Boosting Public Understanding of Climate Change:
Global Warming Denial is Reduced by 6+
Polarization-Free Kinds of Scientific/Statistical Information
by
Michael Ranney
(University of California, Berkeley)

w/: L. Velautham, L.N. Lamprey, E. Munnich, C. Chang, T. Ng, J. Teicheira, T. Luong, D. Clark, Rachel M. Ranney, O. Arnold, Q. Brow, L. Goldwasser, S. Cohen, M. Beale, P. Schank, F. Kaiser, E. Harrison, the Reasoning Group, & many others.


(2) Ranney et al. (2016). Increased wisdom from the ashes of ignorance and surprise: Numerically-driven inferencing, global warming, and other exemplar realms. *The psychology of learning and motivation, 8*, 49-75.


Current Reasoning Group Interests

The Intersection of Euler Circles & the sweet spot of Climate Change Cognition:

- Science Cognition
- Mathematical Cognition (especially Numeracy)
- Societal Importance

Sweet! (e.g. CCC)
Some Good News About US Acceptance
(Yale & George Mason data; [Leiserowitz, Maibach, & colleagues])

Dec. 2013 to Dec. 2018; 5-year change (n = 13,103; 11 US surveys)
(Note: In Dec. 2013, our HowGlobalWarmingWorks.org went live!)
The US is poorly informed about the % of climate scientists who think Global Warming is happening:

- 24% of Americans believe that half of climate scientists, or fewer, think human-caused global warming is happening.
- 36% believe that between 51 and 90 percent of scientists think global warming is happening.
- 17% correctly understand that almost all climate scientists think global warming is happening.
- 21% don't know.

Source: Yale Program on Climate Change Communication survey conducted in April; figures do not add up to 100 percent because of rounding.
First-Person Experience: Choose for Yourself!

Which of these graphs represents the change in Earth’s Surface Temperature?

...And which is the change in the (Adjusted-Inflation) Dow Jones Industrial Average?

(Each point represents 16 years of data)

The graphs: rising, dropping, or flat?

Nb: +6°C = a 109.4°F body! (from 98.6°F)

See Ranney et al., 2016

Such “Bex” graphs represent our“4th way” of increasing global warming knowledge (inspired by Lewandowsky, 2011)!
An ("If we had time") Talk Outline re: **Six Ways**

- **Background:** The US “diverges” from peers nations (e.g., on GW); Changeable?
- **A psychology-in-the-public-interest approach to Climate Change denial**
  * A Key: (Basically) No Deceptions! “You can share this w/ your family now!”
- **Dearth of Climate Change knowledge:** in San Diego, Germany, Japan, etc.
- **~7 400-word Mechanism Expt.s:** CA, TX, German, US-MTurk samples
  - Huge increases in knowledge; increases in GW acceptance & concern
  - M-Turk Expts: similar gains bet. Conservatives & Liberals, no polarization
  - No stasis, good longevity! Studies used test-delays of up to 34 days
- **Connecting GW work with NDI (Numerically Driven Inferencing):** Stats, graphs
  - E.g.: 11th-grade curriculum w/ both Mechanism & Diagnostic numbers
  - 3 **Representative-Statistics** NDI Studies (e.g., about GW’s effects so far)
  - Also **Other Statistics** (e.g., re: sea-level rise)
  - Bex/graphs studies neutral-method on determining trends via Averaging
  - [HowGlobalWarmingWorks.org](https://HowGlobalWarmingWorks.org): Direct-to-the-public, Now in Mandarin, etc.
  - A new mega-study comparing “dosages” of Videos, texts, & stats
- **Modifying folks’ sense of Nationalism**
- **Conclusions & Implications**
“Vested interests” are trying to sow doubt (e.g., misinformation)
- Many politicians rely on this money

Yet people/societies learn; they are not in stasis!
  - E.g., Galileo’s heliocentrism vs. Papal power
  - Cf. Smoking-causes-cancer vs. Tobacco money

So, maybe knowledge helps re: climate, as w/ planets & smoking!
  - False dichotomy on attitudes from culture vs. info (cf. Kahan)
  - Compare to nature-nurture false-dichotomy
  - But cf. Kahan on MD’s & geo-engineering, though

