



Climate Crisis

Facing Uncertainties with Vision



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Outline

- **Science of climate change**
 - Global and local
 - What is happening in the Northeast?
- **The catastrophe we face**
 - How can we stabilize the climate?
 - What are our responsibilities?
 - To our children
 - To the Earth
 - *Will we sacrifice these to “Business as Usual”?*
 - *Or will we creatively transform society?*
 - *Guided by moral values rather than just profit*
 - *Will we reconnect to the Earth?*



**Grandchildren digging rye cover crop
January 3, 2020 (smart resilience & fun)**

Garden soil unfrozen all winter

[Cover crop, mulch and some snow cover]

First time since Vermont settled: 15000 yr ago



February 5, 2020

**Soil still unfrozen
(despite T_{\min} to -5F)**



March 1, 2020

Little left to dig!

Strategies for Resilience

- Understand technical/ecological issues
 - **And place great value on future**
- Engineer for efficiency and resilience
 - **Reject: “cost effective for today’s bottom line”**
- Spend \$1 trillion on climate resilience
 - **saves \$60 trillion later this century**
- If we ignore climate change
 - **Catastrophic costs for humanity and Earth’s ecosystems**
 - **Community resilience & resistance!**
 - **Needs imagination and creativity - which inspire!**

Different Mindsets-1

- ***Technology will save us***
 - ***We are in charge: no need to change behavior***
 - ***Economics based on individual consumerism produces 'wealth'***
 - ***Oil has made us rich***
 - ***Inventions will power the future***
- **Climate, life & humanity interwoven**
 - Environmental intelligence crucial
 - Community imagination & creativity essential
 - Intergenerational time-frame
 - Sustainability & Justice interwoven

Environmental Intelligence

- “Blend of natural science, social science and indigenous knowledge that helps humans interact constructively and creatively with the living natural world”
 - Missing as we exploit the environment to support corporate profits; dumping the costs on the poor, the indigenous, our children and all life
- Huge conscious challenge for society
 - Key to smart community resilience
 - Spiritual roots are key

Different Mindsets-2

- **Western capitalist mindset**
 - Anthropocentric, egocentric & *dualistic*
 - *Exploit & subdue natural world*
 - Growth based on cheap fossil fuel
(\$3/barrel, 1945-1973, when OPEC rebelled)
 - *[Driving climate change & ecosystem loss]*
- **Indigenous mindset**
 - Ecocentric: respecting life and nature
 - Shared resources, *holistic*
 - Long-term view
 - *[Not part of our education]*

Economic doctrine vs Reality

- “Free market” promotes material growth
 - = Freedom to exploit Earth’s resources & poor
 - “Regulation” interferes with growth/profits
 - The assets and interests of the wealthy must be protected, since they fund politicians
 - Choices must be “cost-effective” now: *future costs can be discounted or paid for later*
- Economics is driving Climate change
- since Earth does not discount the future; it accumulates huge energy imbalance in oceans
 - *Earth’s energy imbalance is 30X fossil fuel burnt*
 - *Catastrophe ahead for our children and all life*

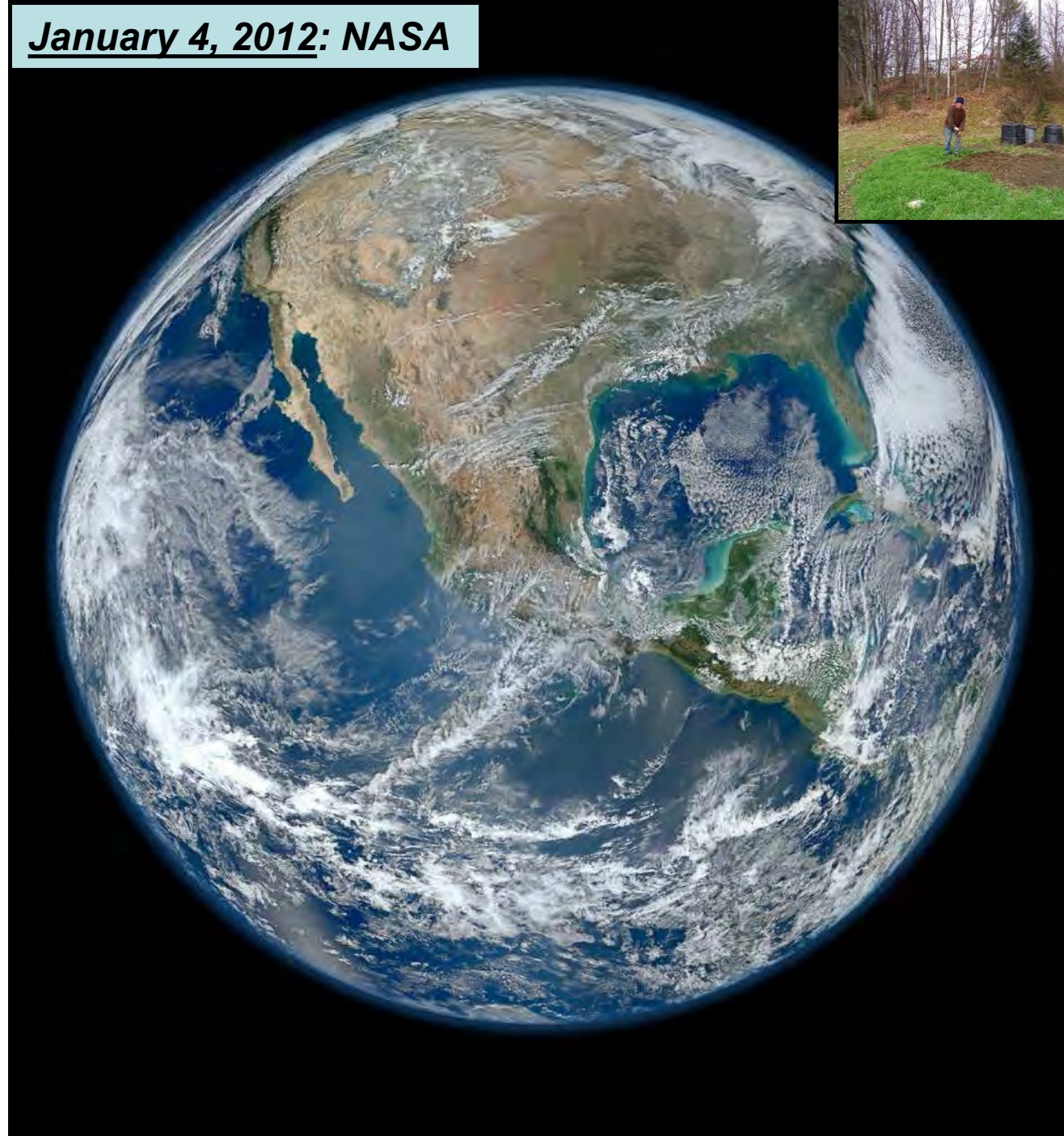
Fundamentals

- ***Burning fossil fuels: transforming climate***
 - *Many water cycle amplifying feedbacks*
 - *Heading for high CO₂ “Hot-house climate”*
 - *Climate extremes increasing*
 - *Severe weather costs: \$300B in US in 2017*
 - *Long memory: decades to centuries*
- **Avoidance of responsibility for decades**
 - Politicians, professionals, public
 - Climate change is Incompatible with business-as-usual
- **Linked to unmanaged technology/economics**
 - Soluble by changing system guidelines
 - Create efficient society, based on renewable energy
- **Choices are value based: moral issue**
 - Beyond science, economics and financial system
 - Must value the future of life on Earth

Earth's climate sustains life

- Greenhouse gases keep Earth warm
 - Increase of CO₂ warms further
 - Evaporation of more water vapor triples warming
- Ice & snow melt; less reflection of sun
 - Arctic warms
 - Winters warm
- Oceans store heat & get warmer
- *Extreme weather is increasing as Arctic warms; westerlies slow down*

January 4, 2012: NASA



Hurricane seasons

- Earth is warming as greenhouse gases increase and reflective ice cover falls
- *Oceans are storing 93% of heat*
 - Warmer Atlantic, Caribbean, Gulf of Mexico and Gulf Stream means stronger hurricanes; when vertical shear is low
- *2017: Harvey, Irma, Maria*
- *2018: Florence, Michael*
- *2019: Barry, Dorian*



Major Hurricane Harvey - August 25-29, 2017

[Weather.gov](#) > [Corpus Christi, TX](#) > Major Hurricane Harvey - August 25-29, 2017

Corpus Christi, TX

Weather Forecast Office

[Current Hazards](#) [Current Conditions](#) [Radar](#) [Forecasts](#) [Rivers and Lakes](#) [Climate and Past Weather](#) [Local Programs](#)

Category 4 Hurricane Harvey: South Texas Landfall & Impacts from August 25th to 29th, 2017

[Overview](#) [Stats](#) [Radar](#) [Satellite](#) [Winds](#) [Storm Surge](#) [Rainfall](#) [Rivers](#) [Seadrift](#) [Tornado](#) [Storm Reports](#) [Photos](#) [One Year Later](#)

Hurricane Harvey Summary PDF

...Hurricane Harvey is the first major hurricane to make landfall along the Middle TX Coast since Celia in 1970...

...Hurricane Harvey is the first Category 4 hurricane to make landfall along the TX Coast since Carla in 1961...



NHC Final Best Track of Harvey (Click points above to view additional information.)

Why was Harvey so Damaging?

