Blending EO and OSINT data to address fragile and conflict-affected contexts

Geospatial World Forum
2-5 May 2023
Rotterdam, The Netherlands
Postillion Hotel & Convention Centre WTC
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TILL END OF 2026!
1. ESA-GDA – The Context

ESA-GDA Mission is to accelerate impact through the power of satellite Earth Observation (EO) in international development assistance, focusing on Agile EO Information Development (GDA AID) applied to 11 thematic priority sectors. GDA was brought to life by ESA Member States at the Space19+ Ministerial Council in November 2019 and implemented in partnership with International Financial Institutions (IFIs) – World Bank and Asian Development Bank.

Recent regional-scale activities (since 2016) under the Earth Observation for Sustainable Development (EO4SD) facilitated the increase of development practitioners’ acceptance of using EO for strategic approach, addressing the value chain of integrating EO.

2. Fragility, Conflict and Security thematic area - Topics addressed

Fragility, conflict, and security (FCS) is a critical development challenge that threatens efforts to extreme poverty, affecting low- and middle-income countries. The ESA-GDA-FCS programme engages with IFIs to co-design tools to support ongoing initiatives, fostering situational awareness, exposure and impact evaluation, food security in countries affected by conflicts.

Products are developed in a multidisciplinary approach, within 3 Cycle agile iterations: EO data are integrated with heterogeneous sources (OSINT), to improve decision making processes.
3. TEAM, PILLARS AND APPROACH

Project launch: January 2022

Activities performed by a consortium of six European companies led by e-GEOS (CGI, DLR, HENSOLDT Analaytics, JANES, VITO) leading in the fields of Earth Observation (EO), Remote Sensing, Open Source Intelligence (OSINT), Socio-Spatial Intelligence (SOSINT), and the integration of technology into international development contexts.

Four project pillars:

1. Improved exposure assessment to fragility risks, analysis of coping capacity.
2. Effective characterization of dynamics and needs in FCS contexts.
3. Enhanced information services for planning, monitoring, management of post-conflict activities.
4. Better assessment of assets and natural resources.
### 4. Use Cases in Scope of the Project

<table>
<thead>
<tr>
<th>Use Case</th>
<th>Description</th>
<th>End User</th>
<th>WB Project</th>
<th>Main Objective</th>
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<tbody>
<tr>
<td>UC4 - Land and Conflict</td>
<td>Endpoint: P. Prettiomo - World Bank</td>
<td>P. Prettiomo - World Bank</td>
<td>P129490 - Assessing the Nexus of Land Administration and Resilience to Disaster and Climate Risk</td>
<td>Integrating EO/OSINT data to identify land grabbing indicators due to the ongoing conflict in Ukraine, as it is producing expropriation, transactions, forced land abandonment phenomena.</td>
</tr>
<tr>
<td>UC5 - Effects of Displaced Population on Local Economy</td>
<td>Endpoint: Jeffrey Tanner - World Bank</td>
<td>Jeffrey Tanner - World Bank</td>
<td>P172830 - The Coxi’s Bazar Analytical Program</td>
<td>Integrating EO/OSINT data to monitor the impact on local economy/welfare growth from refugee camps in Ukhrul/Teelak districts (Bangladesh), to better addressing budget.</td>
</tr>
<tr>
<td>UC6 - IGAD through the Emergency Response Program</td>
<td>Endpoint: V. Fabbro, E. De Benedetti – ADB</td>
<td>V. Fabbro, E. De Benedetti – ADB</td>
<td>P174546 - Emergency Local Response Project</td>
<td>Integrating EO data to monitor desert locust flow, through eastern African regions, enhancing IGAD’s inter-regional platform, as locusts affect agriculture, producing food insecurity.</td>
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<tr>
<td>UC7 - Population Movement</td>
<td>Endpoint: V. Fabbro, E. De Benedetti – ADB</td>
<td>V. Fabbro, E. De Benedetti – ADB</td>
<td>TA 9986 Regional: Enhancing Differentiated Approaches in Conflict-Sensitive Situations</td>
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5. Users engagement through Agile iterations

In order to ensure a responsive, iterative and impact-driven implementation, an agile development approach is adopted under the GDA activities: three 6-month sequential iteration cycles, where users represent the key drivers for any implementation and success.

Monitoring and evaluation of ESA-GDA-Fragility activities and results.

- Requirements collection: online and offline tools.
- Use Cases design: offline contributes.
- Validate and enhance from users' feedback to Cycle 2.
- Enhancement application: offline contributes.
- Validate and enhance from users' feedback to Cycle 3.
- Results dissemination.

Cycle 1:
1. Users requirements
2. Plan
3. Use Cases (UC) Design
4. Develop
5. Release
6. Test and validation

Cycle 2:
1. Users requirements
2. Plan
3. Enhance UC Design
4. Develop
5. Release
6. Test and validation

Cycle 3:
1. Users requirements
2. Plan
3. Enhance UC Design
4. Develop
5. Release
6. Test and validation

Results dissemination.

