ESA Climate Change Initiative – Fire_cci
D5.3 User workshop Report

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Summary

This document is the Report of the User Workshop that was organised as part of the European Geosciences Union (EGU) General Assembly 2023. This document summarizes the results of the survey done during the workshop, and presents some recommendations for future burned area product developments.

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1.1	16/11/2023	ESA	Section 3 Section 5	Text in second paragraph rephrased. Text updated.

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1. Aims and objectives

Global information on burned area (BA) has now been investigated for more than 20 years. Initially delivered from the MODIS sensor in 2005 (Roy et al. 2005) on a monthly basis and at coarse 500m resolution, this information tremendously improved along the years, including smaller fires (Randerson et al. 2012) and finer resolution (Chuvieco et al. 2018), or fire intensity (Schroeder et al. 2014) or severity (Alonso Gonzalez et al. 2020). Based on this improving knowledge on burned area delivered at global scale, key results on fire emissions (van der Werf et al. 2017) and fire drivers could be identified (Haas et al. 2020) and implemented in fire hazard models embedded in Dynamic global vegetation models (Hantson et al. 2016, Rabin et al. 2017).

In the early stages of the BA developments, the Earth Observation community was devoted to technical issues related to producing accurate information on burned area and other Climate or Biodiversity essential variables. Once the major information, i. e. burned area, could be delivered, end-users increasingly raised issues and future needs (Mouillot et al. 2014) for climate assessment or other applications. Among other, the coarse resolution missing small fires, the high omission and commission errors in some areas, the low temporal accuracy, and the too short term fire history reconstruction appeared as the main weaknesses preventing accurate and timely fire emissions and climate/atmospheric impacts.

These end-user needs, first assembled from a bibliographical review and a user requirement questionnaire (Mouillot et al. 2014), paved the way to the FireCCI objectives since its early stages and lead to the delivery of the FireCCI51 finer resolution burned area (Chuvieco et al. 2018), the long term reconstruction from AVHRR sensor (Otón et al. 2019, 2021), and the Small Fire Dataset for Africa at high resolution (Chuvieco et al. 2022).

After more than 10 years of FireCCI activities, and the delivery of these updated burned area datasets, the pixel-based derived fire patch database FRY (Laurent et al. 2018), and keystone results on climate/atmospheric impacts (Ramo et al. 2021), FireCCI launched a new end-user survey during the splinter meeting workshop at the EGU 2023 General Assembly. This document presents the workshop programme, attendees' profiles, results of the survey and main conclusions.

2. EGU 2023 FireCCI workshop programme

The European Geophysical Union (EGU) conference aims at assembling the scientific community in earth sciences, covering many fields of research on earth, planetary and space science (https://www.egu23.eu/). Held in Vienna (Austria) from April 23rd to 28th 2023, EGU23 welcomed 15,453 onsite attendees from 107 countries, offering a fantastic opportunity to meet and advertise the earth/atmosphere interaction community about new earth observation data on global burned area, but also get their feedbacks on their perceptions of the data, how they use them, on what purposes, and request feedback on their future needs in terms of improvements.

Three oral presentations on the current updates of the FireCCI burned area data and application were given, with an audience composed of earth observation developers and end-users (Table 1), on April 24th and April 25th, allowing for an extending advertisement before the Workshop held on April 26th.

Table 1: Oral presentations related to FireCCI at EGU2023.

EGU23-9575 | Orals | BG1.2 **FRYv2.0 : a global fire patch morphology database from FireCCI51 and MCD64A1** **Florent Mouillot**, Wentao Chen, Manuel Campagnolo, and Philippe Ciais Mon, 24 Apr, 11:05–11:15 | Room C
EGU23-8151 | Orals | NH7.1 **Assessment of fire contribution to forest loss in sub-Saharan Africa using medium-resolution BA** **Amin Khairoun**, Florent Mouillot, Wentao Chen, Philippe Ciais, and Emilio Chuvieco Tue, 25 Apr, 11:47–11:57 | Room 1.31/32
EGU23-1317 | Orals | NH7.1 **Global and continental burned area detection from remote sensing: the FireCCI products** **M. Lucrecia Pettinari**, Joshua Lizundia-Loiola, Amin Khairoun, Ekhi Roteta, Thomas Storm, Martin Boettcher, Olaf Danne, Carsten Brockmann, and Emilio Chuvieco Tue, 25 Apr, 08:33–08:43 | Room 1.31/32

Beside the direct advertisement at EGU2023, a flyer about the workshop was sent to the attendees of the sessions BG1.2 (Fire in the Earth system: understanding effects across spatiotemporal scales) and NH7.1 (Spatial and temporal patterns of wildfires: models, theory, and reality) one week before.

The ESA FireCCI workshop on Burned Area products was organized on April 26th (16:15-18:15 CEST) during the SPM8 splinter Meeting negotiated with EGU2023 organizers. 4 presentations were given to synthesize FireCCI data and their benefits for the climate science community (Table 2).

