Establishing the European Geological Surveys Research Area to deliver a Geological Service for Europe

Technical review report for project HIKE

This report is part of a project that has received funding by the European Union's Horizon 2020 research and innovation programme under grant agreement number 731166.

INTRODUCTION

Technical review report is part of GeoERA's Monitoring and evaluation process for co-funded projects (*hereinafter: project*). The aim of a technical review is to assess the work carried out under the project over a certain period and provide recommendations. Such technical review evaluates the project reports and deliverables, the proper use of resources, the management of the project and the expected impact.

Technical review report consists of four sections, each representing one level of monitoring and/or evaluation of the project:

Level	Monitor / Reviewer	Input	Aim
1 – Monitoring of progress indicators	Monitoring and reporting officer (GeoZS)	MPPR* FPPR**	Monitoring of the effectiveness of implementation of selected projects with respect to finance, time and administration.
2 – Scientific review	Reviewers (GeoZS)	Submitted deliverables MPPR FPPR	Quality review of the deliverables and review of achieving scientific and professional goals.
3 – Review of the theme progress	Theme coordinators	MPPR FPPR	Review of achieving theme objectives.
4 – GeoERA Progress evaluation	Stakeholder Council member(s)	Sections 1 and 2 of this report Review meetings	Overall project progress and general recommendations.

*MPPR = Midterm Project Progress Report (see PI doc no 2)
**FPPR = Final Project Progress Report (see PI doc no 2)

Monitoring and evaluation process:

M0 = End of reporting period
M1 = Submitted (Final) Project progress Report (MPPR / FPPR)
M2 = 1 – Monitoring & 2 – Evaluation
M3 = 3 – Evaluation of the theme progress
M3 = (Final) Review Meeting & 4 – Progress evaluation

Each project will be reviewed twice: for first project period M1-M18 – Technical review report, and second project period M19-M36 – Final review report.
Technical review report is based on Horizon 2020 templates but adopted to GeoERA needs. Technical reviews of projects shall be carried out on a confidential basis.

GENERAL INFORMATION

ERA-NET Cofund Grant Agreement:	731166
ERA-NET Cofund acronym:	GeoERA
Call identifier:	H2020-LCE-2016-2017/H2020-LCE-2016-ERA
Project full title:	Hazard and Impact Knowledge for Europe
Project acronym:	HIKE
Project reference number:	GeoE.171.011
Project topic:	GeoEnergy
Project specific topic:	GE4-Induced impacts and hazards
Lead partner:	TNO - Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek (The Netherlands Organisation for applied scientific research)
Project website:	http://geoera.eu/projects/hike/

☒ Technical review report
☐ Final review report

Period covered	01/07/2018 – 31/12/2019
Review meeting date	03.02.2020; concise 24.02.2020

Contributor:	Role:	Approved on:
Maja Ilić	Monitoring and reporting officer	13.02.2020
Barbara Simić	Monitoring and reporting officer	12.02.2020
Mateja Jemec Auflič	Scientific reviewer	26.02.2020
Jernej Jež	Scientific reviewer	20.02.2020
Jasna Šinigoj	Scientific reviewer	11.03.2020
Matija Krivic	Scientific reviewer	10.03.2020
Serge van Gessel	Theme coordinator	17.03.2020
Jørgen Tulstrup	Theme coordinator	03.04.2020
Elisabeth S. Cochran	Stakeholder Council member	20.03.2020
Massimo Cocco	Stakeholder Council member	26.04.2020

1 LEVEL 1 – MONITORING OF PROGRESS INDICATORS

In this section the project is monitored "remotely" on the basis of the respective reports. This part is filled in by Monitoring and reporting officer with aim to monitor the effectiveness of implementation of the selected projects with respect to finance, time and administration, based on submited MPPR and FPPR.

	Yes	Partially (comment needed)	No
PROJECT MANAGEMENT			
Has the MPPR / FPPR report been submitted on time?	☒		☐
Have there been any changes in project partnership?	☐		☒
Has the project management been performed as required?	☒		☐
Has the collaboration between partners been effective?	☒		☐
Do you identify evidence of underperforming partners, lack of commitment or change of interest of any partners?	☐ (see comment)		☒
DELIVERABLES and MILESTONES			
Have the planned deliverables for the period been submitted on time according to timeline in Project Agreement?	☐	See comment no.1	☒
Have the planned deliverables for the period been completed (from MPPR / FPPR, sheet 4)	☒		☐
Have any changes to deliverables occurred (type/ dissemination level)? (from MPPR / FPPR, sheet 4 and 5)	☒	See comment no.2	☐
Have planned milestones been achieved for the reporting period? (from MPPR / FPPR, sheet 4)	☒		☐
Have the project partnership identify any difficulties achieving any of the deliverables / milestones?	☐		☒
DEVIATIONS (from MPPR / FPPR, sheet 5)			
Has the project partnership identify any deviations that will not affect projects outputs?	☒		☐
Have any deviations occur on the project, with impact on project outputs?	☐		☒
In case of deviations, have the project adopted corrective measures?	☒		☐
DISSEMINATION, COMMUNICATION			
Has the project adopted its dissemination plan?	☒		☐

