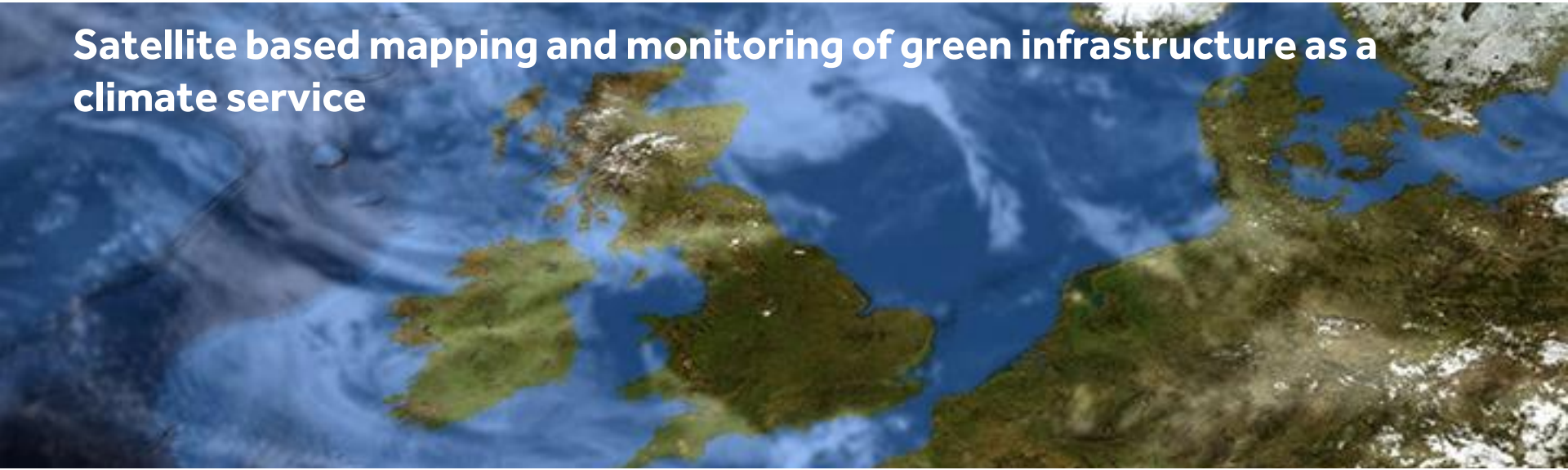
GREEN INFRASTRUCTURE SOLUTIONS

Satellite based mapping and monitoring of green infrastructure as a climate service



www.the-iea.org/space4climate

Futurebuild, ExCeL, London 6th March 2019

SPACE4CLIMATE GROUP

We're a public-private-academic partnership working collaboratively to ensure a seamless supply chain for climate data from space.

We support the UK's world-leading climate community to deliver, sustain and make use of climate information from space, enabling it to be integrated "as standard" in a variety of climate services for global economic and societal benefit.

We do this by coordinating activities, expertise and resources across our partners to:

- Expand market uptake domestically and internationally, raising the profile of UK expertise, products and services, identifying climate services user requirements and facilitating and brokering new market growth opportunities.
- Sustain and grow the network, expanding our community by developing and maintaining lists of UK providers, and building community capacity by providing training and alerts to funding sources.
- Support delivery of a seamless supply chain, by identifying new requirements and barriers to provision and sustainability, and working together to address these.

