National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

CEOI

NCEO/CEOI Earth Explorer 10 Mission Candidate Workshop

Alessandro Battaglia – NCEO/CEOI
John Remedios – Director of NCEO
Mick Johnson – Director of CEOI

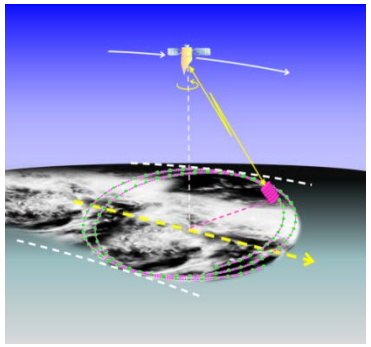
14th December 2018

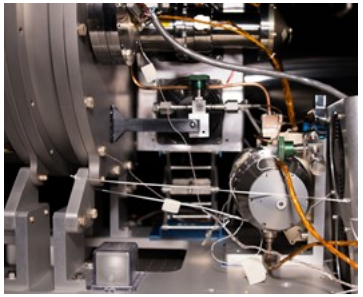
Agenda

Time	Title	Speaker	Organisation
10.00	Arrival and Registration		
10.30	Introduction and Welcome	Mick Johnson/ Alessandro Battaglia John Remedios	CEOI NCEO
10.45	**The G-CLASS:H20 Mission Concept** A mission to make observations of diurnal water cycle processes	Prof. S. Hobbs	Cranfield University
11.30	Discussion on technology/science needs for G-CLASS:H20 *		
12.15	**The STEREOID Mission Concept** A mission to measure small shifts in the ocean surface, in glaciers and in Earth's surface	Prof P. Lopez Dekker	TU Delft
13.00	Lunch		
13.30	Discussion on technology/science needs for STEREOID *		
14.15	**The Daedalus Mission Concept** A mission to quantify amounts of energy deposited in the upper atmosphere	Dr Mark Clilverd	British Antarctic Survey
15.00	Discussion on technology/science needs for Daedalus *		
15.45	Closing discussion		
16.00	Close		

What is the CEOI?

- UK Space Agency initiative to boost UK capability and remain at the forefront of EO technology for space
  - Fund innovative technologies for global EO mission opportunities
  - Support developments for commercial exploitation opportunities
  - Build capability, create new UK jobs and economic growth through leverage of investment in EO
  - Parallel industry investment, total approx £2-3M pa
- CEOI Programme focus on:
  - development of new EO instrumentation and technologies, taking EO technologies to higher TRL
  - horizon scanning and knowledge exchange
  - building highly capable academia/industry partnerships
  - Liaison with ESA
- Partnership led by Airbus with QinetiQ, STFC/RAL and University of Leicester





Science & Technology Facilities Council
Rutherford Appleton Laboratory

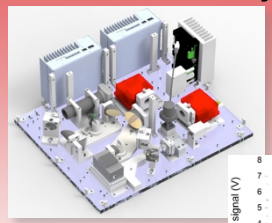
UNIVERSITY OF LEICESTER

QinetiQ

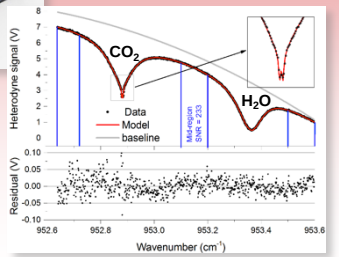
AIRBUS DEFENCE & SPACE

Recent CEOI Developments

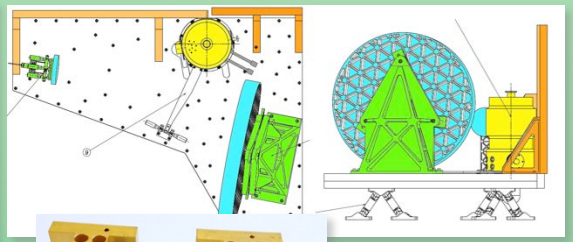
LIDAR & Laser Heterodyne Radiometry (LHR)