- We can fix global warming “easily” (or at least “readily”!):
  - Switch our $5T/yr Fossil Fuel subsidy—into solar & wind for all
  - For only ~ $125T total; let’s become the (new) greatest generation!
  - If we’d started 25 years ago, we’d have already been done...?
Motivation, Science-Defamation, and a Pledge

- **Real** scientists overwhelmingly wish global warming weren’t true
  - Especially parents—or people who care about “eating-while-old”
  - Also, PhD’s have very low joblessness & quite-high job satisfaction
  - So, climate scientists can do other things & still get good pay!
  - Impugning climate scientists’ goals = **libel** (i.e., passing falsehoods)

- I’d be ecstatic if human-caused GW weren’t happening

- Thus, my **pledge**: (a) rent, (b) thank, (c) cease, & (d) give $’s back
  - Disconfirming GW → “Most famous scientist alive”
  - Heck, I’d (e) split half of the Nobel money!

- Still, misleading (e.g., cherry-picked) information is ubiquitous
  - E.g., about scientists’ “bias”
How is it that Earth is getting hotter? What’s the physical/chemical mechanism?

1. How would you explain how climate change occurs?
   - Think about this for 10 seconds!

2. Why does heat have a hard time getting away from Earth’s surface and troposphere?
   - Shouldn’t heat have just as hard a time getting in?
   - Why the asymmetry?
How Global Warming Works:

Climate Change's Mechanism Explained

(From HowGlobalWarmingWorks.org)

Haiku version (not given to participants), Ranney et al., 2016:

Global Warming’s Mechanism:
Earth turns sunlight to
IR light that’s sponged by folks’
Greenhouse gases glut.
How does climate change ("global warming") work? The mechanism of the greenhouse effect

Scientists tell us that human activities are changing Earth’s atmosphere and increasing Earth’s average temperature. What causes these climate changes?

First, let’s understand Earth’s “normal” temperature: When Earth absorbs sunlight, which is mostly visible light, it heats up. Like the sun, Earth emits energy—but because it is cooler than the sun, Earth emits lower-energy infrared wavelengths. Greenhouse gases in the atmosphere (methane, carbon dioxide, etc.) let visible light pass through, but absorb infrared light—causing the atmosphere to heat up. The warmer atmosphere emits more infrared light, which tends to be re-absorbed—perhaps many times—before the energy eventually returns to space. The extra time this energy hangs around has helped keep Earth warm enough to support life as we know it. (In contrast, the moon has no atmosphere, and it is colder than Earth, on average.)

Since the industrial age began around the year 1750, atmospheric carbon dioxide has increased by 40% and methane has increased by 150%. Such increases cause extra infrared light absorption, further heating Earth above its typical temperature range (even as energy from the sun stays basically the same). In other words, energy that gets to Earth has an even harder time leaving it, causing Earth’s average temperature to increase—producing global climate change.

In molecular detail, greenhouse gases absorb infrared light because their molecules can vibrate to produce asymmetric distributions of electric charge, which match the energy levels of various infrared wavelengths. In contrast, non-greenhouse gases (such as oxygen and nitrogen—that is, O2 and N2) don't absorb infrared light, because they have symmetric charge distributions even when vibrating.

Summary: (a) Earth absorbs most of the sunlight it receives; (b) Earth then emits the absorbed light’s energy as infrared light; (c) greenhouse gases absorb a lot of the infrared light before it can leave our atmosphere; (d) being absorbed slows the rate at which energy escapes to space; and (e) the slower passage of energy heats up the atmosphere, water, and ground. By increasing the amount of greenhouse gases in the atmosphere, humans are increasing the atmosphere’s absorption of infrared light, thereby warming Earth and disrupting global climate patterns.

Shorter summary: Earth transforms sunlight’s visible light energy into infrared light energy, which leaves Earth slowly because it is absorbed by greenhouse gases. When people produce greenhouse gases, energy leaves Earth even more slowly—raising Earth’s temperature.

* Which part(s) of this does Donald Trump not accept? A Chinese Hoax?
How is it that Earth is getting hotter?
What’s the physical/chemical mechanism?

1. How would you explain how climate change occurs?
   - Think about this for a bit!

2. Why does heat have a hard time getting away from Earth’s surface and troposphere?
   - Shouldn’t heat have just as hard a time getting in?
   - Why the asymmetry? Do atmospheric molecules know “up” vs. “down”?

