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1 Abstract

A large portion of the rare-earth metals mined right originates from artisanal and small scale mining sources. Artisanal and small scale mining pose a multitude of challenges for supply chain, the government of the mining and land rights, compliance of worker rights and much more. This short *paper* motivates the use of a cloud based satellite imagery detection of artisanal and small scale mining pits. The main goal of *this tool* is to support human rights for miners. **ATTENTION: This paper is currently a perspective of machine learning engineers for a technical feasibility study. The motivation reeks of unthinking global north builds and global south adopts scheme!** Three factors encourage the project to be worked on right now, adherent to all is the timing. The first two factors describe the value opportunities generated by the use of the tool(s). The last factor acts as an adaption catalyst.

1. The National Action Plans on Business and Human Rights (NAPs) are policies created to prevent human rights abuses linked to business activity. These policies are adopted by governments around the world. The results are laws which enforce manufacturer and vender to comply for human rights along the supply chain. The laws enable us to express a monetary value for previously unaccounted risk of human rights violations. Which itself drives new business opportunities in the countries with strong NAP laws. However tools on a global scale are unavailable and new investments have to be made to measure the risk of human rights violation along the supply chain.
2. Satellite imagery is available on a global scale. Specifically the ESA Copernicus project is three years old and provide enough data to measure artisanal and small scale mining. (The Landsat data also provides valuable data.) In the past years new easy to use tools were placed on the market. The user base which utilises satellite imagery grows. These factors lower the threshold for value creation. The availability of data is accompanied by accessible computation infrastructure. Machine learning tools to build detection methods matured. The access threshold to build end-to-end user-friendly tools is much lower than three years ago. The investment to build artisanal and small scale mining detection on a global scale has decreased dramatically in the past three years.
3. **More research needed on this section** Geo-information cloud tools become more popular (?). This means that the usage of the tools around the globe increase and become way more viable to use. Internet access to every inch of the globe is about to drop to 70 dollar a month (e.g. starlink). No upfront investment in this new cloud based tooling is needed. Governmental agencies previously challenged by costs of new systems can embrace the tooling more easily.

2 Resources and links

1. "local" ML-community: <https://deeplearningindaba.com/2021/>
2. data community data4sdgs: <https://www.data4sdgs.org/index.php/initiatives/africa-regional-data-cube>
3. digital earth africa has pre-set jupyter notebooks: <https://www.digitalearthafrika.org/platform-resources/platform/#geo-portal>
4. open data on mining: https://ipisresearch-dashboard.shinyapps.io/open_data_app/

3 Geo-information

The compendium gives additional paper information comments of the raw latex version.

Paper : Deep learning in remote sensing applications: A meta-analysis and review [4]

The paper presents: status of remote sensing deep learning (DL) studies. Neural network methods such as deep learning are the state of the art. Prior to deep learning support vector machines (SVM) and random forests (RF) were used. Classification is a popular problem for remote sensing, 3D imagery is rarely used. Conv-nets and auto-encoders are often used. The paper mentions GANs and notes that ca. five papers use this method, but do not refer to any remote sensing application of GANs explicitly. The authors consider twelve attributes for DL and remote sensing. Most interesting is the study *target type*: Image fusion, scene classification or object detection, Land-use and land-cover (LULC) classification, seg., other. This attribute most likely also determines other attributes considered by the authors such as: data type, DL model, accuracy, training samples etc. Used taxonomy: **Image fusion** superimposes layers of different frequencies of resolution to one image. The resolution mapping is also known as *super sampling* in the context of video games.

Image registration is a method of aligning two or more images captured by different sensors, at different times or from different viewpoint (Ye et al., 2017, Zitova and Flusser, 2003). [...] The process is (1) feature extraction, (2) feature matching, (3) transformation model estimation and, (4) image re sampling.

GANs are applied in image matching.

Scene classification determines the image categories from numerous pictures. **Object detection** detects different objects in one image.

LULC classification use lesser resolution than object detection. The model requirements change with the resolution and different CNNs are needed (Sharma et al., 2017), namely patch-based CNNs. Three dimensional convolution along the spectral layers enable joint spectral spatial information processing (Zhu et al., 2018-Ben Hamida et al., 2018). **Semantic segmentation** assigns labels to each pixel. State of the art methods use encoder and decoder sub-networks. The following methods help to overcome challenges from low-resolutions:

- 1 A no-downsampling encoder network by atrous convolution (Sherrah, 2016) or combining features from multiple resolutions (Zhang et al., 2017)
- 2 Symmetric unconvoluted layers and skip connections improve the decoder network (Kemker et al., 2018).
- 3 *Using an ensemble of networks.*
- 4 Different post process methods enrich the results of semantic segmentation: Probabilistic graph models (Sherrah, 2016), fusing segments produced by unsupervised segmentation (Zhao et al., 2017a), by use of an overlay strategy (Chen et al., 2018c) or using filtering methods (Xu et al., 2018b)

Object based image analysis (OBIA) is not properly differentiated from semantic segmentation and LULC classification. Benchmark data sets used:

1. RSSCN7
2. UC-Merced
3. WHU-RS
4. PatternNet, UCMD, aerial image dataset (Zhou et al., 2018)

Paper : Mapping Mining Areas in the Brazilian Amazon Using MSI/Sentinel-2 Imagery (2017)

