

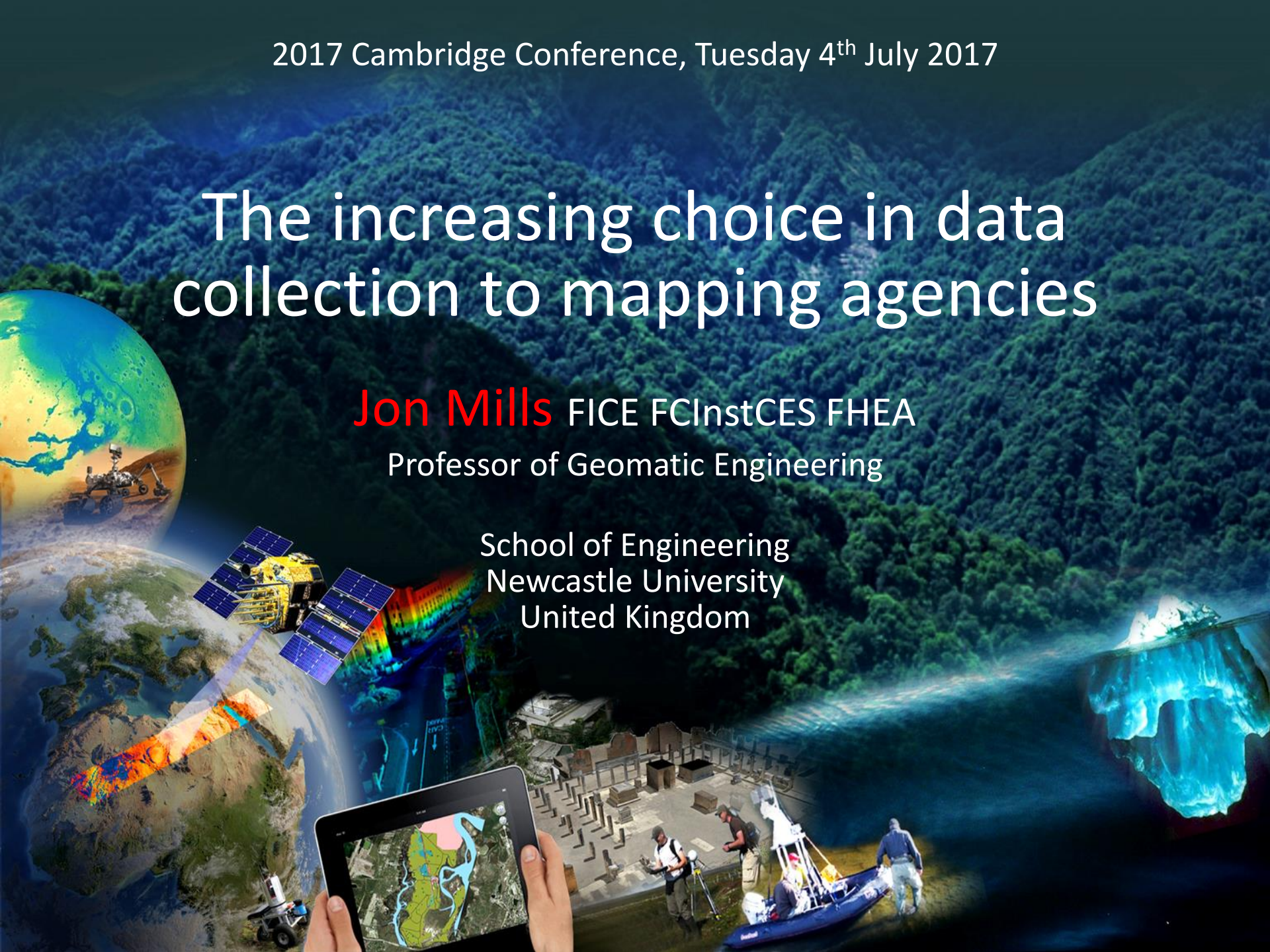
2017 Cambridge Conference, Tuesday 4<sup>th</sup> July 2017

# The increasing choice in data collection to mapping agencies

**Jon Mills** FICE FCInstCES FHEA

Professor of Geomatic Engineering

School of Engineering  
Newcastle University  
United Kingdom



# Introduction: remit and boundary conditions

- “Discuss the increase in collection technologies over recent decades, considering what is yet to come in air, land, water and space and suggesting how these can be used by the geospatial and mapping community”
- Focus on “traditional” data sources
  - Professional land surveyor – aerial survey – Satellite EO
  - Point clouds and photogrammetry
- Not: satellite positioning, GIS, crowdsourcing, mobile comms, big data analytics, machine learning, etc., etc.



# Introduction: contents

- Introduction
- Retrospective
- Current trends
- Conclusions: data collection in 2030?

# Retrospective: EU Expansion, 2004

Low graphics | Accessibility help

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Last Updated: Friday, 30 April, 2004, 06:23 GMT 07:23 UK

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## EU expansion: The end of the beginning

By James Arnold  
BBC News Online business reporter

**It may smack of cliché to point out that expansion of the European Union is not the end of a process, but rather a station along the way.**

For the past decade, a batch of (mainly ex-communist) European states have been re-tuning their laws, upgrading their bureaucracies, selling off state property and generally aligning their economies as closely as possible to EU norms.

Their entry into the EU is a sign that this process has been successful.

But only up to a point: with a few slick exceptions, Central Europe does not look or feel Western yet, and the deeper you dig into the region's political and economic structures, the



AP

Is everyone singing from the same hymn sheet?

## EU ENLARGEMENT

**KEY STORIES**

-  **An Irish welcome**  
Ten new members get a warm welcome to the EU in Dublin
- ▶ Reporters' log - 1 May
- ▶ In quotes: Leaders hail new EU

**IN PICTURES**

- ▶ Day of celebrations
- ▶ A family's view
- ▶ Your pictures of the celebrations

**BACKGROUND**

-  **Guide to new members**  
Click on a country for key facts and statistics
- ▶ Profile: Bertie Ahern
- ▶ Q&A: Enlargement basics
- ▶ **OPEN** EU economies compared

**HAVE YOUR SAY**

- ▶ EU enlargement: Your views

<http://news.bbc.co.uk/1/hi/business/3659059.stm>

# Fast forward 13 years: Brexit, 2017



[www.epc.eu](http://www.epc.eu)

## Commentary

24 June 2016

### **Brexit: a new beginning for the EU or the beginning of the end?**

*Fabian Zuleeg and Janis A. Emmanouilidis*

Despite all the evidence presented by a range of respected figures and institutions, and the paucity of the arguments on the Brexit side, which failed to set out the alternative to EU membership, the emotional appeal for 'independence' has won. This is a bad day for Europe. The Remain campaign has not connected with enough voters, with the perceived need to limit migration, the wish to make decisions independent of the EU and a vote against 'the establishment' all seemingly playing a role.

#### **What next?**

What follows is a high degree of uncertainty. The UK has to notify the EU of the intention to leave, which kicks off a divorce negotiation that will probably last around two years unless the remaining countries of the EU decide unanimously to extend the period of negotiation. It is unclear who will lead the negotiations on the UK side, with Prime Minister Cameron unlikely to have a political future.