Bonus: Are all gases “greenhouse gases” (GHGs)?
   If not, what makes something a greenhouse gas?
   Is $O_2$ a greenhouse gas? Is $N_2$? Is $CH_4$?

* Videos narrated by Daveed Diggs (“Hamilton” Tony winner; “Blackish,” “Blindspotting”); storyboard & prototype by Dr. Rachel M. Ranney
“Expert” Opinions

#1: “Wow, I guess I don’t know the right answer!”
   -- A 6th-year Environmental Sciences grad student

#2: “No, it’s not ‘alright’ that I didn’t know! You don’t understand; I’ve published papers about global warming!”
   -- A famous colleague

#3: “Having spent nearly 20 years as a research scientist at UCSD's Scripps Institution of Oceanography . . . Certain emissions caused by human activities have caused the "greenhouse effect" and have been shown (with excellent scientific evidence) to have affected the ozone layer and contributed to global warming.”
   -- A San Diego participant

Nope! The greenhouse effect is way pre-human, and is not due to ozone depletion.
270 San Diegans’ (Mis)conceptions

- When asked the “mechanism” questions:
  - None (0!) of the 270 were basically correct re: global warming!
  - None of the 270 mentioned the visible --> infrared change
  - Most wrongly believed ozone depletion to be a major cause of climate change cause

- (We got similar results from 11th-grade chemistry students)
- It’s odd that journalists & teachers haven’t informed us!
- Glob. Warm. acceptance is linked to mechanistic knowledge
  - This link has now (2014) been replicated in Germany
  - Our effect has again (2014) been replicated in the U.S. (mTurk; r ~ .5)
  - Our findings disconfirm the “stasis view”

- The San Diegans had modest knowledge, even though:
  - Most “strongly agreed” that global warming is occurring, and
  - Almost half “strongly agreed” that “Human activities are a significant cause of global warming.”

- So, why not just tell folks how climate change truly works?
What if we just told folks the mechanism? (5-7X Replicated) 400-word “Jam” expt.

- Does mechanistic ignorance (partly) explain the U.S. reluctance to accept Climate Change?
- A causal question? Time for an experiment!
- Metaphor: A “test” is a slice of bread
  - Intervention is the “jam”
  - “Sandwich” (S) group:
    - (pre-test) Knowledge and attitude
    - 400-word Description
    - (post-test) Knowledge and attitude
  - Another, “no-pretest,” group was used as a control & for replication
They Knew Way More After 400 Words!

I.e., giving folks the mechanism worked, as Knowledge doubled-to-tripled (**p’s < .01)

<table>
<thead>
<tr>
<th>Light (visible ⇒ infrared)</th>
<th>Before Description</th>
<th>After Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>20%</td>
<td>56% **</td>
<td></td>
</tr>
</tbody>
</table>

| GHGs                       | 27%                | 63% **            |
| Energy Dynamics            | 19%                | 48% **            |

... and Knowledge correlates w/ GW Acceptance—both as occurring and anthropogenic, as in our San Diego data (cf. stasis!)
“But wait!” Learning the Mechanism Improved Climate Change Acceptance!!

- Participants closer to “extreme agreement” with Climate Change items:
  - UC Berkeley undergrads shifted, on average, 14% \((p = 0.01)\)
  - UT Brownsville students shifted, on ave., 20% \((p < 0.0001)\)

- So, (a) not only did we show that GW-learning *is* possible—
  (b) *attitude change* is possible, too—disconfirming stasis theory! 😊

- [It worked w/ heliocentrism & the smoking-cancer link, too!]

