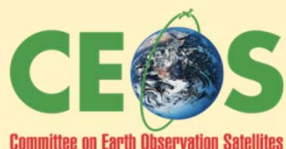


# CEOS QA4EO at CEOS WGCV IVOS May 10, 2012

**Greg Stensaas (USGS) - WGCV chair**

## How do we get . . .

- Common QA definitions and documentation, defined quality indicators & metadata, cal/val processes and information, traceable uncertainty assessment to allow comparable/ interoperable data and products, ...,
- From . . .
  - Different system data
  - Different product algorithms
  - Different models
  - Difference in scales
  - MORE ....
- **We need to follow a defined Quality Assurance framework and processes**



# GEO QA Strategy Background

- The GEOSS must deliver **timely, quality, long-term, global information** to meet the needs of its nine SBAs
- This will be achieved through the synergistic use of data derived from a variety of sources (satellite, airborne and surface-based) and the coordination of resources and efforts of the members
- Accomplishing this vision, starting from a system of disparate systems that were built for a multitude of applications, requires the establishment of an internationally coordinated framework to facilitate interoperability and harmonization
- The QA4EO was established and endorsed by the CEOS as a direct response to a GEO Task DA-06-02/ DA-09-01a/ **(now) IN-02, C1**
  - **TASK DA-09-01a: GEOSS Quality Assurance Strategy**
  - **IN-02, C1 - IN-02 Earth Data Sets, C1: Advances in Life-cycle Data Management**

## GEO 2012-2015 WORK PLAN

*Please note that the lists of Leads (and Points of Contact) have been updated since the present document (Revision 1) was produced. The latest versions of these lists may be found online at: <http://www.earthobservations.org/docshow.php?id=129>*

**13 December 2011**

# Quality Assurance framework for Earth Observation (QA4EO) principle

## **QA4EO Principle**

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

### **Quality Indicator**

*A Quality Indicator (QI) shall provide sufficient information to allow all users to readily evaluate the “fitness for purpose” of the data or derived product*

### **Traceability**

*A QI shall be based on a documented and quantifiable assessment of evidence demonstrating the level of traceability to internationally agreed (where possible SI) reference standards*

- Measurement/processes are only significant if their “quality” is specified
- In order to achieve the vision of GEOSS, Quality Indicators (QIs) should be ascribed to data and products, at each stage of the data processing chain - from collection and processing to delivery.

## WHAT IS QA4EO?

- **The Quality Assurance framework for Earth Observation (QA4EO) principles:**
  - It is critical that **data and derived products** are easily accessible in an open manner and have associated with them an **indicator of their quality traceable to reference standards** (preferably SI) to enable users to assess its suitability for their application i.e. its **“fitness for purpose”**.
  - This Quality Indicator needs to be unequivocal in its interpretation and derivation , yet sufficiently flexible, to be **implemented across the full range of EO activities which are coordinated through GEO.**

# QA4EO Events

- **Four previous QA4EO Planning Workshops**
  - GEO SEC (Oct 2007), NIST USA (May 2008), TÜBİTAK UZAY Turkey (Sept 2009), UK Harwell (Oct 2011)
    - *Guiding Principles, Establish Operational Framework, Facilitating Implementation, Providing Harmonised Quality Information for 2015*
- **Many related efforts:**
  - ESA GMES Initiative, UK National Initiative, WMO-BIPM Workshop, NASA ESIP QA Cluster, ISO processes/documents, ....
- **Many Sessions and Papers (past, present, future)**
- **Capstone Workshop (2011) including key GEO and CEOS members and users**
  - Defined Actions and Timelines
  - GEO SEC members recommended a Ad Hoc QA4EO Working Group/Team
- **QA4EO Implementation Plan written to include workshop recommendations**
  - CEOS QA4EO Implementation – WGCV lead, support from other WGs and VC

## QA4EO SEC and Support

- UKSA with Centre of Carbon Management (CCM) at the National Physical Laboratory (NPL)
  - 2 year effort to support QA4EO implementation support – secretariat, web, leadership
  - Dr. Hillary Elliott
  - <http://www.npl.co.uk/carbon-measurements>



