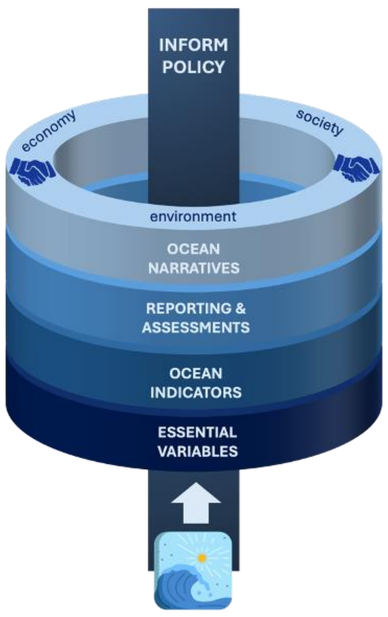
Global Ocean Indicators:

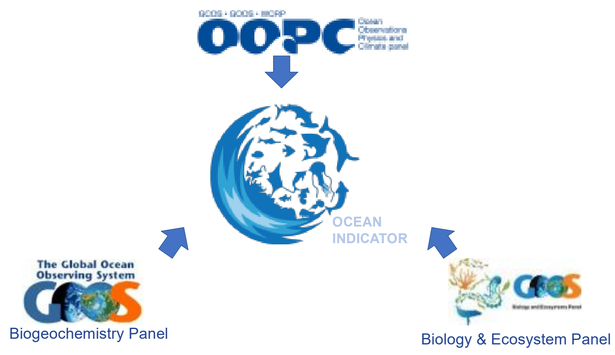
Marking Pathways at the Science-Policy Nexus

Karina von Schuckmann (1), Alex Godoy-Faundez (2), Véronique Garçon (3), Frank Muller-Karger (4), Karen Evans (5), Ward Appeltans (5), Narissa Bax (6), Lisandro Benedetti Cecchi (7), Anthony Bernard (8), Kim Bernard (9), Jarret Byrnes (10), Gabrielle Canonico (11), Lucille Chapuis (12), Malcolm Clark (13), Audrey Darnaude (14), Claire Davies (15), Pia Englyst (16), Agneta Fransson (17), Emma Heslop (5), Elisabeth Holland (18), Maria Hood (1), Stefan Kern (19), Ana Lara-Lopez (20) (5), Nora Loose (21), Belén Martín Míguez (22), Clive McMahon (23), Lina Mtwana Nordlund (24), Joanna Post (5), Sabrina Speich (25), Adrienne Sutton (26), Toste Tanuha (27), Maciej Telszewski (28), Dimitris Poursanidis (29), Weidong Yu (30)



Ocean indicators translate complex data and science on the status and health of the ocean into simpler meaningful and useful metrics. When effectively designed and applied, they can prove very effective to support informed decision-making.

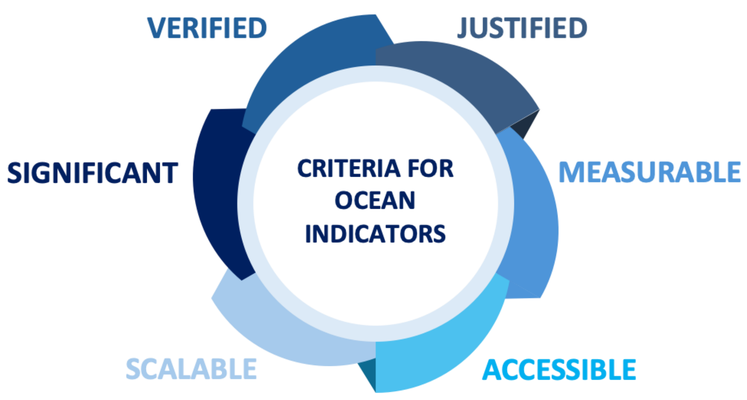
Today there is still no unified framework with standardized methodologies and no internationally agreed-upon comprehensive set of ocean indicators to characterize ocean physical, biogeochemical, biological and ecosystem variables. ➔ Adopting an international, multidisciplinary approach will strengthen the coherence of ocean knowledge, providing more reliable insights for policy and decision-making.



GOOS cross-panel task team on ocean indicators to define a unified framework

DEFINITION: Ocean indicators refer to measures based on scientifically verified approaches and data that allow for the identification of the state in ocean phenomena across a range of temporal and spatial scales that are accessible to inform decision makers and beyond.

CRITERIA



(1) **Verified.** The indicator must represent a state of an ocean phenomenon that relies on a peer-reviewed scientific rationale of the fully traceable indicator approach.

(2) **Significant.** The indicator must provide robust information on the state of an ocean phenomenon within a scientific framework.

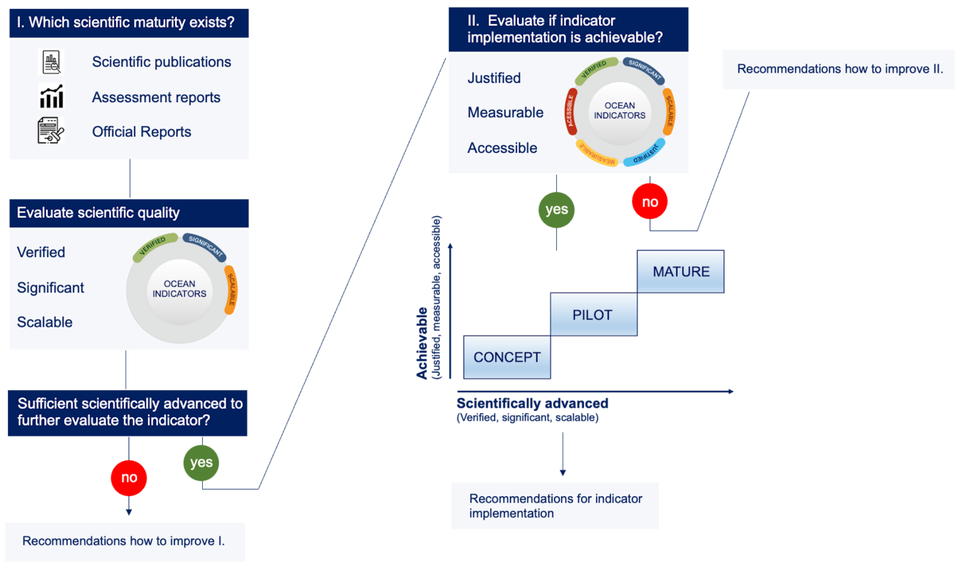
(3) **Scalable:** An ocean indicator should be scalable spatially and temporally, and where possible interoperable.

