

Science AMA Series: We're NOAA and NASA scientists on the Jason-3 satellite mission set to launch January 17, used to observe global sea surface height, AUA!

NASAEarthRightNow ¹ and r/Science AMAs¹

¹Affiliation not available

April 17, 2023

[REDDIT](#)

Science AMA Series: We're NOAA and NASA scientists on the Jason-3 satellite mission set to launch January 17, used to observe global sea surface height, AUA!

NASAEARTHRIGHTNOW [R/SCIENCE](#)

[removed]

[READ REVIEWS](#)

[WRITE A REVIEW](#)

CORRESPONDENCE:

DATE RECEIVED:
January 06, 2016

DOI:
10.15200/winn.145199.97405

ARCHIVED:
January 05, 2016

CITATION:
NASAEarthRightNow ,
r/Science , Science AMA
Series: We're NOAA and NASA
scientists on the Jason-3
satellite mission set to launch
January 17, used to observe
global sea surface height,
AUA!, *The Winnower*
3:e145199.97405 , 2016 , DOI:
[10.15200/winn.145199.97405](#)

© et al. This article is
distributed under the terms of
the [Creative Commons
Attribution 4.0 International
License](#), which permits
unrestricted use, distribution,
and redistribution in any
medium, provided that the
original author and source are
credited.



Hi! I have a bunch of questions if you don't mind!

1. SpaceX's Falcon 9 rocket, which'll carry Jason-3 to orbit on the 17th, was grounded for six months after a launch failure in June. In addition, prior to the rocket's grounding, the launch date had slipped from March to August of last year due to F9 certification issues. Overall, Jason-3 is launching 10 months later than originally planned. How did this delay impact (a) the satellite construction & integration process, (b) overall spacecraft costs, and (c) the mission's scientific goals?
2. What is the precise mass of Jason-3 (to the nearest kg, preferably)? Some sources have it at 510kg, others at 560kg, others at 600kg? It'd be great if you could specify dry vs. wet mass.
3. Are you able to disclose the target injection orbit? Although CNES describes a [1336 km, 66° operational orbit](#), is the injection orbit (that the rocket delivers the spacecraft directly into) the same? Or does the spacecraft itself do any of the insertion work using onboard propellant?
4. How much commonality is there between the three Jason spacecraft? Externally they appear very similar, since they're all based off the same bus ([Jason-1, 2, 3](#)), but how are the instruments and other systems different?
5. As somebody who's planning on being at Vandenberg for the launch, do any team members have recommended viewing spots?

[stratohornet](#)

- 2) The dry mass is about 500 kg, and the wet mass is about 525kg. -ClimateElvis

Hi! I have a bunch of questions if you don't mind!

1. SpaceX's Falcon 9 rocket, which'll carry Jason-3 to orbit on the 17th, was grounded for six months after a launch failure in June. In addition, prior to the rocket's grounding, the launch date had slipped from March to August of last year due to F9 certification issues. Overall, Jason-3 is launching 10 months later than originally planned. How did this delay impact (a) the satellite construction & integration process, (b) overall spacecraft costs, and (c) the mission's scientific goals?
2. What is the precise mass of Jason-3 (to the nearest kg, preferably)? Some sources have it at 510kg, others at 560kg, others at 600kg? It'd be great if you could specify dry vs. wet mass.
3. Are you able to disclose the target injection orbit? Although CNES describes a [1336 km, 66° operational orbit](#), is the injection orbit (that the rocket delivers the spacecraft directly into) the same? Or does the spacecraft itself do any of the insertion work using onboard propellant?
4. How much commonality is there between the three Jason spacecraft? Externally they appear very similar, since they're all based off the same bus ([Jason-1, 2, 3](#)), but how are the instruments and other systems different?
5. As somebody who's planning on being at Vandenberg for the launch, do any team members have recommended viewing spots?

[stratohornet](#)

3) The injection orbit is actually 1326 km, 10 km below the target, and the spacecraft itself maneuvers in the the final 1336 km orbit over the course of a few weeks. -ClimateElvis

Hi! I have a bunch of questions if you don't mind!

1. SpaceX's Falcon 9 rocket, which'll carry Jason-3 to orbit on the 17th, was grounded for six months after a launch failure in June. In addition, prior to the rocket's grounding, the launch date had slipped from March to August of last year due to F9 certification issues. Overall, Jason-3 is launching 10 months later than originally planned. How did this delay impact (a) the satellite construction & integration process, (b) overall spacecraft costs, and (c) the mission's scientific goals?
2. What is the precise mass of Jason-3 (to the nearest kg, preferably)? Some sources have it at 510kg, others at 560kg, others at 600kg? It'd be great if you could specify dry vs. wet mass.
3. Are you able to disclose the target injection orbit? Although CNES describes a [1336 km, 66° operational orbit](#), is the injection orbit (that the rocket delivers the spacecraft directly into) the same? Or does the spacecraft itself do any of the insertion work using onboard propellant?
4. How much commonality is there between the three Jason spacecraft? Externally they appear very similar, since they're all based off the same bus ([Jason-1, 2, 3](#)), but how are the instruments and other systems different?
5. As somebody who's planning on being at Vandenberg for the launch, do any team members have recommended viewing spots?

