Remote Surveillance Technologies for Assessing Biological Threats

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Agenda

- Overview of paper
  - Bio-threats defined
  - Elements of an NMGI I
- Illustration of capabilities
  - Satellite Assets and ESMF
  - Asthma
  - HPS
- Recommendations
BTR Scope and Opportunities

- DHS & NMDHS Bio-threat Reduction Initiatives
  - Bio-Surveillance Program Initiative (BSPI)
  - DHS’s Information Analysis & Infrastructure Protection Program (IAIP)
  - Homeland Security Working Group (HSWG)
  - Geospatial Data Acquisition Coordination Committee (GDACC)

- Target Applications for NMGII
  - Respiratory & Infectious Diseases (Forecasting, Prevention & Mitigation)
  - Tracking Microorganisms, Plants and Animals (Food Security and Infrastructure Protection)
  - Hazardous, Toxic, & Nuclear Materials Transport (Public Safety, Evacuation Planning, & Risk Avoidance)
Elements of a New Mexico Geospatial Information Infrastructure (NMGII)

- National Assets
  - Satellite Resources
  - NSGIC
  - NSDI
    - FGDC
    - HSWG
    - National Map
    - Geospatial One-Stop

- New Mexico Assets
  - RGI S
  - NMGI C
  - GI SAC
  - GDACC
  - EDAC, UNM (Public Health)
  - LI SA, NMSU (Animal Health)
To Protect Our Homeland & Planet
Continuity of Operational Satellite Programs

- Actual launch dates are determined by the failure of on-orbit assets
- Assumes METOP will provide the morning orbit and NOAA-N’ will provide afternoon orbit instruments
- GOES R-Series may be single or suite of satellites (distributed constellation)

** European Coordination

Satellite is operational beyond design life
Onorbit GOES storage

12/3/03
BTR & National Applications

- Carbon Management
- Public Health
- Energy Forecasting
- Aviation Safety
- Water Management
- Homeland Security
- Coastal Management
- Disaster Management
- Agricultural Efficiency
- Invasive Species
- Ecological Forecasting
- Air Quality
**Integrated System Solution**

**Value & Benefits**
1. NASA assets feed DSS
2. Integrated NASA/CDC solution
3. Stimulate Wkrfc Dev w/ space products
4. Benchmark value of solutions
5. Expand user base for RSVP
6. Migrate RSVP-2 to RSVP-3
7. Provide quicker public health response
8. Refine quality of public health response

**Earth System Models**
1. Modeling Framework
   - MAESTRO* / MAESTRA*
   - CLSM*
   - NCEP-ETA* + “DREAM”
2. Candidate Adjunct Models
   - NARAC / ERS
   - HOTMAC / RAPTAD
   - Ecological Models (e.g. HPS)
   - COAMPS*
3. Statistical models
   (e.g., NARA, NARISA)

**Decision Support Tools**
- Enhancing RSVP capabilities
- Improving knowledge of vector ecology
- Improving NCEP-ETA model w/ DREAM inputs
- Improving DREAM inputs w/ NASA products
- Improving aerosol and smoke dispersion models w/ NASA products
- Visualizations and animations of key environmental triggers

**Monitoring & Measurements**
1. TRMM Data Products
   - PR 3A-25,26
   - TMI 2A-12, 3A-11
   - TRMM 2B-31, 3B-31, #B-42,43
2. ASTER Data Products
   - AST14, AST05,08
3. MISR Data Products
   - MIS05,08,09
4. MODIS Data Products
   - MOD04,08,09,11-17
5. *NPOESS
### Reported Predictors/Triggers Of Asthma

#### Respiratory Predictors

1. Urbanicity
2. Traffic density
3. Age
4. Gender
5. Temperature
6. Precipitation
7. Humidity

#### Respiratory Triggers

- **A. Outdoor Environment**
  1. Dust
  2. Pollen

- **B. Indoor Environment**
  1. Wall-to-wall carpet
  2. Cockroaches
  3. Stuffed toys
Sample Coverages For Asthma Predictors

Bernalillo County Population Density and Annual Precipitation

Albuquerque Public School Locations and Intersection Traffic Density Rates
BTR/ NASA Data Products

- Tropical Rainfall Measuring Mission (TRMM)
  - Precipitation Radar (3A-25) *Monthly accumulated rainfall*
  - PR (3A-26) *Accumulated surface rainfall*
  - TRMM Microwave Imager (2A-12) *Surface rainfall & vertical structure*
  - TRMM (3B-31) *Monthly combined accumulated rainfall & vertical structure*

- Advanced Spaceborne Thermal Emission & Reflection Radiometer (ASTER)
  - (AST14) *Digital elevation models*
  - (AST05) *Surface temperatures*
  - (AST07,09) *Surface reflectance and radiance*

- Multi-angle Imaging Spectroradiometer (MISR)
  - (MI S05) *Aerosol and surface product*

- Moderate Resolution Imaging Spectroradiometer (MODIS)
  - (MOD04) *Aerosol product*
  - (MOD08) *Atmosphere products (Aerosol properties, radiative energy fluxes)*
  - (MOD09) *Surface reflectance, atmospheric correction, algorithms (Vegetation & Land cover, vegetation & land cover dynamics)*
  - (MOD11-17) *Surface temperature, vegetation dynamics, land cover, fire, thermal anomalies*
Digital Elevation Model/
Shaded Relief

DEM (1-km)

Shaded Relief
## DEM
(Sandia Crest)

### Digital elevation values (m asl)

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**Area enlargement**
30-m pixel
Terra/ MODIS Land Surface Temp/ Emissivity-Daily, 1-km
AZ/ NM (MOD13A4) 16-Day Vegetation Index 1-km
TRMM/ TMI - Rain Rate
11/12/03
TRMM/ PR Surface Rain Rate
11/12/03
Temporal Visualization of Global Aerosol Migration

APR 01 2001
A World of Dust

Aral Sea  Bio-Threat  Nadir

Calm before the storm  70° Forward

Haze over China  Saharan dust to Italy
Dust Storm over New Mexico & Texas
Aqua/ MODIS 12/15/03
More BTR/ NASA Products

Smoke

Carbon Monoxide

Sulfur Dioxide

Temperature Anomalies
Hantavirus Pulmonary Syndrome

Peromyscus Maniculatus

Reservoir for Sin Nombre Virus

AVHRR NDVI- 1991-1997

HPS Cases & Controls as a Function of Elevation

% Frequency of HPS and Control Sites w/ i NDVI Intervals
Data Flow and Delivery System

Resource Geographic Information System Clearinghouse

RGIS  TRIMS

Data  Toolkits

Internet Map Services

Land Management  Transportation  Hydrology

New Technology Development

RSVP & BTR

Public Health

Secure BTR Operational System

Science and Public Users
Federal and State Partnerships

Elements collaborate at minimal level with untested compatibility and interoperability; Gaps prevail; Architecture is incomplete.
“Human actions have become a dominant force [for] environmental change. Globalization has led to the introduction and spread of invasive species and infectious diseases with little understanding of the consequences...

“Achieving a mechanistic and predictive understanding [of changes] will require [spanning] large spatial and temporal scales, and transcending [many] levels of biological complexity (National Science Foundation, NEON Announcement, March ’04. Page 4).”