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Editorial



From 19 to 21 September 2023, the city of Silvi Marina, in the province of Teramo, hosted GeoVet2023, continuing a tradition that, since 2001, has positioned the conference as a global reference for interdisciplinary research at the intersection of geospatial science and veterinary medicine. With the theme "Expanding Boundaries: Interdisciplinary Geospatial Research for the One Health Era", GeoVet2023 gathered experts from diverse fields to address critical challenges, including the impacts of climate change, human activities, and interactions between domestic and wild animals on veterinary and public health, as well as food safety. GeoVet2023 continued the trajectory set by GeoVet2019, which explored how emerging technologies and data-driven approaches in the Big Data era redefined spatial analysis in animal and public health. The 2023 edition expanded these discussions by incorporating practical applications of real-time data science, artificial intelligence, and decision-making tools, along with social network data, citizen science, and advanced spatio-temporal methods to address challenges posed by climate change and the interconnectedness of human, animal, and environmental health. Another key aspect of the conference was the dialogue between scientists and international organizations, pointing out the crucial role of effective communication in bridging research and policymaking. Indeed, in his opening keynote, Marius Gilbert shared lessons from managing the COVID-19 pandemic in Belgium, highlighted the challenges related to public communication and underscoring the need for health science literacy, trust, and structured scientific debate.

The [scientific program](#) of GeoVet2023 included five keynotes, eight senior presentations, 43 engaging talks, and 50 informative posters, representing 106 research projects in total. The relationships established and the knowledge shared during this conference not only reflect its innovation but also provide a roadmap to guide the progress of interdisciplinary geospatial research and One Health strategies in the years to come.

This special issue of *Veterinaria Italiana* captures the innovation, integration, and practical applications that characterized the GeoVet2023 conference discussions. Presenting 12 selected studies, it showcases the latest development in spatial epidemiology and geospatial tools, providing solutions for pressing issues such as disease surveillance, antimicrobial resistance, and the impacts of environmental changes on health systems. These studies provide concrete examples of how geospatial research improves veterinary and public health within the One Health framework.

Keywords

Geospatial Science, Spatial Epidemiology, Climate Change, Disease Surveillance, Science Communication, One Health

Overview of Contributions to the Special Issue

Complementing the emphasis on communication between science and policy highlighted by Marius Gilbert's keynote talk, Olaf Berke's contributions illustrate the importance of clarity within the scientific community. Berke's study "*Communication Breakdown: Of Disease Clusters, a Trillium and One Health*", addressed the definitional ambiguities often encountered in geographic epidemiology. The study explored inconsistencies in the use of terms like cluster, clustering, and hotspot, highlighting how varying definitions can lead to confusion in interpreting spatial data. Through a critical review of existing methodologies, Berke identified gaps in consistency and proposed the Geographic Epidemiological Trillium as a conceptual framework. This model integrates three components of disease dynamics — pathogen, host, and environment — into spatial analyses, enabling a more nuanced understanding of disease distribution and risk factors. By applying this model, the study demonstrated how overlapping spatial data layers can

help distinguish true disease clusters from random aggregations, offering practical insights for improving the interpretation and communication of epidemiological findings. Expanding on the theme of scientific clarity, in another study *“Dazed and confused: how map projections affect disease map analysis and perception – An echo from GeoVet2019”*, Berke revisited discussions initiated at GeoVet2019, illustrating how biases introduced by map projections can significantly alter spatial analyses and impact public health decisions. Using case studies from Israel, Southern Ontario, and North Carolina, the study demonstrated how changing map projections can distort distances, areas, and the identification of clusters. For example, a single disease cluster was fragmented into three distinct clusters depending on the projection applied. These insights stressed the need for transparency in reporting geographic projections, a key step toward ensuring reproducibility and reliability in spatial epidemiology.

Advanced geospatial tools and data-driven platforms can be of immense benefit to policy makers and in communications: novel data sources (such as sensor data, genomic data, crowdsourced data) and advanced operational tools were another key point that emerged during the GeoVet Conference and addressed in this Special Issue by two impactful studies. De Ruvo et al., in *“SPREAD: Spatiotemporal Pathogen Relationships and Epidemiological Analysis Dashboard”*, introduced a standalone web application that integrates spatial, temporal, and genomic data for infectious disease surveillance. Tested on pathogens like SARS-CoV-2 and *Listeria monocytogenes*, SPREAD demonstrated its ability to rapidly identify transmission clusters, enabling timely public health responses and fostering collaboration among researchers and policymakers. In a distinct context, Tora et al., in *“The ‘Working Group Land of Fires’ Platform for emergency management, data Sharing and dissemination”*, tackled the pressing issue of illegal waste dumping and land contamination in Italy’s Campania region. Their study presents the TdF-WG Platform, a GIS-based system designed to support strategies for addressing the Land of Fires crisis through standardized data dissemination and geospatial visualization. By facilitating transparency and collaboration among stakeholders, the platform serves as a replicable model for managing environmental crises, while fostering data sharing and public trust.

