Public Health Applications in Remote Sensing

Assessing Environmental Impacts on Human Health: Sample Programs and Initiatives

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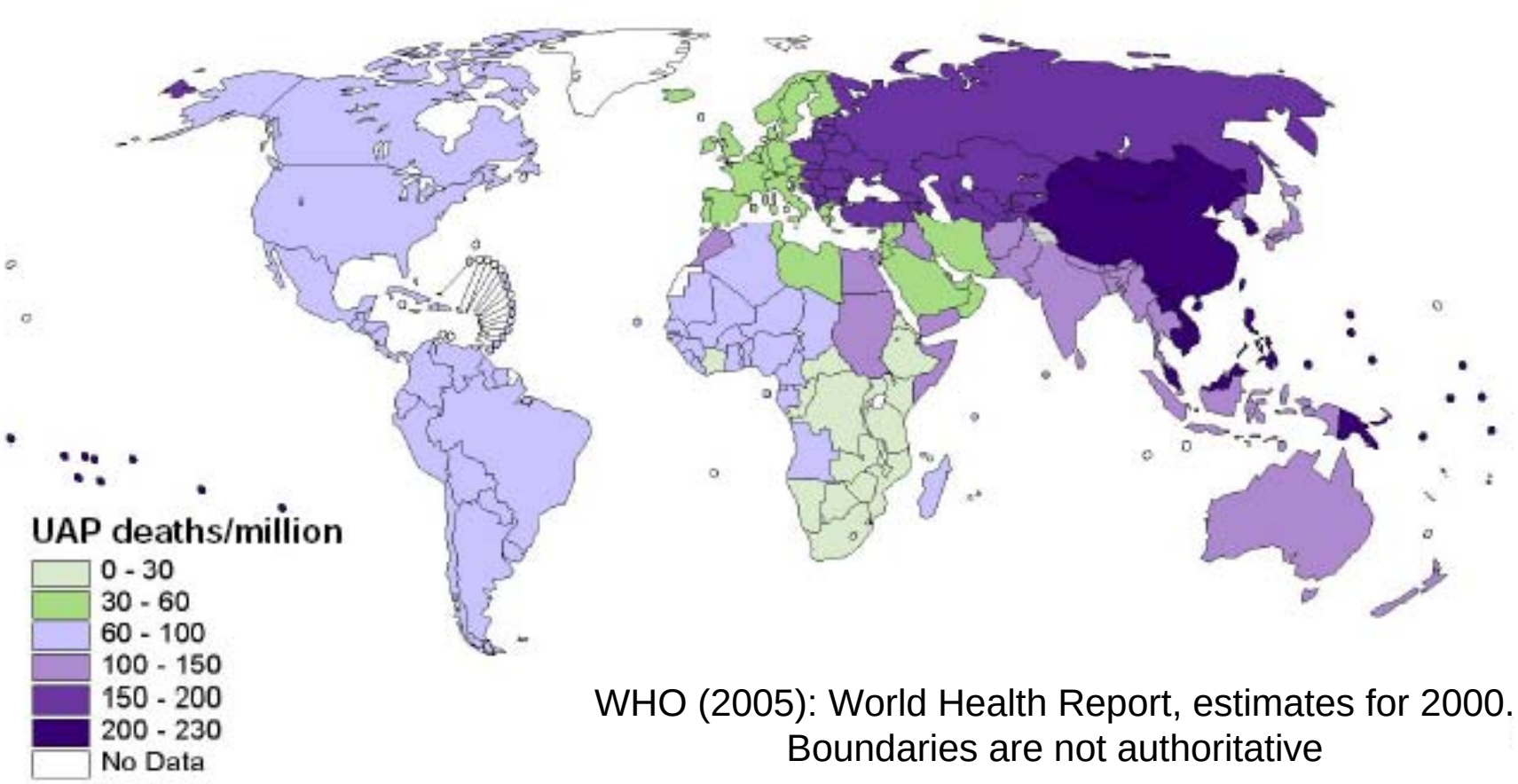
Selected Samples

- WMO—International Sand and Dust Storm Warning & Assessment System (ISDSWAS)
- NASA / Earth Science Applications Div.
- CDC / Environmental Public Health Tracking System
- GEO / Global Earth Observing SoS
- ICSU / Science for Health & Well-being

Classification of Diseases

- **Infectious and zoonotic**
  - **e.g. Influenza, plague, hantavirus, anthrax, AIDS, TB**
- **Degenerative**
  - **e.g. Atherosclerosis**
- **Environmental**
  - **e.g. Asthma, cholera, meningitis, malaria, yellow fever, west Nile virus,**
- **Neoplastic**
  - **e.g. Cancer**
- **Metabolic**
  - **e.g. diabetes**

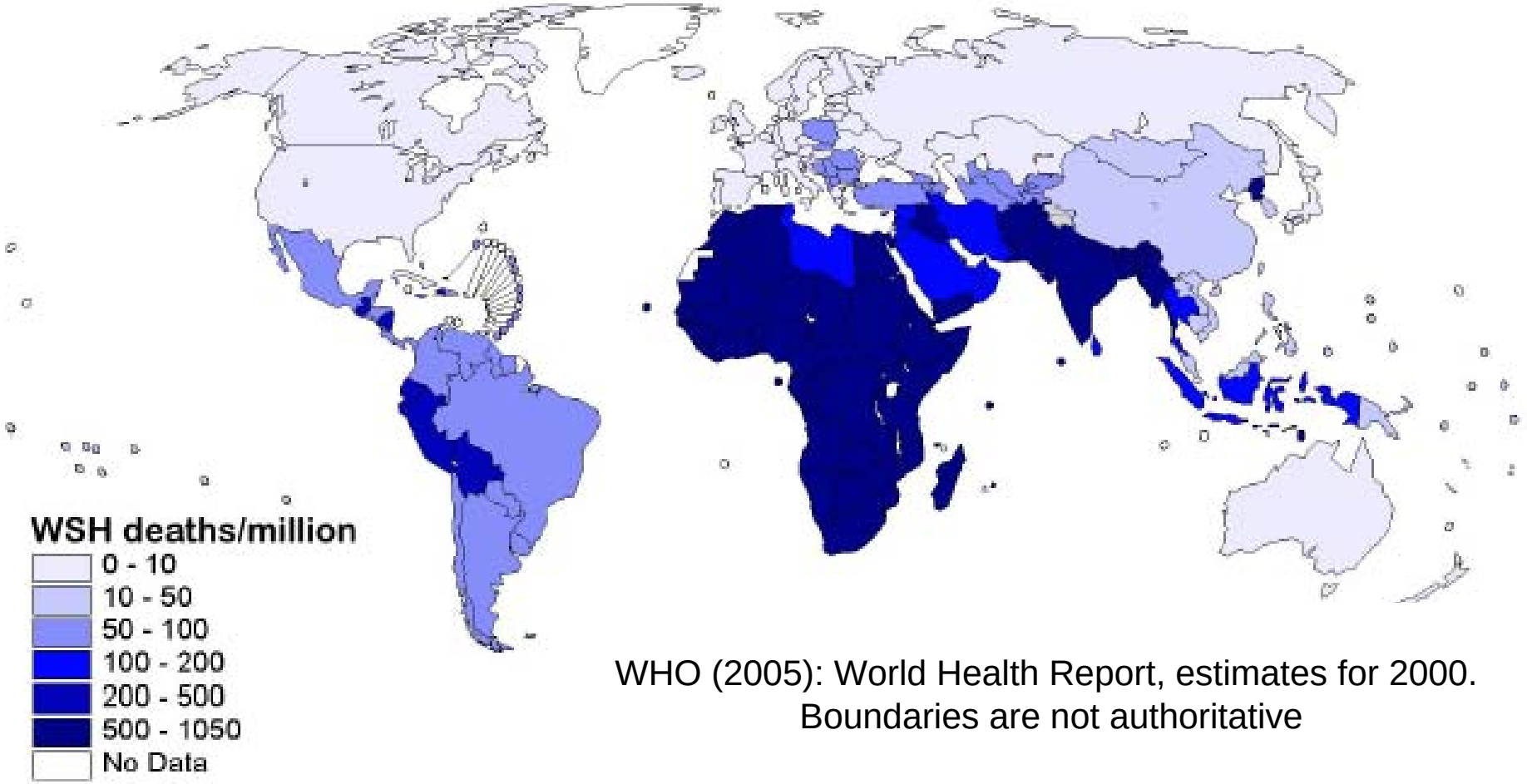
Deaths from Urban Air Pollution



WHO (2005): World Health Report, estimates for 2000.
Boundaries are not authoritative

