GHG-KIT

GHG-KIT Keep it traceable - Prototyping a satellite enabled, independent tool-kit system for GHG verification in Austria

Programm / Ausschreibung	ASAP, ASAP, ASAP 18. Ausschreibung (2021, KP)	**Status**	abgeschlossen
Projektstart	15.09.2022	**Projektende**	30.04.2025
Zeitraum	2022 - 2025	**Projektlaufzeit**	32 Monate
Keywords	GHG Reporting; Verification; Copernicus; LULUCF; Inverse modelling		

Projektbeschreibung

Das Pariser Abkommen sieht vor, dass alle Staaten über ihre Treibhausgasemissionen (THG) und deren Abbau an die UNFCCC berichten. In Österreich zeichnet das Umweltbundesamt (UBA) für die Erstellung des österreichischen Nationalen Inventarberichts (NIR) verantwortlich. In den letzten Jahren haben sich die internationalen und europäischen Berichterstattungspflichten deutlich erweitert. Eine kürzlich erlassene EU-Verordnung verpflichtet die Mitgliedsstaaten ihre Berichterstattungsregeln zu übernehmen und nationale Inventarsysteme einzurichten, um Datenkonsistenz zu gewährleisten. Die Bilanzierung von Treibhausgasemissionen und deren Berichterstattung ist aufgrund der Vielfalt der sich abzeichnenden politischen Maßnahmen, sowie der nationalen Unterschiede und Abweichungen jedoch immer noch mit Unstimmigkeiten behaftet. Aus diesem Grund besteht ein erheblicher Bedarf für eine unabhängige Qualitätssicherung und -kontrolle, insbesondere durch Satellitendaten und spezialisierte Informationsprodukte aus dem Copernicus Umweltprogramm.

Die Motivation des Projekts “GHG-KIT: Keep it traceable” besteht in der Entwicklung von Methoden und eines Prototyps für ein unterstützendes System für die integrierte Treibhausgasbilanzierung und -überwachung auf der Grundlage bestehender und neuer Satellitenmissionen. Dieses System soll die österreichischen Berichterstattungskapazitäten unterstützen und signifikant verbessern.

Das übergeordnete Projektziel ist die Konzeption und Entwicklung eines zuverlässigen und wissenschaftlich geprüften satelliten-gestützten Berichterstattungssystems. Unter Gewährleistung maximaler Standardisierung und Flexibilität für die Implementierung basiert das System auf einem modularen Toolkit-Design, welches alle Elemente eines nationalen Überwachungssystems abdeckt. Das Konzept sieht die Integration bereits vorhandener Workflows und Informationsströme in eine offene Wertschöpfungskette vor, die flexible und leicht skalierbare neue Lösungen ermöglicht. Dadurch bietet GHG-KIT eine zentralisierte, satellitenbasierte Daten- und Informationsquelle für die THG-Verifizierung und -Berichterstattung mit Mehrwert für einzelne Benutzer.

Der Wert von Satellitendaten für die Verbesserung und Überprüfung der THG-Berichterstattung wird anhand der Implementierung von zwei spezifischen Prototypen

1. zur Verbesserung der LULUCF-Berichterstattung (Bottom-up-Ansatz) und
2. der unabhängigen Überprüfung der aktuell gemeldeten Emissionen (Top-Down-Ansatz), demonstriert.

„GHG-KIT: Keep it Traceable“ wird in einer einzigartigen Kooperation zwischen einem multidisziplinären österreichischen Industrie-Wissenschafts-Team und internationalen Experten entwickelt. Der daraus resultierende Entwurf für die System- und Serviceimplementierung wird ein wichtiger Meilenstein hin zu einer neuen nationalen Treibhausgasüberwachungsexpertise mit hohem Potenzial für den europäischen Exportmarkt sein. Dieses ASAP-Leitprojekt wird die beteiligten Unternehmen und Wissenschaftspartner in die Pole-Positionen für zukünftige operative CO2M-Missions Anwendungen bringen.

Abstract

The Paris Agreement requires all nations to report on their greenhouse gas (GHG) emissions and removals to UNFCCC, with the Austrian Environmental Agency (UBA) is responsible for the development of the Austrian National Inventory Report (NIR). A recent EU regulation requires member states to adopt their national reporting rules and encourages them to establish national inventory systems to ensure data consistency. However, the practice of GHG emission accounting and reporting is still plagued with inconsistencies due to the variety of emerging policies, national varieties and deviations. There is a need for independent GHG reporting and verification capacities through integration of specialised satellite information products, specifically from the Copernicus programme.

The overall motivation of the project “GHG-KIT: Keep it traceable” is to develop methods and prototype a supporting system for integrated Greenhouse gas accounting and monitoring based on existing and upcoming new satellite missions. This system shall support and improve the national Austrian reporting capacities.

