Samuel Appiah Kubi

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github · 0009-0002-1376-108X · Portfolio · English (C1)

PROFESSIONAL SUMMARY

Geospatial software engineer and Earth observation researcher, currently a student in the **Copernicus Master's in Digital Earth** (Erasmus Mundus, Paris Lodron University of Salzburg) with a **First Class Honours** BSc in Geomatic Engineering (KNUST). I build the software that sits between satellite archives and decisions: **pygeofetch**, an open-source Python platform (PyPI, Zenodo DOI, CI-tested) that unifies search, download and processing across **22 verified providers** and ships a full **Sentinel-1 InSAR chain** through to SBAS time series; **Django/PostGIS and FastAPI backends** for flood early warning and site screening; and GeoAI models for crop mapping, mining detection and deformation monitoring, validated with spatial cross-validation and field ground truth. I work daily in Python with GDAL, Rasterio, PyTorch, Docker and PostgreSQL/PostGIS, and I document limitations as carefully as results.

Languages: English (fluent).

OPEN-SOURCE GEOSPATIAL SOFTWARE

pygeofetch – Unified Satellite Data and Processing Platform *(author and maintainer)* 2025 – Present
GitHub · PyPI: pygeofetch · Docs · DOI: 10.5281/zenodo.22087230 · MIT

- **Federated search and resilient download** across 22 verified providers (Copernicus Data Space, USGS, NASA Earthdata, ASF, Planetary Computer, Element 84, OpenTopography, Planet, Maxar and others), including a generic OGC WMS/WFS/WCS connector. Results export as **STAC 1.0** GeoJSON, GeoParquet or CSV with real footprint geometry; downloads are parallel, resumable, band-selective and checksum-verified, with Fernet-encrypted or system-keyring credential storage.
- **Processing engine**: atmospheric correction (DOS, Sen2Cor, 6S), cloud masking and filling, reprojection, pan-sharpening, mosaicking, 17 spectral indices, SAR calibration and despeckling, vectorisation and **Cloud Optimized GeoTIFF** export, chainable from Python, a CLI, or scheduled **YAML pipelines** with run history.
- **InSAR chain**: orbit-based coregistration with per-burst Enhanced Spectral Diversity, flat-earth and topographic phase removal, ERA5 tropospheric and IONEX ionospheric correction, SNAPHU unwrapping and SBAS inversion, guarded by a preflight check on AOI coverage, network connectivity and baselines.
- **Engineering practice**: typed Python API, pytest suite on GitHub Actions with Codecov coverage, optional-dependency extras (`[geo]`, `[insar]`), a `doctor` command for install and connectivity diagnostics, and Read the Docs documentation.

Case studies built end-to-end with pygeofetch (real data, reproducible notebooks):

- **Mexico City land subsidence (Sentinel-1 InSAR)** – EOCoreINT/mexico-subsidence-project. Searched and downloaded 67 SLC scenes, reduced 2,211 candidate pairs to 78 valid interferograms, and recovered vertical velocities of -35.5 to -2.9 cm/yr (2nd–98th percentile), directionally consistent with the peer-reviewed -39.1 cm/yr peak (Cigna & Tapete, 2021). Documented openly that the stack fragments into 17 disconnected SBAS networks, so the result is not presented as a validated replication. The same chain is applied to the 2021 Piton de la Fournaise eruption and the 2016 Amatrice earthquake.
- **Obuasi Municipal District, Ghana (Landsat NDVI trend, 2018–2024)**. Boundary-clipped USGS Landsat time series showing 32.0% of the district in measurable vegetation decline (9.2% strong, 22.8% moderate), spatially concentrated around mining activity.

pygeovision – End-to-End Geospatial AI Platform *(author and maintainer; pre-alpha)* 2025 – Present
GitHub · PyPI: pygeovision · Docs · DOI: 10.5281/zenodo.22258220 · MIT

One package that goes from a bounding box and a date to a finished map, mask or dataset, owning both data acquisition (through pygeofetch) and model inference, a gap left open by modelling libraries such as TorchGeo and TerraTorch.

- **Native AI inference** with no external platform: building and water segmentation, SAM auto-segmentation, YOLO ship and vehicle detection, CLIP zero-shot scene classification, ESA WorldCover land cover, and ChangeFormer bi-temporal change detection with a dependency-free spectral fallback.
- **EO foundation models**: NASA Prithvi-EO-2.0, DINOv3, SAM, TESSERA embeddings and AlphaEarth Foundations, plus **SAR-to-foundation-model adapters** that map Sentinel-1 VV/VH into the band formats Prithvi and DINOv3 expect.
- **51 end-to-end pipelines**, including crop monitoring, land cover, deforestation, flood and water mapping, urban growth, building footprints and disaster assessment, each running from search to finished output without manual

wiring.

