CROWDSOURCING IONOGRAM SCALING: A CITIZEN SCIENCE PROJECT

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ABSTRACT

Citizen science (CS) is defined as a form of research collaboration or data gathering performed by non-experts or untrained individuals. CS projects benefit scientists by providing resources for data processing, gathering, pattern recognition, etc. On the other hand, for volunteers, CS represents the democratization of science, and the opportunity to be involved in local issues as well as a strong public education aspect. In this work, we will use zoouniverse.org to create a CS project using data from Jicamarca Radio Observatory's ionosonde. Participants will use a built-in draw tool to identify the ordinary and extraordinary lines from an ionogram power image, which then can be used for parameter estimation. Furthermore, we will describe our plans for data management and public engagement. We hope this work will motivate our community to use CS projects both as a scientific and an outreach approach.
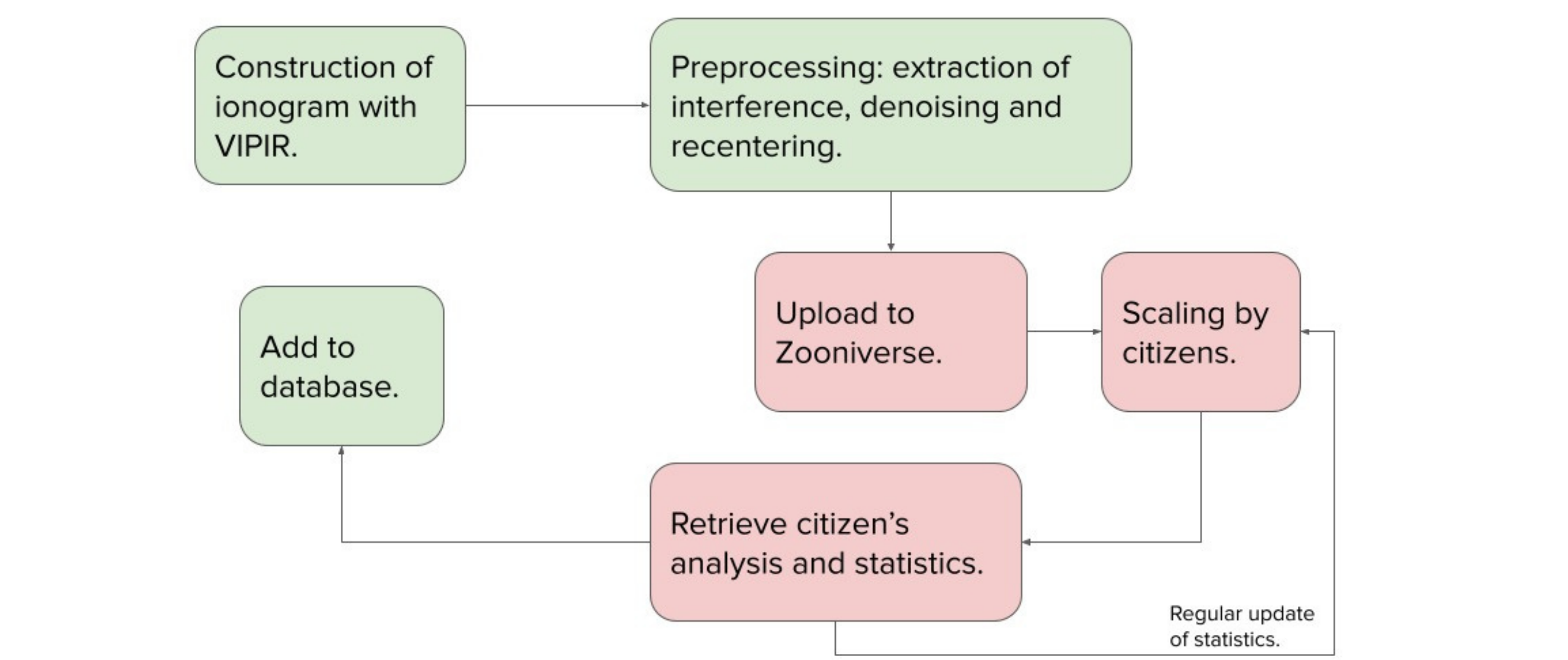
INTRODUCTION AND MOTIVATION

