The Global Ocean Observing System

unesco
Intergovernmental
Oceanographic
Commission

WORLD
METEOROLOGICAL
ORGANIZATION

UN environment programme

International Science Council

Operational requirements
– RRR, Co-Design, GBON –

Emma Heslop
GOOS, IOC/UNESCO

GRA Meeting April 2025

What is RRR?

The Rolling Review of Requirements (RRR) is a **systematic** and **transparent process** within the WMO Integrated Global Observing System (WIGOS) framework that supports the **design** and **evolution** of WIGOS by compiling information on **service (user) requirements** for observations across various WMO Earth System Application Categories (ESACs). These are then brought together into a summary called a Statement of Guidance (SoG) document.

The RRR involves a review of service (user) requirements for a set of Application Areas (AAs).

It is also designed to query the needs for existing and developing services, not future services. As the name suggests the RRR is undertaken regularly, and there have been 10 SoGs developed since 2011-2020.

Ocean advances in RRR

First Ocean Earth System Application Category

6 Application Areas:

- 3.1 Ocean Forecasting and Real-Time Monitoring
- 3.2 Coastal Forecasting
- 3.3 Oceanic Climate Monitoring and Services
- 3.4 Tsunami Monitoring and Detection
- 3.5 Marine Environmental Emergency Response
- 3.6 Maritime Safety (ports to open ocean)
- 3.7 Ocean Biogeochemistry

First Statement of Guidance for Ocean ESAC complete: *Definitions, Variables (EOVs), collect and consolidate requirements from operational systems, gap analyses by variables, recommendations, risks*

Application Area Definitions –

6 approved by ET-EOSDE & published in OSCAR (here)

3.1 Ocean forecasting and real-time monitoring: Provide essential information to support monitoring ocean state in near-real-time & ocean forecasting systems on global, basin and regional scale, and vital for model development for verification of numerical weather prediction on medium-range to seasonal forecasts.

3.2 Coastal forecasting: Contribute to oceanographic forecasting systems from nearshore to estuaries to continental shelf and slope.

3.3 Oceanic climate monitoring and services: observations defined by the GCOS as essential to detect, model and assess climate change and its impact; support adaptation to climate change; monitor the effectiveness of policies for mitigating climate change; and develop climate information services.

3.4 Tsunami Monitoring and Detection: is a processes to detect and forecast tsunamis, assess their potential threat to the coasts, marinas and harbours and issue timely tsunami advisory information to the stakeholders. The essential elements for early detection include the real-time transmission of seismic data, sea-level observations, and GNSS (Global Navigation Satellite System) measurement

3.5 Marine Environmental Emergency Response: refers to the response of any immediate and imminent threat of harm to the marine environment. This response is highly time sensitive as marine pollutants drift and disperse in the surrounding fluid and, thus, increasing the extent of the potential environmental harm. The time sensitivity of the data required to monitor and predict the transport of pollutants is of the utmost importance to mitigate damage to the marine environment.

3.6 Maritime Safety (ports to open ocean): It covers the sets of observations to provide the services and warnings for the protection of life and property on all ships on all voyages at sea and in all [port] waters connected therewith.

