

Traditional way of thinking and prediction of climate change in New Caledonia (France)

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In this paper we explore how the original inhabitants of New Caledonia, a French Pacific collectivity, view current climate change, explain its causes and predict climate modifications in the coming 10-, 30- or 100-year periods. We start with the presumption that the traditional worldview of indigenous habitants of New Caledonia allows the construction of a holistic view of climate change despite the “western” teachings based on fundamental analytical thinking in the French school system. Analysis of 61 semi-structured interviews with indigenous adults of New Caledonia demonstrates a universally held systemic view of climate change, in which the circular interaction between activities (including pollution of the air, surface water, cryosphere, lithosphere and biosphere of the Earth) is life threatening for all human beings.

Keywords: Holistic thinking, Climate change, Indigenous knowledge, New Caledonia

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This paper represents a component of a larger research project seeking to identify how people in different physical environments and from different cultural traditions, understand and explain the phenomena of climate change. According to our preliminary studies in traditional societies, indigenous knowledge systems enable people to build complex understandings of climate, and to make weather predictions based on animal or plant behavior, on the movements of the stars or other natural phenomena. This knowledge allows people to organize their activities, both short term and long term. We also highlight the benefits of holistic thinking, an approach dominant in these societies, in understanding systemic phenomena such as climate^{1,2}. We recently compared the understanding of climate change phenomena in different environments and different cultures within France³, and bring the results of this study into the present discussion. Recent literature also emphasizes the importance of indigenous knowledge in fighting against global climate change, and in dealing with mitigation and adaptations^{4,5,6,7,8}.

In this research we are not looking for traditional and often secret knowledge held mainly by weather specialists. Rather, we are interested in analyzing how a holistic way of thinking can help us to understand

the interconnectedness and complexities of causes and visible signs of environmental change. One of the crucial differences between holistic and analytic worldviews is reflected in the differing concepts of "nature". In societies where thinking is more holistic, as in traditional new Caledonian cultures⁹, there is no perceived separation between natural entities and humans. Thus, even the human part of nature does is not separated out as an independent component^{10,11,12,13}. Such holistic views can influence people's perceptions of the causes of climate change. Therefore, the objective of this study was to explore how traditional education based on holistic thinking can allow for a richer and more accurate understanding of the climate change phenomena that among in westernized populations.

Research methodology

The research was conducted in New Caledonia, a Sui Generis Collectivity of France, which is located in the Southwest Pacific in the region of Melanesia. Composed of a main island, the Loyalty Islands and several small islands, the surface area of this collectivity totals 18.575 km². The number of inhabitants is estimated at 249 000. The indigenous Melanesian population of New Caledonia constitutes approximately 44.6 % of the total population.

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This paper is based on empirical data. Data was collected through semi-directive interviews. In all, there were 61 participants (31 women, and 30 men, $M=26.2$, $SD=11.11$.) All were born in New Caledonia, and all are Melanesian and speak or understand one of the 28 Austronesian indigenous languages, in addition to French. All of them attended French school at least until the age of 18. Their socioeconomic status fits into low middle class category while living actually in Noumea, the main city of New Caledonia.

Open ended questions were designed to obtain information on the understanding and perceived causes of climate change at local and global levels, and to document people's predictions of future change. All the interviews were conducted by the psychologist, Olga Marest during 2009, in public places. The surveys were completed between 30 minutes and 2 hours, depending on participants.

In the interviews, association tasks were first proposed, enabling us to better understand the people's overall perceptions of the concept of climate change and how similar these perceptions were across the group of interviewees. We asked participants to tell us the first three words (in French) that came to their mind on hearing the term "climate change". Statistical analyses for the study of representational field were drawn up by Márquez¹⁴. This technique can be applied to social psychological data to study the structure of the representational fields of social representations. Two dependent variables were studied: the "extension" and the stability of cognitive organisation of concepts. The quantitative indicator of "extension" is the ratio of the total number of words produced by all the participants and the number of different words. The "extension" of a concept demonstrates its structural complexity and its conceptual richness. The stability was measured by the indicator "hapax". The indicator of "hapax" is the ratio of the number of words appearing only once by the total number of different words. The indicator of "hapax" is a measure of stability and consistency of a representation. For the semantic networks analyses, we used EgoNet software¹⁵. The semantic network is often used to identify the knowledge representation. It is a graph which represents the relationship between concepts. We adapted this software to analyse the relationship between the various productions of words. First, we identified the three words most frequently cited by all the participants. Secondly, we

