Use of GFM Data to Support The Update of The Flood Vulnerability Atlas

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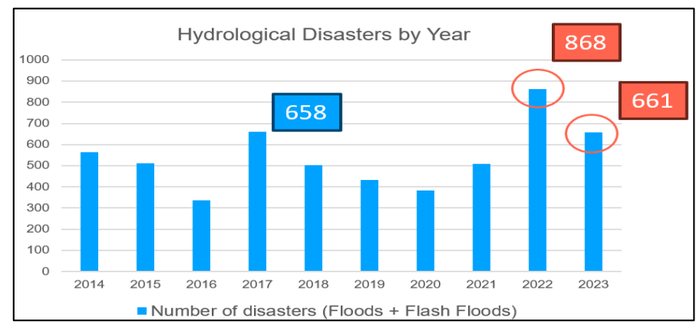
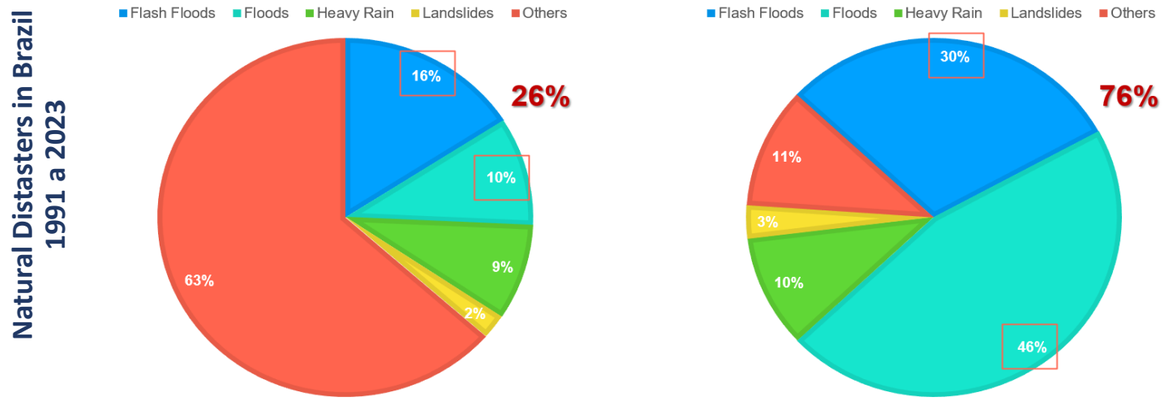
Introduction

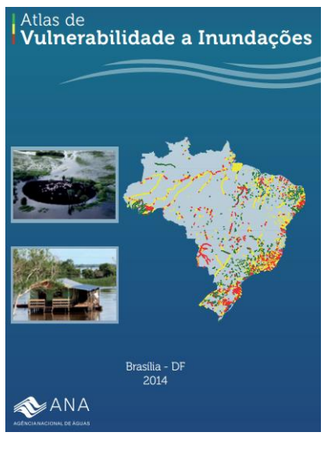
Floods, among the most devastating natural hazards, profoundly impact the lives of millions each year, resulting in tragic losses and widespread destruction. In Brazil, data obtained from the Integrated Information System About Disasters (S2iD), administered by the National Civil Defense, reveals that from 1991 to 2023, floods and flash floods accounted for 26% of the total number of natural disasters. The past two years have witnessed the highest frequency of occurrences. While hydrological events constitute a small percentage, floods and flash floods have affected over 75% of the population. Timely forecasts and alert systems play a crucial role in minimizing casualties and damage. Furthermore, obtaining accurate measurements of floodwater extent is imperative for an effective emergency response.





Flood Vulnerability Atlas

In accordance with its responsibilities, the National Water and Sanitation Agency (ANA) developed the initial Flood Vulnerability Atlas in 2014. This atlas resulted from qualitative research conducted among stakeholders at the state and municipal levels. Through interviews, a risk matrix was formulated, and river segments were classified according to low, medium, and high vulnerability categories.
An updated iteration of the Atlas is scheduled for release in 2026, integrating a quantitative methodology and leveraging advanced technologies, including Remote Sensing.



