1) Partnerships, data, national products/impact

While IOOS operates as a distributed system of regional associations, the program office, and the IOOC, some of its greatest achievements have arisen from its role in standardizing data through common portals, coordinating data collection, facilitating partnerships that maximize the value of the data, and integrating within the broader NOAA enterprise. For example, the Animal Telemetry Network operates a national data portal that enables tracking of highly migratory marine organisms across regional associations. The ATN has a common data format and data-processing workflow that enable efficient, economical data collection and sharing on a scale that would not otherwise be possible. Similarly, IOOS's establishment of a common national glider data assembly center created a data standard, now adopted internationally, through which observations are rapidly disseminated for assimilation into operational forecasting by NOAA, the Navy, and the research modeling community.

A key to the success of these programs is that they were established in coordination with their communities of practice. IOOS funds the collection of observations directly, but also serves a role in coordinating their collection (for target species, to focus on essential ocean features represented in models, etc.), and provides a way to leverage externally-funded observations. In the case of hurricane gliders, IOOS leverages partnerships that provide weekly guidance to NOAA EMC based on weekly model-data comparisons, and has the potential to inform the transition to the next generation of NOAA operational models. By facilitating integration of multi-agency coordination of storm observations, the impact of these IOOS-funded efforts extends well beyond any single program within NOAA.

IOOS should find/focus on these success stories, noting the key achievements that have enabled this success, and do a better job of taking credit for it. Identify next grand challenges that can be addressed with IOOS obs -- leverage and engage communities of practice and stakeholders, develop and sustain working relationships between research and operations to accelerate and support transitions with funding for these critical partnerships, rather than relying on volunteer efforts from non-NOAA partners.

2) DMAC review

IOOS has a strong legacy of flexible data management, leveraging open source tools and coordinating valuable regional coordination on Data Management and Communications (DMAC) The current DMAC system is a distributed system with overlap between national and regional data management. The system includes data catalogs, metadata, data access points, and tools to visualize data. There are regional systems that share technology managed by each regional

association and national systems of Data Assembly Centers (DAC), including the Glider DAC, the ATN, the HF Radar DAC, and buoy data, which is delivered to NDBC.

Due to the rapid changes in technology, including Cloud adoption and AI, IOOS is evaluating the use of commercial cloud solutions and AI. The distributed nature of the DMAC systems provides flexibility and allows RAs to use technologies that suit their regional priorities, but there is potentially a challenge in modernizing legacy systems that use numerous technologies, data storage, and access, and could potentially increase the effort required to transition to a cloud-first ecosystem that enables AI.

IOOS should consider a review of the distributed DMAC solutions and technologies and evaluate the readiness of the current systems for AI applications. Modern DMAC systems should be AI-ready, seamlessly managing structured and unstructured data (text, audio, video), a unified metadata and semantic layer, automated quality control, and compute resources that can cost-effectively support machine learning and Large Language Model (LLM) workloads. The review should evaluate the effectiveness and cost tradeoffs of focused regional data management activities, versus a centralized national approach. It is important that any evaluation considers the highly productive legacy of cooperation between the regions, and the highly collaborative coordination of scientists and data management experts.

3) Modeling strategy

The IOOS Regional Associations use models and tailored model products to analyze and predict current and future marine conditions. Numerous numerical models have been developed and validated by the regional associations for their area of interest, combining high resolution local data with deep local expertise to provide high quality model forecasts that are data-driven, and provide valuable analysis and forecasts for regional stakeholders, including coastal protection, fisheries and emergency response. Multiple user focused products are often developed from these models, providing information specifically tailored to unique stakeholder needs in their respective regions. IOOS DMAC systems disseminate these models, forecasts, and products so that decision-makers can take action to improve safety, enhance the economy, and protect the environment. A number of these regional models have transitioned to NOAA for 24/7 operational implementation.

The collaboration of the IOOS regional modelers with NOAA/NOS aligns very well with the NOS modeling strategy goals, including 1) Address user needs through sustained community

engagement and partnerships; and 2): Develop ocean and coastal models and products through community modeling.

The transition of IOOS community models to NOS has been a success, but each model transition has taken many years. IOOS and NOS may wish to evaluate the transitions of models from research to operations, considering factors such as, a) do the regional model modeling technologies align with the NOS model technology strategy, b) are NOS and IOOS coordinated in filling critical data gaps and consider a modeling steering team to coordinate national and regional strategy, c) a coordinated approach to the use of Cloud and hybrid numerical models combined with AI, and d) can NOS and IOOS use similar infrastructure (such as the IOOS Cloud Sandbox and the NOS Coastal Coupling Sandbox) to reduce the time to transition quasi-operational regional models to fully operational models managed by NOS.