Summary Report of the Review of the NOAA Climate Program Office

24-26 May 2022

Review Panel

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1. Overview

The Review of the NOAA Climate Program Office (CPO) was held virtually on 24-26 May 2022. The Review Panel (hereafter, "the Panel") was charged by NOAA leadership to assess the quality, relevance, and performance of five CPO Activity Areas (AAs) for the 2014-2019 period: AA1 (Climate Science/Earth System Science and Modeling), AA2 (Climate and Societal Interactions), AA3 (Communication, Education, and Engagement), AA4 (Integrated Information Systems, Risk Areas Initiative), and AA5 (Portfolio Management, Administrative, and Organizational Excellence). The Panel was also asked to provide forward-looking recommendations as CPO develops its next strategic plan.

In preparation of the review, two conference calls between NOAA personnel and panel members occurred on 30 March 2022 and 2 May 2022. Led by NOAA's Office of Oceanic and Atmospheric Research (OAR) and CPO leadership, these calls provided review instructions, logistical details of the review, and information about resources relevant to CPO including its relationship to NOAA OAR's strategic plan, mission, and priorities. In addition, CPO hosted watch-party events to allow the Panel to view pre-recorded presentations for each AA with relevant NOAA personnel. During the watch party, the panelists typed questions into a chat box. Some questions were addressed before and during the event, and others were addressed in detail during the review. All questions were collected and made available to the Panel with answers.

Each panelist was instructed to prepare independent written evaluations, using an Evaluation Sheet provided in advance. The charge to the panelists was to deliver an overall rating of either "Highest Performance," "Exceeds Expectations," "Satisfactory," or "Needs Improvement" as well as ratings for the quality, relevance, and performance on each AA. Guidance to each of the above-mentioned categories was also provided. The panelists were asked to identify specific areas of improvement. Feedback on the review process was also solicited from the Panel to improve future reviews.

The Panel Chair was tasked with summarizing the individual evaluations, developing a list of recommendations, and compiling them into a summary report. As per the guidance provided, NOAA leadership was not seeking a consensus report. The individual panelist's Evaluation Sheets were also provided verbatim to OAR leadership.

Section 2 provides the individual ratings of panelists. Each panelist was randomly assigned a number. Section 3 synthesizes the evaluations and findings of the Panel for each AA. Panel recommendations for each AA are provided in Section 4. Finally, remarks about the review process and comments for OAR management are given in Section 5 and 6, respectively.

2. Summary of Panelist Ratings

The table below summarizes the assessment ratings of each panelist for each AA. For brevity, "Highest Performance" rating is denoted in the table as HP, "Exceeds Expectations" as EE, "Satisfactory" as S, and "Needs Improvement" as NI. Activity areas for which a panelist did not provide an evaluation are left blank.

		Panelist									
	Rating Criteria	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Climate Program Office (CPO)	**Overall**	**HP**	**EE**	**HP**	**HP**			**EE**	**EE**	**HP**	**HP**
Activity Area 1 (AA1) Climate Science/Earth System Science and Modeling	Quality	HP			EE	EE		EE		HP	HP
	Relevance	HP			HP	EE		HP		HP	HP
	Performance	HP			HP	EE		EE		HP	HP
	Overall	**HP**			**HP**	**EE**		**EE**		**HP**	**HP**
Activity Area 2 (AA2) Climate and Societal Interactions	Quality	HP	EE	HP			HP			HP	
	Relevance	HP	EE	HP			HP			HP	
	Performance	HP	EE	HP			HP			HP	
	Overall	**HP**	**EE**	**HP**			**HP**			**HP**	
Activity Area 3 (AA3) Communication, Education, and Engagement	Quality	HP					HP		EE	HP	
	Relevance	HP					HP		EE	EE	
	Performance	HP					HP		EE	EE	
	Overall	**HP**					**HP**		**EE**	**EE**	
Activity Area 4 (AA4) Integrated Information Systems, Risk Areas Initiative	Quality	HP			S					HP	
	Relevance	HP			HP					HP	
	Performance	HP			EE					HP	
	Overall	**HP**			**EE**					**HP**	
Activity Area 5 (AA5) Portfolio Management, Administrative, and Organizational Excellence	Quality	HP						HP		HP	
	Relevance	HP						HP		HP	
	Performance	HP			EE			EE		HP	
	Overall	**HP**			**EE**			**HP**		**HP**	

3. Summary of Evaluations and Findings

The overall ratings of HP (5) and EE (3) by panelists (shown as blue text in the table above) reflect the favorable impression of CPO on the Panel. The subsections below synthesize the overall evaluations and findings of each Activity Area (AA).

(a) AA1: Climate Science/Earth System Science and Modeling

The provided overall ratings of AA1 by different panelists are HP (4) and EE (2).

Quality of AA1: The research and products produced by the Earth System Science and Modeling (ESSM) Division are of extremely high quality and critical to NOAA's mission of understanding and predicting changes in climate, weather, ocean, and coasts. ESSM staff are deeply invested in the success of their programs. Program managers are well-connected to the research community and are to be lauded for building partnerships and trust within NOAA and across other federal agencies. Supported research areas span a broad range of relevant topics that align with the ESSM R2O goal and elucidate the primary physical drivers of the climate system. The high-quality funded projects leverage outside expertise to complement and accelerate specific OAR laboratory missions and research programs. ESSM has maintained a high-quality research portfolio by being responsive to scientific needs identified through National Academy reports, community-oriented workshops, conferences and meetings, and external partnerships. ESSM continues to be held in high regard in the U.S. GCRP interagency space through its contributions to National Climate Assessments (NCA) and the Interagency Group on Integrative Modeling (IGIM). Programs like Climate Variability and Predictability (CVP) are well-aligned with U.S. efforts that correspond to international programs at WCRP (e.g., CLIVAR). Many publications stemming from efforts supported by ESSM are influential and appear in high-impact journals.

