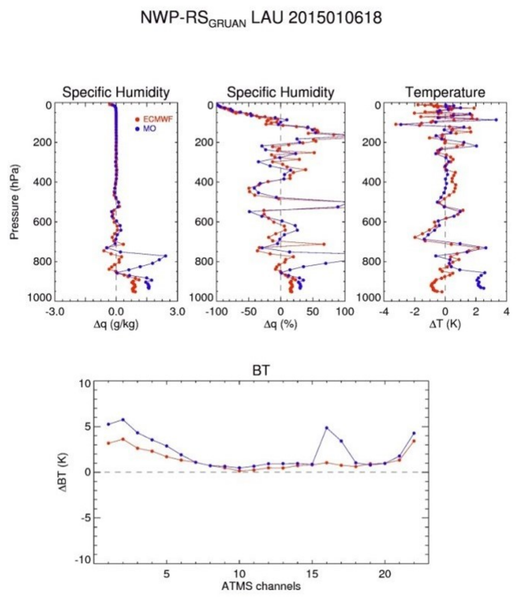
GAIA-CLIM: Gap Analysis for Integrated Atmospheric ECV CLImate Monitoring

www.gaia-clim.eu



IMPACT OBJECTIVES

- Define and map existing non-satellite measurement capabilities
- Improve metrological characterization of a subset of non-satellite observations
- Better account for co-location mismatches between satellite observations and non-satellite (reference) observations
- Provide usable and actionable information to end users
- Identifying and prioritizing gaps in knowledge and capabilities

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 640276

GAIA-CLIM is an H2020 project expected to lead to significant advances in greater consistency and cross calibration/validation of long term space based measurements with ground based historical references (balloon-borne and aircraft measurements), providing a better overview of uncertainty of available data to generate Climate Data Records, including impacts on gaps on information

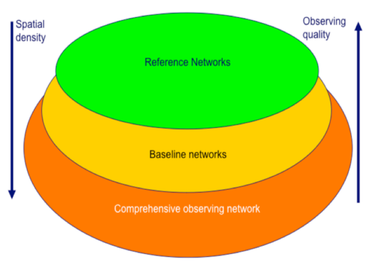
The tools developed within this project will increase the ability to accurately use a robust mapping framework that assures metrological traceability into future EO missions, and would maximize and open up new opportunities for their usage in long-term environmental monitoring of ECVs

Define and map observing capabilities

GAIA-CLIM has made significant advances in the comprehensive geographical review of capabilities and gaps in the existing surface-based and sub-orbital observing systems at both the European and the global scales for the characterization of EO measurement performance. This has included:

- Mapping and visualization of the existing capabilities based upon objective assessment criteria by ECV and by measurement fundamental characteristics.
- Considering the scientific understanding of the impacts of spatial capabilities gaps upon our ability to characterise EO sensor performance on a sustained basis.
- A report describing the approach followed in the collection of metadata along with a discussion and rationale for the adopted protocols for metadata collection.
- Technical solutions and protocols for a common metadata format for GAIA-CLIM

This geographical review will directly increase the ability to comprehensively characterise EO sensor performance and support the precision of remote sensing instrumentation by improving their uncertainty characterisation.



Metadata	Documentation	Uncertainty characterization	Public access, feedback and update	Usage	Sustainability	Software (optional)
Standards	Formal Description of Measurement Methodology	Traceability	Access	Research	Siting environment	Coding standards
Collection level	Formal Validation Report	Comparability	User feedback mechanism	Public and commercial exploitation	Scientific and expert support	Software documentation
File level	Formal Measurement Series User Guidance	Uncertainty Quantification	Updates to record		Programmatic support	Portability and numerical reproducability
		Routine Quality Management	Version control			Security
			Long term data preservation			
Legend						
1	2	3	4	5	6	Not applicable

Fig 1. Top figure, tiers of measurement capabilities adopted within GAIA-CLIM. Existing capabilities have been further assessed against seven quantifiable aspects in a maturity matrix as in the table above for NDACC (Network for the Detention of Atmospheric Composition Change)

Improve metrological characterisation of existing measurements

Work is ongoing to characterise six target measurement techniques (LIDAR, MWR, FTS, UV-vis, Max-DOAS and GNSS-PW) to enable metrologically traceable processing and uncertainty quantification. Traceability chains have been completed for the six target measurement techniques. These will benefit these measurement programs by providing increased understanding of the instruments, their characteristics and uncertainties.

