



# Earth Observation for Health

International trends & developments

Earth observation applications

Business development

Capacity building



## ***0. Introduction***

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HCP international:

consulting, marketing of earth observation

Project director EOPOWER:

project for promotion & capacity building of  
earth observation applications



## *Sequence:*

- General assessment of the state-of-the-art of earth observation
- Major trends and developments in the application field
- Description of earth observation solutions
- Assessment of market potential for earth observation solutions and marketing instruments
- Capacity building for successful application of earth observation solutions



***Earth Observation helps you:***

***save money***

***save lives***

***save the environment***



## *Earth observation applications*

- On the verge of reaching new user communities
- These new user communities need to be involved
- Weakest link / last mile aspects are important
- Marketing needed: promotion & capacity building



# *Life cycle of products & services*

Initialization

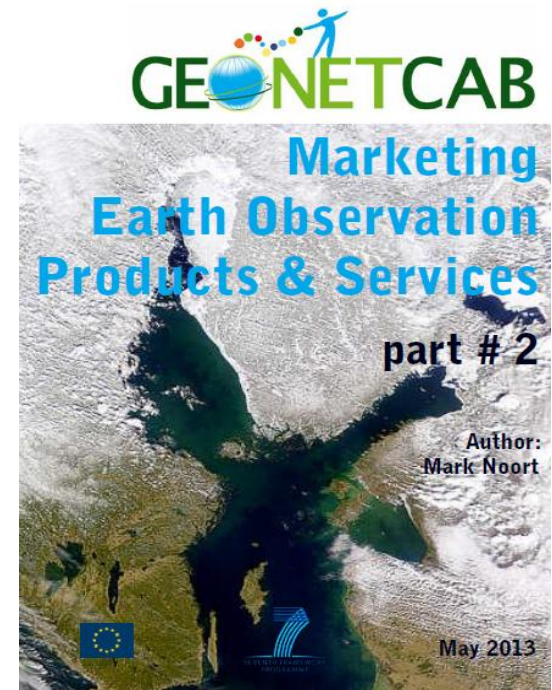
System analysis & design

Rapid prototyping

System development

Implementation

Post-implementation





## *Scope*

### **Health:**

Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.

**Air quality:** The state of the air around us. Good air quality refers to clean, clear, unpolluted air.

**Disease:** Any condition that causes pain, dysfunction, distress, social problems, or death to the person afflicted, or similar problems for those in contact with the person.

*Environmental aspects are dealt with more in detail in the environmental toolkit, industrial accidents and other disaster-related aspects in the disaster management toolkit.*



## *Assessment of business & funding opportunities*

- Categories of environmental management products & services
- Life cycle phase of product or service
- Regional context, level of technological & economic development
- Optimum marketing mix





# ***1. International trends & developments in health***



## *Issues & trends in health*

- Importance of monitoring and improving **air quality** (pollution, aeroallergens, dust storms);
- Improved options for early warning for possible health hazards, such as **sand and dust storms**
- Increased opportunities and possibilities for **fighting diseases** (malaria, meningitis, dengue, rift fever, West-Nile virus, cholera, etc.);
- Increased attention for the relation between **climate change and health**.



## *Drivers (1)*

### **Negative:**

- Increasing population;
- Economic growth;
- Increasing urbanisation;
- Increasing (energy) consumption;
- Increasing mobilisation -> motor vehicles;

Lead to increased pollution of air, water and soil.



## *Drivers (2)*

### **Positive:**

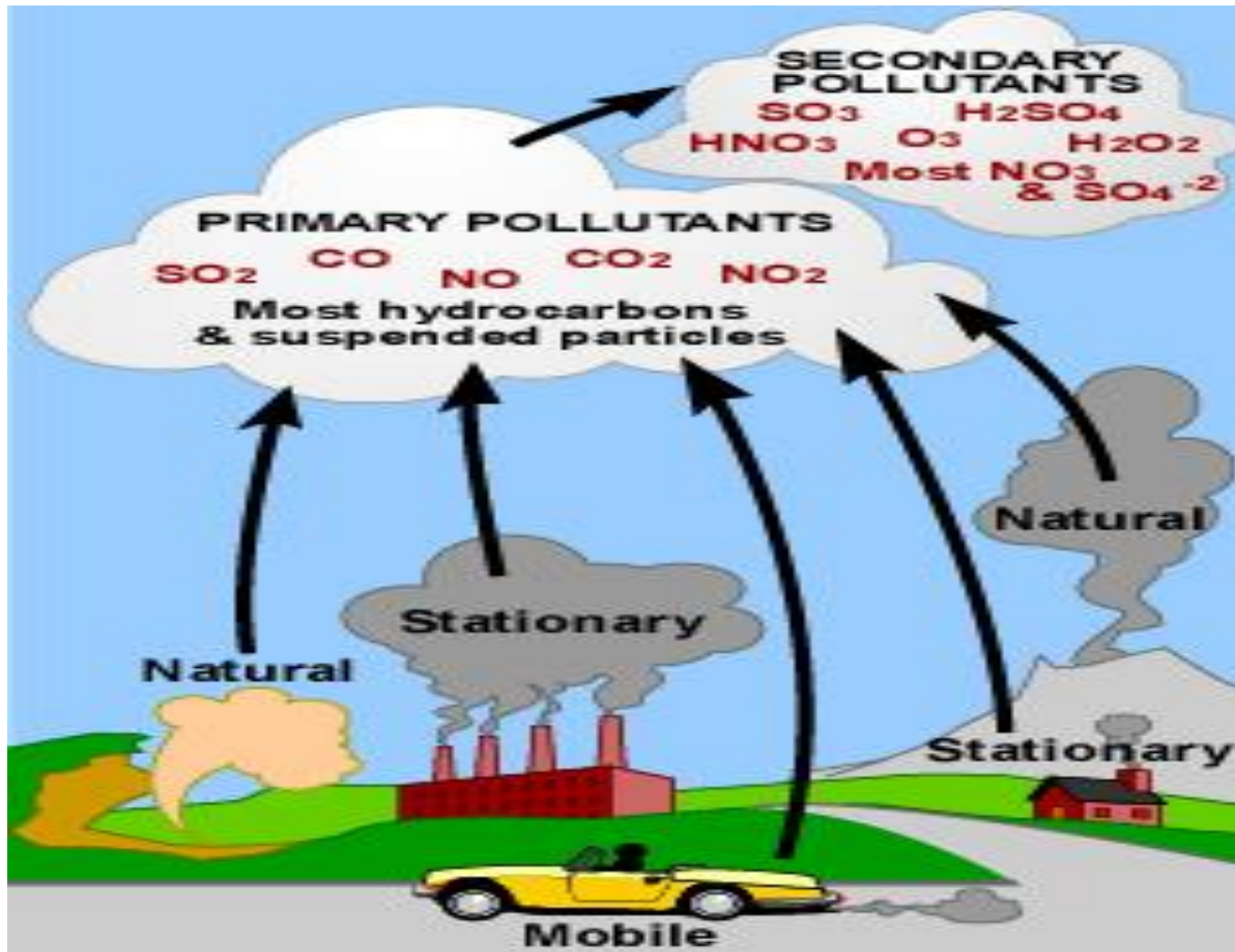
- New, cleaner technologies available
- Increased attention for environmental issues
- Increased attention for sustainable economic development
- Improved living standards and increased life expectancy
- Improved monitoring, forecasting and early warning
- Improved understanding of processes affecting human health