Relevance of AA1: The work of ESSM is foundational in climate system understanding, Earth system modeling, and climate predictability and prediction -- all critical to national priorities and the NOAA Mission. The funding provided by ESSM supports cutting-edge research at universities and national labs, without which the scientific advances achieved to date (and those needed for the future) in ESSM programs would not occur. ESSM has made tangible and important contributions to the OAR Strategic Plan and CPO Goals and Objectives, such as driving innovative science, improving forecasts, documenting the predictability of the coupled system across timescales, and improved climate understanding. The strong relevance is substantiated by stakeholders, with one noting that, with respect to AA1, "CPO fills a gap that no other federal agency currently does - it supports climate science (across timescales) by bridging the gap between process-based science and prediction/predictability in a way that no other program currently supports." Hence, the Panel found that CPO is strongly positioned for success in the R2O pipeline, and CPO/ESSM is well-positioned to contribute to research in climate adaptation and mitigation.

Performance of AA1: The performance of various programs within ESSM (AC4, COM, CVP, ERB and MAPP) has been strong. Many impactful, peer-reviewed publications have resulted from these grant programs, and community activities organized by ESSM (e.g., NMME) have provided tangible advancements. Examples of key progress include advances in process understanding through field campaigns, critical new Earth system observations that led to enhanced monitoring capabilities, improved understanding of the predictability of climate phenomena, advances in modeling capabilities and the skill of predictions from subseasonal through decadal timescales, and projections of future climate variability and change. ESSM provided leadership in NCAs and made contributions toward R2O and R2A transitions over the review period, including research in direct support of user needs and addressing risk areas. ESSM has guided numerous task forces and maintained strong connections with U.S. CLIVAR. ESSM routinely delivered on its Annual Operational Plan (AOP) metrics and milestones, and, where items were quantified, ESSM routinely exceeded its target (e.g., publications). The Panel especially noted that the very high-

performance level of ESSM has continued despite program budget reductions and budgets not keeping pace relative to inflation. Stakeholders praised ESSM's strength in communicating with, supporting, and leading the research community.

(b) AA2: Climate and Societal Interactions

The provided overall ratings of AA2 by different panelists are HP (4) and EE.

Quality of AA2: The Panel was of the opinion that the Climate and Societal Interactions (CSI) team and the quality of its work products are outstanding. AA2 deliverables are effective and impactful. The CSI team members are thoughtful, self-reflective, and strategic. CSI is widely viewed with high regard in interdisciplinary policy-relevant research with the highest standards of excellence. The Regional Integrated Sciences and Assessments (RISA) program is excellent. The Panel recognized that the CSI members are clearly working to achieve the maximum with the resources available to deliver high value across all the CSI programs.

The Panel felt that there may be some opportunities for improvements, including better strategic integration with the work of the risk areas, modelling efforts, line offices and the laboratories, including strategic interactions with other agencies where shared interests exist.

Relevance of AA2: CSI's work is highly relevant to top-level priorities of the current Administration, as well as to communities on the frontline addressing issues related to climate change impacts and to environmental justice. CSI's program managers continue making ongoing improvements through evaluations, connecting with stakeholders and partners, and transforming areas as needs arise. The Panel appreciated that the CSI's portfolio focuses on relevant issues and outcomes that are connected, for example, to underserved communities, water management, adaptation science, health, and international resilience. CSI's commitment to the inclusion of stakeholders in the research process keeps CSI programs at the forefront of climate change science and brings unique value to NOAA and climate efforts at other federal agencies.

Given CSI's effectiveness in ensuring the relevance of research efforts and in building strong stakeholder relationships, the Panel believes that these efforts should be an ongoing feature of CSI's work. CSI programs should be strongly leveraged in the all-of-government Climate Ready Nation initiative to provide essential scientific knowledge for how to address societal needs. The climate adaptation community is over-saturated with tools that are often too hyperlocal, overly specific, or insufficiently user-friendly to be useful to decision-makers. CSI could lead CPO and NOAA in an approach to refine climate and resilience data, modeling, and prediction products that are broadly applicable and highly usable by diverse stakeholders across the country.

Performance of AA2: CSI programs and team members perform at the highest level and provide significant value for the resources invested by CPO. CSI continues to produce results that are novel, cutting edge, and robust. The low staff turnover rate in CSI is a testament to the current strength of this division. Diversity, Equity, Inclusion, and Justice (DEIJ) has been a priority in CSI's work. The increasing national attention and Presidential directive present a continuing opportunity for CSI to build upon its work and establish a leadership position in advancing DEIJ.

The Panel expressed concerns that CSI operating well above its resource level is not sustainable. As climate change affects more communities, the translation of research results to the stakeholders needs to be sustained. However, the growing demand for CSI programs will eventually outstrip the program resources. As is, several RISAs already appear to be greatly underfunded to meet their mission. This imbalance between resources and expectations poses a risk to the CSI programs and team.

(c) AA3: Communication, Education and Engagement

The provided overall ratings of AA3 by different panelists are HP (2) and EE (2).

Quality of AA3: The quality of products developed and deployed by the Communication, Education, and Engagement (CEE) Division was deemed to be excellent and, in many cases, best-in-class in the government for climate communications and engagement. The well-designed education program anticipates pedagogical needs of students and administrators and seems to be well deployed. The engagement program is robust with discrete goals that are operationalized in programmatic activities and evaluation. The content curated at *climate.gov*, Climate Explorer, and the U.S. Climate Resilience Toolkit (CRT) are high-quality, critical tools for accessing climate related information. *Climate.gov* has established a reputation as a leader in its field, having made quantum improvements in its content and accessibility in recent years. CRT is a go-to repository of tools, data, and information for practitioners in the climate resilience field. Overall, these products reflect the exceptional work done by the small and dedicated CEE team on limited budgets.

The Panel acknowledged that ascertaining the actual impacts of the CEE products is difficult. It is unclear if these products and content streams are reaching the right audiences and producing meaningful outcomes. In its self-evaluation of quality, CEE at times conflates activities with impacts and assumes how its programs and products are both being used and the results of their usage. Claims about being “trusted” and “authoritative” require more evidence to substantiate. Like other AAs, CEE appears exceptionally overtaxed – driving strategic vision for some form of National Climate Service while supporting the new demand for more content, products, and mechanisms of engagement.