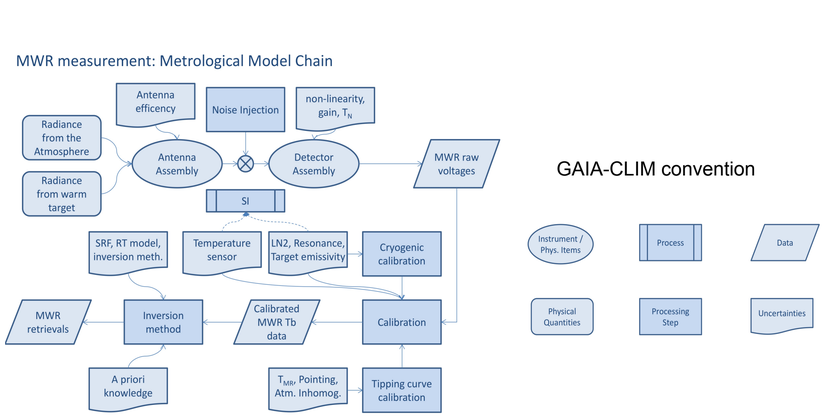


Fig 2: Uncertainty chain for Microwave Radiometer

Account for non-coincidence of space-based and sub-orbital measurements

GAIA-CLIM addresses the uncertainty budget of these crucial satellite-to-reference comparisons which requires careful consideration of the additional uncertainties that arise due to co-location mismatches. A paper describing the principles of the OSSE (Observing System Simulation Experiment) approach and application for the example of Ozone total columns has been published

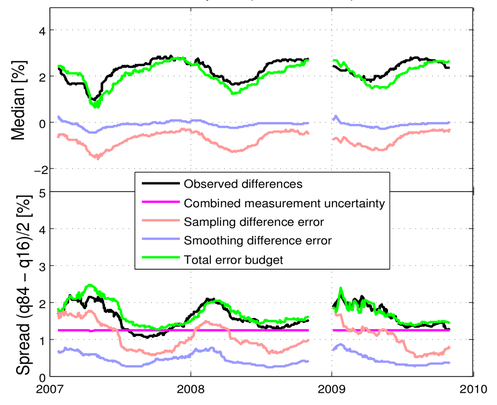


Fig 3: First results deal with a case study on total ozone column validation. The black solid lines represent the median and spread on the differences between co-located measurements. The combined measurement uncertainty (u_1 and u_2 shown in magenta) cannot explain the observed differences. When taking into account smoothing (blue) and sampling (red) differences , and the impact of local orography simulated differences (green) match very well those observed. From Verhoelst et al., 2015, AMT.

The use of data assimilation as integrators

Comprehensive calibration and validation of data from two satellite missions (GCOM-W AMSR-2 and FY-3C) has been undertaken, with respect to global NWP systems at both ECMWF and the Met Office. An initial prototype of the GRUAN processor has been developed and subsequently used to monitor GRUAN data relative to NWP models. This is a novel development enabling the transfer of the geophysical profile information to equivalent TOA radiances/brightness temperatures, including uncertainties.

This GAIA-CLIM development supports the validation of both level 1b and level 2 products, whereas previous validation by reference in-situ measurements was limited to level 2 comparisons

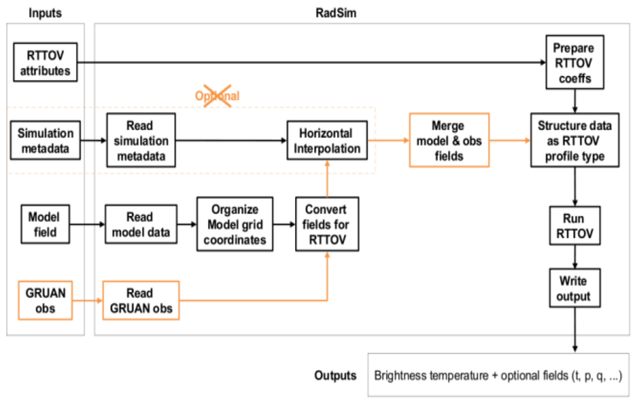


Fig.4 Schematic representation of the top-level design of the GRUAN processor. Orange lines show the changes from the NWP SAF RadSIM software

A "Virtual Observatory" to visualise, interrogate and download co-location data and corresponding uncertainties

