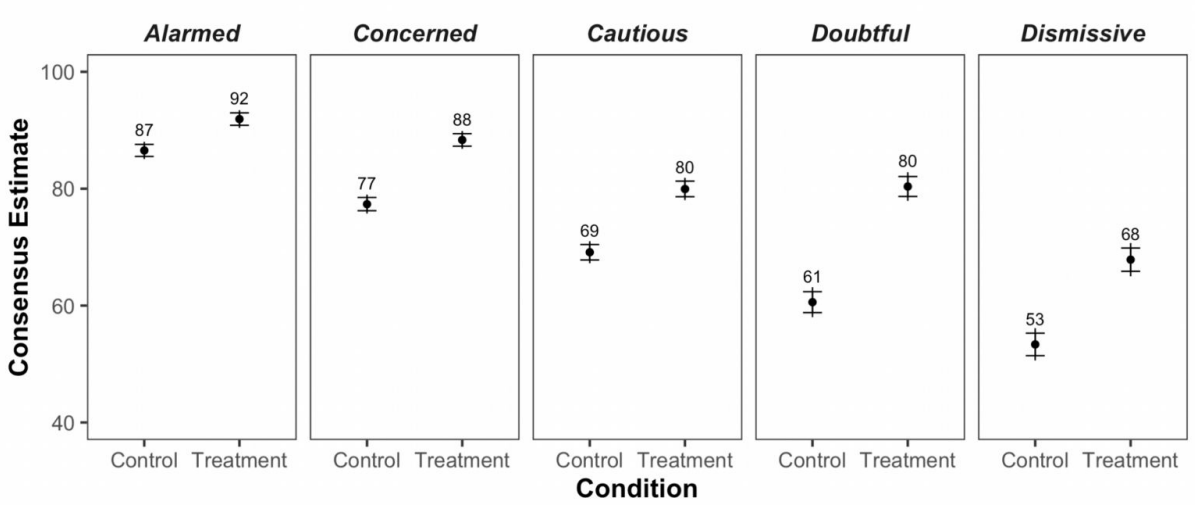
The ability to change minds and behaviors can depend simply on providing information or may require more involved processes of interaction and activations of a sense of identity

Tanenbaum et al., 2013

What is effective at changing minds?

Enforcing that there is scientific consensus

Estimates of the scientific consensus across conditions and audience segments



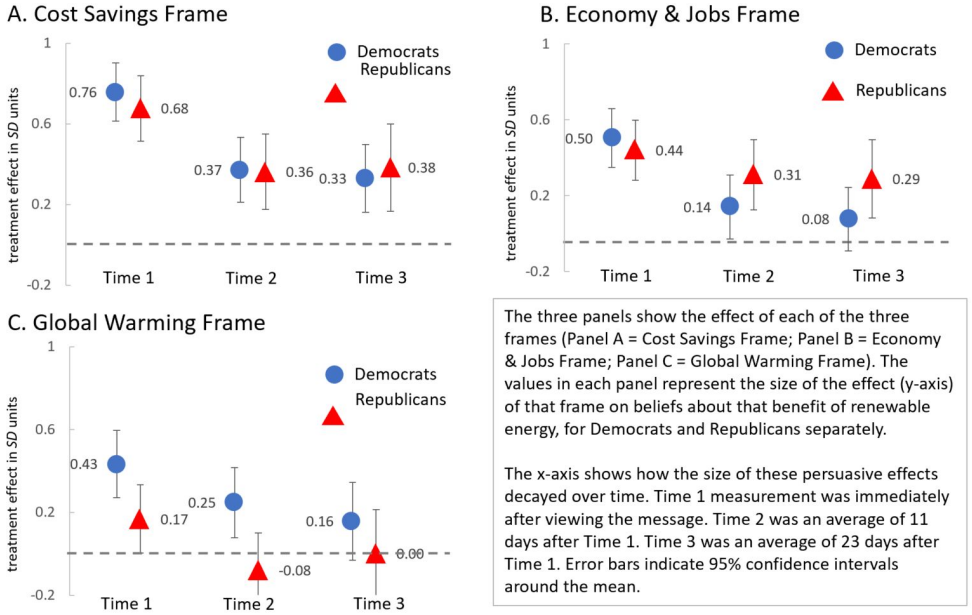
Note. Vertical error bars represent 95% confidence intervals. Horizontal error bars represent 83% confidence intervals to facilitate visual comparisons of significant differences at $p = .05$. Values are means adjusted for pre-treatment estimates of the scientific consensus.

"We delivered a consensus message (i.e., "97% of climate scientists have concluded that human-caused global warming is happening") to members of five of the six U.S. climate audiences. We found that all audiences – from *Alarmed* to *Dismissive* – updated their beliefs about the scientific consensus."

https://climatecommunication.yale.edu/publications/communicating-the-scientific-consensus-on-climate-change-diverse-audiences-and-effects-over-time/

What is effective at changing minds?

Emphasizing co-benefits



The three panels show the effect of each of the three frames (Panel A = Cost Savings Frame; Panel B = Economy & Jobs Frame; Panel C = Global Warming Frame). The values in each panel represent the size of the effect (y-axis) of that frame on beliefs about that benefit of renewable energy, for Democrats and Republicans separately.

The x-axis shows how the size of these persuasive effects decayed over time. Time 1 measurement was immediately after viewing the message. Time 2 was an average of 11 days after Time 1. Time 3 was an average of 23 days after Time 1. Error bars indicate 95% confidence intervals around the mean.