- Huge evaporation off warm ocean
- Category 4 hurricane developed fast
- Very heavy rain-rate: 10-12 inches per day
- Two stationary high pressure systems to the north **trapped** Harvey for 4 days over Houston
- Result **40+ inches** of rain & massive flooding



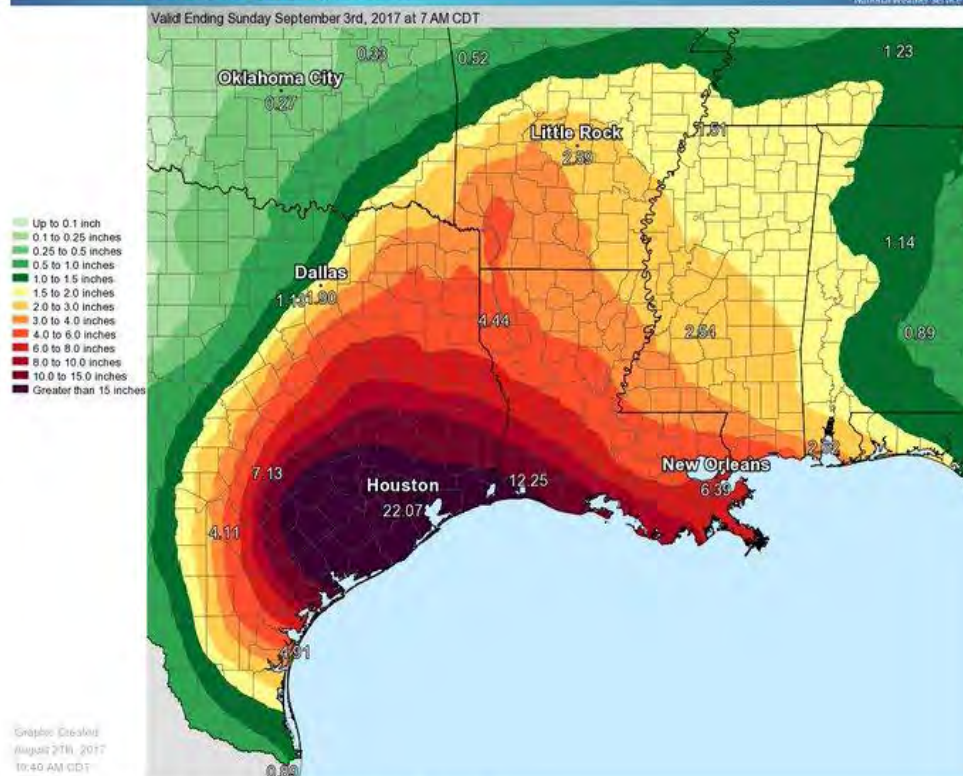
Challenge to Forecast & Emergency Services



National Weather Service
@NWS

This event is unprecedented & all impacts are unknown & beyond anything experienced. Follow orders from officials to ensure safety. [#Harvey](#)

