Understanding Our *Changing* Climate

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Climate Change and Health for Virginia

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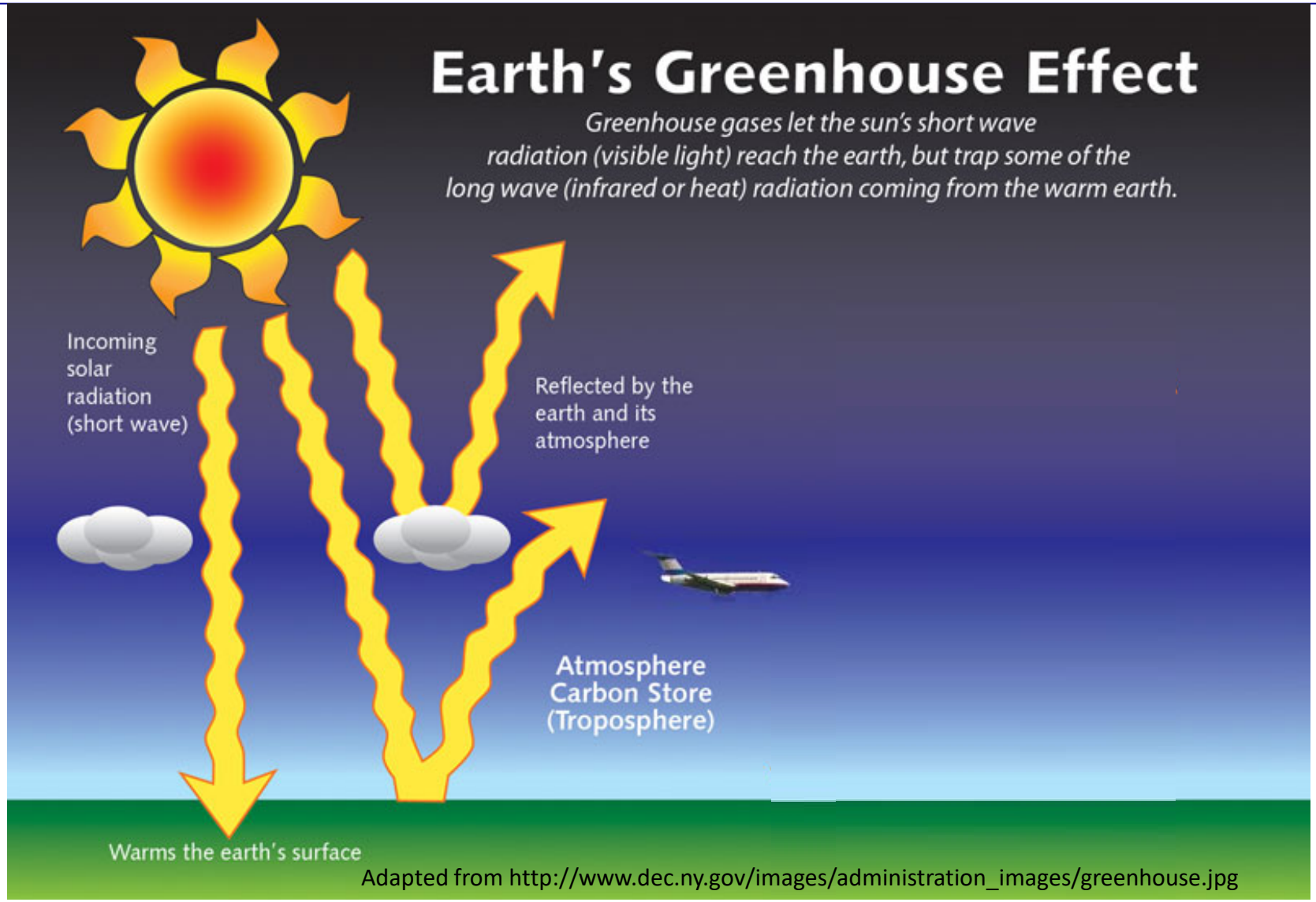
Understanding Our *Changing* Climate

- **What is the greenhouse effect?**
  - **Natural and anthropogenic**
- **Why is the climate changing?**
  - **Role of human activity**
- **What is happening now?**
  - **Many independent warming indicators**
- **How do we know humans are responsible?**
  - **Basic physics**
  - **Complex models**
- **What will happen in the future?**

What is the Greenhouse Effect?



Adapted from http://www.dec.ny.gov/images/administration_images/greenhouse.jpg

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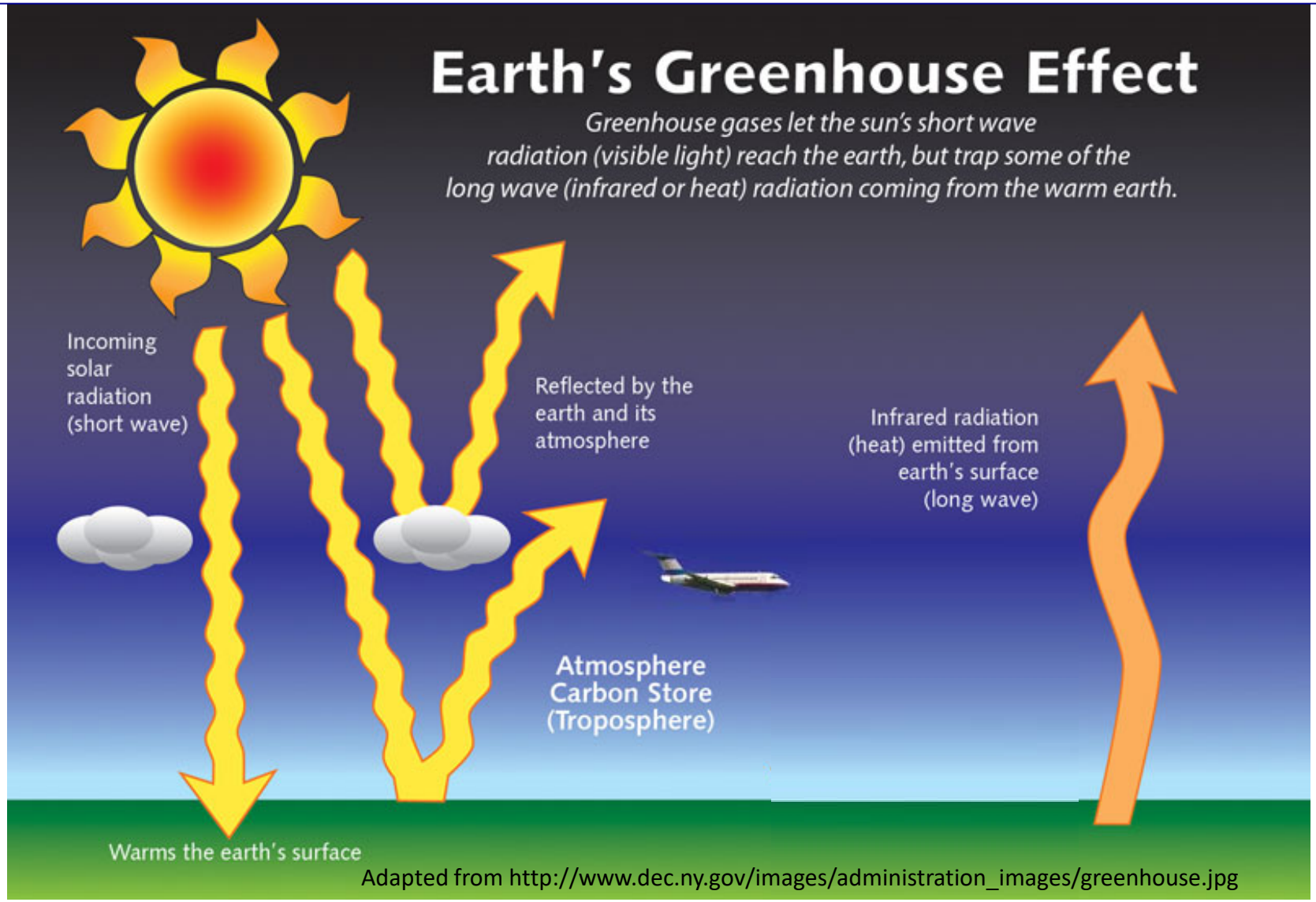

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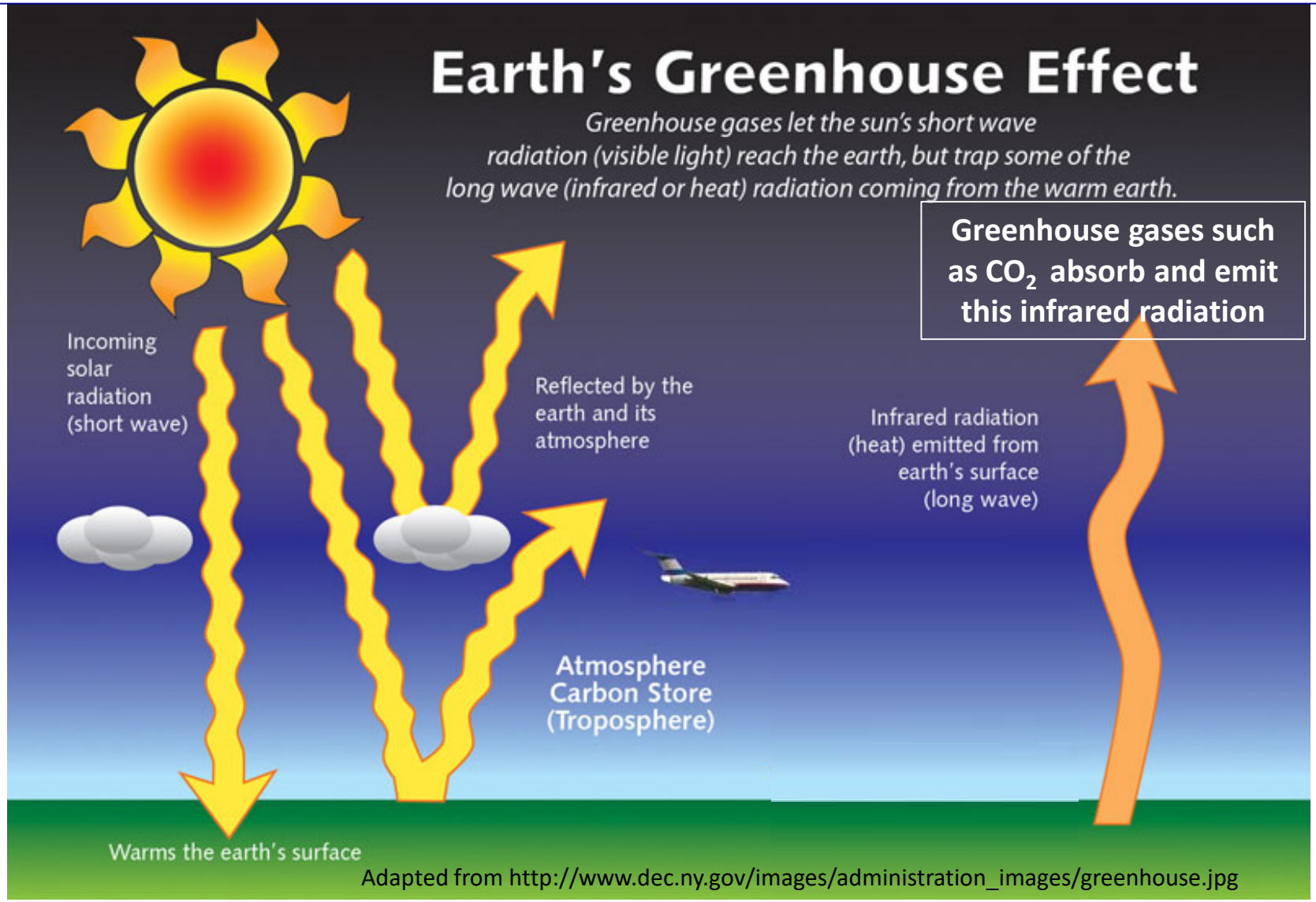

