Envisioning NLP for Intercultural Climate Communication

Steven Bird, Angelina Aquino, and Ian Mongunu Gumbula
Northern Institute, Charles Darwin University
Darwin, Australia

Abstract

Climate communication is often seen by the NLP community as an opportunity for machine translation, applied to ever smaller languages. However, over 90% the world's linguistic diversity comes from languages with 'primary orality' and mostly spoken in non-Western oral societies. A case in point is the Aboriginal communities of Northern Australia, where we have been conducting workshops on climate communication, revealing shortcomings in existing communication practices along with new opportunities for improving intercultural communication. We present a case study of climate communication in an oral society, including the voices of many local people, and draw several lessons for the research program of NLP in the climate space.

1 Introduction

Central to climate action is communication – not only among climate scientists, industry leaders, and heads of state – but across all peoples and levels of society, for understanding, collaboration, and behavioural change. A common assumption is that climate communication consists of broadcast of information from 'experts' to 'laypeople', on the belief that "the public are 'empty vessels' waiting to be filled with useful information on which they will then rationally act", ie. the so-called *information deficit model* (Ockwell et al., 2009, p321). However, effective climate communication calls for engagements that connect with people's values, identities, and motivations, through culturally-appropriate language and modes of discourse (Nerlich et al., 2009).

How do we meet this challenge using language technologies? In particular, how can language techologies support actors from diverse cultures and standpoints to develop mutual understanding and respect for each other's knowledge practices, and to work together in devising effective and sustainable solutions? This is intercultural work in that it exceeds the definition of communication as a mere conduit for the transfer of information from expert to layperson, and of machine translation as mere substitution and rearrangement of word sequences to surmount language barriers (cf. Bird, 2024).

We, all researchers based at Charles Darwin University (CDU), are engaging with remote Aboriginal communities in the far north of Australia. In the course of this early work, we have observed how intercultural communication problems go beyond what can be addressed by *machine translation inside the information conduit* (see Fig. 1). The differences can be traced to linguistic and cultural differences which are not well handled in NLP, as others have also noted (Liu et al., 2021; Hershcovich et al., 2022).

We present viewpoints coming from local communities that point to an alternative approach that involves co-creating meaning amongst participants, leading to new possibilities for language technologies.

This paper is organised as follows. In Section 2 we discuss climate communication as an opportunity for NLP, focussing on oral languages outside the 500 institutional languages. In Section 3 we examine the social geography of Arnhem Land, Aboriginal country in Australia's Top End, including the various institutional and Indigenous stakeholders, and including our own positionality as authors. In Section 4 we report on our field-based research including two workshops on climate communication which brought together these stakeholders in order to document local matters of concern and explore new avenues for more effective intercultural communication. In Section 5 we reflect on the findings and draw out lessons for NLP which are guiding our ongoing field-based research. Finally, Section 6 presents conclusions and future prospects.

2 Climate Communication as an Opportunity for Multilingual NLP

Thanks to climate change, and to the increasing frequency and severity of weather events, climate communication is an important opportunity for NLP. Here, as in relief and military operations (e.g. the DARPA TIDES and GALE programs; Liberman and Wayne 2020), international responders typically depend on English or another major language, and need translation in order to broadcast instructions, or to access actionable information and deliver tailored messages.

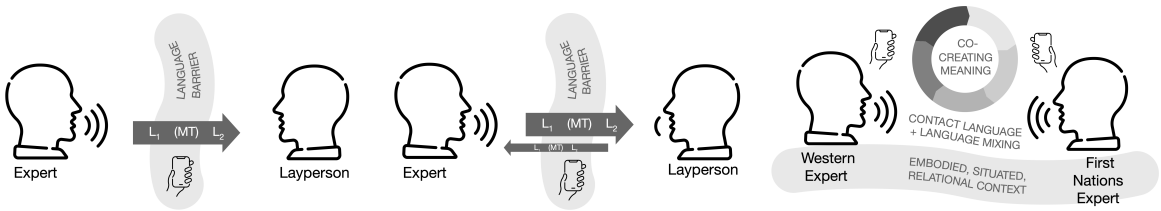
We assume that there is a central authority which transmits knowledge, policies, and instructions within a multilingual jurisdiction. The purpose is to inform local communities concerning disaster risk reduction and disaster response. Communities may need to access help, which prototypically involves an information need satisfied by a response, drawing on access to a knowledge base, and mediated by machine translation (e.g. Lewis, 2010; Lewis et al., 2011). The central authority may analyse social media in order to sense what is going on, and to direct a response to the best place (e.g. Anastasopoulos et al., 2020). This is an obvious approach for NLP in the case of so-called 'standardised languages' or 'institutional languages' (Bird, 2022; Bird and Yibarbuk, 2024), where every language has a standard orthography and long-term institutional support for developing language resources, including systems for text analysis and translation.

However, this position does not consider the matter of cultural diversity. What is the potential of NLP for *intercultural* climate communication?

