APPENDIX 3

TA PROJECT REPORT (TEMPLATE)

(see following pages)

TA PROJECT REPORT PACKAGE

- The completed and signed forms included in this package should be sent by email to jerico.ta@marine.ie and **jerico**-s3**@ifremer.fr** within **one month after the completion of the TA project** by the User Group Leader.
- **Refunding of the TA reimbursement to the user group will be processed as soon as these forms will be submitted**.
- The TA project report will be published in the JERICO-S3 website. The report, as well as other information collected with the attached forms, will be used to report to the European Commission.
- **Please note that any publication resulting from work carried out under the JERICO-S3 TA activity must acknowledge the support of the European Commission – H2020 Framework Programme, JERICO-S3 under grant agreement No.871153.**

1. Project Information

Proposal reference number[1]	N°21/1002072
Project Acronym (ID)[2]	RADCONNECT
Title of the project[3]	Underwater radioactivity measurements
Host Research Infrastructure[4]	Helmholtz-Zentrum Geesthacht (HZG) & Alfred-Wegener-Institut (AWI)
Starting date - End date[5]	13/4/2022 – 30/6/2024
Name of Principal Investigator[6] **Home Laboratory** **Address** **E-mail address** **Telephone**	Christos Tsabaris 46.7 Km Athens-Sounio Ave, 19013 Anavyssos, Attica, Greece tsabaris@hcmr.gr +302291076410

2. Project objectives[7] (250 words max.)

- Deploy and operate on a continuous basis an innovative underwater radioactivity device on a cabled observatory.

- To study the environmental total gamma ray intensity anomalies due to high precipitation events and correlating the activity concentration of radon daughters with precipitation rates as calculated with other methods.

- To study potential anthropogenic pollutants.

[1] Reference number assigned to the proposal by the TA-Office.

[2] User-project identifier used in the proposal.

[3] Title of the approved proposal. The length cannot exceed 255 characters

[4] Name of the installation/infrastructure accessed with this project. If more than one installations/infrastructures are used by the same project, please list them in the box.

[5] Specify starting and end date of the project (including eventual preparatory phase before the access).

[6] Fill in with the full contact of the Principal Investigator (user group leader).

[7] Write the short-term, medium and long-term objectives of the project. Use no more than 250 words.

3. Main achievements and difficulties encountered (250 words max.)[8]

Efficient integration of GeoMAREA underwater sensor. Continuous data in two areas (one close to seabed and another one in seawater). Surveillance of marine environment in terms of radioactive contamination and potential development of decision making system support.

4. Dissemination of the results[9]

A paper will be published in Journal of Marine Science and Engineering (Sep 24). Presentation of results in the Hellenic Nuclear Physics Society Symposium (Thessaloniki, Greece, 2024).

5. Technical and Scientific preliminary Outcomes (2 pages max.)[10]

[8] Describe briefly the main achievements obtained and possible impacts, as well as possible difficulties encountered during the execution of the project. Use no more than 250 words.

[9] Describe any plan you have to disseminate and publish the results resulting from work carried out under the Transnational Access activity in JERICO -S3: scientific articles, books - or part of them -, patents, as well as reports and communication to scientific conferences, meetings and workshops. Highlight peer-reviewed publications. **Note that any publications resulting from work carried out under the JERICO -S3 TA activity must acknowledge the support of the European Commission – H2020 Framework Programme, JERICO -S3 under grant agreement No. 871153.**

[10] Describe in detail results and main findings of your experiment at the present stage.

