## The Role of El Nino in Ocean Warming Since the 1950s

Dr. Roy W. Spencer Principal Research Scientist The University of Alabama in Huntsville 8 July 2014

## How Can Global Warming/Cooling Happen Naturally?

### <u>Warming/cooling only requires ~0.1% energy imbalance between</u> <u>absorbed sunlight and emitted IR</u>

(e.g. Levitus OHC data: since 1950s, 0.25 W/m2 imbalance vs 240 W/m2 avg)

<u>"RADIATIVE" Forcing</u>:

EXAMPLE: Global albedo can change slightly with circulation regime (we don't know the global albedo to 1% from either first principles or observations)

"NON-RADIATIVE" Forcing:

EXAMPLE: Changes in ocean mixing, combined with temperature stratification with depth, will cause surface warming or cooling

The IPCC <u>assumes</u> these natural forcings are largely non-existent on multi-decadal (or longer) time scales (i.e. climate system is naturally in a state of energy balance).

<u>IRONY</u>: We showed in Spencer & Braswell (2014) that some of the IPCC models do not even conserve energy in the oceans (Essex effect?)

#### **NON-RADIATIVE forcing:**

any change in ocean mixing/overturning can cause global surface warming or cooling



Since climate models do not have "natural forcings" on multi-decadal time scales, ALL of the warming since the 1950s is assumed to be human-caused...

## $\Rightarrow$ Model sensitivity too high

### $\Rightarrow$ Models predict too much warming



#### **Ocean temperature increase since the 1950s can be explained\* with:**

1) RCP assumed forcings (mostly increasing CO2),

- 2) low climate sensitivity [1.3 deg. C], and
- 3) more frequent El Ninos causing radiative imbalance



\*Spencer, R. W., and W. D. Braswell, 2014: The role of ENSO in global ocean temperature changes during 1955-2011 simulated with a 1D climate model. *Asia-Pac. J. Atmos. Sci.*, **50(2)**, 229-237.

# The "smoking gun" that natural, El Nino-caused, forcing of global warming occurs is the ~10 years of CERES Earth radiative budget data, which shows:

- El Nino is preceded by a decrease in cloud cover (decrease in albedo), leading to solar-forced warming of the oceans

- MOST (~2/3) of El Nino warming is still ocean-circulation caused, but ~1/3 is radiatively-caused (increase in absorbed sunlight)



- Ocean circulation changes can cause global warming or global cooling
- It is unknown how much of past warming and cooling periods might be due to changes in ocean circulation:

Temperature Reconstruction\* for N. Hemisphere, 1 - 2000 AD Shows Modern Warm Period Not Exceptional



Year AD

\*Ljungqvist, F.C. 2010. A new reconstruction of temperature variability in the extra-tropical Northern Hemisphere during the last two millennia. Geografiska Annaler: Physical Geography, Vol. 92 A(3), pp. 339-351, September 2010. DOI: 10.1111/j.1468-0459.2010.00399.x

Without understanding of long-term changes in ocean circulation, it will remain unknown how much of climate change is natural versus human-caused.

If we didn't start it, we can't stop it.