Table 2: FireCCI presentations during the workshop

- **User requirements for global burned area data: literature review**. Florent Mouillot (IRD, France)
- **BA dataset from the ESA FireCCI project**. M. Lucrecia Pettinari (University of Alcala, Spain)
- **FRYv2.0: a global fire patch morphology database: new developments**. Florent Mouillot (IRD, France)
- **Emission estimates and top-down constraints from FireCCI BA products**. Dave Van Wees (VU, Netherlands)

Interactive discussions took place between each presentation to perceive end-user interests, technical, quality or format limitations in using the data, and their future needs. To operate this discussion in real time, and make it interactive and dynamic, we prepared an online questionnaire, which attendees could fill on their smartphone in real time.

We used the Wooclap © application (www.wooclap.com) to prepare our questionnaire allowing multiple choice answers or open answers, and to be able to offer a real-time

calculations and graphic representation of answers, thus enhancing and capturing the attention of attendees, often reluctant in answering anonymous online questionnaires sent by emails.

14 questions were prepared to get user's profiles and their views and expectation on burned area products (Table 3).

Table 3: Interactive Questionnaire of the FireCCI Workshop

Q1: Please indicate what kind of institution you belong to: University/Research Institute Governmental organization Non-governmental/Non-profit organization Commercial sector Other
Q2: Please indicate the country in which you are working (Open)
Q3: For what general application(s) do you require burned area information? Atmospheric chemistry (-climate) modelling Biogeochemical modelling Dynamic vegetation modelling Land cover / Land use change modelling Statistical modelling of fire patterns and fire drivers Forest and fire management planning (e.g., fire prevention, early response, post-fire measures) Environmental law Others
Q4: What satellite-derived burned area products have you used in the past? FireCCI51 FireCCI - Small Fire Database Africa (11/20) MODIS MCD64 MODIS MCD45 GFED4 GFED4s GABAM Other So far, none C3S BA FireCCILT11 FireCCIS310 CGL BA
Q5: Do you trust the BA delivered by global remote sensing? 100% confident Looks good enough Don't fully trust but still using it; nothing else available I actually never checked. I'm just using it and taking it for granted I prefer not to use it

Q6: What is your preferred file format for BA products? NetCDF-CF HDF Geo TIFF TXT (ASCII files) Shapefile Other
Q7: What spatial resolution is useful for you? < 5 m 15 - 30 m 250 - 500 m 1 km 0.01 degrees 0.05 degrees 0.25 degrees 1 degree Other
Q8: How important are these BA product's characteristics related to your choice in using it? Longest time period covered Near real time release Accuracy in total BA Accuracy of burned pixel location Accuracy in burn date The most used in the scientific literature of your scientific field
Q9: What are your most important complains in current data? Data format (NetCDF, TIFF, …) Data accessibility (FTP, download issues, ...) Data size (too heavy for my connection or computing facilities) Inaccuracy Too coarse resolution Too short period covered
Q10: How do you consider BA uncertainties in your studies? Never using Just looking, never using Always checking… rarely using Fully consider
Q11: How many BA products have you tried? None Mostly 1, just checking others but not convinced on benefits 2, to be scientifically sound 2, to please the reviewers More for different topics More for considering uncertainties on the same topic

Q12: What is your opinion on the recent fine resolution 20m BA data for Africa (Sentinel-2, FireCCISF11/20)? Amazing to get this, it opens new research topics and new potential results Nice but too short period so I wouldn't use it Confusing, I lost trust in other coarse resolution products Trying to adjust other product to these new values
Q13: What is your opinion on the long-term BA data (AVHRR FireCCILT11)? Have not checked it Checked and did not use it Good enough for my research Used after clean up/filtering Found it very useful to get this long-term data
Q14: What would be your favourite next accomplishment(s) in global BA products? Improve spatial resolution Improve temporal resolution Improve the real-time delivery of data Merging coarse resolution sensors Merging backwards all data in a longest period possible, even with high uncertainty Adjust coarse resolution BA to new results obtained at fine resolution Provide updates in previous versions with reduced uncertainties Improve acknowledged weaknesses as peat/surface fire or cropland fires

3. Workshop attendees' profiles and experience with BA datasets

37 attendees participated in the workshop. Among them, 28 came from a research institute or university (87.5%) (Figure 1), while other attendees were coming from governmental agencies, non-governmental agencies or commercial sector.