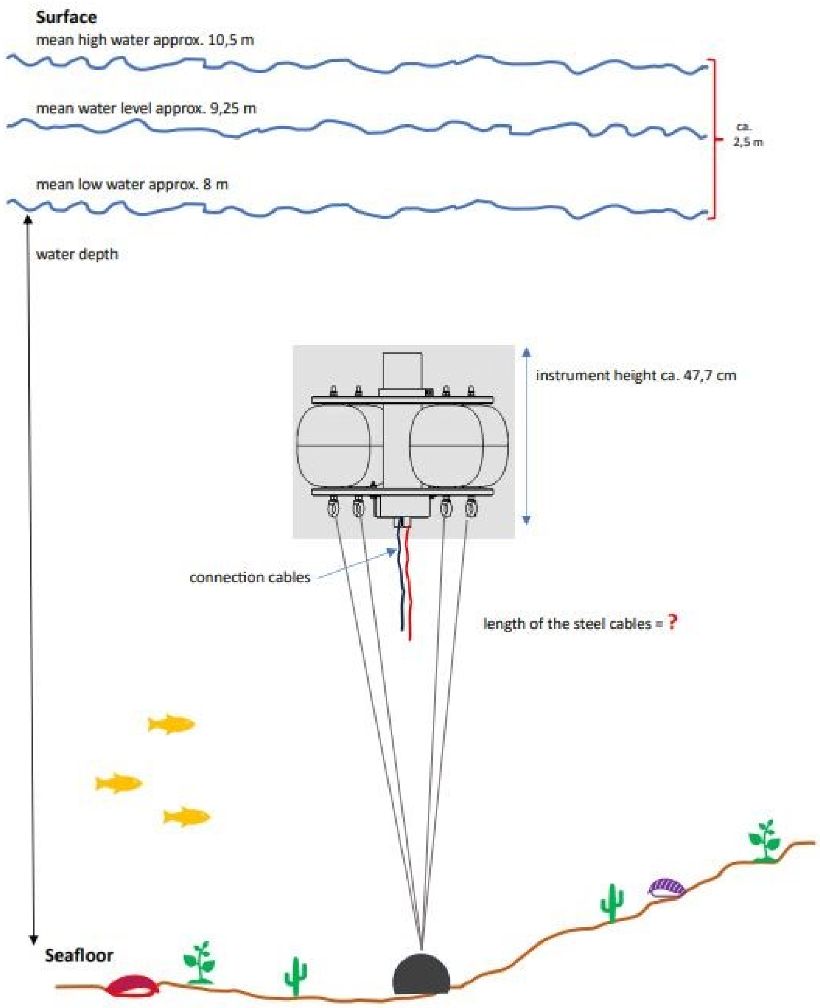
Understanding the distribution and change of oceanic rainfall patterns is a major component of global/regional water cycle and climate change. The most common instruments used to measure rainfall are rain gauges, which however represent a point measurement. A lot of effort is given the last year to monitor radioactivity in the sea as well as in the air for studying air-sea interactions. As concerns the radioactivity measurement in the sea, radon progenies can be observed after and during a rainfall event. Radon progenies in the atmosphere are transported to the sea surface by the scavenging effects of rainfall. Radon can be detected via its daughters (214Bi and 214Pb) which are gamma-ray emitters. The continuous monitoring of gamma radiation in the marine environment provides significant information on various environmental processes where radon (and/or thoron) can be applied as a tracers. 222Rn (half life 3.825 d) is a noble gas and is found in aerosol particles in accumulation-mode. It has been observed qualitatively after rainfall from the short-lived radon daughters (214Bi and 214Pb). However, the variation of radon activity is not constant mainly due to rainfall intensity, rainfall type and humidity. It has been measured (using the lab-based method) that the volumetric activity of radon decay products in rainwater amounts up to 105 Bq/l.

This phenomenon causes the environmental gamma ray intensity at the sea to increase significantly during the rainfall, anywhere from several to tens of percentage points of intensity compared to dry conditions. The study of radon progenies is necessary in order to correctly assess rates of precipitation and fallout issues and processes (after an accident). Furthermore, the radon progenies in rainwater are useful when studying the atmospheric scavenging of harmful substances and aerosols because these progenies behave as tracers that reveal the dynamics of the process.

The vision of the proposed technology gave an effective autonomous, robust, low power consumption and cost-effective in-situ radioactivity system that provided real-time measurements of gamma-ray intensity as well as of all gamma-ray emitters present in the seabed and in the seawater. Furthermore, the data analysis did not exhibit potential contaminants originated from anthropogenic activities. This complementary information will dramatically support existing actions for assessing the state of the sea in the future.

A. Seawater Monitoring Data

The experimental set up for the integration of GeoMAREA system in the COSYNA cabled observatory is shown in Figure 1. The GeoMAREA system was deployed in a distance of around 2m below sea surface and 9m from the seabed. This set up was decided to avoid contribution of gamma-rays produced in the atmosphere as well as from the sediment of the seabed.



