The Increasing Use of Remote Sensing Data in Studying the Climatological Impacts on Public Health

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Abstract

One of the more fortunate outcomes of the capture and transformation of remote sensing data into applied information is their usefulness and impacts to better understanding climatological impacts on public health. Today, with petabytes of remote sensing data providing global coverage of climatological parameters, public health research and policy decision makers have an unprecedented (and growing) data record that relates the effects of climatic parameters, such as rainfall, heat, soil moisture, etc. to incidences and spread of disease, as well as predictive modeling. In addition, tools and services that specifically serve public health researchers and respondents have grown in response to needs of the these information users.

Motivation

Our goal is to provide a (strong) flavor of the data and information services available to public health research and decision making; to invoke new ways of thinking about how public health work can be accomplished; and to stimulate new ideas on how information services can be further utilized.

Conclusions

- Satellite remote sensing data and services hold great promise for alleviating limitations of monitor-based environmental data collection
- Obstacles such as uncertainties in methodology, data accessibility (for epidemiologists) and data quality are being addressed
- Numerous community efforts are addressing these issues
- A further increase in health research and modeling nurtured by more satellite products, reduced uncertainties, and user-oriented data services are on the horizon

NASA Funded Systems Developed to Facilitate Specific Public Health Decision and Public Support Services

Project	PI	Remote Sensing Datasets Used
Vector Borne Disease:		
Predicting Zoonotic Hemorrhagic Fever Events in Sub-Saharan Africa using NASA Earth Science Data for DoD - Global Emerging Infections Surveillance and Response System	Jorge Pinzon	MODIS (NDVI, temperature), TRMM/GPCP (precipitation), SRTM (topography)
Development of a Detection and Early Warning System for Malaria Risk in the Amazon	Benjamin Zaitchik	TRMM (prcipitation), MODIS/Landsat (land cover type), AMSR-E (soil moisture), GRACE (terrestrial water storage), MODIS/landsat (vegetation fraction, LAI), SRTM (topography)
SERVIR Africa	Daniel Irwin	TRMM/GPCP (precipitation), MODIS, SRTM (topography), AMSR-E
Investigating the Potential Range, Expansion of the Vector Mosquito Aedes aegypti in Mexico with NASA Earth Science Remote Sensing Results	Sue Estes	MODIS (NDVI, LST, LCLU), AMSR-E (soil moisture), SRTM (topography),CMORPH
Enhanced Forecasting of Mosquito-Borne Disease Outbreaks Using AMSR-E	Michael Wimberly	AMSR-E (soil moisture), MODIS, TRMM
Modeling Global Influenza Risks using NASA Data	Richard Kiang	TRMM (precipitation), MODIS (LST)
Avian Influenza Risk Prediction in Southeast Asia and Early Warning of Pandemic Influenza	Richard Kiang	TRMM (precipitation), MODIS (LST)
Integrating Earth observations and satellite telemetry of wild birds for decision support system of avian influenza	Xiangming Xiao	MODIS (surface reflectance)
Application of NASA Data to Develop an Influenza Forecasting System	Katia Charland	from ECOCAST holdings
Water Borne Disease:		
Service Monitoring and Forecasting Cyanobacterial Blooms for Public Health Protection and Response	Richard Stumpf	MODIS (temperature, ocean color)
Feasibility Study of Satellite-Assisted Detection and Forecasting of Oyster Norovirus Outbreak	Zhiqiang Deng	MODIS (ocean color)
Influence of Land-Use and Precipitation on Regional Hydrology and Public Health	Charles Tilburg	TRMM (precipitation)
Air Pollution Related Disease:		
Enhancing Environmental Public Health, Tracking with Satellite-Driven Particle Exposure Modeling and Epidemiology	Yang Liu	MODIS (aerosol), GOES (aerosol/smoke), MISR (aerosol), OMI (aerosol index)
Integration of Airborne Dust Prediction Systems and Vegetation Phenology to Track Pollen for Asthma Alerts in Public Health Decision Support Systems	Jeffrey Luvall	MODIS Direct Broadcast (NDVI)
Linking NASA Environmental Data with a National Public Health Cohort Study to Enhance Public Health Decision Making	Leslie McClure	MODIS (temperature),NARR (solar irradiance, temperature, humidity)
Adding NASA Earth Science Results to EPHTN via the NM/EPHT System	Stanley Morain	MODIS (AOD, land cover), CALIPSO (aerosol), SRTM (topography)
Using NASA Satellite Aerosol Optical Depth Data to Create Representative PM2.5 Fields for Use in Human Health and Epidemiology Studies in Support of State and National Environmental Public Health Tracking Programs	Amy Huff	MODIS (AOD)