- **Training stack**: 119+ registered architectures (U-Net, SegFormer, DeepLabV3+, ViT, ChangeFormer, YOLOv8/v9), imbalance-aware losses (Focal, Tversky, Lovász, OHEM, class-balanced), distributed mixed-precision training, and Gaussian-blended tiled inference for full-scene prediction.
- **Automated labelling** from seven sources (OpenStreetMap, Microsoft and Google building footprints, ESA WorldCover, Dynamic World, SAM) to remove the annotation bottleneck.
- **Production layer**: FastAPI REST and WebSocket inference server with a model registry and batch inference, drift detection and performance monitoring, explainability (Grad-CAM, SHAP, uncertainty), and deployment to ONNX Runtime, NVIDIA Jetson, AWS SageMaker, Azure ML and GCP Vertex AI, packaged as modular install extras.

pyunwrap – Hybrid, Regime-Aware InSAR Phase Unwrapper *(author; pre-alpha)* 2025 – Present
GitHub · PyPI: pyunwrap-insar · Docs · DOI: 10.5281/zenodo.22209219 · MIT

- Network (`AmbiguityNet`) predicts the integer phase ambiguity rather than the phase itself, so re-wrapping the output reproduces the observed interferogram by construction; trained with a physics-informed loss.
- The project's own benchmarks show SNAPHU winning on most scenes and the learned model winning under low-coherence decorrelation, so pyunwrap routes each region of a scene to the stronger method instead of claiming one method is universally best.

ps-gnn – Graph Neural Networks for Persistent Scatterer Selection *(author; pre-alpha)* 2025 – Present
GitHub · PyPI: ps-gnn · DOI: 10.5281/zenodo.22706887 · MIT

- Reframes classical amplitude-dispersion PS selection as node classification on a spatial graph, so each candidate pixel is judged with its neighbours: GCN, 8-head GAT and GraphSAGE layers in PyTorch Geometric over a 19-feature node vector.
- Physics-informed loss with a circular phase-stability term, a spatio-temporal ViT baseline for ablation, and 5-fold **spatial-block cross-validation**; benchmarked on synthetic stacks, with real-data validation in progress.

Geospatial Data-Engineering Toolkit – EOCoreINT 2025 – Present
github.com/EOCoreINT

- **raster2pm** (GeoTIFF to **PMTiles** with NDVI/NDRE colour ramps, block-wise for large rasters), **geoviz** (one-command interactive maps for 20+ formats including STAC and GeoParquet; 200+ tests), **geo-repair** (automatic fixing of 20+ vector and raster defects such as invalid geometries, missing CRS and NoData mismatches), **pygeoproof** (data-quality profiling, topology validation and spatial-drift detection for vector datasets), **geoshift** (9×9 vector format conversion including FlatGeobuf and PMTiles) and **geo-auto-train** (Optuna HPO and ONNX/TorchScript export for geospatial deep learning).

PROFESSIONAL EXPERIENCE

AI Research Engineer – Agricultural Remote Sensing Sep 2024 – Present
Afarinick Company Limited – Accra, Ghana

- Integrated high-resolution mobile imagery, satellite NDVI/EVI time series and IoT ground-sensor readings into a production agricultural monitoring system, containerised with Docker and deployed on AWS (EC2, S3).
- Diagnosed a domain-generalisation failure in a CNN crop-disease detector (95.8% training-domain accuracy, near-zero on smallholder farms) and resolved it through geographically stratified data diversification and field re-validation.

Geospatial Researcher – Satellite and Ground-Data Fusion 2024
Rainforest Alliance – Accra, Ghana · Remote

- Built a hybrid monitoring system fusing Sentinel-2 (10 m) with participatory plot-level ground truth, running automated change detection over 333.9 km^2 for land and forest monitoring.

Geospatial Data Engineer 2024
Ghana Export-Import Bank / SKTLive Ltd – Accra, Ghana

- Engineered PostgreSQL/PostGIS spatial databases and Python/GDAL pipelines converting GeoTIFF aerial imagery into multi-scale tile pyramids for web map delivery.

Assistant Mine Surveyor (Intern) Oct – Nov 2023
Asanko Gold Ghana Ltd – Manso-Nkwanta, Ghana

- Operated Total Stations, GNSS receivers and UAVs to establish ground-control points used to validate satellite- and drone-derived models.