[PF1]

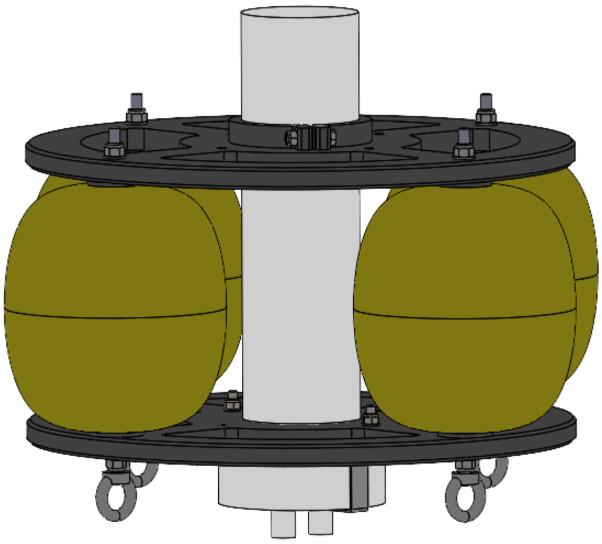


Figure 1. Experimental set up of GeoMAREA integration into the COSYNA network for the deployment in the seawater environment in Helgoland.

In the Figure 2, we show the time series of the observed values in terms of gamma-ray per second (or total counting rate-TCR). In literature this is called a gamma-ray intensity rate parameter. The TCR is a key factor to assess any potential parameter. There are two main phenomena when there is such gradient of TCR. The first one is to check the natural gradient of radon progenies due to rainfall and the second one has anthropogenic origin and may be due to a nuclear incidence (e.g. an identification of a radioactive plume due to a nuclear accident or nuclear blast). The key anthropogenic tracer that it is easily detected after a nuclear accident of nuclear blast is Cs since it has high production fission yield and it is soluble in the seawater. The observed data are analysed appropriately for this period of measurements and show that the gradients of TCR is due to rainfalls and not to any anthropogenic reason. The level of Cs-137 (as the most adequate radionuclide exhibited an average value of (8 ± 2) Bq/m^3.

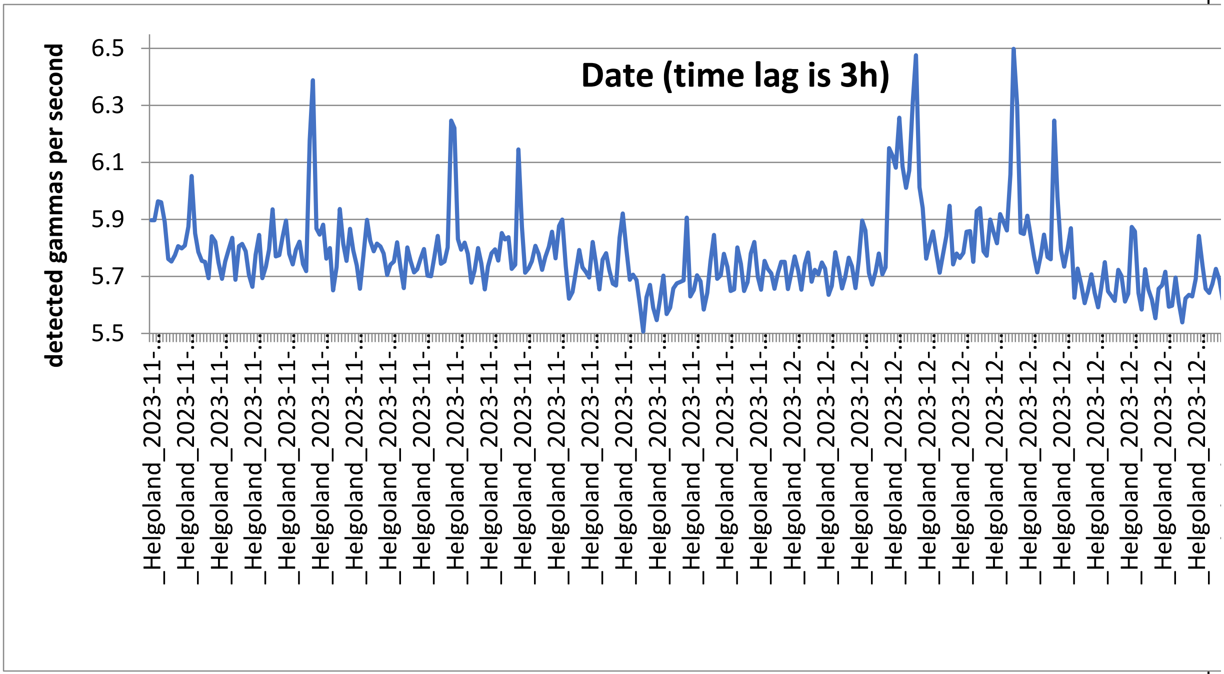


Figure 2. The time series of gamma-ray intensity rate during the period of monitoring.

17/06/2024

Location and date
Anavyssos 17/6/24

Signature of principal investigator