[stratohornet](#)

In reply to part 4, this site helps explain: <http://www.nesdis.noaa.gov/jason-3/mission.html>

"Jason-3 will maintain the nation's satellite altimetry observations of global sea surface height that began in 1992 with the TOPEX/Poseidon

The TOPEX/Poseidon mission, which launched in 1992, was a joint mission between NASA and CNES to measure ocean surface topograp

Named the Ocean Surface Topography Mission, Jason-2 was the follow-on mission to Jason-1, this time with EUMETSAT and NOAA includ
-- Renata and Stephanie

Hi! I have a bunch of questions if you don't mind!

1. SpaceX's Falcon 9 rocket, which'll carry Jason-3 to orbit on the 17th, was grounded for six months after a launch failure in June. In addition, prior to the rocket's grounding, the launch date had slipped from March to August of last year due to F9 certification issues. Overall, Jason-3 is launching 10 months later than originally planned. How did this delay impact (a) the satellite construction & integration process, (b) overall spacecraft costs, and (c) the mission's scientific goals?
2. What is the precise mass of Jason-3 (to the nearest kg, preferably)? Some sources have it at 510kg, others at 560kg, others at 600kg? It'd be great if you could specify dry vs. wet mass.
3. Are you able to disclose the target injection orbit? Although CNES describes a [1336 km, 66° operational orbit](#), is the injection orbit (that the rocket delivers the spacecraft directly into) the same? Or does the spacecraft itself do any of the insertion work using onboard propellant?
4. How much commonality is there between the three Jason spacecraft? Externally they appear very similar, since they're all based off the same bus ([Jason-1, 2, 3](#)), but how are the instruments and other systems different?
5. As somebody who's planning on being at Vandenberg for the launch, do any team members have recommended viewing spots?

[stratohornet](#)

We'll take these by number...

1) In fact, from the original plan, Jason-3 is more than 2 years delayed. There were delays because of budget and selection of the launch vehicle, but hey, why point fingers? We're just happy to see it launch soon. The satellite and instruments have been completed for quite some time, but they continue to regularly test its components to make sure everything is working, and we've been lucky to

stay pretty much on target in terms of the budget. For science, we've been lucky because our last satellite Jason-2, has lived well beyond it's expected 5-year life and is still quite healthy. So we are still meeting a lot of our science goals, but we are really looking forward to passing the baton off from Jason-2 to Jason-3 over the course of the next year or so. -Climate Elvis

Curious, since we use sea level at the coast to determine height of land objects what base line do you use at such high accuracies for the many different sea levels? Because of tides, weather, and currents an area's sea level varies considerably at any given time, what level do you use to determine upper and lower limits for the data you will be gathering? Thanks for all the work you do! EDIT: grammar + aw what awesome answers, thanks!

[Old John](#)

Great question (simple and complicated)! The short answer is that satellite altimeters measure sea surface height with respect to a reference Earth shape, the WGS-84 ellipsoid.

The longer answer is more interesting, and involves the mean sea level that Old John alludes to and the geoid that Oceans88 alluded to, and also explains why we have chosen the orbit for Jason-3 that we have chosen. So here is the longer answer, as we hope it will be interesting to some of you.

If we could get the wind to stop blowing, the current to stop flowing, and the sun and moon to go away so there were no tide producing forces, then sea water could come to rest and lie still upon the solid Earth. If the seas could do this, the sea surface would be a level surface, meaning a surface everywhere perpendicular to gravity and on which gravitational potential energy is the same everywhere. (If this were not so the water could lower its energy by flowing in a downward direction, so the sea surface at rest in hydrostatic equilibrium must rest on a level surface.) This imaginary surface we call the geoid.

The geoid is as much as 100 meters above or below the ellipsoid, and its shape is quite irregular, with bulges and hollows caused by variations in the strength and direction that Earth's gravity pulls. (Yet there is no downhill direction on this surface, because it is always perpendicular to gravity. You couldn't gain energy by riding down this surface on a surfboard. There is no down direction on this surface.)

We have used satellite altimeter measurements of these sea level bulges and hollows to make reconnaissance maps estimating the depth of the sea floor below, because mountains and valleys on the ocean floor are a big cause of gravity anomalies that perturb the shape of the geoid. Our page on our research using altimetry to map the ocean floor topography is here:

<http://www.star.nesdis.noaa.gov/sod/lsa/AltBathy/> and NOAA's National Ocean Service has more on the geoid here: <http://oceanservice.noaa.gov/facts/geoid.html>

When you lift an object, you have to do work to raise its gravitational potential energy. But objects moving on level surfaces do not change their gravitational potential energy. Therefore we need to measure heights with respect to level surfaces in order to characterize the energies, forces, and dynamics in play.

