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JOINT ICTP-IAEA CONFERENCE ON PREDICTING DISEASE PATTERNS ACCORDING TO CLIMATIC CHANGES

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BOOK OF ABSTRACTS

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CONTENTS

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PREFACE

Detection of infectious diseases at larger and larger regions is partially due to the improvement in diagnostic systems. Their spreading is also due to changes in transportation systems, in the habitat's extension (specially for vector borne diseases) and to changes in climatic conditions. Therefore one needs to take climate into account in modelling epidemics.

This Conference should give disease specialists and epidemiologists an insight into current research in climate modelling with the aim of improving the predictive power of epidemiological models by integrating climatic data and forecasts.

The influence of climatic conditions and the predictability of epidemics will be discussed also on specific case studies, such as the ongoing Coordinated Research Projects by IAEA focusing on a Rift Valley Fever and Avian Influenza.

Consequence of this meeting should be a better cooperation between climatologists and epidemiologists to improve the data base and exchange practises due to better understanding respective needs and limitations.

ORGANIZERS:

Director: Hermann Unger - IAEA, Vienna, Austria
Local Organizer: Matteo Marsili - ICTP, Trieste, Italy

INVITED SPEAKERS:

Giulio De Leo - University of Parma, Italy
Leopold Haimberger - University of Vienna, Austria
Jeremy Pal - Loyola Marymount University, Los Angeles, USA
Dirk U. Pfeiffer - Royal Veterinary College, UK
Franz Rubel - University of Veterinary Medicine of Vienna, Austria
Thomas Selhorst - Federal Research Centre for Animal Health, Germany
Lorenzo Tomassini - Max Planck Institute for Meteorology, Germany
Wolfgang Wagner - Vienna University of Technology, Austria

ABSTRACTS OF TALKS AND CONTRIBUTED TALKS

(as per presentation order on the preliminary programme)

SESSION 1 - ABSTRACTS

Modelling for Informing Policy Development: Constraints and Challenges

Dirk Pfeiffer, Royal Veterinary College, London, UK

Policy development has to consider a variety of sources of information, one of them being the outcome of risk assessments. Models are used as part of risk assessments to quantify risks and identify key risk factors, and also to evaluate and possibly compare different policy options. The challenge with such models when aimed at supporting the policy development process is to achieve an adequate level of understanding amongst decision makers with respect to the strengths and weaknesses of a particular model. As part of this the validity of a model and the uncertainty associated with model outputs needs to be communicated in an effective manner. It is also important for policy makers to not expect too much from a predictive model, and to accept that they will always have to apply opinion and judgement when considering the outcomes of the models in the policy development process. Examples will be presented of recent complex decision scenarios in relation to animal health.

Global warming and mosquito-born diseases in mid-latitudes

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After an overview on recent epidemics of mosquito-born infectious diseases in mid-latitude (West Nile virus in the U.S.; Usutu virus and bluetonge virus in Central Europe) a general approach to explain the dynamics of these diseases will be introduced. It is based on epidemic models forced by weather or climate data. This process models must be able to simulate the seasonal cycles of vector populations (mosquitoes) and hosts populations (e.g. birds) as well as virus cross-infections. Observed and predicted climate data are specified for e.g. the temperature-dependent development rates of the mosquitoes as well as the temperature-dependent extrinsic-incubation periods. Finally, applications for short- and long-term predictions of mosquito-born diseases are demonstrated by selected case studies.

Rubel, F., K. Brugger, M. Hantel, S. Chvala, T. Bakonyi, H. Weissenböck, and N. Nowotny, 2008: Explaining Usutu virus dynamics in Austria: Model development and calibration. Prev. Vet. Med., in print.

Brugger, K., and F. Rubel, 2008: Explaining Usutu virus dynamics in Austria: Simulation of climate change scenarios. Prev. Vet. Med., revised.

Modeling the impacts of climate change on water resources, agriculture, and extreme events.

Jeremy S. Pal, Noah S. Diffenbaugh, Sara A. Rauscher

Increases in atmospheric greenhouse gases are likely to result in substantial changes to temporal and spatial distribution of temperature and precipitation. Global climate models (GCMs) are powerful tools for projecting climate change over large regions. Their typically limited spatial resolution, however, does not allow us to make projections of the impacts climate at scales that matter to humans. Regional climate models (RCMs) have been developed to help bridge the scaling gap of climate change projections provided by GCMs and those needed for assessing impacts. This presentation will focus on providing an understanding of regional climate models and how they can be used for predicting the impacts of climate change on water resources, agriculture, and vector borne disease at scales useful to humans.

The Influence of the Fraction of Vaccinated Individuals on the Incidence of Tuberculosis

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Abstract

The effectiveness of the Bacille Calmette-Guérin (BCG); the only vaccine in current use against tuberculosis, in preventing tuberculosis is controversial; studies have shown variable efficacy. The estimates of protection range from 0 to 80 percent, and this variability is aggravated by an association between low vaccine efficacy and high prevalence of the disease.

A mathematical model for the dynamic of tuberculosis incorporating vaccination is proposed. From the analysis of the disease free equilibrium and the endemic equilibria, a new reproduction number is derived. Conditions for local and global stability of equilibria are conducted. The influence of the fraction of vaccinated individuals on the incidence is examined.

[0]Keywords: BCG Vaccination, Mathematical Model, Reproduction Number, Stability.
MSC2000 Classification: 34D99, 92D30.

SESSION 2 - ABSTRACTS

Climate modeling – global and regional scenarios

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Climate models serve to integrate the knowledge about the climate system und to study and simulate the interactions between its components. They are designed for studying climate processes and natural climate variability, and for projecting the response of the climate to human-induced forcing. The nucleus of the most complex AOGCMs is based upon physical laws describing the dynamics of atmosphere and ocean, expressed by mathematical equations.