# Retrospective: XXth ISPRS Congress, 2004



## THE UNITED KINGDOM NATIONAL REPORT FOR PHOTOGRAMMETRY AND REMOTE SENSING 2000 - 2004

Prepared for the External Affairs Committee of  
The Remote Sensing and Photogrammetry Society

by  
I. Downey\*<sup>a</sup>, J. Mills<sup>b</sup>, RSPSoc ISPRS Committee<sup>a</sup>

<sup>a</sup> Remote Sensing and Photogrammetry Society, RSPSoc Office, c/o School of Geography,  
University of Nottingham, University Park, Nottingham, NG7 2RD, UK - [rspsoc@nottingham.ac.uk](mailto:rspsoc@nottingham.ac.uk)

<sup>b</sup> School of Civil Engineering and Geosciences, University of Newcastle,  
Newcastle upon Tyne, NE1 7RU, UK - [j.p.mills@ncl.ac.uk](mailto:j.p.mills@ncl.ac.uk)

### Commission VI – National Reports

**KEY WORDS:** Education, Industry, International, National, Organisation, Professional, Research, United Kingdom.

#### ABSTRACT:

The National Report of the United Kingdom describes current activities and new developments in photogrammetry and remote sensing during the period 2000-2004. The balance between photogrammetric and remote sensing interests is tabulated and new research, recent implementations and organisational developments are considered. The increasing use of digital imagery and lidar systems, the availability of imagery via the Internet, and the recently completed merger of the former Photogrammetric Society and Remote Sensing Society are noted as features of the report period.

DOWNEY, I., MILLS, J. and RSPSoc ISPRS COMMITTEE, 2004. The United Kingdom national report for photogrammetry and remote sensing 2000 - 2004. *International Archives of Photogrammetry, Remote Sensing and Spatial Information Sciences*, 35 (B6): 275–280.



# Retrospective: XXth ISPRS Congress, 2004



- Extracts from UK National Report
  - At Ordnance Survey:
    - The conversion from analytical to digital plotter based production was complete by 2001
    - Since early 2001, all photogrammetric update has been carried out on digital workstations, using scanned stereo photography
    - In June 2001, monochrome photography was replaced by colour photography, to aid in photo-interpretation
    - Announced it will include an imagery layer within the new Digital National Framework

# Retrospective: 2004 v 2017

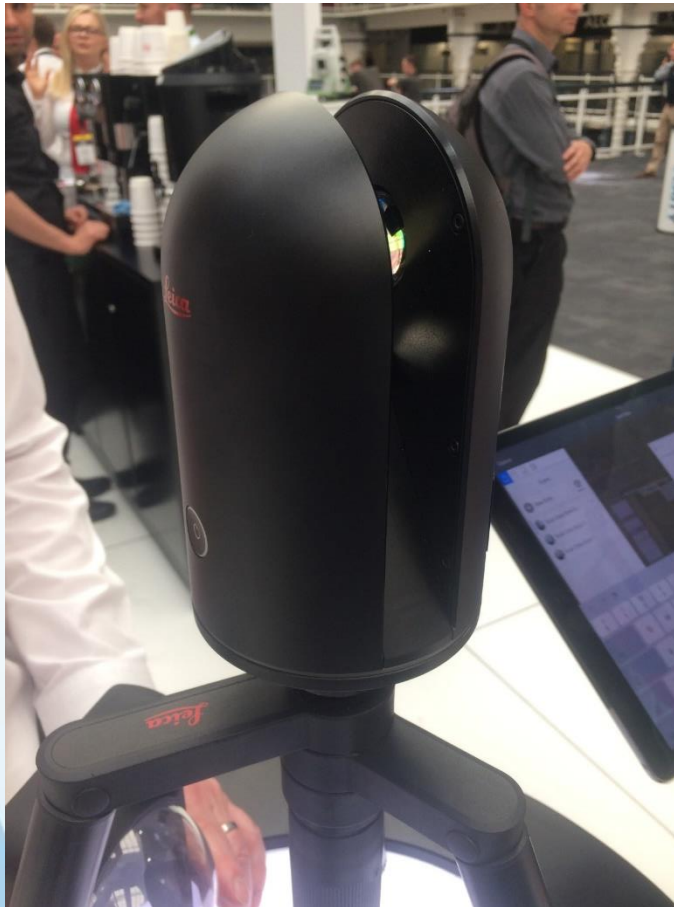
- Land - 2004
  - “This reporting period has seen a dramatic rise in the use and application of [terrestrial] laser scanning”





# Retrospective: 2004 v 2017

- Land - 2017: Leica BLK360 and Trimble SX10



# Retrospective: 2004 v 2017

- Air - 2004
  - “The prospect of digital air survey cameras produced by Leica Geosystems and Z/I Imaging is generating considerable interest in the UK”
    - Leica ADS40 vs Z/I Imaging DMC



[http://www.leica-geosystems.us/thumbs/originals/QCLX\\_1366.jpg](http://www.leica-geosystems.us/thumbs/originals/QCLX_1366.jpg)



[http://aerialsurveysintl.com/images/MyDMC\\_Med.jpg](http://aerialsurveysintl.com/images/MyDMC_Med.jpg)

# Retrospective: 2004 v 2017

- Air - 2017

## Geo-matching.com

Aerial Mapping Products on Geo-matching.com - Monday 8 May

### Vexcel Imaging - UltraCam Condor Mark 1



With 38,000 pixels across the flight strip, the UltraCam Condor enables the collection of large regions – even continents – in record time.

[Read More](#)

### Airborne Technical Systems - AOSx5 nikon



AOSx5 serves for automated capturing of oblique imagery in five directions. It makes from all objects vertical and oblique images.

[Read More](#)

### Phase One - iXA-R 180




Phase One aerial cameras are designed as the central hub in an open aerial data acquisition system.

[Read More](#)



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### VisionMap - A3 Edge



A3 Edge is VisionMap's all-in-one large-format mapping and oblique camera system that completes your projects in a fraction of the time.

### IGI - Quattro-DigiCAM-300



The IGI Quattro-DigiCAM's unique feature is to modify the camera from a large-format camera to an oblique camera system.

### Optech - CS-10000



Stand-alone or integrated with Lidar, the Optech CS-10000 is a complete corridor and small-area mapping solution.

### Highlighted Products

#### Applanix - POS LV 220





# Retrospective: 2004 v 2017

- Space
  - “2002 saw the launch of the long awaited Envisat”

