Crowdsourcing for observations from satellites

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In collaboration with the Crowd4Sat consortium
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ESA Project: AO/1-8068/14/F/MOS

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INTRODUCTION

Crowd4Sat overview

- European Space Agency funded – €170,000 over 14 months
- Explore new ways and methodologies to use CS
  - space data validation
  - space data exploitation
- Demonstrate value of CS for science, applications, education and citizen engagement
  - 4 use cases demonstration projects
  - targeting key scientific issues across space domains
- Develop strategy for better exploitation of CS
  - ESA data exploitation
  - educational activities.

Consortium

- 2 partners in satellite observation
  - Starlab
  - e-GEOS
- 1 partner in crowdsourcing
  - University of Sheffield
- 2 real world users of EO and OS data who can benefit from crowdsourced data validation
  - The Floow
  - Alto Adriatico Water Authority
- 1 international technology advisor / provider
  - AizoOn

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WORK AREAS

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Area 1: Analysis and planning

- Analysis of:
  - existing crowdsourcing projects
  - wider crowdsourcing and citizen science communities

- Roadmap detailing:
  - challenges and needs raised by crowdsourcing and citizen science initiatives
  - technological and community trends
  - ways to capitalise on such opportunities for ESA and the wider industry

Area 2: four case studies

- Explore opportunities for crowdsourcing and OS:
  - methods and technologies for the validation, integration and enhancement of OS products and services using both opportunistically and participatory crowdsourced data
  - methods for the validation of quality, reliability and usability of crowdsourced data for OS products and application;
  - citizen engagement with ESA activities

- Each case study will have
  - differing types of crowdsourcing
  - domain of application
  - type of OS products and data

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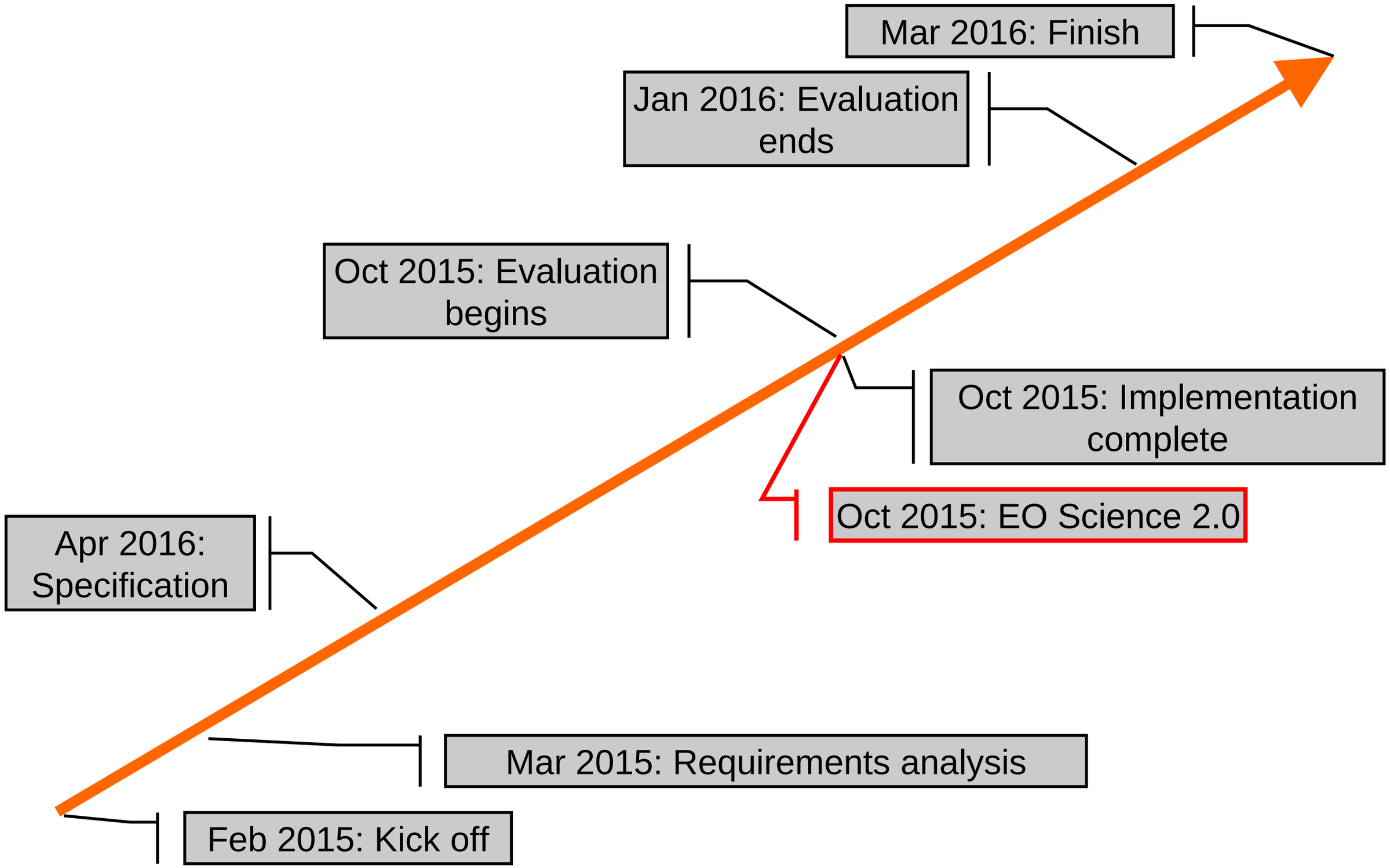
Timescales



