Climate, QA & "Traceability":
A UK strength and opportunity?

Dr Nigel Fox

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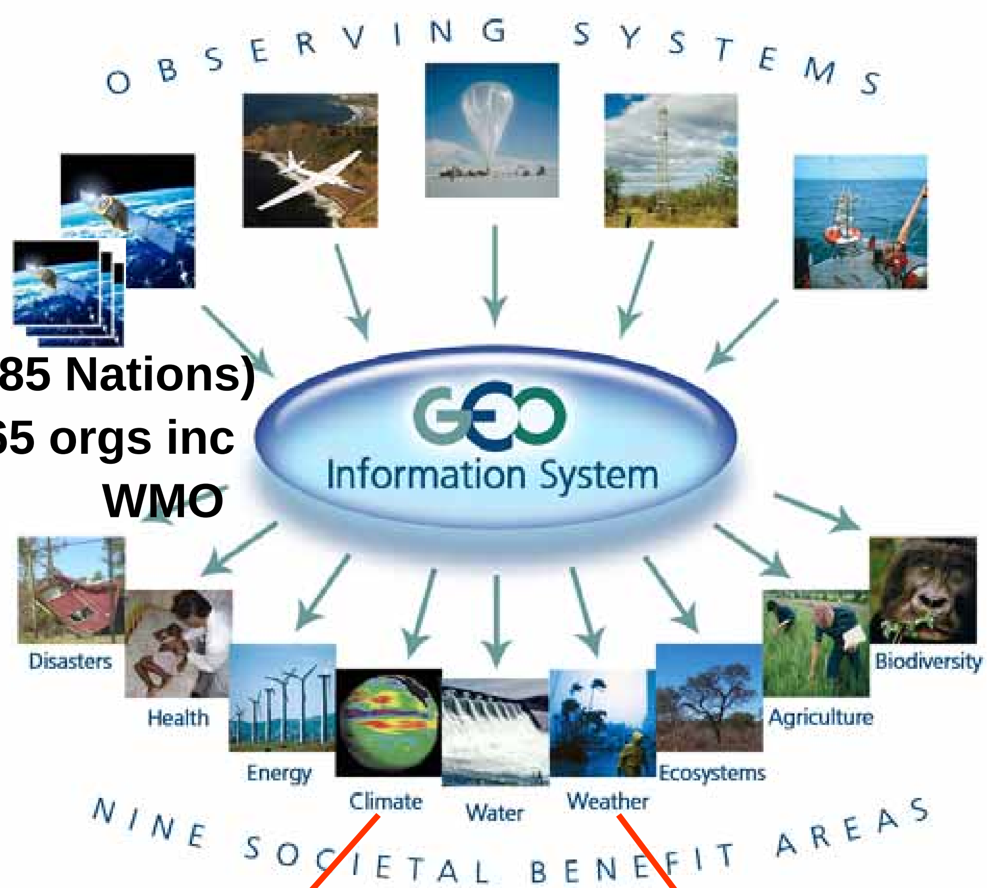
National
Measurement
System

“Community” requirement



(85 Nations)
65 orgs inc WMO

Climate **Weather**

- **The Group on Earth Observations (GEO)’s (founded 2002) Global Earth Observation System of Systems (GEOSS) must deliver comprehensive “knowledge / information products” worldwide and in a timely manner to meet the needs of its nine “societal benefit areas”.**

- **This will be achieved through the synergistic use and combination of data derived from a variety of sources (satellite, airborne and *in-situ*) through the coordinated resources and efforts of the GEO members.**

- **Achieving this vision (2015) requires the establishment of an operational framework to facilitate interoperability and harmonisation.**

Initiated (2008) by "space-community" on behalf of GEO to facilitate harmonisation and interoperability – Quality does not have to be "best" simply quantified