Surveyors have historically characterized land elevations as heights above mean sea level, mean here meaning average. This comes from a 19th century notion that we could imagine digging canals across the land from ocean to ocean and then time-averaging the water level in the canal to define the geoid height on land.

But now in the 21st century our measurements of gravity and sea level are so precise that we realize that time-averaged sea level includes not only the hydrostatic equilibrium Earth geoid but also the time-averaged deformation of the Earth by the tides from the sun and moon, and also the time-averaged dynamical heights in the ocean. These dynamical heights are caused by a geostrophic force balance between current flows and pressure gradients, and are one of the scientific objectives of satellite altimetry.

One of the reasons we do satellite altimetry is to measure the geoid, but the other reason is to measure the dynamical displacements of sea level away from the geoid. So one scientist's signal is another scientist's noise in this game. Usually we can separate the two by considering the space and time scales over which they vary. When satellite altimetry got started, we didn't have much independent information about the geoid, and so, in order to study ocean dynamics, satellite altimeters were often placed in exact repeat orbits. These orbits repeat the same path over and over again. Jason-3 will make 127 trips around the Earth in exactly the time it takes the Earth to turn 10 times under Jason-3's orbit, so that after 127 revolutions Jason-3's path over Earth's surface will repeat itself. And this path was previously surveyed by Jason-2, Jason-1 and TOPEX. By measuring sea level over and over again in the same place, we can observe changes in sea height over time, and these must be due to dynamical or climatic changes, and not to the geoid, as the geoid changes only very slowly. So

oceanographers use exact-repeat orbits to observe ocean dynamics without needing to know the geoid.

Nowadays we can make estimates of geoid height that are independent of satellite altimetry, but only at large scale. An interesting consequence of Newton's law of gravity is that you have to be fairly close to sources of gravity anomalies in order to be sensitive to their details. For example, if the sea floor topography has a mountain (extra mass, adding to gravity) and a valley (an absence of mass, subtracting from gravity) and they are only a few miles apart, then they will produce a hill and a hollow in sea level and the geoid, but they won't be felt by a satellite gravity mission such as GRACE. This is because the distance between the mountain and valley is very short compared to GRACE's orbital altitude (about 400 km above the Earth), and so the effects are cancelled out a few miles above the Earth, leaving nothing at 400 km altitude for GRACE to feel. So GRACE (and other satellite data) can show us the large scale (several hundred km and wider) geoid, but not the details of individual mountains and valleys. For that we need altimeters. But at large scale, we combine altimeter data with GRACE and other data to (for example) separate total sea level rise (measured by altimeters) into a component due to adding water mass by melting glaciers (measured by GRACE) and a component due to thermal expansion of water that is already there (measured by ARGO).

--WHFSmith

How much of the ocean floor have you discovered from the previous missions? By mapping all of the ocean's topography, how much will that add to the 5%(?) known part of the ocean?

[bhagzogy](#)

Interesting question, Bhagzogy. You are correct that only a few percent of the ocean has been mapped the conventional way, by ships, and most of what we know about the topography and geology of the ocean floor has been inferred from satellite altimetry. Our research along these lines is outlined here: <http://www.star.nesdis.noaa.gov/sod/lsa/AltBathy/>

The Google Earth overlays that my colleague, Dave Sandwell, made are really cool, and I thank Slalomstyle for linking to them.

Jason-3 will not, at least initially, add much to ocean floor mapping, because it will re-fly the same orbital ground track previously surveyed by TOPEX, Jason-1 and Jason-2. This is a deliberate feature, to allow us to monitor changes in sea level over years and decades. We don't expect to get new information on the ocean floor under these tracks from Jason-3.

But after Jason-3 has been calibrated to Jason-2, then we can move Jason-2 to a new orbit. If there is reason to believe, at some point in the future, that the orbiteers will no longer be able to maintain Jason-2's orbit, then it will be moved out of the way of Jason-3 to avoid a crash that would produce space junk. The out-of-the-way orbit may bring Jason-2 over new points on Earth we haven't seen before. The gaps left by previous orbital coverage are large enough for unknown seamounts to hide in, so eventually an end-of-life mapping mission by Jason-2 may show us new seamounts.

And farther in the future, after Jason-CS/Sentinel-6 has been launched and inter-calibrated to Jason-3, we may be able to move Jason-3 to an end-of-life mapping orbit. So in the long run, after Jason-3 has done its primary job of monitoring ocean dynamics and climate, we may be able to use it for more bathymetry from space. --WHFSmith

Will this ever be used for tsunami detection? It would be really interesting to see a satellite or satellites take real time measurements of the world's oceans to immediately check anomalies.

[Brandonthecreator](#)

This is a great question! If detection means discovering that a danger is happening and warning people about it, then the answer is no, but if you mean measuring something we can't measure any other way, then the answer can be yes.

