

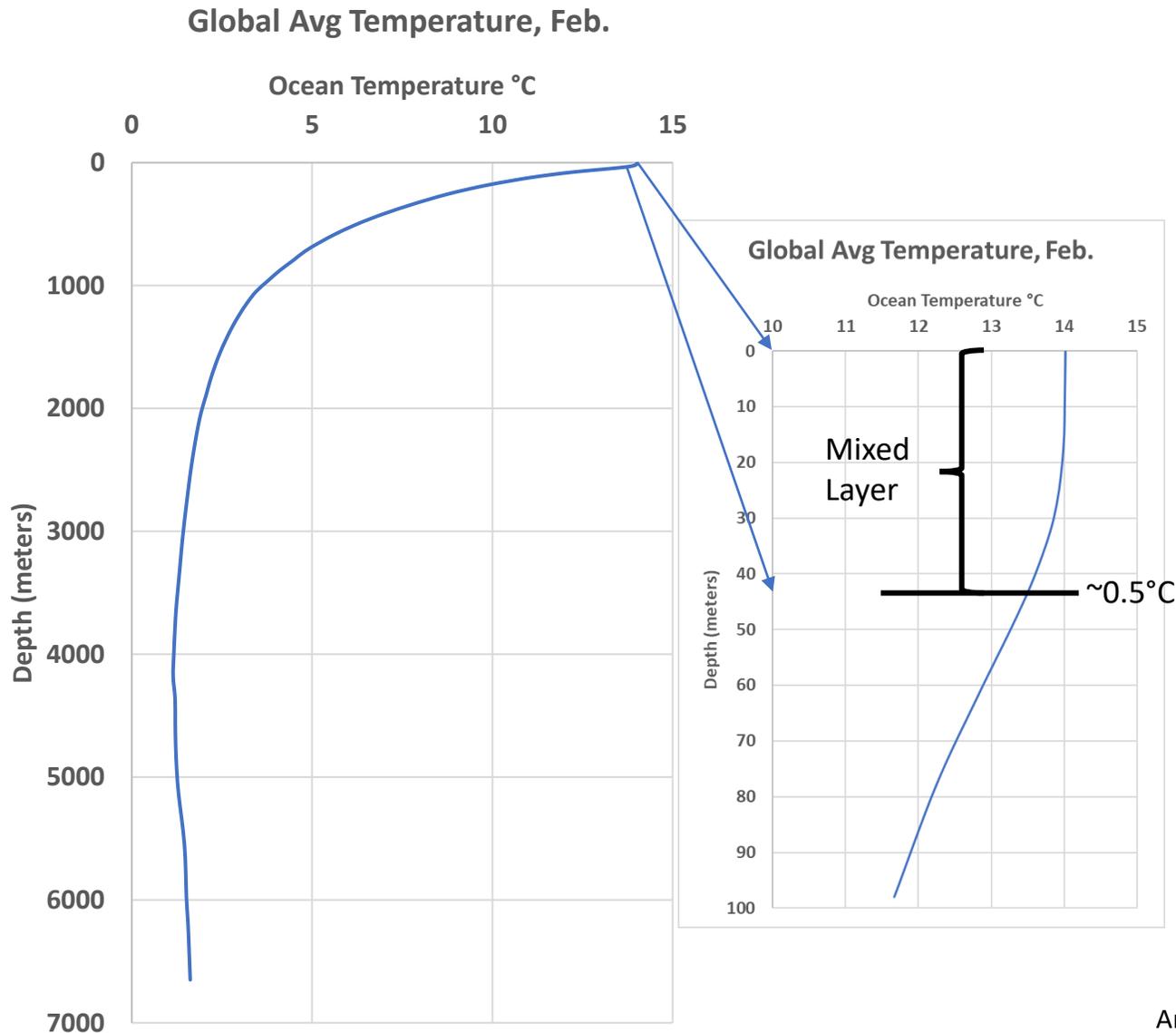
# How to measure climate change?

