Environmental Justice Core on the Gulf Coast (EJ CORE GC)
Engaging diverse researchers and underserved communities in inclusive environmental justice and climate change-related Open-Source Science for an equitable and sustainable Gulf Coast region

1.0 Proposal Summary

A search of GitHub pull requests reveals a striking lack of participation in open source projects across the Southern United States. At the same time, many parts of the region struggle against pervasive environmental injustice and inequity revealed in health, education, vulnerability and socio-economic disparities. NASA data is rapidly developing proven capacity to provide an improved evidence base on urgent issues of air quality, flooding, climate change-related extreme events, and disaster resilience [1]. Currently, there is a massive but unfortunate missed opportunity for greater engagement of underserved communities and minority serving institutions in the Open-Source Science for climate and environmental justice that is possible with NASA data streams and approaches.

EJ CORE GC responds as a ScienceCore proposal for NASA Earth Science Division priority (b.) environmental justice with relevance to associated priorities of health & air quality, disasters, climate, and water resources. EJ CORE GC will bring together a coalition of environmental justice leaders with experienced NASA investigators, multidisciplinary scientists (health, Earth, and social scientists) and local open source advocates to co-create a SCIENCE CORE module focused on the most pressing climate justice and environmental harms prevalent in the Southern Gulf Coast States (Louisiana, Alabama, Mississippi, Florida and Texas). The goals of EJ CORE GC are:

- **OSS-EJO 1.** Increase understanding and adoption of Open-Source Science principles and techniques for climate justice (CJ) and environmental justice (EJ) applications
- **OSS-EJO 2.** Train a diversity of professional, academic and community-based EJ scientists to leverage Open-Source Science for inclusive collaboration to accelerate major scientific discoveries urgently needed to address climate change-related increasing disparities and vulnerability
- **OSS-EJO 3.** Broaden participation in SMD-funded research into EJ and climate change by historically under-represented communities in the Southern Gulf Coast States

EJ CORE GC will not create only static content. A dynamic and engaging multi-lingual multimedia platform is envisioned that will promote the creation, management, and sharing of reproducible Open-Source Science workflows related to climate and environmental justice. This will build on all five of the Open Core modules, principles and approaches to build capacity for EJ/CJ analysis and visualization particularly based on the Earthdata Pathfinders including Health and Air Quality, Sea Level Change, Disasters, Water Quality, and GIS. We intend to use both TOPS Open edX platform for a 3-hour MOOC and interactive Jupyter Books hosted on the TOPS GitHub. EJ CORE GC investigators will be available for teaching at in-person or virtual professional meetings and science team meetings. The impact of these modules will be magnified by the regionally relevant user groups based at longstanding environmental justice advocacy organizations and university centers focused on mobilizing for improved student and researcher data literacy. The EJ CORE GC module and approach will have provided both content and tools that could be adapted to any number of regional climate and environmental justice contexts around the nation and potentially around the world.

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3.1.1 Open-Source Science Objectives for Environmental Justice CORE - GC

A search of GitHub pull requests reveals a striking lack of participation in open source projects across the Southern United States. At the same time, many parts of the region struggle against pervasive environmental injustice and inequity revealed in health, education, vulnerability and socio-economic disparities. NASA data is rapidly developing proven capacity to provide an improved evidence base on urgent issues of air quality, flooding, climate change-related extreme events, and disaster resilience[1]. Currently, there is a massive but unfortunate missed opportunity for greater engagement of underserved communities and minority serving institutions in the Open-Source Science for climate and environmental justice that is possible with NASA data streams and approaches.

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> **OSS-EJO 1.** Increase understanding and adoption of Open-Source Science principles and techniques for climate justice (CJ) and environmental justice (EJ) applications

> **OSS-EJO 2.** Train a diversity of professional, academic and community-based EJ scientists to leverage Open-Source Science for inclusive collaboration to accelerate major scientific discoveries urgently needed to address climate change-related increasing disparities and vulnerability

> **OSS-EJO 3.** Broaden participation in SMD-funded research into EJ and climate change by historically under-represented communities in the Southern Gulf Coast States

EJ CORE GC objectives are aligned with the NASA mission Transform to Open-Source Science (TOPS) that is a decade long strategic commitment beginning in 2022 to engage the scientific community in Open-Source Science practices through events and activities aimed at:
- Lowering barriers to entry for historically excluded communities
- Better understanding how people use NASA data and code to take advantage of big data collections
- Increasing opportunities for collaboration while promoting scientific innovation, transparency, and reproducibility.

