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Landslide Hazard and Exposure Modeling for Situational Awareness and Response in Rio de Janeiro

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The city of Rio de Janeiro is situated within a coastal region with steep slopes, intense seasonal rainfall, and vulnerable populations located on marginal slopes. Landslides are a seasonal challenge within the city and proximate regions and increasing real-time awareness of the hazard and exposure is paramount to saving lives and mitigating damage. A local alerting system has been developed for the city that leverages a global landslide hazard assessment for situational awareness (LHASA) framework, developed by NASA, with local rainfall thresholds and landslide susceptibility information. The LHASA-Rio system uses a decision tree approach to first identify extreme rainfall based on a series of rainfall thresholds established by Geo-Rio (the City's agency responsible for landslide hazards) for 1 hour, 1 day or 1 hour and 4 day thresholds. This is then coupled with information on landslide susceptibility also developed by the Geo-Rio team. The LHASA-Rio system has been running operationally since 2017 within the city to provide real-time, high resolution estimates of areas within the city at higher hazard at 15-minute intervals consistent with the rainfall gauge network distributed throughout the city. Results of the LHASA-Rio system indicate excellent performance for several case studies where extreme rainfall triggered landslides within the city over areas identified as high hazard zones by LHASA-Rio. The model has recently been updated to accommodate additional rainfall thresholds to differentiate moderate to very high and critical intensities. The modeling effort is also incorporating information on landslide exposure by connecting the hazard estimates to city-wide data on population, road networks and other infrastructure. The goal of this system is ultimately to provide key tools to emergency response teams, civil protection and other hazard monitoring organizations within Rio's City Government in real-time and provide actionable information for key communities, city management and planning. Future work of this system is the application of a regional precipitation forecast to improve the lead time.

This work has been done in partnership through an agreement established between NASA and the

City of Rio de Janeiro in 2015 that was recently extended in 2020. This agreement seeks to support innovative efforts to better understand, anticipate, and monitor hazards and environmental issues, including heavy rainfall and landslides, urban flooding, air quality and water quality in and around the city. This collaboration leverages the unique attributes of NASA's satellite data and modeling frameworks and Rio de Janeiro's management and monitoring capabilities to improve awareness of how the city of Rio may be impacted by hazards and affected by climate change. If the success of this technology is demonstrated, other cities in the world with physiographic and socioeconomic characteristics similar to Rio de Janeiro may benefit by implementing, or strengthening, their own Early Warning Systems for landslides triggered by heavy rains using LHASA's open source algorithms and the experience gathered by the use of LHASA-Rio. This presentation highlights the achievements and advancements of the LHASA-Rio system and discusses lessons learned regarding the applications of the landslide modeling systems to advance decision-relevant science at the city level.