ARPAE

Agenzia regionale per la prevenzione, l'ambiente e l'energia

dell'Emilia - Romagna

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Atti amministrativi

Deliberazione del Direttore Generale	n. DEL-2022-151 del 07/12/2022
Oggetto	Struttura Idro-Meteo-Clima. Presa d'atto dell'approvazione del finanziamento al Partenariato Esteso "RETURN", tematica "3. Natural, man-made and environmental risks", per la realizzazione del Programma di Ricerca e Innovazione "RETURN".
Proposta	n. PDEL-2022-148 del 05/12/2022
Struttura proponente	Struttura Idro-Meteo-Clima
Dirigente proponente	Nanni Sandro
Responsabile del procedimento	Nanni Sandro

Questo giorno 7 (sette) dicembre 2022 (duemilaventidue), presso la sede di Via Po n. 5, in Bologna, il Direttore Generale, Dott. Giuseppe Bortone, delibera quanto segue.

Oggetto: **Struttura Idro-Meteo-Clima. Presa d'atto dell'approvazione del finanziamento al Partenariato Esteso "RETURN", tematica "3. Natural, man-made and environmental risks", per la realizzazione del Programma di Ricerca e Innovazione "RETURN".**

RICHIAMATI:

- il Regolamento (UE) 2021/241 del Parlamento europeo e del Consiglio del 12 febbraio 2021, pubblicato nella Gazzetta Ufficiale dell'Unione Europea L57 del 18 febbraio 2021, che istituisce il dispositivo per la ripresa e la resilienza dell'Unione Europea;
- il Regolamento (UE) 2018/1046 del 18 luglio 2018, che stabilisce le regole finanziarie applicabili al bilancio generale dell'Unione, che modifica i Regolamenti (UE) n. 1296/2013, n. 1301/2013, n. 1303/2013, n. 1304/2013, n. 1309/2013, n. 1316/2013, n. 223/2014, n. 283/2014 e la decisione n. 541/2014/UE e abroga il Regolamento (UE, Euratom) n. 966/2012;
- il Regolamento (UE) 2020/852 del Parlamento europeo e del Consiglio del 18 giugno 2020 relativo all'istituzione di un quadro che favorisce gli investimenti sostenibili e recante modifica del Regolamento (UE) 2019/2088;
- il Regolamento delegato (UE) 2021/2106 della Commissione del 28 settembre 2021 che integra il Regolamento (UE) 2021/241 del Parlamento europeo e del Consiglio, che istituisce il dispositivo per la ripresa e la resilienza, stabilendo gli indicatori comuni e gli elementi dettagliati del quadro di valutazione della ripresa e della resilienza;

VISTI:

- il Decreto interministeriale del MIUR-MISE prot. 116 del 24 gennaio 2018, che reca "Semplificazione in materia di costi a valere sui programmi operativi FESR 2014-2020: approvazione della metodologia di calcolo e delle tabelle dei costi standard unitari per le spese del personale dei progetti di ricerca e sviluppo sperimentale";
- il Piano Nazionale di Ripresa e Resilienza (di seguito "PNRR"), ufficialmente presentato alla Commissione Europea in data 30 aprile 2021 ai sensi dell'art. 18 del Regolamento (UE) n. 2021/241 e valutato positivamente con Decisione del Consiglio ECOFIN del 13 luglio 2021 e notificato all'Italia dal Segretariato generale del Consiglio con nota LT161/21, del 14 luglio 2021;
- il Decreto del Presidente del Consiglio dei Ministri 9 luglio 2021 recante l'individuazione delle amministrazioni centrali titolari di interventi previsti nel PNRR, ai sensi dell'articolo 8, comma 1, del decreto-legge Ministero dell'Università e della Ricerca 31 maggio 2021, n. 77 convertito con modificazioni dalla Legge n. 108 del 2021;

- il Decreto del Ministero dell'Economia e delle Finanze del 6 agosto 2021 e successiva rettifica del 23 novembre 2021, recante "Assegnazione delle risorse finanziarie previste per l'attuazione degli interventi del Piano Nazionale di Ripresa e Resilienza (PNRR) e ripartizione di traguardi e obiettivi per scadenze semestrali di rendicontazione";

CONSIDERATO:

- che, ai sensi del Decreto di cui al precedente Visto, il Ministero dell'Università e della Ricerca è assegnatario di risorse per l'attuazione degli interventi del PNRR nell'ambito della Missione 4 - Componente 2 "Dalla Ricerca all'Impresa" (di seguito "M4C2"), per complessivi 11,44 miliardi di Euro;

VISTI:

- la riforma 1.1 della M4C2 "Attuazione di misure di sostegno alla R&S per promuovere la semplificazione e la mobilità";
- l'investimento 1.3 della M4C2 "Creazione di "Partenariati estesi alle università, ai centri di ricerca, alle aziende per il finanziamento di progetti di ricerca di base" che mira a rafforzare le filiere della ricerca a livello nazionale e a promuovere la loro partecipazione alle catene di valore strategiche europee e globali;
- le Linee Guida definite dal Ministero dell'Università e della Ricerca per le iniziative di sistema della M4C2, approvate con Decreto Ministeriale n. 1141 del 7 ottobre 2021, condivise con la Cabina di Regia del PNRR;
- il Decreto Ministeriale 14 dicembre 2021, n. 1314, recante "Disposizioni per la concessione delle agevolazioni finanziarie", emanato dal MUR in attuazione della suindicata riforma 1.1 della M4C2 e successivamente modificato con Decreto Direttoriale 24 dicembre 2021, n. 1368;
- il Decreto Direttoriale 15 marzo 2022, n. 341 di emanazione di un "Avviso pubblico per la presentazione di Proposte di intervento per la creazione di "Partenariati estesi alle università, ai centri di ricerca, alle aziende per il finanziamento di progetti di ricerca di base" - nell'ambito del Piano Nazionale di Ripresa e Resilienza, Missione 4 "Istruzione e ricerca" - Componente 2 "Dalla ricerca all'impresa" - Investimento 1.3, finanziato dall'Unione europea - NextGenerationEU" (di seguito "Avviso);

CONSIDERATO:

- che l'art. 1, comma 1, dell'Avviso prevede la creazione di almeno 10 e massimo 14 grandi Partenariati estesi alle università, ai centri di ricerca, alle aziende sul territorio nazionale rispetto alle seguenti 14 tematiche di cui alle Linee Guida del MUR di ottobre 2021: 1. Intelligenza artificiale: aspetti fondazionali; 2. Scenari energetici del futuro sottotematica

2.a. Energie verdi del futuro; 3. Rischi ambientali, naturali e antropici; 4. Scienze e tecnologie quantistiche; 5. Cultura umanistica e patrimonio culturale come laboratori di innovazione e creatività; 6. Diagnostica e terapie innovative nella medicina di precisione; 7. Cybersecurity, nuove tecnologie e tutela dei diritti; 8. Conseguenze e sfide dell'invecchiamento; 9. Sostenibilità economico-finanziaria dei sistemi e dei territori; 10. Modelli per un'alimentazione sostenibile; 11. Made-in-Italy circolare e sostenibile; 12. Neuroscienze e neurofarmacologia; 13. Malattie infettive emergenti; 14. Telecomunicazioni del futuro. La tematica 15. "Attività spaziali", di cui alle richiamate Linee guida MUR approvate con Decreto Ministeriale n. 1141 del 7 ottobre 2021, sarà promossa e sostenuta attraverso successivo bando di finanziamento adottato dall'Agenzia Spaziale Italiana (ASI), a valere sulle ordinarie risorse nella disponibilità dell'Agenzia;

- che, ai sensi dell'art. 3, comma 1, dell'Avviso, le risorse finanziarie complessive a disposizione ammontano ad Euro 1.610.000.000,00 (unmiliardoseicentodiecimilioni/00) a valere sulla Missione 4, Componente 2, Investimento 1.3 - Creazione di "Partenariati estesi alle università, ai centri di ricerca, alle aziende per il finanziamento di progetti di ricerca di base" - del PNRR, assegnate al MUR ai sensi del Decreto del Ministro dell'Economia e delle Finanze del 6 agosto 2021 e successiva rettifica del 23 novembre 2021;

VISTI:

- la circolare n. 21 del Ministero dell'Economia e delle Finanze del 29 aprile 2022, avente ad oggetto "Piano Nazionale di Ripresa e Resilienza (PNRR) e Piano nazionale per gli investimenti complementari - Chiarimenti in relazione al riferimento alla disciplina nazionale in materia di contratti pubblici richiamata nei dispositivi attuativi relativi agli interventi PNRR e PNC";
- la circolare n. 30 del Ministero dell'Economia e delle Finanze dell'11 agosto 2022 avente ad oggetto "Linee Guida per lo svolgimento delle attività di controllo e rendicontazione degli interventi PNRR di competenza delle Amministrazioni centrali e dei Soggetti attuatori";
- la nota del Ministero dell'Economia e delle Finanze - Servizio centrale per il PNRR del 7 marzo 2022, n. 3609, avente ad oggetto chiarimenti in merito all'ammissibilità dei costi riguardanti il personale di ricerca;
- il Decreto Direttoriale 2 agosto 2022, n. 1243, con il quale sono state approvate le graduatorie delle proposte pervenute in risposta all'Avviso, con la contestuale ammissione alla successiva Fase 2 delle 14 proposte risultate idonee, ai sensi dell'art. 12 dell'Avviso;

- la nota del 3 agosto 2022, prot. MUR n.13701, con la quale il MUR, nel comunicare gli esiti della valutazione della manifestazione di interesse, ha chiesto all'Università degli Studi di Napoli Federico II, Soggetto proponente del Partenariato Esteso PE00000005 "RETURN" la presentazione della proposta integrale, entro il 7 settembre 2022;

CONSIDERATI:

- gli atti finali della Commissione che, di concerto con il soggetto proponente, e in esito all'esperimento della Fase Negoziale, ha definito il Programma di Ricerca e Innovazione, il Piano dei costi e delle agevolazioni e il Cronoprogramma di attuazione che riporta milestones di progetto e il relativo Piano dei pagamenti connesso al conseguimento degli obiettivi, conservati agli atti;
- l'art. 16 dell'Avviso che dispone che il decreto di finanziamento sia corredato anche dal Disciplinare di concessione delle agevolazioni che regola i rapporti tra il MUR ed il Soggetto Attuatore, nonché i relativi termini e condizioni, le modalità di attuazione e gli obblighi di rendicontazione del Programma di Ricerca e Innovazione identificato con codice PE00000005 dal titolo "RETURN" che ne forma parte integrante;
- che le spese ammissibili sono quelle indicate all'art. 9 dell'Avviso, dalla normativa PNRR nonché, per quanto compatibili, quelle riferite ai fondi strutturali di investimento europei (SIE);
- che, coerentemente con il PNRR, il periodo di eleggibilità della spesa del Programma di Ricerca e Innovazione denominato RETURN della durata di 36 mesi decorre dal 1 dicembre 2022 ed è prorogabile non oltre la data del 28 febbraio 2026;
- il Decreto n. 1552 del 11/10/2022 del Ministero dell'Università e della Ricerca, che formalizza la concessione del finanziamento del Partenariato Esteso denominato "RETURN", tematica "3. Natural, man-made and environmental risks", domanda di agevolazione contrassegnata dal codice identificativo PE00000005, per la realizzazione del Programma di Ricerca e Innovazione dal titolo "RETURN", nonché i termini, le condizioni, le forme, le misure, le modalità di attuazione e gli obblighi di rendicontazione del Programma finanziato, indicati nella normativa citata in premessa;
- la comunicazione pervenuta da parte del capofila, allegata e conservata agli atti (PG/2022/0190682), relativamente alla proposta definitiva approvata, contenente le principali caratteristiche, nonché gli elementi di fattibilità e controllo;

PRESO ATTO:

- che nell'ambito del Partenariato Esteso (PE) i singoli beneficiari possono essere identificati come Hub (Soggetto attuatore), Spoke, ovvero affiliati agli Spoke;

- che il Soggetto Attuatore del Programma di Ricerca e Innovazione si è costituito nella forma di Fondazione denominata "MULTI RISK SCIENCE FOR RESILIENT COMMUNITIES UNDER A CHANGING CLIMATE (RETURN)"(CF 10123341215) e si configura come soggetto responsabile dell'avvio, dell'attuazione e della gestione dell'Ecosistema dell'Innovazione e si obbliga a garantire la piena attuazione del Programma di Ricerca e Innovazione del suddetto Ecosistema dell'Innovazione, a rispettare i vincoli previsti dall'art. 7, comma 2, dell'Avviso relativi alla disparità di genere e ai campi di intervento di cui all'art. 3 dell'Avviso; si obbliga altresì a non arrecare con l'attuazione del Programma un danno significativo agli obiettivi ambientali, ai sensi dell'art. 17 del Regolamento (UE) 2020/852 e ad essere coerente con i principi e gli obblighi specifici del PNRR relativamente al principio del "Do No Significant Harm" (DNSH), Ministero dell'Università e della Ricerca Segretariato Generale Direzione generale della ricerca nonché a garantire la correttezza, l'affidabilità e la congruenza dei dati del monitoraggio procedurale, finanziario e fisico, ponendo particolare attenzione a raccogliere anche i dati utili al monitoraggio degli indicatori comuni associati alla misura, ossia il numero di ricercatori che lavorano in centri di ricerca beneficiari di un sostegno, differenziato per genere, e il numero di imprese beneficiarie di un sostegno evidenziandone gli elementi essenziali quali dimensioni e codice ATECO;
- che l'Hub rappresenta il referente unico per l'attuazione dei Programmi nei confronti del MUR, svolge le attività di gestione e di coordinamento, riceve le tranche di agevolazioni concesse da destinare alla realizzazione del Programma di Ricerca, verifica e trasmette al MUR la rendicontazione delle attività svolte dagli Spoke e loro affiliati;
- che ogni Spoke riceve dall'Hub le agevolazioni in ragione delle attività svolte così come previste dal Programma di Ricerca e provvede alla rendicontazione all'Hub delle spese proprie e dei soggetti aggregati sostenute per l'attività di ricerca di sua competenza;
- che per la realizzazione delle attività tematiche di propria competenza, gli Spoke possono avvalersi, attraverso la formalizzazione di specifici accordi, della collaborazione di altri soggetti giuridici autonomi già esistenti, indicandoli nella proposta ("soggetti affiliati allo Spoke");
- che Arpae parteciperà al citato Partenariato Esteso in qualità di soggetto affiliato allo Spoke 8 - DS - Science underpinning climate services for risk mitigation and adaptation - coordinato da UNIBO con il supporto di UNIPD, e che come tale non ha quindi l'obbligo di partecipare alla Fondazione appositamente costituita e citata al punto precedente, bensì sarà chiamata a sottoscrivere apposito Accordo per disciplinare i rapporti con lo Spoke di

riferimento (individuato nell'Università di Bologna);

CONSIDERATO:

- che il PE "RETURN" avrà durata di 36 mesi, a decorrere dal 1 dicembre 2022 ed è prorogabile non oltre la data del 28 febbraio 2026, con un budget complessivo pari a Euro 115.099.876,40, nella forma del contributo alla spesa a valere sulla Missione 4, Componente 2, Investimento 1.3 - Creazione di "Partenariati estesi alle università, ai centri di ricerca, alle aziende per il finanziamento di progetti di ricerca di base" - del PNRR, assegnate al MUR ai sensi del Decreto del Ministro dell'Economia e delle Finanze del 6 agosto 2021 e successiva rettifica del 23 novembre 2021;
- che l'obiettivo principale del PE "RETURN" (Multi Risk Science for resilient Communities under a Changing Climate) è lo sviluppo della ricerca nel campo della riduzione del rischio e dell'adattamento al cambiamento climatico, relativo a diversi pericoli geofisici e ambientali quali Inondazioni, Siccità, Inondazioni costiere, Instabilità del suolo, Terremoti e Vulcani, Degrado ambientale;
- che Arpae collaborerà alle attività rivolte alla definizione dello stato dell'arte e base di conoscenze per definire indicatori di pericolo orientati all'impatto, alla valutazione dell'incertezza per gli scenari climatici e meteorologici e all'individuazione di un sistema di supporto alle decisioni per integrare gli indicatori di pericolo nel processo decisionale per la mitigazione e l'adattamento a pericoli specifici;
- che per la realizzazione del progetto potranno essere sostenuti da Arpae complessivamente costi per Euro 391.200,00 così articolati:

  Costi di Personale: Euro 138.000,00

  Costi per assegnisti: Euro 150.000,00

  Attrezzature, materiali, licenze e consulenze: Euro 60.000,00

  Costi indiretti: Euro 43.200,00
- che, dal finanziamento per la partecipazione al progetto, deriverà per Arpae un'entrata pari a Euro 391.200,00;
- che tale contributo sarà utilizzato da Arpae nel rispetto delle norme contenute nei richiamati regolamenti e i costi sostenuti saranno rendicontati, secondo le scadenze stabilite;

RITENUTO:

- opportuno che Arpae partecipi, in qualità di affiliato allo Spoke al PE "RETURN", sottoscrivendo l'Accordo con lo spoke di riferimento (Università di Bologna);
- che la partecipazione al PE "RETURN" rappresenti per Arpae un'opportunità per

migliorare, attraverso il contatto e lo scambio di esperienze con altri centri internazionali e di ricerca, lo stato delle conoscenze sugli aspetti legati alla riduzione del rischio e all'adattamento al cambiamento climatico;

- che la Struttura Idro-Meteo-Clima possa fornire competenze e risorse nell'ambito di tale progetto, che risulta di estremo interesse per l'Agenzia;
- di individuare il Responsabile della Struttura Idro-Meteo-Clima quale soggetto legittimato ad agire, in qualità di delegato del legale rappresentante di Arpae Emilia-Romagna, nell'ambito del PE "RETURN", nei confronti del soggetto attuatore, in particolare sottoscrivendo apposito accordo con lo Spoke di riferimento (Università di Bologna);
- di delegare al Responsabile della Struttura Idro-Meteo-Clima l'adozione di ogni atto che si renda necessario per garantire lo svolgimento delle attività progettuali, nel rispetto del budget assegnato;
- di individuare il Dott. Sandro Nanni, Responsabile della Struttura Idro-Meteo-Clima, quale coordinatore;

DATO ATTO:

- che il budget assegnato ad Arpae Emilia-Romagna per la realizzazione del Progetto è gestito dalla Struttura Idro-Meteo-Clima;
- che la Struttura Idro-Meteo-Clima potrà, nell'arco della durata del progetto, coinvolgere nella realizzazione delle attività altre strutture di Arpae, previo accordo con i relativi Responsabili in merito al monte ore previsto per l'impegno, dei collaboratori individuati e al corrispondente trasferimento di quote di budget;

