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Young People Are Changing Their Socio-Ecological Reality to Face Climate Change: Contrasting Transformative Youth Commitment with Division and Inertia of Governments

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Abstract: This paper contributes to a critical re-reading of the notion of climate services. It does so by problematizing the discontinuity between young people's commitment to climate change, and the lack of a common vision regarding climate policy among governments. In this essay, youth commitment is characterized in terms of participation in the Global Youth Climate Pact (GYCP, 2015–2022). Here, young people share projects from their own high schools and communities and participate in a citizen consultation. Most projects have achieved a good success score, increasing over the years, especially for those carried out in emerging and developing countries. Some of them were presented at the COPs. In contrast, a textual analysis of intended nationally determined contributions (INDC) illustrates divergent understandings of the Paris Agreement and exemplifies the poor results of governmental climate diplomacy. This study establishes the need to closely monitor early warning signs of climate change in conjunction with high schools and school communities. The initiatives of young people are building a civic and planetary awareness for climate change in contrast with governmental division and inertia. In this sense, climate services, directed to young people, could contribute to design a sustainable future. We approach the practices, attitudes, and commitments of young people from the angle of cooperation rather than a moral vision of responsibility. Particularly, we propose a dialogical link between the treatment of climate issues and its effects on the constitution of networks, notably as they relate to practices of action, that is, the way in which distinct groups of young people develop relationships with their environments, organize themselves, and act and transform reality.

Keywords: young people; involvement; climate services; knowledge; awareness; transformation action

1. Introduction

The environmental challenges that humanity is facing in the 21st century, and climate change in particular, require a radical transformation in the way we dwell in, inhabit, and understand nature. Responses given by the governments are still below requirements, despite the mobilization of part of the international community [1], including researchers, citizens, and particularly, young people. A complex and integrative vision of the world is needed to tackle climate change issues, including the cultural diversity between countries [2,3] and generations. There is an urgent need to change the way we prepare the next generation of scientists and social leaders to effectively deal with the problems of the Anthropocene [4]. Unfortunately, there is a shortfall in the way we effectively teach

subjects such as climate change in the classroom due to a variety of causes, ranging from ideology, inadequate training, and state or country level ordinances, for example [5–7]. This is a cause for concern, considering the growing disconnect between young people and nature [8].

To what extent are climate services an appropriate method to undertake such issues? According to the analysis of the 27 volumes published by the Climate Services Journal (2016–2022, Appendix A), climate services seek to provide understandable climate data and scenarios to facilitate decision-making by individuals, governments, economic interests, and public sector actors. Climate services often entail the co-production of indicators that make sense to stakeholders, considering their perceptions and knowledge and evaluating the relevance of communication tools (web service, mapping, application). However, the climate services enterprise needs to be challenged to better support interdisciplinary, action-directed educational efforts. As an original contribution, this notion has not yet been applied for education purposes nor addressed to young people. Our approach is, therefore, innovative, seeking to increase awareness among a social category thus far under-addressed in the climate services literature and research. In this sense, our project adopts an action-based research approach to inform future leaders who will have to cope with climate change. Co-construction is at the heart of the pedagogical approach we advocate.

In the first section, this paper reports the case study of the Global Youth Climate Pact (GYCP hereafter) project and the methodology used to monitor and assess its efficiency and effectiveness, compared to the inertia and division of governments. The second section traces how GYCP was driven by young people's growing concern about climate change, the transformation that the GYCP project generates in students, in their awareness of the problem and in their eagerness to become actors of change. The third section compares this transformative pathway with the fragmentation of views and inaction of the governments, highlighted by a mapping of the discourse underlying the contribution made by governments to the Paris agreement. The conclusion puts this experiment in perspective with those conducted in the context of climate services.

2. Presentation of the Study Case and the Methodology

2.1. The GYCP Project: An Urgent Need for an Active and Participative Pedagogy

The GYCP project began in 2014 as a response to the critical lack of involvement from young generations and insufficient consideration of the human dimensions of climate change in the COP meetings and reports. Developed in 30 countries (Figure 1), it involves more than 12,000 young people and prioritizes their awareness and continuing education. The question was whether young people were aware of the challenges and opportunities that a pathway toward a low-carbon model entails and ready to join the world debate on the ways to reach it. In this context, we contacted schools and science teachers in different countries to carry out a pilot experience of reflecting on climate change in the school and in their localities. This reflection process led to the organization of projects by the students and required further knowledge to support the work of both teachers and students. Scientists have a leading role to play in this process. As agents of knowledge dissemination, they interacted with students to explore scientific results, issues and uncertainties about global warming, and helped build their pilot projects.

Our approach differs from traditional pedagogy, which tends to treat young people as mere receptacles of adult knowledge. In this context, it is critical that climate change is understood by young people and not merely explained to them. This new paradigm needs to tackle creative complexity, particularly in the field of education [9–11]. It points to the need for a new teaching strategy that embraces the interconnected nature of planetary society, where fundamental notions such as uncertainty, interdependency, and nonlinearity become embodied knowledge, thus, aligning the increasing commitment of young people with their ownership of scientific knowledge. This issue is opening a new field of research [10,12–15] and action–research projects such as the Global Youth Climate Pact (<http://www.globalyouthclimatepact.eu/> (accessed on 30 July 2022)).