## *Air quality*

- **Healthcare costs** associated with poor air quality: € 189 billion/year (Europe) + **reduced life expectancy**;
- The WHO estimates that by **reducing illness** caused by airborne PM the EU could save up to € 29 billion/year
- **Particulate matter** (PM) and **ozone** (O<sub>3</sub>) are most harmful for human health;
- **Emission reduction** does not always cause a drop in atmospheric concentrations, especially for PM and O<sub>3</sub>;
- Pollutants of interest: PM, ground-level O<sub>3</sub>, **nitrogen oxides, sulfur dioxide, carbon monoxide, heavy metals, benzene and benzo(a)pyrene.**

# Type and sources of air pollutants



*Optical remote sensing for measurement and monitoring of emission flux (source: EPA Handbook; 2011)*

# Particulate matter, relative size

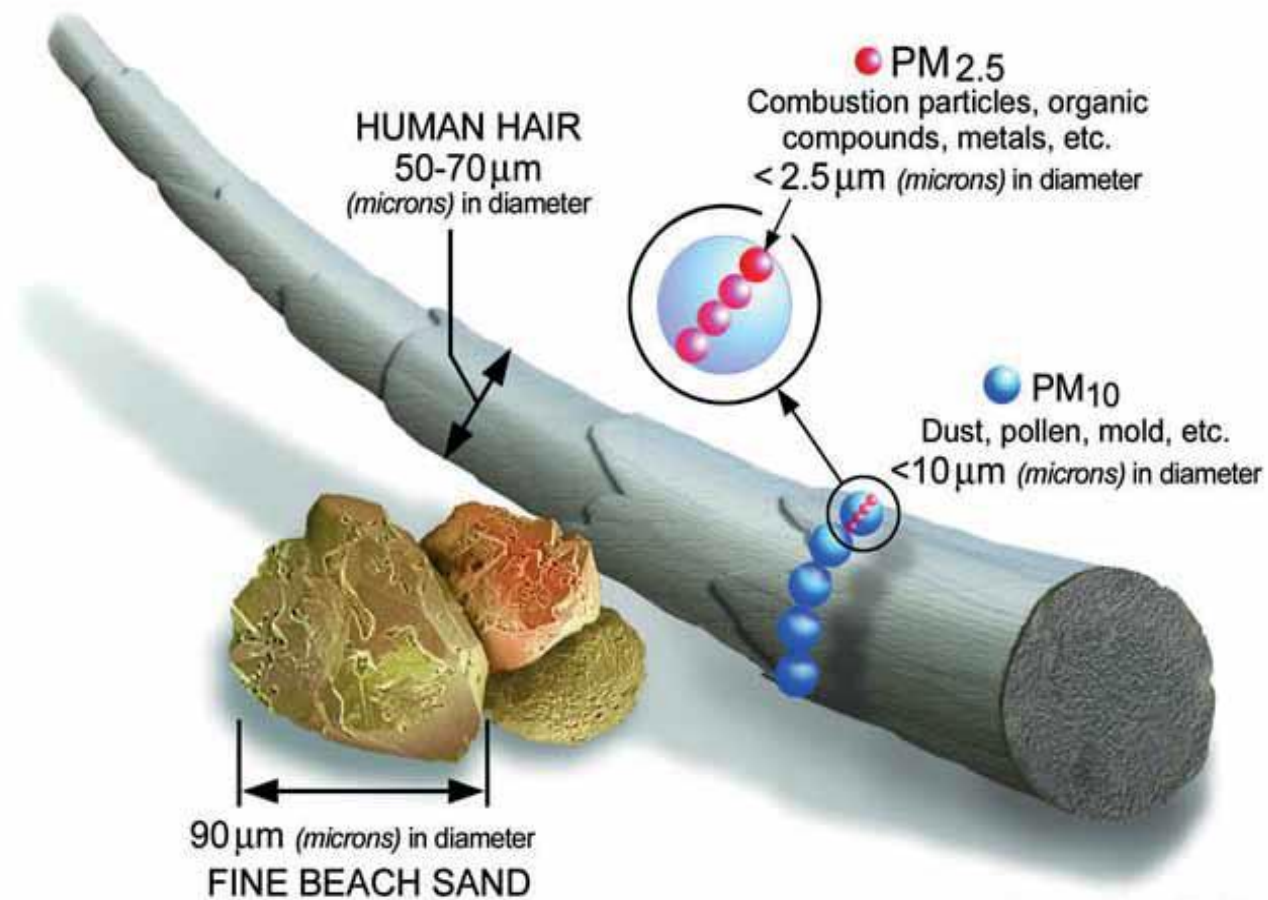
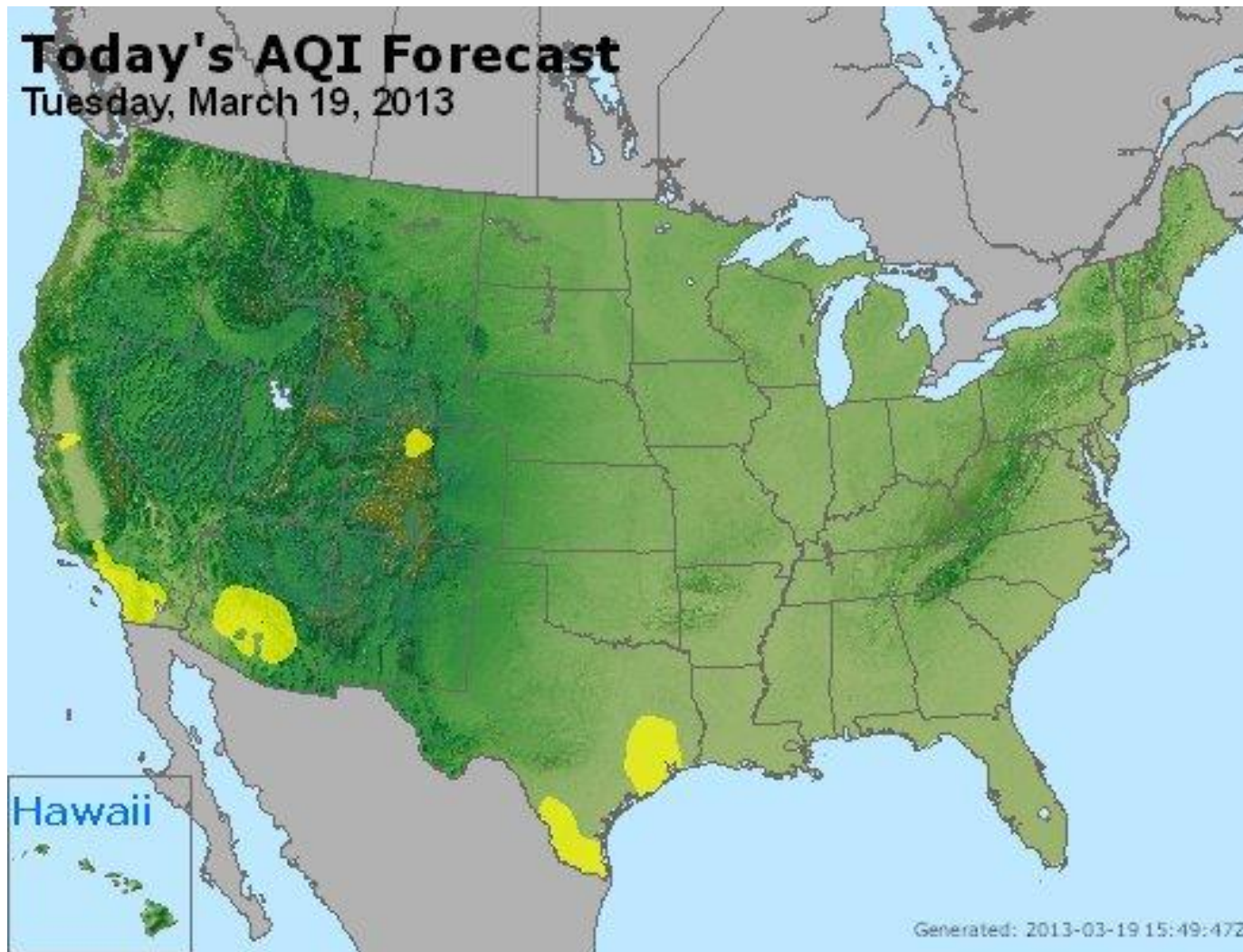


Image courtesy of the U.S. EPA

(source: EPA; 2010)

# *Air Quality Index map of the US*



*AIRnow* website: <http://airnow.gov/>







## *More information:*

**Air quality in Europe – 2012 report (EEA; 2012)**

**AirBase database:**

<http://www.eea.europa.eu/themes/air/air-quality/map/airbase>

**Air Quality Index – a guide to air quality and your health (EPA; 2009)** *Brochure that explains air quality index, causes of air quality variation (ozone, particle pollution, sulfur dioxide, carbon monoxide), health effects and possible action (avoidance)*