Courtesy WHO

Deaths from Unsafe Water, Sanitation, and Hygiene



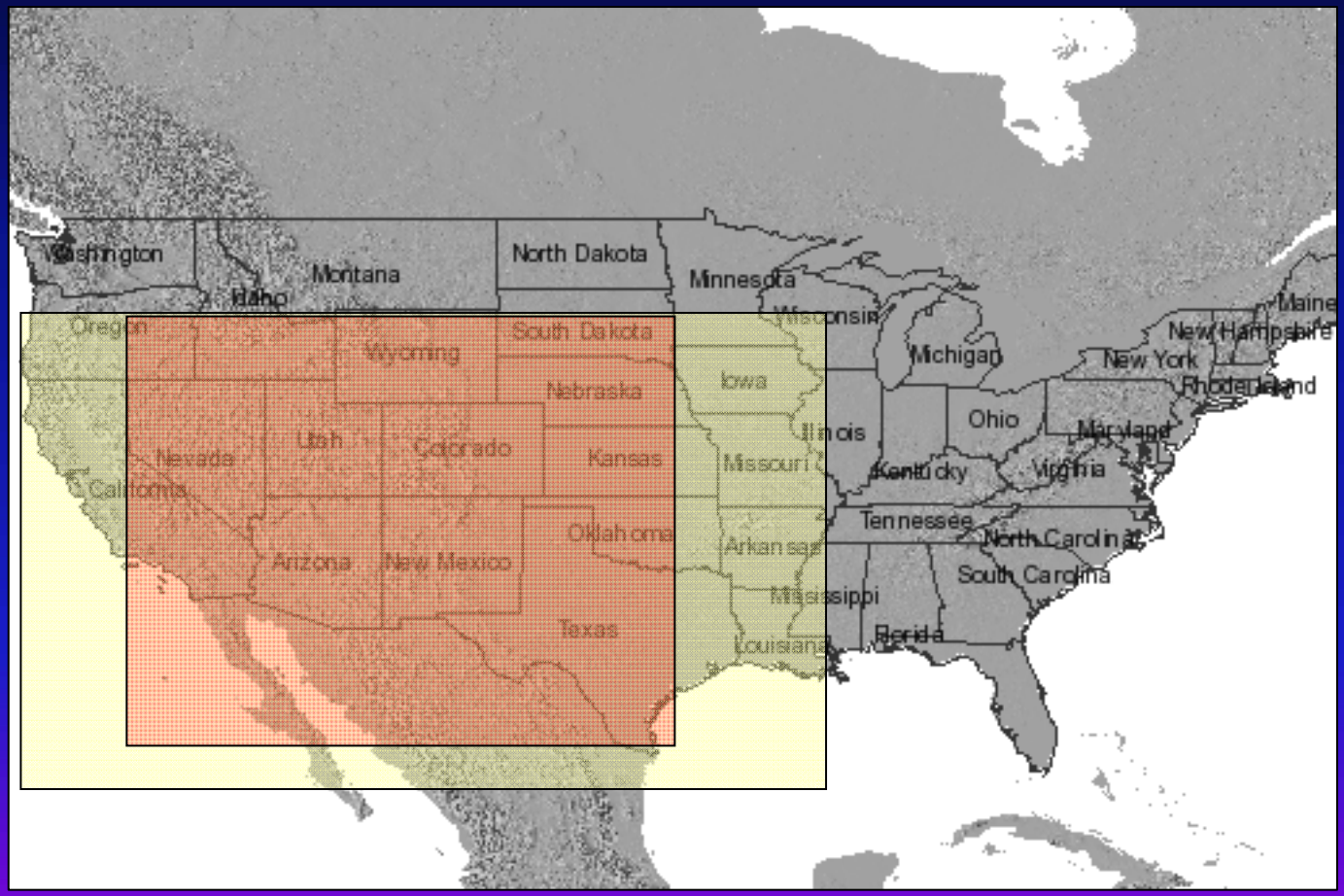
WHO (2005): World Health Report, estimates for 2000.
Boundaries are not authoritative

Courtesy WHO

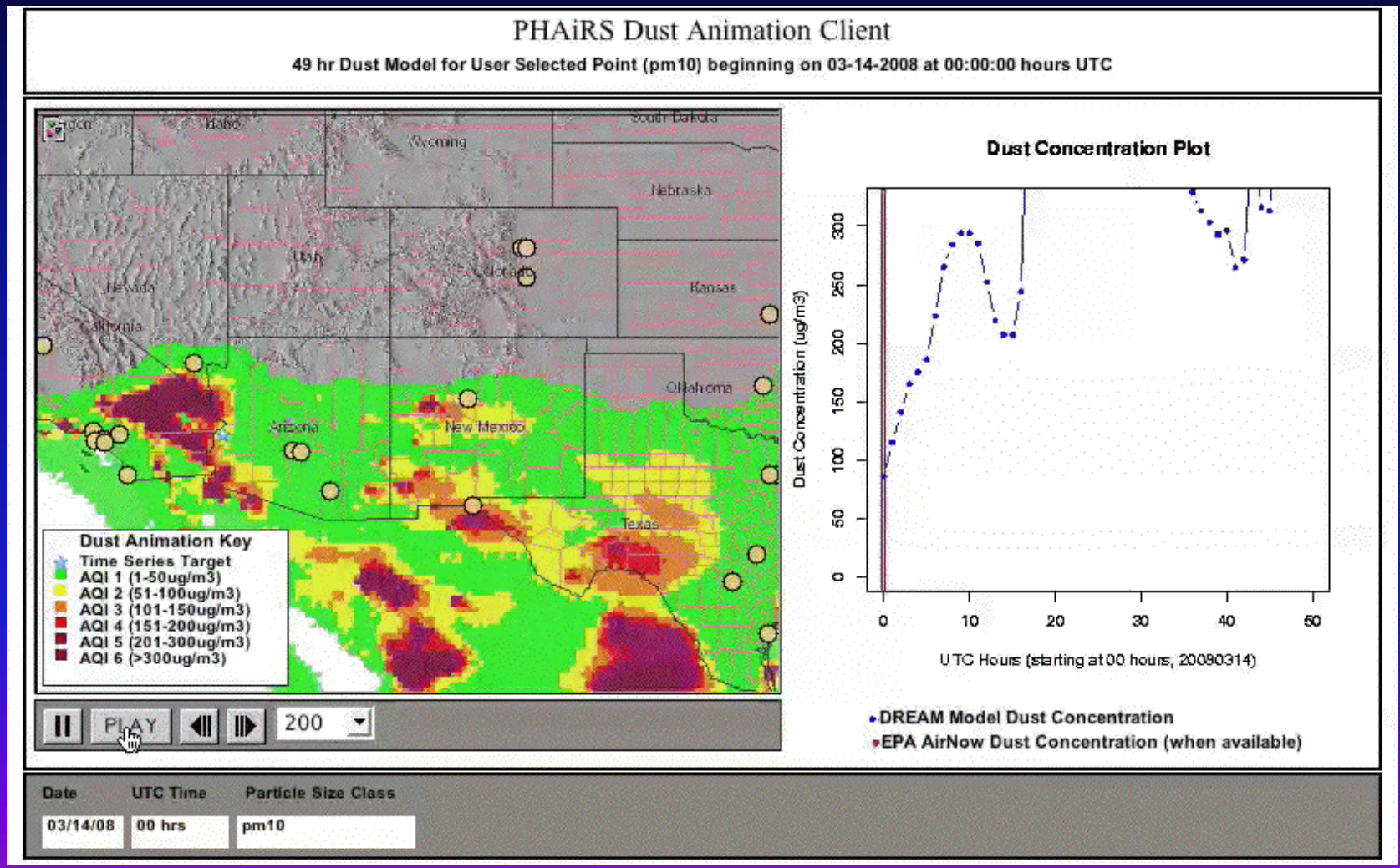
NASA Earth Science Applications (ROSES)

- Research, Education and Application Solutions Network (REASoN). 2002. Projects focused on existing or evolving DS Systems using a “Missions-to-Models” approach to improve the performance of models in societal benefit areas, including public health. One of the funded projects was PHAiRS.
- Decisions. 2007. Projects are partnering with the owner of a functioning DSS to demonstrate how NASA inputs make the system better, and engage in transition efforts for routine implementation of NASA inputs. One of the funded projects is ENPHASYS
- Decisions, 2008 (proposals in Review)