Since the beginning of the Industrial Revolution, mid-18th century, the impact of human activities has begun to extend to a larger scale, continental or even global. Human activities, in particular those involving the combustion of fossil fuels for industrial or domestic usage, and biomass burning, produce greenhouse gases and aerosols which affect the composition of the atmosphere. Such effects change the radiative forcing and have a potential impact on regional and global climate.

Since the Industrial Revolution, the concentration of various greenhouse gases has increased. The amount of carbon dioxide, for example, has increased by more than 30 % since preindustrial times and is still increasing at an unprecedented rate of on average 0.4 % per year. The concentration of other natural radiatively active atmospheric components, such as methane and nitrous oxide, is increasing as well due to agricultural, industrial and other activities.

Climate models are used to simulate and quantify the climate response to present and future human activities. This is done in two steps: first the present climate is simulated for extended simulation periods, typically many decades, under present conditions without any change in external climate forcing; second the model is forced with a greenhouse and aerosol scenario. The difference between such simulation and the baseline simulation provides a projection of climate change.

We present the results of various climate change simulations using global and regional climate models and discuss potential impacts of a warming earth.

Climate and Insects

Thomas Selhorst
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Institute of Epidemiology, Wusterhausen, Germany

The presentation deals with all aspects of modeling the influence of temperature on the dynamics of insect populations.

The population dynamics of poikilotherm organisms like insects depend on temperature and humidity i.e. depend on the weather conditions. Climate change influences local weather conditions and therefore has a significant impact on the population dynamics of insect population dynamics and its geographical extension.

The dynamics of insect populations is governed by the mortality, fecundity and by the duration of the growth stages. All these processes describe a time frame: the time form birth to death, the time to fertility and the time needed to develop from one growth stage to the following one. The durations of these processes can be measures in controlled experiments using climatic chambers.

It has been observed that the duration of all the processes can be modeled with the use of lifetime distribution functions. The parameters of these functions are different for different constant temperatures used in experiments. With the help of secondary functions parameter dependency of the lifetime distribution functions on the temperature can be modeled.

In order to predict the dynamics of insect populations depending on temperature the models developed above can be used to parameterize e.g. transition matrices. With the help of the matrices indices (dominant eigenvalue, eigenvectors) describing the overall dynamics can be calculated. Furthermore, the models are expected to predict insect population dynamics with fluctuation temperatures. These predictions can be validated with controlled field experiments.

Studies on Thermal Health Effects of Climate Change – India

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ABSTRACT

The present global warming has already perturbed the global climate system for the present climate change from the acquired radiative forcing from the greenhouse gases emissions and land-use changes that triggered the extreme climate events across the globe together with the risks to not only to humans but even plant and animal species and that has been destabilizing the economy of the nations that come under its finger-prints and warns us for a proper understanding of the intensity and frequency of these to manage with minimum casualties. The physiological failures of the human system under extreme heat or cold related climate stress are of utmost concern in diagnosing the acute and chronic ailments but the present report addresses the increased climate related heat stress that might govern the lives and adversely affecting productivity through efficiency, energy costs, recreational patterns and societal factors. The thermal effects of climate change on human system are reported using the well known bioclimate concepts of heat load, heat storage (MENEX model), thermal strain and relative strain over India for the months of hot weather season not only in distinct epochs for a comparative study but also expressed in terms of physiological significance since the extreme summer weather provoke reflexive and involuntarily physiological responses to maintain hemostasis. The climate related heat stress over India in terms of heat load, net heat storage, thermal and relative strain varied in space over India in the hot weather season and increased as the summer progress with a simultaneous health risks that might support clinical syndromes that include cardiovascular and respiratory diseases. The hill stations were well below the threshold risk values of heat load and net heat storage but were subjected to lower order of physiological stress.

Climato - health for urgent intervention

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SESSION 3 - ABSTRACTS

Role of infection in an eco-epidemiological system - a mathematical study

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Mathematical ecology has its roots in population ecology, which treats the increase and fluctuations of populations. It was along these lines that Lotka (1924) and Volterra (1926) established their original works on the expression of predator-prey and competing species relations in terms of simultaneous nonlinear differential equations, making the first breakthrough in modern mathematical ecology.

The importance of transmissible disease in an ecological situation is not to be ignored. There are many references in this context (Beltrami and Caroll (1994), Chattopadhyay and Pal (2002)) in such eco-epidemiological system. The viral disease can infect bacteria and even phytoplankton in coastal water.

Chattopadhyay et al (2003) dealt with the problem of a classical predator-prey dynamics in which viral infection spread on prey population and classical predator-prey system is splitted into three groups, namely susceptible prey, infected prey and predator. They observed the dynamical behaviour of this system around each of the equilibrium and point out the "exchange of stability".

Force of infection in any eco-epidemiological system is of great importance. In this paper we have considered standard incidence as the force of infection. This system is of rich dynamics in zero equilibrium. Moreover, the co-existence of the species is of ecological importance. We find some conditions on this force of infection for which the extinction possibilities of the species may overcome. We investigate the criteria for which the system will persist. We may conclude that infection factor may act as a biological control.

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Epidemiology and Diagnostic Techniques of Rabies in Indian prospective

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Abstract

Rabies has been recognized in India since the Vedic period (1500–500 BC) and is described in the ancient Indian scripture *Atharvaveda*,(1)The dog population of India is around 25 to 30 million. With an estimated dog: man ratio of 1:36 Most of these are ownerless or stray dogs. The majority of the stray dog population is found in rural areas. These dogs play a major role in the spread of rabies. (2)At present, rabies is reported from all areas in India except Andaman, Nicobar and Lakshadweep Islands.(3) Human infection by rabies virus usually occurs as a result of a transdermal bite or scratch from an infected wild or domestic animal. (4) All mammals are potentially susceptible to rabies, but only a few species are considered to be reservoirs of rabies and these vary globally(5) .