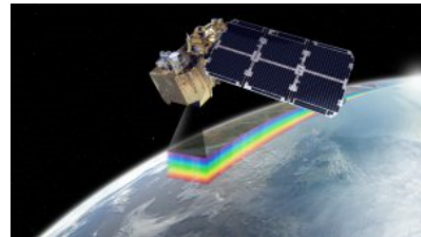


# Retrospective: 2004 v 2017

- Space - 2017: Sentinel missions

## SUCCESSFUL LAUNCH OF SENTINEL-2B ADDS TO EU'S COPERNICUS EARTH OBSERVATION CONSTELLATION

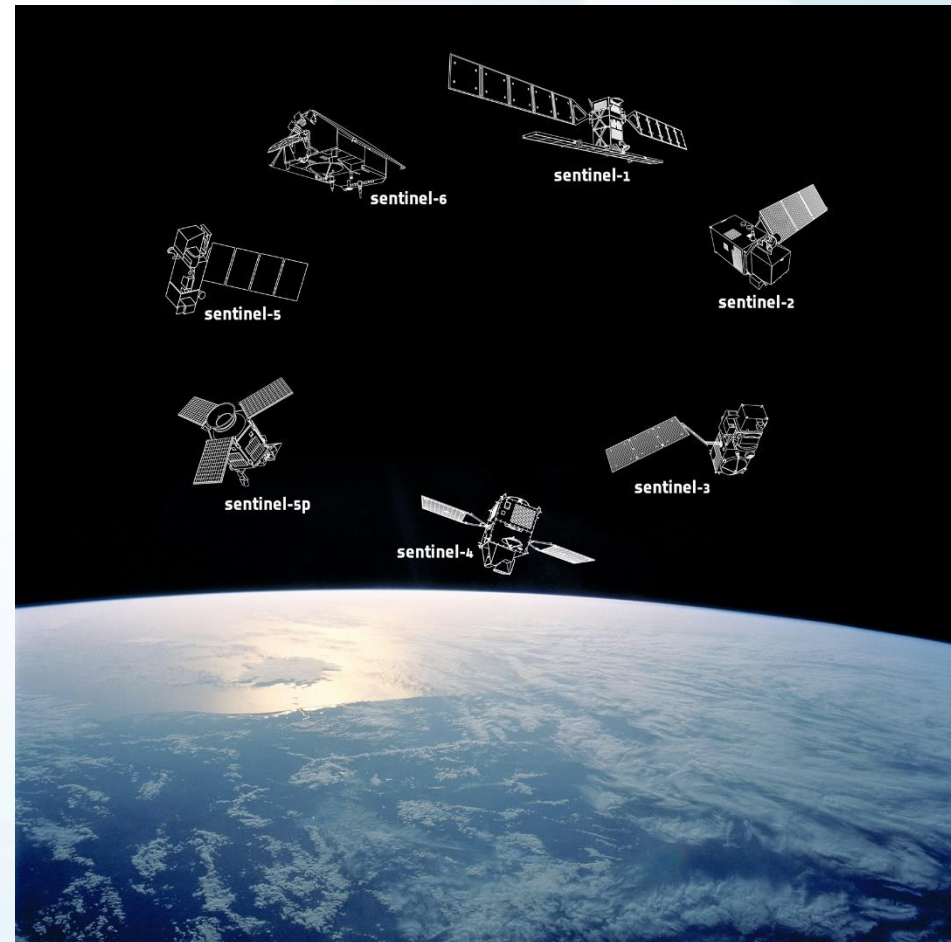
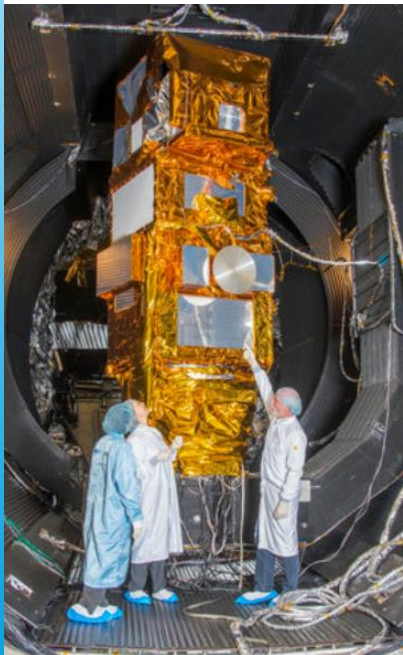
Europe's Copernicus programme has got its second eye. On Tuesday, March 7, 2017, at 02:49 am CET (March 6, 2017, at 10.49 pm local time), a Vega launcher successfully took off from the spaceport in Kourou, French Guiana, carrying the satellite developed and built under the industrial



An artist's conception of the Airbus-built Sentinel-2B remote sensing satellite. Image courtesy of Airbus Defence and Space.

786 kilometres above the Earth.

<https://spacewatchme.com/2017/03/successful-launch-sentinel-2b-adds-eus-copernicus-earth-observation-constellation/>



[http://www.esa.int/spaceimages/Images/2014/04/Sentinel\\_family](http://www.esa.int/spaceimages/Images/2014/04/Sentinel_family)

# Current trends

- Photogrammetric Computer Vision
    - SfM: Structure from Motion
      - “... technique for estimating three-dimensional structures from two-dimensional image sequences that may be coupled with local motion signals”
    - SLAM: Simultaneous Localisation And Mapping
      - “... the computational problem of constructing or updating a map of an unknown environment while simultaneously keeping track of an agent’s location within it”
- (Wikipedia)
- Supporting ubiquitous / pervasive imaging



# Current trends

The Telegraph

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## Science

Science

### How the way you hold your smartphone could allow hackers to steal your bank details



8 Comments



By Henry Bodkin

11 APRIL 2017 • 7:11AM

### The Telegraph SHOP

PLEATED CHINO SHORTS  
*was £29.99* Now £19.99  
or two for £35

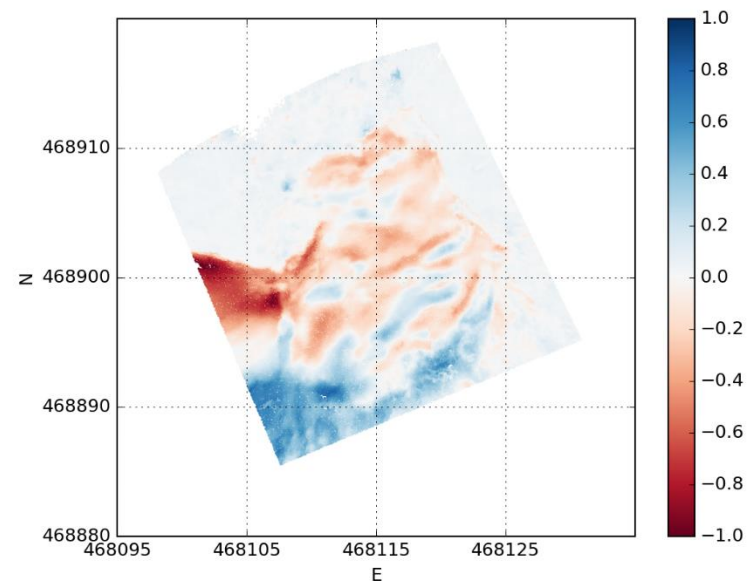
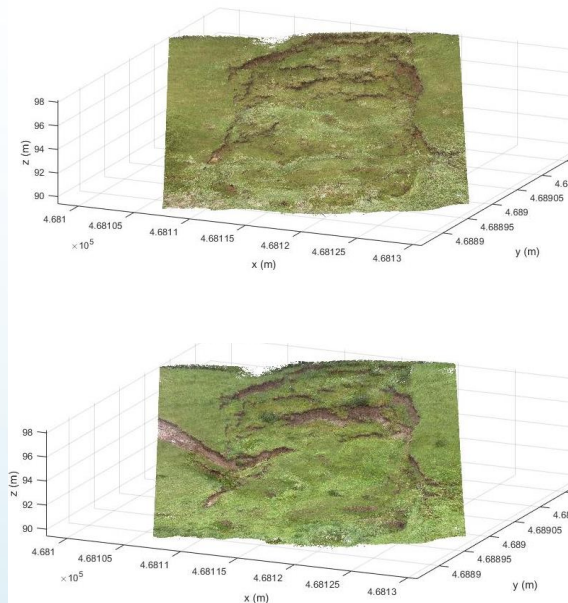
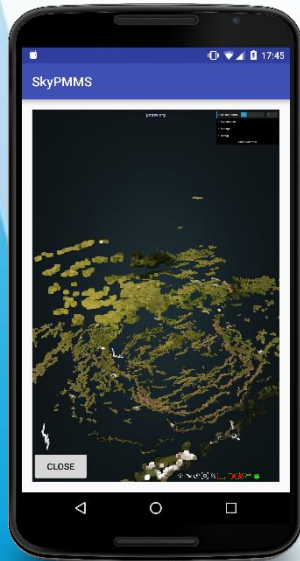
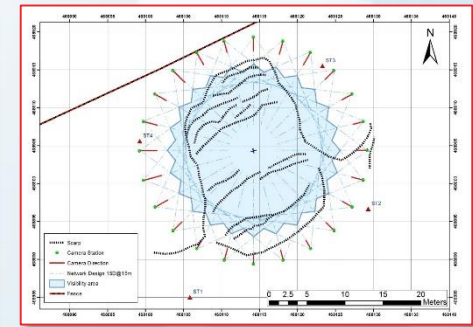
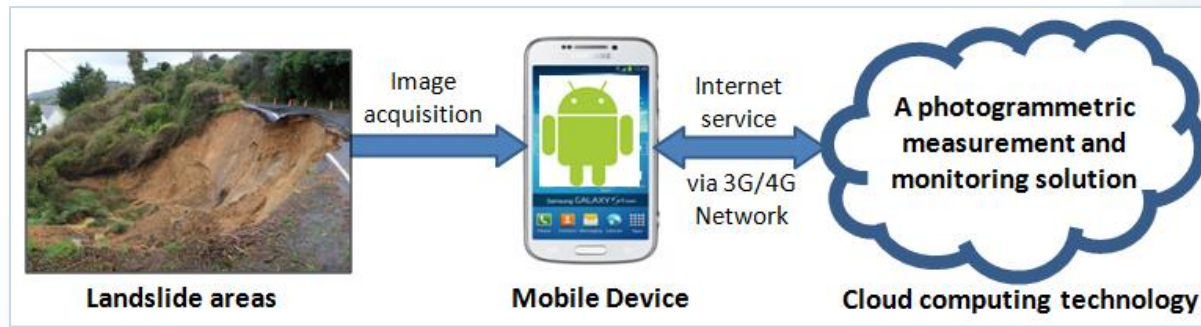
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#### MORE STORIES

