

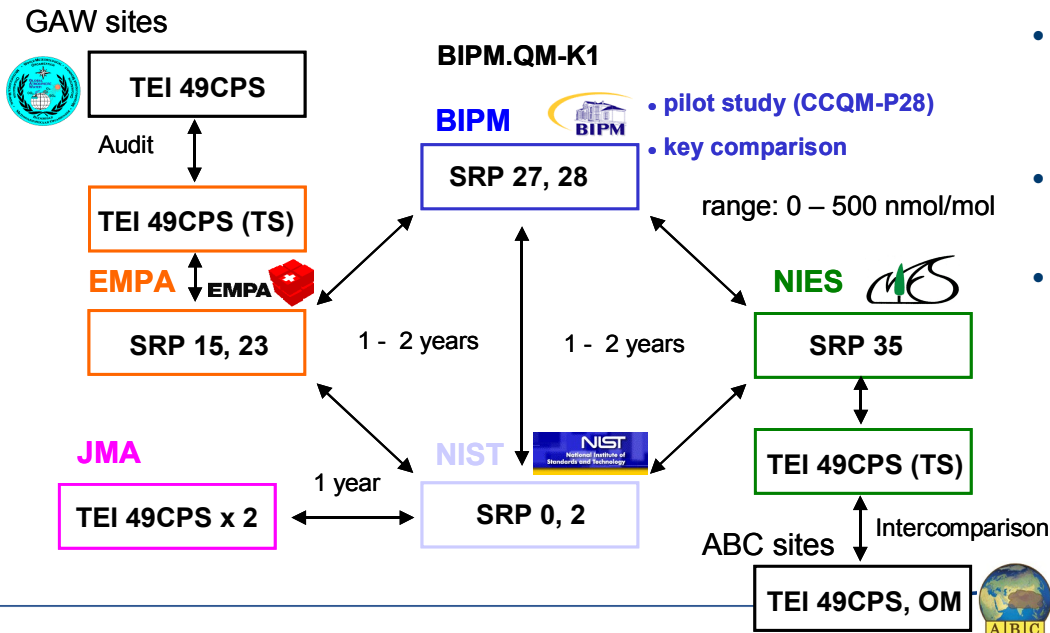
Traceability of Measurements and the International Metrology Framework

GRUAN Implementation Meeting
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Tom Gardiner
National Physical Laboratory, UK

International Metrology Framework

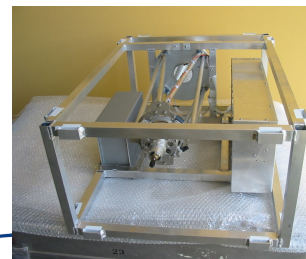
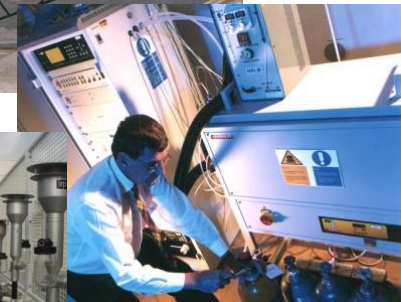
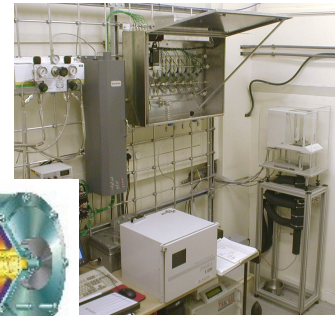
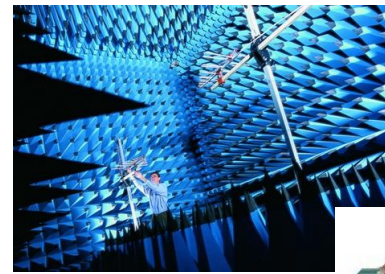
- National Measurement Institutes (NPL, PTB, NIST, etc.) provide national support for metrology – initially for industrial measurement, but increasingly for ‘quality of life’ measurements (health, environment, ergonomics).
- NMI’s also provide international comparability/traceability for measurements under the auspices of the BIPM (International Bureau for Weights and Measures).
- Metrological Traceability : property of a measurement result whereby the result can be related to a stated reference through a documented unbroken chain of calibrations, each contributing to the measurement uncertainty (VIM 2006).
- BIPM and WMO are planning a joint workshop on ‘Metrology for Climate Change Monitoring’.



- **National and international networks for atmospheric ozone measurements**
- Joint BIPM-NIST programme to maintain the comparability of the worldwide network of ozone reference standards
- Key comparison exercises to determine the equivalence of ozone reference standards.
- All results publicly available : http://www.bipm.org/en/scientific/chem/gas_metrology/ozone_comparisons.html

Activities at NPL

- **Temperature** – new acoustic resonance thermometer (sub-mK absolute accuracy)
- **Humidity** calibration range from +90(+/-0.2)^oC to – 97 (+/-0.5)^oC dew/frost point.
- **Radiative Calibration** – new cryogenic radiometer as World Radiation Reference.
- **Satellite optics/detector characterisation** (GOME, MODIS, GERB)
- **Microwave** – antenna calibration (20 Hz to 110 GHz), power flux density and specific absorption rate measurements.
- **Gas Standards** – gravimetric and active preparation methods for single and multi-component VOC, CO, CO₂, SO₂, etc. Micro-cylinders for in-situ calibration.
- **QA/QC of Air Quality Networks.**
- **Differential Absorption Lidar** (IR and UV).
- Balloon- and aircraft-borne **laser spectrometers**
- **Solar FTIR** with radiometric calibration (water-vapour continuum)
- **Instrument validation** – open path optical, environmental / industrial conditions.
- **Particle measurements** / validation – mass, speciation, size distribution.
- **Mathematical / statistical uncertainty studies.**



CEOS Knowledge/Information Product

To produce global knowledge/information products from a system of disparate systems requires a framework to facilitate inter-operability and harmonisation. This requires two key principles for the data :

Suitability and Reliability

Accessibility and Availability

All data products have an associated '**Quality Indicator**' with documented quantitative traceability to internationally agreed standards covering all steps in the data product delivery chain

The data policy applies to both the data products and all related data quality information (metadata)

Terminology, Format, Quality Assurance, Access Policy

Pre-launch : All measurement aspects should, where possible be traceably calibrated against international standards (ideally SI), with witness samples of key components.

Post-launch : Sensors should seek to demonstrate their performance for the following :

- Characteristics compared to pre-flight
- Biases to similar in-flight sensors
- Stability during mission life and correlation with other data sources.

Specific Issues

- Is GRUAN an operational network, or a research network ?
- Who is customer and what data delivery time is required? What time is available for data QA ?
- Will primary outputs be individual instrument data sets or a series of 'GRUAN columns' ?
- How will GRUAN activities feed down the doughnuts (traceability pyramid) ?
- Some form of regular intercomparison required for long-term stability – should this involve intercomparison campaigns (multiple teams at single location) or 'travelling standard' ?