SU PROPOSTA:

- del Responsabile della Struttura Idro-Meteo-Clima, Dott. Sandro Nanni, il quale ha espresso, ai sensi del Regolamento per l'adozione degli atti di gestione delle risorse dell'Agenzia approvato con D.D.G. n. 114 del 23/10/2020, il proprio parere favorevole in ordine alla regolarità amministrativa del presente provvedimento;

DATO ATTO:

- del parere di regolarità contabile espresso dal Dott. Giuseppe Bacchi, Responsabile del Servizio Amministrazione, Bilancio e Controllo Economico, ai sensi del Regolamento per l'adozione degli atti di gestione delle risorse dell'Agenzia approvato con D.D.G. n. 114 del 23/10/2020;
- del parere favorevole espresso dal Direttore Amministrativo, Dott.ssa Lia Manaresi, e del Direttore Tecnico, Dott. Eriberto de' Munari, reso ai sensi dell'art. 9, comma 5, della L.R. n. 44/95;

- che il responsabile del procedimento è il Dott. Sandro Nanni, Responsabile della Struttura Idro-Meteo-Clima;

DELIBERA

1. di prendere atto dell'approvazione, da parte del Ministero dell'Università e della Ricerca, del Partenariato Esteso "RETURN", tematica "3. Natural, man-made and environmental risks", per la realizzazione del Programma di Ricerca e Innovazione "RETURN", secondo quanto indicato nell'allegato sub A) al presente atto;
2. di dare atto che Arpae Emilia-Romagna riveste il ruolo di affiliato allo Spoke nell'ambito del PE "RETURN" di cui l'Università di Napoli è partner capofila e membro dell'Hub, con compiti di coordinamento;
3. di dare atto che il progetto di cui trattasi avrà durata di 36 mesi con decorrenza dal 1 dicembre 2022 ed è prorogabile non oltre la data del 28 febbraio 2026;
4. di dare atto che per la realizzazione del progetto potranno essere sostenuti da Arpae complessivamente costi per per Euro 391.200,00 così articolati:
   Costi di Personale: Euro 138.000,00
   Costi per assegnisti: Euro 150.000,00
   Attrezzature, materiali, licenze e consulenze: Euro 60.000,00
   Costi indiretti: Euro 43.200,00
5. di dare atto che il costo complessivo stimato per la realizzazione delle attività previste nel PE "RETURN", da parte di Arpae è pari ad Euro 391.200,00; tale importo è coperto interamente dal contributo del MUR;
6. di dare atto che, per Arpae Emilia-Romagna, il soggetto competente all'attuazione e alla gestione del PE "RETURN" è la Struttura Idro-Meteo-Clima;
7. di individuare il Responsabile della Struttura Idro-Meteo-Clima quale soggetto legittimato ad agire, in qualità di delegato del legale rappresentante di Arpae Emilia-Romagna, nell'ambito del PE "RETURN", in particolare per la sottoscrizione dell'accordo di affiliato allo Spoke nei confronti di Università di Bologna, Spoke di riferimento per la propria attività nell'ambito del progetto;
8. di delegare al Responsabile della Struttura Idro-Meteo-Clima l'adozione di ogni atto che si renda necessario per garantire lo svolgimento delle attività progettuali nel limite del budget assegnato;
9. di individuare il Dott. Sandro Nanni, Responsabile della Struttura Idro-Meteo-Clima, quale coordinatore del PE "RETURN";

10. di individuare nei seguenti collaboratori le competenze e le professionalità necessarie alla partecipazione di Arpae al progetto:
    - Dott. Sandro Nanni, con funzione di responsabile della partecipazione di Arpae al progetto e coordinamento delle attività di ricerca;
    - Ing. Andrea Valentini, con funzione di ricercatore senior;
    - Dott.ssa Giulia Villani, con funzione di ricercatrice junior;
    - Dott.ssa Rosanna Foraci, con funzione di ricercatrice senior;
    - Dott. Gabriele Antolini, con funzione di ricercatore senior;
    - Ing. Silvia Unguendoli, con funzione di ricercatore junior;
    - Dott. Pier Paolo Alberoni, con funzione di ricercatore senior;
    - Ing. Tommaso Diomede, con funzione di ricercatore senior;
    - Dott.ssa Giulia Caiani, con funzione di referente amministrativo e finanziario per la gestione del progetto;
    - Rag.re Lucia Pirro, Luisella Iervolino, Annalisa Massano, collaboratrici amministrative per la rendicontazione e registrazione dei costi del progetto.

PARERE: FAVOREVOLE

IL DIRETTORE TECNICO

(F.to Dott. Eriberto de' Munari)

IL DIRETTORE AMMINISTRATIVO

(F.to Dott.ssa Lia Manaresi)

IL DIRETTORE GENERALE

(F.to Dott. Giuseppe Bortone)

Annex 1 - Project proposal –B. CHARACTERISTICS, FEASIBILITY AND CONTROL

B.1 The composition of the critical mass that will be involved in carrying out the research program

Spokes & Affiliates

RETURN, the Extended Partnership based on "Environmental, natural and anthropic risks" (PE3), involves 26 entities, including 13 Public Universities and Public Research Institutions (EPR), 1 Governmental Entity (the Italian Civil Protection Department - DPC), 2 Territorial Agencies, 10 Private Entities; the latter include 3 research centres or foundations, 1 private University and 6 Private Companies. As shown in Fig. B1, these are distributed over eight thematic areas, each corresponding to a specific Spoke. Exceptions are the DPC and the private company "Generali", which will participate in the Hub, contributing to the governance of the Extended Partnership, but will not be involved into the research activities developed by Spokes. As shown in Fig. B2, each Spoke will be participated by 8 to 17 entities.

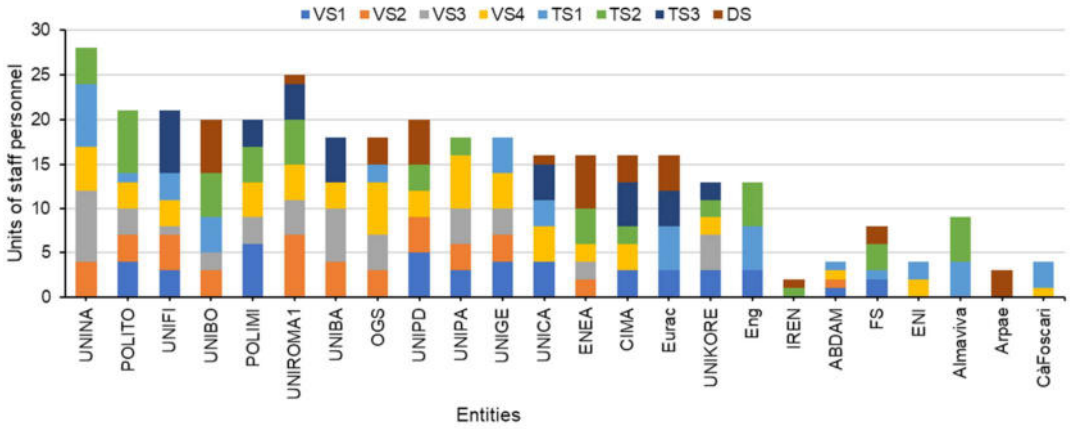

Fig. B1 – Bar chart showing entities contribution to each spoke in terms of units of staff personnel. Colored bar-segments identify Spokes according to the legend at the top of the graph.

Critical Mass

The overall human resources dedicated to carry out the research activities of this Extended Partnership is of 348 units of staff personnel. Overall, they represent the critical mass of the project, which can be grouped in 8 different Spokes, according to Fig. B2. Each Spoke will have from 34 to 56 units of staff personnel, so that the minimum requirements for the definition of the critical mass, set out in Article 7, paragraph 3 of the Call, are satisfied: a) the units of permanent staff involved in the project are within a minimum of 250 and a maximum of 350; b) each Spoke has at least 3 units of permanent staff for at least 3 PM/y. Table 1 depicts current roles and related gender proportion of the units in terms of either position grade and equivalent standard cost (i.e. "costo standard, Decreto n°116, 24/01/2018"), for university and non-university staff personnel, respectively. The equivalent standard cost criterion has been selected for homogenizing university and non-university staff personnel grade classification, providing a consistent overview of unit distribution (see classification in Table 1). The critical mass is highly interdisciplinary, with **83 Scientific Sectors** ("Settori Scientifico Disciplinari, SSD") represented by selected staff personnel and units that operate across multiple Scientific Sectors, strengthening the multi-disciplinarity of the critical mass.

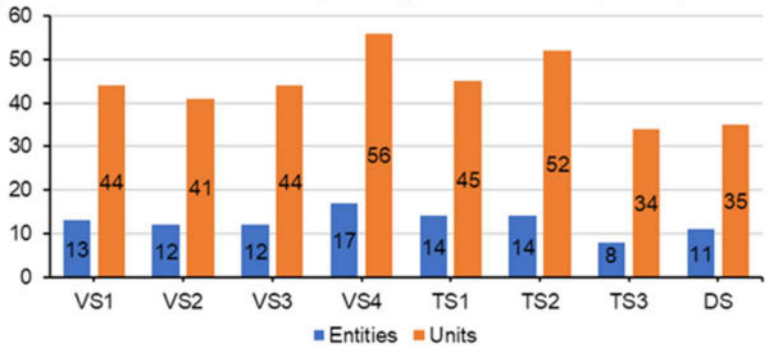

Fig. B2 – Bar chart showing both distribution of entities and units of staff personnel for each Spoke.

Annex 1

Selection Methodology

The selection of the entities and researchers to be involved in the RETURN Extended Partnership and the division in Spoke Leaders and Spoke Affiliates was implemented considering diverse criteria. The 24 partners were selected according to their a) scientific productivity, b) experience in national and international collaborations, c) fundraising and fund management capability, d) consistency of their expertise with the proposed research program. The involvement of research institutions, in terms of Spoke Leader and Spoke Affiliate, was defined also according to the geographical locations of the entities following the budget allocation constraints set by the Call.

Table 1 – Classification of units of staff personnel participating to the Extended Partnership in terms of both university position grade (e.g. Full Professor etc…) and standard cost equivalent (e.g. High etc…).

Role	Female	Male	<10 years from PhD	Total resources involved
Full Professor/High	33	126	1	159
Associate Professor/Medium	60	69	11	129
RtDs/Low	30	29	33	59
Total	**123**	**225**	**45**	**348**
% Percentage	**35,3%**	**64,7%**	**13,0%**	

The Spoke Leaders (POLIMI, VS1; UNIROMA1, VS2; UNIBA, VS3; OGS, VS4; UNINA, TS1; POLITO, TS2; UNIFI, TS3; UNIBO, DS) are among the most excellent entities in the 8 thematic areas previously described *(also in terms of publications and impact on the topic of the PE3)* and all of them have a strong expertise in leading international projects and top-level scientific productivity as indicated by significant H-index of staff personnel units (where applicable, i.e. University and Research Centre).

POLIMI, leader of VS1, is ranked 6th at the EU level in Civil Engineering, has a solid knowhow in hydrological issues and water use optimization. UNIROMA1, leader of VS2, has a strong expertise in engineering-geological analysis of ground instability phenomena, also in marine environment, and hosts the CERI research centre on landslide risk. UNIBA, leader of VS3, hosts i) a supercomputing center (RECAS) for seismologic and volcanological modelling and ii) the seismic network (OTRIONS) of the Apulia Region. OGS, leader of VS4, has strong capabilities in the observation and modelling of ocean physics, biogeochemistry and marine ecology, including pollutant fate and transport models. UNINA, leader of TS1, is ranked 1st at the EU level for H-index citations in Civil Engineering, has leadership in several EU and national projects in multi-risk, including DRR and CM issues, and its member co-directs the Urban Climate Change Research Network European Hub. POLITO, leader of TS2, is the World Top 31th in Civil Engineering (QS), has top-level expertise in natural hazard and industrial risk assessment and hosts the Large Lab for structural diagnostics (SISCON). UNIFI, leader of TS3, host a Civil Protection Center, a Research Competence Center of the National Civil Protection System and has strong background in multi-risk management. UNIBO, leader of DS, is ranked 20th for impact in World Reputation Rankings and has a strong experience in numerical modelling of the Earth systems and climate change impact assessment, as well as climate change mitigation and adaptation planning.

Affiliates to the VS1 have proven expertise in i) water resources and hazard modelling, ii) flood/drought analysis, iii) risk estimation, iv) social resilience development and v) sustainable water resource management. This expertise is confirmed by participation in many international projects and excellence in national and international rankings. Affiliates to the VS2 have a top-level experience in i) engineering geological and geotechnical analysis of landslides, subsidence and sinkholes, ii) numerical modelling, iii) field monitoring and forecasting modelling, iv) risk estimation and v) sustainable management. Many of them host research centres that support land planning and emergency management at national level. Affiliates to the VS3 have a significant background in i) structural geology of seismogenic faults, ii) seismology and engineering seismology, iii) seismic and volcanic hazard assessment, iv) seismic vulnerability of settlement and v) risk estimation. Many of them host research and monitoring centres that support land planning and emergency management at national level. Affiliates to the VS4 have a top-level experience in i) ecotoxicological analysis and bioremediation, ii) contaminant analysis and fate tracking, iii) land-degradation monitoring and modelling, iv) environmental risk estimation in urban and rural areas and v) mitigation and remediation techniques. Affiliates to TS1 have robust interdisciplinary competences in i)

data interoperability services for Smart Cities, ii) urban vulnerability and hazard, iii) risk and multi-risk assessment and iv) territorial policy and risk management. Affiliates to TS2 have extensive experience in i) critical infrastructure analysis, ii) big data and AI based vulnerability assessment, iii) critical infrastructure monitoring, iv) risk and multi-risk assessment for critical infrastructure safety and v) maintenance approaches testing. Affiliates to TS3 have robust background in i) risk and multi-risk management, ii) individual risk attitude analysis, iii) community resilience, iv) multi-level governance, v) philosophical and epistemological aspect of risk management. Affiliates to DS have robust experience in i) climate change impact assessment, ii) extreme event analysis and forecast, iii) climate service development, iv) economic impact analysis and v) geomorphological effects.

B.2 Management and Administrative structure of PE RETURN

Legal and Administrative structure

The Legal form of RETURN "multi-Risk sciEnce for resilienT commUnities undeR a changiNg climate" (PE3) Partnership will be a Consortium (in Italian "*Società Consortile a Responsabilità Limitata"* (S.c.a.r.l)) and, as requested in Art. 4 paragraph 2 by the Call, it will be based on a Hub&Spoke architecture. There are 26 funding members of the Hub, among which Public Universities and Public Research Institutions (EPR) overseen by MUR, and other Entities, as shown in Fig. B.3, that will participate actively in the governance of the Partnership through the governance bodies illustrated below. As described in Art. 4 paragraph 6 of the Call, the Public Universities and Public Research Institutions overseen by MUR will represent the majority of the members in the governance bodies of the Hub. The *Proposing Entity* of this research project is Università degli Studi di Napoli Federico II (UNINA)

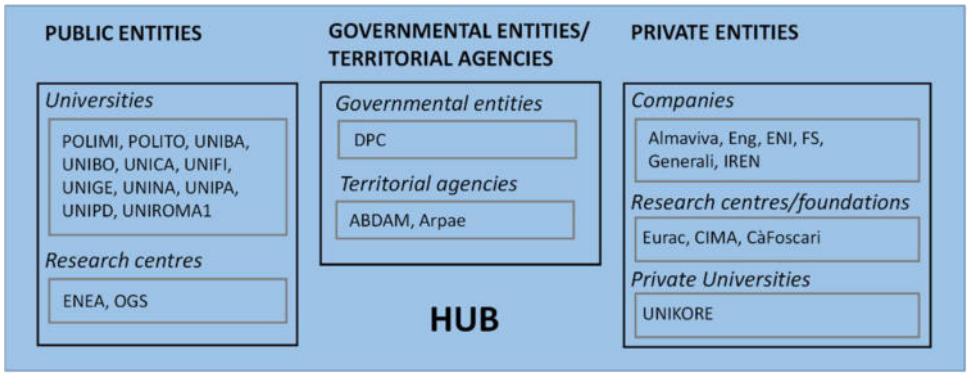

Fig. B.3: Overview of the HUB founders classified in terms of public/private status and typology.

The ***Hub*** will have the legal form of a S.c.a.r.l and it will perform the management and administrative accounting control on its expenses and on those that are incurred by the Spokes, as the Spokes will report their expenses incurred during the research program within RETURN to the Hub. The Hub will be responsible for the partnership and it will supervise the correct implementation of the work plan and its compliance with the milestones and time plans, managing directly and indirectly the critical mass and actions of the professionals involved. The Hub will ensure the accomplishment of the macro-objectives collaborating with the Spoke Leaders, which will manage the relationships with the Spoke Affiliates and realize a synergistic interconnection with the territory, by exploiting the whole range of available measures, including the Open Calls during the project lifetime.

The ***Spoke***, which is an existing legal entity, is organized and regulated by agreements among the parties. The Spoke Leader has the task of carrying out the project activities and reporting to the Hub. It will include the overall management and coordination (i.e., governance) of the "**Spoke Affiliates**", which are other existing autonomous legal entities contributing to part of the Spoke activities depending on their competencies, as well as monitoring the scientific and technical progress of the entire Spoke, the knowledge management, other innovation related activities (e.g., dissemination and exploitation, and Intellectual Property Rights (IPR)), and the relationship with the Hub. The Spoke Leader will be supported by one of its affiliates with the role of "Co-Leaders".