ANA duties (art. 4º, Federal Law nº 9.984/2000):

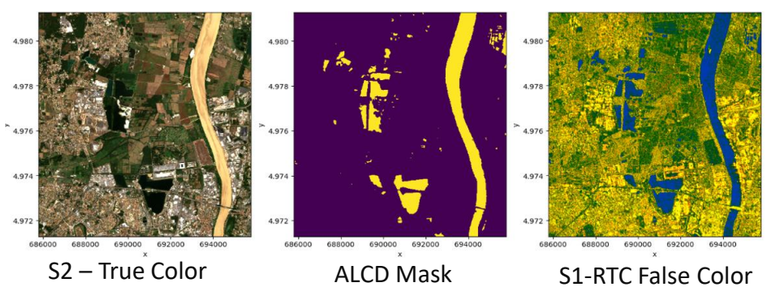
"...
X – to plan and promote actions to prevent or minimize the effects of droughts and floods, witin the National Water Resources Management System, in articulation with the central agency of the National Civil Defense System, in support to States and Municipalities;..."

Impact	Frequency		
	RT > 10 years	5 < RT < 10 years	RT < 5 years
Localized damage	Low	Low	Medium
Reasonable damage to essential services, public facilities and homes	Medium	Medium	High
Damage to human life, significant damage to essential services, public facilities and homes	High	High	High

Sentinel-1 Water Detection

Initial model is a RF trained on 26 water masks derived from Sentinel-2 (ALCD [1])
Masks were paired to Sentinel-1 Radiometric Terrain Corrected (RTC) imagery

Mask pairing example

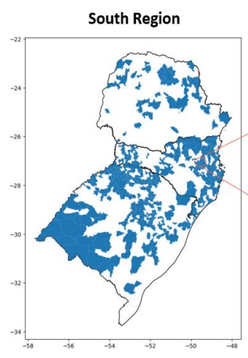


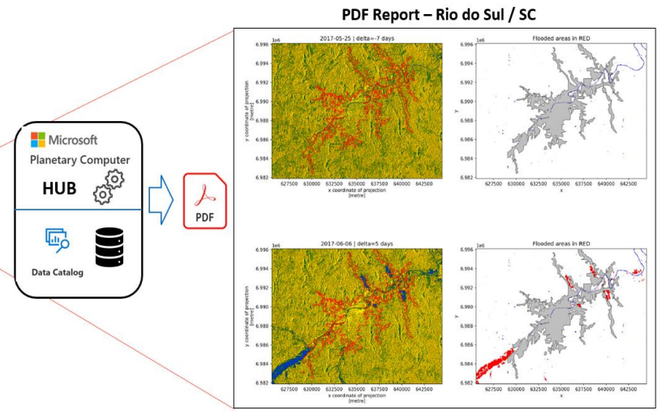
S2 – True Color | ALCD Mask | S1-RTC False Color

Automated Processing (Sen1Flood)

Disasters occurred between **2016 and 2020** in South of Brazil
700 floods and flash floods in 430 distinct municipalities
Focus on main urban areas

