Hazardous Weather Communication En Español

Challenges, Current Resources, and Future Practices

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ABSTRACT: According to recent Census data, the Hispanic or Latino population represents nearly 1 in 5 Americans today, where 71.1% of these individuals speak Spanish at home. Despite increased efforts among the weather enterprise, establishing effective risk communication strategies for Spanish-speaking populations has been an uphill battle. No frameworks exist for translating weather information into the Spanish language, nor are there collective solutions that address this problem within the weather world. The objective of this article is threefold. First, the current translation issue in Spanish is highlighted. Through research conducted at the NOAA/NWS Storm Prediction Center, situations are revealed where regional varieties of Spanish contributed to inconsistent risk messaging across the bilingual weather community. Second, existing resources are featured so that interested readers are aware of ongoing efforts to translate weather information into Spanish. Organizations within the weather service, like the NWS Multimedia Assistance in Spanish Team and the NWS Spanish Outreach Team, are highlighted for their pioneer work on Spanish weather communication. Last, a framework for translation standardization in the atmospheric sciences is introduced, along with future initiatives that are being sought by NWS and AMS to enhance Spanish hazardous weather communication.

KEYWORDS: Social Science; Broadcasting; Communications/decision making; Education; Emergency preparedness; Societal impacts

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D uring the infamous 2013 El Reno, Oklahoma, tornado outbreak, a Guatemalan, Spanish-speaking family of seven heeded tornado warnings and decided to seek shelter in a nearby storm drain. Tragically, the seven family members perished after flash floods swept them away (Kringen 2013). A NOAA/NWS assessment of the event found that a lack of meteorological products and resources expressed in Spanish prevented these communities from taking life-saving measures (NWS 2014). Despite the abundant lead time that meteorologists provided, it was clear that no matter how timely the forecast was, failing to communicate in the native language of impacted people led to catastrophic consequences.

As the fastest growing group in the United States, the Hispanic or Latino[1] population of 59.7 million represents nearly one in five Americans today (U.S. Census Bureau 2019). According to the 2018 U.S. Census Bureau Community Survey, 71.1% of the total Hispanic and Latino population in the United States speak Spanish at home, where 28.9% of these individuals speak English less than "very well." Recent studies predict that there will be more Spanish speakers in the United States than in any other country in the world, except Mexico, by 2060 (Instituto Cervantes 2019). The need for improved communication in Spanish is becoming increasingly important in the weather enterprise as communities continue to diversify.

[1] The U.S. Census Bureau defines "Hispanic or Latino" as individuals of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture of origin regardless of race.

The Spanish communication challenge, while acknowledged, has yet to find a strategic solution. Present-day consensus for Spanish-language risk terminology in the meteorological community is still a challenge and can lead to Hispanic or Latino populations receiving inconsistent information (Trujillo et al. 2020). To address these issues, efforts to build a geoscience community of practice for Spanish-language resources and cross-institutional collaboration within the United States have begun (Medina Luna et al. 2019). This paper continues these efforts by focusing on one aspect of geoscience, specifically the weather enterprise. In doing so, this paper raises awareness of existing resources within NWS and AMS and highlights developing practices that meteorologists can utilize to enhance Spanish weather communication.

The challenge

The Spanish language has been spoken continuously in what is now the United States for more than 400 years, and since the turn of the twentieth century, regional and social varieties, known as dialects, of Spanish from other nations have become integral components of U.S. Spanish (Lipski 2008). In ethnically homogeneous neighborhoods, these varieties may stay close to those of the countries of origin, while in multi-ethnic urban settings, dialect mixing inevitably occurs. As with American English, all dialects of Spanish in the United States are mutually intelligible and use mostly the same words for basic weather-related terms such as clouds, wind, rain, snow, thunder, and lightning. However, there are instances where dialects influence the way hazards and risks are understood and interpreted in Spanish. For example, Abukhalaf and von Meding (2021) identified that Spanish speakers do not

use the words "twister" and "tornado" interchangeably like American English speakers do. These linguistic discrepancies, coined disaster linguicism, are linked to greater vulnerability among underrepresented communities (Uekusa 2019; Méndez et al. 2020). Moreover, severe weather phenomena are not common in some Spanish-speaking countries, and individuals from these countries may fail to recognize the inherent danger, even if they have heard the words before. The combination of these factors exemplifies the difficulty of communicating consistent, relevant Spanish messages in the United States.