A key challenge is the difference in the common ground, most apparent in the differences in which concepts are lexicalised (cf. Hershcovich et al., 2022). For example, in traditional Indigenous societies in Australia, people do not think of weather events in the quantitative way that is favoured by meteorologists, such as: "20% risk of a category 4 cyclone"; "90% chance of at least 100mm precipitation". Many English terms have no counterpart in local languages, e.g.: catchment, prediction, threat, safety, data, vulnerable, impact, and so on. When the lifeworlds are so different, well-translated messages can fail to communicate, and fail to prompt the desired response. Such failures can be hard to address from inside the communication model in which they arise (Figs. 1(a), 1(b)), surfacing as deficits on the receiving end, to be fixed with yet more of the same kinds of communication.

We believe that the transaction model in Figure 1(c) suggests a promising way forward for climate communication and for NLP in the intercultural space more generally, building on the belief that effective communication is "grounded in dialogue and contextual understanding" (Nerlich et al., 2009, p100). And so we ask: how do we envision language technologies for supporting intercultural climate communication? Here we focus particularly on the question of communication about disaster preparedness and response for remote First Nations communities in the far north of Australia. However, we view this as a stepping stone towards the pressing question of intercultural climate change communication.

This is no longer a question of mere information broadcast or question answering. It concerns co-construction of meaning in the climate space spanning: housing consultations; communication strategy; policy development; local capacity building; and so on. We see this as an opportunity for a new kind of agency-enhancing approach which has been called *Third Wave NLP* (Bird, 2024), where we shift from mediating communication to enlarging human communicative competence (Fig. 1).



(a) Transmission Model (b) Interaction Model (c) Transaction Model

Figure 1: Models of Communication, and three ways to understand the opportunities for language technologies: (a) broadcasting messages from experts, where machine translation (MT) is built in to the information conduit; (b) similar to (a) but with layperson input, posing questions, or revealing comprehension or compliance; and (c) collaboration between institutional and local experts (following Lapum et al. 2020; Bird 2024).

3 Climate Communication in Arnhem Land

First Nations people have inhabited Arnhem Land for at least 65,000 years (Clarkson et al., 2017), developing practices that have enabled them to live sustainably and mitigate the risks borne by the severe weather phenomena that are endemic to the region, including monsoon cyclones, floods, and dry season wildfires (Russell-Smith et al., 2022). Weather knowledge has been codified in seasonal practices which rely on reading environmental indicators including animal behaviour, plant growth, and atmospheric characteristics. This enables people to anticipate severe weather, and to manage the country, e.g. with controlled burning (Narndal et al., 2015; Ansell et al., 2019).

The changing hazards differentially impact Indigenous people who comprise the majority of the population in many remote areas (Russell-Smith et al., 2022). Furthermore, the climate risks are amplified thanks to the adoption of more westernised housing and lifestyles which are unsuited to the local climate and ecology, and to the decline in local knowledge transmission and practice among younger generations.

Several Australian government agencies are responsible for climate and emergency communication in the Northern Territory (NT): the Bureau of Meteorology (BOM) disseminates weather forecasts and warnings through news broadcasts and digital media; the NT Police, Fire, and Emergency Services (PFES) issue and implement emergency plans, hold awareness-raising activites, and train volunteer responders; and the NT Aboriginal Interpreter Service (AIS) provides capacity to translate messaging into many of the widely-spoken Aboriginal languages in the region.

These agencies operate under western models of governance and communication, broadcasting climate messages to remote communities. Community leaders have repeatedly called for government agencies to shift from one-way outsider delivery to local participation and two-way learning:

> The Government should not be taking more responsibility. We know our people and we know our land. We blackfellas mob should make our own plan for our people. Family still strong and we would look out for our people.
>
> Emergency planning needs to have decisions by clan leaders front and centre when they are putting plan together; they should plan for whole country.

There is a tendency to assume that communication issues can be solved by translation into a greater number of languages. For example, PFES is translating educational materials and advisories into 18 of the most spoken Aboriginal languages (Bellenger, 2019), even though most First Nations speech communities have a linguistic repertoire that includes Aboriginal English (Butcher, 2008). Moreover, communications between western institutions and First Nations communities are often hindered by more fundamental differences in cultures and knowledge systems, which can only be addressed through extended efforts to develop and strengthen collaborative practices (Armstrong et al., 2023).

3.1 Positionality

The authors represent diverse cultural backgrounds and fields of expertise. Steven Bird is a non-Indigenous Australian of British and German descent, and has worked in minoritised linguistic communities in Africa, Melanesia, Amazonia, and Australia. His principal focus concerns the design of programs for keeping Indigenous languages strong, working in collaboration with remote Indigenous language centres, schools, and ranger programs.

Angelina Aquino is a non-Indigenous doctoral student from the Philippines with Tagalog, Bicolano, and Pangasinense heritage. She was a lecturer in electronics and communications engineering, and much of her research relates to NLP for local and Indigenous languages.

Ian Mongunu Gumbula is a Yolŋu researcher and elder from the Daygurrgurr Gupapuyŋu clan in Galiwin'ku (Elcho Island), Australia. He has worked extensively in education and community engagement over a long career, and has served as a cultural advisor, mediator, and consultant for private and government sectors in northern Australia. Ian has lived in the Northern Territory his whole life, and has extensive personal experience of severe weather events, beginning with Cyclone Tracy in December 1974.

