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How GIS tools and sensor-based data models are impacting the UAS civil missions: Identification of suitable vertical ports and optimal flight planning to quickly deliver defibrillators in alpine terrains

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During the last decades, the introduction of Unmanned Aerial Systems (UASs) in civil applications has exponentially grown. Environmental monitoring, mapping, and surveying, agriculture and precision farming, (infra)structure inspection, and medical supplies delivery are some clear examples. For many of these applications, the organization and planning of the missions are very similar: the variables or phenomena are clearly identified, the area of interest is previously defined, the flight plans are meticulously prepared to extract the features of interest (e.g. overlap and constant elevation for high-quality orthomosaics), the payload and on-board instrumentation is previously configured, the crew is informed in advanced about the objective of the missions, and in general, all these missions are executed in really good weather conditions. However, for some applications, like UAS-assisted Mountain Emergency Medicine, these protocols are totally different, because of the type of emergency (search and rescue operation, first kit provision, avalanche search) resulting in a quick and efficient configuration of payloads, accuracy of the reported incident (accuracy of GPS and distress call), preparation and level of stress for the rescue teams operators and adverse weather conditions (poor visibility, unknown terrain, wind, snow, rain). In addition, the physical localization of the UASs is in regional stations, so it is necessary to mobilize equipment and crew in a very short time to guarantee the success of the missions or, ideally, standby at distributed sites for autonomous operation if cleared for take-off from remote. In order to attend any mountain emergency that requires the use of UASs inside of the Province of South Tyrol, Italy (alpine region) to identify the most suitable operations area (vertical port), to elaborate an efficient point-to-point flight plan maximizing the use of its batteries (considering changes of terrain, elevation, and possible obstacles), and delivering a defibrillator (specific use case), here we propose a basic data management system based on Geographic Information Systems (GIS) that create a distributed vertical port stations in the Province and identify the closest point to the distress call. The system is able to plan an efficient flight plan in a mountainous area using a

sensor-based data model based on a commercial UAS system (MAVTech Q4X) to provide a dedicated payload (defibrillator). We used the system in two scenarios (winter and summer) and they showed a reduction of nearly 50% of the delivery time of the defibrillator by traditional means.