

CIRES Outstanding Performance Award (OPA)

[← Return to Committee View](#)

General Information **Nomination ID:225 - Submitted: 02-04-2024**

Chia-Wei Hsu and Cathy Smith

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Nominated for Science Service Award

Nominator Information

Michael Alexander
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Nomination Statement

I nominate Chia-Wei Hsu and Cathy Smith for the CIRES Outstanding Science Service Award for developing the Marine Heatwave Portal. The portal, available at the URL <https://psl.noaa.gov/marine-heatwaves/>, allows users to easily and rapidly access (displays global information in less than 10 seconds) a wide-range of information about marine heat waves, including observed events in the historical record, present day conditions and seasonal predictions. This innovative portal has made significant contributions to the field of marine heatwave research and public education. Chia-Wei and Cathy tackled this difficult job with patience and determination over the two year development process, as the portal underwent multiple iterations, addressed security hurdles and enables access through an interactive web-based dashboard.

Marine heatwaves (MWHs) are regions of persistent anomalously warm ocean temperatures, which can have significant impacts on marine life as well as coastal communities and economies. For example, they can cause coral bleaching in the tropics, trigger algae blooms, and are responsible for many large fish kills. Two of the most famous MWHs recently include "The Blob" in the NW Pacific Ocean from 2013-2016, which adversely affected a wide-range of species, including entanglements of humpback whales in crab trap lines; another one off the northeast US coast in 2012 severely affected the lobster population. Given the impact of MWHs, they have been a subject of intensive research in recent years.

Criteria

Criteria 1: Implementation of a service, idea, device, process, or system that aids in research, teaching, or outreach at CIRES.

The idea for implementing an MHW portal was initiated by the groundbreaking Nature paper by Jacox et al. 2022, which showed that skillful seasonal predictions of MHWs were feasible based on forecasts of historical conditions using sea surface temperatures (SSTs) from climate models. Given that these models are used to make actual monthly SST forecasts, CIRES and NOAA scientists/software engineers developed a system for rapidly obtaining the SST model output, generating marine heatwave forecasts and visualizing the results via the MHW portal. Specifically, the portal offers the first global monthly forecasts of the probability of an MHW event up to a year in advance, significantly improving the ability to make decisions based on these forecasts. The portal was further developed to allow users to explore current and historic MHWs and provide a broader view of ocean conditions, including fine scale SST features in coastal regions.

Many news sites and environmental organizations have utilized the MHW portal. The total number of unique users at the site (web bots removed) over the past year was about 20,000, with greater access over time and during higher MHW activity. In addition, there was a total of ~1.8 terabytes of data accessed over the last year. The monthly forecast report, added to the site approximately 6 months ago, has been widely read and generated requests from news outlets such as the New York Times and National Public Radio.

Criteria 2: Development or improvement of a service that increases the efficiency, quality, or visibility of scientific research or outreach.

The MHW portal includes access to forecasts, forecast summaries, observations, data sources, and links to research, news and outside resources, enabling efficient access to a wide-array of information, enabling users to investigate MHWs. Instead of downloading very large datasets, and writing code to read and visualize data, interactive maps and menus allow a user to select a region and time of interest and then change them according to the results. Examples from the portal for examining MHW observations and forecasts are shown in Figs. 1 and 2 (supporting documentation).

The MHW portal is based on the open-source Python software. Care was taken to make sure the user interface is fast and accessible through different platforms. As new tools are developed, they can easily be added to the page. For example, there are plans to allow users to plot vertical profiles of ocean data and allow users to examine histograms of historic SST values. The portal also enables downloading data in standard netCDF format for further scientific research. Data access follows the NOAA open data rule and the Findability, Accessibility, Interoperability, and Reuse (FAIR) principle.

Criteria 3: Providing a service that promotes or inspires excellence and dedication to research performed at CIRES or in the wider community.


One of CIRES research foci is the ocean-climate system, including how it has changed in the past and may change in the future. The portal enables scientists to examine how MHWs have varied from 1982 (when SST estimates from satellites became available) to the present and how they may change in the near future. A current debate in the scientific community is whether SSTs should be detrended before estimating MHWs (e.g., see Amaya et al. 2023). Scientists and the media use the term 'marine heatwave' to refer to extreme conditions compared with historical temperatures but also relative to an evolving 'new normal' due to the mean warming associated with climate change. Both can be relevant for marine species, depending on their response to extreme temperatures and given how rapidly they can adapt to long-term warming. To address this issue the portal displays marine heatwaves using both definitions: with and without the trend removed

(refer to Figs. 1 and 2).

