National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

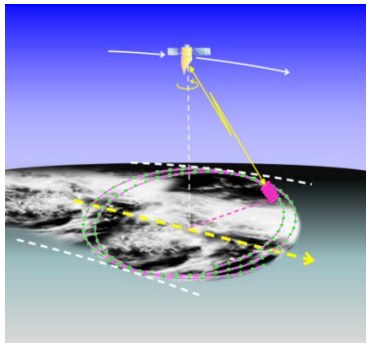
Centre for EO Instrumentation

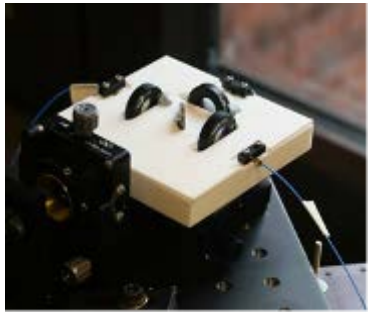
Conference Welcome

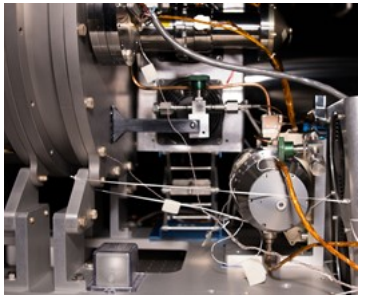
John Remedios & Mick Johnson

What is the CEOI?

- UK Space Agency initiative to strengthen UK EO technology capability, with enhanced breadth and depth
  - Funds innovative technologies for global EO mission opportunities
  - Supports developments for commercial exploitation opportunities
  - 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

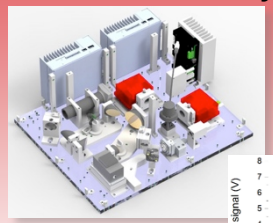
QinetiQ

AIRBUS DEFENCE & SPACE

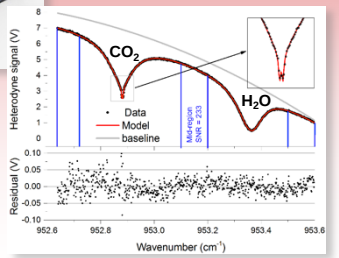
Recent CEOI developments

(non-exhaustive)

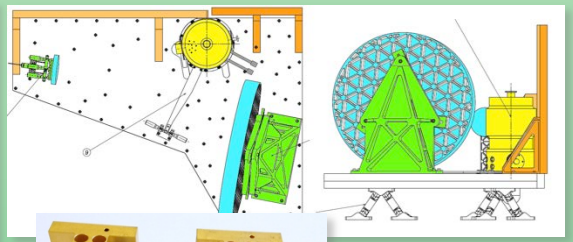
LIDAR & Laser Heterodyne Radiometry (LHR)



