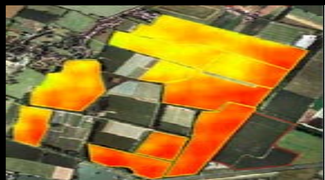
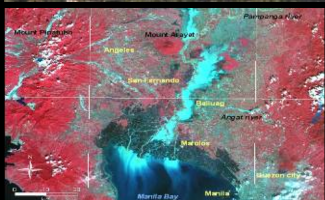
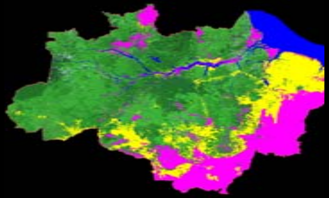






DMCii Preliminary Experiences towards QA4EO Implementation

WGCV 30



Steve Mackin

Chief Scientist

DMC International Imaging Ltd

Conclusions

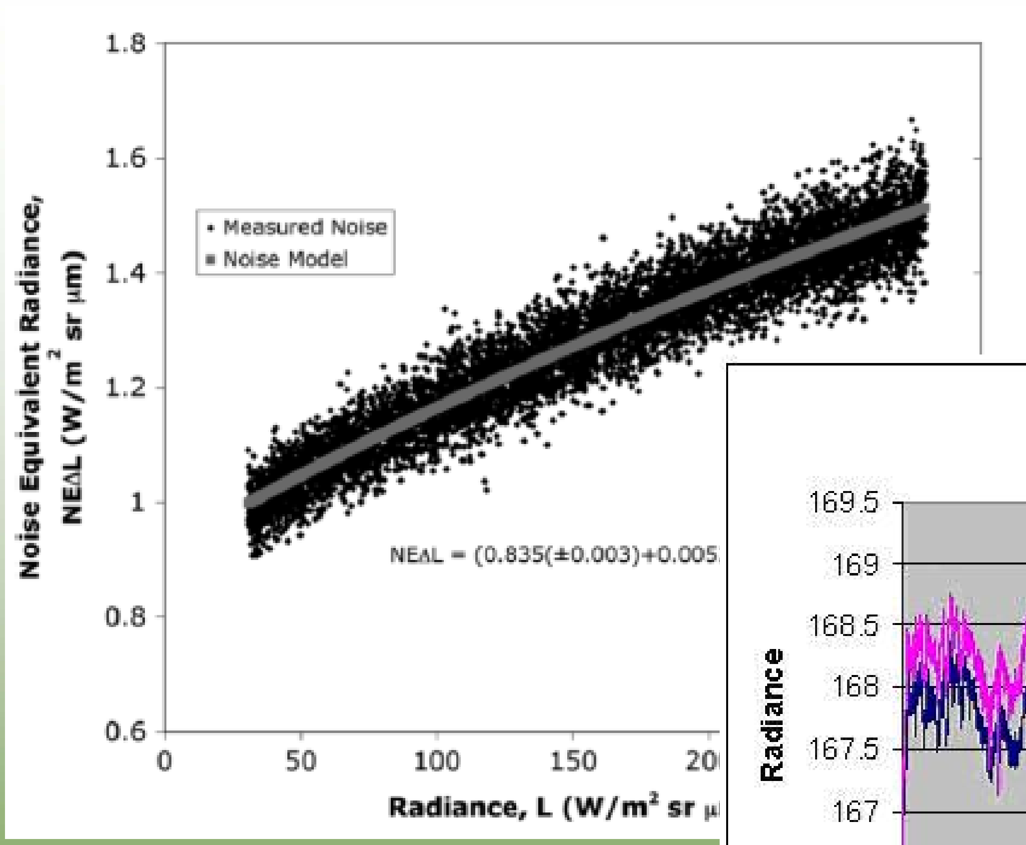
- I am **not** happy with the quality indicators we currently produce for the DMC satellites.
- I believe we need to move towards a pixel based quality indicator for products
- To do this I need to understand the uncertainties of the processes I use to make the products
- To understand the uncertainty I need to document **every** process and understand how it contributes to my overall uncertainty budget
- I believe the QA4EO guidelines provide a structure that will allow me to do this