We have conducted this work in partnership with the BOM Community Services Group, who bring years of experience of engagement with Indigenous communities in the space of weather and climate, including on-the-ground activities in remote communities.

As this is Indigenous research, we have operated under Indigenous governance and to met the requirements of the national code (AIATSIS, 2022).

4 Climate Consultations

In this section we report findings from our engagement with Indigenous community leaders. We have adopted decolonising practices (Smith, 2012; Land, 2015; Bird, 2020), and have structured our work around the values of (1) Indigenous self-determination, (2) Indigenous leadership, (3) Impact and value, and (4) Sustainability and accountability, and a commitment to "repositioning Indigenous peoples from subjects of research to partners in research" (AIATSIS, 2022, p4).

This work is an example of 'both-ways' learning involving 'Yolŋu' and 'Balanda'. Yolŋu denotes the original people of North-East Arnhem Land, and also Indigenous Australians more broadly. Balanda denotes white people (a word derived from 'Hollander'), a label which we extend to refer to non-Indigenous people in general (including Aquino), when they are enacting western knowledge practices. Both terms also denote the corresponding lifeworlds of these groups.

We convened a three-day workshop in Darwin, entitled *First Nations Climate Communication* (May 2023), and six months later, a two-day workshop in Ngukurr, entitled *Ngukurr Climate Consultation* (November 2023), as reported by Aquino et al. (2024). Here we summarise the workshops and report findings which we believe are relevant to NLP.

4.1 Darwin workshop

The workshop brought together 30 people from six remote communities across the top end of Australia into Darwin, along with representatives of BOM, PFES, AIS, and CDU. The first day was reserved for the 20 First Nations participants, to articulate the desired outcomes in community terms, to share stories of personal experiences with severe weather events, and to refine a set of discussion prompts for the following day.

The second and third days involved the addition of 10 western participants, all with extensive experience of institutional responses to severe weather events and part of institutional planning for the impacts of global warming. We opened by playing a string game, where each person introduced themselves and their intentions for the workshop before throwing the string to someone they are connected to (Fig. 2). Later, small groups selected from the discussion prompts, discussed their responses, and reported back. The workshop concluded with individuals from institutions and from communities articulating their personal commitments to taking further action.

Throughout the program, the Indigenous leaders stressed their connection to the land and their knowledge about how to stay safe through reading the weather (in the smell of the air, the behaviour of animals, the seasonal predictors), and the local social structures which are responsible for disseminating critical information. The institutional leaders shared about their policies and procedures for keeping people safe through pre-season training, emergency warnings via radio stations and mobile apps, and so on. This called everyone's attention to the distinct cultural assumptions about how to read the country, how to keep people safe, and how to communicate.

We describe these here, as important context to guide our thinking about the place of language technologies.

Figure 2: Opening with string game, reminding us of our interdependencies, led by Vinette Ngalmi from Ngukurr, with members of the Emergency Services, Bureau of Meteorology, Aboriginal Interpreter Service, Elders, Academics, and PhD students

Throughout the workshop, First Nations participants explained how local life centres community and country. Local decision making is the responsibility of elders who derive their authority from their ancestral connections to the land. Accordingly elders must give their approval before local knowledge is transmitted to outsiders.

Unusual weather phenomena are caused by metaphysical events, such as occurrences in the Dreaming (Stanner, 1956), or disturbances at sacred sites. This is revealed in how people talk about sensing the country:

- *We are people of the land. We are part of the land. If the land is destroyed, we feel bad.*
- *If a cyclone damages a sacred site then we see signs and we feel it.*
- *Something in the Dreaming causes an usual weather phenomenon, e.g. at the time of a cyclone there was a smokey effect in the air.*
- *Creation tells us and warns us.*

From this place of intimate connection to the land, people assert their sovereignty, self-determination, and cultural continuity:

- *We need to have primacy over our land.*
- *We need Balanda to understand that they should not disturb the sacred sites because this is creating problems and destroying the country. Mother nature looks after us but she is turning on us.*
- *The traditional owners need to have a good explanation to inform the Emergency Services when their plane will disturb sacred sites and Emergency Services need to listen and ask us if there are risks to sacred sites.*
- *We want to share about land, what the weather is doing to our country and how it changes the environment.*
- *We tell kids knowledge on country and how country has changed.*
- *We told the kids the story about a plant that was put in a pot and the roots can't grow. We want the pot broken so the roots can grow and the plant can be strong. We make time to include kids, share knowledge and culture to kids.*

Language is implicated, for each area of country has its local language, and people have capacity in many languages, both individually and via their family groups:

- *We have common language for our areas, e.g., in East Arnhem we can interpret the common languages of the islands, like Djambarrpuyngu, Mawng, Tiwi.*
- *We have different languages but we all know them.*
- *There is a ripple effect, and one person interprets to another.*
- *Your big responsibility is your own household, and your [extended] family.*