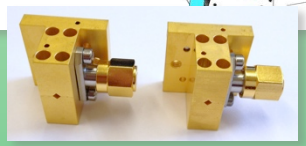
LHR Field Deployment
RAL Space



Sub-millimetre & THz technology

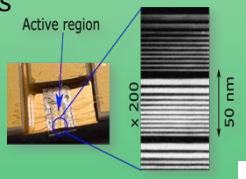


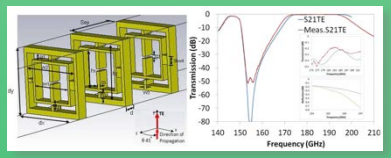
LOCUS
RAL/Leeds



Supra-THz Mixers
RAL & Leeds

THz Quantum Cascade Lasers
Leeds

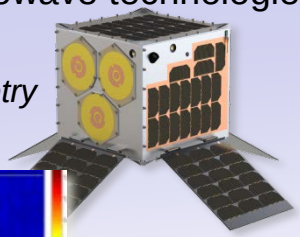


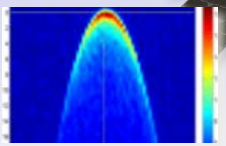


Frequency Selective Surfaces
QUB

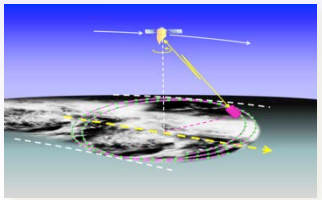
Microwave technologies

GNSS Reflectometry
SSTL

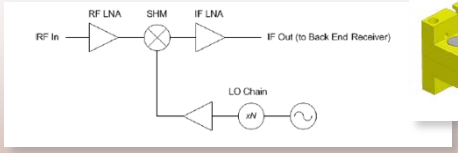


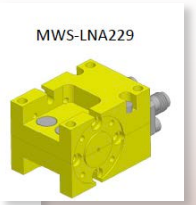


94GHz Wind/Rain Radar Reading/RAL

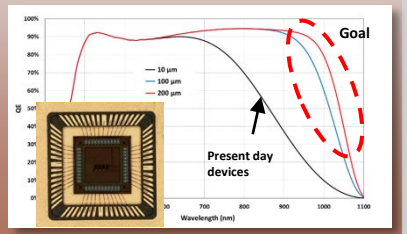


mm-Wave receivers
RAL Space

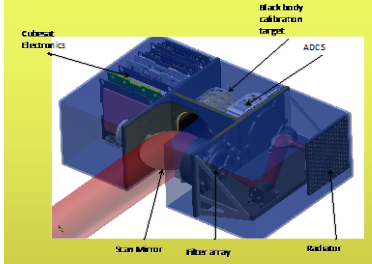




Detectors
Teledyne E2V



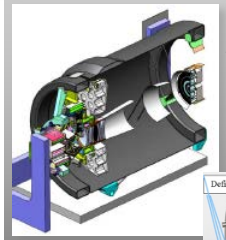
Spectroscopy



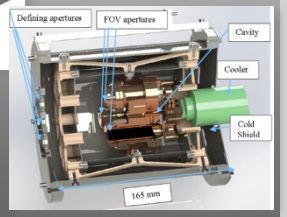
IR Radiomometry (Cubesat)
U. Oxford

GHOST
U. Edinburgh
STFC ATC

Optical instrumentation



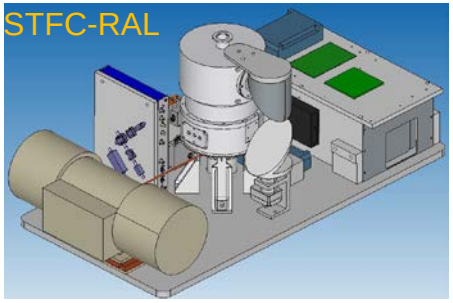
Hi-Res Imaging & Video
SSTL

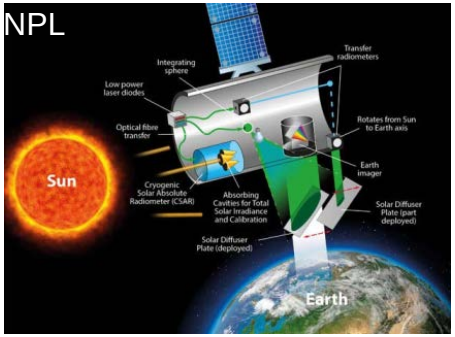


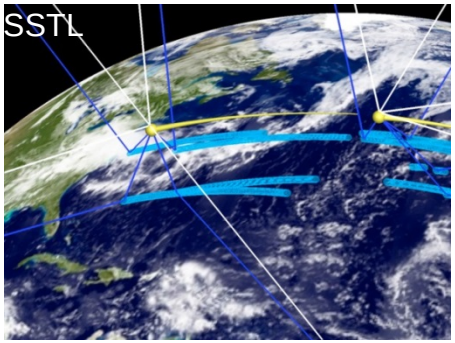
TRUTHS
National Physical Laboratory

Developing technologies for future EO missions

- UV/visible high resolution spectrometer
  - CompAQS instrument for air quality
- Advanced millimetre wave and TeraHz technologies
  - Microwave Sounder (MWS) for MetOp-2G
  - Development of LOCUS mission and technologies
- Climate and GHG Monitoring
  - In-orbit SI-traceable calibration (TRUTHS)
  - Technologies for CNES bilateral (MicroCarb)
- Advanced Radar Systems and Missions
  - Ocean currents and global winds
- GNSS reflectometry for sea surface winds
- Low cost EO imaging systems







CEOI Programme for 2017

- **Industrial Consultation Workshop (6th April 2017)**
  - Advanced manufacturing techniques for EO
  - Focused workshop with 16-20 attendees from non-space community (CEOI Industry Club)
- **Emerging Technologies Challenge Workshop (3rd and 4th May 2017)**
  - Targeting CEOI technology and EO science community, to investigate future needs and opportunities.
  - 60 attendees from academia, industry, ESA and government
- **Joint Annual EO Science Conference with NCEO (27-30th June 2017)**
  - EO science progress and results
  - New missions, instruments and technologies
  - Linking scientists with technologists
- **CEOI Technology Showcase (26th October 2017)**
  - Joint event with Satellite Applications Catapult
  - To publicise the work of CEOI projects to broader space and non-space community (including ESA, InnovateUK, Research Councils, industry etc)