The virus reaches its highest titer in the brain, making postmortem examination of brain tissue the most reliable diagnostic procedure. (6) The standard test for identifying rabies over the past 40 years has been the direct fluorescent antibody (DFA) test which can identify the presence of rabies virus in the tissue(s) examined. (7)

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MODELLING THE EFFECT OF GEOGRAPHICAL LOCATION , EDUCATIONAL QUALIFICATION AND AGE ON STATE OF CANCERS: HIERARCHICAL LOG-LINEAR APPROACH

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ABSTRACT

This paper deals on modeling the effect of geographical location, educational qualification and age on the state of cancers using hierarchical log-linear approach. Data on cohort of cancers were collected from University of Ibadan Teaching Hospital, Ibadan, Nigeria. Results were analysed using hierarchical log-linear analysis to find the association between the categorical variables. It was observed that 4^{th} and 3^{rd} order effects had no significant contributions to the saturated model, but three of the 2-way and 1-way effects were significant. This means that the major determinants of states of cancer patients are age and geographical location of the patients. Hence effort at combating cancer should seriously be targeted at these two important variables.

KEYWORD: Saturated model, hierarchical, categorical , parsimonious model, restricted model.

Atmospheric control of Aedes aegypti populations in Buenos Aires (Argentina) and its variability (Ruben Bejarán)

The mosquito *Aedes aegypti* is the main urban vector responsible for the transmission of dengue fever and dengue hemorrhagic fever. The city of Buenos Aires, Argentina, is located at the southern end of the world distribution of the species. The population abundance of *Ae. aegypti* is mainly regulated by environmental factors.
We calculated the potential number of times that a female could lay eggs during its mean life expectancy, based on potential egg production and daily meteorological records. The model considers those variables implying physical hazard to the survival of *Ae. aegypti*, mosquito flying activity and oviposition. The results, obtained after calibration and validation of the model
with field observations, show significant correlation ($P<0.001$) for different lags depending on the life stage.
From these results, more favorable atmospheric conditions for *Ae. aegypti* reproduction (linked to the urban climatic change) can be observed. The climatic variability in the last decade resembles conditions at the end of 19th century.

Dengue transmission risk maps of Argentina(Ruben Bejarán)

Dengue is an emerging disease that has become important in Argentina because of its vector's presence (Aedes aegypti) and its endemicity in neighbouring countries. Thematic maps were built for Argentina considering four main factors: population susceptibility to dengue virus infection (population density); entrance of the virus from endemic countries (main roads and airports); conditions for the vector (urbanization, altitude, minimum, maximum and mean daily temperatures) and virus extrinsic incubation period (EIP) completion in the mosquito before its death. EIP duration was modelled with a temperature-dependent function and considering life expectancies of 10, 15 and 20 days for the adult mosquito.
The results show maximum risk of dengue transmission in the northern and north-eastern part of the country year-round and in the centre during the summer. Although life expectancy of the adult mosquito has a considerable in¯uence on EIP completion, the north-east to south-west decreasing gradient is maintained. Assuming 20-day life expectancy, the EIP would be completed in almost any region of the country; whereas with 15-day life expectancy it would be limited to vector distribution area, and at 10 days it would be restricted to the northern extreme of the country.

Chemical Composition of Atmospheric Precipitation as an Indicator of Local Impact on Global Air Quality Change

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Precipitation is one of the factors of chemical composition forming of surface and ground water. Its role is the most important in the discharge-forming zone. Study of the chemical composition of precipitation allows estimating influence of both nature-climatical and anthropogenic factors on precipitation quality.

The aim of the investigations is to reveal forming features of chemical composition of precipitation in zones with different natural-climatical conditions and various ranges of ecological load and to find out anthropogenic impact on precipitation quality.

Precipitation was selected as an investigation subjects. It was collected in a complex background monitoring, in a meteorological station located in a developed industrial center and a meteorological station, which is situated at some distance from an industrial center.

Precipitation samplings were conducted using standard methods.

The data of component composition of inorganic anions and cations obtained for 17 observation years have been analyzed.

Sulfur oxide, nitrogen oxide, carbon oxide, and various composition paniculate matters are primary components of emissions polluting air over Tashkent region.

The most polluting precipitation was collected in MS Kaunchy. The highest concentration of sulphates, nitrates, hydrocarbonates were found there. It is likely, emissions from other industrial centers transferred with air masses influence local source of pollution in Kaunchy stations, especially in Tashkent city.

Therefore local atmosphere pollution plays an important role in process. If precipitation pollution levels in industrial and back ground zone are compared the admixture concentration is much higher in industrial zone.

SESSION 4 - ABSTRACTS

Emerging diseases; early detection and rapid response

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In order to control and reduce the impact of emerging diseases on animals and humans, their epidemiology in correlation to geographical and climatic settings has to be known. This includes as well the viability in vectors and maintenance hosts. For Rift Valley Fever the maintenance of the virus in infected mosquito eggs was long seen as the major factor leading to outbreaks. Epidemiological studies in Kenya during the RVF outbreak showed the important role of wildlife and their infection / immunity rate. This adds an important replication factor for the virus. So outbreak predictions, today mainly based on weather factors, have to take this into account. In order to generate models for RVF outbreaks, the immunity rate of animal populations, domestic and wild, and the prevalence of the virus in a given region must be monitored. For such an endeavour suitable diagnostic tests together with sentinel herds and a rapid reporting system are vital to produce up to date information for the continuous update of prediction models to create risk alerts.