The rapid development of new technologies has brought the possibilities for instant collection, transmission, and submission of data and provides researchers the capability to validate data [1]. CS projects benefit scientists by providing resources for data processing, gathering, pattern recognition, etc. On the other hand, for volunteers, CS represents the democratization of science, and the opportunity to be involved in local issues as well as a strong public education aspect [2].

Nowadays the development of online citizen science projects represents multiple benefits associate with their amplified range of action due to no physical barriers and overall the low cost to strengthen the infrastructure for scientific research and engage members of the public in science, which opens the possibility to applied citizen science to many fields of study [3]. Platforms such as Zooniverse represent a unique virtual space for the user to find projects of their interest and participate with simple and intuitive methodologies. Zooniverse CS projects have achieved large participation of non-scientific in science [4], which position it as a useful tool to promote participative projects in scales that researchers cannot accomplish on their own.
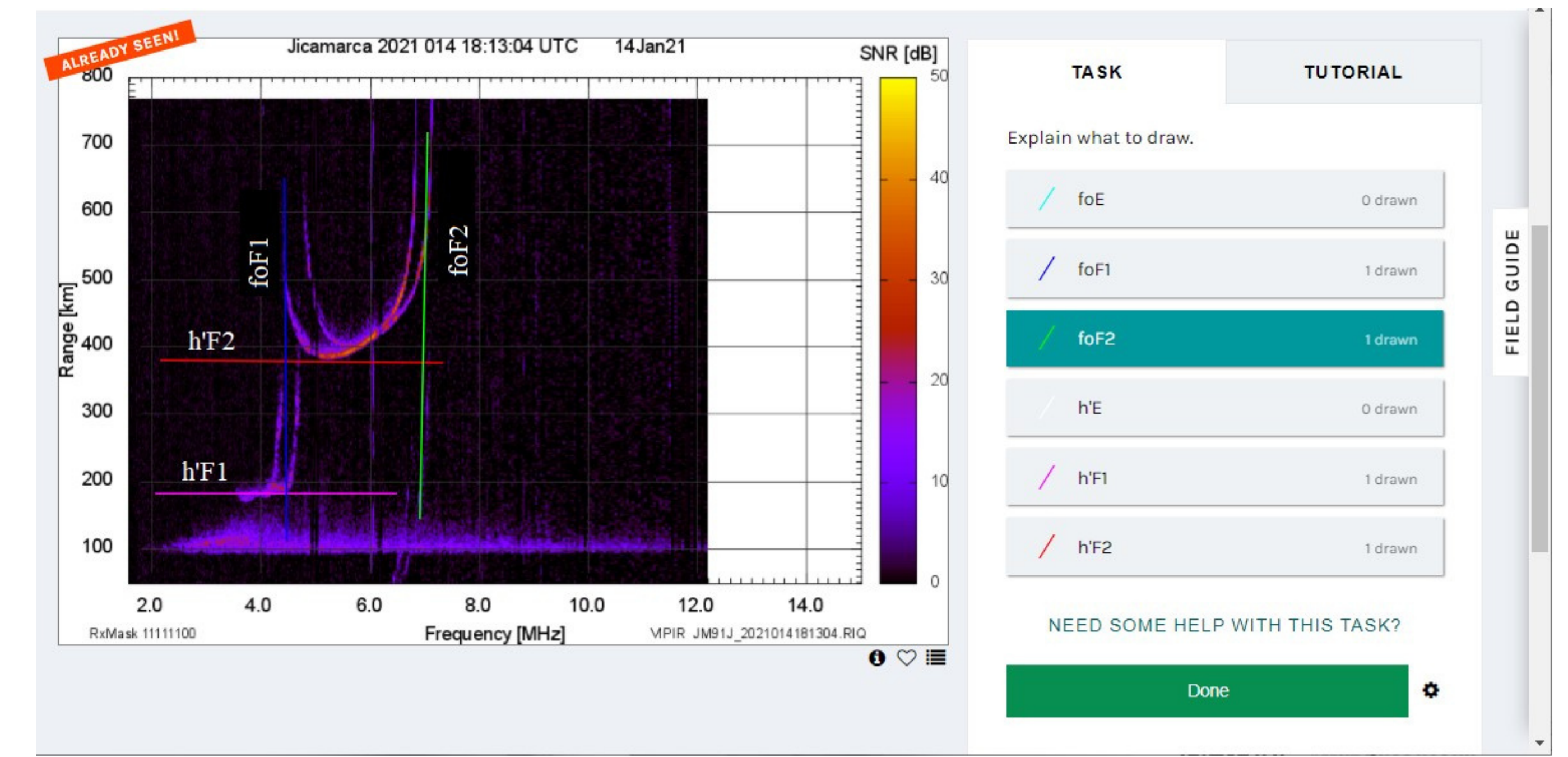
METHODOLOGY