connected them to the two other words given by the participants who indicated one of the three more frequently cited word. EgoNet with VisualLyzer are designed to graphically display small and mid-size networks. It offers an excellent methodological tool to analyse the underlying semantic conceptualization of complex concepts, like climate change. To obtain information on people's understanding of the causes of climate change and its consequences, as well as on predictions of change over time, an open ended questionnaire was used in individual interviews. A qualitative thematic analysis with independent judges enabled us to identify the basic themes that emerged from these interviews and by using elementary statistical analyses we identified the frequency in which they were raised as an indication of their relative importance.

Results and discussion

Semantic organisation of the concept of climate change

The results of the structure analysis of the concept of climate change as held by the Indigenous participants are presented in Table 1. Results from the analyses of semantic networks are presented in Fig. 1. We expected that the structure of the concept of climate change would relate to a relative reach (extension more than 0.50) and homogenous, stable concept (hapax less than 0.50). The findings confirm our presumptions.

Table 1—Extension and hapax indicators

extension	0,61
hapax	0,37

We predicted that the way of thinking among New Caledonian aboriginal adults would be basically holistic, with interrelated concepts. Consequently, we presumed that the semantic organization of the highly complex concept of climate change would reflect holistic and integrated thinking. The data confirmed our prediction. The semantic network, for climate change was organized around only three main axes: pollution (degree: 20, degree normalized: 46.51%); melting ice (degree: 18, degree normalized: 41.86%); and water rising (degree: 13, degree normalized, 30.23%). There is a strong relationship among these elements, which reflects the global nature of climate change. The semantic network is made up of two clusters reflecting a separation between the causes and the consequences of climate change. The first cluster includes words relating to the multiple causes of climate change (carbon dioxide, deforestation,