Remote Sensing for Epidemiological Studies

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Earth observation satellites and airborne sensors are increasingly used in epidemiological studies. The most common usage of remote sensing has been to delimit vector habitats or breeding sites using high to medium resolution satellite images. Some studies have also used remotely sensed vegetation and surface temperature data to characterize the vector ecosystem. Nevertheless, it has been pointed out by several authors that beyond the recurrent praises for the use of remote sensing tools in epidemiology, the range of uses, data and processes have been limited to a few. Problems have encompassed, but are not limited to, the high costs of high resolution (< 10 m) images and the technical expertise required for selecting, processing and analyzing the remote sensing data. These problems are not unique to epidemiology, but are shared with many other applications requiring earth observation data. In recognition of these problems, space agencies and other public organizations have started extending their ground processing facilities to produce land cover and many other geophysical products, such as leaf area index, surface temperature, soil moisture, water dynamics and many more. As a result, epidemiologists do not any longer need to process and interpret the remote sensing data themselves, but can concentrate on unraveling the complex dependencies of vector dynamics on environmental controls. This contribution reviews recent developments in remote sensing in general, and then shows some new remote sensing products derived from radar (soil moisture, wetland dynamics) and lidar (topography, vegetation height) observations that might open new opportunities for epidemiologic studies.

An assessment of the impact of climate change on food production, water availability and health condition in India

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Changing climate pattern is a serious challenge to the food and water securities in India, because of the large and fast increasing population, fast degrading land and water resources, inadequate finance and the lack of a proper mitigation strategy and adaptation mechanism. India is included in the list of countries potentially threatened by desertification. One-sixth of the country is already drought-prone. With large areas of cultivation still rain-fed, extremes in rainfall and temperature affect farming in different parts. Climate change together with changing policies favouring industrialisation is gradually leading India towards a food crisis. This has reflections in all facets of life, as life of millions is related to agriculture and related activities and nearly 40% of the rural poor live below poverty line. Water availability in certain states has been falling sharply due to changes in the amount as well as the seasonality of rainfall. Changes in the frequency and intensity of severe weather systems and the possible sea level rise are of serious concern in the thickly populated coastal zones. Changes in wind speed and direction may affect the coastal circulation and upwelling patterns and so the fish population, affecting the life of millions depending on marine resources around the 7500Km coastline. Salinity intrusion may contaminate aquifers further inland. Perhaps the most significant impact of climate change may be on the health conditions. Cold waves and heat waves are becoming severe and casualties are reported in places where it never occurred before. Children and the aged suffer more from respiratory problems associated with high humidity. Vector-borne deceases spread into more areas. In the year 2007, almost one-fourth of the population of the southern State of Kerala was affected with Chicun guinea, Dengue fever or Japanese encephalitis. An assessment of the impact of climate change on various sectors in India, especially food production, water availability, and health condition and their impacts on the society, and a review of the current strategies and polices to meet such challenges have been made.

Correlation between plasmid pSFn1 and Virulence of *Vibrio nigripulchritudo*

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Vibrio nigripulchritudo, the etiological agent of *Litopenaeus stylirostris* summer syndrome, is responsible for mass mortalities of shrimps in New Caledonia. Epidemiological studies led to the suggestion that this disease is caused by an emergent group of pathogenic strains. It appears urgent to develop reliable diagnostic tools to detect virulent *V. nigripulchritudo* strains. Indeed, *V. nigripulchritudo* strains are easily identifiable taxonomically using phenotypic characters, however, experimental infections revealed that only some of them are virulent. Furthermore these strains were found undistinguishable from avirulent ones using classical biochemical tests. Genomic subtractive hybridization was carried out between two strains demonstrating no (driver) and high (tester) virulence. Our subtraction library was constituted by unique tester-specific fragments, some of these unique fragments were only detected in the strains demonstrating the highest pathogenicity suggesting that they could be used as genetic markers for high virulence capacity. Interestingly, majority of these markers are carried by a replicon of 11,2 kbp that share strong identities with a plasmid evidenced in *Vibrio shilonii,* a coral pathogen. The origin and consequences of this plasmid acquisition will be discussed.

SESSION 5 - ABSTRACTS

Seasonality, climate change and the dynamics of infectious diseases

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The dynamics of infectious diseases in the wildlife may exhibit a strong climatic footprint. In many cases, outbreaks are clearly synchronized with seasonal fluctuations in temperature, humidity and rainfall patterns. Climatic fluctuations can affect the infective agent either directly by modifying the life-expectancy of free living stages or, indirectly, through changes in behaviour, demography (timing of reproduction, mortality, etc.), abundance (birth pulses, resources availability) and immune response of the host. This may result in turn in a change of probability of transmission between susceptible and infected animals or between susceptible hosts and infective stages/propagules. In the present work we illustrate two examples of how seasonality in meteo-climatic variables can affect the dynamics of infectious diseases caused by micro and macroparasites. In the first case, we investigate how seasonal fluctuations in demography of the host affect the dynamics of rabies epidemics and we show how short-living, fast-reproducing host species may respond to seasonality differently than long-living, slowly reproducing ones. The second example is about the effect of seasonality in the development of hypobiosis (arrested stage of development of parasite larvae in the gut mucosa of the definitive host), a strategy carried out by a number of nematodes species to overcome harsh environmental conditions - such as extremely drought summers or very cold winters - during which survival of free-livings stages (and, thus, the probability of infection) is low or negligible. In both cases, modifications in the seasonal forcing due to anthropogenic climate change have the potential to alter the parasite burden, the prevalence of infective individuals and the abundance of the host. In the temperate areas of Europe, for instance, winter seasons have been progressively milder in the last 30 years and possible effects both on host demography and on the transmission of infectious diseases have begun to be observed.

