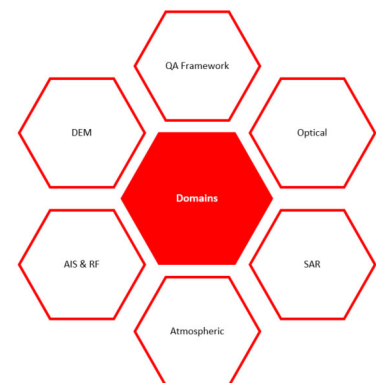# DATA QUALITY
ASSURANCE SERVICES

INTRODUCTION

Telespazio UK (TPZ UK) is a leader in Earth Observation (EO) data quality assessment and assurance, delivering quality assurance & quality control (QA/QC) services to institutional and commercial customers. EO data is vital to address critical societal challenges, whilst also presenting numerous economic opportunities. We see data quality as a key priority to ensure the trustworthiness of EO data, to ensure its increased uptake within all sectors and to enable it to provide decision-critical information.

EARTHNET DATA ASSESSMENT PROJECT (EDAP)

The ESA Earthnet Programme provides the framework for integrating non-ESA missions, i.e. TPMs into the overall ESA Earth Observation strategy. Complementary to ESA-owned EO missions, the programme allows European and international users access to a large portfolio of TPMs and is particularly important for promoting the use of EO data internationally.

TPZ UK leads a team of domain-specific scientific and technical experts to perform independent preliminary quality assessments of the data and documentation procured for the identified missions (i.e. potential / candidate TPM), in a fair and consistent way following the QA framework and best practice guidelines, and establish fitness for purpose.

The generated technical notes provide important quality information that can be used to support decisions on whether assessed missions are suitable for integration into the programme as ESA Third Party Missions (TPMs).

QUALITY ASSURANCE FOR EARTH OBSERVATION 2 (QA4EO-2)

QA4EO-2 provides operational EO data quality monitoring for the European Space Agency (ESA) that covers ESA and selected Third Party Missions (TPMs). The project is a continuation of previous collaborations, which covers expert scientific and reprocessing support, software, Instrument Processing Facilities (IPF), and tool maintenance and evolution. TPZ UK is the prime contractor with responsibility for the overall service management, operations, reporting and evolution. We provide specialist support for data quality assurance relating to specific missions (and instruments) including Landsat, SMOS, CryoSat, ERS (ATSR, SAR), Envisat (AATSR, MERIS, ASAR), JAXA's ALOS mission and others.

The project includes four main tasks:

Quality Control Operations & Tools Maintenance & Evolution

Mission-focused operational task for:
- monitoring mission & instrument performance
- checking data production & quality
- assisting reprocessing campaigns
- providing information & support to users

Contributes to the algorithms, processors & QC tools activities, supporting the production of required documentation (e.g. Product Specification Documents and Product Handbooks).

Task 1

R&D Cal/Val and Metrology

- Supporting R&D (in Algorithms & Product evolution, and Cal/Val) and Metrology
- Works in close collaboration with SPPA for promoting & supporting R&D and Metrology activities in EO domains (Land, Water, Cryosphere & Atmosphere) Cal/Val and algorithm evolution
- Supports the longer-term strategic aims of SPPA – international collaboration in Cal/Val measurements, campaigns & working groups, and organisation of workshops.

Task 2

Web Service & Communication

- Support for ESA SPPA web pages as part of the ESA Online web portal.
- Makes information available to EO users via a consistent and harmonised structure on the SPPA web portal and via social media..

Task 3

Expert Support for Mission Management and Cal/Val

Expert support of on-site personnel for different mission managements – missions & activities included are:
- SMOS
- SWARM
- Proba-V & Optical Sensors
- Atmospheric Missions & Cal/Val Systems
- Heritage Missions Activities.

Task 4

EO SUPPLY CHAIN QUALITY ASSURANCE

Building on the importance of high-quality satellite data, TPZ UK as prime contractor along with the National Physical Laboratory (NPL) and Lloyd's Register's Business Assurance and Inspection Services (LRQA), is working closely with ESA and EARSC to explore how to better understand and improve the quality assurance of the whole end-to-end EO supply chain.

This project will:

- **_Recommend_** improvements to metadata across the different product levels
- **_Rollout_** the EARSC Quality Management System (QMS) certification to EO companies
- **_Identify_** an approach for EO Product Certification and pilot the process with EO companies
- **_Define_** a Quality Assurance Facility (QAF) of EO products and services.

EOSure activities are split into three main areas:

EO Product Metadata: Ensuring quality outputs from satellite data providers

To make recommendations for metadata improvements throughout the EO supply chain & define a Quality Assurance Facility (QAF) through:

- An industry survey & requirements analysis
- Reviewing state-of-the-art EO product traceability techniques
- Proposing recommendations for metadata specifications
- Identifying & cataloguing validation sites and measurements
- Defining a library of validation site information
- Reviewing innovations in checking EO data quality
- Defining a QAF for EO products.

1

Quality Management Systems: Review the Quality management processes of an EO information service / product provider

To run a pilot that will certify EO companies to the EARSC QMS certification scheme, by:

- Producing a business case analysis for the QMS certification scheme
- Rolling out a certification scheme to EO value adding companies, supporting Lloyd's Register.

2

Product Certification: Investigating a product certification scheme for EO information products

To develop an EO Product Certification scheme in line with end-user requirements and run a pilot activity rolling out the scheme, by:

- Producing a business case analysis for EO Product Certification
- Defining an EO Product Certification scheme
- Piloting the scheme to certify candidate products.

3

EASE QC

Ease QC is a TPZ UK toolset that uses AI to support quality control of EO data. It employs advanced models to detect anomalies in large data volumes, which were previously identified only by human QC operators.

AI developments have focused on:

- Deep learning models for detecting visual anomalies
- Infrastructure and tools for model development and deployment

AI MODELS

- Detect visual anomalies in 600,000+ Landsat data products
- Developed and assessed models for specific and multi-anomaly detection.
  - Supervised Supervised models successfully detect specific anomalies ("Scan Start") in Landsat 1-5 data.
  - Experimental multi-anomaly detection models are in development, using chained ML models.
- These models have been further developed and extended to Sentinel-1 and Sentinel-2 sensors through the AI4QC project.

TOOLS

- Developed to support the QC assessment process and data preparation for AI model development:
  - Assembling labeled training and validation datasets is often the most time-consuming part of AI development.
- QCOLT software by TPZ UK offers:
  - Tools for QC engineers to assess, label, and interrogate data.
  - Tools for AI developers to filter data by anomaly and create training datasets.
- QCOLT features include:
  - Backend database for metadata and results.
  - Customized GUI for visual data inspection, metadata review, and anomaly assignment.

AI4QC

The Artificial Intelligence for Quality Control (AI4QC) project, funded by the European Space Agency (ESA), aims to develop validated AI models for automated detection of clouds and anomalies in data from the Copernicus Sentinel-1 and Sentinel-2 missions.

The project focuses on specific anomalies identified by our data scientists and sensor experts, including Clouds, Radiation Frequency Interference (RFI), Image Artifacts, and newly detected issues.

All relevant data has been meticulously curated and formatted into AI-ready datasets for effective model training, validation, and testing. These datasets are available on a dedicated platform.

The framework is expected to reach at least Technology Readiness Level (TRL) 5, indicating its potential for integration into ESA's operational data QC tools.