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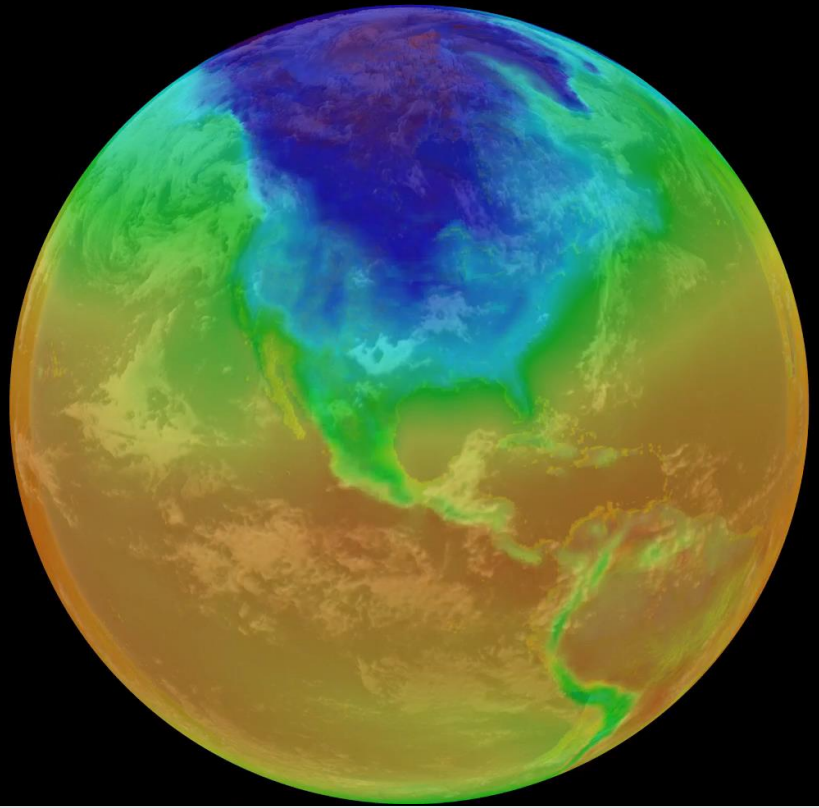
ESA CCI Monitors the Health of the Planet



CLIMATE SERVICES

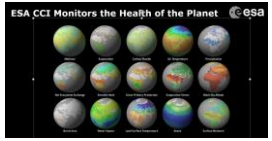
Data creation

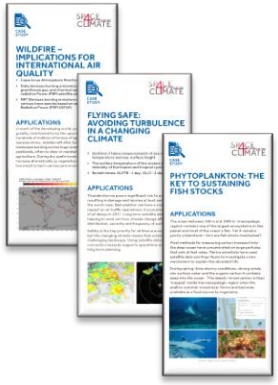
Dataset collation and platforms

Data verification and quality assurance

Information translation and big data analytics

Value-added services





SENSING OUR ENVIRONMENT

Sensory Modalities	Sense
Haptic - Tactioception	Sense of touch
Visual - Ophthalmoception	Sense of vision/sight
Auditory - Audioception	Sense of hearing / Sense of the perception of sound
Gustatory - Gustaoception	Sense of taste
Olfactory - Olfacception	Sense of smell
Thermoreception/Themoception	Sense of temperature
Vestibular - Equilibrioception	Sense of balance
Interoception	Sense of the physiological condition of the entire body
Nociception	Sense of pain
Proprioception	Sense of limb/body position without visual cues: the ability to perceive position, weight, and resistance of objects in relation to the body
Kinaesthesia (often incorporated into proprioception)	Sense of movement; the ability to sense the extent, direction, or weight of body movement

Sources of information (Craig, 2002; Craig, 2009; Macpherson, 2010; Haverkamp, 2012; Matthen, 2012; Stokes et al., 2014; Schulz, 2015)

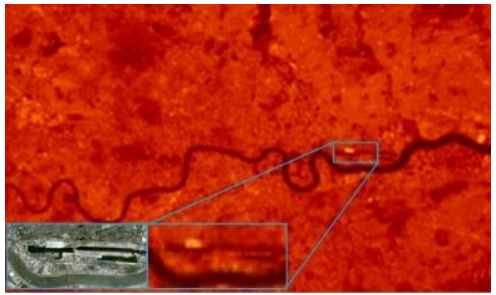
Source: Table 3.1: Summary understanding of our sensory modalities, from Turner, B., Clements-Croome, D., and Pallaris, K. (2017). *Chapter 3. The Multi-Sensory Experience in Buildings*. In Clements-Croome, D., (Editor). *Creating the Productive Workplace*. Third Edition. Routledge, Taylor & Francis, 2018.