NOAA's National Weather Service operates Tsunami Warning Centers, such as this one: <http://ptwc.weather.gov> Warnings have to be both reliable and rare, or people won't pay attention, as Aesop's fable about the boy who cried wolf teaches us. NOAA's warning system uses the seismic network to detect earthquakes and landslides that might produce a tsunami, and then uses bottom pressure gauges linked to surface buoys (the DART buoy system) to verify the existence of tsunamis and measure their height. Only after this are watches and warnings issued. (I hope all our readers understand the difference between watches and warnings, not just for tsunamis but for all hazardous weather.) <http://www.ndbc.noaa.gov/dart.shtml>

In the open ocean a tsunami's height can be very small, and it is spread over a very large area. The wavelength is many miles long, and ships don't even feel them as they go by. Satellite altimeters may not be in the right place at the right time in order to observe a tsunami, and if they are able, the height anomaly associated with the tsunami may be hard to distinguish from that of a storm or other ocean dynamics phenomenon. Also, it can be a few hours between the time that an altimeter makes a measurement and the time it is able to relay that measurement to the ground. So altimeters are not a good foundation for a fast and reliable tsunami warning system.

However, during the tsunami in the Indian Ocean on 26 December 2004, it happened that four altimeters were in the right place at the right time. We did not get the data until long after real time, too late to be useful as a warning, but we were able to use the data after the fact to do research. This was important because these altimeter data were the only measurements available in much of the Indian Ocean, and we were able to use these data to settle an important debate about the source of the tsunami. Our paper on this is here: <http://dx.doi.org/10.5670/oceanog.2005.62>

Unfortunately, when Japan suffered a big tsunami a few years ago, the altimeters did not get a good look at it. --WHFSmith

Do you have any really fun stories about the production of the satellites? When I was building custom hardware for antarctic research, there were many 'fun' (in retrospect) stories to tell about all nighters and blind alleys.

What's this job like? Is it fun? Is it tough? Is it exciting?

[m_bishop](#)

Building satellites ain't for sissies! It's tough work and the folks who do it work really hard. As a scientist, I'm not a hands-on participant in building the satellites. But I am spoiled by the fact that all these hard working French and American engineers have done such an amazing job giving us a string of satellites that have provided an unbroken, global record of sea level change since 1992. - ClimateElvis

Do you have any really fun stories about the production of the satellites? When I was building custom hardware for antarctic research, there were many 'fun' (in retrospect) stories to tell about all nighters and blind alleys.

What's this job like? Is it fun? Is it tough? Is it exciting?

[m_bishop](#)

Like ClimateElvis, I am not directly involved in bending sheet metal and soldering wires. (Actually these things have microchips custom built with layer by layer of atoms, and other cool fabrication systems.)

You may be interested to know that we put satellites and their hardware systems through "Shake and Bake" tests before we launch them. (In the 70s, there was a food product called Shake and Bake, for breading chicken.) This is what we call the tests that assure us that the spacecraft and its systems will survive the vibration of launch and the temperature extremes of the space environment.

The European Space Agency engineers have a wonderful story about the CryoSat2 satellite. Something broke during Shake and Bake and the only way to fix it was to get a medical doctor to come out with the kind of surgical tools you use to do micro-surgery through video and tools pushed through small tubes. And this was after it had been transferred to a launch site in a remote part of Russia.

So amazing things do happen during the pre-launch phase. But I have my fun after launch, playing with the data. --WHFSmith

Since there will be made a map of your data eventually (assuming you measure the data in 3D right now)

What kind of projection do you prefer to visualise the globe?

Further, I study geography and learn allot about measuring techniques and everything that can go wrong with it and even on Earth the consequences of little errors can be huge.

How do you take all the variables in account (atmosphere, systematic errors,...)?

Thanks :-)

[rockwarriorsway](#)

I love your question about map projections, Rockwarriorsway, and I am delighted that you are studying geography.

For those who don't know, when you take data on a curved surface like Earth and visualize those data on a flat surface like a paper map or computer screen, you must distort things. If the shapes are right, the sizes and distances must be wrong; if the sizes are right, the shapes must be wrong; and so on. This is why NOAA developed Science on a Sphere, a spherical projection screen for looking at planetary data: http://sos.noaa.gov/What_is_SOS/index.html

To answer the question: the topography of the sea floor is often shown in a conformal (correct angle) projection, because the angles between plate boundaries are important in the theory of plate tectonics.
--WHFSmith

I would like to ask:

1. how much of the work is done within the hardware/software of the satellite, and how much of it afterwards, on Earth?
2. is the technology advanced in any way by the current satellites or are they the "receivers" end of advancements in the various fields? In any case, where do most of these advancements take place - hardware or software?
3. Project scientist stands for? I mean, could you be a bit more specific about your background, not in terms of degrees (unless you want to) but in terms of expertise - i distinguish these 2 since eg someone working in image processing and someone in voice recognition might both have a PhD in Machine Learning. I am asking in order to fully understand the **actual** involvement of different fields, and not the **supposed** one.
4. Congrats! You must/should be proud! Best of luck!