Epidemiology of bluetongue in Northern Europe

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Identification and prioritisation of risks from vector borne diseases and climate change in Europe – output of EPIZONE, an EU network of excellence

A. Lindberg[1], P. Gale[2] and participants of EPIZONE Work Package 7.4 (see www.epizone-eu.net)

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EPIZONE is an EU funded Network of Excellence with a main strategic objective to improve research on preparedness, prevention, detection and control of epizootic diseases through integration and collaboration, while taking into account the public health concerns of stakeholders throughout the food chain. The network operates as a virtual institute with scientific activities organised in 4 vertical integration themes; Diagnostics, Intervention Strategies, Surveillance and Epidemiology and Risk Assessment, which in turn are organized in work packages (WP). Within the Risk Assessment theme, WP 7.4 is devoted to identifying new, emerging and re-emerging viruses which have the potential to enter the EU due to changing environmental factors, such as climate change, and their consequences on the distribution of virus vectors. Due to the nature of the topic, a broad range of experts are engaged in the WP; risk analysts, epidemiologists, virologists, parasitologists/entomologists and pathologists from nine of the 19 consortium partners.

During the initial work period of 18 months, starting in June 2006, the work package developed a hazard identification, focusing on risks associated with the impact of climate change on the distribution of arthropod vectors of importance for transmitting epizootic viruses. The vectors considered were *Culicoides* biting midges, mosquitoes, ticks and sand flies. The hazard identification was structured according to a framework that was developed specifically for this task, to ensure that the information collected was equivalent and that qualitative conclusions on the risks to the EU could be drawn. The starting point was the identification of epizootic viruses that could be spread by vectors in EU. Secondly, the impact of climate change in Europe on the vector population was considered, followed by the identification of possible routes of infected vector introduction into Europe. For each vector, climatic factors that affect susceptibility of a vector to replication of the virus, or to maintaining infection in the vector were identified, as well as the presence of hosts and their immune status with respect to the agent in question.

Following the hazard identification, an expert opinion workshop was performed, with the purpose to prioritise the identified vector-borne livestock diseases in terms of their likelihood of release into the EU, livestock exposure and their consequences on animal health. The elicitation of expert opinion followed a modified Delphi technique, using a questionnaire developed and piloted by one of the partners (Veterinary Laboratories Agency, Weybridge, UK). The structure of the questionnaire followed the risk assessment framework of the OIE, with release (risk of introduction), exposure (risk of livestock being exposed, given entry) and consequence assessment (risk of infection, given exposure) to provide input for the final risk estimation/prioritisation. After exclusion of viruses for which the level of expertise was considered low, five agents were considered in the final prioritisation. These were; West Nile Fever virus (WNFV), Rift Valley Fever virus (RVFV), Crimean-Congo Haemorrhagic Fever virus (CCHFV), African Swine Fever virus (ASFV) and African Horse Sickness virus (AHSV).

The joint outcome of the workshop suggested that ASHV, RVFV and CCHFV had an increased overall risk of emerging due to climate change, whereas WNFV and ASFV would be less affected. The work package has now moved on to explore the feasibility of developing an EU-wide qualitative risk assessment for the impact of climate change on the presence of CCHFV infection in livestock. The feasibility study involves investigating the availability of data (including spatial) to support such an assessment, and also to review existing risk assessments for tickborne diseases in Europe.

SESSION 6 - ABSTRACTS

Approaches to Modelling of Infectious Livestock Disease Occurrence

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Modelling approaches have evolved significantly in the last 10-20 years, partly as a result of the continuously increasing computational power becoming available that allows the processing of complex statistical algorithms and also of large quantities of data. There are many ways of defining modelling approaches, one that is particularly useful when communicating with decision makers is to divide them into data- and knowledge-driven methods. Amongst data-driven methods, it is now possible to conduct statistically valid analyses with data that has a complex dependence structure. Fully Bayesian regression approaches are used, but the more traditional maximum likelihood methods have also been adapted so that different types of clustering within datasets can be taken into consideration. Knowledge-driven approaches have always been looked at by decision makers with some level of scepticism. This is due to their perceived susceptibility of bias resulting from using usually imperfect knowledge rather than 'objective' data, and in the case of simulation models it is associated with the difficulty to communicate assumptions and abstract mathematical mechanisms. In parallel, it has also been realised that the complexity of biological relationships and the need for scientific assessment of policy alternatives necessitates the use of such methods. Specific examples of data- and knowledge-driven modelling approaches will be presented.

USE OF BAITED LIVESTOCK TO CONTROL VECTORS OF RIFT VALLEY FEVER

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ABSTRACT

The first outbreak of Rift Valley Fever in Kenya was reported in the year 1912. However the isolation of RVF virus was first isolated in 1931 in Kenya in a town called Naivasha which lies on the floor of the great East African Rift Valley. Thereafter the outbreaks were recorded after every four (4) to five (5) years. The containment of the disease in all subsequent years involved vaccination of the animals within the infected and uninfected areas. The most recent outbreak was reported late in the year 2006 in areas with differing livestock farming systems that included pastoral, intensive, zero-grazing and free ranging farming systems. It is believed that this outbreak was due to the upsurge of virus activity from latent mosquito eggs in flooded areas that had previously registered an outbreak in 1997/98. To contain the situation, several strategies were put in place with the control activities launched early in January, 2007. The strategies involved an integrated approach that involved surveillance of the virus, sustained vaccination in uninfected areas, treatment, vector control, public awareness and control of livestock movement from infected to uninfected areas. Baited livestock using synthetic pyrethroids were used as mobile targets in the grazing fields and within homesteads. Netted zero-graze units, residue spraying of the habitat and application of the larvicides in the swamps were also used to control the vector in the infected and uninfected areas. Results and feedback from both the technical personnel and the community showed that the approach had considerable success though faced with several challenges.