- Humans
- Arduinos
- Internet of Things
- Networks of sensors
- Urban observatories
- Satellites

King's College London FreeStation Initiative, and seeks to develop open source hardware, open source software and open source 3-D printing technology to build and deploy reliable automatic weather stations with the lowest cost and easiest build possible

LANDSAT 7 Land Surface Temperature data for London April 2011, at 90 m resolution.

Dark red = lower temperature, light red = higher temperature



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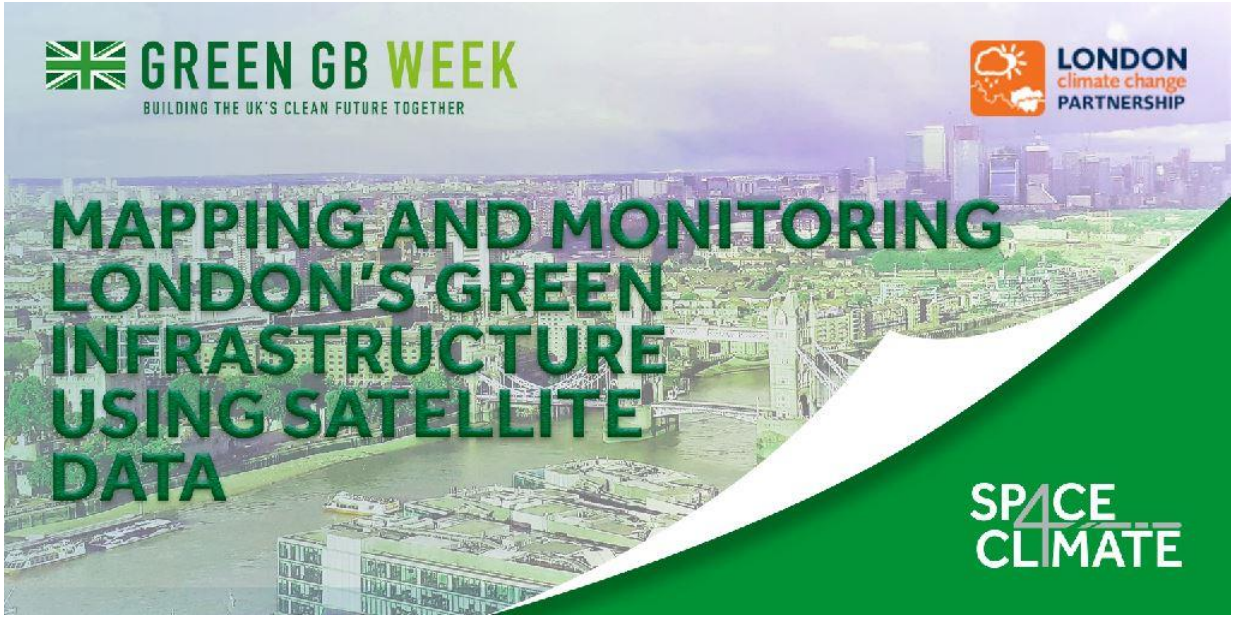
WORKSHOP HIGHLIGHTS



- GLA
- LCCP
- S4C
  - KCL
  - UCL
  - University of Nottingham
  - University of Oxford
  - University of Leicester
- LB Southwark
- LB Brent
- Natural England

ACCESSING EO DATA

TELESPAZIO a LEONARDO and THALES company

Copernicus Climate Data Store

The Climate Data Store is part of Europe's Copernicus Climate Change Service and interfaces to key climate data sets and data providers

- Free
- Diversity of data-sets on land, ocean and atmosphere parameters
- Diversity of interfaces (web, API, tools)
- Quality metrics
- Huge potential for added value in monitoring & mapping applications

Urban:
- Economic impact due to precipitation, flooding, snow
- Health impact due to temperature, air quality

Agriculture:
- Crop yield due to temperature, precipitation

Copernicus | European Commission | ECMWF

https://cds.climate.copernicus.eu/#!/home

What could we learn from agriculture?