- Also, both knowledge and acceptance predict folks’ global warming
  “willingness to sacrifice” (our S.D. data show)

- Knowledge & Acceptance both corr. w/ Envir. Att./Behavior (German data)

→ Longevity: Ranney & Clark’s Expt. 5 (2016) showed & replicated the changes’ durability (in *Topics in Cognitive Science*)

→ Notable attitude & knowledge gains even *after* 5.5 - 9 days (US M-Turk sample) and *34 days* (high school chemistry students); \(p’ s < .01\)

- Such findings disconfirm (a) “stasis theory”—which suggests futility in
  boosting public climate wisdom—& (b) polarization (re: next slide)
No Polarization From Mechanistic Info

- Change in acceptance was not negative for conservative political party members

- This coheres with a mega-study (N ~ 1100) we ran with 18 interventions, with immediate & 9-day post-tests:
  - Democratic: +.29 +.20
  - Republican: +.31 +.30
  - Independent: +.21 +.22
  - Libertarian: +.40 +.46
  - Tea: +.36 +.44

- And the correlation between acceptance change & conservatism (both economic and social) was significantly positive after 9 days (r ~ .1, p < .05)
In **Contrast To Good Mechanistic Knowledge**...

This is a quote from a May 5 (2016) speech to people in a coal community by one of the two highest-polling candidates for US president:

“ I said [to the climate scientists] ‘Wait a minute: So if I take hairspray, and if I spray it in my apartment, which is all sealed... you are telling me that that affects the ozone layer, yes? I say, no way.’ Folks: No way!”

[https://www.youtube.com/watch?v=i30pZSVuyv8](https://www.youtube.com/watch?v=i30pZSVuyv8)

(5:53 to 6:08)

Can you guess which candidate? Hillary or Donald?

What does it say about one’s understanding of gases?

(Btw, the ozone layer is **not** a significant factor in GW.)
More “Evidential” Studies: Merging RTMD With NDI (Numerically Driven Inferencing)

Estimate this:

What has been the change in Earth’s atmospheric methane concentration since 1750 CE?

+/- ___% 

Is it +5%? Nope!

What would you think if the answer were:

+151%? …because it is!

Would you boost the $’s you’d give to stop climate change?
Merging NDI (*MoreNumerate.org*) with RTMD’s Experimental Methods

Somewhat like to our “Sandwich” Mechanism group:

- Attitudes (& Knowledge) pre-test
- 7-9 estimation items w/ “why” rationales
- Then the feedback # for each estimate
- Attitudes (& Knowledge) post-test
Representative Numbers (alone) Can Increase GW Acceptance! Three examples

1) Based on a set of 1372 researchers who are actively publishing in the field of climate research, 98% believe in human-caused climate change (published in the Proceedings of the National Academy of Sciences).

2) According to a published 2009 study using 9 years of data from the National Oceanic and Atmospheric Administration (NOAA), there were 204 record temperature highs observed in the U.S. for every 100 record temperature lows.

3) According to the National Climatic Data Center, including January of 2015, 358 of the last 358 months have been above that 20th-century average. Cf. My “40 Numbers That Everyone Should Know But Most People Don’t” (2014 Data: Fukushima-affected people also underestimate GW’s effects)

!! Ranney & Clark ‘16: Such statistics increase global warming acceptance in a wider (US M-Turk) sample (p = .002)

* Also—again, no polarization (r ~ 0; i.e., r = -.07; p = .67, ns)

!! Twice replicated! And a 28% gain of what’s possible—even 9 days later (Ng, ‘15; Ranney et al., 2016)
Here’s another way to think about Stat #2, but just looking at summer temperatures:
Reinforced Theistic Manifest Destiny (RTMD) theory (e.g., Ranney, 2012) Graphically Depicted: Associationist/Connectionist/Explanatory-Coherence (with 5 proximal links shown)

Much of this cognition is relatively within-individual:
[being a human]

But this level is more societal & less individual:

Military & Economic Victories and Nationalism

(OK’s Bone-dry Red River)
And 9 “Supra-Nationalist” Stats (also alone) Can Boost Global Warming Acceptance!: 3 examples

1) At 69.2%, the United States ranks 1st of the 34 countries of the Organization for Economic Cooperation and Development (OECD) for the percentage of residents who are technically overweight (BMI over 25).

[Source: WHO]

2) Of the 34 countries of the Organization for Economic Cooperation and Development (OECD), the United States ranks 21st in median internet speed.

3) The United States ranks 3rd of the 34 countries of the Organization for Economic Cooperation and Development (OECD) in the number of intentional homicides per 1 million people.