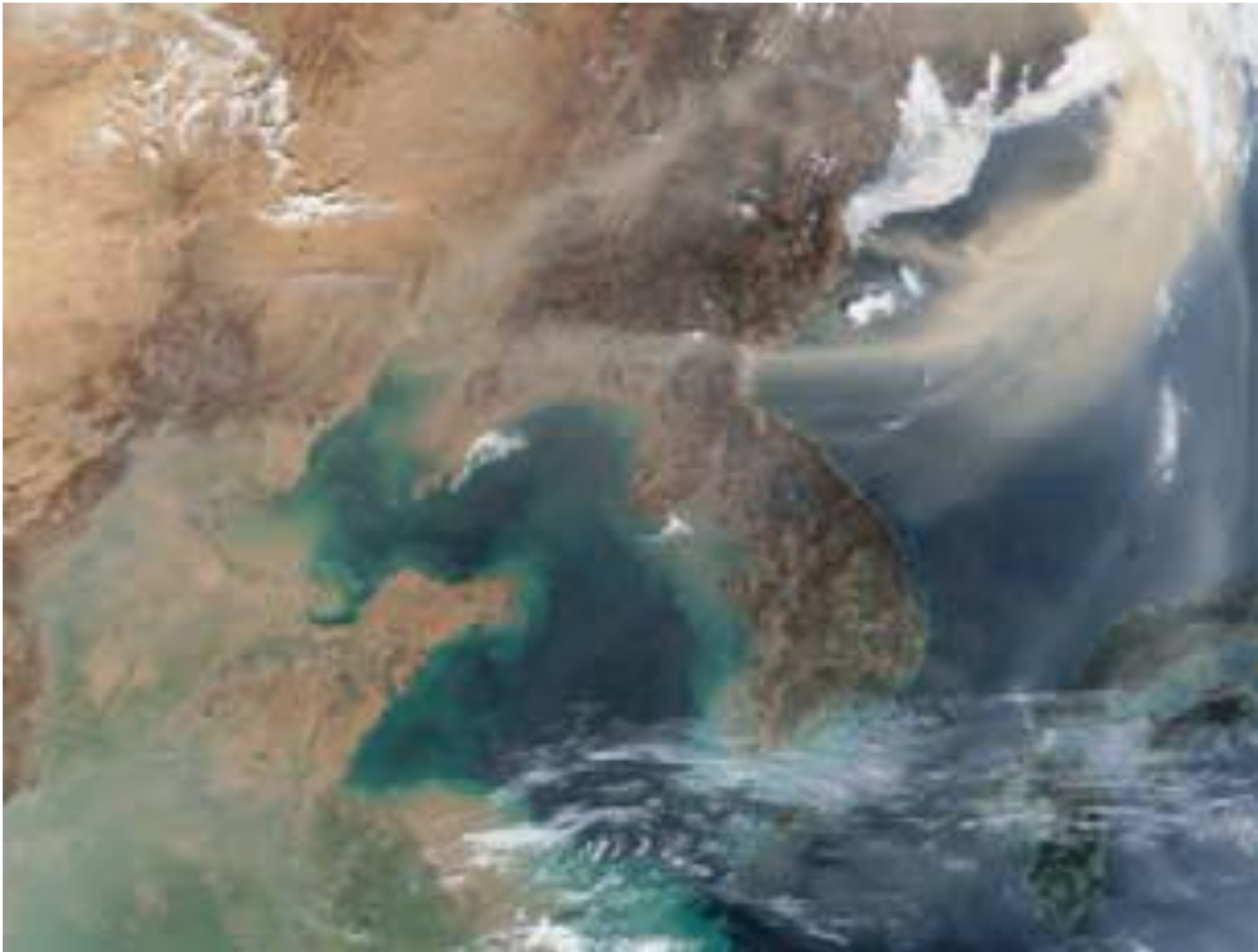
**The EveryAware sensor box: a tool for community-based air quality monitoring (Elen et al.; 2012)** *Description of sensor box that users can apply to measure / monitor air traffic pollution*



## *Sand & dust storms*

- Sand and dust storms **affect air quality** (sand and dust particles, transport of pollutants);
- Sand and dust storms are responsible for worsening of asthma and other respiratory diseases, **meningitis** and other **negative health effects**;
- Sand and dust storms cause **general damage** (dust cover, reduced plant growth decreased visibility) ;
- **Early warning can reduce impact**: better forecasts enable better preparation (lives saved, reduced exposure, reduced damage).