Relevance of AA3: CEE engages with the right stakeholders across different communities. As the main climate site for NOAA, *climate.gov* is effective in attracting many visitors (at an increasing rate) and serves as a key repository for data and a platform to improve climate literacy. CEE is very relevant in NOAA’s efforts in the communication, education, and engagement space. It directly addresses a top priority of the current Administration and contributes toward efforts to support a Climate Ready Nation. Given its interface with the press and news media, CEE has a significant amount of influence in how CPO is perceived among its key audiences.

One of the panelists noted that evaluating relevance (e.g., CEE’s effectiveness at promoting climate literacy or the national discussion/conversation around climate change) is difficult given the data provided during the review process. It is also clear that providing access to data and tools is not, in and of itself, a climate service, which requires a more tailored approach. Clearcut relevance is mostly evident in CEE’s education and curricular programs which may be aligned with educational standards in science. The relevance of *climate.gov* is difficult to assess based on

number of visits. Site growth, downloads, and page views may not be good proxies for the motivations that people have for engaging with content on *climate.gov*, or its impact in improving climate literacy

Performance of AA3: CEE is considered one of the top federal climate communications and education programs. From internal CPO communications to the external audience interface, CEE demonstrates best practices in active communications and engagement. The level of intra-institutional literacy among the staff and stakeholders is remarkable. Given its limited resource, CEE is highly effective. The CPO Hot Items are very well done and could serve as an important way to share research and professional highlights with leadership. However, it isn't clear that they are being read or used by target audiences. CEE has developed potentially transformative tool kits and community engagement strategies.

The Panel expressed concern about how the CEE team will maintain its performance with its small size and heavy reliance on a large contractor staff. This is particularly acute in the context of gearing up for the Climate Ready Nation directive. CEE already operates above its resource level. The Panel also noted an increase in program-specific communications staff hired into the programs to promote specific program activities and research. While this increase relieves the pressure on CEE to support program needs, there are risks that such program-focused communication products may only help brand individual programs at the expense of an overarching CPO brand.

(d) AA4: Integrated Information Systems, Risk Areas Initiative

The provided overall ratings of AA4 by different panelists are HP (2) and EE.

Quality of AA4: The established programs and deliverables of AA4 are of excellent quality. The National Integrated Drought Information System (NIDIS), National Integrated Heat Health Information System (NIHHIS), and the substantive CPO contributions to the NCA process and products are outstanding, highly visible, and recognized nationally and internationally. The high quality of NIDIS and NIHHIS was further underscored in the feedback from stakeholders. The large number of regional Drought Early Warning Systems (DEWS) stakeholders, webinars, virtual workshops, NIDIS Consultations across sectors, and other efforts demonstrate strong relationship-building effort fostered in AA4. The Risk Areas Initiatives portfolio promises risk-specific deliverables and serves as a potential mechanism for achieving greater integration across CPO's (and NOAA's) assets. A strong number of publications (in influential journals) related to water resources and drought further point to the high quality of AA4.

Relevance of AA4: The Panel was of the opinion that the work under the AA4 portfolio is highly relevant to NOAA and Administration priorities. NIDIS and NHHIS are addressing issues of critical importance to the nation in terms of response to climate change. The rising prominence of NIHHIS is evident, both nationally and internationally. NIDIS has clear ties to legislative mandates and public laws, which are referenced in the OAR Strategy. Contributions to NCA are foundational to a Climate Ready Nation. Program managers help maintain relevance of the Integrated Information Systems (IIS) and the NCA through ongoing evaluation of effectiveness stakeholder engagement. The Risk Areas Initiatives align with key risks identified in NCA4 and with core NOAA

functions though there may be some transactional costs associated with making these programs mesh with other CPO projects properly.

Performance of AA4: CPO engagement with affected communities, government agencies, and policymakers with respect to AA4 has been very successful. As attested by stakeholders, AA4 activities and outputs are clearly making a difference. With clearly defined objectives and ability to evolve over its lifetime, NIDIS shows strong leadership as well as efficient efforts. CPO performance in climate and health through NIHHIS is remarkable, particularly on an international stage through WHO and WMO.

Demands on the science and services delivered via IIS, assessments, and, presumably, the emerging Risk Areas Initiatives are expected to grow rapidly. As such, the Panel foresees issues in sustaining the efforts and productivity in AA4. A minor issue raised by the Panel was the following: it is unclear how the learnings and research identified through the IIS approach is integrated back into CPO programs, so they can be more responsive to user needs.

(e) AA5: Portfolio Management, Administration and Organizational Excellence

The provided overall ratings of AA5 by different panelists are HP (3) and EE.

Quality of AA5: The Administrative Services Division (ASD) has a large and difficult job of managing day-to-day office operations including personnel actions, responses to grants and budget inquiries, domestic and international travel support, space planning, facilities support, and acquisition management. In addition, it oversees the development, implementation, monitoring, and reporting of CPO's policies and procedures in support of CPO's mission. By all the provided evidence, the Panel generally recognized that the ASD members are dedicated and high performers. The sheer volume of positive client testimonials was extremely impressive, further attesting to the high quality of services provided by ASD.

Relevance of AA5: ASD activities (e.g., budget formulation and spending, grants management, management of cooperative agreements, fostering diversity) are highly foundational. ASD works with CPO programs, with OAR, and across other NOAA line offices. For example, ASD manages the UCAR Cooperative Agreement, and some tasks under that Cooperative Agreement support NOAA line offices. Furthermore, ASD will play a strong role in supporting CPO with the developed Business Applications Solutions as it is implemented across the Department of Commerce. To this end, ASD activities are highly relevant not only for CPO but also to OAR, NOAA, and beyond.