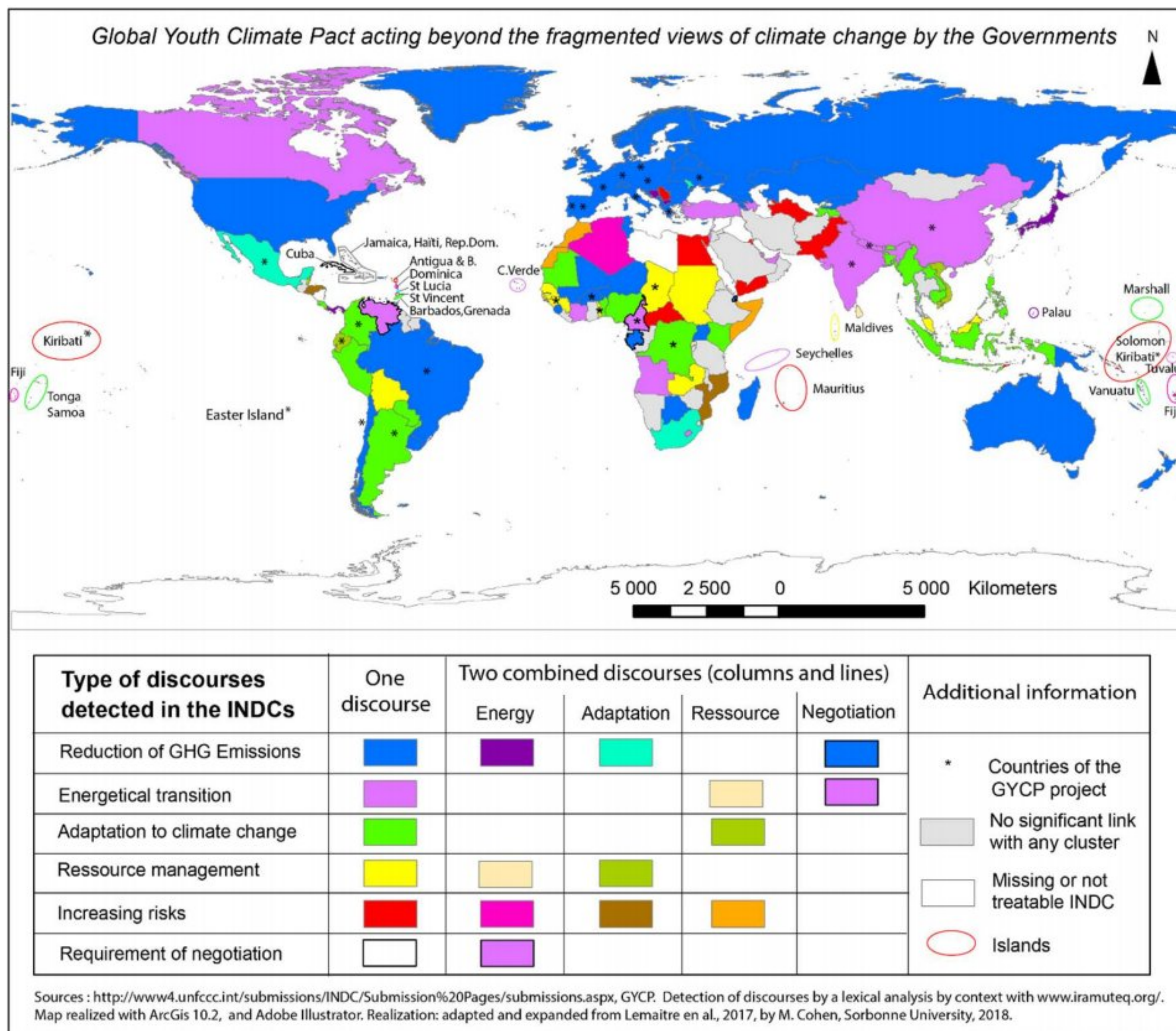


Figure 1. Map of the discourse underlying the intended nationally determined contributions (INDC) to the Paris Agreement and locations of the GYCP projects. Realization: Marianne Cohen (Material English, French and Spanish corpus: INDC <https://unfccc.int>, accessed on 30 July 2020, location of GYCP projects: <http://www.globalyouthclimatepact.eu>, accessed on 30 July 2022; Method: lexical analysis by context of the 3 corpus with IraMuTeQ free software; Mapping: ArcgisPro© software.

2.2. Young People, at the Crossroads of Knowledges and Cultural Diversity

Contrary to current stereotypes of young people [16,17], the GYCP experience demonstrates that they are not disengaged from the ongoing climatic crisis. They are eager to understand and find ways to generate actions in the face of governmental inaction. They desire to be agents of change now and in the future. Drawing upon this awareness, one can conclude that there is a great opportunity to propose action-oriented pedagogical experiences that nurture this interest and transform it into ways of knowing and creating citizens that can fit into a carbon neutral world by 2050. This requires, however, rethinking the dominant discipline-oriented teaching paradigm and working instead toward problem-oriented strategies that allow and enable contributions from all disciplines, integrating and crossing knowledges and enhancing the open-mindedness of all the actors of the teaching system [18,19]. In particular, it is critical to develop an open-minded learning by doing and to create learning institutions that serve human interactions. In this sense, the GYCP experience points toward the opportunity and need for a radical re-reading of the notion of climate services (Appendix A).

2.3. Methodology Used to Monitor and Assess the GYCP Project

Several methods were used to monitor the projects and assess the growing awareness of the students and to co-construct a common parlance and vision while respecting cultural diversity. During the large meetings that brought together the delegations of all the countries, we used crowdsourcing to question a large panel of participants dynamically, including those who were physically present. This method, implemented with the help of an external service provider specializing in this technique, made it possible to obtain significant statistical results. The main question asked referred to the degree of sensitivity of young people to the impact of climate change. Three editions followed one another, in 2015 during the COP 21 with 600 participants, in 2017 with 918 participants, and in 2019 during the COP24 in Madrid with 300 participants.

During the development of the project in each country, we used focus groups to capture and characterize the experience of specific groups of students. The focus groups made it possible to bring to light deep-seated questions on the part of the young people and stimulate the appropriation of the knowledge related to climate change, its integration in their cultural reality, and the elaboration of action-oriented projects.

We also sought to evaluate the success of 53 projects by developing a composite index, taking into account the focus of the projects, their ability to be disseminated in the wider youth community, and the level of concrete realization they achieved. Each of these criteria were scored from 1 to 4 (Table 1), providing a readable indicator for evaluating the projects and comparing their level of success.

Table 1. Multi-criteria assessment of the success of projects.