Have the planned dissemination activities been completed for the reporting period? (from MPPR / FPPR, sheet 6)	☒		☐
Have the partners' disseminated project results and information adequately?	☒		☐
Is the project following dissemination plan?	☒		☐
Is the project interacting in a satisfactory manner with other GeoERA projects?	☒		☐
Is the project interacting in a satisfactory manner with national/international bodies?	☒		☐

FINANCE			
To the best of your estimate, have the resources used been utilised for achieving the project? (according to MPPR / FPPR, sheet 9)	☒		☐
To the best of your estimate, have the resources used been in a manner consisted with the principle of economy, efficiency and effectiveness? *	☒		☐
Are there any major deviations in the budget consumptions from the financial plan? (zero consumption in M18; deviation from plan exceeding 20% in M36)	☐		☒
Are there any major deviations in the Person - Months consumptions from the plan? (zero consumption in M18; deviation from plan exceeding 20% in M36)	☐		☒
Are any budget modifications for the project needed? (from MPPR / FPPR, sheet 5)	☐		☒

***The principles of economy, efficiency and effectiveness**: refers to the standard of "good housekeeping" in spending public money effectively. Economy can be understood as minimizing the costs of resources used for an activity (input), having regard to the appropriate quality and can be linked to efficiency, which is the relationship between the outputs and the resources used to produce them. Effectiveness is concerned with measuring the extent to which the objectives have been achieved and the relationship between the intended impact and the actual impact of an activity. Cost effectiveness means the relationship between project costs and outcomes, expressed as costs per unit of outcome achieved.

Comments (highlighting the project progress) / deviations / recommendations:

Comment no.1: In the first reporting period 12 deliverables were due:
4 deliverables were submitted in time
4 deliverables were submitted with eligible delay (amendment 1)
4 deliverables are postponed into the second reporting period (amendment 1)
Comment no.2: Changes to deliverables:
D1.1: postponed from M2 → M4
D1.4a: postponed from M6 → M7
D1.5: postponed from M6 → M7
D1.6: postponed from M6 → M7
D2.1a: postponed from M15 → M19
D2.2a: postponed from M17 → M19
D4.2a: postponed from M17 → M19
D1.3a: postponed from M18 → M19
The changes have no impact on the project outputs.

Project HIKE aims to support the latest state of the art in hazard and risk management through development, demonstration and implementation of essential subsurface data sets, assessment methodologies and setting up a knowledge share point where research institutes and stakeholders are guided towards the information they need.
In the first reporting period most of the planned deliverables are finalized, 3 deliverables are postponed for a few months into the second reporting period. The delays were recognized and communicated in time and corrective measures were adopted. The delays have no impact on expected project outputs.
Communication and dissemination plan have been adopted and detailed description of activities with timetable provided. The project communication and dissemination activities competently follow the plan. Cooperation with other GeoERA projects (mainly HotLime, VoGERA, GIP-P, GeoConnecte3d and 3DGEO-EU) is adequate and regular.
Project management structure is well defined and efficient. Overall financial consumption at the end of first reporting period is 39 %, which is a bit low. According to the project plan, the majority of activities will be done in the second reporting period, consequently the financial consumption will increase. Besides this, Project lead will discuss expenditure with two underspending partners (ISOR and PIG-PIB) to see, if any additional spending challenges exist.
Stakeholder council members were not available for the first review meeting and were asked by GeoERA coordinator to participate at the concise review meeting on 24th February via teleconference.

No challenges in achieving project outcomes are recognized, the project lead provides good support to partners with implementation of project activities.

Overall assessment of the project:

☐ 5 - **Overachiever** (the project has achieved all objectives and goals for the period and has even exceeded expectations)

☒ 4 - **Excellent progress** (the project has fully achieved its objectives and goals for the period)

☐ 3 - **Good progress** (the project has achieved most of its objectives and goals for the period with relatively minor deviations)

☐ 2 - **Acceptable progress** (the project has achieved some of its objectives; however corrective action will be required)

☐ 1 - **Unsatisfactory progress** (the project has failed to achieve critical objectives and/or is not at all on schedule)

Summary of dissemination activities (detailed activities are annexed to this report):

Activity	Target audience	Number of people reached
Publications (online)	Scientific community	Tbd
Events	EU institution	120
Events	Scientific community	212
Events	Non-EU institution	65
Events	Other	30
Meetings	Scientific community	75
Media	General public	>508
		1.010

Are the dissemination activities adequate? (link to GeoERA WP5)

☐ 5 - **Overachieved** (the projects dissemination activities have exceeded expectations)

☒ 4 - **Excellent** (the projects dissemination activities have fully achieved its expectations)

☐ 3 - **Good** (the projects dissemination activities are adequate; however, some additional activities are needed)

☐ 2 - **Acceptable** (the projects dissemination activities need corrective actions; additional activities are needed)

☐ 1 - **Unsatisfactory** (the project has failed to disseminate)

Cummulative financial statement:

	Person months	Total eligible costs	Reimbursement rate	GeoERA contribution	In-kind contribution
Plan	245,23	1.620.649	29,7%	481.333	1.139.316
1st period consumption	107,05	637.090,93	29,7%	189.216,00	477.874,92
2nd period consumtion					

2 LEVEL 2 – SCIENTIFIC REVIEW

In this section the project is reviewed ”remotely” on the basis of the respective reports. This part is filled in by reviewer with aim to review the quality of the deliverables and review of achieving scientific and professional goals. Scientific review is based on submitted deliverables and reported Impact statement in MPPR/FPPR.