- European Farmers are already experiencing effects of climate change including:
  - **Climate induced stresses**
  - **Pests and diseases**
- These crop can have **"climate memory"** and are responsive to cumulative change in climate conditions
- They are **highly vulnerable** to climate change and therefore require a long-term management strategy

Geoff Busswell

Head of Satellite Systems & Operations Marketing & Sales

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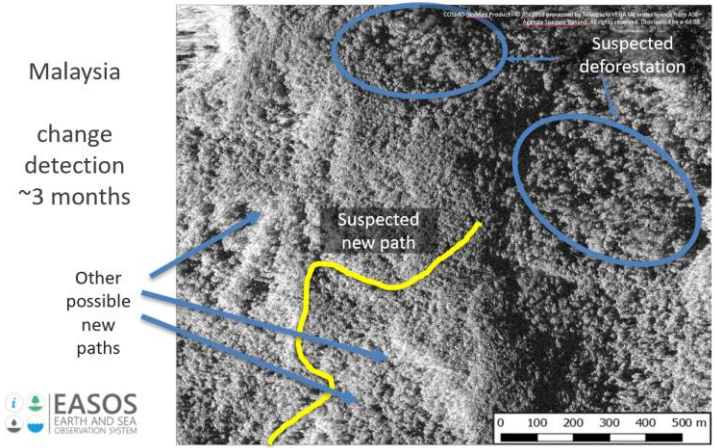
THINKING LATERALLY

TELESPAZIO a LEONARDO and THALES company

Geo Information

EASOS ForestWatch



The Earth and Sea Observation System (EASOS) platform is designed to provide high value decision support to tackle country-specific environmental, security and human challenges

Telespazio working with Leicester University combining optical data processing (e.g. Sentinel 2 optical NIR)

Impact of subsidence on GI health and effectiveness?

Structural Health Monitoring

- Baseline Ground Motion Pre-Construction

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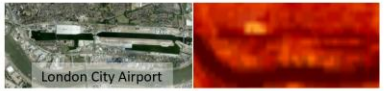
National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

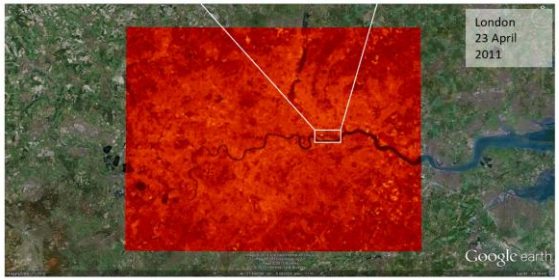
UNIVERSITY OF LEICESTER

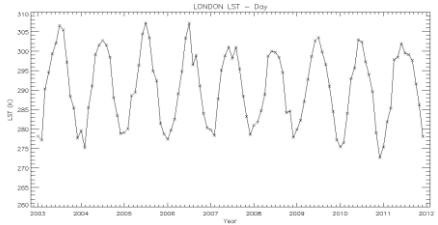
SPACE CLIMATE

LAND SURFACE TEMPERATURE



Surface temperature plot over central London using LANDSAT 7 thermal data 90m resolution. LST accuracy limited by a lack of high resolution urban emissivity data.





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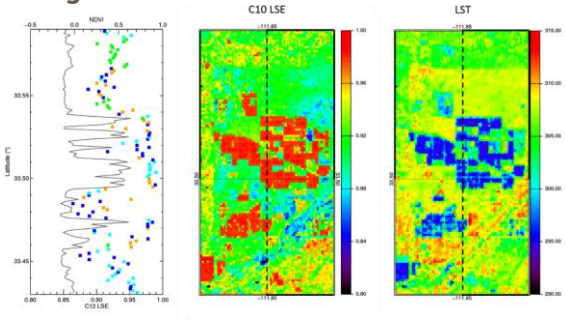
- Satellite data records can reveal how the mean temperature of a city fluctuates year on year, helping us to understand important times and magnitudes of thermal conditions including times of special interest.
- The higher spatial resolution observations can then help reveal the spatial distribution of heat within the UHI. This can be of significant importance for human health and comfort, future urban development, the urban heat consequences of climate change and heat mitigation effect of GI.
- **Future missions: 30-50m resolution data –strong lobby from agriculture, should there be one from cities for understanding GI health and heat mitigation effectiveness?**