3.7 Ocean Biogeochemical Cycles: yet to be developed – initiate in 2025

Contacts Ocean Pilot

Current Status 12/2024

ESAC	**Ocean Applications**	**Emma Heslop**	**GOOS-in collaboration with SERCOM/SC-MMO Andreas Schiller and WMO**
	Area	POC / AAO	Committee / Additional consulted
AA	3.1 Ocean Forecasting and Real-Time Monitoring	Hao Zuo / Sabrina Speich	OOPC / in collaboration NWP, OceanPredict, ETOOFS, CMEMS
AA	3.2 Coastal Forecasting	Laura Tuomi / Val Swail	SERCOM/SC-MMO / in collaboration with CMEMS, EuroGOOS Coastal WG, CoastPredict, OceanPredict, ETOOFS, CMEMS
AA	3.3 Oceanic Climate Monitoring and Services	Belén Martín Míguez / Sabrina Speich	OOPC / in collaboration with GCOS, WCRP, ETOOFS, OceanPredict
AA	3.4 Tsunami Monitoring and Detection	Dr. Yuji Nishimae, Chair of the TOWS-WG Task Team on Tsunami Watch Operations / support Ocal Necmioglu (IOC)	IOC/TOWS-WG / in collaboration SERCOM/SC-MMO
AA	3.5 Marine Environmental Emergency Response	Graigory (Graig) Sutherland / Øyvind Breivik	SERCOM/SC-MMO / in collaboration with community
AA	3.6 Maritime Safety (ports - open ocean)	Anish Hebbar / Daniel Peixoto de Carvalho	SERCOM/SC-MMO, in collaboration ETOOFS and user community 9port/shipping)
AA	3.7 Ocean Biogeochemical Cycles	Maciej Telszweski /	GOOS BGC Panel (IOCCP), 3GW – estimated for 2025

ESAC-Ocean Variables

1. **Ocean surface currents (vector)**
2. **Ocean velocity**
3. **Ocean salinity**
4. **Sea surface salinity**
5. **Ocean temperature**
6. **Sea surface temperature**
7. **Significant wave height**
8. **Dominant wave direction**
9. **Dominant wave period**
10. Ocean dynamic
12. Surface Stokes Drift
13. Tsunami Wave Amplitude
14. 1D Wave Spectra
15. Coastal sea level (tide)
16. Colour Dissolved Organic Matter (CDOM)
17. Dissolved inorganic carbon (DIC)
18. **Nitrate**
19. Nitrous oxide (GHG)
20. **Phosphate**
21. **Ocean chlorophyll**
22. Sea level
23. Ocean subsurface tracers
24. **Ocean subsurface dissolved oxygen concentration**
25. pH
26. **Sea surface heat flux**
27. **Silicate**
28. Water-leaving spectral radiance
29. **Sea-ice age**
30. **Sea-ice cover**
31. **Sea-ice elevation**
32. **Sea-ice motion**
33. **Sea-ice surface characteristics (included in albedo)**
34. **Sea-ice surface temperature**
35. **Sea-ice thickness**
36. **Sea-ice type**
37. **Snow depth**
38. Wind Stress
39. Wind vector (near surface)

Bold – Variables required by ≥ 3 AAs

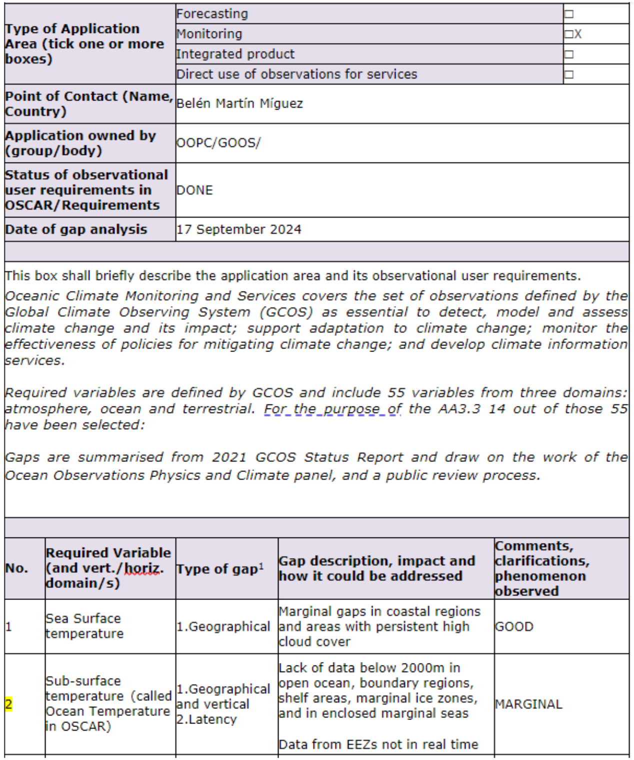
🟩 Available in OSCAR

🟨 Coordinate with Cryosphere

Activity Areas – Gap Analysis (examples)