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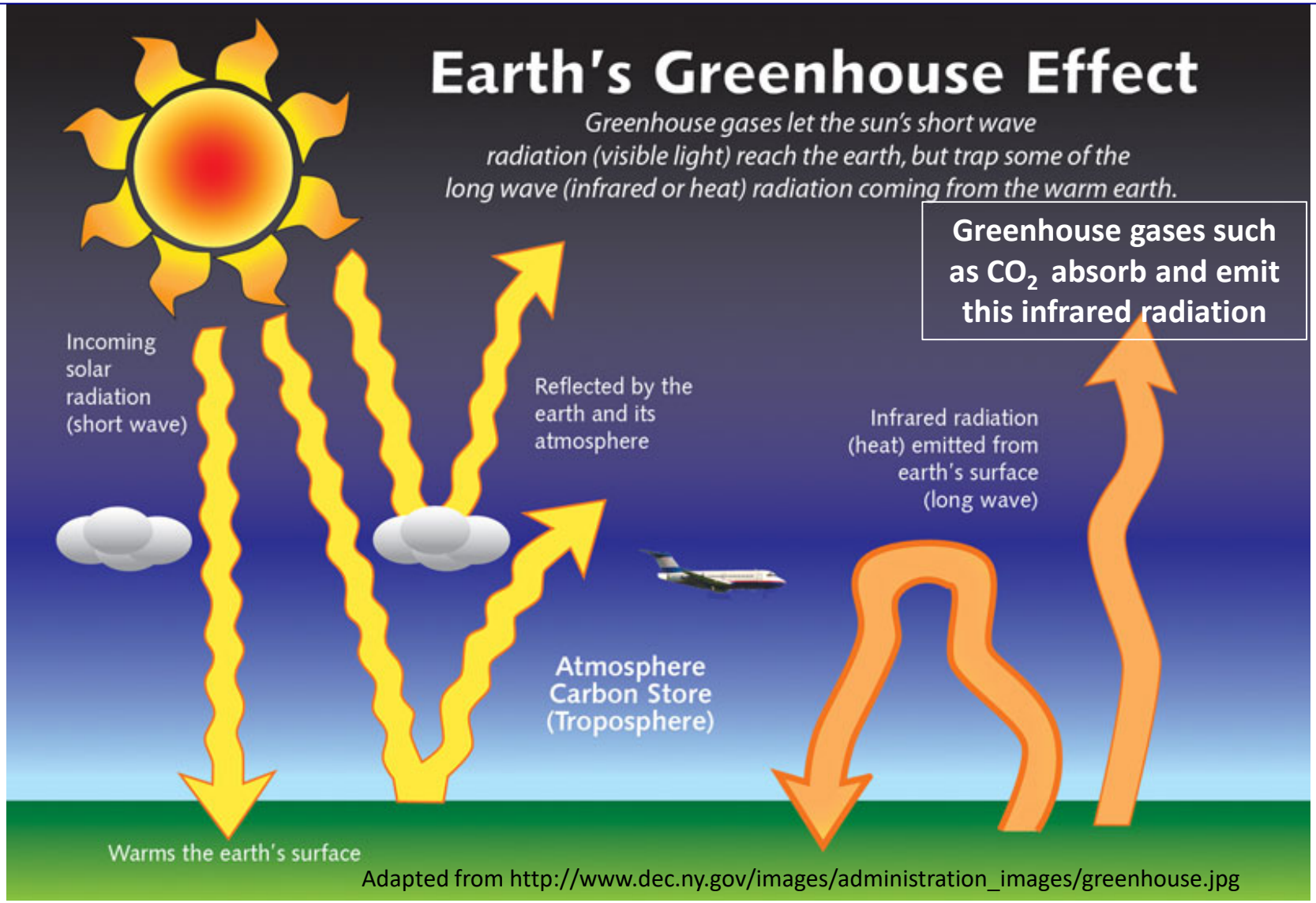

Greenhouse gases such as CO_2 absorb and emit this infrared radiation

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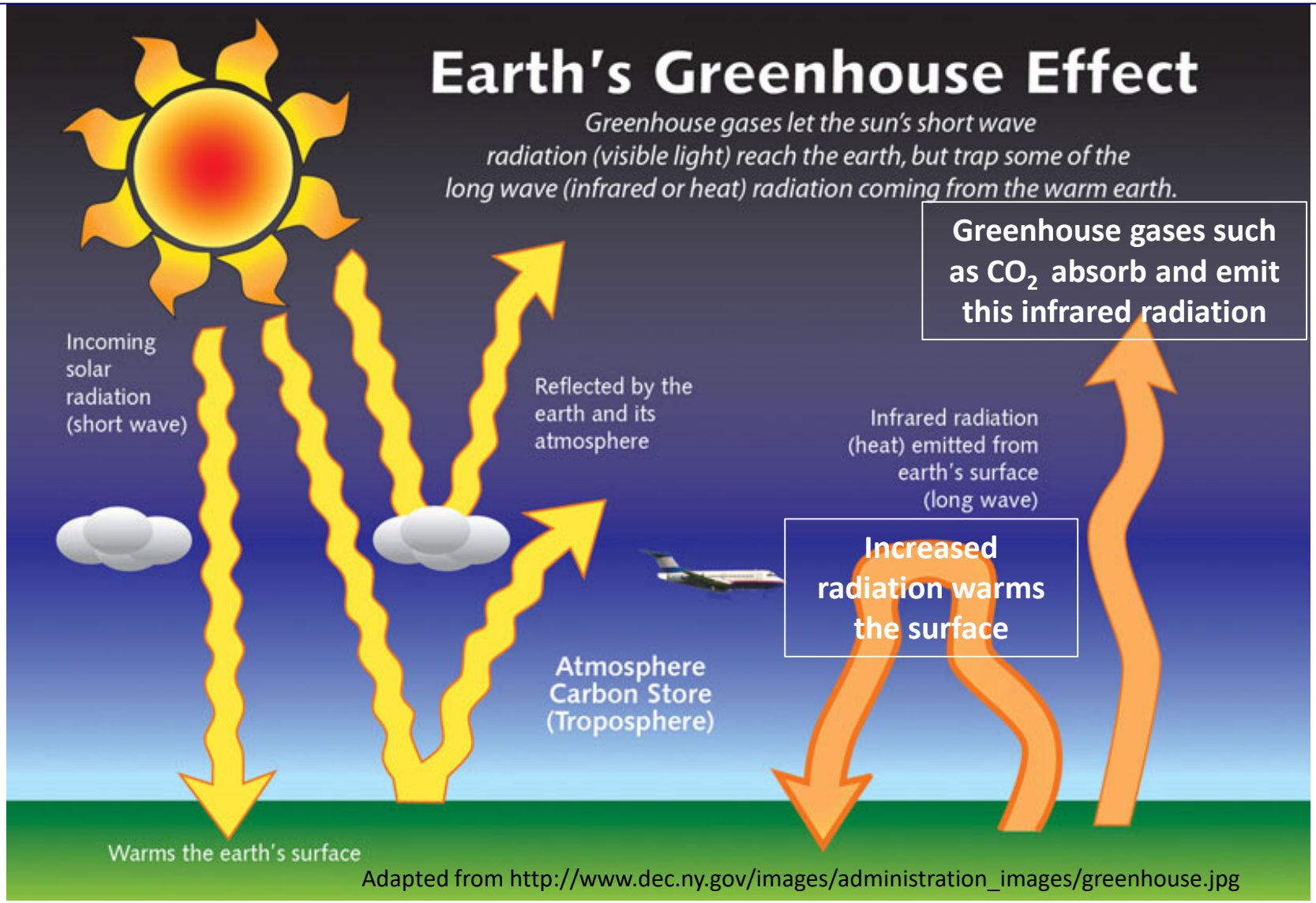
What is the Greenhouse Effect?