3.1.2 Relevance of ESD Open-Source Science to advancing EJ and addressing underlying disparities driving vulnerability of underserved Gulf Coast EJ communities

NASA designated 2023 as the Year of Open-Source Science (YOOS). Open-Source Science approaches for interdisciplinary complex system problems such as climate change were pioneered by the Sciences and Exploration Directorate/Goddard Space Flight Center/Earth Science Division. Now, Open-Source Science is an institutional-level priority strategy to maximize data, software and science investment value by broadening engagement with diverse communities for applied and citizen science, capacity development, and innovation.

Equity and Environmental Justice is one of the newest program element of the Earth Sciences Division (ESD) of the NASA Science Mission Directorate (SMD). In describing this new initiative, NASA cites recent executive orders that advance equity by focusing programmatically on underserved communities, redoubling efforts to understand domestic impacts of environmental and climate change, and intentionally promote diversity, inclusion and accessibility. The ESD Applied Science Program promotes measurable social benefit from NASA research and information products with the aim to improve decision making and resulting actions. As more inclusive science processes promote greater consensus around the evidence base for policy formation that in turn advances collective action in implementing the shared solutions, research into the links between Open Science, equity, and environmental justice may demonstrate practical pathways for realizing sustainable and more equitable program benefits.

Despite a relatively long history of ESD efforts to make open data more accessible and promote open source software, NASA Open-Source Science leadership recognizes the tantamount importance of new efforts to promote inclusive and diverse engagement throughout the scientific process with intentional empowering infrastructure that builds lasting sustainable relationships and capacity. Measuring the impact of NASA investments also now requires interdisciplinary engagement with social and applied scientists whose institutions have the experience promoting evidence-based policy and ensuring quality policy implementation. Health, wellbeing, equity and inclusion are pillars of environmental justice. Making measurable impact on environmental justice will require bringing together the work of Earth scientist, data scientists and engineers with institutions and organizations specializing in resilience, health, governance/policy formulation and implementation, and environmental disciplines.

Open-Source Science broadens participation in the scientific process with tangible benefits of increased value for money, faster innovation, and equitable policy response. Perhaps most importantly for policy impact, Open-Source Science inclusion of the private sector, public entities, academia and citizens builds common trust in the evidence that informs decisions and policy dialogues. The synoptic observational power of NASA data products to address environmental/climate justice-related domestic challenges remains largely underutilized even as it has played a decades long role in global monitoring of Earth system changes. Increased temporal and spatial resolution of NASA data streams make previous research on global issues like climate change now tractable for decision support at more local levels. The resilience of the Gulf Coast with a broad diversity of communities facing a wide-range of environmental challenges could potentially benefit the most as well as provide real world assessment of opportunities for value addition to NASA investments with greater inclusive and equitable engagement in Open-Source Science.

Three NASA researchers published a paper to articulate the defining elements of Open-Source Science that are illustrated in Figure 1 [2]. The researchers identify three focus areas that explain their proposition to move from Open Data to Open Science.
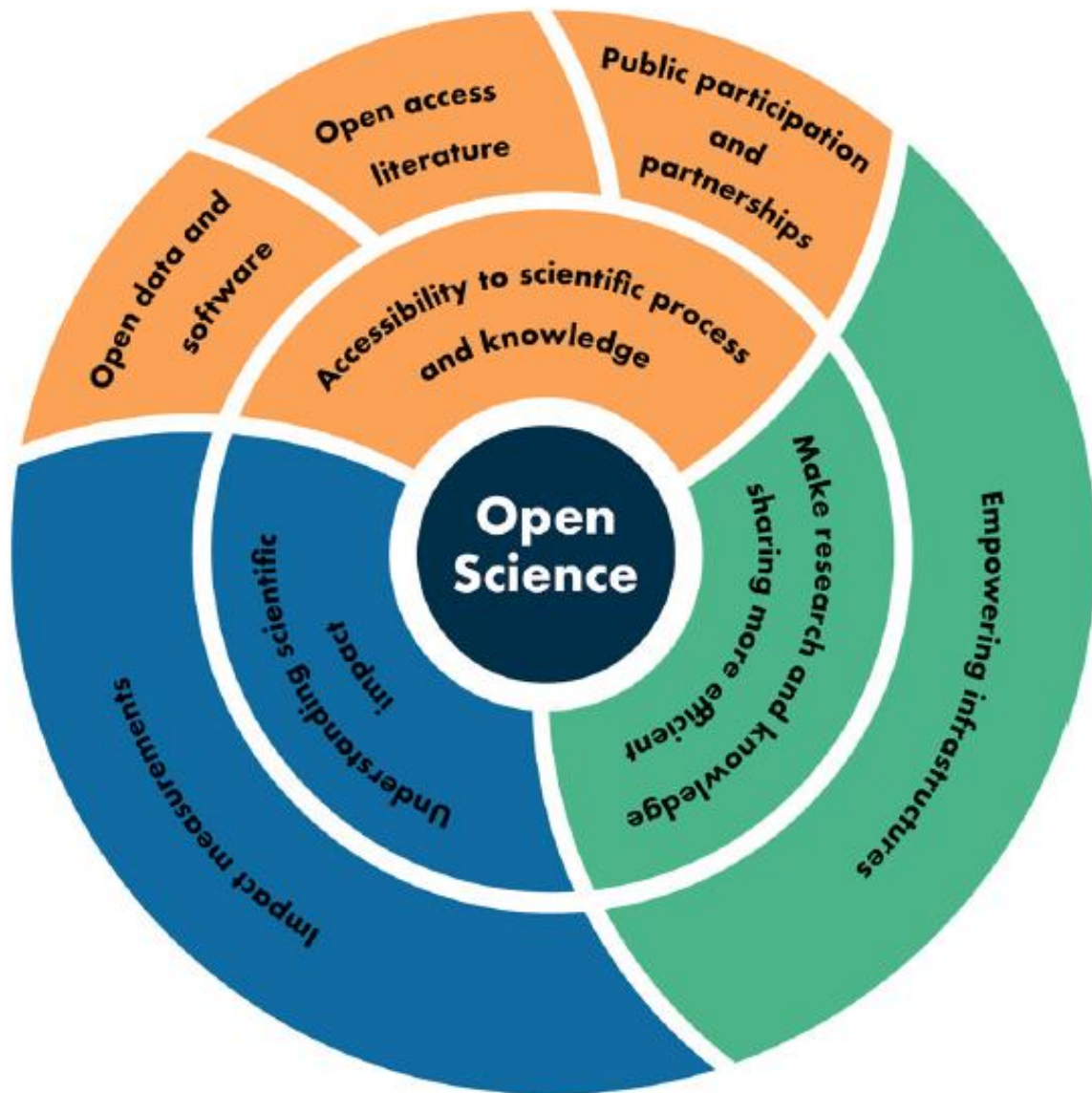