QA4EO Principle

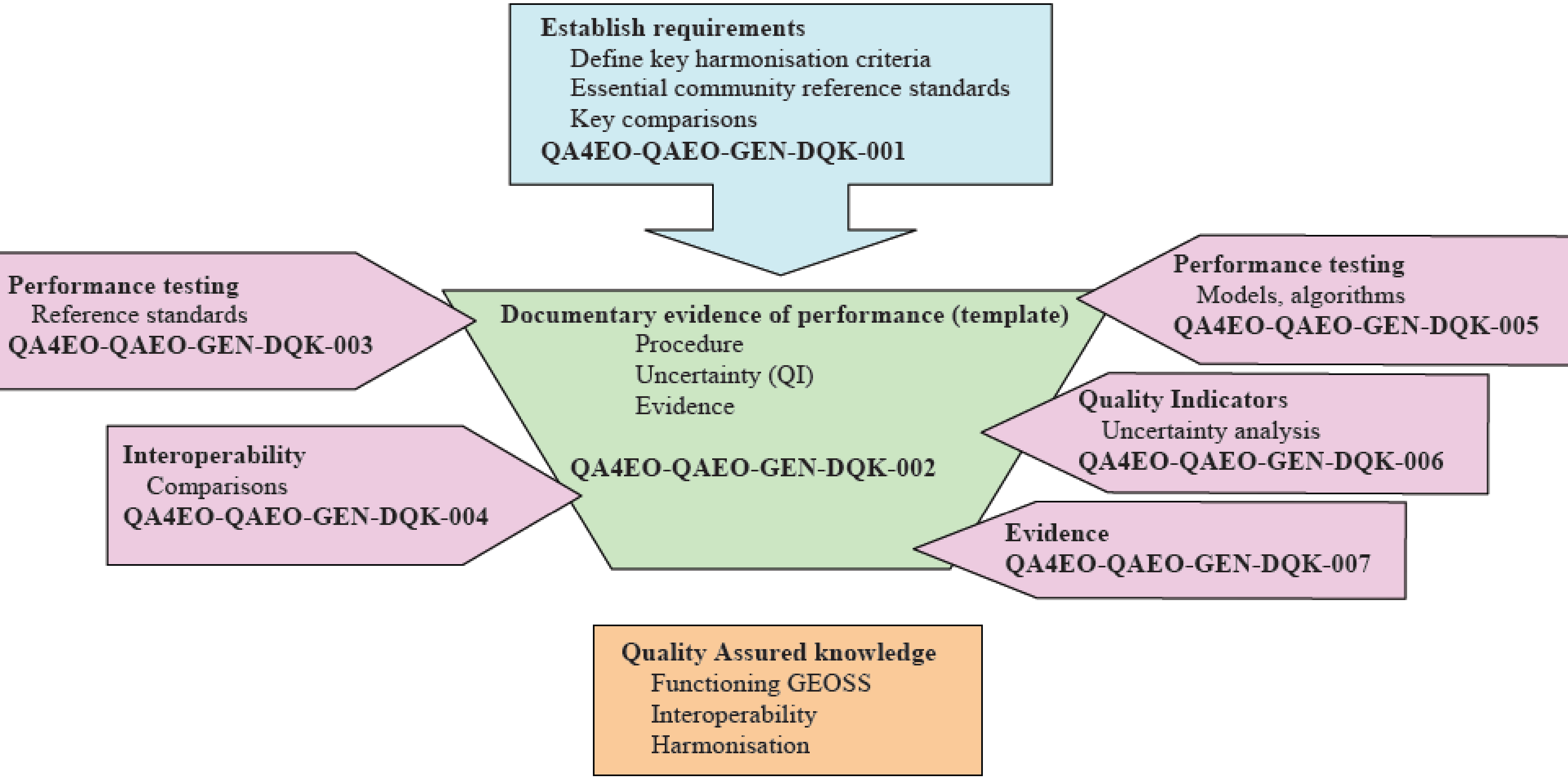
Data and derived products shall have associated with them a fully traceable indicator of their quality

Measurement has no meaning without an uncertainty statement "can be a guess!"

