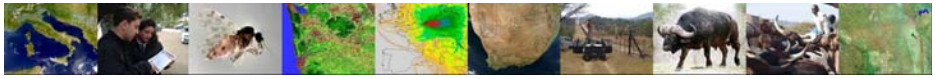
epiSTIS

Remote sensing tools to study the EPIdemiology and Space/TIme dynamicS of diseases

[**EPI**demiological **S**pace **T**ime **I**nformation **S**ystem]

Louis van Schalkwyk

AHEAD GLTFCA WG 05-03-2008



epiSTIS Partners

- **University of Pretoria / Peace Parks Foundation**
  - Department of Veterinary Tropical Diseases: Koos Coetzer, Nick Kriek, Wilna Vosloo
  - Louis van Schalkwyk
- **Université Libre de Bruxelles**
  - SIGTEL: Eléonore Wolff & Sabine Vanhuysse
  - LUBIES: Marius Gilbert & Thibaud Rigot
- **Institute of Tropical Medicine, Antwerp**
  - Animal health department: Peter Van den Bossche & Claudia De Pus
- **Université Catholique de Louvain**
  - Department of Geography: Eric Lambin & Elise Dion
- **Avia-GIS**
  - Guy Hendrickx & Els Ducheyne
- **Istituto Zooprofilattico Sperimentale, Teramo, Italy**
  - Annamaria Conte, Maria Goffredo & Carla Ippoliti
- Broader multidisciplinary group will remain operational beyond end of project

epiSTIS Objectives

- Main epidemiological hypothesis
  - Remote Sensing tools can be developed to highlight the spatial patterns that underlie - in time and space - the epidemiology of certain diseases
- Two main scientific objectives
  - Explore how a wide range of RS tools and GIS can be integrated and contribute to the understanding of the space/time dynamics (i.e. the outbreak risk / spread) of diseases
  - Explore how integrated spatial analysis outputs can contribute to improved information and decision support for disease management

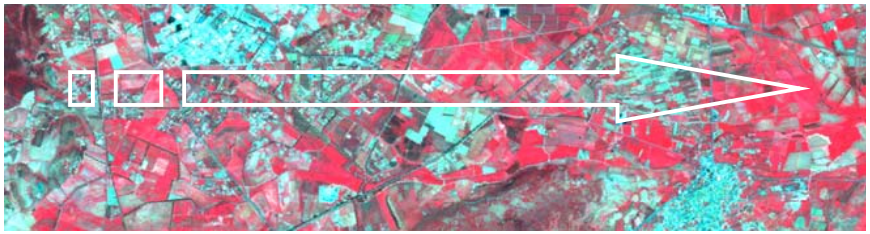
epiSTIS Case-studies

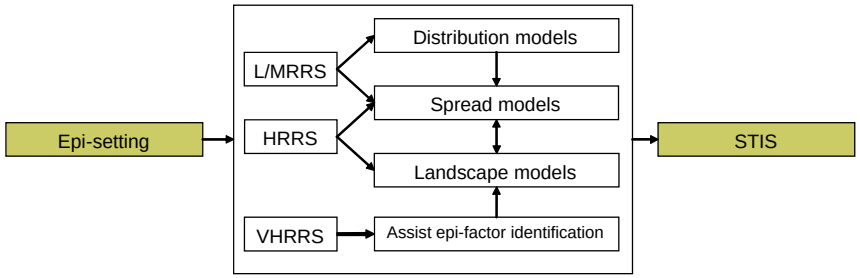
- Two case-studies
  - **Foot-and-Mouth Disease**
    Direct contact disease
    Dynamics of transmission at the wildlife/livestock interface of the Great Limpopo Transfrontier Park in southern Africa

  - **Bluetongue**
    Vector-borne disease
    Presence and spread in Italy, the Mediterranean Basin, Belgium and Western Europe

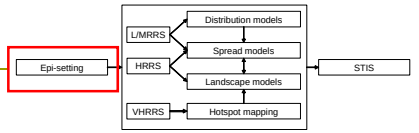
- Generic innovative approaches
  - ⇒ readily applicable to other diseases with similar epi-settings

epiSTIS Role of remote sensing

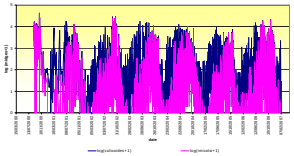




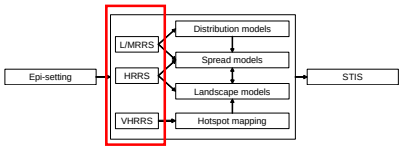
epiSTIS Epi-setting



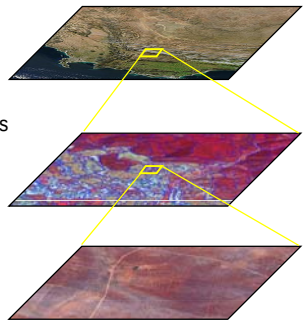
- Defining the **epi-setting**
  - **Collecting** all **relevant historical & current data** on disease outbreaks, disease vector populations, wild & domestic host/carrier populations, human populations
  - **Storing, processing & analyzing raw data** with regular updates. Adapting field sampling procedures routinely to fit specific project needs
  - **Setting up a GIS database** including necessary information to map the physical environment & prevailing farming systems