- 1 The secret button that gives you more space on a plane
- 2 Month of birth affects long term health, major study shows
- 3 I had an affair and now I'm stuck with the 'other woman' - how did this happen to me?
- 4 16-year-old boy killed by a bear during Alaskan mountain race 'texted family to say it was chasing...
- 5 Noisy cities disrupt heartbeat and could trigger disease, study suggests

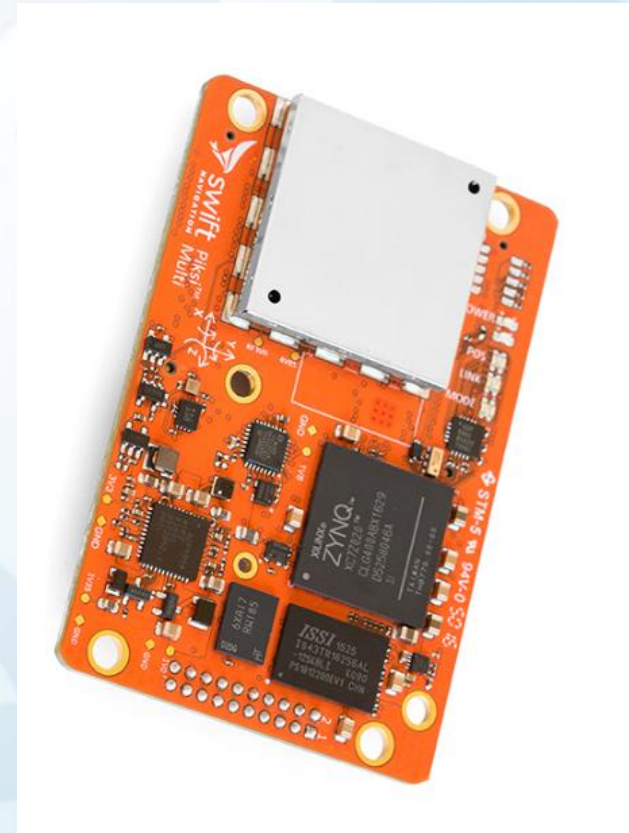
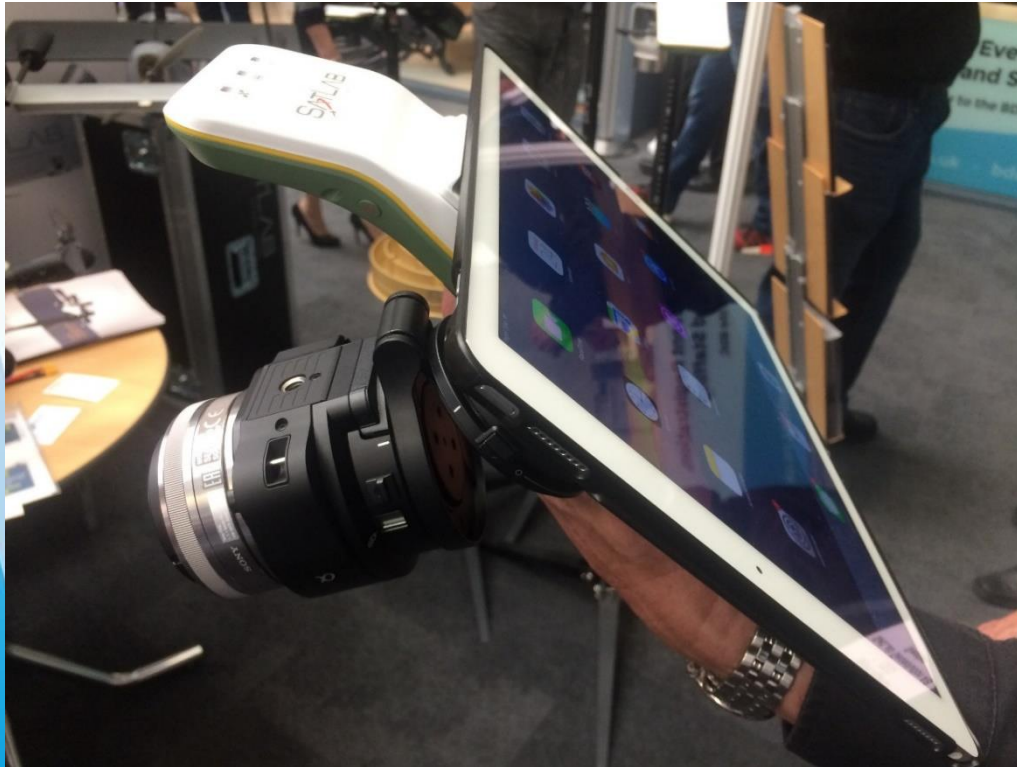
# Current trends: land

- The smartphone as a surveying instrument



# Current trends: land

- Sensor fusion, inc. dual frequency GNSS
  - SLC Multi-Purpose GNSS Receiver (L)
  - Piksi Multi GNSS Module (R)





# Current trends: air

## Other UAS for Mapping and 3D Modelling on Geo-matching.com

### Datamate - Site Survey Solution



Site Survey Solution is a professional surveying suite for civil engineering, construction and infrastructure mapping.