Compartment models for Bluetongue (BTV 8) – mission impossible?

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Predicting the dynamics of Usutu virus according to climate change

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The emergence and spread of infectious diseases in mid-latitudes, so far mainly observed in the tropics, considerably increase under the current situation of climate change. Recent example is the Usutu virus (USUV) outbreak in Austria 2001 - 2005. This arthropod-borne virus (arbovirus) circulates between arthropod vectors (mainly mosquitoes of the *Culex pipiens* complex) and avian amplification hosts (mainly blackbirds, *Turdus merula*).

Rubel *et al.* (2008) developed an epidemic model to explain the USUV dynamics in Austria 2001 - 2005. It has been demonstrated, that the USUV dynamics was mainly determined by an interaction of developing proportion of the avian hosts immune and climatic factors affecting the mosquito population. This mechanism is implemented into the model that simulates the seasonal cycles of mosquito and bird populations as well as the virus cross-infections. Observed monthly climate data are specified for the temperature-dependent development rates of the mosquitoes as well as the temperature-dependent extrinsic-incubation period. The model reproduced the observed number of dead birds in Austria between 2001 and 2005, including the peaks in the relevant years.

Forcing the model with temperature predictions from climate models enable to simulate disease dynamics for climate warming scenarios (Brugger and Rubel, 2008). For the latter the *Tyndall Centre for Climate Change Research* dataset (TYN SC 2.0), based on 4 emissions scenarios defined by the *Intergovernmental Panel on Climate Change* (IPCC) *Special Report on Emission Scenarios* (SRES), is used. A total of 20 time series of temperature predictions have been selected to force the USUV model. The simulations cover the period 2001 - 2100. USUV will persist in the host population after the epidemic peak observed in 2003. Simulations of worst-case scenarios result in an endemic equilibrium with a decline of the blackbird population of 23.7 %. On average, however, a constant annual bird mortality of 7.3 - 11.9 % was predicted for the end of the century. Additionally the annually averaged basic reproduction number was calculated for the period 1901-2100. The latter depict that undetected major outbreaks before 2000 were unlikely, whereas it is likely that the USUV becomes endemic after 2040.

Rubel, F., K. Brugger, M. Hantel, S. Chvala, T. Bakonyi, H. Weissenböck, and N. Nowotny, 2008: Explaining Usutu virus dynamics in Austria: Model development and calibration. Prev. Vet. Med., doi:10.1016/j.prevetmed.2008.01.006.

Brugger, K., and F. Rubel, 2008: Explaining Usutu virus dynamics in Austria: Simulation of climate change scenarios. Prev. Vet. Med., revised.

Prediction of floods and other weather events causing diseases

Leopold Haimberger

Outbreaks of diseases are often related to floods or other extreme weather events such as heat waves. During floods or shortly after, mosquito populations can dramatically increase due to the optimal growing conditions for larvae. Floods often lead to shortage of clean water, since wells are contaminated and pumps fail. Especially if accompanied with storms, the infrastructure may be severely damaged, making supply with medicine difficult. Heat waves can lead to the spread of rare diseases normally confined to warmer regions. Examples from fauna and flora are the Usutu bird virus outbreak near Vienna, or the "fire blight" disease, leading to low apple yields. Outbreaks of diseases related to rare weather events are often severe due to the low immunization of the population.
The quality of weather forecasts has dramatically increased in the past 20 years, not only in the extratropics but also in the tropics. This allows prediction of severe weather events several days in advance. If used efficiently, the public can be warned early enough to take precautionary measures, especially distribution of bottled water and drugs prior to the damage of infrastructure. Thanks to improved communication, such as cell phone networks in Africa, substantial advances could be made by establishing efficient weather warning systems.
Lessons learned from weather forecasting and verification may be also interesting for the prediction of disease patterns as a dynamical system. The recent advances in meteorology have been possible due to systematic investments in the observing system, which allow both the determination of the initial state of the weather but also objective evaluation of changes in the forecast system.
Several examples illustrating the above considerations will be given during the talk.

SESSION 7 - ABSTRACTS

A framework to depict climate change induced-emergence of novel disease agents

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Whilst models are available to predict the impact of changes in temperature, humidity and the onset of spring time on the temporospatial behaviour of disease complexes, the full breadth and depth of these ecological dynamics are still difficult to capture. Climate change brings epidemic forms of disease, and may cause disease agents to intrude novel territories and ecologies, sometimes with spill-over to uncommon host species. These introduction events are rate dependent and more aggressive, opportunistic, and flexible pathogens have a relatively better chance to become established in a new developing host ecological vacuum. Where the progenitor (old) pathogen invasion translates a gradual lengthening of the transmission chain, it is possible that a novel pathogen emerges with an R nought value greater than one, leading to sustained transmission in the novel host niche. Once this bottleneck is taken, the new agent may start to rapidly spread to the full extent of the host ecological range. As epidemic waves settle down persistent foci emerge, providing an incentive to the pathogen to specialise and adjust to local host niches, pursuing sustained occupancy. The latter steps of pathogen emergence are conveniently captured by the classical invasion process, with introduction followed by establishment, diffusion, colonisation, and eventually consolidation in the form of a new pathogen displaying a novel host range, infection course and transmission pattern.

