

The EVER-EST Virtual Research Environment (VRE): outcomes and solutions for Earth Science

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The EVER-EST project developed a Virtual Research Environment (VRE) to manage the full research lifecycle in Earth Science: from discovery and access of data input, to the coding necessary to extract the information, till to the sharing of methodologies and results.

The logic behind EVER-EST is to put the scientist at the center and to bridge the technological and knowledge gap and barriers for open science, application of EOSC principles and digital innovation. The EVER-EST VRE enables FAIR services to improve findability, accessibility, interoperability and reusability of research data, processes and results in a web environment. EVER-EST ensures to its users the functionalities which are needed to search, access and process Earth Science data: but most importantly it provides services to re-use, preserve and share among researchers both data and scientific processes. This is enabled by the adoption – for the first time in Earth Science – of the Research Object paradigm and related technologies.

The Research Object (RO) aim to account, describe and share everything about the research, including how those things are related. The RO model takes the central point to encapsulate all the resources relevant to the scientific work (data, live code, workflows, results, documents) in a single information unit [<http://www.researchobject.org>].

The RO model has been adapted to the Earth Science according to the user needs provided by the four different Virtual Research Communities (VRCs) engaged in the EVER-EST project (Land Monitoring, Supersites, Natural Hazard and Sea Monitoring). Nevertheless the four communities use the VRE for different goals (e. g. change detection on land, monitoring, risk assessment, marine habitat mapping), with different data, processes and results, working with the same facilities led to a cross-fertilisation process between VRCs, generating new knowledge.

The CNR-ISMAR represents the Sea Monitoring community and, in this view, developed case studies providing practical methods, procedures and protocols to support coherent and widely accepted interpretation of Good Environmental Status (GES) in the Marine Strategy Framework Directive (MSFD). In this context, we present the Research Objects implemented so far, focusing on methodologies and results related to benthic habitat mapping such as Cold Water Corals habitat suitability models and seafloor roughness extractions using the EVER-EST VRE platform.

The Sea Monitoring portal provides the main user web interface to create and share Earth Science ROs, to discover data, to access, to process and visualize services rely on OGC standards (OpenSearch, Web Coverage Service, Web Processing Service, Web Map Service), to manage Research Objects, and finally, to execute remote workflow implemented via Taverna [<https://taverna.incubator.apache.org>]. Moreover, the VRE provides different user interfaces such as: *Collaboration spheres*, for the

visualization of correlation between similar objects (e.g., users, Research Objects) based on collaborative filtering and versatile keyword content-based recommendations; *RoHub*, the reference platform for Research Object management supporting the preservation and lifecycle management of scientific investigations, research campaigns and operational processes; and *Jupyter Notebook* a web-based application suitable for capturing the whole computation process: developing, documenting, and executing code, as well as communicating the results.

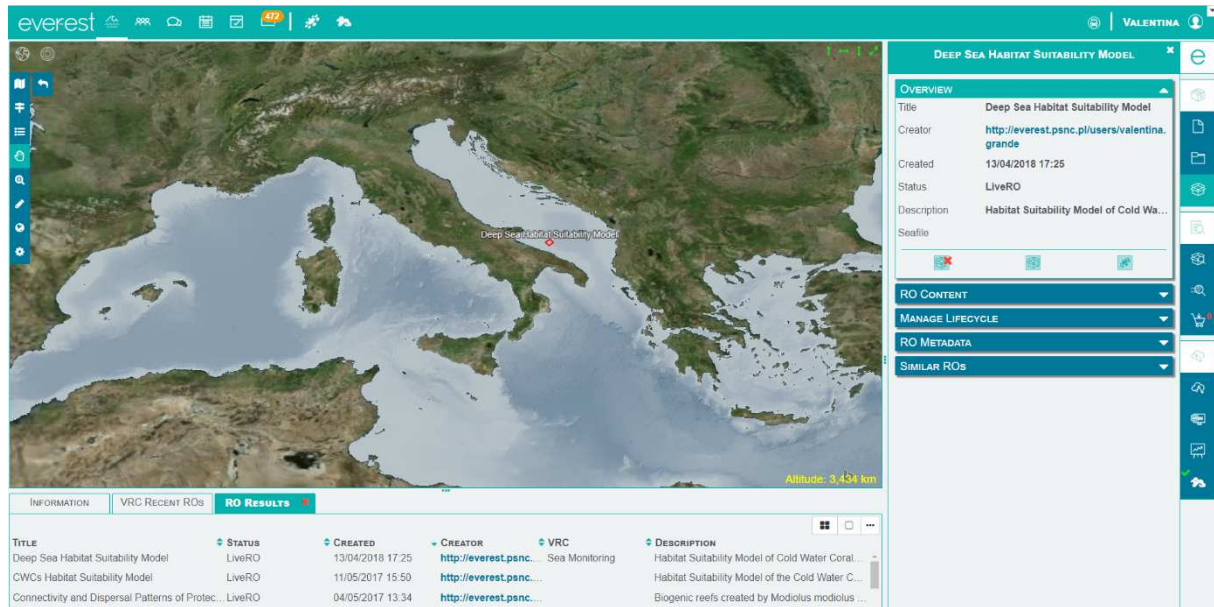


Figure 1: Overview of the EVER-EST VRE (<https://vre.ever-est.eu/demovrc/>).