Responding to severe weather events begins with sitting together:

- *Make the right message together.*
- *Share to family, kids.*
- *Build awareness and trust.*
- *We need time to prepare. People have different needs. A police person comes and tells us we must leave. But the household needs time to prepare.*
- *Need to have shelters that don't group people together inappropriately.*
- *Balanda and Yolŋu need to work together to be strong. (cf. Fig. 2)*

It was a learning experience for the balanda professionals to sit in this space without the possibility of delivering their usual powerpoint presentations about how their system works. Nevertheless, individuals tried. One of the meteorologists began describing the operation of satellites in sensing the weather, and the improvement in climate models for predicting severe weather incidents. A minute in to her explanation, she stopped, realising that participants did not want to engage with technological accounts. During discussions of the recent flood and mass evacuation in Daguragu and Kalkrindji, one of the participants from the government explained the system of flood sensors and how they failed. However, this technological story did not meet the needs of community leaders:

"Mayor Pedwell said that one of the most frustrating parts of the Emergency Response from the Northern Territory Government was the fact local decision makers were not being listened to. 'The voices of local decision makers are not being listened to when it comes to natural disasters, and

that has to change,' Mayor Pedwell said. 'We are the people that live on Country and have first-hand knowledge of what's going on. Why aren't they listening?'"[1]

In responding to technological solutions, one participant said: "We need to teach our kids about our knowledge so they don't just rely on technology. When we don't have technology, we have knowledge for our survival, for example, when there is no service on phones." This revealed the problem of relying on technology in a place beset by frequent service outages.

One discussion turned on the nature of 'threats' and 'safety', and how there is no local vocabulary corresponding to such generic notions. However, we can talk about particular cases: moving to higher ground for safety from flooding or to shelter for safety from storms. In each case there are dangers invisible to balanda authorities, such as being transported over sacred sites which are flooded and hidden from view, or corralled in a shelter together with family members where there are avoidance relationships. The institutional agenda of "keeping people safe" hid complexities which were not apparent until local leaders were included in the conversation, only possible when communication follows the transactional model (Fig. 1(c)).

4.2 Ngukurr workshop

Six months later, in November 2023, members of CDU and BOM travelled 9 hours by road to the remote community of Ngukurr to hold a follow up workshop. We began by hearing stories about people's long experience of extreme weather and climate change. Our meeting venue was in its present high ground location because of the big flood in 1944. As in Darwin, people talked about the preeminence of nature and their ability to sense the weather:

- *Our animals gave us the sign, nature tells the story itself.*
- *Nature tells us; we've got all the birds coming in.*
- *Nature can take control of everything. Sometimes meteorology mob can't predict where it's going.*
- *There is a story about cleverman (healer) standing against storm. But he ran away when it got too strong [laughter].*

People described disconnects between policymakers in the capital Darwin and the situation on the ground here in Ngukurr:

- *Some people don't want to leave the house when the police come. Maybe they want to arrest somebody.*
- *The emergency message talked about torches, but the shop is closed. We don't just have torches with good batteries.*
- *There's a big mob of dead cars in our yards, they can be dangerous, and we need help to clean them up.*
- *The emergency services cleared some trees that were going to fall, but we have to ask the djungkayi (caretakers) to do that. Not just anyone can do that.*

In view of these disconnects, the research community's focus on an MT panacea would seem to be misplaced. This is further illustrated by a longer story, frequently recounted by workshop participants, concerning Cyclone Trevor and the call from PFES to evacuate the town, given that the capacity of the town for accommodating people during a cyclone is about 25%.

"The people of Ngukurr were preparing for Cyclone Trevor and the police were driving around and letting everyone know about the cyclone approaching quickly, and how there's going to be buses coming from the town to pick everyone up. Everyone waited at the shop area for hours, into the middle of the night. But the buses never arrived, and everyone was struggling to find shelter. Some people were panicking. Everyone was rushing. Some people took off with their private vehicles, overloaded with people. But they didn't know the cylcone had changed direction. No one told us. They were in cars that were not roadworthy, and they could have been going into the path of the cyclone, and without any network connection. It was really dangerous for them. Afterwards when everyone came back, no one came and talked to us about what happened, or how to be organised next time. We never had an evacuation before" (Ngukurr workshop participants, November 2023).

[1] *Emergency declared in Daguragu and Kalkrindji*, 1 March 2023, https://www.victoriadaly.nt.gov.au/emergency-declared-in-daguragu-and-kalkrindji/ retrieved 16 May 2024.

5 Opportunities for NLP

How can we envision NLP for *intercultural* climate communication? The typical NLP framing of climate communication is on a deficit model, expertise exists in the western world and needs to be communicated outwards.

Unfortunately, the key domain concepts have no lexicalisation in the target language and are passed through untranslated (Fig. 3(a)). For example, the concept of 'wet catchment' comes from catchment hydrology, and depends on an understanding of the capacity of land to absorb water before further rainfall runs off into tributaries that continue downstream and impact human settlements. This is a geophysical understanding of country which is not readily conveyed into local cultures through translation of warning messages.

