What can GRUAN learn from the GAIA-CLIM measurement system maturity matrix assessment?

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Outline

- Network of networks concept formalisation
- Measurement System Maturity Matrix assessment approach
- GRUAN assessment
- Holistic assessment across all networks
- Common strands
- For further info

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Network or networks

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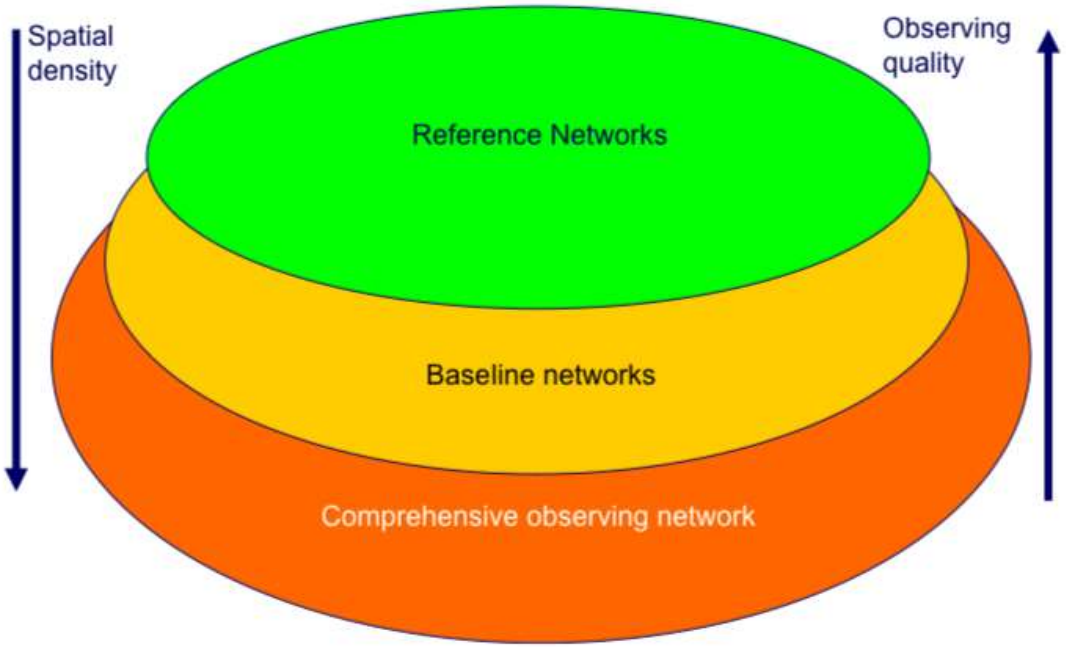
A tiered system of systems approach



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Reference networks (I)

These networks provide metrologically traceable observations, with quantified uncertainty, at a limited number of locations, or for a limited number of observing platforms, for which traceability has been attained.

- The measurements are traceable through an unbroken processing chain to SI units or community recognised standards
- Uncertainties arising from each step in the processing chain are fully quantified and included in the resulting data.
- Full metadata concerning the measurements is captured and retained, along with the original raw data, to allow subsequent reprocessing.

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Reference networks (II)

- The measurement and its uncertainty are verified through complementary, redundant, observations of the same measurand on a routine basis.
- The observations program is actively managed and has a commitment to long-term operation, to the extent possible.
- Change management is robust.
- Measurement technology innovation is pursued.

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Baseline networks(I)

These networks provide long-term records that are capable of characterising regional, hemispheric and global-scale features.

- The measurements are periodically assessed, either against other instruments measuring the same geophysical parameters at the same site or, alternatively / in addition, through intercomparison campaigns held under international or national auspices.
- Representative uncertainties, that are based upon understanding of instrument performance or peer reviewed lines of evidence, are available.

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Baseline networks (II)

- Metadata about changes in observing practices and instrumentation are retained.
- The observations have a long-term commitment.
- Changes to the measurement program are minimized and managed
- The measurements aim to meet stakeholder stated requirements.

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Comprehensive networks

These networks provide high spatio-temporal density data information necessary for characterising local and regional features.