[Source: UN Office on Drugs and Crime]

• Ave. (Over-)Nationalism level dropped about 10% of the possible loss

• GW Acceptance gained about 10% of the possible gain (as per RTMD)

(Ranney et al., 2016 & 2019)
Returning to the Graphs: “Bex” Stories Were Compelling Even 9 Days Later

• Our (Ranney et al., 2016) reasoning: (a) It’s pretty obvious, visually, that both Temp & DJI-Adj graphs are rising (Visual Evidence). (b) If one can’t be sure which is which, and they both seem to rise, then infer this: Temperature has been rising (Evidence+Logic). (c) If you firmly believe that DJIA-Adj has been rising and you have a hard time discriminating the graphs (even if you aren’t sure they are rising), then infer this: Temperature has been rising (Evidence +Logic).

• We tried 10 Bex interventions of different extents (N ~ 750)
  • “Full Sandwich” included: (1) Pretest/Posttest/DelayedPosttest, (2) 1,4,8,16,64-year averaging, (3) Span and Moving averages, and (4) Correct Feedback.

• Each intervention yielded robustly signif. GW acceptance gains even after 9 days (Ranney et al., 2019)
  • The 2 Full groups showed 26% denial reduction (i.e., increase w.r.t the possible gain) in GW Acceptance, even after 9 days
Bex’s 64-year Moving Averages (Ranney et al., 2016 & 2019)

- Which is temperature and which is the DJIA(-inflation-adjusted)?
- The Bex curricula’s GW acceptance-gains *again* show no polarization!
Our Interventions’ Successes Led to: HowGlobalWarmingWorks.org

... A “Direct-to-the-Public” Wisdom Boost

- Grab a card, if you wish!
- **HGWW** explains GW’s physical-chemical mechanism
- Avoids the middlefolk of (data show) suboptimal instructors/journalists
- We hope to make Global Warming “round-earth evident”
- Please go to the site and (if you would) share the link!
- So far, we have over 300,000 page-views (site + videos)
  - From 200 countries and over 10,000 towns
- If one adds in page-views about our videos, it’s over 1,000,000
- We’re analyzing/incorporating the many comments generated
  - Few deniers; the main comment is “Thanks! This is great.”
  - Non-public comments seem different from public (e.g., NPR.org) ones
  - We’re analyzing **Chinese** comments (Gan, etc.); even Chinese deniers!
- We’ve included **7 Representative Statistics** you can pass along!
- We’ve now added some **Bex Graphs** you can pass along!!
How Global Warming Works

This site's information helps people understand global warming's scientific mechanism.

The 5 videos below explain how global warming (related to climate change) works in as few as 52 seconds. Even our most chemistry-rich video is less than 5 minutes long. Please click on the version you want to watch.

Global Warming
In Under 5 Min.

Global Warming
In Under 4 Min.

Global Warming
In Under 3 Min.

Global Warming
In 1.2 Min.

Global Warming
In 52 Sec.

For a more full explanation, click on a longer version. For a more summarized explanation, watch a shorter version. Please vote here for your favorite video.

If you prefer to read an explanation, we now have several options available online: the script of the video, the 400-word explanation the videos are based on, and the 35-word summary (all available in several languages, with more coming soon).

Help spread this information to your family, friends and co-workers. Please share using any of the choices below or by telling others about HowGlobalWarmingWorks.org.
Some Features of the 5-minute Version

- HGWW usually crucially first asks for mechanism-guesses
- Makes explicit that we offer “secret knowledge” virtually nobody knows
- 1st big concept: different light yields a (leaky) 1-way valve
- 2nd big concept: global warming is an un-natural, human-caused(!) extra greenhouse effect
- Evidential impact: 40% and 3X increases are not trivial
- 2 sentences of technical info (4.7-min. video): Because it’s real science, and the causal mechanism has many deeper levels!
  - But we got a significant GW acceptance gain in a video that excludes the sentences! (Arnold et al., 2014, with our German 4-min. video)
- Please go to HowGlobalWarmingWorks.org & share the link!
“But Wait! There’s More! How Much Would You Pay For a Mandarin Version?”