AOD - aerosol optical depth	LST - land surface temperature
AMSR-E - Advanced Microwave Scanning Radiometer for EOS	MISR - Multi-angle Imaging Spectro-Radiometer
CALIPSO - Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation	MODIS - Moderate Resolution Imagig Spectroradiometer
CMORPH - Climate Prediction Center Morphing Technique	NARR - North American Regional Reanalysis
GOES - Geostationary Operational Environmental Satellite	NDVI - Normalized Difference Vegetation Index
GPCP - Global Precipitation Climatology Project	OMI - Ozone Monitoring Instrument
GRACE - Gravity Recovery and Climate Experiment	SRTM - Shuttle Radar Topography Mission
LAI - leaf area index	TRMM - Tropical Rainfall Measuring Mission
LCLU - Land cover land use	

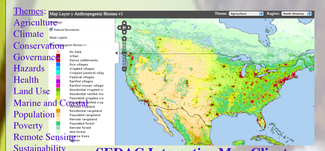
Remote Sensing Data and Information Services Available for Public Health Studies and Decision Making

(NASA Projects)

Health-related Data and Services from the NASA Socioeconomic Data and Applications Center (SEDAC)

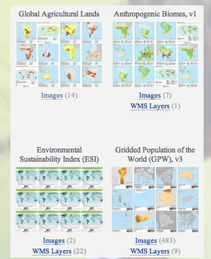
Meredith L. Golden

SEDAC is a NASA Earth Science Data Center specializing in data related to human interactions in the environment, and in particular on demographic and socioeconomic data that can be integrated with remote sensing data



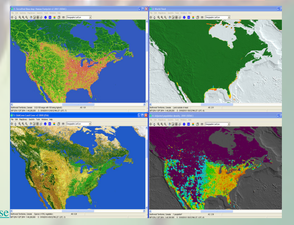
SEDAC Interactive Map Client
http://sedac.ciesin.columbia.edu/maps/client

SEDAC Population Estimation Service
http://sedac.ciesin.columbia.edu/gpw/wps.jsp



SEDAC Map Gallery
http://sedac.ciesin.columbia.edu/maps/gallery/browse

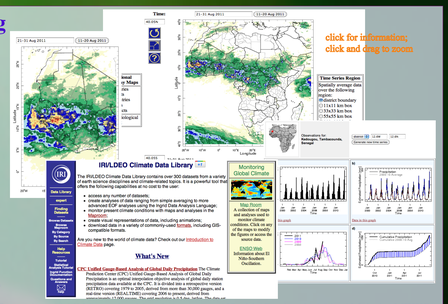
TerraViva! SEDAC: Standalone data and viewer
http://sedac.ciesin.columbia.edu/terraVivaUserWeb/



The Use of Remote Sensing Data for Monitoring Rainfall, Vegetation and Water Bodies for Malaria Surveillance

Pietro Ceccato

Monitoring variations in environmental conditions such as rainfall and vegetation helps decision-makers to assess the risk levels of malaria epidemics

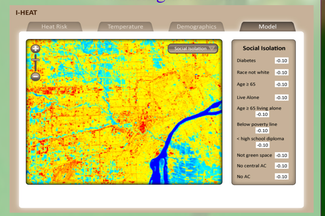


From: http://iridl.ldeo.columbia.edu/maproom/.Health/.Regional/.Africa/.Malaria/.MEWS/

Internet-based Heat Evaluation and Assessment Tool (I-HEAT)

