# Health and the Environment
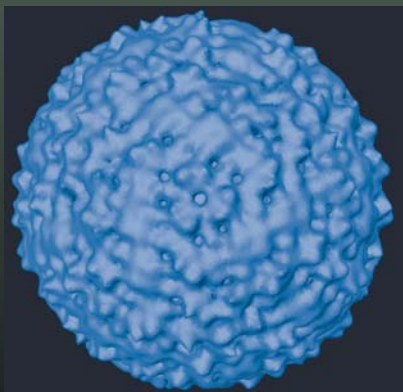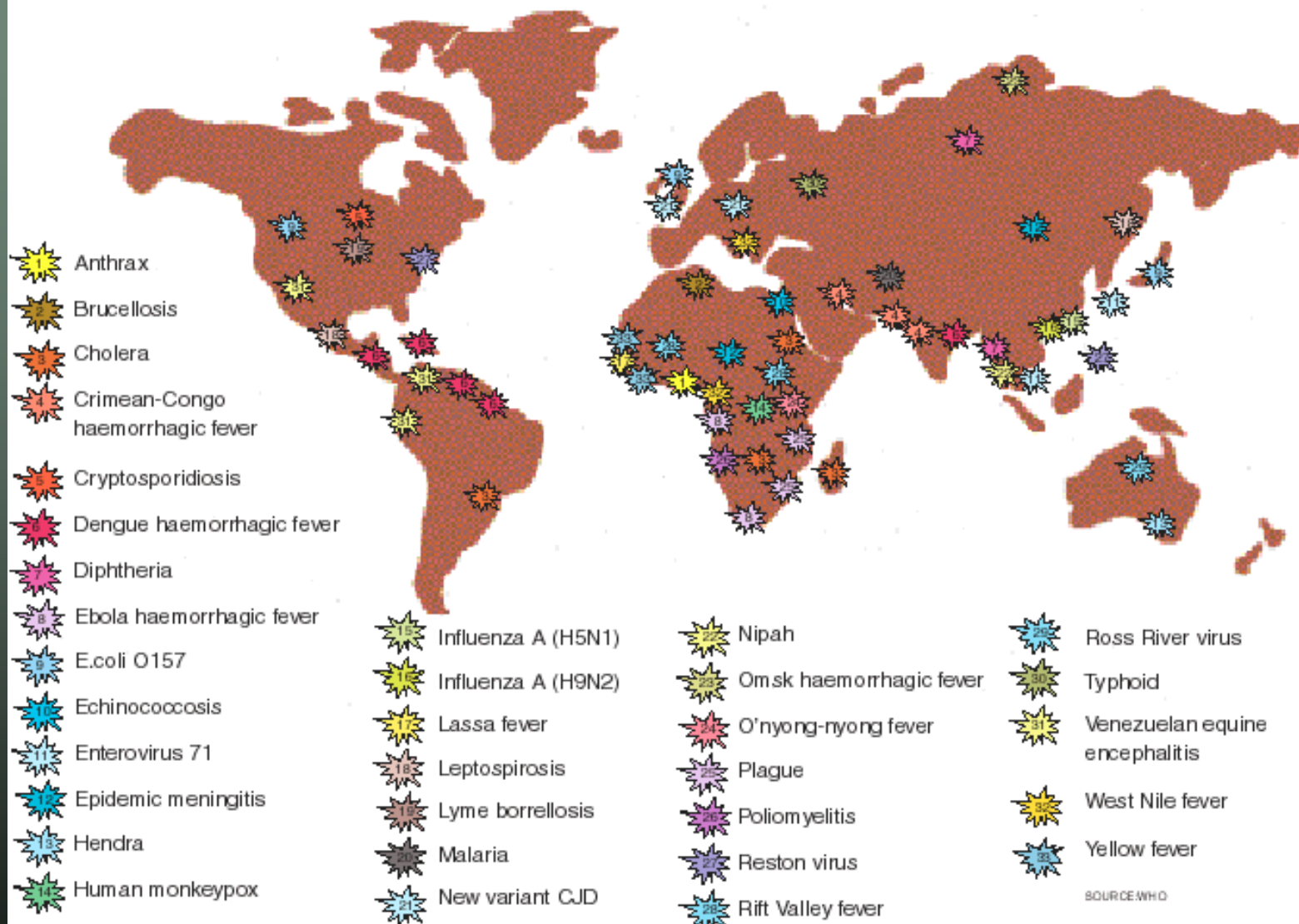
# Unexpected outbreaks

