## Front Matter

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**A Fresh Look at the Watery Side of Earth’s Climate Shows ‘Unabated Planetary Warming’**

By ANDREW C. REVKIN FEBRUARY 2, 2015 4:05 PM

## Credits



A paper has charted a steady recent rise in ocean heat.

A fresh analysis of thousands of temperature measurements from deep-diving Argo ocean probes shows (yet again) that Earth is experiencing “unabated planetary warming” when you factor in the vast amount of greenhouse-trapped heat that ends up in the sea. This is [not even close to a new finding](http://www.climatecentral.org/news/oceans-getting-hotter-than-anybody-realized-18139), but the new study shows more precisely where most of the heat has been going since 2006 (in the Southern Ocean outside the tropics; see the red splotches in the map below).

Photo



A map shows where heat has accumulated in the world's seas since 2006, as measured by ocean-probing Argo instruments.

The study, “Unabated planetary warming and its ocean structure since 2006,” was published today in [Nature Climate Change](http://www.nature.com/nclimate/current_issue.html). [*I’ll add a direct link when there is one.*]

The paper illustrates the importance of remembering that the atmosphere and ocean surface are just a small component of the Earth’s climate system — with the ocean depths having a vast capacity to absorb and move heat on time scales ranging from years to centuries and longer.

This excerpt (my italics) explains why a recent pause in warming of sea surface temperatures (SST) can hide important deeper processes:

Global mean SST has increased by about 0.1 [degrees Celsius per] decade since 1951 but has no significant trend for the period 1998-2013. Explanations for the recent ‘pause’ in SST warming include La Niña-like cooling in the eastern equatorial Pacific, strengthening of the Pacific trade winds, and tropical latent heat anomalies together with extratropical atmospheric teleconnections. However, *it is heat gain and not SST that reflects the planetary energy imbalance and thus the warming rate of the climate system*.

Maybe it’s time to revisit a question I explored in 2008: whether [it’s better to track “global heating” (heat gain) than “global warming”](http://dotearth.blogs.nytimes.com/2008/02/18/global-heating-atmosphere-cancer-pollution-death-whats-in-a-name/)(temperature change).

Carbon Brief has posted an excellent piece by Roz Pidcock putting the new Nature Climate Change paper in broader context: “[Beneath the waves: How the deep oceans have continued to warm over the past decade](http://www.carbonbrief.org/blog/2015/02/how-the-deep-oceans-have-continued-to-warm-over-the-past-decade/).” Here’s a snippet:

Scientists are currently interested in why temperatures at the surface of the ocean have been rising [slower](http://www.climatechange2013.org/images/report/WG1AR5_SPM_FINAL.pdf) than in previous decades, even though we’re emitting greenhouse gases [faster than ever](http://www.carbonbrief.org/blog/2014/09/world-on-course-to-overshoot-two-degrees-target-study-shows/). Sea surface temperatures across the globe increased by about 0.1 degrees Celsius since 1951, but showed no significant trend between about 1998 and 2013, today’s paper notes. This raises an obvious question. If Earth is[gaining heat](http://onlinelibrary.wiley.com/doi/10.1002/2014GL060962/full), but the surface isn’t warming very much, where is the heat going instead?

**Into the deep**

Monitoring temperature change at Earth’s surface is a poor indicator of what’s happening below, says the new paper. The surface is strongly affected by natural climate fluctuations, such as [El Niño](http://www.carbonbrief.org/7874.aspx), which can temporarily speed up or slow down the pace of warming. Data collected by a network of free-floating sensors, known as [ARGO](http://www.argo.ucsd.edu/) floats,

 show that from January 2006 to December 2013, a lot more heat has been finding its way to the deep ocean instead.

The work is [also nicely described in a news release from the Scripps Institution of Oceanography](https://scripps.ucsd.edu/news/distinct-rise-global-ocean-temperatures-detected?hash=iqtzt-yElQ53QARaJXsby7VajaNBuqYNy4-M_IPhc5Q), the home base for the lead researcher, Dean Roemmich. Here’s an excerpt, followed by some input (including criticism) I got from other scientists focused on the interplay of the ocean and atmosphere:

Researchers…found that the top 2,000 meters (6,500 feet) of the world’s oceans warmed at a rate of 0.4 to 0.6 watts per square meter (W/m 2 [SQUARE?? –FNC]) between 2006 and 2013. The rate translates to a warming of roughly 0.005° C (0.009° F) per year in the top 500 meters of ocean and 0.002° C (0.0036° F) per year at depths between 500 and 2,000 meters. For perspective, Roemmich noted that the heat gain was the equivalent of adding the heat of two trillion continuously burning 100-watt light bulbs to the world’s oceans.