Point 1

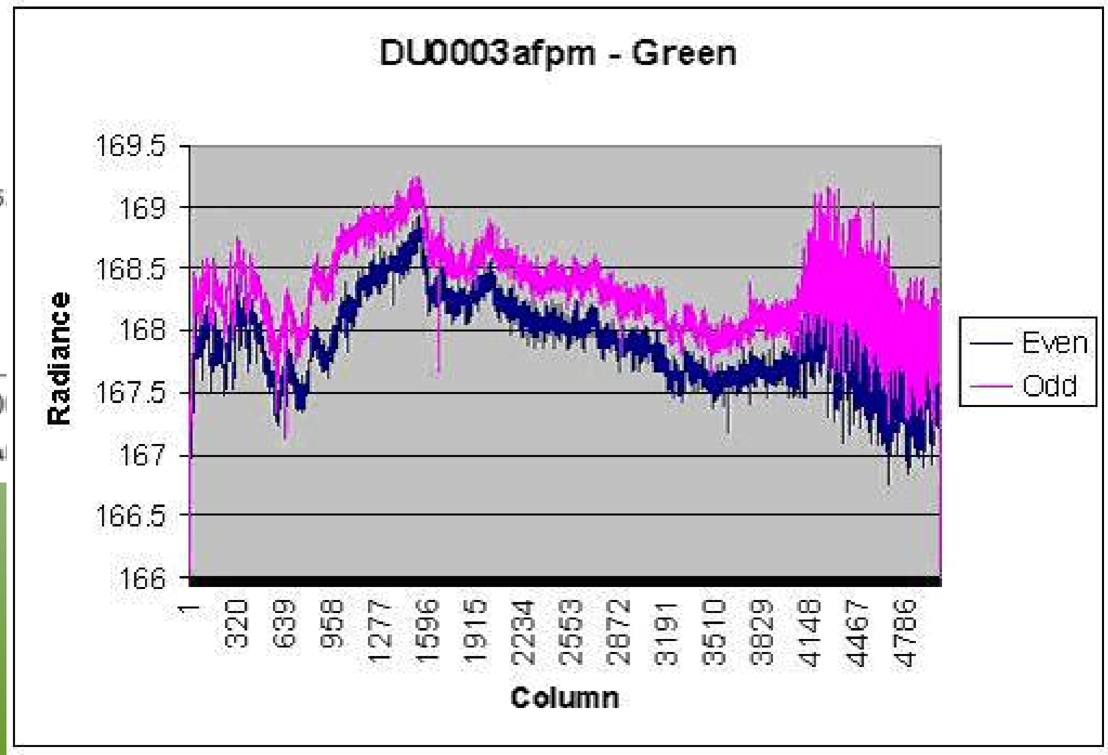
- I am **not** happy with the quality indicators we currently produce for the DMC Satellites.

- The calibration of the DMC satellites is as good as many other systems. However, when I produce a product I can only state
  - The overall calibration uncertainty per band (not per pixel)
  - The SNR or NEdL of a specific band
- This does not tell me if there is any “low-level” anomalous behaviour in the sensor
- This does not tell me the level of uncertainty over different targets in my image

Examples



Measured Noise
Noise Model
Noise Equivalent Radiance, NEΔL (W/m2 sr μm)
1.8
1.6
1.4
1.2
1
0.8
0.6
0
50
100
150
NEΔL = (0.835(±0.003)+0.005
Radiance, L (W/m2 sr



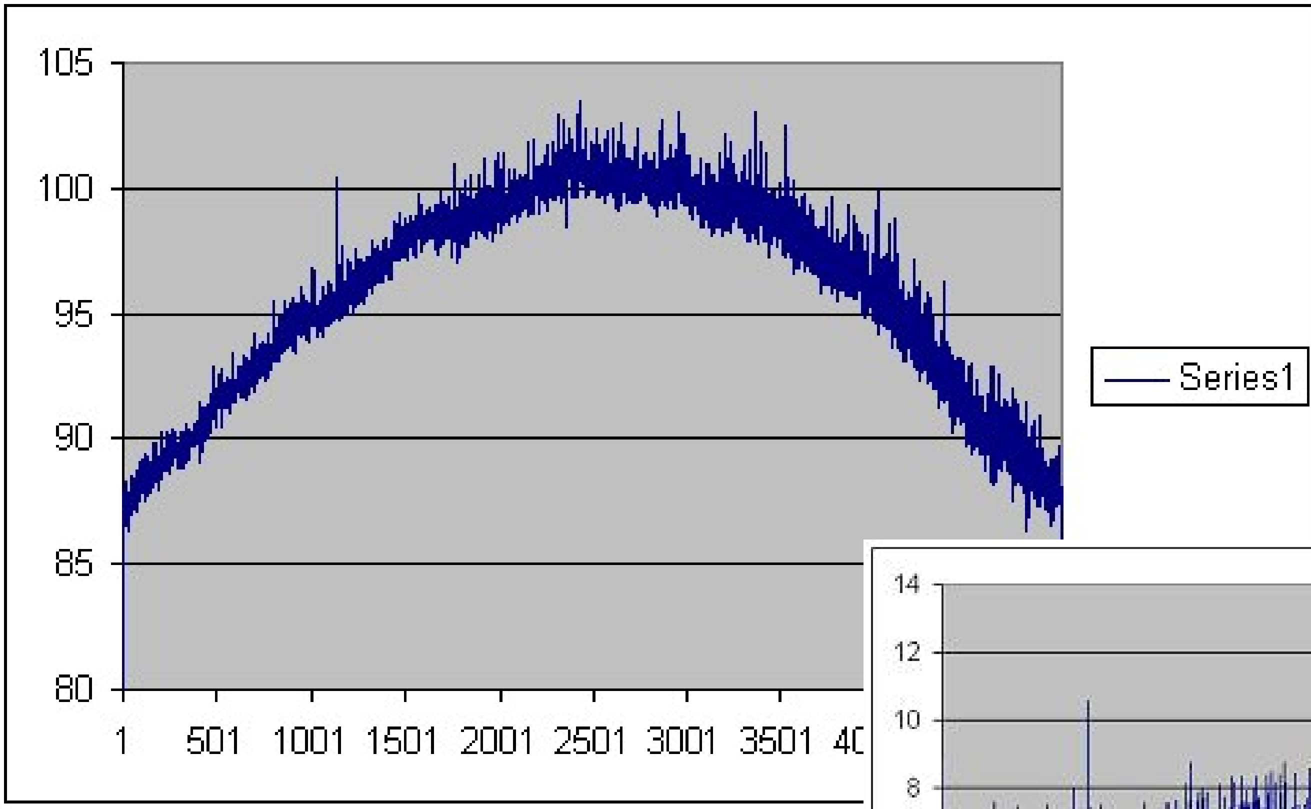
DU0003afpm - Green
Radiance
169.5
169
168.5
168
167.5
167
166.5
166
1
320
639
958
1277
1596
1915
2234
2553
2872
3191
3510
3829
4148
4467
4786
Column
Even
Odd