Using the simultaneous retrieval of Land Surface Emissivity (LSE) and Land Surface Temperature (LST) and NDVI to understand difference in spatial and thermal structure for agriculture in Phoenix, could be applied to Heat Mitigation effect of GI



Lead contact: Mike Perry, University of Leicester and NCEO mp317@le.ac.uk

Products: http://www.globtemperature.info/

URBAN GREEN UP

- Monitor Nature Based Interventions (NBI) KPIs for Challenges 4, 5, 6 using Copernicus data
- Use EO and in-situ data for model generation → spatially continuous variables: meteo, air quality, temperature, LULC, etc
- GOAL→ Monitoring solutions for KPIs "Urban Regeneration" & "Management of Green Spaces" . URBAN ATLAS (212) as baseline/starting point for models
- Goal→ use in monitoring "Air Quality" KPI monitoring . Copernicus CAMS to correlate with heat island models, air quality and in-situ data

URBAN GreenUP

aims at developing, applying and validating a methodology for Renaturing Urban Plans to mitigate the effects of climate change, improve air quality and water management and increase the sustainability of our cities through innovative nature-based solutions.

Limitation: urban management scale E 1:2.000 o higher

Advantage: High revisit of EO data→ valueable for model calibration/validation

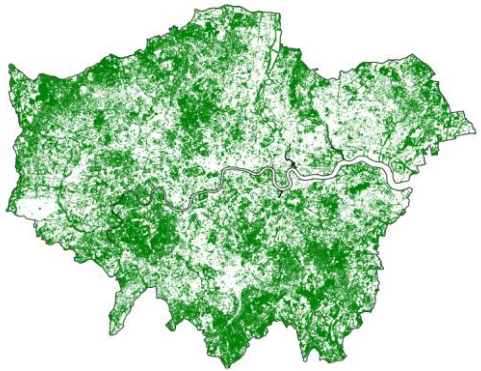
- Sentinel 2 → 10m Pixel → E 1:20.000 (use in large urban areas)
- Sentinel 3 → TIR 1Km (e.g. heat islands in large urban areas)

Challenge: downscaling models

http://www.urbangreenup.eu/

Contact: Ana Sebastian Lopez, GMV-UK

ESTIMATING LONDON'S URBAN FOREST



47% of London could be considered forest using the UN FAO definition (credit: Ollie Baines)

- Remote sensing "images" the urban forest at different scales from ground, air and satellite platforms.
- Scientists from UCL and NCEO, working with local tree officers, are using these techniques to measure urban forest attributes such as canopy height and cover as well as extent and biomass.
- Terrestrial laser scanning can measure 3D tree structure in great detail.
- This can then be used to train models using airborne and satellite data to generate maps over larger areas.

URBAN FOREST CONTINUED

- Found that pockets of London's urban forest compare to temperate and tropical forests and therefore could require consideration in global budgeting particularly in light of increased urbansiation.

- Scan QR codes to view 3D models on SketchFab

- Acknowledgements

We would like to thank Kieron Dorick from Forest Research for providing iTree data, David Houghton at Camden Council for his advice and providing inventory data and Ian Dungavell and Frank Cano for allowing us to scan at Highgate Cemetery and their assistance on the day.

- Contact: Phil Wilkes p.wilkes@ucl.ac.uk @kungphil

FUTURE ACTIONS

- Shifting from designing for an end output, to designing for operation over a lifetime experiencing a variable and changing climate
- Considering use of satellite data for monitoring and learning about the effectiveness of green infrastructure interventions
- Building up a stronger lobbying base to set out urban needs and priorities for new satellite missions

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