# *Air quality: sand and dust*



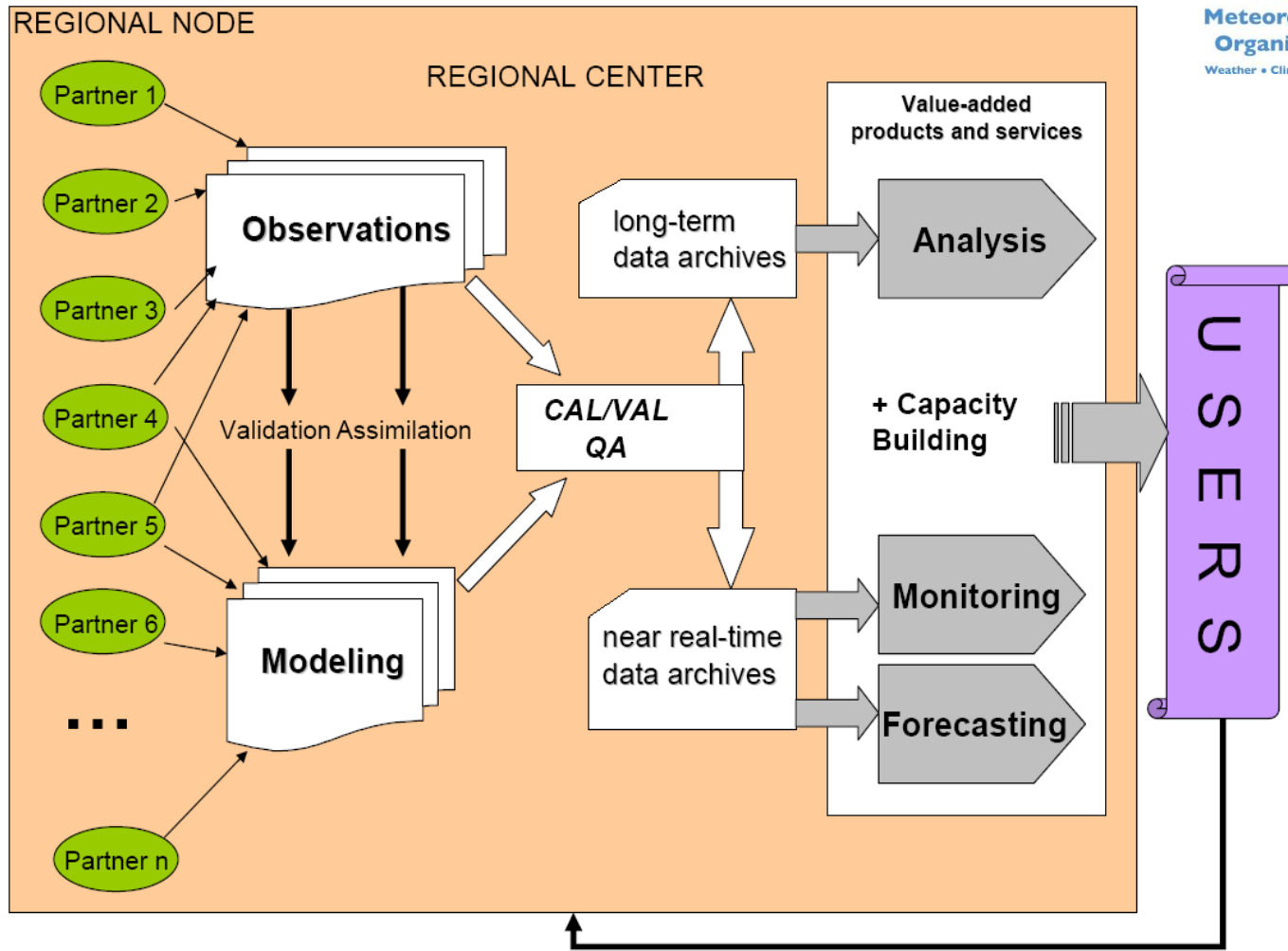
*Sand and dust storm over Japan (MODIS image; 2002)*

# Dust storm life cycle



*Dust storm early warning (source: UNEP)*

# Information flow SDS-WAS



*Sand and dust storm warning, advisory and assessment system  
(source: WMO)*



## *More information:*

**Forecasting and early warning of dust storms - UNEP global environmental alert service (UNEP; 2013)** *Presents general process and role of forecasting and early warning*

**Dust and sand storms (Ministry of the Environment Japan; 2008)** *Description of how the sand and dust storm mechanism works and the usefulness of improved forecasts and early warning*

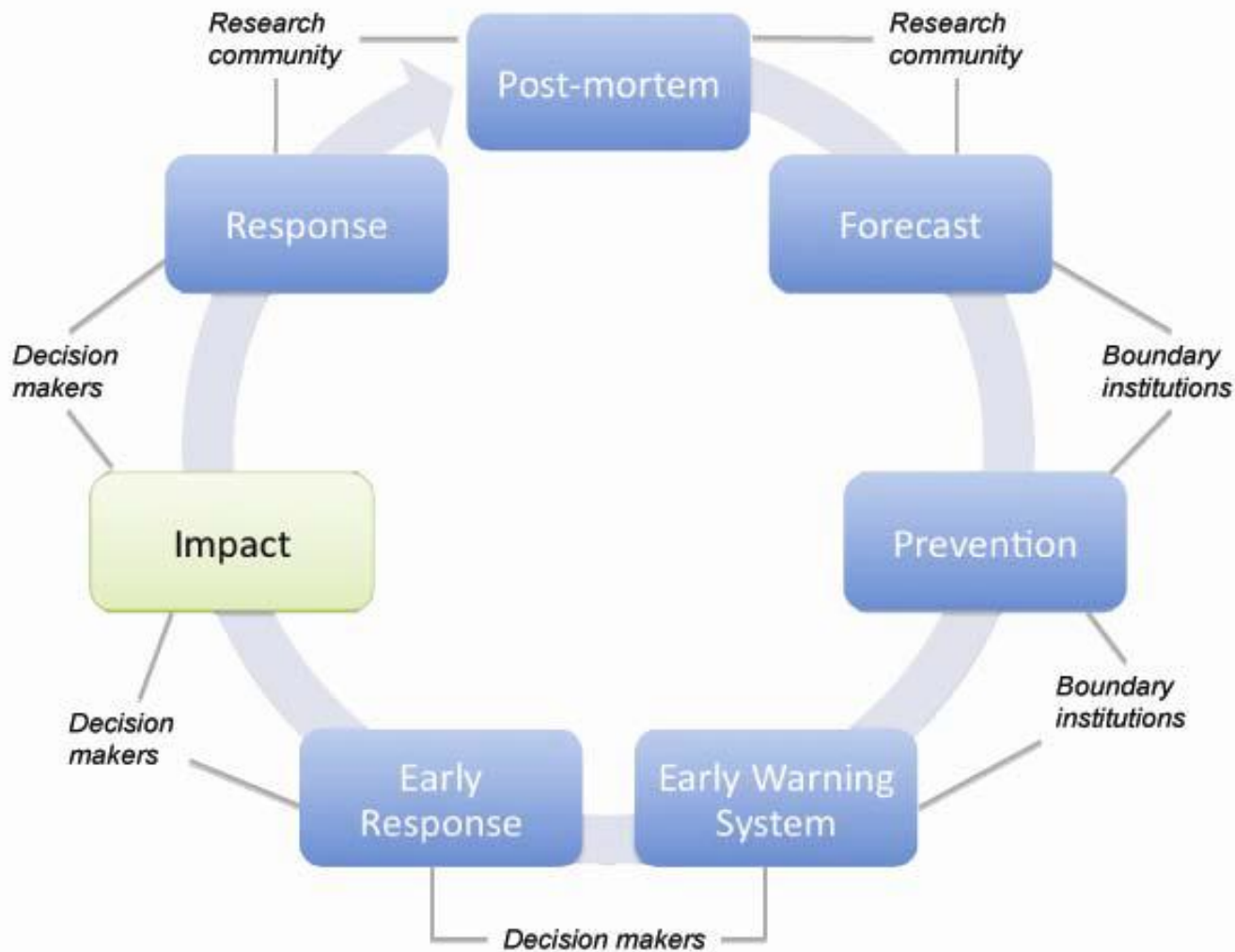
**WMO sand and dust storm warning, advisory and assessment system (SDS-WAS) – science and implementation plan 2011 – 2015 (WMO; 2011)** *Research to improve forecasts, modelling and information to user communities, including meningitis risk in the Sahel region*



