Oceans sustainability: an AI approach to address new challenges in a global change scenario

**PROCOPIO:** A Portable robotic observatory for Coordinated Oceanographic Observations

**Alternative**

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**The Idea**

Our oceans are in trouble. It hosts enormous biodiversity, sustaining a vibrant economy, and plays a significant role in climate regulation. Therefore, we need a sustained, persistent, and affordable presence there to help us understand and monitor how key processes such as acidification, hypoxia, toxic blooms, pollution and erosion (amongst others) are impacting global ocean sustainability and stewardship. Traditional ship and remote-sensing methods neither prove cost-effective nor provide assimilated real-time information at appropriate human-relevant scales. This aim can be achieved with the help of coordinated observations from space, aerial, surface, and underwater robots guided by Artificial Intelligence (AI) while providing persistent and reliable oceanographic data.

Actually, huge telescopes point toward the heavens, but no such observational system exists for looking at and into our oceans. We want to change that. Our mission is to build a rapidly deployable, multi-domain, portable robotic observatory for observing and managing the health of our endangered coastal waters (Fig. 1).

PROCOPIO will be a modular system with bespoke approaches for site-specific problems. The use of SmallSat’s and smart robotic technologies reduces development time to provide proper solutions.

**Why now?**

The climate crisis is upon us, and the oceans are changing very quickly in ways we don’t understand. There is an urgent need to develop and deploy new smart observational methods to provide information at scales that matter to the 600 million people living along the coast. Predicting change and providing early warning of hazardous events, including poor water quality, tainted fish stocks and intensifying coastal erosion, is essential for the well-being of an increasingly vulnerable coastal ecosystem and in line with the goals of the UN Decade of Ocean Science for Sustainable Development.

By leveraging rapid advances in technology, PROCOPIO will field an innovative system of small satellites and robust autonomous in-situ platforms in order to engineer an Oceanumscope for obtaining unprecedented views of coastal oceans and atmospheric and land interfaces. We want to aid in the understanding and monitoring of coastal waters so that they can be explored and utilized in a sustainable and informed manner.

(a) PROCOPIO will build a train of SmallSat’s with a range of sensors to measure explicit ocean variables from space.

(b) PROCOPIO Oceanumscope will provide persistent, reliable, integrated real- time information at scales that matter to the 600 million people living along coasts.

Figure 1: PROCOPIO is an ensemble of small satellites, aerial, surface and underwater vehicles.

**What will it take?**

The PROCOPIO team comes ready with the aerial, surface and underwater vehicle platforms, together with the extensive suite of software to provide coordinated observations in the coastal ocean. We will build custom sensors keyed towards important ocean variables integrated into a ’train’ of SmallSat platforms. Such a system working closely with the in-situ robots will provide a clear consistent set of data products. This data will be integrated to provide actionable information to policymakers on the ground. We estimate the total project cost to be about ∼ $43 Million over a period of 3 years.

**Governance**

The governing board of PROCOPIO will consist of prominent strategic advisors from the US, including stakeholders and funders. In addition, the project principals will be aided and advised by a scientific advisory board (SAB) consisting of technologists, ocean going scientists, ecologists and policymakers from the US, Europe, and coastal African nations.

**The Team**

PROCOPIO’s inter-disciplinary team of seasoned researchers from the universities of Columbia, Porto and Vigo have worked in all the major oceans, fielded tens of robots at sea simultaneously, designed/built/flown and operated multiple SmallSat’s, and two NASA missions including on the surface of Mars. PROCOPIO will build on these efforts, augmented by new sensors, hardware and software to develop the first portable Oceanumscope.

Brief Bios of the Principals