Examples of emerging and re-emerging infectious diseases 1994-1999

1. Anthrax
2. Brucellosis
3. Cholera
4. Crimean-Congo haemorrhagic fever
5. Cryptosporidiosis
6. Dengue haemorrhagic fever
7. Diphtheria
8. Ebola haemorrhagic fever
9. E.coli O157
10. Echinococcosis
11. Enterovirus 71
12. Epidemic meningitis
13. Hendra
14. Human monkeypox
15. Influenza A (H5N1)
16. Influenza A (H9N2)
17. Lassa fever
18. Leptospirosis
19. Lyme borrellosis
20. Malaria
21. New variant CJD
22. Nipah
23. Omsk haemorrhagic fever
24. O'nyong-nyong fever
25. Plague
26. Poliomyelitis
27. Reston virus
28. Rift Valley fever
29. Ross River virus
30. Typhoid
31. Venezuelan equine encephalitis
32. West Nile fever
33. Yellow fever

SOURCE: WHO

USGS

# Scientific Rationale

- NAS *Grand Challenges in Environmental Sciences:* develop a comprehensive ecological and evolutionary understanding of infectious and environmental diseases affecting human health

- NAS *Future Roles and Opportunities for USGS:* explore the "intersection between natural sciences and allied health sciences"

- USGS has the capability and the unusual combination of disciplines to make significant breakthroughs in this area

# Emerging Environmental Health Threats

- Vector-borne and zoonotic diseases

- Contaminants and microorganisms in ground and surface water

- Contaminants and microorganisms in air and dust

- Bioaccumulation of contaminants and microorganisms in consumable tissue

- Transient occurrences of high levels of pathogens in water bodies

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# Vector-Borne Disease Ecology