# QA4EO Implementation Profile

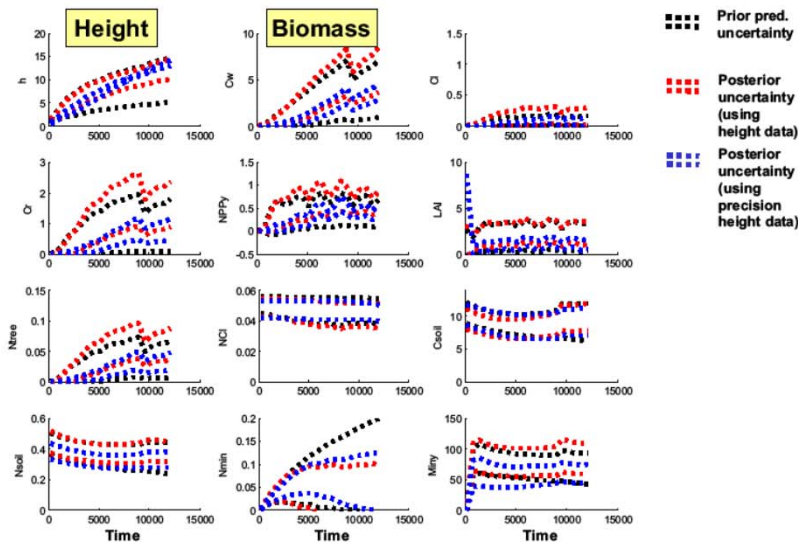
- **QA4EO implementation is supported by a framework document and a set of key guidelines to assist in its interpretation and implementation**
  - Principles and Guidelines Version 4.0 and Implementation management
    - CEOS, IEEE, agency support and workshop revisions
  - QA4EO Website <http://qa4eo.org/>
  - Overall Key Guidelines and associated reference documentation populated on QA4EO
  - Enhanced documentation continually being developed
- **Organizations that fund and oversee the development and execution of Earth Observation programs are responsible for implementing QA4EO principles**
  - Need CEOS and GEO requirements, guidelines, and implementation mechanisms
  - Need to support CEOS and GEO data and information architecture
  - Need to continue to provide QA4EO Showcases and Implementation Pilots

## Dynamic modelling of the carbon cycle in forests: Data needs and uncertainty quantification



Marcel van Oijen (CEH-Edinburgh)

### 3.2 Prior & posterior uncertainty: use of height data



### 3.3 How to use the data

- So data can be informative in two ways:
  1. Having high precision (small S.D.)
  2. Being numerous (large  $n$ )
- But ... how realistic is the previous example ?

- Only stochastic measurement error considered
- Measurements may be biased
- Measurements may be taken in an 'atypical' forest (e.g. forest on polluted soil)
- Measurements may not be at the 'believable scale' of the model