Performance of AA5: ASD performance appears to be outstanding, with a very impressive track record. The ASD's team culture focuses on and emphasizes innovation in workflows and processes. ASD and CPO management exhibited agility in its hiring practices and ability to pivot to address challenges. Notable examples of the latter are the successful and dramatic shift to digital grant packages during COVID-19 and turning the unexpected need for remote work into an opportunity for process streamlining. The Universal Programmatic Spend Plans (UPSP) was instituted to provide uniformity and streamlining in the budget formulation process, allowing staff to combine information and share files remotely. Stakeholders were pleased with their interactions with ASD, the level of dedication of staff, and its effectiveness.

The Federal Employee Viewpoint Survey (FEVS) results demonstrated strong support for the telework program as well as CPO leadership's support for work-life programs, communicating about CPO goals, and promoting communications across CPO.

CPO has an intentional approach to its diversity, equity, inclusion, and accessibility (DEIA) efforts, both within the office and in its extramural funding programs. Language on DEIA was added to the Notices of Funding Opportunities (NOFO) and included as part of the proposal scoring. PIs are required to report forms of harassment that occur in the teams. By all accounts, CPO is a leader in setting the tone on these DEIA fronts within NOAA and is to be congratulated for taking these issues seriously.

ASD's management of the CPO's DEIA portfolio was well-conceived with DEIA efforts and awareness across CPO. The goals of the DEIA Working Group are sound with noteworthy key accomplishments that reflect strong leadership. Arrangements for honoraria and the use of virtual panels have been initiated to improve the diversity of review panels. The Panel applauded CPO's continued investments and support for education and training programs to help build the next generation workforce while also addressing DEIA with training programs.

4. Summary of Recommendations

The Panel was of the opinion that CPO is significantly under-resourced for the mission and responsibilities it has, especially in the context of increasing commitments to the Climate Ready Nation concept. This sense was shared by stakeholders as well. Despite resource constraints, the Panel noted that the quality, relevance, and performance of CPO's efforts have continued to be high. They are of high importance to the overall mission of OAR and NOAA, as well as the research community and stakeholders. While the Panel was of the opinion that additional resources are warranted, it was not clear if they are attainable. The Panel encourages CPO leadership, in laying out its strategic visioning, to reflect on how the existing programs link with each other, and other parts of OAR, NOAA, and other agencies. The goal would be to identify ways that line offices can work in collaboration with CPO to achieve more impactful outcomes without increased spending. Additionally, focusing on and prioritizing fewer items could help CPO address urgent needs or emerging areas. The upcoming strategic planning process can support efforts in articulating value propositions and identify the highest priority items serving the CPO mission.

The Panel noted that the 2015-2019 CPO strategic plan had a very large number of objectives across the four goals. The Panel suggests that CPO pursue a more streamlined strategic plan and use another document (e.g., an implementation plan) to capture specifics in greater detail. The Panel further suggests that the next strategic plan should provide greater attention to articulating outcomes and impacts, to put CPO outputs into a larger context. Much of the reviewed information focused on activities and outputs from various Activity Areas. For some activities, CPO can take on more ambitious measures and milestones and develop organizational capacity around them. For example, NIHHIS could strive to operationalize numerous heat products and target NIHHIS information to help advance heat forecast capabilities as well as heat health adaptation and mitigation planning.

A few recommendations are presented below to help CPO formulate its strategic plan for the next five years with respect to each Activity Area.

(a) AA1: Climate Science/Earth System Science and Modeling

In large part through its competitive grants program, ESSM has accelerated OAR laboratory research and, thus, has played a critical role in aiding NOAA labs and programs in meeting their missions. Maintaining and possibly expanding the grants program is thus an important objective for CPO, even in difficult budget times. Not only is this critical for advancing Earth system science and modeling but it also helps to enhance CPO engagement with universities. The latter effort will be a key to diversifying and reinforcing the NOAA workforce. Effectively leveraging university talent provides a huge return on investment. ESSM should continue its efforts of obtaining community input and feedback on its programs and their priorities and evolve and expand them accordingly.

Many aspects of Earth system prediction need further investigation through cutting-edge research. The mission goal of predicting changes in the Earth system is tightly connected to the research community. Expectations of urgent delivery of actionable information and OAR's emphasis on R2O is understandable. The Panel was of the opinion that CPO programs supporting university-based research efforts for the "long-haul", as is required to tackle complex problems, is a plus. The research community could help CPO/ESSM leadership identify clear examples of how long-term investments have led to transformational advancements of central importance to the NOAA mission. CPO should facilitate ways for more visibility of its research outcomes.

Addressing research issues associated with Earth system predictability requires a continuum approach, in which the distinction between short-term predictions and long-term Earth system projections is seamless. All predictions, regardless of time scale, share common processes and mechanisms; moreover, interactions across time and space scales are fundamental to the Earth system itself. This reality must be reinforced by NOAA. Supporting research on only discrete parts of the time continuum within CPO will not optimally accelerate advancements in Earth system prediction required by society in this time of rapidly changing environmental conditions. Removing many critical aspects of S2S prediction and predictability research from ESSM, for instance, has stymied progress in the weather-climate timescale.

CPO and ESSM should explicitly address NOAA's operational mandate for prediction by moving its focus from weather to the coupled Earth system. An intentional shift from observing the physical state of the atmosphere to observing the physical states of the ocean, sea ice, and vegetation, as well as atmospheric and oceanic chemistry, would help enhance NOAA capabilities if sufficient funding exists. It is suggested that NOAA and the CPO expand prediction products beyond the current 10-day weather forecasts to include reliable forecasts of the environmental parameters that affect people's lives, health, property, and economic situations directly (e.g., air quality, pollen, sea level rise, waves and storms, sea ice thickness and extent, ecosystems including fish and other living marine resources, fire, agriculture, and crops). Prediction should strive to encompass the next 50 years to best enable the most just and equitable outcomes as we address current climate trends.