Natural and essential aspect of the climate



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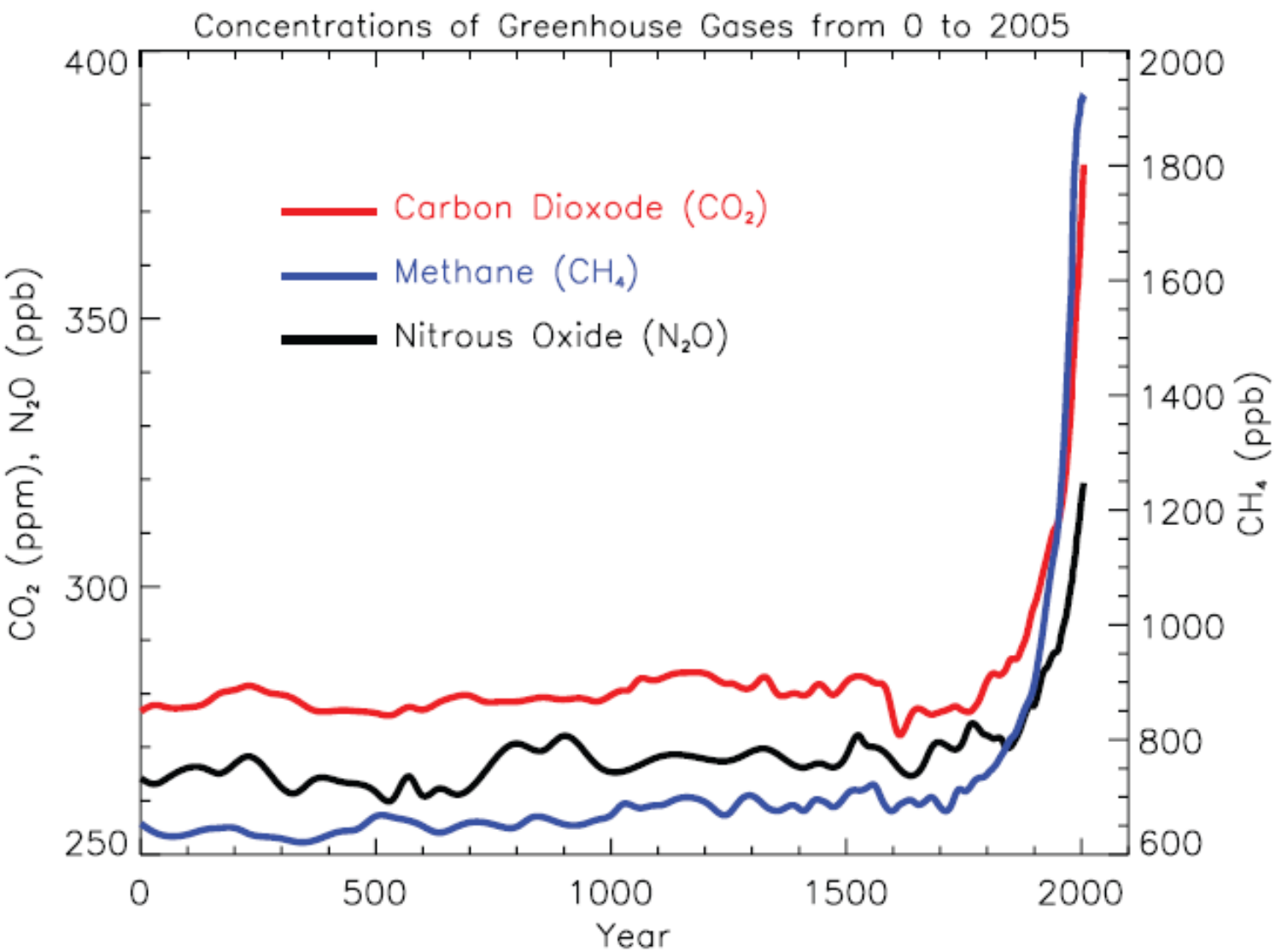

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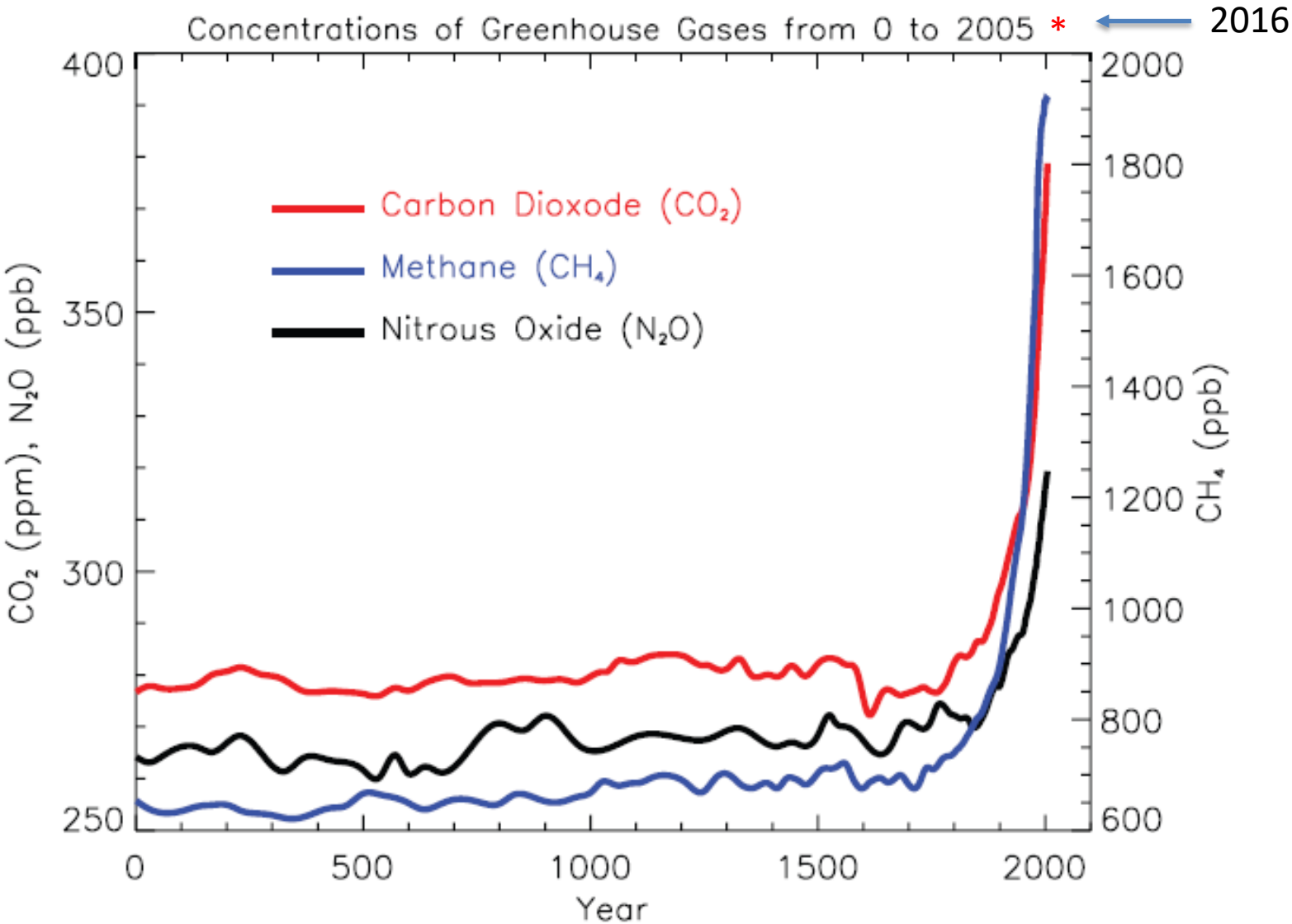

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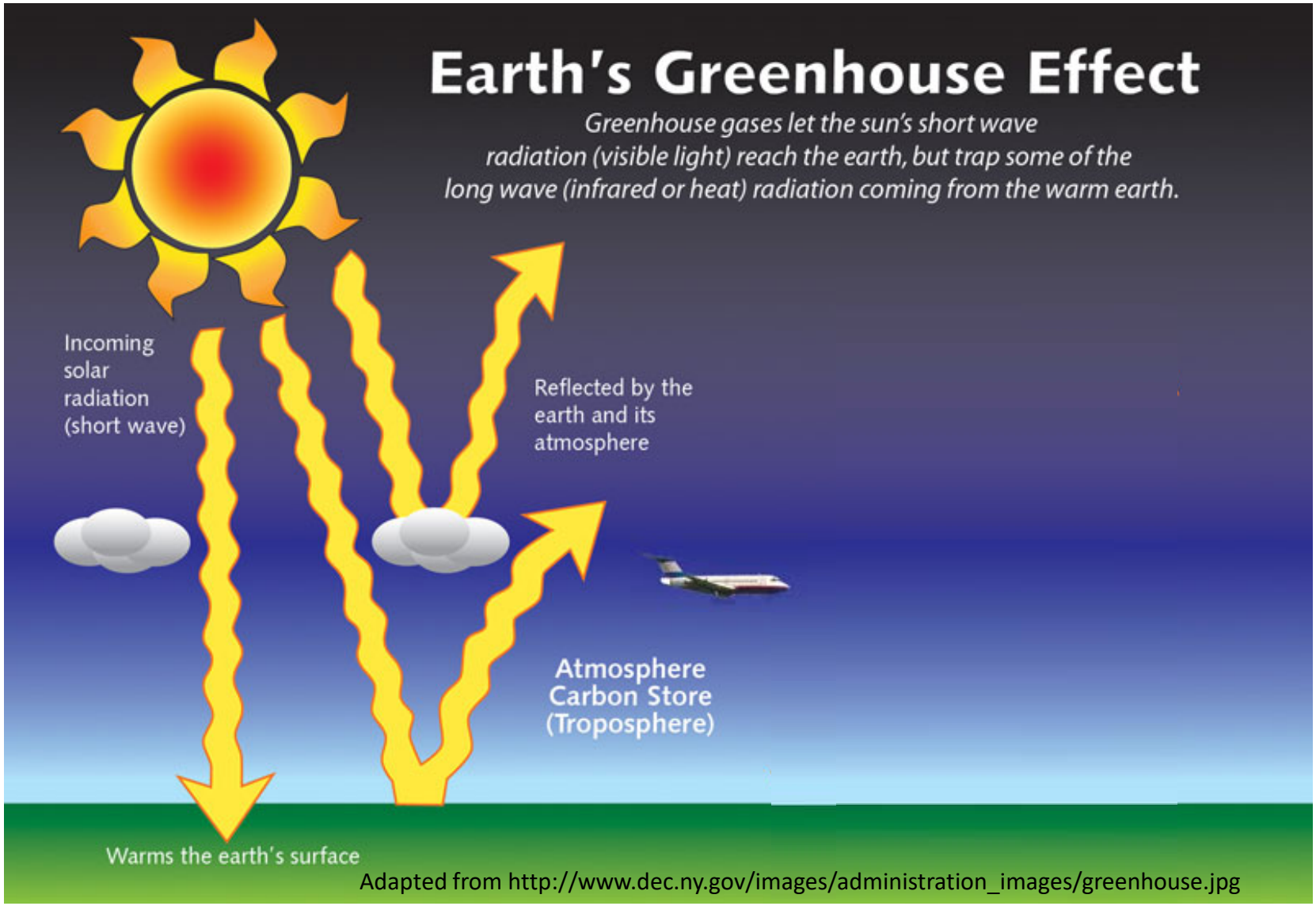