Governance structure

The Governance of RETURN will be based on the following elements as presented in Fig. B.4

Annex 1

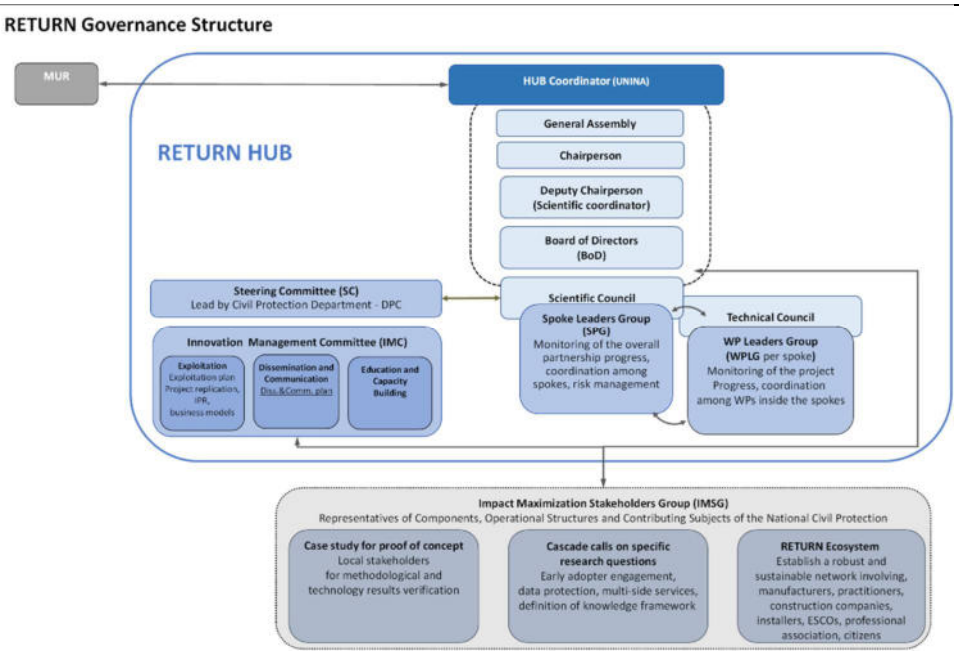

Fig. B4: Governance structure of the RETURN project

- ***General Assembly*** is composed by one representative for each member of the Consortium and its members will remain in charge for the entire duration of the Research Project. The General Assembly is entitled to make changes to the Bylaws, to define the guidelines and general criteria of the Consortium's activities, including the approval of the final balance sheet and the forecast planning report for the following year. It elects the members of the Board of Directors (BoD), the Chairperson of the Consortium, and it proposes a list of subjects within which the BoD will nominee the members of the Scientific Council. This Assembly is entitled to the admission or exclusion of members, and to the approval of probable delegation of power to the Chairperson, the General Manager and the Consortium Regulation.
- ***Chairperson*** **– CP** is appointed by the General Assembly and he/she will be chosen among the Consortium Universities' professors. He/She will be the Legal Representative of the Consortium and will convene and chair the General Assembly and the BoD. He/She appoints the Deputy Chairperson and proposes the appointment of the General Manager to the BoD. The Chairperson adopts urgent measures and supervises the correct execution of the Consortium resolutions and carries out the tasks assigned to him/her by the Bylaws. He/She has the power to execute and to approve the amendments and initiatives of the Consortium bodies, to supervise the activities of the Consortium according to the BoD directives, and to coordinate the operational structure of the Consortium. He/She also prepares the project of the forecast report and the final balance sheet and he/she is responsible for the management of personnel, including the proposal to the BoD, for the recruitments, promotions and dismissals. In case of absence or impediment of the Chairperson, he/she will be replaced by the Deputy Chairperson.
- ***Deputy Chairperson*** **– DCP** is appointed by the Chairperson and substitutes the latter in all functions in cases of impediment or absence. He/She will play also the role of Scientific Coordinator of the Research Program.
- ***Board of Directors - BoD (Strategic body)*** consists of the Chairperson of the Consortium, of the Deputy Chairperson and of 7-11 members appointed by the General Assembly, as representatives of the Consortium, with a public majority. It has the role of appointing, after the Chairperson's proposal, the General Manager (Programme/Research Manager) and the members of the Scientific Council, choosing within the names drafted by the General Assembly. It also drafts regulations which are submitted to the General Assembly. Together with the General Manager (Programme/Research Manager), it prepares and deliberates on the contracts, agreements and conventions necessary for the aims of Consortium; and it prepares the final balance sheet, the income statement, the report on the activities carried out during the previous year, and the provisional planning report for the following year to submit for approval by the General Assembly.

- ***Programme/Research Manager – PM*** is appointed by the BoD, upon proposal of the Chairperson, and he/she has executive powers. He/She implements the decisions of the BoD, manages and coordinates all the RETURN activities, and is responsible for the correct execution of the whole research program. The PM oversees the scientific activities, collects the documentation from the Spoke for technical and administrative reporting, prepares budget forecast, and it reports any issue to the BoD. Moreover, among others, the PM coordinates the operational structure of the Consortium and the management of personnel.
- ***Scientific Council*** **- SC** (***Spoke Leaders group)*** is composed by all the Spoke Leaders, Co-Leaders and other private entities appointed by the General Assembly. It is the body responsible for the scientific planning of RETURN activities. It provides scientific advice to the BoD, it is in charge of coordinating the scientific activities of different Spokes and scientific interactions. Moreover, it sets up the didactic, technological and research activities including: designing and defining educational paths; planning annual teaching and research activities; proposing to the BoD the assignment of teaching and research contracts; maintaining relations with national and international bodies interested in research. It is chaired by the Deputy Chairperson, who has also the role of Scientific Coordinator of the program.
- ***Technical Council - TC (WP leaders group):*** is composed by the Work Package Leaders of each Spoke and has the duty to coordinate the WP activity progression and align the Spoke Leader on possible risks and delay.
- ***Steering Committee - SC:*** it is a committee chaired by the National Civil Protection Department (ICPD) and composed by distinguished experts on the different RETURN research fields among the HUB as well as by other members appointed by the ***Board of Directors*** . The SC has a role of guidance and address, ensuring that activities conform to the policies, priorities and needs of the national civil protection system as well as of the European Civil Protection Mechanism, aimed at the disaster risk reduction and management. This will also allow to harmonize RETURN research and products with other scientific activities developed under different national and European financing tools and calls. The SC organizes periodical meetings with the ***Scientific Council*** and collaborates with the Innovation Management Committee (IMC). Presides the meetings with the Impact Maximization Stakeholders Group.
- ***Innovation Management Committee – IMC :*** it is a committee chaired by the General Manager and is composed by all contributors (Task leaders of the Spokes) involved in the Exploitation, Dissemination, Communication and Education activities. The main role of the IMC is to coordinate these activities among the spokes. The IMC organizes periodical meetings with ***Scientific Council*** and collaborates with the Innovation Management Committee (IMC). When invited, presides the meetings with the Impact Maximization Stakeholders Group.

In addition, there will be an external group of stakeholders with an advisory role:

- ***Impact Maximization Stakeholders Group (IMSG)*** is composed by relevant HUB members, including DPC and private HUB members, and additional members who expressed their support to the EP RETURN initiative. Regions, Metropolitan Areas (ANCI), Municipalities, Volunteer Associations, large private companies, SMEs, Universities and research centers etc. are part of IMSG. Some of the mentioned entities already expressed their support to the initiative by signing an endorsement letter*. IMSG has a consultation role in the project for: a) the Scientific Council b) the BoD; c) the Innovation Management Committee, in order to address the exploitation and economic vision and originate scalable and high impact project targets, with high national and international impact, and support outreach on the territory.

*Endorsement letters by: ANCI (national coordination of Metropolitan Cities)/Città di Firenze, Città Metropolitana di Torino, Città Metropolitana di Napoli, Regione Calabria, Regione Friuli, Regione Campania, Assessorato alla Protezione Civile Liguria, Protezione Civile Puglia, TRE ALTAMIRA.

From a policy and strategic perspective, RETURN aims to maximize the impact of its research project. In particular, it adheres to Open Science standards (e.g., following the guideline "as open as possible, as closed as necessary") and to the principles of the upcoming EU Data Act in maximizing "the value of data in the economy by ensuring that a wider range of stakeholders gains control over their data and that more data is available for innovative use, while preserving incentives to invest in data generation". Indeed, in line with Art. 18 paragraph 1 of the Call, RETURN will respect the principles of “Open Science” and “FAIR Data”.

RETURN is committed to provide a solid reference point for the Italian scientific community, even beyond the 3 years of the PNRR funding. To this extent, great care is put in planning the sustainability of the Partnership, by demanding precise commitments to its members.

B.3 Budget

RETURN Extended Partnership aims to fund basic research projects on "Environmental, natural and anthropogenic risks" to contribute to the development of a supply chain that starts from the research frontier and arrives to final products and services considering other transversal aspects, such as: strengthening of key competences, technology and knowledge transfer and the ability to integrate technologies into systems and services. In order to achieve these objectives adequate funding will be needed to support Spoke's activities and a solid recruitment plan of young scholars to be part of the research program.

Additional resources will be needed to support a strategic guidance and coordination by the central structure of the Hub, which will be involved in technology transfer, training and promotion of start-up ventures.

The total cost of the program is estimated to be € 120,763,679.

Cost Categories and allocation criteria

The cost items selected are represented as follows:

1) Personnel: i) Permanent Staff; ii) New RTDAs; iii) PhD Fellowships; iv) Research Fellowships
2) Equipment, materials, licences and other services
3) Open Calls
4) Hub Management and administration

Cost	Allocation Criteria
Personnel	Allocation on Participants
Equipment, materials, licences and other services	Allocation on Spokes according to Preliminary Proposal and Planned Activities
Open Calls	Allocation on Spokes according to Preliminary Proposal and Planned Activities
Hub Management and administration	Allocation on Hub

1) Personnel

- **Permanent Staff**: an average of 14 resources with 3,3 person month per year have been estimated for each Spoke and Affiliate with an average unitary cost of about 6 k€ per month.
- **New Research Contracts (RTDAs)**: the number of new RTDAs was estimated in proportion to the permanent staff presented by the universities (50% of the permanent staff), with an additional 1 for the Spoke. The average unitary cost of each new RTDA is 50 k€ per year and the new RTDA positions cover 18,3 M€. This amount is in line with requirements set at the Art. 7, Paragraph 3, point 2 of the Call. For the Affiliate that are not Universities is envisaged an increase in the amount of Research Fellowship.
- **PhD Fellowships:** fellowships for each Spoke and Affiliate are assigned only to Universities in proportion to the permanent staff. The yearly cost of each PhD Fellowship 25 k€.
- **Research Fellowships**: fellowships for each Spoke and Affiliate are assigned in proportion to the permanent staff (with an increase for Affiliate who are not Universities, as stated before). The yearly cost of each Research Fellowship is 25 k€.

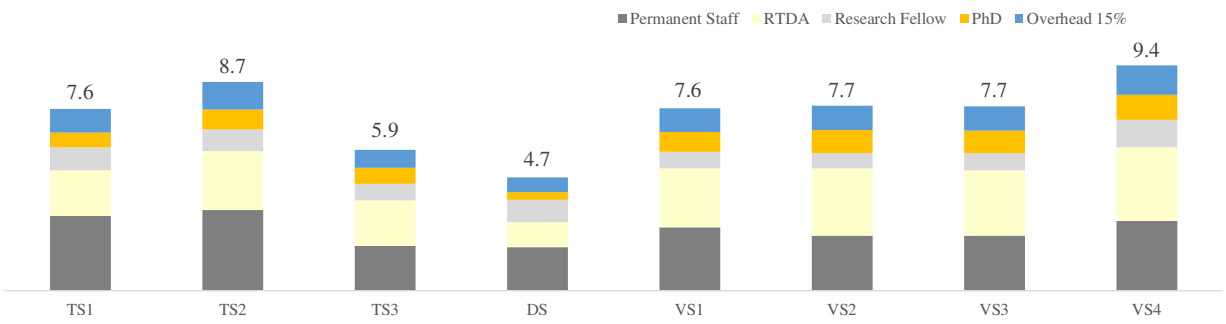

Fig B5 – Personnel budget per Spoke (M€)

Overall, 122 RTDA, 83 PhD fellowships and 88 research fellows will be recruited to contribute to the development of the research and technological transfer activities. Personnel Budget distribution is reported in the following figures.
RETURN will act in order to raise the amount of RTDAs within 10 years from PhD through recruitment (target percentage of new young RTDAs: 25% of the total)

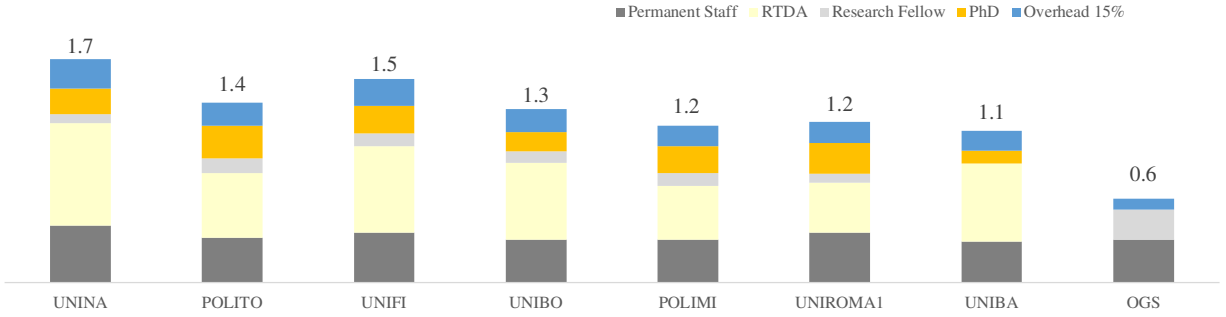

Fig B6 – Personnel budget per Universities and Research Centers - Spoke (M€)

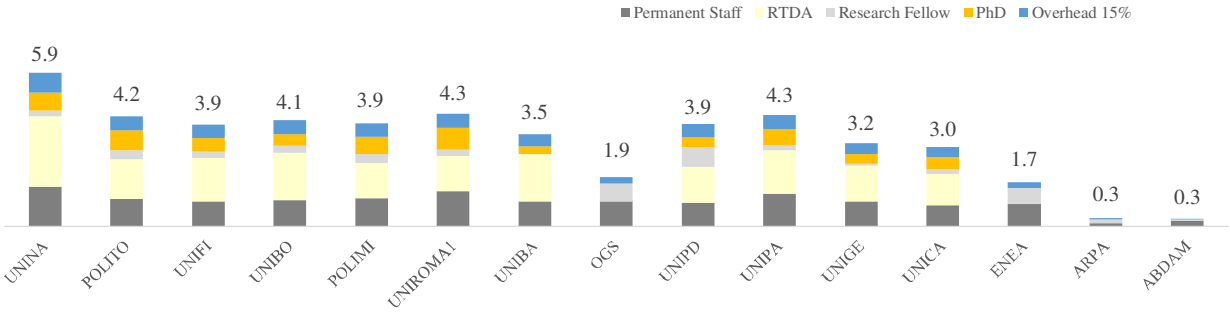

Fig B7 – Personnel budget per Universities and Research Centers - Affiliate (M€)

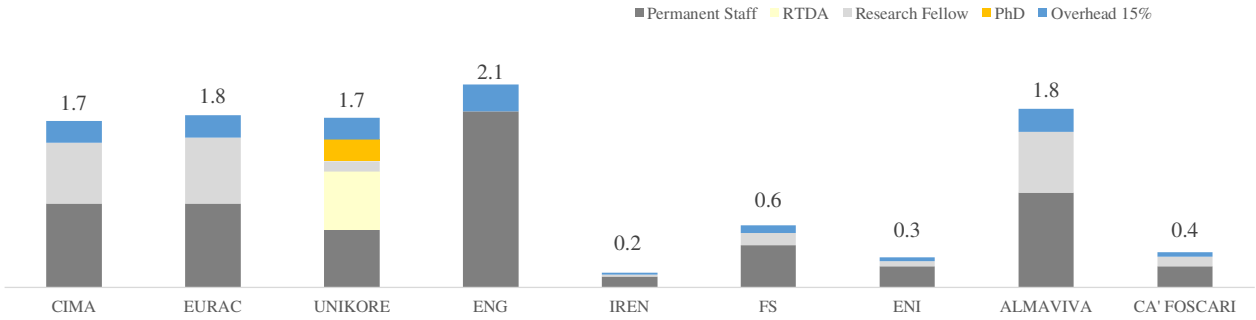

Fig B8 – Personnel budget per Private Entities - Affiliate (M€)

2) Equipment, materials, licences and other services

This cost category includes equipment and materials needed for the research activities of the Spokes. Since RETURN proposes to carry out research with medium-low TRL, Technology Transfer activities have a crucial role for the success of the research project and can collaborate to develop and apply research outcomes (details provided in section C). The total budget allocated to Spoke is 22 M€ (Fig. B9).

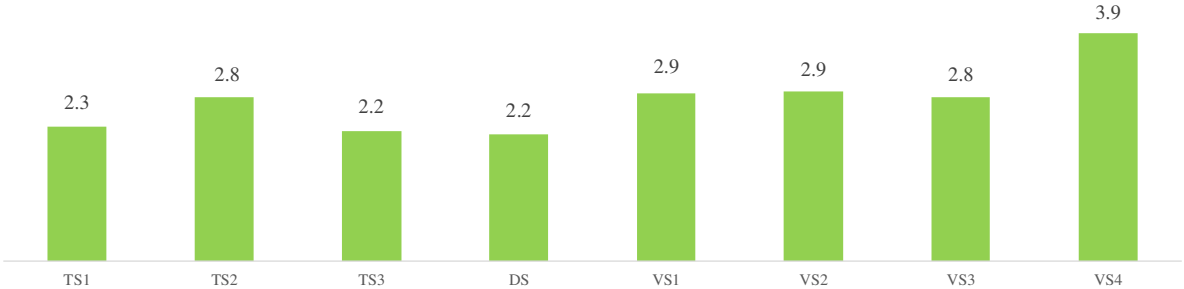

Fig B9 – Equipment, materials, licences and other services (M€)

Annex 1

3) Open call

In line with Art. 5 of the Call, 22,5M€, equal to 19% of the total budget, has been allocated for Open Calls. A careful analysis of the necessary and complementary skills has been conducted to estimate the amount of the Open Calls, as well as an evaluation of the interest of external entities on the research themes of the spoke. The amount is distributed among the Spoke, with the only exception for UNICA and UNIPA in consideration of territorial reasons.

A strong involvement of the South Regions is expected, as detailed in paragraph "Total Budget by Territory". In particular, 35% of the Open Calls will be dedicated to the involvement of research start-up and spin-off.

4) Hub Management and administration

In line with Art. 9 of the Call, Hub management and administration costs will be within 8% of personnel budget, for an amount of 4,1 M€.

HUB headquarter will be located in Campania, therefore the HUB budget will compete to the pursuit of the objectives of the NRRP related to the development of the south of the country.

Total Budget by Territory

43% of the total budget are allocated to investments in the Southern Regions, in line with the conditions set in Art.3 last point of the Call. Fig. B10 shows the percentage of investment in the southern regions per Spoke.