Indexes	Focus	Dissemination	Effectiveness
1	General	Only one class	Meeting
2	Accurate but limited	More high school class	Community
3	Accurate and concerning more people	More high schools	Community, decision makers
4	Targeting	Community	Implementation of concrete experiments

Finally, we compared the accomplishment of the young people who participate in the GYCP project with governmental inertia and fragmentation of national policies. With this aim, we overlaid the location of all the GYCP projects with a map highlighting the diverse ways governments understood their engagement to the Paris Agreement. This map was produced by analyzing the intended contributions of 191 countries with an automatic method (Appendix B).

3. The GYCP Project, a Process from Consciousness to Action

3.1. A Growing Youth Concern and Engagement

According to our first (2015) crowdsourcing survey during the COP21 with 600 young people, more than 89% of respondents said that they and their families were concerned about climate change. While it is not surprising that individuals attending a COP would be highly focused on climate change issues, this is nevertheless a high proportion, especially when considered in light of pervasive, widespread stereotypes of a youth that is uninformed and uninterested in climate issues [16,17]. We differentiated the answers according to the origin of the young people: developed countries (European origin), emerging countries (China, India, Brazil, Colombia, Chile), and developing countries (Guinea, Burkina-Faso, Lebanon, Nepal). Thus, while 87% of young people from developed countries said they were concerned, 100% of young people from emerging countries and 94% of those from developing countries did so. The level of concern is higher in emerging and developing countries and lower among young people from developed countries, perhaps because they perceive climate change as a distant threat, removed from their lives both in space and time. It could be argued that at that time (2015), in the minds of people and including young

people, climate change risks were perceived as non-personal, about the future, other places, and other species (plants and animals, not humans) [1].

Comparing these results with the 2017 survey on perceived impacts, we also see a shift. Indeed, among the 918 exchanges of views that generated the most interest, 41.5% believe that extremely negative impacts will be felt in terms of rising sea levels, land flooding, and the disappearance of some cities (Venice) or island countries (Kiribati, Maldives). In 2017, the proportion of the risk of natural disasters was twice as low (21%), on par with concern about a disruption of the seasonal cycle.

During the COP25 held in Madrid in 2019, this concern was shared by 15.4% about one or more of these disasters. In the same year, the second most important concern (24%) was about the lack of water resources, desertification, and the increased risk of famine, a result similar to 2017. A smaller proportion of exchanges (18.9%) revealed concern about the reduction in biodiversity, more than twice as many as in 2017. When asked about the impact of climate change on their way of life, 300 young people from 8 European and Latin American countries gave a clear answer: more than 90% of the responses from young people from Europe and Latin America agreed that global warming would have negative or very negative consequences. There is a convergence of views compared to the 2015 survey, the negative or very negative impacts of global warming are, all things considered, identical in terms of percentages. In 2019, unlike in 2015, young Europeans were proportionally more likely than young Latin Americans to perceive negative impacts; they were no longer seen as a distant threat by 96.5% of them [20].

We take these figures as an illustration that shows that students from emerging countries were more likely to experience, in their own lives, the impact of climate change in the year 2015, whereas the concern about climate change is nowadays shared by all students whatever country they are living in.

3.2. *Young People May Be the Wellspring of Socio-Ecological Change*

Concrete examples are given by the diagnosis established by learners in contrasting geographical contexts (Figure 1). Projects carried out under the GYCP came from young people living all over the world: central France, Colombia, Brazilian Amazonia, rain forest in central Africa, semi-arid northern Chile, Easter Island, and northern Argentina, and all highlight a multi-level ecological deficit. From their diagnosis, they set up specific action projects and contribute to socio-ecological change in their territories. During this process, scientists provide their knowledge, and learners contextualize it to elaborate a diagnosis and further an action plan, teachers being the linchpin.

A key point, brought in by the students' projects, is how ancestral knowledge may contribute to thinking about the future under climate change, particularly in territories where the memory of the past has a great importance in knowledge transmission. For example, in the Puyanawa indigenous community of Brazilian Amazonia (Appendix C), a link was established between the students and the elders' knowledge, and the diagnosis and action project were translated into the indigenous experience. Other projects by young Pygmies belonging to Bantu, Nilotic, and Sudanese communities, living in the Congo Basin Forest, were engaged in combating deforestation as "forest gatekeepers". In Easter Island, students were engaged in the reactivation and reinterpretation of the Rapa Nui techniques of "rock gardens" as a way of enhancing the sustainability of agriculture and addressing water shortages affecting the territory (Appendix C). From this insular experience, learners suggest rethinking "our planet like an island in the middle of the Universe". Other proposals are oriented on innovative technologies without abandoning the native heritage. In the Chicolco agricultural school in central Chile, learners are elaborating on a multi-objective hydroponic technology to adapt to water shortages (Appendix C), while students in the Azapa Valley of Northern Chile are reflecting on improving carbon sequestration in their local vegetation and wetlands. Young Colombians, on the other hand, are developing an agroecology book to bring alternatives to rural populations facing climate change, thus, becoming actors in one of the most important mitigation and adaptation strategies for

climate change, known as nature-based solutions [18,21,22]. In a French rural territory and in northern Argentina, scholars are rethinking the carbon footprint of their school canteen or their city and bringing a proposal at the regional level.

This demonstrates how each contextualized experience may facilitate or compel socio-ecological change when it is built upon a place-based reality anchored in experience, including the most recent projects designed during the health context of the pandemic. All these examples are creating virtuous circles in which young people are at the source of socio-ecological change, bridging the gap between traditional knowledge, local experiences, innovative solutions, and transformative change.

In the process of building projects with young people, we did not try to transpose the UN concepts. They were free to choose their own words, and what was important was creativity. The frequency of key words in the titles of the projects shows the way in which young people appropriate their “climate reality”. Thus, among the titles of the 54 projects, 10 mention environmental issues, 9 citizenship and awareness, and the same number education or resources. According to a focus group, these notions underlie the notion of “transformation” that is dear to the hearts of the young people. The projects related to the climate issue as such occupy only the fifth position with eight efforts directly focusing on climate change. The notion of adaptation is not mentioned, and mitigation is rarely put forward (six projects), and this is the case regardless of the level of development of the countries where the young people live. Project success indicators show that most projects achieved a good score, increasing over time (average score from 4.4 in 2015 to 9.8 in 2021, decreasing to 7.2 in 2021 due to the COVID-19 pandemic). The level of success of the projects was inversely proportional to the level of development of the countries, the average score being 4.9 in developed countries, 6.6 in emerging countries, and 8 in developing countries. This shows that young people in countries where the effects of climate change are most dramatic are the most involved in finding local solutions (see Table 2).