Susan Maxwell

I-HEAT interface showing a heat-risk map of Detroit, Michigan and modeling controls



The Feasibility of Interoperable Multi-resolution Dust Modeling for Accelerated Forecast Availability

Karl Benedict

Information technology study analyzing the feasibility of developing dust forecasting system with improved system performance and utility:

- Timeliness to create forecast products after event has been identified
- Spatial resolution of the forecast products relative to the preferred analytic and alert units
- Utility of the forecast products – that they are in form usable by public health system users

Conclusions:

- Demonstrated efficient transfer of remote sensing data
- Alternate data transfer protocols are feasible
- Simplified parallel execution has significant potential

Remote Sensing Data and Information Services at the Goddard Earth Science Data and Information Services Center (GES DISC) Related to Public Health Research

Steven Kempler

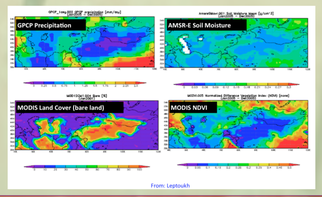
GES DISC Data Search and Access Services

Mirador
http://mirador.gsfc.nasa.gov/

Choose:
Keyword search,
Time, Location…
or Project…
or Science Area

GES DISC is a NASA Earth Science Data Center specializing in servicing atmospheric, hydrologic, and precipitation remote sensing, and remote sensing based assimilated data useful for public health research, modeling, surveillance, and decision support systems

Select location, time, measurement… and visualization



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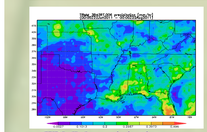
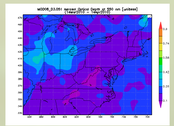
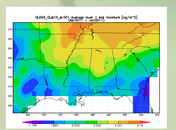


TRMM precipitation rate



MODIS aerosol optical depth



GLDAS soil moisture

NASA's Earth Science Data Centers	Discipline
Alaska Satellite Facility SAR Data Center (ASF SDC) website: http://www.asf.alaska.edu	• Synthetic Aperture Radar (SAR) • Sea Ice • Polar Processes • Geophysics
Crustal Dynamics Data Information System (CDDIS) website: http://cddis.gsfc.nasa.gov/	• Space Geodesy
Global Hydrology Resource Center (GHRC) website: http://ghrc.msfc.nasa.gov/	• Hydrologic Cycle • Severe Weather Interactions • Lightning • Atmospheric Convection
Goddard Earth Sciences Data and Information Services Center (GES DISC) website: http://disc.sci.gsfc.nasa.gov/	• Global Precipitation • Solar Irradiance • Atmospheric Composition • Atmospheric Dynamics • Global Modeling
Land Processes (LP) DAAC website: https://lpdaac.usgs.gov/	• Surface Reflectance • Land Cover • Vegetation Indices
Level 1 Atmosphere Archive and Distribution System (MODAPS LAADS) website: http://ladsweb.nascom.nasa.gov/	• Radiance • Atmosphere
NASA Langley Research Center Atmospheric Science Data Center (LaRC ASDC) website: http://eosweb.larc.nasa.gov/	• Radiation Budget • Clouds • Aerosols • Tropospheric Chemistry
National Snow and Ice Data Center (NSIDC) DAAC website: http://nsidc.org/	• Snow • Ice • Cryosphere • Climate
Oak Ridge National Laboratory (ORNL) DAAC website: http://daac.ornl.gov/	• Biogeochemical Dynamics • Ecological Data • Environmental Processes
Ocean Biology Processing Group (OBPG) website: http://oceancolor.gsfc.nasa.gov/	• Ocean Biology • Ocean Color • Biogeochemistry • Sea Surface Temperature
Physical Oceanography (PO) DAAC website: http://podaac.jpl.nasa.gov/	• Sea Surface Temperature • Ocean Winds • Circulation and Currents • Topography and Gravity
Socioeconomic Data and Applications Data Center (SEDAC) website: http://sedac.ciesin.columbia.edu/	• Human Interactions • Land Use • Environmental Sustainability • Geospatial Data • Multilateral Environmental Agreements