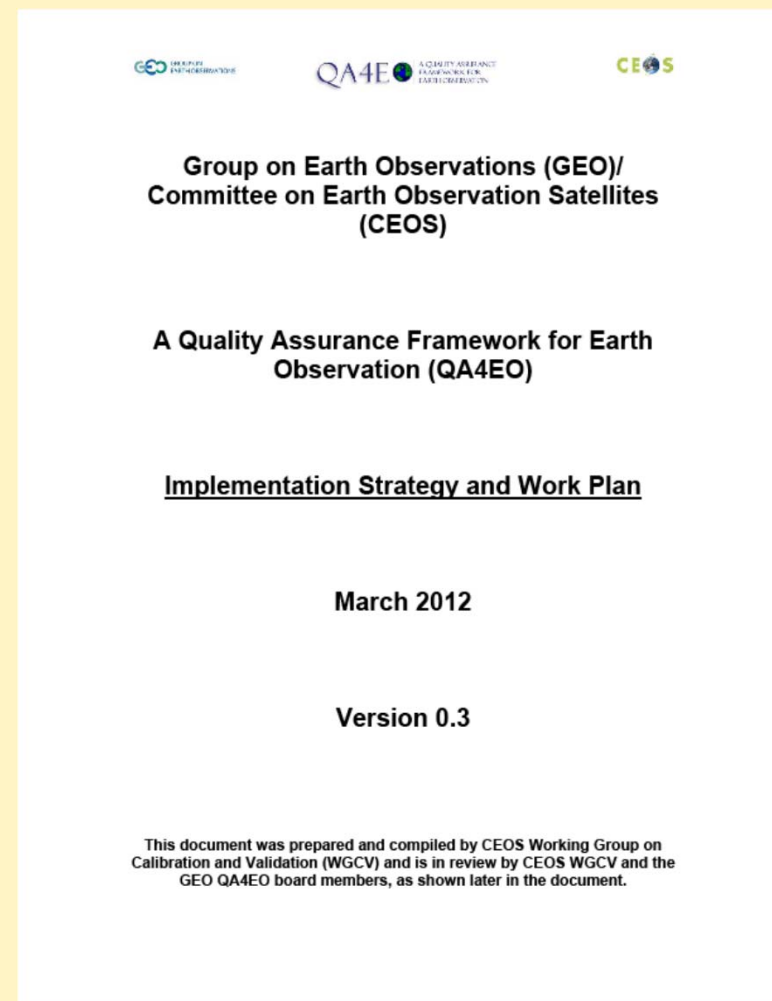
### 4 Discussion

1. Process-based models for forest C-tracking are available
2. Bayesian Calibration: easy to implement and effective
3. Not a clear question: "What data does the model need"?
  - Instead ask: "How much do we want to reduce model output uncertainty?"
4. Data quality = fitness for purpose = informative to models
  - Must be clear how to write the likelihood function
5. Defining the likelihood function requires understanding of both data (errors and representativeness) and model (believable scale)
  - Data that are given with +/- stochastic error are NOT well-enough defined
  - Precision of measurement equipment (stochastic error) is far less important than data being unbiased and representative
  - Future projects: data-providers assess data-quality interactively with modellers



# QA4EO Implementation Plan

- Based on, previous workshop outcomes and actions
- Approve a high-level working implementation plan
  - GEO QA4EO Implementation Task Force
  - Key activities and outputs defined and details mapped in action tracker
  - CEOS QA4EO Implementation Management Team (direction and prioritization)
  - CEOS QA4EO Implementation Taskforce (detailed implementation)



# QA4EO Implementation Workshop

## Actions and Timeline:

- QA4EO presentation for GEO plenary
- 2011 – Ensure that QA4EO is included in the CEOS report to GEO plenary.
  - Introduce the principles/guidelines of QA4EO, as a part of the CEOS report
  - Plenary Chair (ASI)
- 2012 - Draft a QA4EO document (~20-page) for GEO plenary 2012 (Giovanni Rum / Yasukini Okubo to lead this). This will:
  - Present solid examples of benefit, display cooperation with tasks, and present some kind of plan to implement QA4EO across GEO activities.
  - Implicit task to establish a GEO *ad hoc* working group (i.e. butterfly man) to be led by the GEO secretariat and to include non-space and space members.
  - Draft document due June 2012; Final document due September 2012.
- 2013 – Aim for a ministerial discussion at GEO plenary 2013.
- QA4EO implementation examples (called (at this meeting) QA4EO Implementation Pilots – (QIPs):
  - GEO Secretariat SBA leads to identify GEO tasks as candidates for QIPs
- GEO task co-leads of DA-09-01a to coordinate with the GEO secretariat on appropriate criteria to define the tasks (both space and non-space based).
- A GEO-level QA4EO working group would need to be established (as in 1.).
- Investigate options to have QA4EO as a subtask to the AIP, or at least to establish connectivity.
- The development of QIPs as test cases for the benefit of QA4EO should be pursued.
- The development of supporting tools (metadata, requirements, templates, etc.) is required.