Spatial epidemiology methods analysed the relationships between organisms, environments, and diseases, enabling the development of targeted interventions for improved animal and public health management. Three contributions addressed bovine tuberculosis disease surveillance and risk mapping. Ruiz Gil et al., in *“Bovine Tuberculosis in San Luis Potosí, Mexico: spatial analysis and risk factors”*, focused on spatial clustering and risk factors. Using spatial-temporal statistical models such as SatScan and Getis-Ord Gi*, the study revealed high-risk clusters in the Mexico regions of Altiplano and Huasteca, where larger farms (>20 animals) were found to have increased infection risk. These results underline the importance of targeting interventions in areas with concentrated risk factors to reduce disease spread. McGrath et al., in *“Farm Fragmentation in Ireland”*, investigated the impact of farm fragmentation on disease dynamics using data from the Land Parcel Identification System (LPIS). By calculating “fragmentedness” and “neighbourhoodness” metrics, the study highlights regional variations in fragmentation and its influence on disease monitoring. Highly fragmented regions were shown to face greater challenges in livestock movement tracking, potentially leading to misaligned surveillance efforts. Complementing this, Tratalos et al., in *“Computing metrics to inform selection of candidate arefoars a regionalized approach to bovine tuberculosis eradication in Ireland”*, proposed a regionalized approach to bovine tuberculosis eradication. Analyzing 20 metrics across 26 counties, the study identified Cork and Kilkenny as high-priority regions for targeted interventions, optimizing resource allocation and enhancing disease control.

Drawing from the foundational work in spatial epidemiology, other contributions target risk management and response strategies for avian influenza, a zoonotic disease with significant implications. Rombolà et al., in *“A Spatial Multi Criteria Decision Analysis (SMCDA) to map the risk of avian influenza in Lazio and Toscana (central Italy)”*, by applying a GIS-based multi-criteria approach, identified high-risk zones. Integrating 11 risk factors such as poultry density, wild bird presence, and proximity to water bodies, the study generated suitability maps showing approximately 30% of Lazio and 20% of Toscana as high-risk areas. These results emphasize the need for stringent biosecurity measures, particularly in coastal regions and areas with significant wild bird activity. Battisti et al., in *“Being prepared for an avian influenza epidemic with a One Health Approach: a cartographic study to identify animal carcasses burial sites in central Italy”*, examined the selection of optimal carcass burial sites during outbreaks. With a GIS-based approach, the study assessed environmental constraints, groundwater vulnerability, and logistical feasibility, identifying 23% of the Lazio Region as suitable for burial. The findings provide a valuable tool for decision-makers, ensuring biosecurity and minimizing environmental risks during epidemic responses.

The impact of climate change and the interconnectedness of ecosystems and health systems are explored through three significant studies in this special issue. Annalisa Viani and colleagues, in their work *“Grading Habitats for Ticks by Mapping a Suitability Index based on Remotely Sensed Data and Meta@ population dataset in Aosta Valley, NW Italy”*, used Earth observation data to create habitat suitability maps for ticks in the Aosta Valley. By integrating multitemporal satellite data, environmental variables (e.g., vegetation indices, rainfall), and data on tick populations and pathogens, they developed a comprehensive suitability index. This approach revealed an upward shift in tick

habitats to higher altitudes due to warming trends, with implications for both wildlife and human health. Their analysis demonstrated the value of remote sensing for strengthening One Health frameworks, particularly in vector-borne disease management.

Pérez-Otáñez et al., in “*Drivers and evolution of acaricide resistance and multi-resistance in two Ecuador's subtropical livestock farming areas*”, addressed acaricide resistance in cattle tick populations. By integrating field surveys with molecular analyses, they used geospatial analyses to characterize the resistance patterns across regions, linking these findings to farm management practices. Their study underscored the need for sustainable and region-specific intervention strategies to mitigate resistance and improve tick control in livestock populations.

Salini et al., in “*Analyzing trend and heatwaves of 15 Years of Sea Surface Temperature Variations along the Italian Adriatic Coast*”, utilised satellite-derived data from the Copernicus Marine Service program to assess sea surface temperature (SST) trends over 15 years. The study highlighted a statistically significant warming trend of 0.010°C per year, with marked regional variations, and identified marine heatwaves and cold spells, exhibiting a north-south gradient in intensity. These findings underscore the value of satellite data in geospatial analysis and epidemiology, offering critical insights into the effects of climate change on marine ecosystems, with potential implications for aquaculture and biodiversity.

In conclusion, the studies presented in this special issue of *Veterinaria Italiana* dedicated to the GeoVet 2023 conference, exemplified the potential of geospatial science in addressing complex challenges at the intersection of veterinary medicine, public health, and environmental systems within the One Health framework. The conference and this Special Issue highlighted the key role of spatial epidemiology, novel data sources (such as genomic and satellite-derived data) and operational tools in addressing veterinary issues in the One Health perspective. Interdisciplinary collaborations and advancing innovative tools are the basis to shape resilient health systems in an era of global changes. In this context, it was also emphasized the critical role of science-policy integration.

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We look forward to the next GeoVet conference, scheduled to take place in Belgium in 2026 jointly organized by the Université Libre de Bruxelles, Université de Namur, and AviaGIS. This event sets the stage for future developments in geospatial science, fostering new innovations and further strengthening the legacy of GeoVet conferences.

List of Contributions

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