Use remote sensing and GIS to characterize habitats and model processes that link hosts, vectors, and pathogens in the environment.
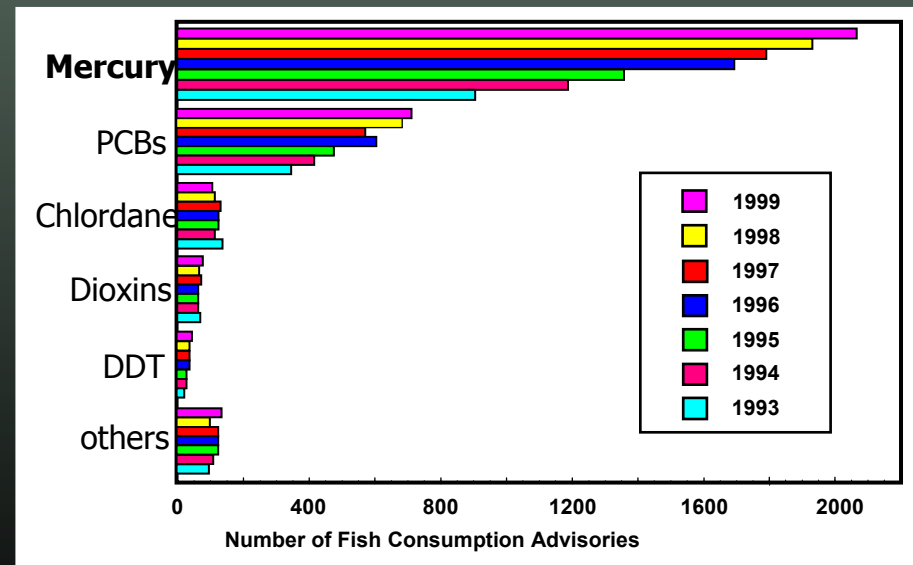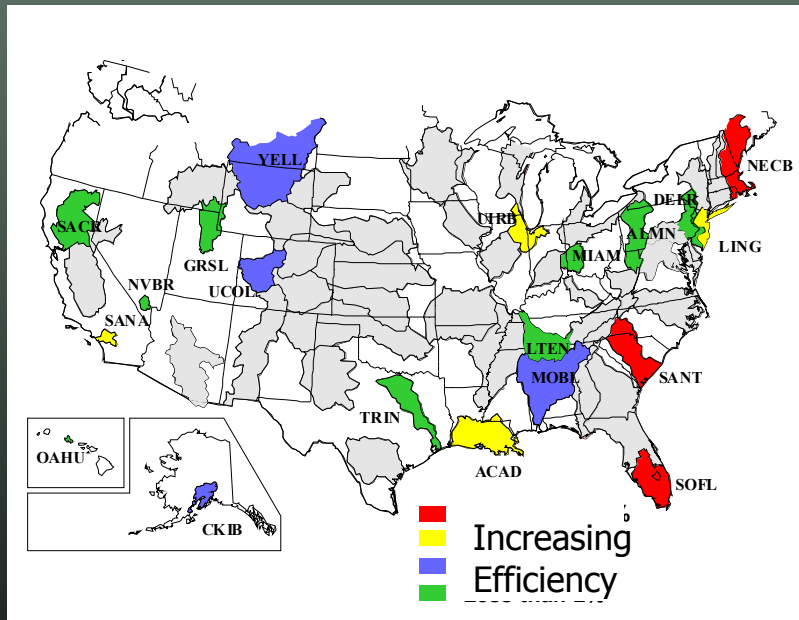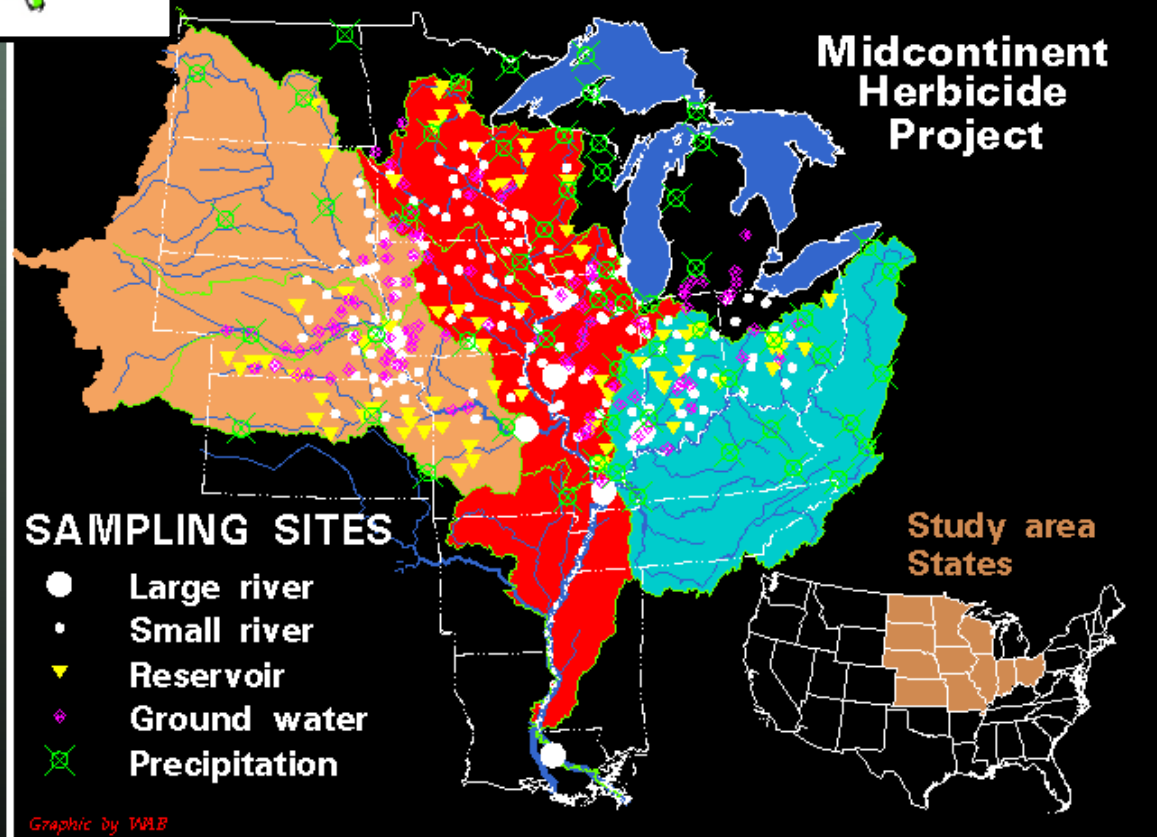