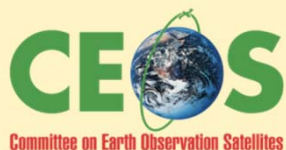
# GEO QA4EO Implementation Workshop

## Actions and Timeline:

- Promotion events needed (workshops)
- QA4EO needs to be routinely addressed at user (GEO, community, etc.) workshops. If a specific session is not appropriate, then an agenda item should be included at each meeting as a minimum.
- Connection to the UIC – user interface committee. The UIC canvass and connect with the users and are a good forum to target for QA4EO involvement.
- Involvement at other workshops as suggested by the new GEO-level QA4EO working group (as in 1.). As suggested by the new ad-hoc working group (i.e. butterfly man)
- Connection to other science groups/committees? Promote greater awareness of QA4EO
- Science implementation group within GEO. This group is already aware, but there is a need to ensure there is a link with QA4EO to ensure a direct connection and to promote greater awareness of QA4EO.
  
- Implement QA4EO focus within CEOS working groups
- Engage activities within all the CEOS working groups including the new Working Groups on Capacity Building and Data Democracy (WGCBDD) and Working Group on Climate (WGC).
- Work with the CEOS Virtual Constellations (VCs) to ensure quality assurance and promote QA4EO.
- Continue to work on the CEOS QA4EO showcases.
  
- *The QA4EO needs a working focus at all levels:*
  - Refinement and extension of the generic guidelines
  - Test case development for promotion of QA benefits
  - Planning for outreach and education
  - Development of supporting tools (metadata requirements, templates, etc.)

# QA4EO Implementation Task Force for GEO

- **Authorisation** - Delegated management from CEOS and GEO, responsible for recommending and proposing to GEO Secretariat
- **Management of GEO QA4EO Implementation:**
  - Develop and define implementation prioritization of QA4EO needs in GEO
  - Create the implementation requests to obtain resource in GEO and present to GEO management
  - Support management and integration across GEO
  - Create Ad hoc Working Groups for Implementation needs
- **Efforts:**
  - Detailed promotion and management of QA4EO at technical and scientific domain level.
  - Evolution of QA4EO, scope and guidelines
  - Development of Implementation Strategy
  - Focal point for guidance on key guidelines
  - Review technical input and approve or recommend; approve procedures/comparisons as appropriate.
  - Provide scheduled actions and work as need



# QA4EO GEO Implementation Task Force

- **Members:**
- GEO Secretariat - QA4EO POC
- GEO IN-02, C1 task team - CEOS WGCV/WGISS
- CEOS SEO
- CEOS SIT member
- WMO
- FAO
- Metrological Standards bodies (2 minimum)
- GEO SBA Leads
- QA4EO Secretariat
- GEO Infrastructure Implementation Board (IIB)
- GEO Data Sharing Working Group
- and/or others as process evolves.
- **Observing Members:**
- INSPIRE
- OGC
- GMES
- GCOS
- ISPRS
- Invited Space Agency, Science, and Quality Expertise as required
- and/or others as process evolves and as needed for interim basis by determined of the group.

# CEOS QA4EO Management Team

- **Authorisation:** Delegated Management of QA4EO from CEOS, responsible for recommending and proposing QA4EO to CEOS (Management, VCs and WGs, CEOS tasks)
- **Members:** Delegates from CEOS, responsible for recommending and proposing direction to CEOS Management and QA4EO Implementation Team

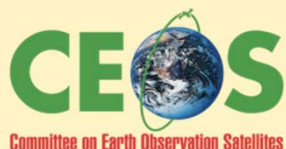
- **Voting Members:**

- CEOS SEO
- WGCV chair
- WGCV vice-chair
- WGISS Chair or Delegate
- WGC Chair or Delegate
- WGCBDD Chair or Delegate
- LTDP Task Lead
- WMO (GSICS)
- WGCV Subgroup Chairs or Delegates
- Metrological Standards bodies
- CEOS SIT Representative
- CEOS SEC Representative

- **Supporting Members:**

- GEO Advisory Member -1
- QA4EO Secretariat -1
- Virtual Constellation Delegates – 7
- CEOS Societal Benefit Area (SBA) Coordinator Delegates - 9 (Agriculture, Climate, Disasters, Ecosystems, Energy, Health, Water, Weather, and Cross-Cutting)
- GEO QA4EO Board Chair- 1
- WGCV Sec -1
- Invited Space Agency, Science, and Quality Expertise as required – 2
- and/or others as process evolves and as needed for interim basis by determined of the group.