[Read More](#)

### Aibotix - Aibot X6



The Aibot X6 is a professional UAS, specifically designed for demanding tasks in surveying and industrial inspection.

### FlyTech UAV - GRYPH



GRYPH system is an innovative, multifunctional unmanned platform designed for a vast spectrum of applications.

[Read More](#)

### Trigger Composites - EasyMap UAV



EasyMap UAV is the most user-friendly photomapping tool on the market.

### SmartPlanes - Freya



Proven through thousands of flight missions over the past few years, this system has an amazing track record of reliability and quality.

[Read More](#)

### Animus Robo-Tek - Kronos XF



Kronos XF was engineered for efficient mapping and surveying by reducing the number of necessary ground control points to zero.

### C-ASTRAL - Bramor ppX UAV



The BRAMOR ppX (GNSS Post Processing) UAS is ideally suited for surveying and remote sensing applications.

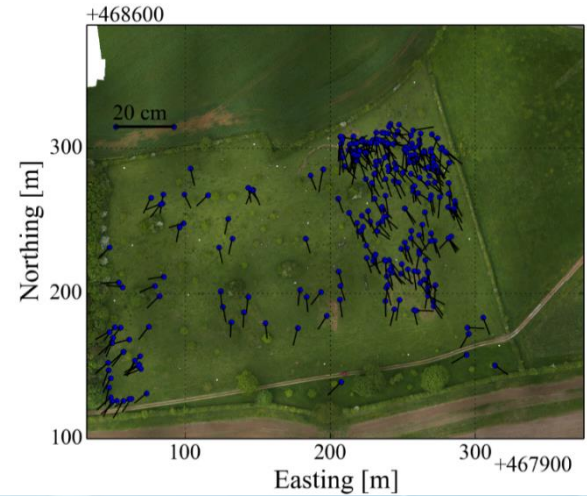
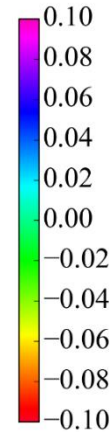
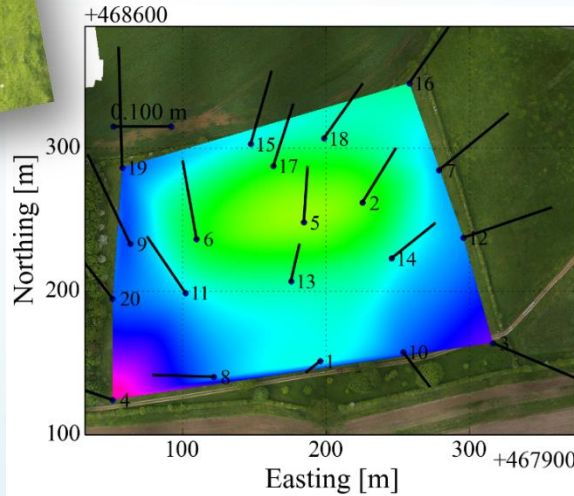
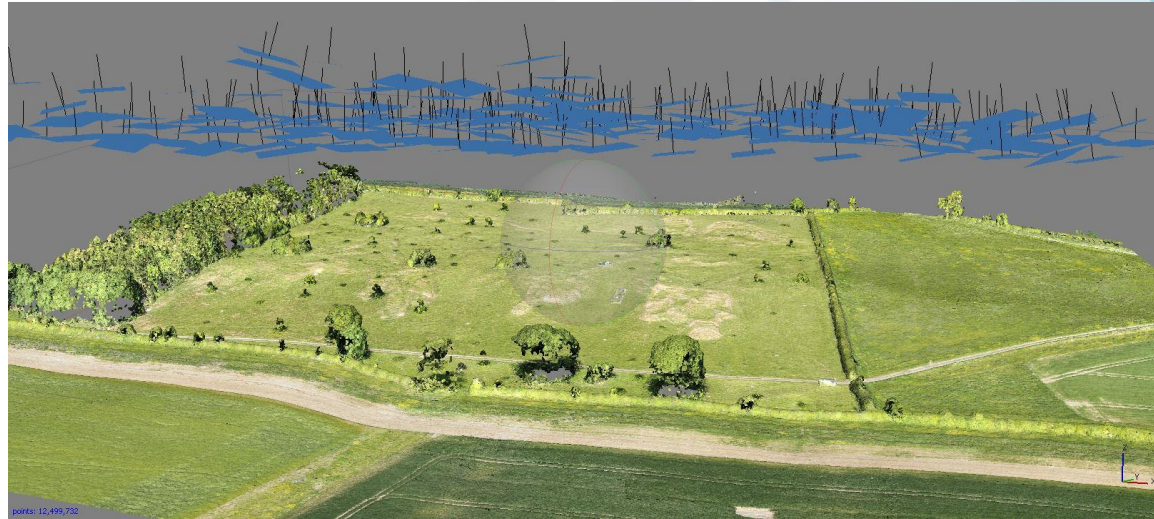
[Read More](#)

### Satlab - SLA-1



Satlab SLA-1 is a photogrammetry UAS delivering high-accuracy point clouds and orthophotos.

# Current trends: air





# Current trends: land/air/water



[http://r1.forconstructionpros.com/files/base/FCP/image/2015/06/16x9/1280x720/Topcon\\_IP\\_S3\\_Topcon.5578b092ae048.jpg](http://r1.forconstructionpros.com/files/base/FCP/image/2015/06/16x9/1280x720/Topcon_IP_S3_Topcon.5578b092ae048.jpg)



<http://informedinfrastructure.com/wp-content/uploads/2015/09/TIMMS2-1.jpg>



[http://www.xyht.com/wp-content/uploads/2015/09/SAM\\_5501-1.jpg](http://www.xyht.com/wp-content/uploads/2015/09/SAM_5501-1.jpg)



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<http://io.wp.com/www.3dlasermapping.com/wp-content/uploads/2016/08/DSCN4300.jpg>



[http://res.cloudinary.com/engineering-com/image/upload/v1466579040/image001\\_ppizpw.png](http://res.cloudinary.com/engineering-com/image/upload/v1466579040/image001_ppizpw.png)



# Current trends: land

- Leica Pegasus 2 (courtesy Leica)