Figure 1: Three key domains of Open-Source Science and their program elements[2].

These include more access to the scientific process and knowledge that is commonly promoted by open access to literature, data and software. The outer most ring on Figure 1 represent the proposed specific program strategies to enable Open-Source Science. Public participation and partnerships have been the focus of previous NASA program elements in Citizen Science and Capacity Development activities often focused on support to STEM education. New initiates and strategy at NASA are redoubling this effort in historically undeserved communities, institutions and jurisdictions. NASA has acknowledged that greater understanding of the communication channels and opportunities for scientific exchange require immediate systematic inquiry and new research.

The framing in figure 1 and program description of [2] is the general organizing framework for the proposed EJ ScienceCore learning module and interactive EJ Open-Source Science workflow development.

The NASA-engaged Earth Science community has less experience in program strategies to enable empowering infrastructure and strengthen impact measurement than other Open-Source Science program elements. Empowering infrastructure is envisioned as both the cyberinfrastructure and associated collaborations. As the scientific process for complex problem research becomes more data centric, the analysis environment must by design must become more focused on how scientists and others interact with data to answer meaningful questions. This calls for leveraging decentralized and sustainability-focused technology for new approaches informed by those using the data [3]. This focus on multisource multidisciplinary connections as well as data that first understands user needs is also the approach for linking science to decision making. Impact measurement has too often been limited to metrics of journal citations and significant user-focused research is required for more relevant metrics aligned to Open-Source Science and focusing on links to decision making and action. EJ CORE GC proposes instead to be user focused and engage with a broad and diverse mix of Open-Source Science experts and EJ/CJ community-based researchers to priorities content and highlight the most effective approaches from a community level results perspective.

Strong concurrency exists between the Open-Source Science focus on accessibility, empowerment, and impact with approaches to advance Equity and Environmental Justice. The first NASA hosted Equity and Environmental Justice workshop was held in October 2021, but lacked participation from Gulf Coast researchers or community representatives [4]. Even as Equity and Environmental Justice is a specific NASA Applied Science program element, it is also a division-wide priority crosscutting all the work of the Earth Science Division. Initial strategic direction coming out of the workshop was summarized into four division level goals: ESD Goal 1: Conduct assessments of current environmental justice engagements, barriers and gaps, and opportunities; ESD Goal 2: Engage with a range of organizations involved with environmental justice communities and harvest lessons and potential partnerships for the strategy; ESD Goal 3: Host data accessibility and utility sessions; ESD Goal 4: Enable transdisciplinary science and applications that integrate physical and social science using NASA datasets. All these goals can be achieved more efficiently, be more broadly relevant, and have greater impact if pursued with Open-Source Science. EJ CORE GC builds on these principles to make concrete progress aligned with NASA priorities and consistent with the expressed requirements of underserved EJ communities and CJ/EJ researchers.