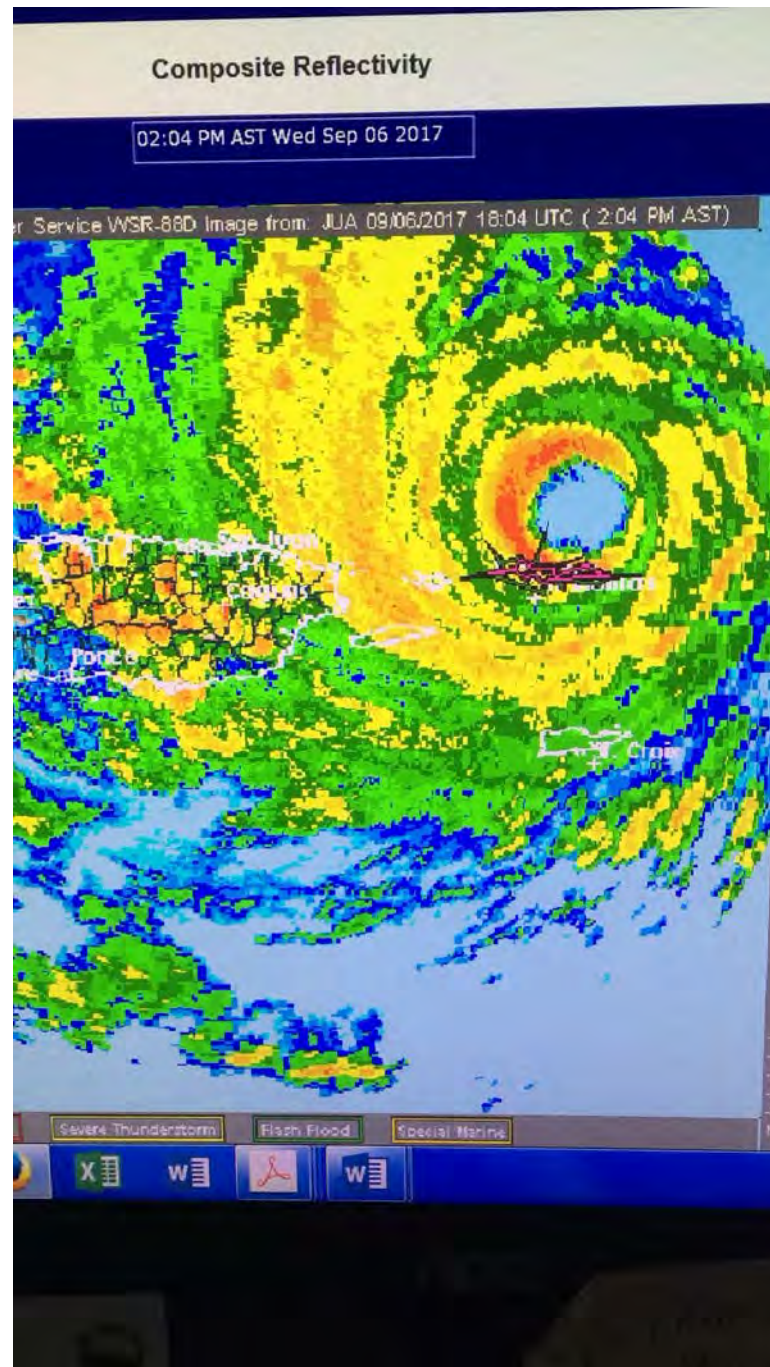
Forecast Precipitation



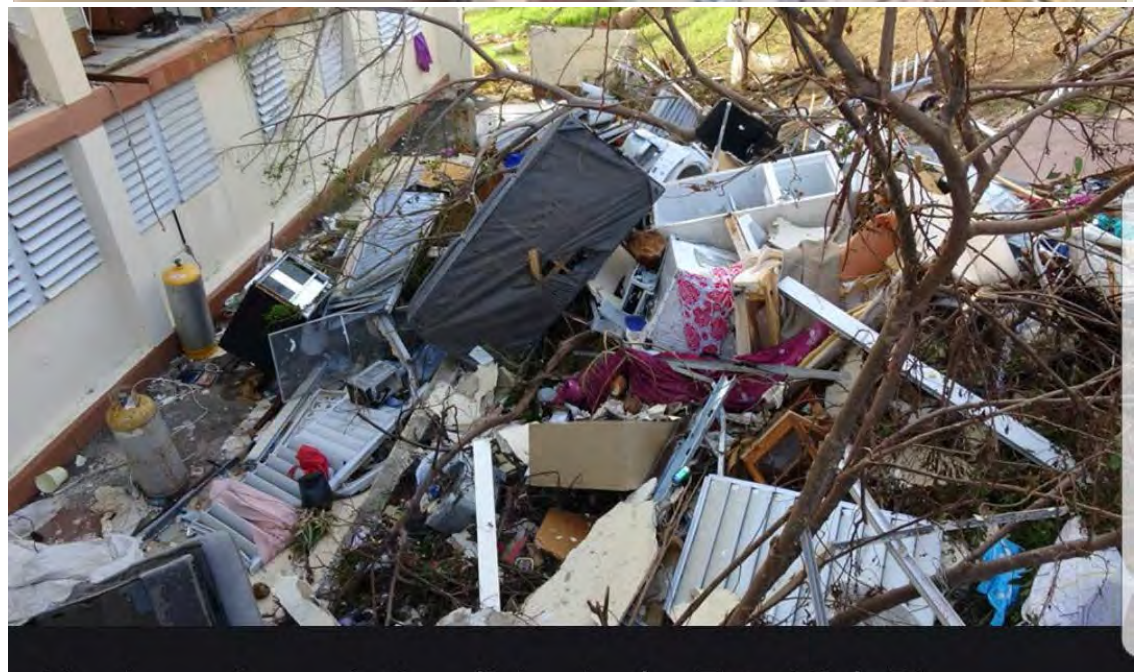
21.8K 11:44 AM - Aug 27, 2017

2pm Sept. 6
Category 5*
IRMA
grazing
St Thomas

****Cat 5 >155mph***
IRMA >180mph



Irma(Cat.5)
Sept. 6
St Thomas



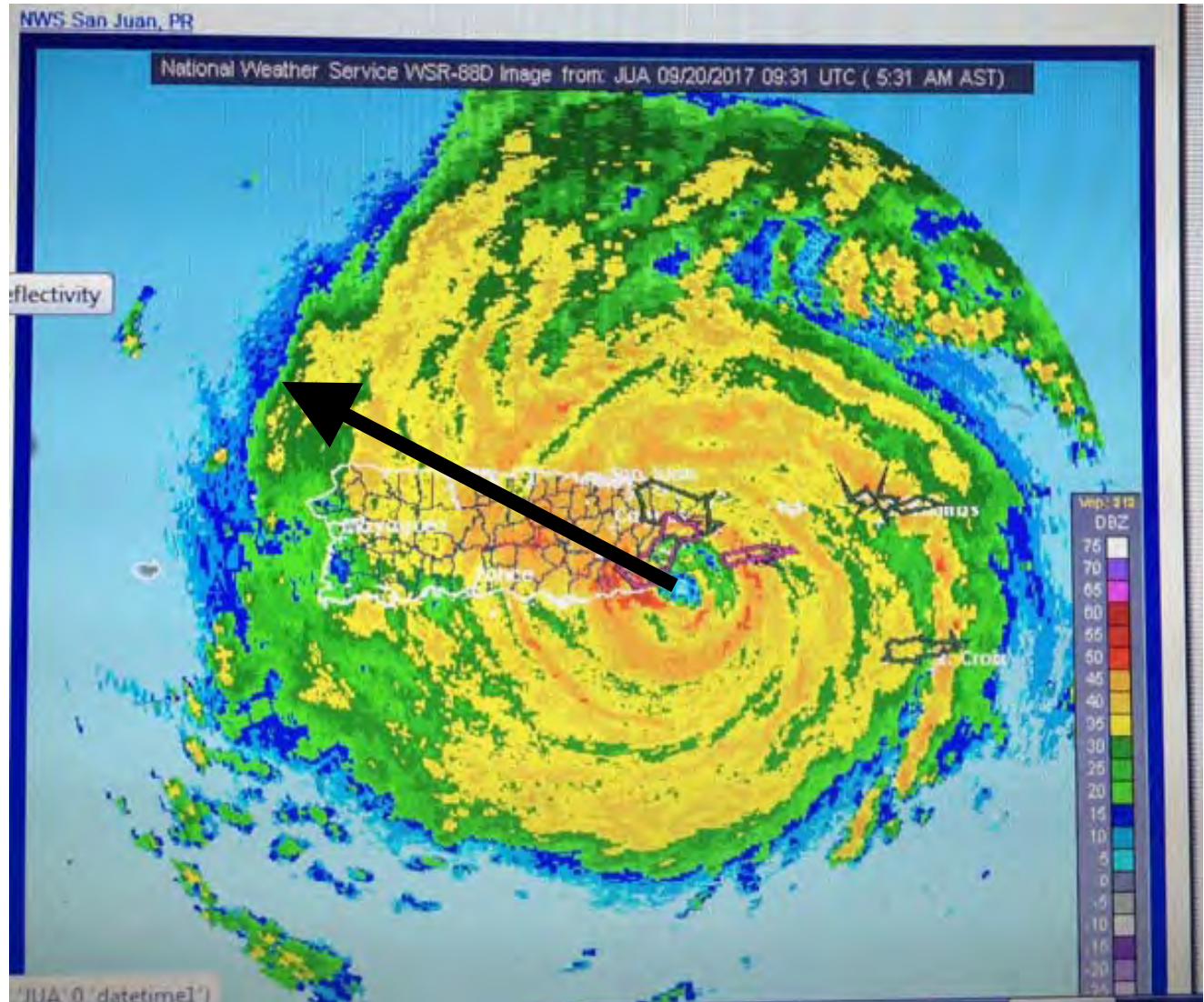
Maria: 5:30am Sept. 20, 2017

Category 4 hits Puerto Rico

Cat 4
>130mph
Maria
>150mph

***Wiped cell
towers and
power grid
(90% back
after 6 mos!)***

***Narratives:
alanbetts.com***



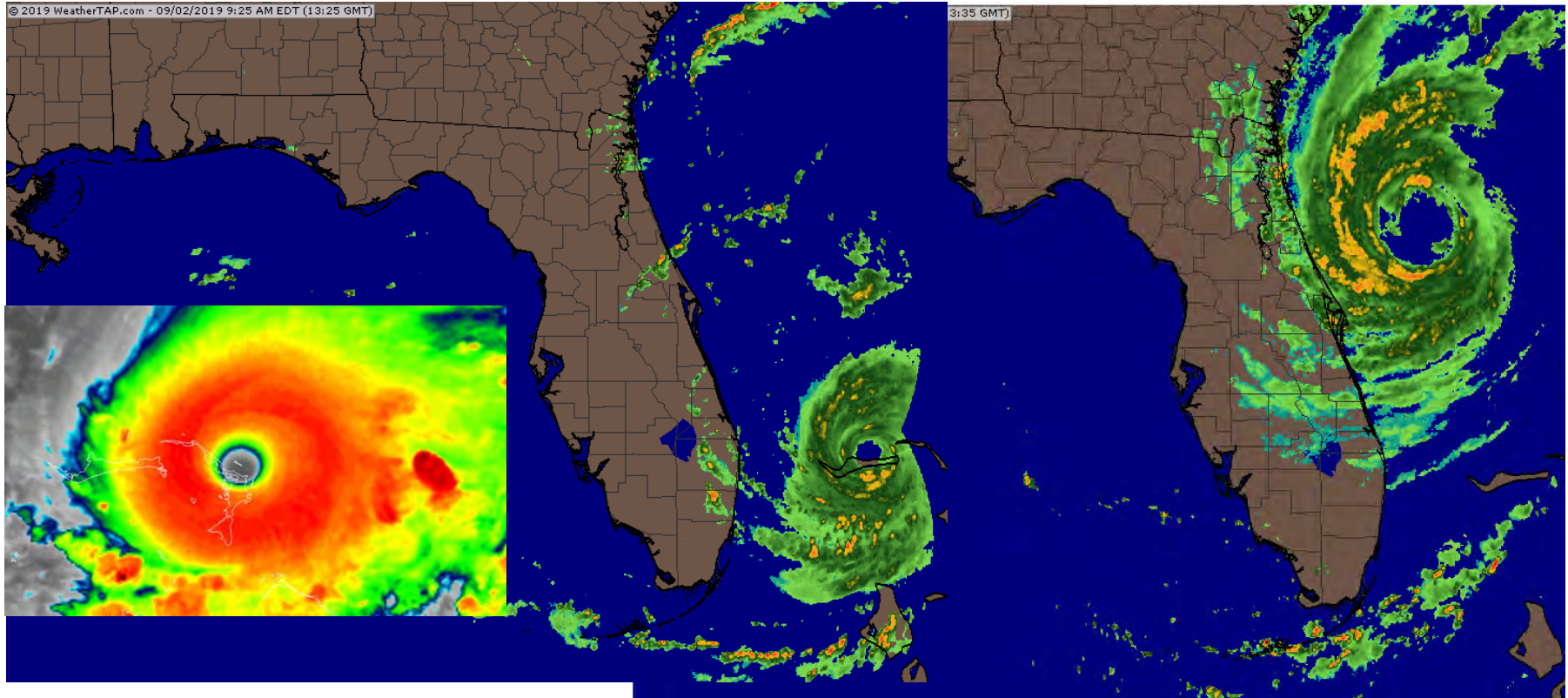
July 2019: track of Barry



Started as band of thunderstorms in Kansas, traveled in slow circle, intensified over warm water of Gulf to weak hurricane, rained on wet Louisiana [Cost: \$1 billion]

Dorian: Cat 5+

Cat 2/3



**Sept 2, 2019
Stationary over
Grand Bahama**

**Sept 4, 2019
Off Florida
Coast**

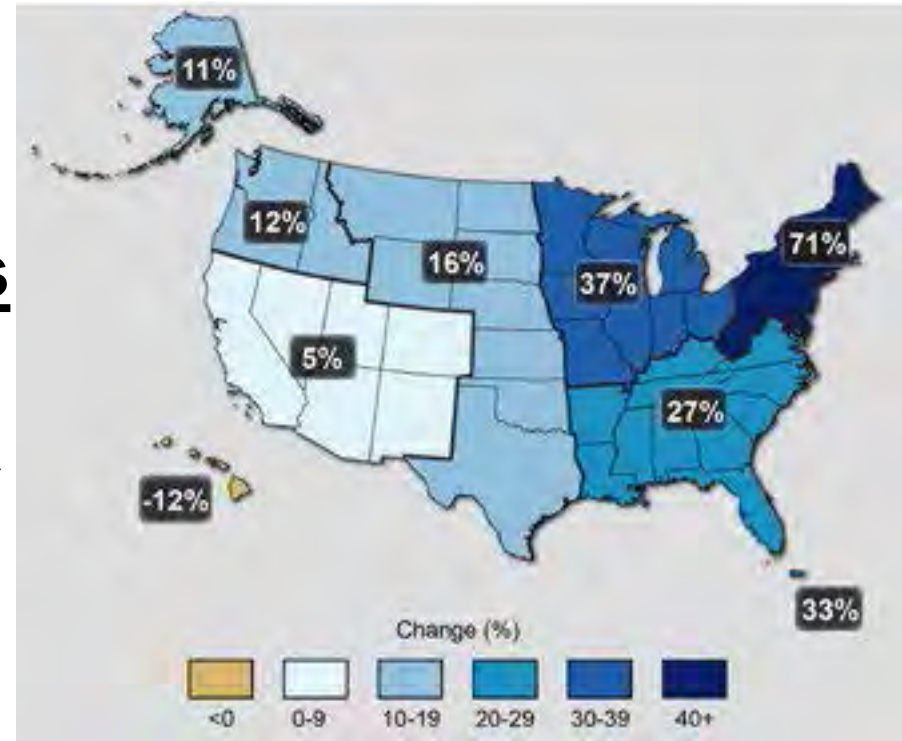
Two Severe Tropical Cyclones hit Mozambique: 2019

- Southeast Africa cyclones *were very rare*
- *Idai* in March left 1000 dead from flooding
- Cat 4 *Kenneth* in April, 2019
 - 60 in of rain



Very Heavy Precipitation Is Increasing

- **Precipitation Extremes**
- Most of the observed precipitation increase during the last 50 years has come from the increasing frequency & intensity of heavy downpours.
- **71% increase in Northeast**



(Walsh et al., 2014)

2011 Classic Flood Situations

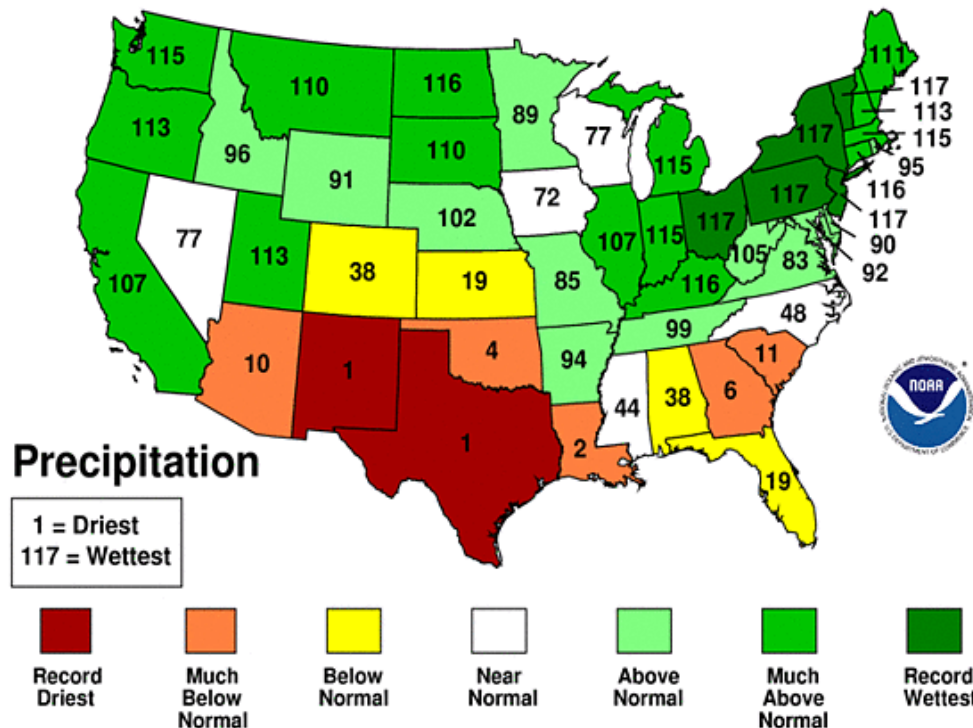
- **Spring flood:** heavy rain and warm weather, melting large snowpack from 2010-11 winter
 - 70F (April 11) and 80F(May 27) + heavy rain
 - record April, May rainfall: 3X at BTV
 - Severe floods on Winooski and Adirondack rivers
 - Lake Champlain record flood stage of 103ft
- **Irene flood: tropical storm** moved up east of Green Mountains and Catskills
 - dumped 6-10 ins rain
 - Extreme flooding

2011 Floods: VT and NY

- Record spring flood: Lake Champlain
- Record flood with Tropical Storm Irene

March-August 2011 Statewide Ranks

National Climatic Data Center/NESDIS/NOAA



March-August, 2011

- Record wet : OH to VT
- Record drought: TX & NM
- Pattern nearly stationary

TS Irene

*Rte 131,
Cavendish
Sept, 2011*

Roads in valleys

Massive damage

**Some roads took
months to repair**

Wake-up call



Value of Flood Plains



- **Otter Creek after Irene on August 30, 2011**
 - **River rose ten feet: flood plain saved Middlebury**