By Application Area and variable

>> consolidated by variable



Type of Application Area (tick one or more boxes)	Forecasting	☐
	Monitoring	☐X
	Integrated product	☐
	Direct use of observations for services	☐
Point of Contact (Name, Country)	Belén Martín Míguez	
Application owned by (group/body)	OOPC/GOOS/	
Status of observational user requirements in OSCAR/Requirements	DONE	
Date of gap analysis	17 September 2024	

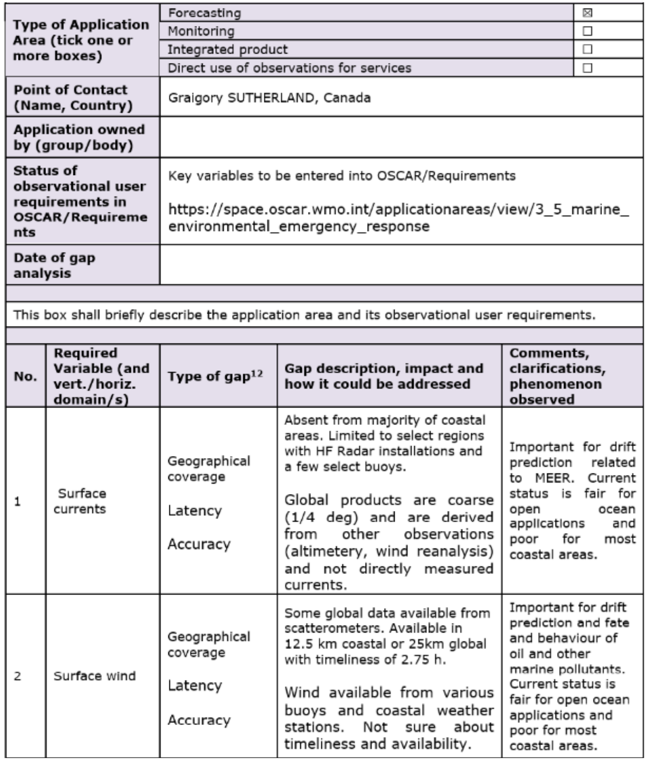
This box shall briefly describe the application area and its observational user requirements.

Oceanic Climate Monitoring and Services covers the set of observations defined by the Global Climate Observing System (GCOS) as essential to detect, model and assess climate change and its impact; support adaptation to climate change; monitor the effectiveness of policies for mitigating climate change; and develop climate information services.

Required variables are defined by GCOS and include 55 variables from three domains: atmosphere, ocean and terrestrial. For the purpose of the AA3.3 14 out of those 55 have been selected:

Gaps are summarised from 2021 GCOS Status Report and draw on the work of the Ocean Observations Physics and Climate panel, and a public review process.

No.	**Required Variable (and vert./horiz. domain/s)**	**Type of gap**[1]	**Gap description, impact and how it could be addressed**	**Comments, clarifications, phenomenon observed**
1	Sea Surface temperature	1.Geographical	Marginal gaps in coastal regions and areas with persistent high cloud cover	GOOD
2	Sub-surface temperature (called Ocean Temperature in OSCAR)	1.Geographical and vertical 2.Latency	Lack of data below 2000m in open ocean, boundary regions, shelf areas, marginal ice zones, and in enclosed marginal seas Data from EEZs not in real time	MARGINAL



Type of Application Area (tick one or more boxes)	Forecasting	☒
	Monitoring	☐
	Integrated product	☐
	Direct use of observations for services	☐
Point of Contact (Name, Country)	Graigory SUTHERLAND, Canada	
Application owned by (group/body)		
Status of observational user requirements in OSCAR/Requirements	Key variables to be entered into OSCAR/Requirements https://space.oscar.wmo.int/applicationareas/view/3_5_marine_environmental_emergency_response	
Date of gap analysis		

This box shall briefly describe the application area and its observational user requirements.