3.2 Technical Approach

EJ CORE GC will not create only static content. A dynamic and engaging multi-lingual multimedia platform is envisioned that will promote the creation, management, and sharing of reproducible Open-Source Science workflows related to climate and environmental justice. This will build on all five of the Open Core modules, principles and approaches to build capacity for EJ/CJ analysis and visualization particularly based on the Earthdata Pathfinders including Health and Air Quality, Sea Level Change, Disasters, Water Quality, and GIS. We intend to use both TOPS Open edX platform for a 3-hour MOOC and interactive Jupyter Books hosted on the TOPS GitHub. EJ CORE GC investigators will be available for teaching at in-person or virtual professional meetings and science team meetings. The impact of these modules will be magnified by the regionally relevant user groups based at longstanding environmental justice advocacy organizations and university centers focused on mobilizing for improved student and researcher data literacy. The EJ CORE GC module and

approach will have provided both content and tools that could be adapted to any number of regional climate and environmental justice contexts around the nation and potentially around the world.

The first research activity of EJ CORE GC is to map and assess the diversity, experience and capacity of EJ stakeholders on the Gulf Coast for engaging in Open-Source Science. In depth investigation will focus on barriers to entry for different communities in finding, accessing and using NASA data, code and research to further social, environmental and wellbeing aspirations. This understanding of differences and disparities will inform all next steps in creating the EJ ScienceCore modules, their validation and communication.

The second research activity is to understand how NASA data, code and research products have been used in the past for decision support around issues of resilience, equity and environmental/climate justice in general and specifically on the Gulf Coast. This research will inform an inclusive structured process that engages both open source science practitioner experts, EJ/CJ leaders and researchers, and specific EJ/CJ thematic experts in formative and validation workshops. In the final stage, these engaged researchers and experts will inform communication aimed at diverse communities, private sector and local authorities on potential pathways for increased relevance and utilization of NASA Open Source Science resources to inform more equitable policy, policy implementation and collective action.

The third research activity is to convene EJ Open-Source Science coalition of climate and environmental justice stakeholders, and EJ thematic experts in collaborative for collective problem solving to first provide use cases and other content to guide the creation of the EJ ScienceCore modules. They will also advise on promoting inclusion and innovation in the use of NASA data, code and research products to address gulf coast environmental justice disparities is intended to maximize the potential for more informed decision making, policy, and policy implementation.

The fourth research activity is to articulate the nexus of Open-Sourse Science, Equity, Environmental Justice and NASA resources for the benefit of communities and decision makers on the Gulf Coast into a 3-hour MOOC that builds on all five of the Open Core modules to be created by the AGU. With real world examples from the Gulf Coast region, the principles and approaches to build capacity for EJ/CJ analysis and visualization particularly based on the Earthdata Pathfinders including Health and Air Quality, Sea Level Change, Disasters, Water Quality, and GIS. This is to be implemented on the TOPS Open edX platform.

The fifth research activity will be to turn the EJ MOOC content into interactive Jupyter Books hosted on the TOPS GitHub that can be used by an expanding number of EJ/CJ researchers in the Gulf Coast region and potentially around the country. This activity includes community level validation with EJ/CJ expert practitioners in all five Gulf Coast States.

A final sixth research activity will use of multiple communication channels aligned with NASA priorities for intentional engagement of historically disadvantaged communities, women and youth. Community facing information strategy will include social media while policy-oriented research communications will include professional society conference presentations, at the American Geophysical Union (AGU), and peer-reviewed journal articles. High quality research on the nexus of Open-Source Science and environmental/climate justice will find a broad audience of researchers, policy makers and program managers.

AGU whose mission is "to advance earth and space science" is the primary forum for NASA related scientific exchange. The proposed EJ CORE GC panel and presentations at the annual meeting of the AGU will be an opportunity to present the Gulf Coast as an emerging and innovative Open-Source Science center for EJ/CJ research. Highlighting the potential of organizations, communities and institutions to engage on the frontlines of environmental justice and costal resilience will be of broad interest to the NASA and other potential stakeholders interested in applying better evidence that leverages observational technologies to decision-making.

3.3 Robustness and Resilience of the EJ CORE GC approach

Born from seminal environmental justice action with significant origins in the Southern USA, measurement, assessment, community mobilization, demand creation, system strengthening, policy-relevant interdisciplinary complex system analysis, and evidence for decision making are traditional strengths of the actively engaged coalitions of EJ communities and institutions of higher education in this region. Longstanding relationships and deep wells of community knowledge will inform EJ CORE GC content and tools prioritization and design. Regular interactions and opportunities for validation in EJ communities will ensure relevance and effectiveness of the deliverables -- that would otherwise risk irrelevance if developed in isolation by disengaged technical experts alone.

