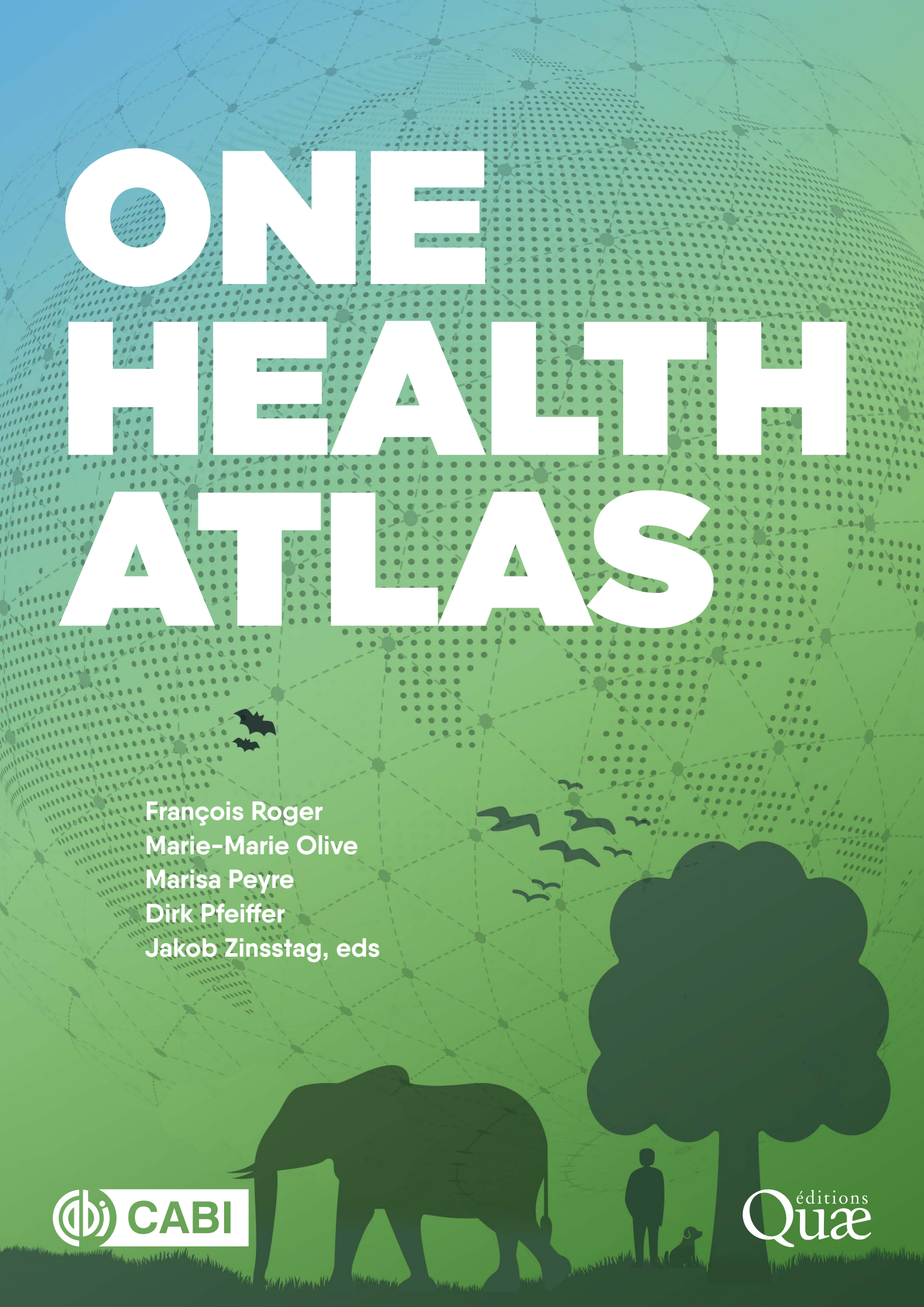
ONE HEALTH ATLAS

François Roger
Marie-Marie Olive
Marisa Peyre
Dirk Pfeiffer
Jakob Zinsstag, eds



CABI
éditions Quæ

Multi-scale spatial modelling to facilitate the implementation of One Health approaches

Annelise Tran, Hobiniaina Anthonio Rakotoarison, Larisa Lee-Cruz, Daouda Kassié

Epidemiological cycles can be considered complex systems. For infectious diseases involving several reservoir or vector species in particular, understanding transmission requires knowledge of the wild or domestic animals and arthropods involved, their interactions, and the impact of climatic conditions, landscape, human activities, etc. Modelling offers a methodological framework to reproduce and study a real system through abstraction. In the field of epidemiology, it has been used to simulate epidemic dynamics, the impact of control actions, and to map areas at risk of transmission. By considering the spatial dimension, we can implicitly consider the environment and spatial interactions, which thus favours One Health approaches.

