**Non-Profit Tiger Team**
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Hilton Silver Spring Severn Room
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**Introduction.** NOAA's Science Advisory Board Climate Working Group Coordinating Committee has been asked to examine the following options for a National Climate Service (NCS):

a. **Federation.** This would be like the US Global Change Research Program, a 13 agency interagency federation of agencies.
b. **Non-Profit.** This would be a non-profit or FFRDC outside the government that could provide a more flexible and nimble organization that could partner with the private, academic, public, and foundation sectors with ease (e.g., UCAR, etc).
c. **NOAA-Led.** NOAA would lead the NCS and have specifically defined partners
d. **Internal NOAA.** Expand NOAA's weather services to include weather and climate services – evolutionary, not necessarily changing the National Weather Service

**Non-profit Tiger Team Charge.** We must:

1. clarify what our option will do, how it will work, who will be involved, and develop a diagram that shows how it will work.
2. develop pros and cons of our option relative to the principles below.
3. Create rough timelines and requirements to implement the option.
4. Examine how our option would address each of the examples below.
5. Provide insights into how success will be judged and performance metrics
6. Create a rough brief packaging – the elevator speech and powerpoint on out option.

**NCS Definition.** To help the Tiger Team deliberations, the Coordinating Committee created the following NCS definition:

> The National Climate Service will assist the nation and the world in understanding, anticipating, and responding to climate, climate change, and climate variability and their impacts and implications. The Service will inform the public and enable the management of climate-related risks and opportunities through the sustained production and delivery of authoritative, timely, useful information about climate and its impacts on local, state, regional, tribal, national, and global scales. The service shall be user-centric, by ensuring that the information is accessible, consistent with users' ability to respond and based on user needs and limitations. The service will provide such usable information through a sustained network of observations, modeling, and research activities.

Additional Note: The NCS provides information to enable policy but not set policy. For example, the Hurricane Center provides info but does not make call on evacuation.

**Pros/Cons of Guiding Principles.** We must analyze the pros/cons of how our option addresses these principles (not in priority order).

1. Serve to develop products and information that will protect the public good and promote a variety of societal benefits including
    a. Improve prediction and projection capabilities on the time scales that contribute to societal benefit
    b. Promote a better understanding of how climate change and variability can promote an improved understanding of other environmental components
    c. Improve decision-making capabilities in particular sectors and regions,
    d. Engender new natural and social science capabilities that may have large expected and unexpected benefit, and
    e. Promote improved federal, state and regional adaptation and mitigation strategies and policies.
    f. Promote a more informed citizenry

2. Reflect the full range of users, ranging from those who can define their needs and are ready to make use of specific information to those who have limited experience and for which the utility of climate information is not yet clear.

3. Address the full range of time scales of interest to society without artificial or arbitrary divisions based on days, weeks, months, years or decades.

4. Promote the extension of climate information to climate system information so that the fundamental problems associated with the climate system and diverse regions (e.g. the coastal region) and sectors (e.g. ecosystems, water, human health, agriculture, energy, insurance, social and economic infrastructure, national security, etc.) can be addressed.

5. Support problem-based assessments and improved decision-making that are on global, regional, sectoral, and integrated scales.

6. Create a science-based and research–supported capability that ensures that information is accessible, authoritative, includes data, interpretation and integration, promotes communication and education, and promotes innovation and interaction.

7. Create an active community of interaction that promotes the 3-way involvement of researchers, users, and climate information providers that is engaged throughout the process from planning, execution, assessment, and improvement and involves the active use of the information within the service.

8. Recognize, incorporate and promote a "cascade" of roles extending from nationally-provided and vetted products, to defined roles of mission agencies, to a variety of interfaces with users (including regional or boundary interfaces such as Regional Integrated Science and Assessments (RISAs), Regional Climate Centers, state climatologists, NGOs, and the private sector), to the active engagement of a wide range of users.

9. Define the role of various federal agencies

10. Recognize that there are significant foundations required for a robust climate service underpinned by
    a. A robust climate observing system (ex. Continuity of data or data stewardship.)
    b. High spatial resolution climate system prediction and projection models with demonstrated skill

11. Ensure that climate services are integrated with active research with feedbacks that will directly impact the generation of new climate service capabilities and climate services, and in turn, will directly influence research directions. This must be based on integrated, cross-cutting and end-to-end research that will support the production of climate system information. Fundamentally, this must be founded on the development of skillful forecasts and predictions and span a better understanding of human and natural systems and how they respond to change

12. Include specific mechanisms to entrain successful products into the operations and capacity of the service

**Demonstration Examples for a National Climate Service.** Below is a set of tangible examples of services, both existing and proposed, that are presently operating and could be provided with the assistance of a National Climate Service. They run a range from environmental stewardship and mitigation activities to economic enhancement and protection of life and property. The Coordinating Committee has asked that we examine how our option would address these situations.