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What is effective at changing minds?

Changing actions can change beliefs

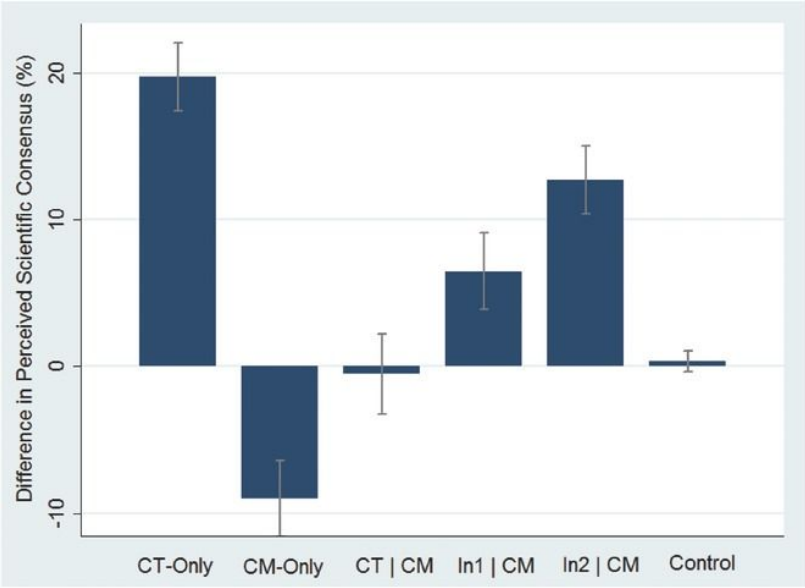
In fact, taking action with concrete solutions can actually help change minds. "Belief and action are connected," said anthropologist Ben Orlove, co-director of the Earth Institute's Center for Research on Environmental Decisions. "Belief is often a basis for action. But once you're committed to a course of action, you tend to find lots of reasons for why you did it."

Hayhoe told a story that illustrates just this point. For years, her colleague argued the science of climate change with his father who was a long-time doubter, but he was never able to change his father's mind. Finally the local community offered a big rebate to get solar panels, so the father installed them on his house. One year later, after telling everyone what a good deal it was and how much money he had saved, the father came to Hayhoe's colleague and said, "You know, that climate thing might be real after all."

https://news.climate.columbia.edu/2017/08/09/what-changes-minds-about-climate-change/

What is effective at changing minds?

‘Inoculation’ against known misinformation



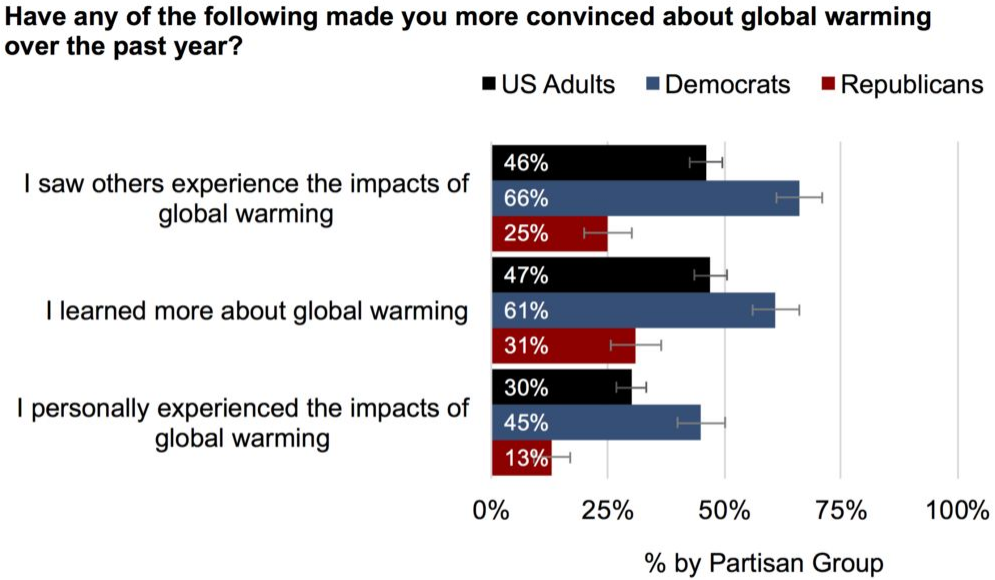
Note: CT = Consensus Treatment, CM = Counter-Message, In1 = General Inoculation, In2 = Detailed Inoculation. Error bars represent 95% confidence intervals.

Letting people know that politically-motivated actors are spreading misinformation about climate change (In1 and In2) can reduce the impact of that misinformation.

https://onlinelibrary.wiley.com/doi/full/10.1002/gch2.201600008

What is effective at changing minds?