# CEOS QA4EO Implementation Taskforce

- **Management of CEOS QA4EO Implementation:**

- Evolve QA4EO, scope and guidelines
- Develop and refine of Implementation Strategy
- Focal point for guidance on key guidelines and implementation
- Team/Effort requirements and tasks needed in CEOS for QA4EO
- Develop and define implementation prioritization of QA4EO needs in CEOS
- Create the implementation requests to obtain resource in CEOS and present to CEOS management
- Support management and integration across CEOS
- Create Ad hoc Working Groups for Implementation of new tasks or efforts in accordance with on-going CEOS efforts

- **Members:**

- WGCV Chair/Vice Chair
- WGCV Subgroup Chairs and delegates
- WMO
- Metrological Standards bodies (2 minimum)
- QA4EO Secretariat
- WGClimate, WGCapD, WGISS delegates
- Virtual Constellation and CEOS effort leads and/or delegates
- All members of the CEOS QA4EO Management Team will be invited and considered as support and maybe called upon as needed by the taskforce.

# SIT-27 QA4EO Planning Meeting

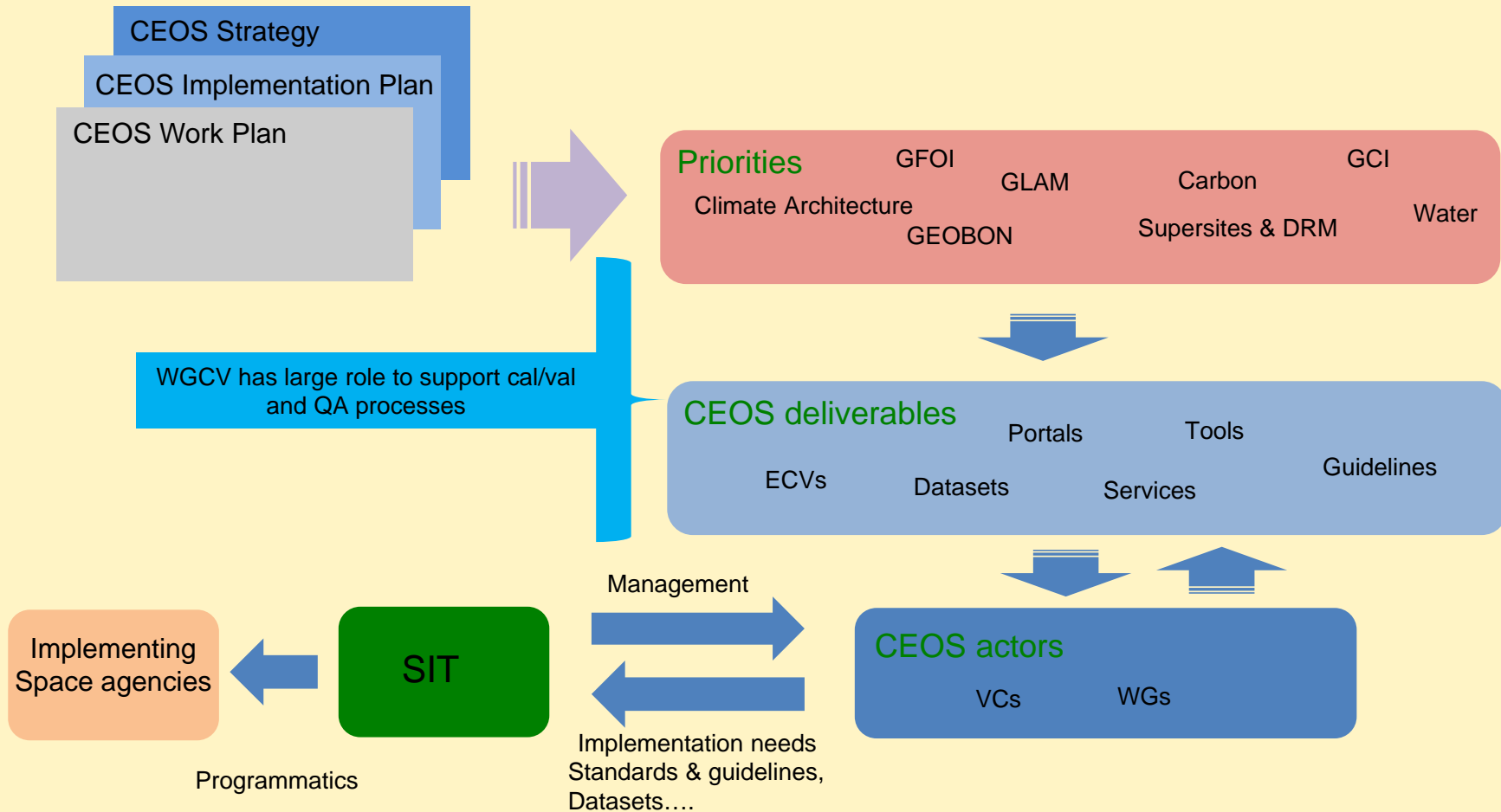
## Conclusions

- QA4EO Workshop Objectives and Goals
  - Leaders and Champions for QA4EO
- Discuss Future QA4EO concept in GEO versus CEOS
- Establish QA4EO Teams in CEOS
- QA4EO GEO Team Lead and establish task force
- QA4EO Secretariat for GEO and CEOS
- Define how to engage group regularly and establish regular work process – develop meetings, reports, .....
- Next meeting and development GEO and CEOS teams