National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

NERC SCIENCE OF THE ENVIRONMENT

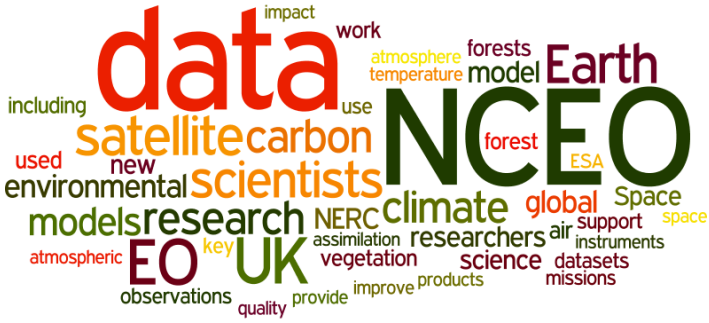
National Centre for Earth Observation

Raison d'etre:

- Remit agreed by NERC Council in 2013
- Approved science programme 2014-2019
- Facilitate "NERC's space infrastructure" for the environmental sciences community.
- Deliver against NERC Strategy: business of the environment

Strengths addressing NERC needs for

- Targeted global to regional scale science aimed at holistic Earth system
- Key EO data sets (a big data challenge) which can be complex to deliver.
- Evaluation and initialisation to deliver robust and credible evaluation of models including DA methods.



Technology Talks @ NCEO-CEOI Conference

- **Talks in each plenary and the poster session**
  - Future EO Missions, Instruments and Technologies
  - ESA missions and technologies, Max Pastena (ESA)
  - Cold Atom Sensors for Gravity Mapping, Tristan Valenzuela
  - Miniaturisation of EO Instruments, Andy Vick, STFC
  - Post-launch calibration approaches, Emma Woolliams
- **"CEOI Technologies in a Nutshell" at 16.30 today**
  - Will include announcement of CEOI 10th Call outcome and ~12 nutsize technology talks
- **Keynote talk – Thursday at 09.00**
  - "The CEOI Technology Strategy" by Chris Brownsword, CEOI Technical Director

National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

NERC SCIENCE OF THE ENVIRONMENT

NCEO Core Research Functions

Delivering to the NERC Council agenda:

Vision: "Transformational EO science capability to meet Earth System challenges"

- Analysis and exploitation of **critical historical and new observations of Earth System evolution** with impact in operational /business services;
- **Research into Model-data evaluation** for global Earth System Model (ESM) and component models with impact in policy;
- Development of **Innovative data assimilation (DA) of EO data** for Earth state representation and interrogation with impact in Numerical Weather Prediction (NWP);
- **Provision** of instruments, data facilities and key tools for use by the wider NERC community.

NERC Strategy: Understanding and prediction; changing world; resilience; large-scale international research; environmental data and technology for gov't and business.

National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

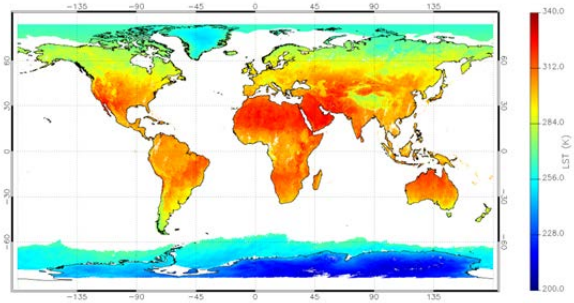
NERC SCIENCE OF THE ENVIRONMENT

NCEO Science Strategy

NCEO's science strategy is to:

- Focus on key NERC science challenges in Earth system science
- Link to specific ESA or other EO research missions, relevant to NCEO's capabilities
  - Key systems: **ESA, Eumetsat, Copernicus**, [NASA/NOAA, JAXA]
  - EO science through ESA (NERC commitments)
  - Excellence of missions; int'l peer review

- Emphasize decadal research and systems requiring sustained efforts
  - Long-term EO data sets (climate etc.)
  - Model-evaluation systems; UKESM, int'l
  - DA systems for NERC science