(4) **Justified:** The indicator should be relevant to inform and support decision-making, and be understandable to a broad audience.

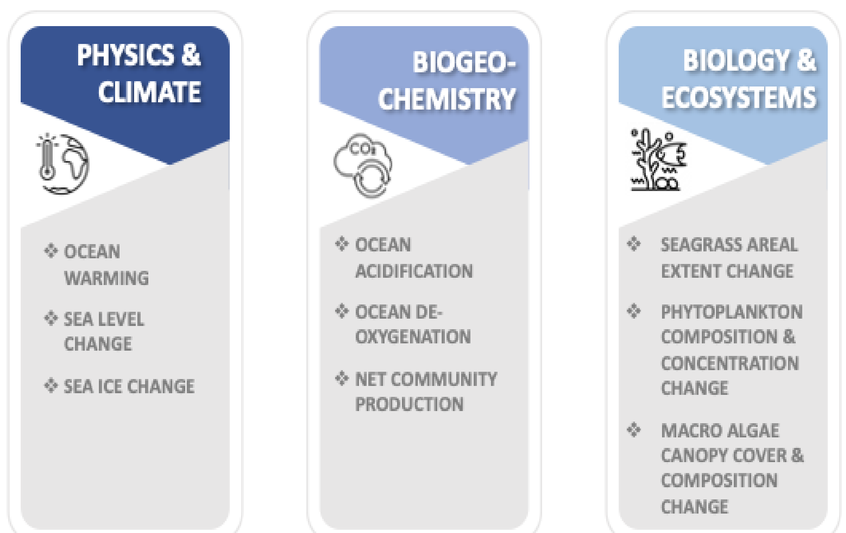
(5) **Measurable:** The indicator should be determined where relevant via one or more Essential Variable framework, such as Essential Varibales.

(6) **Accessible:** The ocean indicator should be provided whenever possible on a regular basis guided by CARE and FAIR principles, and enables past and near-term information, forecasts, and projections.

A guide for applying expert judgment in the evaluation of a proposed ocean indicator



The nine pilot indicators proposed by GOOS for three general disciplines: physics & climate, biogeochemistry, and biology and ecosystems.



(1) Mercator Ocean international, Toulouse, France
(2) Sustainability Research Center, Facultad de Ingeniería, Universidad del Desarrollo, Santiago, Chile
(3) Institut de Physique du Globe IPGP/CNRS, Paris, France
(4) College of Marine Science, University of South Florida, St. Petersburg, USA
(5) UNESCO-IOC, Paris, France
(6) Pinngortitaleriffik, Greenland Institute of Natural Resources, Greenland Climate Research Centre, Nuuk, Greenland
(7) University of Pisa, Department of Biology, Pisa, Italy
(8) South African Institute for Aquatic Biodiversity, Makhanda, South Africa
(9) Oregon State University, College of Earth, Ocean, and Atmospheric Sciences, Corvallis, USA
(10)Department of Biology, University of Massachusetts Boston, Boston, USA
(11)NOAA U.S. Integrated Ocean Observing System, Silver Spring, USA
(12)Biomedicine and Environment, School of Agriculture, La Trobe University, Australia
(13)National Institute of Water & Atmospheric Research, Wellington, New Zealand
(14)MARBEC, Univ. Montpellier, CNRS, IRD, Ifremer, Montpellier, France
(15) Environment, CSIRO, Tasmania, Australia
(16) Danish Meteorological Institute, Copenhagen, Denmark
(17) Norwegian Polar Institute, Tromso, Norway
(18) Independent researcher, Santa Fe, Nouveau-Mexique, USA
(19) University of Hamburg, Integrated Climate Data Center (ICDC), Hamburg, Germany
(20) Institute for Marine and Antarctic Studies, University of Tasmania, Battery Point, Tasmania, Australia
(21) [C]Worthy, LLC, Boulder, USA
(22) WMO, Geneva, Switzerland
(23) IMOS Animal Tagging, Sydney Institute of Marine Science, Mosman, New South Wales, Australia
(24) Dept. Of Earth Sciences, Uppsala University, Campus Gotland, Visby, Sweden
(25) Laboratoire de Météorologie Dynamique, École Normale Supérieure-PSL, Paris, France
(26) NOAA Pacific Marine Environmental Laboratory, Seattle, USA
(27)GEOMAR Helmholtz centre for Ocean Research Kiel, Kiel, Germany
(28)International Ocean Carbon Coordination Project, Institute of Oceanology of Polish Academy of Sciences, Sopot, Poland
(29) Foundation for Research and Technology—Hellas (FORTH), Institute of Applied and Computational Mathematics, Heraklion, Greece
(30) School of Atmospheric Sciences, Sun Yat-Sen University, Zhuhai, China