The Panel recommends WPO and CPO foster a stronger synergistic relationship and clarify their respective roles to the research community as well as interagency partners. Even though the weather enterprise is distinct from climate effort, the two share common processes and mechanisms that interact across time and space scales; consequently, the definitions of weather-

to-climate timescales are somewhat artificial. How research products, focus, efforts are transitioned between WPO and CPO should be done with great care to minimize tension between the offices and duplication of efforts as well as to avoid confusion among the stakeholders, particularly in a budget-constrained environment.

CPO should have a clear strategy (involving leadership to its staff) to better integrate ESSM efforts and the other Activity Areas, especially CSI and RISAs, as well as other line offices.

(b) AA2: Climate and Societal Interactions

Supporting a Climate Ready Nation needs to be undertaken by NOAA in partnership with entities outside NOAA. Ongoing, strategic, and high-level partnerships with other agencies are crucial. In addition, the development of climate services is a broad interdisciplinary effort, not just a source of information. A Climate Ready Nation needs to integrate climate considerations throughout the functions and decisions of the country on various facets, that include managing risk, maximizing opportunities, and simultaneously reducing emissions. While this is a tall (but imperative) order, there is no better program in NOAA, or for that matter, even in the federal government that is more appropriate to lead such an initiative than CPO through CSI.

In its new Strategic Plan, the Panel recommends that CPO consider ways to strategically leverage CSI better throughout CPO. This should involve a closer integration of CSI with the ESSM, CEE, and IIS/Risk Area Initiatives, as well as improved connectivity with the laboratories, the other line offices and services. CSI's deep engagement with stakeholders and insights from such engagement should contribute to that integration. Currently, integrative alignment appears to occur sporadically within funded projects. A strategic integration at the program and/or leadership level could help direct resources to the most useful and impactful areas of effort. This strategy can extend across NOAA and other federal climate efforts to help ensure that CSI is at the center of the whole-of-government approach for a Climate Ready Nation.

Within CSI, the Panel believes that it should explore strategies to enable the implementation and scaling of the innovative climate solutions that emerge from funded projects. Entrepreneurship from within or in conjunction with funded research teams should also be encouraged and supported. CSI should likewise explore opportunities to support PI entrepreneurship through NOAA's SBIR and STTR programs. A collaboration with NSF's iCorps program or partnership with NSF's new TIP Directorate might also enable opportunities for scaling climate adaptation solutions. The growing national interest in climate security could unlock fruitful partnerships, especially with DoD and FEMA. As noted above, CSI should deepen its engagement with other federal agencies to explore opportunities for partnership and additional funding.

The Panel believes that the RISA networks could form the backbone of a national system to support climate adaptation. Some panel members were of the opinion that RISA investments need to grow by at least an order of magnitude for the networks to meet ever-expanding needs across the U.S. To do this, NOAA would need to work in a more robust and effective way with Congress. Although it is acknowledged that RISAs are intended to be primarily focused on research rather than R2O, a Climate Ready Nation will require that RISAs be less tied to a "research only" approach and be allowed to work towards solutions. RISA investments are so highly leveraged that they are a huge impact multiplier.

The added funding would allow for the RISA program to develop and implement strategies to facilitate and support the long-term viability, sustainability, and scaling of each RISA beyond the five years of support initially provided by NOAA. There is a clear demand for the co-production of research and on-the-ground mitigation and adaptive work of RISAs. The decline of a successful RISA at the expiration of NOAA's support is both disruptive to the regional climate community and detrimental to the trust engendered in NOAA's climate science and services.

The AdSci and International grants programs within CSI need to be sustained and expanded. They provide an opportunity to diversify across universities and partners beyond the RISA-based efforts. There is a huge unmet need in adaptation science with many at-risk communities lacking the capacity to take steps towards resilience. The adaptation science program helps CPO maintain its focus on DEIJ which was already a motivator for CSI before DEIJ became a national imperative. This is an opportunity for CSI to pick up the mantle of leadership in advancing and institutionalizing DEIJ efforts in a Climate Ready Nation. This would involve perseverance from CSI to include diverse stakeholders at the frontline of climate impacts in co-developing research and adaptation activities.

The Panel was of the opinion that vis-à-vis climate services development in fisheries is an area that NOAA can take ownership of and provide/pilot end-to-end climate services. Through CSI, NOAA could expand its engagement in food systems and associated communities to be a demonstration of what a "resilient fishery system" looks like, while helping to promote food security. Such engagement between science and society with a coordinated effort across a range of fisheries and geographies could enable the scaling of innovation solutions emerging from co-production of research and connect fisheries, health, and international programs.

(c) AA3: Communication, Education and Engagement

A corporate communications vision needs to be a central part of CPO. Some panelists were of the opinion that the visibility and perception of CPO in the constellation of climate entities needs to be enhanced, even within NOAA. This requires sophisticated public relations and marketing, including strong branding and message fidelity. "News" about climate science or CPO activities do not truly capture this vision.

The Panel views CEE as the appropriate place to house and propagate the corporate communications vision. For it to operate effectively, it is recommended that CEE be a central part of the new CPO strategic plan, and OAR strategic plan, for that matter. The plan would explicitly spell out reasonable goals for CEE, desired outcomes, and metrics that will be used to document achievement of outcomes. CEE should not be considered as a distributed service to the other programs. Instead, it should be considered a strategic asset. CEE activities were a throwaway line in the previous Strategic Plan; the Panel recommends the next plan give CEE a prominent place.

Despite the importance of CEE, some members of the Panel were of the opinion that CEE does not appear to be adequately resourced to carry out its functions as well as it could. If CEE were to be a central part of CPO's Strategic Plan, the Panel strongly recommends CPO to address the resource scarcity and staff overload issues in CEE. In many cases, CEE has become the visible face of NOAA, and thus NOAA may need to invest more heavily in CEE efforts in the context of a

Climate Ready Nation. Without an adequately resourced and supported CEE, much of CPO's wonderful work could be "the proverbial tree falling in the forest that no-one hears."