“The rate of ocean heat gain during the past eight years is not unusual – indeed many studies of ocean data over the past 50 years and longer have produced similar rates. What is new is that the rate and patterns of ocean heat gain are revealed over a period as short as eight years, thanks to the Argo array, that the warming signal is shown to extend to 2,000 meters and deeper, and that it is occurring predominantly in the Southern Hemisphere ocean south of 20° S,” said Roemmich.

“When we measure globally and deep enough, we see a steady rise in the earth’s heat content, consistent with the expected greenhouse gas-driven imbalance in our planet’s radiation budget,” said study co-author Susan Wijffels of Australian research agency the Commonwealth Scientific and Industrial Research Organization (CSIRO).

The study puts a widely reported “hiatus” in global surface air temperatures since 1998 into context. Roemmich said the study illustrates that the hiatus in warming of the sea surface and the lower atmosphere is not representative of the steady, continuing heat gain by the climate system. Scientists measure that heat gain in terms of increasing temperature averaged over the water column.

In an email chat, Yair Rosenthal of Rutgers University and Braddock Linsley of Columbia University, whose [related work was explored here](http://dotearth.blogs.nytimes.com/2013/10/31/10000-year-study-finds-oceans-warming-fast-but-from-a-cool-baseline/) in 2013, said the Argo analysis appeared to support their view that giant subtropical [gyres](http://www.whoi.edu/main/topic/currents--gyres-eddies) are the place where heat carried on currents from the tropics descends into the deeper ocean.

Linlsey said: “I think the Argo data point to the central gyre regions as key to the ocean-atmosphere heat exchange story.”

Rosenthal noted that this heat-banking process could buy humanity time, providing what he has called “[a thermal buffer for global climate change](http://rosenthal.marine.rutgers.edu/index.php/holocene-climate-variability-ocean-heat-content-role-in-past-climate-change),” particularly because the deeper ocean layers are still relatively cool (compared to much of the Holocene period since the end of the last ice age).

But, he added, the oceanic heating will have consequences, as well:

For heat, as with CO2 (where the ocean is the largest reservoir), increasing ocean heat content may have a price in the future (see ocean acidification with respect to CO2). Heat can change ocean dynamics and eventually will increase glacial melting, which is mainly responding to subsurface water rather than air warming. For years we though we can bury CO2 in the ocean and all will be well. I tend to think for the reasons we discuss last year that the large heat content provides us with a buffer, but it also has its own limitations.

In an email exchange, Kevin Trenberth of the National Center for Atmospheric Research said he was concerned that the analysis, limited to data from the relatively sparse array of Argo devices, was missing large areas of the seas that other studies, including his own, have identified as significant. As a result, he said, “their estimates look low-balled”. Here’s more from Trenberth:

It is disappointing that they do not use our stuff (based on ocean reanalysis with a comprehensive model that inputs everything from SST, sea level, XBTs and Argo plus surface fluxes and winds) or that from Karina von Schuckmann. [*Trenbert pointed me to two studies,*[*here*](http://www.cgd.ucar.edu/cas/Trenberth/website-archive/trenberth.papers-moved/Balmaseda_Trenberth_Kallen_grl_13.pdf)*and*[*here*](http://www.cgd.ucar.edu/staff/trenbert/trenberth.papers/T_F_B_energyImb_JCLI_14.pdf).]

From Karina (2014 Ocean Sciences p 547) : “Our findings show that the area around the Tropical Asian Archipelago (TAA) is important to closing the global sea level budget on interannual to decadal timescales, pointing out that the steric estimate from Argo is biased low, as the current mapping methods are insufficient to recover the steric signal in the TAA region.” [[*Here’s the von Schuckmann paper*](http://archimer.ifremer.fr/doc/00202/31365/29753.pdf).]