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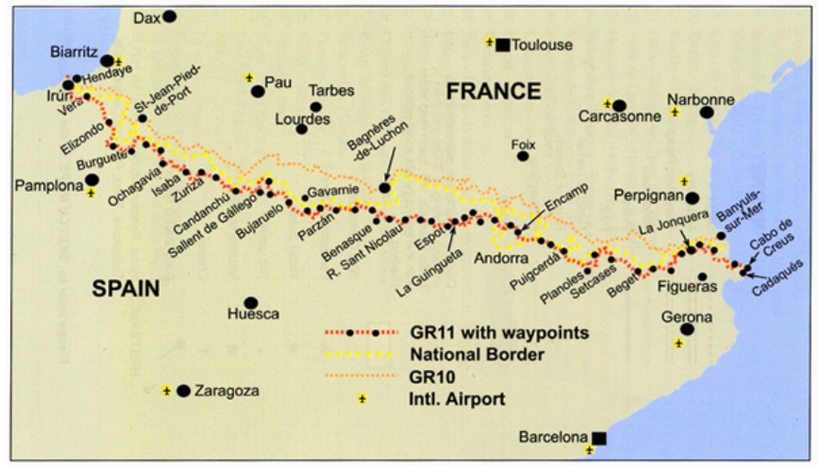
DEMONSTRATION PROJECTS

DP1: Snow coverage

- Snow Covered Area (SCA) estimation valuable
  - Accessibility and safety of transport routes and settlements
  - Leisure activities (skiing, hiking, etc.)
    - Avalanche prediction, etc.
  - Snow melt is key parameter for
    - management of water resources
    - runoff modelling
- Sentinel-1A will improve SCA accuracy and revisit time but…
  - Mountainous terrains remain problematic: slant-range distortion effects
    - foreshortening, layover, shadowing

DP1: Snow coverage

- Crowdsourcing snow coverage in the Spanish Pyrenees



- Collaboration with
  - citizens
  - citizen associations (hikers)
  - professionals (e.g., civil protection and park rangers)

- Facilitates
  - validation and integration of data and models from satellite (Sentinel-1 and MODIS)
  - increase their precision and coverage
  - identification of safe routes for hikers