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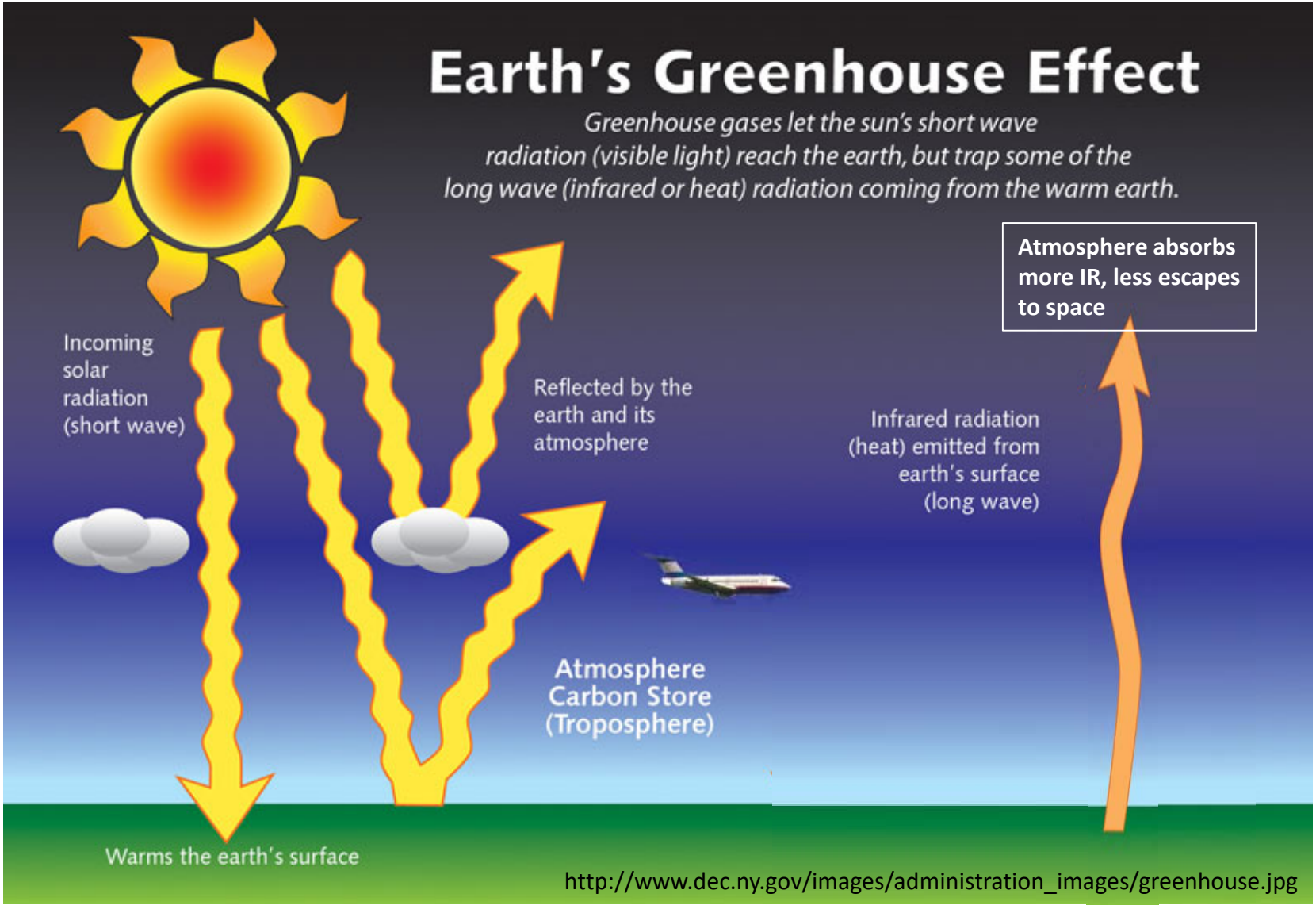

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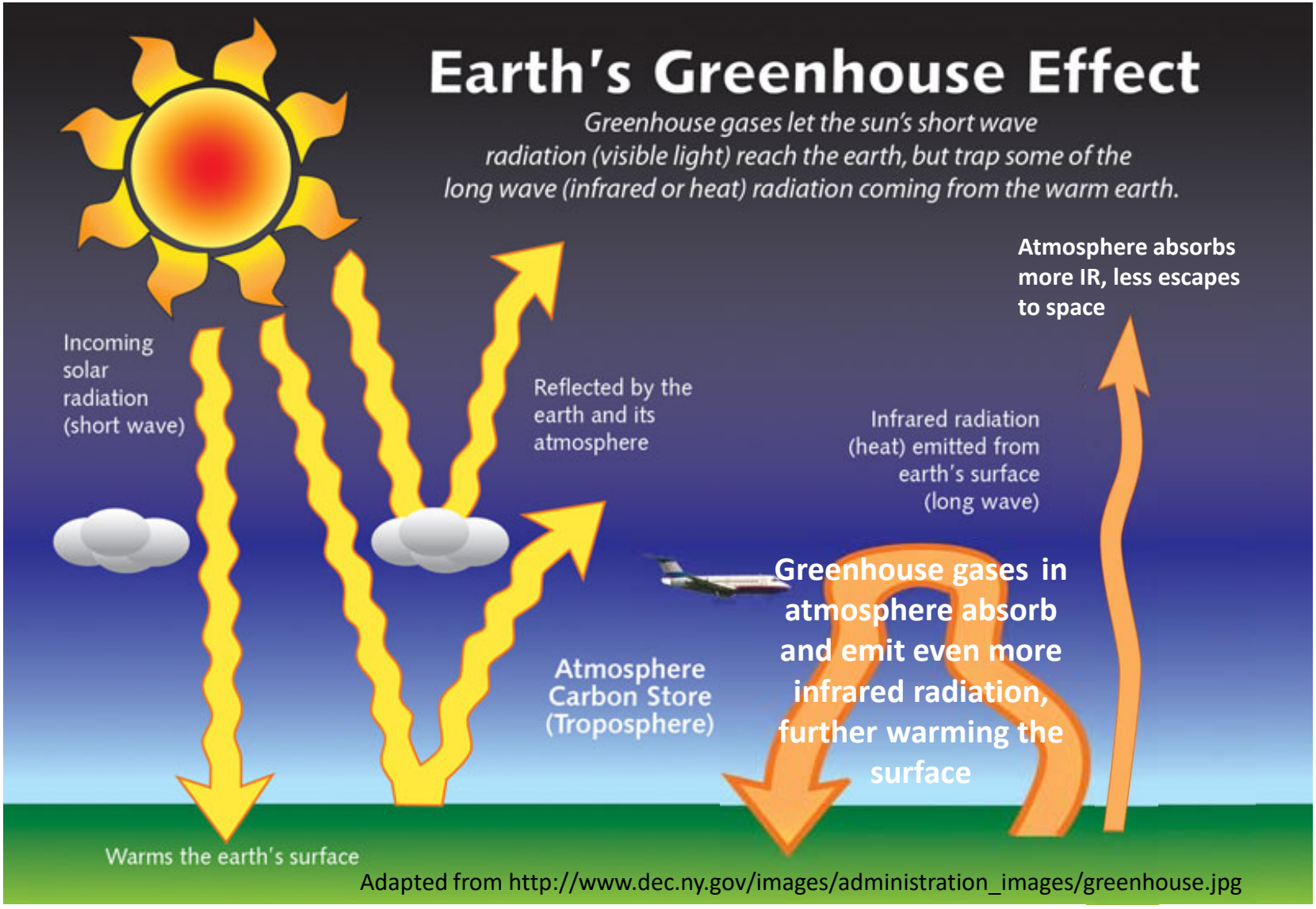

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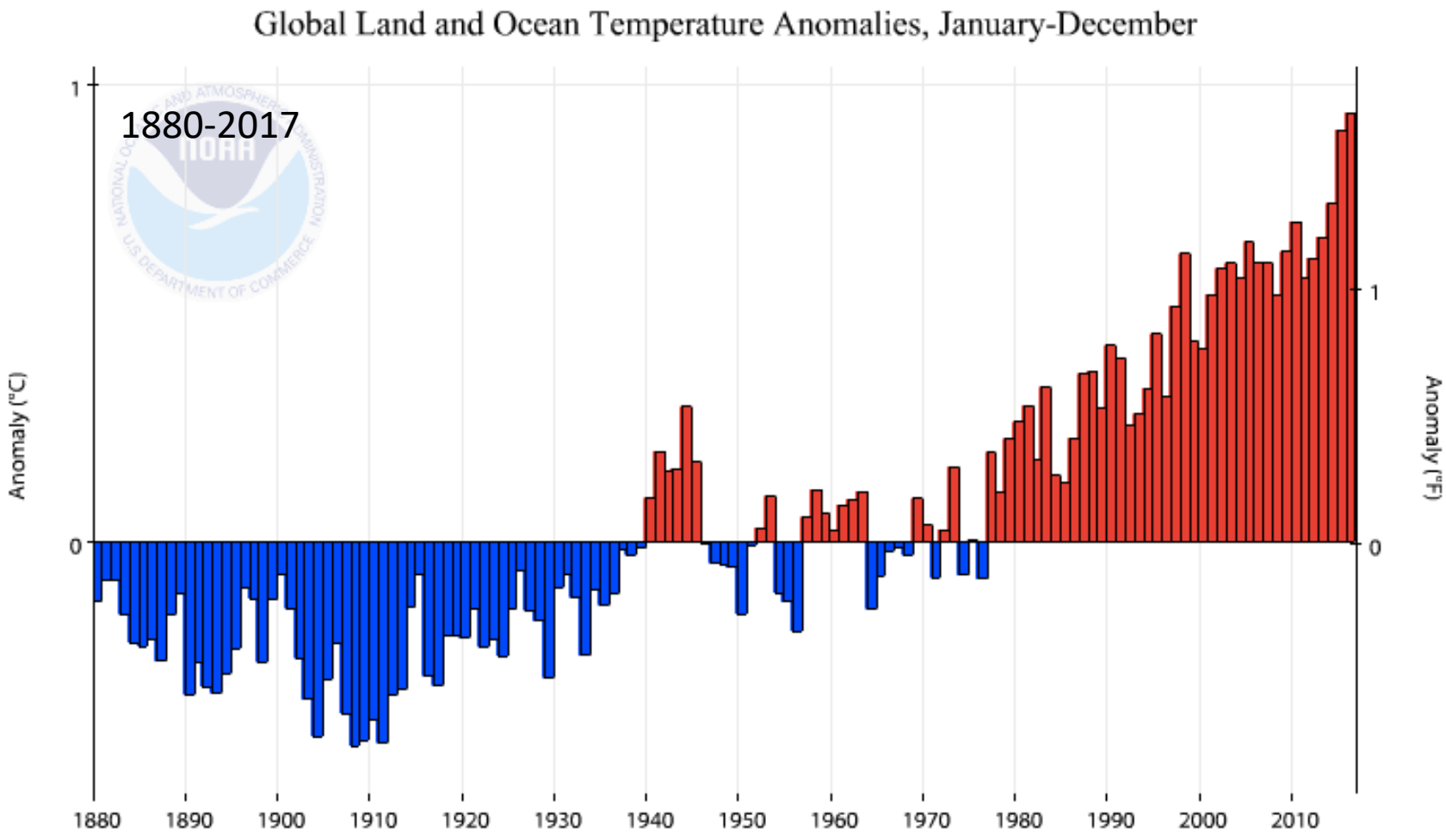
Greenhouse Effect Summary