The new strategic plan needs to do more than tie itself to a decade-old climate literacy framework and the three-decades-old concept of a "climate attentive public." It should adopt contemporary engagement models for both formal and informal learning, and with contemporary research in science communication, specifically about how audiences seek, find, and use climate products like those developed by CEE. CEE should explore ways to advance the marketplace of climate information. The public is increasingly looking for climate information that is relevant for mitigation decisions and civil society planning efforts; however, NOAA currently does not have the capacity to meet demands. Although a strategic interagency approach is required to address needs, CEE could be a good place to start to address them.

To promote climate literacy, CEE should find/contract for and apply longitudinal metrics that tie CEE deliverables to achieving progress there. Case studies of individual curricular interventions, community engagements, or use data from resources provided by the website offer the best way to document that CEE is being successful. These case studies do not have to be national in scope but they do need to go beyond anecdotal at a reasonable scale to demonstrate impact.

It was suggested that CPO re-examine the Hot Items approach, especially in the context of a full-up internal communications strategy. A tremendous amount of energy and resources are tied up in products that don't seem to have a ready/anticipatory audience. Instead, CPO should consider its own internal communications strategic plan, informed by the Director and Senior Leadership rather than developed from the ground up without explicit guidance. Potentially, the Hot Items approach can be repurposed in ways that ensure a larger and more impactful audience, such as federal agencies, Academia, or even the Press.

If CPO is the proto-climate service, then there needs to be some level of coordination with the rest of NOAA. Multiple NOAA offices working independently on climate IS NOT a national climate service or even a NOAA climate service. Strategic communications are required inside NOAA, across the federal agencies, especially NASA, NSF, and EPA, and across the U.S. Because NOAA has a visible role at USGCRP, much more could be accomplished by innovative, far-sighted leadership that encourages other agencies to step up and work towards real solutions to the climate crisis. Potentially relevant to these strategic communications is *climate.gov*, which is part of CEE. CPO needs to have a clear vision of what it should be, based on a thorough, thoughtful, and stakeholder-inclusive process. There needs to be clarification from leadership at NOAA and beyond on whether this is or should be the all-federal climate portal noting that USGCRP must also be a significant player.

Resilience planning should be an essential precursor to implementation, and CEE should be able to provide a framework that is accessible and relatable. A panelist mentioned that, at present, it is unclear about the uptake rate of the Steps to Resilience framework, and if this too is being utilized as hoped. If this framework is not meeting this need, it is recommended that CEE revisit and consider revising it, especially considering the limited resources.

(d) AA4: Integrated Information Systems, Risk Areas Initiative

Because of its emphasis on integration across CPO assets, as well as within CPO and NOAA line offices/services, the Risk Areas Initiative could possibly provide a framework for a coherent, CPO-centered, cross-agency approach for accomplishing the goals of NOAA's Climate Ready Nation effort. Like other areas, AA4 is a crucial part of CPO and is in unique alignment with the goals of a Climate Ready Nation. Considering limited resources in an environment of increasing demands on products and services AA4, the Panel recommends members in AA4 coordinate the other offices with agency and administration priorities to leverage additional resources.

In addressing stakeholders' input, the shifting nature of demand for specific services and products, or emerging issues/priorities, the Risk Areas Initiative offers a mechanism for strategic considerations within various CPO programs. Some on the Panel suggested Risk Areas as an organizing principle for developing the upcoming strategic plan, using them to rebalance the CPO portfolio or enhancing partnerships with other NOAA line offices and services. CPO might need to give some additional thought as to how particular Risk Areas are chosen and pursued as integrative categories. A systematic and strategic approach is needed – e.g., should the portfolio of risks focus primarily on where NOAA has statutory authority, and can thus directly take "action," such as fisheries?

The Panel recommends teams in AA4 to consider compound, cascading, or otherwise more complex risks within the Risk Areas Initiatives context going forward. The science and solutions for multi-hazards and cascading effects are critical. Communities will experience extreme events through multiple lenses.

NIDIS activity appears well funded and staffed. Still, given the impact of drought on so many communities and sectors, CPO needs to consider the staffing model for DEWS. As some stakeholders noted, one person is often serving more than one DEWS, which seems to spread them too thin. Additionally, NIDIS should provide more feedback to the modelers regarding stakeholder needs to strengthen the society-science ties.

Relative to OAR and CPO strategic plans, AA4 strongly aligns with CPO but the connection with OAR was less clear. The five strategies laid out in the OAR strategic plans include no language about fostering the application of knowledge or engagement with stakeholder and user communities, which seems to be foundational aspects of AA4. As CPO pursues its next strategic plan, the Panel recommends that CPO leadership clarify and work with OAR leadership about the strategic alignment of AA4 activities to OAR strategic priorities.

Pilot efforts that support climate assessments driven directly by stakeholders with interests in climate-related decisions across regions, industries, and communities, especially underserved and disadvantaged ones are encouraged. While NCA may involve regional public meetings and an allowance for public reviews, an impression persists that the NCA efforts are largely a scientist-driven process. Coupling ongoing stakeholder-driven assessments with NCA could greatly provide CPO with a much broader input. The Panel recommends that CPO work with AMS and similar organizations to help build stakeholder-driven, strategically designed climate assessments.

(e) AA5: Portfolio Management, Administration, and Organizational Excellence

If CPO budgets were to increase, the Panel recommends CPO and OAR Management take a careful look at workload of the ASD staff. To ensure the level of services continues to be sustained, the number of FTEs in ASD might need to be increased. There may be implications for FTEs to be increased in the other Activity Areas as well.

Attention to diversity was connected to the previous CPO Strategic Plan; however, there was only one direct reference to a diverse workforce. The Panel encourages CPO to align its future strategic plan with DEIA more directly, following the great progress already under way. The Panel offers these suggestions:

- To further address CPO DEIA effort while supporting climate resilience, CPO should draw on its familiarity with addressing complex and compound risks to human and economic values (CSI has made significant progress with this) particularly with historically underserved communities. CPO can provide real leadership to the nation in supporting the beneficial considerations of these risks and impacts, especially as the nation seeks to address systemic racism.
- CPO should address two items on grants and cooperative agreements with respect to CPO's DEIA goals. (1) CPO could consult with similar government programs to compare/lead on smart practices on DEIA at all stages of the solicitation process. (2) CPO could establish mechanisms for awardees to report on the success of DEIA efforts conducted during the award, helping encourage awardees to follow-through on efforts presented in their proposal. For example, an awardee's annual report could address/report on the outcomes of their DEIA efforts, and CPO program managers could account for this in end-of-year discussions with the awardees and guidance for renewals.