An interesting alternative is to use a language model to translate the scientific English source text into a plain English target then rely on local human capacity for bicultural work to express the message in local languages (Fig. 3(b)).

In the Australian context, such translations are problematic because they cross the line between the role of BOM in forecasting the weather, and the role of PFES in directing the emergency response. A further problem lies in the assumption that simplification is a universal task, when it needs to be undertaken relative to the knowledge practices of a different culture. Nevertheless, this suggests a flipping of the deficit story, from the difficulty of communities in understanding scientific English, to the difficulty of government officials in producing plain English. Here is an opportunity for language technology (see Fig. 4).

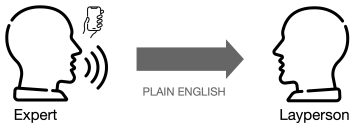
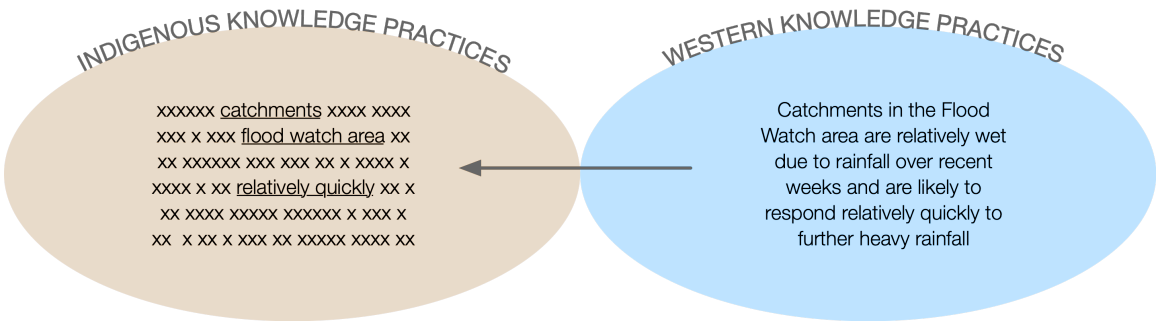


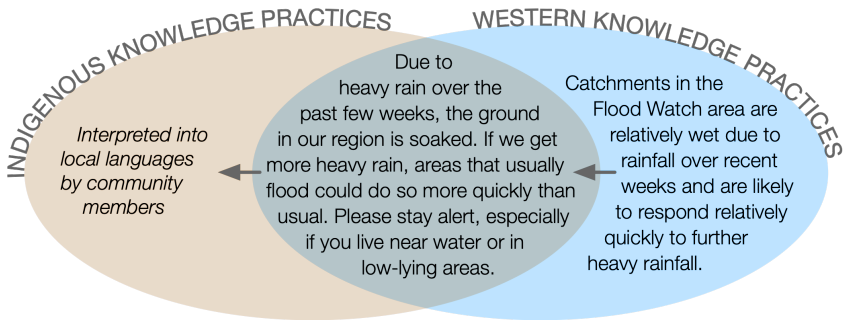
Figure 4: Assistive technology to help the 'expert' communicate in a variety of plain English tailored to the local audience

Another response to the translation difficulties is suggested by the transactional model of communication (Fig. 1(c)). How can language technologies support the practice of 'working together' in the intercultural space, in which both western and Indigenous knowledge practices are enacted?

We propose a task of designing for communication across a culture area – such as Indigenous northern Australia – centering on the understanding of key concepts in multiple languages (Fig. 5, Bird 2022). The goal is to collaboratively expand the space of shared concepts, by enumerating the concepts on both sides in a WordNet-like struc-



(a) Machine-centric solution: MT into local language



(b) Human-centric solution: MT into plain English

Figure 3: Two Designs for Translation in Climate Communication, Machine- vs Human-Centric

ture including a central hierarchy and cross-links (Fellbaum, 1998). The difference is that each concept node has a label in a western language or in one of the languages of the culture area, and it is associated with multiple audio or video exegeses providing 'thick translation' of each concept (cf. Evans and Sasse, 2007).

This semantic network would not depend on the artifice of hard boundaries between local languages, and could leverage the high degree of receptive multilingualism. If a concept like "wet catchment" is explained in one Yolŋu language, the community will be able to successively interpret it into others.

A further shift concerns the local valuing of relationships, set against the institutional valuing of scalable, technological solutions. This is most clear in the comments like: "Build awareness and trust" and "Make the right message together." This continues the pattern reported during the COVID-19 response, when instructions to self-isolate were dispatched to communities with an average house occupancy of 17 and no food delivery services (Wanambi et al., 2021). Crafting the right local response to existential threats calls for awareness, trust, and collaboration, and understanding "Climate Change as a series of complex and constantly evolving cultural discourses" (Hulme, cited in Nerlich et al., 2009, p98). These are areas where NLP may yet be able to contribute.

6 Conclusion and Future Prospects

Communication is central to climate action, and faces particular challenges in oral cultures due to the lack of common ground (e.g. how climate is conceptualised) and the reduced overlap of lexicalised concepts (e.g. how climate terminology does not translate).