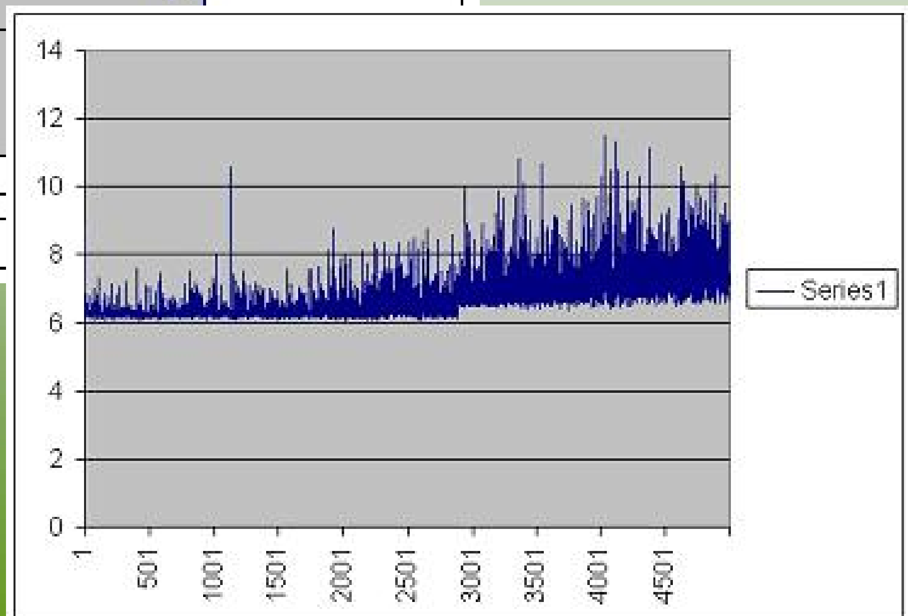
Point 2

- I believe we need to move towards a pixel based quality indicator for products

- In a CCD array of 20,000 detectors every one has its own noise characteristics.
- Vignetting in the optics means that the edges of the FOV the noise contribution is greater.
- The noise contribution is a function of signal level, hence the uncertainty varies with brightness of the target

Examples


105
100
95
90
85
80
1
501
1001
1501
2001
2501
3001
3501
Series1


14
12
10
8
6
4
2
0
1
501
1001
1501
2001
2501
3001
3501
4001
4501
Series1

Point 3

- To do this I need to understand the uncertainties of the processes I use to make the products
- All satellite operators have values for calibration accuracy, SNR, MTF etc. which are often stated
- Most operators have knowledge and experience of what impact these values have.
- But…can they say that a specific pixel has a specific uncertainty in its value and which processes contribute

Point 4

- To understand the uncertainty I need to document **every** process and understand how it contributes to my overall uncertainty budget

- Unless I now explore each process and document how it operates and determine which areas contribute I can not assess where the uncertainty lies.
- Many processes are dependent on lower-level operations which also need documenting.
- Assumptions need to be explored where possible and proof given of their validity or at least an estimate of the uncertainty they induce

TOA Radiance – Steps (in outline…!!!)

Steps

1. TOA Radiance Product

    a. Absolute Calibration (5 acquisitions)
        i. Generation of TOA radiance (band integrated value)
            1. Ground data collection at RRV
                a. Instrument and Panel Calibration
                b. Surface Measurement
                c. Surface Variability across site
            2. Atmospheric analysis at RRV
                a. Instrument calibration
        ii. DMC Data Collection at RRV
            1. Surface Variability across site
            2. System noise (two pixel average)
            3. CCD stability – odd/even pixels
            4. CCD stability – CCD cross array variability
            5. Dark Image
        iii. DMC Transfer to Dome-C
            1. Surface Variability across site
            2. System noise (large column average)
            3. CCD stability – odd/even pixels
            4. CCD stability – CCD cross array variability
            5. Atmospheric variability
            6. Dark Image
    b. Cross-Calibration (19 image pairs)
        i. DMC Collections over Dome-C
            1. Atmospheric change between overpasses
            2. Surface variability
            3. Accuracy of pointing
            4. System noise (per overlap area)
            5. CCD stability (per overlap area)
            6. Dark Image Collection
            7. Absolute Calibration accuracy (from above)
            8. Calibration drift
    c. Calibration Drift (many images)
        i. DMC collections over stable sites
    d. TOA Radiance product
        i. Variability in target brightness (hence noise)
        ii. Absolute calibration after transfer via cross-calibration and adjustment for calibration drift.
        iii. CCD stability