- Potential for emitted CO_2 to alter climate has been recognized for a long time
  - 1824: Joseph Fourier establishes existence of natural greenhouse effect
  - 1859: John Tyndall confirms heat-trapping properties of greenhouse gases
  - 1890: Svante Arrhenius computes first estimate of expected global temperature increase from fossil fuel use

- Simple physics tells us increasing CO_2 should increase temperature
  - NOT having the temperature go up would be the odder result
  - Climate system is extremely complex, so odd results are possible
    - Does not appear to be the case

What is happening now?
Global Temperature is Increasing



data from http://www.ncdc.noaa.gov/cmb-faq/anomalies.php#mean

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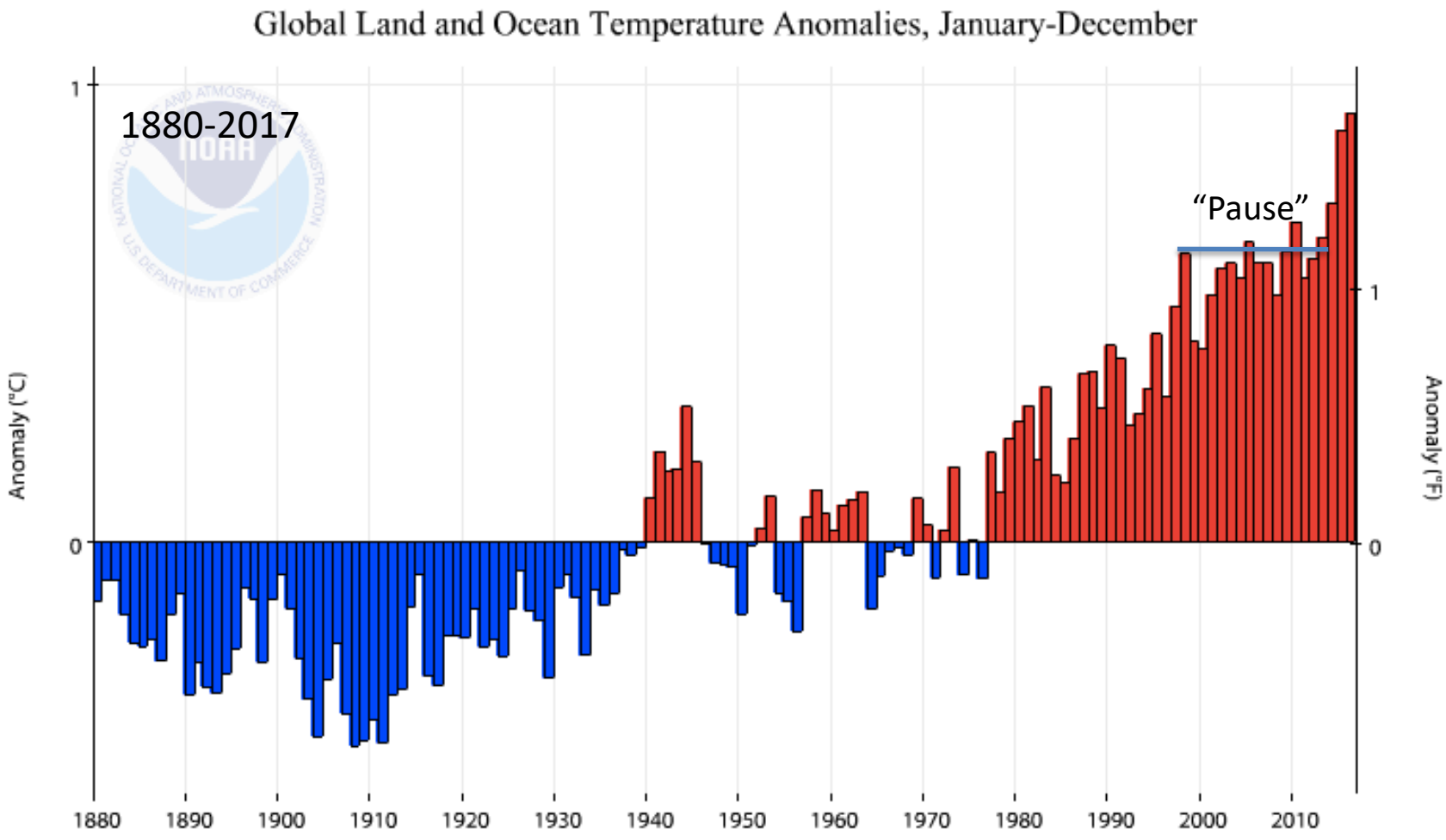

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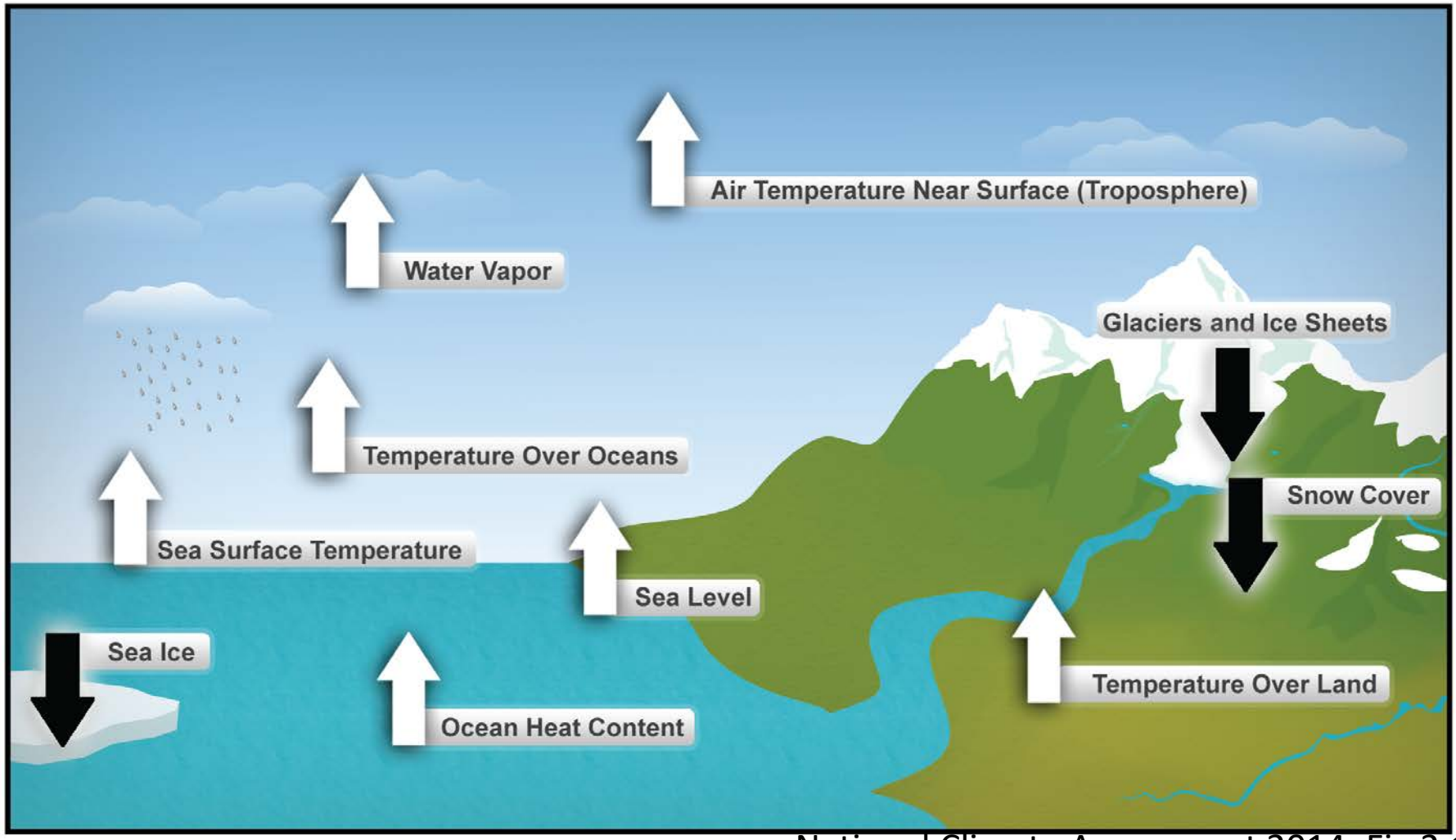
Is the temperature really increasing? How do we know?