Quality Indicator (QI)	Traceability

Interdependency of QA4EO guidelines

An aid to data provider and "user" to facilitate transparency and demonstration/interpretation of QI and its evidence



Each ECV should have a QI (uncertainty) with documented evidence trail - we should not be afraid of potentially large uncertainties

QA4EO A QUALITY ASSURANCE FRAMEWORK FOR EARTH OBSERVATION

NPL National Physical Laboratory

October 18 – 20 2011 at RAL

QA4EO Workshop on Providing Harmonised Quality Information in Earth Observation Data by 2015

The Quality Assurance for Earth Observation (QA4EO) Workshop on Providing Quality Information in Harmonised Earth Observation Data by 2015 will be held from 18 – 20 October 2011 at Rutherford Appleton Laboratory (RAL) near Oxford, UK.

Figure 1: RAL, Oxford, UK

The workshop will present and discuss data quality assurance implementation examples across a wide variety of societal benefit areas. In particular how quality information is derived, maintained and presented following the QA4EO principle that "all data and derived products must have associated with them a Quality Indicator (QI) based on documented quantitative assessment of its traceability to community agreed (ideally SI) absolute reference standards".

Examples will be drawn from a broad cross-section of disciplines that span from global modeling and systems of distributed sensors to local environmental monitoring and small-scale field-based observations. Best practices within each community will be discussed with the ultimate aim of addressing any existing gap(s) and necessary improvements to achieve the implementation of QA4EO.

This event will establish a roadmap of key objectives by 2015 that will cover technical, coordination and governance aspects of QA4EO. Your active participation in this very important workshop is critical to moving forward with the Group on Earth Observation (GEO)'s vision for a Global Earth Observation System of Systems (GEOSS).

Figure 2: GEOSS

Additional logistical information about the workshop will follow shortly; **please reserve the workshop dates in your calendar.** If you have a contribution to make to this event by way of a presentation or poster, please do not hesitate to contact the workshop local organiser Dave Smith (dave.smith@stfc.ac.uk) to register your interest.

Sincerely, **The GEO QA4EO Team**

Optical uncertainty requirements (GCOS) for decadal climate change UN Global Climate Observing System

NPL National Physical Laboratory

Objectives for SI traceability	Climate Requirement	Pre-flight	In-flight	Terrestrial	Primary
Solar Irradiance	0.01%	0.2%	?	0.2%	0.01%
Spectral radiance (clouds, albedo)	0.3%	2% - 5%	?	~1%	<0.05%
Water-leaving radiance (Ocean Colour)	1%	5%	~5%	~1%	<0.05%

"Strategy!": Need to monitor change – not necessarily absolute values

- Sensors only require "sensitivity" and stability (or means to check) and sufficient overlap with another sensor to avoid data gap

High risk:
- **<u>Guaranteed</u> Data continuity - high cost – "data-gaps" likely**
- **small drifts undetected - potential bias build-up with time**
- **discourages innovation**
- **sensitive to natural fluctuations (particularly during "overlaps")**

SI Traceability (maintained in operation) **– Flexible observing, innovation, coherence between methods (traceability routes) and observing systems**

Operational framework:

Principles and scope (space example)

All activities which contribute to the delivery of an end product derived from an input measurand