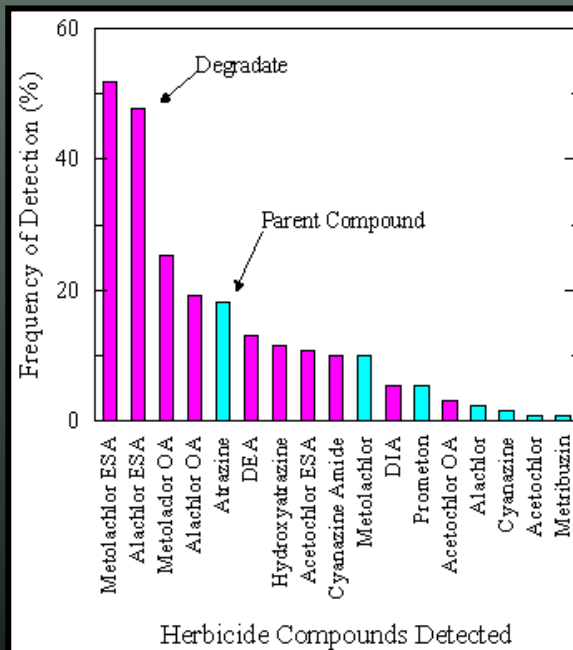
**≋USGS**
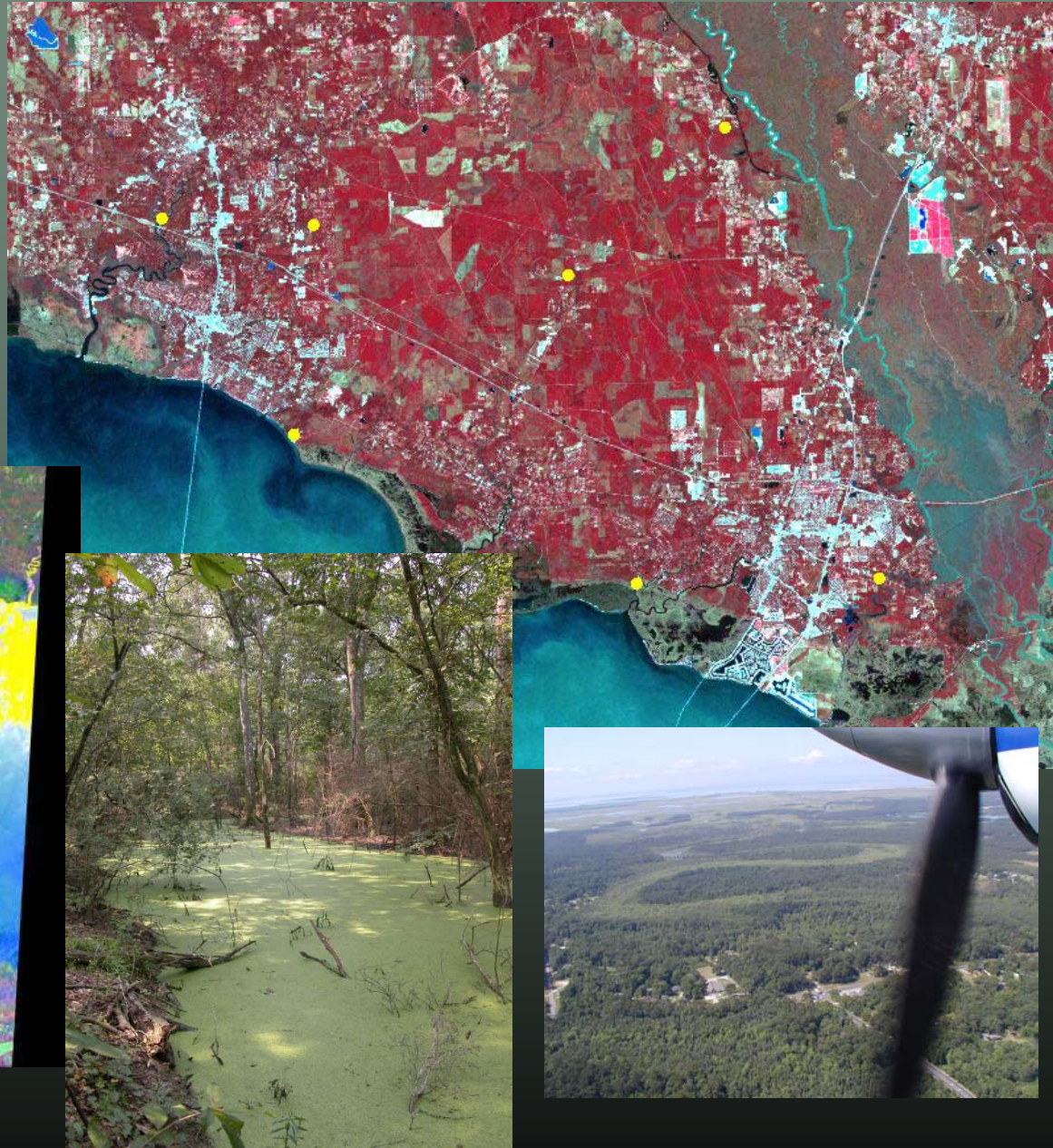
# Climatic Effects on Severity of Endemic Diseases



