

Vigie-Ciel, a collaborative project to study fireballs and organise meteorite recoveries

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Abstract

Research on fireballs and meteorites has always been of interest to the public, due to the beauty of shooting stars in the night sky and to the extraterrestrial origin of meteorites. A fireball observation network called FRIPON [1] (Colas et al, 2015) is currently being setup, funded by ANR (Agence Nationale pour la Recherche). It will cover France with 100 cameras and is expected to be operational for the end of 2015. FRIPON will detect fireballs and hence allow us to define meteorite strewn fields within 24h, so that meteorite searches can be launched very early on. Because of the need to search all over France, including in private land, it is important that the general public be aware of our project and be willing to help or participate. Indeed, as the main goal of FRIPON is to recover fresh meteorites (within a few days), our aim is to be able to organize a search with at least 50 persons to scan an area of a few km² within a week. Help from the public would hence be most helpful but it is also important to have an operational and trained research team. This project thus appears as a unique occasion to involve the public in a scientific project while promoting informal scientific education. This prompted us to set up Vigie-Ciel, a citizen science network centered on meteorite recovery. FRIPON is an open network based on open-source software, it will accept citizen-run cameras. In addition to fireballs, it will allow scientists and Vigie-Ciel participants to study anything that can be observed by all-sky cameras: bird migrations, bats, clouds, lightning, etc. The data will be freely available to all.

1. Collaborative sciences in France

1.1 Natural sciences

The MNHN (Muséum National d'Histoire Naturelle) has had experience in citizen science networks in natural history for close to 30 years. It runs a series of programs on varied topics (birds, bees, bats, plants in towns...) built over time by a number of researchers with the help of associations involved in nature study and protection. The development of new communication technologies fundamentally changed the number of participants and the amount of data to be processed. Moreover, these programs having all been built small and independently, they are not designed to operate together smoothly and basically each have their own website. As a result, someone wanting to participate in several topics will have to manage several memberships, several philosophies for data base management. MNHN hence decided to integrate the running of all these programs in a global project called "65 Millions d'Observateurs" (shortened to 65MO and meaning 65 million observers, as France has 65 millions inhabitants!)

1.2 Astronomy

Astronomy is well known to be the oldest science, and therefore the oldest collaborative science as a professional astronomer is quite a "new" concept (only a few hundred years) compared to astronomical history (a few thousand years). As for natural science, the Internet and the new technologies have changed the context. First, all the information is now "on-line" rather than restricted to a few professionals. Secondly, efficient computers and electronic receptors are now affordable for amateurs. It is amazing to think that the groundbreaking work on the expansion of the universe done by Hubble in the fifties with the biggest telescope of the time can now be made with an amateur size telescope! More important is the fact that the sky is huge and that one telescope, even the biggest one, can only observe one

object at a time. This is particularly obvious for asteroid studies where we actually know more than 700 000 objects! As for natural sciences, many programs were developed in France over the years, by SAF (Société Astronomique de France), AFA (Association Française d'Astronomie), Planète Sciences, AUDE (Association des Utilisateurs de Détecteurs Electroniques) etc.

2. 65 Millions Observers (65MO)

To build 65MO, MNHN obtained a grant from a general education and outreach program of ANRU (Agence Nationale de Rénovation Urbaine). 65MO is divided into four sub-programs: Vigie-Nature (the main program on biodiversity and climate change), Vigie-Mer (everything concerning sea and seashore), Vigie-Ciel (fireballs, meteorite searches and crater spotting) and finally Vigie-Nature-Ecole (a program concerning all the topics together, including Vigie-Ciel, but dedicated to students of all levels to teach about sciences and scientific protocols).

3. Vigie-Ciel

The prime object of Vigie-Ciel is to exploit data from the FRIPON network that will be fully operational by the end of 2015. Participation could involve:

- use of the free data produced by the network to study phenomena other than fireballs seen by the cameras: for example cloud cover, bats, bird migrations, lightning, etc.
- direct participation in the network by acquisition of a FRIPON compatible camera,
- development of software based on FreeTure open-source platform,
- participating in the network with images made with digital cameras or visual witnesses obtained and/or sent with smartphones,
- participating in meteorite search campaigns,
- online search for unknown impact structures in aerial photographs of the Earth's surface,
- attendance at educational programs (general public or students; conferences, exhibits, workshops...)

Participants will benefit at a number of levels, one of which is simply the involvement in a scientific quest, obtaining a better understanding of the scientific results obtained by the program and being, in some cases, associated by name with declarations of new meteorites and new craters and other scientific publications. Another benefit will be belonging to a

community with a large variety of participants, including scientists, and participating in a project with field work and other informal contacts.

Vigie-Ciel will have a website expected to be fully operational by the spring of 2017. Like FRIPON, the program is structured around regional poles in order to be in close contact with the public all over France to obtain a good knowledge of local conditions and to be able to form search teams that can be active within 48h in the case of a meteorite fall. The centers mainly rely on planetariums, scientific museums and other outreach structures that are connected to the FRIPON network through the scientific centers constituted by local/regional scientific laboratories.

Another goal of Vigie-Ciel is to involve any scientific domain connected to astronomy (from our solar system to the whole universe) and to earth sciences. A good example is Rochechouart (the only known meteorite impact crater in France) where the public will be able to see in the same museum both impact breccias and fireball online detections. Another example is the ability to search for unknown impact structures in aerial photographs of the Earth in an online program similar to Galaxy Zoo.

4. Conclusion

Vigie-Ciel is designed to let the public participate in a true research quest on the universe and reconnect with science using their natural attraction to fireballs and meteorites. It will be based on new information technology but also on direct contacts with the scientists using pedagogic tools that will be specifically designed to show how to recognize a meteorite, to observe radio meteors, etc.

5 Acknowledgements

The FRIPON project is funded by ANR (Agence Nationale de Recherche); 65 MO is funded by ANRU (Agence Nationale pour la Rénovation Urbaine).

References

- [1] Colas, F., Zanda, B., Bouley B., S., Vaubaillon, J., Marmo, C., Audureau, Y., Kwon M.K., Rault J.L., Caminade, S., Vernazza, P., Gattacceca, J., Birlan, M., Maquet, L., Egal, A., Rotaru, M., Birnbaum, C., Cochard, F., Thizy, O.: French fireball network FRIPON, EPSC 2015.