GEOSPATIAL SYSTEMS AND BACKEND PROJECTS

Flood Watch Ghana · *IoT + Satellite Flood Early Warning, Accra* 2025 – 2026

- Django + PostGIS backend with 10 spatial data models, MQTT ingestion from ESP32 water-level and rain gauges, WebSocket live updates, Celery-scheduled Sentinel-1/2 flood detection, and a rules engine sending Twilio WhatsApp/SMS community alerts; five delivery phases complete, Dockerised, with automated tests per phase.

Fatal Flaw Geospatial Risk Platform · *Renewable-Energy Site Screening* 2025 – 2026

- FastAPI + PostGIS + Redis service screening Solar, Wind, BESS and data-centre sites against 15 authoritative constraint layers (e.g. wetlands, protected areas) with fatal-flag detection, weighted risk scoring, PDF reporting and a QGIS plugin client; designed for sub-500 ms assessments and deployed with Docker.

Urban Subsidence Watcher · *InSAR Digital Twin, Accra* 2026 – Present

- Sentinel-1 acquisitions (2020–present) retrieved from the ASF Vertex API and processed through an SBAS InSAR chain, with a lightweight Tiny U-Net trained on an 8-channel stack (coherence, amplitude, DEM, slope, temporal baseline, proximity to water) and exported to ONNX for edge deployment.

APPLIED EO RESEARCH – AGRICULTURE, LAND AND ENVIRONMENT

Crop-Type Mapping with EO Foundation Models · *Ejura, Ghana* 2026

- Fine-tuned the Clay foundation model on multi-temporal Sentinel-2 stacks for 10 m crop-type classification, benchmarked against a ResNet-50 baseline; spatial cross-validation across agro-ecological zones yields F1 above 0.70.

Agricultural Digital Twin · *NDVI Forecasting* 2024 – Present

- LSTM forecasting of 10 m Sentinel-2 NDVI from CHIRPS precipitation and ESA CCI soil moisture, with cloud gap-filling; R^2 above 0.50 and MAE below 0.07 at field-parcel level under spatial cross-validation.

Atewa Illegal Mining Detector · *SAR–Optical Fusion* 2026

- U-Net and YOLOv8 dual-stream model fusing Sentinel-1 and Sentinel-2 to detect artisanal mining in the Atewa Forest Reserve, trained on UAV-derived labels; hard negative mining and focal loss handle a class occupying under 4% of the landscape. Recall 82%, F1 0.79 on held-out tiles.

SMART-FOREST · *Forest Carbon Digital Twin (REDD+)* 2026 – Present

- Fuses Sentinel-1/2, GEDI LiDAR, SMAP soil moisture and ERA5 in an object-based and temporal graph neural network framework to forecast above-ground biomass over 10-year horizons under RCP scenarios, with spatial-block cross-validation.

Coastal Erosion Digital Twin · *Shoreline Change* 2025 – Present

- 3-month shoreline forecasts (MAE below 8 m) from Sentinel-1/2, Landsat, UAV orthomosaics and wave climatology using a Swin-UNETR backbone and Bayesian LSTM, validated against DSAS transects.

Crop Detection and Counting from UAV Imagery · *Afarinsene* 2026

- YOLOv8 with multi-temporal analysis and ensemble uncertainty scoring to detect and count cocoa plants across smallholder and commercial layouts, evaluated on a held-out test set.

RESEARCH AND PUBLICATIONS

Principal Researcher – Multi-Modal Sensor Fusion for Road Assessment Aug 2025 – Present
TRECK / Roadessy Lab, KNUST

- Led a five-component camera/IMU/GPS fusion architecture for metric-accurate road assessment, validated against 50 manually surveyed ground-truth measurements along 50 km of road. *Manuscript submitted to IEEE Transactions on Intelligent Transportation Systems.*

Software citation: Appiah Kubi, S. *pygeofetch: a unified satellite data and geospatial processing platform.* Zenodo. doi:10.5281/zenodo.2

Research interests: InSAR deformation monitoring and learned phase unwrapping; graph neural networks for irregular spatial data; EO foundation models for agriculture and land monitoring; validation and uncertainty quantification for AI-derived environmental indicators; cloud-native, STAC-based EO data infrastructure.