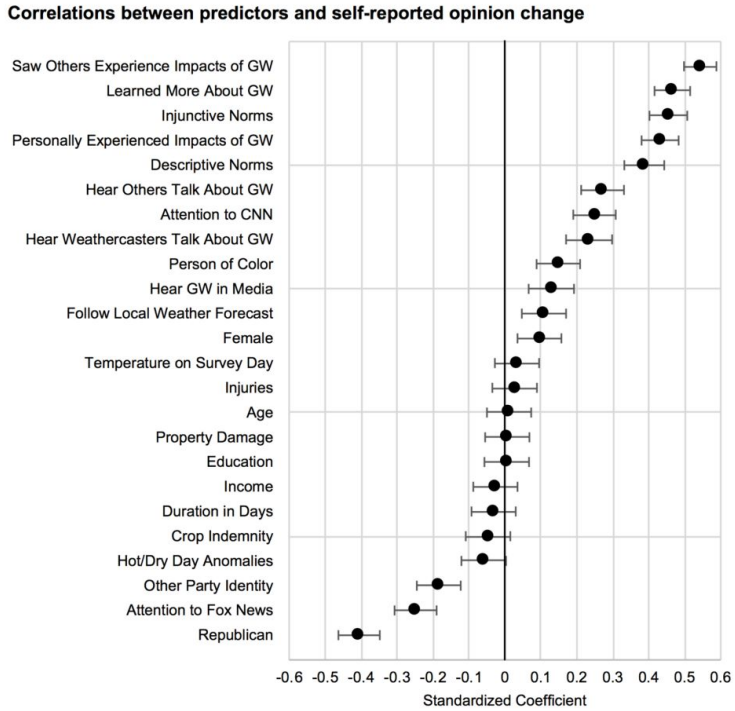
Experience with the effects of climate



December 2018
N = 1,114 (505 Democrats; 389 Republicans)

YALE PROGRAM ON Climate Change Communication

GEORGE MASON UNIVERSITY CENTER for CLIMATE CHANGE COMMUNICATION



December 2018, *N* = 1,114
GW = Global warming
Error bars indicate the 95% confidence interval of the standardized coefficient

YALE PROGRAM ON Climate Change Communication

GEORGE MASON UNIVERSITY CENTER for CLIMATE CHANGE COMMUNICATION

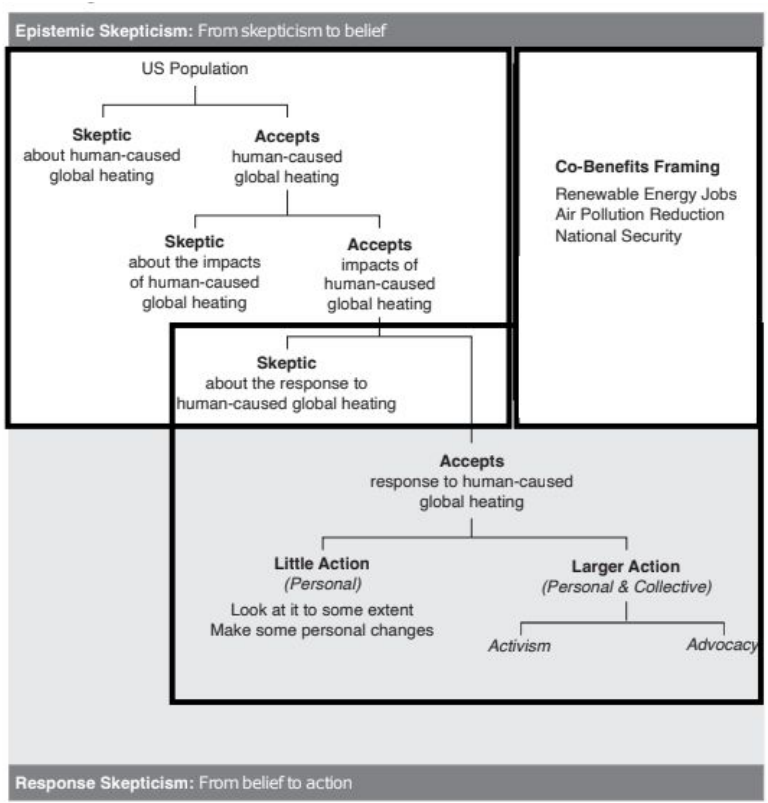
https://climatecommunication.yale.edu/publications/experience-with-global-warming-is-changing-peoples-minds-about-it/

Three ways to get a broader social mobilization:

Shift the skeptics to belief

Shift the believers to action

Leverage co-benefits to get policy support



https://aronclimatecrisis.net/resources/

Paper Deep Dive

VISUALIZING THE CONSEQUENCES OF CLIMATE CHANGE USING CYCLE-CONSISTENT ADVERSARIAL NETWORKS

Victor Schmidt*, Alexandra Luccioni*, S. Karthik Mukkavilli,
Kris Sankaran, & Yoshua Bengio
Montreal Institute for Learning Algorithms
Montreal, Canada
{schmidtv, luccionis, mukkavis}@mila.quebec

Narmada Balasooriya
ConscientAI Labs,
Colombo, Sri Lanka

Jennifer Chayes
Microsoft Research New England
Cambridge, Massachusetts

https://arxiv.org/pdf/1905.03709.pdf

The goal

“Recent studies have shown that **political will is currently the main obstacle** to keeping temperature rise within the limits proposed by the IPCC”

“It is difficult for people to mentally simulate the complex and probabilistic effects of climate change. **People often discount the impact that their actions will have** on the future, especially if the consequences are long-term, abstract, and at odds with current behavior and identity”

“Aim to generate images that depict **accurate, vivid, and personalized outcomes of climate change**” (particularly flooding)

Brainstorm

What kind of data would you want to have to be able to approach this problem?

What kind of methods would you apply?

How would you measure success?

What difficulties might we face?

Data

Collected by “manually searching open source photo-sharing websites for images of houses from various neighborhoods and settings”

Collected 500+ images of flooded homes, and 500 of non-flooded homes (not matched)

300x300 pixels

Data problem!

1000 images is not a lot of images for such a complex problem.

What can be done?