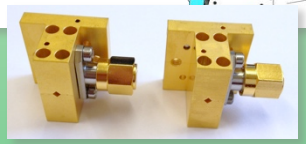
LHR Field Deployment
RAL Space



Sub-millimetre & THz technology

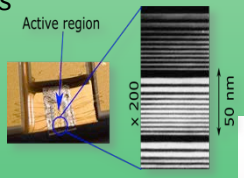


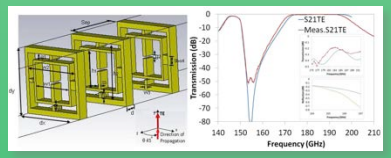
LOCUS
RAL/Leeds



Supra-THz Mixers
RAL & Leeds

THz Quantum Cascade Lasers
Leeds

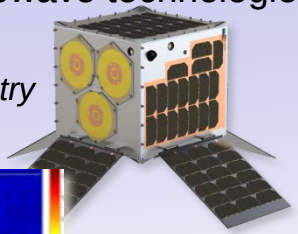


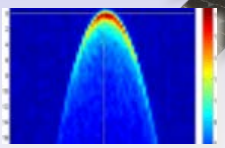


Frequency Selective Surfaces
QUB

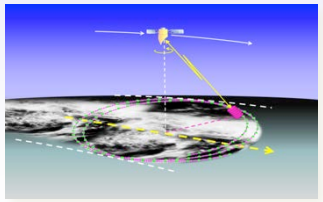
Microwave technologies

GNSS Reflectometry
SSTL

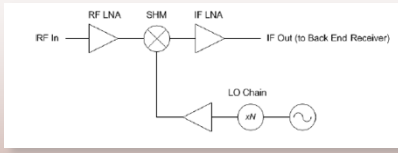


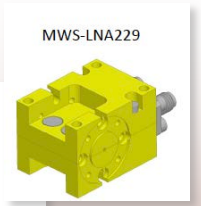


94GHz Wind/Rain Radar Reading/RAL

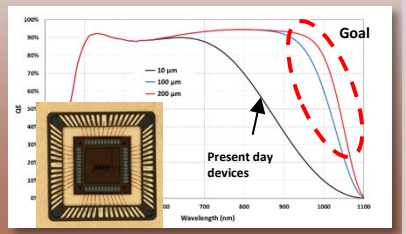


mm-Wave receivers
RAL Space

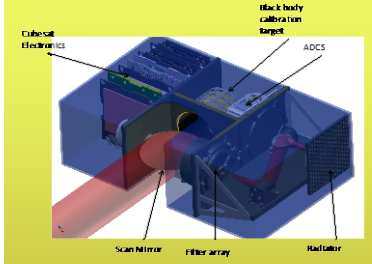




Detectors
Teledyne E2V



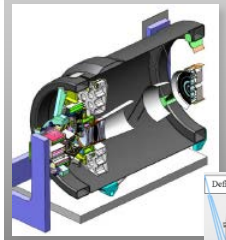
Spectroscopy



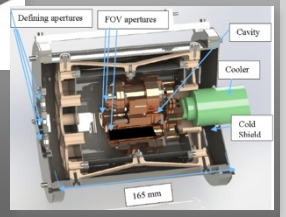
IR Radiomometry (Cubesat)
U. Oxford

GHOST
U. Edinburgh
STFC ATC

Optical instrumentation



Hi-Res Imaging & Video
SSTL



TRUTHS
National Physical Laboratory

CEOI Programme for 2018/19

- **Challenge Workshop (30th April 2018)**
  - Future EO Mission Portfolio – community consultation
- **Industrial Consultation Workshop (22nd May 2018, MRC HQ)**
  - 'Miniaturisation of High Performance Remote Sensing Instruments'
- **National EO Conference (4th to 7th September 2018)**
  - Tri-annual conference, with NCEO and RSPSoc;
  - Venue: University of Birmingham;

- **CEOI Technology Review (10th December 2018)**
  - Review of CEOI-7, 8 and 9 projects
  - Targeting space audience including ESA, InnovateUK/KTN, UKSA, STFC
- **CEOI ESA Earth Explorer 10 Mission Candidates (14th December 2018)**
  - Workshop to identify potential future UK activities related to the 3 ESA Earth Explorer candidate 10 missions;
  - Venue: Imperial College, London

- **Emerging Technologies Challenge Workshop (1st & 2nd May 2019)**
  - An investigation of innovative technologies for future EO missions
  - Bi-annual CEOI event
  - Venue: Cosener's House, Abingdon