Table 2. Results of the Multi-criteria assessment of projects.

Title of the Project	Country	Type	Year	Focus	Dissemination	Effectiveness	Score
Environmental education	China	Developed	2015	1	1	1	3
Environmental awareness	Italy	Developed	2015	1	1	1	3
Gardens in the school	Poland	Developed	2015	4	1	1	6
Environmental awareness	Romania	Developed	2015	4	1	1	6
Citizenship and environment	Ukraine	Developed	2015	2	1	1	4
Biosorbent	Colombia	Developing	2016	1	1	1	3
Crossroads Climate Program	Guinea	Developing	2016	3	4	3	10
Climate change global—ocean	Kiribati	Developing	2016	2	4	2	8
Waste management in Kathmandu	Nepal	Developing	2016	3	4	2	9
Stone gardens from the ancestors of Rapa Nui	Rapa-Nui	Developing	2016	4	4	4	12
CO ₂ outside Melle city	France	Developed	2016	1	1	1	3
Education environment	Brazil	Emergent	2016	1	1	1	3
Planetary citizenship, sustainability	Brazil	Emergent	2016	1	1	1	3
Carbon sequestration in Azapa Valley soils	Chile	Emergent	2016	3	4	4	11
Climate change monitoring—Chiloé Island	Chile	Emergent	2016	1	1	2	4

Table 2. Cont.

Title of the Project	Country	Type	Year	Focus	Dissemination	Effectiveness	Score
Environment social service	Colombia	Developing	2017	4	4	1	9
Eco Blanket and spherical panel	Colombia	Developing	2017	1	1	1	3
Higher Education Organized for the Prevention of Environmental Damage	Colombia	Developing	2017	4	4	3	11
Fight against global warming and environmental education	Congo	Developing	2017	3	4	3	10
Educobien's student alliance	Venezuela	Developing	2017	4	3	1	8
Human regulation of ecosystems in the Chizé forest.	France	Developed	2017	1	1	1	3
CO ₂ Footprint in Santiago's High Schools	Chile	Emergent	2017	1	1	1	3
Anthropic disasters in the O'Higgins region	Chile	Emergent	2017	3	1	1	5
Hydroponic system for all	Chile	Emergent	2017	4	4	4	12
Domestic wastes compacter	Colombia	Developing	2018	3	4	1	8
Land rescue	Colombia	Developing	2018	1	3	1	5
One million trees for the world	Colombia	Developing	2018	1	4	1	6
Walking with the Frailejones	Colombia	Developing	2018	1	1	1	3
Carbon footprint, San Pedro de Jujuy	Argentina	Emergent	2018	4	2	2	8
Puyanawa: Traditional Knowledges and the challenges changes	Brazil	Emergent	2018	3	4	2	9
Compost generation from organic matter produced in food specialties.	Chile	Emergent	2018	3	2	1	6
Environmental awareness To reduce the carbon footprint of the school canteen	Morocco	Developing	2019	4	1	2	7
Nature in the city	France	Developed	2019	3	1	1	5
Raising awareness of the climate problem	Spain	Developed	2019	4	4	3	11
Climate change and rural youth	Spain	Developed	2019	3	1	1	5
Bocashi, a natural fertilizer	Chile	Emergent	2019	1	1	1	3
The impact of our footprints	Chile	Emergent	2019	1	3	1	5
Coyhaique, an acid city?	Chile	Emergent	2019	3	3	1	7
Coyhaique submerged	Chile	Emergent	2019	4	4	1	9
Water explorers in Patagonia	Chile	Emergent	2019	3	4	1	8
Social research on the harvesting of wild fruits in Balmaceda	Chile	Emergent	2019	3	4	1	8
The school garden of the 21st century.	Chile	Emergent	2019	2	1	1	4
Natural fertilizers	Chile	Emergent	2019	3	3	1	7
	Chile	Emergent	2019	3	4	1	8

Table 2. Cont.

Title of the Project	Country	Type	Year	Focus	Dissemination	Effectiveness	Score
Biodiversity and deforestation	Cameroon	Developing	2020	4	4	3	11
Gayer—reforestation	Madagascar	Developing	2020	3	4	2	9
Reforestation	Mali	Developing	2020	3	4	1	8
Youth and the environment	Rwanda	Developing	2020	4	4	3	11
Waste management	Panama	Developing	2021	3	4	1	8
Reforestation with native trees	Chile	Emergent	2021	4	4	2	10
Rainwater harvesting	Chile	Emergent	2021	4	3	2	9
Understanding Antarctica to understand the climate	Chile	Emergent	2021	3	1	1	5
Education climate change	India	Emergent	2021	3	1	1	4

3.3. Youth Acting for the Adaptation to Climate Change

These experiences are all based on the desire “to act now”, but what is really acting? Contrary to the statement of Claudia Gorr [23], young people who participate in the GYCP do not agree that “citizens cannot do anything to mitigate climate change”. This common vision also emerges from the claim for political action raised by the growing youth mobilization against climate change. In the GYCP, participant’s drive to take action rests on their engagement and on a collective and reflexive participation primarily oriented towards adaptation to climate change and, secondarily, towards its mitigation. For half of them, “I, us, young people” can act against climate change; it is up to them. A considerable proportion think that it requires the involvement of all the inhabitants of the planet, with only a few thinking that governments have to play the major role. Contrary to other studies, the experience associated with the projects developed by students raised awareness of the importance of becoming involved in the struggle against one of the most important problems facing society, climate change. The experience of the GYCP provides information that appears to counter the conventional wisdom that young people do not take seriously the issues related to climate change. Nevertheless, there are clearly barriers to overcome in order to change the way we explain complex and multifactorial problems, such as climate change. This requires finding new forms of explanation. This problem could be addressed by enhancing a deep understanding by teaching through actions and by bringing scientists to schools to monitor the progress of projects and provide scientific evidence, which has the important co-benefit of fostering an appreciation for science and science-based actions.

