

Fire to Flora: Effects of Ash from the Thomas Fire on the Biology of the Santa Barbara Channel in December 2017

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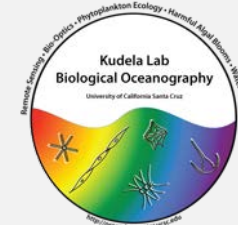
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UNIVERSITY OF CALIFORNIA
SANTA CRUZ



OVERVIEW

Big Question: How does ash and particulate matter from the Thomas fire affect the biology of the Santa Barbara Channel?

Background



1. Where did the smoke plume go?



2. Where did the water in the Santa Barbara Channel go?



3. How did all of this change the biology of the Santa Barbara Channel?



- CO₂ concentration anomaly (Sarmiento 1993) from Mauna Loa is plotted by:
 - Removing the seasonal response
 - Removing remaining signal of industrial release by using a constant airborne fraction
- CO₂ decreased
 - Hardly anything else causes this decrease in the signal
 - Pinatubo erupted: volcanic ash deposited nutrients in the water
 - Which increased the rate of photosynthesis
- Volcanic ash has implications on a global and biological scale

CARBON CYCLE

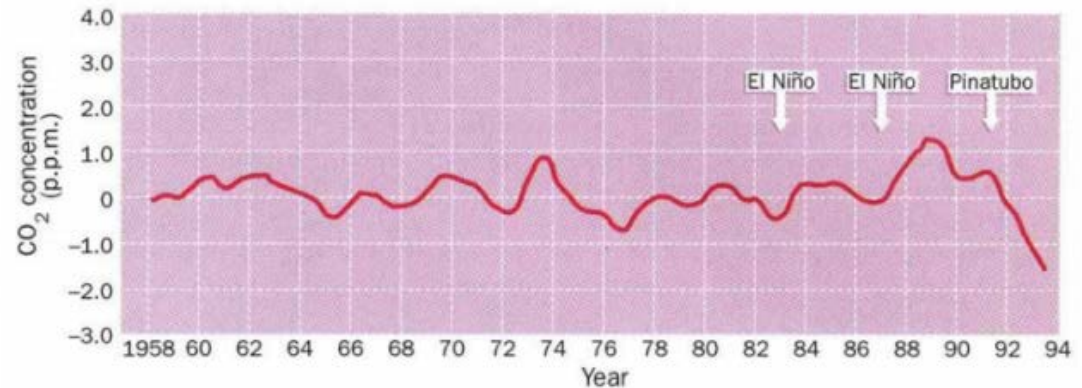
Atmospheric CO₂ stalled

Jorge L. Sarmiento