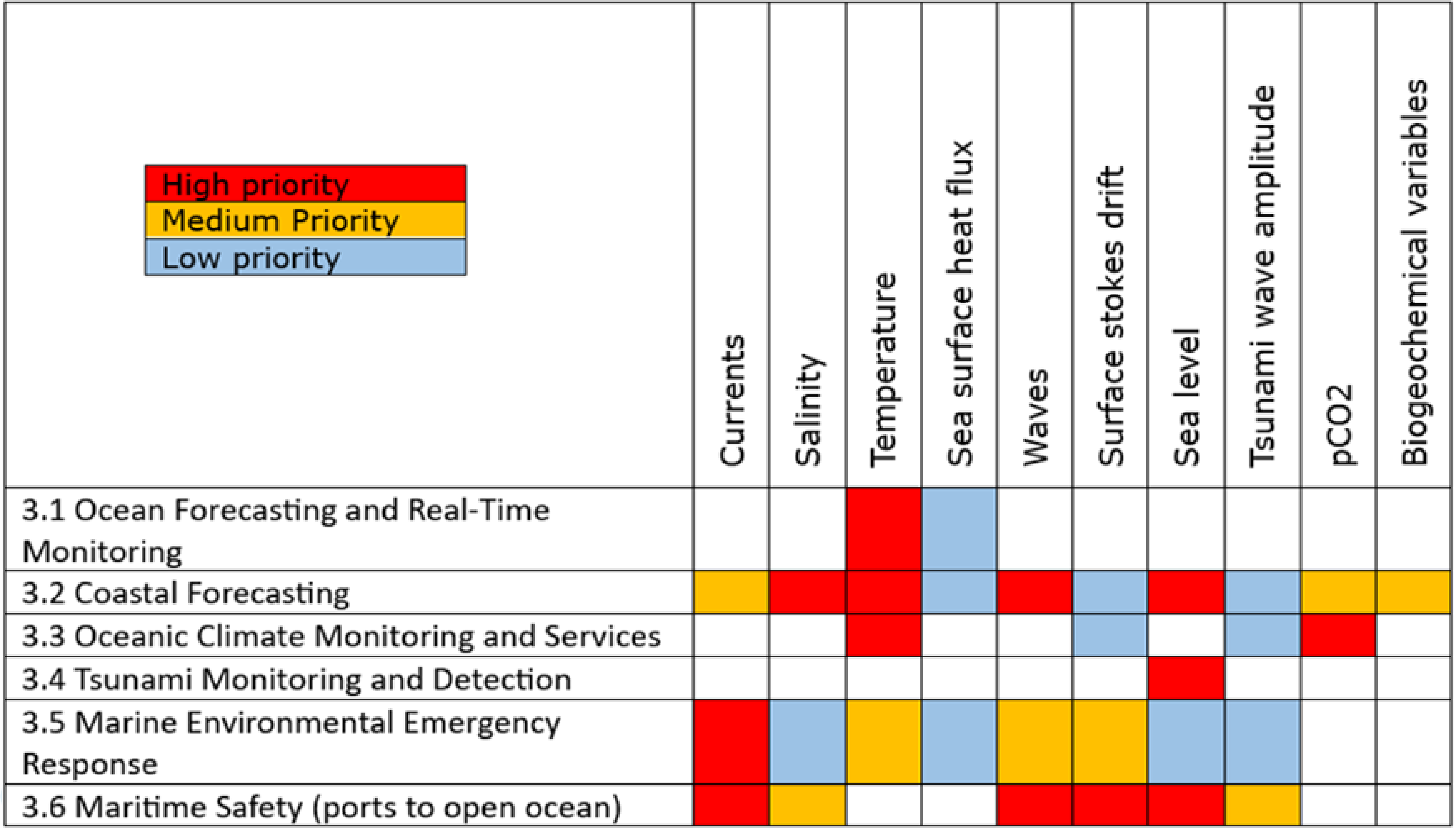
No.	**Required Variable (and vert./horiz. domain/s)**	**Type of gap**[12]	**Gap description, impact and how it could be addressed**	**Comments, clarifications, phenomenon observed**
1	Surface currents	Geographical coverage Latency Accuracy	Absent from majority of coastal areas. Limited to select regions with HF Radar installations and a few select buoys. Global products are coarse (1/4 deg) and are derived from other observations (altimetery, wind reanalysis) and not directly measured currents.	Important for drift prediction related to MEER. Current status is fair for open ocean applications and poor for most coastal areas.
2	Surface wind	Geographical coverage Latency Accuracy	Some global data available from scatterometers. Available in 12.5 km coastal or 25km global with timeliness of 2.75 h. Wind available from various buoys and coastal weather stations. Not sure about timeliness and availability.	Important for drift prediction and fate and behaviour of oil and other marine pollutants. Current status is fair for open ocean applications and poor for most coastal areas.

