THRIVE

TIMELY HEALTH INDICATORS USING REMOTE SENSING & INNOVATION FOR THE VITALITY OF THE ENVIRONMENT

Why we care so much?

Approximately 50 million Americans have allergic diseases, including asthma and allergic rhinitis, both of which can be exacerbated by PM_{2.5}.

Every day in America 44,000 people have an asthma attack, and because of asthma 36,000 kids miss school, 27,000 adults miss work, 4,700 people visit the emergency room, 1,200 people are admitted to the hospital, and 9 people die.





Public health, environmental and social determinants of health (PHE)

7 million deaths annually linked to air pollution





In new estimates released, WHO reports that in 2012 around 7 million people died - one in eight of total global deaths – as a result of air pollution exposure. This finding more than doubles previous estimates and confirms that air pollution is now the world's largest single environmental health risk. Reducing air pollution could save millions of lives.

Read the news release on air pollution attributable deaths

Read the feature story on air pollution

- FAQs on air pollution and health pdf, 169kb
- Air pollution estimates
 pdf, 1.16Mb
 Summary of results and method descriptions

3.7 million deaths

attributable to ambient air pollution

Mortality from ambient air pollution for 2012 - summary of results pdf, 293kb

4.3 million deaths

attributable to household air pollution

Mortality from household air pollution 2012 - summary of results. pdf, 558kb

1600 cities

worldwide are reporting air pollution levels

Air quality in cities database – summary of results pdf, 304kb





Fine Particulate Matter Size Comparison



µm = micrometer







PM2.5 Invisible Killer



2 will be born

If the world were a village of 100 people



	Short-term Studies			Long-term Studies		
Health Outcomes	PM10	PM2.5	UFP	PM10	PM2.5	UFP
Mortality						
All causes	xxx	xxx	х	XX	xx	х
Cardiovascular	xxx	xxx	X	xx	xx	Х
Pulmonary	xxx	xxx	X	XX	XX	X
Pulmonary effects						
Lung function, e.g., PEF	xxx	xxx	XX	xxx	xxx	
Lung function growth				xxx	XXX	
Asthma and COPD exacerbation						
Acute respiratory symptoms		XX	X	xxx	xxx	
Medication use			X			
Hospital admission	xx	xxx	X			
Lung cancer						
Cohort				XX	XX	X
Hospital admission				XX	XX	X
Cardiovascular effects						
Hospital admission	xxx	xxx		x	X	
ECG-related endpoints						
Autonomic nervous system	xxx	XXX	XX			
Myocardial substrate and vulnerability		XX	X			
Vascular function						
Blood pressure	xx	xxx	X			
Endothelial function	x	XX	Х			
Blood markers						
Pro inflammatory mediators	xx	XX	XX			
Coagulation blood markers	xx	XX	XX			
Diabetes	x	XX	X			
Endothelial function	x	х	XX			
Reproduction						
Premature birth	x	х				
Birth weight	xx	x				
IUR/SGA	x	x				
Fetal growth						
Birth defects	x					
Infant mortality	xx	X				
Sperm quality	x	x				
Neurotoxic effects						
Central nervous system		x	xx			

Table 1. PM and health outcomes (modified from *Ruckerl et al.* (2006)).



Decreased Lung Function < 10 μ m

x, few studies; xx, many studies; xxx, large number of studies.



Aqua DeepBlue

Rank	Source	Variable	Туре
1	Satellite Product	Tropospheric NO ₂ Column	Input
2	Satellite Product	Solar Azimuth	Input
3	Meteorological Analyses	Air Density at Surface	Input
4	Satellite Product	Sensor Zenith	Input
5	Satellite Product	White-sky Albedo at 470 nm	Input
6		Population Density	Input
7	Satellite Product	Deep Blue Surface Reflectance 470 nm	Input
8	Meteorological Analyses	Surface Air Temperature	Input
9	Meteorological Analyses	Surface Ventilation Velocity	Input
10	Meteorological Analyses	Surface Wind Speed	Input
11	Satellite Product	White-sky Albedo at 858 nm	Input
12	Satellite Product	White-sky Albedo at 2,130 nm	Input
13	Satellite Product	Solar Zenith	Input
14	Meteorological Analyses	Surface Layer Height	Input
15	Satellite Product	White-sky Albedo at 1,240 nm	Input
16	Satellite Product	Deep Blue Surface Reflectance 660 nm	Input
17	Satellite Product	Deep Blue Surface Reflectance 412 nm	Input
18	Satellite Product	White-sky Albedo at 1,640 nm	Input
19	Satellite Product	Sensor Azimuth	Input
20	Satellite Product	Scattering Angle	Input
21	Meteorological Analyses	Surface Velocity Scale	Input
22	Satellite Product	Cloud Mask Qa	Input
23	Satellite Product	White-sky Albedo at 555 nm	Input
24	Satellite Product	Deep Blue Aerosol Optical Depth 550 nm	Input
25	Satellite Product	Deep Blue Aerosol Optical Depth 660 nm	Input
26	Satellite Product	Deep Blue Aerosol Optical Depth 412 nm	Input
27	Meteorological Analyses	Total Precipitation	Input
28	Satellite Product	White-sky Albedo at 648 nm	Input
29	Satellite Product	Deep Blue Aerosol Optical Depth 470 nm	Input
30	Satellite Product	Deep Blue Angstrom Exponent Land	Input
31	Meteorological Analyses	Surface Specific Humidity	Input
32	Satellite Product	Cloud Fraction Land	Input

 $PM_{2.5}$

In-situ Observation







Target

This is a BigData Problem of Great Societal Relevance

- Collecting data in real time from national and global networks requires **bandwidth**.
- With the next generation of wearable sensors and the **internet of things** this data volume will rapidly increase.
- A variety of applications enabled by **BigData**, **higher bandwidth** and **cloud processing**.
- Future finer granularity and two way communication will dramatically increase the size of the data bringing air quality to the micro scale, just like weather data.

	Time Taken			
	10 Mbps	20 Mbps	50 Mbps	1 Gbps
40 TB training data	185 days	93 days	37 days	1 day 21 hours
4 Gb update	54m	27m	11m	32s

Long-Term Average 1997-present



Think Big: Holistic & Comprehensive Informatics



THRIVE

Multiple Big Data + EMR + Social Media + Machine Learning + Causality A Cross-cutting Platform for Comprehensive Informatics for **Data Driven Decisions** in **Patient Centered Care** facilitated by *High Speed Low-Latency networks*, multiple massive datasets from large distributed sensor networks, EMR, and *local cloud computing*.

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