Andy May

# Global Mean Surface Temperature (GMST)

- Average of land weather stations and Sea Surface Temperatures (SST), it has been the official *IPCC measure* of climate change
- Solar and orbital effects on climate are regional, so focusing on global averages is misleading. Both orbital precession and orbital obliquity affect temperature by latitude, only CO<sub>2</sub> is quasi-global.
- Surface Weather is chaotic at all time scales, the “climate” limit of 30 years is arbitrary.
- July Vostok Station, Antarctica average low air temp is -95°F/-70 °C
- July Doha average high air temp is 106°F/41°C
- What does a July global mean of +41C and -70C tell us?
- In the AR6 the IPCC plans to replace GMST with GSAT (Global Surface Air Temperature) from a *model*. They have no dataset, only a model.

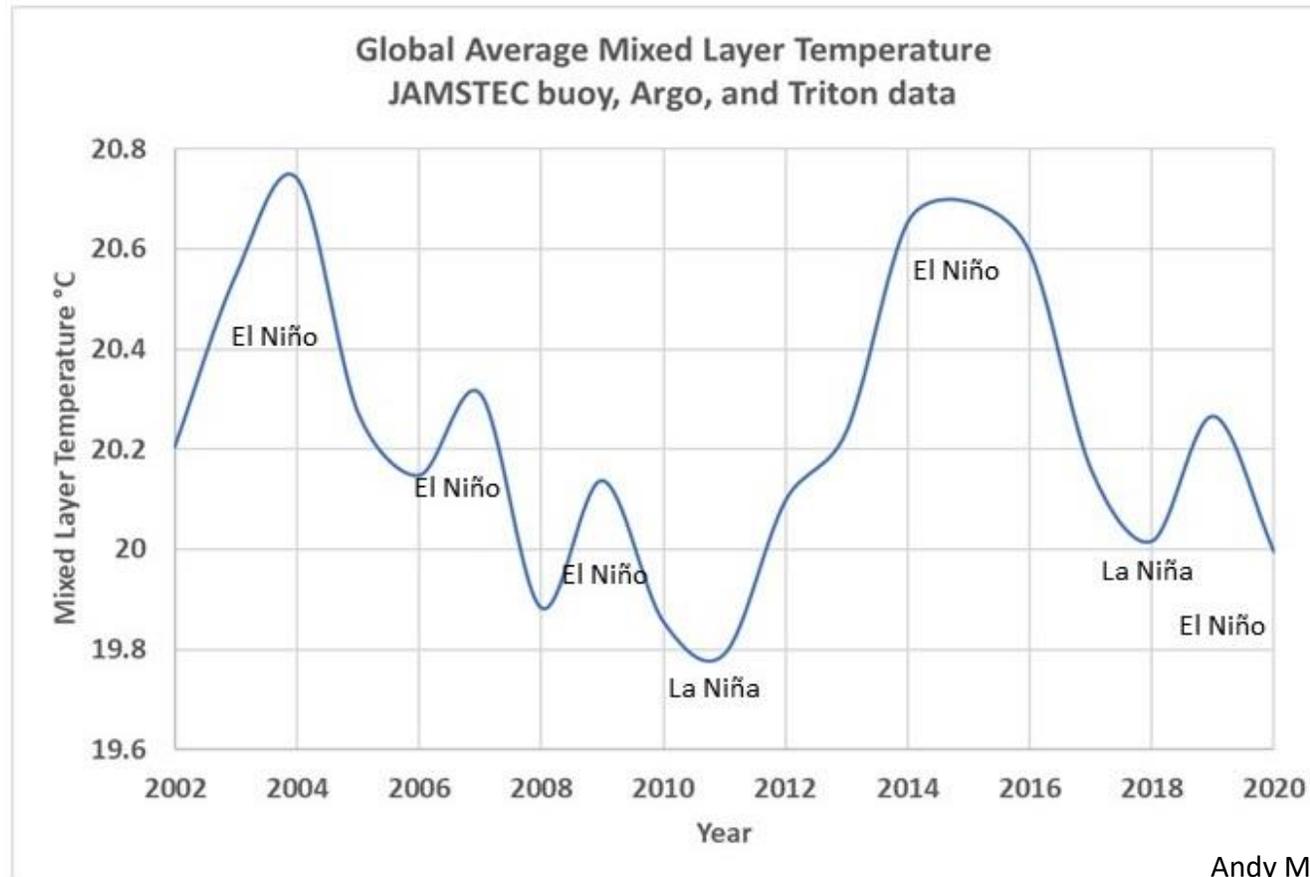
# Ocean Temperature Profile



Andy May

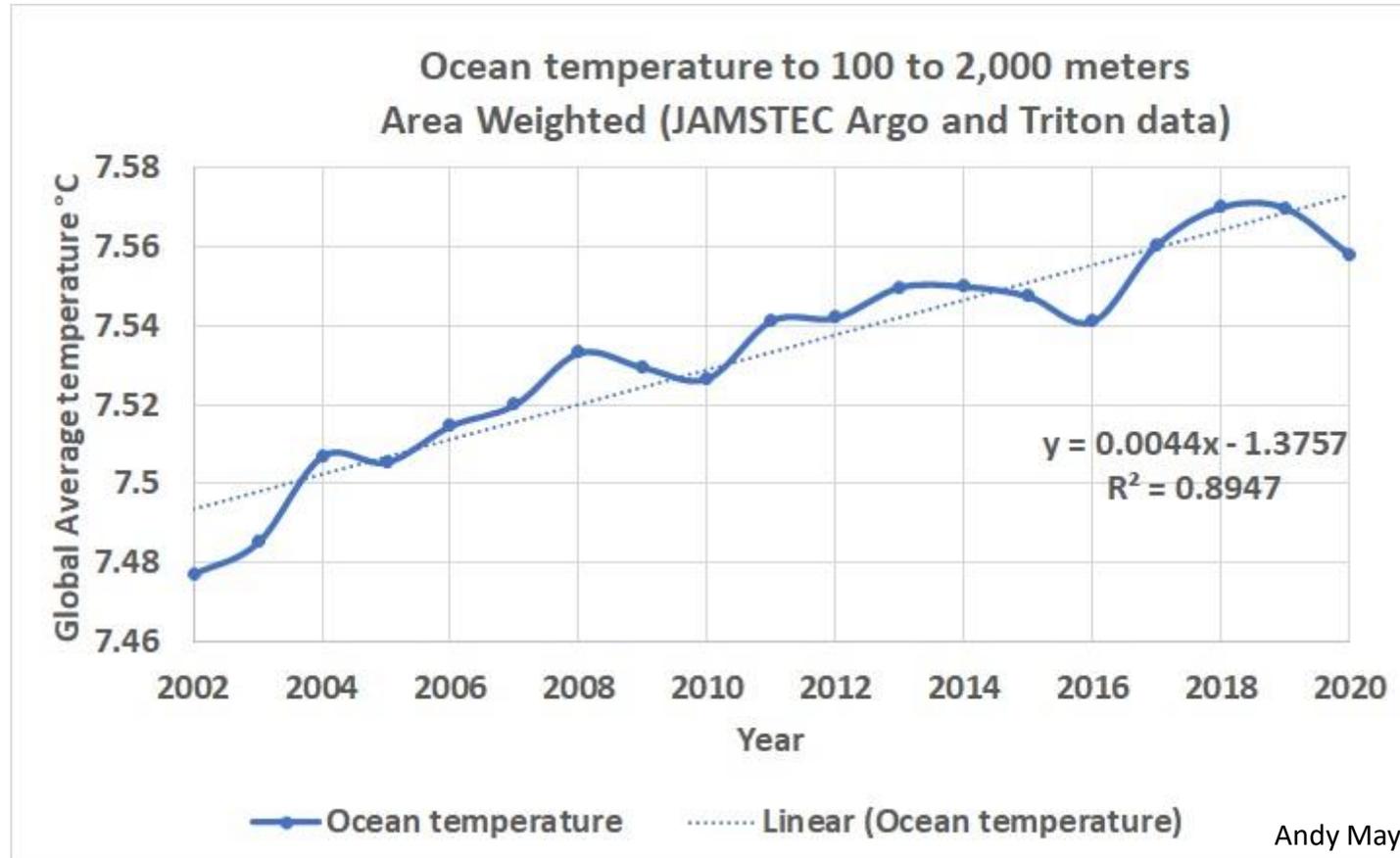
- The Ocean mixed layer is in constant communication with the surface, oceans cover 71% of the surface.
- Defined as a turbulent zone with nearly constant temperature and density (within  $\sim 0.5^{\circ}\text{C}$  of surface)
- Below the mixed layer the age of the temperature increases with depth, dependent upon ocean current speed and direction
- Model needed; it could be the best record of past ocean surface temperatures.
- Data from University of Hamburg