In 2019, the NOAA/NWS Storm Prediction Center (SPC) supported a Spanish-language initiative to explore how Spanish dialects play a role in risk and crisis communication by analyzing how bilingual meteorologists went about translating SPC severe weather risk categories. The SPC uses probabilistic severe weather forecasts of coverage and intensity to create five risk categories: marginal, slight, enhanced, moderate, and high (Fig. 1). The risk categories are also available in Spanish, and an official graphic is accessible on the SPC web page (Fig. 2). Despite the official SPC translation, bilingual broadcast meteorologists used various Spanish words to communicate identical risks. Morning and evening shift broadcasters in severe-weather-prone areas used different translations of SPC risk categories within and across stations, despite being in the same television market (Table 1).

To propose a solution to the inconsistent information, this study leveraged strategies from a parallel field that faces the same challenges when it comes to translating risk: the medical field. According to bilingual health communication studies, extra consideration needs to be taken when translating risk terminology into other languages, as people's worldviews shape how they interpret the information, verbal and nonverbal, resulting in different responsive actions (Hsieh 2016). In other words, when it comes to translating jargon (i.e., terminology with which only the organization is familiar), medical experts are free to come up with their own

Fig. 1. NWS SPC severe thunderstorm risk categories.

Categorías de Riesgo de Tormentas Severas

Tormentas (sin categoría)	1 - MÍNIMO (MÍN)	2 - LEVE (LEVE)	3 - ELEVADO (ELEV)	4 - MODERADO (MOD)	5 - ALTO (ALTO)
Se esperan tormentas no severas* Amenaza de rayos/inundaciones pueden existir en _todas_ las tormentas	**Posibles tormentas severas aisladas** Limitadas en duración/cobertura/ intensidad	**Posibles tormentas severas aisladas** De corta duración/ no tan extensas, posiblemente alguna intensa aislada	**Posibles tormentas severas numerosas** Más persistentes/ de amplia cobertura, pocas intensas	**Probables tormentas severas de amplia cobertura** Larga duración, amplia cobertura e intensas	**Se esperan tormentas severas de gran cobertura** Muy larga duración, gran cobertura y particularmente intensas

* El Servicio Nacional de Meteorología, NWS, define una tormenta severa como: ráfagas de vientos de por lo menos 58 MPH y/o granizo con 1 pulgada de diámetro y/o un tornado. Todas las categorías de tormentas implican rayos/descargas eléctricas y el potencial de inundaciones. Las categorías también están ligadas a la probabilidad de tiempo severa a 25 millas de su ubicación.

National Weather Service
www.spc.noaa.gov

Fig. 2. NWS SPC severe thunderstorm categories in Spanish.

Table 1. Severe weather risk categories used by two Spanish stations in 2019 from the same designated market area (DMA) in Texas and Oklahoma illustrate how broadcast meteorologists went about translating risk terminology to their audiences. Risk categories in bold font represent terminology that differs from the official SPC Spanish translation.

Selected Texas DMA	Station #1 Risk Categories	Station #2 Risk Categories
AM Programming	**Level 1: Marginal**	Level 1: Mínimo
	Level 2: Ligero	Level 2: Leve
	Level 3: Ampliado	Level 3: Elevado
	Level 4: Moderado	Level 4: Moderado
	Level 5: Alto	Level 5: Alto
PM Programming	Level 1: Mínimo	Level 1: Mínimo
	Level 2: Ligero	Level 2: Leve
	Level 3: Ampliado	Level 3: Elevado
	Level 4: Moderado	Level 4: Moderado
	Level 5: Alto	Level 5: Alto
Selected Oklahoma DMA	**Station #1 Risk Categories**	**Station #2 Risk Categories**
AM/PM Programming	**Level 1: Marginal**	**Level 1: Muy Leve**
	Level 2: Ligero	Level 2: Leve
	Level 3: Ampliado	**Level 3: Acentuado**
	Level 4: Moderado	Level 4: Moderado
	Level 5: Alto	**Level 5: Elevado**

translations and embark on educational campaigns, so that all patients are familiar with the new terminology. However, when translating risk-related words, medical professionals need to consult with language experts, as connotations of risk-related translations vary depending on the context of the situation and worldview of the public. Risk categories are not exclusive to healthcare: they can also appear in safety labels on the back of household products or be displayed on television to communicate imminent weather hazards, and the words used to describe these risks may change according to one's dialect.

Taking bilingual health communication research into account, this study aimed to find unifying, yet culturally-relevant ways to translate weather-related risks into Spanish, so that the public could adopt concerted actions to minimize their risk exposure. To guarantee that all dialects of Spanish were taken into account, researchers consulted with Spanish linguistic experts from The Pennsylvania State University. As an assigned project, a group of doctoral students taking Dr. John Lipski's Spanish Dialectology class learned all existing interpretations of risk categories across the weather enterprise and used their knowledge of various Spanish dialects to come up with words that universally communicated risk and urgency. Overall, the results of this exercise revealed that enough interdialect variation for severe weather terminology existed to potentially represent an area of concern, and an "ideal" SPC Spanish risk category graphic was created as a recommendation moving forward (Table 2). As of December 2020, the SPC is reviewing these risk categories and feel the study provided a unique perspective on existing weather risk terminology research (Grundstein et al. 2019; Ernst 2020; Krocak et al. 2021).