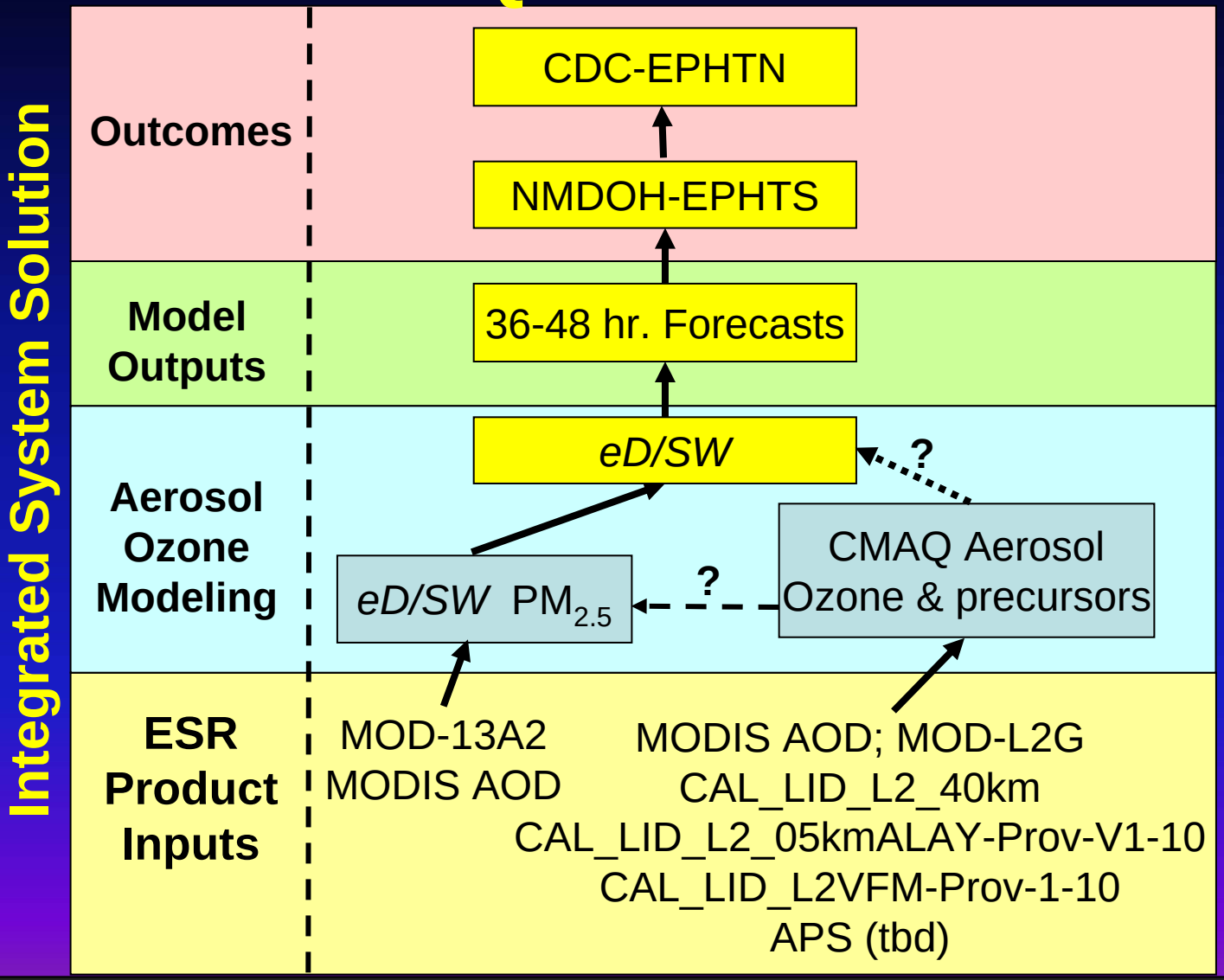
PHAiRS Modeling Domain & Dream Dust Forecast Domain



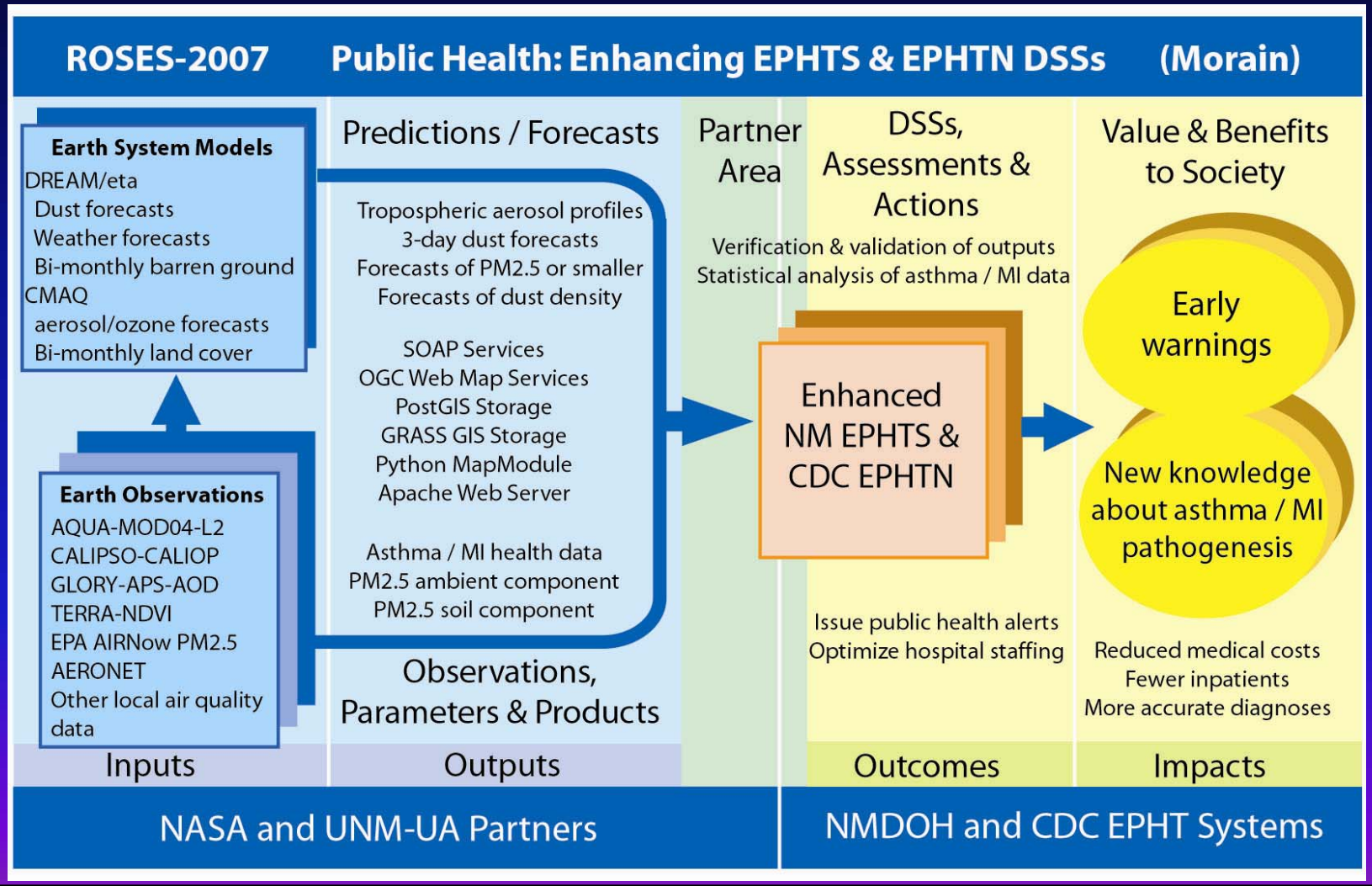
Dust Storm Animation (PM-10)
49 Hr Outlook for Yuma, AZ (14 Mar 08)



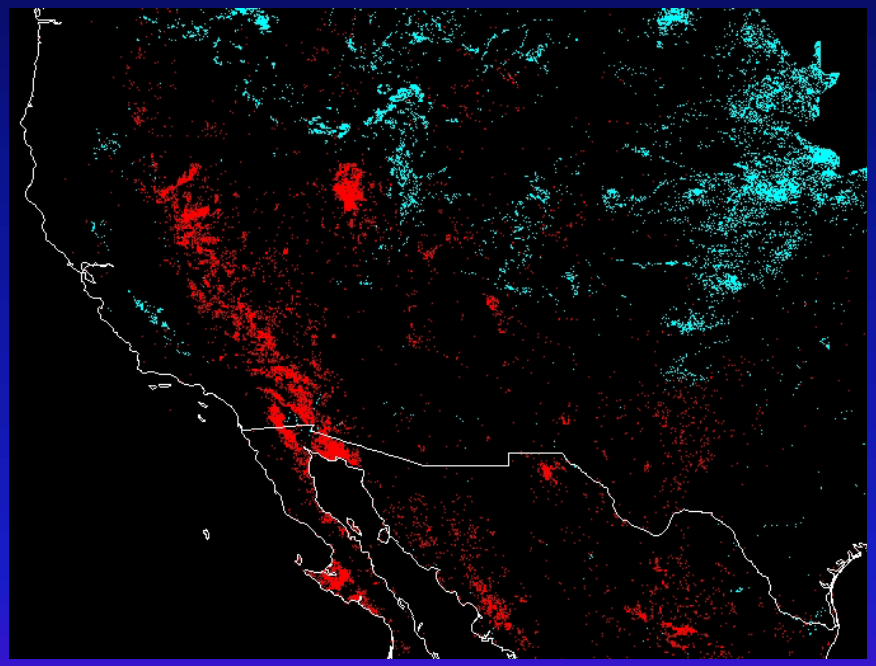
Seasonal Dust Source Updates for CMAQ and *e*D/SW