Covid and potentially other health-related restrictions to engage face-to-face with community may limit some ground truth and research broadcast activities. The PI has recently led a major international organization to pivot a global capacity development program to online. Lessons from this experience include leveraging collaborative online tools for better engagement, fully facilitating virtual sessions with dedicated technological backstopping, and adjusting the length/frequency/tempo of sessions to promote active interaction. Engaging with stakeholders across the Gulf Coast may require health safeguards and adjustment to virtual or 1-to-1 meetings rather than in-person group interviews.

A diverse EJ CORE GC team and coalition will enhance robustness of the project with attention to multiple perspectives. Recruitment plan for graduate student will follow standard procedure that emphasizes Equity, Diversity and Inclusion. A similar approach will be followed in selecting coalition partners.

Finally if a suitable independent Open Source standards consultant is not available within the projects scope or resources, there are numerous capacities available at the participating institutions that are available for limited consulting services. In this way, we assure there is sufficient budgeted resources for very high level quality control and documentation of the final deliverables.

3.4 Plan to meet EJ CORE GC objectives and management structure

3.4.1   Management structure

The EJ CORE GC management structure aims to encourage collaboration enabled by technology [1] with clear shared objectives, empowered thematic sub-teams, and easy exchange through advanced digital tools for inclusive communication. The small team of Principal Investigator (PI) and a graduate student will engage a wider group of Open-Source Science expert practitioners and

CJ/EJ researchers in the process of identifying and prioritizing content for the EJ ScienceCore modules. This voluntary group will have a shared workspace hosted on GitHub and quarterly all group meetings. A thematic lead will be identified for each of air quality & health, water resources/localized flooding/sea level, heat & energy poverty, disasters. There will be two engagement meetings. The year one meeting will focus on the identification and validation of the module content and examples. The year two meeting will focus on validation of the content and communication/broadening engagement strategy. A consultant, managed by the PI, will be retained to ensure quality of the final Open Source Science deliverables (MOOC, Jupyter Books) and their full documentation on GitHub.

3.4.2   Task by task description of contribution by identified personnel

The PI is accountable for grant implementation, compliance, risk management and quarterly/annual/final reporting. Supported by an experienced sponsored project team, they are responsible for maintaining the control environment, quality and timeliness of all deliverables, implementation of the Open-Source Science Development Plan, responsive communication, and reporting to NASA and all stakeholders. They will supervise the graduate assistant and consultant with responsibilities for collaboration enabling technology including management of the GitHub site(s), virtual team data management workspaces, and deliverables. The PI's primary task is continuous progress on deliverables and whole team communication and follow-up on schedule of implementation tasks. In this role, they are responsible for leading annual work planning, actively monitoring dependencies, and engaging with stakeholders. They will convene two 'in person' team workshops, lead authorship of two peer-reviewed publications, monitor kickoff tasks, and facilitate data/information ex-changes while monitoring for dependencies. They will ensure GitHub, Zenodo and NASA open source sites/repositories are stood up and Open-Source Science Development Plan indicators are monitored. They will contribute to data management and analytical tasks as required and lead documentation and article production. He will engage with community partner scientists in the second year to validate content and build capacity for use of Jupyter Book tools. In the final quarters, they will shift of project focus to the end user and CJ&EJ community engagement events and promotion of new applications for project results and deliverables – and ensure timely final reporting.

Consultants: One consultant will be engaged as an independent quality assurance expert for ensuring absolute compliance of deliverables with industry leading standards in Open source platform project/MOOC/Jupyter Book deployments and their documentation.

3.4.3 Implementation Strategy and Milestone Schedule

In the first quarter of Ej CORE GC activity, the PI will be accountable for submitting a revised Work and Costing Plan, setting up Open-Source Science platforms/sites (see Figure 2 Deliverable,, Open Science and Reporting Milestones). In this quarter, all relevant existing literature and secondary data will be scanned for review with regards to Open-Source Science, CJ and EJ in the region – to produce an Open-Source Science scan for the region.

The first AGU meeting will mark a second major milestone where revised project plans will be presented and discussed with colleagues. Before the meeting identified personnel will ensure they have the CORE Open-Source Science Badges and will actively encourage others to follow the course as well. An Open-Source Science plan for the project will also be registered at this point – in the second quarter of the project.

A coalition with at least one EJ/CJ community or network representative and an Open-Source Science researcher from each of the five Gulf Coast States will be identified. They will be invited to contribute to EJ CORE GC content prioritization and Open-Source Science strategy discussion at the first EJ CORE GC coalition meeting. Open-Source Science scan results will inform the discussion.