Ionograms have been manually scaled for many years. In this work, we propose a way for the citizens to participate in this process.
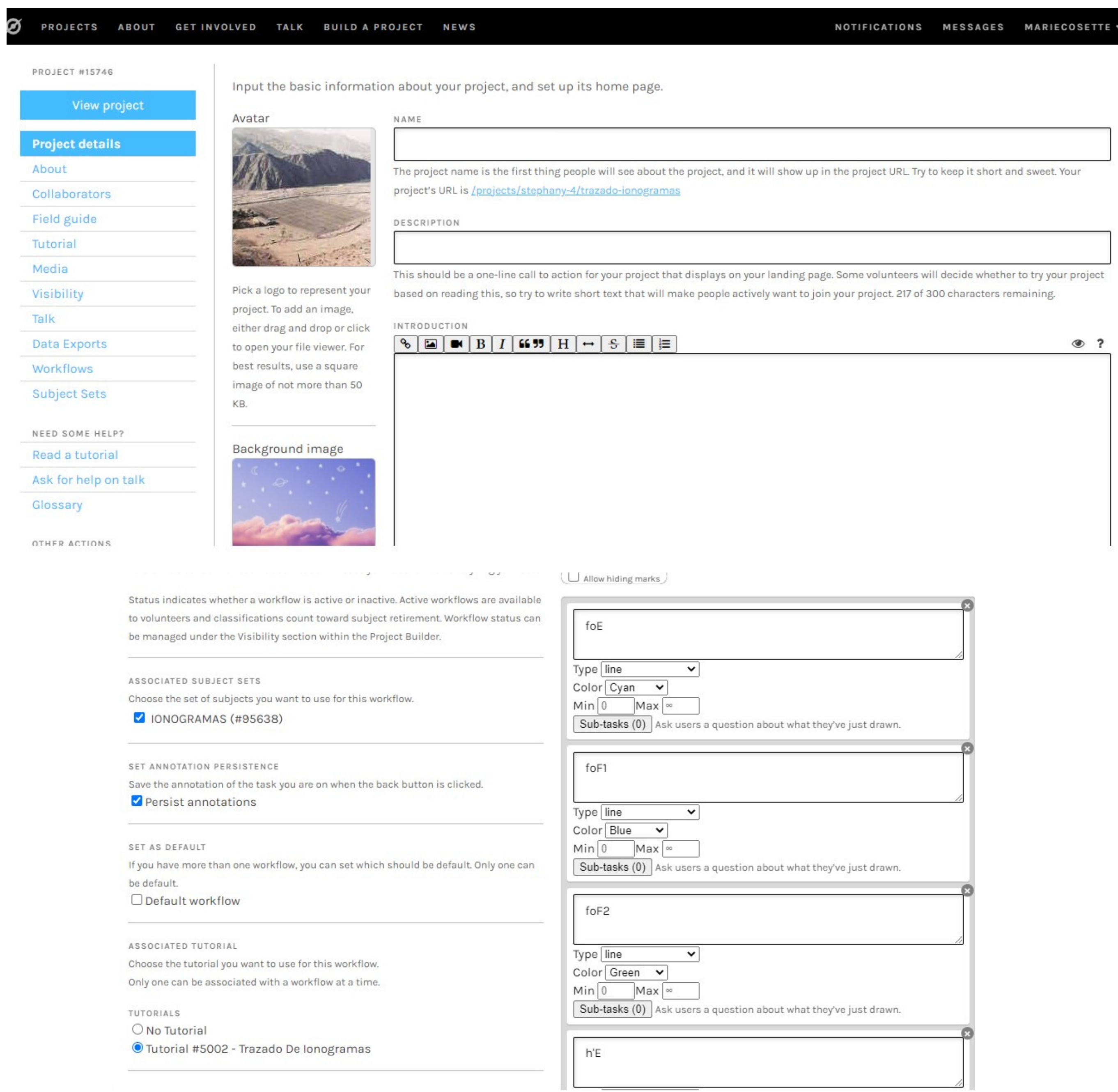