4. GYCP Is at Odds with the Division and Inertia of the Governments

The actions of youth seem at odds with the *climate paradox*: the more acute the consequences of climate change, the more divided and paralyzed are decision-makers [1,24,25]. Due to their engagement in local actions, such as those illustrated through the GYCP, young people provide hope and scope for action. Their projects were presented at the different COPs. In Paris, during the COP21 in 2015, we presented 21 proposals from 10 countries in a side-event to the organizers. The same happened at COP 22 in Marrakech in 2016 and at COP 23 in Bonn. In Katowice at COP 24, in 2018, posters reporting on the different projects (Appendix C) received a warm welcome from the assembled authorities, including ministers of the environment, the UN youth representative, the European Commission environment representative, and mayors of large cities. In Madrid, we were invited by the president of the COP to present our proposal for the future (six items: education) [26–28], valuing forests, reduced carbon footprint, biodiversity, resources, water and soil, sustainable agriculture, protection of the oceans, and nature in the city (see Appendix D), but this ended with a report being presented to her presidency coordinator. Should we see in this kind but short-lived reception an illustration of the distance between the concrete commitment of young people and the inaction of political leaders and a justification for

young people's lack of trust in decision-making processes at national and international levels? In Glasgow, the young people were not admitted to the conference for health reasons, but they did participate in a citizen's consultation, of which we made ourselves the spokespersons (Appendix E). From a report on the degradation of ecosystems, the growing role of social networks and a global crisis, they proposed among the solutions, acceleration of decision-maker actions, awareness among young people, and change in the dominant modes of consumption [29].

On the other hand, government discourse underlying their contributions to the Paris Agreement INDCs are revealing a divided world and explain the inaction on the part of governments (Figure 1). This division is shaped by strategic alliances (e.g., UNFCCC negotiation groups, OECD, ASEAN, Francophonie, Commonwealth . . .) beyond the "South-North" divide. As previously described, these discourses were evaluated by means of an automatic text analysis of the INDCs of 191 countries, first applied to the English corpus [30] and further to French, Spanish and English corpus separately, synthesized and mapped (Appendix B). Regions highly vulnerable to climate change have a fragmented view on the issue (Africa, island countries) that weakens their political force in the negotiations [31]. Developed countries focusing their INDC on the "Reduction of GHG emissions" constitute a more homogenous group strengthened by the efficiency of their negotiation groups. Emergent countries have different visions, either adopting the dominant discourse on the "Reduction of GHG emissions" (Chile, Brazil) or a composite discourse in line with the vulnerability of part of their territory (Mexico, South Africa). Inequalities are not enough counterbalanced by the financial aid brought to low-emitting countries to cope with climate change while a low proportion of countries focusing their INDC on the "Reduction of GHG emissions" and on the "Energetic transition" implemented a carbon policy, illustrating a disconnect between rhetoric and decision-making [20]. This may explain the disappointing results obtained five years after the Paris Agreement since CO₂ emissions have continued to rise between 2015 and 2019 by 4.88%, in 8 out of 10 countries emitting nearly 70% of total carbon dioxide. The 2020 numbers show a reverse trend, related to the effects of the COVID-19 pandemic (www.carbonproject.com, accessed on 30 March 2022). While countries adopting the discourse on the reduction in GHG emissions moderately decreased their CO₂ emissions (−1.8%), those focusing their INDC on energetic transition experienced a very strong increase (7.3%) (<https://edgar.jrc.ec.europa.eu/overview.php?v=booklet2020> (accessed on 30 March 2022)) due to their high coal consumption, the exact opposite of the rhetoric behind their INDC. Beyond this geographical fragmentation, this inaction can also be interpreted by the low political benefit expected from the drastic measures needed, which will only materialize after 2050, given the inertia of greenhouse gases in the atmosphere. The distance between the INDCs and the actions, 7 years after the Paris Agreement, suggests a climate diplomacy made of magic words, very far from or even the exact opposite of the reality of political decisions. In this sense, the map of the discourse underlying the INDCs of the governments in 2015 was premonitory of the weak results obtained through COP26, which was, however, decisive. Far from the acceleration desired by young people, a policy of small steps has prevailed, leaving fears that the objectives of the Paris Agreement are out of reach.

5. Conclusion: Youth Lessons beyond the Cop26 and Renewing Climate Services

As we are writing, the growing youth claim to act against climate change is another expression of their awareness and need for action. Involvement of the younger generation should go beyond wishful thinking or goodwill, and advance toward mobilization, such as the movement launched by Greta Thunberg. Young people of the GYCP involved in action-oriented projects conceived to change their territory are currently acting beyond the fragmentation between countries while nevertheless building their projects in recognition of cultural specificities. This demonstrates the importance of climate change education through active teaching methods but also the need to integrate them as qualitative indicators of countries' commitments, as proposed by the GYCP during the COP25. Young people

are opening new avenues that can bring a change to us all. Unfortunately, in Glasgow, decision-makers once again demonstrated their lock-in to short-sighted geopolitical divisions, contrasting with the promising narratives employed in their intentional contributions to the Paris Agreement. Our hope is thin that the voices of the young people were heard by their representatives, but despite this, the GYCP will continue its transformative action. Young people's call for actions to mitigate and adapt to climate change and ultimately to foster multilateral cooperation is becoming stronger. It can provide the required additionality to cross the tipping point and help to address collective action problems associated with climate change, fostering an increase in countries' level of ambition in their CO₂ abatement commitments.

In this sense, the GYCP has great potential as a test bed for activities that could contribute to a renewal within the enterprise of climate services by deepening their objectives and applying them to a promising segment of society. Our approach, while inspired by certain aspects of the concept of climate services, is a rather radical re-reading of it on several points. Our partners are underprivileged high school students from the public sector. The researchers and associated teachers are volunteers. The depth of the co-construction of knowledge is far from both traditional pedagogy and the co-construction carried out within the framework of climate services, which aims at transforming knowledge and climate data into "useful" indicators for policy and economic activity.