By the end of the first year, a draft MOOC will be produced with interactive, video and multi-lingual delivery capacities. A manuscript for peer review on the project approach will be produced. A workflow of the Jupyter Books interactive EJ ScienceCore delivery will be produced. This is intended to 'teach' the EJ CORE GC to community members in situ – where they can follow the course to investigate EJ/CJ issues with NASA data streams that are of interest to them and their community. Also – annual reporting will be complete in a timely fashion.

The second year will begin with a validation and revision of the MOOC. There will be a second meeting of the EJ CORE GC coalition to validate and make final adjustments to the MOOC. Also, validation of the Jupyter Book with community-based testing and validation in at least one underserved EJ community in each state will be conducted.

At this point the PI, graduate assistant and potentially a EJ CORE GC coalition member from each state will be available to present/teach the MOOC in person or virtually. They may also be able to simply encourage and coach or open and close science team meetings and other stakeholder events that may make use of the EJ CORE GC MOOC or Jupyter Book workflow. Presentations and a potential professional development workshop may be presented at the AGU.

The second half of the second year of project activities will focus on quality assurance and documentation and communication. All materials will be archived with high quality documentation to EJ ScienceCore upload sites on TOPS Open edX platform and TOPS GitHub. All OSSDP plan activities will be completed. Exemplary final reporting and project closure will be completed in a timely manner.

Table 1 Open-Source Science, Reporting and EJ CORE GC deliverable milestones

Project Year 1			
Q	Milestone deliverable	Open science output	Reporting
Q1	Literature review and stocktaking: • Open-Source Science for Equity & Environmental Justice in Gulf Coast • Remote sensing of Gulf Coast Environmental Justice with NASA products Open-Source Science scan & CJ/EJ stakeholder map • Open-Source Science initiatives on the Gulf Coast • Environmental justice initiatives, organizations and communities across the Gulf Coast	• Open Access Annotated Bibliography • GitHub site • Annual 4-day TOPS coordination meeting in Washington DC participation/learning/ presentation	• Submit Work and Costing plan • Submit PY1 Q1 report • Check against Research activity 1 – "barriers to entry"
Q2	• AGU – Chicago	• Register open science plan for reproducibility	• PY1 Q2 report with some discussion of state of GC open science

Q	Milestone deliverable	Open science output	Reporting
	-Convene a panel session on Earth Observation, Open Science, Equity & Environmental Justice -Identify and invite participants to EJ CORE GC coalition meeting		• Open-Source Science scan • CJ/EJ stakeholder map • Check against Research activity 2 – "engage EJ/CJ community"
Q3	• 1st EJ CORE GC coalition meeting in New Orleans • Prepare publication based on AGU panel	• Open science badges PI/graduate assistant • Open-Source Science Scan results • Report on EJ CORE GC coalition meeting with content priorities	• PY1 Q3 Report w/initial module overview • Check against Research activity 3 – "convene Open-Source Science & EJ/CJ community"
Q4	• Draft MOOC for comment • Jupyter Books Open-Source Science workflow map	• GitHub updated • Annual inclusion/DMP tasks	• Submit Manuscript 1 for publication • PY1 Annual Report
Project Year 2			
Q	**Milestone deliverable**	**Open science output**	**Reporting**
Q1	• Revised MOOC • MOOC testing with coalition partners • 2nd EJ CORE GC coalition meeting in New Orleans	• CJ community Open Science badge contest • Annual 4-day TOPS coordination meeting in Washington DC • Validated MOOC piloted	• Share PY2 workplan • Submit PY2 Q1 report • Check against Research activity 4 – "3-hour MOOC"
Q2	• Jupyter Books testing in EJ communities with coalition partners • AGU – Chicago -Present draft EJ ScienceCore products	• Community GitHub event • Posting of CJ/EJ CORE engagement materials	• PY2 Q2 report w/Jupyter Books overview • Check against Research activity 5 – "Jupyter Books"
Q3	• Quality Control & final documentation: -MOOC -Jupyter Book Prepare publication based on AGU presentation	• EJ ScienceCore upload to: -TOPS Open edX platform -TOPS GitHub	• PY2 Q3 Report w/ discussion of open source science engagement • Check against Research activity 5 – "Check-in w/CJ/EJ communities"
Q4	• Project Closure and Reporting	• GitHub final update • OSSDP tasks checked and completed	• Final Technical Report • Final Financial Report

Section 4.0: Bibliography & Open-Source Science Plan

Section 4.1 EJ CORE GC Proposal Bibliography

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4.2 Open-Source Science Development Plan
Accountability for full implementation of the Open-Source Science Development Plan (OSSDP) and ensuring full compliance to NASA ESD requirements lies with the PI. EJ CORE GC is committed to Open-Source Science and identified personnel will complete NASA TOPS core curriculum to earn a minimum of 5 open science badges.