Fig. 1. *Diagram showing the whole processing of the data. The green blocks represent the usual steps for manual scaling and the pink ones the contribution of the public.*

The ionograms are produced by the ionosonde VIPIR, from the LISN network. Simple processing of the images is done to decrease interference, noise and to shift the echoes to the center of the image. Then, these images are uploaded to the platform zoouniverse.org (Figure 1).

The zooniverse.org platform is quite versatile and allows researchers to personalize the design (Figure 2). There, the participating public will find a video explaining the physics of the acquisition of the ionogram in a non-technical language. With this instruction, they will proceed to scale the ionogram.

Figure 2. *Screenshots of the zooniverse.org platform. Top: Edition layout to build the website that the citizens will see. Bottom: Tools to build the buttons that citizens will use to analyze the ionograms.*

The scaling data is stored by the platform and then can be downloaded, analyzed, and stored in a database for future scientific use. An example of the preliminary design of the buttons for scaling is shown in Figure 3.

Figure 3. *An example of one ionogram scaling. On the left, we can see a VIPIR ionogram and the identified characteristic frequencies and virtual heights. On the right, we see an example of how we can construct buttons to identify different patterns in the ionogram.*

Figure 4. *Diagram illustrating the structure of the public engagement strategy for the project.*

PUBLIC ENGAGEMENT

Citizen science projects depend on public participation. For this reason, it is essential to design a public engagement strategy taking motivational factors into account [4]. These motivational factors can be summarized in interest in the project's topic or in science in general, interest in learning something and contribution to scientific knowledge [5] (Figure 4).

The **first** motivational factor, interest in science, will be handled through a social media campaign to launch the project, explaining the main goals, the relevance of the Jicamarca observatory, and the steps to participate in the zooniverse project.

The **second** motivation is related to interest in learning something, which will be addressed through free talks organized for current and potential participants. This information will be complemented with scientific dissemination through posts in social media.

The **third** motivation is the interest in contributing to scientific knowledge. De Vries [5] found that participants value the accessibility of their collected data, communication of project findings, and acknowledgment in publications. Therefore, monthly reports about the data processing and advances in research will be shared with participants through social media, and special recognition to the most active participants in the platform.

The multimedia material to be used must show the potential to transform the learning experience, moving from a passive approach to an active one.

CONCLUSIONS AND FUTURE WORK

- Although there are tools for automatic scaling of ionograms, these are expensive and often need tunning.

- A citizen science project for ionogram scaling can provide useful scientific data and at the same time popularize Peruvian space science.

- In the next months, we will: explore possible success metrics, statistical techniques for reducing bias, design social experiments.

- We hope this work will motivate researchers in the CEDAR community to explore the advantages of citizen science methodologies.

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