A popular approach in NLP is to respond to linguistically diversity with mechanical translation to "conquer language barriers". Multilingual models give the spectre of scalability, but only because the effectiveness of their outputs is unexamined. We doubt that having more bilingual training data will solve this issue, because of the lack of common ground and common lexicalised concepts. Initiatives to collect more climate-specific text on the side of institutional languages do not address the reality of cultural diversity (e.g. Webersinke et al., 2021).

Instead, we have focussed on the challenge of building human capacity for working together effectively in intercultural spaces. We have proposed concrete solutions for moving forward by building a multimodal semantic network of domain terminology. This is a rich resource which can support intercultural work which respects the participation and agency of local knowledge experts and their long experience of living on the land and reading the weather.

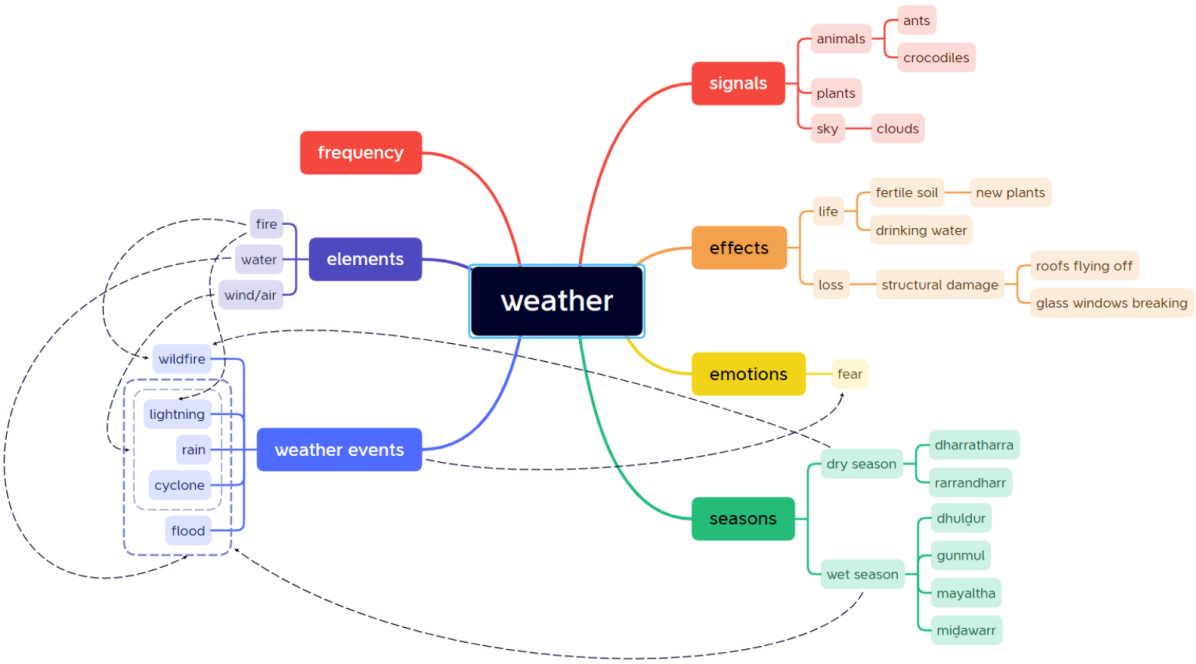


Figure 5: Prototype Weather Concept Map: concepts are anchors for audio and video exegesis into other languages

Acknowledgements

We respectfully acknowledge the First Nations of Australia and their unceded lands where we live and where this work has taken place. We are indebted to the workshop participants for contributing their time and expertise, leading to the insights that we have shared here. This work was supported by Charles Darwin University under its Rainmaker seed funding program, by Australian Research Council grant *Learning English and Aboriginal Languages for Work*, and by the Department of Science and Technology, Philippines, under its Foreign Graduate Scholarship program.

This research has been approved by traditional owners in the communities where it was conducted, the board of Yugul Mangi Development Aboriginal Corporation, the Northern Land Council, and the CDU Human Research Ethics Committee.

Ethical Considerations

The community involvement occured during two workshops held in May and November 2023.

The first workshop was held from 16-18 May, 2023 at the CDU Library in Darwin. The participants in this workshop included: 12 Aboriginal leaders representing 6 NT remote communities; 4 representatives from BOM; 4 interpreters from AIS; 5 representatives from PFES; and 5 researchers from CDU (including the authors). Planning and recruitment for this workshop were conducted over the two months prior to the workshop, under the leadership and guidance of Gumbula.

As part of our efforts to shift the focus of our engagement towards Aboriginal viewpoints, we aimed for a 2:1 ratio of Aboriginal to non-Aboriginal participants, resulting in a total of 21 Aboriginal and 9 western participants, including facilitators. Participants were identified on the basis of existing relationships, prior consultations, and referral by existing community and government collaborators. We informed participants of the workshop objectives and expectations through phone calls, virtual meetings, and in-person meetings. We obtained participants' consent to participation and data collection prior to the workshop through the provision of information sheets and signing of informed consent forms.