Impact statement (from MPPR / FPPR, sheet 8):

In the first 18 months the HIKE project has not produced public deliverables that can be implemented by end-users and stakeholders. There is however a separate Public Summary and Outlook (in prep) which will provide a complete overview of the project activities and preview of results. This is an additional deliverable not formally defined in the project plan.

Below we are discussing the expected impacts as reported in the proposal:

Overall GeoERA Grand Challenges

Economy and strategic value: Hazards and impacts may significantly raise the cost of economic activities. These costs must be evaluated in the total cost and benefit equation when assessing the net economic value of resource exploitation. All activities in HIKE are aimed at improving the assessment and disclosure of essential underpinning information and knowledge

- Fault Database: assess hazard of seismicity and fluid migration
- Methods and use cases: improve quality of hazard assessment
- Knowledge Share Point: disclose information, data and tools to stakeholders

Welfare and health: Subsurface resources (energy, groundwater, minerals) provide benefits to society. These benefits should be in balance with the potential hazards and impacts resulting from their exploitation (see “economy and strategic value). The results in HIKE (Fault database, Methodology development, Knowledge Share Point) deliver information and tools to better assess these hazards and support preventive measures.

Climate: Escape of greenhouse gases (e.g. methane emissions) and safety of CO2 storage are typical topics in hazard research. Two out of the four case studies in WP3 specifically address the safety of subsurface storage, taking into account the influence of faults

Safety and environment: This is the main scope of HIKE. The results in HIKE (Fault database, Methodology development, Knowledge Share Point) deliver information and tools to better assess these hazards and support preventive measures.

Specific HIKE impacts

1) Foundation and platform for the (future) alignment of national research on geo-energy related (induced) impact and hazard assessments across Europe.
Current activities in WP2, WP3 and WP4 already lead to concrete collaboration and knowledge-sharing among partners and partner projects. With the available developed concepts, the HIKE project needs to engage external stakeholders (applicability for use cases, align with relevant projects and science platforms). We are currently linking with national case studies, regulators as well as the EU research infrastructure EPOS.

2) Means and support to develop and improve methods to predict, prevent and mitigate hazardous and polluting effects induced by subsurface exploitation
This is concretely done in WP3 in actual use cases. WP4 works on making these results available to the broader science community. We engage EPOS to enhance the integration outside GeoERA

3) Contribution to the reduction of economic and societal costs resulting from such effects by minimizing the risks.
The Fault database is connected to clear hazard cases. In partner countries the application of the fault database is evaluated in the context of national induced seismic hazard assessments. With a successful implementation we can better avoid such seismic risks (reduce societal costs) and make assessment more efficient (reduce assessment costs).

4) Translate the achievements and results to the policy and societal domains.
With the specification of the Knowledge Share Point HIKE identifies specific user groups. The semantics concept framework is developed to assist non-technical end-users to information that is relevant for them (assisted search).

5) Help countries to improve their own assessment and determination of induced hazards and impacts.
These impacts are reached with the common specifications and structures of the fault database and knowledge share point. These products are aligned with other external platforms (interfaces). The knowledge on fault characterization is shared between countries in various workshops (including links to other projects)

6) Allow stakeholders and end-users to benefit from the established results and thereby avoid unnecessary data acquisition and research costs.
HIKE has delivered the technical and scientific specifications. The joint development of the platform infrastructure is programmed between the projects and will be realized towards end of 2020 (prototyping, elaborating the final platform). We engage EPOS to align with other relevant repositories and to reduce costs

7) The transparency and open access to information are considered first principles and requisites for public awareness creation.
One of the challenges for HIKE is to bring the achievements and results under the attention of external stakeholders and the public. For this reason we are developing an extra deliverable "public summary and outlook report" to create awareness and exposure. All results are open and publicly accessible through EGDI.