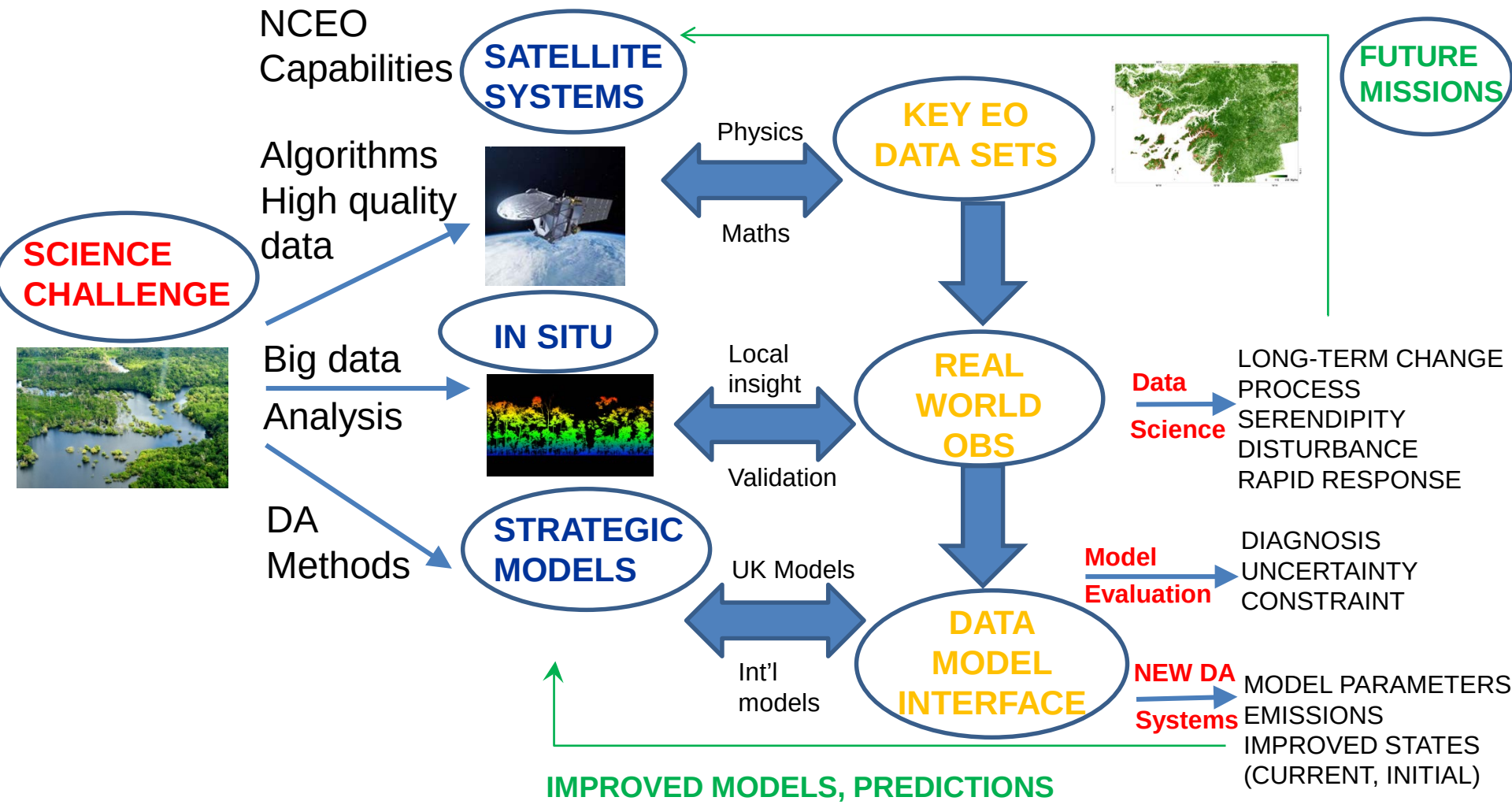


- Support and grow the user community

National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

NERC SCIENCE OF THE ENVIRONMENT

NCEO: High quality, long-term science



National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

NERC SCIENCE OF THE ENVIRONMENT

Examples of NCEO community action

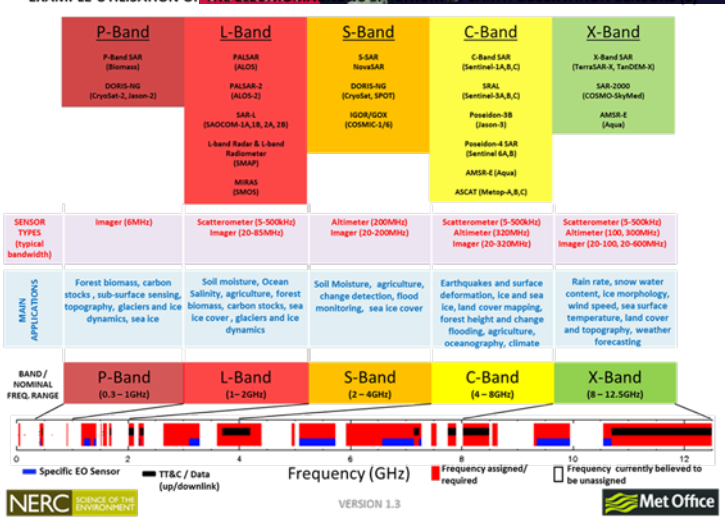
- Science voice with UK Space Agency, ESA and Eumetsat.
- EO Business Cases
- Promotion of specific missions e.g. SWOT

