FIRST FOUR CLIMATE-SENSITIVE
INDICATORS

IDAlert has co-designed and co-developed the first set of indicators for climate-sensitive infectious diseases in the European context. These indicators aim to provide concise information, raise awareness, improve understanding, and facilitate informed discussions on the urgency and importance of addressing climate change and infectious disease preparedness.

CLIMATE CHANGE IMPACTS THE EMERGENCE AND SPREAD OF INFECTIOUS DISEASES IN EUROPE

According to the World Health Organization (WHO), climate change may become a significant global public health threat in the 21st century. It affects human health through multiple interconnected and interdependent pathways, making it challenging to discern cause and effect. Concretely, climatic conditions have been identified as a crucial factor in the emergence, re-emergence, and spread of infectious diseases. These conditions affect the survival, reproduction, and distribution of pathogens and disease vectors, influencing their transmission and distribution patterns. In Europe, climate change, and changing societal inequalities is increasing the vulnerability of European population to the transmission of several infectious diseases.

The indicators developed by IDAlert aim to improve understanding, facilitate communication, and provide early warning systems on intricate interactions between climate change and infectious diseases in Europe.

ENHANCING GLOBAL PUBLIC HEALTH RESILIENCE TO CLIMATE CHANGE

The full suite of IDAlert indicators facilitates proactive planning and implementation of adaptation policies, programs, and infrastructure improvements. This effort aims to protect public health and reduce vulnerability to health risks associated with climate change.

AN INDICATOR SUITE THAT MEETS END USERS' NEEDS

Ensuring the effectiveness, usability, and adoption of IDAlert indicators has been a critical and integral part of the project, involving early collaboration with stakeholders across sectors in co-designing, co-developing, and co-producing indicators, guaranteeing alignment with end users' needs and priorities.

BEYOND THE IDALERT PROJECT

The IDAlert indicators are integral to the new European initiative The Lancet Countdown in Europe, and will be integrated into the European Climate and Health Observatory to support policy and decision-makers in the European Commission and EU Member States. This first suite of indicators will be featured in The Lancet Countdown Europe report on climate and health, set for publication in 2024.

![IDAlert — Infectious Disease decision-support tools and Alert systems]

CLIMATE SUITABILITY INDICATORS

These four priority indicators focus on climate suitability for vector-borne and water-borne diseases. This enables health practitioners to identify areas at high risk of disease outbreaks.

DENGUE, CHIKUNGUNYA, AND ZIKA

Disease agent: Arboviruses.
Spread agent: Mosquito species *Aedes aegypti* and *Aedes albopictus* (also known as mosquito tiger).
**Model:** Mechanistic model

This indicator monitors the emergence of arboviral diseases in Europe by tracking human mobility and climatic conditions favorable to *Aedes* mosquitoes. It estimates mosquito reproduction rates and the length of the transmission season for arboviruses.

Human mobility is the movement of people travelling from endemic areas to European regions with suitable climatic conditions for *Aedes* mosquitos.

Climate conditions (temperature, rainfall, latitude, and human population density) have a direct impact on mosquito abundance and, indirectly, on the transmission rates of the disease.

Climate suitability for Aedes — Human mobility
Mechanistic model
Emergence of arboviral diseases in Europe
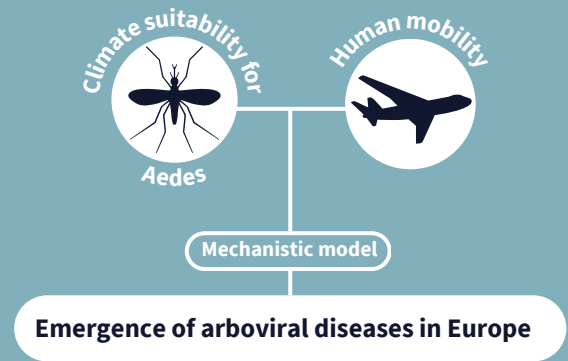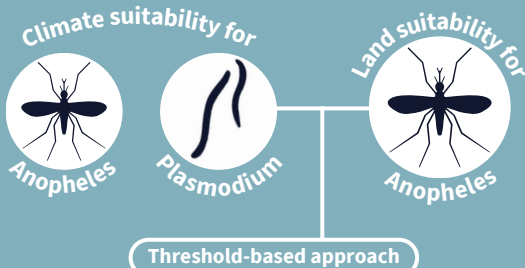
MALARIA

Disease agent: *Plasmodium* parasite
Spread agent: *Anopheles* mosquitoes.
Model: Threshold-based approach

The indicator assesses the number of months per year with climatic conditions suitable for malaria transmission, as well as the landcover classes suitable for *Anopheles* mosquitoes.

Both the *Anopheles* mosquitoes and *Plasmodium* parasites are very climate-sensitive, thriving within specific limits of **climatic conditions** (temperature between 14.5ºC and 33ºC, and relative humidity greater than 60%).

In addition, *Anopheles* mosquitoes proliferate in specific **land cover uses**, such as race fields, permanently irrigated croplands and sports and leisure facilities.

Climate suitability for Anopheles — Plasmodium — Land suitability for Anopheles
Threshold-based approach
Number of months per year suitable for the transmision of *Plasmodium* parasites

WEST NILE VIRUS (WNV)

Disease agent: West Nile Virus
Spread agent: There are multiple, being *Culex* mosquitoes considered the principal vectors
Model: Supervised machine learning model

This indicator monitors the evolving risk of West Nile virus transmission in Europe by comparing current infection data with climatic variables.

It provides the risk of WNV outbreak considering the actual **case records of infection** from different regions of Europe with data on those **bioclimatic variables** that affect the spread of the virus.

WNV infections data — Bioclimatic variables
Supervised machine learning
Change in the risk of West Nile virus transmision in Europe
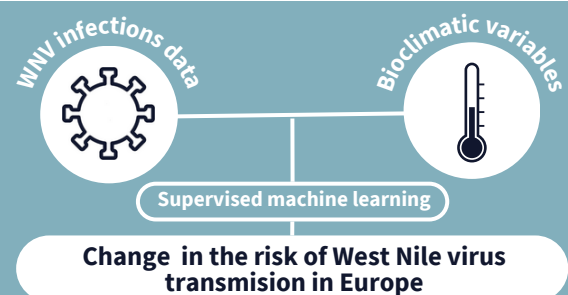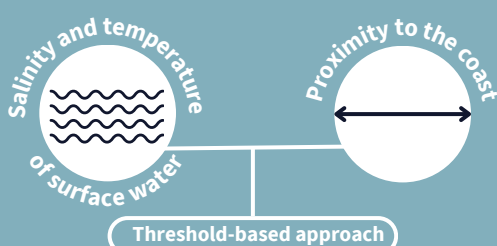
VIBRIO

Disease agent: *Vibrio* bacteria
Spread agent: Water
Model: Threshold-based approach

The indicator provides a proxy for the areas at risk of infections by mapping environmental suitability for non-cholera *Vibrio* bacteria in coastal zones on a global scale.

Vibrio bacteria, found in **warm estuarine and coastal waters** (>18ºC, closer than 10km to the coastline) **with low to moderate surface salinity** (<28PSU) worldwide, can cause sporadic cases of illnesses such as gastroenteritis, wound infections, ear infections, or even potentially fatal septicaemia.

Salinity and temperature of surface water — Proximity to the coast
Threshold-based approach
Proxy for the areas at risk of infections