Expected impact (from Project Agreement):

The successful implementation of a European Hazards and Impacts knowledge share point will provide the foundation and platform for the (future) alignment of national research on geo-energy related (induced) impact and hazard assessments across Europe. The gathering, harmonization and central dissemination of geosciences data sources, methodologies and case study results will deliver the means and support to develop and improve methods to predict, prevent and mitigate hazardous and polluting effects induced by subsurface exploitation. By supporting measures to prevent and mitigate induced hazards and impacts, the project indirectly contributes to the reduction of economic and societal costs resulting from such effects by minimizing the risks. Through the implementation and demonstration of real and actual use cases, the project will be better able to translate the achievements and results to the policy and societal domains. The collaboration between project partners as well as between the project and other national/transnational studies is vital to establishing common agreed and broadly applicable standards and functionalities in alignment with end-user needs as well as to increasing the effective deployment of innovation capacity in the entire research area. This will help many countries to improve their own assessment and determination of induced hazards and impacts. The open-access and dissemination of information via the GeoERA Information Platform will allow stakeholders and end-users to benefit from the established results and thereby avoid unnecessary data acquisition and research costs. Last but not least, the transparency and open access to information are considered first principles and requisites for public awareness creation. By the cooperation between the identified partners, the project will establish a clear transnational focus. Through the development of generic information sources and methodologies as well as national oriented sources and use cases, the project reaches out to both national and European stakeholders and end-users. The public availability of information regarding hazards and impacts may be subject to confidentiality and other access restrictions that are imposed by national and local regulations. These restrictions cannot be resolved within the project yet attempts will be made to include references where possible. Furthermore, it can be expected that certain use cases cannot be promoted by the project due to their political and societal sensitive nature.

Evaluation of deliverables

Deliverables list status			
No.	Title	Status (Approve/ Reject)	Comments
D1.1	Project Implementation Plan	Approved	/
D1.3a	Midterm Project Progress Report	Approved	/
D1.4a	Cumulative Expenditure Report 2018	Approved	/
D1.4b	Cumulative Expenditure Report 2019	Approved	/
D1.5	Project Data Management Plan	Approved	See below
This deliverable provides a first version of the HIKE Data Management Plan. It is structured according to the guidelines of the Overall GEOERA Data Management following Horizon 2020 FAIR Data and Management Plan. Since GIP-P did not yet provide recommendations and EGDI will furtherly develop, this report could be updated in the future.			
D1.6	Project Communication, Dissemination and Exploitation Plan	Approved	/
D2.1a	Draft Fault Data Characterization Catalogue		Postponed to period 2
D2.2a	Mid-term fault data collection report		Postponed to period 2
D3.1	Mid-term report on definition of integrated case scenarios in WP3	Approved	/
D4.2a	Scientific specifications and requirements for the hazards and impacts data share point and definitions for the Semantics Web service (draft)		Postponed to period 2
D5.1a	Technical IP requirements of the Fault Database (in EGDI	Approved	/
D5.1b	Technical IP requirements of the knowledge share point (in EGDI)	Approved	/

Has the quality as a whole been achieved according the objectives? Has the project as a whole been making satisfactory progress?

☐ 5 - **Overachiever** (the project has achieved all objectives and goals for the period and has even exceeded expectations)

☒ 4 - **Excellent progress** (the project has fully achieved its objectives and goals for the period)

☐ 3 - **Good progress** (the project has achieved most of its objectives and goals for the period with relatively minor deviations)

☐ 2 - **Acceptable progress** (the project has achieved some of its objectives; however corrective action will be required)

☐ 1 - **Unsatisfactory progress** (the project has failed to achieve critical objectives and/or is not at all on schedule)

Comments (highlighting the project progress) / deviations / recommendations:

The project consortia clearly presented the progress done so far, references and activity plan till the end of project.
The HIKE project involves good links with other projects (e.g. HotLime, GeoConnect3D, 3DGeo-EU) as well as links with existing databases (e.g. EPOS platform).
The main focus of this project is fault database. Project collects data from different countries, consequently the data differs greatly (heterogeneous sources, different repositories etc.). Complete data harmonisation could / will not be achieved. Project consortia decided which data attributes are mandatory, so at least some comparison is possible.
The recommendation by scientific reviewers to the project is to apply different methodology to different settings and observe which method is better for which fault. In the final report each case study area will be presented separately because they cover different examples of geohazards/structural settings, but some key relationships among case studies will also be highlighted.

3 LEVEL 3 – REVIEW OF THE THEME PROGRESS

In this section the project is reviewed ”remotely” on the basis of the respective reports. This part is filled in by Theme coordinator with aim to review the achieved scientific goals in accordance with theme objectives, on the basis of Sheet 3 in MPPR / FPPR – Project contribution to GeoERA project.

Project contribution to GeoERA project (from MPPR / FPPR, sheet 3):

General Objective: Interoperable, pan-European data and information services on the distribution of geo-energy, groundwater and raw material resources
The Fault Database (WP2) and Knowledge Share Point (WP4) will result in novel pan-European data and information services inside EGDI that will help to better manage and reduce anthropogenic risks related to exploration and exploitation of subsurface capacities and resources (e.g. by developing and disseminating public data and knowledge needed for identifying and analysing geological features that pose a hazard during subsurface exploitation). WP5 (information platform interface) supports the integration of the Fault Database and Knowledge Share Point in the larger European Geological Data Infrastructure (EGDI).
Concrete contributions 2018/2019
• Development of a standardized model for collecting, analysing and disseminating fault data (D5.1a)
• Development of a fault semantic concept approach to correlate faults across Europe and establish tectonic relationships between different faults and fault systems (D2.1a). A clear example is available from the Austrian Geological Survey (https://www.geologie.ac.at/services/webapplikationen/multithematische-geologische-karte/)
• Collection of country fault data (D2.2a)
• Collaboration with other projects to establish a joint fault model, among others GeoConnect3d (Structural Framework concepts), 3DGEO-EU (fault modelling and characterization, HotLime (semantic concepts) (a.o. MS-4)
• Development of a common knowledge share point concept for hazard and impact documents, data and tools based on a dedicated semantic concept model (smart searching, integrating and relating information sources) (D5.1b, D4.2a).