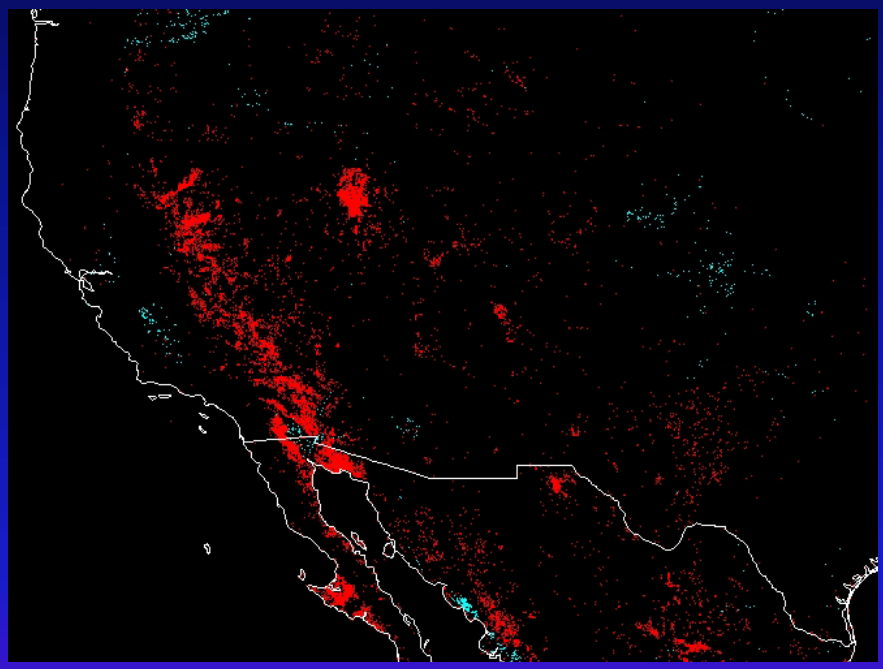
Integrated System Solution for ENPHASYS



Seasonal Barren Ground Patterns February and July 2008

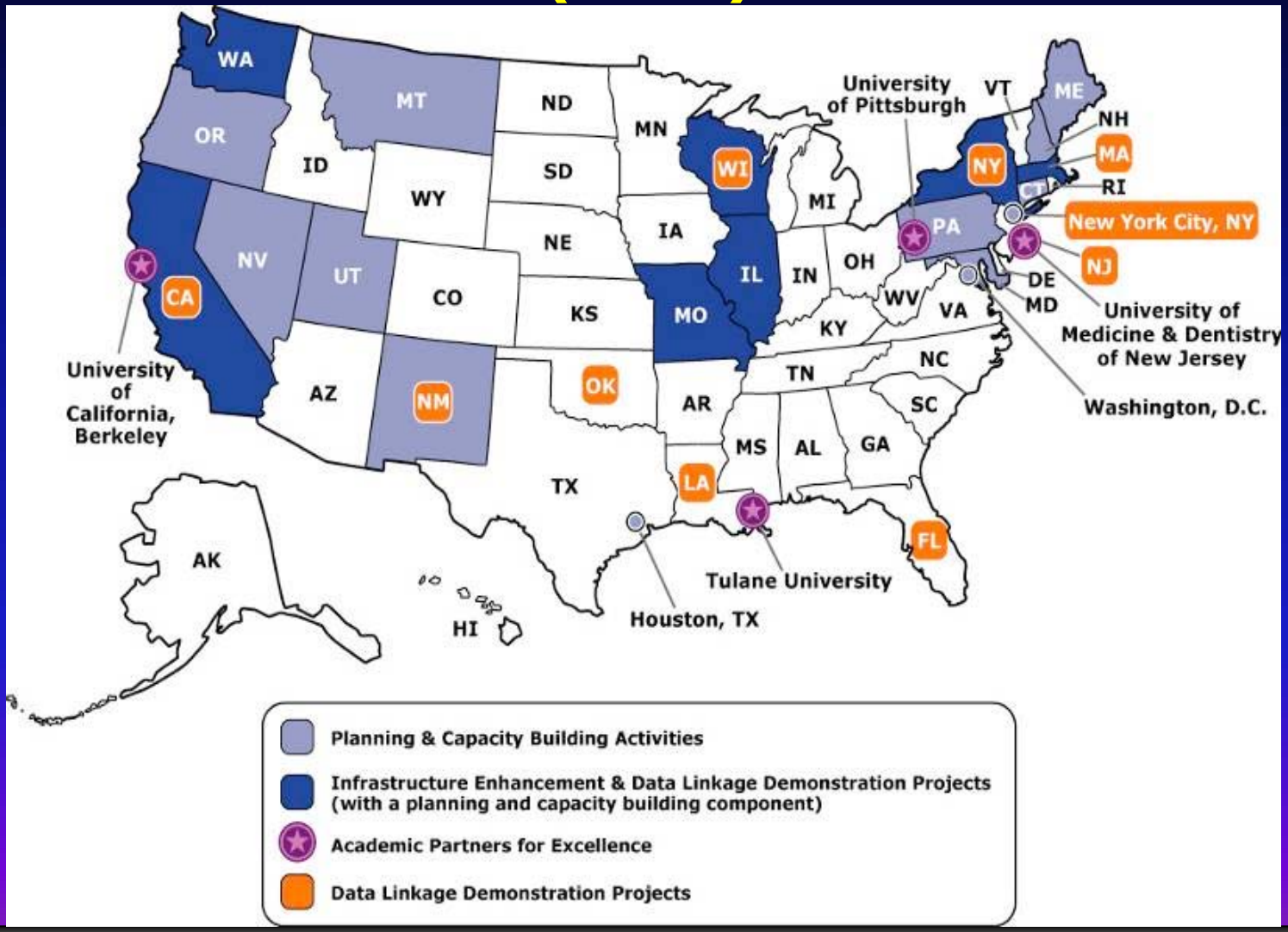


February



July

CDC EPHTN Grant States (2007)



Uses of Tracking Data

- Quantify the magnitude of a problem
- Detect unusual trends, occurrences, relationships
- Identify populations at risk
- Generate hypotheses
- Provide data to test some hypotheses
- Direct and evaluate control and prevention measures
- Facilitate policy development

Air Quality and Health Effect Linkage Studies

- Asthma Emergency Department visits and air quality – completed for San Juan County, ongoing for Albuquerque and Los Alamos
- Adding cardiovascular – MI to air quality linkage studies

- Logistic regression for any summer asthma visit

  Two-day lagged ozone (8-hr max)

  odds ratio of 1.7 (95% CI 1.1 to 2.8) for a 10 ppb increase in ozone (P = 0.01)

- Poisson regression on summer counts

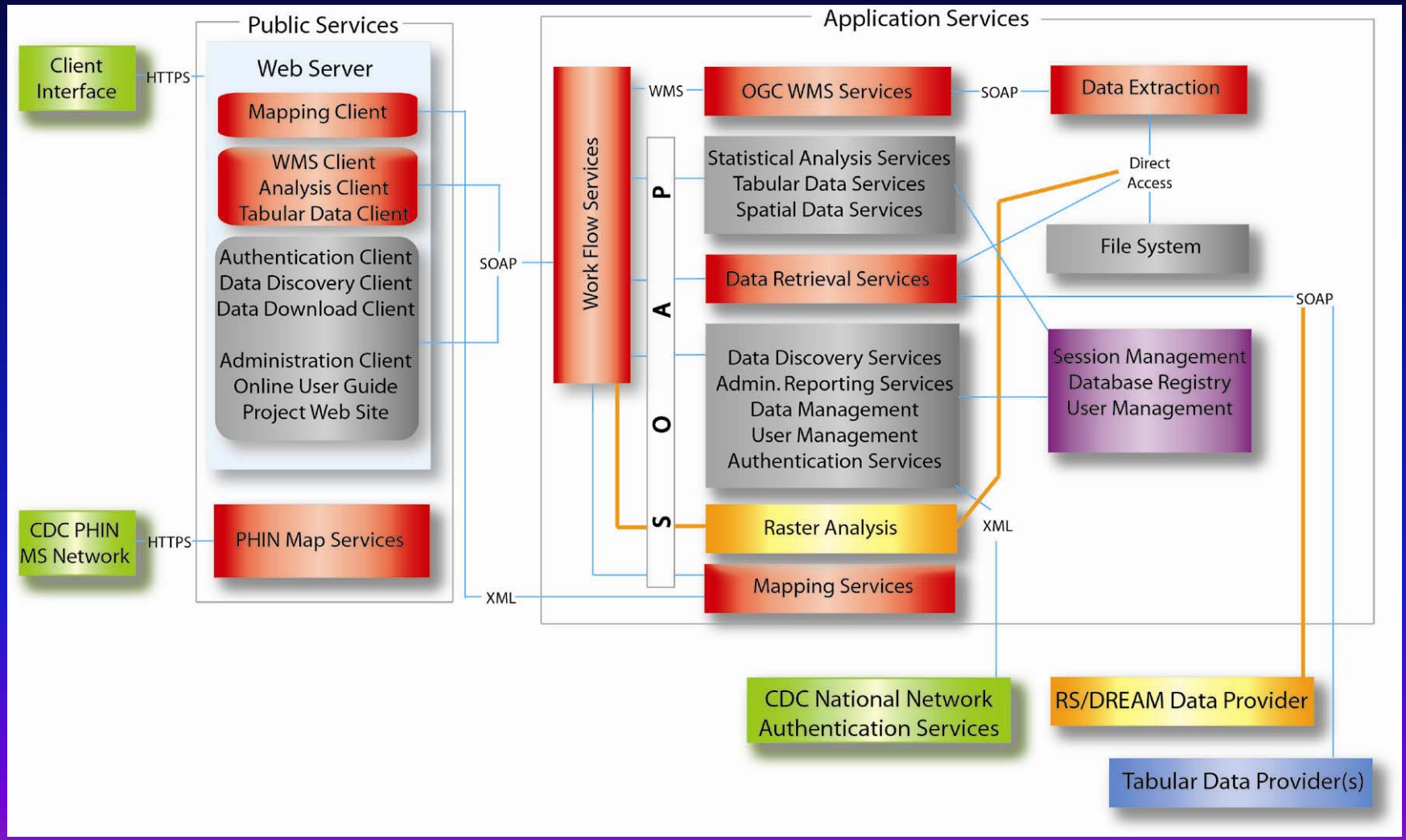
  Two-day lagged ozone (8-hr max)

  relative risk ratio of 1.17 (95% CI 1.02 to 1.34) for a 10 ppb increase in ozone (P = 0.03)