In short, the Marine Heatwave Portal exemplifies outstanding service in science by advancing our understanding of marine heatwaves, promoting open science, and providing a valuable, easily accessible resource for researchers and the public alike. It is used by a number of scientific organizations including NOAA fisheries (<https://www.fisheries.noaa.gov/feature-story/new-global-forecasts-marine-heatwaves-foretell-ecological-and-economic-impacts>) and was included as one of the top research stories by NOAA in 2023 <https://research.noaa.gov/2023/12/19/top-noaa-research-stories-from-2023/>.

Supporting Documentation

- Chia-Wei_Hsu_and_Cathy_Smith_supportingdocs_02_04_24_429.pdf

 Download All Documents as a ZIP File

Supporting Statements

Michael Jacox

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To the selection committee,

I am writing to enthusiastically support the nomination of Chia-Wei Hsu and Cathy Smith for the 2024 CIRES Outstanding Performance Awards. I am a research oceanographer working jointly between the NOAA Fisheries Laboratory in Monterey, CA and the Physical Sciences Laboratory in Boulder, and their efforts have supported and amplified the work of myself and my colleagues.

In 2022, I led the development of the first global forecasts of marine heatwaves (ocean counterparts to atmospheric heatwaves). After acceptance of the paper by the journal Nature, I needed to put a retrospective set of forecasts online, and Chia-Wei and Cathy took up the task of not only posting the forecasts but building a website to serve them. In a very short timeframe dictated by Nature's publication schedule (~1 month), Chia-Wei and Cathy built and launched the website with not only the retrospective forecasts described in the paper, but also new real-time forecasts (psl.noaa.gov/marine-heatwaves/#forecasts). This latter step was a huge addition that I was not expecting to get done; it required developing a workflow that downloads data from multiple climate modeling centers, identifies marine heatwaves and calculates their likelihood of occurrence, and makes a huge amount of data quickly and intuitively accessible for visualization and download.

Once the marine heatwave portal was online, we received immediate interest from users. This portal met a need that had been explicitly expressed by ocean stakeholders including the managers of our National Marine Sanctuaries. At the request of these managers, we held a "knowledge exchange" to introduce

them to the portal and how to use it. They let us know how they envisioned it benefitting their decision making; for example, by informing the timing of kelp restoration efforts that could be thwarted by an unexpected marine heatwave. The products Cathy and Chia-Wei developed are foundational to NOAA's nascent Climate, Ecosystem, and Fisheries Initiative (CEFI) – the next generation national program for incorporating climate information in the management of resilient and sustainable oceans. The portal has also seen impressive recognition outside the realm of ocean management, and has been a highly valuable resource for communication about marine heatwaves by both scientists and journalists.

Since the initial development of the portal, Chia-Wei and Cathy have continued to expand its scope and utility, supplementing the marine heatwave forecasts with historical and near-real-time observations, historical metrics (e.g., placing current conditions in the context of past heatwaves), and additional resources. This past summer, they launched a monthly discussion of the latest forecasts, which summarizes ongoing and expected conditions globally both in descriptive text and a set of updated figures with key information. This discussion is served on the website and is also distributed to a mailing list, all set up by Chia-Wei and Cathy. In addition to this monthly update, periodic adjustments to account for upstream changes in the data (e.g., new global climate models coming online, old ones being retired) have been handled seamlessly, with no interruption of this now highly valued and relied-upon resource.

In summary, the quality, efficiency, and care with which Chia-Wei and Cathy have built and maintained NOAA's Marine Heatwave Portal are truly remarkable and without doubt deserving of this award. Their work in this area is a feather in the cap of CIRES – a concrete example where this cooperative institute has produced something undeniably valuable to the scientific community, stakeholders, and the general public. I hope you will recognize them for it!