Requirements refinement and Use case definition.
Release Cycle 1 baseline prototypes and feedback forms.
Results dissemination.
Release Cycle 2 enhanced prototypes and feedback form.
Results dissemination.
Final review.
**6. Use Case 7 – Population Movement**

**6.1 Objective and Requirements**

**IFI & project**
Asian Development Bank - TA 9986 Regional: Enhancing Differentiated Approaches in Context-Sensitive Situations

**Objective**
In the context of migration flow from North Afghanistan to South Tajikistan, UC7 aims at assessing migration pressure along the borders and also on existing settlement, as an added value for ADB to better drive investments supporting agriculture, migration, agencies etc. ADB wants to develop capacity among the Tajik authority through a dedicated dashboard as a means to support decision making processes.

**Areas of interest**
Afghanistan / Tajikistan, Uzbekistan

**Time window**
Baseline: from 2014 to May 2021
Monitoring: from May 2021 onward.
Frequency: reporting twice a year (spring/autumn + events based)
6. USE CASE 7 – POPULATION MOVEMENT

6.2 METHODOLOGY

The work logic is split into two different types of products:

1. OSINT/intelligence-based
2. EO data-based

Those products have been identified and refined with the stakeholder.
6. Use Case 7 – Population movement

6.3 Products example

IDPs camps identification and monitoring through optical VHR EO data.

Checkpoint monitoring through Sentinel-1 based heatmaps products.

Reports and social media mentions analysis supported the identification of keywords, driving EO-based assessment through both HR and VHR data.
6. Use Case 7 – Population movement

6.3 Products example

Settlement extent changes over the border: the biggest change occurred in Termez (Uzbekistan). Along the border, changes are smaller and more scattered.

- Overview product (geolocation of OSINT events and relevant areas for EO-based analysis), 3 detailed products over temporary camps, checkpoints and urban areas with macro evidence of changes (optical VHR EO-based change detection).
- Statistics over assets involved in the area of interest
6. USE CASE 7 – POPULATION MOVEMENT

6.4 FINAL DASHBOARD VISUALIZATION

CGI is developing analytics functionality during the 3rd cycle to enable those data to be exploited by end user.
7. USE CASE 8 – COUNTRY PERFORMANCE ASSESSMENT

7.1 OBJECTIVE AND REQUIREMENTS

**Objective**
ADB estimates a biannual Country Performance Assessment (CPA) index at country level, for all the Asian Development Fund (ADF) eligible countries, assessing policy and institutional frameworks, coherence of structural policies, policies and institutions equity and inclusion, quality of governance, etc. CPA scores are from 0 to 6: countries with an avg. CPA of 3.2 or below are classified as Fragile Conflict-Affected Countries.

**Areas of interest**
First iteration: 9 countries (Timor-Leste, Afghanistan, Pakistan, Tajikistan, Uzbekistan, Kyrgyz Republic, Myanmar, PNG, Lao PDR)
Second iteration: first 9 above and adding further 3 countries (Cambodia, Buthan, Nepal)

**Time window**
From 2020 – up today

**IFI & project**
Asian Development Bank - TA 9986 Regional: Enhancing Differentiated Approaches in Context-Sensitive Situations
As the main constraint refers to the subjectivity of the CPA presently estimated, on which the analysis of the expert economists are based, UC8 aims at enhancing the CPA through EO/OSINT based indicators (both in the security domain as well as social/traditional media covering non-subjective aspects and developing an unsupervised Machine Learning (ML) model that takes in input trends and statistics of new indicators, grouping countries that according to ML model are similar from in terms of CPA and new indicators.
Completed data collection and pre-processing (two iterations) for:

- a total of 107 indicators, EO and non EO, divided in 3 classes called economy, society and policy
- 12 countries
- 6 years (2017-2022)

Completed data normalization
Completed data rescaling
Currently developing AI model for:
- country ranking
- country clustering
- visual assessment and comparison

Also in the process of preparing selected geographical data for ingestion in UC8 software tool.
7. Use Case 8 – Country Performance Assessment

7.4 Preliminary Products and Requirements

1. Qualitative Insights
   Example – Built areas in Timor Leste, zone around Dili, 2017 vs. 2022 (density clustering)

2. Selection of Most Relevant Indicators
   Example – Feature selection for EO indicators on heat & humidity (simulated annealing)

3. Maturity Assessment and Clustering
   Example – Clustering with Web news, sample cluster with high volumes on policy with predominantly positive sentiment

4. Visual Representation
   Example – Country Web reputation: positive and negative sentiment on Web news
7. CONCLUSIONS

Conclusions and overall outcomes

The combined OSINT and EO-based techniques, also within artificial intelligence models revealed to be a high valuable approach to raise awareness, evaluate impacts and assessing countries performance in fragile and insecure contexts, at country level. Both OSINT and EO results have been delivered to the IFIs end-users of ESA-GDA-Fragility project (i.e. WB, ADB) in comprehensive reporting, dashboard for data analytics and visualization, other formats according to their request.

Feedback from World Back end-user

Cycle 1: highly satisfied, expectations fully met, ESA-GDA-Fragility, Conflict and Security proposed approach recommended by some users to be adopted in case further opportunities many come. Approaches developed are in most of the cases scalable and applicable to other contexts, with similar requirements available.

Cycle 2: highly satisfied, expectations fully met, results were useful.

Next steps: addressing Cycle 3

ESA-GDA team is presently interacting with WB and ADB end-users to gather further drivers and better address cycle 3. Results dissemination by the end-users to other WB and ADB teams may be interested are ongoing for UC7 and UC8.

Communication material

Overview video (under publication), brochure and introductory e-flyer have been realized and available on gda.esa.int.