It is a nice paper but sad that oceanographers are slow to utilize all of the available information to produce better estimates.  They seem to take pride in… “exclusive use of Argo” data with no use of anything else, including sea level. SSTs are mentioned in Fig. 1 but then it is not clear what areas are included.  So there are issues of the areas not included and they assume the 17 percent of the ocean not sampled warms at the same rate, but in fact the Arctic and Indonesian regions are warming much faster, but at least they did include something.  The other issue, which they touch on is the short record and the dominance of interannual fluctuations in the upper ocean that are not trends.

For more perspectives on related questions, click back to RealClimate’s 2013 post, “[What ocean heating reveals about global warming](http://www.realclimate.org/index.php/archives/2013/09/what-ocean-heating-reveals-about-global-warming/),” and also this 2010 post from climate scientist Roger Pielke, Sr.: “[A Short Explanation Of Why The Monitoring Of Global Average Ocean Heat Content Is The Appropriate Metric to Assess Global Warming](https://pielkeclimatesci.wordpress.com/2010/09/12/a-short-explanantion-of-why-the-monitoring-of-global-average-ocean-heat-content-is-the-appropriate-metric-to-assess-global-warming-2/).”

## Comments

### Kurt in Switzerland

 is a trusted commenter Switzerland [3 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14023165)

Very exciting stuff.

Rather than attempt to project what the data means for life on earth over the coming century from the outset, perhaps it is worthwhile to analyze what the data shows for the present time period (realizing we only have reasonably good data from 2003 and from the top 2000 m depth):

Bob Tisdale has some observations:[https://bobtisdale.wordpress.com/2015/01/22/nodc-data-continues-to-indic...](https://bobtisdale.wordpress.com/2015/01/22/nodc-data-continues-to-indicate-the-deep-oceans-are-warming-in-some-basins-but-not-others/)
- Indian and S. Atlantic trends approx. 0.7 deg C / CENTURY.
- No. Atlantic & Pacific trends approx. 0.1 deg C / CENTURY

Without knowing what happened during the latter part of the past century (let alone what is happening BELOW 2000 m), I don't see how we can predict what will transpire for the "ocean surface" or the first 2000m depth (or deeper) during the coming decade or thereafter.

Do we have a good quantitative understanding of how this additional heat will affect atmospheric temperatures over the coming decade?

I think the science of predicting future temperatures (ocean or atmosphere) is still in its infancy.

We're only measuring the "top half" even though the term "deep ocean" is being used.

Kurt in Switzerland



### Kip Hansen

 is a trusted commenter On the move, Stateside USA [3 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14023048)

Andy, please ask your sea temp experts what the accuracy of measurement is for Argo floats -- and to express their final assessment of the original measurement error (or, if they prefer, maximum measurement accuracy).

If Professor Dean Roemmich is reading here, I ask this question:

What is the Uncertainty Range for your reported metric?

I believe they are promoting a result that is much more precise than the original accuracy -- which is scientifically invalid in any other field of science.

The Met Office UK, as you know, acknowledged that Global Average Surface Temperature over Land and Sea (using HADCRUT4) can only be measured to an accuracy of +/- 0.1°C -- meaning that data with differences smaller than that can not be said to be different.

With an ARGO data set less than 10 years long, and with very spotty sampling (and without any way of recalibrating sensors, etc) their Uncertainty Range almost certainly must be greater than the HADCRUT4 Uncertainty Range. Thus, differences stated in thousandths of a degree C can be expected to fall within the Uncertainty Range for the metric.

Kennedy et al -- "Reassessing biases and other uncertain ties in sea-surface temp erature observ ations measured in situ since 1850, part 2: biases and homogenisation", which is used to define uncertainty for the HADCRUT4 sea surface element, shows an uncertainty range at ~0.15°C for this well document and long term data set.

* Reply

* 4Recommend



### Kip Hansen

 is a trusted commenter On the move, Stateside USA [3 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14023048:14023113)

The link for the paper above is:[http://www.metoffice.gov.uk/hadobs/hadsst3/part\_2\_figinline.pdf](http://www.metoffice.gov.uk/hadobs/hadsst3/part_2_figinline.pdf%22%20%5Co%20%22http%3A//www.metoffice.gov.uk/hadobs/hadsst3/part_2_figinline.pdf%22%20%5Ct%20%22_blank)

* Reply

* 4Recommend



### Kurt in Switzerland

 is a trusted commenter Switzerland [2 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14023048:14023533)

Kip,

Good questions. I'd be willing to bet the raw data is extremely messy (seasonal and weather-driven patterns must be tough to filter out). Even if one can state a trend over this short period, it is difficult to say what this means relative to "typical" decadal, century or millennial trends. (Is it faster, slower or about the same as prior?).