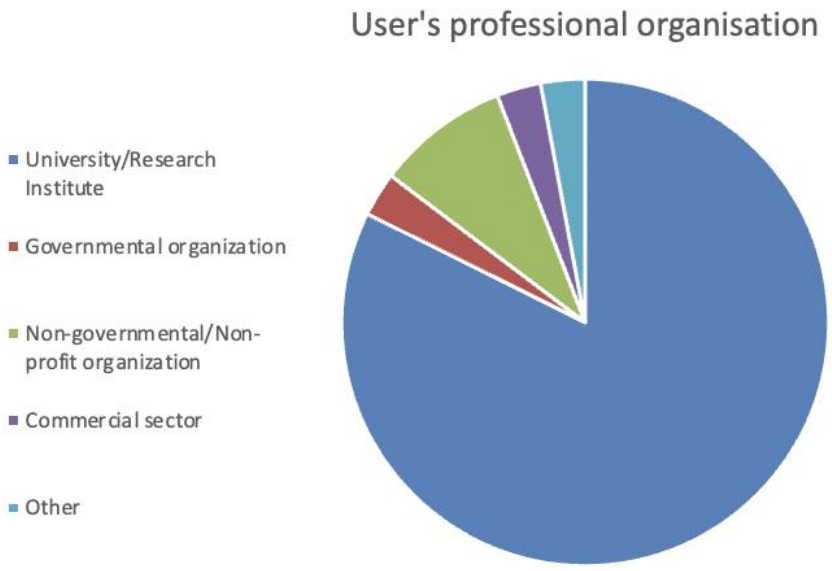

Figure 1: Distribution of workshop attendees' professional organization

Regarding the nationalities of attendees (who could only participate on-site), 32 were based in European countries, with only 3 attendees from Asia, and 2 from the Americas, illustrating the potential bias of the study due to the European location of the conference (Figure 2). This is also in line with the general attendance to the EGU2023, where more than 70% of the on-site participants were from Europe (see the statistics of the participants' nationalities at https://www.egu.eu/meetings/general-assembly/meetings/participants-2023/). UK, Netherlands and Germany represented half of the attendees to the workshop, followed by Spain, Greece and Switzerland.

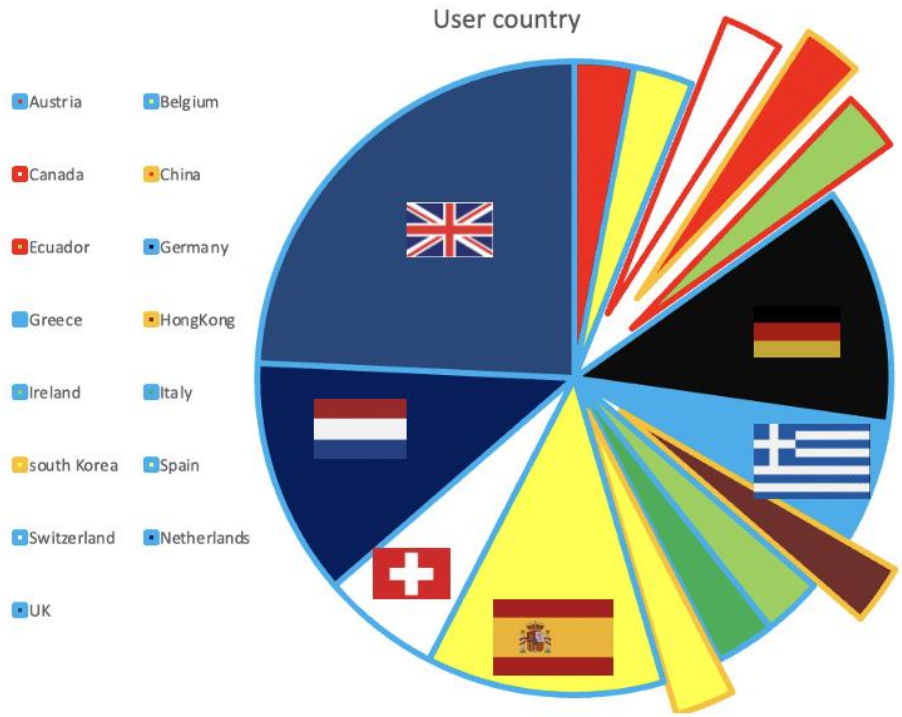

Figure 2: Distribution of workshop attendees according to their nationality.

The "field of research" analysis of the workshop attendees illustrated that only 1/3 were interested in fire/climate modelling, the scientific community which was initially the most targeted by the ESA Climate Change Initiative (CCI) (Figure 3). This result is actually in agreement with Mouillot et al. (2014), who could identify the various scientific community using global burned area data, outside the climate modelling community. Biogeography of fire, analysis of fire drivers (Fire regime analysis) and Forestry scientists accounted also each for 1/3 of the attendees.

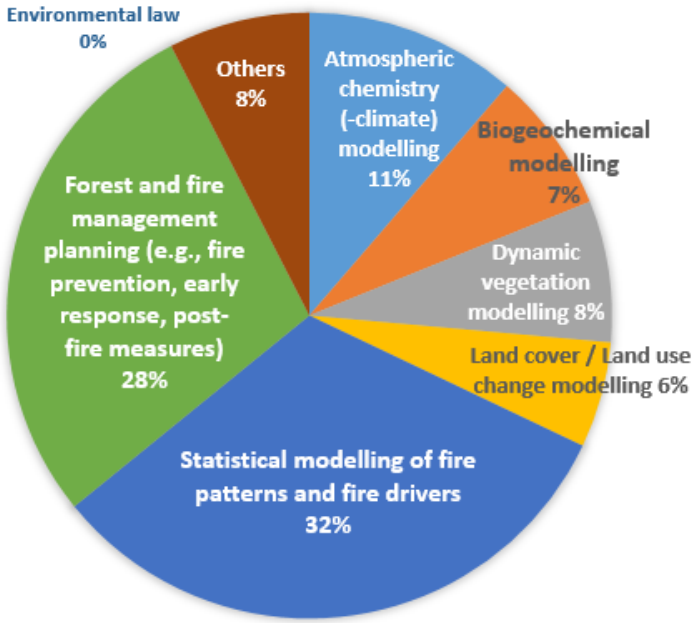

Figure 3: Distribution of workshop attendees according to their field of research