- **HGWW** has gone even more international
- A full set of Mandarin, Czech, & German set of videos is now up!
  - A Technological/Political Challenge: China prohibits YouTube, Facebook, & Twitter—so we use sites such as Youku, Renren, Weibo, etc.
  - China-and-the-US = ~1/3 of Earth’s buying power & ~ 1/4 of humanity
- Good translations of our video-scripts now available for Mandarin, Spanish, Japanese, German, Russian, Czech, Trad. Chinese, etc.; 400 words, too!
- 71 other closed-caption languages ready (albeit Google-translate quality)
- Imminent languages: Portuguese, Arabic, Hebrew, French, Hindi, Korean (and then Thai, Vietnamese, Turkish), etc.
- We need help with Bengali, Arabic, Turkish, Hindi, other common languages
- Our goal modest: 7 Billion unique visitors; so spread the word!
  - This may help yield international agreements to reduce greenhouse gases
  - Sending our videos to your leaders (representatives, senators, president, etc.) can help, as many don’t know the mechanism either
什么是全球变暖？

这个网站的信息是用来帮助大家了解全球变暖的科学原理的。

下面的五个视频在最短51秒的时间内解释全球变暖（与气候变化有关）是如何形成的。其中最富有化学知识的视频时长也少于5分钟。请点击查看你想观看的版本。

- 什么是全球变暖？
  - (51秒)
- 什么是全球变暖？
  - (1.2分钟)
- 什么是全球变暖？
  - (少于3分钟)
- 什么是全球变暖？
  - (少于4分钟)
- 什么是全球变暖？
  - (少于5分钟)

如果你想得到一个更加全面的解释，请点击时长较长的版本。如果你想得到一个更简短地解释，请点击时长较短的版本。

请点击这里为你最喜欢的视频投票。

Site in English

为了让更多人看到这些视频，请用以下任何方式把你认为大家最愿意看的视频分享给你的朋友和同事们。

或把 HowGlobalWarmingWorks.com 告诉其他人。
### Global Warming Denial Decrease
(i.e., in % of possible room to increase acceptance; N ~ 1,100)

<table>
<thead>
<tr>
<th></th>
<th>Immediate post-test</th>
<th>Nine days later</th>
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</thead>
<tbody>
<tr>
<td><strong>All interventions combined</strong></td>
<td>10.6 ***</td>
<td>7.5 ***</td>
</tr>
<tr>
<td>35 word text</td>
<td>6.2 ^</td>
<td>2.0</td>
</tr>
<tr>
<td>400 word text</td>
<td>6.6 ^</td>
<td>6.6 *</td>
</tr>
<tr>
<td>596 word text (of 5-min video)</td>
<td>11.2 **</td>
<td>13.6 **</td>
</tr>
<tr>
<td>52 second video</td>
<td>11.3 **</td>
<td>5.8 ^</td>
</tr>
<tr>
<td>1.2 minute video</td>
<td>-2.2</td>
<td>5.0 ^</td>
</tr>
<tr>
<td><strong>Two shortest videos combined</strong></td>
<td>5.0 *</td>
<td>5.4 *</td>
</tr>
<tr>
<td>3 minute video</td>
<td>10.3 **</td>
<td>7.6 *</td>
</tr>
<tr>
<td>4 minute video</td>
<td>11.5 **</td>
<td>7.3 *</td>
</tr>
<tr>
<td>5 minute video</td>
<td>20.7 ***</td>
<td>8.5 *</td>
</tr>
<tr>
<td><strong>9 statistics</strong></td>
<td>15.1 **</td>
<td>11.0 **</td>
</tr>
</tbody>
</table>

|                          |                      |                 |
| Control 1 (Mechanism-less Video) | 2.0                | 3.7             |
| Control 2 (No Intervention)   | N/A                 | 2.9             |

**A** = Bigger denial-reductions via consolidation using immediate post-tests  
**B** = Not a single significant decay over the 9-day retention period (n ~ 500)  
**C** = Boosting global warming acceptance briefly reduced nationalism  
**D** = Even our 9-stats & control-video boosted mech. knowledge after 9 days

*, **, *** => respective p’ s of .05, .01, and .001; ^ = marginal significance
A peer-reviewed article in *Nature* (March 31, 2016) projected sea level to rise 6 feet by the year 2100.

With these data and elevation maps from the National Oceanic and Atmospheric Administration (NOAA), Zillow.com, a real estate company, calculated property losses based on that 6-foot change to the U.S. coastline: 1.9 million homes in the U.S. (about 1 in 50 homes) would be swamped, for a total loss of $882 billion dollars.