Saying "This explains the lack of observed air temperature warming" sounds like wishful thinking.

The deepest oceans (everything BELOW 2,000 m, approx. the same volume as that ABOVE 2000 m) would have even MORE "heat buffering capacity" than the top 2000 m. We have very little baseline understanding (quantitative) of the deep oceans.

Kurt in Switzerland

SEE ALL REPLIES



### Mike Roddy

 is a trusted commenter Yucca Valley, Ca [3 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14022340)

Calling Anthony Watts. We need him to check the underwater thermometers, so he can reassure Adrian, Kip, etc.

* 4Recommend



### Kurt in Switzerland

 is a trusted commenter Switzerland [2 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14022340:14023356)

That's cute Mike.
Good to see you have a sense of humor. Got any scuba gear?

### Adrian O

 State College, PA [7 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14015565)

THE ETERNAL STIMULUS OF THE GREEN MIND
(aka oozles of green cash)
"your publications on warming, climate change, and ways of coping"

Do you have publications on how it's sunny during the day and dark during the night and on ways of coping?
Is there any urgent need for them?
(HINT. Typical ways of coping:
sunshades during the day and streetlights at night)

It's the same with the current warming. It's a garden variety, of the most common kind, our glaciers records show.

Some, OK, not some but a lot of people are trying to squeeze trillions out of it all, mostly from the very poor, in a giant scam. Promising to "do something about it". Don't ask what they hope to achieve, or you'll be vetoed out.

Politicians especially are fond of it, because it provides tens to hundreds of billions a year in disposable funds.

To be used without any question on helping political friends, with a few billions each, save the Earth. The ultimate legal slush fund: a kind of eternal stimulus of the green mind.
\*\*\*\*

Third rate scientists love it because it provides a generously funded outlet for them.

One in which those annoying classmate nerds who always got predictions right are for once kicked in their behind and thrown face down in the dust as deniers.

Climate is for the consensus fellows!
\*\*\*\*

The way to cope with it all is to make sure that all these fellows aren't given the chance to grab that money with their stretched dirty green hands. And save the world from them.



### Michael Berndtson

 Berwyn, IL [6 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14015565:14019240)

Hey Adrian O., let me help you off your soapbox. (Man, you must have gotten jilted by a climate scientists in grad school of something. Maybe it was months apart while she was doing fieldwork in the Antarctic. You were left alone pining in the student office back at university solving math problems. It was the sea captain, wasn't it?)

Here's the website for the Argo floats. It's a pretty established area of study and just one more piece to the puzzle.
<http://floats.pmel.noaa.gov/>

and a very interesting website from UC San Diego:
<http://www-argo.ucsd.edu/>



### J.C. Clark

 San Francisco [7 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14015593)

Thanks for the article. With all the focus on surface temperatures, the oceans are little talked about in comparison, yet are absorbing large amounts of heat that will come back to bite us in a number of ways (ocean acidification and a possible break in the food chain; extinction of most forms of sea life, plankton, coral reefs; release of large amounts of frozen carbon and methane into the atmosphere that will fuel heavy future warming on top of emissions, loss of the Earth's albedo...; melting of the major ice sheets and rising sea levels; release of heat into the atmosphere...). This is something that needs to be a part of the regular dialogue on climate change with the public and needs to fuel a rapid call to action by governments and Congress here in the states, as they can change things much faster than the rest of us.

### Adrian O

 State College, PA [7 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14015801)

HAUNTING US, AND THE SECOND LAW

Is this supposed to be a kind of Rorschach test?
<http://en.wikipedia.org/wiki/Rorschach_test>

The warmer and colder on the map are as balanced as anything you'll ever get in nature.

Now stand back by the fireplace with a good brandy and wait for the hysterical reactions - the heat, which we cannot find, is going to come to haunt us from deep down there.

To haunt us when we least expect it, jumping at us from the ocean into the air, over the dead body of thermodynamics. Which, when alive, makes such a jump impossible.