This is an innovative project that includes gathering data from community-based networks as well as academics and subject matter experts. To address potential privacy, ethical and consent issues, EJ CORE -GC will conduct a Privacy Impact Assessment (PIA), following the NASA PIA Summary as a template, during annual planning for engagement. As a general privacy safeguard, data will only be collected, analyzed or presented at spatially aggregated level. No data will be collected about individuals. Results of the PIA will be reviewed and all identified potential risks will be mitigated or eliminated by substituting lower impact data collection approaches.

The EJ CORE GC team will pursue the development plan along the lines of the "Geosciences Paper of the Future" with the intention move towards improving the OSSDP "to make data, software, and methods openly accessible, citable, and well documented" [5] and the FAIR principles: Findable, Accessible, Interoperable, & Reusable [6]. As part of the specific expertise of the EJ CORE GC science leadership in this research area, the team will leverage GitHub, data.nasa.gov, and Zenodo to ensure data and information are shared in ways that maximize access, reuse and application to new problems, contexts, and research questions. Data will be made publicly available with enough detail to allow for validation and metadata standards will conform to open science standards of the repository such as coding in XML.

The EJ CORE GC data management plan ensures public access to publications and digital datasets arising from NASA research. All EJ CORE -GC data posting and archiving tasks will be **confirmed quarterly**. Open Science milestones are identified on the schedule and assigned responsibility to the postdoc and accountability to the PI. The preprints will be posted on Earth and Space Science Open Archive, associated with the American Geophysical Union, pre-print server https://www.essoar.org/. Open access articles will be available as soon at final revisions are accepted, but expected to be within one year from project closure.

Data sets, meta data and other materials developed to support the proposed research will be archived at data.nasa.gov, as appropriate, and Zenodo (https://zenodo.org/) site associated with European Organization for Nuclear Research (CERN) and expected to maintain the open archive as long as CERN exists. EJ CORE -GC has created an Environmental Justice 'community' on Zenodo to encourage findability of the research and exchange with other CJ&EJ researchers.

Final deliverables of a 3-hour MOOC TOPS will be transferred to the Open edX platform and interactive Jupyter Books will be hosted on the TOPS GitHub. All documentation will be checked for high standards and quality assurance. EJ CORE GC investigators will be available for teach the in person at professional meetings and science team meetings using these openly accessible materials.

All data and documents produced by EJ CORE GC encourage redistribution, reproduction and creation of derivatives with a Creative Commons Attribution 4.0 International license, and uploaded to Zenodo/Open edX platform/Github including:

- 3-hour MOOC with interactive elements, video, graphics and text
- Jupyter Books that follow the 5-modules of the AGU-NASA Open Source Science Core that will allow a diversity of users to pursue their own EJ projects
- Model source code, guidance notes and results
- Guidance documents on the CORE and EJ ScienceCore approach and tools. These will be given a unique doi when uploaded.
- The MOOC modules will be tailored for both e-learning and in person workshops

Development of the project will take place primarily on a dedicated TOPS or a project specific stagging GitHub site. During initial extraction of remote sensing products,, for use in interactive modules, will be stored on local machines for testing. As appropriate, links or use of an API will enable dynamic connection to relevant NASA data products. As data sets are finalized and model source code documented in a distributable version, these information assets will be open source licensed and uploaded to data.nasa.gov and Zenodo. In the final year, broad stakeholder and community engagement will be dedicated to the open source Open edX platform/Github portals.

The PI will maintain communication as necessary with the data repository and the NASA program manager to ensure that: OSSDP is updated as needed at time of award; appropriate attribution is included; data meet minimum quality standards; and data are appropriately evaluated for and secured to prevent disclosure of personally identifiable information and to protect proprietary interests, confidentiality, and intellectual property rights.

Section 5a. Budget Narrative:
*Note budget is for two years. Cover page budget has 3 time periods. Last time period(year) intentionally left blank.

Key Personnel:

Personnel will be leading the project from start to finish over the proposed period of 24 months.

The Principal Investigator will contribute a level of effort (LOE) 30%, is accountable for achievement of science objectives and quality of research. This will be achieved through exemplary project management. The PI is accountable for maintenance of resource control environment, meeting all award milestones and reporting requirements, grant administration, and regular communication with stakeholders and deliverables. They are NASA's primary contact point. They will ensure clear communication between all project partners and stakeholders by convening meetings and direct communication. They will provide overall supervision as well as strategic and technical direction of activities. They will dedicate a minimum of 8 month equivalent of time over life of project and will be paid 30% of his effort for the life of the project.

