### Hot Science Cool Talks

UT Environmental Science Institute

#### **# 62**

#### **Reach for the Stars**

#### Dr. Sally Ride October 30, 2009

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- Earth from the perspective of Space
- Some basic science behind climate and global warming
- Effects of changing climate that we're seeing now
  - Effects to expect in the future
  - Importance of embracing solutions now











## Earth's Air

 Nearly all of our air (99%) is made of oxygen (O<sub>2</sub>) and nitrogen (N<sub>2</sub>).



 Each of these molecules is made of two atoms:





- Carbon dioxide (CO<sub>2</sub>) and water vapor (H<sub>2</sub>O) are different!
- They have more atoms, so more ways to vibrate



...So, they are very good at absorbing and emitting infrared (heat) radiation

Molecules that have many ways to wiggle are called "Greenhouse" molecules Solar radiation powers the climate system.

The Greenhouse Effect

Some of the infrared radiation passes through the atmosphere but most is absorbed and re-emitted in all directions by greenhouse gas molecules and clouds. The effect of this is to warm the Earth's surface and the lower atmosphere.

Some solar radiation is reflected by the Earth and the atmosphere.

# ATMOSPHERE

FAR

About half the solar radiation is absorbed by the Earth's surface and warms it.

SUN

Infrared radiation is emitted from the Earth's surface.







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## Where Has CO<sub>2</sub> Come From?





### But....How Much $CO_2$ Was There in the Past?

We know from Studying ice cores





Vostok (400k yr) Ice Core data (Petit et al, 1999)



# CO<sub>2</sub> & Temperature





# "Recent" Temperatures

























# The Impacts

- Surface temperatures increasing
- Glaciers, ice sheets, sea ice shrinking
- Dry areas drier; wet areas wetter
- Storms more intense
- Ocean temperature increasing
- Sea Level rising
- Ocean more acidic
- Ecosystems, agriculture affected



## The Future...

 As world warms, changes (to ecosystems, coastlines, weather, agriculture) will continue

- Our Challenge: control & reduce the emission of CO2
  - No Magic Bullet

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**"Scientists are** necessary, but not sufficient to solve the climate problem"

Dr. Ralph Cicerone, President of the National Academy of Science, November 2007

## **Historical Emissions**



## The "Stabilization Triangle"





### Possible Wedges (no magic bullet)







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#### CLIMATE CHANGE BIOLOGIST



"What excites me most about my job is being in the wilderness. It's what I've loved since I could walk."

#### White House or Wilderness?

Camille's work has launched her into the spotlight. She's been featured in newspapers across the country and appeared on TV talk shows. She's even been invited to speak at the White House.

#### CAMILLE PARMESAN

University of Texas at Austin

#### **Butterfly Buddies**

In college, Camille Parmesan studied all kinds of animals—from honeybees to monkeys. But when Camille started studying a butterfly called Edith's checkerspot, she found her future. The 4½ years Camille spent tracking the butterfly led to a groundbreaking discovery. In response to climate change, the butterfly has disappeared from many of its habitats in Mexico and southern California. It's moving north and up the mountains to areas that are cooler places to live. Camille's research gave her the opportunity to work in her favorite lab, the outdoors. She hiked and camped from Mexico to Canada." The butterflies have a schedule that is perfect for me," Camille says. "They wake up at 10 A.M. and go to bed at 4 P.M."

#### **Big Answers**

"Don't be afraid of looking for answers to big questions," Camille says. That's how she's provided the first evidence that Earth's creatures are struggling to adapt to climate change. She has become an expert on the effect of climate change on plants and animals around the globe. Camille has figured out that many other species are moving north, including dragonflies, rufous hummingbirds, starfish, and red foxes.

"I eat really well while camping—we're talking lamb chops with sautéed asparagus."







#### www.SallyRideScience.com



OUR WORLD AND ITS CLIMATE-AND HOW HUMANS ARE CHANGING THEM

## Dr. Sally Ride



In addition to being the first American woman in space, Sally Ride has served as a member of the President's Committee of Advisors on Science and Technology and is the only individual to have investigated both the Space Shuttle Challenger and Columbia accidents.

Dr. Ride has written 6 books, received numerous honors and awards, including induction into the National Women's Hall of Fame, the California Hall of Fame, the Aviation Hall of Fame, and the Astronaut Hall of Fame.

Her momentous journey to space inspired the foundation of Sally Ride Science in 2001, whose mission is to motivate young women to follow their dreams and pursue careers in science, math, and