Integration of NASA Earth-Sun research results into CDC's ArboNET/Plague Surveillance System

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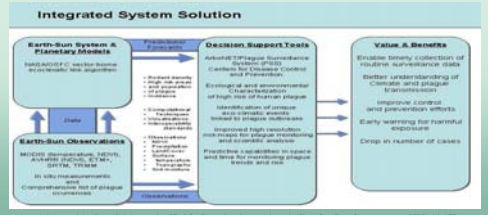
Objectives

- To integrate Earth-Sun measurements and mathematical modeling to enhance the CDC's ArboNET/PSS.
- To investigate the role of climatic factors in human plague cases and characterize plague vector habitats.
- To enable ArboNET to improve outbreak detection and better identification/prediction of areas and conditions associated with human plague risk.

Methodology

- Implement a Reverse Engineering Paradigm to identify, evaluate, validate&verify and benchmark Earth-Sun research results as plague surveillance solutions.
- Implement a prototype that characterizes ecological and environmental conditions of human plague incidences through modeling and data integration of Earth-Sun research results and provides a predictive capability for monitoring plague trends and outbreaks in space and time.
- Implement an interagency partnership that will ultimately allow CDC to adopt operationally the new capabilities offered by this prototype.



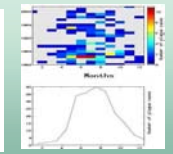
Integrated system solution diagram for in incorporation of Earth-Sun Research results to en enhance the Plague Surveillance System component of CDC's ArboNET.

Background

- Plague outbreaks need to be continually monitored to reduce transmission.
- Collaborative research over the past decade show how climate influence plague activity (Parmenter et al. 1999, Enscore et al. 2002, Pinzon et al. 2005.): Seasonality of transmission, survival of fleas and their ability to transmit and retain infection.
- Major Pandemics (Justinian's plague and the Black death) were associated with major climatic fluctuations: temperature, humidity and rainfall effects (Greenwood 1911, Brooks 1915-1917, Rogers 1928)
- Decreased transmission at temperatures above 27°C (Cavanaugh and Marshall 1972), severe drought forces bush rodents into peridomestic environments (Issacson 1983.), outbreaks after El Nino in Peru.

Affected regions are large parts of Central and South Asia, Africa, South America and Southe West of US

Plague cases in time



Seasonal behavior revealed in the South West of US

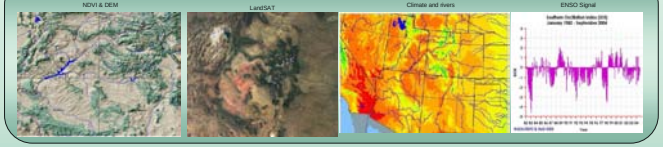
Climate and Plague Transmission

Results

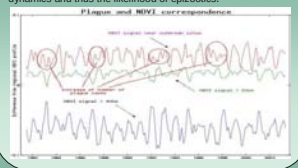
- Earth-Sun Research results being applied and evaluated as plague surveillance solutions.

	Earth-Sun System Science Results	Source
Atmospheric and Weather	Precipitation Temperature Humidity	TRMM & GOES MODIS & GOES MODIS
Vegetation **Land Use/Land Cover** **Topography**	Habitat quality Land surface class Surface Topography	AVHRR & MODIS NDVI MODIS/LandSAT SRTM
In-situ calibration		
Relevant Earth-Sun Modeling Efforts in Public Health	Visualization tools Climate and plague activity	NASA/GIMMS visualization tools NASA/GIMMS infectious-disease & Eco-climatic model

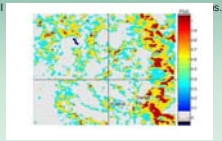
- Habitat Characterization of the Four Corners States: New Mexico, Colorado, Utah, Arizona



- Annual and seasonal variations in climate (precipitation, vegetation, temperature) influence rodent and flea population dynamics and thus the likelihood of epizootics.



- High risk maps based on environment, habitat conditions and vegetation dynamics are used for the identification/prediction of regions with potential human plague activit. They provide a predictive capability for monitoring plague trends and outbreaks in space and time. Population density will s.



Conclusions

- The implementation of a Reverse Engineering Paradigm allows us to identify and evaluate Earth-Sun research results as plague surveillance solutions which will be validated&verified and benchmarked.
- A prototype using modeling and data integration of Earth-Sun research results to characterize ecological and environmental conditions of human plague incidences, provides a predictive capability for monitoring plague trends and outbreaks in space and time.
- These results from this interagency partnership show that ArboNET/PSS could improve in its ability to predict potential human plague outbreaks and increase warning time. Benchmark measures will quantify the improvement.
- The quick comparison of reported plague activity with the output of the NASA/GIMMS disease ecoclimatic model when ingested with NASA data provides a first validation&verification solution and helps to identify a baseline for measuring improvements to the ArboNET/PSS.

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