CEOI 12th EO Technology Call

- CEOI 12th Technology Call now live!
- At least £2M of funding will be available
- Innovative new EO technologies and airborne demonstrators
- Flagship, Fast Track and Pathfinder projects:
  - Projects should advance the EO Technology Strategy
  - New technology ideas and mission options for global export
  - CEOI looking to fund a balanced portfolio of technology projects

Event	Date
Announcement	6th Dec 2018
ITT Issued	13th Dec 2018
Closing date for Proposals	12th Feb 2019
Projects Commence	From Mar/Apr 2019

Web: ceoi.ac.uk

Twitter: @CEOI_Space

Selection Procedure for ESA Earth Explorer 10 Mission Candidates

Alessandro Battaglia
CEOI Science Co-Director

ESA Earth Explorer Missions

1. GOCE– Gravity Field and Steady-State Ocean Circulation Explorer (launched on 17 March 2009).
2. SMOS – Soil Moisture and Ocean Salinity (launched on 2 November 2009).
3. CryoSat2 (launched on 8 April 2010).
4. Swarm, a trio of satellites to map the Earth's magnetism (launched on 22 November, 2013).
5. Aeolus – Atmospheric Dynamics Mission (launched on 22 August, 2018) .
6. EarthCARE – Earth Clouds Aerosols and Radiation Explorer (launch expected 2021).
7. Biomass (launch expected in 2021).
8. FLEX the FLuorescence EXplorer mission (launch expected in 2022).
9. SKIM or FORUM (launch expected in 2026).

NCEO
major involvement

The Call for Earth Explorer-10 Mission Ideas was released on **25 September 2017**

A CORE mission (last call March 2005)
The total **cost of the mission should not exceed 400 M€** to ESA (at 2017 economic conditions) covering the development of the mission up to the end of the commissioning phase (phase B1 to E1).
225 M€ has been set for all industrial development costs for the space segment, excluding launch services, operations, ground segment, level 2 processor and ESA internal costs.

Deadline for submission: **2nd March 2018**

EE10 selection process

List of Submitted Proposals

Ref. No.	Short Name	Proposal Full Name
CEE10_001	STRATUS	SaTellite RAdar sounder for earTh sUbsurface Sensing
CEE10_002	ARRHENIUS	AbsoRption spectRometric patHfindEr for carboN regIonal flUx dynamicS
CEE10_003	Nitrosat	Mapping reactive nitrogen at the landscape scale
CEE10_004	LEONARDO	Low Earth Orbit Novel Advanced Radiation Diurnal Observation
CEE10_005	ATLAS	Atmospheric Thermodynamics LidAr in Space
CEE10_006	LOCUS	Linking Observations of Climate, the Upper-atmosphere, and Space-weather
CEE10_007	SEASTAR	A mission to study ocean submesoscale dynamics and small-scale atmosphere-ocean processes in coastal, shelf and polar seas
CEE10_008	G-CLASS:H2O	A mission to observe and understand processes of the daily water cycle over land
CEE10_009	WIVERN	WInd VElocity Radar Nephoscope to observe global in-cloud winds, clouds and precipitation.
CEE10_010	EAGER	EArth enerGy imbalance ExploreR
CEE10_011	RISC	Radar Imager to Sense a changing Cryosphere
CEE10_012	STEREOID	Stereo Thermo-Optically Enhanced Radar for Earth, Ocean, Ice, and land Dynamics
CEE10_013	CryoRad	Low frequency wideband radiometer for the study of the cryosphere
CEE10_014	MOBILE	Mass variation OBservIng system by high-Low inter-satellitE links
CEE10_016	MIN$_2$OS	Monitoring Nitrous Oxide Sources
CEE10_017	IRIS	Interferometric Radar for (the observation of) Ice, glaciers and permafrost dynamicS
CEE10_018	Daedalus	A Low-Flying Spacecraft for the Exploration of the Lower Thermosphere - Ionosphere
CEE10_019	SATMEP	SATellite for Monitoring Earthquake Precursors
CEE10_020	TIREX	Thermal InfraRed EXplorer
CEE10_021	CAIROS	Constellation of Atmospheric hIgh Resolution Occultation Spectrometers
CEE10_022	Qsat	Profiling Water Vapour from Space

The **scientific evaluation** has been carried out by the Advisory Committee for Earth Observation (**ACEO), with the support of two scientific panels** including 32 external experts.