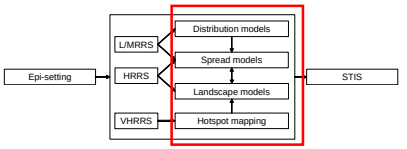
epiSTIS Remote Sensing



- **Low / medium resolution** (NOAA-AVHRR, MODIS)
  - Extracting annual time series of relevant predictors
    - Eg eco-climatic, grazing, biomass
- **High resolution** (Landsat, SPOT & ASTER)
  - Mapping land use/cover and computing indices to derive landscape predictors used for modelling
    - Eg buffalo movement corridor ID, human settlement patterns
- **Very-high resolution** (Ikonos, QuickBird)
  - Identifying local-scale landscape features playing an important role in the disease epidemiology
    - Eg Water & other animal congregation points

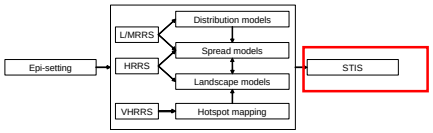


epiSTIS Modeling



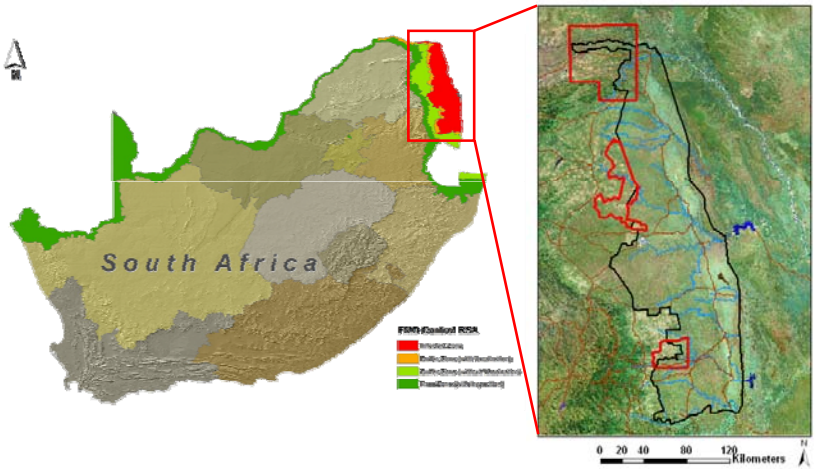
- **Distribution models**
  - Linking the distribution and/or abundance of vectors/hosts/livestock to eco-climatic features & animal/human behaviour
- **Spread models**
  - Integration of spread algorithms, assessment of the role of spread of the vector qualitatively and quantitatively
- **Landscape models**
  - Development of spatial models based on landscape measures
  - Agent-Based Modelling

epiSTIS STIS



- **Space/Time Information System (STIS)**
  - Integration of all previous in development of a STIS
  - STIS includes a set of generic tools for disease modelling based on Earth Observation data, multi-criteria analysis and simulation tools.

epiSTIS FMD Study



epiSTIS FMD Study

- Contribution of RS at **multiple scales** to **explain the system/disease dynamics**
  - **Where & when** is **highest risk** for FMD transmission?
  - **How is risk** of contact **affected by environmental and land use change**?
  - Understand the interactions between wildlife, livestock, environment, people, infrastructure (fence) wrt FMD
    - **Spatial statistical/epidemiological** approach
    - **Multi-agent simulation** approach
    - Above methods **supported by very high resolution mapping, GIS database, time-series analysis**