Theme objectives:

Theme objectives: compliant

- Potential subsurface contributions with regards to energy resources and storage capacities;
    - Not part of project scope

- Potential risks and environmental impacts associated with subsurface use for energy applications;
    - Primary objective of the project. Results presented in case studies and fault database and
- Risks of competition and interference between different uses of subsurface space, including interactions with surface infrastructures, and rewards of synergies.
    - Interference of subsurface activities is included as a hazard/risk factor

Theme scope: compliant

HIKE does not assess subsurface resources and activities as such presented below (e.g. distribution of resources) but incorporates such information in the hazard knowledge base to assess the relation between activities and hazards/impacts

- Hydrocarbons including conventional/unconventional oil and gas, gas hydrates;
- Energy derived from solid resources such as coal (including coal bed methane (CBM) and underground coal gasification), lignite, peat, uranium;
- Geothermal energy from hydrothermal and petro-thermal resources, both shallow and deep;
- Capacities for temporary storage of energy carriers (natural gas, hydrogen, compressed air and heat);
- Capacities for permanently storage of CO2 and other energy effluents.

Aspects below are relevant/compliant:

- Identification and analyses of overlap and interactions between geo-energy resources and areas prone to seismic activity;
    - Core aspect for HIKE (presented fault database, case studies)
- Determination and analysis of potential connections to groundwater and surface water systems;
    - Core aspect for the hazard/impact knowledge share point (definitions) and part of the case studies
- Identification and analysis of potential interferences as well as synergies/pooling between various geo-energy resources and subsurface uses.
    - Interference of subsurface activities is included as a hazard/risk factor (definitions for the knowledge share point)

Theme approach and methods: compliant

- Deliverables proposed by geo-energy theme projects should be compatible with a common spatial geological framework defined by the extent, depth, thickness, as well as essential properties of geological intervals containing relevant geo-energy resources and storage capacities.
    - The project presents a common framework concept for evaluating, managing and disseminating fault data (incorporating elements from existing concepts for EU seismogenic fault databases). Common representation of fault in collaboration with Hotlime, 3DGeo-EU, GeoConnect3D. Results presented
- Common state-of-the-art methodologies will be developed and applied with the aim to assess and quantify technically recoverable resources.
    - Not in project scope
- Development and demonstration of advanced 3D modelling and assessment activities may be proposed for complex geological configurations typical for specific cross-border regions under the condition that these methodologies have generic value and can be linked to the future objectives of a common spatial-assessment framework.
    - The project integrates national fault data repositories into a pan EU framework. Results presented. Interaction with GeoConnect3D, 3DGEO-EU and HotLime to establish transnational correlation concepts (semantics principles)
    - Case studies are locally defined yet outcomes are intended to be synthesized at EU level
- The joint call will either ask for final deliverables and methodologies consistent on a transnational to pan European level, or for the demonstration and development in cross-border regions of methodologies that have generic value for future pan-European assessments.
    - The project integrates national fault data repositories into a pan EU framework. Results presented. Interaction with GeoConnect3D, 3DGEO-EU and HotLime to establish transnational correlation concepts (semantics principles)
    - Case studies are locally defined yet outcomes are intended to be synthesized at EU level
- Correlation schemes of cross-border geo-energy resources;
    - Implementation of semantics concept for cross-border fault correlation
- Compatible and interoperable model scales/resolutions and geometries;
    - Project focuses primarily on national/transnational scale. Relevance of fault data is often defined at local scale however (point of attention)

- Commonly agreed modelling and assessment methodologies.
    - The fault database specifications and concepts will act as a common approach for the compilation and integration of passive and active faults

Beyond state of art

- Advanced mapping and 3D modelling strategies that allow for regional to pan-European cross-border consistency and integration;
    - Implementation of novel semantics concepts to harmonize and correlate fault data (presented as work-in-progress)
- Advanced and harmonized resource estimation workflows addressing uncertainty and sensitivity;
    - Uncertainty aspects are partly element of case studies (e.g. presentation of results/progress on localization of seismicity)
- State-of-the-art assessment workflows for analysis of potential geologically related surficial and subsurface effects induced by resource exploitation (e.g. subsidence, tremors, etc.);
    - The project provides core information (faults) and tools (knowledge share point) to perform such analyses. Actively assessed in case studies of WP3 (results/progress presented)
- Methodologies to objectively weigh interacting or mutually exclusive potential uses of space within the geoenergy theme and across the other themes on groundwater and minerals.
    - Not a part of project scope

Project-2-Project:

HIKE actively interacts with GeoConnect3D (structural framework concept) and 3DGEO-EU/Hotlime (exchange of fault data). Interactions with Vogera planned.