Point 5

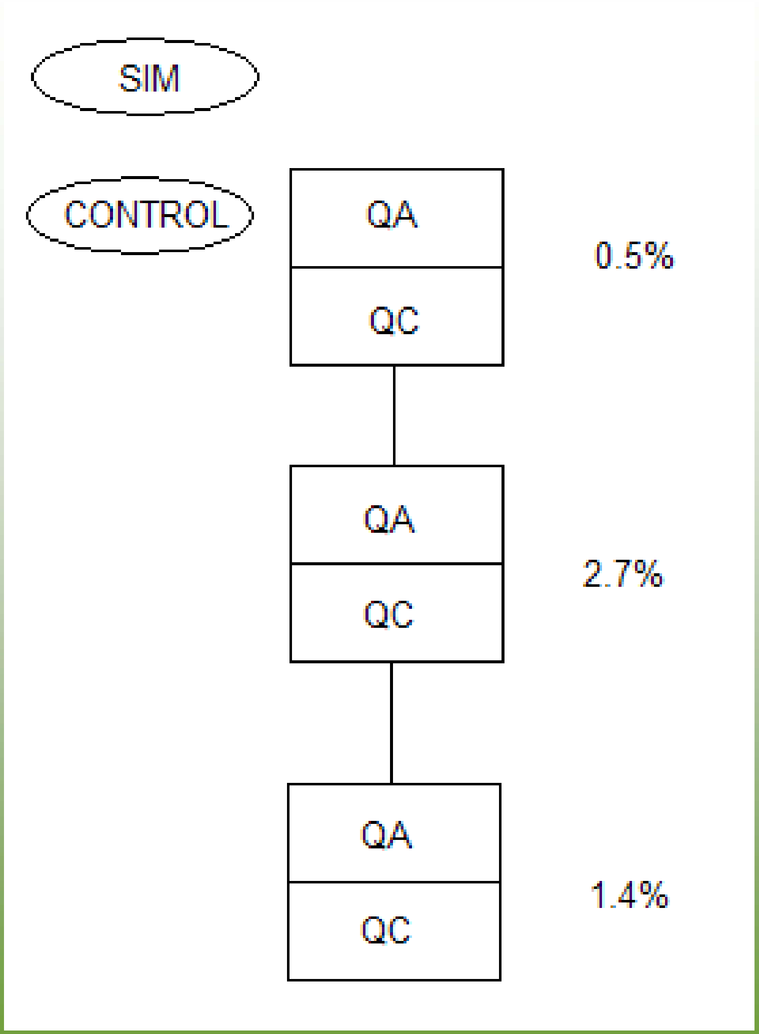
- I believe the QA4EO guidelines provide a structure that will allow me to do this

- The guidelines and structure provided by QA4EO is based on sound practices employed by Metrology institutes
- The structure defines, but does not dictate and provides structure on the documentary evidence and proofs.
- How you do things is up to you, as long as you can prove how you do things.

What next

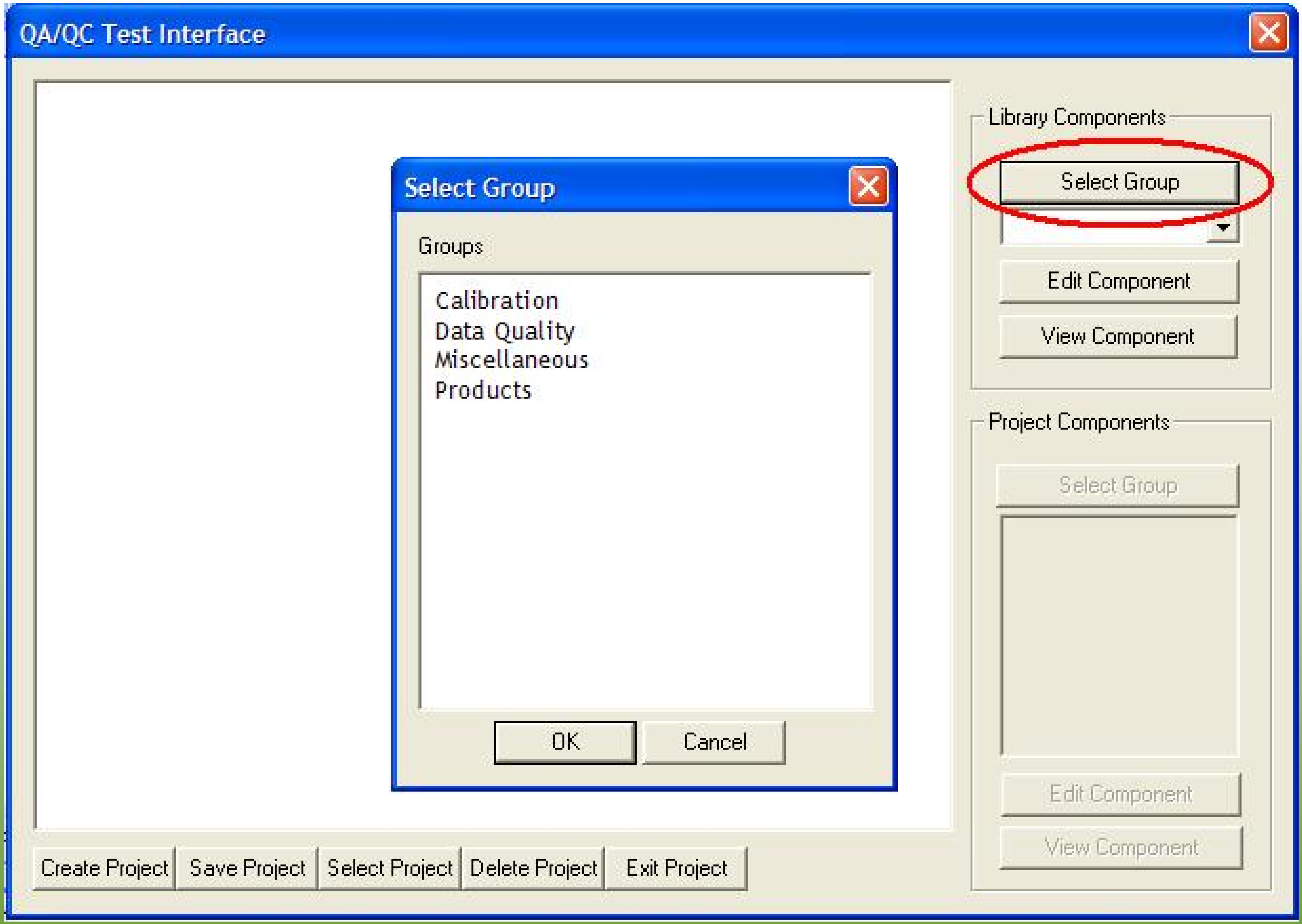
- Developing software product to
  - Manage the modules created
  - Adhere to the structure proposed within QA4EO
  - Simulate process flow in my system
  - Automatically monitor system operation (and correct..?)