Sincerely,
Mike Jacox
NOAA Southwest Fisheries Science Center
NOAA Physical Sciences Laboratory

Dillon Amaya

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Dear CIRES OPA Committee,

I am writing to give my fullest recommendation that Chia-Wei Hsu and Cathy Smith be awarded the CIRES Outstanding Performance Award in the Science Service Category. For context, I am a Research Scientist that has worked with both Chia-Wei and Cathy over the last year as they have developed the now widely-used NOAA Marine Heatwave Portal (<https://psl.noaa.gov/marine-heatwaves/>). This webpage provides up-to-date information on the latest marine heatwave conditions around the globe as well as synthesizes operational seasonal forecasts to produce marine heatwave outlooks for public use.

Since its inception, this innovative tool has become a foundational piece of how I conduct marine heatwave research and, perhaps more importantly, how I communicate marine heatwave risk to the general public and the media. During summer 2023, much of the globe experienced record-breaking marine heatwaves, leading to a flurry of scientific and public interest in these ocean warm extremes. As a result, NOAA was inundated with dozens of media requests looking for more information on the current

conditions and what we might expect in the coming months. I personally fielded many of these interviews, and I heavily relied on this web portal to quickly identify the most important aspects of these rapidly evolving events so that I could answer media concerns about rising temperatures and possible ecosystem impacts. The care and effort that Chia-Wei and Cathy put in to making the web portal both beautifully designed and easy to use made it possible for media personnel to explore many important aspects of marine heatwaves (such as intensity and duration) themselves, leading to new knowledge and understanding of complex scientific topics.

What makes the elegance of the Marine Heatwave Portal more impressive is the technical expertise required by both Chia-Wei and Cathy to make the web page as seamless as it is. Behind the veil of the Portal's public-facing output, Chia-Wei and Cathy masterfully manage and manipulate large, unruly, and varying datasets, allowing users of all backgrounds to interpret potentially abstract climate model simulations in ways that were previously limited to technical experts. In doing so, their hard work has made our science more accessible and, most importantly, more equitable.

The tools and resources that Chia-Wei and Cathy have provided further both NOAA's and CIRES' research initiatives as well our collective goal to effectively communicate our science to the wider scientific and public communities. Without a doubt, they deserve to be recognized for their efforts. Thank you for your consideration.

Sincerely,
Dillon J. Amaya

Theo Stein

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As the NOAA Communications public affairs specialist supporting NOAA's four Boulder research labs and the Pacific Marine Environmental Lab in Seattle, I'm constantly assessing the trajectory of newsworthy NOAA research and findings in the media. Often what we have to offer is incremental: new findings expanding our understanding of recognized issues. Sometimes, media interest is driven by a striking photo or visualization. More rarely, our scientists introduce a novel subject that captures a compelling story of international importance.

Having an attractive, well-designed web resource to provide context and visual resources is important, but having such an elegant, visually compelling, real-time portal coming on line just as a globally significant breaking news story emerged was an extraordinary boost for our media outreach efforts.

Even before its official debut, I started using visuals I poached from the portal to pitch numerous news outlets on PSL's new experimental marine heatwave forecast product, with great success. OAR and NESDIS were soon swamped with ocean heat-related media queries. I captured two dozen stories on marine heatwaves and the experimental marine heatwave forecast product in my 2023 media tracker (plus another 5 bottom MHW stories), including bylined stories in major outlets like the Washington Post, The Atlantic, Science, Reuters, Vox, Fox Weather, and more. The beautiful design and intuitive navigation made it easy for journalists and their graphics support colleagues to explore important aspects of marine heatwaves themselves, which generated more informed and impactful coverage of a novel scientific topic.

Not only did journalists utilize the portal's graphics for coverage of MHWs, outlets covering other aspects of the ocean heat story incorporated the heatwave maps into their reporting, including those writing about other NOAA research efforts (ie: AOML's coral reef watch) and National Weather Service ENSO updates. The PSL MHW site log shows a large number of influential visitors, from the New York Times, ABC News, NBC News, Seattle Times, The Guardian, Nature, Axios, the Atlantic, Time...even NASA's Earth Observatory.

I understand that the marine heatwave portal tools and resources built by Chia-Wei and Cathy are just the latest web tool they've worked on that have supported NOAA's and CIRES' research initiatives. The MHW portal in particular has been invaluable for helping us effectively communicate our science to the wider scientific and public communities.

I'm grateful that they have been nominated for this award and wholeheartedly lend my support for this deserved recognition.

[← Return to Committee View](#)