<http://www.sintegra.fr/wp-content/uploads/2015/01/car.jpg>

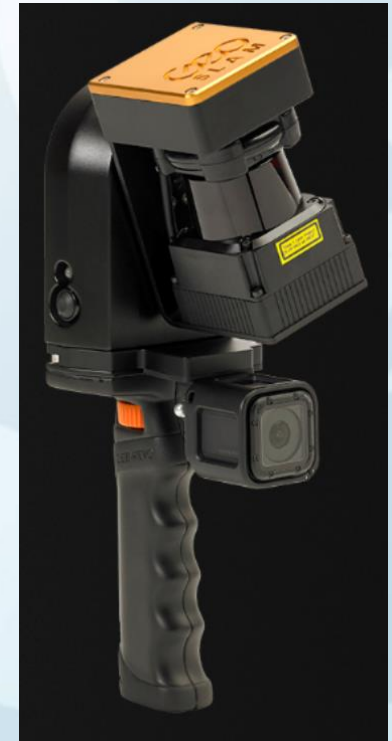
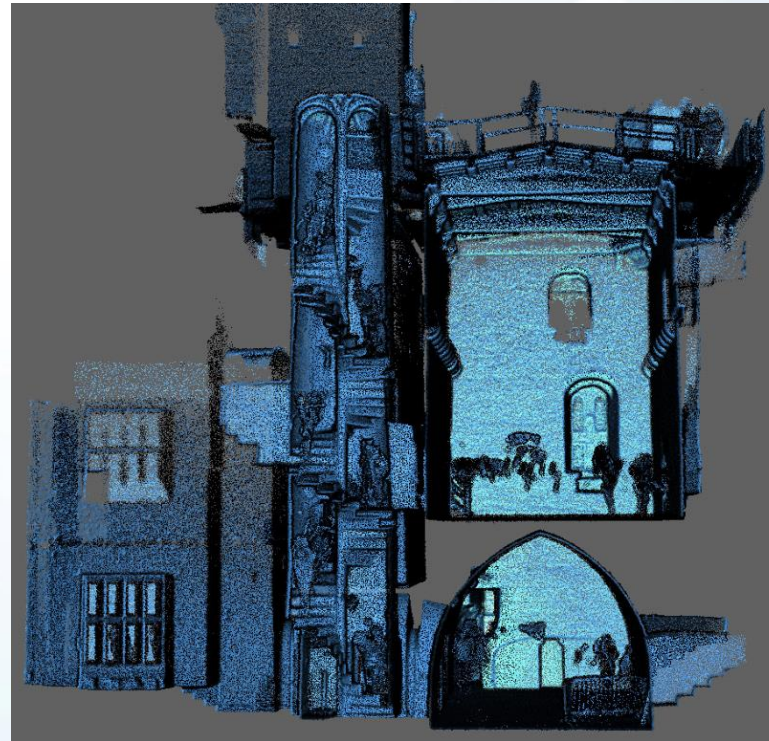
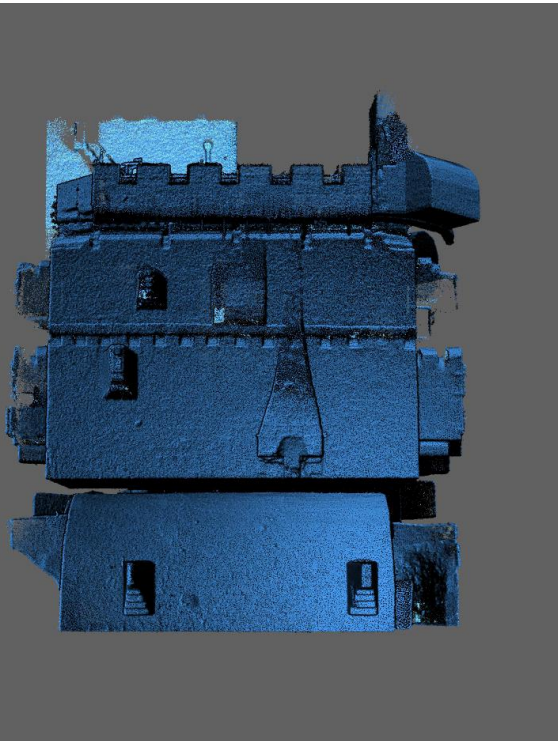


[https://media.thebimhub.com/user\\_uploads/cover-story-159-09-2015.jpg](https://media.thebimhub.com/user_uploads/cover-story-159-09-2015.jpg)



# Current trends: land

- Zeb Revo
  - Belsay Castle (courtesy Historic England)





# Current trends: land

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England Regions Oxford

## Oxford street cleaner creating 3D maps for driverless cars

11 April 2017 Oxford

f t w e Share



Sensors have been attached to an Oxford City Council street cleaner

A 3D street mapping project has been launched in Oxford to pave the way for driverless vehicles.

Sensors have been attached to a street cleaning vehicle in the city centre to create digital maps.



Will Trump be hurt by Paris climate pact decision?





# Current trends: air



[http://www.imagemaps.com/Products%20and%20Services/Others/RouteScene\\_LidarPod\\_onUAV.JPG](http://www.imagemaps.com/Products%20and%20Services/Others/RouteScene_LidarPod_onUAV.JPG)



<http://www.riegl.com/products/unmanned-scanning/riegl-vux-1uav>





# Current trends: air

- Riegl Ricopter

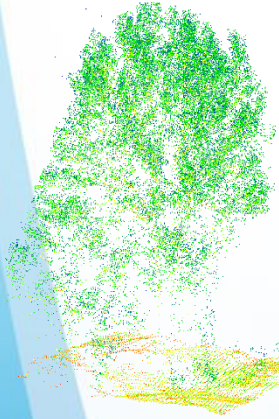




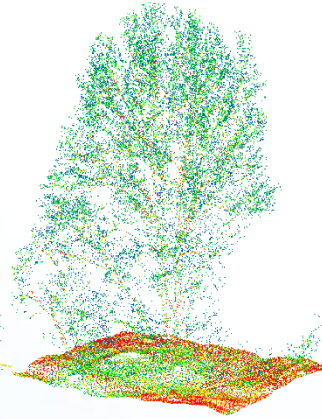
# Current trends: air

- Courtesy TU Wien

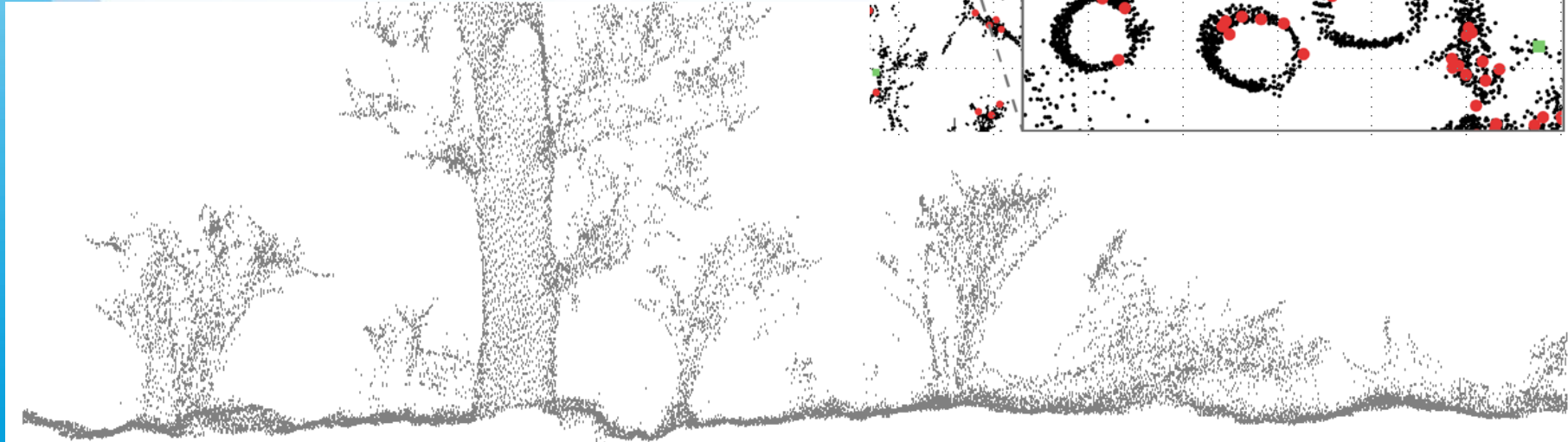
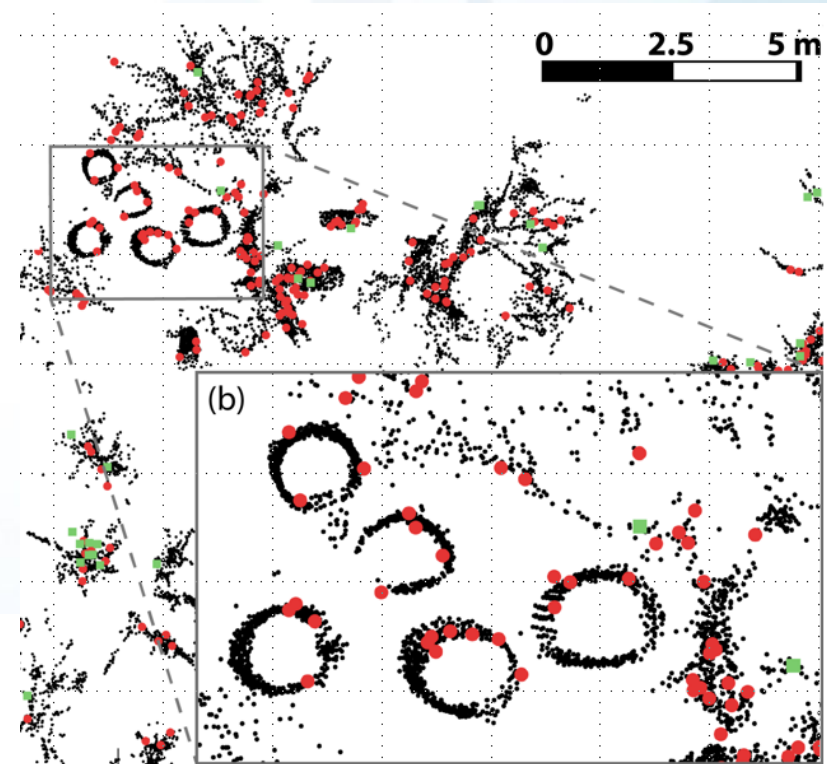
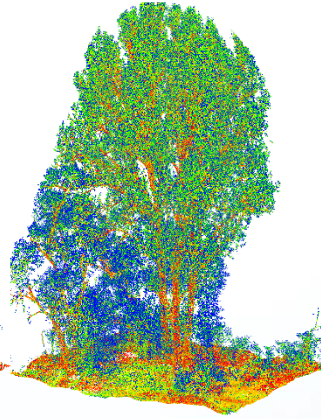
(a) VQ-880-G