Prior to the workshop, we asked participants about their motivations for attending, information they wished to share, and any concerns about the nature and ethics of the engagement. Community participants including our Aboriginal co-author wanted to ensure that non-Aboriginal participants would listen deeply to Aboriginal perspectives on weather and emergencies, and were concerned about potential cultural risks if government materials were presented to community members using typical western methods (e.g. slideshow presentations and formal documents) which are not conducive to Aboriginal communication and understanding.

After the workshop, we gathered oral feedback from participants. We found that all participants were very satisfied with the organisation and outcomes of the workshop, and were keen to come back for similar engagements in the future. We take this as indication that the ethical concerns raised prior to the workshop were resolved through the workshop structure as well as open communication with participants throughout the process.

The second workshop was held from 14-15 November, 2023 at the Guluman Child and Family Centre in Ngukurr. The participants included: 8 traditional owners and community leaders of Ngukurr; 3 representatives from BOM; and 4 researchers from CDU. This workshop was jointly organised by CDU and BOM representatives. Similar protocols for participant recruitment and informed consent were followed here as in the first workshop. The 2:1 Aboriginal to non-Aboriginal ratio was also maintained (ie. 10 Aboriginal people and 5 non-Aboriginal people).

During this workshop, no ethical concerns were raised by participants (of whom two each from Ngukurr and BOM also participated in the previous Darwin workshop). We put this down to the positive outcomes and trust established in the first workshop.

The feedback gathered from this second workshop was similarly positive, and Ngukurr participants expressed their willingness to continue working with visiting CDU and BOM representatives in the future in connection with this project.

We disseminated all data back to workshop participants at the end of each workshop, as well as video and paper summaries of the workshop program and outcomes. All participants consented to this data being shared publicly for research use with proper accreditation, and no participants withdrew the use of their data at any point.

Overall, we have followed a decolonising practice in which we do not pretend to conduct impersonal research at arms length from cultures and relationships. There is no doubt that different individuals, with their own motivations and goals, would have come up with different responses to the situations discussed here. Thus, we do not present this work as an objective academic exercise where the researcher is hidden from view, and where Indigenous subjects are held up for examination by western eyes (Smith, 2012). Accordingly, we have revealed our motivations and goals (cf. Berry and Patti, 2015, p267).

References

AIATSIS. 2022. *AIATSIS Code of Ethics for Aboriginal and Torres Strait Islander Research*. Australian Institute of Aboriginal and Torres Strait Islander Studies.

Antonios Anastasopoulos, Alessandro Cattelan, Zi-Yi Dou, Marcello Federico, Christian Federmann, Dmitriy Genzel, Franscisco Guzmán, Junjie Hu, Macduff Hughes, Philipp Koehn, Rosie Lazar, Will Lewis, Graham Neubig, Mengmeng Niu, Alp Öktem, Eric Paquin, Grace Tang, and Sylwia Tur. 2020. TICO-19: the translation initiative for COVID-19. In *Proceedings of the 1st Workshop on NLP for COVID-19*. ACL.

Jennifer Ansell, Jay Evans, Adjumarllarl Rangers, Arafura Swamp Rangers, Djelk Rangers, Jawoyn Rangers, Mimal Rangers, Numbulwar Numburindi Rangers, Warddeken Rangers, Yirralka Rangers, and Yugul Mangi Rangers. 2019. Contemporary Aboriginal savanna burning projects in Arnhem Land: a regional description and analysis of the fire management aspirations of Traditional Owners. *International Journal of Wildland Fire*, 29:371–385.

Angelina Aquino, Ian Mongunu Gumbula, Nicola Bidwell, and Steven Bird. 2024. What's the weather story? both-ways learning in Indigenous-led climate communication workshops in northern Australia. In *Participatory Design Conference*. ACM.

Emily Armstrong, Ḻäwurrpa Maypilama, Yuŋgirrŋa Bukulatjpi, Dorothy Gapany, Lyn Fasoli, Sarah Ireland, Rachel Dikul Baker, Sally Hewat, and Anne Lowell. 2023. Nhaltjan dhu ḻarrum ga dharaŋan dhuḏi-dhäwuw ŋunhi limurr dhu gumurrbunanhamirr ga waŋanhamirr, yolŋu ga balanda: how we come together to explore and understand the deeper story of intercultural communication in a yolŋu (first nations australian) community. *AlterNative: An International Journal of Indigenous Peoples*, 19:334–344.

Gemma Bellenger. 2019. Building community resilience in the NT - when language is the barrier. In *Proceedings of the AFAC19 Conference*. Australian Institute for Disaster Resilience.

Keith Berry and Chris J Patti. 2015. Lost in narration: Applying autoethnography. *Journal of Applied Communication Research*, 43:263–268.

Steven Bird. 2020. Sparse transcription. *Computational Linguistics*, 46:713–744.

Steven Bird. 2022. Local languages, third spaces, and other high-resource scenarios. In *Proceedings of the 60th Annual Meeting of the Association for Computational Linguistics*, pages 7817—-7829.

Steven Bird. 2024. Must NLP be extractive? In *Proceedings of the 62nd Annual Meeting of the Association for Computational Linguistics*.