Data augmentation

“In order to increase the quantity of images that we could use for training, we performed several **data augmentation techniques** such as: random crops of a subset of each image, horizontal flipping, small rotations, etc., which enabled us to increase our data set five-fold to over 5000 images total.”

https://www.baeldung.com/cs/ml-data-augmentation

Method

Unpaired Image-to-Image Translation using Cycle-Consistent Adversarial Networks

Jun-Yan Zhu* Taesung Park* Phillip Isola Alexei A. Efros
Berkeley AI Research (BAIR) laboratory, UC Berkeley

https://arxiv.org/pdf/1703.10593.pdf

“CycleGAN”, developed in 2017

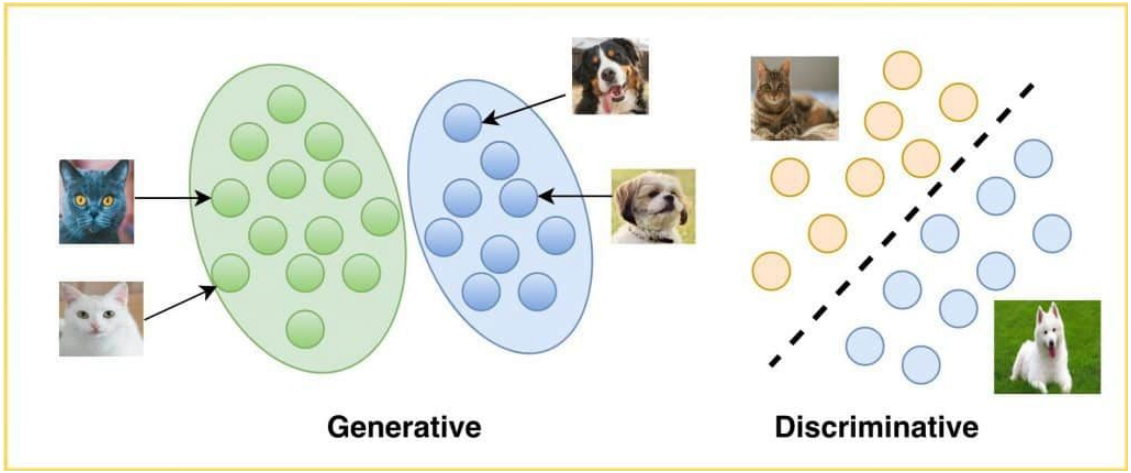
Cycle-consistent generative adversarial network

What is a generative model?

What is an adversarial network?

What does cycle-consistency mean?