From a social experimentation point of view, we solicit the collective intelligence of young people by suggesting a reflexive involvement and a conscious commitment from the elaboration of action and experimentation projects. The impact on educational orientations is reflected above all in the way we deal with the complexity of an essentially transversal subject. Our approach is the opposite of a utilitarian, top-down orientation. It is the group of students who, after a local diagnosis, suggest a contextualized and problematized project, according to a bottom-up approach. The question is not what researchers can solve in climate-vulnerable regions but what the "good actions" are that these young people can propose to obtain useful results. This suggests the benefits that may accrue through integration of place-based, ancestral knowledge in climate services. All these principles are the basis of a pedagogical book for teachers [18].

Appropriately configured, climate services may be a tool that can help young generations to cope with the dangers and perspectives linked with the increasing variability and change in climate; perhaps serving as a mechanism to reinforce actions undertaken by the students, similar to forest gatekeepers, stone-gardens, or agroecology. The question raised by this experience is how far climate services can support young people in their efforts to design a sustainable climate reality.

Finally, considering our results, we would like to highlight a line of thought, part of which is borrowed from Michael H. Glantz's book: *Climate Affairs* [32]). We have described how our project is based on three fundamental principles: reflexive knowledge, awareness raising, and the importance of socio-anthropology in the climate system. Although there are sophisticated models of global warming scenarios with increasingly advanced technological means to scrutinize our Earth, there are still a significant number of people who ignore the evidence of climate change. However, there are several ways of integrating a socio-anthropological dimension to climate problematization. Some are tactical, others are strategic. On the tactical level, the socio-anthropological dimension can be considered in climate discussions when it directly, visibly, and largely, influences issues of societal change. On the other hand, a strategic focus on climate disruption leads to an overemphasis on the long-term climate change issue at the expense of the shorter-term socio-anthropological dimension. However, a multidimensional approach that encompasses both tactical and strategic concerns in time and space integrates the socio-anthropological condition into the overall complex problem of global warming. "We are in a world faced with the difficulties of global thinking, which are the same as the difficulties of complex thinking" [32,33].

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M.C., L.M.F. and P.M.; investigation, A.P.-V., L.M.F., P.M., A.G., M.L., J.C.C. and H.L.T.; resources, A.P.-V.; data curation, P.M.; writing—original draft preparation, A.P.-V., M.C., L.M.F. and P.M.; writing—review and editing, A.P.-V. and M.C.; supervision, A.P.-V.; project administration, A.P.-V. and L.M.F.; funding acquisition, A.P.-V. and L.M.F. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: Individual informed consent statement was unnecessary due to the use of the crowdsourcing methodology. Hundreds of students contribute simultaneously and anonymously to the discussions via the web platform Synthetron (<http://synthetron.com> accessed on 10 August 2022), identified only by their country.

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Appendix A. Meta-Analysis of the Literature on Climate Services

In order to define climate services, we listed and analyzed the titles of 212 articles published in the journal *Climate Services*, published by Elsevier, between 2016 and 2022 (<https://www.sciencedirect.com/journal/climate-services> (accessed on 10 August 2022)). Additionally, we used Google Scholar to search for articles associating the key-word climate services with “youth”, “education”, or “high school”.

We found that 68% of the 212 titles focused on a region, a country, or a level of development; 36% were applied to developed countries; and 32% to developing countries. The remaining 31% had a global or a general approach. Less than half (43%) of the titles focused on the benefits of climate services on the economy, with agriculture being the main sector (25%). Another significant proportion (21%) referred to the contribution of climate services to risk management (floods, droughts, heat waves, etc.) without focusing economic stakeholders. Only one title out of 5 referred to the need for co-construction of indicators and to the perception and knowledge of stakeholders. A higher proportion (36%) referred to the description of climate data, projects or climate services in general, i.e., following the point of view of the researchers. No article associated the term climate service with youth, education, or high school in this corpus, neither on Google Scholar.

The lexical analysis, by context with IRaMuTeQ 0.7 free software, differentiated six types of titles of equal importance. More information on this software is given in Appendix B. The words and illustrative variables best related to the types are listed in the Table A1, along with the χ^2 value that assess the strength of their relationship with the type. Only one type referred to a disadvantaged social category, namely, rural smallholders, preferentially published in volume 20 (year 2020). The others referred to market and methodological issues of data analysis and simulations that differ in time. The word citizen was used in only one title, and the words youth, student, or education were not used.

Six types of titles of Climate Services were published during the period 2016–2022, analysis with IRaMuTeQ 0.7 software

Table A1. Results of the lexical analysis by context of the titles of *Climate Services* journal.

Market		Smallholder		Research Framework		Simulation					
Type 1	Qhi ²	Type 2	Qhi ²	Type 3	Qhi ²	Season		Country		Region	
Type 1	Qhi ²	Type 2	Qhi ²	Type 3	Qhi ²	Type 4	Qhi ²	Type 5	Qhi ²	Type 6	Qhi ²
Forms (words)											
Market	35	smallholder	36	Framework	13	prediction	44	scenario	29	West	19
Uptake	17	agro	21	Process	11	seasonal	17	national	29	Multi	14
EU	17			Enable	11					Africa	13
Engagement	17										
Illustrative variables											
Volume 17	11	Volume 20	10	volume 22	4	Volume 27	5	Year 2016	10	Volume 13	5
						Year 22	4	Volume 1	9	Volume 11	5
								Volume 4	9		

Appendix B. Automatic Text Analysis of the INDCs of 191 Countries

In order to explore the human dimension of climate change at the global scale, we applied a lexical analysis by context to 191 intended nationally determined contributions (INDCs) to the Paris Agreement (COP21). Furthermore, [34] assessed the expected effects of state commitments on greenhouse gas emissions.