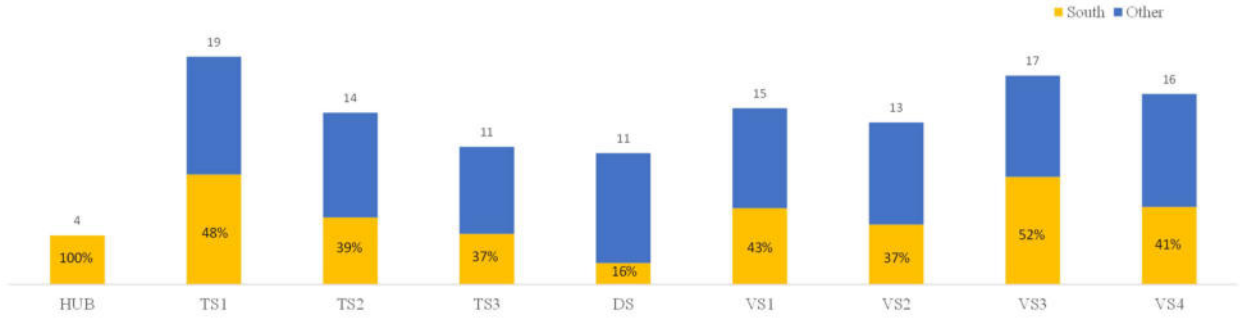

Fig B10 – Budget by Territory (M€)

Breakdown by Intervention Fields

The intervention fields, as illustrated in Art.3 paragraph 2 and in Art.7 paragraph 2 (point 4) of the Call, are for the topic of the Extended Partnership on "Environmental, natural and anthropogenic risks" (PE3) the following:

- Constraint 022 – Research and innovation processes, technology transfer, and cooperation among enterprises focused on low-carbon economy, resilience and adaptation to climate change at least 100% of the Budget

Indeed, RETURN respects the 100% budget distribution thresholds for the intervention field 022.

Budget Recap Table (M€)

Table 2 – Budget Recap (M€)

	HUB	TS1	TS2	TS3	DS	VS1	VS2	VS3	VS4	TOTAL
Permanent Staff		3.1	3.3	1.8	1.8	2.6	2.3	2.3	2.9	**20.1**
RTDA		1.9	2.4	1.9	1	2.5	2.8	2.7	3.1	**18.3**
Research Fellows		1	0.9	0.7	0.9	0.7	0.7	0.7	1.1	**6.7**
Phd		0.6	0.9	0.7	0.3	0.8	0.9	1	1.1	**6.3**
Overhead		1	1.1	0.8	0.6	1	1	1	1.2	**7.7**
Personnel		7.6	8.6	5.9	4.6	7.6	7.7	7.7	9.4	**59.10**
Equipment, materials, licenses and research consulting		2.3	2.8	2.2	2.1	2.8	2.9	2.8	3.9	**21.8**
Activities for technology transfer, research valorization, support for spin-off creation		1.7	0.8	1.1	1.1	0.8	0.8	2	1.1	**9.4**
University-business synergy training to reduce misalignment		1.2	0.3	0.4	0.5	0.3	0.3	0.7	0.1	**3.8**
Open call		6.2	1.7	1.8	2.5	3.1	1.8	4.1	1.3	**22.5**
Hub: management and administrative costs	4.08									**4.1**
TOTAL	**4.08**	**19**	**14.2**	**11.4**	**10.8**	**14.6**	**13.5**	**17.3**	**15.8**	**120.7**

Annex 1

B.4 Promoting Gender Equality opportunities

RETURN acknowledges gender equality as one of the general challenges of the PNRR and supports the objectives of the EU Gender Equality Strategy 2020-2025.

Gender balance in research teams

This Extended Partnership seeks to keep a gender balance in the whole organizational structure of the Hub and in each Spoke. All the RETURN's partners are committed to gender equality through their respective internal practices. The academic background and excellence will be the selection criteria for selecting researchers. Most of the participants to this Extended Partnership have already developed or will develop in the near future their own Gender Equality Plan (GEP). The GEP was proposed by the EU Gender Equality Strategy 2020-2025 and it is a mandatory requirement at European level for participating at Research and Innovation (R&I) projects. The GEP deals with the following topics, using definite measures and targets: a) work-life balance and organizational culture; b) gender balance in leadership and decision making; c) gender equality in recruitment and career progression; d) integration of the gender dimension into research and teaching content; e) measures against gender-based violence, including sexual harassment.

Gender neutrality in the context of the research

The 8 Spokes included in RETURN are gender neutral. In each Spoke, the fraction of female permanent unit staff personnel is between 18 and 52 %, as shown in Fig B.11. Overall, it averages at ~35 %. According to Article 7, paragraph 2, of the Call, to strength gender neutrality, of the 122 fixed term researcher positions, 83 PhD candidates positions and 265 annual research fellowships to be recruit, 49 fixed term researcher positions, 34 PhD candidate position and 106 research fellowships (i.e. slightly higher than 40% of the total) will be reserved to female units of staff personnel.

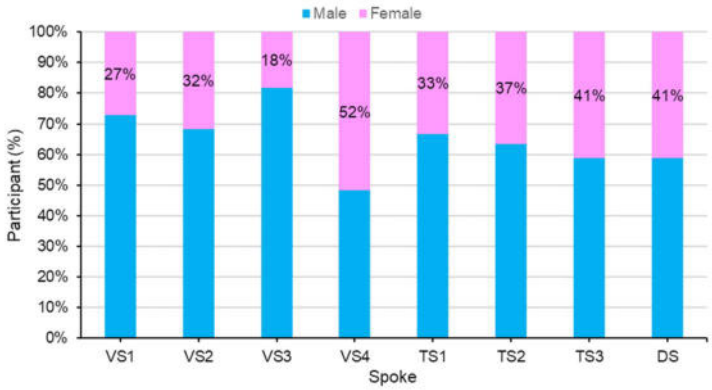

Fig B.11– Bar chart showing relative fraction of male and female permanent units of staff personnel for each Spoke.

Specific measures

During the implementation of the Extended Partnership, the partners will conduct their activities and align their policies following the EU guidelines. Some examples of concrete measures that will be implemented are listed below:

- *Actions to shape a more inclusive organizational culture.* Entities will implement those policies able to ensure an open and inclusive working environment, and the visibility of women both in the organization that externally. Also, there will be some specific measures on parental leave and flexible working time.
- *Actions to ensure equality in decision making organisms.* All the decision-making bodies of the Extended Partnership will take into account gender balance. Measures to ensure that women can take on and stay in leadership positions can include providing decision-makers with targeted gender training, adapting processes for selection and appointment of staff on committees, ensuring gender balance through gender quotas, and making committee membership more transparent.
- *Actions to ensure equality in recruitment.* The participants to the Extended Partnership will be asked to critically review the selection procedures and remedy any biases to ensure that women and men get equal chances to develop and advance their careers. Following the EU Gender Equality Strategy 2020-2025, organizations will establish recruitment codes of conduct and they will proactively identify women in underrepresented fields and consider organization-wide workload planning models.

B.5 Work plan feasibility and Viability –

Annex 1

As outlined in section A, the RETURN Hub coordinates the activities of 8 Spokes that collectively contribute to the achievement of the main objectives. The coordination among the Spokes and the HUB is guaranteed by the presence of a specific Task of coordination and interaction in each WP1, devoted to the Spoke Management. The Spokes Milestones are, also, designed to ensure relevant temporal checkpoints to monitor and guarantee the swift flow of activities within each spoke and considering the relevant needs of intra-spokes results exchange. Fig. B12 highlights the spokes connections as well as the conceptual work domains that permeate the activities, namely: (i) "Physical, functional, socio-economic and cultural systems"; (ii) "Interacting hazards and multi-risk"; (iii) "Data fusion and enrichment" (where activities devoted to data exchange and standardization are considered); (iv) "Exploitation" (during and after the project towards impact maximization).

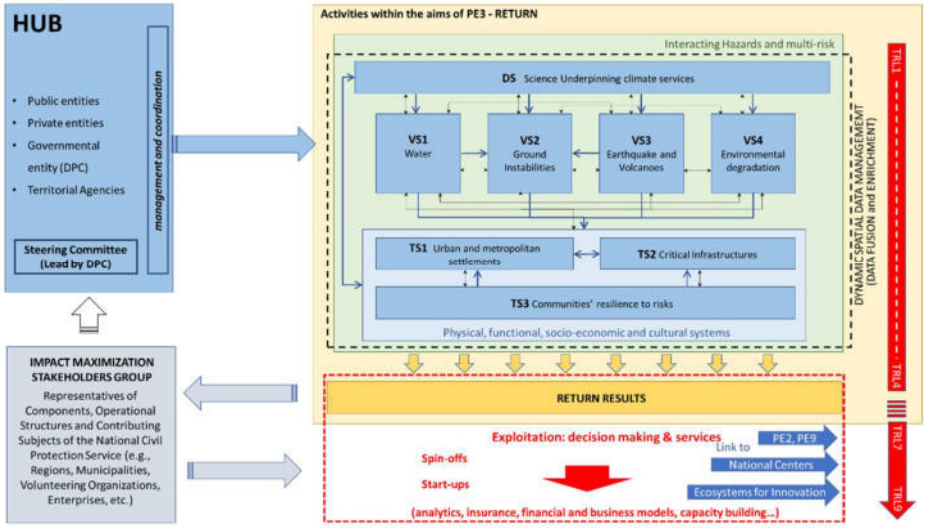

Fig B.12– Concept model for Spokes organization and work domains

The project foresees the development of the research in the field of DDR/CCA related to different geophysical and environmental hazards through the VSs (Flood/ Drought/Coastal flooding, Ground instabilities, Earthquakes and Volcanoes, Environmental degradation). These will be correlated to CC research enhancement in DS. The results obtained will feed and integrate the models developed in the TSs for different exposed elements (urban settlements, infrastructures, communities), where an overall vision for DDR/CCA will be built, in the respect to a shared methodological framework considering the risks interactions towards a resilient, ecological and sustainable transition. As described in section B.2 the RETURN activities will be steered by Steering Committee led by DPC. Moreover, the Impact Maximization Stakeholders Group (IMSG), to which besides DPC, also Regions, Metropolitan Areas, Municipalities, Enterprises etc. belong, is cooperatively involved in meetings, round-tables, testing, needs assessment, to ensure that the RETURN results will fit a framework aligned with future exploitation needs. This will allow to maximise the project impact, envisioning more effective actions towards technological transfer from project results (TRL 4) to future prototypes and products that will be ready for the market and commercialization with an increase of TRL up to 7-9. This way, the RETURN extended partnership, embracing the inputs from the (IMSG), proactively contributes to the activities of the National Civil Protection Service with the aim to enhance risk prevention, reduction and management

Spoke 1- VS1 Water (Spoke: POLIMI – Supported by-UNIPD)

WP1 – Spoke management, dissemination and exploitation (Lead.: POLIMI, Part.: all partners)

T 1.1 - Spoke administration and management

DV 1.1 - Spoke report plan

DV 1.2 - Spoke risk management plan

T 1.2 - Spoke evaluation and monitoring

DV 1.3 - Spoke KPI evaluation report

T 1.3 - Coordination with other spokes

DV 1.4 - Monitoring and coordination plan, contribution to RETURN Data Management Plan

T 1.4 - Dissemination and exploitation

DV 1.5 - Synergic dissemination and exploitation plan with RETURN-HUB, including IPR management

WP2 – Flood risk under environmental and climatic changes (Lead.: UNIPD, Part.: all partners)

Annex 1

Main challenges: i) dynamic impact scenarios, to overcome the dichotomy between planning scenarios and current flood prediction systems towards a concept of impact-based scenario, seamless deterministic-probabilistic prediction from the real-time to the long-term climatic scales; ii) effective real-time decision-making with uncertain forecasts, to transform probability measures of flooding into context-aware risk mitigation actions.

T 2.1 - Monitoring and data (VS2, VS4, TS1, TS3, DS)

DV 2.1 - Development of a focused observation and validation strategy for floods in poorly observed systems.

DV 2.2 - Development of an integration strategy of existing monitoring systems aiming at high-resolution, quasi-dynamic precipitation mapping and nowcasting at flash/pluvial flood scales.

DV 2.3 - Identification, collection and preprocessing of available data sources and analysis of hazards, exposure, vulnerability and damage under the effects of the global climate change

T 2.2 - Flood hazard modelling (VS2, VS4)

DV 2.4 - Enhanced models of the hydrologic response for ungauged basins, with special focus on flash floods.

DV 2.5 - Improved models of water-induced debris-flow to be used both in real-time and for prediction purposes.

DV 2.6 - Comprehensive modelling of complex river systems and floodable areas, including sediment transport, vegetation dynamics, levee breaches, river training work, hydraulic infrastructures.

T 2.3 - Flood impact modelling (TS1, TS2, TS3)

DV 2.7 - Identification of impact metrics and models for all exposed assets indicated in the EU Flood Directive.

DV 2.8 - Improved models for indirect flood impacts, cascade effects and interconnections among critical infrastructures, such as energy or transport networks.

WP3 – Drought risk under environmental and climatic changes (Lead.: CIMA, Part.: POLIMI, UNIPD, POLITO, UNICA, Eng, UNIFI, UNIPA, Eurac, ABDAM)

Main challenges: i) integrated monitoring and modelling of surface- and groundwater resources; ii) integration of existing monitoring systems and process-based models to predict droughts and water crises under climate change; iii) models and strategies to predict the threat to key sectors including ecosystems; iv) technical and policy strategies to reduce conflicts among users under water scarcity and mitigate impacts.

T 3.1 - Monitoring and data (DS)

DV 3.1 - Integrated monitoring strategies (ground and remote) to deliver a comprehensive overview of the status of hydrological and agricultural drought in real time.

DV 3.2 - Use of climatic scenarios for (sub)seasonal forecast of meteorological forcing for drought management

T 3.2 - Drought hazard modelling (VS2, VS4, TS1, TS2, TS3, DS)

DV 3.3 - Models of surface and groundwater resources (quantity and salinization) to generate deterministic/probabilistic scenarios based on climatic projections and seasonal meteorological predictions.

DV 3.4 - Hazard model of long-term droughts by using historical data and future climate scenarios.

T 3.3 - Drought impact modelling (VS4, TS3)

DV 3.5 - Models of the direct impacts on food and energy sectors, human health, ecosystems.

DV 3.6 - Cross-sectorial evaluations of drought impacts and strategies for mitigating water use conflicts and improving governance policies.

WP4 - Coastal flooding and beach erosion under environmental and climatic changes (Lead.: UNIGE, Part.: UNIPD, UNIKORE, UNICA, Eng, ABDAM, FS)

This WP aims at an effective management of risks at sea and by the sea by focusing on: i) the forecast and mitigation of the impact on people and infrastructures of extreme oceanographic events and sea-level rise; ii) the resilience to coastal flooding and beach erosion of estuarine and coastal communities. Both issues share the need of an accurate monitoring of the marine forcing, at the probabilistic and deterministic level.

T 4.1 - Monitoring and data (VS4, TS1)

DV 4.1 - Identification, and preprocessing of data from public private databases of offshore and coastal assets.

DV 4.2 - Integrate hydro-morphological stressors from nation-wide monitoring systems and integration with remote and inland sensors for both real-time warning and resilience measures design.

T 4.2 - Coastal floods and beach erosion hazard modelling (VS4, TS1, DS)
DV 4.3 - Implementation of a multi-scale modelling suite, for a proper account of the forcing evolution from the open sea to the coast, for both short-and long-term predictions (event forecast, hazard evaluation)
DV 4.4 - Seamless modelling of water and sediment dynamics from nearshore circulation to inland flows, with specific focus on swash zone dynamics and related interactions
T 4.3 - Coastal floods and beach erosion impact modelling
DV 4.5 - Model-guided assessment of impacts on offshore, coastal, and estuarine assets.
DV 4.6 - Adaptive modelling of scenarios through increasing inclusion of protection and mitigation measures.
WP5 - Integration towards a Digital Twin (Lead.: Engineering, Part.: all partners)
This WP synthetizes models from WP2-4 and from other spokes, into an integrated architecture based on open standards and specifications (e.g. FIWARE open source components and data models), to be validated with respect to water-related risk mitigation and community resilience strategies under climate change scenarios.
T 5.1 - Architecture and components for proofs of concept (VS2, VS4, TS1, TS2, TS3, DS)
DV 5.1 - Definition of a high-level reference architecture able to conceptually integrate models and input/output data, adopting standard data models and protocols for the information interoperability.
DV 5.2 - Design and prototyping of data collection, preprocessing and integration tools to support the execution of the models and to manage the output data generated.
DV 5.3 - Design and prototyping of components for the visualization and exploration of hazards' forecasts, risks and their impacts, by taking into account data generated by the models.
T 5.2 - Assessment of risk mitigation and adaptation strategies (TS1, TS2, TS3)
DV 5.4 - Analysis of uncertainty propagation along the modelling chain for global unbiased risk evaluations, as requested by risk-based design of mitigation strategies.
DV 5.5 - Analyses of field cases with focus on i) win-win adaptation/mitigation strategies; ii) impact assessment and optimization through CBA / MCA methodologies.
Milestones: M1.1 - Detailed plan of the technical-scientific basics (Month(M) 1)**; M1.2** - Monitoring and data collection (M 12); **M1.3** - Hazard models (M 18); **M1.4** - Impact models (M 24); **M1.5** - Proposal of Integration architecture (M 30); **M1.6 -** Water-related risk reduction strategies tested (M 36).

Spoke 2 - VS2 - Ground instabilities (Spoke: UNIROMA1; Supported by UNINA)
WP1–Spoke management, dissemination and exploitation (descr. in VS1**,** L: UNIROMA1, Part.:all)
WP2 - Detection of predisposing factors to ground instabilities (Lead.: UNIFI & UNIBA, Part.: UNIROMA1, UNIPD, UNINA, UNIBO, OGS, UNIGE, UNIPA, ENEA, POLITO)
Analysis of physically-based predisposition factors for ground instabilities in subaerial and submarine environments, by innovative techniques, tools and platforms for geo-databases.
T 2.1 - Identification of areas at different scales affected or predisposed to ground instabilities, either in the subaerial (a) and submerged (b) environment by existing inventories and archives –implemented and updated by EO services – and permanent and temporary geophysical observatories (dynamic mapping).
DV 2.1 - Collection of inventoried events in a comprehensive integrated dataset;
DV 2.2 - Detection and classification of potentially threatening ground instabilities;
T 2.2 - Quantitative analysis of predisposition to ground instabilities through: (a) geological, geomorphological (including erosion, transport, deposition processes), and geotechnical parameters; (b) factors controlling coastal and seafloor environment, geomorphological setting, submarine mass wasting.
DV 2.3 - Rationale for the quantification of parameters measuring the proneness to ground instabilities in both offshore and onshore areas;
DV 2.4 - Data processing and analysis by the implementation of a geodatabase in advanced computing cloud systems;
T 2.3: Spatial analysis of proneness to ground instabilities: statistical and deterministic approaches.
DV 2.5 - Rationale for selecting and scale-dependent weighing of predisposing factors;
DV 2.6 - Procedures to map the areal distribution of values of predisposing parameters.**WP3 – Monitoring & Modelling: toward a digital twin of ground instabilities effects** (Lead.: UNIROMA1, Part.: UNIFI, UNIBA, UNIPD, UNINA, UNIBO, OGS, UNIGE, UNIPA, ENEA, POLITO)
Monitoring and modeling of the preparatory processes to ground instabilities caused by climatic and weather factors. Digital twin approach for anticipating effects of ground instabilities due to variation of physical and geotechnical parameters.