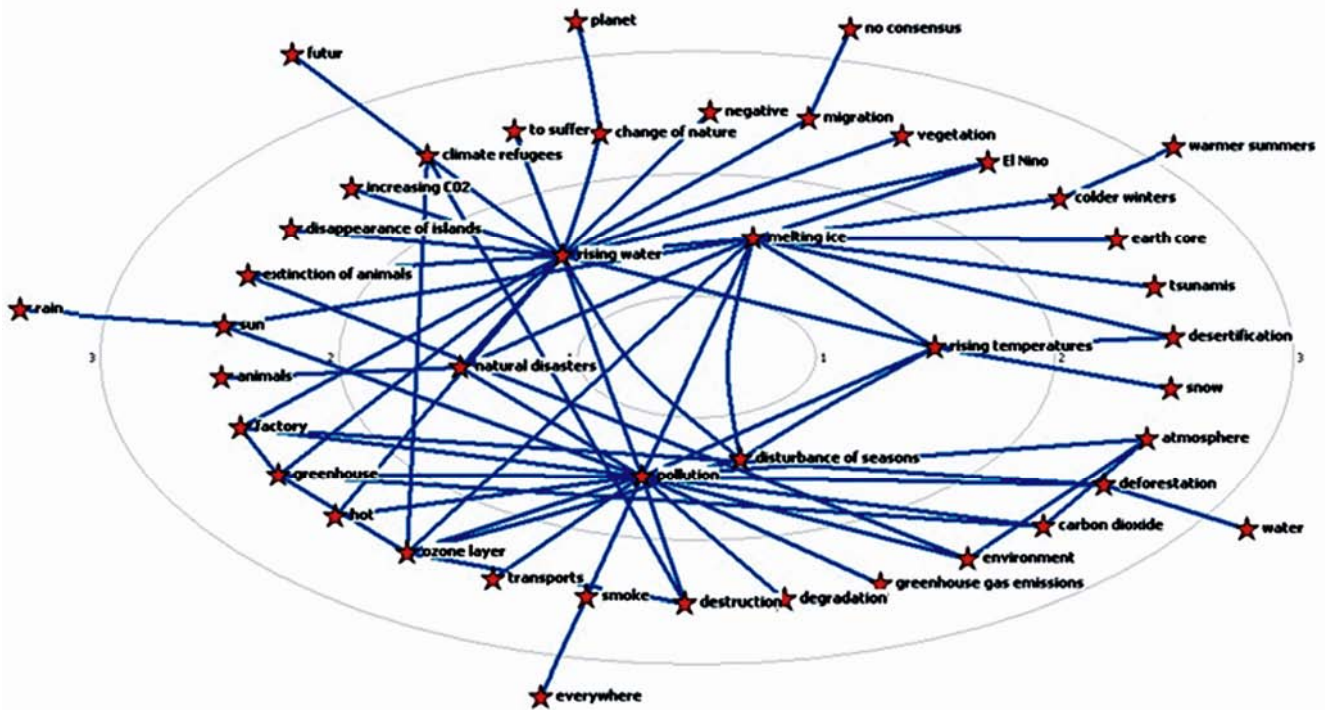


Fig. 1—Representation of relationships of worlds related to climate change as drawn from association task in French language with Indigenous New Caledonians

degradation, environment, smoke, greenhouse gas emission, ozone layer, pollution, transport). The second cluster mostly includes the actual effects of global warming (animals, nature change, climate refugees, colder winters, desertification, destruction, disappearance of islands, displacement of populations, disruption of seasons, earth core, el Nino, heat, increasing Co2, melting ice, natural disasters, no consensus, ozone layer, rain, rising temperatures, tsunamis, sun, vegetation, warmer summers).

A total of 44 nodes and 72 links connect the network, which indicates a tight organization among the different components. These findings demonstrate that the semantic network of the participants is complex and stable based on a holistic way of thinking, thus confirming our original assumption that our respondents would view climate change holistically.

Definition of climate change and its causes

How do New Caledonians define a phenomenon as complex as climate change and how do they identify its causes? The participants in this research were asked to answer the questions: "What is climate change for you?" and, "What are the causes of climate change?" After analysis of the responses by independent judges, we could identify a large number

of themes around which the representation of this phenomenon is built. The same participant could follow several themes. The more relevant topics are shown in Fig. 2, along with the relative frequency of their mention in the interviews.

The definitions provided by the interviews integrate five components of the changing climate system: atmospheric phenomena (e.g., radical warming, natural warming, wind patterns, cyclones, tornadoes); surface water regimes (e.g. flooding, water table levels, watersheds, lakes, ocean levels); cryosphere (i.e., melting ice from glaciers and polar ice caps); lithosphere (terrestrial impacts, most notably on islands); and biosphere (phenology, productivity and diversity of living species and systems, e.g. fruiting of trees; marine ecosystems). Under the influence of solar radiation, these components collectively both determine and influence the Earth's climate. The definition of climate also integrates the presence of non-desirable elements, such as pollution and more specifically, greenhouse gas emissions. These negative elements fall within the global concept of "pollution of the planet". The theme "the end of the world" refers to the possible consequences of an already observed disorder.

New Caledonians do not question the presence of current global change (only four participants portray climate change as a natural process). Apart from holistic thinking, this vision may also be influenced by the fact that the islands of New Caledonia are exposed to increasingly higher water levels.

Our data suggests, therefore, that the New Caledonian aboriginal peoples subscribe to a systemic representation of climate change. The data from this study demonstrates a holistic representation of climate change that includes the parameter of life forms (human beings, fauna and flora). On the contrary, Parisians, as presented in our previous article ³, tend to have an analytical, less holistic, less integrated representation of global warming, focused on physical changes in weather (temperature, precipitation, extreme weather conditions). These results are consistent with other studies, suggesting that people with an analytic representation of climate change focus mainly on temperature increases ¹⁶.

Given that participants in both studies followed the same general type of education and have attended formal school at least up to age 18, the difference can be attributed to the variation in culturally transmitted systems of thought and worldviews. This also indicates that the traditional worldview of the aboriginal peoples of New Caledonia allows the representation of climate as a phenomenon characterized by assessing a long term average, while Parisians identify climate change with variations in weather over a short period (weather forecasting).

We were also interested in how native New Caledonians deliberate about the causes of climate change albeit that many of the participants already

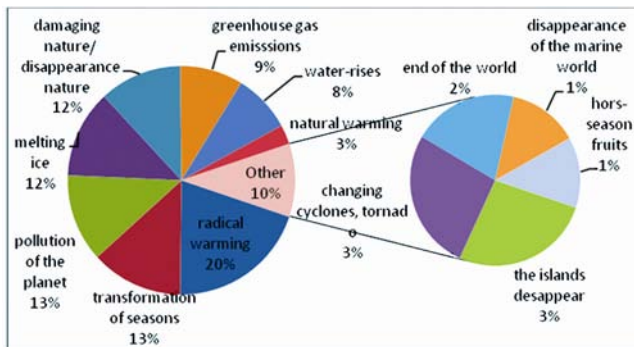


Fig. 2—Main themes regarding the representation of climate change, as drawn from interviews with Indigenous New Caledonians

discussed the causes in their definitions. The themes identified as causes are presented in Fig. 3.

