Satellite Oceanography at the National Oceanography Centre

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Providing end-to-end capability in ocean remote sensing

End-user needs

New sensor and mission proofs of concept

Satellite algorithms and validation

New observations from satellites

Applications & Services

Environmental Research

Commercial

Government

Industry

NGOs

Operational

• Work with space industry
• Scientific lead & definition of new sensors missions
• Airborne demonstration
• In-orbit proof of concepts
• Work with science & business partners
• New algorithms
• Calibration/Validation
• Demonstration products
• Work with software companies
• Production of new products and datasets
• Science
• Pull-through to forecasting
• Support downstream services
• Education & Training
• Capacity building & ODA
• Advice to government & agencies

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New Sensors & Missions: SEASTAR

• Leading the definition & development of new missions for the European Space Agency

• SEASTAR for ESA Earth Explorer
  ▪ Large satellite; ~450 Meuros
  ▪ Science lead by NOC with Ifremer (France)
  ▪ 70 international partners, 17 countries
  ▪ Partnership with Airbus D&S Ltd

• Innovative technology for science excellence
  ▪ Squinted along-track SAR interferometry
  ▪ 2D images of **total ocean surface current vectors**; wide-swath; **1km resolution**; unprecedented accuracy
  ▪ Unique capability, never flown in space before

• Critical new spaceborne observing capability
  ▪ **Collocated current-wind-wave** data to support modelling
  ▪ Special focus on strategic **coastal, shelf & polar seas (Arctic)**
  ▪ Surface divergence/convergence indicate vertical exchanges
  ▪ Key for ocean carbon and heat and climate projections
New Sensors & Missions: GNSS-R

• GNSS-Reflectometry (GNSS-R)
  - Earth Observation with signals of opportunity from Global Navigation Satellite Systems e.g. GPS, Galileo..
  - GNSS-R receivers are small, low-power and low-cost

• Long-term partnership with Surrey Satellite Technology Ltd (SSTL)
  - 2003: proof-of-concept on UK-DMC mission
  - 2014: full-scale demonstration on UK TechDemoSat-1
  - 2016: SSTL receivers used on NASA CYGNSS mission

• UK leadership in GNSS-R space technology & science
  - first global GNSS-R winds; first hurricanes with spaceborne GNSS-R
  - new applications to cryosphere and land monitoring

• Towards a new multi-satellite GNSS-R constellation
  - E.g. ESA SCOUT mission proposal (30MEuros)
New & better satellite measurements

- Innovative algorithms to extract new & better information from existing satellite data
  - Improved satellite altimetry within 10km of land to monitor coastal sea level variability & understand environmental drivers
  - Exploit sequences of satellite images to detect & monitor coastline and bathymetry changes anywhere in the world
  - New ocean surface current mapping with Sentinel-1 SAR Doppler Radial Velocity data, with applications to ship routing, safety at sea, pollutant dispersal, coastal management, etc.

Image sequence from Copernicus Sentinel-1 over Liverpool

Ocean eddy in Sentinel-1 Doppler signals offshore from Barcelona
Building long-term satellite datasets

- Growing satellite datasets now span several decades
  - Needs careful cross-validation to ensure multi-mission consistency

- ESA Climate Change Initiative (CCI) develops long-term climate-quality satellite data records for various Essential Climate variables (ECVs)

- NOC role in three CCI projects to date
  - Sea Level (coastal)
  - Sea State (extreme waves)
  - Sea Surface Salinity (changing water cycle)
EO capacity building & new services

• Many applications of satellite ocean data in developing countries and Small Island Developing States
  ▪ Large coastal populations vulnerable to environmental changes e.g. coastal flooding and cyclones
  ▪ Economically reliant on coastal ecosystems sensitive to climate change
  ▪ Limited resources for traditional monitoring

• Example ODA project for UK Space Agency in Mozambique, Madagascar & South Africa
  ▪ Produce bespoke products and information for coastal sea level, winds and waves from satellites & models
  ▪ Deliver tailored tools and local training for long-term EO data uptake by partners in Africa
  ▪ Working with SMEs to demonstrate new commercial services that could be deployed in other ODA countries and in the UK

http://www.satoc.eu/projects/c-rise/
Summary

- Satellite Earth Observation is well placed to address many of the challenges raised by hazards and changes in the marine environment
  - Many opportunities for UK to provide leadership in Earth Observation ocean science, mission & sensor technology and development of new EO marine datasets & services

- NOC provides end-to-end capability in ocean remote sensing
  - Both global and local applications, with increasing focus on coastal, shelf and polar seas

- Marine EO research is critically dependent on ESA and EU funding
  - No competitive funding for Marine EO Science in the UK

- International leadership in space technology & science achieved through academia/industry partnerships and leveraging UK investments in Europe

- Many more opportunities for ocean EO applications if consistent UK investment could be secured
Thank you

QUESTIONS?

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