Code available at:
https://github.com/cordmaur/Sentinel1-Flood-Finder





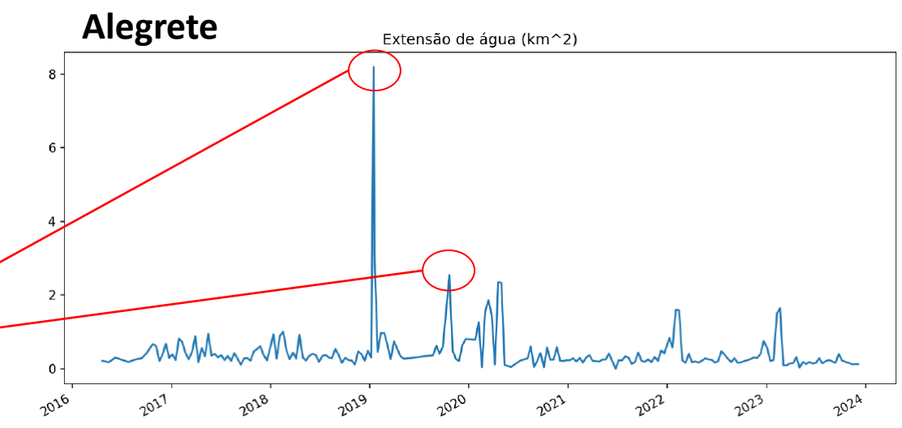
Initial Results

Identification of undocumented or misclassified flood events seem promising

Jan/2019 flood can be confirmed by media press

Disasters Sheet (Alegrete)

RS-F-4300406-12100-20170411	Alegrete	RS	4/11/2017	**River Flood**
RS-F-4300406-12100-20161017	Alegrete	RS	1/8/2019	**Heavy Rain**
RS-F-4300505-12200-20190511	Alegrete	RS	10/27/2019	**Storm**



Next Steps

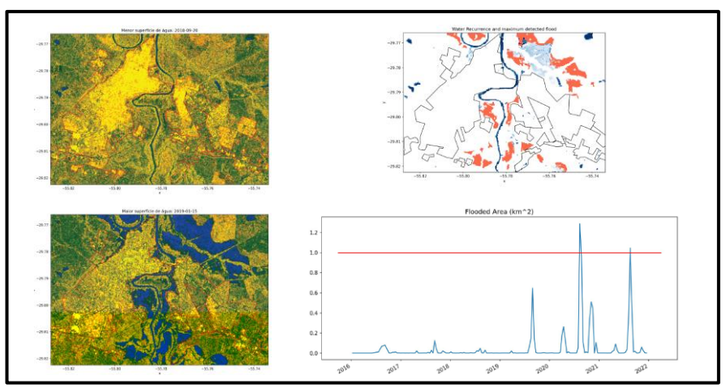
Automated GFM retrieval of historical data to be implemented through WMS services

Comparison of results obtained from GFM and the Random Forests model

Global Flood Monitoring → WMS

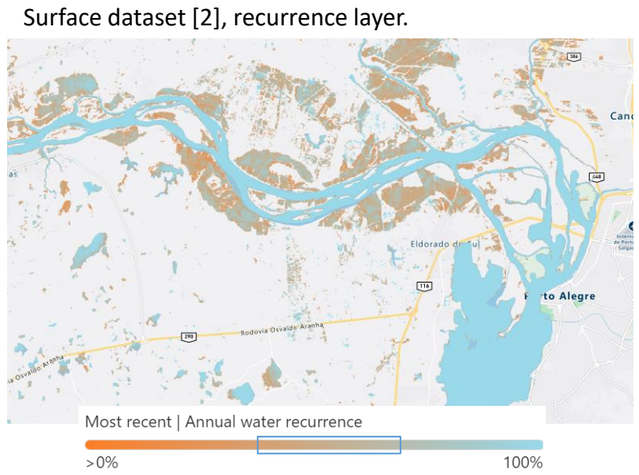
LAYERS
[Observed flood extent]
[Observed water extent]

Microsoft Planetary Computer HUB — Data Catalog



Permanent and seasonal water obtained from Global Water Surface dataset [2], recurrence layer.

Water Baseline



References

[1] PENA LUQUE Santiago. (2019). CNES ALCD Open water masks (1.1) [Data set]. Zenodo. https://doi.org/10.5281/zenodo.3522069
[2] Pekel, JF., Cottam, A., Gorelick, N. et al. High-resolution mapping of global surface water and its long-term changes. Nature 540, 418–422 (2016). https://doi.org/10.1038/nature20584