Irene: Resilience

- 13 towns cut off overnight
- State emergency systems flooded
- FEMA: no road access
- Communities reorganized overnight
- Those with equipment stepped in
 - “Can fix this in 72 hrs”: will need engineer to check bridge (Brandon)
 - “We worked 120hrs last week...” (Wardsboro)
 - Social networks collected supplies; and rescue services across mountains
 - Communication networks critical

Flooding increasing

- Warmer temps = higher rain-rate (4%/°F)
- As Arctic warms 2X faster than equator
 - N-S temperature gradient decreasing
 - Westerly jet-stream slowing & meandering
 - Patterns stationary for longer
- Slower moving storms mean more rain over one place - more flooding
- Harvey stayed 4 days over Houston, raining 10 in/day [Florence 3 days; NC]

Management of water

- Engineering approach was to get it off the land into streams & rivers (“manage it”)
 - Must now oversize all culverts/ bridges
- As extremes of flood and drought increase
 - Need to store water in ground for summer use
- Summer water extraction by roots from ground storage damps 60% of precipitation anomalies: maintains evaporation in dry years

Environmental Intelligence

- “Blend of natural science, social science and indigenous knowledge that helps humans interact constructively and creatively with the living natural world”
 - Missing as we exploit the environment to support corporate profits; dumping the costs on the poor, the indigenous, our children and all life
- Huge conscious challenge for society
 - Key to smart community resilience

Community Resilience

- Shared local infrastructure, resources, knowledge and awareness
 - Designed to maximize efficiency and renewable energy use
 - Localized shared food supply
 - Shared efficient transport system
 - Support ecosystems long-term
 - Needs imaginative, determined community
 - ***Contrast to ‘happy isolated individuals addicted to consumerism, escapism and the media’
(Joanna Macy)***

Distinguish Human-made World and the Natural World

- We understand the human-made world, the world of computers & technology – because we made it - predictable, controllable
- The same is not true of the natural world – which is far more complex and alive. We struggle to understand it. *Prediction & control are uncertain*
- *E. F. Schumacher called it the ‘created’ world*
 - *Capitalism does not value creation*

Gardening in Vermont for 40 years

- How long was growing season in 1970s?
 - About 125 days: now 155 days
- How long was the ground frozen?
 - About 155 days: now 125 or much less
 - No longer hard freeze in November
- Winter climate zones in 1970's were
 - Zones 4-5: now zones 5-6 (10F warmer)
- BUT winter variability increasing

My Wake-up Call: Gardening in January, Pittsford, VT



January 7, 2007

December 2006:

- Warmest on record



January 10, 2008

Warm Fall:

- Record Arctic sea-ice melt
- Snow cover in December,
ground unfrozen



January 2, 2012



March 11, 2012



October 2011– March 2012

- **Warmest 6 months on record**
- **My garden frozen only 67 days**
- **January 15, 2013**



February 5, 2016

(Digging in Feb. first time ever)



March 3, 2017



January 3 and Feb 5, 2020



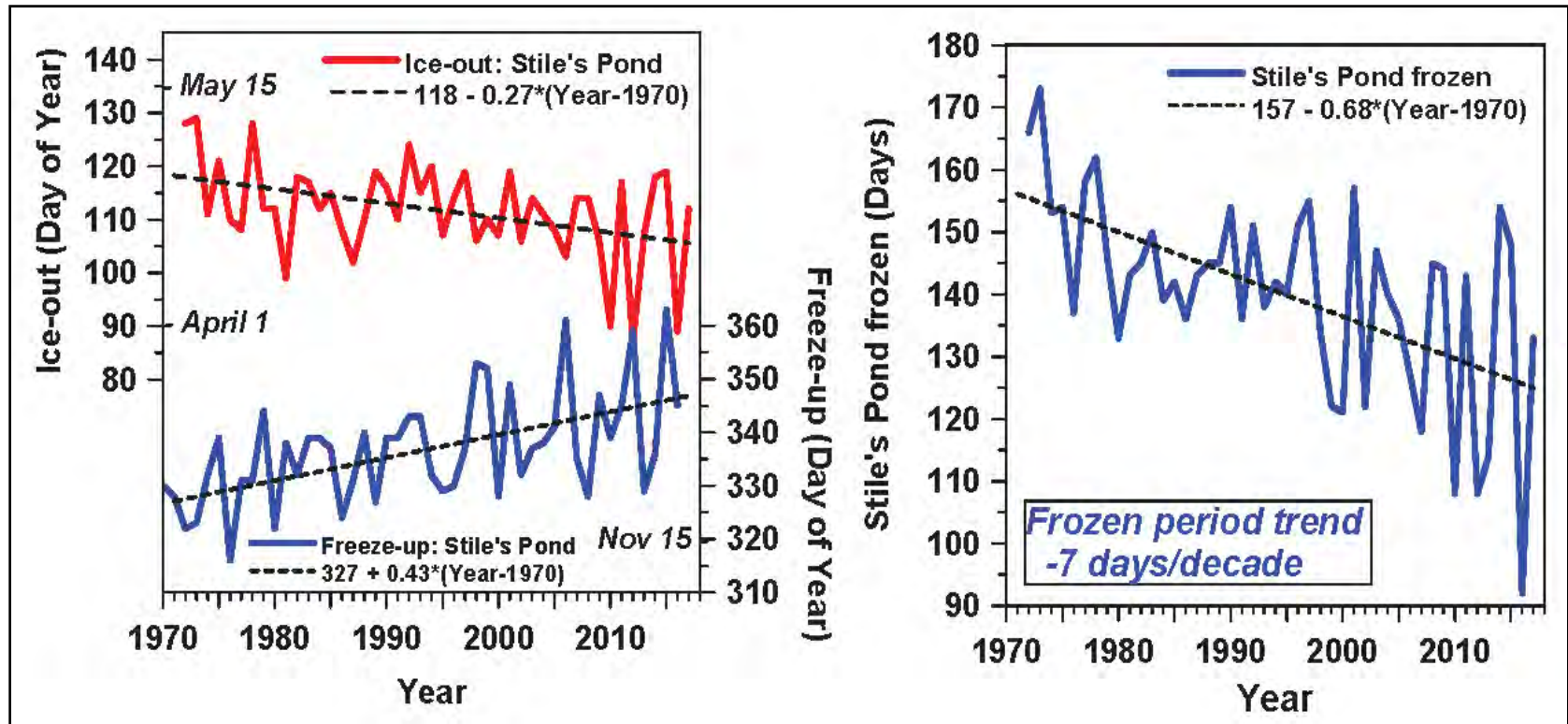
January 3, 2020
Digging cover crop
(smart resilience)



February 5, 2020
Soil still unfrozen
(despite T_{\min} to -5F)

Marker: Lake Freeze-up & Ice-out

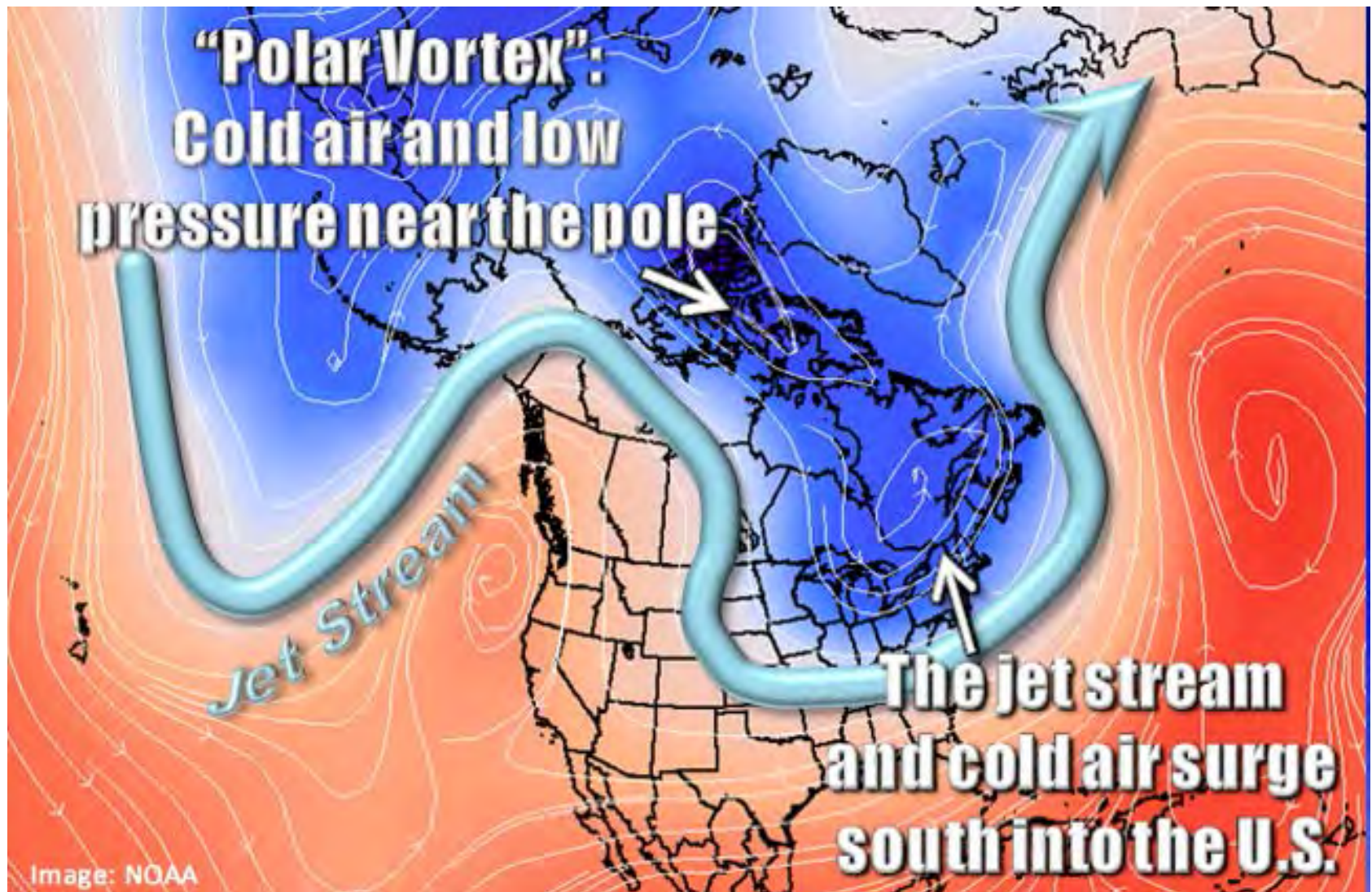
Frozen Period Shrinking: variability huge



- Freeze-up later by **+4 days / decade**
- Ice-out earlier by **-3 days / decade**
- Lake frozen period trend **-7 days/decade**
- Interannual variability \approx 40 yr trend