Surface currents

Impact/ need	Sea surface currents are **vital** for many ocean forecasting and monitoring application areas. Near-real-time and seasonal forecasting, both weather and ocean, benefit from surface current data as they are responsible for transport of heat, salt, passive tracers and pollutants. Information on surface currents also enhances safety of maritime traffic and helps route optimization and increases the energy efficiency of shipping. For the planning and execution of search and rescue operations at sea, information of surface currents is **essential**.
Gap analysis	Surface currents are available from in-situ and satellite observations. Although the global coverage of satellite data is relatively good its accuracy, and spatial resolution especially in coastal regions does not fully meet the requirements of ocean applications The current in-situ observation network. including lagrangian drifters, ACDPs and buoys,– spatial coverage is too sparse and there are significant gaps, especially in polar, coastal and boundary current regions. Coastal high frequency (HF) radars provide relatively good coverage in coastal regions, where they are present. However, there are some challenges in data availability in near-real time.

Subsurface currents

Impact /need	Subsurface currents are responsible for the transport of heat, salt, passive tracers and pollutants in the ocean.
Gap analysis	Subsurface current data is based on in-situ profile measurements, which are very sparse, and estimates from autonomous floats at drift depth (e.g. Argo floats) and subsurface gliders.



🟥 High priority

🟧 Medium Priority

🟦 Low priority

	Currents	Salinity	Temperature	Sea surface heat flux	Waves	Surface stokes drift	Sea level	Tsunami wave amplitude	pCO2	Biogeochemical variables
3.1 Ocean Forecasting and Real-Time Monitoring			🟥	🟦						
3.2 Coastal Forecasting	🟧	🟥	🟥	🟦	🟥	🟦	🟥	🟦	🟧	🟧
3.3 Oceanic Climate Monitoring and Services			🟥			🟦		🟦	🟥	
3.4 Tsunami Monitoring and Detection							🟥			
3.5 Marine Environmental Emergency Response	🟥	🟦	🟧	🟦	🟧	🟧	🟦	🟦		
3.6 Maritime Safety (ports to open ocean)	🟥	🟧			🟥	🟥	🟥	🟧		

Launch and impact

Review

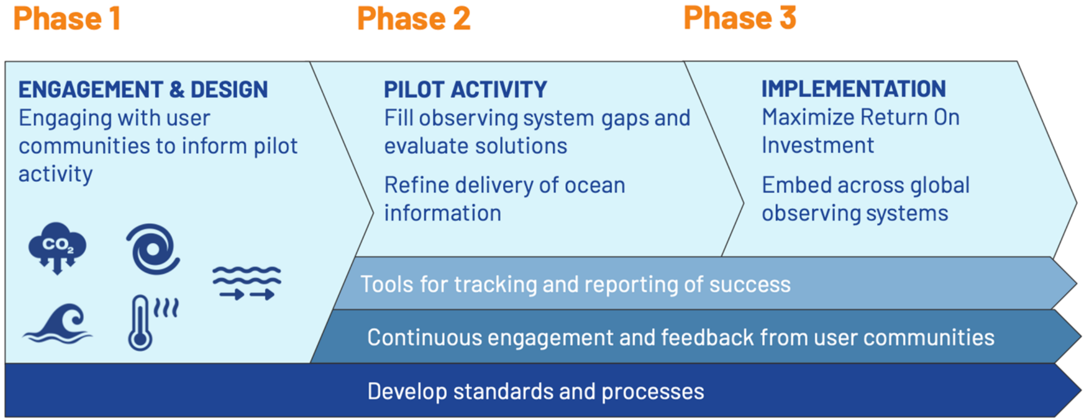
- **April 2025 review by OCG, GOOS, others**
- **Ocean, atmosphere and ice SoG**
- June approval by INFCOM president
- Sept 2025 launch - comms WMO/ GOOS