DP1: Snow coverage

- OS data
  - Starlab already have a commercial SCA processing chain using
    - ENVISAT
    - RADARSAT
    - MODIS
    - (Sentinel-1)

- Crowdsourced data (participatory)
  - Mobile app
    - Snow / no-snow classification
    - Textual description
    - Photograph (optional)
    - GPS location and orientation
    - iOS and Android (platform independence via Cordova / Adobe PhoneGap
    - Anonymous

DP2: Traffic and pollution

- Vehicles are the source of 50% emissions and **90%** of the health impacts within the atmosphere.
  - satellites only sees the full ‘column’ (c.f., atmospheric inversions)

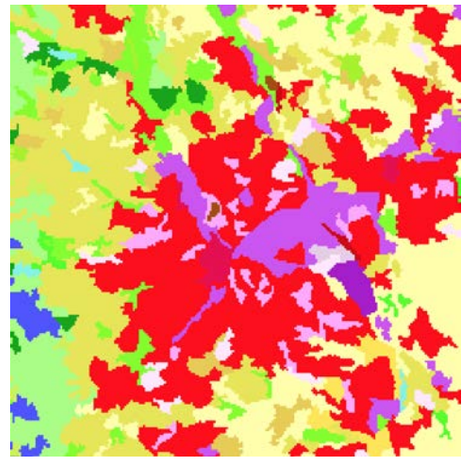
- CS data (via telematics) can augment OS data to improve:
  - pollution / emissions / exposure models
  - pollution mapping
  - traffic management and city planning

DP2: Traffic and pollution

- Location
  - 3 regions of Sheffield, UK
  - Availability of high precision ground truth emissions data (e.g., NO_x)
  - Highly engaged stakeholders
    - Sheffield City Council
    - Regional transport authority (SYPTE) & South Yorkshire Intelligent Transport Systems (SYITS)
    - Citizen lobbyists

DP2: Traffic and pollution

- OS data
  - CORINE Land Cover (CLC)
  - Digital Elevation Models (ASTER GDEMv2)



- Crowdsourced data (opportunistic)
  - Telematics data (second-by-second)
    - tens of thousands of vehicles in the UK
    - black box recorders
    - white box recorders
    - OBD-2 devices
    - smartphone apps
    - wearable computing devices
    - manufacturer-embedded telematics electronics

  - Anonymised
    - Removal of journey endpoints, demographics, personal data, unique personal IDs

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DP2: Traffic and pollution

THE FLOOW

DP3: Flood emergency mapping

- Flooding is most recurrent natural disaster
  - causes significant damages and losses.
  - next 70 years will see doubling in:
    - number of people affected by flooding each year (to 0.5-0.8 million)
    - annual damages (increasing to €7.7-15 billion)
- OS data and imagery used for flood mapping
  - Request to acquisition can be 24 hours
    - too slow for rapidly changing situation
- CS can bridge the gap and augment OS-derived flood mapping

DP3: Flood emergency mapping

- Location
  - Somerset Levels / Bridgwater, UK
  - Historic flood event – 10 February 2014
    - Heavy rain from end of January caused severe floods
    - Over 17,000 acres (6,900 ha) of agricultural land under water for many weeks

- Highly engaged stakeholders
  - Local authority emergency planners
  - Local citizens

DP3: Flood emergency mapping

- OS data
  - Sentinel-1 SAR
  - Landsat-8 Optical
  - MODIS
  - COSMO-SkyMed

- Non-EO data
  - OpenStreetMap, Wikimapia, Geonames, Copernicus Land Service

- Crowdsourced data (opportunistic)
  - Photographs from social media
    - Panoramio, Twitter, YouTube, Instagram, Flickr, etc.
    - geotagged / POI / place names
  - Anonymised
    - Removal of personal data, unique personal IDs

