UAV thermal images to support the study of the expansion and contraction dynamics of river networks: a preliminary methodological approach

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River networks are dynamic entities, periodically subject to expansion and contraction processes due to natural hydrological and climatic fluctuations. The ERC project "DyNET: Dynamical River Networks" aims at providing a systematic and quantitative description of such processes. The experimental activities are focused on the mapping at the basin scale of the active (i.e., characterized by flowing water) portion of the river network with the aid of drones, satellite images and field surveys, for the collection of data useful to the modelling of evolutionary processes and the development of theories to be extended on a regional scale. The use of UAVs (Unmanned Air Vehicles) specifically concerns the observation of the space-time evolution of processes, allowing to monitor wide areas and identify the presence/absence of flowing water in the river network with the help of infrared (IR) thermal imaging cameras.

The contribution discusses the effectiveness of UAVs for river networks dynamics monitoring in the Turbolo creek network (Calabria, southern Italy). Specifically, an experimental method is described that identifies and extrapolates from thermal images the pixels representing the active river network. The method is defined based on multiple acquisitions of thermal IR images on some channelized sites in different periods of the year, weather conditions, daytimes and flight altitudes. Several surveys were carried out in autumn, winter and spring seasons, with variable cloud conditions, always repeating the same flight plan, at three different altitudes and at three different times for each day of analysis. During the experiments, air temperature data were recorded by a weather station near the test area, as well as the water temperature values in a small control area in the river bed, with the ascertained presence of water, monitored by the UAV. The thermal images were analyzed on GIS software, extrapolating the pixels falling within a range of values defined from the control area. The "water pixels" thus obtained allowed, through appropriate post-processing, to reconstruct the active river network even in areas not accessible by land. The methodology developed allows defining, for different periods of the year and weather conditions, optimal altitudes and flight times to accurately identify the expansion/contraction dynamics of river networks.

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