Has the project as a whole achieved the objectives and expected impact of the theme?

☐ 5 - **Overachiever** (the project has achieved greater impact on project theme and/or other themes than expected)

☐ 4 - **Excellent progress** (the project has fully achieved its objectives and goals towards the theme as expected)

☒ 3 - **Good progress** (the project has achieved most of its impact towards the theme for the period with relatively minor deviations)

☐ 2 - **Acceptable progress** (the project has minor impact; corrective action will be required)

☐ 1 - **Unsatisfactory progress** (the project has failed to achieve critical objectives and/or is not at all on schedule and/or has no impact on the theme; corrective actions are required)

Comments / deviations / recommendations:

HIKE progresses in line with the project objectives and thereby follows the theme scope/objectives and GeoERA principles in general as mentioned in the call description.

Additionally the review analyses how the project performs beyond the project scope and raises the overall profile of the Energy Theme and GeoERA as a whole, i.e.:

- Developing and actively implementing standards and methods for panEU harmonization in the GSO community that are of value to the Energy Theme and/or GeoERA in general (i.e. beyond the project scope)
- Successfully introducing and implementing innovative and novel methods and standards in stakeholder/science communities leading to wider recognition of the Energy Theme and/or GeoERA
- Stimulating synergies between projects and themes
- Raising the overall impact and recognition of the Energy theme and/or GeoERA though active engagement of stakeholder and science communities
- Opening opportunities for future research and spin-offs including EP-GSE (i.e. possibilities for sustained development of results after project lifetime)

The HIKE project is rated as 'good' for the following reasons:

1) The project actively develops new standards and tools for fault data management and knowledge sharing (hazards and impacts) that have a good potential for broad implementation in GeoERA and future research in general.
2) Although the project has synergies and interactions with other Energy Theme projects, the activities are still mostly internally focused. It is recommended to create broader exposure and seek further involvement of external stakeholders, science communities and external projects (e.g. EPOS). For example, how can the HIKE results contribute to broader recognition of the added value and impact of the Energy Theme and GeoERA?

4 LEVEL 4 – GEOERA PROGRESS EVALUATION

In this section the project is reviewed on the Review meetings, where projects present their overall progress and achievements. This section relates to particular project, broader impact of GeoERA as a whole on policies will be covered at the Final Review meeting with questionnaire and interview with Evaluator.

Based on technical review summaries provided by Sections 1 – 3 of this report, and project presentation on the (Final) Review meeting:

Has the project as a whole been making satisfactory progress according to your own understanding and expectations of the GeoERA project?

☐ 5 - **Overachiever** (the project has exceeded expectations)

☒ 4 - **Excellent progress** (as expected)

☐ 3 - **Good progress** (minor recommendations given below)

☐ 2 - **Acceptable progress** (below expectations; minor corrective action will be required)

☐ 1 - **Unsatisfactory progress** (the project has failed; corrective actions are required)

Overall comments for the project (overall recommendations, modifications, corrective actions, or re-tuning the objectives to optimize the impact or keep up with the State of the Art, re-focusing; or a simple praise)

Stakeholder 1 feedback:

At the point of the project, the researchers are making excellent progress towards completing tasks by the planned deadlines. To date, they have coordinated with numerous partners to compile, from existing databases, a Europe-wide fault map. They have developed approaches to handle the correlation of structures, due to differing fault resolution, across political or regional boundaries. While the existing databases are acknowledged to be incomplete, the compiled database will make it easier to identify regions that need additional study. Overall, the team has considered many of the potential issues with developing such a large-scale database. Below I highlight some items that should be prioritized as the project continues.

Comment 1. The critical decision that needs to be taken at this point in the project is identification of the primary stakeholder(s). The project should not attempt to meet the needs of all potential users/stakeholders of the database, at least at this stage of the project. It is recommended to strictly limit the number of considered stakeholders to one or two and further to define a limited set of potential uses of the data by those stakeholders. The project should be careful to avoid trying to meet all needs, as they risk creating a database that is not ideal for any of the stakeholders. The project team should prioritize discussions with representatives of the primary stakeholder group to understand their needs and requirements from the database.

Comment 2. Metadata will be extremely important for the proper use of the database by stakeholders. Metadata should be developed by considering the primary stakeholder groups, their likely expertise, and expected uses of the database. Metadata at a minimum should highlight the resolution and potential acceptable (and not acceptable) applications. In areas where data conflicts (overlapping fault maps that do not agree) or is ambiguous (associating faults across boundaries) the user should be presented with alternative interpretations and/or descriptive explanation of how the data have been handled.