Stiles Pond:
"Eye on the Sky"

Arctic Warming: Polar Vortex Unstable



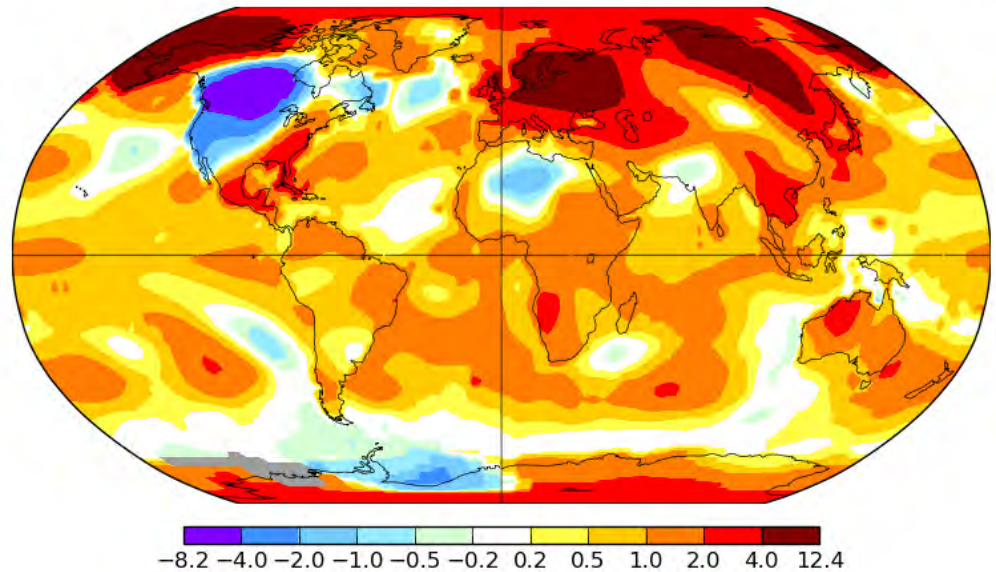
Feb-2019

Extreme cold, central US, Canada
Extreme warmth UK, Europe, Asia,
NW Alaska

February 2019

L-OTI(°C) Anomaly vs 1951-1980

0.94



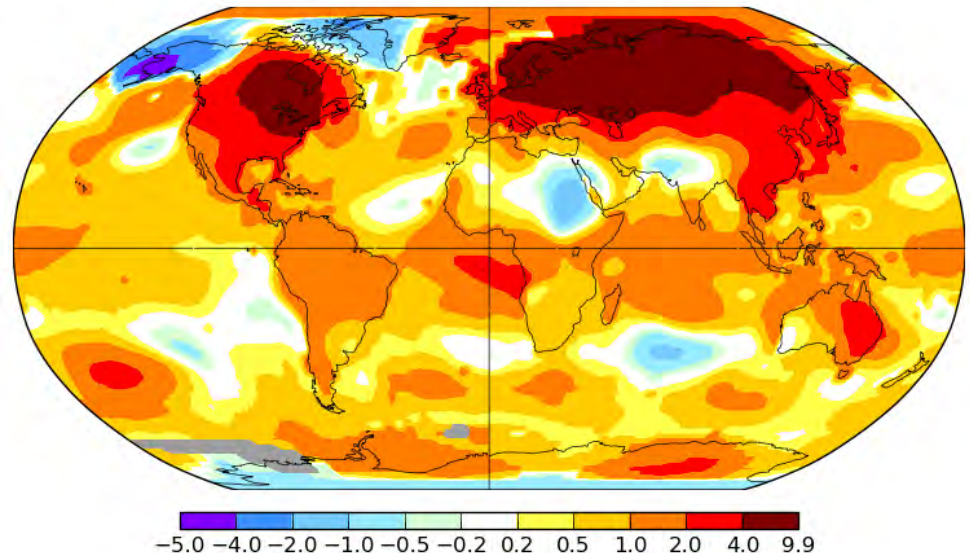
January 2020

L-OTI(°C) Anomaly vs 1951-1980

1.17

Jan-2020

Warm US and Canada, Cold
Alaska. Extreme warmth in Asia
Record Global temperature

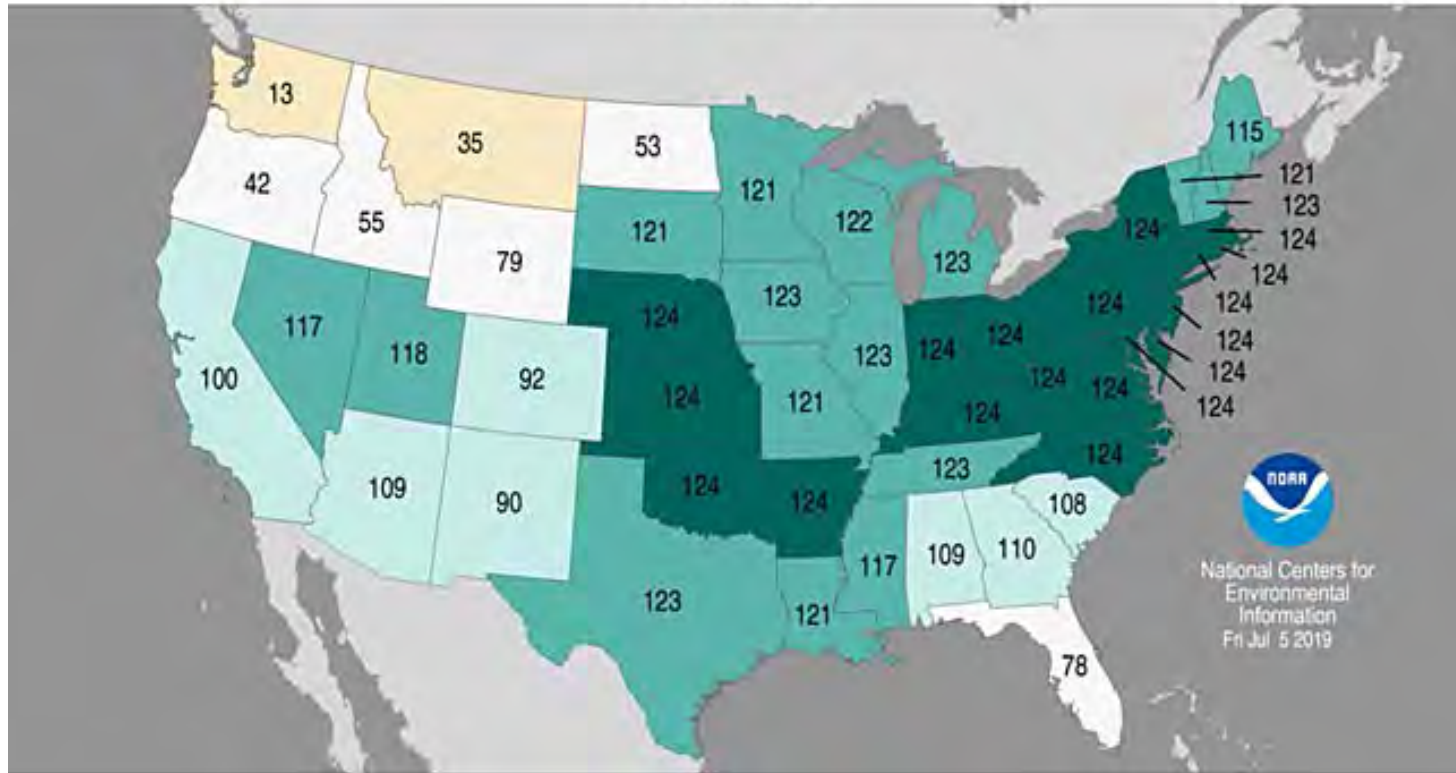


July 2018 to June 2019

Statewide Precipitation Ranks

July 2018–June 2019

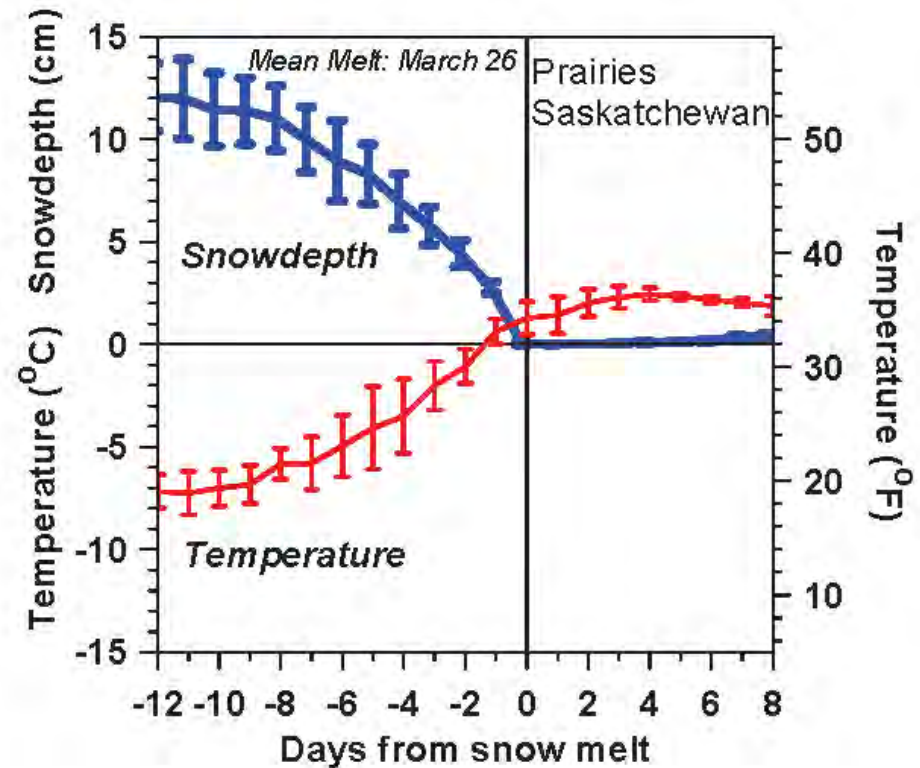
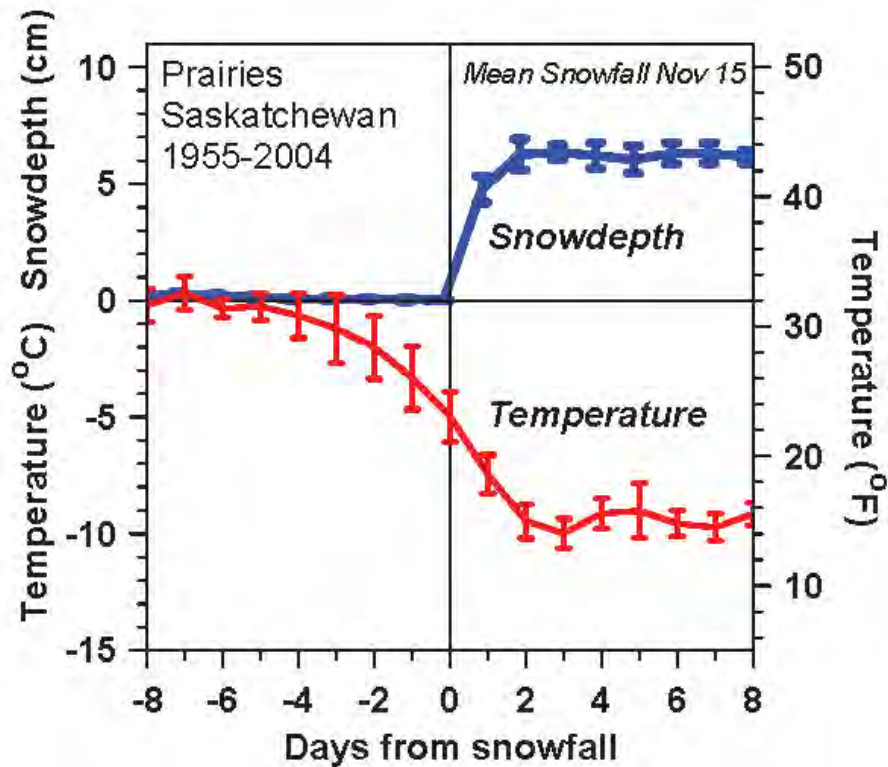
Period: 1895–2019