(b) LMS-Q-1560



(c) VUX-1

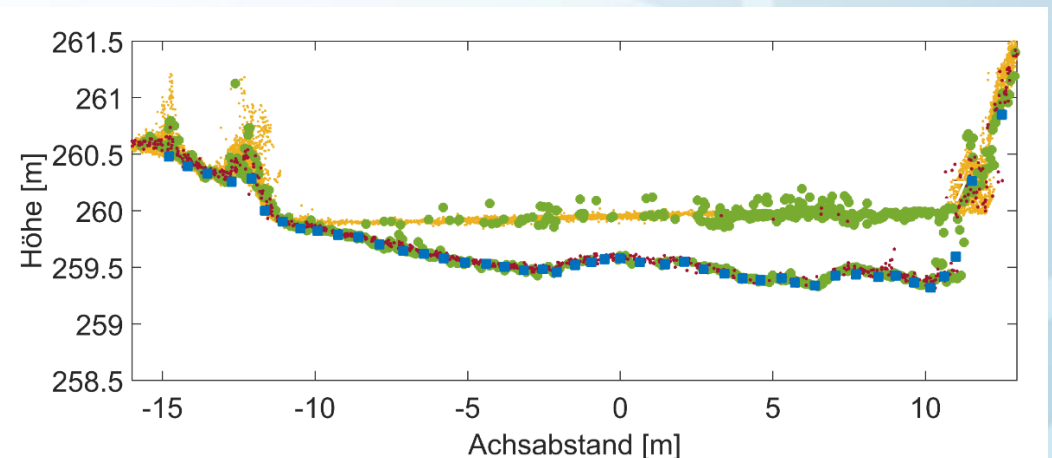
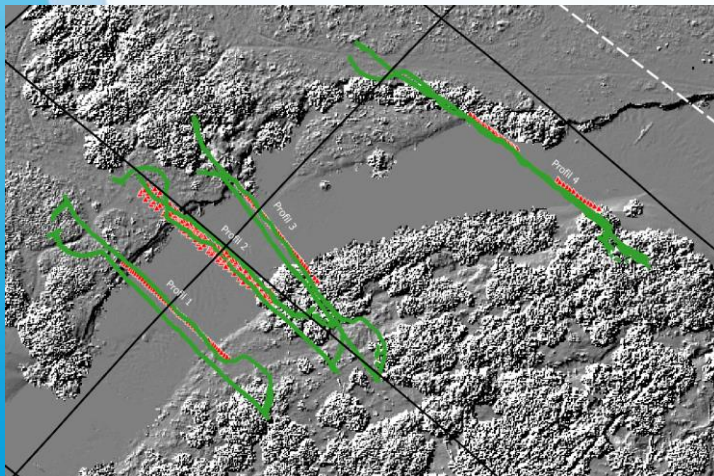
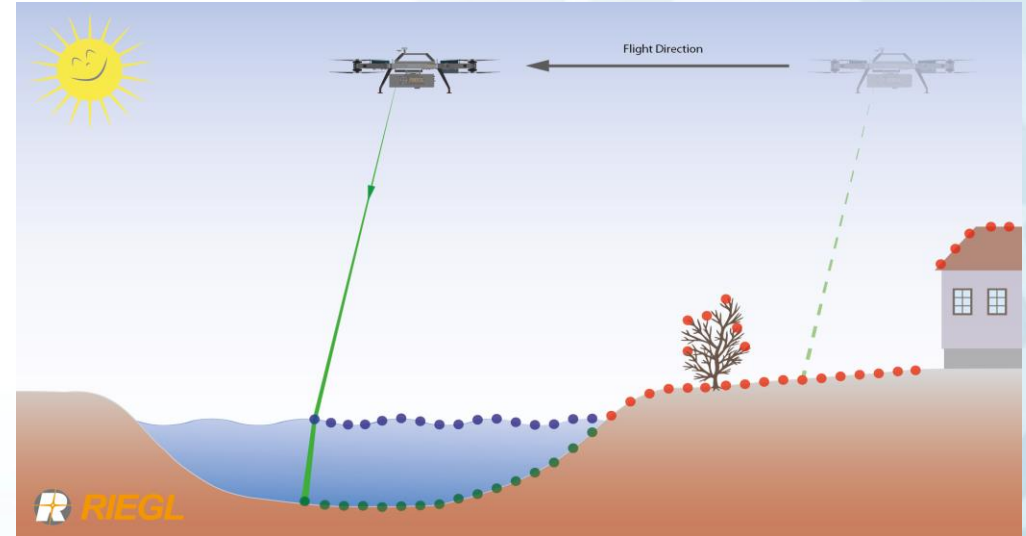




# Current trends: air/water



- Courtesy TU Wien



# Current trends: air - space

- HALE UAV and small sat constellations

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**Space industry** + Add to myFT

## UK start-up aims to provide super-sharp images of planet

Earth-i plans to launch a prototype satellite this year



Hong Kong's Victoria harbour taken from the DMC3 constellation of three very high-resolution optical satellites which Earth-i currently uses

MAY 29, 2017 by: **Peggy Hollinger**, Industry Editor

A UK start-up is aiming to provide the world's most advanced commercial imaging of the earth from space, with plans to launch a prototype satellite this year and a 15-strong orbiting network within three years.