Whatever their background, most attendees (except one) had experience in at least one burned area product in their field of research (Figure 4). Our survey revealed that the most used dataset were the long lasting (available since 2005) MODIS MCD64A1 (1/3) and followed by the MODIS-derived GFED4 and GFED4s (25%). FireCCI data (FireCCI51, FireCCISFD11/20, FireCCILT11), despite being released later after 2018, accounted for 1/3 of the used datasets. This result illustrates how FireCCI data are now part of the acknowledged reliable burned area dataset to rely on within the panel of available products, not necessarily competing or over performing MCD64A1, but as part of the technical and processing uncertainties in estimating burned area.

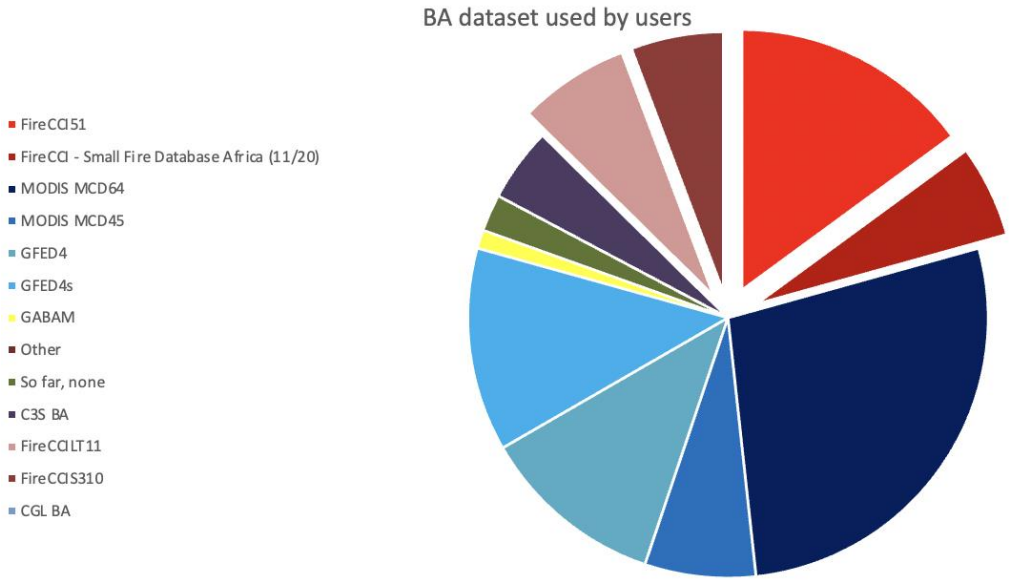

Figure 4: Fractional distribution of burned area datasets used by workshop attendees in their research. No attendees stated having used CLG BA.

Figure 5 actually illustrates that current end-users rely on multiple burned area data sources depending on the research objectives (50%), but also at least two burned area products to be scientifically sound and account for uncertainties. 25% of attendees still use only one single burned area information in their studies, not convinced or informed about the differences between each fire products.

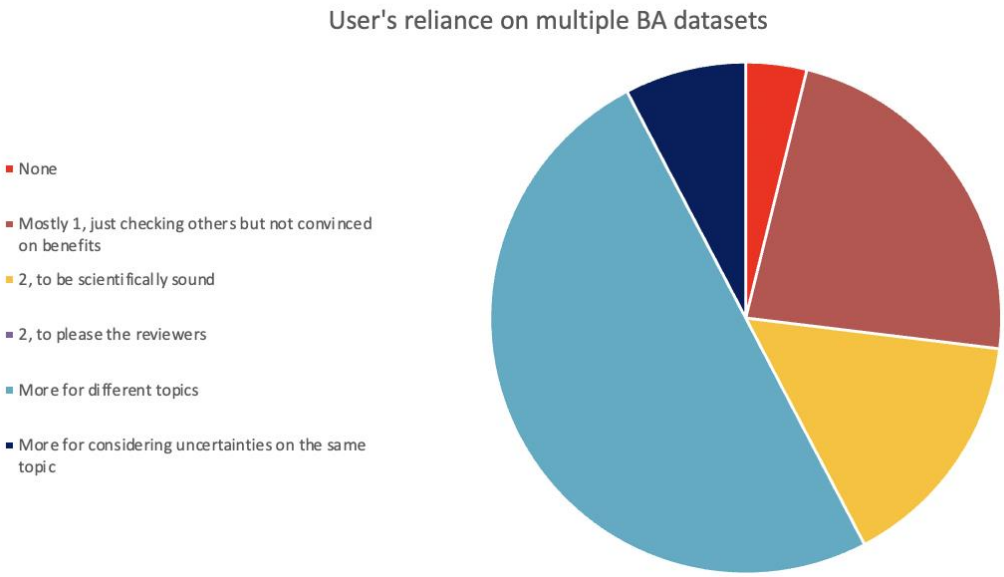

Figure 5: Fractional distribution of workshop attendees' decision strategy in using a single or multiple burned area datasets in their research.