[He’s noting that the heat will not jump from the oceans to the air if the air is hotter! –FNC]

The missing heat will jump out and haunt us. As the greatest mind in climate science ever - and I don't mean here your nephew who said "Look, auntie! It snows a lot again, like every year!," but none other than the magnificent Kevin Trenberth - as he exclaimed in one of his unexplained bursts of semi honesty. [In .. the last 5 years, there’s a discrepancy ….]
<https://www.youtube.com/watch?v=868nr1Pgxw0>

PS And by the way, what did YOU do today
to have those green temperature valleys be exalted and the yellow temperature mountains and hills made low, the crooked graphs made straight, and their rough places plain, as Handel put it so well?
<https://www.youtube.com/watch?v=7NCO6UzZ2R8>

### Adrian O

 State College, PA [7 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14016188)

OVERBOILING MINDS
Andy,

Your link to Nature Climate Change contains the greatest perennial paper ever, with more lives than a whole herd of cats, if cats would ever let themselves be herded.

This time with 43 (that is forty three, I counted them) authors. Which of them was "the brains"? We'll never know, in the mist and midst of 1/20 billion in grants.

It is titled as usual “Rising temperatures reduce global wheat production“
<http://www.nature.com/nclimate/journal/v5/n2/full/nclimate2470.html>

and is based on the foundational premise that ALL farmers around the world are gross imbeciles.

That they are as idiotic as the climate scientists who write such papers.

And would NOT change the variety of wheat planted to an adequate one if it warms. Especially since warmer weather varieties have typically greater yields.

Would the California Central Valley (where it's pretty hot, to put it mildly) be one of those world famine places, according to these amazing scientists?
(A: check where the food in your fridge comes from.)

Would a few hundred thousand billions spent, would they bring the climate back to the wheat variety, if the wheat variety isn't changed to the climate?

### Inspector Clouseau

 Palo Alto [7 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14016191)

The Roemmich et al. paper is another variation on a now very old theme ~ torture the data until it screams out what the CO2mageddon faithful desperately wish to hear.

[http://hockeyschtick.blogspot.com/2015/02/new-paper-finds-oceans-warming...](http://hockeyschtick.blogspot.com/2015/02/new-paper-finds-oceans-warming-only.html)

### Adrian O

 State College, PA [7 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14016310)

LO AND BEHOLD
Andy's posts are only apparently random.

Today's deep ocean post answers a previous post, on why the pope is all of a sudden interested in climate.

A reason is that in this day and age it's really hard to find a good miracle.

It's hard to find miracles, that is, unless you look at the oceans.

Where the missing heat is said to have hidden after 2000, when the atmospheric warming stopped, in spite of a huge emissions increase.

And, miraculously, as you see in the graphs in figures 1 and 2 of
<http://www.pas.rochester.edu/~douglass/papers/DK_reply_PLA_2012.pdf>

miraculously all that missing heat up here, once it reached down there made the warming slope SMALLER than it was before.

As you can see.

Climate science has one such miracle waiting for us around every corner.



### Susan Anderson

 is a trusted commenter Boston [5 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14016310:14020173)

Lo and behold, we are in

dot.adrianO

again, with caps and specious OT arguments, disregarding the substance of Andy's thorough and intelligent coverage, what a surprise!

Why not start your own blog to hold court with your disciples. It's not fair to Andy to carpet his comment sections with hogwash.

* Reply

* 9Recommend

### Dale R. McIntyre, PhD

 is a trusted commenter Bartlesville, Oklahoma [17 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14015282)

Dear Andy,

This sentence struck a chord with me:

"The rate [of oceanic warming] translates to a warming of roughly 0.005 [degrees]C (0.009 [degrees]F) per year in the top 500 meters of the ocean..."

That is 0.5 degrees C per century.

Anyone trying to pass that off as a world-shattering catastrophe is going to have to tell some very tall tales indeed.

As they say in the South, that dog just won't hunt.



### J.C. Clark

 San Francisco [7 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14015282:14015809)

National Oceanic and Atmospheric Administration (NOAA): Biological Impacts of Ocean Acidification
[http://www.pmel.noaa.gov/co2/story/What+is+Ocean+Acidification%3F](http://www.pmel.noaa.gov/co2/story/What%2Bis%2BOcean%2BAcidification%3F)

"Ocean acidification is expected to impact ocean species to varying degrees. Photosynthetic algae and seagrasses may benefit from higher CO2 conditions in the ocean, as they require CO2 to live just like plants on land. On the other hand, studies have shown that a more acidic environment has a dramatic effect on some calcifying species, including oysters, clams, sea urchins, shallow water corals, deep sea corals, and calcareous plankton. When shelled organisms are at risk, the entire food web may also be at risk. Today, more than a billion people worldwide rely on food from the ocean as their primary source of protein. Many jobs and economies in the U.S. and around the world depend on the fish and shellfish in our oceans."