## *Fighting diseases*

- **Infectious disease and disease vectors:** environmental factors (land and water surface temperatures, rainfall, water depth, marine organisms) contribute to disease outbreaks, changes in weather and climatic conditions (example: cholera).
- Initiatives are undertaken for the **prevention and control of malaria** in Africa;
- A **comprehensive approach** is needed, including a suitability analysis of transmission and vulnerability risk indicators.

# Epidemics forecasting & environmental factors



*User cycle framework (Source: EO priorities infectious diseases; 2010)*





## *More information:*

### **WHO/UNICEF HealthMapper**

<http://healthmapper.software.informer.com/>

**Malaria Early Warning Systems – Concepts, indicators and partners – A framework for field research in Africa (WHO; 2001).** *Description of approach for Roll Back Malaria initiative*

**Use of Google Earth™ to strengthen public health capacity and facilitate management of vector-borne diseases in resource-poor environments (Lozano-Fuentes et al.; 2008)**

*Search for novel, inexpensive solutions in Mexico*

**Environmental health risks (EO2HEAVEN; 2013)** *Description of relationships between environmental changes and their impact on human health*



# *Climate change and health*

## **Areas of concern:**

- **Infections:** malaria, diarrhea, meningitis, dengue fever are the most important ones;
- **Emergencies:** floods and cyclones, drought, airborne dispersion of hazardous materials;
- **Emerging environmental challenges:** heat stress, UV radiation, pollen, air pollution.

## **Need for:**

- **Indicators** to monitor climate-change-related health outcomes within surveillance systems;
- Development of **early warning systems**;
- **Improved decision support** for vulnerability and adaptation assessment, operational predictions and understanding of the decision making process.



## *More information:*

### **Global climate change impacts in the United States (US global change research program; 2009)**

*Predicts: increase in risk of illness and death related to extreme heat and heat waves, reduced extreme cold, challenge to meet air quality standards, more extreme weather events (storms, floods, wild fires), increase of some diseases transmitted by food, water or insects (west nile, lyme, salmonella, etc.), increased pollen health risk*

### **Human health, climate change 2007: impacts, adaptation and vulnerability (IPCC; 2007)**

*Covers: heat and cold effects on health, wind, storms and floods, drought, nutrition and food security, food safety, water and disease, air quality and disease, aeroallergens and disease, vector-borne, rodent-borne and other infectious diseases, occupational health and UV radiation*