The main reason for the end-users to select one given datasets (Figure 6) is the accuracy of total burned area, with a score of 4.3 (over a maximum of 5), followed by the accuracy in BA pixel location and the period covered (both with score 3.7). The accuracy on burned date had a lower score of 3.2, while the characteristics less important to the attendees, with a score of 2.8, where the near real time release of the product (some datasets being released in near real time as thermal anomalies MCD14ML, with a few months delay as MCD64A1 or more than a year as FireCCI51), and the product most used in the scientific literature (showing that attendees are willing to test and use new BA products).

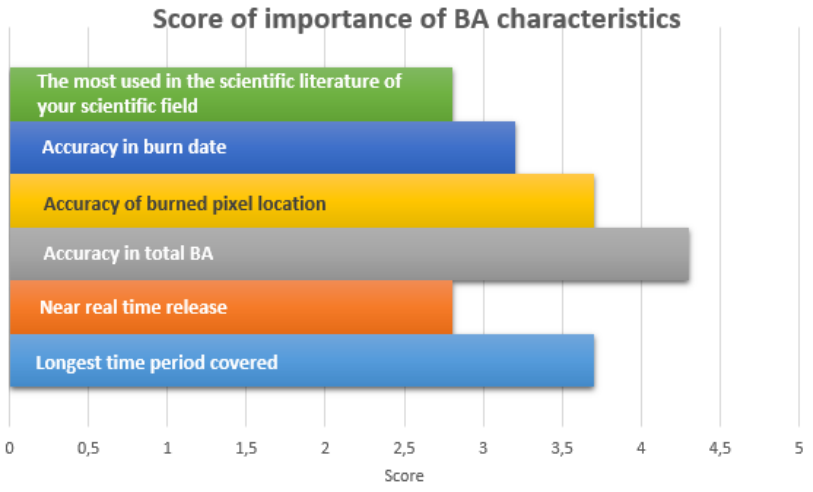

Figure 6: Score of workshop attendees' main reasons to select a given BA dataset for their research.

4. Results of the survey on BA user's experience and future needs

4.1. User requirement on resolution and data format

Among user requirements from Mouillot et al. (2014), finer resolution appeared as a keystone target to achieve. Indeed, ten years after this early survey, more than 1/3 of the workshop attendees still request very fine resolution burned area <30m (Figure 7). This goal was actually reached by the FireCCISFD11/20 database for Africa in 2016 and 2019, but the dataset remains to cover almost one continental and for two years, although expected to be applied at global scale in the future. Coarse resolution (250m-1km) was still considered as a convenient resolution for 1/3 of the attendees, as well as gridded information (0.05°-1° resolution) mostly because global dynamic vegetation models or fire emission models are yet hardly applicable at finer resolution (Rabin et al. 2017, Hantson et al. 2016). These user requirements are covered by the different data formats delivered by the FireCCI project, offering both gridded and pixel-level information, and thus covering most of the user needs.

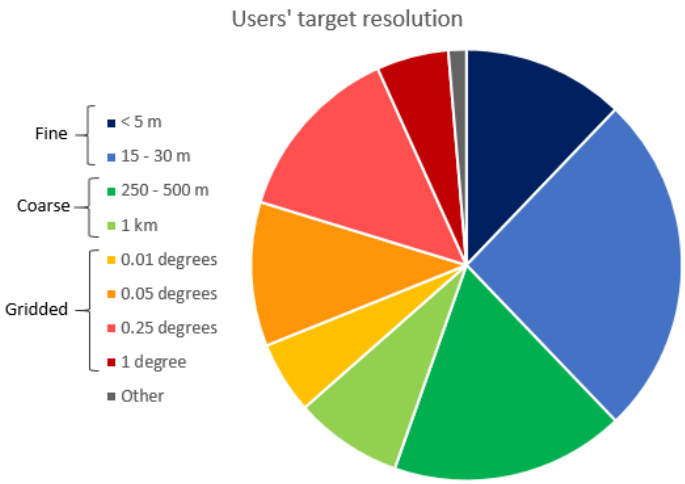

Figure 7: Fractional distribution of workshop attendees needs referred to the spatial resolution of burned area datasets

Data format's preference was mostly the widely used NetCDF and GeoTIFF formats, currently delivered by the FireCCI project, thus fitting the users' preferences (Figure 8).