Earth-i, a [space imagery](#) company founded in 2013 by aerospace engineer Richard Blain, said the constellation of satellites would be capable of capturing images at resolutions higher than 1m per pixel.

**Read next**

Second Tim Peake space flight under threat on cost



Latest on Space industry >

<http://www.airforce-technology.com/projects/zephyr/zephyr3.html>

Second Tim Peake space flight under threat on cost

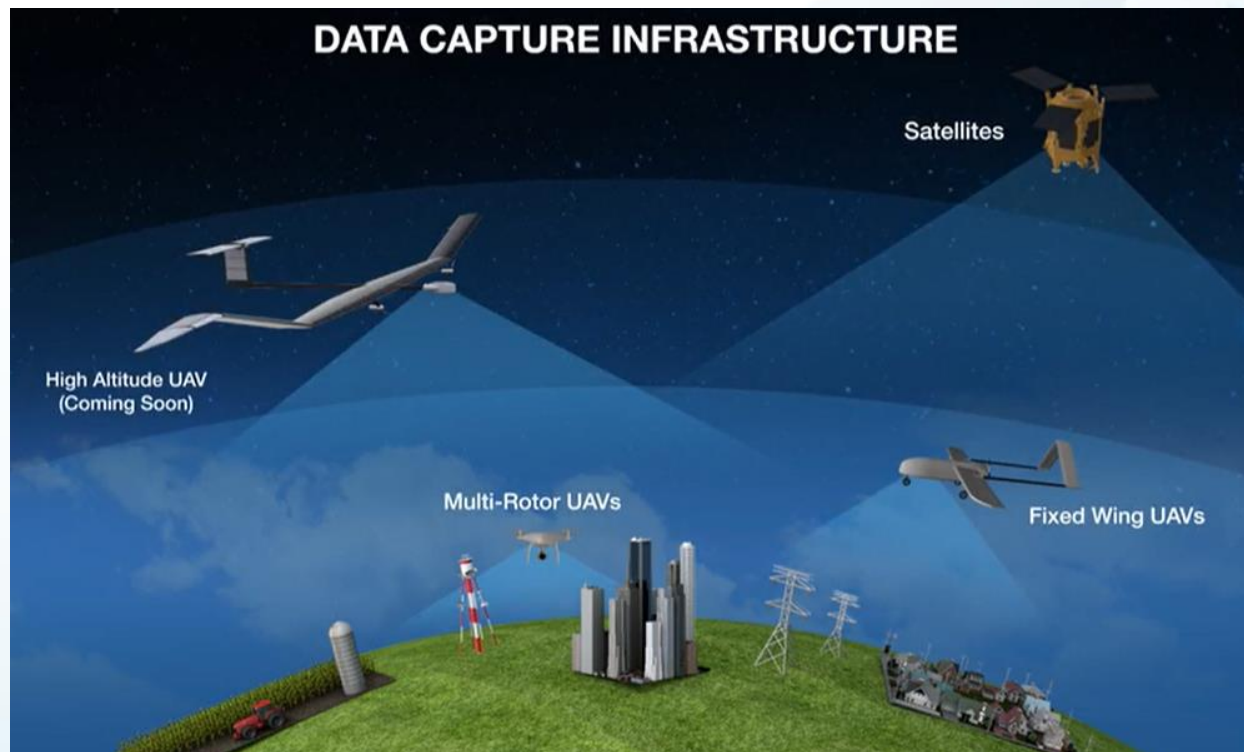
# Current trends

- Plus all the other survey-related platforms and sensors not mentioned:
  - Robotic total stations...
  - Generalised cameras...
  - Gaming technologies...
  - Sub-surface geophysics...
  - Oblique aerial camera systems / integrated lidar...
  - Lidar – single photon, multi-wavelength, full waveform, solid state, spaceborne...
  - UAV – multispectral / hyperspectral / thermal imaging, swarms, HALE...
  - InSAR – ground, UAV, air, space...
  - Satellite EO – VHR, small / mini / nano satellites, constellations
  - Etc., etc...



# Current trends: air - space

- Airbus Aerial
  - “A comprehensive digital service...”



<http://www.airbusgroup.com/>

- Currently lacking terrestrial services...

# Conclusions: 2030?

- Within boundary conditions:
  - Disruptive technologies increasingly prevalent
    - “Where were UAVs in 2004?”
  - Total blurring between land/water-air-space platforms
    - Seamless fusion of multi-modal sensors / data
    - Miniaturisation, lower power consumption
    - True multi-platform mobility
      - “wearable” survey tech to UAV
    - Truly autonomous data capture and processing pipelines
- Around the clock, multi-scale surveying with sensor networks
  - “Laser scanners akin to CCTV” augmented by autonomous terrestrial and low level UAV data capture
  - Wide area “surveillance” by HALE UAV
  - Better-than-daily VHR satellite image capture



# Conclusions: 2030?

- Outside boundary conditions:
  - Consider role of the professional NMA surveyor versus:
    - “Service” providers
      - Airbus Aerial
      - K-SERVICES
      - Google, et al...
    - Wider industries
      - Automotive industry and driverless vehicles
      - Refuse lorries, Uber taxis, DHL delivery vehicles...
    - General public
      - Crowdsourcing
      - Citizen science...
    - Autonomous data capture
      - AI / robotics
      - Land, sea, air and space...
- Real-time serving of information, not data

# Future prospects: XXIII ISPRS Congress, 2016



ISPRS Journal of Photogrammetry and Remote Sensing

Volume 115, May 2016, Pages 3-21



## Information from imagery: ISPRS scientific vision and research agenda

Jun Chen<sup>a</sup>, Ian Dowman<sup>b</sup>, Songnian Li<sup>c</sup>, Zhilin Li<sup>d</sup>, Marguerite Madden<sup>e</sup>, Jon Mills<sup>f</sup>, Nicolas Paparoditis<sup>g</sup>, Franz Rottensteiner<sup>h</sup>, Monika Sester<sup>i</sup>, Charles Toth<sup>j</sup>, John Trinder<sup>k</sup>, Christian Heipke<sup>g,h</sup>

**Show more**

<https://doi.org/10.1016/j.isprsjprs.2015.09.008>

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### Abstract

With the increased availability of very high-resolution satellite imagery, terrain based imaging and participatory sensing, inexpensive platforms, and advanced information and communication technologies, the application of imagery is now ubiquitous, playing an important role in many aspects of life and work today. As a leading organisation in this field, the International Society for Photogrammetry and Remote Sensing (ISPRS) has been devoted to effectively and efficiently obtaining and utilising information from imagery since its foundation in the year 1910. This paper examines the significant challenges currently facing

CHEN, J., DOWMAN, I., LI, S., LI, Z., MADDEN, M., MILLS, J., PAPANODITIS, N., ROTTENSTEINER, F., SESTER, M., TOTH, C., TRINDER, J. and HEIPKE, C., 2016. Information from imagery: ISPRS scientific vision and research agenda. *ISPRS Journal of Photogrammetry and Remote Sensing*, 115: 3–21.





# Acknowledgements

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- Historic England
  - Jon Bedford, Paul Bryan
- Newcastle University
  - Maria Peppas, Polpreecha Chidburee



# Thank you for listening

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Internet: <http://www.ncl.ac.uk>



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