# Ocean Mixed Layer



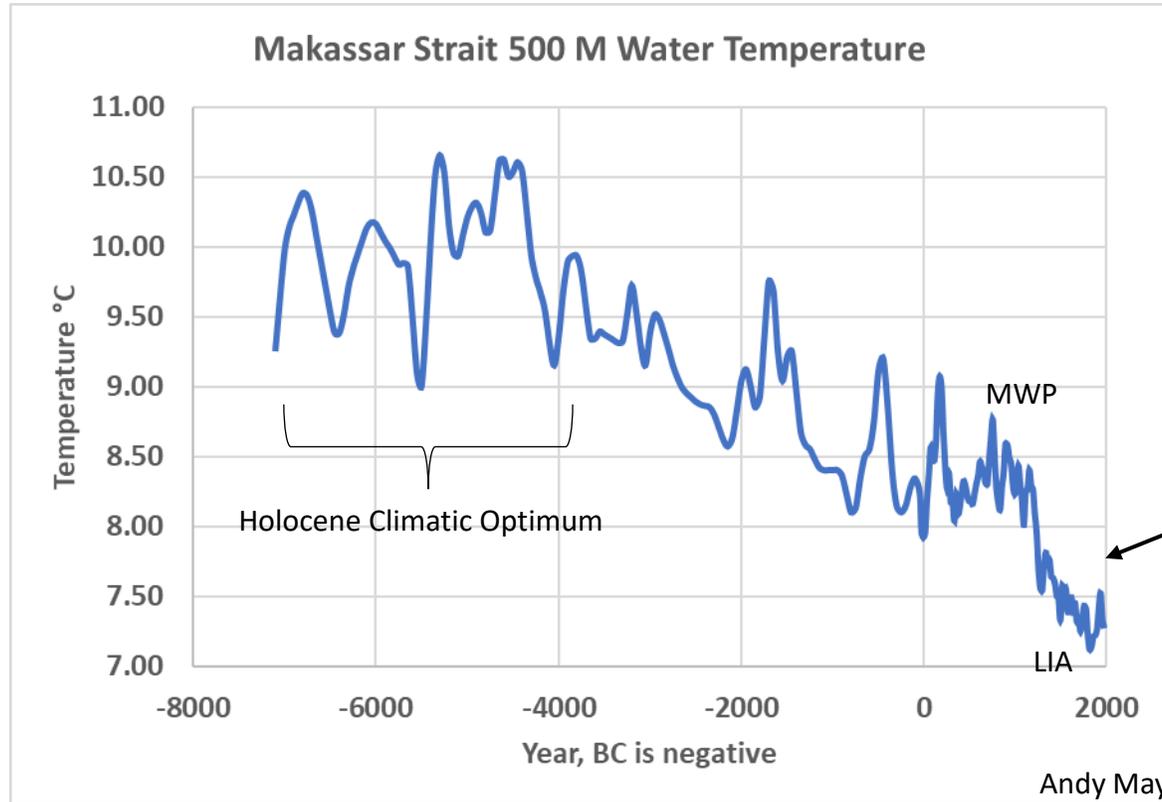
- On average, the upper 72 meters of the ocean
- 27x the heat capacity of the whole atmosphere
- Atmosphere temperature increases  $27^\circ >$  mixed layer  $1^\circ$
- Constant communication with atmosphere
- Current temperature trend is down
- Only good data from ~2005 to 2020

# The Deeper Ocean



- No ENSO events
- Little and/or slow communication with the surface
- Age of temperature increases with depth
- Temperature increase very linear
- Warming at 0.44°C/century
- Probably this warming is all natural
- Age of temperatures function of currents and depth
- Model needed

**Rosenthal, et al., 2013, *Science*, 10,000 yr. Temperature Reconstruction of 500 m water in the Makassar Strait.**



**U. Of Hamburg temperature profile, ~2004-2016**