Expert knowledge, biological surveys and participative approaches can be combined using spatial modelling techniques to tackle human and animal health issues. In Madagascar, a spatial multicriteria evaluation (MCE) approach was used to identify areas where pigs are at a higher risk of contamination with synthetic anabolic hormones, present in human contraceptives illegally used in pig farms. Data describing the drug supply chain in veterinary and human sectors were combined to produce risk maps at the country level (Figure 1), consistent with results from pig samples collected in slaughterhouses and with breeders' responses collected at local scale.

Similar approaches have been used to better understand the transmission cycle of the Ebola virus, which potentially involves several intermediate animal host species. A recent study at regional scale used a spatial MCE approach to combine different categories of data—climatic, environmental, anthropogenic, and the distribution of animal species potentially involved—to map the risk of Ebola emergence (Figure 2), which varies in space and time according to the seasons.

To facilitate the use of spatial models by non-specialists, tools like the QGIS "Full MCE for public health" plug-in[1] have been developed. Such tools allow public health actors to generate risk maps and integrate them into their action plans. These tools and methods can be used together to combine risk factors from different sectors and disciplines to help better integrate knowledge into health and health policy actions. They can also be useful in implementing systemic approaches such as the One Health approach.

1. www.geoinformations.developpement-durable.gouv.fr/qgis-r625.html

References

Lee-Cruz L., Lenormand T., Cappelle J., Caron A., De Nys H. *et al.* 2021. Mapping of Ebola virus spillover: Suitability and seasonal variability at the landscape scale. *PLoS Neglected Tropical Diseases*, 15(8), 29 p. https://doi.org/10.1371/journal.pntd.0009683

Rakotoarison H.A., Rasamimalala M., Rakotondramanga J.M., Ramiranirina B., Franchard T. *et al.* 2020. Remote sensing and multi-criteria evaluation for malaria risk mapping to support indoor residual spraying prioritization in the central highlands of Madagascar. *Remote Sensing*, 12(10), 1585. https://doi.org/10.3390/rs12101585

Ramahatafandry D.A. 2020. Cartographie des risques d'utilisation détournée du medroxyprogesterone acétate (MPA) dans les élevages de porcs à Madagascar. Institut Pasteur de Madagascar, 47 p.