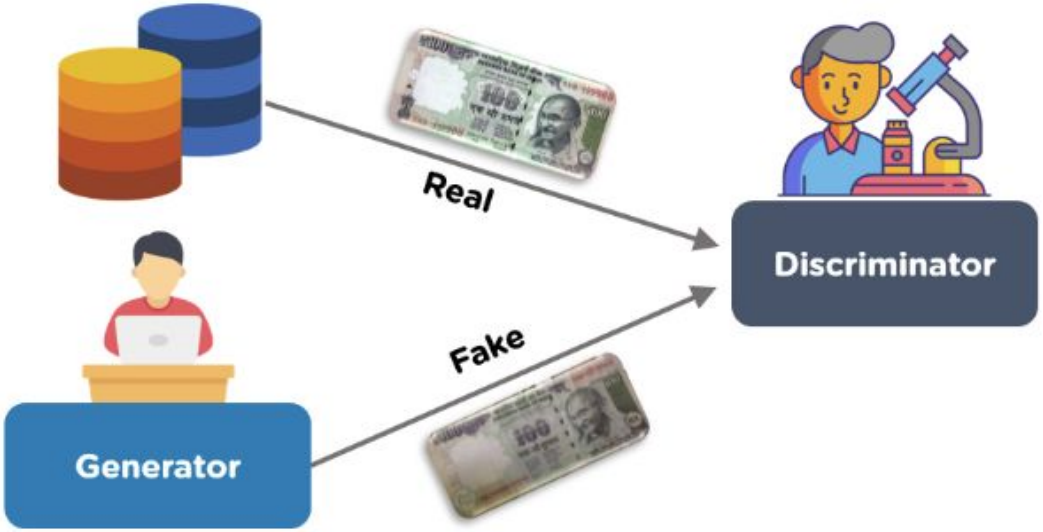
Discriminative vs Generative models



Discriminative models find a way to separate input data

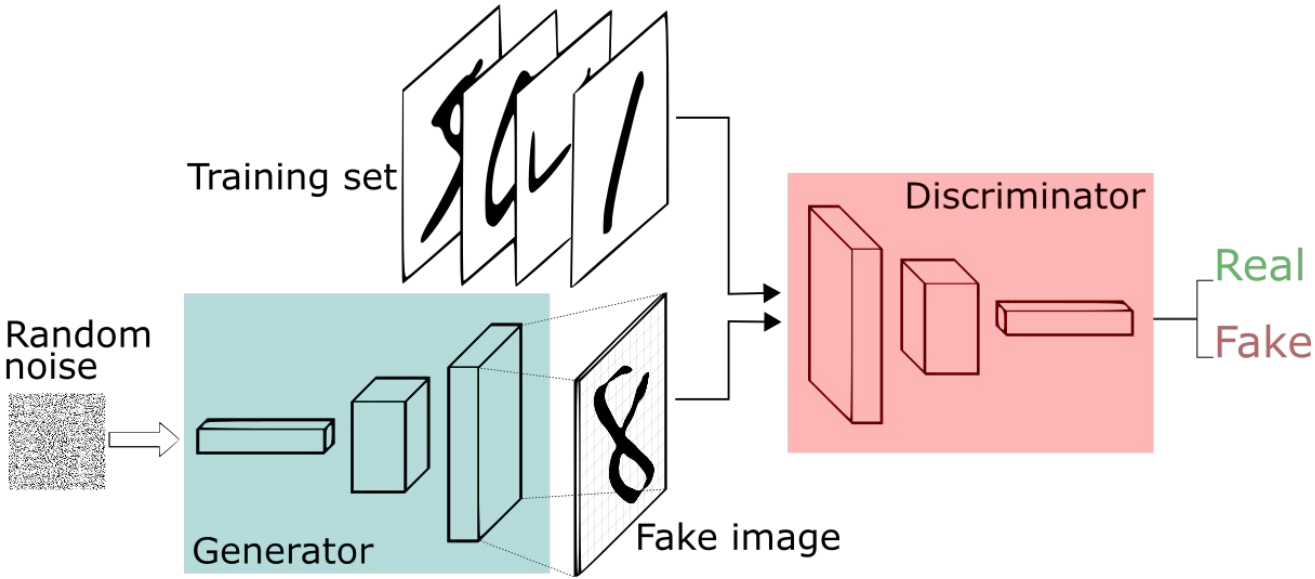
Generative models aim to identify the populations that underlie the data and sample examples from them. ***In this way, they can *generate* data***

What are generative adversarial networks (GANs)?



GANs are based on the idea that a generative model will get better if it needs to fool a discriminator that is trying to spot real vs. fake (generated) data.

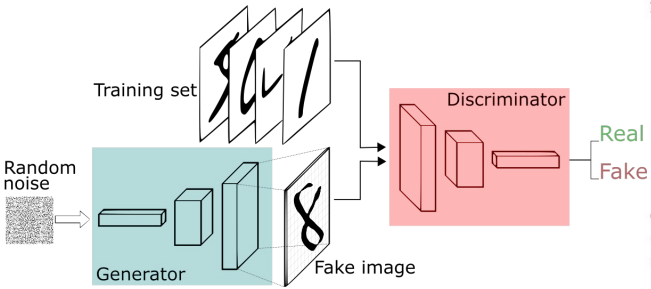
What are generative adversarial networks (GANs)?



In a GAN, both the generator and the discriminator are artificial neural networks. They are trained together.

https://sthalles.github.io/intro-to-gans/

What are generative adversarial networks (GANs)?



Algorithm 1 Minibatch stochastic gradient descent training of generative adversarial nets. The number of steps to apply to the discriminator, k, is a hyperparameter. We used $k = 1$, the least expensive option, in our experiments.

for number of training iterations **do**

  for k steps **do**

  - Sample minibatch of m noise samples $\{\boldsymbol{z}^{(1)}, \ldots, \boldsymbol{z}^{(m)}\}$ from noise prior $p_g(\boldsymbol{z})$.
  - Sample minibatch of m examples $\{\boldsymbol{x}^{(1)}, \ldots, \boldsymbol{x}^{(m)}\}$ from data generating distribution $p_{\text{data}}(\boldsymbol{x})$.
  - Update the discriminator by ascending its stochastic gradient:

$$\nabla_{\theta_d} \frac{1}{m} \sum_{i=1}^{m} \left[\log D\left(\boldsymbol{x}^{(i)}\right) + \log\left(1 - D\left(G\left(\boldsymbol{z}^{(i)}\right)\right)\right) \right].$$

  end for

  - Sample minibatch of m noise samples $\{\boldsymbol{z}^{(1)}, \ldots, \boldsymbol{z}^{(m)}\}$ from noise prior $p_g(\boldsymbol{z})$.
  - Update the generator by descending its stochastic gradient:

$$\nabla_{\theta_g} \frac{1}{m} \sum_{i=1}^{m} \log\left(1 - D\left(G\left(\boldsymbol{z}^{(i)}\right)\right)\right).$$

end for

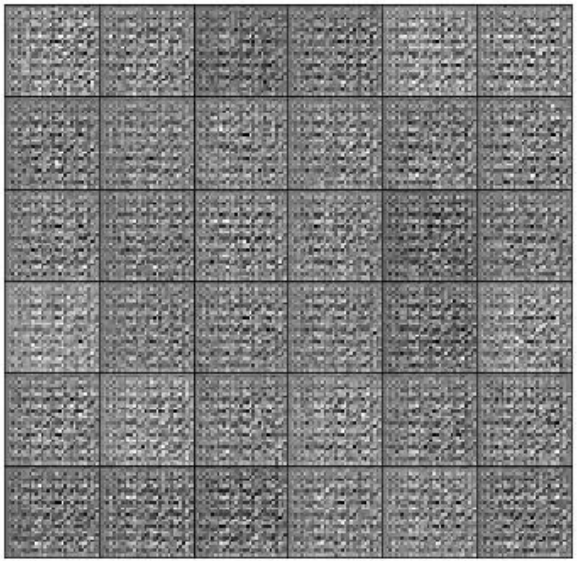
The gradient-based updates can use any standard gradient-based learning rule. We used momentum in our experiments.

The two networks are trained together, with opposite goals.

Diego Gomez Mosquera

https://sthalles.github.io/intro-to-gans/

What are generative adversarial networks (GANs)?



Here, the generator learned the statistics of hand-written digits.

https://sthalles.github.io/intro-to-gans/

Image-to-image

In a standard GAN, a meaningless input is put into the network and it generates an image that looks like it could have come from the training set. In this version, there is no way to control the specific properties of the generated image.