TRIDS

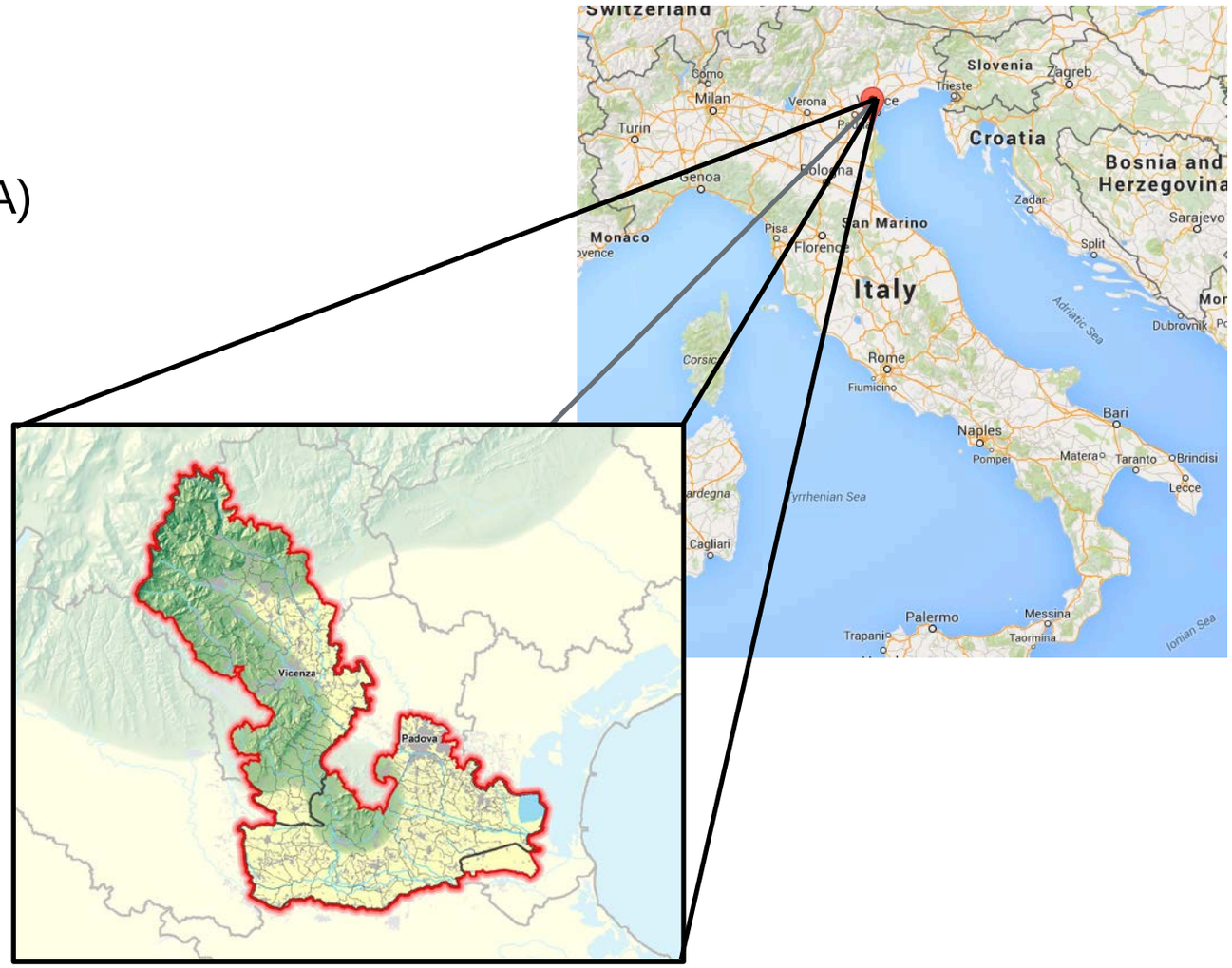
Tracking Real Time Intelligence in Data Streams