An initial prototype of the Virtual Observatory (VO) software has been developed and will be tested with external users. The results of the exercise in mapping observing capabilities will be used to populate a tool under the virtual observatory which will provide a 3D description of all identified reference-quality stations. Users will be able to interrogate a colocation database and visualize/download match-ups between target satellites and reference quality non-satellite data for use in their applications

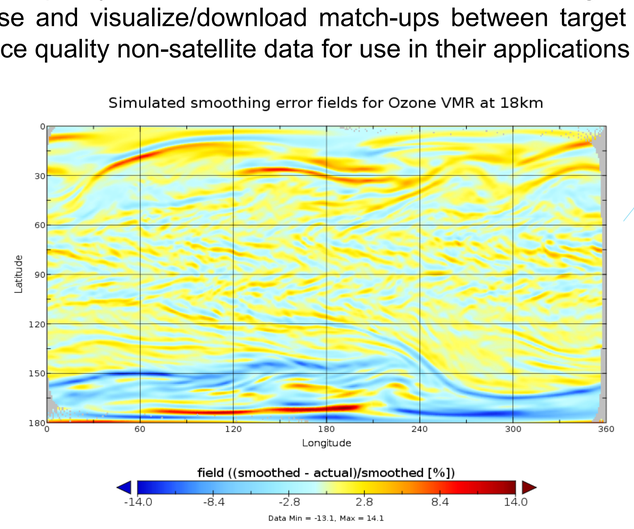


Fig.5. Simulated global smoothing error fields calculated with OSSSMOSE for Ozone VMR measured by MIPAS/ENVISAT

Partners

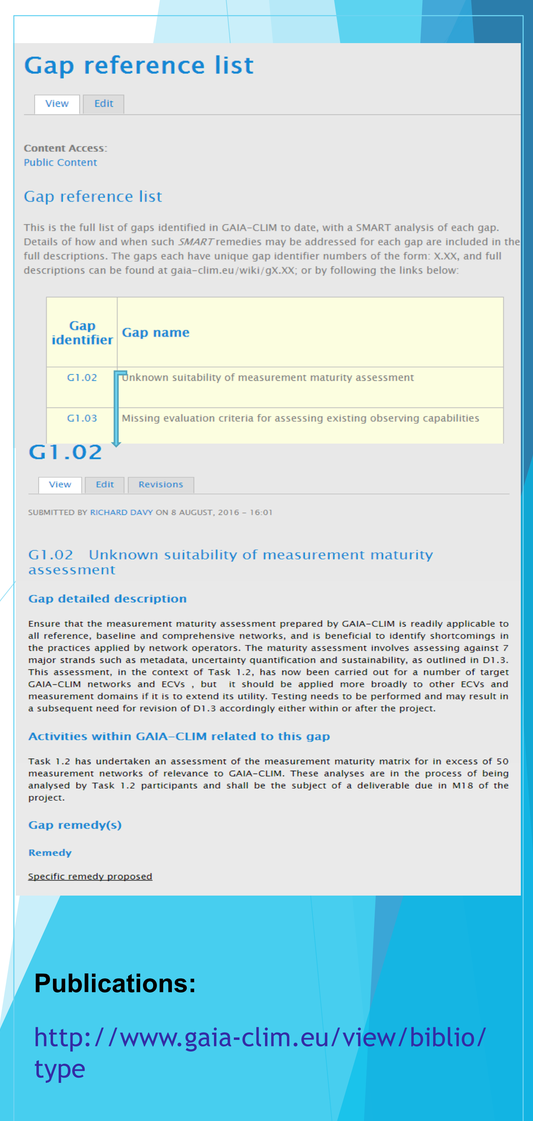
Gaps Assessment and Impact Document (GAID)

GAIA-CLIM activities include an iterative internally and externally informed assessment of gaps in knowledge, capabilities, governance etc. This is achieved through a Gaps Assessment and Impact Document (GAID), which is a living document. The overall aim is to undertake an assessment of the gaps diagnosed by all work packages and external users through careful analysis against both existing and envisaged user requirements within the sphere of the GAIA-CLIM project.

The project has a dedicated web page to GAID progress with regular updates, and the possibility for external users to have access and give feedback to a complete gap reference list, with a wiki link per gap that includes: a detailed description, possible remedies and gaps risk to non-resolution.

For the latest version of this gaps reference list please visit:

http://www.gaia-clim.eu/page/gap-reference-list



Publications:

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