Despite research to improve the translation of SPC risk terminology, numerous challenges remain to be addressed in the Spanish weather world. For example, the NWS Hazard Simplification project reported that various translations of the word "warning" are currently used in public communication (Eastern Research Group, Inc 2019). Previous NWS assessments pointed to insufficient bilingual resources and personnel, inhibiting them from meeting the demand of media requests and translations (NWS 2016). As a result, current studies only scratch the surface on the many existing challenges of translating weather information into the Spanish language.

Current resources

NWS staff created two groups to improve mission delivery to Spanish-speaking communities. The first group, the NWS Spanish Outreach Team (SOT), is composed of bilingual meteorologists from the various NWS regions and NOAA Headquarters. Since 2014, SOT members have been instrumental in translating many of the outreach and preparedness materials created by NWS Communications Division and locally prepared at many weather forecast offices. These

Table 2. Comparison of the official NWS SPC risk terminology categories in Spanish with ones recommended by Spanish linguistic experts. To make this table accessible to the general public, the English equivalent of each word is noted in quotation marks. Note that levels 2–5 are different. According to Spanish linguistic experts, the word used to describe the second risk category, "leve," is mainly used in Spain, while the majority of Latin American countries would not understand that word in a risk context. Levels 3–5 were changed in order to make more categorical sense in Spanish.

NWS SPC Official Definitions	0	1	2	3	4	5
	Tormentas	Mínimo	Leve	Elevado	Moderado	Alto
	"T-Storms"	"Minimum"	"Slight"	"Enhanced"	"Moderate"	"High"
Linguistic Expert Suggestion	0	1	2	3	4	5
	Tormentas	Mínimo	Bajo	Moderado	Alto	Extremo
	"T-Storms"	"Minimum"	"Low"	"Moderate"	"High"	"Extreme"

Fig. 3. Example of one of the many infographics that the NWS Spanish Outreach Team translated for the NWS Communications Division/Weather-Ready Nation Seasonal Campaigns. To access Spanish materials, visit www.weather.gov/wrn. "Spanish-language content" can be found under the "Safety Campaigns" drop-down menu.

materials include hazardous weather safety pamphlets, weather and safety campaigns, fact sheets, infographics, and SKYWARN presentations, all of which are distributed across the United States, Puerto Rico, and Latin America (Fig. 3, www.weather.gov/wrn).

The second group, the NWS Multimedia Assistance in Spanish (MAS) team, was formed in 2017 to support active weather operations for NWS Southern Region offices needing messaging assistance in Spanish. After the success of MAS in the Southern Region, the team became national with the representation of NWS bilingual employees across the United States and Puerto Rico in 2018. The translation of information contained within critical products and services, whether in-text products, media interviews, or social media posts, helped ensure effective messaging before, during, and after life-threatening weather emergencies. The MAS team efforts have been highlighted as a best practice as part of NWS Service Assessments completed during recent tropical seasons (NWS 2018, 2020). The MAS team can be reached through NWSChat (https://nwschat.weather.gov) if one is a core partner, such as emergency management, media, or academia, by searching and connecting to the mas_coord chatroom.

Under the AMS Board on Representation, Accessibility, Inclusion, and Diversity, the AMS Committee for Hispanic and Latinx[2] Advancement was inaugurated in 2020 to help organize community efforts and initiatives within the weather, water, and climate enterprise (Trujillo 2020). Comprising Hispanic and Latinx scientists in academia, broadcast, public, and private sectors, the newly established group recently focused on raising awareness and accessibility of existing resources for bilingual meteorologists and practitioners to use. For example, the committee worked with AMS leadership, NWS

[2] According to the Oxford English and Spanish Dictionary, the term "Latinx" is the gender-neutral alternative of Latino or Latina. The AMS Board on Representation, Accessibility, Inclusion, and Diversity uses this term to be more inclusive.

MAS/SOT, and UCAR's Cooperative Program for Operational Meteorology, Education and Training (COMET) to add hyperlinks on the AMS Glossary website that direct users to existing Spanish weather and climate dictionaries in the United States (https://glossary.ametsoc.org/wiki/Welcome). Long term, the group hopes to explore avenues in funding to create a possible AMS Glossary "en español."

