

Project overview and progress to date, synergies  
with Q4ECV, C3S and international activities.  
Objectives of GA

Peter Thorne



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

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# GAIA-CLIM project overview

- Three year project (3/15-2/18) €6 million H2020 EO
- Aim is to improve use of non-satellite measurements to characterise, calibrate and validate satellite measurements
- 18 partners
- 7 Work packages (incl. management)
- Aims to ensure best metrological practices followed
- Makes use of Statistical, modelling and Data Assimilation tools



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# Metrological basis

- Determine uncertainties on two measurements (ideally fully traceable)
- Determine the variability ( $\sigma$ ) of a variable ( $m$ ) in time and space from measurements or models
- Two observations on different platforms are consistent if

$$|m_1 - m_2| < k\sqrt{\sigma^2 + u_1^2 + u_2^2}$$

- ✓ This test is only meaningful, i.e. observations are co-located or co-incident if:

$$\sigma < \sqrt{u_1^2 + u_2^2}$$



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# GAIA-CLIM scientific work packages

1. Mapping and assessing observational capabilities
2. Improving metrological characterisation of measurements
3. Quantifying co-location mis-match effects
4. Using data assimilation as integrators
5. Serving match-ups with uncertainties via a Virtual Observatory



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# Principal outcomes from a Commission / User perspective

- Virtual observatory
  - Discovery of relevant co-locations
  - Visualisation of colocations
  - Simple analysis operations
  - Ability to download data and metadata
- Demonstration project so Virtual Observatory as delivered shall constitute static capabilities showcase
- Gap Analysis and Impacts Document
- Set of recommendations for future work in the area



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# High level overview of substantive indicators of progress to date

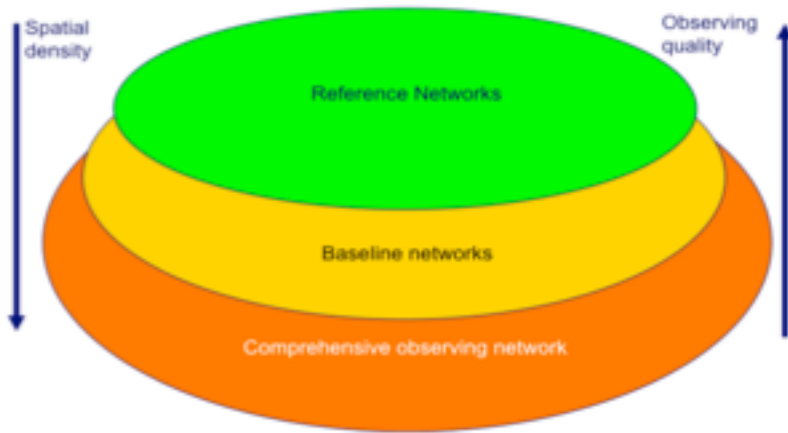
We shall see much more details in sessions to come



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# 1. Sub-orbital measurement maturity assessment and metadata



Defined three fundamental measurement quality tiers

Extension of CORE-CLIMAX CDR maturity assessment to deal with measurement maturity

Measurement maturity assessment completed for >40 candidate high-quality networks

Discovery (WIGOS/ISO19115) and measurement (ESA CCI -CF / WIGOS) metadata collected