epiSTIS Application

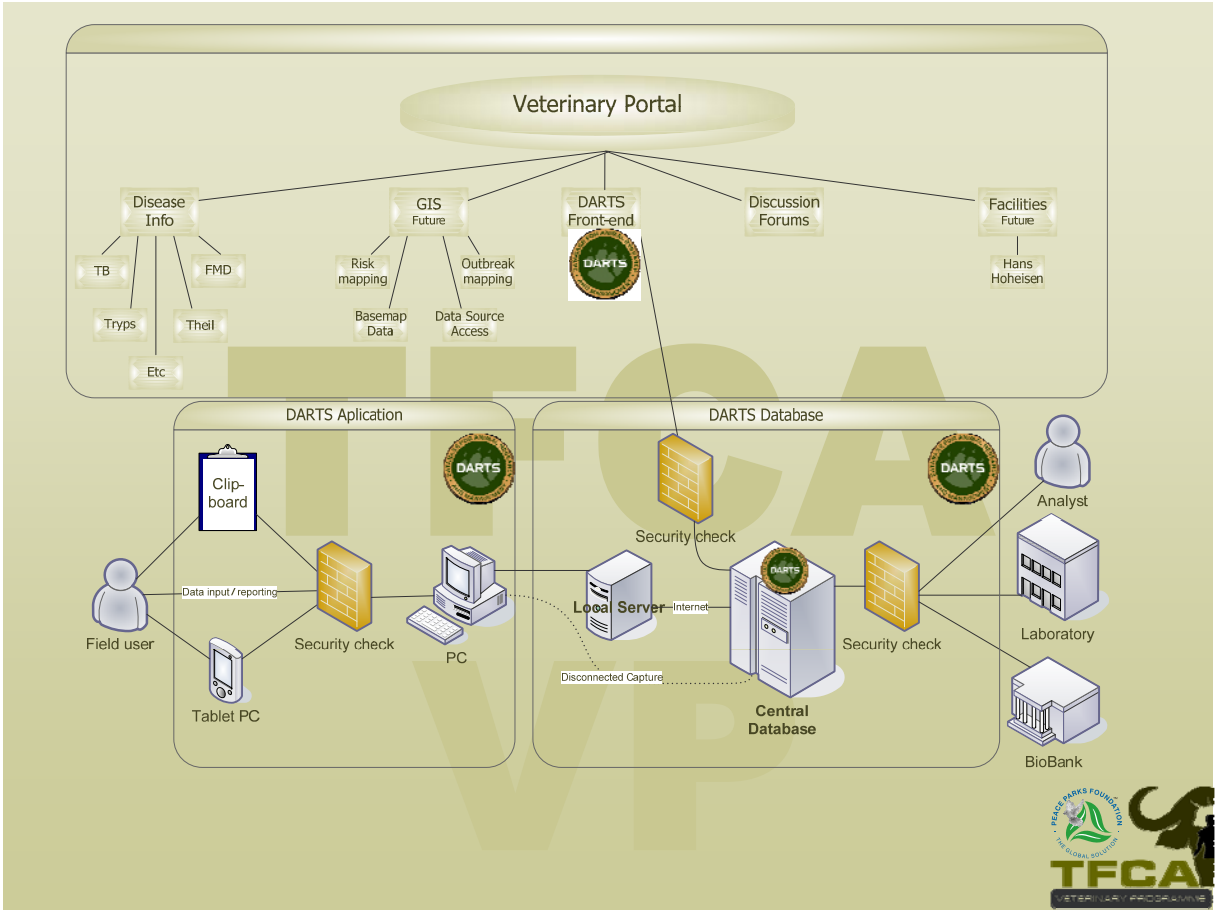
- **Risk Mapping**
  - "Near" real-time risk mapping(?)
  - Allows critical assessment of current FMD outbreak prevention strategies
- **Agent Based Modeling**
  - Scenario analysis
- **Multi-Scale / Multi-Sensor approach**
  - Identification of innovative ways of measuring key risk indicators in areas where ground data collection is difficult/limited
- **Zimbabwe & Mozambique**
  - Develop key methodologies in identified RSA study sites with data for validation
  - Apply and tweak methodologies in rest of GLTFCA interface area

epiSTIS Summary

- Use RS & Spatial epidemiological modeling in FMD outbreak **risk mapping**
  - Develop new or expand existing RS tools
  - Identify risk factor indicators / proxies with low ground data dependence
- Agent Based Modeling for **Scenario analysis**
  - "What if…?" scenarios
- Develop **STIS**
  - Identify sustainable sources of RS and ground data
  - Provide tool to decision makers to assist in disease control strategy development
- **Apply & adapt** to Zimbabwe, Mozambique & other countries

epiSTIS AHEAD Context

- **Environment**
  - Conservation areas harbour FMD carrier animals
  - If we cannot adequately control the disease in livestock, we lack the buy-in from those directly affected by FMD in conservation of biodiversity
- **Economy**
  - Macro-economical impact massive
    - Export embargoes
    - Possibility of export for currently non-exporting neighbours
  - Micro-economy
    - Access to markets
- **Social**
  - Value of livestock in the context of outbreak compensation
  - Access to lucrative markets – sustainability of communal farming



Update

- **DARTS**
  - *Name & logo change due*
  - *Recent upgrade workshops with Dimension Data*
    - Fencing & vector monitoring components added
    - Central database & web interface to become functional as first data gets synchronized & historic data is imported (not enough data yet)
  - *Maintenance contract between PPF & Dimension Data*
  - *Demo can be run on request*
- **Web Portal**
  - *Up & Running*
    - BTB, Tryps, Theileriosis, Anthrax
    - need more input though
  - *In the pipeline*
    - FMD, Brucella, RVF
  - *Failure to launch*
    - Discussion forums