Software Structure

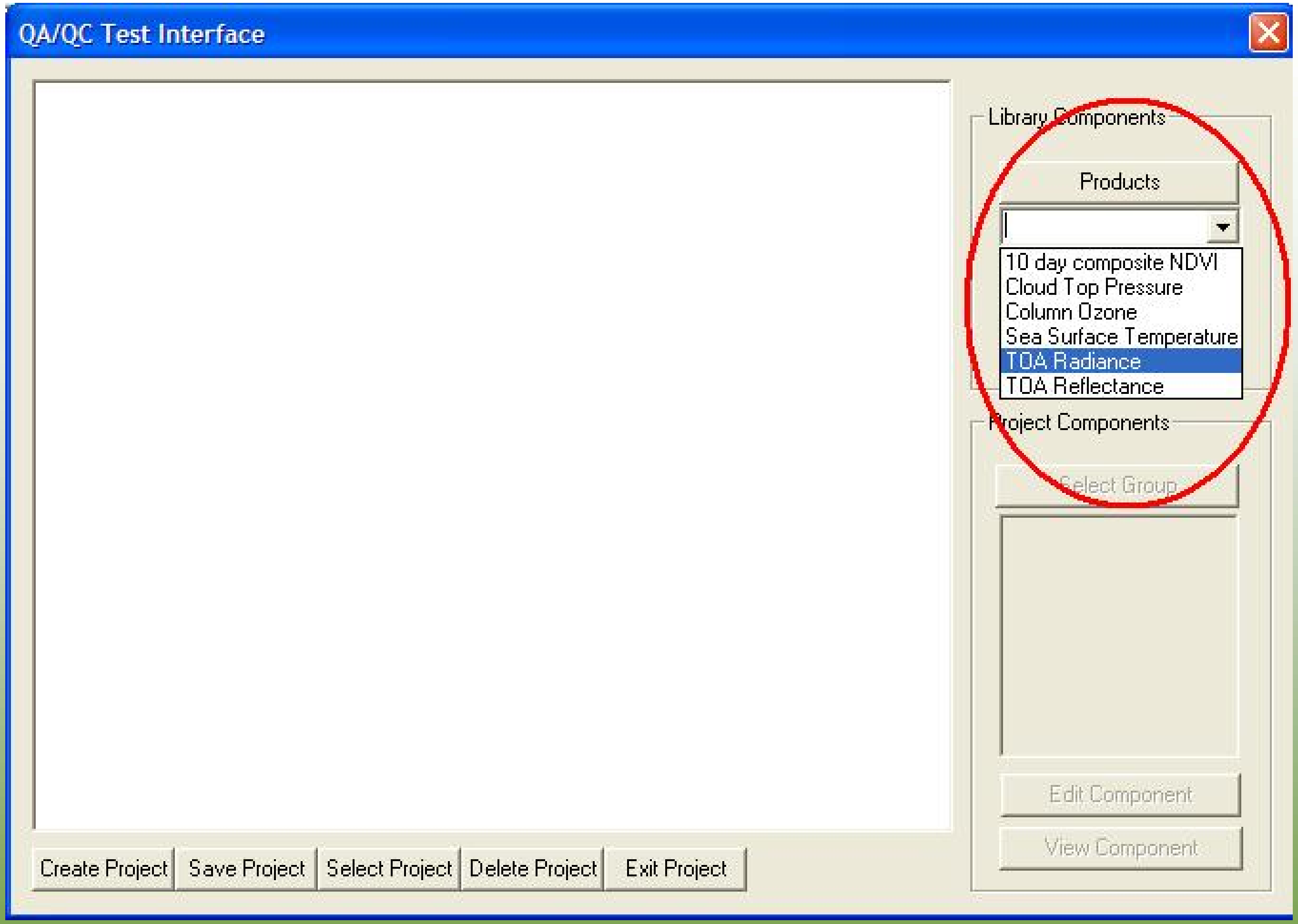


- Single or aggregated (management) modules
- Modules can be added, removed or modified
- NOT a time sequence
- QA4EO documentation supports QA and QC components
- QC can actively change operation
- Can be run as a simulator