Impact / why matters

- First consolidated multi-application set of requirements - operational services
- First Ocean and Ice SoGs
- Step towards expressing a Global Basic Observing Network (GBON)

RRR connection to Co-Design?

- Concepts are similar - Co-Design working in areas where services not yet mature / impact regional
- WMO supporting Exemplar projects - Tropical Cyclones, Marine Heatwaves, Storm Surge and Carbon
- New partnerships - interacting WMO (national and regional), CLIVAR, users



Phase 1

ENGAGEMENT & DESIGN
Engaging with user communities to inform pilot activity

Phase 2

PILOT ACTIVITY
Fill observing system gaps and evaluate solutions

Refine delivery of ocean information

Phase 3

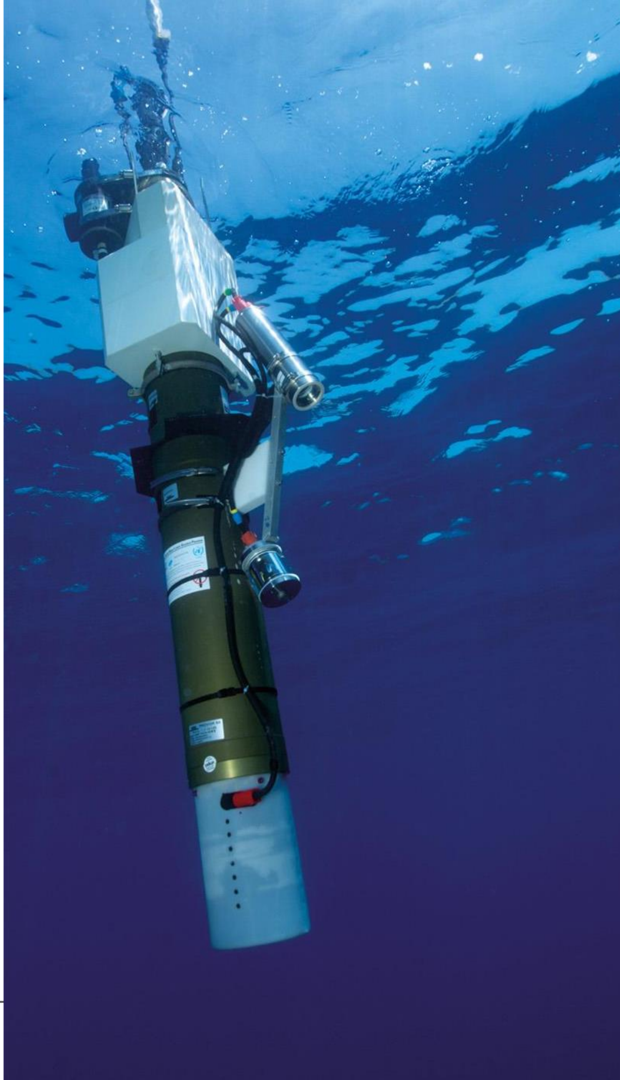
IMPLEMENTATION
Maximize Return On Investment

Embed across global observing systems

Tools for tracking and reporting of success

Continuous engagement and feedback from user communities

Develop standards and processes



The Global Ocean Observing System

Thank you

goosocean.org

unesco Intergovernmental Oceanographic Commission

WORLD METEOROLOGICAL ORGANIZATION

UN environment programme

International Science Council