We first downloaded the INDCs and gathered them in three corpuses, according to their language: English (558,641 words); French (66,026 words), and Spanish (45,065 words). We then formatted these three corpuses, deleted tables of numbers and graphs, corrected the spelling, and homogenized technical notations (for example CO₂ eq).

We further processed each corpus using an R interface for lexical analysis by context with IRaMuTeQ 0.7 free software. Among many techniques, this type of lexical analysis is easily reproducible and well adapted to highlight the differences of views in a large corpus [35]. First used for literary analysis [36], it was applied to political or sociological purposes (i.e., [37]).

The software cut the corpus into basic context units containing about 200 characters, further grouped in context units, and then in significant statement classes using a descending hierarchical analysis. Each cluster was characterized by its own vocabulary according to the Chi-square test. Combined with a careful reading of the text, this analysis made it possible to understand the linguistic particularities of the different discourses. We detected six main types of discourses and then mapped out the significantly-linked discourse by countries, according to the Chi-squared test, by using the geographical information system (ArcGIS 10.2[©]).

Appendix C. Three Examples of Projects presented in the COP24 in Katowice in 2018)

Global Youth Climate Pact



UFRJ

Authors: Jósimo Constant;

Puyanawa: Traditional Knowledges and the Challenges Changes



Introduction/Problem

Our people Puyanawa (people of the frog) we are an indigenous ethnic group that we are located in the State of Acre, north of Brazil, before the arrival of the rubber explorers, we inhabited the banks of the Juruá River. According to the elders, we derive from the junction of the frog and the leaf. This work aims to identify a series of problems that we are facing because of climatic factors. It will be taken in relevance the memory of the oldest, the oral transmission of the traditional stories of the own people.

Justification

Despite all the mishaps that we have experienced over time in the hands of the settlers, we are working hard so that our traditional customs are preserved. The relationship with nature to us indigenous peoples is something symmetrical and relevant, we Puyanawa, we still master many practices, tactics and techniques of our ancestors. It is these knowledge of the ancients that made us go through many difficulties, continue to seek in nature all the elements necessary for maintaining the group and preserving the environment.

Considerations

Colonization was the main negative factor to break with our customs, cultural and environmental ties. But we are working hard for what remains of our customs are maintained, especially our mother tongue which is seriously threatened by the reduced number of speakers. We are monitoring, raising awareness to promote the sustainable management of each resource extracted from our environment. We are seriously concerned about the terrible and sad environmental catastrophes that are destroying the world.

Methodology

The methodology used is translated into the indigenous experience itself, but the memory of the elders will be taken into account. In addition, the ethnographic method will be used, which I propose through this method to carry out a dense description of indigenous traditional knowledge together with the other members of the community and the effective participation of students from the Itxuwäy Rabuy Puyanawa school, indigenous medical practices and impacts environmental and their consequences in our indigenous territory.

Results

The remarkable project is being the gateway to many other things, especially in opening the minds of the younger ones, so that they become more interested in traditional knowledge. Lately our community has been working to rescue the traditional language and culture, but we still need a deeper, dense and long-term work as deforestation, fishing and predatory hunting have increased. In this way, sustainable management and traditional knowledges have been important for the preservation of our land.



References

CONSTANT, Jósimo. History, memory, traditional knowledge and challenging climate change under the Puyanawa indigenous perspective.

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Figure A1. Puyanawa: Traditional knowledges and Challenge changes. Source: Constant Josimo (UFRJ), GYPC.



Figure A2. Stone gardens: from the ancestors of Rapa-Nui to the world. Source: Young people, High school Aldea, Rapa Nui, GYPC.

PACTO MUNDIAL DE LOS JÓVENES POR EL CLIMA GLOBAL YOUTH CLIMATE PACT

HYDROPONICS FOR ALL

Drought is one of the effects of the climate change that is affecting many places all around the globe. Chincolco, a town from Chile, located in the Petorca river basin, is one of the places that have been strongly impacted by the decrease in rainfall and the increase in temperatures.



Liceo Cordillera de Chincolco is located in the foothills of The Andes Mountain Range, in the northeast of Valparaíso, Chile, and addresses all the different educational needs of the community. It's in this place, where a group of young students make the change through a project that intends to mitigate the effects of desertification in their community.

RESULTS:

It is feasible to establish hydroponics modules:

- Using recycled materials.
- Optimizing the water resource saving up to % 80.
- Increasing the production per unit area.
- Using less time for cultivating.
- Replicating the module anywhere.

METHODOLOGY

- Gathering of historical data on distribution of rainfall and temperature in the zone. Gathering of information about the legal distribution of the water resource in the zone.
- Research on types of crops that optimize the water resource and space.
- Determining Hydroponics as the cultivation system that will eventually optimize the water resource and space.
- Implementing the vertical cultivation module in order to reduce space, considering the reuse of materials, feasibility and ease of construction.
- Implementing the cultivation system.
- Implementing a working system that uses renewable energy.
- Working with organic nutrients.







El Huerto de las Tres R

El módulo donde crecen los lechugas hidropónicas está hecho de materiales 100% reciclados.

Cómo funciona el proceso

1. Con la fuerza de un motor de lavadora, el agua sube por unos pequeños tubos que conectan los tubos de PVC de cada lado del módulo.
2. Un ángulo semi-circular permite que el agua circule por los tubos.
3. El agua regresa al fondo donde vuelve a iniciar el proceso.

Pequeño Liceo Cordillera





PROGRESS STATUS

- Module implemented with recycled materials and a system that reuses water.
- Production of leafy vegetables.



We are a generation directly affected by the climate change that wants to have a sustainable life in the Earth, by giving solutions that provide the community with food security to face the water resource scarcity.



Figure A3. Hydroponics for all. Source: Young people, High school Cordillera, GYCP.

Appendix D. The Proposals of Action in the Face of the Climate Emergency presented in COP25 in Madrid in 2019)

Table A2. Working group, GYCP.