Ten Indicators of a Warming World



National Climate Assessment 2014: Fig 2.1

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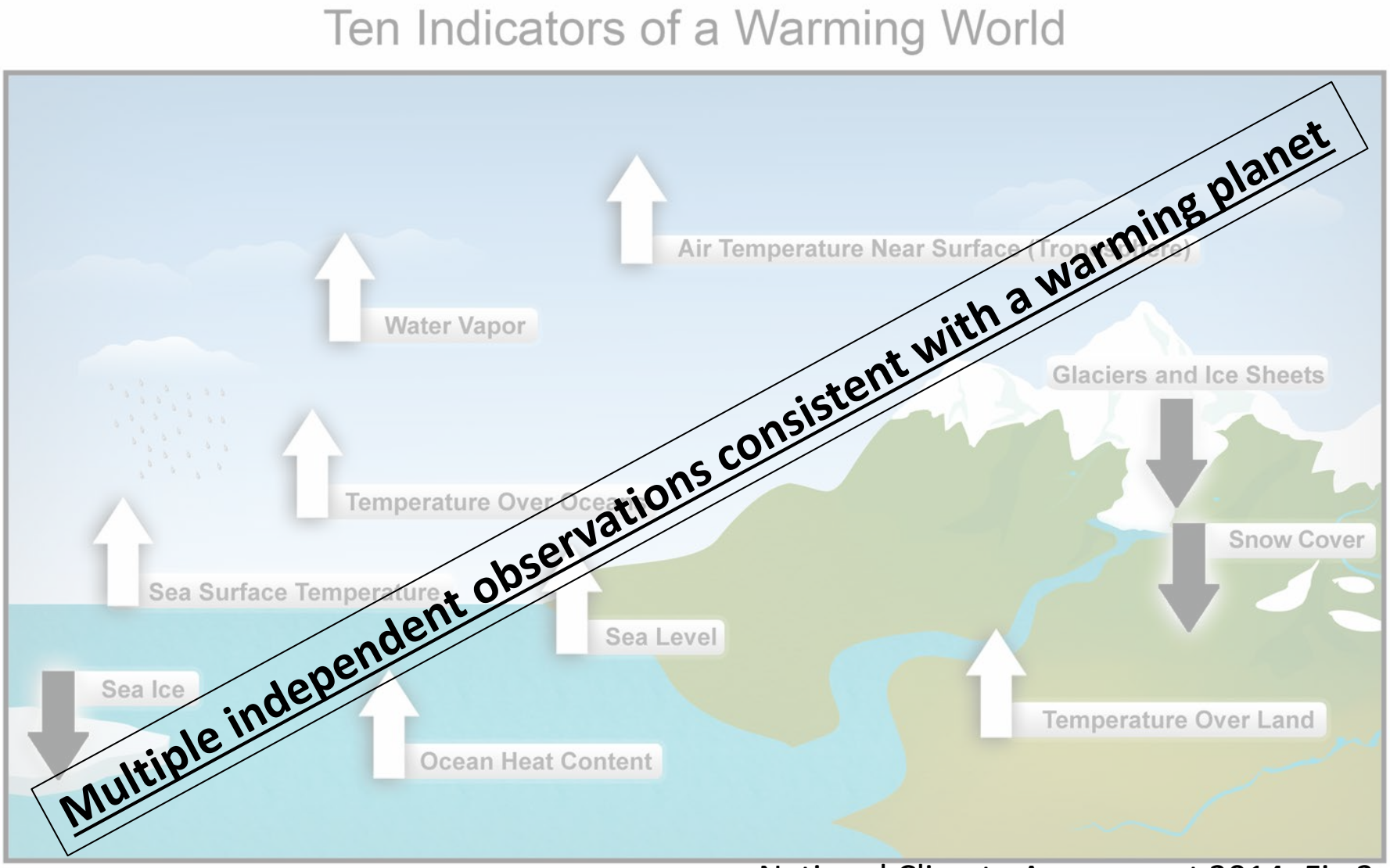
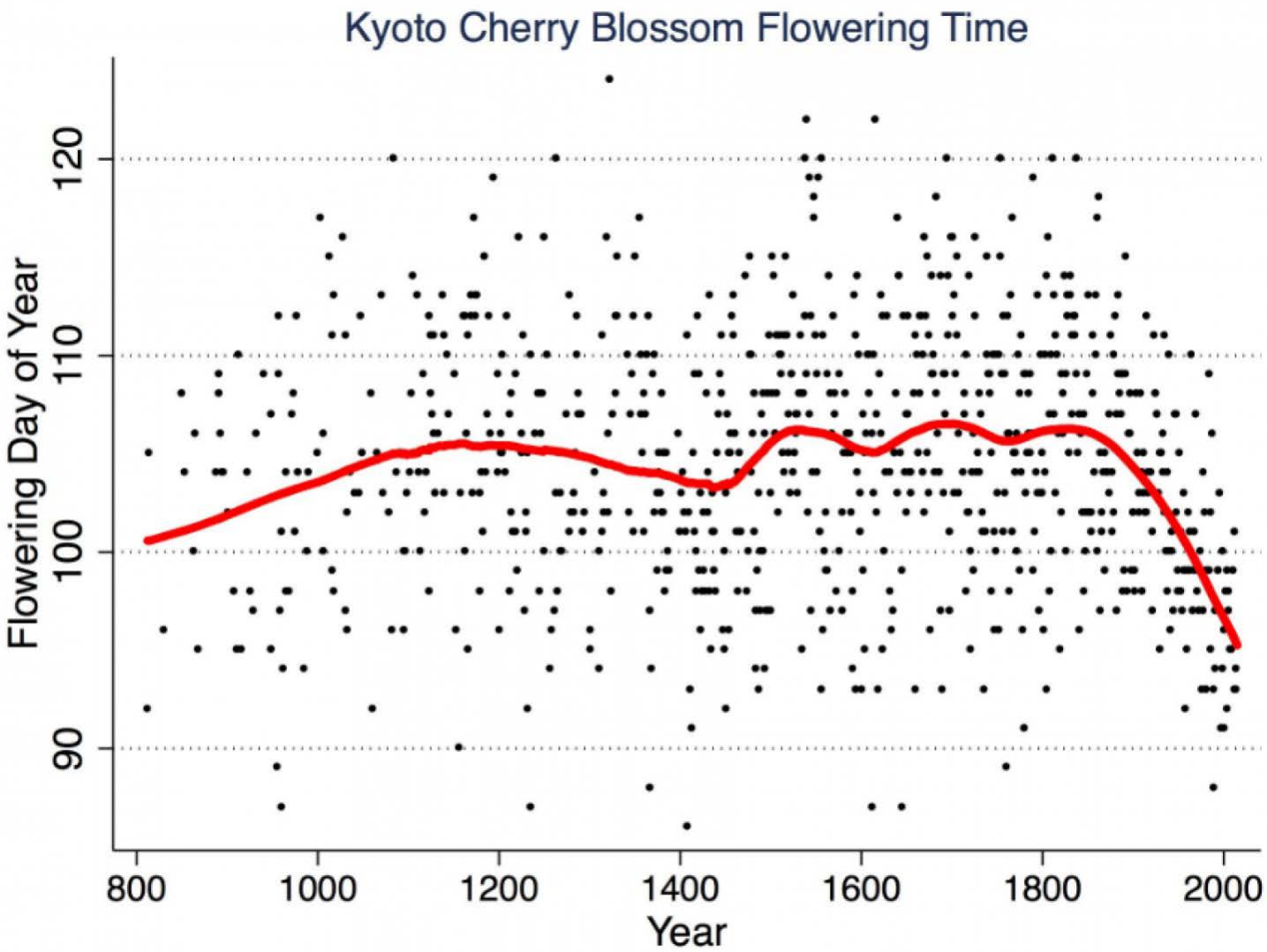


National Climate Assessment 2014: Fig 2.1

What is happening now? Trees Are Blooming Earlier



Lowess smooth, bandwidth 0.2. Data from http://atmenv.envi.osakafu-u.ac.jp/aono/kyophenotemp4/

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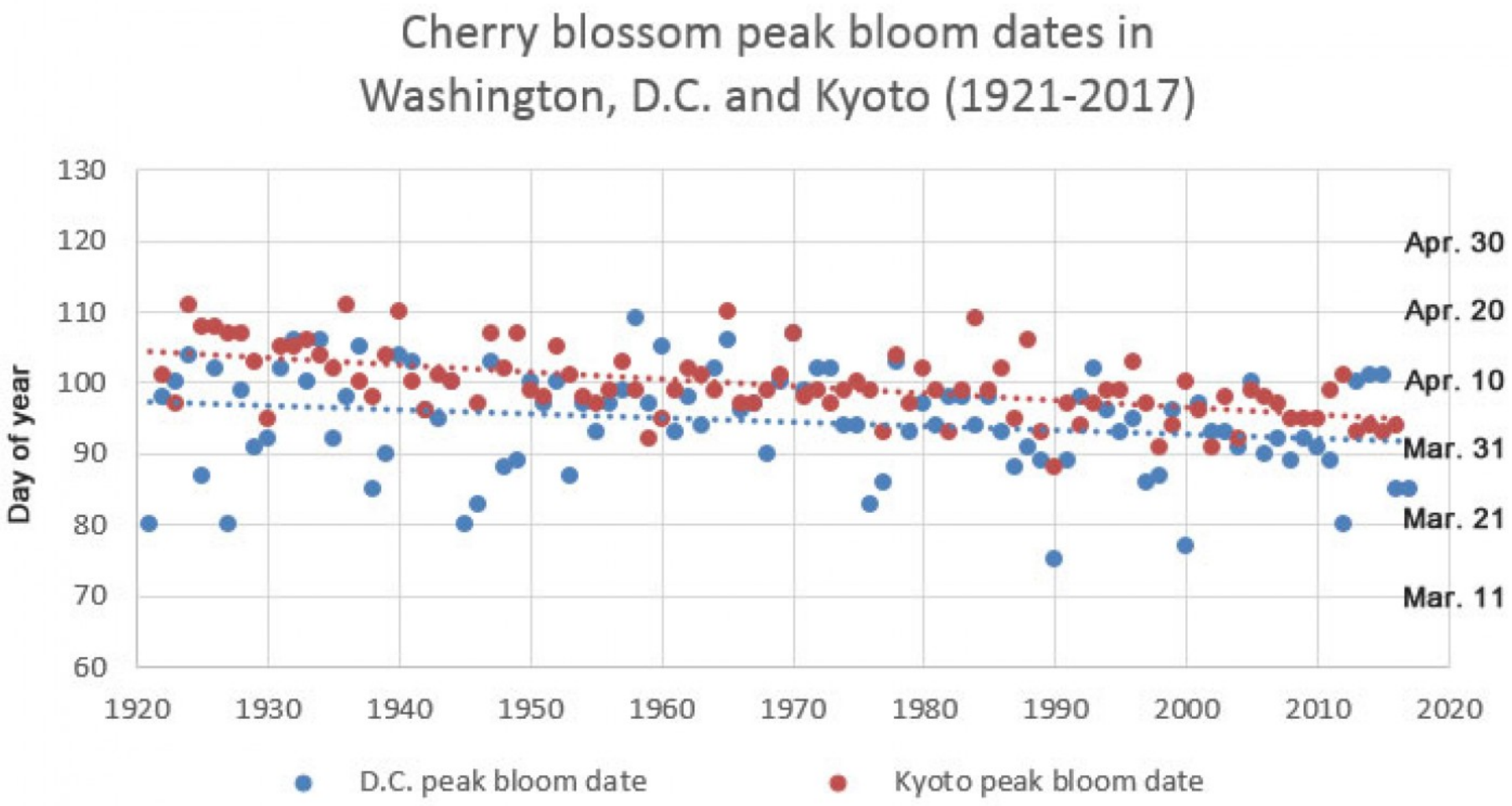


What is happening now?
Sea Level is Rising

How do we know humans are responsible for these changes?