WNV Incidence 2002

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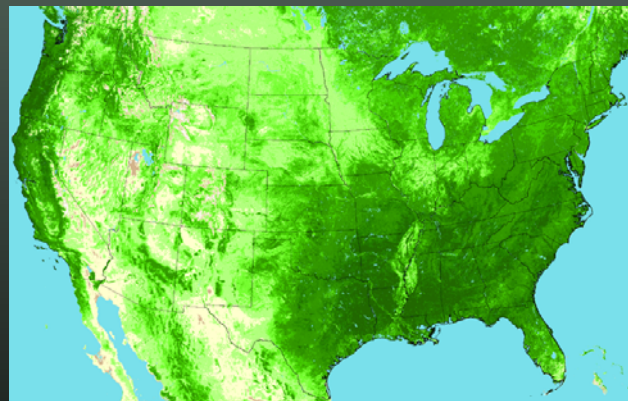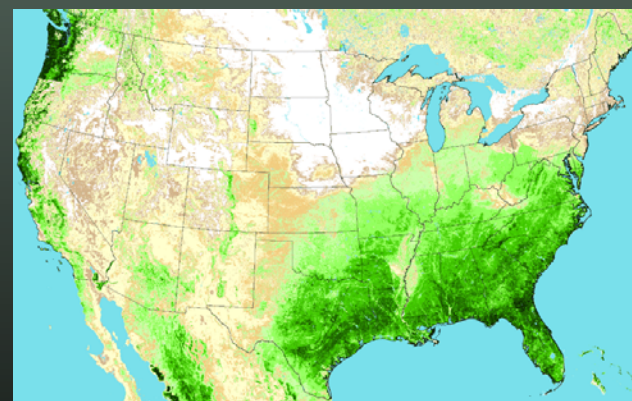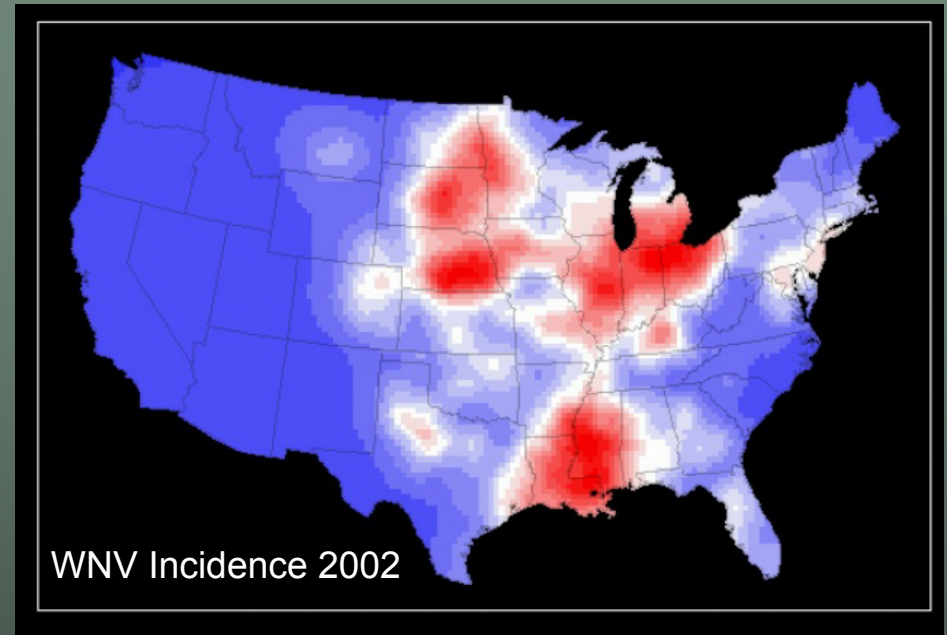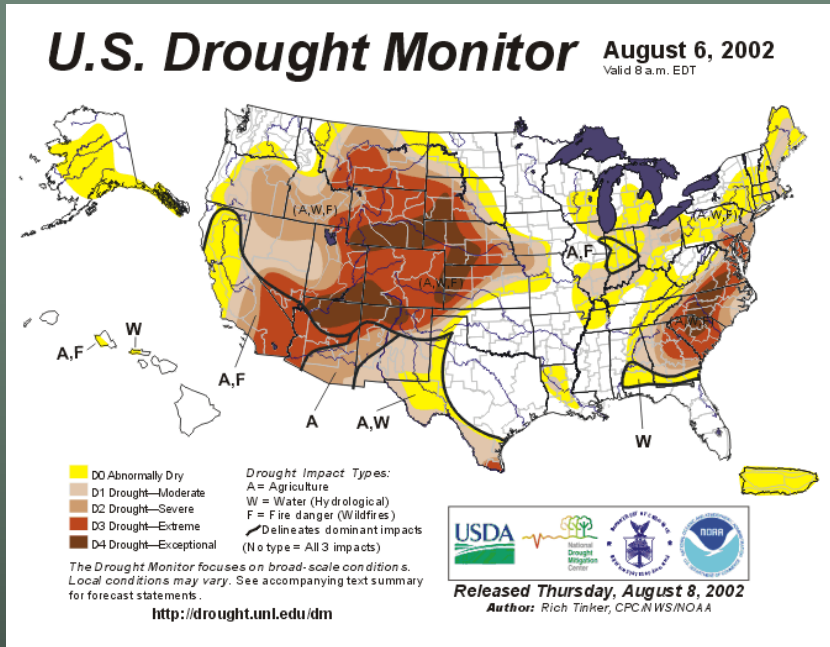
# Mercury in Aquatic Ecosystems:


Everglades National Park, FL
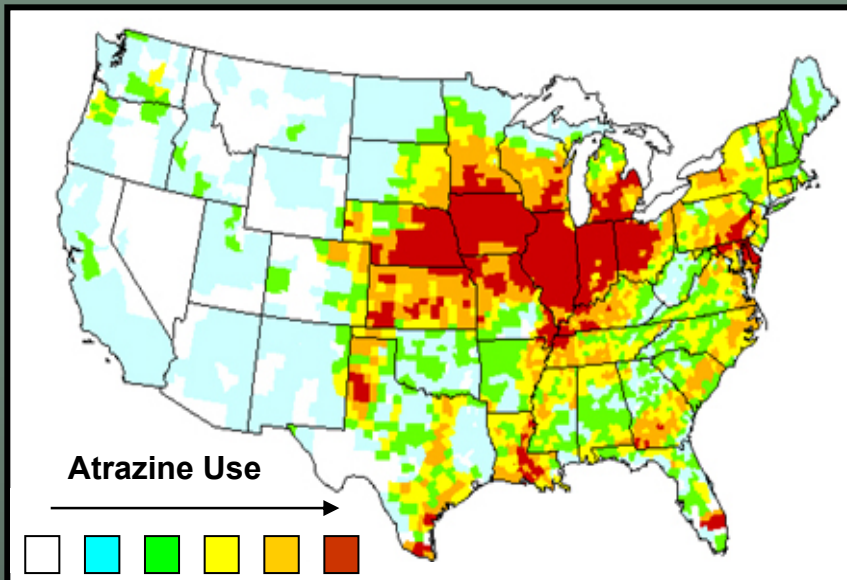
◆ Developed *ppt* mercury-species analyses.

◆ 1st National synoptic of Hg in water sediment and fish tissue at 112 sites.

◆ Explaining controls on mercury cycling and bioaccumulation in sensitive ecosystems. (Everglades, FL; *Metaalicus Ont*.)



YELL
NECB
DEIR
UHRB
ACMN
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SACR
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GRSL
NVBR
UCOL
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LTEN
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TRIN
OAHU
ACAD
SOFL
CK IB

Increasing
Efficiency



Mercury
PCBs
Chlordane
Dioxins
DDT
others

| | 1999 |
| | 1998 |
| | 1997 |
| | 1996 |
| | 1995 |
| | 1994 |
| | 1993 |

0    400    800    1200    1600    2000
**Number of Fish Consumption Advisories**

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# Pesticide Occurrence and Transport in the Hydrologic cycle