Scientific American: Coral Clues Hint at Looming Global Warming Spike
[http://www.scientificamerican.com/article/coral-clues-hint-at-looming-gl...](http://www.scientificamerican.com/article/coral-clues-hint-at-looming-global-warming-spike/)

"The Pacific Ocean can belch heat back into the atmosphere depending on the winds, a new record written in coral shows

Linsley said the new results were “exciting,” suggesting that the “poorly understood, rapid rise” in surface temperature from 1910 to 1940 was, in part, “related to changes in trade wind strength and heat release from the upper water column” of the Pacific Ocean."

### Robert

 Out West [7 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14015282:14016373)

They also say "can't find his, ah, hip pocket with both hands and a hunting dog," for situations in which somebody a) didn't bother to read the whole article, b) didn't notice that that is one part of the water column, c) didn't notice that Trenbearth et al suggest that that's probably a lowball figure, d) didn't bother to pay attention to hiw much added heat energy is involved, e) didn't bother to notice that their own claim is no warming at all.

SEE ALL REPLIES

### Paul Klemencic

 Portland, Oregon [17 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14014451)

Global heating instead of global warming - Exactly!

Examine heat and energy balances first, before drawing conclusions based only on surface temperatures. Climate models are [Should be.] energy models, so an energy balance is the first step to evaluate model output. Thats why RPielke Sr concluded that ocean heat uptake ruled (unfortunately he extrapolated a short-term trend from '08 to 2010 to underestimate SLR and ocean heat).

Trenberth pushed this issue, with his relevant on-target comment about "... not being able to account for the missing heat ..." in one email, taken out-of-context by the fringe.

It doesn't take long to calculate that relatively small areas of downwelling can transport a significant amount of heat into the deep. Important downwelling zones could be missed, even by an extensive Argo network.

Fortunately SLR provides another estimate of global heating. SLR is primarily due to steric expansion + land based ice melt. The GRACE satellites, "Tom and Jerry", chase each other around the world measuring gravity, and can estimate ice melt; they can even tell us when water "stacks up" on a continent like Australia. Factoring out ice melt, indicates the energy imbalance is 60-80% what the models show (with large uncertainty). But due to SLR, we can be reasonably be certain the imbalance at not less than 50% of model results.. [SLR sounds interesting!]

More GRACE and SLR data, with ARGO data reduces uncertainty, but we know that Earth heated every year except one in the last 25.

### Doug

 Massachusetts [17 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14014989)

Uncertainties in ocean heat content are very large, and there is no particularly convincing evidence that the ‘missing heat’ is hiding in the ocean.

Raw ARGO-based temperature data don’t evidence much warming. The Argo data have to be ‘adjusted' to show anything more than minimal warming.

Additionally, the recent JPL study found deep ocean cooling

from 2005 to 2013, or since we’ve begun to get somewhat reliable data on ocean temperatures.

As for the ‘adjustments’ made to the raw ARGO data, the adjustments change not the model/theory to better comport with the data (the way science normally proceeds and works), but instead change the data to better comport with the model/theory:

[http://joannenova.com.au/2014/10/missing-heat-not-in-deep-oceans-but-fou...](http://joannenova.com.au/2014/10/missing-heat-not-in-deep-oceans-but-found-in-missing-data-in-upper-ocean/)

“Missing heat not in deep oceans but “found” in missing data in upper ocean instead”

* 9Recommend

### Robert

 Out West [7 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14014989:14016389)

Shockingly, Jo Nova a) isn't her real name, b) has no education in any of the sciences concerning warming, c) has a BS degree only, d) has pimarily worked as a children's show host, e) is directly affiliated with the Heartland Institute.

Oh, and has never even one serious scientific paper in any field.

yeah, let's all give up and run over to her side.

* 9Recommend



### Susan Anderson

 is a trusted commenter Boston [4 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14014989:14021643)

[Now, a vigorous ad hominem attack! –FNC] Given the number of people taken in by these arguments, here's some background: Joanne Nova is known to be a source of false PR against the overwhelming conclusions of top experts in the field. As is often the case, the trail also includes money from big fossil:

Bachelor's degree in microbiology, graduate certification in science communication.