**1. Environmental Stewardship and Sustainability**

   a. **Northwest Salmon and Streamflow.** The salmon fishery in the Pacific Northwest experiences significant variability in landings from year to year, often independent of effort, and it had been thought that a large fraction of this variability was associated with climate. Efforts of the Climate Impacts Group (CIG) of the University of Washington highlighted this association and its application to fisheries management. The phrase "Pacific Decadal Oscillation" (PDO) was first coined within the CIG. In its positive phase, the PDO is a pattern of Pacific sea surface temperature, with cold anomalies in the central northern Pacific and warm anomalies along the eastern edges of the basin (i.e., the west coast of North America). Annual streamflow is the single most sensitive terrestrial signal of climate variability in the Pacific Northwest, and almost all climate impacts are mediated through the regional hydrology. More than half of the variations in annual salmon catch in the U.S. are associated with the PDO. The general pattern is that Alaskan fisheries do worse during the negative phase of the PDO (e.g., 1945-1977) and better in the positive phase (e.g., 1925-1945), while fisheries in Washington, Oregon, and California do worse during the positive phase and better in the negative phase. The implications of these findings are that management of many western salmon stocks is more vulnerable to (and constrained by) climate variations than managers had realized. CIG researchers also applied their knowledge about the linkages between the PDO and El Nino/Southern Oscillation to produce improved streamflow forecasts on the Columbia River, with direct application to the hydropower industry. In this case, useful information from research was translated into a service application for both a major ecosystems and a major energy issue. It should be noted from this case that often demands of users were for finer scale information than could be produced. For example, the PDO research focused on basin-wide impacts to salmon fisheries, yet fisheries management focuses on rivers, a much smaller scale.

b. **Pine Beetles in the Rocky Mountain.** Mountain pine beetles appear to be doing more than killing large swaths of forests in the Rocky Mountains. Some experts believe that the loss of trees could be leading to warmer and dryer climates and increased ground-level ozone and particulate matter. Normally, the beetle population and damage is regulated by cycles of cold, sustained weather. The past few warmer winters in Colorado have not produced enough sufficiently cold days to eradicate the beetles. Thus, climate change may be playing a key role in this widespread pine destruction, and the loss of trees may be ultimately be exacerbating that change. A National Climate Service will need to work with forestry managers and researchers to ensure they produce the right information to better understand pine beetle dynamics and what policies should be adopted to counter or recover from these events (e.g., no reforestation, reforestation with pine beetle resistant trees, reforestation with local pines, etc).

## 2. Mitigation Strategies

a. **Monitoring Requirements and Methods for Greenhouse Gas Management.** Cost-effective carbon policy and management require monitoring data to support decision-making. Availability of good data about past trends, and projections based on reasonable assumptions and models, can support debate about response options and avoid the pitfall of arguing about information quality or creating policy that is ineffective or detrimental. A hierarchical or multi-tier approach to environmental monitoring has been used in pilot studies since the mid-1990s to integrate understanding of carbon dynamics to spatial and temporal variability in carbon sequestration across the landscape. This approach is a three-tier integrated monitoring hierarchy: intensive process-level monitoring sites nested within regional surveys of condition linked experiments and process modeling to improve natural resource assessments. For example, a pilot study linking methods and results for each tier using data and analyses was conducted by USDA Forest Service in the Pinelands Management Area of New Jersey, a reserve area of 360,000 ha. A cluster of flux towers and associated plot-scale measurements of soil and forest carbon storage and flux comprised the process monitoring. A survey network of biometric monitoring sites allowed estimates of the landscape-scale conditions, and forest inventory with remote sensing tools were applied to characterize the region. Methods to integrate information include statistical techniques for diagnostic analysis, and ecosystem models for prognostic analysis. The pilot was successful in providing regional predictions of dangerous fire weather and identifying focus areas for managing wildfire fuels. The New Jersey Pinelands site is part of a national network of multi-scale monitoring sites being developed to meet many of the emerging needs for greenhouse gas management and climate change detection. A second pilot collaboration among USGS, USFS, NPS, and NASA built a hierarchical monitoring structure for the Delaware River Basin by enhancing existing monitoring programs operated by the agencies. This first integrated forest, soil, and surface water carbon budget, which utilized collaborative research sites, climate gradient sites, forest soil and surface-water surveys, and modeled remote sensing coverage, showed surface water export to be a small portion of the total budget but significant in its potential effect on the nutrient balance of the Delaware Estuary and coastal ocean.

## 3. Economic Vitality and the Green Economy

a. **Kicking the Carbon Habit.** The world current energy consumption rate is 13 trillion thermal watts or 13 terawatts. 85% of this consumption comes from fossil fuel (coal, gas, and oil). About 4.5 terawatts is used to create 1.5 terawatts of electricity. No one really cares where electricity comes from…just that it costs about 5 cents per kilowatt because that is what electricity costs from fossil fuel. To lower carbon concentrations in the atmosphere will require very carefully balancing increased energy efficiency and the right mix of carbon sequestration and energy sources. All energy options need to be included -- fossil fuels, hydro, biomass, nuclear, wind, and solar. Hydro, biomass, and nuclear options are constrained by fuel, surface area, and efficiency issues. Wind is the cheapest renewable today, while solar is the most expensive of the options, about 25 cents per kilowatt. However, technology and management approaches for solar and wind are very promising. 120,000 terawatts of solar power hits the Earth each day. We could supply all the U.S. energy needs with 400 kilometers of solar cells if we can solve the cost and energy storage issues with solar. The siting and operational approaches of solar and wind system will be critical to how much they can contribute to world energy needs and much of that will rely on accurate and properly scaled weather and climate information. A National Climate Service will need to work with all these energy sectors to ensure they produce the right information to allow all these energy sectors to optimize their investments and operations.