[iamthetio](#)

Well, as a few other posts have noted, this mission is almost a carbon copy of the last satellites. That's good because we are trying to build a climate record here so the science benefits from the satellites being as similar as possible.

That said, there are always small changes and advancements, in both hardware and software. Of course, once the satellite has launched, they are limited only to software changes, unless Superman flies out to give us a hand.

Project Scientist is just a name used by the agencies to refer to the lead scientists for the missions. These folks are responsible for writing the science requirements of the mission, which are ultimately met by the engineering teams who build and test the satellites. So they need to have a good understanding of what the data will ultimately be used for and how accurate it needs to be. Usually, they are scientists in a particular field with a PhD.

Thanks! We are super-excited!

-ClimateElvis

What kind of resolution are we looking at here? Could this detect rogue waves? Obviously not real time but I'm curious how else this could be applied.

[Notathingys](#)

Rogue waves are an area of research.

By "detection" I suppose you mean being able to find them fast enough to warn ships. That isn't going to happen in real time, for the same reasons as I gave elsewhere in connection with a question about detecting tsunamis. But we are looking into the altimeter's sensitivity to large waves. --WHFSmith

Do you find yourselves under any political pressures when it comes to reporting of results?

[MarchToTorment](#)

No. Not myself anyway. I just report the facts as they become clear, and mostly the politicians have left me alone. -ClimateElvis

Thanks for taking the time to do this! Your project sounds pretty cool. Not being a science person, I have some (maybe dumb) questions. Answer as you see fit:

1. I am vaguely aware that the oceans are different heights (otherwise the Panama Canal would be a lot simpler). Besides the impact of the moon's gravitational pull, how is that possible?
2. Besides the obvious flooding and salination of groundwater in coastal water tables, what are the effects that rising sea levels will have?
3. I noticed several of you are from JPL, which I know best in the context of the novel *The Martian*. Is that book accurate to the workings of NASA (you're not manned missions to Mars, I know, but the culture and day-to-day operations), and does it accurately portray what you do in JPL?
4. When do you expect to transition Jason-2 to ocean floor mapping, and where is it going to be focused?
5. What are you most excited for with this project? Is there a particular part of ocean floor you want to map, or a particular ocean-height phenomenon you want more data on, or something like that?

[Duke Paul](#)

Great questions! Here's some answers: 1. A BUNCH of reasons! The pull of gravity reshapes the ocean surface a bunch, and deciphering that is how we use these data to map the sea floor. But also warm water stands taller, and so does fresh water. So temperature and salinity play a roll as well. On top of that, you waves, storm surges and the tides (caused by the pull of both the Sun and the Moon).

1. Those are the big ones, but in some places coast erosion is a big deal, too. Especially here in California where much of the coastline is made up of cliffs.
2. <https://www.youtube.com/watch?v=GLYzYf0k9yQ>
3. Not entirely sure yet. It will probably be a year or two. We need good cross-calibration with Jason-3, and after that we will put Jason-2 into an orbit where, combined with Jason-3 it doubles the resolution. After, it will move to a very long-time repeating orbit that covers the sea floor densely, everywhere between 66 degrees of latitude. So stay tuned.
4. Personally, I want to see another 5 years of global sea level rise. We are in a period where sea level rise could begin to speed up and Jason-3 might be the first mission to see it.

-ClimateElvis

How serious do you consider climate change threats? And, do the efforts of individuals to slow or revert climate change make any difference? Specifically, do you do anything in your daily lives (outside of the work you do) to fight the climate changes?

If you could ask every person on the planet to do one thing to help that effort, what would it be?

[crumpledlife](#)

Human caused global warming and the climate change that it implies are very serious threats. In terms of sea level rise, hundreds of millions of people live in zones that will be affected by the end of the Century, and possibly by the middle of it.

In short, what you do does make a difference, but it's not enough on its own. We need to encourage individual efforts, but world leaders and governments have to help out, too. Personally, I was encouraged by the agreements reached in Paris, but we need to continue to encourage our leaders to address the issue. -ClimateElvis

What types of sensors will Jason-3 have on board for this and future projects?

[grahamfw](#)

Sea surface height, significant wave height, and ocean surface wind speed are all measured by the radar altimeter, which is the primary instrument onboard Jason-3. To convert the range measurements from the altimeter into sea surface height we need a very accurate satellite orbit. There are 3 orbit determination systems onboard Jason-3 for this purpose: the DORIS system, a GPS receiver, and a passive laser retroreflector. Finally, to get the best estimates of sea level we need to correct the radar range for path delays, as the signal passes through the atmosphere. The most important of these is due to water vapor in the atmosphere. Estimates of this are provided by the dedicated Advanced Microwave Radiometer. Details about the satellite and its instrumentation can be found at <http://www.nesdis.noaa.gov/jason-3> (JL)

Not about the satellite, but for the NOAA guys;

I'm currently a atmospheric sciences student in college and I'm curious as to how I could get a job within the field or even with NOAA. Any advice/tips?