The Panel recommends that CPO consider improving some aspects of its grants and agreement processes. One improvement could be reducing the steps in the signature routing for routine grant packages, embracing CPO's strategic objectives to empower people and decision making. Another improvement could be in the interagency transfer (IAT) process, especially for NOAA to receive and send funds from/to other agencies for mutually beneficial work. Given limited resources and interests in interagency collaboration, addressing this issue of IATs into NOAA is critical for CPO success.

5. Numbered List of Recommendations

Below is a numbered list of the Panel's recommendations for each Activity Area for CPO. The context behind this list can be found in the recommendation summary (Section 4).

AA1: Climate Science/Earth System Science and Modeling

1. Continue efforts to obtain the research community's input and feedback on ESSM programs and their priorities to allow these programs to evolve and expand accordingly. Many aspects of Earth system prediction need further investigation through cutting-edge research.
2. Continue supporting university-based research efforts for the "long-haul," as is required to tackle complex Earth systems problems. Enhanced engagement with universities can also help diversify and sustain the NOAA workforce.

3. Reinforce holistic approaches that seamlessly integrate short-term predictions and long-term Earth system projections in addressing research issues associated with Earth system predictability.
4. Address NOAA's operational mandate for prediction by shifting focus from weather to the coupled Earth system. This shift would involve expanding prediction products beyond the current 10-day weather forecasts to include reliable forecasts of the environmental parameters that impact society.
5. Foster a stronger synergy between WPO and CPO and clarify their respective roles to the research community as well as interagency partners. This includes exercising care in how research products, focus, and efforts are transitioned between WPO and CPO to minimize duplication and tension between the offices as well as to provide more clarity to stakeholders.
6. Develop a clear strategy (involving leadership as well as staff) to better integrate ESSM efforts and the other Activity Areas, especially CSI and RISAs, as well as other line offices.

AA2: Climate and Societal Interactions

1. Strategically leverage CSI throughout CPO by integrating it closely (at the program and/or leadership level) with ESSM, CEE, and IIS/Risk Area Initiatives to help direct resources to the most useful and impactful areas of effort.
2. Extend CSI efforts and connectivity across NOAA and other federal climate efforts (e.g., those in NSF's iCorps program and/or new TIP Directorate at NSF, and/or efforts at DoD and FEMA) to help ensure that CSI continues to remain at the core of the whole-of-government approach for a Climate Ready Nation.
3. Explore ways to enable the implementation and scaling of the innovative climate solutions that emerge from funded projects by (a) encouraging and supporting entrepreneurship from within or in conjunction with funded research teams; and (b) exploring opportunities to support PI entrepreneurship through NOAA's SBIR and STTR programs.
4. Find ways to allow for the RISA program to develop and implement strategies to facilitate and support the long-term viability, sustainability, and scaling of each RISA beyond the initial five-year support. RISA networks could form the backbone of a national system to support climate adaptation, and so that investments in RISA have huge returns.
5. Sustain and expand the AdSci and International grants programs as they provide an opportunity to diversify across universities and partners beyond the RISA-based efforts -- helping CPO maintain its focus on DEIJ.
6. Explore climate services development in the fisheries sectors with a goal to provide/pilot end-to-end climate services thereby expanding NOAA's engagement in food systems, sustaining associated communities and helping promote food security.

AA3: Communication, Education and Engagement

1. Develop a clear vision of what *climate.gov* should be as a possible part of the strategic communications inside NOAA, across the federal agencies, especially NASA, NSF, and EPA, and

across the U.S. This vision should be based on a stakeholder-inclusive process with clarification/guidance from leadership at NOAA and beyond on whether *climate.gov* is or should be the all-federal climate portal.

2. Explicitly spell out reasonable goals for CEE, desired outcomes, and metrics for deliverables and achievements.
3. Give CEE more prominence in the new strategic plan as CEE should be considered a strategic asset to house and disseminate the corporate vision of CPO (in the context of sharing educational and scientific information).
4. Address the resource scarcity and staff overload issues in CEE so as to enable it to function effectively. In many cases, CEE has become the visible face of NOAA, and thus NOAA may need to invest more heavily in CEE efforts in the context of a Climate Ready Nation.
5. Adopt contemporary engagement models for learning and contemporary research in science communication, specifically about how audiences seek, find, and use climate products.
6. Explore ways to advance the marketplace of climate information that is relevant for mitigation decisions and civil society planning efforts that are much needed by the public.
7. Re-examine the Hot Items approach and consider an internal communications strategic plan, informed by the leadership rather than developed from the ground up without explicit guidance. The Hot Items approach may be repurposed in ways that ensure a larger and more impactful audience.
8. Provide a framework for resilience planning that is accessible and relatable. At present, it is unclear about the utilization and uptake rate of the Steps to Resilience framework. If this framework is not meeting this need, CEE should consider revising it.

AA4: Integrated Information Systems, Risk Areas Initiative

1. Coordinate with the other NOAA offices with agency and administration priorities to leverage additional resources to address the increasing demands on products and services within AA4.
2. Consider Risk Areas as an organizing principle for developing the upcoming strategic plan, using them to rebalance the CPO portfolio or enhancing partnerships with other NOAA line offices and services.
3. Adopt a systematic and strategic approach as to how particular Risk Areas are chosen and pursued as integrative categories. Should the portfolio of risks focus primarily on where NOAA has statutory authority, and can thus directly take “action,” such as fisheries?
4. Consider compound, cascading, or otherwise more complex risks within the Risk Areas Initiatives context going forward since the science and solutions for multi-hazards and cascading effects are critical for societal needs.
5. Assess the staffing model for DEWS, given the impact of drought on so many communities and sectors. Current model seems to spread staffing too thin.