Recent studies on the representation of pollution in metropolitan France (more precisely, in Paris), have demonstrated that research participants consider that individual humans are not directly responsible for pollution, but they are rather considered as victims of industrial activity, traffic, and nuclear power plants and so on ^{17,18,19}. Attributing human responsibility in relation to climate problems is completely different from the representation of the New Caledonian Indigenous people. As we expected, traditional holistic thinking can identify relationships among causal factors of environmental problems. Recent climate change is considered by the New Caledonians interview to a result of error of humans and modern civilization, and at the same time as the fault of the technology created and used by them.

We can group the main causes of climate change as cited by the participants in this study into three categories: 1. Causes directly related to humankind; the participants clearly expressed the responsibility of human beings (climate change "...is because of mankind", "...is because of us"); 2. Causes indirectly related to humankind; the participant did not explicitly identify humans as responsible (e.g. in pollution, deforestation); and 3. Causes are entirely natural (i.e., part of a naturally occurring cycle). However proportionally humans were seen the principal cause of the recent situation (47 % identified human beings as the causal agent), attributing evolution and the need for human comfort as causes, and citing a problem of lack of conscience and lack of reflection by humans.

The representation by New Caledonians of humans as the protagonists in the "destruction" of the climatic

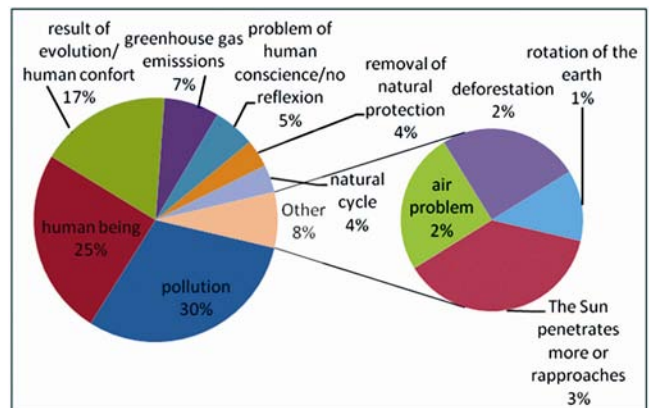


Fig. 3—Themes of the causes of climate changes as drawn from interviews of indigenous new Caledonians

order also reflects their perceptions of humans as a part of nature, rather than as ranking higher than nature. Even if the idea was rarely stated explicitly, our data suggest that the underlying idea is that nature will eventually take back what belongs to it. As an old man on the small island of Ouvea told us: "The sea will take back what belongs to it". This idea is not shared at all by the Parisians' way of thinking, where strong anthropocentrism suggests that humans can repair the faults of their "machinery" by creating "more suitable machines" ³. The thinking behind our data suggests that New Caledonians are far more realistic than their Parisian counterparts, and thus hold a more realistic representation of the climate change process and its causes. We believe that apart from specific traditional knowledge that our participants would have acquired through their families and their direct experiences with "nature", the holistic way of thinking captures the causal continuity between the constituents of the world.

Current manifestations of climate change and predictions for the future

Fig. 4 presents the signs of climate change, locally and globally, as perceived by New Caledonians. The results are consistent with the elements already discussed above: the signs of climate change reflect a global vision of the problem. However, the most common manifestation - that of the ocean level rises – reveals the sad reality of these islands. Climate change is regarded as completely negative; it is already present, and it alters or destroys livelihoods. In this regard, people are far from the optimistic viewpoint in other parts of the world, in which some see potential positive effects of climate change.