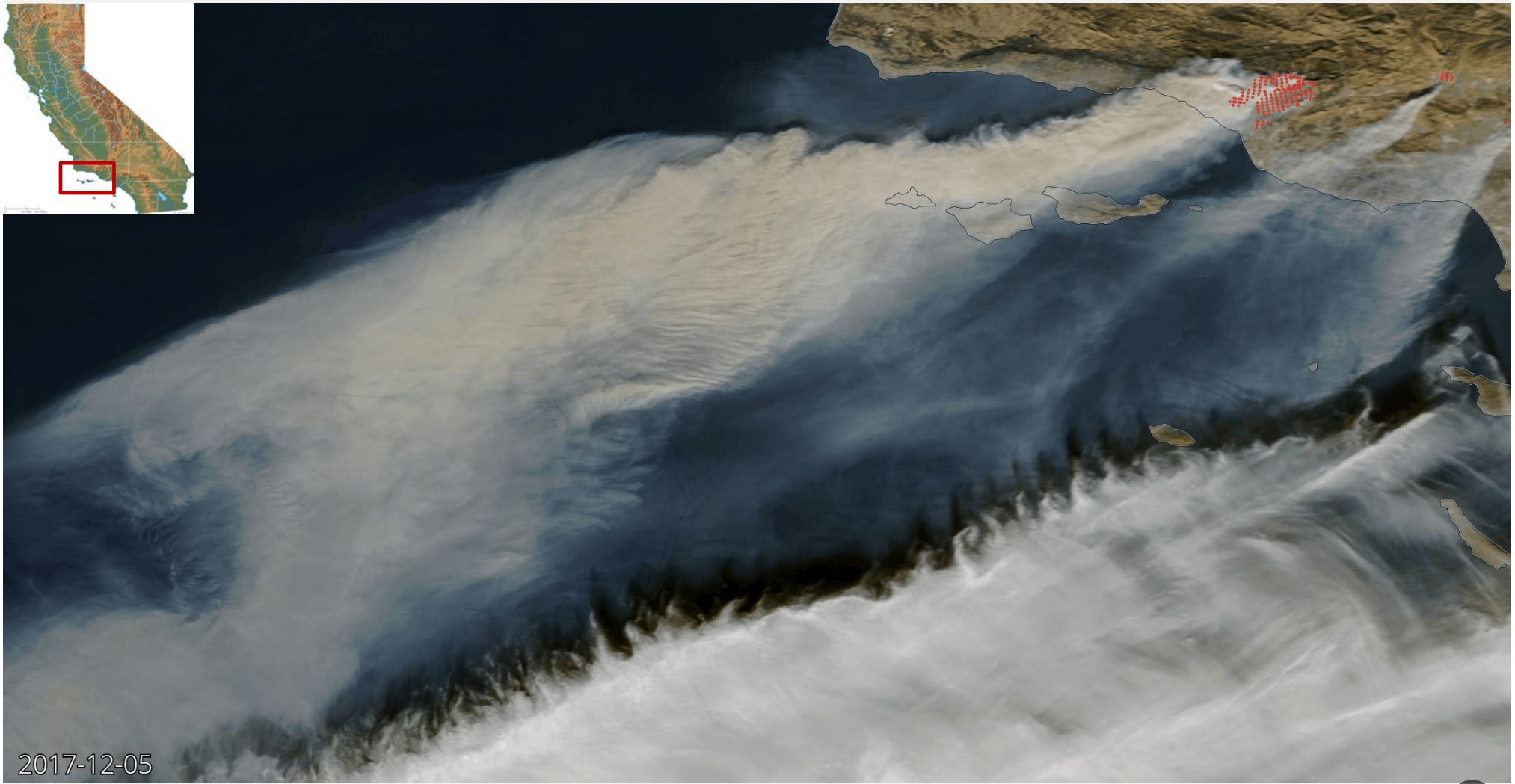
DURING the past year the growth rate of atmospheric carbon dioxide resulting from anthropogenic emissions has slowed by an amount that is unprecedented in the 35 years of David Keeling's time series of samples from Mauna Loa. Keeling unveiled these dramatic results at a meeting in Snowmass this summer*. Once the long-term trend and seasonal signal have been removed from the Mauna Loa record, the variability is strongly correlated

1991-92 El Niño should have led to increased growth of CO₂.

We can be relatively confident that the anomaly is not due to a reduction of CO₂ released to the atmosphere from fossil sources by industrial processes. Fossil-fuel emissions in 1991, estimated from the most recent United Nations statistics, were 6.19 Pg carbon, comparable to the 6.10 Pg emitted in 1990, and well within the trend of previous years (Greg Mar-



The Mauna Loa carbon dioxide anomaly obtained by removing the seasonal signal and detrending the remaining signal using a constant airborne fraction (58.58%) of the industrial release (D. Keeling, personal communication). After the first El Niño event of 1982-83