T 3.1 - Natural onshore and offshore field laboratories for remote and in-site monitoring of environmental forcings and deformation responses. Validation of cutting-edge sensors, technological devices, and techniques to identify and monitor precursor signals of ground instability, as well as the occurrence of ongoing deformations.
DV 3.1 - Data collection and analysis; implementation of geodatabases in advanced computing cloud systems;
DV 3.2 - Novel sensors and techniques validation reports;
T 3.2 - Numerical laboratories for digital twin reconstruction: numerical analyses devoted to quantifying the preparation parameters through multi-physical approaches based on data monitoring.
DV 3.3 - Field-to-Num_Lab: experiencing innovative solutions for a real-time digital twin between in-site monitoring and numerical computation systems;
T 3.3 - Deep learning (DL) and machine learning (ML) for mass wasting characterization in subaerial and submarine areas.
DV 3.4 - Rationale for the selection of parameters to implement Artificial Neural Network machine learning through a 3-step based methodology (training-validating-forward computing).
WP4 -Trigger-based multiple geohazard scenarios (Lead. UNIPD, Part: UNIROMA1, UNIBA, UNINA, UNIBO, UNIGE, UNIFI, UNIPA, ENEA, POLITO, DAM)
Construction of trigger-based ground instabilities scenarios as a challenge for resilience. Transfer to mitigation strategies in urban areas, critical infrastructure, and community resilience.
T 4.1 - Multiple geohazards for ground instabilities in near-shore and coastal areas, volcanic islands.
DV 4.1 - Near-shore and coastal areas, volcanic islands: rationale for trigger-based multiple geohazards severity mapping and zoning;
DV 4.2 - Near-shore and coastal areas, volcanic islands: thematic maps including hazard severity indicators and zoning for coupled/combined triggers;
T 4.2 - Multiple geohazards for ground instabilities in hilly and mountain areas, including debutressed glacial valleys, high-intensity erosion slopes, permafrost deglaciation areas, and thermally stressed rock walls.
DV 4.3 - Hilly and mountain areas: rationale for trigger-based multiple geohazards severity mapping and zoning
DV 4.4 - Hilly and mountain areas: thematic maps of hazard severity for coupled/combined triggers;
T 4.3 - Multiple geohazards for ground instabilities in large plains, sinkhole zones.
DV 4.5 - Large plains: Rationale for trigger-based multiple geohazard severity mapping and zoning;
DV 4.6 - Large plains: Thematic maps, of hazard severity indicators and zoning for coupled/combined triggers;
T 4.4 - Reliability and uncertainness of statistical solutions. Uncertainty assessment methods, based on back analysis of event distribution, for ensemble and single process as well as for coupled/cascade multiple triggers.
DV 4.7 - Checklist to identify the contexts and geohazard indicators subjected to uncertainty;
DV 4.8 - Scripting for uncertainty evaluation;
DV 4.9 - From deterministic to stochastic prediction in a weighted uncertainty range.
WP5 -Outcomes for mitigation strategies (Lead. UNINA, Part.: UNIROMA1, UNIBA, UNIPD, OGS, UNIPA, POLITO, ENEA, DAM)
Dynamic hazard scenarios for planning mitigation strategies and solutions both on a structural and socio-economic level. Sharing of hazard scenarios with TS spokes focused on structural vulnerability of urban areas, critical infrastructures and socio-economic impacts.
T 5.1 - Mitigation solutions with respect to ground instabilities
DV 5.1 - Application of outcomes from ground instability scenarios to structural vulnerability
T 5.2 -Complements for multiple hazard scenarios from other vertical Spokes
DV 5.2 - Report about the sharing with VS spokes: identification and selection of the enablers
T 5.3 - Remediation and mitigation solutions in a resilience perspective for other transversal Spokes
DV 5.3 - Report the output to TS spokes: identify and select the enablers
T 5.4 -Eco-sustainable mitigation of ground instability scenarios in a changing climate framework
DV 5.4 -Report about the sharing with the DS spoke: identification and selection of the enablers
Milestones: M2.1 Detailed plan of the technical-scientific basics (M 1); **M2.2** Data collection for the work flow (M 12); **M2.3** Novel methodology for processing, standardization and analytical tools (M 18); **M2.4**

Calibration and validation tests by the analytical tools (M24); **M2.5** Procedures and outputs for the reconstruction of quantitative scenarios (M36).

Spoke 3 -VS3 - Earthquake and volcanoes (Spoke: UNIBA – Supported by-UNINA)

WP1–Spoke management, dissemination and exploitation (descr. in VS1**,** Lead.: UNIBA, Part.: all)

WP2 - Innovation in multiparametric monitoring on volcanoes (Lead.: UNIPA, Part: OGS, UNIBA, UNIBO, UNIFI, UNINA, UNIPA, UNIROMA1**)**

New methods of real-time gas and ash sensing in volcanic plumes, and for source characterization via geochemical and 3D-4D geophysical tools, including muon volcano radiography. Submarine and subaerial volcanic gas emissions will be studied as proxies of climate-change impact on ocean and land. Time-series processing for pattern/precursor recognition through machine learning. Buildings' monitoring for the impact of precursory events will also be performed.

T 2.1 - Progresses in multiparametric volcano observations.

DV 2.1 - Report on new sensors' development (technology validated in lab);

T 2.2 - Linking volcanoes and climate change.

DV 2.2 - Models of volcanic gas-related acidification in ocean and land;

T 2.3 - Artificial intelligence time-series analysis.

DV 2.3 Machine learning codes (proof-of-concept level) and report on pattern recognition;

T 2.4 - Buildings' monitoring in volcanic areas.

DV 2.4 - Guidelines to building's monitoring under effect volcanic precursor events

WP3 - Hazard and expected impact of explosive volcanoes (Lead.: UNIBA, Part.: UNIBA, UNINA, UNIBO, UNIFI, UNIROMA1)

Knowledge of explosive volcanoes will be integrated by a multi-hazard approach. Modelling of magma characteristics of explosive eruptions will be carried on. Data bases of pyroclastic deposits will be implemented. Plumes and density currents will be simulated, for resolving the hazard variables, dynamic exposure and vulnerability. Maps will be generated by interpolating the hazard variables.

T 3.1 - Pre-eruptive physico-chemical magma characteristics

DV 3.1 - Report with graphs and data tables;

T 3.2 - Reverse engineering of pyroclastic deposits.

DV 3.2 – Report with graphs and data tables;

T 3.3 - Time-space numerical simulation and experiments.

DV 3.3 - Reports with data base, tables and graphs;

T 3.4 - Elaboration of Probabilistic hazard and impact maps.

DV 3.4 - Maps

WP4 - An integrated end-to-end earthquake monitoring, early warning and rapid response system (Lead: UNINA, Part.: UNINA, OGS, UNIBA, POLITO, UNIGE, UNIROMA1)

Existing and new knowledge on earthquake monitoring, early warning and rapid response will be integrated. Definition of EEW parameters will be improved using physics-based approaches integrated with AI. Automatic procedures spanning from seconds (EEW) to minutes after the earthquake will be used as to combine the fast information of early P waves with ground motion based on observed and synthetic waveforms. New hazard models (including OEF), decision modules, control systems and operating actions will be developed for real-time risk reduction at target infrastructures.

T 4.1 - Novel methods and technologies for real-time monitoring.

DV 4.1 - Description of new methods and technologies for real-time earthquake monitoring

T 4.2 - Integrating automatic procedures for EEW and rapid response.

DV 4.2 - Guidelines on design, implementation and test of an integrated EEW and Rapid response method

T 4.3 - Real-time hazard assessment.

DV 4.3 - Time-dependent hazard model developments including Operational Earthquake Forecast, EEW and rapid response approaches

T 4.4 - End-to-end real-time risk mitigation.

DV 4.4 - Proof-of-concept applications of an end-to-end, target specific risk reduction system

WP5 - Earthquake source processes and wave impact on structures (Lead.: OGS, Part.: OGS, UNINA, UNIBA, UNIBO, UNIGE, POLIMI, UNIROMA1, UNIPA)

New methodologies for the analysis of source processes and of wave propagation will be included in innovative seismic hazard assessment focusing on novel generation of data (arrays, DAS) and on improved detection of seismicity in relation with fault complexity. Simulations of seismic rupture and wave

propagation in complex media including city-soil interaction and leading-edge forecasting procedure, will be developed.
T 5.1 Leading edge fault observations, signal analysis and AI for source and seismicity models.
DV 5.1- Report on tools and approaches for fault observation, signal analysis, source and seismicity models
T 5.2 - Laboratory experiments and digital twins.
DV 5.2 - Methods and guidelines for a new generation of analog and digital simulations
T 5.3 - Earthquake hazard forecasting under uncertainties.
DV 5.3 - Guidelines for Earthquake hazard forecasting.
WP6 – Vulnerability of the built environment: assessment and reduction through sustainable solutions
Lead.: UNINA, Part.: ENEA, POLIMI, UNIKORE, POLITO, ENEA, UNIPA)
Novel vulnerability models, both static and dynamic, will be developed taking advantage of data from different sources. Fast, sustainable and integrated rehabilitation solutions for mitigation/adaptation with innovative materials will be experimented. Combined geo-hazards and climatic strategies will be analyzed as to reduce impacts through resilience enhancement and governance support in a circular economy framework.
T 6.1 - Data challenge: collection, analysis and exploitation including AI methods
DV 6.1 - Report on data exploitation to feed vulnerability models based on innovative techniques
T 6.2 - Assessment: static/intrinsic and evolving/dynamic vulnerability
DV 6.2 - Report on static and dynamic vulnerability models
T 6.3 - Investigation of innovative methods and techniques for mitigation/adaptation
DV 6.3 - Report on development and validation of innovative techniques for integrated rehabilitation
T 6.4 - Reduction: Resilience-oriented and climate-proofing rehabilitation
DV 6.4 - Report on ex-ante vs ex-post impact analysis of combined strategies.
WP7 - Strategies for loss reduction based on a systemic approach (Lead.: POLIMI, Part.:ENEA, UNIGE, POLIMI, UNIBA, UNINA, UNIPA)
Risk and resilience metrics to support multi-risk prevention, also based on socio-economic loss models and acceptable risk thresholds will be introduced in cooperation with Spoke TS3. Dynamic seismic, volcanic and climatic risk maps as a function of the dynamic exposure and vulnerability models, for multi-objective intervention strategies will be developed in cooperation with Spokes TS1 and TS2.
T 7.1 - Development of holistic risk and resilience metrics
DV 7.1 - Report on the development of shared risk metrics and thresholds
T 7.2 - Dynamic risk maps for multi-objective strategies
DV 7.2 - Report on dynamic risk maps
T 7.3 - Multi-criteria optimal selection of integrated mitigation/adaptation strategies for loss reduction
DV 7.3 - Report on mitigation/adaptation strategies by multi-criteria analyses
Milestones: M3.1-Detailed plan of the technical-scientific basics (M 1); **M3.2**- Data collection for the workflow (M 12); **M3.3**- New methodology for monitoring and hazard models (M 18); **M3.4**-Vulnerability models (M 24); **M3.5-** Earthquake and volcanic integrated risk: proof-of-concept studies (M 36).

Spoke 4 -VS4 Environmental degradation - (Spoke: OGS – Supported by UNIPA)
VS4 is keyed to innovative and basic research and the development and application of methodologies and approaches to address relevant aspects in environmental degradation through land, coastal and marine regions. VS4 favors feedbacks and exchange of expertise and best practices across terrestrial and marine scientific communities, as well as the development of integrated approaches to monitor and model environmental degradation from source to multiple impacts, through all environmental components.
WP1–Spoke management, dissemination and exploitation (description in VS1**,** Lead.: OGS, Part.: all)
WP2 – Setting the scene on environmental degradation stressors in terrestrial and marine environment (Lead.: UNIGE/UNINA, Part.: UNIPA, UNIPD, POLIMI, ENI)
Mapping and prioritizing sources of pollution and environmental threats, related hazard, and habitats vulnerabilities; state of the art, mapping, prioritizing and trend analysis.
T 2.1 - Identification and mapping of source and scale of processes and sites critically relevant from exposure to chemical/physical/biological stressors, also considering climate change and extreme events, and their compound-occurrence and effects.
DV 2.1 – Report on sources and scale of source of environmental degradation.

T 2.2 - Time series analysis and synergy with other projects, including Centri Nazionali (e.g. biodiversity, HPC) and major European program (e.g. EMODNET, COPERNICUS). Collection of data and information on the status of air, water, groundwater, soil, coast, and development of comprehensive data set. Trend analysis to frame formulation.
DV 2.2 – Definition of MOU with relevant entities. Design of key databases.
T 2.3 - Habitats vulnerabilities, resilience and adaptation of valuable ecossystems to environmental degradation and potential socio-economic relevance. Identification of hot spot, relevant emerging pollutant and stressors.
DV 2.3 – Report on habitat vulnerabilities.

WP3 – Enhancing capability to observe, model, and assess environmental hazards (Leader: POLIMi/UNIFI, Part.: UNIROMA1, UNIPA, POLITO, UNIGE, UNINA, UNICA, CIMA, UNIPD, OGS, UNIBA)

Identify and develop new strategies and methodologies for monitoring, modeling and assessing environmental hazard-related physical, chemical, and biological causes (e.g., contaminants, pathogens, fires).

T 3.1 - Contaminant fate and transport models in water, groundwater and soils; innovative approaches to monitoring environmental pollution and quantification and reduction of uncertainty.
DV 3.1 – Improved methodologies for contaminant monitoring.
DV 3.2 - Multiscale modeling framework for contaminants transport and reaction with uncertainty quantification.
T 3.2 - Contaminants and microplastic fate and transport in coastal and marine areas and their bioaccumulation and magnification: novel observation methodologies; modeling space-time distribution of emerging contaminants; bottom sea distribution and vertical fluxes of plastic; plastic food web; reducing uncertainty. DV 3.3 - Improved methodologies for contaminant monitoring in marine coastal area.
DV 3.4 - Multiscale modeling framework for contaminants transport and reaction with uncertainty quantification in marine coastal systems.
T 3.3 - Space-time distributions and variabilities of coastal acidification, eutrophication, and de-oxygenation. DV 3.4 – Novel modeling framework for observation-constrained hi-res simulations of coastal ecosystems
T 3.4 - Wildfire: innovative monitoring techniques and modelling approaches to enhance knowledge of terrestrial ecosystem dynamics and wildfires interactions under climate change scenarios. Strategies for wildfire risk prevention and mitigation considering the value of forest management. DV9 – Improved methodologies for wildfire monitoring.
DV 3.5 - Novel wildfire models and wildfire mitigation risk DSS.
T 3.5 - Pathogens and biological invasion.
DV 3.6 - Novel protocols for observation and ensuing modeling of space distribution;
DV 3.7 - Report on antimicrobial resistance.

WP4 – Multi risk assessment, and proof of concepts (Lead.: OGS/ENEA, Part.: UNINA, POLITO, UNIPA, POLIMI, UNIROMA1, ABDAM, CA'FOSCARI)

Understanding, modeling and assessing cumulative multi-hazard related to pollution and environmental threats, including climate change, with a critical focus on selected representative processes.

T 4.1 - Climate change and environmental degradation. Field- and laboratory-scale experiments to assess synergistic/antagonistic effects and cumulative impact of multiple environmental degradation causes, including combined effects of warming, acidification, deoxygenation; heavy metals contaminations.
DV 4.1 - Report on field experiments in coastal, transitional and shallow hydrothermal vents area.
T 4.2 Screening and advanced (probabilistic and uncertainty based) methodologies for risk assessment, chemical and chemical/particle mixture, individual based effect models, in silico tools and QSAR approaches.
DV 4.2 - Methodology for ecological risk assessment of combined exposure to multiple chemicals.
T 4.3 - Integrated modelling, uncertainty analysis, inverse modeling and uncertainty reduction.
DV 4.3 - Radar constrained integrated simulation for oil spill and contaminant dispersion.
DV 4.4 - Theoretical framework and operational workflow validated vs synthetic scenarios and observations.
T 4.4 - Ecotoxicological approaches, experiments, assays and data base.
DV 4.5 – Report, meta-nalysis and data base on effects of contaminants and mixtures.

T 4.5 - Implementation of selected relevant approaches and national level settings (to be identified among e.g. plastic, mixtures e cumulative impacts of untargeted and poorly known contaminants, urban mine, accident and NaTech).
DV 4.6 – Report on proof of concept realization.
WP5 Prevention and remediation (Lead.: UNIPA/UNICA, Part.: UNIROMA1, UNIKORE, ENEA, UNIGE, UNIPD, POLITO, POLIMI, ENI)
Identify and develop novel strategies to quantify the impact of contaminants in the above mentioned systems with particular reference to mitigation and remediation techniques.
T 5.1 - Sensing and/or removal of heavy metals, organic pollutants and pathogens in water, soil and soil-water systems with physical-chemical, electrochemical, bio-electrochemical and photoelectrochemical processes.
DV 5.1 - Procedure for nanoparticles tracking.
DV 5.2 - Fate and removal of microplastics in wastewater treatment plants.
DV 5.3 - Assessment of remediation methodologies performances.
T 5.2 - Development of innovative and ecofriendly bioremediation processes and technologies for contaminated soil, water and groundwater, with aerobic and anaerobic pathways for the removal of organic and recalcitrant compounds.
DV 5.4 – Guideline for bioremediation implementation.
T 5.3 - Multi-risk approaches for marine water and sediments treatments through the application of biological processes, also considering the presence of emerging contaminants, identifying a proper in-series treatment combination in the remediation processes.
DV 5.5 - Assessment of remediation methodologies performances.
T 5.4 - Sustainable remediation technologies for contaminated sites, brownfield and mining sites recovery and regeneration.
DV 5.6 - Assessment of remediation methodologies performances.
T 5.5 - Consequences modeling of major accidents of industrial nature in terms of environmental impact; resilience and adaptation of interdependent infrastructures increasingly exposed to NaTech hazards due to climate change.
DV 5.7 – Report, data base on industrial accident.
Milestones: M4.1-Detailed plan of the technical-scientific basics (M 1); **M4.2**-Monitoring and data collection (M 12); **M4.3**-Hazard models (M 18); **M4.4**-Multi-risk models and report on proof of concept (M 24); **M4.5**-Prevention and remediation techniques (M 36).