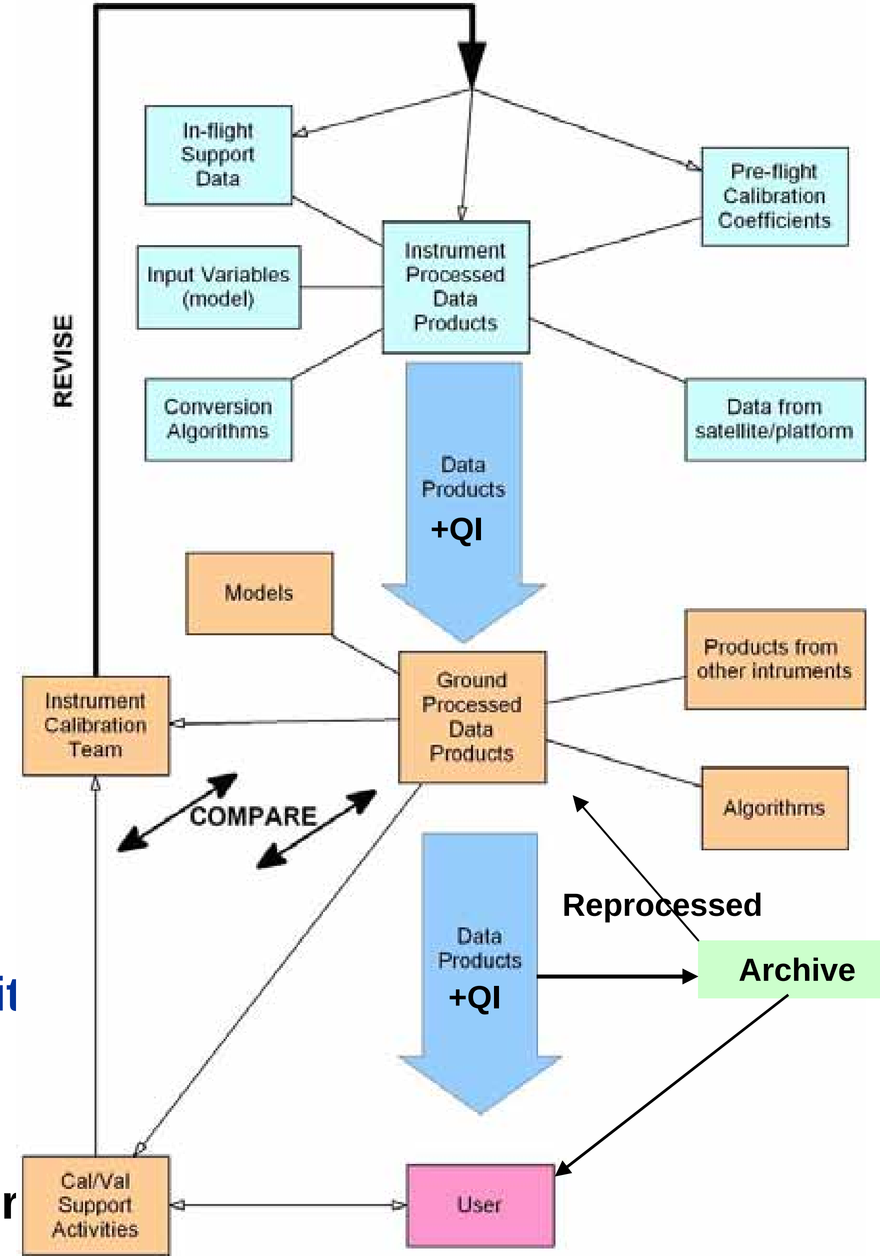
Pre-Flight

- **Requirement/Design Specification**
- **Instrument build: characterisation/calibration**
- **Data processing: algorithms, ref/support data,**

Post-Launch

- **Instrument performance**
- **Output data quality characteristics:**
  - **accuracy**
  - **equivalence to others (sensors/in-sit**
- **Processing – high level products**
- **Data distribution/archive …**

Collection – Processing – Validation - Deliver



Vision to establish UK led European Metrology Centre for Earth Observation and Climate (EMCEOC) http://EMCEOC.org

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- Transfer standards
- Comparisons
- Innovation on techniques
- Measurement & test protocols
- International link
- Independence

Modelling & Data processing

QA

Calibration

Traceability

Audit

Validation

Academia

Advice

Public sector

Private Industry

Services delivered through existing organisations –

Opportunity for UK / ISIC

Towards a "European Metrology Centre for Earth Observation and Climate" (EMCEOC)

National Physical Laboratory

EU funded Project: ~40 MY over 3 yrs expect a follow-on in 2013/14.