The project goal is the finalisation of a reliable and scientifically proven concept for the development of an Earth Observation (EO)-supported GHG reporting system, together with the main stakeholders. To facilitate a standardized approach that will provide maximum flexibility for operational implementation the system is based on a modular tool-kit design to cover all different sub-elements of a national monitoring system. The concept foresees integration of already available workflows and information streams with an open value chain enabling flexible and readily scalable new solutions. Thereby GHG-KIT will offer a centralized, satellite-based data and information source for GHG verification and reporting with added value for individual users.

The value of EO information for the improvement and verification of GHG reporting is demonstrated along the implementation of two specific prototypes, enabling

1. an improvement in the LULUCF reporting (bottom-up approach) and
2. the verification of the currently reported emissions (top-down approach).

“GHG-KIT: Keep it traceable” is being developed through a unique cooperation between a multi-disciplinary Austrian industry-science team and international experts. The resulting blueprint for system and service implementation will be a major milestone towards a new national greenhouse gas monitoring expertise with high potential for European export. This ASAP lead project will leapfrog the participating companies and science partners into pole-positions towards operational

future CO2M mission services.

Endberichtkurzfassung

The Austrian Space Applications Program (ASAP 18) flagship GHG-KIT project - “Prototyping an EO-enabled kit supporting greenhouse gas reporting” successfully achieved its scope to develop a scientific Proof-of-Concept (PoC) for an Earth Observation (EO)-integrated CO 2 and CH 4 MVR system in Austria using Copernicus satellite data and derived-information products, including two prototypes: (i) The Verification Element based on atmospheric modelling of GHG fluxes (“top-down” approach), and (ii) The Land Use Land Use Change and Forestry (LULUCF) Inventory Report (“bottom-up” approach). The GHG-KIT overall system was developed in close collaboration with the main user and beneficiary, namely The Environment Agency Austria (Umweltbundesamt GmbH - UBA) in support to their GHG national inventory report (NIR) process, in alignment with the climate change mitigation strategy of The Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (Bundesministerium für Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie - BMK). Moreover, the outreach extends to a broader community of stakeholders in both the compliance and voluntary carbon markets, by driving and fostering European standardisation, connectivity, scalability and operationalisation of services.

The Verification prototype successfully achieved its goal to set-up an Austrian inverse modelling framework that now relies on both in-situ and EO data. Existing satellites (i.e., Sentinel-1, Sentinel-2, Sentinel 5P Tropomi, OCO-2/3, GOSAT) were integrated for the first time in Austria into complex atmospheric models such as FLEXPART and FLEXINVERT. WP5 laid solid foundations and prepared the ground for future Copernicus expansion missions (e.g., CO2M, ROSE-L, CHIME and other smaller commercial satellites). The first encouraging results obtained enables the inter-comparison with available existing products over Austria and act as a starting point to increase and foster synergies with other European initiatives such as from ESA, EEA Copernicus Atmospheric Service (CAMS) and projects such as RECAPP-2, AVENGERS or EYE-CLIMA. The Viennese use case offers an insightful dive into EO capabilities at subnational and city scale. The main challenges include the Alpine mountainous terrain, the low emission sources, as well as the lack of ground measurements stations in Austria and independent satellite data to verify the atmospheric models.

The GHG-KIT project successfully developed an EO LULUCF MRV operational ICT system combining Sentinel-2 and Landsat 8/9 time series, ancillary data from the Copernicus Land Monitoring Service and national data sets (i.e., IACS, LPIS, Cadastre, BFW forest and settlement masks) into an AI deep learning Convolutional Neural-Network U-Net trained model. LULUCF Activity Data for the period 2015-2023 was produced for the first time over Austria with an overall accuracy of 97%. By providing a concept for backward extension based on Landsat heritage from 1990-2015, the GHG-KIT project also started to address one of the main challenges of the consistency of land use transitions between the Sentinel-2 and Landsat era. The advanced LULUCF technological solution developed within the GHG-KIT project is fully compliant with the EU LULUCF regulation (2023 revision), The IPCC Guidelines (2019 refinement) tier 3 approaches and wall-to-wall methodologies, as well as the UNFCCC TACCC principles of Transparency, Accuracy, Consistency, Completeness and Comparability.

The potential use of the EO-integrated CO 2 and CH 4 MRV system developed within GHG-KIT by UBA consists of three scenarios: (i) Verification of area estimates in NIR, (ii) Inclusion of data in NIR compilation, (iii) Support transition to spatially explicit reporting, according to new revision of LULUCF regulation. This new LULUCF service serves a best practice country example and is scalable with some adjustments at pan-European level and to other Member States.

Projektkoordinator

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Projektpartner

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- Technische Universität Wien
- Universität Wien
- EODC Earth Observation Data Centre for Water Resources Monitoring GmbH
- GeoSphere Austria - Bundesanstalt für Geologie, Geophysik, Klimatologie und Meteorologie
- Cloudflight Austria GmbH