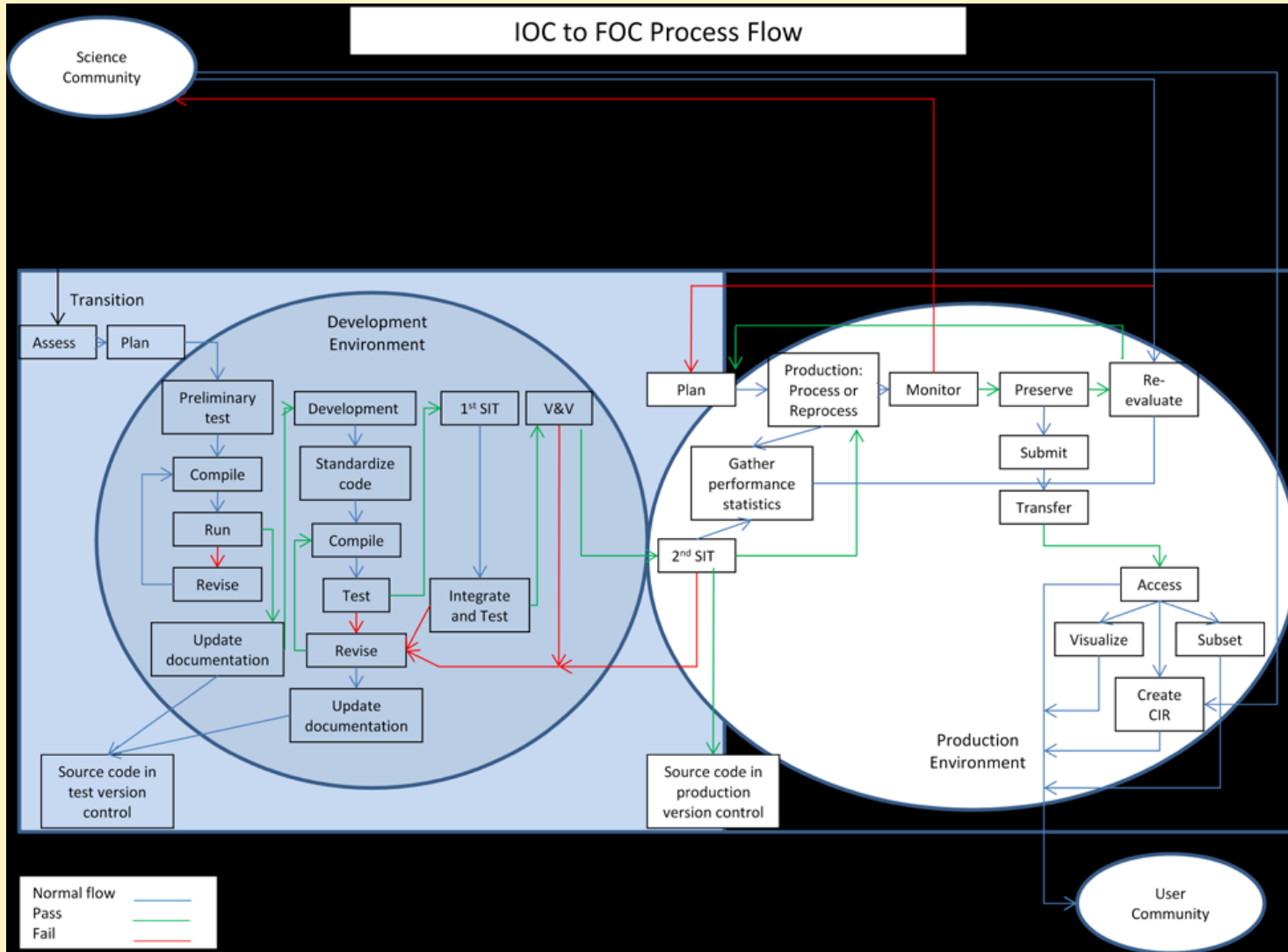
# SIT-27 QA4EO Meeting Actions

Action	Details	Due
1	Contact GEO Secretariat Volden and Rum to lead and support implementation, and finalize GEO Task Team	May 2012
2	Work with GEO to develop spaceborne requirements	May 2102
3	Utilize new QA4EO SEC to establish team contacts and meetings	May 2012
4	Work within CEOS to define implementation requirements across WGs, VCs, and SBA coordinators	June 2012
5	Discuss QA4EO Implementation Plan at CEOS SEC telecon	April 2012
6	Prepare CEOS Chair letter to GEO on QA4EO requirements	June 2012
7	Work to FCT Showcase as high priority, and work to better define other showcase or QA4EO Implementation Pilots	June 2012

