



## NASA-Rio Disaster Preparedness Cooperative Effort



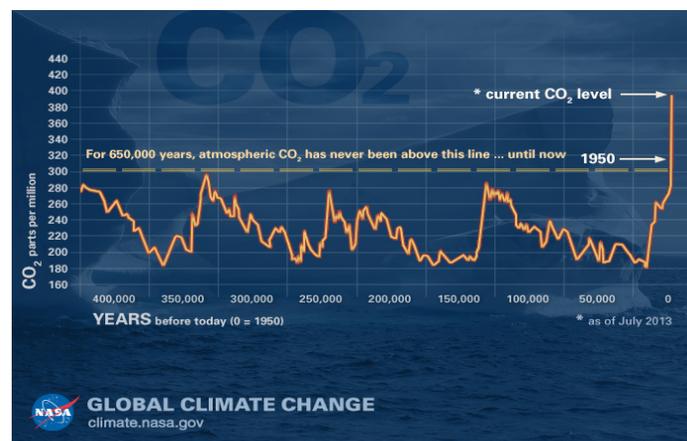
### Climate Change Basics:

“The Earth's climate has changed throughout history. Just in the last 650,000 years there have been seven cycles of glacial advance and retreat, with the abrupt end of the last ice age about 7,000 years ago marking the beginning of the modern climate era — and of human civilization. Most of these climate changes are attributed to very small variations in Earth's orbit that change the amount of solar energy our planet receives. The current warming trend is of particular significance because most of it is very likely human-induced and proceeding at a rate that is unprecedented in the past 1,300 years.

Earth-orbiting satellites and other technological advances have enabled scientists to see the big picture, collecting many different types of information about our planet and its climate on a global scale. This body of data, collected over many years, reveals the signals of a changing climate.

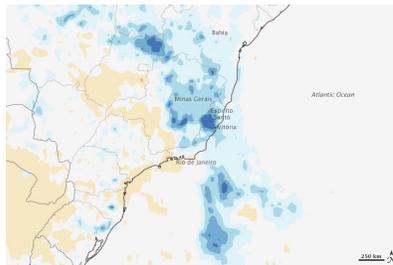
The heat-trapping nature of carbon dioxide and other gases was demonstrated in the mid-19th century. Their ability to affect the transfer of infrared energy through the atmosphere is the scientific basis of many instruments flown by NASA. There is no question that increased levels of greenhouse gases must cause the Earth to warm in response.

Ice cores drawn from Greenland, Antarctica, and tropical mountain glaciers show that the Earth's climate responds to changes in greenhouse gas levels. They also show that in the past, large changes in climate have happened very quickly, geologically-speaking: in tens of years, not in millions or even thousands.” *Climate Change Evidence: How Do We Know?* *Climate Change: Vital Signs of the Planet*. NASA, n.d. Web. 04 Aug. 2016.



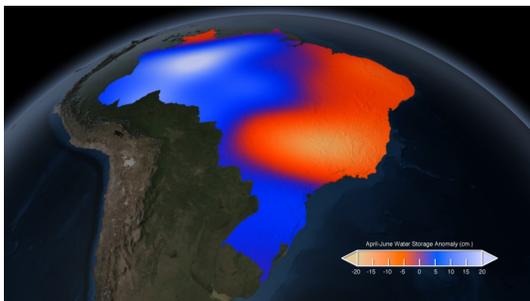
The City of Rio is working closely with NASA scientists on innovative efforts to better understand, articulate, and monitor natural hazards related to our changing climate. NASA provides satellite imagery and data that is openly available to the public and which can be used to diagnose potential hazards within the region. Some of these hazards include drought, flooding, and landslides in and around the city.

Satellite-based measurements of precipitation show the wider pattern throughout the states. The map below compares December 2103 rainfall rates with the average December rainfall between 1998 and 2012. Blue areas show where rainfall in 2013 was much more intense (more rain fell daily) than average. The extreme rain resulted in flooding and landslides that left 45 people dead, some 70,000 evacuated, and many communities isolated by the collapse of roads.



from <http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=82759>

The 2014-2016 Brazilian drought has been described as the worst drought to hit the region in 80 years. While the rainy season at the end of 2015 brought relief, monitoring precipitation will be essential to the citizens of Rio de Janeiro.



*A still image showing GRACE water storage anomaly data over Brazil for the months of April, May, June in 2014. Red and orange are areas with water losses; blues are gains.*

Resources in English:

- NASA's "Global Climate Change": <http://climate.nasa.gov/>
- NASA's "Earth Observatory": <http://earthobservatory.nasa.gov/>
- NASA's "Earth Right Now":
- "A Watchful Eye on Rio" article from Earth Observatory: <http://earthobservatory.nasa.gov/blogs/earthmatters/2016/08/16/a-watchful-eye-on-rio/>
- "Flooding in Brazil after Dam Breach" article from Earth Observatory: <http://earthobservatory.nasa.gov/IOTD/view.php?id=86990>
- "Flooding Near Manaus, Brazil" article from Earth Observatory: <http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=39359>
- "Landslides in Brazil" article from Earth Observatory: <http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=49120>