Steven Bird and Dean Yibarbuk. 2024. Centering the speech community. In *Proceedings of the 18th Conference of the European Association for Computational Linguistics*, pages 826–839.

Andrew Butcher. 2008. Linguistic aspects of Australian Aboriginal English. *Clinical Linguistics and Phonetics*, 22:625–642.

Chris Clarkson, Zenobia Jacobs, Ben Marwick, Richard Fullagar, Lynley Wallis, Mike Smith, Richard Roberts, Elspeth Hayes, Kelsey Lowe, and Xavier Carah. 2017. Human occupation of northern Australia by 65,000 years ago. *Nature*, 547(7663):306–10.

Nicholas Evans and Hans-Jürgen Sasse. 2007. Searching for meaning in the Library of Babel: field semantics and problems of digital archiving. *Language Documentation and Description*, 4:58–99.

Christiane Fellbaum, editor. 1998. *WordNet: An Electronic Lexical Database*. MIT Press. http://www.cogsci.princeton.edu/~wn/.

Daniel Hershcovich, Stella Frank, Heather Lent, Miryam de Lhoneux, Mostafa Abdou, Stephanie Brandl, Emanuele Bugliarello, Laura Cabello Piqueras, Ilias Chalkidis, Ruixiang Cui, Constanza Fierro, Katerina Margatina, Phillip Rust, and Anders Søgaard. 2022. Challenges and strategies in cross-cultural NLP. In *Proceedings of the 60th Annual Meeting of the Association for Computational Linguistics*, pages 6997–7013.

Clare Land. 2015. *Decolonizing Solidarity: Dilemmas and Directions for Supporters of Indigenous Struggles*. Zed Books.

Jennifer Lapum, Oona St-Amant, Michelle Hughes, and Joy Garmaise-Yee, editors. 2020. *Introduction to Communication in Nursing*. Pressbooks, Toronto, Canada.

William Lewis. 2010. Haitian Creole: How to build and ship an MT engine from scratch in 4 days, 17 hours, & 30 minutes. In *Proceedings of the 14th Annual Conference of the European Association for Machine Translation*.

William Lewis, Robert Munro, and Stephan Vogel. 2011. Crisis MT: Developing a cookbook for MT in crisis situations. In *Proceedings of the Sixth Workshop on Statistical Machine Translation*, pages 501–511.

Mark Liberman and Charles Wayne. 2020. Human language technology. *AI Magazine*, 41(2):22–35.

Fangyu Liu, Emanuele Bugliarello, Edoardo Maria Ponti, Siva Reddy, Nigel Collier, and Desmond Elliott. 2021. Visually grounded reasoning across languages and cultures. In *Proceedings of the 2021 Conference on Empirical Methods in Natural Language Processing*, pages 10467–10485. Association for Computational Linguistics.

Julie Narndal, Donna Nadjamerrek, Connie Nayinggul, Lois Nadjamerrek, Mary Nadjamerrek, June Nadjamerrek, Doreen Nabulwad, Molly Nayilibidj, Andrew Managku, Daniel Nawirridj, Helen Nawirridj, Barbara Galamirnda, Princess Narloman, and Emma Ligtermoet. 2015. Kunwinjku seasons, Kunbarlanja (Gunbalanya), Northern Territory, Australia. https://www.csiro.au/en/research/indigenous-science/indigenous-knowledge/calendars/kunwinjku, Accessed Dec. 2022.

Brigitte Nerlich, Nelya Koteyko, and Brian Brown. 2009. Theory and language of climate change communication. *Wiley Interdisciplinary Reviews: Climate Change*, 1:97–110.

David Ockwell, Lorraine Whitmarsh, and Saffron O'Neill. 2009. Reorienting climate change communication for effective mitigation: Forcing people to be green or fostering grass-roots engagement? *Science Communication*, 30:305–327.

Jeremy Russell-Smith, Glenn James, Alan Maratja Dhamarrandji, Ted Gondarra, Danny Burton, Bevlyne Sithole, Otto Bulmaniya Campion, Hmalan Hunter-Xenie, Ricky Archer, Kamaljit K Sangha, et al. 2022. Empowering Indigenous natural hazards management in northern Australia. *Ambio*, 51:2240–2260.

Linda Tuhiwai Smith. 2012. *Decolonizing Methodologies*, 2nd edition. Zed Books.

W. E. H. Stanner. 1956. The dreaming. In T. A. G. Hungerford, editor, *Australian Signposts*, pages 51–65. F. W. Cheshire Publishing.

Gawura Wanambi, Joy Bulkanhawuy, Stephen Dhamarrandji, and Rosemary Gundjarranbuy. 2021. Caring for Yolŋu and Ways of Life During COVID-19. https://indigenousx.com.au/caring-for- yolnu-and-ways-of-life-during-covid-19, accessed March 2022.

Nicolas Webersinke, Mathias Kraus, Julia Anna Bingler, and Markus Leippold. 2021. Climatebert: A pretrained language model for climate-related text. *ArXiv*, abs/2110.12010.