NPL lead (~40% of resource) Partners (NMIs from) D, F, I, Fi, CH + JRC Ispra

Vision to be a "one-stop-shop" for EO metrology **Starts ~ Oct 2011**

Case study projects: largely optical – illustrate range and scope

- **Pre-flight laboratory-based calibration standards and methodologies**
  in vacuum spectral radiance traceability, Stray light, linearity, microwave sounders
- **On-board calibration standards**
  Flat plate IR black bodies for limb sounders (accuracy ~0.1 K)
- **Recovering/establishing in-flight traceability through reference standard measurements and test-sites**
  Ocean Colour Cal/Val (target 1%), RT codes, field spectroscopy (leaf level) autonomous self-calibrating networks
- **Prototype in-flight SI traceability methodology - TRUTHS mission**
- **Supporting international QA and providing training**
  e.g. uncertainty/traceability of forest carbon

Centre for Carbon Measurement

Supporting climate research & a low carbon future

NPL

National Physical Laboratory

CCM Technical Work-programme

LOW CARBON TECHNOLOGIES

- Energy efficiency:
- Fuel Cells & PV:
- Energy distribution:.
- Offshore renewables:
- Life Cycle analysis:
- Eco Design:

accelerate development and assess performance of low-carbon technology

CARBON PRICING AND TRADING

- Current trading:
- Emerging instruments
- Interoperability:
- Harmonised reporting:
- Long-term issues:

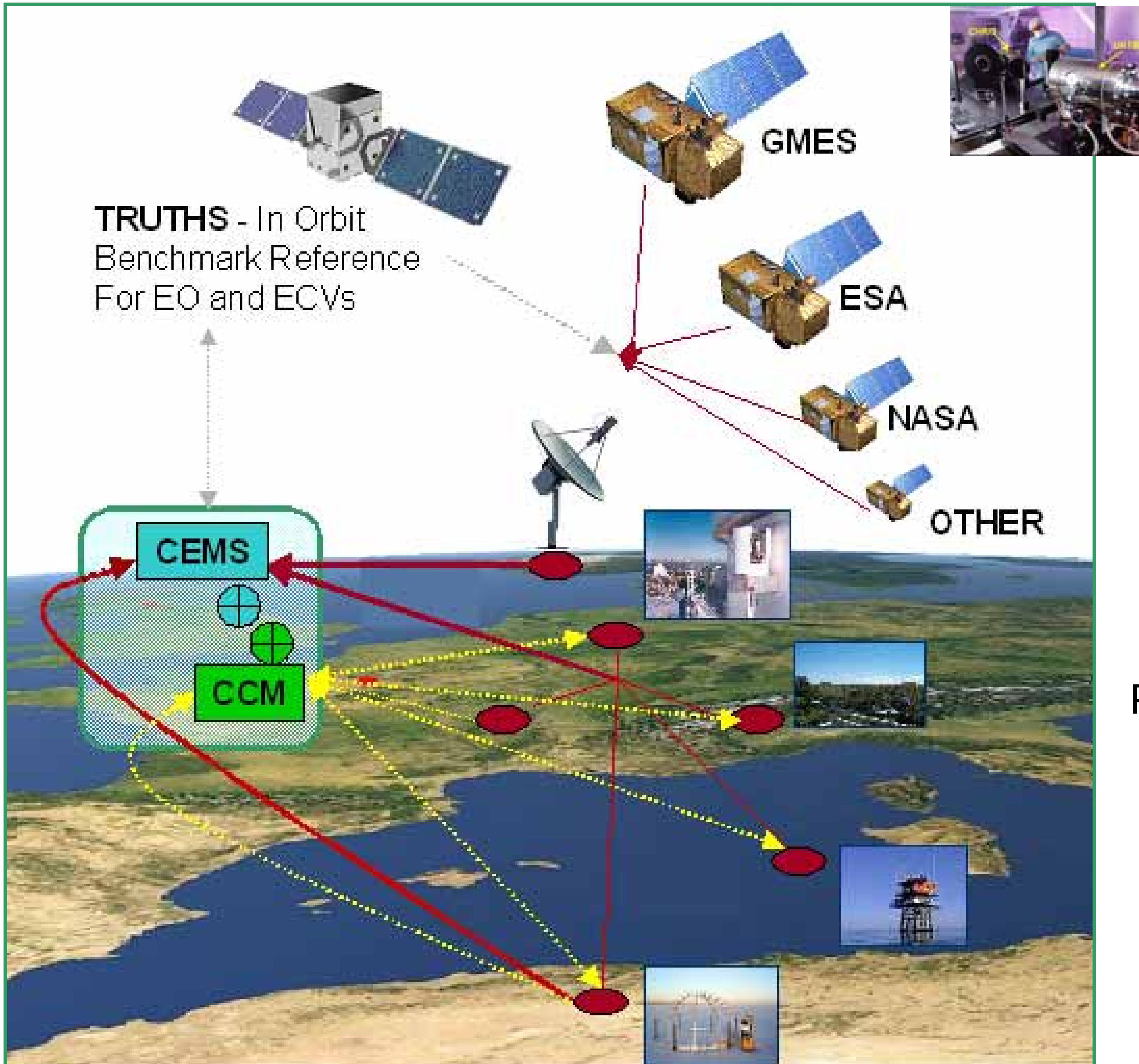
support existing and emerging tax, trade and regulatory instruments for carbon pricing and reporting

