**Sea Level Rise Program for Science On a Sphere: Bullet Points**

 \*Most of the visual information shown on the SOS was produced and collected by National Oceanic and Atmospheric Administration (NOAA) scientists and satellites.

SOS Dataset A. *Blue Marble, Earth at 23° tilt*

White areas of ice, as well as clouds, reflect much of sun’s incoming energy back towards space. Blue Marble composite image shows average ice cover for the 1980s.

Oceans are the focus of this talk, given the topic is sea level rise (**SLR**). Note that greenhouse gases trap much of the ice reflected solar energy, adding further heat energy to the Earth as a whole.

Our use of fossil fuels has increased CO2 and other greenhouse gases in our atmosphere resulting in a human contribution to climate change.

SLR (again SLR = sea level rise) sums up many global warming and climate change impacts.

SOS dataset B. *Earth Surface Air Temperatures: 1884-2012*

Presently, the most important factor in SLR is the heat expansion of seawater due to air temperature increases since the industrial revolution began. About half (1/2) of the oceans’ waters expansion has been due to heating of air and the transfer of this heat into oceans since the industrial era began.

White on the SOS Earth is a *baseline* period - the average of 1960s temps at any particular location - so that we can have a better look at changes in air temperatures from 1884 to present day.

Comparing Arctic region 2012 vs. 1884 temps shows that 2012 temps are more than 4 ºF warmer than 1884 temps.

There is less than one in 900 chance that a 4 °F average surface temp increase over the Arctic could be “natural” (i.e., in the range of temps during the 1890s to 1910s).

Warming of the human body by 4 ºF (98.5 to 102.5) produces a high fever. A 4 ºF warming of Earth’s surface temperature produces a range of problems of similar magnitude for life on Earth.

Example: Orca (killer) whales, given their passage into the Hudson Bay is no longer impeded by ice, are finding many mammals easy prey - bears, walruses, even other whales.

More than 90% of the greenhouse warming energy caused by human-induced temperature increases since the 1960s has gone into the oceans. If this human contribution to greenhouse warming had stayed in the air, average surface temps would be roughly 40 ºF higher today than in the 1890s-1910s timeframe.

The huge heat energy added to the oceans since the industrial era began is the reason why half of the SLR per year rate of rise is due to heat expansion of the oceans’ waters.

SOS dataset C. *Arctic Sea Ice Minimum: 1987-2012*

Comparison of 1987 with 2012 shows clearly that a great deal of Arctic Ocean sea ice and land ice in the greater Arctic region has been lost in just 35 years.

Across the entire planet, glacier ice melt is contributed about one-fourth (1/4) of the SLR per year rate of rise since the industrial era began.

Recently, scientists have shown that Greenland ice melt is also contributing substantially to SLR. About one-fifth (1/5) of the SLR per year rate of rise is due to melting of the Greenland ice sheet plus a poorly defined portion due to the Antarctic ice sheet (*Science, 30 November 2012, pg. 1138).*

Note that more solar energy was, in the past, reflected back to space. Today, more solar energy is absorbed by the dark waters of Earth’s oceans. Compare the “brightness” of the Arctic region in 1987 vs. its “brightness” in 2012.

SOS Dataset D. *Earth at Night with 1-meter Sea Level Rise shown in red*

Show the audience a 1 meter stick and a yardstick next to each other (in the US). Showing meter and yard sticks together will help many in public lectures with appreciating “1 meter”. It is valuable to clarify 1 meter since this dominates visually on the SOS dataset D; 1 meter SLR is shown in red.

The Intergovernmental Panel on Climate Change (**IPCC\*\*)** has shown that SLR - by 2050 vs. pre-industrial era levels - will be about one-half (1/2) meter and by 2100 about 1 meter (just over 1 yard). (A remark about the uncertainty in the SLR amounts of ½ m and 1 m when projecting to 2100 may be useful, depending upon the audience.) \*\* A few words about IPCC may be helpful at this point (depending on audience).

Sea Level Rise (SLR) is likely to displace 5-12 million people (globally) by 2050 and, perhaps, 60-240 million by 2100. The marked increase in people displaced, 2100 vs. 2050, is an important discussion point.

9% of Florida will be under water with 1 meter SLR. Similar remarks can be made about the Carolinas. The NEUS coastline may be a good talking point regarding SLR since it is known that SLR is increasing more rapidly along the NEUS coastline than the global average SLR. As of 2010-2012, SLR has been measured, at several NEUS sea height sites, to be one ft. vs. the global average of 8 inches.

SOS dataset E. *Blue Marble, Earth at 23° tilt; SOLUTIONS* discussion

The marked increase in people displaced globally, 60-240 million by 2100 vs. 5-12 million by 2050, is certainly one good way to lead into SLR solutions discussions. How might we be able to hold SLR to just ½-meter rise by 2100 instead of the expected 1-m rise? If we can do so, the number of people displaced by 2100 would be about 10 million as opposed to the estimated 100 million; only 10% of that estimated given the expected pattern of carbon dioxide emitted into the atmosphere.

It is useful to consider three different Solutions arenas: government, the private sector, and what each of us can do individually.

* Government: renewable energy credits and subsidies.

Wind power is already making a big difference: e.g., Iowa & South Dakota

 Solar and Geothermal making big difference in Europe: e.g., Germany

* Private Sector: The Insurance Industry (TII); 7% (largest) of global economy

1973: TII acknowledged “there is human contribution to climate change”

 “weather catastrophe” payouts up 400% in last two decades

 Well over 1000 climate change mitigation activities by TII

 Climate Change mitigation investment: ~25 billion $s

* Individuals: Biggest personal choice impact; Your Car (2013 data)

 Hybrid cars: Volt, ~$27,000; Prius, ~$28,000; C-max Energie; ~$28,000

 Electric cars: Leaf, ~$30,000 and Focus E, ~$29,000