Does a lot of work for Heartland.

"After graduation, Nova joined the Shell Questacon Science Circus, a Shell-sponsored program that employs university students to travel around Australia teaching interactive science programs to children. Currently, Nova works as a professional speaker, the Director of Science Speak, and the writer and creator of the blog, JoNova.

"Science Speak is a business Nova runs with fellow climate change skeptic David Evans. It describes itself as a “scientific modeling and mathematical research company,” that also “speak[s] about some science issues.” The website appears dedicated to the issue of global warming, yet doesn't appear to provide any examples of current projects or areas of research.

"Furthermore, Science Speak does not accredit Nova with any of its research in the area of global warming."

More at:
<http://www.desmogblog.com/joanne-nova>

Sourcewatch is another good resource:
<http://www.sourcewatch.org/index.php?title=Joanne_Nova>

The PC aversion to SkepticalScience is carefully promoted because SkS does such a good job of revealing falsehood.

* 4Recommend



### Susan Anderson

 is a trusted commenter Boston [19 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14014441)

Interesting.

I recommend reading the whole and all the links. There is a bias understating the case, which is reiterated by the several professional papers linked here. Roger Pielke Sr.'s repost in 2010 of his mild comments from 2008 is a response to the egregious WUWT and others bent on discrediting the vast majority of credible science; Pielke Sr.is hardly a radical (his son, however, does substitute politics for substance on a regular basis, and serves as a resource for our Republican anti-science legislature).

However, while it is good to note that the oceans are large and capable of absorbing some of our excess heat to moderate the continuing impacts of our emissions of heat-trapping greenhouse gases, this is, as also noted by the experts cited, not something that allows us to hide our eyes from the ongoing warming. Ultimately, warming the deep oceans stores the impact in a more durable form, which eventually will be without respite.

The use of the word pause in this context is just wrong. The implication that once a planetary budget accounts properly for all the heat that well established physics has told us is building up, there is still some excuse to claim a pause is not legitimate.

I repeat: the experts cited all state that Argo is a limited resource and result in understating available information.

Meanwhile, in the northeast we are suffering from of a very warm ocean (4-6 C anomaly) meeting a very cold arctic exhalation. Planetary heating has consequences.

* 13Recommend



### Susan Anderson

 is a trusted commenter Boston [19 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14014441:14014526)

Misleading grammar, bad susan: The experts cited suggest that using only Argo floats leads to understating the problem. Please take a look at \*all\* the links. There's a lot of information there. We don't need more data, we need less disinformation willing to exploit anything and everything to mislead.

* 7Recommend

### Adrian O

 State College, PA [7 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14014441:14015939)

"We don't need more data"

Data is ALWAYS in the way of action.
Which makes
"We don't need to check it"
the greatest among all last words.

* 3Recommend

SEE ALL REPLIES



### Michael Berndtson

 Berwyn, IL [19 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14013307)

An easy answer to a difficult question is more Argo floats. I listen to NPR too much. It seems like foundations are becoming the major funder of programming lately. Usually stating an interest in education, environment and climate change. Why not pool all that nonprofit money, take a smidgen from the $2 trillion in corporate profits being offshored, and buy some more floats for NASA and NOAA. Instead of say funding "All Things Considered." It really seems so much more can be learned from this type of data. I'm really interested in learning more about this work, so more Dot Earth posts on it please. There couldn't be a "tech" more important than remote monitoring of the oceans along the x, y and z axes. Makes all that R&D on the smartwatch seem silly.

* 4Recommend

### Lee Harrison

 Albany [19 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14013683)

It's worth remembering why the mean global surface temperature was "selected" as the metric for "global warming" -- it was the perception that it was the only number the world's public would care about and see as "fair."

The mean global surface temperature is dominated by the tropics (where AGW is least) and dominated by the ocean. It isn't the best metric to detect global warming (high latitude temperatures and night-time temperatures both provide more robust signatures.)

Using the heat content of the oceans as a public measure is sure to draw the response "who cares about 0.1 °C in the oceans?"

And explaining to people who have their ears nailed firmly shut why they should won't work.

* 4Recommend

### Lee Harrison

 Albany [7 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14013683:14015402)

Dale -- go back and find what I said verbatim and we will talk about it.