[3] Motivation: find out about "attributes such as area, type, scale, and current status as well as socio/environmental impacts". The lack of information about the mining areas are "explained by the nature of the mining activity characterized by a diversity of techniques and scale of exploitation." Modernization of mining pit tagging. Pushing GIS-tags/boundaries directly into National Department for Mineral Production—DNPM System. Uses **Sentinel-2 images** and validates the result with high-resolution **RapidEye images** [Rapid Eye is provided by ESA, and available upon request. The constellation was deactivated on March 31st, 2020. The data is still provided and has a 5m-pixel resolution]. Methods used: SVM, RF Sentinel-2 insights: "Bands 1 (443 nm), 2 (490 nm) and 10-Cirrus (1375 nm) were omitted due to high atmospheric effect" GIS system uses Tiff files.

4 National act plan

In October 2018, 21 states have adopted National Action Plans on Business and Human Rights (NAPs). The policies created by the National Act Plans aim to prevent human rights abuses linked to business activity. The adaption process and progresses can be seen on the website: <https://globalnaps.org>. This foundation for the national act plans is the UN Guiding Principles on Business and Human Rights (UNGPs) from 2011. The topics of the national act plans include: human rights, development, corporate social responsibility, women's rights, peace and security, children's rights, climate change, renewable energy, cyber-security, and open government. The goals are linked to the 2030 Agenda for Sustainable Development (2030 Agenda). The Danish Institute for Human Rights (DIHR) is the main information root link for this paper right now.

The European Commission plans to introduce a tighter supply chain draft than Germany, Great Britain, the Netherlands or France. It is suspected that the draft is released before summer 2021.

Paper : Website: globalnaps

83 to 87 percent of the German companies do not comply with the NAP requirements (German companies with 500 and more employees). This will have direct impact to the degree of which companies are enforced to comply for human rights.

Paper : Die Durchsetzung menschenrechtlicher Sorgfaltspflichten von Unternehmen

German book for *Enforcement of human rights due diligence obligations of companies*. Focuses on CSR-Guide lines.

Paper : National Human Rights Institutions: The Missing Link in Business and Human Rights Governance? [2]

Links National Human Rights Institutions (NHRIs) to NAPs.

Several NHRIs have taken up a role in monitoring the State obligation to protect against corporate human rights abuse. NHRIs have been involved, to different degrees, in the creation of National Action Plans on Business and Human Rights (NAPs) [...] The development of NAPs on Business and Human Rights has been pushed by civil society organizations

There is no discussion on future compliance implications from the NAPs or other sources of human rights laws.

Paper : National Action Plans on Business and Human Rights: Progress or Mirage? [1]

tags: intragovernmental policy coherence

Human rights law is essentially composed of obligations of means, which contemplate the importance that the state takes all necessary measures to ensure compliance with and protection of human rights standards, and where this is not possible, to ensure adequate investigation, sanction and redress for wrongdoing. [...] even if they are not necessarily of a legal nature. Undoubtedly, that is one of the aims of the UNGPs: the combination of instruments of a different nature that allow achievement of the ultimate objective, that is, an economic regulation and management that respects the conventional principles and commitments in the field of human rights. It is a novel focus that could offer results depending of the degree of commitment of each state.

NAPs are permanent complements to laws?

Paper : Lieferkettengesetz

The **German supply chain law** was agreed upon on the 3rd of March 2021. The law is applicable to companies with more than 3000 employees and valid from the 01.01.2023. Lieferkettengesetz: <https://dip21.bundestag.de/dip21/btd/19/286/1928649.pdf> The text accompanied by the law mentions costs for the companies by the law. These costs can be seen as basis for an insurance business case. The German law anticipates a European regulation. This Regulation is discussed right. The regulation, I think, will become national law

4.6 Business along the German Supply chain law

White paper (German language) from a company which sells risk management. <https://www.riskmethods.net/media/Content/Whitepapers/de/whitepaper-lieferkettengesetz.pdf>.

5 Data

This section describes data sources. The github repository <https://github.com/chrieke/awesome-satellite-imagery-dataset> has a list of data sets and can be used as an entry for search for curated data sets. How to curate data: <https://www.dataiversity.net/data-curation-101/>. The goal for our data set should be to appear on <http://registry.mihub.earth/>.

Paper : SEN12MS [5]

The SEN12MS dataset contains 180,662 patch triplets of corresponding Sentinel-1 dual-pol SAR data, Sentinel-2 multi-spectral images, and MODIS-derived land cover maps. The patches are distributed across the land masses of the Earth and spread over all four meteorological seasons. This is reflected by the dataset structure. All patches are provided in the form of 16-bit GeoTiffs containing the following specific information:

1. Sentinel-1 SAR: 2 channels corresponding to sigma nought backscatter values in dB scale for VV and VH polarization.
2. Sentinel-2 Multi-Spectral: 13 channels corresponding to the 13 spectral bands (B1, B2, B3, B4, B5, B6, B7, B8, B8a, B9, B10, B11, B12).
3. MODIS Land Cover: 4 channels corresponding to IGBP, LCCS Land Cover, LCCS Land Use, and LCCS Surface Hydrology layers.

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