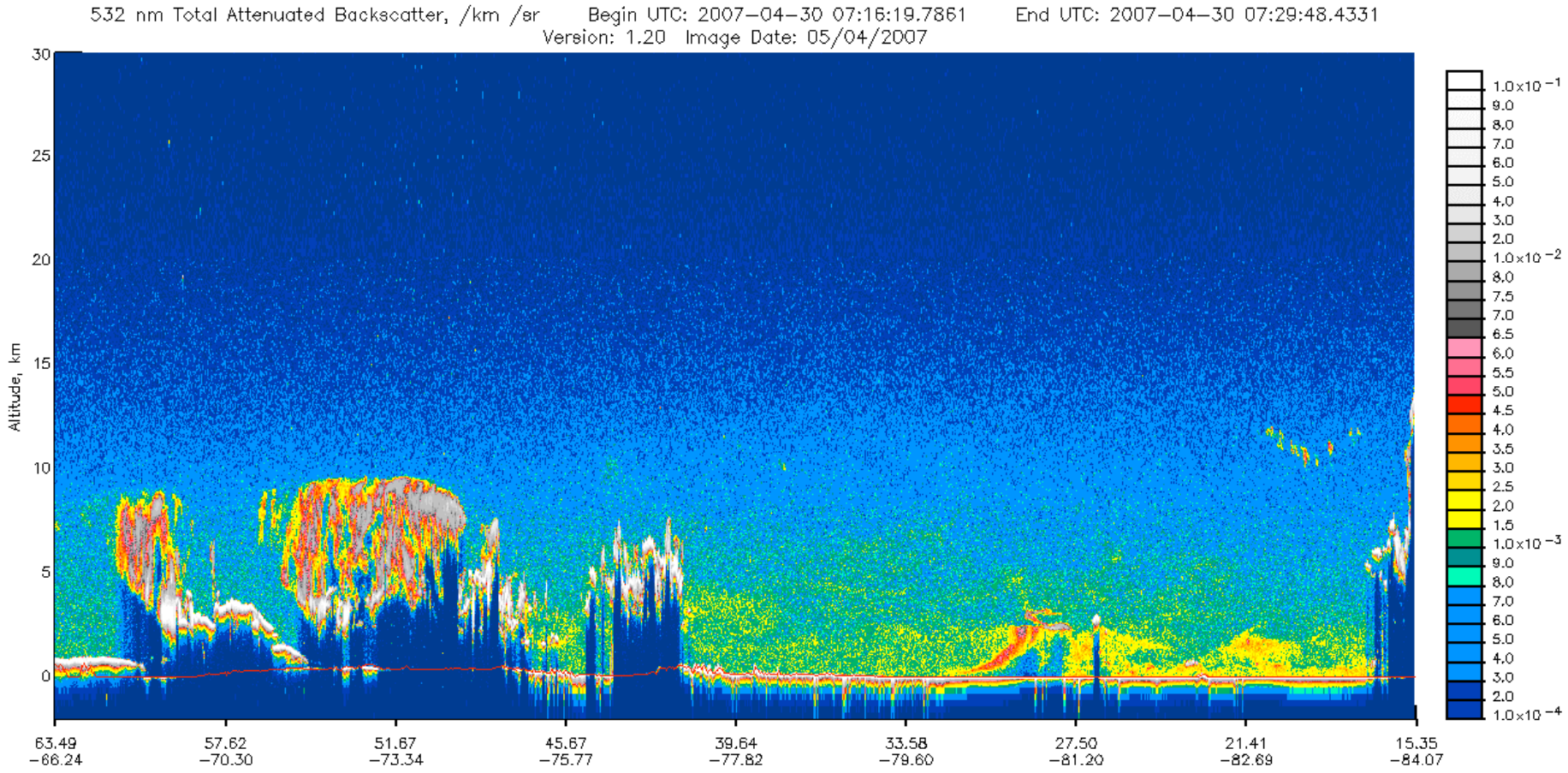
- Small effect of PM2.5 (2-day lag)

  relative risk ratio = 1.02 (P = 0.10)

NM EPHTS Delivery and Decision Support System



Sample CALIOP Data



The Tower of Babel Problem!

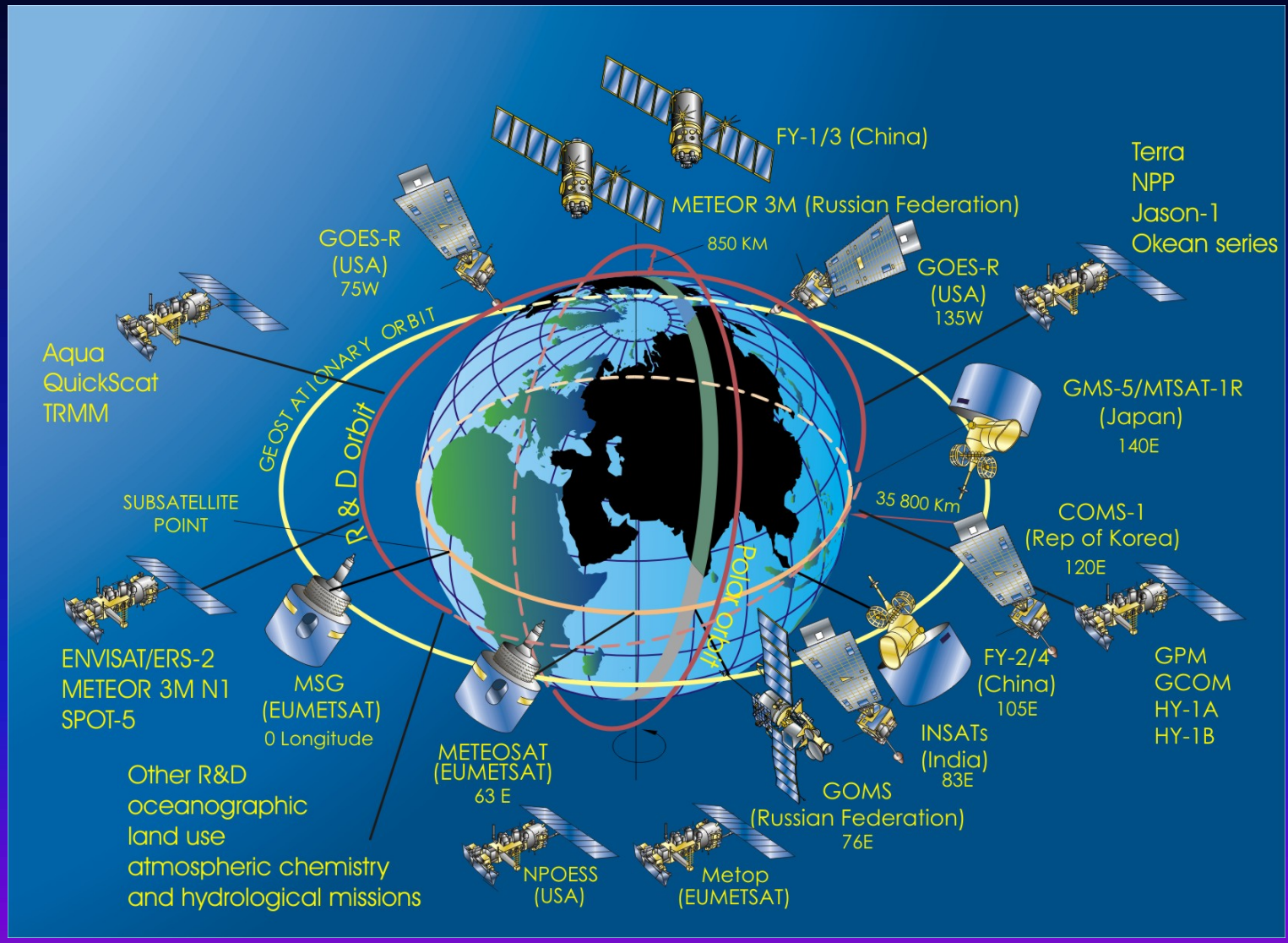
Need a system providing access to EO data in standard, interoperable formats

Portals and Clearinghouses

- **Based on existing portals, systems, and networks**
- **Designed to increase quality and accessibility of information**
- **Providing tools**

Modified from CIESIN

Satellite Observation Systems



GEOSS Architecture

…will provide system interoperability and easier, more open data access

Seven shortcomings are target areas for GEOSS:

Poor access to data having benefits in the developing world
Nascent technical infrastructure
Large spatial and temporal gaps in data sets
Inadequate data integration and interoperability
Uncertainty over continuity of observations
Nascent user involvement
Absence of DSSs to translate data into actionable plans