Spoke 5 - TS1: Urban and metropolitan settlements - (Spoke: UNINA, supported by Eurac)
WP1–Spoke management, dissemination and exploitation (descr. in VS1**,** Leader: UNINA, Part: all)
WP2 – Multi-risk-oriented modeling of urban systems (Lead.: UNINA, Part.: Eurac, OGS, UNIBO, Eng, UNIFI, UNIGE)
Towards a multi-scale knowledge framework for holistic understanding and modelling of complex urban and metropolitan systems for disaster risk reduction and climate change adaptation: combining quantitative and qualitative methods to describe functions, interactions, urban metabolism and derive exposure of systems.
T 2.1 - Holistic understanding and dynamic modeling of urban and metropolitan systems (TS2, TS3, VS*)
DV 2.1 - Risk-oriented taxonomy and ontology of urban subsystems and functional models
T 2.2 - Integrated physical and socio-ecological exposure to multiple hazards (TS3)
DV 2.2 - Multi-criteria metrics and methodology for integrated exposure assessment
T 2.3 - Models and methods for urban multi-risk data management (VS*, TS2, DS)
DV 2.3 - Review of relevant data sources and methods/algorithms for urban multi-risk data fusion and integration
DV 2.4 - Template and smart data models for data interoperability and pre- and post-event phase collection (including example datasets)
T 2.4 - Best practices for urban and metropolitan risk management
DV 2.5 - Repository of national and international good practices, projects and policies
WP3 – Multi-risk vulnerability and impact assessment and forecasting (Lead.: UNIBO, Part.: Eurac, OGS, UNINA, UNIFI, UNICA, ABDAM, UNIGE)

Analysis and modelling of multi-vulnerabilities of physical, socio-economic, health and environmental systems with respect to complex and emerging risks. Multi-hazard risk/impact modelling with harmonized metrics and indicators for monitoring and forecasting.
T 3.1 - Complex and emerging risks for urban and metropolitan areas (VS*, TS*,DS)
DV 3.1 - Report and scenarios for multi-risks, cascading and compounding effects and emerging risks
T 3.2 - Physical vulnerability of urban assets to multiple hazards (VS*, TS2)
DV 3.2 - Harmonized modelling approach for multi-hazard physical and functional vulnerability
T 3.3 - Urban systemic vulnerability to multiple hazards (TS3)
DV 3.3 - Systemic vulnerability modeling including physical, socio-economic, health, safety and environmental aspects
T 3.4 - Integrated multi-risk urban impact assessment and forecasting at variable scale (VS*, TS2, DS)
DV 3.4 - Multi-hazard impact and risk modelling and rapid forecasting methodology
WP4 – Mitigation and adaptation for more resilient and livable cities (Lead.: Eurac, Part.: UNINA, UNIBO, UNIFI, UNICA, UNIGE, POLITO, CàFoscari, ENI)
Strategies and proposals of actions for climate change adaptation and mitigation to risk drivers, by enhancing the urban resilience with respect to multi-hazard risk and climatic type hazard interaction
T 4.1 - Comprehensive Risk Management for urban settlements
DV 4.1 - Multisectoral comprehensive planning and design along the Disaster Risk Management cycle
DV 4.2 - Governance guidelines and policy recommendations for multi-scale integration of DRR and CCA
T 4.2 - Urban systemic transformation including multi-side risk mitigation and adaptation measures
DV 4.3 - Urban Roadmap to resilient and climate-neutral cities: 2030 and 2050 visions
T 4.3 - Green transition towards resilient and regenerative urban eco-districts (TS3, DS)
DV 4.4 - Concept guidelines, design proposals and assessment protocols to monitor urban integrated resilience in compliance with NEB – New European Bauhaus principles
T 4.5 - Towards a circular metabolism for urban and metropolitan settlements (TS3)
DV 4.5 - Evaluation framework for monitoring circularity, sustainability and resilience of urban metabolism
WP5 – Urban labs for dynamic multi-risk management (Lead.: Eng, Part.: Eurac, UNINA, OGS, UNIBO, UNIFI, UNIGE, POLITO, CàFoscari)
Conceptual model and simulation tests of dynamic scenarios for multi-risk assessment in case-studies cities considering multi-risk mitigation and adaptation strategies, allowing to measure the effect of strategies implementation and test the use of decision support tools for their selection.
T 5.1 - Conceptual model of dynamic scenarios (VS*, TS2, TS3, DS)
DV 5.1 - Relevant multi-risk scenarios in city case-studies
T 5.2 - City-scale exercise for risk scenarios evaluation
DV 5.2 - City-scale exercise preparation and setup report
T 5.3 - The resilient-city simulation test of mitigation and adaptation scenarios
DV 5.3 - What-if scenarios: measuring the effect of multi-risk mitigation and adaptation in case-study cities
T 5.4 - Decision support tools for optimal policies and strategies selection (VS*, TS*, DS)
DV 5.4 - RETURN evidence-based decision-making tools for urban sustainable and resilient transition
WP6 – Co-design, capacity building and interaction with stakeholders (Lead.: UNIGE, Part.: Eurac, UNINA, OGS, Eng, ENI)
Dissemination and embodiment of the models developed in WP2/WP3 and applied in WP4 urban labs. Training activities concerning the procedures/models defined in WP1/2/3 and WP4 tools within specific urban contexts, addressing the non-technical actors of public institutions, stakeholders of civil society, and the population.
T 6.1 - Framework for evidence-based & multi-risk urban twin transition decision making (VS*, DS)
DV 6.1 - Selection of models and tools for the dynamic scenarios and the multi-risk assessment
T 6.2 - Interaction with local stakeholders, raising awareness
DV 6.2 - Interaction meetings report
T 6.3 - Training and capacity building
DV 6.3 - Training material and tools tailored to public institutions, civil society, and the population
Milestones: MTS1.1-Detailed plan of the technical-scientific basics (M1); **MTS1.2**-Urban system and exposure model completed and partly populated (M12); **MTS1.3**-Physical and urban vulnerability models (M24); **MTS1.4**-Decision support tool for optimal strategy and policy decision (M30); **MTS1.5**-Integrated framework for multi-risk decision making (M36).

Annex 1

Spoke 6 -TS2: Multi Risk Resilience of Critical Infrastructures (CI) - (Spoke: POLITO, supported by Eng)

WP1–Spoke management, dissemination and exploitation (descr. in VS1**,** Lead.: POLITO, Part.: all)

WP2: Asset Systems Definition and Characterization (Lead.: ENEA, Part.: POLITO, UNIROMA1, UNIPD, UNIPA, CIMA, Eng, UNIKORE, IREN)

Extreme natural events have the potential to disrupt several key infrastructures at the same time with subsequent effects difficult to predict. WP2 aims at identifying, modelling and analysing the relevant critical infrastructures on the national territory as well as at eliciting their intra- and inter- dependencies which are likely to lead to service interruptions and impacts on citizens and economic activities.

T 2.1 - Acquisition, Inventory and Classification of CI systems and mapping of their interdependencies

DV 2.1 - Inventory, Description and Classification of Interdependent Infrastructures and their Critical Assets

T 2.2 - Critical Component Classification with respect to Assets' Age and vulnerability to Man-Made hazards

DV 2.2 - Classification of the IC's Components with respect to Age and vulnerability to man-made hazards.

T 2.3 - Modelling and analysis of different CI systems and their systemic and functional interdependencies

DV 2.3 - Analysis of Cis and their interdependencies from a systemic and functional point of view

T 2.4 - Analysis of service continuity and classification of the intra- and inter-CI impact of service failure

DV 2.4 - Report on intra- and inter-CI service failures impact

T 2.5 - Requirements for dynamic threat mapping

DV 2.5 - Functional Interrelation Requirements for dynamic mapping of Natural and Climatic Hazards

WP3: Dynamic mapping of Natural and Climatic Hazards over the Infrastructure systems (Lead.: POLITO, Part.: UNIROMA1, CIMA, Eng, IREN)

This WP will develop dynamic countrywide knowledge maps of natural hazard over the Infrastructure Networks (IN) and Critical Points (CP). Using results from VS1-VS4, and the DS4 climate scenarios, robust hazard classifications of links and critical nodes will be produced for main roads, railways, water and utility IN, dams, power generation, wastewater plants, considering the functional interrelations enhanced in WP2.

T 3.1 - Robust Hazard Mapping over Network Infrastructures, in connections to the VS 1 – 3

DV 3.2 - Natural Hazards classification maps of individual network of linear infrastructures

T 3.2 - Robust Hazard Mapping over Point Critical Infrastructures, in connections to the VS 1 – 3

DV 3.3 - Natural Hazards classification maps of point-like infrastructures of national relevance

T 3.3 - Climate specific hazard maps: e.g. drought, fire, wind, heatwaves, pluvial flooding

DV 3.4 - Reports on climate-related service interruption threats over critical infrastructures

WP4: Modelling and experimental technologies (including AI) for vulnerability assessment (Lead.: UNIBO, Part.: POLITO, POLIMI, UNIROMA1, UNIPD, UNINA, UNIPA, Eng, UNIKOE, IREN)

WP4 addresses advanced technologies to evaluate the vulnerability of CIs. In-situ and Lab diagnostics for the monitoring of degradation phenomena, unmanned surveys, AI recognition systems and deep learning, as well as remote sensing (including SAR– interferometry) will be used. Advanced infrastructure modelling based on dynamic identification will be used for vulnerability assessment and for setting thresholds for early warning.

T 4.1 - Advanced in-situ and laboratory techniques for diagnostics and monitoring

DV 4.1 - Report on advanced in-situ techniques for diagnostics and real-time monitoring of critical components

T 4.2 - AI and deep learning systems for intelligent unsupervised surveys

DV 4.2 - Protocols and procedures for CI inspections and damage detection/recognition with UAV systems

T 4.3 - Modelling of degradation phenomena and residual life estimates

DV 4.3 - Models for degradation prediction of infrastructure components and residual life estimates

T 4.4 - Advanced strategies for infrastructure modelling and vulnerability assessment

DV 4.4 - Advanced modelling approaches for scenario analyses and vulnerability/robustness assessment of CIs

T 4.5 - SAR interferometry and remote sensing for deformation control

DV 4.5 - Procedures for integration of in-situ systems and SAR interferometry for monitoring of CIs

DV 4.6 - Alarm thresholds for early warning systems

WP5: Multi-hazard risk assessment of infrastructure networks and assets (Lead.: UNIPD, Part.: POLITO, UNIBO, POLIMI, UNIROMA1, UNINA, UNIPA, CIMA, Eng, UNIKORE, ENEA)

Annex 1

WP5 deals with the creation of a comprehensive multi-hazard risk assessment framework to be used for linear CIs like road and railway networks, oil, gas and water pipelines, as well as point-like infrastructures. Scenario simulation criteria will be identified, considering also potential interactions between different hazard sources, and cascading effects and interdependencies between CI components.
T 5.1 - Logical and physical multi-hazard classification of impacts and fallout (impact assessment)
DV 5.1 - Report outlining main consequences and impacts for CIs.
T 5.2. - Interrelated Man-made and natural disasters and climate hazards
DV 5.2 - Protocols for the estimation of potential multi-hazard scenarios.
T 5.3 - Different Asset classes interaction and interdependencies under threat
DV 5.3 - Report on interactions and interdependencies for multi-hazard risk assessment framework for CIs.
WP6: Integrated Technologies and Solutions for Holistic Risk Reduction (Lead.: Eng, UNIROMA1. Part.: POLITO, UNIBO, POLIMI, UNIPD, UNINA, UNIPA, ENEA)
Based on the results from the previous WPs, WP6 provides systemic solutions addressing an overall protection of CIs through a holistic approach. Security is considered at different levels - from single asset to global chains of CIs, with focus on interdependencies and cascading effects, considering emerging risks (including physical, cyber and hybrid dimensions), unintentional, accidental or with malicious intent and will be addressed through development of IT tools and open knowledge-sharing methodology
T 6.1 - Predictive Maintenance methods
DV 6.1 - Predictive Maintenance IT Framework
T 6.2 - Pro-active solutions for risk reduction against accidental events
DV 6.2 - Solutions for robustness increase, business continuity, emergency and early-warning protocols
T 6.3 - Situational Awareness application to real-time approaches to risk reduction
DV 6.3 – IT tools for advanced and integrated Situational Pictures
T 6.4 Information and knowledge sharing for critical infrastructure protection and resilience
DV 6.4 – Open knowledge-sharing Platform
T 6.5 - Re-skilling and up-skilling of the asset management workforce
DV 6.5 – Customized Training Platform for CI personnel
Milestones: MTS2.1-Detailed plan of the technical-scientific basics (M 1); **MTS2.2**-Inventory report of CI relevant at national level (M 12); **MTS2.3**-Vulnerability and impact first assessment (M 24); **MTS2.4**-Solutions for risk reduction (M 36).

Spoke 7 - TS3 – Communities' resilience to risks: social, economic, legal and cultural dimensions -
(Spoke: UNIFI – Supported by CIMA)

WP1–Spoke management, dissemination and exploitation (descr. in VS1**,** Lead.: UNIFI, Part.: all)
WP2 - Innovative tools to evaluate risk mitigation effectiveness (Lead.: POLIMI. Part.: CIMA, Eurac, UNIBA, UNIFI)
Developing innovative tools to evaluate the effectiveness of risk mitigation strategies, allowing to combine and weight the perspectives/values of main stakeholders in the identification of costs and benefits of alternatives of intervention
T 2.1 - Definition of costs and benefits at the base of societal decision making (types, assessment tools, metrics, scales of analysis) for the different phases of the risk chain, special focus on indirect/secondary and intangible/subjective ones.
DV 2.1 - Guidelines on benefits and costs assessment
T 2.2 - Identification of tools for the participative evaluation of risk mitigation strategies, exploiting innovative techniques (e.g., machine learning) and considering real application examples (T 1.3).
DV 2.2 - Abacus of tools.
T 2.3 - Validation of identified tools by means of the ex-post evaluation of really adopted mitigation strategies, collecting data and challenges to tune the tools.
DV 2.3 - Report on validation examples
WP3 - Multi Risk (MR) assessment for Cultural Heritage (CH) and role of CH on resilience (Lead.: UNIFI. Part.: CIMA, Eurac)
*Definition of innovative technological, methodological, and political measures of risk mitigation to safeguard the cultural heritage, including also cultural landscapes and intangible values, represents a central element of resilience and cohesion of communities***.**
T 3.1 - Valuing CH exposure to MR, special focus on art cities, intangible social, aesthetic, and spiritual values.

DV 3.1 - Methods and guidelines for valuing intangible assets.
DV 3.2 - Methods and guidelines for valuing CH exposure for MR assessment.
T 3.2 - Technological advancements for MR-CH monitoring of monumental cultural heritage parameters that indicate their exposure to MR at site and urban scales.
DV 3.3 - Methods and Guidelines for MR-CH Monitoring.
DV 3.4 - MR-CH exposure monitoring Proof of Concept (PoC).
T 3.3 - Systematic mapping and application of MR analysis for CH, from site to urban to regional scales and national.
DV 3.5 - Methods and guidelines for multi-scale MR assessment of CH.
DV 3.6 - Multi-scale MR assessment PoC.
T 3.4 - Hazard-Risk-Resilience Nexus in a CH-centered socio-economic context (art cities and cultural landscapes).
DV 3.7 - Hazard-Risk-Resilience Nexus assessment method and guidelines.
DV 3.8 - Hazard-Risk-Resilience Nexus assessment PoC.
WP4 - Community-Based (CB) approaches, codesign and policies (Lead.: CIMA Part.: Eurac, POLIMI, UNIBA, UNIFI, UNIKORE)
Definition of innovative policies and participatory governance measures for planning, co-design and co-decision-making in DRR
T 4.1 - Common set of methods and guidelines for CB activities.
DV 4.2 - Transdisciplinary co-design methods and guidelines CB approaches.
DV 4.3 - Model of trust dynamics in DRR.
DV 4.4 - Model of effectiveness evaluation of the CB approaches
T 4.2 - CB Early Warning Systems (EWS) based on preparedness principles to empower individuals and communities.
DV 4.5 - Methodology for implementing a people centered EWS. DV 4.6 - PoC of the methodology.
T 4.3 - Citizen participation in civil protection planning (CPP) considering different demographic and socio-cultural contexts. DV 4.7 - Methodology for CPP with participatory approach.
DV 4.8 - PoC of the methodology at different scale.
T 4.4 - New approach in integrated planning based on co-design processes for DRR e CCA policies.
DV 4.9 - Guidelines a new approach to the integrated planning strategies based on co-design.
DV 4.10 - PoC of the methodology.
WP5 - Psychological, sociological and behavioral aspects in decision making (Lead.: UNIBA. Part.: Eurac, POLIMI, UNIROMA1, UNIKORE)
Design of innovative nudging interventions, based on the analysis of the gap between risk perception and objective risk, to improve the choices of different stakeholders during the phases of emergency management.
T 5.1 – Measurement of the gap between objective risk and perceived risk, analyzing existing evidence on relevant variables affecting people's choices.
DV 5.1 - Report on variables, processes and biases.
T 5.2 – Identification of suitable risk elicitation methods, both standard and innovative implying also the use of technological tools.
DV 5.2 - Abacus of methods.
T 5.3 – Identification of risk-taking functions and interdisciplinary models of trust and awareness, at the community and at the policy maker levels.
DV 5.3 - Critical overview of models of trust.
T 5.4 – Design of nudging interventions to improve choices of prevention, participation, and response.
DV 5.4 - Draft of nudges.
WP6 - New models of education and communication for resilience to risks (Lead.: UNIROMA1. Part.: UNICA, POLIMI, Eurac, CIMA, UNIFI, UNIBA)
New models and strategies for risk education and (top-down and bottom-up) communication, tailored for different target groups and a variety of risks, educational settings and communication channels.
T 6.1 - International benchmarking aiming at highlighting risk education and communication best practices;
DV 6.1 - International benchmarking.