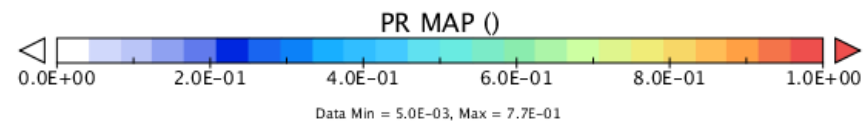
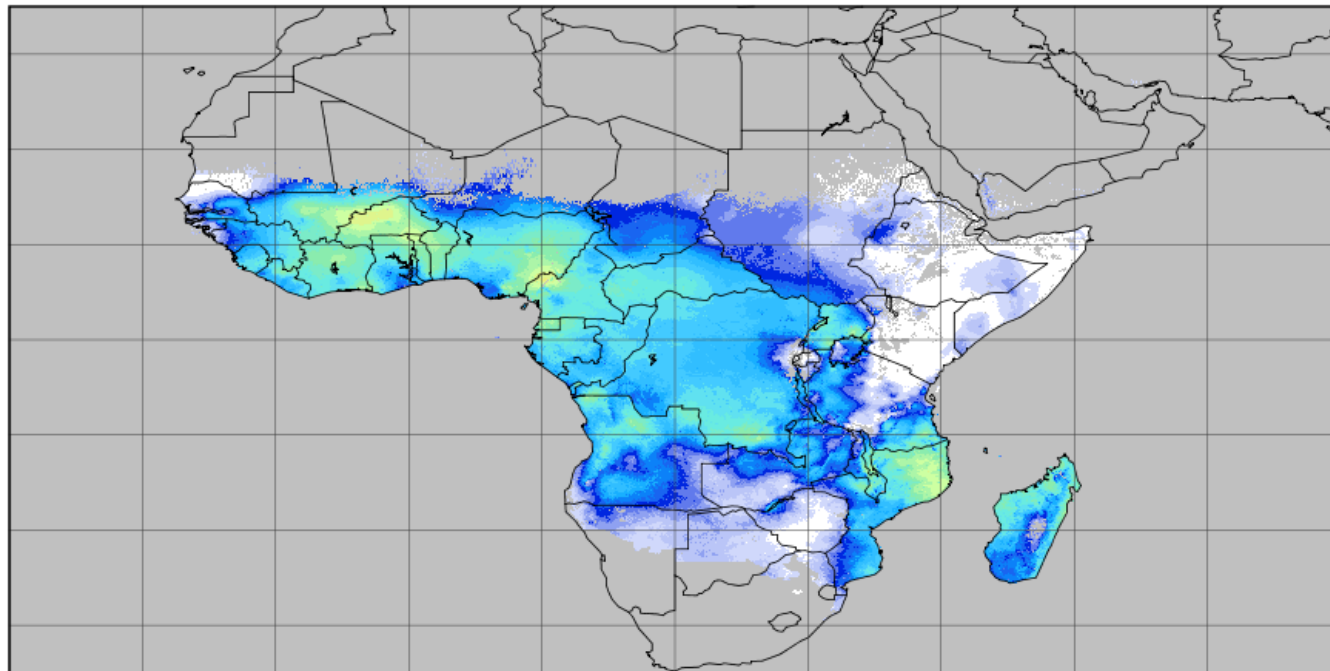
### **Atlas of health and climate change (WHO / WMO; 2012)**



## ***2. Earth observation applications***

## PR MAP

MAP Malaria Atlas project <http://www.map.ox.ac.uk/>



*Malaria Parasitic Rate map, derived from field data and a Bayesian regression model with rain and temperature inputs (source: ECWMF; 2012)*



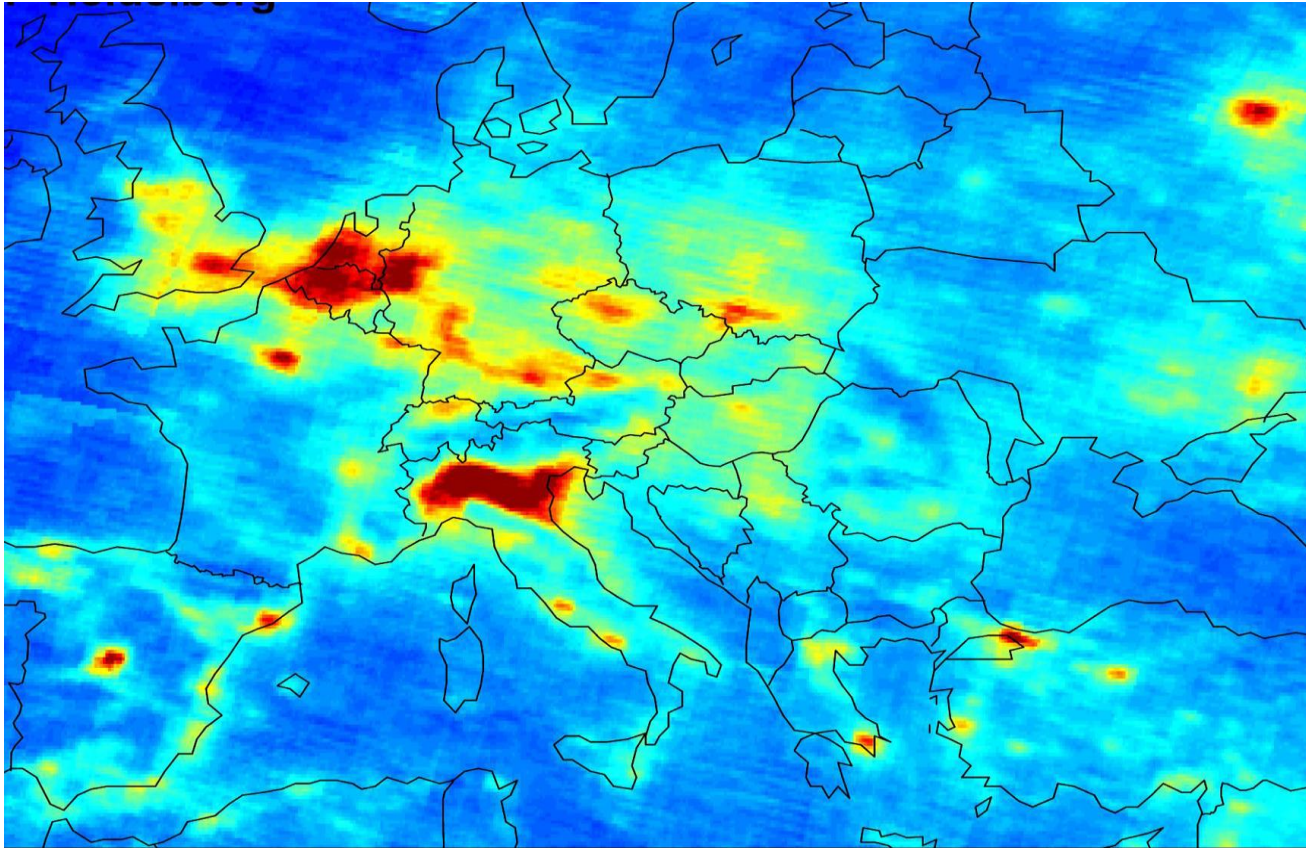
## *Earth observation contribution*

- **Air quality forecasting / early warning / monitoring**
- **Epidemics forecasting**
- **Relationships between diseases and environmental factors**