- 1st national EO conference; annual NCEO/CEOI conference.
- EO Centres Forum
- Royal Society report on Environmental Observations

- Defra EO Centre of Excellence and UK GEOS
- UK International GEO/CEOS Office

- Space4Climate Group
- EO and Spectrum
- EO data and services: Space Growth Action Plan

- EO Detective Outreach



National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

NERC SCIENCE OF THE ENVIRONMENT

NCEO ext-NET

RESEARCH COUNCILS AND HEIs

- Funding
- Community
- Discovery

LARGE INDUSTRY

- Technology
- Ground segments and processing
- Mission operations
- Towards services

SPACE AGENCIES

- Advice
- Missions
- Operations
- Contracts

NCEO

- Science collab
- Operational science
- Data exchange
- KE
- Impact

MET. AGENCIES

- Collaborative contracts
- Management
- Consultancy
- Data processing and computing

SMEs

- Advice
- Impact
- EO services

GOVERNMENT GEO/CEOS

National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

NERC SCIENCE OF THE ENVIRONMENT

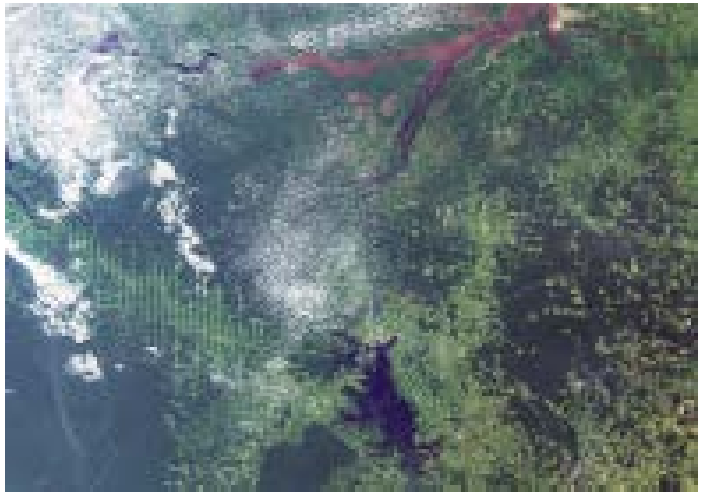
Breakout sessions

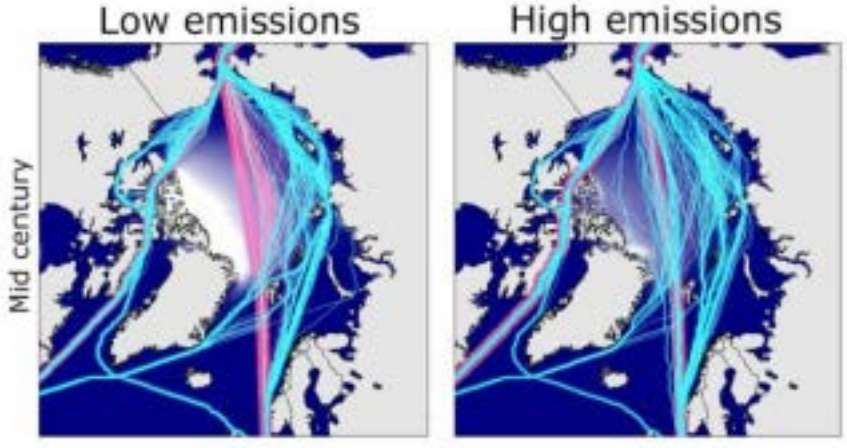
- EO Technologies in a nutshell
- Acquiring and disseminating EO Data
- Significance Testing R.I.P.
- LTSM UKESM/ACSIS progress and potential synergies
- Public engagement – future opportunities
- EO for Oceans
- Drone technology products and applications

National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

NERC SCIENCE OF THE ENVIRONMENT

Around the world…





Melia, Haines and Hawkins, 2016