Graduate Student, level of effort 20-30%. will manage support documentation for open source sites, literature review and contribute to ongoing Open-Source Science activities. They will assist in managing meetings, ensuring information is handled as per OSSDP, and fully collaborate on analysis and reporting activities. The grad students will contribute between 10-15 hours per week during the academic year and additional effort during the summer recess for a total of 600 hours over the life of the project.

Fringe Benefits:

Fringe Benefits are charged as direct costs and are set at the current negotiated rates for budgeting purposes. FY23 rates: Faculty: XX%, Students: XX%, Staff: XX%.

Supplies and Materials (small equipment):

Laptop: In the first year of the project, a UNIX/GNU open source capable laptop will be purchased for the project requirements. This is necessary because they will be totally dedicated to their time to project activities and will need to travel to EJ/CJ community engagement events. Estimated cost is $2000 per unint.

Tablets: Are used for the development and piloting of the Jupyter Books application where communities and experts can work through the EJ Science Core Modules will examples from their own communities or research sites. Completion of the EJ ScienceCore Modules will then allow the user to continue their Open-Source Science project for eventual communication, sharing or publication – or contributing to a larger Open Science effort of the EJ CORE GC coalition. Tablets will also allow access to in-person/hybrid MOOC teaching session *in situ* EJ and underserved communities. Estimated cost is $450 per unit.

Total Requested for Supplies and Materials: $7400

Travel: $11,500. The PI will travel to TOPS meetings in Washington DC each year. They will also travel to the American Geophysical Union (AGU) conference each year to present results and potentially lead EJ ScienceCore sessions at science team or other meetings. They will travel to EJ/CJ community validation and teaching in at least one community in each Gulf Coast State.

Airfare (6 round trip domestic)	$2400
Lodging (22-nights at 200$)	$4400
Meals & Incidentals (22-days at 100$)	$2200
Ground transportation to study site communities for 1-day events (twice for 10 Communities at 125$)	$2500
Total Costs	**$11,500**

Other Expenses:

EJ CORE GC coalition meetings: In year one of the proposal, at least one EJ/CJ community representative and one Open-Source Science expert from each of the five Gulf Coast states will be invited for input into EJ CORE GC content and tool development priorities. Each participant will be expected to present compelling EJ/CJ cases from their state that might be appropriate for investigation with Open-Source Science. Attendance at a two day meeting in a Gulf Coast location will be paid for including travel, transfers, meals and accommodation. Four experts in the NASA priority thematic areas will also be invited to the first meeting (eg. air quality & health, localized flooding, disasters, an water quality). If savings are realized from the budgeted 1500 USD per participant, then additional participants will be invited from EJ/CJ networks, organizations and communities. We will invite 14 participants in Year 1.

In the second year, a smaller group that will still include representation from EJ an Open-Source Science to validate MOOC content, flow, look and feel. The EJ CORE Coalition will also make significant contributions at the meeting to Jupyter Book work flow and potential validation site selection. We will invite 10 participants in Year 2.

Cost: $36000

Consultant: will contribute a level of effort xx-days. Will be engaged as an independent quality assurance expert for ensuring absolute compliance of deliverables with industry leading standards in Open source platform project/MOOC/Jupyter Book deployments and their documentation.

Cost: XXXX

Section 5b. Budget details

EJ CORE Budget - Redacted

		Year 1	Year 2
A. Direct Labor			
	Faculty (.3 LOE)	XX	XX
	Graduate Students	XX	XX
	Fringe Benefits	XX	XX
	Subtotal A.	**XX**	**XX**
B. Supportive Expenses			
	Travel		
	AGU Trip	2,500.00	2,500.00
	DC trip	2,000.00	2,000.00
	Coastal visits	-	2,500.00
	Supplies & Materials	7,400.00	-
	Communications	-	-
	Equipment	-	-
	Other Expenses		
	Stakeholder Meetings	21,000.00	15,000.00
	Consultant	XX	XX
	Subtotal B.	XX	XX
	Total Direct Cost	XX	XX
	F&A (Indirect) 53%	XX	XX
C. Total Project Cost			
		XX	**XX**

*As per ROSES guidance, all cost for people including salary, benefits, overhead or totals have been removed.

Section 6. Table of Work Effort

Name	Role	Commitment (months per year)								
		Year 1			*Year 2*			*Sum*		
		This Project		*Other Funded Projects*	*This Project*		*Other Funded Projects*	*This Project*		*Other Funded Projects*
		NASA Support	*Total*		*NASA Support*	*Total*		*NASA Support*	*Total*	
	PI	4	4	7	4	4	7	8	8	14