T 6.2 - Risk communication tools and strategies design, adopting an inclusive and multi-stakeholder approach;
DV 6.2 - Communication plans for multi-hazard risks (targeting different audiences, including both legacy and digital media);
DV 6.3 - pilot communication campaigns.
T 6.3 - Risk communication strategies pilot testing;
DV 6.4 - Research report on communication tools' and strategies' pilot testing;
DV 6.5 - Guidelines for designing effective and inclusive risk communication.
T 6.4 - Innovative tools and strategies for risk education: design;
DV 6.6 - Report on the role of new technologies (augmented reality, immersive environments, local sensors, and broadcast technologies), in enhancing communities' resilience;
DV 6.7 - Executive planning of piloting activities.
T 6.5 - Innovative tools and strategies for risk education: pilot testing;
DV 6.8 - Research report on innovative education tools' effectiveness;
DV 6.9 - Guidelines for designing effective innovative risk education tools and strategies.
WP7 - Legal and Ethical Aspects Prospects (Lead.: UNICA. Part.: UNIFI, Eurac, POLIMI, CIMA, UNIROMA1)
Within the ethics of risk framework, assessment of multilevel risk governance, public participation, compliance with international obligations and restorative justice, strategies of precautionary principle and accountability methods for civil protection system (CPS).
T 7.1. Ethical analysis of the evaluation methods in the context of natural risks.
DV 7.1 - Critical review of the epistemological aspects of natural risk.
DV 7.2 - Critical review of the ethical aspects of natural risk
T 7.2 - Assessment of institutional and legislative frameworks relevant for risks.
DV 7.3 - Recommendations on identified gaps/conflicts in multi-level institutional framework and in sectoral multi-level legislation
T 7.3 - Advancing compliance with International and EU obligations for empowering vulnerable groups and reducing State and Corporate liability.
DV 7.4 - Recommendations for policy- and decision-makers.
DV 7.5 - MOOT Court. DV39 Legal training for law professionals.
T 7.4 - Implementation strategies of restorative justice and precautionary principle
DV 7.6 - White paper on state of art, recommendations, and guidelines.
DV 7.7 - Restorative Justice post laurea course addressed to lawyers, judges, decision makers.
DV 7.8 - Insurance plan.
T 7.5 - Profiles of responsibility, compliance, and accountability of the CPS.
DV 7.9 - White paper on mitigating decision-makers' responsibilities.
DV 7.10 - Methodology for assessing the legal risk of decision-makers.
DV 7.11 - Methodology for integrating accountability methods in decision support system
T 7.6 - Powers of the CPS in reconstruction stage.
DV 7.12 - PhD curriculum on the legal analysis of the CP planning.
DV 7.13 - White paper on the main aspects concerning the transparency and anticorruption issues with the aim to give guidelines to the public authorities.
Milestones: MTS3.1-Detailed plan of the technical-scientific basics (M 1); **MTS3.2**-1st Stakeholder consultancy (M 3); **MTS3.3**-1st Inventory of methodological approaches for communities' resilience to risk (M 12); **MTS3.4**-Proofs of concept of methodological approaches for communities' resilience to risk (M 27); **MTS3.5**-2nd Stakeholders consultancy on Proofs of Concept (M 30).

Spoke 8 - DS – Science underpinning climate services for risk mitigation and adaptation - (Spoke: UNIBO – Supported by UNIPD)
WP1–Spoke management, dissemination and exploitation (descr. in VS1**,** Lead.: UNIBO, Part: all)
WP2 – State of the art and knowledge base to define impact-oriented hazard indicators (Lead: UNIPD, Part.: UNIBO, ENEA, Eurac, OGS, UNICA, UNIROMA1)
Indicators will be defined for specific climate- and weather-related hazards. Indicators will identify the climatic features that are generating climate change impact on hazard and risk and therefore may support the definition of adaptation strategies. Examples of indicators are climatic (rainfall), hydrological (surface runoff), and marine (sea surface temperature, acidification) variables.

T 2.1 - Identification of impact-oriented indicators for relevant hazards and sectors in Italy.
DV 2.1 - Inventory and assessment of impact-oriented hazard indicators.
T 2.2 - Collection, harmonisation and analysis of paleo and historical climate records.
DV 2.2 - Paleo and historical climate datasets for Italian regions.
T 2.3 - Assessment of impact-oriented hazard indicators for the past and current climate for Italian regions.
DV 2.3 - A database of multi-hazard indicators for Italian regions for past and current climate.

WP3 – Generation of specific hazard indicators based on state-of-the-art and high-resolution climatic scenarios to support hazard assessment at multiple scales (Lead.: Eurac, Part.: UNIBO, UNIPD, ENEA, OGS, CIMA, Arpae)

WP3 provides the foundations for the project in terms of testing and evaluating state-of-the-art climate data and advanced methods to generate tailored indicators for hazard assessment in vulnerable systems. Innovative statistical techniques for downscaling and data integration for sectoral indicators will be tested, validated and applied in a seamless approach from real-time monitoring to future scenario projections.

T 3.1 - Data integration and assimilation to develop a novel seamless regional prediction system.
DV 3.1 - An integrated framework for data assimilation to generate multi-scale weather and climate predictions.
T 3.2 - Seamless integration of numerical, statistical, and deep learning models for scenario generation.
DV 3.2 - An integrated model for scenario generation combining process-based and data-driven approaches.
T 3.3 - Innovative techniques of statistical downscaling and bias correction of climate simulations for customised indicators.
DV 3.3 - Downscaled and corrected, impact-oriented scenarios for Italian regions.
T 3.4 - Hazard indicators for future climate at the spatio-temporal scales and sectors of interest.
DV 3.4 - Software package to produce downscaled and bias-corrected hazard indicators.

WP4 – Towards a regional high-resolution convection-permitting climate model for weather scenario generation (Lead.: ENEA, Part: UNIBO, UNIPD, CIMA)

Climate modelling at convection-permitting grid spacing (1-2 km) will be considered to produce high-resolution regional information for climate change impacts assessments with focus on small-scale extreme events. High-resolution and more skilfull climate simulation will be obtained through improved resolution of regional physiography, atmospheric motions, as well as processes at the interface between land and atmosphere, and sea and atmosphere. The adoption of coupled modelling frameworks will be also considered.

T 4.1 - Implementing convection-permitting regional climate models including coupled frameworks.
DV 4.1 - Proof of concept for the description of cloud dynamics in convection permitting models.
T 4.2 - Assessing the performances of the newly developed models for studying convective events.
DV 4.2 - Report on the performances of convection permitting models in weather generation.
T 4.3 - Application of regional climate information at convection-permitting scale.
DV 4.3 - Proof of concept for assimilating regional climate information in convection-permitting models.
T 4.4 - Reassessment of hazard indicators for future climate under the impact of convective.
DV 4.4 - Hazard indicators under the impact of convective events at the Mediterranean and Black Sea scales.

WP5 – Uncertainty assessment for climate and weather scenarios. (Lead.: UNIBO, Part: ENEA, Eurac, CIMA, OGS)

WP5 will define innovative statistical methods to estimate confidence bands for the hazard indicators. Uncertainty assessment methods will refer to both ensemble and single climatic and weather scenarios and will be based on the comparison with historical estimates of indicators.

T 5.1 - Validation of the processed predictions and evaluation of their performance for multiple time scales.
DV 5.1 - Checklist to identify the contexts and hazard indicators subjected to uncertainty.
T 5.2 - Definition of a statistical method to assess uncertainty of hazard indicators for the historical period.
DV 5.2 - Software for regressing indicator uncertainty against climatic and other contextual features.
T 5.3 - An innovative procedure for seamless integration of uncertainty assessment into scenario generation.
DV 5.3 - A method for converting deterministic projections into a stochastic prediction.

WP6 – Towards a decision support system to integrate hazard indicators into decision making for mitigation of – and adaptation to – specific hazards. (Lead.: CIMA, Part: ENEA, Eurac, Arpae, IREN)

This work package will develop a decision-maker-oriented framework for risk management and climate change mitigation and adaptation. It will include a selection of decision-support tools, such as concepts and workflows for deriving critical thresholds and decision rules for early warning, that are necessary to

implement the framework and will be developed in cooperation with the other spokes. The tools may include pilot case studies demonstrating the application of the framework.
T 6.1 - Adaptation enablers identification and selection.
DV 6.1 - Report about enablers identification and selection.
T 6.2 - Mitigation enablers identification and selection.
DV 6.2 - Report about enablers identification and selection.
T 6.3 - Risk management framework formulation and testing.
DV 6.3 - Report about decision support system application to pilot case studies.
Milestones MDS.1-Detailed plan of the technical-scientific basics (M 1); **MDS.2**-Identification of impact-oriented indicators (M 12); **MDS.3**-Statistical downscaling and bias correction for indicators (M 18); **MDS.4**-Proof of concept for seamless integration of projections and uncertainty assessment (M 24); **MDS.5**-Convection-permitting model completed and tested over Italian case studies (M 30); **MDS.6**-Risk management framework tested (M 36).

B.6 Working group composition and coherence between research activities and the skills of the executing subjects (Spoke leaders and Affiliates)
The Spoke Leaders and Affiliates were chosen with care, according to the criteria of excellence illustrated in section B.1. Below it is presented an overview of the composition of the working groups and of the expertise and skills of the executing subjects involved in the Spoke.
The disposition of partners across the 8 Spokes was managed in order to achieve the best coherence and correlation in terms of research activities and the subjects' skills needed to develop ….

Capabilities for Spoke VS1 – Leader: POLIMI - CoLeader: UNIPD
UNIPD: Ranked 22nd globally for research in Water Resources (Shanghai Ranking). Leadership in national/international projects in water resources, including flood numerical modelling, groundwater, coastal subsidence/flooding risk, flash floods, debris flows. POLIMI: Ranked 6th at the EU level in Civil Engineering. Leadership in several international projects in water resources, including hydrological, flood damage, sediment transport modelling and optimization of water uses. Strong commitment in technological transfer on water-related risks. UNIGE: Ranked 9th among large University in Italy in CWUR and in ANVUR VQR3. Research activities focus on flood hazard and risk modelling and assessment at different spatial scales (catchment and urban), remote sensing of floods, modelling of meteo-marine hazards and risks. POLITO: World Top 31 in Civil Engineering (QS). Flagship researchers in water research in Italy and high international reputation in environmental hydraulics, extreme hydrometeorological events, flood risk management, climate modelling. CIMA: CIMA Research Foundation is the reference centre for the Italian civil protection system on weather-related risks. CIMA leads fundamental and applied research in the flood and drought domains at the international level supporting the EC, UN initiatives and IFIs. UNIKORE: Ranked among the 7 top private universities during the most recent VQR exercise, UNIKORE runs several research projects related to flood modelling development and modelling uncertainty estimation and propagation. UNICA: International excellence in statistical characterization of hydroclimatic extremes, hydrological and hydrogeological modelling, vulnerability of aquifers and soil characterization, collection and treatment of geophysical data, monitoring and modelling of coastal dynamics. Eng: Expertise within water smart society and water related risk management projects on digital platforms and data/service interoperability based on open standards. Active in several EU initiatives such as: Water Europe, FIWARE Foundation, BDVA, IDSA and GAIA-X. UNIFI: Founding partner of the EUniWell Alliance. Leadership in international and national projects in water resources management, including hydrological monitoring and modelling, flood damage assessment and CBA, flood/drought resilience and mitigation, sustainable water use. Strong commitment in participatory approaches for water-related risks and public engagement. UNIPA: Highly qualified expertise in the fields of hydrological modeling, remote sensing, flood hazard and impact modeling; from long-time collaboration with prestigious US universities (MIT, GeorgiaTech and Princeton); experience with high resolution multi-sensors rainfall network. Eurac: Leading research institute in the Alpine region. Provider of advanced snow and water monitoring technologies based on field observation, remote sensing, scalable processing ad AI. ABDAM: Prepares and implements the planning and programming of water resources in the hydrographic district, through a scientifically based approach, aimed at a good qualitative and quantitative status of the water, and within sustainable development of the

territorial and social systems. FS: Manages approximately 17,000 km of railway lines in operation and approximately 32.000 km of roads. Several km of these lines are subject to phenomena of hydraulic instability and coastal erosion. In recent years we have developed mitigation plans to make the the Italian transport system more resilient to these phenomena.

Capabilities for Spoke VS2 – Leader: UNIROMA1 - CoLeader: UNINA

UNIROMA1: Hosts the research center CERI focused on landslide risk. Expertise: marine and engineering geology, geotechnical engineering. Facilities: instrumented field laboratories, advanced IaaS. UNIBA: Hosts the RECAS supercomputing center for simulation and computation; the center CDC on coastal dynamics. Expertise: landslides, sinkholes, geotechnical engineering. UNIFI: Hosts the Civil Protection Centre of Competence of the National Civil Protection Department. Expertise: innovative remote sensing, ground-based monitoring and forecasting models. UNIPD: Hosts the Artificial Intelligence laboratory for landslide. Expertise: landslides; sustainable structural mitigation; monitoring systems; debris and sediment dynamics; cascading effects. UNINA: Expertise: landslide and sinkhole, modelling and monitoring. Partecipates to C.U.G.RI., CRISP-UNINA, CIRAM-UNINA, CITTAM-UNINA; coordinated AdB activities. UNIBO: Expertise: landslides landslide-generated tsunamis; development of decision support systems for multi-hazard risk in both emerged and submerged environments. OGS: Expertise: ground instabilities onshore and offshore; remote sensing; monitoring networks and geophysical prospecting; early warning; hazards scenarios for long-term projections.

UNIGE: Expertise in ground instabilities, remote sensing, constitutive modelling of soils and numerical analysis of slope stabilities, innovative techniques for capillary groundwater. UNIPA: Research center for multiscale susceptibility to ground instability (GIS-Lab); marine geology (research vessel); physically-based hydro-mechanical modelling (geotechnical lab). ENEA: Expertise: ground instabilities in near-shore and coast; susceptibility of landslides; geohazard assessment; remote sensing; mitigation for DSS, resilience strategies, NBS best practices. POLITO: Expertise (among the WorldTop31 in Civil Engineering): identification, triggering, evolution and mitigation of slope instabilities with monitoring, surveying, numerical modeling. ABDAM: Expertise in innovative multi-scalar models, landslide risk mitigation and management with territorial impact in terms of safeguarding human life and exposed elements.

Capabilities for Spoke VS3 - Leader: UNIBA - CoLeader: UNINA

UNIBA: Hosts a supercomputing center (RECAS) where seismic and volcanology models are developed and run. Hosts a seismic network (OTRIONS) serving Apulia Region. UNINA: Hosts a seismic network serving the Campania Region. At UNINA there are two DPC Centers of competence PLINIVS on volcanic risk and RELUIS on earthquake engineering. UNIPA: Is a world-recognized center for technological innovation in instrumental volcanic gas monitoring and for seismic structural systems and health monitoring. OGS: Is DPC Center of competence, has expertise, seismicity, source processes, in real-time and quasi real time impact assessment, multi-risk and multi-hazard exposure models. UNIKORE: UNIKORE has experience in real- and large-scale dynamic testing on structures and in the soil-structure interaction (by shaking tables and large scale laminar box). UNIROMA1: Hosts the ERC-Advanced Grant: TECTONIC, The Physics of Earthquake Faulting; structural and isotopic surveying of faults; volcanic hazard assessment. POLIMI: has a leading role in seismic and geotechnical risk assessment, drafting technical norms, consulting services for design and maintenance of infrastructures. UNIGE: has a leading role in seismic monitoring at international levels and in multiscalar mapping and characterization of deformation structures in geomaterials. ENEA: Strategies for natural hazard mitigation, development of sustainable technologies for structural vulnerability reduction and validation by static and shaking table tests. POLITO: Is a leader in seismic vulnerability and monitoring. UNIBO: Geological, structural and seismic prospection techniques to assess volcanic hazards and seismogenic faults; physical modeling of eruptive processes. UNIFI: Hosts a network of real time monitoring of volcanoes.

Capabilities for Spoke VS4 - Leader: OGS - CoLeader: UNIPA

ABDAM: ABDAM prepares and implements innovative technical-scientific models aimed at assessing the environmental risk in areas with high urban density and agricultural/manufacturing production. CIMA: CIMA provides scientific, and technological innovation for developing tools and new governance system for the reduction of impacts of wildland fire on land degradation. ENEA: ENEA's ecotoxicological activity on contaminants/mixture and on biotechnologies for bioremediation are well established and based on fully equipped labs and field facilities. OGS: OGS has strong capabilities in the observation and modelling of ocean physics, biogeochemistry and marine ecology, including pollutant fate and transport models. POLIMI: Groundbreaking expertise in experimental and modeling approaches to contaminant fate in

environmental matrices and risk-based eco-designed and technological corrective actions. POLITO: Ranked as top technical Universities POLITO has strong expertise on contaminant monitoring, transport and site remediation and own specialized experimental facilities. UNICA: Proven experience in environmental monitoring systems, processes for the rehabilitation of contaminated sites and economic enhancement of industrial and mining residues. UNIFI: The research group presents relevant multidisciplinary experiences in plastics management and microplastics monitoring in the natural and built environment. UNIGE: The UniGE staff, skilled in investigating trace environmental pollutants by means of powerful facilities, relies on international networking, is awarded European and national projects. UNIKORE: UNIKORE has decades of experience in the management of funded projects in the field of sediment remediation, sediment transport and characterization. UNINA: Among the top universities in environmental degradation studies; coordinates many European (H2020, LIFE+, IP) and National (PON, PRIN) relevant research projects. UNIPA: UniPA is a recognized center in environmental monitoring, protection and remediation, with an eco-toxicological approach for the evaluation of the impacts of contaminants. UNIPD: UniPD has a consolidated leadership for the study of Earth and Marine Sciences and in international projects dealing with ecotoxicology and characterization of the fire risk. UNIROMA1: Expertise on advanced characterization, treatment/recovery/remediation and monitoring of materials, residues and environmental compartments, with focus on real-scale applications. UNIBA: UniBa hosts top of the nation laboratories for investigation of sea-sediment interaction. CàFoscari: Proven experience on: methodologies development and high tier application for ecological risk assessment on contaminated sites and sustainability assessment of technologies. ENI: It is the major Italian company on contaminated site remediation through efficient and sustainable requalification projects. It is managing 1,844 ha of contaminated land.