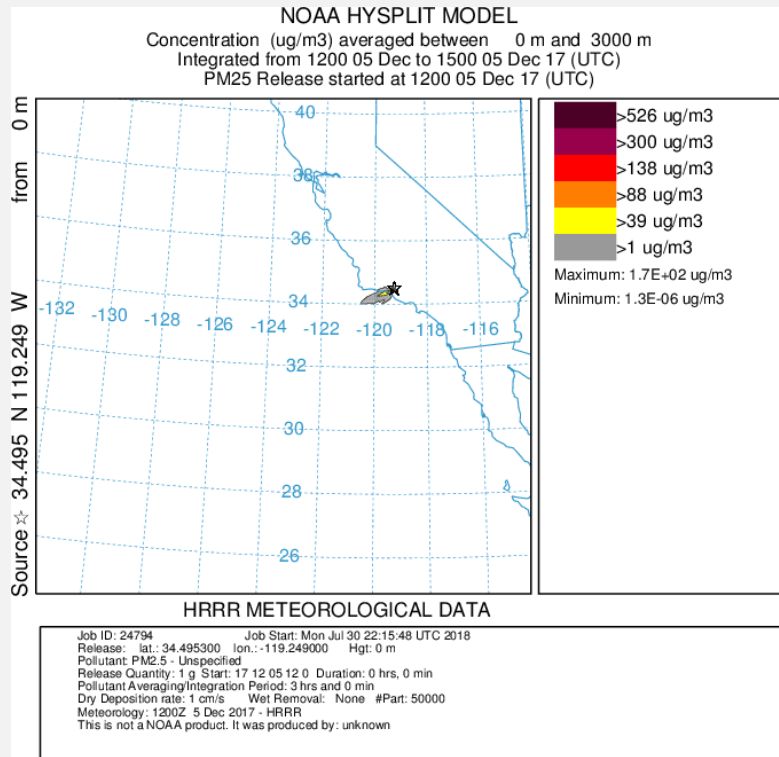


2017-12-05

“Worldview: Explore Your Dynamic Planet.” *NASA Worldview*, NASA, worldview.earthdata.nasa.gov/.

Where did the smoke go?

HYSPLIT vs. MODIS *aqua* Imagery



- Despite the fact that MODIS does not have the same temporal resolution as HYSPLIT, the model closely aligns with the actual imagery, and allowed me to see the change in plume path over time

-We do know that ash deposition did occur over the Santa Barbara Channel



Where does water in the Santa Barbara Channel go?

G N O M E



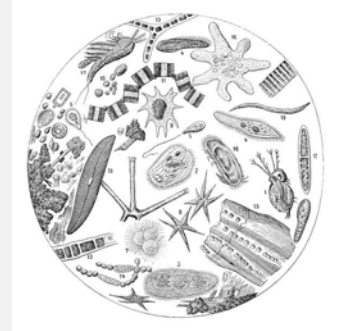
- The trajectory of deposited ash is displayed from the GNOME (General NOAA Operational Modeling Environment) model by plotting the 'plume shadow'
- The Santa Barbara Channel currents have eddies, and deposited ash lingers in the same place over a period of time.

How does this change the biology of the Santa Barbara Channel?