Comment 3. Once the stakeholder(s) needs and uses are determined, attention should be given to development of the platform that will be used to interface with the database. Tools should be developed through consideration of the different expertise of, computational literacy of, and common software tools used by the stakeholder groups to ensure that use of the database is not hampered by output formats that are not typically used by the stakeholder community. The project team may wish to consider methods used by other large scale fault database efforts in other countries (one example is the Southern California Earthquake Center's Community Fault Model) to see if existing tools, metadata formats, or other information could be leveraged by this project. The platform should also consider as development choices are made what the long term maintenance needs will be, how easy it is to extend the platform if/when other stakeholder groups are considers and/or if new data types are to be added.

Stakeholder 2 feedback:

During the concise Review meeting held on 24th February a few general comments were highlighted:

- The most important part of the project is fault database. The focus should be on the harmonized data with as precise background information as possible concerning access to data and information.
- The data provided by different countries differs in quality, metadata and spatial resolution, so the harmonization and integration are a challenge. Project is working with standardized metadata and are testing them on pilot areas. However, data interoperability should be further tested and better explained in order to foster the use of data and scientific products through other platforms such as EGDI and EPOS.
- The Project aims at building a platform for users with different needs and level of knowledge about its access and use. GSO's are trusted data providers for the public and authorities / policy makers. The data should be adapted according to the needs of users / stakeholders. Details on the data policy and access rules for different stakeholders are needed.

Further comments are provided relying on the subsequent remote evaluation.

The project is relevant for science and society. The implementation of the fault data base and the "knowledge share point" are certainly novel and innovative.

The impact of the HIKE project is essentially focused on hazard and risk management through development, demonstration and implementation of subsurface data sets, assessment methodologies and setting up a knowledge share point where stakeholders are guided to get the information they need. It would be useful to clarify and explain the impact of access to data, access to the derived scientific products and the access to the information describing

the scientific contents and their use for hazard assessment and decision making. These distinct actions are presented altogether, and it is difficult to appreciate how they will separately contribute to achieve the objectives and to foster exploitation and impact.

The word “access to data” is rarely used in the report. For instance, the access to the fault database is presented as a contribution to hazard and risk, not to science as a precondition to create awareness of stakeholders on hazards assessment and risk mitigation. The Methods and use cases are focused to the quality of hazard assessment, and not to the use of data and products for the development of deliverables for subsequent hazard assessment. It is therefore difficult to understand what the Knowledge Share Point will deliver to stakeholders: disclose information by presenting data and products or allowing access to data and products as well as to methodologies for hazard assessment. The services associated to the proposed methodologies have to be better defined.

Focusing on geo-energy is clear and highly relevant. However, this should require high quality data at local level rather than a pan-European scale fault database; the integration of high-resolution data in areas identified for geo-resources exploitation should be prioritized. The identification of these areas is also relevant for the engagement of private sector and stakeholders.

Interoperability with other geo-data would be extremely important and it would further strengthen the impact of HIKE. In particular, seismic data and induced seismology, geodetic data from GNSS and Satellite observations, anthropogenic hazard and multi-hazard assessment. This might be facilitated by discussing the interoperability with the EPOS services. Fault Database and the Knowledge Share Point will be integrated in EGDI; however interactions with other scientific communities might be useful.

Annex 1: Review meeting list of participants

Name	Role	Organisation
Tessa Witteman	GeoERA coordinator	Netherlands Organisation for Applied Scientific Research
Barbara Simić	Monitoring and Reporting Officer	Geological Survey of Slovenia
Jasna Šinigoj	Scientific Reviewer	Geological Survey of Slovenia
Mateja Jemec Auflič	Scientific Reviewer	Geological Survey of Slovenia
Jernej Jež	Scientific Reviewer	Geological Survey of Slovenia
Matija Krivic	Scientific Reviewer	Geological Survey of Slovenia
Jørgen Tulstrup	Information Platform Theme coordinator	Geological Survey of Denmark and Greenland
Serge van Gessel	GeoEnergy Theme coordinator	Netherlands Organisation for Applied Scientific Research
Hans Doornenbal	HIKE Project manager	Netherlands Organisation for Applied Scientific Research
Harry Middelburg	HIKE Project member	Netherlands Organisation for Applied Scientific Research
Tine Larsen	HIKE Project member	Geological Survey of Denmark and Greenland
Sabrine Ben Rhouma	HIKE Project member	French Geological Survey
Esther Hintersberger	HIKE Project member	Geological Survey of Austria
Concise Review meeting 24.02.2020		
Elisabeth S. Cochran	Stakeholder council member	US Geological Survey
Massimo Cocco	Stakeholder council member	National Earthquake Observatory, Italy