CLIMATE DATA

- Climate data:
- EO:
- Instrumentation:
- UK forum:

provide confidence and reduce uncertainties in climate data used to monitor and to model climate change.

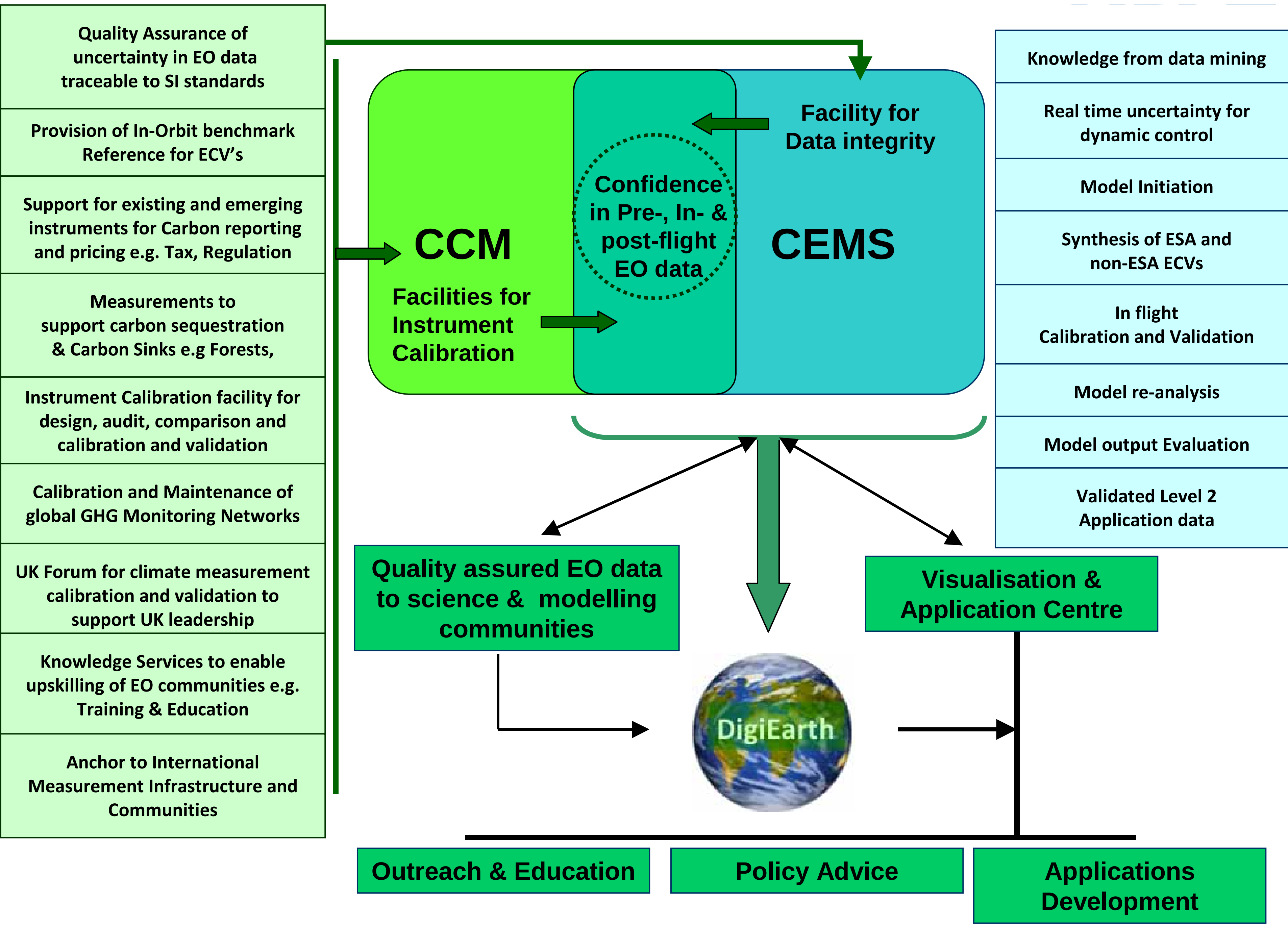
Traceability "operational"