The Working Group 'Zoonotic Diseases' at the Swiss Agency for Development and Cooperation

The Swiss Humanitarian Aid Unit is a branch of the Swiss Agency for Development and Cooperation (SDC) and comprises expert groups on several topics, including drinking water and sanitation, construction, human medicine, prevention and preparedness, and rescue. The spread of Avian Influenza and the corresponding economic and public health risks have led in 2007 to the addition of a new expert group for the prevention, management and control of zoonotic diseases. The Working Group Zoonotic Diseases currently assembles 28 experts with a broad background in animal diseases and will support countries before, during and after outbreaks of zoonotic diseases or other animal diseases with potentially high impact on human livelihood. Focus of the work will be as much as possible on preparedness and prevention, risk assessment and risk management, communication, contingency planning, and public awareness, but support with the coordination of emergency disease control measures are in scope as well.

Climate change is supposed to be a key factor influencing the future spread of existing and the emergence of new animal diseases. The Working Group Zoonotic Diseases will organize an international workshop on the potential impact of climate change on production animal health from a humanitarian aid perspective. The workshop is scheduled for the fourth quarter of 2008 in Switzerland. Scientific and technical inputs from researchers in this field will be highly appreciated.

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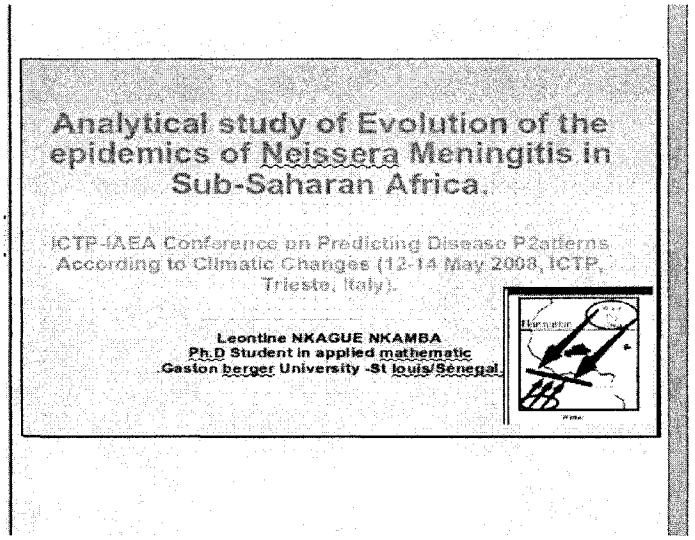

Summary:

Sub-Saharan Africa suffers from meningitises for more than 100 years, they arise on average all ten. The last two decades saw the period inter epidemic to repeat considerably, the epidemics of meningitis,after the diarrheic diseases and respiratory or the malaria, one of the main causes of to least than 15 years, These epidemics of meningitises concentrate in the said zone " belt d the meningitis " The belt of the meningitis is characterized by the alternation of a dry season in winter and a wet season in summer

. Alternation due to the movement in latitude of the intertropical front (zone of meeth winds (Harmattan) and the South winds (Monsoon) (harmattan is a warm and dry wind loaded with dusts, which weaken the mucous membrane of the respiratory system the passage of the bacterium in the blood what often pulls the release of the epidemics.

The epidgenerally during six first month of the year and come to an end with the arrival oft the OMS Recommends the emergency vaccination, strategie which is subject to warm discussions, studies led by researchers of the IRD to Niahkar (Senegal) on the impact of both strategies of vaccinations the one said about routine and the other one said immediately, about three years of epidemics (1998,1999,2000) showed the efficiency of the vaccination of routine.

The subject of miss Nkague Nkamba Leontine's thesis, titled mathematical Modelling of the infection to Neissera meningitis has for:

Main objective: confirm by simulation by means of the models the interest of the vaccination of routine.

Objective secondary: integrate the carriers and appreciate the cost of both strategies on the human and social plan.

Constraints: take into account the heterogeneousness of the individuals, and the spatial heterogeneousness.

Underlying theory: analysis compartmental.

SESSION 8 - ABSTRACTS

Airborne spread of foot-and-mouth disease virus

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Firstly, a review on the airborne spread of foot-and-mouth disease (FMD) virus is given. Secondly, a Lagrangian particle model to predict the airborne spread of FMD virus in the atmospheric boundary layer over a complex terrain is presented. Two case studies are made with study domains located in a hilly region in the northwest of the Styrian capital Graz, the second largest town in Austria. Mountainous terrain as well as inhomogeneous and time varying meteorological conditions prevent from application of so far used Gaussian dispersion models, while the proposed model can handle these realistically. In the model, trajectories of several thousands of particles are computed and the distribution of virus concentration near the ground is calculated. This allows to assess risk of infection areas with respect to animal species of interest, such as cattle, swine or sheep. Meteorological input data like wind field and other variables necessary to compute turbulence were taken from the high-resolution numerical weather prediction model LMK running at the German weather service. The LMK model provides meteorological parameters with a spatial resolution of about 2.8 km. To account for the spatial resolution of 400 m used by the Lagrangian particle model, the initial wind field is interpolated upon the finer grid by a mass consistent interpolation method. Case studies depict a significant influence of local wind systems on the spread of virus. Finally, it will be demonstrated that the Lagrangian particle model is an appropriate tool for risk assessment of airborne spread of FMD virus by taking into account the realistic orographic and meteorological conditions.

Mayer, D., J. Reiczigel, and F. Rubel, 2008: A Lagrangian particle model to predict the airborne spread of foot-and-mouth disease virus. Atmospheric Environment, 42, 466–479.

Rubel, F., and K. Fuchs, 2005: A decision-support system for real-time risk assessment of airborne spread of foot-and-mouth disease virus. Methods of Information in Medicine, 44, 590-595.

GIS based model for FMD

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After an outbreak of a highly infectious disease, the official veterinary authority (together with other organizations) controls the spreading of the infection by stopping animal movements or transports of possible fomites. But there are some other ways of spreading infections which can work beside these main routes. One of these possible ways is the airborne spread of virus, currently uncontrollable. So it is an interesting question, if there is an outbreak and we stopped the main routes of the spreading of infection, which areas are likely affected by airborne transmission of infectious particles.