Here, we want to be able to edit a specific image.

Image-to-image

Previous work has built GANs based on *pairs* of images instead. For example, if you want to generate a photo-realistic image from a sketch/edges.

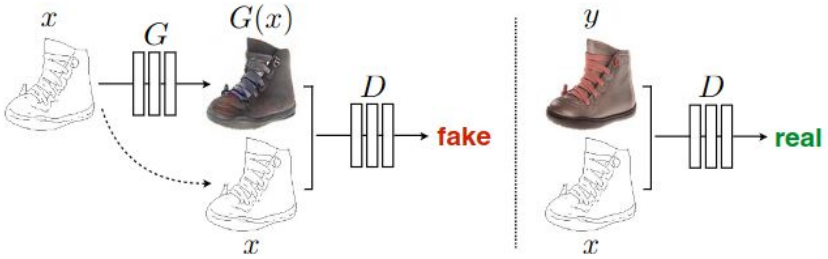


Figure 2: Training a conditional GAN to map edges→photo. The discriminator, D, learns to classify between fake (synthesized by the generator) and real {edge, photo} tuples. The generator, G, learns to fool the discriminator. Unlike an unconditional GAN, both the generator and discriminator observe the input edge map.

Image-to-Image Translation with Conditional Adversarial Networks

Phillip Isola Jun-Yan Zhu Tinghui Zhou Alexei A. Efros

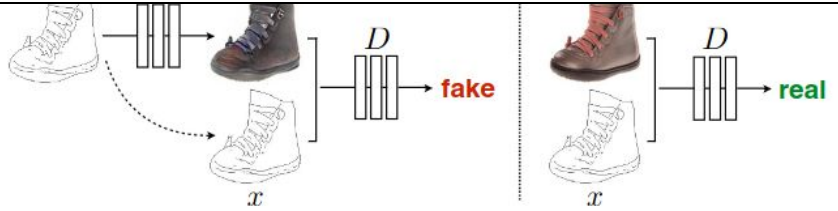
Berkeley AI Research (BAIR) Laboratory, UC Berkeley

{isola,junyanz,tinghuiz,efros}@eecs.berkeley.edu

Image-to-image

Previous work has built GANs based on *pairs* of images instead. For example, if you want to generate a photo-realistic image from a sketch/edges.

But we don’t have paired images!



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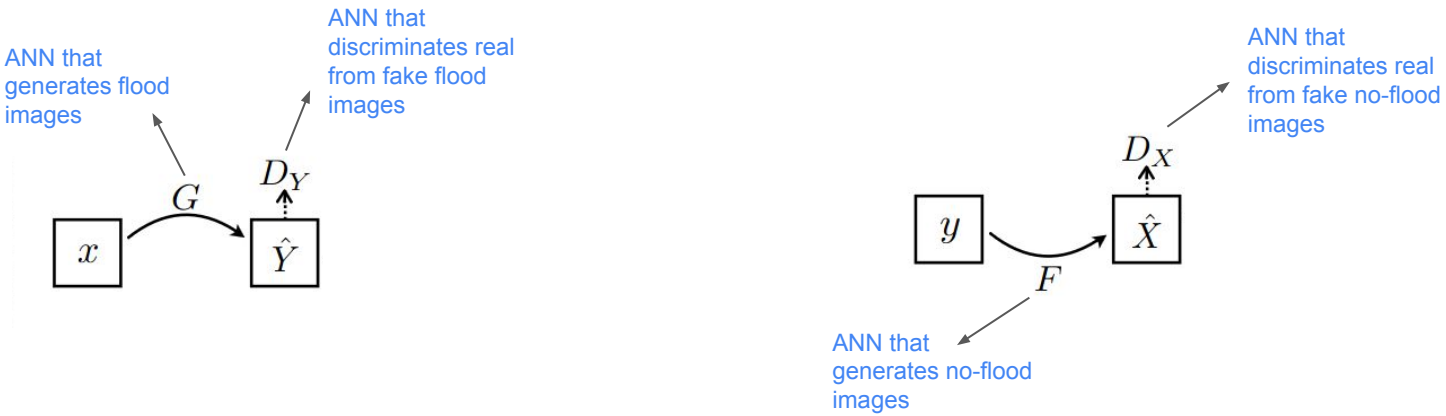
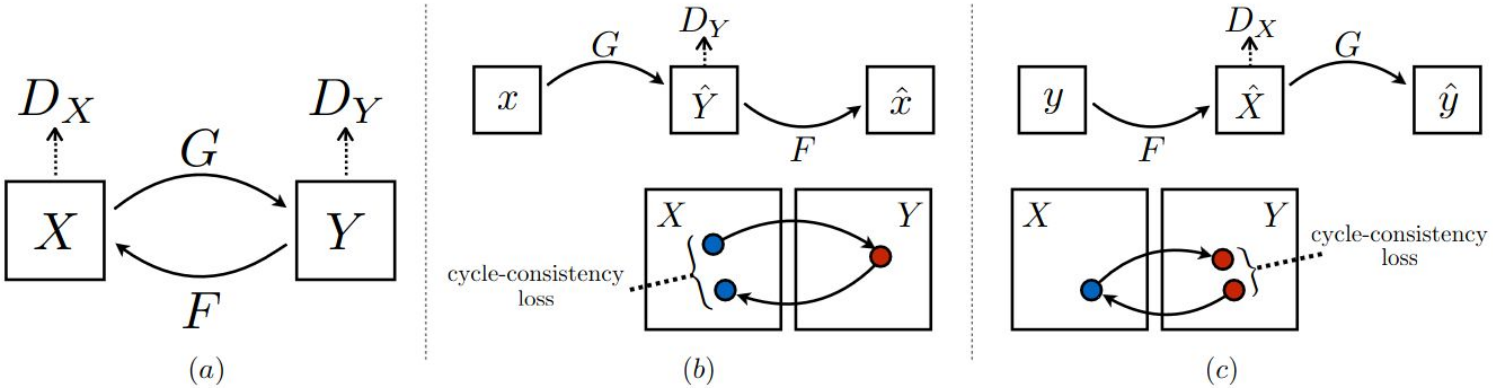
Cycle-consistent generative adversarial network