TECHNICAL SKILLS

- **Languages:** Python (primary), SQL, JavaScript (Earth Engine), R, Bash
- **Backend and Data Engineering:** Django, FastAPI, PostgreSQL/PostGIS, Redis, Celery, MQTT, WebSockets, REST API design, Docker, Linux, AWS (EC2, S3), GitHub Actions CI, pytest, Codecov, PyPI packaging
- **EO Data Standards and Formats:** STAC 1.0, OGC WMS/WFS/WCS, Cloud Optimized GeoTIFF, GeoParquet, FlatGeobuf, PMTiles, NetCDF, GeoJSON; Copernicus Data Space, Planetary Computer, NASA Earthdata, ASF
- **Geospatial Processing:** GDAL/OGR, Rasterio, GeoPandas, Shapely, Xarray, Google Earth Engine, QGIS (incl. plugin development), ArcGIS Pro, MapLibre, Leaflet

- **SAR and InSAR:** Sentinel-1 SLC processing, burst coregistration and ESD, interferogram formation, coherence estimation, SNAPHU unwrapping, SBAS time series, ERA5 tropospheric and IONEX ionospheric correction, despeckling
- **Machine Learning for EO:** PyTorch, PyTorch Geometric, TensorFlow, scikit-learn; U-Net, Swin-UNETR, SegFormer, YOLOv8, LSTM, GNNs, foundation-model fine-tuning (Clay); Optuna, ONNX export; spatial-block cross-validation and domain adaptation
- **Field and Validation:** Total Station, GNSS, UAV photogrammetry, ground-control networks, participatory plot-level ground truth

EDUCATION

Paris Lodron University of Salzburg – Salzburg, Austria — Sep 2026 – Present
MSc Copernicus Master's in Digital Earth (Erasmus Mundus Joint Master Degree)

- Earth observation, geospatial data science, machine learning for satellite data and multi-scale spatial analysis, delivered in cooperation with the Copernicus programme.

Kwame Nkrumah University of Science and Technology (KNUST) – Kumasi, Ghana — Jan 2020 – Aug 2024
BSc Geomatic Engineering – First Class Honours (CWA 71.74%)

- Best Final Year Project Award (88%) for sensor-fusion and computer-vision research.
- Coursework: Remote Sensing, GIS and Spatial Analysis, Satellite Image Processing, Photogrammetry, Geodesy, Engineering Survey, Cartography.

HONOURS AND AWARDS

- **Admitted – Copernicus Master's in Digital Earth** (Erasmus Mundus Joint Master Degree) · Paris Lodron University of Salzburg, 2026
- **Best Final Year Project – Highest Departmental Score (88%)** · Dept. of Geomatic Engineering, KNUST, 2024
- **First Class Honours in Geomatic Engineering** · KNUST, 2024
- **2nd Place – TRECK Annual Research Conference** · KNUST, 2024
- **Ghana Institution of Surveyors Students Society (GhIS-SS) Award** – academic excellence and professional service

CERTIFICATIONS

- **AWS Certified Solutions Architect – Professional** · Amazon Web Services
- **Machine Learning and Advanced AI Techniques** · TensorFlow, PyTorch, scikit-learn
- **Geospatial Analytics Essentials** · Remote Sensing and Spatial Analysis
- **Remote Sensing Basics** · Satellite Image Processing and Interpretation

LEADERSHIP AND AFFILIATIONS

University of Salzburg – Student Assistant, Geospatial Sustainability Compliance — 2026 – Present
samuel.appiah-kubi@stud.plus.ac.at
Department of Geoinformatics (Z_GIS), Salzburg, Austria. Supporting research on sustainable change through geospatial innovation. My research focuses on advancing geospatial intelligence by integrating physics-informed and geometric deep learning, cloud-native computational radar interferometry, and agentic AI for multi-sensor Earth observation and autonomous workflows.

EOCoreINT – Founder and Lead Engineer — 2025 – Present
eocoreint.com · EOCoreINT
Open-source EO software organisation and learning academy teaching applied remote sensing and GeoAI to African students and professionals with open tools; home of pygeofetch, ps-gnn, pyunwrap and the data-engineering toolkit above.

Roadessy Lab – Member, Multi-Modal Sensor Fusion Research — 2024 – Present
roadessy · Roadessy
Road monitoring, road asset management and road asset inventory lab in the Department of Geomatic Engineering, Faculty of Civil and Geo-Engineering, KNUST, Kumasi. I contribute camera/IMU/GPS fusion research for road infrastructure assessment, including the TRECK project listed under Research.

Deep Metrics Research – Member, Computer Vision for Intelligent Transportation — 2025 – 2026
deepmetrics · dpm-research

AI research group based in Columbia, Missouri, USA, developing computer vision and sensor-fusion methods for real-time traffic analytics and infrastructure assessment.