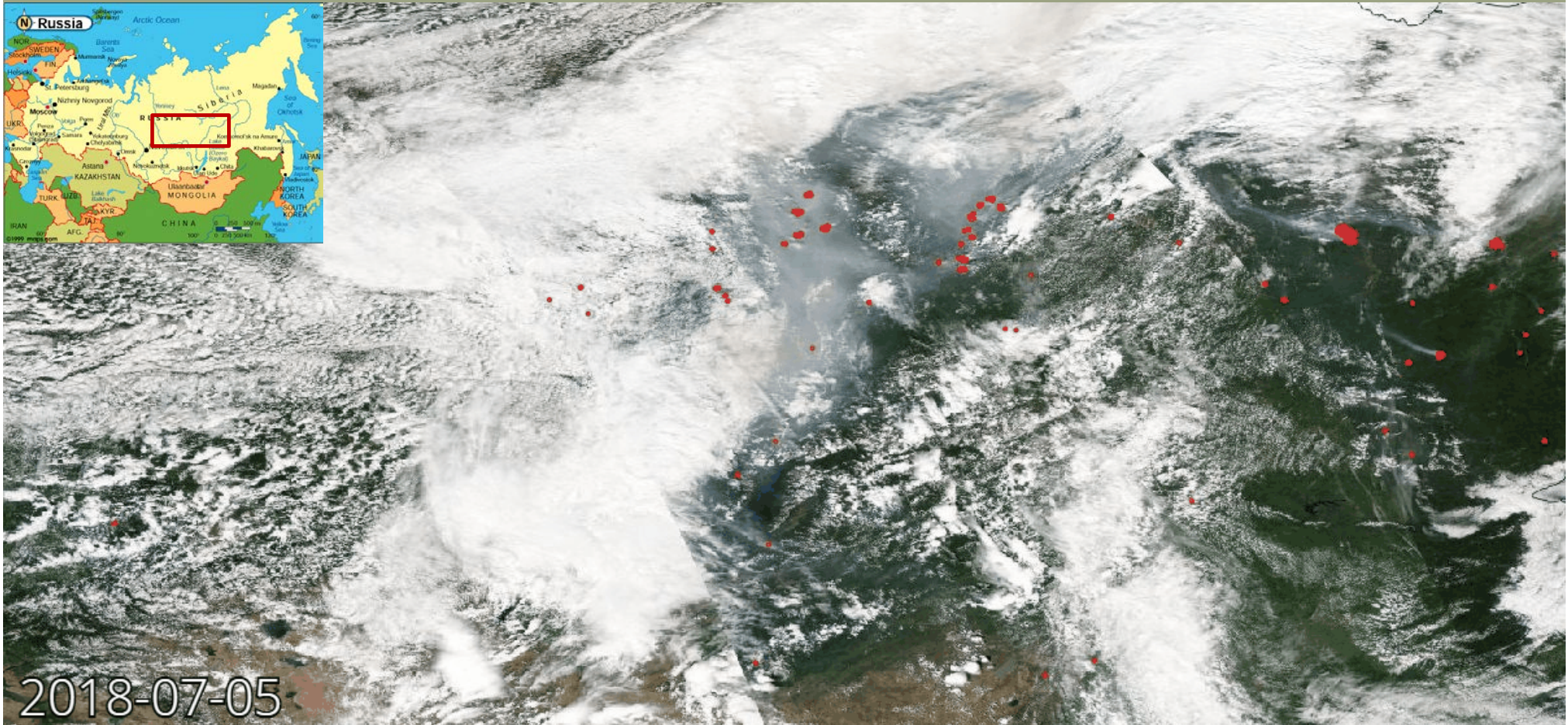
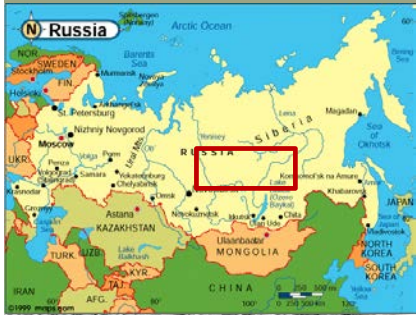
- Ash is a significant nutrient input once it is deposited in the ocean (Sarmiento 1993).
- Volcanic ash can induce fertilization that enriches the nearby ocean regions with nutrients and stimulates growth of some phytoplankton species (Duggen 2007).

From these findings, we can conclude that volcanic ash is a novel nutrient source in the oceans.

But what about ash from wildfires?