Modified from CIESIN

Relationship Between CEOS and GEO

National Space Agencies

National Governments, International Organizations & Professional Societies

CEOS

GEO

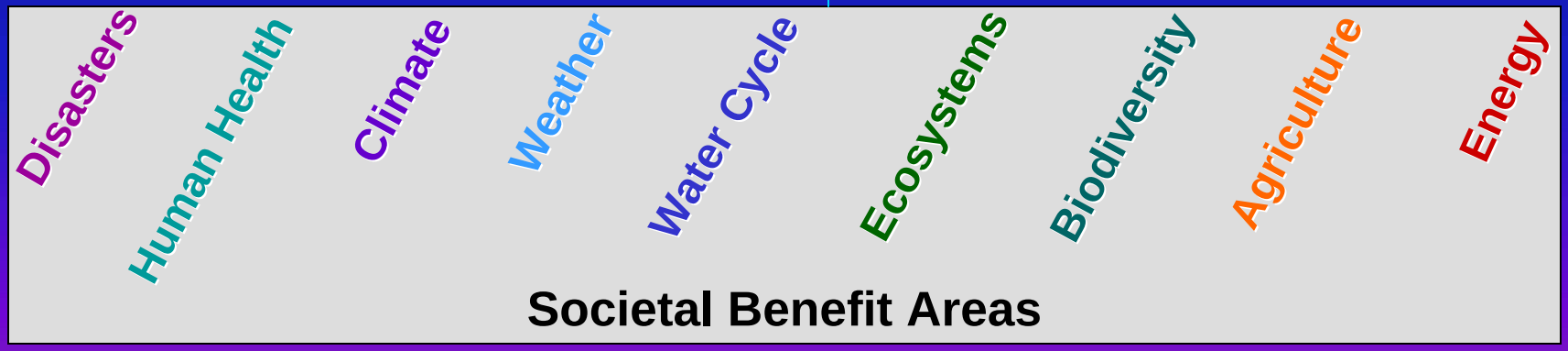
International cooperation for:
1. platform / sensor design, integration & deployment;
2. Sensor webs, analysis & systems

Capacity Building

Science & Technology

User Interface

Architecture & Data



GEOSS

OBSERVING SYSTEMS
GEO
Information System
Disasters
Health
Energy
Climate
Water
Weather
Ecosystems
Agriculture
Biodiversity
NINE SOCIETAL BENEFIT AREAS

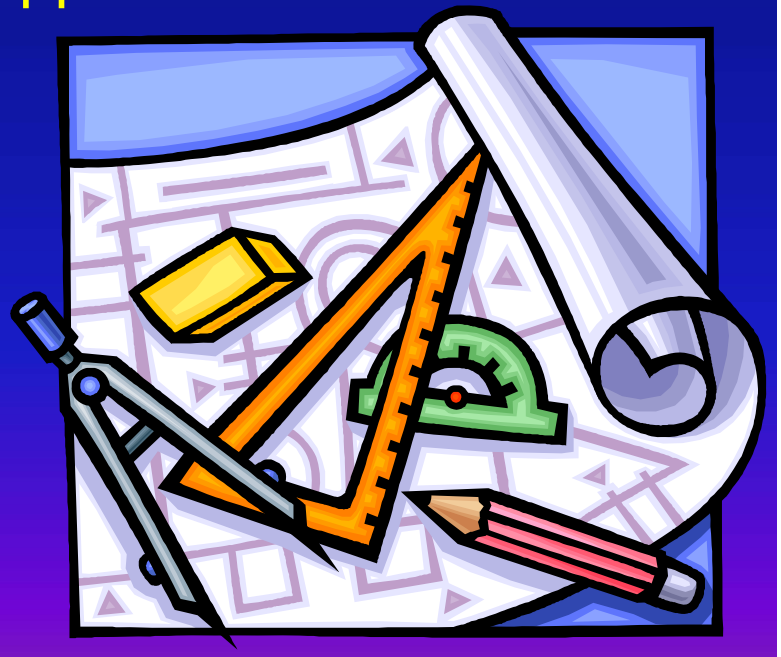
GEOSS Architecture

A user-driven approach to answer society's need for informed decision making

- Improve and Coordinate Observation Systems
- Provide Easier & More Open Data Access
- Foster Use through Science and Applications

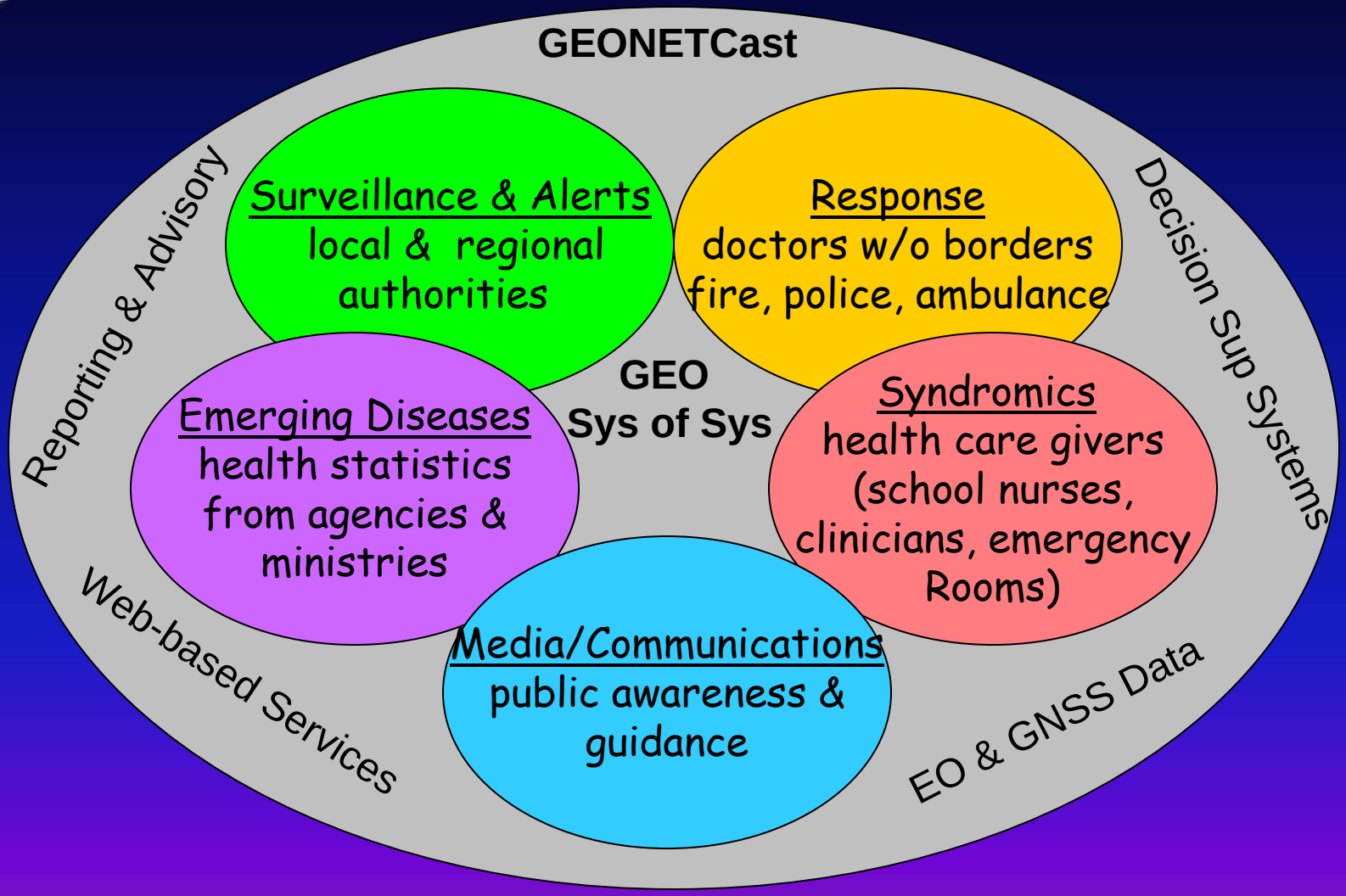
"What few things must be the same so that everything else can be different?"

Eliot Christian

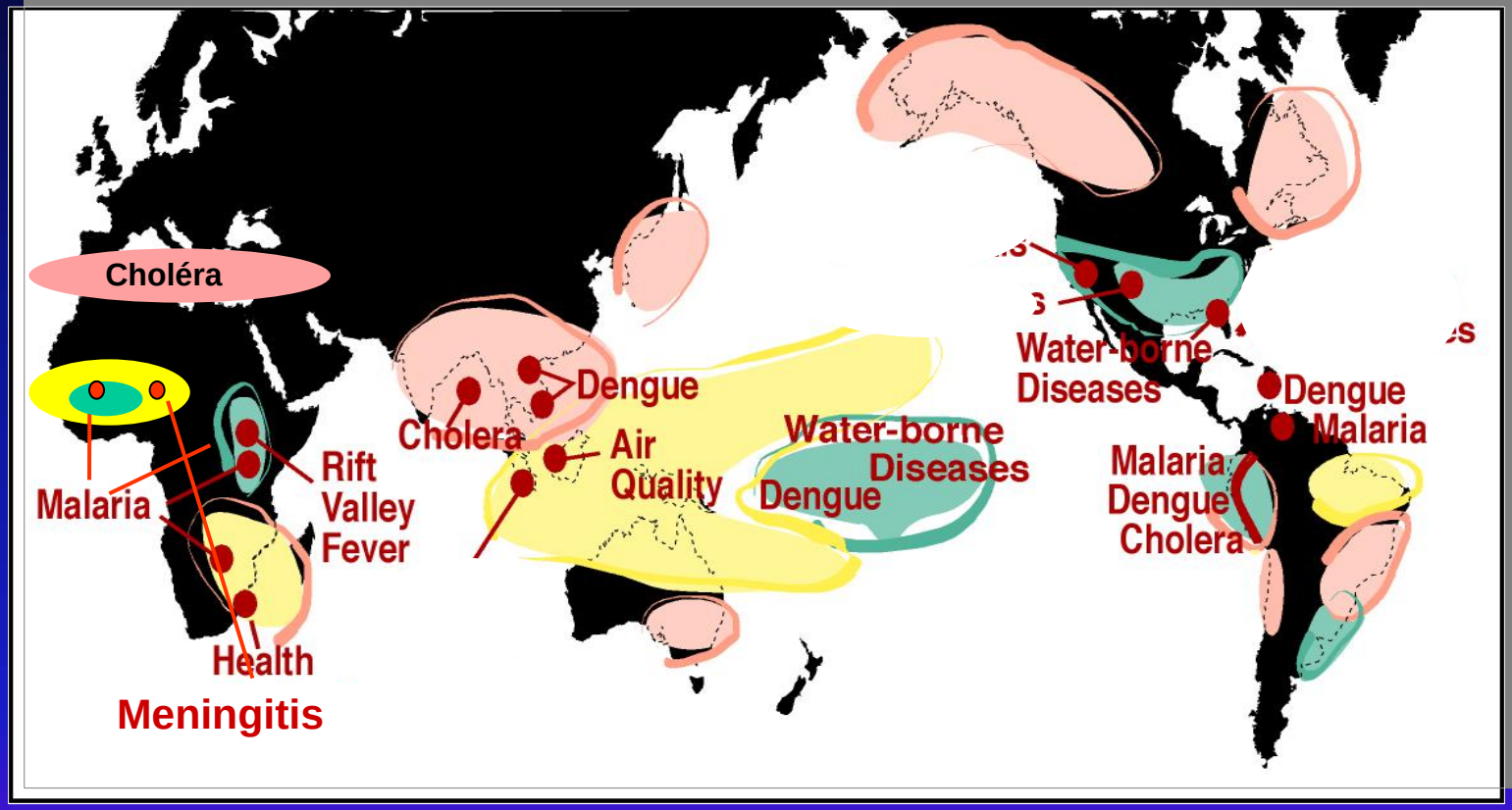


Communities of Practice
Societal Benefit Area = *Health*

GEO



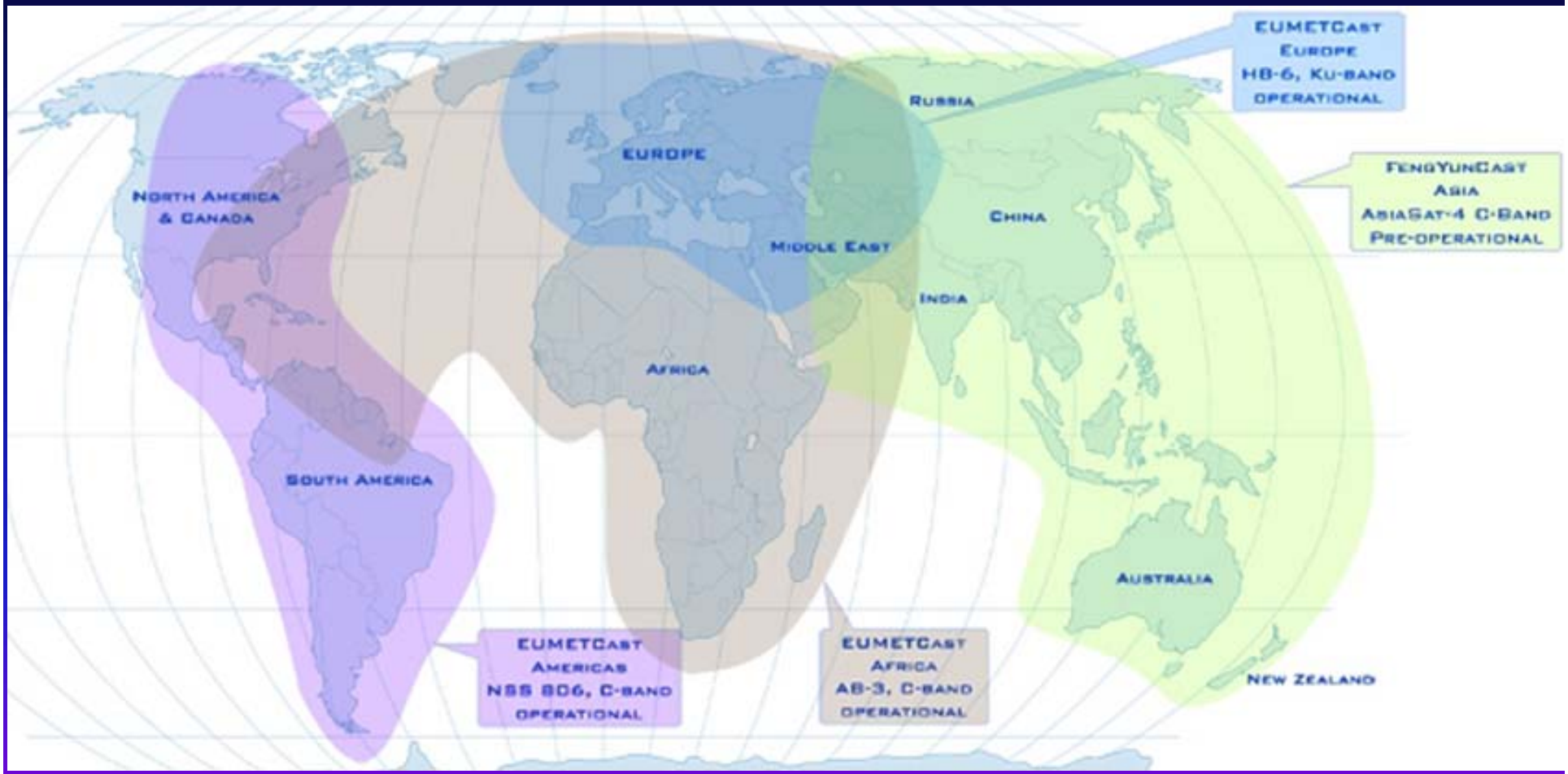
Emerging and Re-Emerging Infectious Diseases



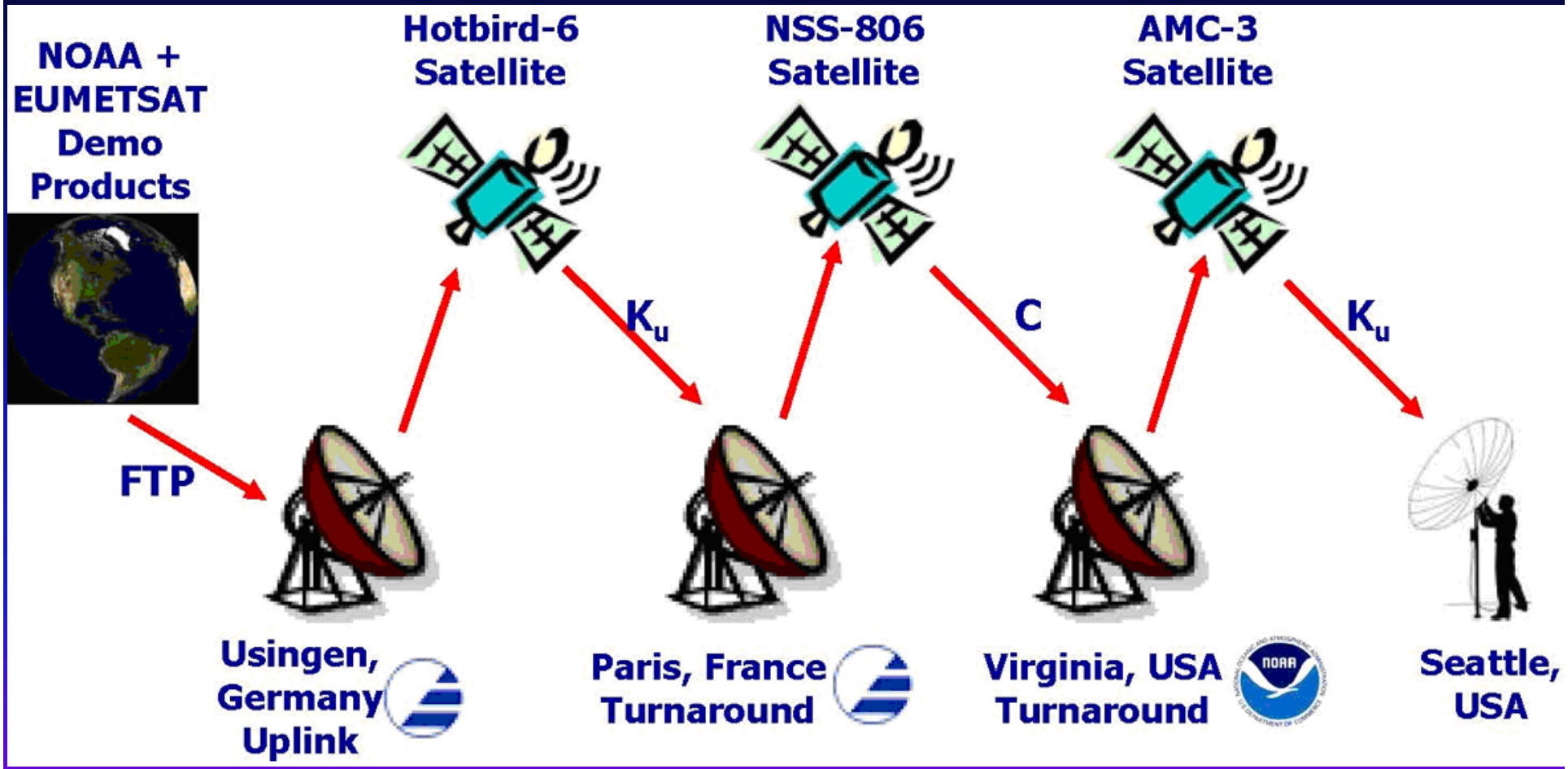
World Population at risk: 2 to 3 billions; Mortality per yr = 3.5 to 4.5 Million; with ½ under 5 yrs (~ 5 millions due to AIDS); Animal Mortality per yr: 10 to 15 millions