Resources in Spanish are also available for communicating the threats from tropical cyclones. The Extreme Events Institute's International Hurricane Research Center at Florida International University, in partnership with NHC and funded by the Florida Division of Emergency Management, created a Spanish-language hurricane information website (Salna 2020; https://huracanes.fiu.edu/). The website educates and informs the public about tropical cyclone science, awareness, preparedness, and safety. To guarantee dialect-neutral material, developers brought in certified Spanish translators. The neutral dialect ensures the information is useful for all practitioners and science communicators for the varieties of Spanish across the United States, Latin America, and Spain.

Future practices

The aforementioned 2019 survey through the SPC Spanish-language initiative provides an appropriate template for systematizing hazardous weather terminology in Spanish. Following advice from Hsieh (2016), meteorological organizations are free to come up with translations that involve jargon (e.g., "shear," "correlation coefficient"), as long as 1) translations are consistent across scientific institutions and 2) an educational campaign is created around the new words. On the other hand, when it comes to translating risk terminology (e.g., "moderate risk," "warning"), consultation from certified language professionals should be considered an essential first step. To *best* enhance hazardous weather communication in Spanish, it will also be necessary to identify the principal regional and social varieties of Spanish found in the target population. Rather than relying solely on often idealized or unrepresentative reference materials, it will be necessary to conduct surveys across all social strata and occupational categories, with particular emphasis on individuals who speak little or no English and do not routinely access English-language media. As the language continues to evolve as a result of new Spanish-speaking populations immigrating to the United States, surveys on hazardous weather terminology in Spanish should be conducted at regular intervals, so that meteorologists and language experts alike are equipped with the best tools going forward to create unifying risk communication "en español."

Moving forward, providing clear, consistent messaging of severe storm hazards on a national scale will continue to be a goal within the SPC. Identifying intended audiences (e.g., broadcast meteorologists, general public) and their perceptions of these risk terminologies will be especially important to address when creating content for Spanish-speaking users, given the aforementioned challenges with translating severe weather terminology into Spanish. Further engagement by SPC meteorologists and Spanish-speaking counterparts, both within the broader NWS and throughout the weather enterprise, is envisioned in order to improve the communication of severe storm hazards within the Spanish-speaking community.

A few initiatives will be further investigated, and results will be shared with SPC on how to disseminate information on Spanish-language-only social media feeds, thus diminishing the need to search and filter through English-language content. For example, efforts are underway to explore how daily social media content in Spanish (e.g., Convective Outlook graphics), can easily be generated and shared by non-Spanish speaking forecasters. The NWS MAS team currently produces social media impact graphics for severe thunderstorm and tornado warnings at the request of NWS Weather Forecast Offices; however, watch information has yet to be translated. Once Spanish-language social media accounts are authorized for use, these

Spanish-language watch graphics will be shared. Finally, safety and education graphics will play a key role in familiarizing Spanish-speaking audiences with SPC products and increasing awareness of how these forecasts translate to risk across a given area. Collaboration with the NWS SOT and MAS team, therefore, will be critical in creating material that effectively communicates this important information.

As they move forward, NWS SOT and MAS will continue to leverage the talent in their groups and provide assistance within and outside the NWS. For the 2020 hurricane season, an experimental new service was provided by the NHC, in collaboration with NWS San Juan and MAS. For years, NWS San Juan has been the sole provider of translation services for tropical products in the Atlantic. A proposal was presented during the 2019 NOAA Hurricane Conference to translate, in graphical format, the Key Messages that are typically part of Tropical Cyclone Discussions issued by NHC for tropical cyclones in the Atlantic Ocean (Negrón et al. 2019). After collaboration and discussions, NWS San Juan provided these translations with the assistance of MAS as a backup to ensure consistency in the product. In addition to continuing to translate infographics provided by the NWS Communication Division, the MAS team also plans to collaborate with other NWS national centers (e.g., Weather Prediction Center, Ocean Prediction Center, Office of Water Prediction) in the near future. Translation efforts will focus on materials to assist weather awareness in Hispanic and Latinx communities when hazards become a threat to life and property.

Finally, the AMS Committee for Hispanic and Latinx Advancement plans to continue to raise awareness of multilingual resources and create a safe space for Hispanic and Latinx scientists within the Society. Acknowledging that Spanish is not the only language that the Hispanics and Latinxs speak, the Committee hopes to foster collaboration with international partners and address issues that pertain to the entire community. The Committee will continue to co-host sessions at AMS annual meetings with partners in the weather, water, and climate network and facilitate important conversations that benefit Hispanics and Latinxs across the Society and beyond.

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