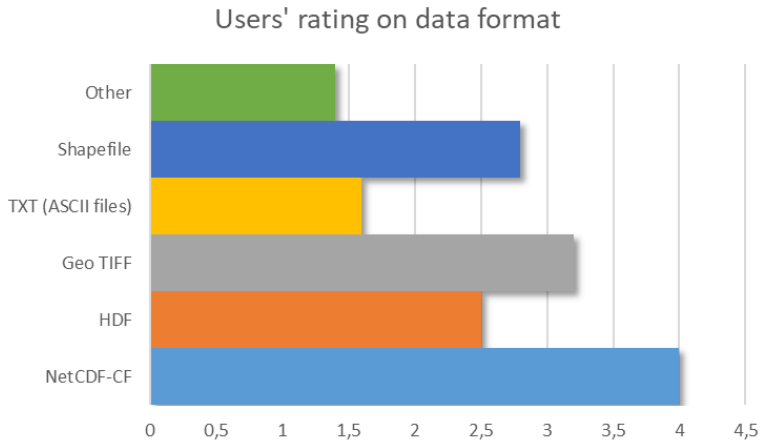

Figure 8: Rating (0: not used, 5: favourite) of burned area data formats

4.2. Users' experience feedback on Burned Area products

In order to get potential difficulties, data caveats or bad experiences raised by end-users, we questioned the attendees on their perception of the quality of BA products currently available.

As a first information, we asked how confident they feel in the BA estimates delivered by the global datasets. None was actually 100% confident in the BA estimates, but 1/3 considered the data to look good enough relative to their scientific goals. Almost 50% of attendees, however, had a relative low trust in the data, but relied on them as the only source of data they could use given the current technological advances. This large proportion of scientists are actually the main contributors to future needs and requirements that the Earth Observation scientific community is trying to reach with the increasing development of new sensors and technologies. We could criticise that 20% of the end-users take the burned area data for granted, without relying on the warnings and uncertainty assessments of the datasets delivered in the Product Specification Document (PSD).

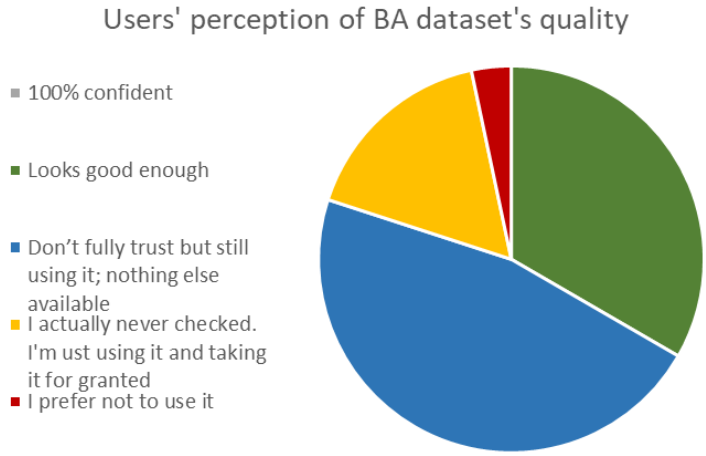

Figure 9: Workshop attendees' perception of the burned are data quality

A specific question on the uncertainty layer, provided by FireCCI51 gridded and pixel-level information (as described in the PSD), actually revealed that end-users don't even look, just browse, but hardly consider this additional layer (Figure 10). Brennan et al. (2019) fully covered this issue over multiple BA products, but has received little attention yet.

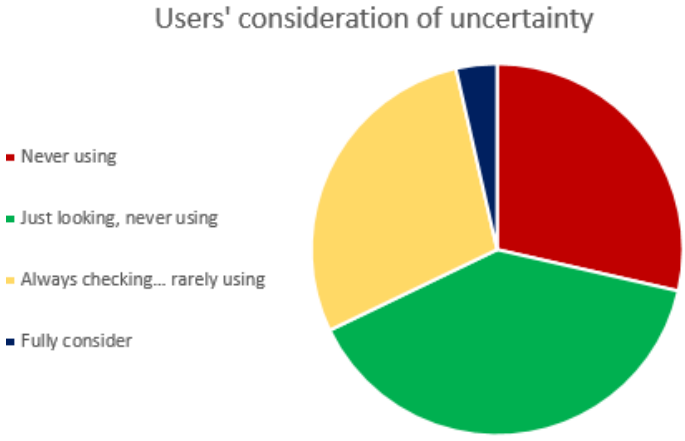

Figure 10: Workshop attendees' use of the uncertainty layer provided in burned area datasets.

As a synthesis (Figure 11), the main critics and complains of the end-users on the current BA developments still cover some data format or downloading technical aspects, maybe mostly for the scientific community of forestry and biogeography of fire regimes, less used to GeoTIFF or NetCDF formats, or hardly trained to manipulate huge and multilayered datasets. Beside these technical complains, the still high rates of commission/omission errors and in turn inaccuracy in the total burned area, a too coarse resolution information for local studies, and a too short period of time (2000-present) remain equally mentioned by the users, a critic similarly pointed out for the early BA datasets (Mouillot et al. 2014).