Climate models represent multiple physical processes and their interactions numerically

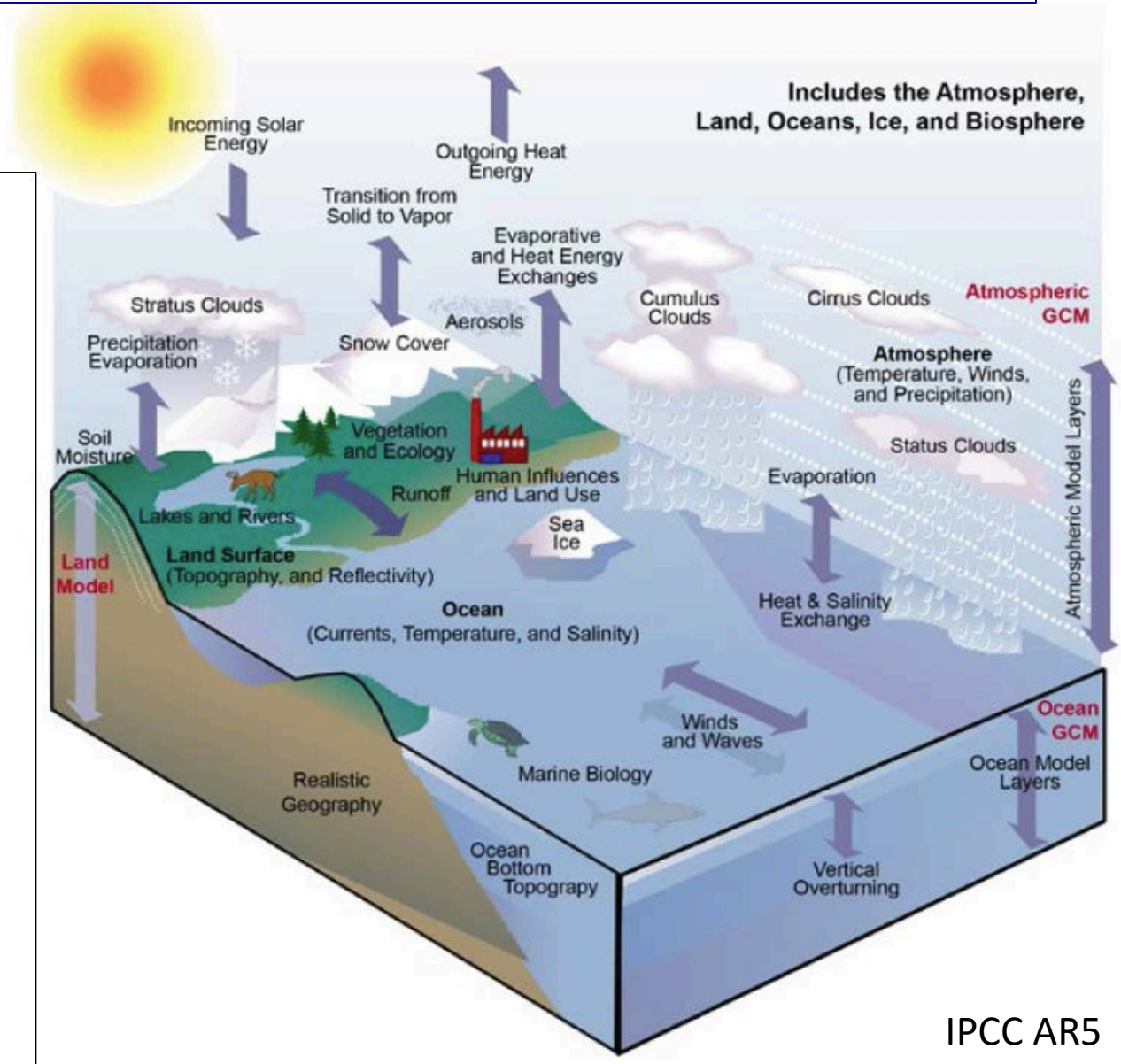
Supercomputers are used to solve resulting equations

Require hundreds of hours on 10's of thousands of processors

Not without flaws!

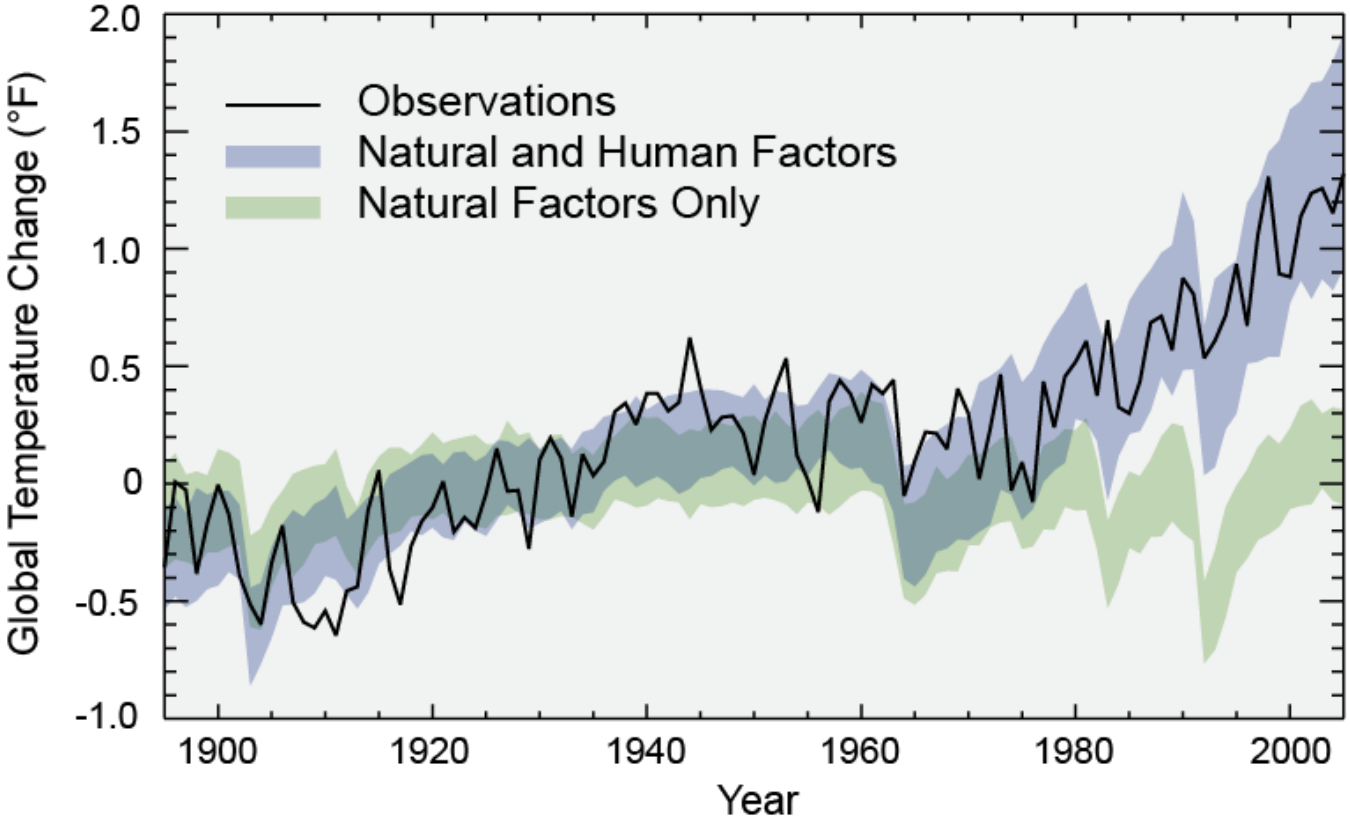
Allow for "What if?" questions

- What if greenhouse gases had not increased?
- What if they continue to increase?



IPCC AR5

Separating Human and Natural Influences



Based on our best understanding of the climate system at this time, recent warming trends cannot be explained by natural forcing alone

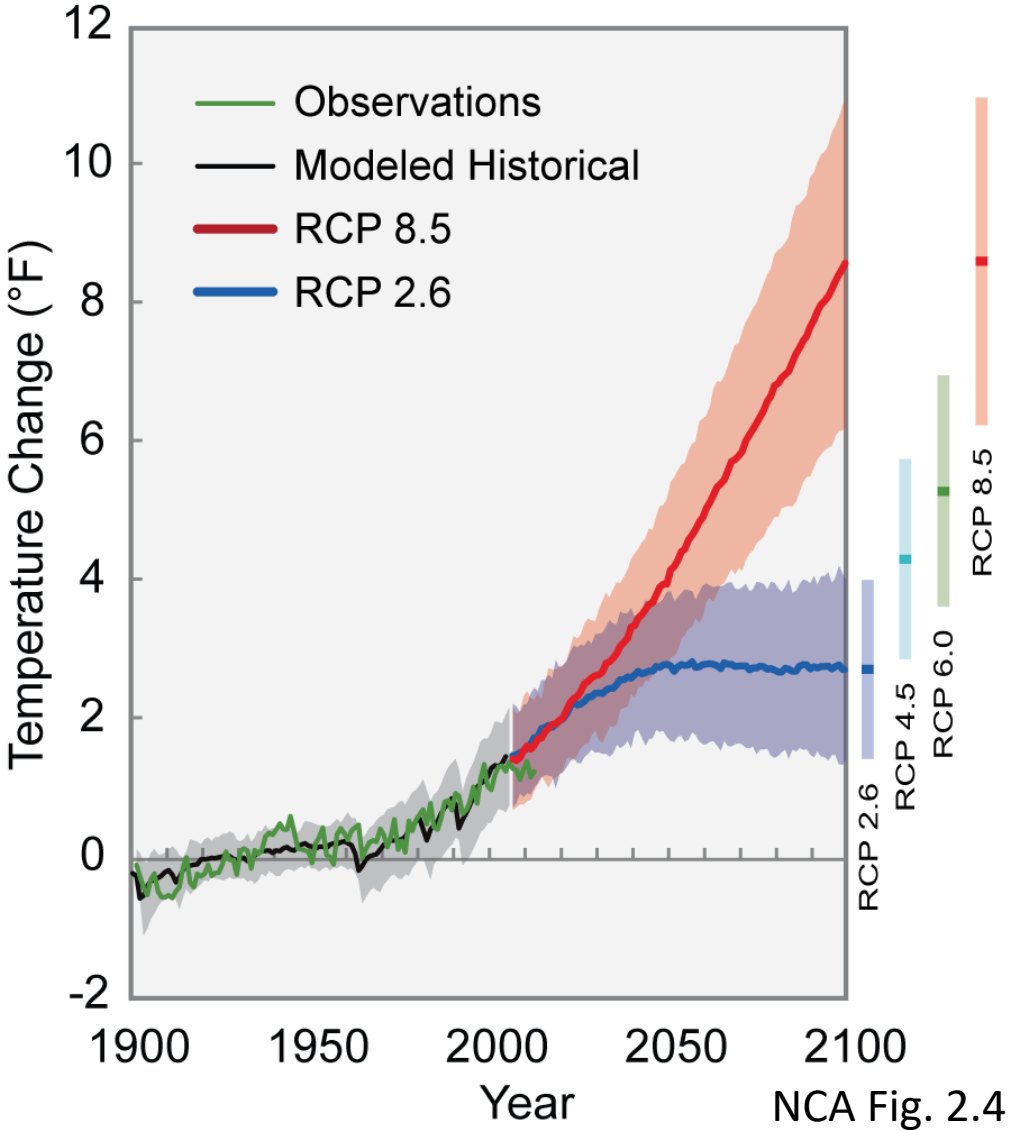
NCA Fig 2.3

What Happens Next?