[TeGrem](#)

NOAA's web site for careers is <http://www.careers.noaa.gov>. Since you're a college student, you can apply for the Hollings Scholarship Program that includes summer internships at NOAA (<http://www.oesd.noaa.gov/scholarships/hollings.html>), which is a great way to learn about NOAA and what it's like to work here. (E.L.)

Where can I find some easy to read data to show those I know that still deny human impact on the earth's climate? Living in a rural community, it's scary how many see climate impact as a "liberal agenda".

Edit: formatting

[zakrak4](#)

I like to point people to the sea level rise page of the National Climate Assessment:
<http://nca2014.globalchange.gov/report/our-changing-climate/sea-level-rise>

There's a plot showing sea level over the last 2000 years, and to me this is one of the most unassailable pieces of evidence that humans have changed the climate in bigger way over the last 150 years, than anything the Earth has seen in the last 2000.

But in the end, this argument is won by making a personal connection to people and understanding what their reservations and motivations are, more so than listing a bunch of well-established, hard-core scientific facts. -ClimateElvis

Where can I find some easy to read data to show those I know that still deny human impact on the earth's climate? Living in a rural community, it's scary how many see climate impact as a "liberal agenda".

Edit: formatting

[zakrak4](#)

Where can I find some easy to read data to show those I know that still deny human impact on the earth's climate? Living in a rural community, it's scary how many see climate impact as a "liberal agenda". Edit: formatting

<http://climate.nasa.gov/evidence/> is a rich resource of data.

-- Stephanie

Does the satellite have a photographic imaging system? If so, what kind of lens does it have?

Also, what kind of antennas/radio system does it use for the up/down link to earth?

[dmyerty](#)

Jason-3 doesn't have a photographic imaging system.

As for the antennas, the downlink data rate is 838 kbit/s and uplink is 4 kbit/s (both at S-band).

(E.L.)

What are the main differences between Jason-2 and the new Jason-3, and how will the new satellite help us better our understanding of Climate Change?

[LukeforBernie](#)

Jason-2 and Jason-3 are nearly identical, and are based on the same Proteus satellite bus. There have been some enhancements to the instruments on Jason-3, but the most important thing is to

maintain continuity of the altimetry measurements that began with the Topex/Poseidon mission in 1992. In order to monitor sea-level rise, and potential acceleration of that rise, we need a very accurate time series of sea level spanning decades. Jason-3 is critical for maintaining that sea level climate data record. (JL)

What are the key differences between Jason-3 and the previous altimetry satellites?

What role does the Argo network play in satellite measurements of the ocean?

[notdez](#)

The question about Jason-2/Jason-3 differences was answered above. Altimetry provides total sea level change. The Argo network provides the component of sea level change due to volume changes (from changes in temperature & salinity). GRACE satellite gravity measurements provide the change in sea level due to mass being added to the ocean by melting ice sheets. Our own Eric Leuliette demonstrated that these 3 independent systems yielded a 'closed budget' where the volume+mass changes from Argo+GRACE agreed with the total sea level change from altimetry. It's currently believed that 2/3 of the total comes from the mass component (ice sheets) and 1/3 from the warming of the ocean. (JL)

Whenever I fire up KSP it reminds me of all the other cool stuff I could be doing with my life, like making satellites. Have any of you started in a different career (like civil engineering) and get pulled into earth science?

[HalfRho](#)

I originally planned on a career in condensed matter physics, but I found oceanography and geophysics a lot more fun. (E.L.)

With the Jason satellites technology, is it possible to apply them on an orbiter and begin measuring the height of the hydrocarbon lakes of the Saturnian moon, Titan? Would it be something we would see in the next ~ +20 years? Are there plans to do so after further improvements of these satellites, or is it just too unclear at this point to begin understanding weather on other bodies in the Solar System?

[TheRazagen](#)

It's not my area of expertise, but NASA's Cassini spacecraft did carry a radar altimeter and was able to measure height changes of lakes.

(<http://onlinelibrary.wiley.com/doi/10.1029/2009JE003557/abstract>) (E.L.)

As I understand it Jason-3 has the same altimeter as Jason-2. Do you foresee a new class of nadir-looking ocean altimeters emerging over the next decade, or do you think swath-based approaches (like the upcoming SWOT mission) will be more popular for oceanographers going forward?

Also, what kind of spatial resolution will a repurposed Jason-2 have for mapping the ocean floor? What do you think of the Shell XPrize they announced at AGU?

[the_chinese_chicken](#)

Jason-3's primary science mission is to provide continuity of measurements from the previous Jason missions, so it must balance between backward-compatibility and new innovation.

There are innovations in nadir-looking, pulse-limited radar altimeters.

The first of these is known as Delay/Doppler or SAR altimetry. It was originally developed in the U.S. at JHU APL under NASA Instrument Incubator funding and proven in aircraft flights. The European Space Agency's CryoSat mission adopted it. Unfortunately the first CryoSat perished in a launch failure and so it was not until 2010 that we were able to get data from space with this technique. It has proven so successful that it is being cloned for Sentinel-3 and cloned and improved for Jason-CS/Sentinel-6. These are all using radar at Ku band.