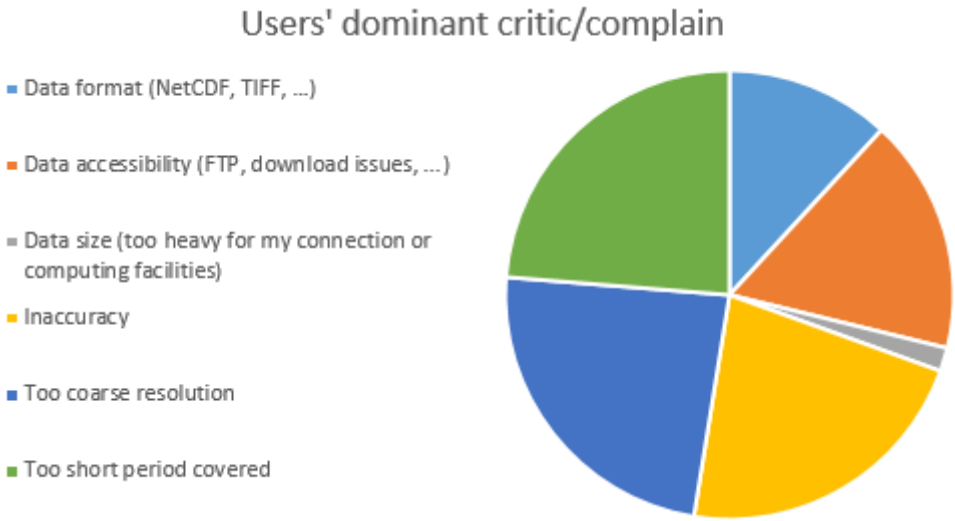

Figure 11: Workshop attendees' main critics in the current burned area datasets

4.3. End user perception of newly delivered fine resolution and long-term FireCCI datasets

To fulfil the initial user requirements on finer resolution and longer-term BA information, FireCCI developed respectively the FireCCISFD11 (for the year 2016) and FireCCISFD20 (for the year 2019) for sub-Saharan Africa at 20m spatial resolution, and the global FireCCILTDR11 at global scale since 1982 but at approx. 5 km resolution. We investigated how the end-users perceived these new developments.

Regarding the fine resolution FireCCISFD11/20 (Figure 12), more than 50% of the attendees valued the benefits of this dataset as a significant scientific step forward for their research. As it covers only the years 2016 and 2019 and only for Africa, this main weakness prevented some attendees to actually use it (as they needed long time series or fully global data). However, they were still enthusiastic of this BA update for Africa, and tried to adjust the observed discrepancy with coarse resolution data, pointing out here future needs and targeted developments for the Earth Observation community.

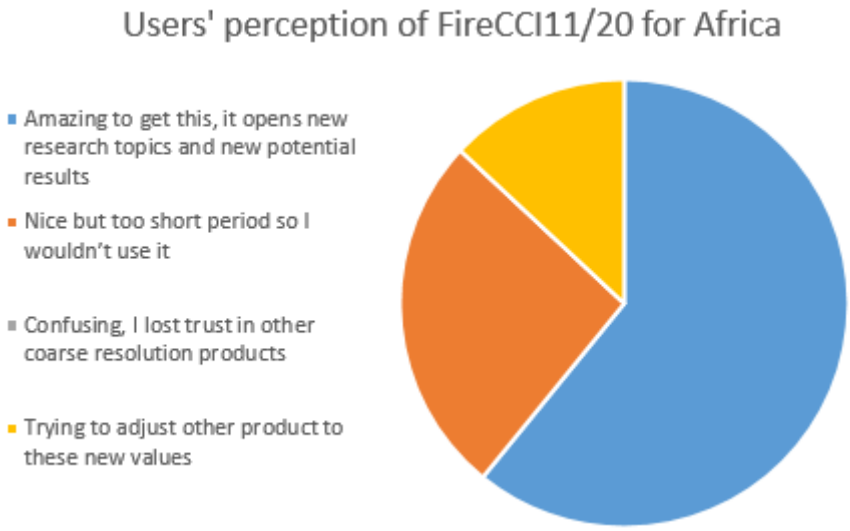

Figure 12: Workshop attendees' perception of the newly delivered FireCCISFD11/20 small fire datasets for Africa

Regarding the long-term BA dataset FireCCILT11, based on data from the AVHRR sensor, it seems it was hardly considered yet in the scientific community (at least between the workshop attendees), as 75% of the attendees had not even checked the dataset (Figure 13). For those who were aware of the dataset, they ended up not using it (too much discrepancy with the coarse resolution datasets), or used it after filtering or readjusting the data. No users were fully satisfied by this information, despite it fulfils a major user requirement (Giglio et al. 2020), but still faces technical issues (Giglio et al. 2022).

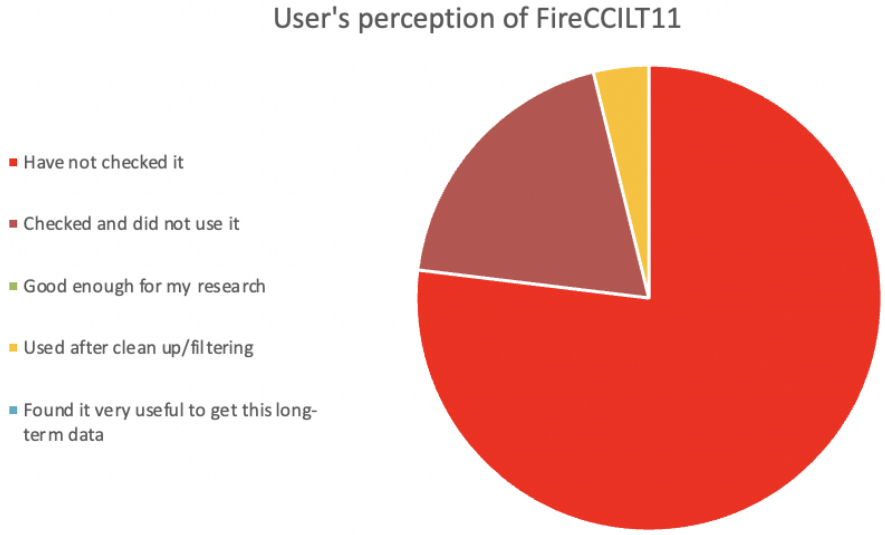

Figure 13: Workshop attendees' perception of the newly delivered long term (1982-2018) burned area dataset FireCCILT11