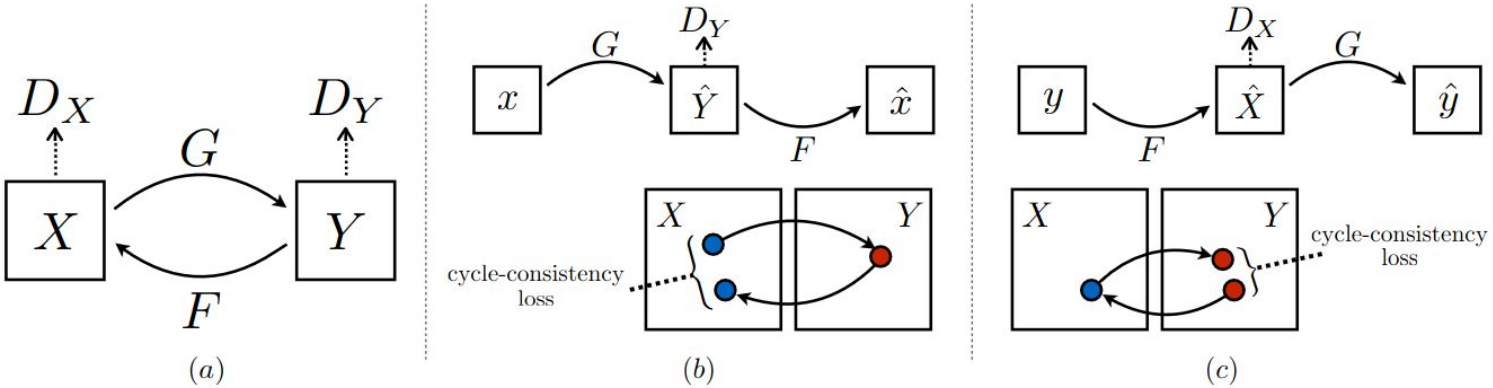
CycleGANs start with two separate GANs, each trained to produce images from the two separate image categories

Cycle-consistent generative adversarial network



“Cycle-consistent” networks constrain the type of image produced by forcing the two image-generating networks to be consistent with each other. Specifically, if an image from one class is transferred to the other, applying the transformation in the opposite direction should return the original image.