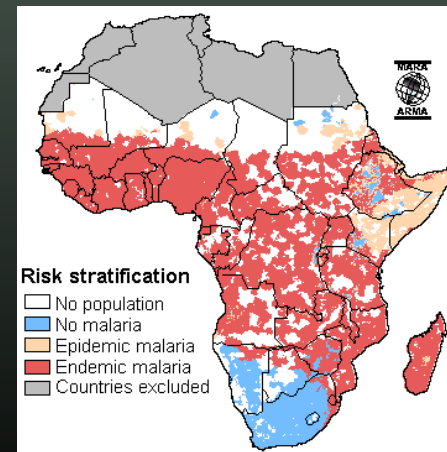# Dust and Soil Components with Potential Health Impacts
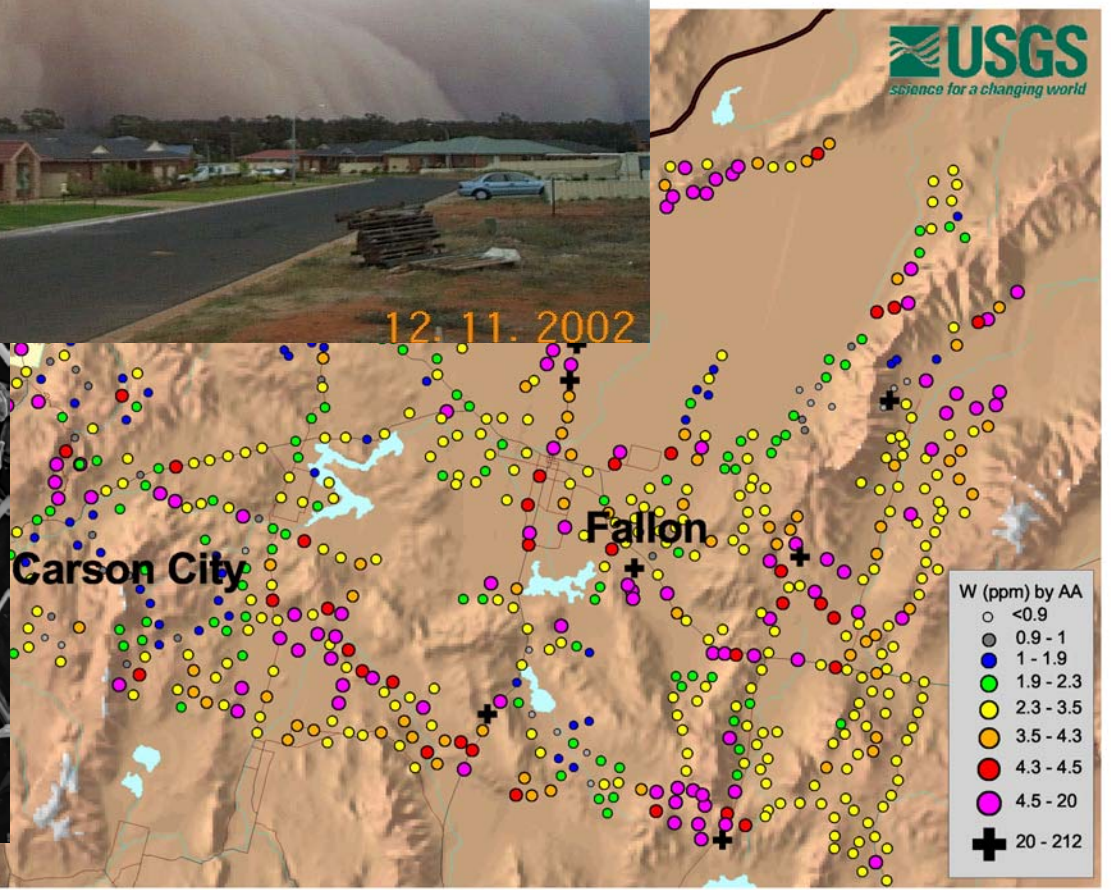


Reanalyses of soils (770) and dry stream sediments (270) collected by the NURE program.

# Understanding the Effect of Environmental Factors on Human Health and Well-being

Continued improvements in quality of life and longevity will require a better understanding of the causes, development and progression of common diseases and dysfunctions—and how they relate to environmental factors.

What are humans being exposed to? How can we improve prediction of outbreaks of acute diseases such as malaria and cholera?

**Risk stratification**
- No population
- No malaria
- Epidemic malaria
- Endemic malaria
- Countries excluded

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# Understanding the Effect of Environmental Factors on Human Health and Well-being

A well-designed, coordinated Global Earth Observation System of Systems (GEOSS) would contribute significantly to providing data and data products on many of the environmental factors that influence stress (extreme weather events, noise), nutrition (price and availability of food), and most importantly exposures (air and water pollution, pathogens) that directly affect human health and well-being..
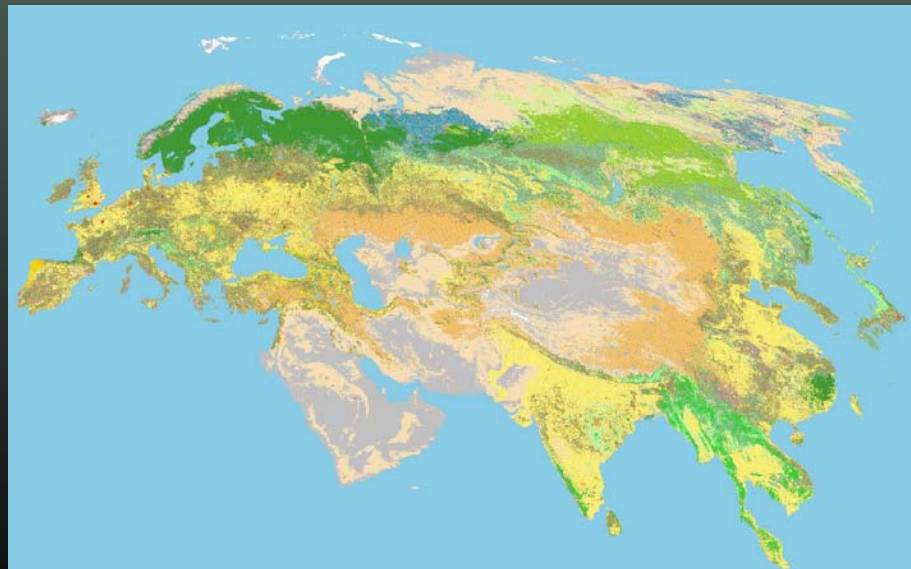
# GEOSS/EGIM Challenges

Form a distributed federation of data bases - including ground based and health data

The collection of quality data to predict changing environmental conditions must be expanded. Data must be collected at higher spatial resolutions and more frequent time intervals. Provisions for sharing environmental and human, plant, and animal data on a timely basis in a distributed federation of databases designed to make existing information more accessible need to be put in place.
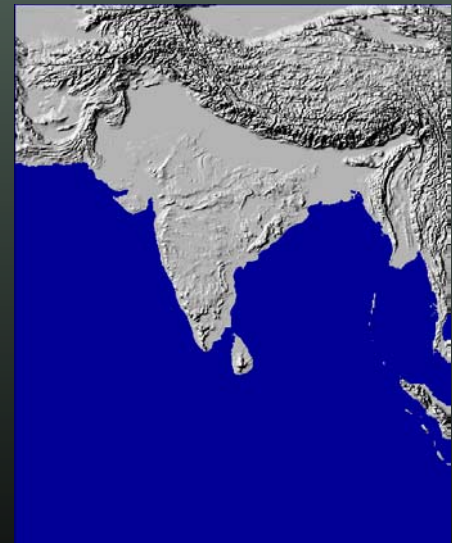
# GEOSS/EGIM Challenges

Improved Access and Use of Remote Sensing Data

Easier access to and use of remote sensing data must be made possible

More continuous temporal and spatial data sets for disease studies

Developing methodologies to measure environmental stressors in real-time across large spatial domains will enable better prediction and forecasts of exposures and the development of diseases caused by exposures.



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# GEOSS/EGIM Challenges

Interoperability

Coordinated data management and interoperability across agencies and user groups must be a high priority for a system of Earth observation systems.

Flexible information system

The system must allow for continuous updating with new and additional information in a near-real time scenario for flexibility in the types of information and the method of update.
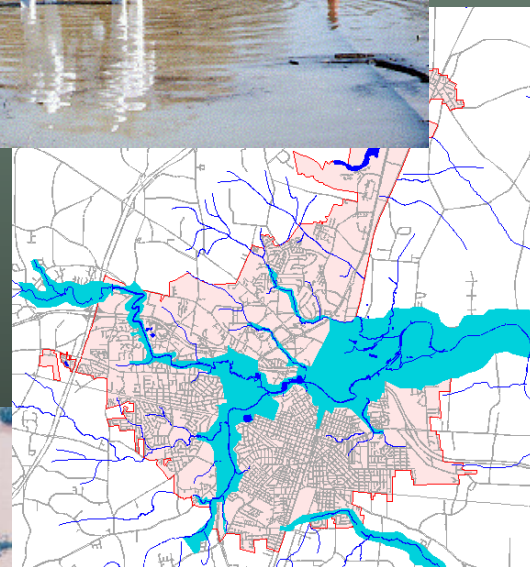
# Conclusions



- Remote sensing and GIS can characterize habitats and model processes that link hosts, vectors, and pathogens in the environment.

- Geographic methods can illuminate the complexities of environmental disease risk.

- Interdisciplinary collaboration among scientists is a key.