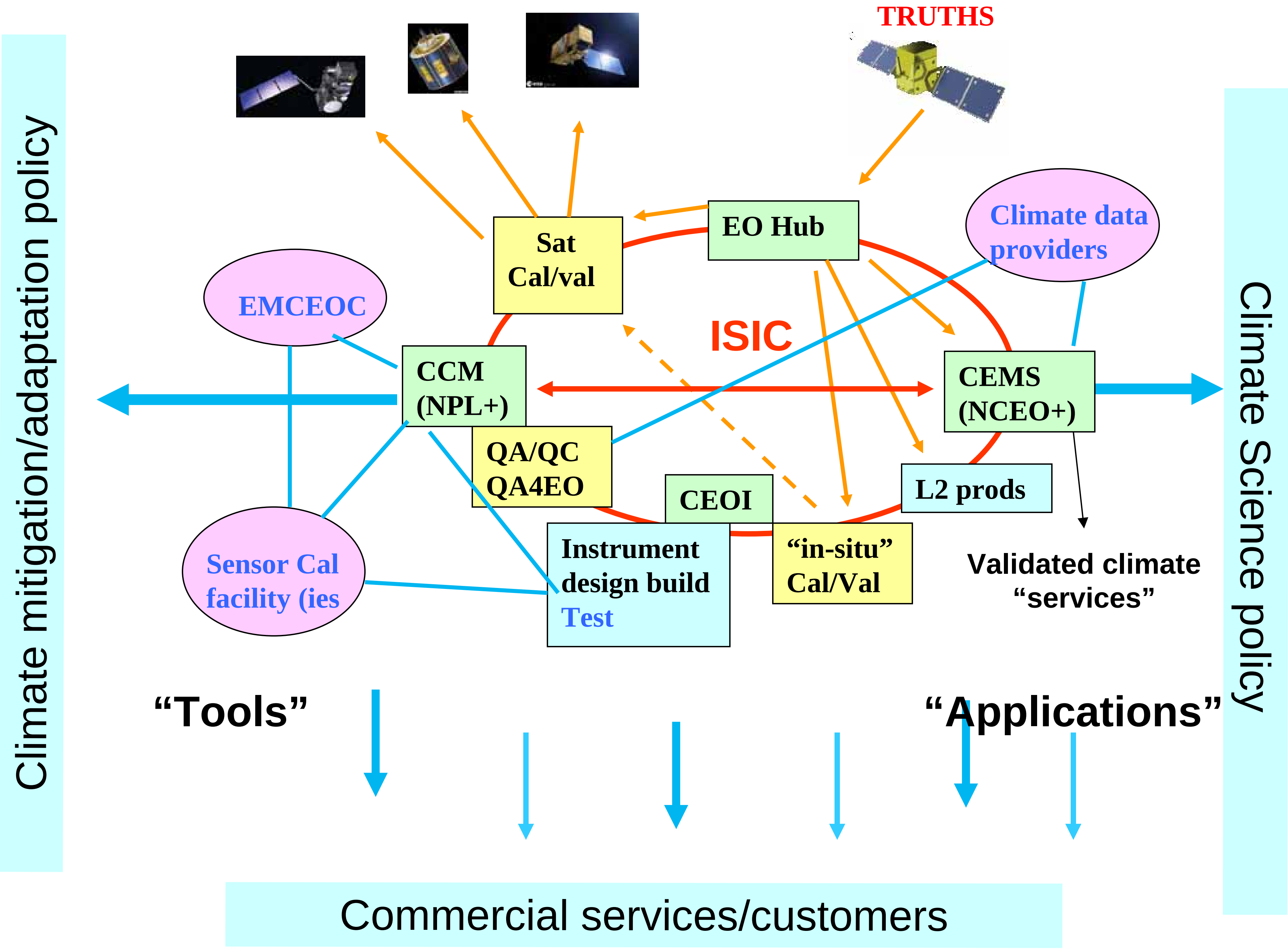


Pre-flight instrument Cal.

Post-launch Cal/Val (QA)

(Data)


Quality Assurance of uncertainty in EO data traceable to SI standards
Provision of In-Orbit benchmark Reference for ECV's
Support for existing and emerging instruments for Carbon reporting and pricing e.g. Tax, Regulation
Measurements to support carbon sequestration & Carbon Sinks e.g Forests,
Instrument Calibration facility for design, audit, comparison and calibration and validation
Calibration and Maintenance of global GHG Monitoring Networks
UK Forum for climate measurement calibration and validation to support UK leadership
Knowledge Services to enable upskilling of EO communities e.g. Training & Education
Anchor to International Measurement Infrastructure and Communities
CCM
Facilities for Instrument Calibration
Confidence in Pre-, In- & post-flight EO data
Facility for Data integrity
CEMS
Knowledge from data mining
Real time uncertainty for dynamic control
Model Initiation
Synthesis of ESA and non-ESA ECVs
In flight Calibration and Validation
Model re-analysis
Model output Evaluation
Validated Level 2 Application data
Quality assured EO data to science & modelling communities
Visualisation & Application Centre
DigiEarth
Outreach & Education
Policy Advice
Applications Development


TRUTHS
Climate mitigation/adaptation policy
Climate Science policy
EMCEOC
Sat Cal/val
EO Hub
Climate data providers
ISIC
CCM (NPL+)
CEMS (NCEO+)
QA/QC QA4EO
CEOI
L2 prods
Sensor Cal facility (ies
Instrument design build Test
“in-situ” Cal/Val
Validated climate “services”
“Tools”
“Applications”
Commercial services/customers

Questions:-

Ideal world we seek to measure everything or at least needs of ECVs – however £$€ we must prioritise

- **What are the priorities for metrology?**
  - **Measurands**
  - **Spectral range**
  - **Uncertainties**
  - **Observing platform – space, air, in-situ**
- **Is the measurand requirement linked to "importance of information" derived from individual ECVs?**
  - **Uncertainty requirement based on need not what is perceived to be achievable**
  - **"trade-off" relative effort to achieve - c.f. "importance/value"**
- **How do we optimise international effort to meet global climate/EO metrology needs?**
  - **UK opportunity to provide leadership and infrastructure**
  - **Facilitates access to data with robust understanding of its "quality"**
  - **Funding model?**

Are these the right questions? And if so How do we get the answers? – questionnaire, Workshop ….