Meanwhile the French space agency CNES has also developed a nadir-looking altimeter at Ka-band and the Indian space agency ISRO gave it a ride recently. Both Delay/Doppler at Ku and also Ka are showing big improvements (almost a factor of two in precision) compared to traditional Ku altimetry.

The question about Jason-2 and ocean floor mapping is answered in some of my other replies. --

WHFSmith

How publicly available will the recorded data be? Will it, for instance, be possible to make realtime animations of regional sea height fluctuations? Or is the goal a more static survey?

[riceshrug](#)

The data will be freely & openly available to the public after an initial verification phase that will last for up to 6 months after launch. Assuming we launch in < 2 weeks, the data would be publicly available around July, 2016. Indeed near real-time maps and animations of sea surface topography could then be made, as we provide data that is only a few hours old as soon as it's processed:

<http://www.nodc.noaa.gov/SatelliteData/jason> (JL)

Couple questions.

What is the error range of Jason's height measurement?

What is the method Jason uses for its height measurement? Time of Flight?

In theory if Jason can get reasonably accurate sea measurements couldn't it eventually be repurposed to do point cloud measurements of the entire earth's surface or is there some sort of restriction?

Is Jason multiple satellites? How with a single orbit can you get a vantage point at all the earth's oceans? Wouldn't you need multiple vantage points or at least to change its orbit at times?

[ThatOtherOneReddit](#)

- 1) The errors in 1-second averaged sea surface height are around 3 cm.
- 2) Altimetry is quite simple: the distance from the satellite to the sea surface is measured by the travel time of each radar pulse (range) subtracted from the height of the satellite above a reference ellipsoid (orbit).
- 3) Actually, at the Ku-band radar frequencies of the Jason-3 altimeter, the clouds are invisible. We make corrections for path delays due to air and water vapor in the atmosphere.
- 4) We like to have two Jason satellites in orbit at the same time, but sometimes there is only one. Each satellite is in a repeat orbit of about 10 days. They make measurements at nadir, directly below the satellite.

For more details, start at NOAA's website for Jason-3:

<http://www.nesdis.noaa.gov/jason-3> (JL)

How many years of college, and what college, did you go to?

[Vexans27](#)

For me I spent four undergraduate years at Carnegie Mellon and then 7 years in Boulder at the University of Colorado. (E.L.)

How many years of college, and what college, did you go to?

[Vexans27](#)

4 years ungrad at SUNY Maritime College, 3 years for an MS at University of Washington (JS)

How many years of college, and what college, did you go to?

[Vexans27](#)

I did 4 years of undergraduate at the U. of Washington, followed by a Masters @ MIT/WHOI (JL).

How many years of college, and what college, did you go to?

[Vexans27](#)

I took a strange path through college, trying different things. When I settled on the path that led where I am now, it started with a year at Cuesta Community College in San Luis Obispo, followed by two years at the U. of Southern California, where I got a B.S. in Geological Sciences, with a concentration in geophysics.

Then six years at Columbia U. in New York for a Master's and PhD. --WHFSmith

Hi! Thanks for doing this AMA. I'm curious: How will tidal influence be removed from the raw data that your satellite will collect? What algorithms and methods are applied to the data after collection?

[bigd0g](#)

Measurements of the tides from Jason and the other altimeters have been incorporated into mathematical tide prediction models. The tide models are now accurate to within 2 cm (3/4 inch) in the open ocean and are used to remove tidal effects from altimetry data in combination with a geophysical model of the tide in the solid Earth.

We use dozens of algorithms and methods to turn the radar pulses from the altimeter and measurement of Jason-3's orbit into sea level, waves, and wind speed. The a good start is to take a look at the Jason-3 User Handbook (http://www.nodc.noaa.gov/media/pdf/jason2/products_handbook.pdf) (E.L.)

What is the lifespan of this satellite?

[neekface](#)

A nominal three-year lifetime is planned for Jason-3 with a possibility of a two-year extended mission. Jason-1 lasted 10 years and Jason-2 is seven and half years old and in very good condition. NOAA will continue to rely on Jason-2 as long as possible. (E.L.)

Where can I find video archives of the earth's atmosphere?

Much like what NASA has for the sun with Soho, but for the earth.

I want to watch months or entire seasons worth of atmospheric patterns

Is there such a thing?

[warmpudgy](#)

NOAA Environmental Visualization Lab has made a video showing 10 years of weather in the Western Hemisphere in 3 minutes. <https://www.youtube.com/watch?v=iellUnkdD90>. And, you can use NOAAView to animate 23 years of sea level changes: <http://www.nnvl.noaa.gov/view/#SSHA>

How do these satellites measure the height of the ocean?