Record Precipitation Eastern & Central US

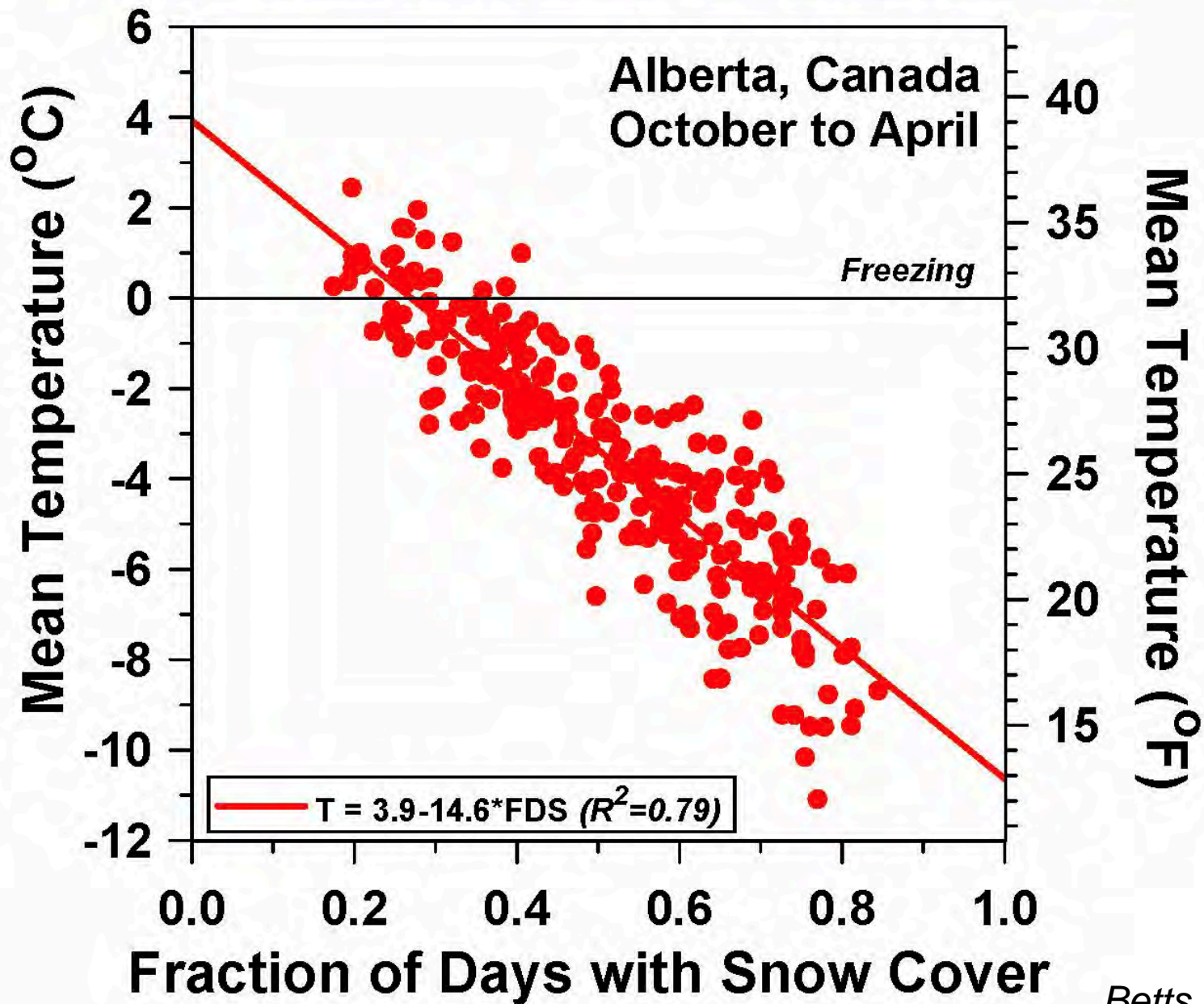
2019 Mississippi flooding longest on record

Snowfall and Snowmelt

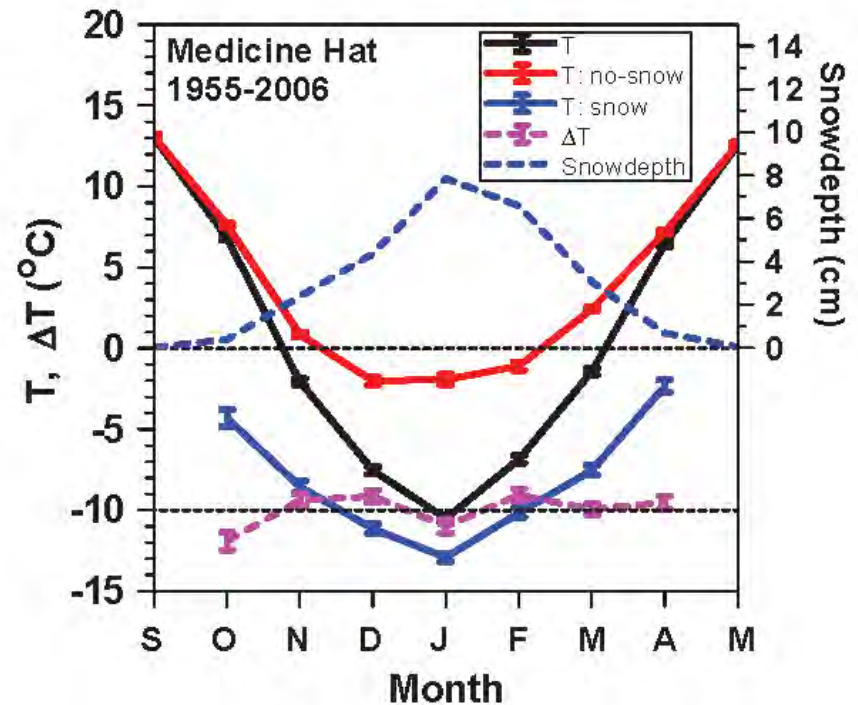
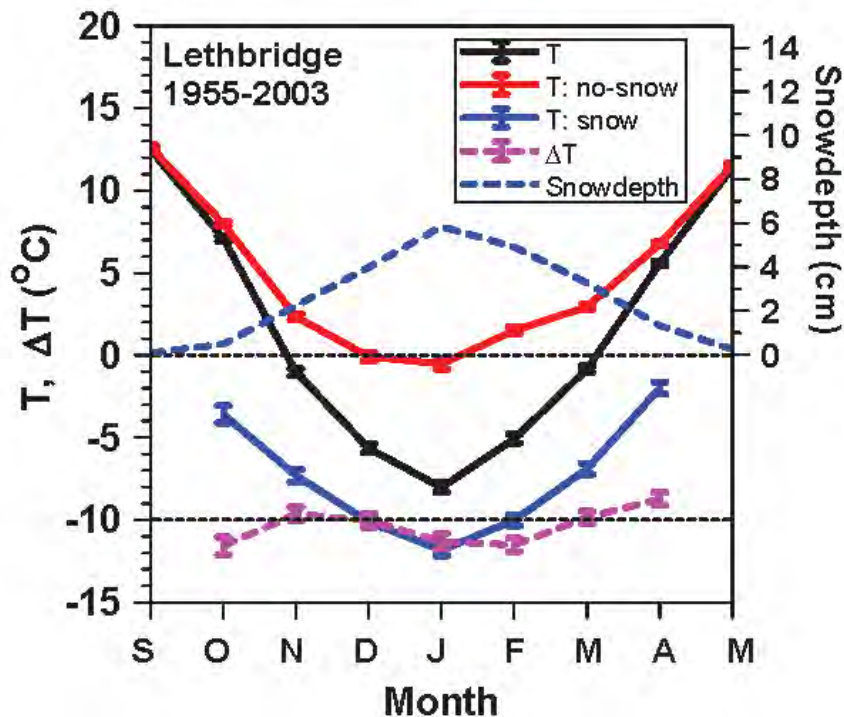


- Temperature changes 10°C with snow cover
- Snow cover is a 'climate switch'
- *Fast transitions in 'local climate'*
 - *Snow reflects sunlight*
 - *Reduces evaporation and water vapor greenhouse*

More snow cover - Colder temperatures



Impact of Snow on Climate



Separate mean climatology into days
with no-snow and snowdepth >0

$$\Delta T = T:\text{no-snow} - T:\text{snow} = -10.2(\pm 1.1)^{\circ}\text{C}$$

Impact of Snow

- **Distinct warm and cold season states**
- **Snow cover is the “climate switch”**