Cycle-consistent generative adversarial network

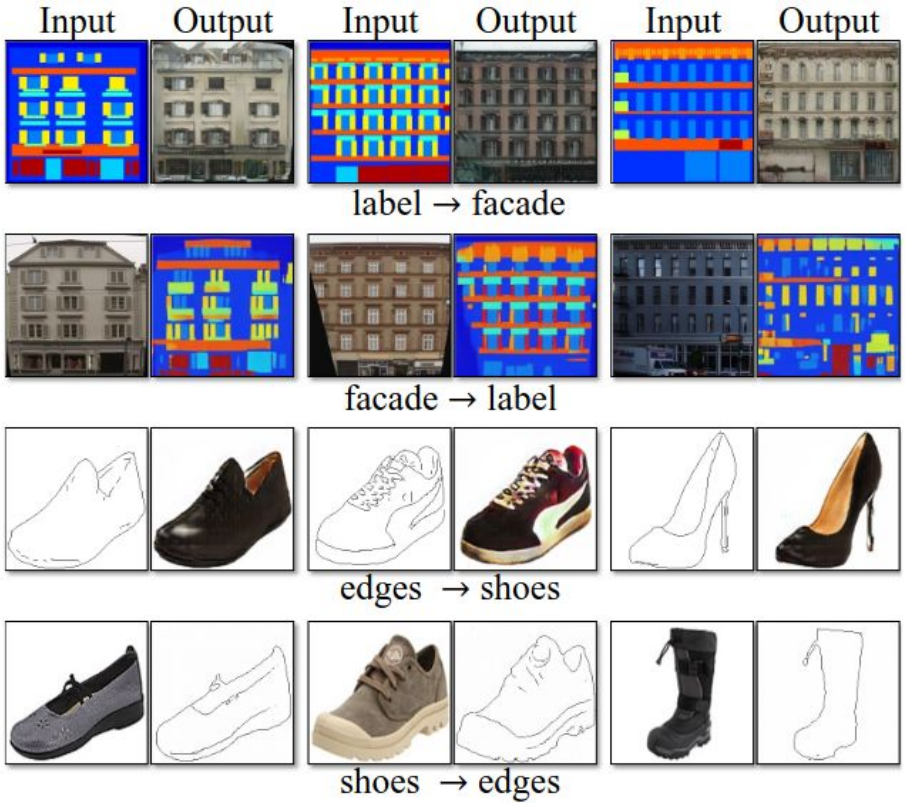


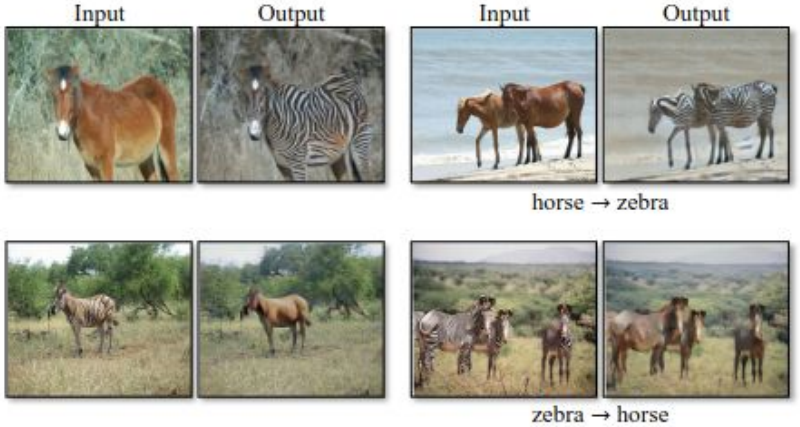
We incentivize this behavior using a *cycle consistency loss*:

$$\mathcal{L}_{\text{cyc}}(G, F) = \mathbb{E}_{x \sim p_{\text{data}}(x)}[\|F(G(x)) - x\|_1] + \mathbb{E}_{y \sim p_{\text{data}}(y)}[\|G(F(y)) - y\|_1]. \quad (2)$$

“Cycle-consistent” networks constrain the type of image produced by forcing the two image-generating networks to be consistent with each other. Specifically, if an image from one class is transferred to the other, applying the transformation in the opposite direction should return the original image.

Cycle-consistent generative adversarial network





Model/data problem

“A challenge that we encountered was the fact that flooding is not truly a one-to-one mapping such as the one assumed by the CycleGAN approach, but in fact a many-to-one mapping, i.e. roads, grass, dirt, fences are all mapped to water. For this reason, our data collection was constrained to houses surrounded by lawns, which were then mapped to water by the model.”

Results

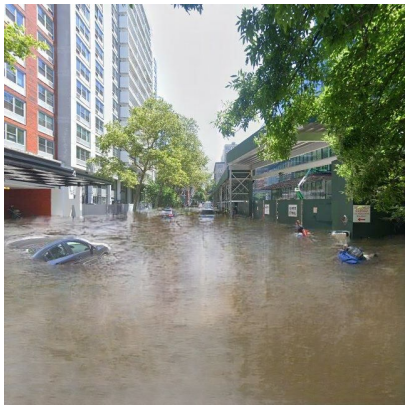
“From the 80 images in the test set, we found that about 70% were successfully mapped to realistically flooded houses”

5 Discussion and Future Directions

The initial version of the CycleGAN model that we have developed in the present paper is a prototype to illustrate the feasibility of applying generative models to create personalized images of an extreme climate event, flooding, that is expected to increase in frequency based on climate change projections. Subsequent versions of our model will integrate more varied types of houses and surroundings, as well as different types of climate-change related extreme event phenomena (i.e. droughts, hurricanes, wildfires, air pollution etc), depending on the expected impacts at a given location, as well as forecast time horizons.

https://thisclimatedoesnotexist.com


NEW YORK UNIVERSITY



Further ideas/issues

Connect the image generation to the output of a climate model (and let users enter actions/pathways). However, most climate model predictions are too spatially coarse to be applied to individual homes.

Will this influence minds/behavior?

Further Resources

Psychology studies from Part II of this course:
https://aronclimatecrisis.net/resources/

Informal survey of ex-climate deniers:
https://news.climate.columbia.edu/2017/08/09/what-changes-minds-about-climate-change/

https://www.tensorflow.org/tutorials/generative/cyclegan

Using Artificial Intelligence to Visualize the Impacts of Climate Change

Using Simulated Data To Generate Images Of Climate Change

Establishing an evaluation metric to quantify climate change image realism

Summary

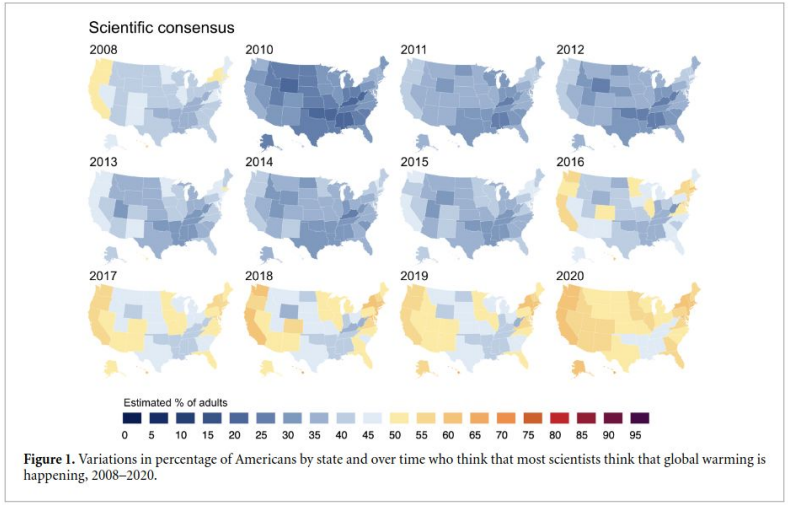


Figure 1. Variations in percentage of Americans by state and over time who think that most scientists think that global warming is happening, 2008–2020.