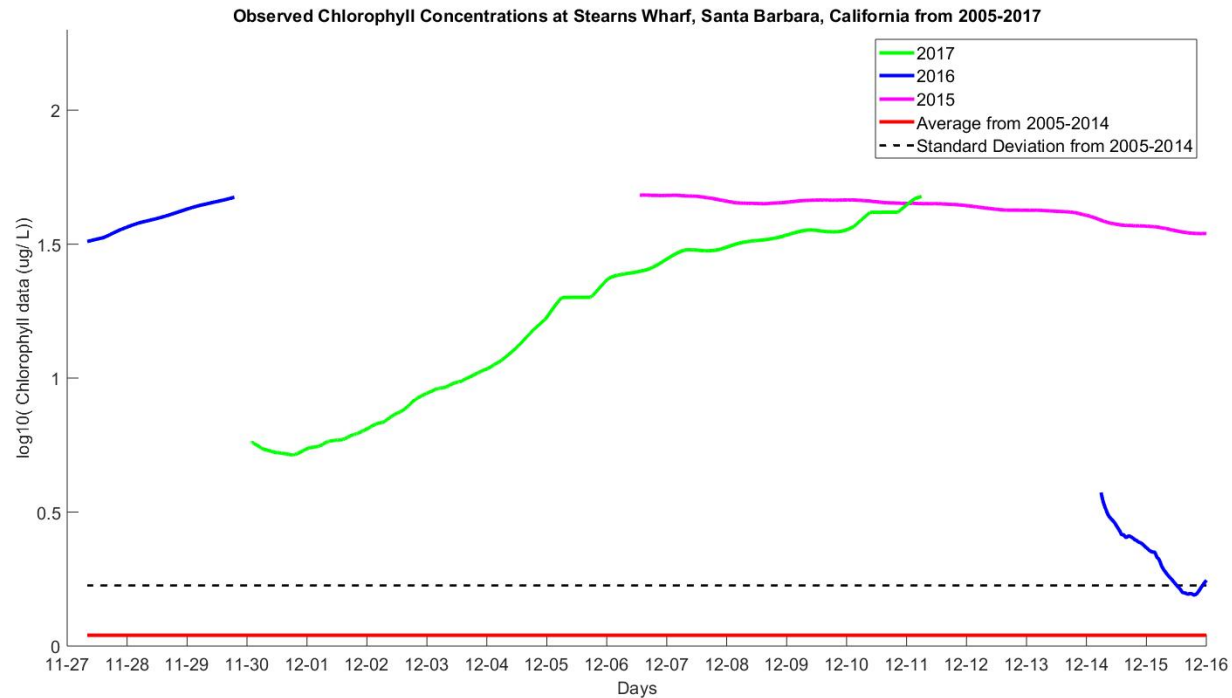


How does this change the biology of the Santa Barbara Channel?



“Worldview: Explore Your Dynamic Planet.” *NASA Worldview*, NASA, worldview.earthdata.nasa.gov/.

How does this change the biology of the Santa Barbara Channel?

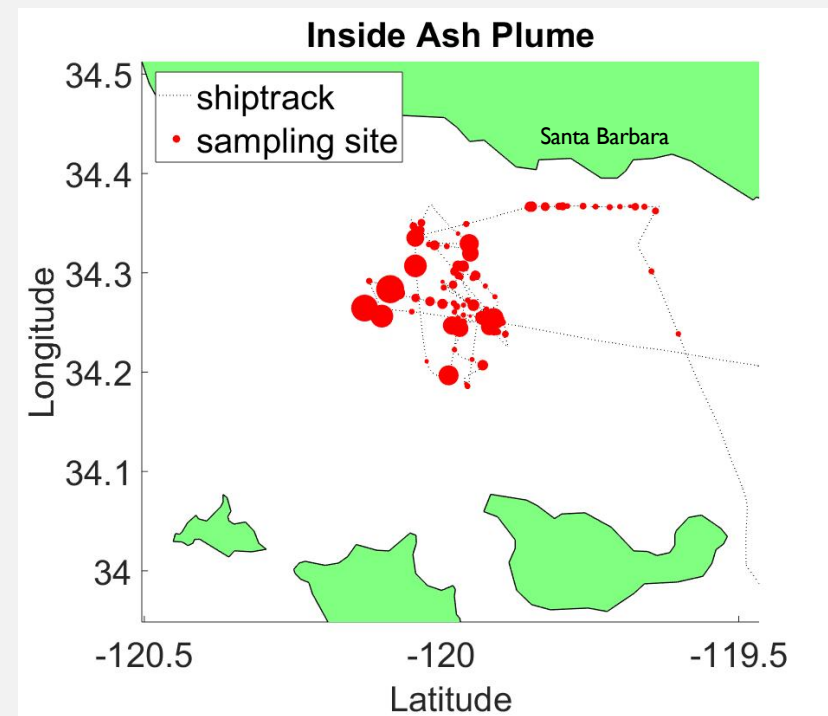
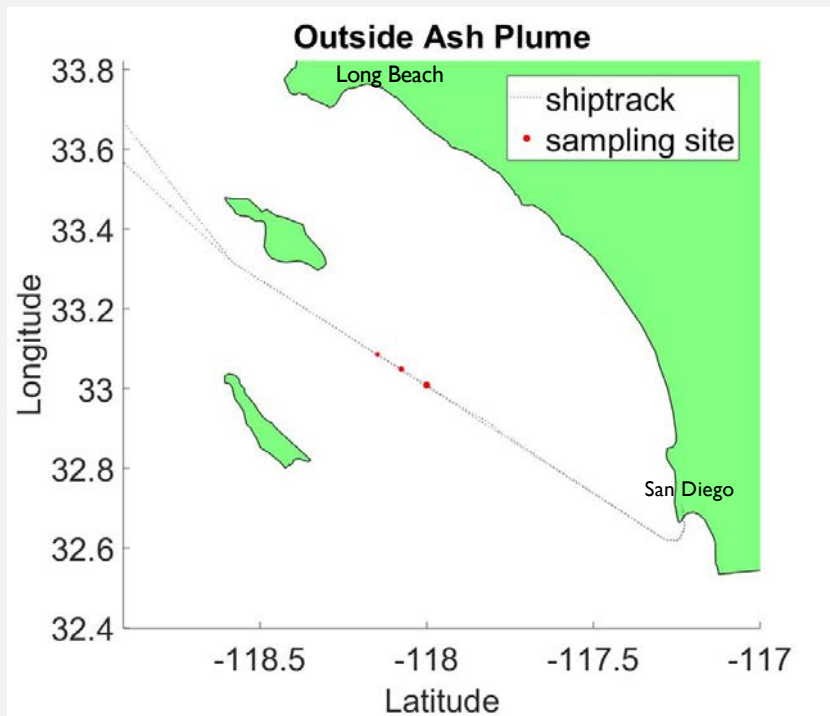