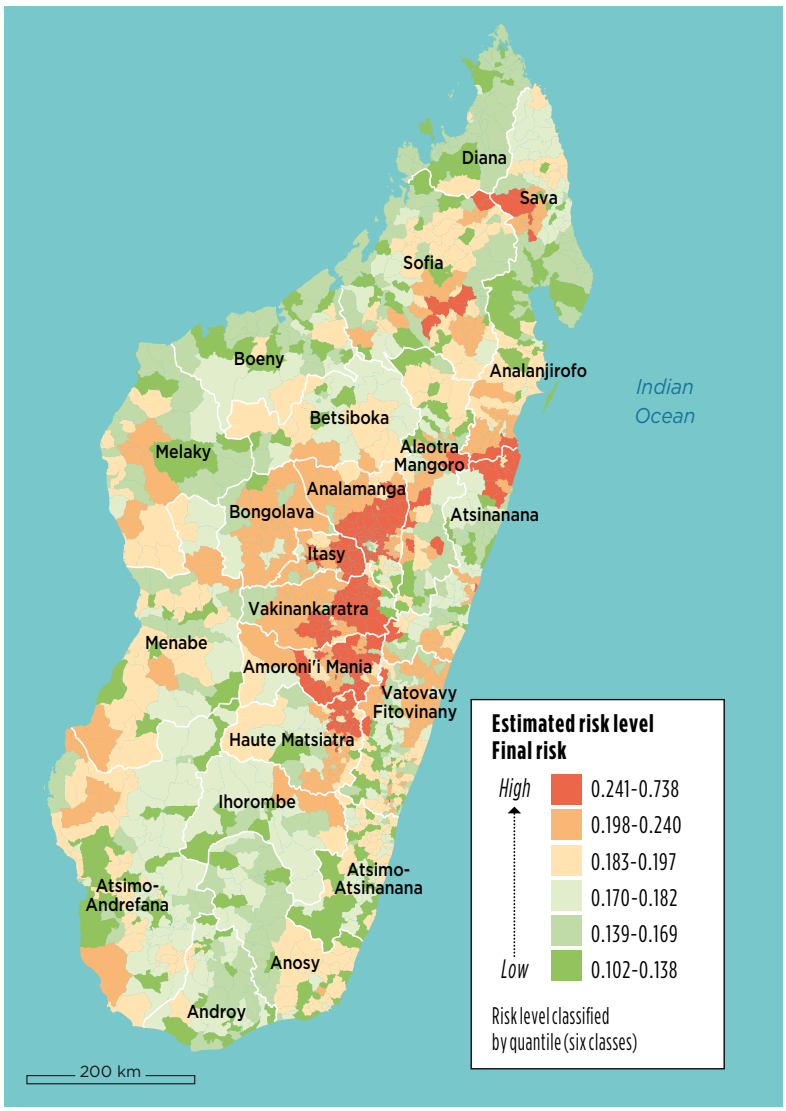


Figure 1. Risk map for residues of synthetic anabolic hormones (medroxyprogesterone acetate) in pigs in Madagascar, produced from expert knowledge, biological surveys and participative approaches.

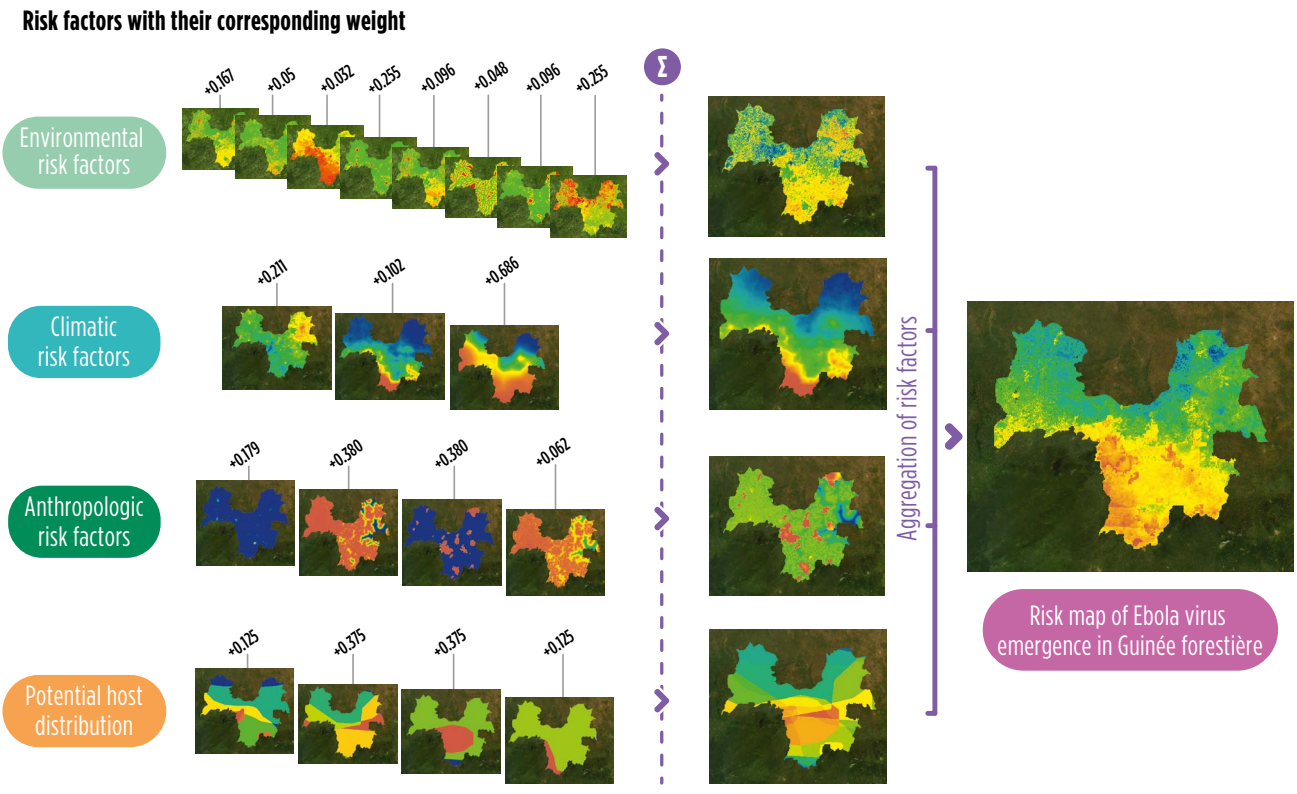


Figure 2. Illustration of the different stages of the spatial multi-criteria evaluation approach, using the example of Ebola virus emergence.