Yes of course the oceans are a thermal buffer. But no, the parts of the earth that human beings actually live on are warming by reasonable fractions of a degree C per decade, faster than the rate over the globe as a whole. And if that continues for a century ... ugly things happen to the carrying capacity of the planet. [Here we see again that we cannot eve agree on the definition of ‘Climate’: (Global or ‘the parts of the earth that human beings actually live on; -FNC]

The simple point of the matter is that it sounds as if you really don't care what happens a century from now -- that's never-never land to you?

* 4Recommend

### Robert

 Out West [7 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14013683:14016395)

Dear, does a buffer of any sort work by not changing at all, or does a buffer work by sopping up some of the added energy dumped into it.

* 2Recommend

SEE ALL REPLIES

### Chris Dudley

 Maryland [19 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14014154)

It is too bad that Pielke's stuff turns up like a bad penny here. That kind of thing was recently shot down along with David Victor and Charles Kennel's regurgitation.[http://www.realclimate.org/index.php/archives/2014/10/ocean-heat-storage...](http://www.realclimate.org/index.php/archives/2014/10/ocean-heat-storage-a-particularly-lousy-policy-target)

* 8Recommend



### Susan Anderson

 is a trusted commenter Boston [5 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14014154:14020034)

hi Chris,

Please note there is a big difference between Pielke Sr. and Pielke Jr. RPSr is not unreasonable. As you say, RealClimate is, as always, one of the most credible, reasonable, science based resource for this kind of issue for those who care about reality and are not blinded by prejudice against anything they don't want to understand.

* Reply

* 2Recommend

NYT Pick

### Andrew Revkin

 undefined [19 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14014399)

Professor Dean Roemmich, the leader of the study, pushed back on my assertion that the term global heating (heat gain) seemed preferable to global warming (rising surface temperatures), saying:

"I wouldn't say it's 'better' to track heat gain than to track surface temperature. They are simply two different physical quantities, each with its importance. Sea surface temperature sets the temperature of the base of the atmosphere, where we live. Ocean heat gain is the yardstick for energy imbalance in the climate system."

* Flag

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### Paul Klemencic

 Portland, Oregon [17 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14014399:14014629)

Speaking as a chemical (process) engineer, we have a discipline that we stick to... Close the energy (heat) and mass balance first. Until the energy balance is complete, we could have major errors in the process calculations.

Andy, if you could ever get the scientists to speak out about this, they might admit the biggest discrepancies between the climate models and observations. Here is my list:

1. According to papers published by scientists like Trenberth, the global heating rate was expected to range from 80-120 x 10^23 joules... but SLR and Argo data point to about 60-100 x 10^23 j. So far, the models seem about 20% high.

2. The deep oceans are taking up more heat than expected.

3. The models underestimated Arctic amplification, with ice loss and permafrost melting occurring much more rapidly that expected.

4. The models haven't done a good job of estimating NH mid-latitude temperatures, especially seasonal trends. Winter temperature anomalies aren't increasing as fast as expected, although spring, summer, and fall temperatures are rising as expected (the paper by Judah Cohen, often quoted here). Elsewhere on the surface of the globe, temperatures are rising mostly as expected. As a result, NH mid-latitudes (e.g. lower 48 USA) hasn't experienced the relatively faster warming of winters to summers that the models projected.

So it seems that models roughly estimated global heating rate, but have missed the distribution of heat in the NH and deep oceans.

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### Paul Klemencic

 Portland, Oregon [7 hours ago](http://dotearth.blogs.nytimes.com/2015/02/02/a-fresh-look-at-the-watery-side-of-earths-climate-shows-unabated-planetary-warming/#permid=14014399:14015300)

... and of course, I make a mistake with the numbers when I write a comment too fast. Global heating rates are about 60-100 x 10^20 joule, not 10^23 joules. At one time, estimates as high as 0.9 w/sq meter imbalance (145 x 100^20 j) were discussed.

If we use a base of 100 (x 10^20 j), we can easily compare energy/heat flows. For perspective all the energy released (including waste or exhaust heat) from burning fossil fuels is 25 compared to the base of 100. Or the amount of heat that heats the land/surface atmosphere is about 2; melting ice (both ice sheets and Arctic) is about 3.

Clearly, ocean heat uptake is the elephant in the room.

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