- There is an increase in chlorophyll concentrations in the Santa Barbara Channel from November 27th – December 15th, 2017.
 - The smoke plume also obscured sunlight, which is needed for phytoplankton to undergo photosynthesis
- Comparing this to other years, this is unusual– there are not many years where these values are prevalent.

How does this change the biology of the Santa Barbara Channel?

Cruise

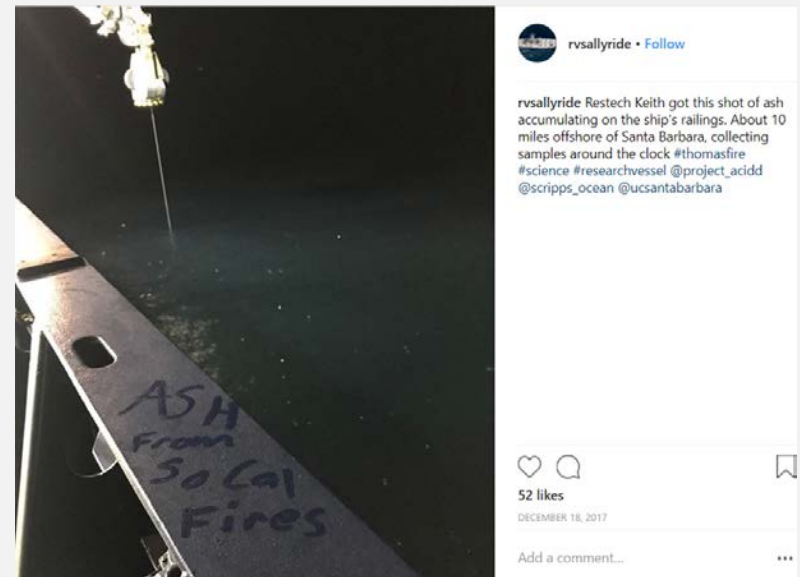
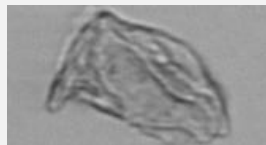
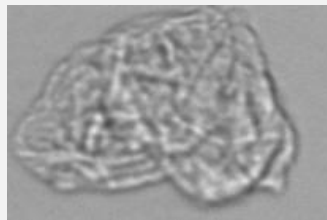
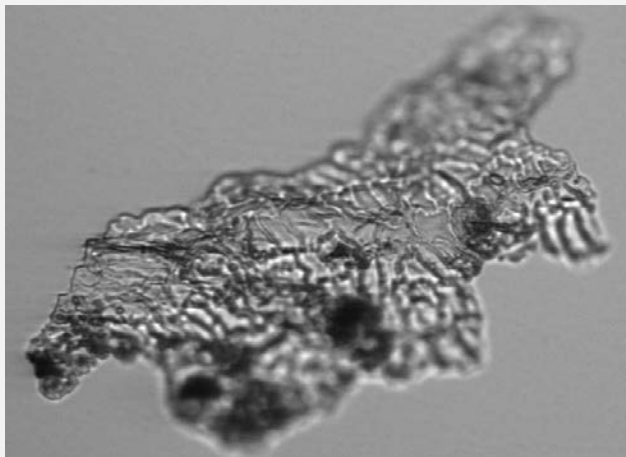
- There was a scientific cruise that collected water samples under the plume during the Thomas fire.
- They had an imaging flow cytobot (IFCB), which sampled water and took pictures of particulates that passed through it and helped determine phytoplankton species
- The diameter of particulates changed with the ship tracks, which can have implications for species type.