<table>
<thead>
<tr>
<th>State</th>
<th>Number of projected Swamped Properties</th>
<th>% of State’s Total Housing Stock Swamped</th>
<th>Value of projected Swamped Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Florida</td>
<td>934,411</td>
<td>12.56%</td>
<td>$413 Billion</td>
</tr>
<tr>
<td>2. New Jersey</td>
<td>190,429</td>
<td>7.35%</td>
<td>$93.1 Billion</td>
</tr>
<tr>
<td>3. New York</td>
<td>96,708</td>
<td>2.10%</td>
<td>$71 Billion</td>
</tr>
<tr>
<td>4. Massachusetts</td>
<td>62,069</td>
<td>3.10%</td>
<td>$51.2 Billion</td>
</tr>
<tr>
<td>5. California</td>
<td>42,353</td>
<td>0.44%</td>
<td>$49.2 Billion</td>
</tr>
</tbody>
</table>
Over the past five years, home sales in flood-prone areas grew about 25 percent less quickly than in counties that do not typically flood, according to county-by-county data from Attom Data Solutions, the parent company of RealtyTrac. Many coastal residents are rethinking their investments and heading for safer ground.

Southeast Florida experiences about 10 tidal floods per year now. That number is likely to be around 240 floods per year by 2045, according to climate researchers.

In the past year, home sales have increased 2.6 percent nationally, but have dropped about 7.6 percent in high-risk flood zones in Miami-Dade County, according to housing data.

Nationally, median home prices in areas at high risk for flooding are still 4.4 percent below what they were 10 years ago, while home prices in low-risk areas are up 29.7 percent over the same period, according to the housing data.
Recent projections published in the *Proceedings of the U.S. National Academy of Sciences*:

With an extra increase in global mean temperature of 1°C, sea levels would eventually rise 7 feet.

With an increase in global mean temperature of 4°C, sea levels would eventually rise 29 feet.

Note:

Though the study’s authors state that sea levels would eventually reach these elevations given a 1° Centigrade and 4° Centigrade increase in global average temperature, they don’t predict when this will happen.

Sea levels don’t respond immediately to warming, just as an ice cube doesn’t melt immediately when removed from a freezer.

The next slides show how much land will be lost in Florida’s bottom half with these two increases in global mean temperature:
Southern Florida with **7** foot sea level rise (after 1 °C rise in global avg. temp.)

**KEY**

- Land under water
- Cities

- Kissimmee
- Tampa
- St. Petersburg
- Sarasota
- Port Charlotte
- Cape Coral
- Cape Canaveral
- Palm Bay
- Port St. Lucie
- West Palm Beach
- Coral Springs
- Ft. Lauderdale
- Miami
- Key West
Southern Florida with 29 foot sea level rise (after 4 °C rise in global avg. temp.)

KEY

- Land under water
- Cities

Ports and cities shown on the map include:
- Port Richey
- Kissimmee
- Cape Canaveral
- Palm Bay
- Port St. Lucie
- West Palm Beach
- Coral Springs
- Ft. Lauderdale
- Miami
- Key West
What if All of Earth’s Ice Melted?

Goodbye to NYC, Boston, Philly, D.C., Savannah, Florida, New Orleans, Houston, etc.

(Also via Velautham, Ranney, & Brow, 2019)

National Geographic recently calculated that a 214 foot sea level rise will occur if all glaciers and land-ice on Earth melted.

(This has happened pre-historically, when Earth was about 12°C warmer. It’s meant to give an idea of how coastlines would be changed if all of Earth’s solid water became liquid.)

The following slides show the coastline of the Southeastern United States with present day sea levels, and the coastline under 214 foot sea level rise:
Southeastern U.S. coastline with 214 foot sea level rise

Key
- Land under water
- Cities
By Popular Demand: What Can You Do?

