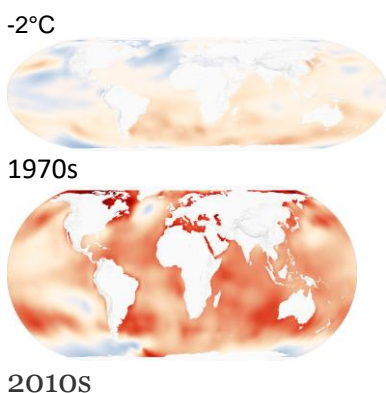


Oceans Are Absorbing Almost All of the Globe's Excess Heat

This year is on track to be the third consecutive hottest year on record. Where does that heat go? The oceans, mostly.

Where the Oceans Have Been Colder and Hotter Than Average



INTRODUCTION: First goal is to determine amount of heat(Q) energy absorbed by oceans 1971 to 2010 with information given below. Knowing Q absorbed by oceans 1971 – 2010 , Δt of oceans will be found in that 39 year period. 71 % of earth surface are oceans. Area of earth surface is $510 \times 10^6 \text{ km}^2$. Depth of oceans affected by atmospheric temperature change is $h = 750 \text{ m}$.

QUESTION SET 1: (a) Find number of seconds in 39 years? , (b) In 39 yrs. find the heat energy given off by 140 billion 1500 Watt(J/s.) hair dryers?

HINTS: 365 days/yr., 24 hrs./day., 3600 s./hr. , Power(watts) = Heat energy(Q)/time
Thus, heat energy(Q) = Power(watts) X time.

ANSWERS: (a) $1,2299 \times 10^9 \text{ s}$., (b) $Q = 258.28 \times 10^{21} \text{ Joules}$

Heat Accumulates in the Oceans

Since 1955, more than **90 percent of the excess heat retained by the Earth as a result of increased greenhouse gases has been absorbed by the oceans, leaving ocean scientists like Eric Leuliette at the National Oceanic and Atmospheric Administration feeling that 90 percent of the climate change story is being ignored.**

For several decades, more energy has been absorbed than emitted at the top of Earth's atmosphere. According to Gregory Johnson, an oceanographer at NOAA, the **(((rate of energy gained between 1971 and 2010 was roughly equal to the power required to run 140 billion 1,500-watt hair dryers over the same number of years)))**. The rate has only increased in the past decade. **This excess energy has largely been sucked up by the oceans, which have a huge capacity to store heat. As the oceans store more heat, however, they expand. Scientists have shown that over the past decade, this thermal expansion has caused about one-third of the rise in sea levels.**

INTRODUCTION 2: $\Delta Q = c m \Delta t$, where $c = \text{specific heat of sea water} = 3850 \text{ J/kg} \cdot ^\circ\text{C}$, $m = \rho_{\text{SEA WATER}} V$,
 $V = A_{\text{OCEANS}} h_{\text{depth considered}}$, $\rho_{\text{SEA WATER}} = 1029 \text{ kg/m}^3$, $h = 750 \text{ m}$.

QUESTIONS: (a) Find surface area of all oceans? (b) Find volume V of top 750 m. of all ocean water?
(c) Find mass m (in kg.) of top 750 m of all ocean water?, (d) ΔQ heat absorbed by oceans was determined above to be $258.28 \times 10^{21} \text{ Joules}$, find temperature increase Δt of oceans in past 39 years?

ANSWERS: (a) $362.1 \times 10^{12} \text{ m}^2$., (b) $2.716 \times 10^{17} \text{ m}^3$, (c) $2.79476 \times 10^{20} \text{ kg}$., (d) $\Delta t = \sim 0.24 \text{ C}^\circ$

COMMENT: Δt determined of $\sim 0.24 \text{ C}^\circ$ is slightly less national oceanic and atmospheric administration reports of $+0.5 \text{ F}^\circ = \sim 0.28 \text{ C}^\circ$. At their site some very descriptive data charts exist on ocean temperature change. Dr. Cise