Capabilities for Spoke TS1 - **Urban and metropolitan settlements** - Leader: UNINA - CoLeader: EURAC

UNINA: Ranked 1st at the EU level for H-index citations in Civil Engineering. Leadership in several EU and national projects in multi-risk, including DRR and CM issues. Co-directing the Urban Climate Change Research Network European Hub. Eurac: Interdisciplinary competences in comprehensive risk management in complex urban and mountainous areas, natural hazards, socio-economic vulnerability, climate- and energy efficiency proofing and nature-based solutions. UNIBO: Environmental epidemiology and integrated assessment of human health impacts. Remote sensing data analysis and retrieval models for the derivation of atmospheric properties. Urban multimodal mobility modelling. Multi-risk and multi-scenario models. Eng: Eng has expertise on open ICT technologies (e.g., FIWARE), Data Platform, Data/Service Interoperability applied in Smart Cities and Environment contexts. It coordinates/participates EU and National projects on topics like Sustainable & Resilient Cities & Communities. UNIFI: Risk assessment and management in complex urban areas, wind and wind-and-rain induced risks, multi-risk evaluation of urban green areas, climate changes impacts, resilient design solutions for the adaptation of complex urban systems, seismic and tsunami risks. OGS: OGS (Centre of competence of DPC) has expertise in real-time and quasi real time impact assessment, multi-risk and multi-hazard exposure model (earthquakes, landslides, tsunami) and is part of the International Consortium on Landslides (ICL). UNIGE: Ranked 9th among large University in Italy in CWUR and in ANVUR VQR3. Research activities on natural hazards and risk in urban areas including, atmospheric pollution. Capabilities on facilitation between political institutions and civil society. UNICA: Study of spatial ecosystem-based planning models to identify, address and mitigate urban hazard and vulnerability related to air pollution, heat islands and waves, floods, landslides, and land-taking processes, through the definition of urban green infrastructures. ABDAM: Prepares and implements in the hydrographic district, through innovative technical-scientific models, actions aimed at assessing the vulnerability of buildings exposed to hydrogeological hazards, including structural and non-structural measures. POLITO: World Top 31 in Civil Engineering (QS) and among top technical universities. High scientific expertise in spatial planning and 2 Departments of Excellence in Climate Change and in territorial policies for sustainable and resilient communities. CàFoscari: Proven experience on selection and measurement of circular economy indicators and development of frameworks, tools, and Decision Support Systems on sustainability. ENI: Relevant experience in the management of solid and liquid hazardous and non-hazardous waste and associated risks (36 Mln m³ of water treated).

Capabilities for Spoke TS2 – Leader POLITO - CoLeader: Eng

POLITO: World Top 31 in Civil Engineering (QS). Expertise in natural hazard and industrial risk assessment and databases. Large Lab for structural diagnostics (SISCON Center). CIMA: CIMA is competence centre for the Italian Civil Protection Department on floods and forest fires risks. Expertise on

floods on CIs and functionality loss in network of services. ENEA: Extensive expertise in CI analysis, including interdependency, and critical components and cascading effects analysis, gained in EU projects and contracts with operators. Eng: Top 5 EU innovators in security research. Coordinates several R&I projects on the cyber-physical protection of CI. Capabilities in Big Data, AI and Machine Learning. IREN: One of the largest Multi-Utility in Italy (water, environment, and energy). High standards Open Innovation approach is achieved by IREN's business companies. POLIMI: International experience on risk assessment of CIs, including diagnostics, monitoring and modelling, extreme events, SMART retrofitting, soil-structure interaction. UNIROMA1: Decades of expertise on multi-risk assessment and management with focus on CIs, with specific contribution on systemic multi-risk mitigation and asset protection. UNIKORE: Top 7 Private Universities in Italy. Strong expertise on energy intrastructures and their vunerabilities to natural risks and on AI models aimed to vulnerability estimation. UNIBO: International experience on risk assessment of transport infrastructures, including diagnostics, displacement control by SAR, advanced monitoring and modelling. UNINA: Expertise on analysis, testing, monitoring of hydraulic and transportation infrastructures; performance analysis measures against natural and anthropic hazards. UNIPA: Relevant experience in disfunctions and disasters limitation in water treatment facilities and in vulnerability evaluation of infrastructures under earthquake-tsunami actions. UNIPD: Expertise on vulnerability assessment of bridges, viaducts, oil/gas pipelines, CI risk assessment, analysis and in-situ testing approaches for maintenance operations.

Capabilities for Spoke TS3 – Leader UNIFI - CoLeader: CIMA

CIMA: Competence Center of the Italian Civil Protection Department. International projects on community resilience, liability, DRR policies, DRA, for EU, ERCC, DG-ECHO, WMO, UN, WB. EURAC: International research projects on interdisciplinary solutions for risk management, multi-level environmental governance, and communities' resilience to risks in urban and rural contexts. POLIMI: Ranked 6th in Civil Engineering and 5th in Architecture (EU level); high competences in natural risks management including philosophical, epistemological, and social aspects; Department of Excellence on "Territorial fragilities". UNIROMA1: Excellence in risk-related socio-cultural and psychological dimensions, including risk communication. Risk-related scientific knowledge transfer and policy expertise. UNIBA: Behavioral Economics and Risk Lab, specialized in the measurement of individual risk attitude and decisions under risk and uncertainty. UNICA: Jean Monnet Chair in European Climate of Change and strong presence of the team' members in important International and European Networks. UNIFI: Civil Protection Center, Research Competence Centers of the national civil protection system. Multi-risk management research projects (e.g. www.micheproject.unifi.it). UNIKORE: Expertise in research on public health issues, evaluation of risks, and communication nudges, through Italian and EU funded projects.

Capabilities for Spoke DS - Leader: UNIBO - CoLeader: UNIPD

UNIBO: Ranked 20th for impact in World Reputation Rankings. UNIBO researchers for the spoke are international leaders and top researchers in (1) numerical modeling of the Earth systems, (2) climate change impact assessment and (3) climate change mitigation and adaptation planning. UNIPD: 22nd in global Shanghai Ranking for research in Water Resources. Internationally recognized in the fields of terrestrial/marine extreme storms under climate change, seasonal forecast in hydrology, terrestrial/coastal eco-geomorphology, snow-ice hydrology, micropaleontology. ENEA: ENEA has long-standing expertise in (1) modelling the climate system (global and regional), (2) evaluating the impacts on relevant economic sectors (3) developing climate services. In these fields, ENEA led and contributed to several EU projects and top level publications. UNICA: The University of Cagliari has a proven experience on advanced technologies for geochronological dating (Luminescence and U-Th series methods) of different geological records and specific competences on Quaternary evolution, with a focus on geochronological framework of the Holocene to recent deposits, which can be applied to identify D-O and Heinrich events and anthropogenic impact in coastal sequences. Eurac: Environmental dynamics monitoring, impact and risk assessment in complex environments such as alpine regions. Transdisciplinary approaches integrating physical and data-driven models, data fusion, statistical downscaling, machine learning and index-based analyses. OGS: Proven capability - through projects participations, high-rank publications, and active participation in consortia - to monitor and evaluate multi-scale impacts on biogeochemical cycles, marine ecosystems, biodiversity and fish resources, including pollutant risk assessment. CIMA: CIMA has a strong atmospheric, hydrologic and hydraulic modelling experience from weather to climate scales to predict water cycle processes, and related climate change effects. CIMA has leaded and contributed to several research and operational projects. Arpae: Arpae-SIMC is the first Italian regional meteorological Service. Its primary

mission is to provide support to productive activities. It was coordinator and partner of European research projects (https://www.arpae.it/it/attivita-e-servizi/progetti-europei/progetti-europei). IREN: One of the largest Multi-Utility in Italy (water, environment and energy). High standards Open Innovation approach is achieved by IREN's business companies. UNIROMA1: Sapienza expertise is focused on the geomorphological effects of climate changes: erosive processes and evolution of coastal slopes. FS: Leader in the passenger rail transport sector with 88% market share, FS has consolidated expertise in the maintenance of railway infrastructures exposed to climate impacts.

B.7 Involving young and foreign scholars

Scholars involved in the proposal

The 13% of total units of staff personnel involved in RETURN have obtained the PhD from less than 10 years. In each Spoke, the fraction of unit staff personnel, which have obtained the PhD from less than 10 years, is between 2 and 23 %, as shown in Fig. B.13.

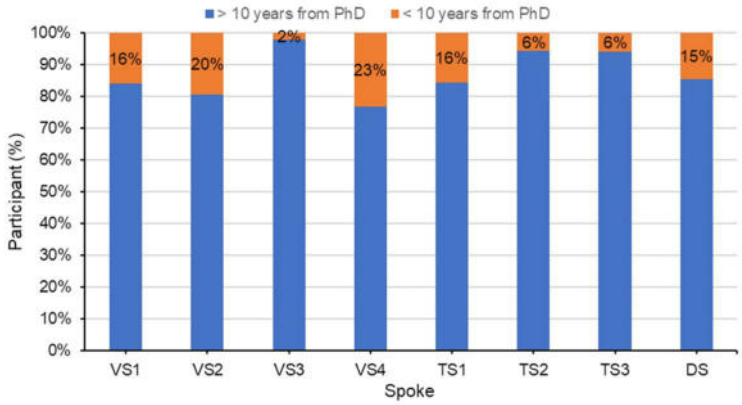

Fig. B.13 – Bar chart showing relative fraction of permanent units of staff personnel which have obtained the PhD from more or less than 10 years for each Spoke.

Scholars to be enrolled with the recruitment plan

Although the initial fraction of unit staff personnel, which have obtained the PhD from less than 10 years, is not so significant, an increase of the above numbers can be easily predicted, based on the recruitment plan of RETURN. In fact, 122 fixed term researcher positions (RTDA) will be held by RETURN (with **25% reserved to scholars which have obtained the PhD from less than 10 years**). Moreover, 83 PhD candidate positions and 265 research fellowships will be held by RETURN. Then, with the subsequent open calls (based on the cascade fundings), other positions will be assigned. Definitively, it can be argued that a significant number of research grants will be consider to ensure the inclusion of young talents in the project. These new contracts will be proposed with public-private partnerships (e.g. type PON-AIM research contracts, or industrial type doctorates). Research grants on programmes that include transdisciplinary paths (possible thanks to the varied composition of the partnership) or periods that can be spent at public administrations (stakeholders relevant to the project) to ensure the transferability of the results, will be also established. RETURN will be attractive for young scientists as its aims are timely and represent global and international priorities. First of all, past, present and future collaborations (both at national and international level), along with an increase of average salary of the post-doc positions, can clearly encourage national and international mobility of the young researchers. This is a crucial step for the growth of the young researchers, that RETURN will support with all his strength. In addition, RETURN will leverage several parallel actions to increase international mobility projects such as for example Marie Curie Actions of the Horizon Europe workplan. Then, RETURN will create a dynamic and exciting environment that will significantly enhance the scientific growth of the young scholars. Moreover, RETURN wants to completely fill the recommendations of the article 47 of Law Decree n.77 of 31 May 2021, that is dedicated to equal opportunities and work inclusion, with a specific focus also on generational issues. In particular, the actions that RETURN intends to take in order to involve scholars who have obtained their PhDs for no more than 10 years (except for maternity, parental or other leave) and to attract researchers from other EU and non-EU countries, based on the quality of their scientific curriculum, can be summarized as follows. Specific strategies for attracting young researchers based on their curricula will be considered. RETURN intends to publish, via its communication channels, international calls with a short interval among them to continuously attract young people with strong curricula from EU and non-EU countries, that manifest their

interest in working inside RETURN. The Calls will also have the purpose of gathering the willingness of the scholars to spend a period (6months up to 1 year) as Visiting Researcher at some of institutions of RETURN, taking advantage of grants and fellowships. Clearly, the calls will be opened to the young researchers by inserting as requisite for the participation the achieving of the PhD in the last 10 years. Then, it is expected to consider recruitment methods that pursue the goal of youth employment also through the simplification of the methods of participation in calls for tenders and access policies to research community. In addition, a monitoring of recruitment policies for young talents will be introduced. RETURN intends to carry out an annual monitoring of the generational variable by collecting data on the average age of the new hires and their subsequent career progress. This data collection will represent the starting point for subsequent reward measures to be introduced in order to lower the average age of access of the career and top research roles. On the basis of this monitoring, indicators will be studied that measure the progress of recruitment policies over time in a qualitative and quantitative manner. Finally, it is expected the introduction of concessions for residential care, innovative working methods, actions that favour care activities and work well-being for the young researchers.

B.8 Level of appropriateness and involvement of large companies, SMEs, innovative start-ups and research spin-offs

RETURN involves both public and private research institutions or foundations as well as private companies to create a bridge between research and practice, thus promoting knowledge transfer to stakeholders involved the field of the risk management, energy and circular economy.

Private partners having a crucial role in the national and international strategic assets (Eng, FS, AlmavivA, ENI, IREN), are directly involved in the spokes, hence directly contributing to RETURN activities, while Generali is involved in the HUB and Governance. Private entities will contribute to the project, together with universities, public research institutions and local government bodies, identifying the main issues and urgent needs to improve the analysis, management, and mitigation of environmental, natural and anthropogenic risks. The contribution of large companies involved in different fields, such as the renewable energies, circular economy and transportation, is fundamental to have a clear picture of the main criticisms of national strategic assets when exposed to different risks. They will further contribute to identify the main opportunities of the market in terms of possible future developments of this project to elevate the products of this project to higher TRLs, thus guaranteeing the sustainability of the activities in the mid-to-long term.

To support this line of activity, 10% of the budget is dedicated to technological transfer, valorisation of research results and support for start-ups and spin-offs. Moreover, a target of 40% of the budget for open calls will be reserved for start-ups and spin-offs with the aim to strengthen the economic structure and productivity at all levels. This scope will be facilitated considering the collaboration with available business incubators/accelerators and with possible venture capitals to be involved in the business development process of SME, start-ups and spin-offs. New start-ups will be also promoted and facilitated relying on the inherent missions of the Universities involved in the HUB. The success of these small enterprises is of great interest of this project to favour the development of products and services to support local government bodies in the analysis, management and mitigation of risks. Indeed, the future sustainability of this project after its official conclusion will be guaranteed by the transformation of the innovative methodologies and proofs of concept, scenario analyses, approaches and strategies developed during the project, in applications and products (higher TRLs) that can be effectively used by stakeholders.

The development of innovative ideas to favour the correct perception of risk at all levels will be of particular interest. This aspect is of paramount importance to create resilient socio-economic model for multi-level risk governance that includes all the key actors involved in preparation and adaptation to disaster risks. The activities of enterprises devoted the development of training activities or training courses (in conjunction with universities, government bodies and government departments) will be favoured, to improve risk perception and the implementation of the results of this project into the common government practice.

The partners involved in this project are distributed on the entire national territory, including the areas frequently exposed to natural hazards, the main islands (Sicily and Sardinia) and region of south of Italy. This will help having a comprehensive view of the main risks for Italy and involving the entire territory with the potential impacts of the research, including the development of innovative start-ups and spin-offs. This is crucial to support the preparedness and resilience of the population exposed to risks through specific

information, education, training, and participatory processes that may be favoured by the presence in the local and national economy of SME devoting their activities to the risk analysis and mitigation.

B.9 Data and indicators proposed for monitoring activities and for ex-post evaluation

The monitoring of program activities will be performed through the periodical check of attainment of the spoke/WP level Milestones and Key Performance Indicators (KPI). Moreover, a number of additional indicators will allow the ex-post evaluation of Long-term measurable impacts (L).

The Milestones, representing the qualitative advancement of the results, are defined in section B5 for each Spoke and are established based on temporal check points ensuring the correct flow of activities through WP in each spoke and intra-spokes.

Quantitative KPIs are defined based on relevant indications from PNR 2021-2027 in relation to the broad research and innovation field of the Safety of Social Systems and considering the level of TRL (maximum 4) that is expected to be reached based on the articulation of the program. The KPI are distinguished based on the (a) Scientific excellence, with respect to their connection to (b) potential Industrial Impact (even if of not immediate application, given the low-medium TRL level) and economic impact, (c) Public Engagement and Citizens security.

KPI ID	Description
	(a) Scientific excellence
KPI.1	Nr. of scientific publications on peer reviewed Journals
KPI.2	Nr of researchers recruited
KPI.3	Nr of high formation initiatives
KPI.4	Nr. of Doctoral scholarship assigned on the research themes
	(b) Potential Industrial and economic Impact
KPI.5	Nr of report describing new procedures, models and proof of concepts developed within RETURN
KPI.6	Nr of researchers involved in public-private initiatives with potential industrial outcomes
KPI.7	Nr of Doctoral scholarships assigned with partnership of Industries
KPI.8	Percentages of cascade funding assigned for involving enterprises, SME, start-ups and spin-offs
	(c) Public Engagement and impact on Citizens security
KPI.9	Nr. of initiatives of results dissemination
KPI.10	Nr. of formation and preparation initiatives (short courses, seminars, trainings)
KPI.11	Nr. of capacity building initiatives
KPI.12	Nr. of workshops/round tables/living-lab exercises involving Italian Civil Protection Department, Regions, Metropolitan Cities (ANCI) and other stakeholders (public decision makers, administrations, citizens associations, representatives from industrial sectors etc.)
KPI.13	Nr. of public stakeholders/administrations involved in RETURN initiatives such as formation, dissemination, round tables etc.

The reaching of target level of results, that can be measured through KPIs, contributes to the effective attainment of significant Long-term measurable impacts (L) that can be considered for ex-post evaluation of the project results. The temporal framework for L impact assessment is 5 years after the project termination.

L ID	Description
L.1	(%) reduction of economic losses
L.2	(%) reduction of affected people and/or mortality
L.3	(%) reduction of carbon emissions and increase of climate mitigation/adaptation
L.4	(%) reduction of service interruptions due to damage of critical infrastructures
L.5	Nr. of new available multi-hazard early-warning systems based on the RETURN results
L.6	Nr. of guidelines/protocols/emergency plans adopting research results produced by the project
L.7	Nr of private companies investing for technological implementation of RETURN tools
L.8	Nr of new technologies, procedures or services developed based on the RETURN results
L.9	Nr of public stakeholders (e.g. decision makers, policymakers) adopting the RETURN tools (maps/services/models)
L.10	Nr of mitigation actions and/or adaptation strategies tested/adopted to counteract the climate change effects based on the RETURN results
L.11	Nr. of qualified personnel employed by public administration and private companies involved in Spoke activity as new researcher positions (PhD and post-doc student, RTDA….)
L.12	Nr. of mitigation actions and/or adaptation strategies tested/adopted to protect specific cultural heritage elements and sites

Section C presents a mapping of the Spoke level results within the proposed KPIs and L.

N. proposta: PDEL-2022-148 del 05/12/2022

Centro di Responsabilità: Struttura Idro-Meteo-Clima

OGGETTO: Struttura Idro-Meteo-Clima. Presa d'atto dell'approvazione del finanziamento al Partenariato Esteso "RETURN", tematica "3. Natural, man-made and environmental risks", per la realizzazione del Programma di Ricerca e Innovazione "RETURN".

PARERE CONTABILE

Il sottoscritto Dott. Giuseppe Bacchi Reggiani, Responsabile del Servizio Amministrazione, Bilancio e Controllo economico, esprime parere di regolarità contabile ai sensi del Regolamento Arpae per l'adozione degli atti di gestione delle risorse dell'Agenzia.

Data 07/12/2022

Il Dirigente