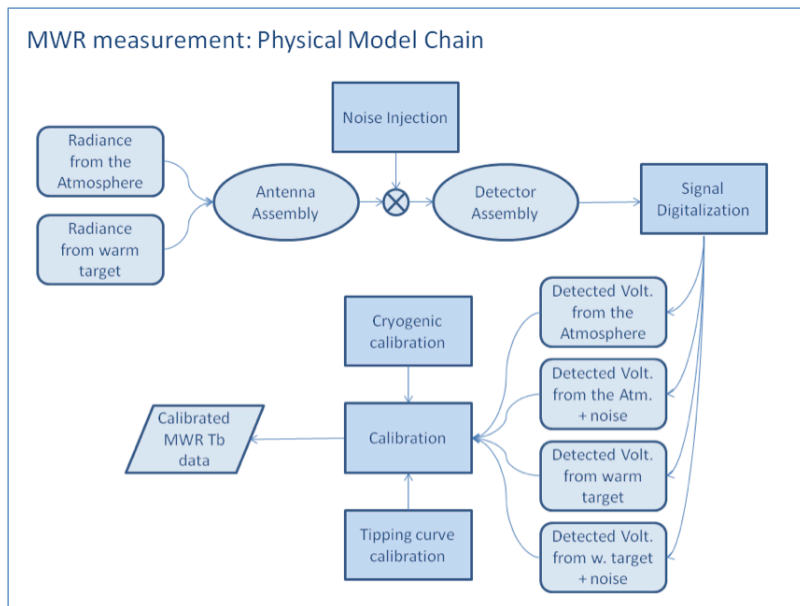


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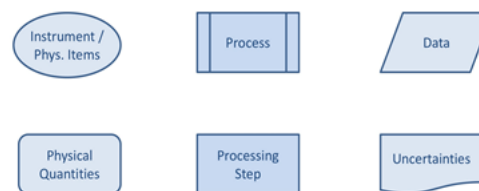
NDACC						
Metadata	Documentation	Uncertainty characterization	Public access, feedback and update	Usage	Sustainability	Software (optional)
Standards	Formal Description of Measurement Methodology	Traceability	Access	Research	Siting environment	Coding standards
Collection level	Formal Validation Report	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 reproducibility
		Routine Quality Management	Version control			Security
			Long term data preservation			
Legend						
1	2	3	4	5	6	Not applicable
<p>The assessment carried out above was performed under the auspices of GAIA-CLIM, <a href="http://www.gaia-clim.eu/page/maturity-matrix-assessment">http://www.gaia-clim.eu/page/maturity-matrix-assessment</a>, in September 2016. It assesses certain quantifiable aspects of typical measurement system maturity across the network for those ECVs and associated measurement systems that are relevant to GAIA-CLIM (<a href="http://www.gaia-clim.eu">www.gaia-clim.eu</a>).</p> <p>Users should be aware that this is a first effort to systematically quantify measurement system performance. Redundant assessments suggest a minimum uncertainty arising from assessor-to-assessor variations in any category of at least 1 score. Although the assessment may be useful to use-case applications at this time and until more broadly tested it should not constitute a primary decision-making tool.</p>						

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## 2. Traceability chains



### GAIA-CLIM convention



As a first step to the production of metrologically traceable estimates traceability chains have been produced for: various lidars, MWR, FTS, UV/vis, MAX-DOAS / Pandora, and GNSS-PW

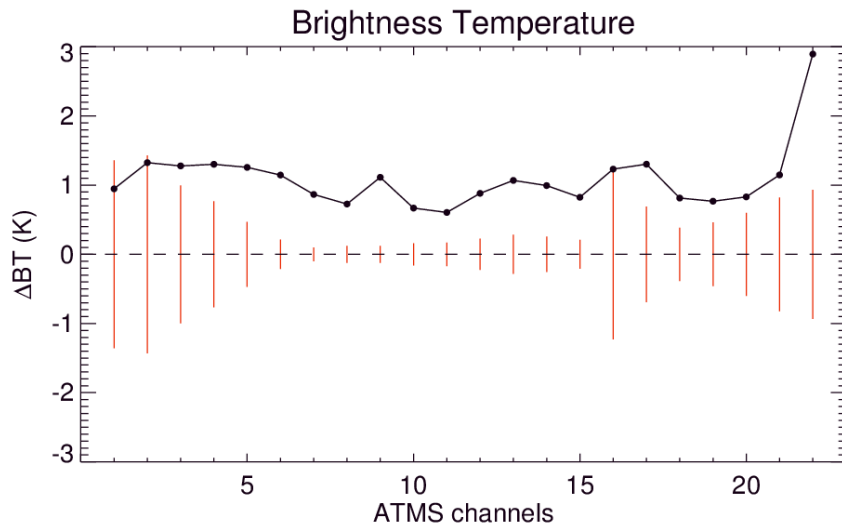


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# 3. GRUAN data processor



Takes a GRUAN Vaisala RS92 radiosonde measured profile, which includes a metrologically traceable uncertainty estimate at every point in the profile.

Converts the profile and its uncertainty into an equivalent TOA radiative profile and uncertainty (note assumptions about non- $T, q, P$  components, surface and atmosphere above balloon burst necessary).

Enables a comparison between the satellite and GRUAN measurement both at level-2 and level-1b.

Work with GRUAN ongoing to better account for correlated / random / structured random terms in the GRUAN uncertainty.