With snow

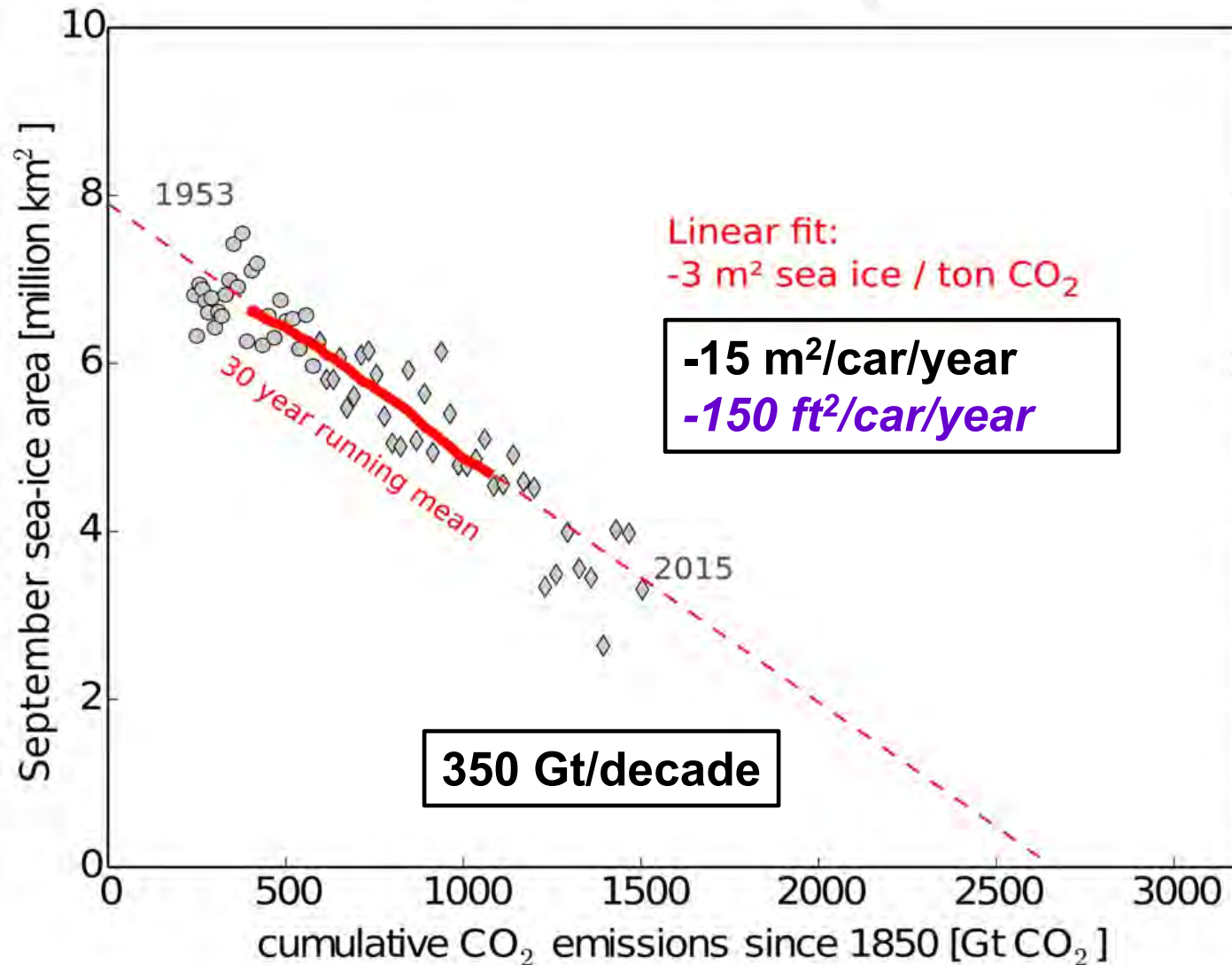
- **Prairies: Temperature falls 10°C (18°F)**
 - **snow reflects 70%**
- **Vermont: Temperature falls 6°C (10°F)**
 - **snow reflects 35% (because more forest)**

- Half the Arctic Sea Ice Melted in 2012
- Open water in Oct. Nov. gives warmer Fall in Northeast

- Positive feedbacks:
- *Less ice, less reflection of sunlight*
- *More evaporation, larger vapor greenhouse effect*
- Same feedbacks as in our winters



September Arctic Sea Ice Loss



Efficient transport

- Gasoline to hybrid: 50% gain to 50mpg
- Hybrid to plug-in hybrid: now 135mpg
- Electricity from community solar array



>3000lbs and 135 mpg
Payload: 750 lbs at 60 mph



180lbs: solar panel on roof
Payload: 350lbs at 20 mph

73lb Cargo bike;
300 lbs at 20 mph



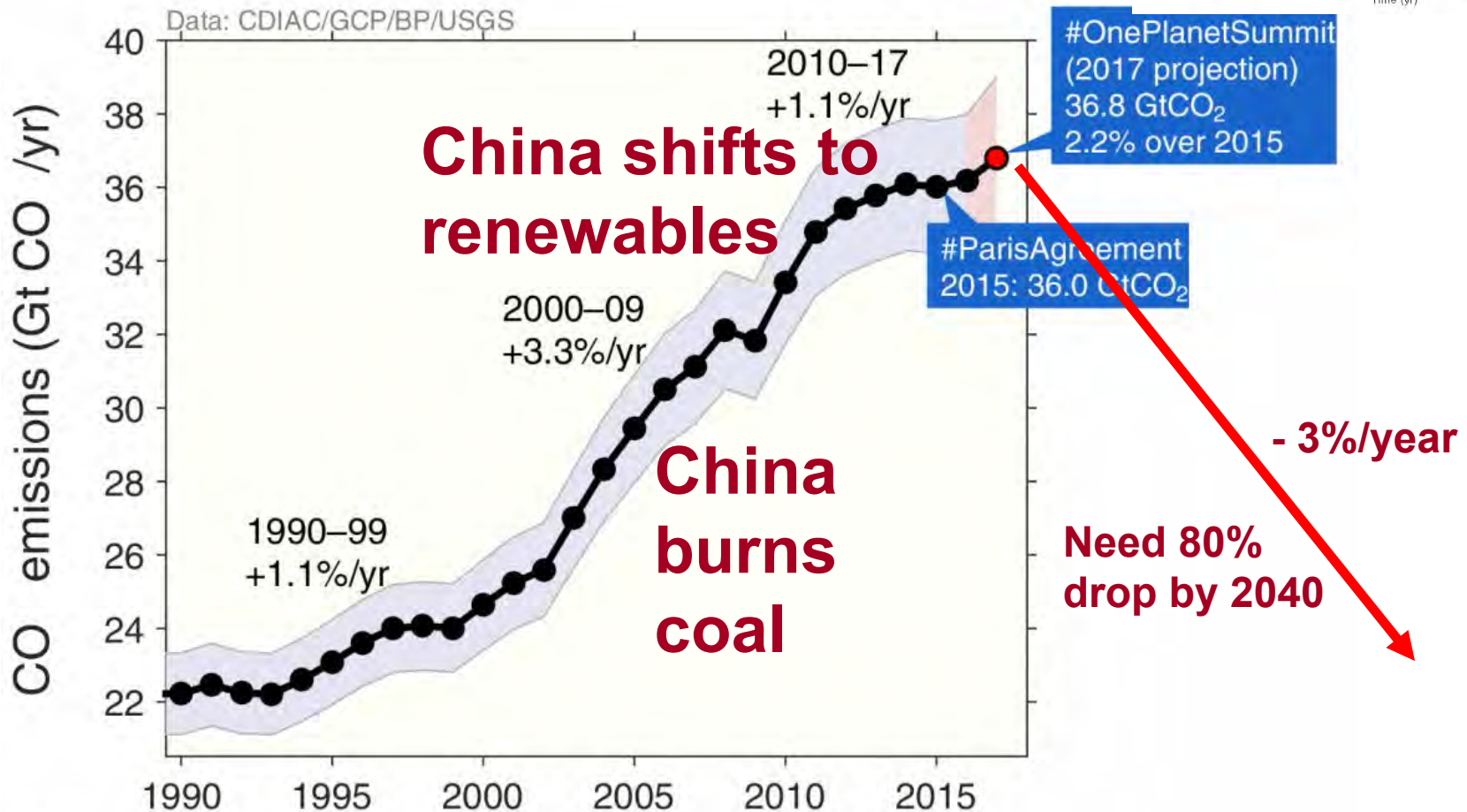
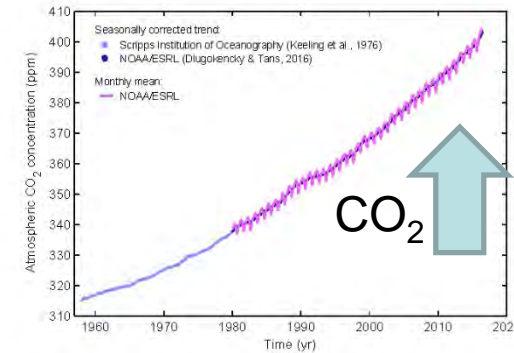
World promised to stop “Dangerous Climate Change”? (UNFCCC 1992)

- **How?** Quickly stabilize atmospheric CO₂
- This means an 80% drop in CO₂ emissions!
- **Possible but difficult for industrial societies**
 - Fossil fuels have driven our industrial growth and population growth for 200 years
 - “Lifestyle” has become dependent on fossil fuels
 - **Powerful vested interests**: trillions \$ at stake
 - No ‘smart’ moral guidance

2015 was Transition Year (?)

- **Climate meeting in Paris in December**
 - **188 Nations made ‘national commitments’**
- **Pope Francis encyclical on the environment, climate change and our responsibilities to the Earth**
 - **Exploitation of the Earth and the poor are inseparable**
 - **Short-term profit as primary motive is immoral**
 - **Told Catholic Church to act: *institutional resistance***
- **2017/20: US cancels the commitments it made**
 - **2019 UN report says one million species will be gone in the next decade or two from habitat loss and climate change**

Growth of CO₂ Emissions slowed – now increasing



What can we “safely” burn?

- Only 750 Gt more for an 50:50 chance of keeping warming below 2°C
Requires leaving 2/3 of remaining fossil fuels in ground
- Only 20 years left at 37 Gt/year
- *Rapid phase-down extends period*
- *Double/triple our energy efficiency*

What do we need?