- Tell representatives & senators about your climate concern
- Vote for people who will inhibit global warming the fastest!
- Talk to other people about this, especially “deniers”

On the home front:

- Consider having one fewer child than you initially planned
- Consider having one fewer dog (or cat) than you initially planned
- Eat less GHG-yielding food
  - E.g., less lamb, beef, & non-canned shellfish etc.
  - And eat all your leftovers; avoid food waste
- Don’t buy dug-up stuff (e.g., gold, silver, diamonds); sell yours?
- According to G. Gardner & P. Stern, these are among the best:
  - Buy a more climate-friendly (e.g., more fuel-efficient) vehicle
  - Insulate—and/or upgrade attic insulation & ventilation
  - Carpool with at least one other person
  - Replace incandescent light bulbs with better ones
  - Get appropriately frequent tune-ups (including air filter changes)

Consider this likelihood:

“History Will Be Unkind to Diehard Climate Change Deniers.”
Conclusions, Part 1

- The data collected so far largely cohere with RTMD:
  - Reinforced Theistic Manifest Destiny predictions replicated re:
    - Afterlife, Deity, Creation, Nationalism, Evolution, Global Warming
  - Many studies now show results supporting RTMD’s 15-21 predictions

- RTMD spurred our (successful) “counter-intuitive” idea that informative media & scientists can inhibit “odd” attitudes

- We found that GW acceptance is (replicably) linked to both knowledge and willingness-to-sacrifice re: global warming

- Folks rarely know GW’s (“extra greenhouse”) mechanism

- But, many can learn it quickly—in a few minutes!! In 400 words!!

- Also in only 400 words—or 1-5-minute videos—we even obtain notable gains in Climate Change acceptance!!
  - Acceptance gains are likely attitude shifts via conceptual change

- Surprise, as in NDI experiments, was increased by asking for participants’ knowledge up front (i.e., we controlled it)

- Estimation-and-Feedback interventions can also effectively shift attitudes & self-assessments (e.g., w/ Representative stats)

- We can readily move folks in appropriate ways w/ representative stats
Conclusions, Part 2

- GW acceptance-boost indirectly, too: via Supra-Nationalist statistics!
- We can increase peoples’ GW acceptance via surprise
  - And people are responding to the content of the instruction
- Bex studies: the averaging idea & the averaged data change minds
- Our recent studies are also showing (9-day to 34-day) longevities
  - Combining mechanism and statistics seem best
  - Stasis theory is rejected; Also: little evidence for polarization
- Latest studies: Longer interventions are better, if attentions last
  * Immediate consolidation (e.g., post-test) seems important
- A 7th way?: We can inhibit global warming “inexpensively” (~25 years of fossil fuel subsidy)
- A 8th way?: Scientists truly wish GW were false & would disconfirm it
- We need to get to “tipping points” in many, or all, nations ASAP
- 7.5 Billion people; they need (e.g., cognitive) scientists’ help!
- HowGlobalWarmingWorks.org is part of that help 😊
  - Now in Mandarin! Other languages, too—and even better soon!
Scientific / factual info boosts climate change acceptance

- 0% know the easily-learned basic global warming mechanism
  - The haiku: *Earth turns sunlight to / IR light that’s sponged by folks’ / Greenhouse gases glut* (Ranney et al., 2016)

- Mechanistic information breaks ties between competing claims
  - ~ 500-word *texts* have repeatedly boosted knowledge & acceptance
  - Short (e.g., 1-5 minute) website *videos* yield similar effects
    - Longer videos and texts boost acceptance more than shorter ones

- Two kinds of 7-9 statistics also boost climate change acceptance
  1) Statistics that mostly involve *climate effects* (now replicated)
  2) Statistics that *reduce hyper-nationalism* (a smaller effect)

- Info about the *economics of future sea-level rise*

- Temperature-over-time *graphs* boost climate change acceptance
  - Temperatures from 1880-2014, with financial-stocks analogs
  - Used 8-year, 16-year, +/- 64-year, etc., averagings to highlight trends
    - All 10 conditions (e.g., moving average or not) proved successful

- See “HGWW” site, Ranney & Clark, 2016, & Ranney et al., 2016
How Global Warming Works:

Climate Change's Mechanism Explained

(From HowGlobalWarmingWorks.org)

Haiku version (not given to participants), Ranney et al., 2016:

Earth turns sunlight to
IR light that’s sponged by folks’
Greenhouse gases glut.
Thanks a bunch!

Please Share This!: HowGlobalWarmingWorks.org

... and HowGlobalWarmingWorks.org/Chinese.html

Some recent products:


