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Science Research

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Summer Assignment

1. The National Weather Service recently released a new mathematical weather forecasting program, called the Finite-Volume Cubed-Sphere Dynamical Core model (GFS-FV3). It is the biggest improvement to the U.S.’s forecasting system in 40 years. While many people are skeptical of this new system, it did an excellent job predicting last fall’s hurricane season, compared to previous models. It has faced some considerable setbacks during development. This winter’s government shutdown temporarily halted progress. Also, during testing, the GFS-FV3 model grossly over-predicted low temperatures and snowfall amounts for the U.S.’s east coast. Although this fault worried many people and set back development for several months, the National Weather Service claims to have fixed it.

120 words

Gramling, Carolyn. “The National Weather Service Has Launched Its New U.S. Forecasting Model.” *Science News*, The Society for Science and The Public, 12 June 2019, www.sciencenews.org/article/national-weather-service-launches-new-us-forecasting-model.

2. According to recent measurements, the Southern Ocean may be outgassing more CO2 than it absorbs in certain locations, contrary to previous conclusions that the Southern Ocean largely absorbs CO2. To accurately observe movement of CO2 in the Southern Ocean, scientists created the Southern Ocean Carbon and Climate Observations and Modeling (SOCCOM) project, consisting of robotic floats measuring temperature, CO2 content, pH, and salinity. The SOCCOM study revealed that the Southern Ocean mainly outgases CO2 during the winter. Other projects used to observe the Southern Ocean’s impact on climate change include Saildrones, robotic sensor-equipped sailboats. Many effects of industrialization on Southern ocean have yet to be studied, and observing it is necessary in order to take care of our planet.

120 words

Witze, Alexandra. “The Southern Ocean May Be Less of a Carbon Sink than We Thought.” *Science News*, The Society for Science and The Public, 2 June 2019, [www.sciencenews.org/article/southern-ocean-antarctica-absorbs-less-carbon-expected](http://www.sciencenews.org/article/southern-ocean-antarctica-absorbs-less-carbon-expected).

3. In 2016 to 2017, scientists observed a large hole temporarily appear in Antarctic sea ice. These holes, known as polynyas have arisen in similar locations in past years. The behavior of the Southern Ocean is poorly understood, but scientists believe that the formation of a polynya is dependent on many factors, including salinity, wind, and the vortex above the seamount Maud Rise. A recent study shows that higher salt concentrations at the surface cause overturning currents that force colder, deeper water up, causing holes to develop in sea ice. Polynyas influence the atmosphere by releasing carbon reserves located deep water. The mechanics of the Antarctic are complex, and it is still unclear how climate change will influence polynyas.

118 words

University of Washington. "Mysterious holes in Antarctic sea ice explained by years of robotic data." ScienceDaily. ScienceDaily, 10 June 2019. <www.sciencedaily.com/releases/2019/06/190610111522.htm>.

4. Images taken by US spy satellites in the 1970s and 1980s indicate that glaciers in the Himalaya Mountains are melting alarmingly fast. To reach this conclusion, scientists compared declassified spy satellite photographs with current NASA images of glaciers and measurements of other factors, such as ice temperature. Other studies, including measurements of temperatures deep inside the glaciers support the conclusion that at current rates of CO2 emissions, the Himalayan glaciers could lose 66% of their ice by 2100. Decreased glacier mass will greatly reduce the water output of many of Asia’s most significant rivers, depriving many people of hydropower, irrigation, and drinking water.

103 words

Maurer/LDEO, Josh. “Himalayan Glaciers Melting at Alarming Rate, Spy Satellites Show.” Himalayan Glaciers Melting at Alarming Rate, Spy Satellites Reveal, National Geographic, 19 June 2019, [www.nationalgeographic.com/environment/2019/06/himalayan-glaciers-melting-alarming-rate-spy-satellites-show/](http://www.nationalgeographic.com/environment/2019/06/himalayan-glaciers-melting-alarming-rate-spy-satellites-show/).

5. To counter the increasing rate of global warming, scientists are exploring ways to directly influence the earth’s atmosphere. One of these proposed strategies involves using crushed olivine, a natural mineral, to absorb CO2 from the atmosphere. However, some scientists are opposed to this strategy because they believe that the environmental cost of processing and transporting such great quantities of olivine outweighs the environmental benefits that it may have. Another plan, known as solar radiation management, is to spray sulfuric acid droplets into the earth’s stratosphere, making it more reflective. While this spraying will undoubtedly quickly reduce the atmosphere’s temperature, it would need to be done continuously. Also, solar radiation management does not counteract other adverse effects of CO2 emissions.

119 words

Fountain, Henry. “Climate Tools Seek to Bend Nature's Path.” The New York Times, The New York Times, 10 Nov. 2014, www.nytimes.com/2014/11/10/science/earth/climate-tools-seek-to-bend-natures-path.html.

6. During the winter of 2017-2018 the Bering Sea contained zero sea ice. This formation of ice causes a pool of very cold water to develop at the sea floor. This cold pool forms a home for arctic cod to feed and breed, safe from the cold-intolerant pacific cod. The sea ice also influences the ecosystem by providing a layer of fresh, nutrient rich water at the surface that provides a habitat for phytoplankton, the vital producers for ocean food webs. This sea ice anomaly is part of a warming trend caused by human greenhouse gas emissions, with catastrophic affects on the arctic. Permafrost melting is adding large quantities of nutrients into the ocean, while sea ice melting is allowing more light to penetrate into the ocean, causing an excessive abundance of toxic algae. These added toxins will have a great effect on the many of the arctic’s ecosystems.

150 words

Gramling, Carolyn. “What Happens When the Bering Sea's Ice Disappears?” Science News,The Society for Science and the Public, 14 Mar. 2019, [www.sciencenews.org/article/bering-sea-ice-disappearing-arctic-ecosystems](http://www.sciencenews.org/article/bering-sea-ice-disappearing-arctic-ecosystems).

7. Oceanographers have discovered an important interaction between the monsoon season and the Indonesia Throughflow, the only warm current connecting the Pacific and Indian Oceans. The easterly trade winds blowing across the Pacific Ocean cause the water level on the Asian side to be higher than on the American side and the Indian Ocean. This imbalance powers the Indonesia Throughflow as water moves downhill. The monsoon winds influence this current by pouring rain on the Indonesian region, obstructing the westward downhill flow. This clogging of the Indonesia Throughflow reduces the amount of warm water entering the Indian Ocean. This seasonal reduction in temperature has significant indirect effects. By reducing the warm water flowing into the Indian Ocean, the monsoons reduce the amount of warm water flowing into the Atlantic.

128 words

Smith, Esprit. “Seasonal Monsoon Rains Block Key Ocean Current.” Edited by Tony Greicius, NASA, NASA, 17 May 2019, www.nasa.gov/feature/jpl/seasonal-monsoon-rains-block-key-ocean-current.

8. 2017’s Hurricane Harvey and other Tropical storms indicate a trend that hurricanes are slowing down. Slow-moving hurricanes are especially dangerous to humans because they are able to cause extensive flooding by continuing to drop rain on the same place for extended periods of time. Hurricane Harvey slowed significantly after making landfall in southern Texas, causing extreme destruction on the coast. Slow-moving hurricanes also change direction more easily, making it harder to forecast their future location. Scientists believe that this trend may be linked to climate change. Scientists have observed that the poles are warming much faster than the tropics, reducing the temperature gradient between the poles and the equator. This reduction is accompanied by a reduction in the pressure gradient and lower large-scale wind speeds. Therefore, there is less force speeding up tropical storms.

Patel, Kasha. “Tropical Cyclones Are Stalling More.” NASA, NASA, 6 June 2019, [www.giss.nasa.gov/research/features/201906\_cyclones/](http://www.giss.nasa.gov/research/features/201906_cyclones/).

9. Scientists hope to use machine learning to improve the speed of earth system models, the computer models that predict earth’s climate. At the moment, there are two main ways to approximate the microscopic processes of cloud formation. The bin microphysics model is highly realistic, but requires huge supercomputing resources. The second model, bulk microphysics is simpler but less accurate. Scientists intended to use machine learning to improve bulk microphysics so that it is as accurate as bin microphysics but does not solve as many complex equations. By feeding a neural network bin microphysics’s inputs and outputs, scientists trained the computer to identify patterns in cloud dynamics. Following machine learning’s success in modeling cloud formation, scientists hope to use neural networks to create a simpler model of the other process involved in earth models. Another similar project scientists are embarking on is using machine learning to predict dangerous solar flares.

149 words

“Can Artificial Intelligence Make Earth System Modeling More Efficient?” NCAR & UCAR News, UCAR, 28 May 2019, [news.ucar.edu/132668/can-artificial-intelligence-make-earth-system-modeling-more-efficient](http://news.ucar.edu/132668/can-artificial-intelligence-make-earth-system-modeling-more-efficient).

10. Recent studies conducted by scientists at the National Center for Atmospheric Research (NCAR) have concluded that accurate weather forecasting will always be impossible more than two weeks in advance. Falko Judt, a scientist at NCAR compared the results of a high-resolution weather forecasting model with weather observations, and observed that there was a significant loss in accuracy after 6 days, and zero accuracy after 17 days. The reason for this limit is known as the butterfly effect, the idea that very small, changes will, over time, impact the entire atmosphere. The butterfly effect was confirmed by another study, in which Judt ran two weather simulations using the same forecasting model. The starting conditions were identical, except for a temperature difference of a few thousandths of a degree. For the first 6 days, the predictions were nearly identical, but after 17 days, there was no similarity between the two predictions.

150 words

Hosansky, David. “Confronting the Unpredictable.” NCAR & UCAR News, National Center for Atmospheric Research, 22 July 2019, news.ucar.edu/132673/confronting-unpredictable.