To estimate the spatial pattern of risk based on climatic parameters some models can be used. One of these models is the so-called Gaussian dispersion model. Using this model one can calculate 3-dimensional virus plumes.

We developed a tool (PlumGen) that can help the user to estimate risk pattern of a certain area after an outbreak based on the Gaussian model. For this development as a model disease the foot-and-mouth disease (FMD) was used. The tool produces a Google Earth output which makes it easy to share the spatial pattern information of possible risk.

Molecular epidemiology & diagnosis of Foot and Mouth Disease virus (FMDV) and Peste des petits ruminants virus (PPRV) in field samples from Punjab, Pakistan

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Foot-and-mouth disease is a highly contagious, viral infection of cloven-footed animals. It is a major threat to world's livestock and of considerable economic importance. FMD can also spread on the wind, the survival of the virus is low at relative humidity below 60%, and wind-borne spread is favoured by the humid, cold weather common to the UK other countries. Peste des petits ruminants (PPR) is an acute, contagious, viral disease of small ruminants, especially goats, which is of great economic importance in parts of Africa and the Near-East. It is transmitted mostly by aerosol droplets between animals in close contact. However, the appearance of clinical PPR is often associated with the onset of the rainy season or dry cold periods pattern that may be related to viral survival.

The in view of climate change and emergence and re-emergence of transboundary animal diseases (TADs), e.g., Foot and Mouth Disease (FMD) and Peste des petits ruminants (PPR) strongly indicate the need for the development of powerful and sensitive diagnostic methods. Molecular biological techniques have been successfully exploited to improve both the speed and accuracy of disease diagnosis. Molecular epidemiology and viral phylogeny provide new possibilities to combat and eradicate infectious diseases. The polymerase chain reaction (PCR) has proved to be very powerful tool for disease diagnosis and molecular epidemiology

At our lab PCR based detection was successfully applied to field samples collected from different districts of Punjab, Pakistan. For molecular epidemiology of these viruses, PCR amplification of specific gene fragments was carried using strain specific primers. These PCR products were cloned and sequenced for studying genetic relationship between different isolates from various geographical regions. We found that all of our recent isolates of PPRV collected from Punjab area fell into lineage-4. Similarly direct sequencing of PCR product derived from FMD field samples showed more than 90 % homology with type 'O' FMDV. Similar work on other zoonotically important disease brucellosis is also being carried out. Work on setting up of PCR based diagnosis of avian influenza was also done. Moreover, at our lab we do environmental monitoring and environmental toxicology studies. Risk assessment of exposure to different hazardous agents is also being done. Our lab is certified by Environmental Protection Department.

SESSION 9 - ABSTRACTS

Spatial analysis of H5N1

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Outbreak Investigation on Emerging and Re-emerging Infectious Diseases in Sri Lanka

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Increasing trend in infectious disease outbreaks has become a serious public health concern in Sri Lanka during this decade. Dengue, Chikungunya and Leptospirosis are three main infectious diseases which have appeared as major outbreaks during the recent past.

Since the year 2000, the country has been experiencing more frequent outbreaks of dengue with major outbreaks in 2002 (8931 cases), 2004 (15463 cases) and in 2006 (11972 cases). In 2008, during the first quarter itself, 2132 cases have been reported, predicting another major outbreak. Entomological investigations have revealed that in addition to *Aedes aegypti, Aedes albopictus* also plays a significant role in transmitting the disease.

Chikungunya reappeared as a massive outbreak in the island in 2006 after about 40 years of its first appearance. Although it was assumed that it may not continue or re-emerge soon, the disease outbreaks continued in several districts of the island in 2007 and in 2008, at present, a massive outbreak is being continued in several districts of the country debilitating thousands of the farming community in rural areas. *Ae.albopictus,* breeding in latex collecting coconut shells in rubber plantations and in axils of banana trees in banana plantations was incriminated as the major vector of chikungunya in rural areas.

An increasing trend in leptospirosis with high mortality rates (22 %) has been observed in several districts of the country. Increased use of abandoned paddy fields where rats are commonly found is believed to be a possible factor contributing to outbreaks this year. However many cases have been reported in non-farmers suggesting occurrence of domestic transmission.

Molecular diagnostic methods have been extremely useful in confirming infectious disease outbreaks in Sri Lanka. Capacity for outbreak investigation in the country needs to be strengthened towards understanding disease outbreaks from ecological, biological and sociological perspectives.

Bird Mortality in Ethiopia: Causes and Threats

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Ethiopia is home to about 52 million domestic poultry and 835 species of resident wild birds (about thirty are endemic). The poultry in Ethiopia mainly includes chickens and 98% are reared in low input backyard production system. Only 2% are kept in commercial poultry production facilities and poultry breeding and multiplication centers. Breeding and multiplication center are genetic improvements centers which select, breed and multiply selected poultry breed to distribute for farmers as day old chick and pullets.

A wide range of poultry diseases are prevalent in Ethiopia. However, poultry diseases caused serious threat to the country only after occurrences global pandemic of highly pathogenic avian influenza (HPAI). In response to the global occurrence of the pandemics, Ethiopia has been undertaking activities which enable early detection and control of the problem since October 2005. Since then serious outbreaks have occurred in poultry breeding and multiplication centers, backyard poultry and wild doves and pigeons at different times. Investigation of these outbreaks had identified the cause of mortality in breeding and multiplication centers as Infectious bursal Disease (Gumboro Disease), in backyard poultry as Paramyxovirus-1 (Newcastle disease) and in wild birds as Pigeon Paramyxovirus -1. Until now no case of highly pathogenic avian influenza was reported in Ethiopia.