[demonicpigg](#)

From the NOAA Jason-3 press kit: (<http://www.nesdis.noaa.gov/jason-3/press.html>)

The Jason series of satellites use a technique called "radar altimetry" to measure sea surface variations. Jason-3's radar altimeter measures the round-trip travel time of microwave pulses that it bounces off the sea surface. From this data, the distance between the satellite and sea surface can be determined. This measurement requires that the precise orbit height of the satellite is known, which is why Jason-3 has on board a combination of three orbit tracking systems. Meanwhile, a radiometer instrument on-board the satellite measures how the radar waves are slowed by the presence of water vapor in the atmosphere. In addition to sea surface height, the shape of the returned radar pulses also gives information on wind speed and significant wave height.

Altimetry measurements employ a different kind technique for data collection than is used by other NOAA satellites, which measure atmospheric conditions, space environment conditions, as well as imaging over land and sea, by measuring radiation at particular wavelengths. (E.L.)

How much does the winter in Northern hemisphere affect the global sea level, when lots of seawater lies on the ground as snow? Is it measurable?

[lux44](#)

We can measure the effect that snow accumulation has on ocean levels using the Jason satellites and a pair of satellites called GRACE that measure mass changes. Studies using altimetry, Argo, and GRACE data show the annual signal of the recent sea level budget to be closed. The seasonal variation of global mean sea level measured by Jason has an amplitude of about 4 mm (about 1/6 of an inch) and reaches a maximum in late Northern Hemisphere summer, when most of the snow has melted and the ocean in the Southern Hemisphere is warm. Using GRACE measurements we can watch the seasonal exchange of water from land to ocean, which raises and lowers sea level by about 7 mm (about 1/3 of an inch). (E.L.)

How much will it improve the prediction of weather and hurricanes? So that preparing the voyage across the Pacific will be more precise. Will it improve the data for hurricane movement so that ships can get it more often? So far you get info every one hour or when it changes and some predictions by calculations. The planning period can get tricky when your only info is likelihood of hurricane to show up, and evade it in time if you're unlucky. You know, I want to cross the ocean ASAP to spare fuel. Evade it in best possible way.

sorry, I know that I'm messy. You should've heard me talk. And prob these questions are bad, but hey it's worth a try.

[Qudo123](#)

JASON-3 will contribute to tropical cyclone prediction in several ways. First it will help to define the amount of heat available in the ocean to potentially be tapped into by a tropical cyclone. The ocean heat data or content is used as input to hurricane forecast models to best address intensity. Second is longer term, significant wave heights from satellite altimeters are used as sea truth for operational wave prediction models and improve the performance of those models. NOAA will be upgrading its tropical cyclone prediction system, the Hurricane WRF system this coming year, to be coupled with the ocean and wave models, to better account for the ocean and wave interactions. SO JASON-3 will help improve both tropical cyclone forecasts of intensity and wave heights. For longer term prediction a whole array of observations from satellites, balloons, aircraft, land stations, buoys, ocean sensors (including the altimeters) help define the state of the earth system (ocean, atmosphere, ocean waves). That initial state is then used as the starting point for numerical prediction models such as the NOAA Global Forecast System (GFS), HWRF, and others. JASON-3 will not increase the frequency of the availability of predictions but will contribute to defining the state of the ocean. JS

One thing that always blew my mind about the Jason missions: You can study the features of the ocean floor (underwater mountains and canyons) by looking for slight changes in sea surface height. Do I have that correct? If so, how is that possible? Why would sea surface height be stably lower above an undersea canyon, wouldn't nearby water rush in and level off? Similarly if sea surface height was a little higher above an undersea mountain, wouldn't it flow downhill until it leveled off?

[DeepBlue_v2](#)

You have the first part right: sea level is higher over mountains and lower over valleys. But that is because the level surface itself is higher and lower due to more and less gravitational pull over mountains and valleys, respectively. Thus it can't "level off" the way you say because it is already level. There is a more detailed answer in reply to Old_John on this thread. See also this site:
<http://www.star.nesdis.noaa.gov/sod/lsa/AltBathy/> --WHFSmith

Hi. Mahalo for answering questions.

How will you launch your satellite?

[some_random_kaluna](#)

Jason-3 will launch aboard a SpaceX Falcon 9. You'll be able to watch live on NASA TV or on <http://nasa.gov/ntv>. Coverage is slated to begin at 8 a.m. PT (11 a.m. ET, 1600 UTC) on Sunday, Jan. 17, with liftoff targeted for 10:42 a.m. PT (1:42 p.m. ET, 1842 UTC).

-- Stephanie

As someone from Louisiana, I would just like to thank you for accurately predicting hurricanes. You have saved many lives because of this kind of technology.

[apepi](#)

Thank you, I will share with my colleagues. (JS)

As someone from Louisiana, I would just like to thank you for accurately predicting hurricanes. You have saved many lives because of this kind of technology.

[apepi](#)

Dear Apepi, You may be interested in the role that satellite altimeters played in forecasting the intensification of Katrina, and in measuring the winds, waves, and storm surge. Our paper on it is here: <http://onlinelibrary.wiley.com/doi/10.1029/2005EO400004/abstract> --WHFSmith