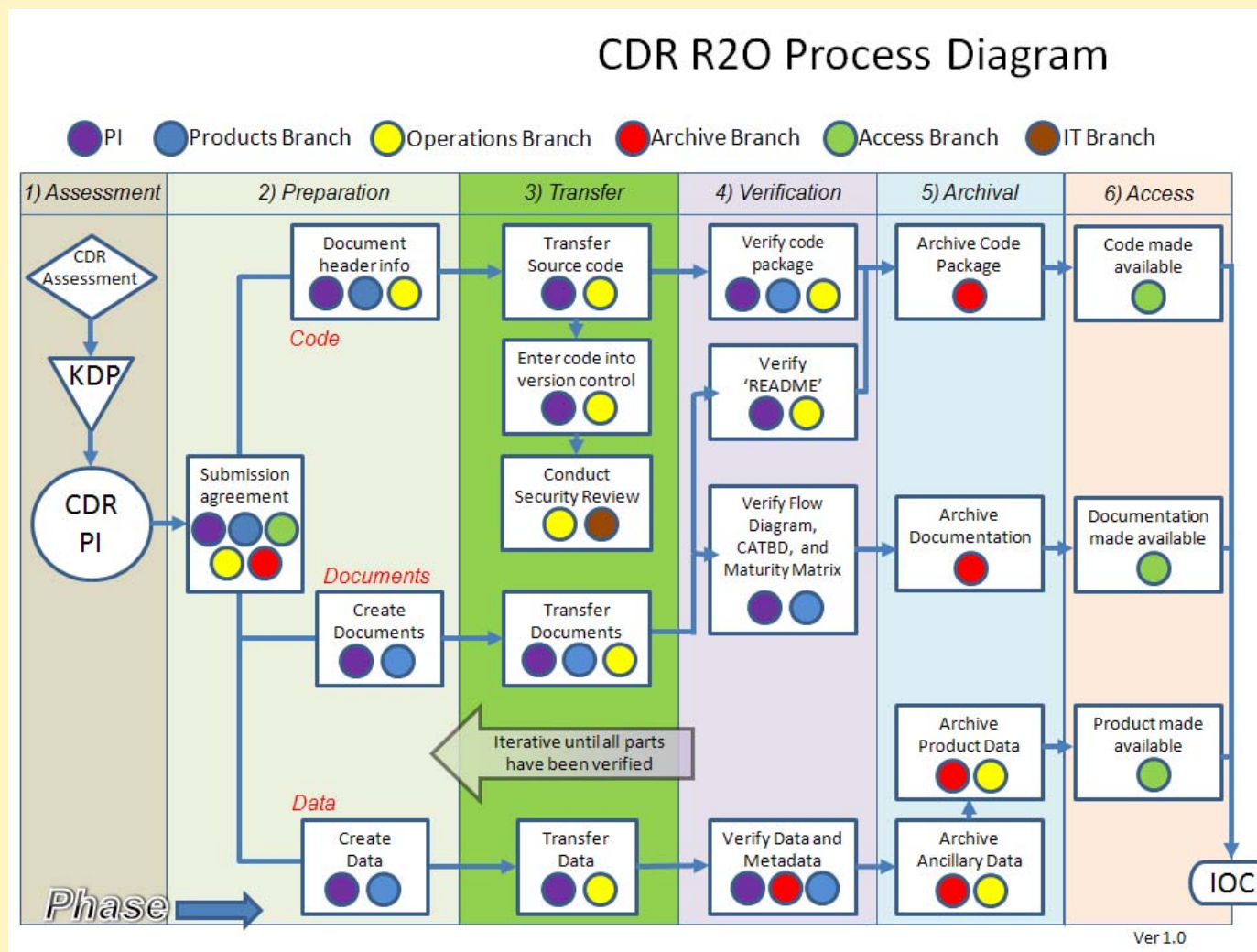
# CEOS Implementation Process

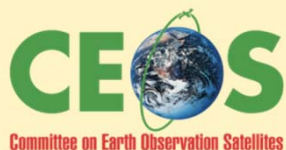


# ECV planning – WG on Climate



# ECV planning – WG on Climate





# WGCV engage in common efforts w/ other CEOS components

- WGCV engage in these efforts and gather GEO/CEOS /support efforts to move QA4EO forward
- What should we work on???
  - Develop QA Data Infrastructure
    - Incorporate QA into GEO and CEOS Data and Information Infrastructure
    - QA definitions/standards?
    - Quality in metadata, “fit for purpose” information, accuracy, error, uncertainty, traceability
    - Fields in GEO and CEOS data structure
    - System specs and standards
    - Cal/val documentation and traceability
  - QA4EO Implementation Pilots (QIPs)
    - Carbon standards?
    - FCT/GFOI
    - Air Quality/Atmospheric Comp
  - ECV definitions and Validation Processes
    - Working Group on Climate
    - ECV cal/val and QA?
  - LTDP?
  - Carbon and climate requirements validation?
  - In situ and modeling quality, uncertainty, traceability
  - Other programs?
- Develop Table of prioritized implementation requirements
- Comments, thoughts, ideas

# Ideas and Questions

- Discussion
- *When you can measure what you are speaking about and express it in numbers you know something about it; but when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind" (Lord Kelvin, 1883)*