- **Future needs creative approaches**
 - **Efficient society run on renewable energy...**
 - **But it needs vision and deep change**
- **We need to work with the Earth's biosphere**
 - **People reconnected to landscape; to Earth**
 - **Manage water on landscape**
 - **Manage forest diversity for a warmer climate**
 - **Manage diversified year-round agriculture**
 - **Manage energy crops and solar farms**

Financial Interests Amoral

- **Fossil fuels reserves are worth \$20-30T**
 - Big money: “of course we will burn them”
- **Banking: JP Morgan Chase is leading US bank investing in new fossil fuel development**
 - CEO chairs business roundtable and talks soothingly about improving capitalism to create a healthier society with affordable health care and better climate policies (*Time*:2/3/20)
- **World's largest asset manager is BlackRock; also the world's largest investor in fossil fuel companies and utilities**
 - Web-site talks about “integrating environmental, social and governance practices into our investment processes to creating positive social impact”
- **Insurance industry routinely invests enormous sums in the fossil-fuel industry**

Capitalism and Covid-19

- Capitalism exploits people and resources to maximize profit and minimize costs
 - Has no consideration for *resilience and long-term stability*
 - Or *justice* for working people, or for life on Earth
- Covid-19 exposed
 - the servitude of the poor with limited assets and health care
 - The collapse of the vulnerable global economy
 - The exploitation in the health-care system

The Coming Catastrophe

- **What are the challenges ahead?**
 - Complex living systems: nearing collapse
 - Fossil capitalism incompatible with livable Earth
 - Financial, political & social resistance to change
 - Corruption in the system at many levels
- **Moral issues surfacing at last**
 - Sacrificing our children
 - Extinction of species & stable biosphere
- ***Global Rebellion has started***

Greta Thunberg (born Jan 2, 2003)

[Fridaysforfuture.org](https://fridaysforfuture.org)



Swedish parliament: Fall, 2018

Crossing Atlantic in August, 2019



September 20-27, 2019

- 7.6 million, 185 countries: School strikes demanding climate action (*Ongoing*)



Extinction Rebellion

- Destruction of Earth now a Civil Rights issue
 - Can only be checked by civil disobedience
 - To defend the rights of our children
 - To defend the rights of the Earth
- Shut down London 4/15 to 4/17 till UK and Scottish governments declared “Climate Emergency”
- October 7-14: actions in 60 cities around the world
 - *Motto: Compassion; awareness; courage*
 - *Visionary and creative* [***https://rebellion.earth***](https://rebellion.earth)
 - Force large reductions in C-emissions this decade
 - *XR-Newsletter 34_ Hell and High Water (weekly)*

Frederick Douglass, 1857

“Power concedes nothing without a demand. It never did and it never will. Find out just what any people will quietly submit to and you have found out the exact measure of injustice and wrong which will be imposed upon them, and these will continue till they are resisted ...”

[Jamaican Black Baptist minister (Samuel Sharpe) 12/25/1831 Rebellion, led to Slavery Abolition Act (1833) for entire British Empire]

Climate Emergency is here

- ***Last decade to avoid the worst***
 - Citizens/communities must demand action
 - Governments paralyzed by corporate \$
 - US particularly helpless
- ***Glimpse of action: 12/29/2019***
 - ***Netherlands Supreme Court ordered the government to meet 2015 climate commitments for 2020 and 2025***
 - ***Legal actions in many other countries***

What matters in Vermont?

- **Of course we cannot fix global challenge alone**
 - Don't wait for Montpelier: partial solutions by 2050 (*'while growing economy'*), veto threats....
 - Redoing capitalism critical but a huge challenge
 - Redoing financial system critical, also huge
 - Drive change in energy and transport systems
- **Relocalize as much as we can**
 - **Businesses, medicine, food supply: year round**
 - **Vermont should have enough water if we plan**
 - **Big changes across US; southern and western drought, fires & floods - will impact migration**

Discussion

**“Power concedes nothing without
a demand”**

***Real info:* climatecentral.org, cleanet.org
www.realclimate.org, skepticalscience.com**

***Rebellion:* 350.org, Fridaysforfuture.org,
Rebellion.earth**

(<https://alanbetts.com>)

This is Dhauladhar mountain range of Himachal, visible after 30 yrs, from Jalandhar (Punjab) after pollution drops to its lowest level. This is approx. 200 km away straight. [#Lockdown21](#)
[#MotherNature](#) [#Global](#) healing.



6,760 10:21 AM - Apr 3, 2020 · New Delhi, India

Rollback of environmental laws

- **Hiding behind Covid-19 crisis, Trump is prioritizing polluters over public health & climate change!**
- **Stop monitoring & reporting air and water pollution – as global economy crumbles!**
- **Rolling back automobile emissions and fuel efficiency standards – burn more oil!**
- **Lawsuits are starting....**

What is a pollutant?

- **First it was the obvious hazards to health**
 - Smoke/smog from burning coal and exhausts
 - Toxic contaminants dumped in drinking water
 - These were regulated by the Clean Air and Clean Water legislation in 1980's & 1990's **(until Trump)**
- **But many of our waste products that look harmless to humans are hazards to life on Earth!**
 - CFCs that destroy the ozone layer that protects life
 - CO₂ from burning fossil fuels, driving climate change
 - Plastics dumped into the oceans
- *In our disconnected human world, these are harder for us to deal with*

How do we do it?

Systems Engineering

- *Change the rule-book from maximizing profit*
 - *Ask: Is this cost-effective for our children?*
- *Minimize human waste products dumped into the Earth's atmosphere and ocean*
 - *Shift from fossil fuel ASAP*
- **Maximize the efficiency** with which our society uses energy and fresh water
- **Maximize the use of renewable energy**

Flooding Issues

- **Maintain mountain forest cover**
 - Devastating floods in 1920's, 30's with reduced forest cover
- **Manage water/pollutants on landscape**
 - Maximize infiltration: urban and on farms
 - Don't wall-in rivers
- **Preserve flood plains**
 - Saves downstream towns (Middlebury)
 - Stop building houses and trailer parks in flood plains

Why Is It Difficult for Us?

- The “American dream” is crumbling
 - “Economic growth” based on **fossil fuels, debt, consumerism and dumping waste streams is unsustainable** — and a disaster for the planet
- We have failed to **guide and manage technology**
 - Resulting in tremendous successes and catastrophic failures
- *Earth strikes back – Earth wins easily*
 - *Climate change and species extinction are existential challenges to corporate capitalism*

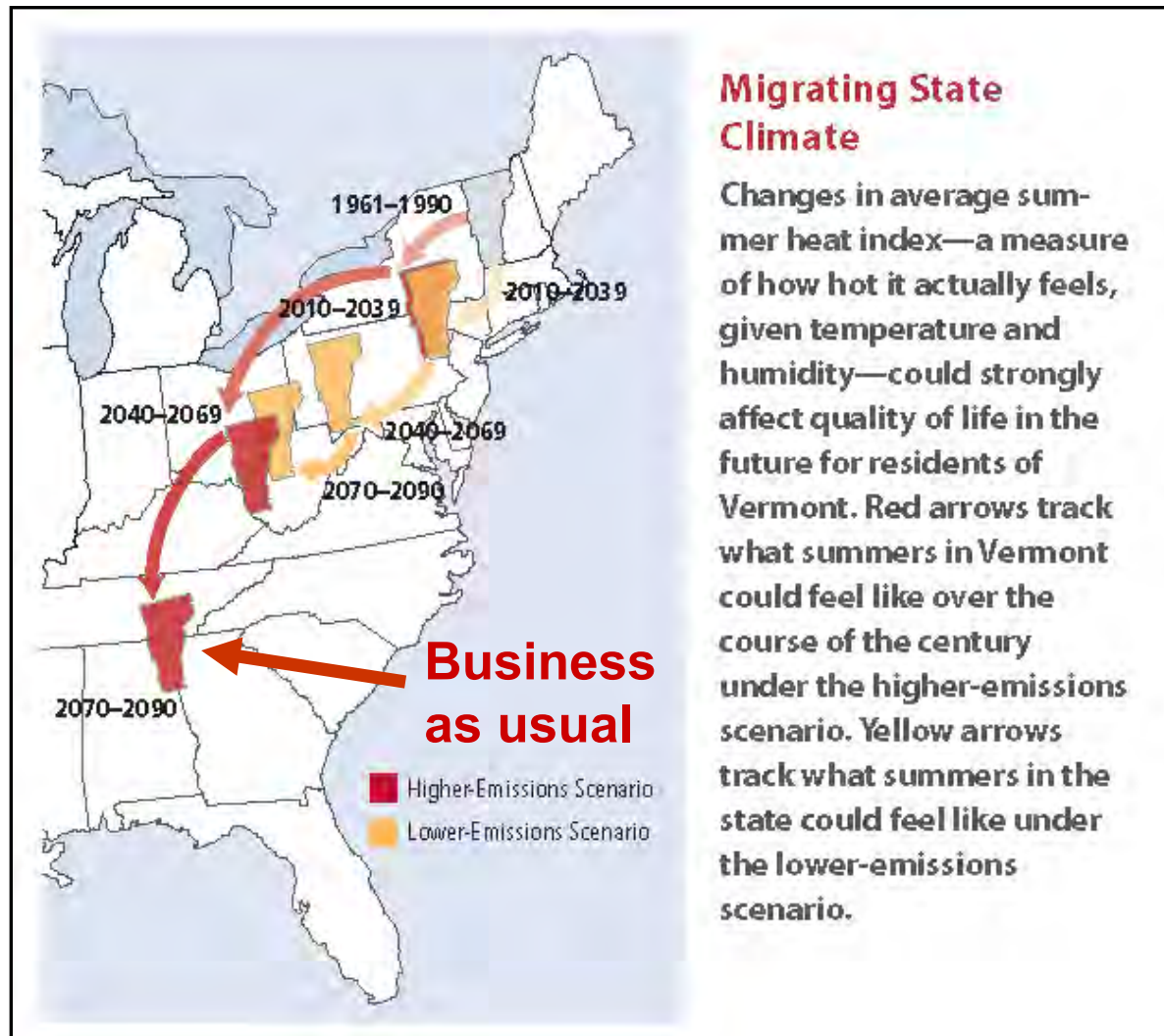
Powerful interests threatened

- **Fossil fuels reserves are worth \$20-30T**
 - Big money: “of course we will burn them”
 - Regulating or taxing emissions of CO₂ is an ‘unfair cost to the free market’
 - Too bad if the Earth’s ecosystems are destroyed: ‘others’ can pay the price
- *US controlled global oil supply/price for 80yrs*
 - Fueled ‘fossil’ capitalism and exploitation of the Earth and the poor
 - Hidden by web of lies: now driving ‘ecocide’

Vermont's Future with High and Low GHG Emissions

What
about VT
forests?

Sub-tropical
drought areas
moving into
southern US



NECIA,
2007

Can Science & Policy be kept separate?

- *Separation was the traditional frame*
 - How scientists are trained
 - It protects the integrity of science
 - Invaluable for global cooperation
- *But we cannot solve global challenges with this dualist mindset*
 - *Dates back to Greek and Roman period*
 - *Drove the rise of science, but also driving destruction of the Earth*

What are Your Responsibilities?

- **Just do what society expects?**
 - Be docile servants; leave policy to ‘others’
 - Avoid public engagement and politics?
- **Or recognize**
 - Climate change is existential issue for humanity, the future of the Earth and its ecosystems
 - Understanding brings responsibility
 - *Your skills essential to create livable future*
 - *Deeper understanding & communication needed*

Indigenous Reconnection

- *Resolve to save the Earth*
alanbetts.com/writings (1/18/2020)
 - Reconnect to Earth awareness
- *This was the holistic teaching of indigenous Aramaic teacher Yeshua*
 - that Christianity suppressed to become the state religion of Imperial Rome
 - *The Hidden Gospel by Douglas-Klotz*