How does this change the biology of the Santa Barbara Channel?

What we found:

- **Ash**
- Despite the fact that ash deposition could not be quantified or modeled, this further proves that ash deposition did occur over the Santa Barbara Channel during the Thomas Fire



 rvsallyride • Follow

rvsallyride Restech Keith got this shot of ash accumulating on the ship's railings. About 10 miles offshore of Santa Barbara, collecting samples around the clock #thomasfire #science #researchvessel @project_acidd @scripps_ocean @ucsantabarbara



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DECEMBER 18, 2017

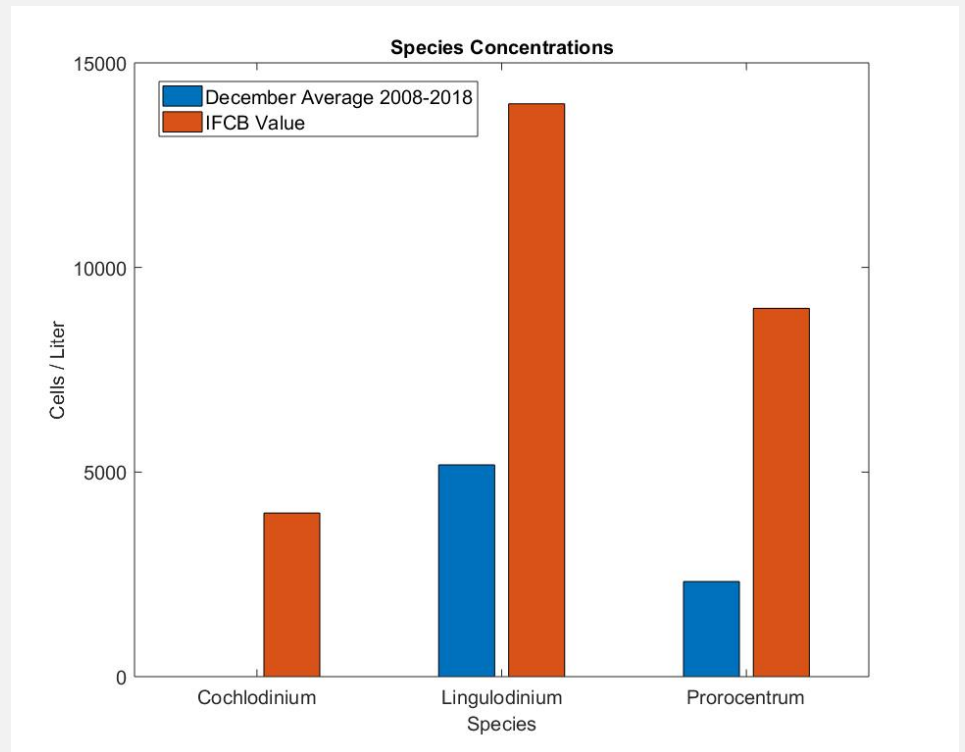
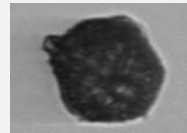
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How does this change the biology of the Santa Barbara Channel?

What else we found:

- **Lingulodinium Polyedrum**
 - Considered a Harmful Algae
 - 1.4×10^4 cells/Liter
 - More than 1 standard deviation from the mean
- **Prorocentrum**
 - Considered a Harmful Algae
 - 0.9×10^4 cells/Liter
 - More than 8 standard deviations from the mean
- **Cochlodinium**
 - Considered a Harmful Algae
 - ~4000 cells/Liter, which was unusual
 - 4x more than the mean during a bloom



C O N C L U S I O N

- Significant traces of lingulodinium and proroentrum were found, both harmful algae, and are not prevalent in December, which is unusual.
- Volcanic plumes can cause phytoplankton blooms, ash fertilizes the ocean, and phytoplankton are controlled by nutrients.
- **The Thomas Fire likely altered the biology of the Santa Barbara Channel. Ash deposition in coastal zones is likely an important biological driver that deserves more research.**



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QUESTIONS?
COMMENTS? ANGRY ANNUNCIATIONS?