- The comprehensive networks provide observations at the detailed space and time scales required to fully describe the nature, variability and change of a specific climate variable.
- Representative uncertainties based upon e.g. instrument manufacturer specification and knowledge of operations should be provided. In their absence gross uncertainties based upon e.g. expert or operator judgement should be provided.
- Metadata should be retained.
- Although encouraged, long-term operation is not required.

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Measurement System Maturity Matrix approach

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Assessing measurement maturity

- Assessment of measurement maturity against assessable metrics in the following areas:
    - Metadata
    - Documentation
    - Uncertainty characterisation
    - Public access, feedback, and update
    - Usage
    - Sustainability
    - Software (optional)

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Within each assessment strand

- Several distinct assessment criteria
- Objectively assessable aspects of measurement system maturity
- Resulting scores align to different tiers
  - 1-2 is comprehensive type
  - 3-4 is baseline type
  - 5-6 is reference type
- Assessment likely needs mix of internal and external experts

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Role of guidance

- Guidance document provides in-depth explanations against each assessed strand
  - even this cannot be hoped to cover all eventualities
  - expert judgment is inevitably required
  - Some fields may not be relevant or may be best done at the individual station / instrument level

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Internal vs. external assessment

- Role for both internal and external assessment
- Internal
  - In-depth knowledge
  - Realistic operator perspective
- External
  - Brings a valuable user / collaborator perspective
  - Likely more objective, on average …

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Consistent analyses

- Although criteria intended to be objective cannot be entirely so
- Key is to try to be honest
- Being too lenient or too harsh yields false impression
- Important that the right data is used for right application
- Value in getting multiple assessments of each contributing network. For GRUAN we had three

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Hypothetical example

Metadata	Documentation	Uncertainty charaterisation	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			

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Limitations and challenges (1)

- Not possible to give a single score to a candidate assessed program
- For different application-areas distinct aspects of the returned matrix of maturity will be important
- Requires ‘rules of round’ to be agreed by all parties to assure a degree of continuity
- Even with rules of round need to guarantee a reasonable degree of homogeneity.
  - Role for ‘redundant’ assessments to ascertain likely heterogeneity

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Limitations and challenges (2)

- Not easily applicable to satellite measurements
  - Would require extension
  - Satellite measures are quasi-global regardless of their fundamental quality.
- Without broad adoption by international community limited value
- Currently different domain areas use very distinct naming conventions and have distinct expectations
  - Challenge in adoption of not harming existing valuable measurements / networks
  - Renaming / reassigning may cause substantial user confusion!

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GRUAN assessment

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The following assessment …

- Was performed at the whole network level and across all instruments
- Conservatively uses a lowest common denominator approach in defining assessed levels
- Is towards the high end of all assessed networks

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GRUAN

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Legend

1	2	3	4	5	6	Not applicable

The maturity assessment carried out above was performed under the auspices of GAIA-CLIM, http://www.gaia-clim.eu/page/maturity-matrix-assessment, 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 ,www.gaia-clim.eu.

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 certain applications; at this time and until it is more broadly tested it should not constitute a primary or unique decision-making tool.

What are some themes to pull out?

- Access and use lets GRUAN down a bit
  - Partly a function of being a relatively new (still, just) network
  - BARON project should help increase access

- Highlights that many data streams although well understood lack traceability and complete uncertainty quantification

- Some more effort on aspects of documentation warranted

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Holistic assessment across all networks

