Summary of the "jam session" during the EOscience2.0 workshop in Frascati 12-14 Oct 2015

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As a little experiment, we have organized an interactive "jam session" during the workshop on Open science for Earth Observation. During this session, five splinter groups have discussed future pathways for EO Open Science projects. Each group adopted a challenging scientific and/or societal issue, and designed a specific project to identify breakthrough methodologies and opportunities (e.g. crowdsourcing, citizen science, interactive technology, open data, virtual research environment, etc.) to address that issue.

The organizers selected the following topics that were each introduced by an expert:

1. Geohazards (Philippe Bally, ESA)
2. Climate change (Pierre-Philippe Mathieu, ESA)
3. Quality of life (Constantinos Cartalis, University of Athens)
4. Land use (Linda See, IIASA)
5. Air quality (Claus Zehner, ESA)

The composition of the groups was established through random selection amongst all the workshop participants. The five groups convened for discussions for ~1 hour on the Monday afternoon. On Tuesday afternoon a representative from each group gave a 5-min plenary pitch with the main ideas, and during the closing session on Wednesday some general conclusions were drawn.

Here, we present the main innovative ideas that each group has produced, and we wrap up by identifying commonalities and general challenges.

Geohazards

The main contributions for open science and new technology in this domain are expected to comprise the joint production of risk maps, and to provide crucial input for urban planning. Furthermore, new ICT tools should provide easy and open access to EO data, and thus help to raise awareness regarding geohazards. One specific challenge identified is how to deal with loss of internet connectivity during the direct aftermath of a natural disaster, when up-to-date information is of the essence. Volunteers at the location should therefore not be called on to collect information, but also to re-establish information flows.

Climate change

One of the many challenges related to climate change is to communicate its impact to the general public. To address this, the group proposed to develop "a game that is not a game". In such a serious game, people can discover the effects of climate change that are already occurring in his/her surroundings (with input from open EO data), and explore future scenarios without/with mitigating actions. The game would primarily target a younger audience who would in turn influence policy makers.

Quality of life
As the majority of the world's population lives in cities, the focus of this topic was on urban areas, and in particular on "regenerating cities". A heterogeneous set of open (and "big") EO data should be used to facilitate city planning, by recognizing interdependencies in city operations, assessing the state of the urban environment and trends, simulating energy and material fluxes, defining vulnerable zones and monitoring changes. Critical parameters for this include urban density and building stock, urbanization and urban sprawl, state of thermal environment, green/blue infrastructure, land use and land cover, urban form and CO2 emissions and air quality. Data fusion and downscaling techniques, multi criteria analysis and mapping algorithms are needed. Input from "citizen scientists" is crucial to obtain the required high spatio-temporal resolution of the data, whereas breakthroughs enabled by Open Science tools include crowdsourcing science, open data platforms, visualization tools, and apps.

Land use
The group recognizes that land use (i.e. modification by people) is generally much more challenging to map than land cover, but nevertheless extremely relevant to obtain global data on agriculture and urbanization. Still, land cover maps are very relevant to measure the impact of climate change. There will therefore be many users for a global land use/cover map, particularly if it is frequently updated. Sentinel2 is adopted as a starting point as it has considerable potential for the generation of high frequency, high resolution land cover maps. What is needed is more data for calibration and validation to complement 'authoritative' existing sources, which could be generated through crowdsourcing and citizen science. One area of considerable potential for cal/val is the millions of geotagged photos on social media as well as better exploitation of existing solutions (e.g. Geo-Wiki, Picture Pile, Zooniverse). In addition, new opportunities are identified in the form of OpenLandMap, Captcha/Recaptcha, and a modified MapBox solution in which users are asked to identify land cover from Sentinel2 satellite imagery whenever they open a new internet browser window. Although it was clearly recognized that human computing should only be used for tasks that computers find difficult or to provide training data for automated algorithms, the idea of having brute-force campaigns in which millions of people perform classifications e.g. during Earth Hour was also mooted.

Air quality
There is a clear demand for air quality maps with higher spatio-temporal resolution that current satellites and ground station can offer. A large-scale citizen science (crowdsourcing) approach exploiting low-cost sensors could therefore contribute in a major way. It would not only expand the overall measuring arsenal (Global Observing System), but crowdsourced data could also be used to evaluate satellite data, and to downscale satellite data to urban scales. Moreover, it would empower citizens and create awareness about air quality issues. The heterogeneous data (including data from mediocre-quality sensors and even street swiping samples) will need to be amalgamated using advanced data fusion. It is also a particular challenge to visualize the data for everybody to understand, including a clear presentation of the uncertainties.

Commonalities & general challenges

- How to recruit citizen scientists, and how to keep them motivated?
- How to deal with low data quality from citizen science and low-cost sensors?
- How to communicate uncertainty?
- Standardization of measurement procedures and data formats.
- Acceptance by (local) policy-makers.
- How to obtain funding for citizen science projects?
- What is the business model when all data are open?
- How to make such projects sustainable (i.e. long-term strategy)?

Generally, technical R&D is not regarded as a major barrier. In other words, the technology is perceived to be (almost) ready to start building up "Science2.0" projects. Most research may actually be needed to study the social aspects of projects that involve citizens and policy-makers on a large scale, and to study how the behavior of citizens changes by participating to citizen science projects.

ESA can play a central role in the establishment of EO Open Science projects, not only as a source of funding, but also as a portal for open EO data and the corresponding tools. Moreover, ESA could take up a central communication role that bridges the EO community, the data science community, policy-makers, and the general public in countries inside and also outside of Europe. ESA could also communicate best practices and establish future pathways, e.g. through workshops and capacity building / training sessions.