How do New Caledonians imagine future changes while even the scientists face the problem of

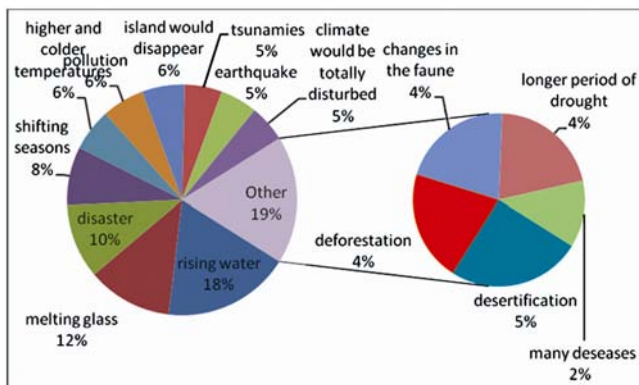


Fig. 4—Current manifestations of climate change as identified by Indigenous New Caledonians

uncertainty given that climate is such a chaotic phenomenon? Here we investigate whether the holistic thinking of New Caledonians as reflected in our data presented will allow us to influence modeling in temporal dimensions (over 5-10 yrs, 20-30 yrs and in 100 yrs) (Figs. 5-7).

Fig. 5 presents some of the more important occurrences predicted as manifestations of climate change at local and global levels by study participants. We can observe significant modifications

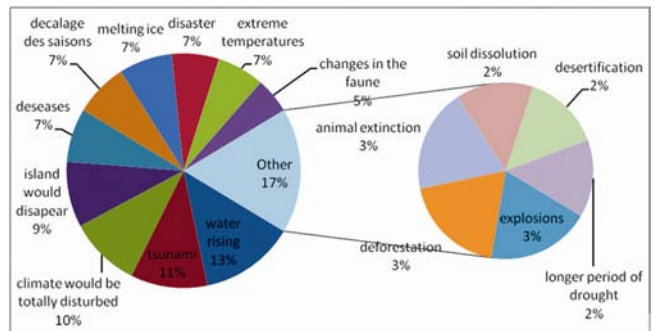


Fig. 5—Manifestation of climate change in 5/10 years as drawn from interviews of indigenous new Caledonians

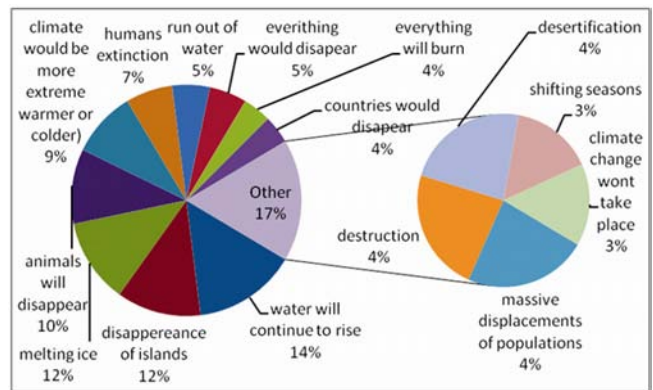


Fig. 6—Prediction of climate change in 20/30 years as drawn from interviews of indigenous new Caledonians

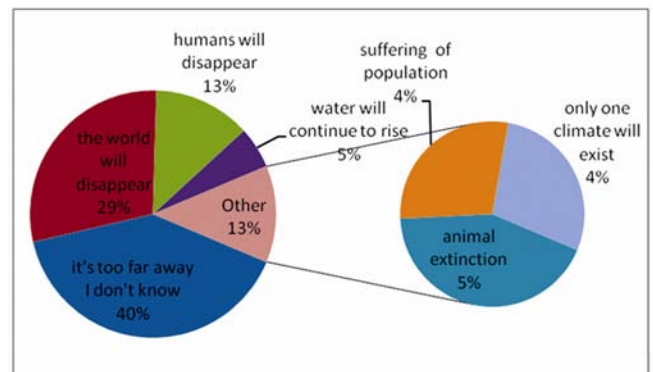


Fig. 7—Prediction of climate change in 100 years as drawn from interviews of indigenous new Caledonians

projected, compared with the current situation. Expected changes concerning this time period are already a reality of the New Caledonian and Melanesian world. Tsunamis are a constant concern, and disappearance of the islands represents a higher possibility, with rising waters will directly affecting the people. Despite this, rising temperatures and melting ice will continue at a global level. People's holistic vision is still present but tends to manifest itself in the local situation. Diseases and changes in fauna and flora will continue to escalate, and some animals may disappear. The climatic situation is seen as a disaster.