4.4. Future needs

We finally used the opportunity of the workshop, after a full presentation of the recent developments and their benefits and improvements, and a summary of how they were aligned with user requirements assembled in Mouillot et al. (2014), to collect an updated list of user needs.

An improved spatial and temporal resolution remain a keystone target for 1/3 of end users, along with an increase in burned area accuracy (Figure 14). The survey also pointed out specific needs for targeted ecosystems where the current BA products are acknowledged to be poorly efficient, such as croplands, peatlands and surface fires.

Overall, with the increasing number of BA sources, compared to the unique MCD64A1 available in the early 2000's, it appeared that a merging of the different sources of BA information into one single data would be beneficial to the community. As an ultimate goal, combining coarse resolution datasets (MCD64A1, FireCCI51), and adjusted to the finest resolution or longest-term datasets could fulfil, all in one, the user's current needs.

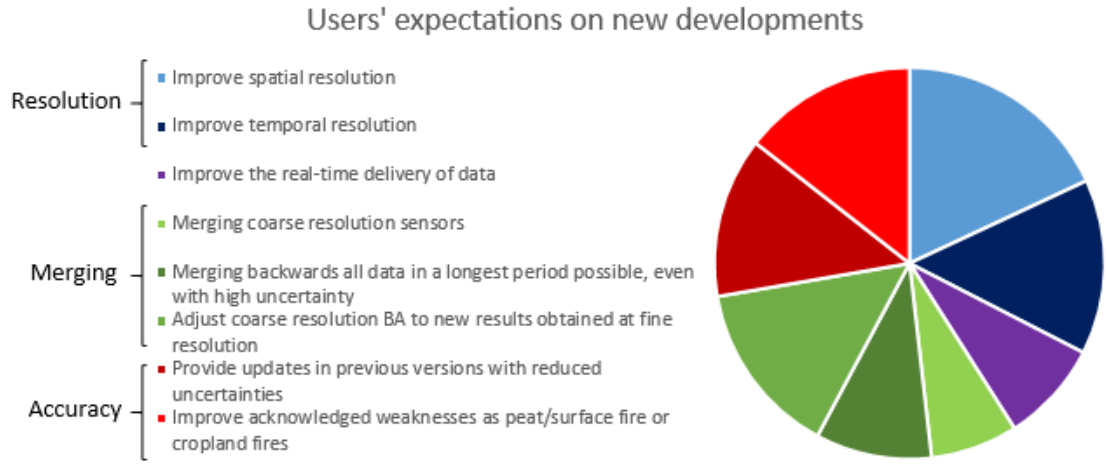

Figure 14: Workshop attendees' future needs following the new developments exposed during the workshop

5. Synthesis and recommendations

This user workshop held at EGU allowed an interactive discussion between burned area data providers and end-users, both clarifying in real time misunderstandings on burned area specificities from data providers to end users, and getting feedbacks from end users for their research needs and how current dataset could be improved to fully cover their scientific goals. We could identify the various end-user communities, way beyond the initially targeted climate modelling community and thus providing contrasting needs. Overall, the developments of new datasets from the FireCCI project benefited the scientific community by revisiting the total global burned area and increasing the spatial resolution of the products based on the MODIS sensor. Current testing of future improvements on finer spatial resolution with the Sentinel sensor appeared a major achievement, while the long term burned area FireCCILT11 received little attention and major doubts on its reliability.

From this survey we could point out that a merged product, with a widely documented and illustrated uncertainty information (which seems to be yet misunderstood and neglected), could fulfil many of the current user needs. Efforts on this line are being made by the FireCCI consortium with the current development of a merged dataset based on medium resolution BA products (MODIS MCD64, FireCCI51 and FireCCILT11).

Still, further efforts are needed to realise the full potential of the high resolution EO datasets, such as Sentinel-2. The existing FireCCISFD11 and FireCCISFD20 are a good and promising starting point, but global time series of burned area datasets at this resolution would allow for new capabilities in BA analysis and modelling.

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Annex 1: Acronyms and abbreviations

AVHRR	Advanced Very High Resolution Radiometer
BA	Burned Area
CCI	Climate Change Initiative
EGU	European Geosciences Union
ESA	European Space Agency
FRY	Fire Patches Dataset
GFED	Global Fire Emissions Database
LTDR	Land Long Term Data Record
MODIS	Moderate Resolution Imaging Spectroradiometer
PSD	Product Specifications Document