Topics/Workshops	Findings	Arguments	Propositions	Future Impacts
Education	Lack of practical and theoretical knowledge to generate sustainable actions. The youth remain without answers or concrete actions.	The mission of the program is to advise public and private institutions in the creation of an educational system based on ecology through transversal projects.	A program on four pillars: —Environment —Engagement —Empowerment —Efficiency	Implement age-appropriate environmental and sustainability activities.
Valuing forests, less carbon footprint	Massive deforestation of large virgin forests such as the Amazon, the Congo Basin Forest, or the Indonesian forests, among others.	The magnitude of the consequences of pollution from large industries incompatible with a sustainable future.	Creating positive rewards, not necessarily economic, for responsible and environmentally friendly countries; the greening of urban spaces —raise public awareness: to know the biodiversity —Created: a labeling system to rate the ecological footprint The preservation of a sustainable agroecology in which the relationship between producer and consumer will be reciprocal	Consider in the near future a legislation that will have to control the countries involved in large-scale deforestation
Biodiversity, Resources, Water and soils	Concerned about a sixth mass extinction, that biodiversity, ecosystems and our own existence are in danger.	Deforestation causes the destruction of ecosystems, loss of animal habitats, and soil infertility.		Reforestation program to restore ecosystems and boost biodiversity
Sustainable agriculture	At least 1300 tons of food are wasted each year; more than 800 million people do not have enough to eat	Indifference of consumers [ourselves!] as to the origin of food products.		to make the school a privileged place for balanced eating habits
Protection of the Oceans	Our oceans are a complex system that connects us as neighbors to all nations. We are in a state of environmental emergency with respect to the conservation status of our oceans. To build a project that starts from their anchorage in the local social environment and that crosses the fight against global warming and the defense of biodiversity [38].	Our governmental and commercial systems and the absurd over-consumption of unnecessary goods have overloaded the capacity of the oceans.	-Impose a maximum rate of imports and exports from each nation. -Nations must commit to reducing their carbon emissions -Creation of complete ecosystems We want to revitalize this area with our Anillo Verde project, plant enough vegetation to isolate the Anillo Verde.	Raise awareness among students and the community at large about the causes and effects of climate change on the oceans. We want to create a biome composed of local and preferably endangered fauna and flora.

Appendix E. Listen to the Youth! Presented in the COP26, in Glasgow (2021)

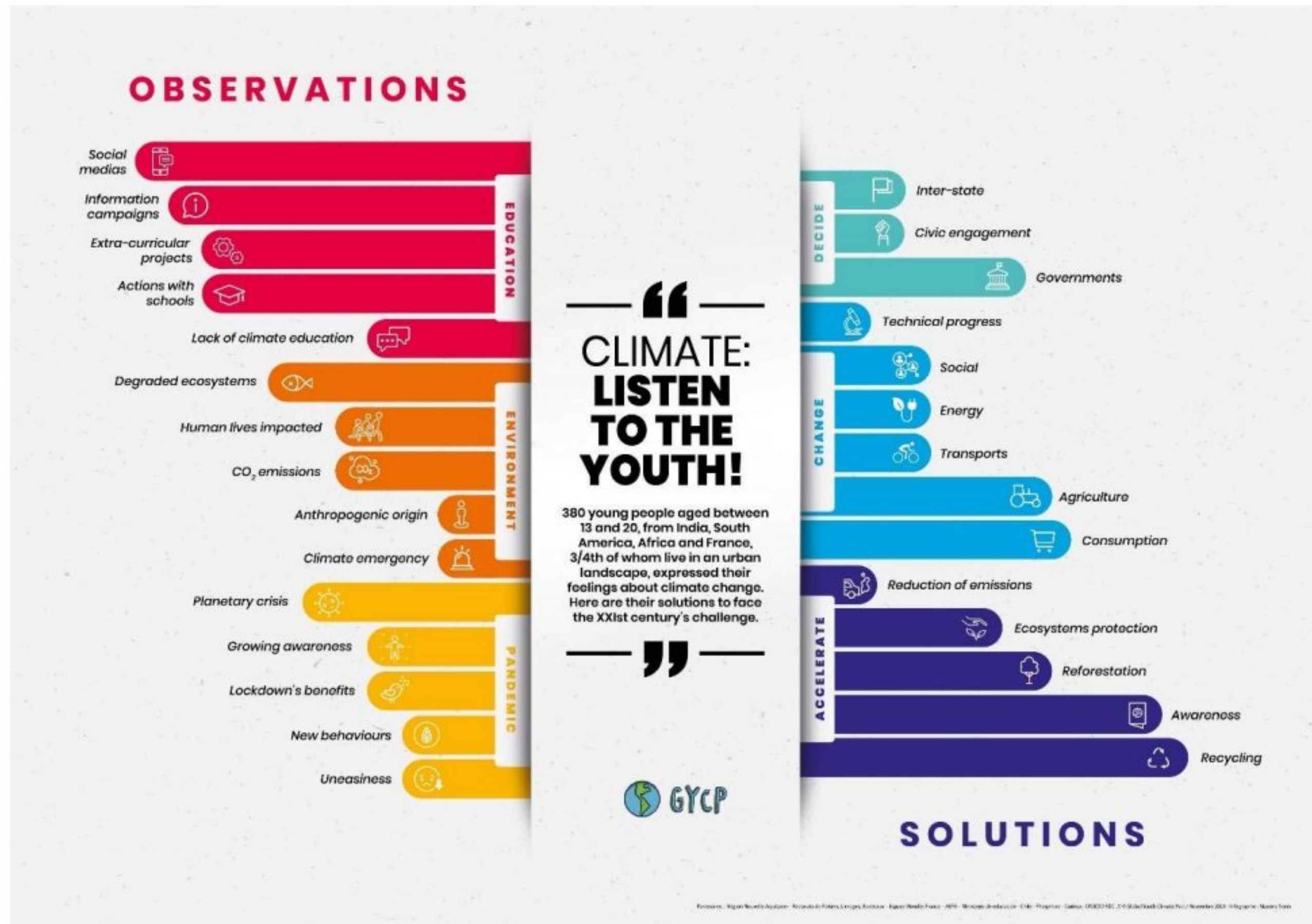


Figure A4. Listen to the Youth. Source: Survey post-COVID-19, 380 people.

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