DP4: Land use

- Land use is key parameter in the management of water resources and the wider environment.
- Land cover and land cover change needed by decision-makers in the implementation of
  - Water Management plans (2000/60/EC)
  - Flood Risk Management plans (2007/60/EC)
- CORINE Land Cover (CLC) main resource
  - 44 different classes
  - refreshed every 5 years
  - 2 year delay between image acquisition and derived results
- CS data can improve accuracy and timeliness of the land cover information
  - improvement of models

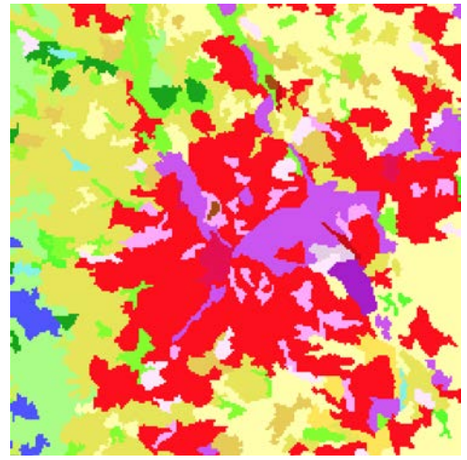
DP4: Land use

- Location
  - high plain area of Bacchiglione river network draining to Vicenza and Padua
    - supports industrial, commercial and agricultural activities
    - intensively used for settlement, production systems and infrastructure.
    - increasing demand for land uptake.
- Engaged stakeholders
  - Alto Adriatico Water Authority (AAWA)
  - Padua Local Authority
  - Vicenza Local Authority
  - Veneto Region Civil Protection

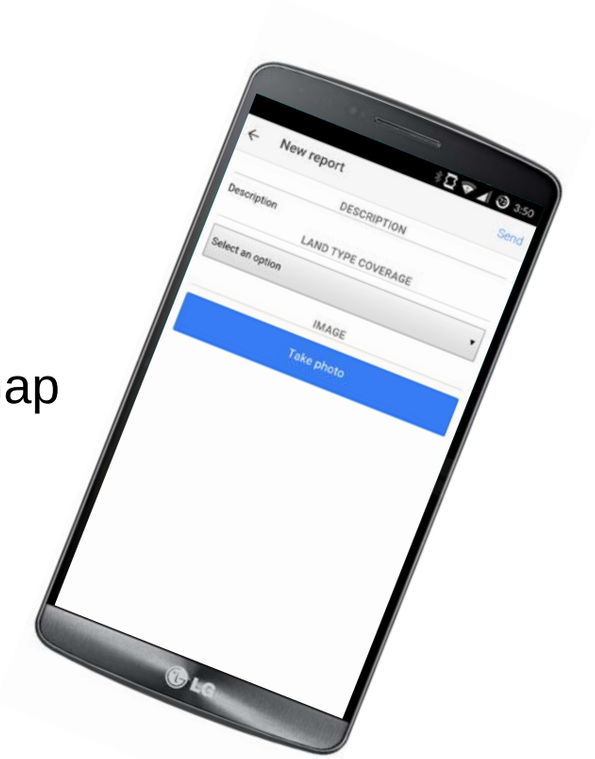


DP4: Land use

- OS data
  - CORINE Land Cover (CLC)



- Crowdsourced data
  - Mobile app (participatory)
    - Land use classification using CLC categories
    - Textual description
    - Photograph (optional)
    - GPS location and orientation
    - iOS and Android (platform independence via Cordova / Adob PhoneGap
    - Anonymous
  - Social Media (opportunistic)
    - Panoramia images
    - Anonymised
      - Removal of personal data, unique personal IDs



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Conclusions

- Surveying of related CS projects and initiatives
  - Related to both OS and non-OS applications
- Roadmapping for increased CS adoption within ESA

- Hands-on investigation into use of CS to validate and enhance OS products and services
  - Supporting technologies and infrastructure almost complete
  - Moving into formal execution and evaluation phase
- Case Study executions start this month
  - Keep in touch to find out more about our findings over the coming months!

Questions

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