© 2002

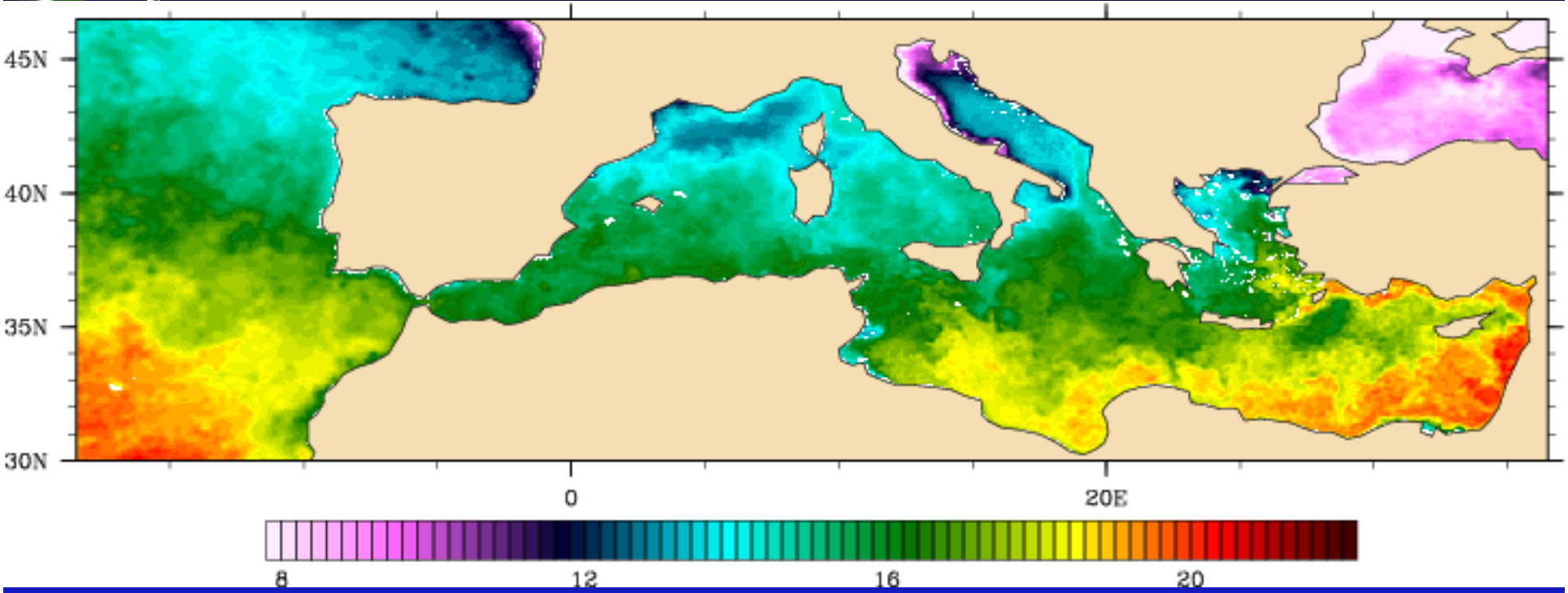
Footprints for GEONETCast



Notional Data Relay System
GEONETCast



Mediterranean SST 03 Jan,'08



The Medspiration project combines SST data measured independently by different satellites, including Envisat-AATSR, into a set of products that represent the best measure of SST, presented in a form that can be assimilated into numerical ocean forecasting models.

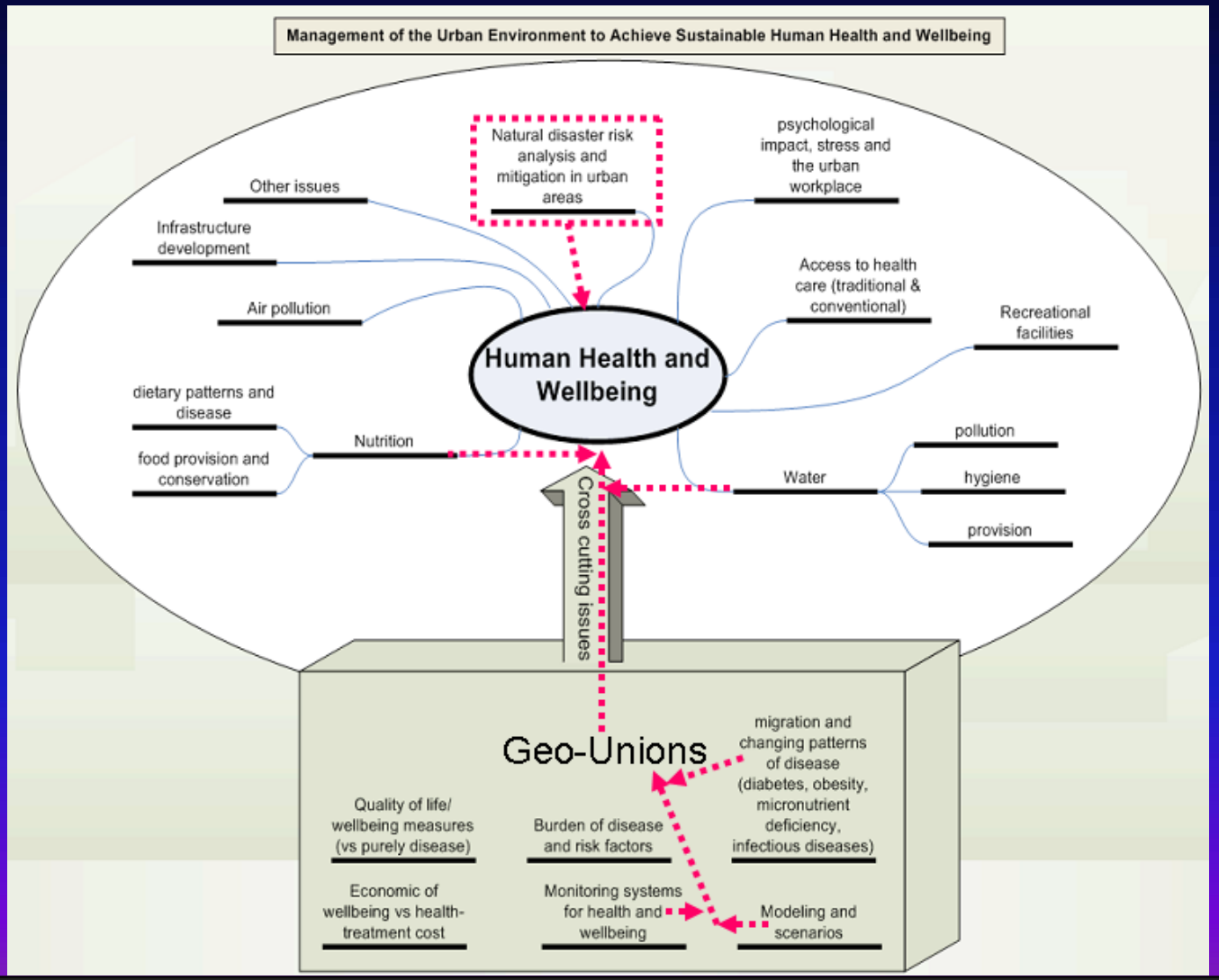
medspiration
EUROPEAN NODE FOR SEA SURFACE TEMPERATURE

UNM EDAC NASA

Aims and Goals of SHWB

- Demonstrate extent to which a range of science and technology is important to health and well-being;
- Educate (at multiple levels) about science and technology using modern means of communication;
- Collaborate to identify areas unmet and produce new ideas, science and technology partnerships to look to the future;
- Develop an inventory of ongoing programs, and activities to identify unmet needs; and
- Develop an appreciation for the SHWB systems approach

ICSU GeoUnions
Science for Health & Well-being



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