In parallel, **three technical panels** were set up by the Agency to **assess the technical and programmatic aspects**, involving technical experts from the Directorate of Earth Observation Programmes and the Directorate of Technology, Engineering and Quality.

The 7 Mission Selection Criteria

1. **Relevance to the ESA research objectives for Earth Observation as set in the** Earth Observation Science Strategy for ESA
2. **Need, usefulness and excellence**.
3. **Uniqueness and complementarity**.
4. **Degree of innovation and contribution to the advancement of European Earth Observation capabilities (**technical/industrial aspects as well as user interests).
5. **Feasibility and level of maturity** (TRL and SRL**,** user community within ESA)
6. **Timeliness** (user needs+implementation constraints).
7. **Programmatics** (schedule, cost, risk, etc., +synergies with other national and international developments)

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CEE10_003	Nitrosat	Mapping reactive nitrogen at the landscape scale
CEE10_004	LEONARDO	Low Earth Orbit Novel Advanced Radiation Diurnal Observation
CEE10_005	ATLAS	Atmospheric Thermodynamics LidAr in Space
CEE10_006	LOCUS	Linking Observations of Climate, the Upper-atmosphere, and Space-weather
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UK/CEOI involvement

Announcement of results ratified
by Earth Observation Panel Board
PB-EO
End of September 2018

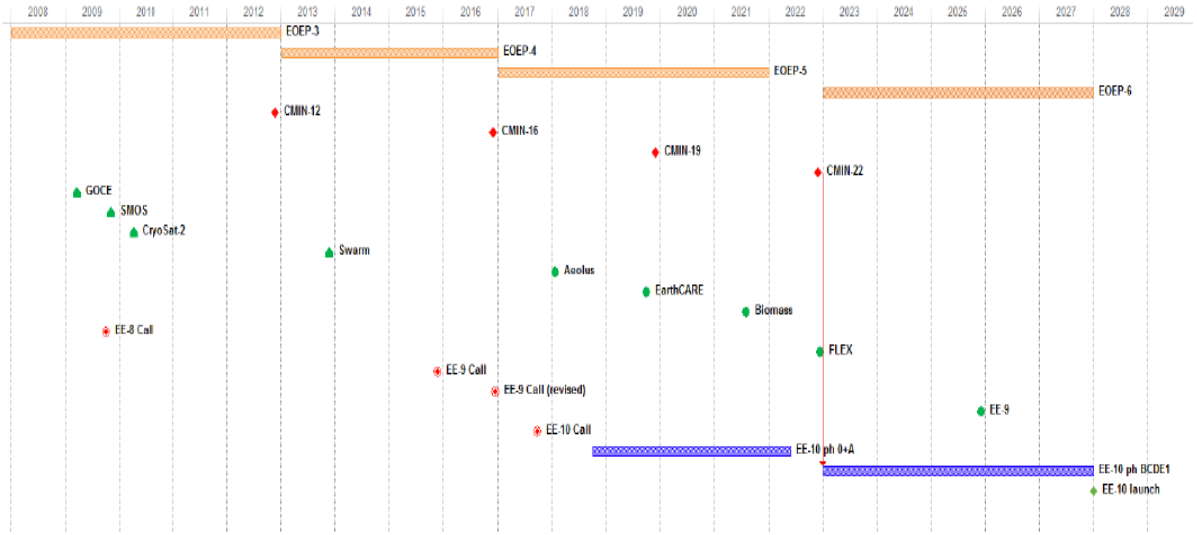
selection of **three mission ideas**,
which will undergo Phase-0 studies.

Next steps

End of November 2018: selection of MAG members
Early 2019: start of Phase 0 studies

At the end of Phase 0 a Mission Definition Review will be performed to assess each mission concept, and the Earth Science Advisory Committee (ESAC+PB-EO) will recommend the two highest ranked concepts to proceed to Phase-A studies.

A decision on the full implementation (Phase B/C/D/E1) of one of the two missions will be taken at the end of Phase A, supported by a public User Consultation Meeting (UCM) and scientific peer-review under the auspices of ESAC.



The Agency foresees a launch of EE-10 in the 2027/28 timeframe.