It's an even more difficult task to predict changes in climate by 20/30 yrs' time. Climate is mostly defined as the weather averaged over a period of 30 yrs (e.g. Dictionary of the French Academy). The ability to predict changes 30 yrs hence presupposes the understanding of the concept of climate and requires manipulation of the concept of "average". We considered that holistic thinking by perceiving relationships may allow a transposition of interacting elements projected into a new time period.

The same previously mentioned processes are involved in predicting changes over 20/30 yrs: rising waters, disappearing islands, melting ice, and also temperature change. The modification of seasons is very little mentioned, reflecting the vision of the radicalization of climatic events. The interview data show a more global view of climatic changes compared with views of the 5/10 yrs time frame. Interviewees suggested that apart from the disappearance of islands, continental countries may also disappear. Predictions of the consequences of global warming also concerned: disappearance of animals, massive displacements of human populations, and even the disappearance of "everything". Only 2% of the items mentioned reflected an optimistic view of the future. Indeed, data present a transposition of the above-mentioned models under worsening conditions. Causes of climate change, such as pollution and deforestation, would disappear as the industrial world itself disappeared. Holistic thinking links the disappearance of animals and humans, probably assuming the previous and concurrent disappearance of plants, which are indispensable for their survival. These predictions are generally very pessimistic.

Finally, we present an analysis based on responses provided on expected changes within a 100-yr time frame. Projecting changes over a 100-yr period is

undoubtedly very difficult; however the issue of current projections over this lapse of time is frequently raised. We were likewise interested in seeing if New Caledonians might imagine an improvement in the climatic situation in 100 yrs, as holistic thinking can recognize contradictions. We have, however, assumed a continuation of the more recent situation into the future, given the negative view of pollution activity in human beings. This may give rise to very pessimistic views, suggesting that natural forces will eventually destroy the human world.

As we expected, prediction of climate change in 100 yrs was a very difficult task; 40% of our participants said they could not predict changes on such a long-term basis. Those participants who made the attempt increased their pessimistic views of the world. We could not identify any optimistic previsions as we had expected in their responses. The data present an apocalyptic picture of the future in which water levels have continued to rise, but a slow rate; ice melting was not actually mentioned. People projected extinction of life on earth, or, in the best-case scenario, a future population subjected to more suffering, within a desolate world with one dominant climate. Without adopting hasty interpretations, it seems to us that the projection of a uniform global climate symbolizes the disappearance of the diversity of life in the world. From a holistic vantage point, the global destruction of a single force could be formed. Obviously, there is no possible way to judge the legitimacy of this view, which is the opposite of that of Parisian adults who were confident that global warming is a natural phenomenon and humans can continue to produce, over-consume and pollute without remorse. We do consider that the New Caledonians' vision and attitude could ultimately encourage behavioral change which could, in turn, reverse the current trend of escalating climate change. The verification and comparison of environmental attitudes will constitute another step in our research.

Conclusion

The present study takes part of researches proposing to identify indigenous knowledge on

climate change. Our results are consistent with other studies which point out the importance of indigenous knowledge, and make it evidence that climate changes are more subtle than the augmentation of global temperature^{19,20,21}.

The aim of the present article was to present the perspectives of climate change and prediction of future situation of indigenous population of an overseas country of France, namely New Caledonia, in the islands of Micronesia. We did not seek specific traditional knowledge among respondents but rather were looking for general approaches to, and perceptions of, climate change. The vision of climate change of these indigenous people highlights the persistence of holistic thinking, despite a “western” educational background in the French system, largely based on the analytic thinking. Their worldview, transmitted from generation to generation captures the interactions between the different components of the climatic system. This finding is tuned with the results reported by other authors^{22, 23, 24, 25}.

A very pessimistic picture regarding climate change has arisen from our interviews. This view may well be related to the geographic and climatic vulnerability of the islands making up New Caledonia. Holistic thinking and environmental characteristics could all contribute to forming a vision of future harm from climate change. We can likewise observe the influence of education and media on the representations of climate change, however integrated in a traditional holistic way of thinking. Results show that holistic thought allows indigenous New Caledonians to identify the interaction between the multiple constituents of climate change and can permit the prediction of future situations in term of the interaction between these elements. Findings suggest that the aborigines of New Caledonia consider that only a global and radical effort can prevent fatal consequences of climate change. Further research can focus on the way how native New Caledonians can plan problem solving strategies to prevent or mitigate risks of climate change.

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