Mostly, it depends on us.

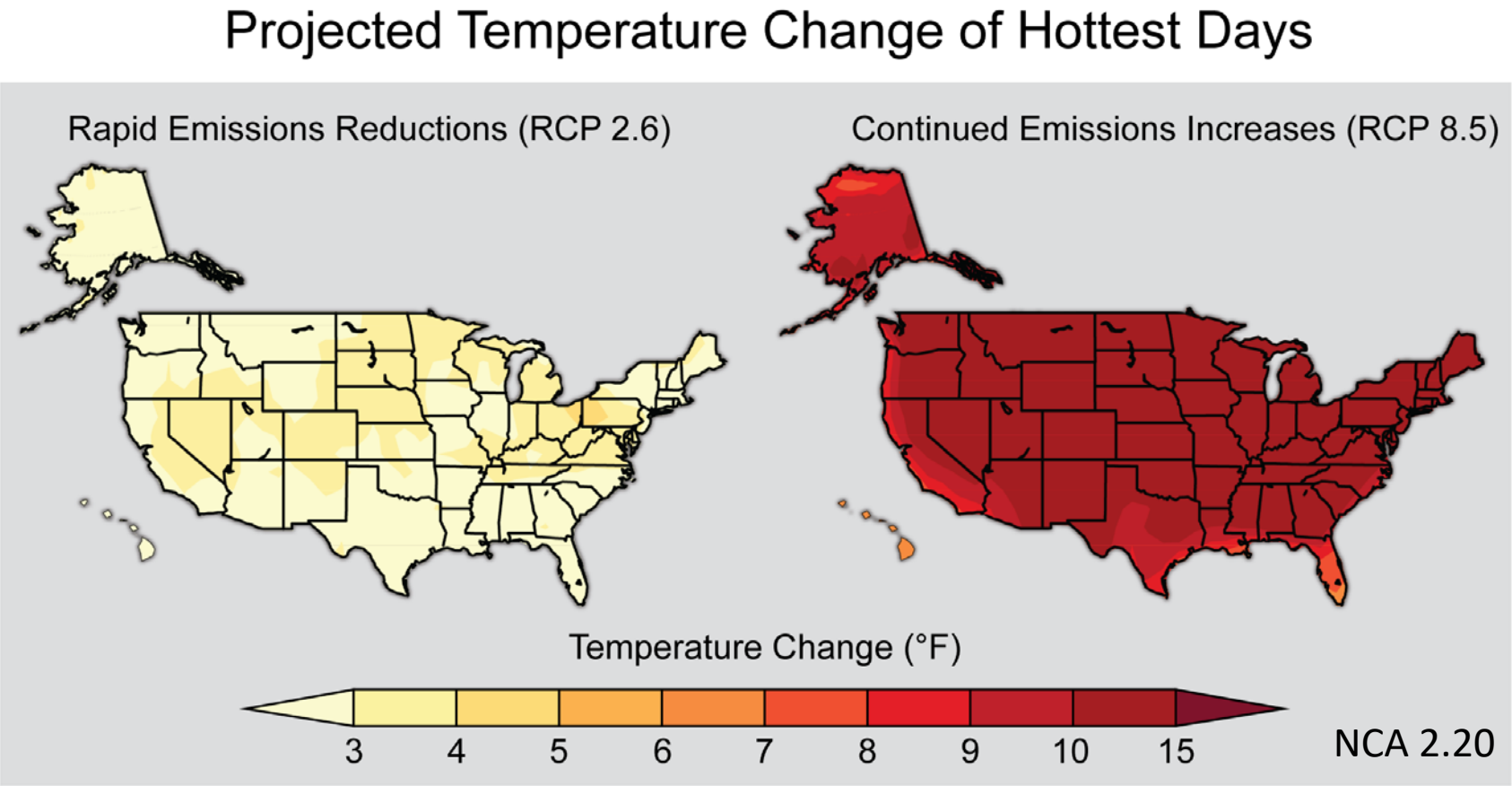
Aggressive emission reductions still lead to additional warming, but only about another 1 °F.

Worst case scenario does not really bear thinking about…



NCA Fig. 2.4

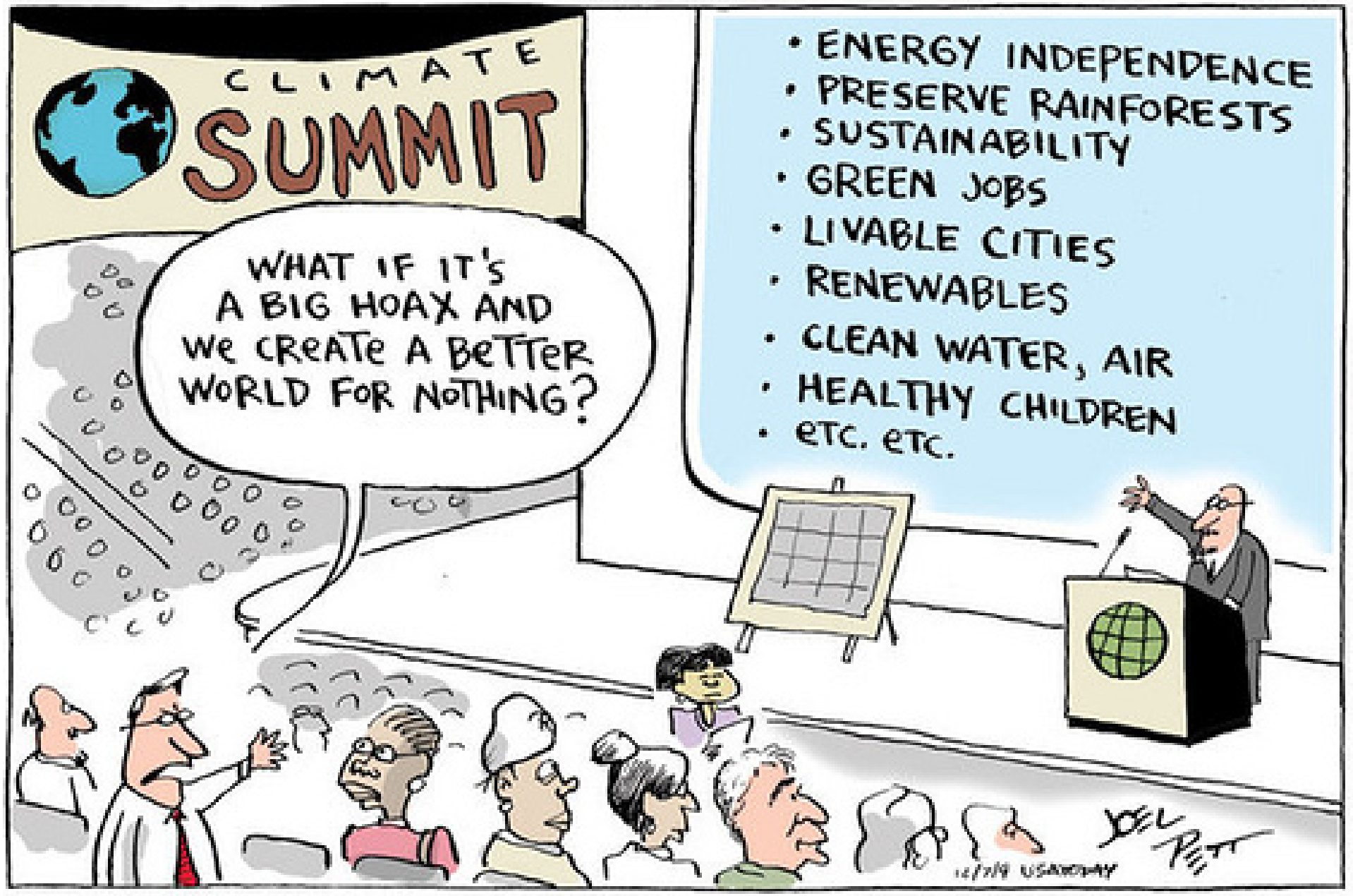
What Happens Next?
Severity of Hottest Days Will Increase



10+ (!) degree increase for Virginia under worst-case scenario

Summary

- Climate change is happening now, and will continue into the future
  - Human activity is amplifying planet's natural greenhouse effect
  - Multiple indicators pointing to a warming planet
  - We (hopefully) still have time to avoid the worst effects
- <u>What do we do now?</u>
  - Reduce, reduce, reduce
    - Mitigation needs to be part of any strategy. The sooner we start, the less painful it will be
  - Benefits beyond carbon reduction
    - Improved air-quality
    - Energy independence
  - We do not want to adapt to a worst-case scenario world


CLIMATE SUMMIT
WHAT IF IT'S A BIG HOAX AND WE CREATE A BETTER WORLD FOR NOTHING?
• ENERGY INDEPENDENCE
• PRESERVE RAINFORESTS
• SUSTAINABILITY
• GREEN JOBS
• LIVABLE CITIES
• RENEWABLES
• CLEAN WATER, AIR
• HEALTHY CHILDREN
• ETC. ETC.
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