Some elements

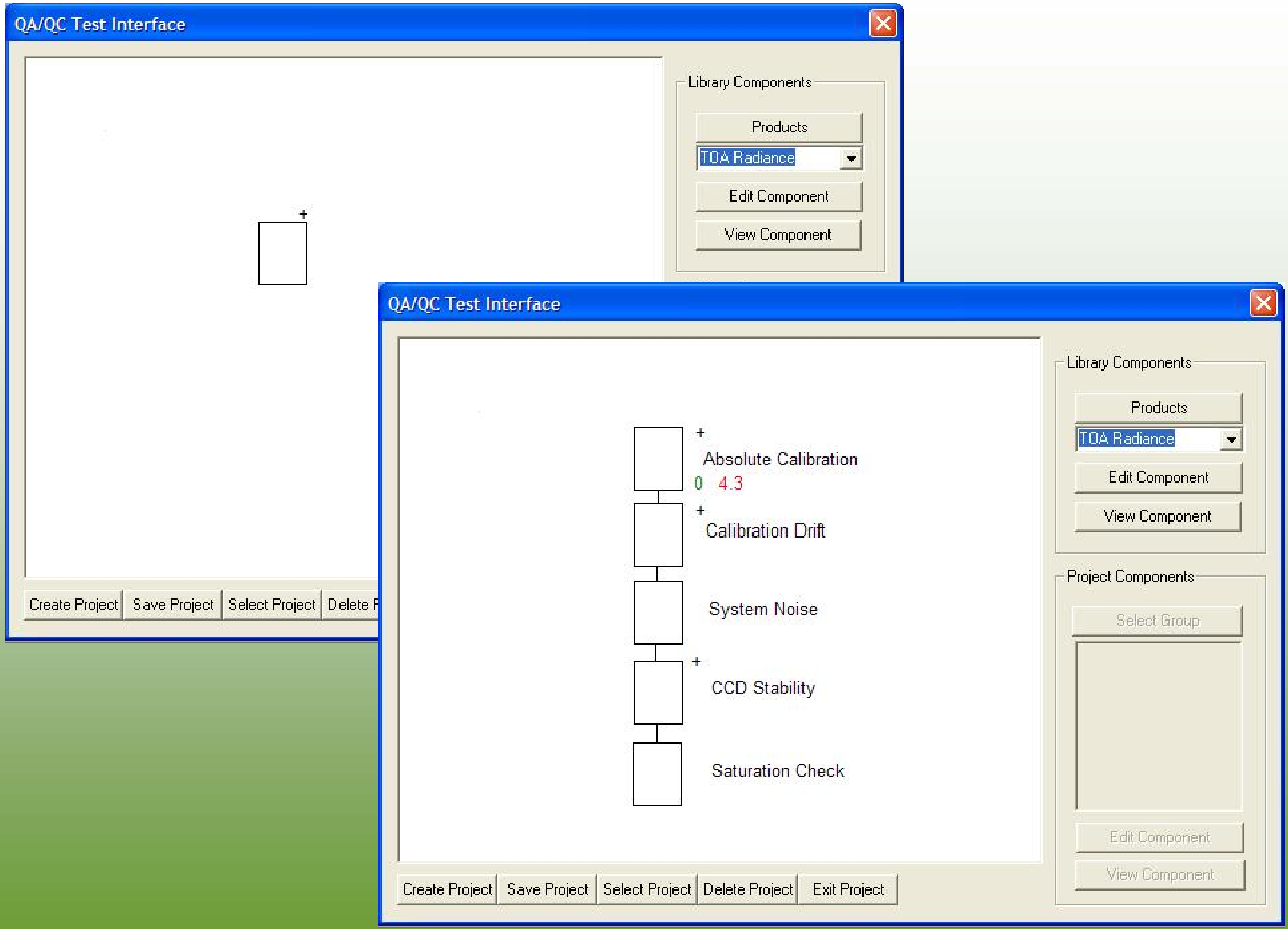


Some elements



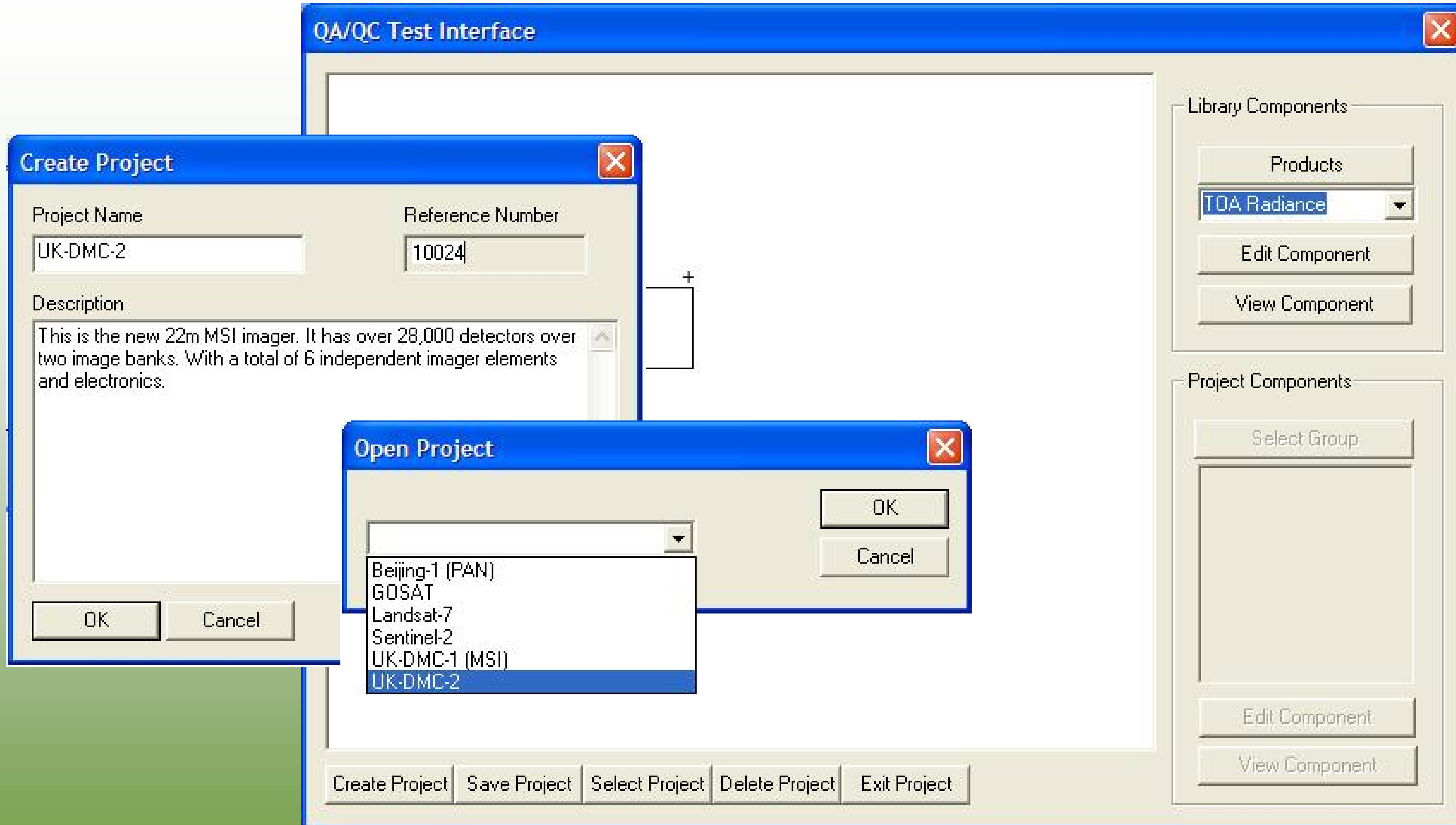
Product based

Some elements



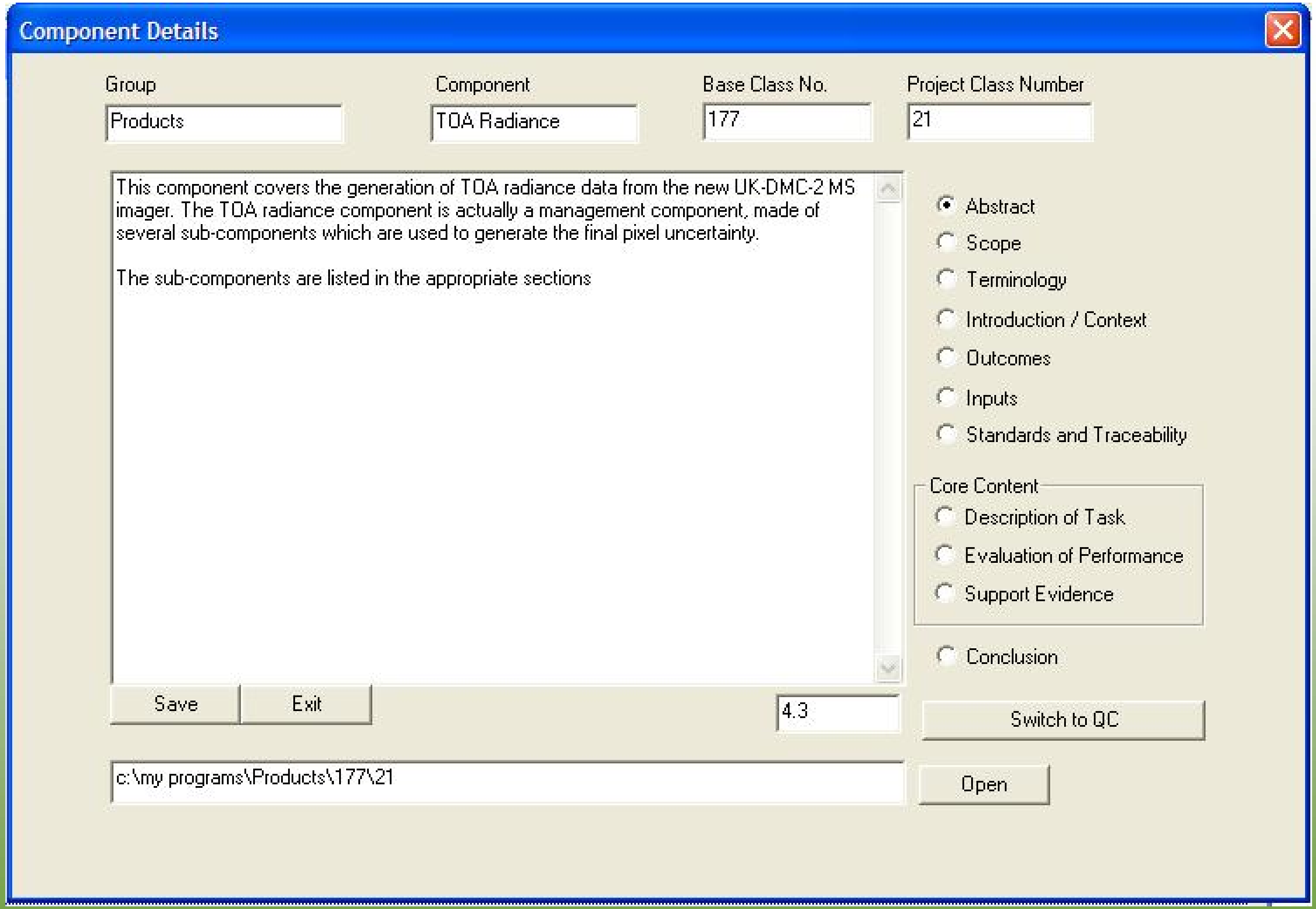
Management and aggregated chains

Some elements



Projects and re-useable components

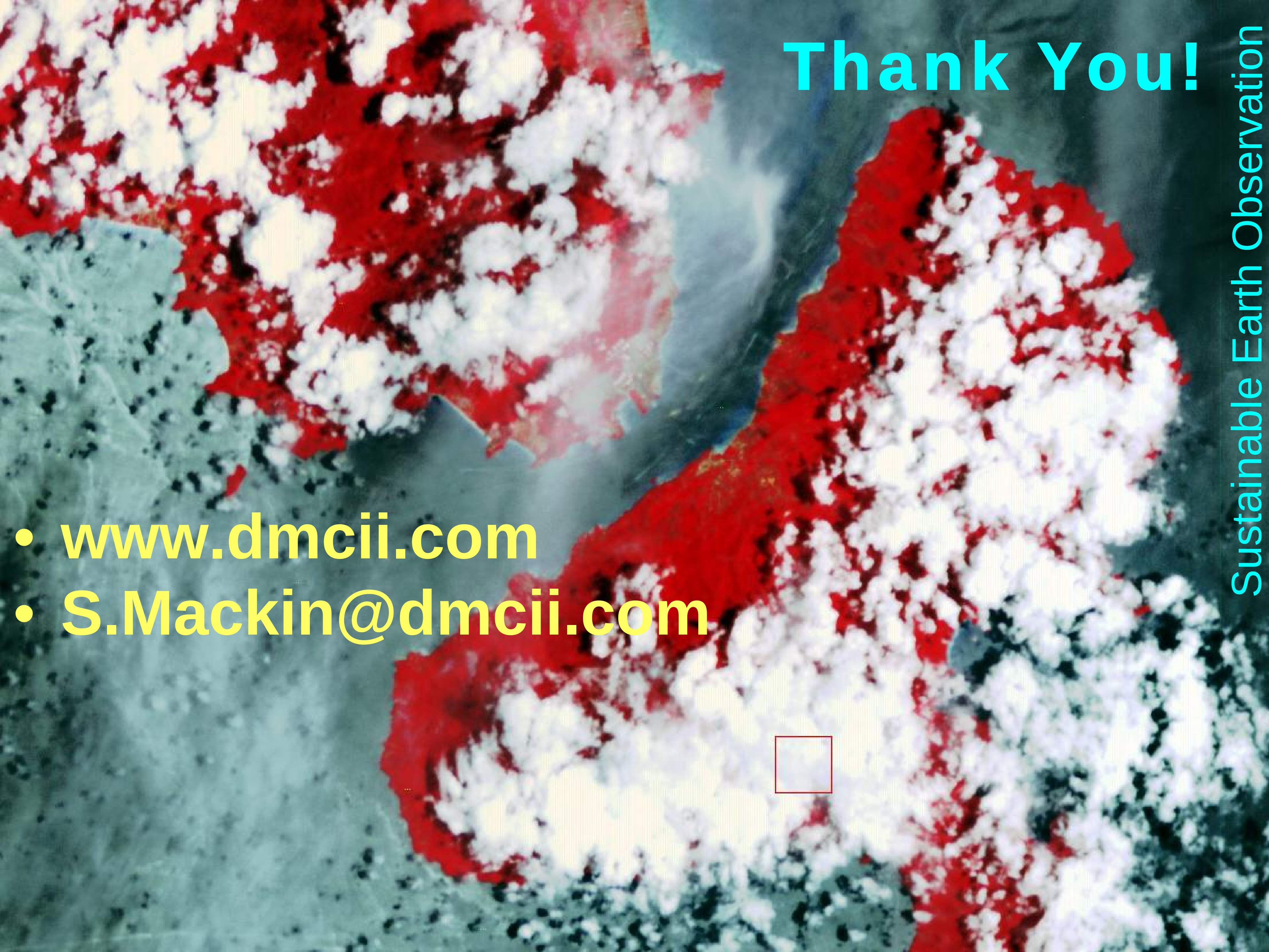
Some elements



Manages QA4EO documentary proof

Conclusions

- I am **<u>not</u>** happy with the quality indicators we currently produce for the DMC satellites.
- I believe we need to move towards a pixel based quality indicator for products
- To do this I need to understand the uncertainties of the processes I use to make the products
- To understand the uncertainty I need to document **<u>every</u>** process and understand how it contributes to my overall uncertainty budget
- I believe the QA4EO guidelines provide a structure that will allow me to do this



Thank You!

Sustainable Earth Observation

- www.dmcii.com
- S.Mackin@dmcii.com