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# 4. Gaps Assessment and Impacts Document

- A living document
- Now in its third iteration (two further to come)
- Gaps are now an online resource
- All WPs provided a new round of input under a common template. WP6 session presentation shall outline further incl. proposed innovations arising from constructive discussions at 2<sup>nd</sup> user workshop and next steps



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# Other progress to date



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# Summary of progress

- To date all deliverables that were due are lodged
- First reporting period completed and decision pending from Commission
- Two formal scientific reviews both with constructive positive feedback
- VO early version showcased at second user workshop (and shall be available during breaks here tomorrow / Wednesday)



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# Outreach

- Presentations at numerous relevant national and international meetings
- Responsive to requests for input from Commission
  - Stand at European Space Solutions conference (staffed by KNMI)
  - Poster for GEOXIII meeting European stand area
- Two user workshops to date
- In year 3 to replace user workshop with more pro-active outreach (plenary discussion tomorrow)



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# Synergies with international activities



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# Collaborations

- Input provided to NEXTSPACE on gaps per DG grow request
- Participation in FP7/H2020 cluster meeting
  - Increased collaboration with QA4ECV
  - Plan to produce GRUAN equivalent TOA radiances for HIRS and MHS/AMSU-B to support FIDUCEO activities using the WP4 GRUAN processor
- ISSI grid to point thematic area engagement



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# Wednesday joint day with FIDUCEO + Copernicus

- FIDUCEO is trying to improve metrological characterisation of several satellite sensors
- There is a degree of cross-over with ECVs / sensors
- We shall have a joint discussion on Wednesday
- We shall also consider potential pull through of our respective activities to Copernicus program



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# BARON

- Fabio will talk more about this shortly
- Builds directly from WP1 activities
- Delivery of data from high-quality observational networks (Reference / Baseline) to the Copernicus Data Store in a harmonised format
- Signatures pending at this time.



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# Publications

Noh Y-, Sohn B-, Kim Y, Joo S, William Bell. Evaluation of Temperature and Humidity Profiles of Unified Model and ECMWF Analyses Using GRUAN Radiosonde Observations. Atmosphere. 2016;7.

T.Verhoelst, J. Granville, Hendrick, U. Köhler, C. Lerot, J.-P. Pommereau, et al. Metrology of ground-based satellite validation: co-location mismatch and smoothing issues of total ozone comparisons. AMT. 2015;8

F. De Angelis, D. Cimini, J. Hocking, P. Martinet, S. Kneifel. RTTOV-gb – adapting the fast radiative transfer model RTTOV for the assimilation of ground-based microwave radiometer observations Geosci. Model Dev., 9, 2721-2739, 2016

In Prep: Thorne et al. (maturity assessment paper)



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# Focus for remainder of project



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# Things yet to come

- Virtual observatory allowing users to explore and download co-locations between satellite and non-satellite measurements (initial version with limited functionality was trialled at second user workshop)
- Assessment of geographical gaps in the non-space observing system and their impacts
- Tools to quantify co-location mismatch effects for a range of ECVs and using a range of approaches to the problem
- Improved metrological characterisation of a range of instruments leading potentially to additional comparisons with satellite measurements



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# Focus of this General Assembly



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# Focus of this General Assembly

- Discuss and plan activities for final year of the project
- This is the opportunity to discuss issues with colleagues so please use the plenary, breaks and breakouts accordingly
- Science advisory panel members please feel free to interject throughout
- Each Work Package has been given at least an hour to present a substantive update
  - Please do not use all the time speaking – we need plenty of time for discussions
- In addition there shall be three plenary discussion sessions



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# Plenary 1 – recommendations document

- A M36 deliverable is a set of recommendations as to future work
- Shall be led by NUIM (me) but need input from many
- Basis shall have to be the version 4 release of the Gaps Assessment and Impacts Document
- Beyond that presently many open questions
  - Form
  - Role of internal partners
  - Role of external parties
  - Etc.



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# Plenary 2 – Uncertainties in the context of the VO

- Underlying WPs are delivering uncertainty information
  - Is this consistent?
  - Is it usable?
- The VO needs to present this uncertainty to users.
  - Visually
  - In terms of data tools
  - In terms of data files
  - With documentation to allow appropriate use
- How are we going to achieve these aims practically?



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# Plenary 3 - Outreach

- Despite substantive efforts user workshops have had limited success to date
- Project Officer has agreed to drop third user workshop in preference to 'road trip'
- Showcase and get feedback upon: VO, GAID and recommendations document
- Who, where, when?
- How to collect feedback to ensure usable?



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# Next GA – date for diaries

- We want next GA to precede project end far enough to be able to make changes still if needed
- Focus shall be on Virtual Observatory and recommendations document
- EUMETSAT have agreed to host
- Meeting will be somewhere in the period 27<sup>th</sup>-30<sup>th</sup> November
- Overlaps slightly with International TOVS Study Conference. EUMETSAT investigating options to have presence at and get feedback from that event.



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# Thanks for your attention

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