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Remote sensing for natural catastrophe risk management: closing the gap between ambition and capability

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Economic losses due to flooding and atmospheric perils are on the rise. While last year's flood "Bernd" caused widespread economic losses in Europe totaling €45 mn billion, in 2022 the costliest flood event on record happened in Australia. The main purpose of insurance is to help customers to recover quickly from such devastating events, thus increasing the resilience of societies and economies. How can remote sensing help the industry in this regard?

Geospatial risk intelligence is firmly established in the (re-)insurance industry today. In fact, insurance is a particularly information-intensive domain that offers many applications for spatial data and technology. Especially with regard to the assessment of risk from natural catastrophes, companies and the insured can significantly benefit from the information that is comprehensive, accurate, reliable and accessible—both before, during and after larger events. Earth observation from space has long promised to fulfill those needs but has only partially met the industry's expectations due to critical limitations. To date, with the exception of agricultural insurance, the uptake of satellite-based remote sensing data and products is still limited in the industry. In the following, we highlight the main application cases of earth observation technology and data for property (re-)insurance, summarize shortcomings and potentials, and suggest a handful of criteria to close the gap between ambition and capabilities going forward.

In the periods leading up to, during and immediately after catastrophic events, rapidly acquired and mapped event information is key to establishing situational awareness for insurance operations. Up-to-date data of sufficient thematic detail and accuracy can significantly support processes such as post-event damage assessment, coordination of event response and on-site support, fast claims settlement and fraud detection. In that regard, remotely sensed information features a unique potential as an area-wide and cost-efficient acquisition technology. While on larger geographic scales the technology has proven as mature and useful to locate and map main affected areas (e.g., for wildfires), shortcomings are particularly apparent on the local scale of affected communities,

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properties and buildings. Taking flood risk as an example, timeliness is one of the main issues, as image acquisition times rarely match the temporal flood peak in affected regions—cloud cover being an obvious constraint for the use of optical imagery in that regard. This is particularly true for flash flooding events which have become a major loss driver due to climate change. For urban areas, automated image analysis—although significantly enhanced through machine learning and increasingly available computational resources in recent years—has not met the key requirement of robust loss assessments: being able to consistently identify flooded buildings and properties with high accuracy. Beyond flooding, the general limitation to differentiate structural damage from natural disasters beyond a binary scheme (total damage/no damage) and to indicate non-structural damage often times hinders operational usage. Most earth observation data and techniques except for cost-intensive airborne surveys featuring oblique views have shown their limits of applicability.

Key insurance business processes such as geographical underwriting and risk assessment, location-based pricing, risk modeling as well as portfolio management rely further on spatial information on exposed assets and their exposure to natural hazard risk. On this much broader perspective, a proven potential of earth observation lies in the mapping and characterization of the built and natural environment in support of catastrophe risk management. In this space, intergovernmental initiatives such as the European Copernicus program with its Sentinel missions and its multitude of easily accessible medium- to high-resolution geo-information products such as elevation, built-up density and vegetation cover -, just to name a few - have provided noticeable advancements in recent years. Property insurance in particular demands even higher spatial resolutions and information that is readily available on the building level. Relevant data dimensions include physical building attributes (e.g., footprint area, building height, floor area, etc.), primary risk modifiers (occupancy, construction type, building age and the number of stories), secondary property features (e.g., roof type, existence of solar panels or swimming pools, etc.) but also demographic and socioeconomic features. Techniques of data fusion that utilize both optical and LiDAR information have shown to be particularly promising but are yet hampered by the cost of data and acquisition as well as limited geographic scale. Artificial intelligence to enhance feature extraction from remote sensing imagery and to extrapolate relevant vulnerability indicators from field samples to larger, at least country-wide, building inventories in a transferrable and cost-efficient manner will play a pivotal role in satisfying the increasing information demand of the industry in the future. Based on further research in this domain, additional sources of information such as drone and street view imagery, volunteered geographic information and geo-tagged social media data might provide complimentary in that regard.

Considering the above, it becomes obvious that remote sensing technology is still on its way to becoming a better ally in building sustainable risk intelligence solutions and data for the insurance applications. The demand for such information by the industry exists without a question. The following points may help in closing this gap and extending the bounds of applicability:

(a) Collaboration—In the past, dialogue between the industry and the earth observation community has many times not been successful. Overall, a stronger collaboration between the two should be established in order to increase the mutual understanding and chance of success for operational applications. In this context, the insurance

industry has a clear mandate to specify the information demand in order to stimulate technical innovation in this space.

(b) Transparency—The remote sensing community has often times tended to over-emphasize the advantages of technology and products while concealing limitations. Data and technology providers must be more transparent on what the technology can and, more importantly, cannot offer in terms of timeliness, accuracy, coverage as well as spatial and thematic detail.

(c) Focus—Exchange between technology providers and insurance partners commonly stresses technical aspects while more focus should be laid on the respective business case and added value for the customer. Only once both partners understand the added value of a respective use case can they create profitable, marketable and scalable solutions.

(d) Accessibility—The Copernicus program has shown an increased uptake of open and easily accessible information through the (re-)insurance industry. Easy access, data interoperability and technical support will remain key on the way to a stronger usage of remote sensing data in the business domain.

After all, wider adoption of remote sensing in the industry will primarily depend on selecting the right use cases to which the technology—with its capabilities and limitations—can effectively add value.

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Declarations

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