6. Provide more feedback from NIDIS to the modelers regarding stakeholders' needs to strengthen the society-science ties.
7. Work with OAR leadership to align AA4 activities to OAR strategic priorities. The existing OAR priorities include fostering the application of knowledge or engagement with stakeholder and user communities, which seems to be a foundational aspect of AA4.
8. Pilot efforts that support climate assessments driven directly by stakeholders with interests in climate-related decisions across regions, industries, and communities (especially underserved and disadvantaged ones).

AA5: Portfolio Management, Administration, and Organizational Excellence

1. Reassess the ASD staff workload to ensure the level of its important services will be sustained. The number of FTEs in ASD might need to be increased (if budget allows).
2. Consider reducing the steps in the signature routing for routine grant packages, embracing CPO's strategic objectives to empower people and decision making.
3. Improve efficiency in the interagency transfer (IAT) process, especially for NOAA to receive and send funds from/to other agencies for mutually beneficial work.
4. Align the future strategic plan with DEIA more directly. This could involve drawing on CPO's familiarity with addressing complex and compound risks to human and economic values with historically underserved communities, consulting with similar government programs to compare/lead on smart practices on DEIA at all stages of the solicitation process, and establishing mechanisms for awardees to report on the success of DEIA efforts conducted during the award.

6. Feedback on the Review Process

The Panel found the CPO review process to be very well-run and organized. The provided materials, pre-recorded webinars, and watch parities were extremely helpful in orienting the panelists to various CPO programs and activities. The watch parties, in particular, were an innovative way of sharing materials and stimulating discussion. The review website was especially beneficial as a reference. Allowing panelists to submit questions ahead of time helped focus the discussions at the panel review itself and facilitated debriefing to CPO leadership. Overall, the Panel felt that the review process was very positive, prompting a few panelists to remark that "it was the best review process they have ever participated [sic] in" and "an amazing production."

The efforts of the CPO and OAR people involved in the review process did not go unnoticed. The time commitment by CPO and OAR reflected the importance of the review, and the Panel greatly appreciated the work done by the staff. The communication between the staff and with the panelists was strong. The short turnarounds on uploading information, Q&As, and responding to panelists' questions and requests was exemplary. The CPO team was candid and forthright when some information or details needed to change. The provided "self-assessment" from CPO managers was particularly useful.

The prevailing sentiment of the Panel was that the review process was quite overwhelming, both for CPO staff and for the panelists given the breadth of the CPO programs and the complexity of the review tasks. With the Panel spending about 40 hours hearing presentations of various kinds (preparation for meetings, watch parties, actual review), the overall review process was taxing. Panelists remarked that a good review can perhaps be done "without quite such an overwhelming effort" and that "the process of navigating through the materials took substantial effort and time." There was substantial preparatory work prior to the 3-day "meeting" itself, and of course it was clear that the staff had spent months, if not much of the last year, preparing for the review.

Some of the information in the background presentations, while largely consistent and necessary, was redundant with materials in the review presentations. The charge to the Panel and the Evaluation guidelines were very thorough, albeit lengthy, thereby making the panelist tasks unclear at times.

The Panel has these recommendations for CPO's future review. CPO should:

- Include the Administrative Services and Business Processes in future reviews. The administrative activities are central to CPO's broader endeavors and integral to CPO's overall success. Such inclusion could be a standard part of all OAR reviews, if it's not already.
- Revisit the review schedule. Three full days in a row were difficult in terms of absorbing and assimilating a lot of new information, and in being away from the panelists' normal job responsibilities.
- Have 1-2 primary persons to serve as points of contact. This would reduce email searching to a limited number of names. In the email correspondence with the Panel, the subject line could have a common initial term (e.g., "CPO Review:") to help sort the incoming emails.
- Provide more succinct and streamlined charge and evaluation guidelines.

7. Comments for OAR Management

Since NOAA is within the Department of Commerce, its budget priorities are out of synch with USGCRP's budget processes. This makes it difficult for the 13 agencies to do actual budget planning together. Budget information needs to be shared in a timely way to ensure truly integrated planning efforts at USGCRP and to promote meeting the needs of the nation.

Deciding on the relevance of the program is predicated on the assumption that the program will have the requisite funding as well as high-quality staff to make decisions on use of program funds. The ability to do something impactful is contingent on sustained funding. The Panel was surprised to see the precipitous drop in funding for the MAPP program in FY20. While the Panel understood that this was due to the S2S research and R2O activities being moved to WPO, the rationale for the decision was not clear. As research efforts in a program mature, related activities may shift to other programs. In the case of MAPP, the Panel was unclear why the funding would move as well. The fund transition to WPO limits MAPP's ability to explore new areas in S2S and the Climate Test Bed, in addition to breaking the "seamless" prediction paradigm mentioned above. The

Panel could not assess if the move to the WPO yielded the performance results that were intended since the current review is only focused on the CPO programs.

With respect to MAPP over the past five years, only one program manager has been taking on the entire workload of the program. Previously, the workload was distributed between two program managers. The Panel noted the workload for the current MAPP program manager to be quite high.

The Arctic is the canary in the coal mine when it comes to climate change. However, the emphasis on studying the Arctic region appears to be lacking in CPO. There are pockets of excellence in OAR (i.e., GFDL, PMEL, ESRL), but no extramural research program is presently focused on Arctic issues. Studies related to the Arctic appear in CPO programs, but they are relatively modest. Should CPO receive additional funds, it should consider enhancing research investments on Arctic-related issues.

ASD is working with other parts of NOAA, outside of CPO. OAR can investigate consolidating its awards activities to perhaps improve efficiencies. If ASD is the place to consolidate the expertise and staff for all award administration, then ASD staff need to participate in potential training and development opportunities. This way ASD will be kept abreast of developments in agencies with substantial awards administration and oversight as well as have a connection with emerging policies in award-making units in the federal government.