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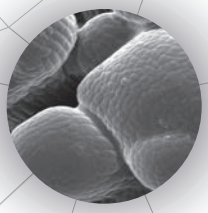
INTERNATIONAL

Expertise of the scientific community in the Occitanie area (France)

COMPLEX SYSTEMS

From biology to landscapes



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Use of observatories

Complex multicontext information systems for alert management

Many complex information system (IS) studies are focused on surveillance and crisis management. Beyond the ISO 27000 standards that formalize the information security management system concept, how do we take alerts into account—under different contexts (software, ecological, environmental, epidemiological, industrial, etc.) and criticality levels—to detect transitions from nominal to accidental system operation? Addressing issues related to paradigm shifts between normal use and crisis management requires that the proposed models include a generic dimension to be able to describe how such shifts in use occur—feedback or alert mechanism, decision making and change of governance type? What is the involvement in information monitoring, IS and its interfaces in decision making, monitoring and alert processes? Phenomena of (false) alarms, fakes, buzzes, spams and social network rumours reposition issues of information quality and trust in systems devoted to the dissemination of all kinds of alerts/alarms and decision support systems. The models below are based on different facets:

- Management of control and monitoring activities
- Management of alerts and abnormal events
- Dynamics and integration of crisis management in IS
- Dynamic reconfiguration of complex environments
- Adaptation of management of the security of infrastructures, connected cities, cybersecurity, crisis management, etc.
- IT sustainability: business continuity plan/IT continuity plan
- Status and maintenance of alert dissemination vectors during crises

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Satellite images for vector-borne disease transmission risk mapping

Vector-borne diseases are infectious diseases that are transmitted between vertebrate hosts by blood-sucking arthropod vectors (flies, mosquitoes, etc.). Many remote sensing and spatial modelling applications have been developed in recent decades to gain greater insight into these complex systems, including the development of predictive tools that may be used by health stakeholders to more effectively target surveillance and monitoring. Satellite imagery-derived information—measured at daily to yearly frequencies—provides indirect indicators of the presence or abundance of vectors or hosts associated with disease transmission in relation to the surface temperature, land-use patterns, the presence of water areas and vegetation. Complementary modelling approaches are also used to integrate this information into risk prediction systems.

Statistical models based on observational data highlight links between environmental indicators and entomological or epidemiological data. Several studies have confirmed the value of this approach, e.g. for mapping animal trypanosomiasis, West Nile fever and Rift Valley fever risks. Moreover, knowledge-based models (transmission cycle, vector and host ecology) can assimilate remote sensing data, including population dynamics models for dynamic mapping of densities of mosquito vectors of dengue, chikungunya and Rift Valley fever. The advent of programming languages dedicated to spatial dynamics modelling, while allowing real-time assimilation of series of satellite image data, fosters this development (e.g. see the Ocelet modelling platform outlined on p. 45). The ever-increasing availability and accessibility of satellite and airborne imagery data, in conjunction with the development of techniques such as telemetry, has given rise to new research opportunities requiring a strong interdisciplinary approach between ecologists, epidemiologists, entomologists, geographers, modellers and remote-sensing specialists.

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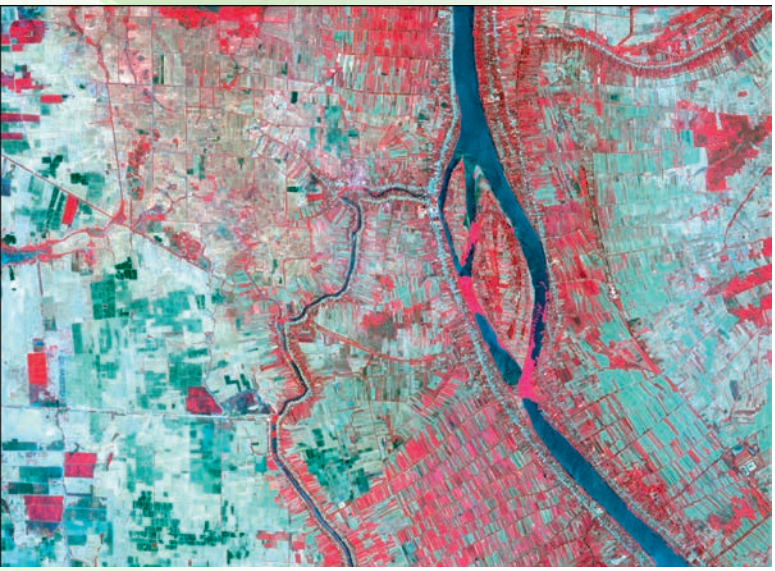
For further information: Theia Land Data Centre, Health & Wellbeing theme: https://www.theia-land.fr/en/themes/health-0



▲ *SPOT-6 image, Cambodia. High-resolution spatial images enable mapping of different land cover types that provide favorable habitats for different mosquito species or other vectors and reservoirs.*

▲ *Tsetse fly* **Glossina palpalis gambiensis.** *© O. Esnault/CIRAD*

▲ *Capturing mosquito vectors,* ***Senegal.*** *© A. Tran/CIRAD*