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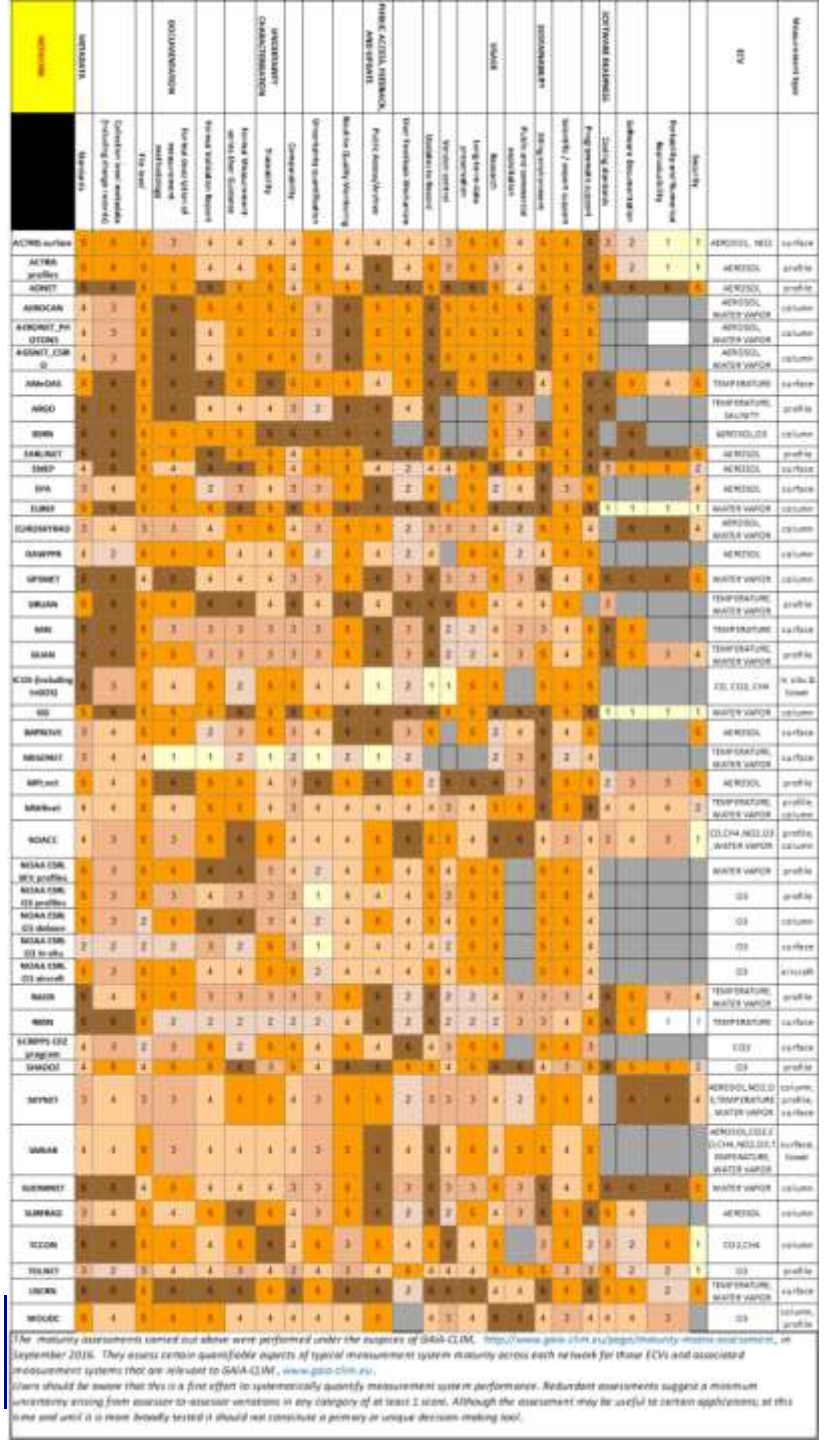
Don’t expect you to read this chart!

Note relative lack of highest scores

Note vertical striping -> common strengths / shortcomings



Assessment was performed on a pre-selection of high quality networks – non-selected networks will have lower scores than attained here!

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Common strands

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Common challenges across non-satellite measurement networks

- Metadata management (in particular collection level discovery metadata)
- Many networks struggle with documentation (GRUAN amongst the better)
- Lack of comparability / intercomparison activities in many networks
- Lack of a user feedback mechanism and version control

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For further information

Deliverables at:
http://www.gaia-clim.eu/page/deliverables
D1.3 and D1.6

Paper under open review at:
http://www.geosci-instrum-method-data-syst-discuss.net/gi-2017-29/

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GRUAN

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