b. **Soybean disease response**. When Hurricane Ivan swept into Mobile Bay in September 2004, it introduced a new disease to the landscape. Ivan had picked up Asian Soybean Rust spores into its circulation as it skirted the coast of Venezuela a week earlier and then deposited them in a swath from the Gulf Coast to the Ohio Valley. What took nearly a century to traverse the Tropics from China westward to South America became an epidemic for U.S. soybean farmers almost overnight. The U.S. Department of Agriculture took quick action by sponsoring a Soybean Rust monitoring and forecast program that brought together a partnership of academic institutions (UNC, St. Louis University and Penn State) and private industry (SkyBit and ZedX, Inc) to use the nation's weather and climate network. The combination surface reports and fine scale numerical models (including trajectory models) has bolstered the effort of growers to contain this invasive species. It is estimated that in the first year alone, the use of climate/weather data and its forecasts increased profits of U.S. soybean producers by a total of $11-$299 million.

c. **Water resources and transportation**. As the demand for fresh water increases due to population growth, agricultural demands and industrial needs, the management of the nation’s water resources will become more important. The improvement of seasonal to interannual forecasts of precipitation on national and regional scales will enable state and local water resource managers, farmers and river transportation managers to plan their future activities more effectively. Barges that operate in the major river systems could plan to adjust their carrying capacity based on projected river levels. Water resources in dams could be managed by reducing the storage volume if excessive precipitation is forecast, thus enabling improved flood control. Farmers could change crop plantings to better account for the expected precipitation during the growing season.

## 4. Protecting Life and Property

a. **National security and societal instability – the US Africa Command.** On February 6, 2007, President Bush and Defense Secretary Robert Gates announced the creation of U.S. Africa Command. The decision was the culmination of a 10-year thought process within the Department of Defense (DoD) acknowledging the emerging strategic importance of Africa, and recognizing that peace and stability on the continent impacts not only Africans, but the interests of the U.S. and international community as well. The designers of U.S. Africa Command clearly understood the relationships between security, development, diplomacy and prosperity in Africa. As a result, U.S. Africa Command, or AFRICOM, reflects a much more integrated staff structure, one that includes significant management and staff representation by the Department of State, U.S. Agency for International Development (USAID), and other U.S. government agencies involved in Africa. The command also will seek to incorporate partner nations and humanitarian organizations, from Africa and elsewhere, to work alongside the U.S. staff on common approaches to shared interests (United States Africa Command website). This new role for the US military will require information on both historical and future climatic conditions. Patterns of precipitation and temperature have greatly influenced the distribution of peoples and states in Africa. Changes in ecosystems, water resources, and disease distribution will all affect the stability of governments that are already only marginally capable of providing critical services to their citizens. As environmental conditions change, the ability of people to adapt will be challenged, leading to migrations and ethnic conflict. The military will need improved estimates of climate variability to guide the allocation of resources.

b. **Disease Vectors.** Weather and climate have a significant impact on human health. Climate variability and change have the potential to impact the number and intensity of heat waves, the distribution and risk of vector-borne diseases, and the risk of food-borne or water-borne bacteria and viruses. The distribution and abundance of infectious disease vectors such as ticks, mosquitoes, and rodents are tied to climate variables. A number of food-borne and water-borne diseases are linked to extreme events, particularly droughts, floods and increases in temperature. Currently, public health professionals focus on surveillance and response as the primary mechanism to address adverse health conditions. However, the strong linkages between environmental conditions and health suggest that there is an extraordinary opportunity to focus on prevention by utilizing climate and weather observations and prediction capabilities to anticipate adverse health outcomes. An ability to anticipate these outcomes is a major step towards an increased ability to identify in advance and then reduce the risks associated with a wide-range of environmentally sensitive diseases and conditions.

c. **Relocation of Alaskan villages –** Rising sea level, melting permafrost, and storm driven erosion are literally washing numerous Alaskan villages into the sea. Village governments, state agencies and the Army Corps of Engineers are involved in relocating the villagers and their supporting infrastructure. Moving to locations that are both safe and that continue to provide access to the natural resources needed for support requires information about future temperatures, precipitation, sea ice, and storminess at the kilometer to tens of kilometer scales. Impacts on living resources including their abundance and availability are also necessary. Additionally, changes in disease vectors and invasive species and their impacts must be taken into consideration. Changes in hydrology need to be anticipated to allow for potable and wastewater requirements to be met. Given the rapid changes in these factors in the past 20 years, reliable estimates of future rates of change are also needed.