Annex 2: Communication and dissemination activities

Please select activity	Subcategory	Date	Target audience	Number of people reached	Short name of project participant	Author(s)	Link (if applicable)
EVENTS	PITCH EVENT	2-5 July 2018	EU INSTITUTION	100-120	All partners	Serge van Gessel	GeoERA Kickoff Event Brussels
EVENTS	WORKSHOP	4-5 July 2018	SCIENTIFIC COMMUNITY	15	All partners	Project Lead & Work Package Leads	GeoERA Kickoff Event Brussels
MEDIA	ONLINE MEDIA	2018/2019	GENERAL PUBLIC	tbd		Project Lead & Work Package Leads	GeoERA website https://geoera.eu/projects/hike10/
MEETINGS	Meeting with other GeoERA projects	24-25 sep 2018	SCIENTIFIC COMMUNITY	20	TNO, GBA	Serge van Gessel, Esther Hintersberger	GeoERA IP Workshop Brussels
MEETINGS	Meeting with international body	3-4 Dec 2018	SCIENTIFIC COMMUNITY	20	TNO + others	Serge van Gessel	GeoEnergy Expert Group Meeting
EVENTS	WORKSHOP	4-5 Feb 2019	SCIENTIFIC COMMUNITY	6	TNO, LfU, GBA	Serge van Gessel, Harry Middelburg, Esther Hinterberger, Gerold Diepolder	Fault DB workshop Augsburg
EVENTS	PITCH EVENT	43508	SCIENTIFIC COMMUNITY	35	TNO	Serge van Gessel	National Delegates Forum EGS
EVENTS	WORKSHOP	11-13 Mar 2019	SCIENTIFIC COMMUNITY	80	Most partners	Project Lead & Work Package Leads	Vienna, Faults workshop, Meeting with HIKE, 3DGEO-EU, GeoConnect3D, GIP ...
EVENTS	PITCH EVENT	15 Mar 2019	NON-EU INSTITUTION (national, regional, local)	40	GBA	Hintersberger	National Kickoff meeting of all Austrian GeoERA participants
MEDIA	ONLINE MEDIA	43547	GENERAL PUBLIC	tbd		Project Lead & Work Package Leads & Task Leads	https://geoera.eu/wp-content/uploads/2019/03/Project-HIKE-newsletter_20190325.pdf

EVENTS	CONFERENCE (tele-conference)	14-16 May 2019	SCIENTIFIC COMMUNITY	50	LfU, GBA	Hintersberger	https://www.lfu.bayern.de/geologie/aktionstage/euregeo/index.htm
MEETINGS	Meeting with other GeoERA projects	43650	SCIENTIFIC COMMUNITY	10	TNO, VITO, RBINS-GSB, …..	Harry Middelburg, Serge van Gessel	Utrecht, Structural Framework workshop with GeoConnect
MEDIA	ONLINE MEDIA	43658	GENERAL PUBLIC	508		Johan ten Veen, Harry Middelburg	https://geoera.eu/blog/how-we-deal-with-our-faults/
EVENTS	PITCH EVENT	43745	OTHER (customers)	30	TNO	Serge van Gessel	General Assembly Event Prague
EVENTS	WORKSHOP	7-9 Oct 2019	SCIENTIFIC COMMUNITY	6	GEUS, TNO, ISOR	Tine Larsen	WP3 workshop Copenhagen
EVENTS	WORKSHOP	43761	SCIENTIFIC COMMUNITY	20	TNO, BGR, GEUS, IGME, LBEG, LBGR BRB, LAGB, PIG-PIB,	Hans Doornenbal, Harry Middelburg	Hannover, Workshop with 3DGEO-EU and HIKE
MEETINGS	Meeting with other GeoERA projects	18-19 Nov 2019	SCIENTIFIC COMMUNITY	10	TNO, GEUS, GBA, BRGM	Serge van Gessel, Esther Hintersberger, Harry Middelburg, Sabrine Ben Rhouma	Copenhagen, Meeting HIKE and GIP
EVENTS	SEMINAR	43789	NON-EU INSTITUTION (national, regional, local)	25	GEUS	Karen Anthonsen, Tine Larsen	CCUS2020 event Denmark
PUBLICATIONS	SCIENTIFIC PUBLICATION	43838	SCIENTIFIC COMMUNITY	tbd		J. VIDOVIC, Y. SCHAVEMAKER, T. WITTEMAN, J. TULSTRUP, S. VAN GESSEL, K. PIESSENS & S. SOLAR	https://sp.lyellcollection.org/content/specpubgsl/early/2020/01/06/SP499-2019-47.full.pdf?ijkey=TrwYVqe8DPskizg&keytype=finite
MEETINGS	Internal project meeting	Monthly	SCIENTIFIC COMMUNITY	5-15	All partners	Serge van Gessel	Monthly project meetings
PUBLICATIONS	PROJECT SPECIFIC PUBLICATION (please	in prep	OTHER (customers)	tbd		Project Lead & Work Package Leads & Task Leads	Public Summary and Outlook

	specify: leaflet, poster, catalogue, …)						
EVENTS	CONGRESS	submitted	SCIENTIFIC COMMUNITY	tbd	TNO + other partners	Serge F. van Gessel, Harry B. Middelburg, Esther Hintersberger, Tine B. Larsen, Sabrine B. Rhouma, Gerold W. Diepolder, Pio di Manna	Submitted abstract for EGU2020 in Vienna (4-8 mai 2020)