*All these categories, particularly the 2<sup>nd</sup> & 3<sup>rd</sup>, are of course linked, the time/response factor providing the main distinction.*



# *Example air quality forecasting / early warning / monitoring*



*Mean density of nitrogen oxide for the period January 2003 – June 2004  
(Source: Copernicus; 2013)*



## *Air quality forecasting / early warning / monitoring*

- Earth observation **measures air masses** (monitoring of extent and source of emissions);
- Earth observation **tracks impact from fires**;
- Earth observation **tracks dust and sand storms** (meningitis, other diseases);
- Earth observation supports **monitoring of trace species in the air** (carbon monoxide, ozone)
- **Cost estimate:** obtaining emission datasets for new regions and cities is expensive, implementation cost 100 k€ / continent / year, daily forecast at local level 100 k€ / year for set-up and 30 k€ / year for operation
- **Main challenges:** cost, complexity, capacity.



## *Examples:*

**Monitoring the air we breathe (Copernicus; 2013)** *Brochure on air quality monitoring and forecasts to protect human health in Europe*

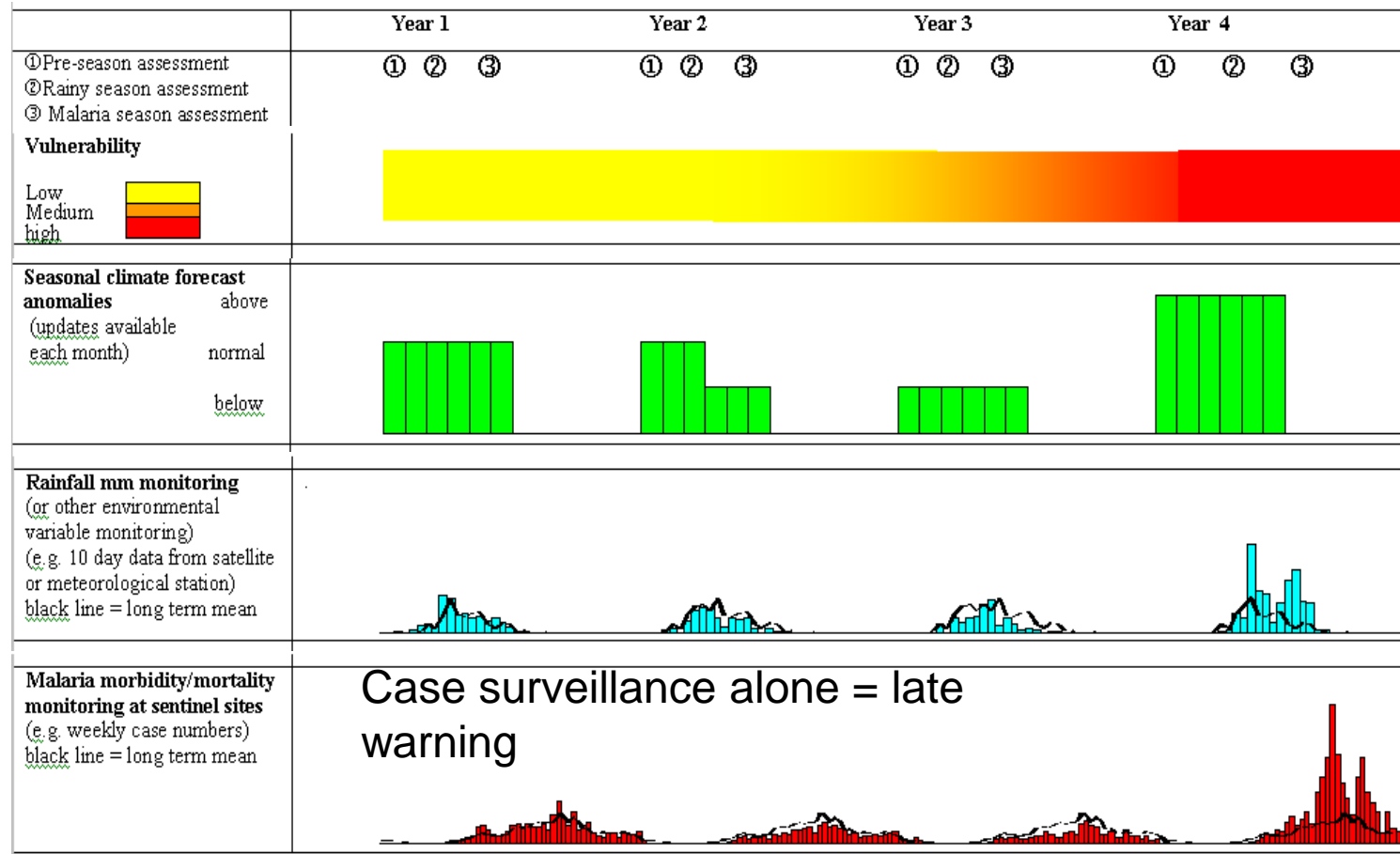
**Air quality monitoring and analysis in Central America and the Caribbean (SERVIR-Air; 2009)** *Description of the use of EO for an air quality monitoring system and public information, including a 'SmogBlog' (as in the US), agricultural fires, volcanic eruptions, Saharan dust + capacity building* <http://www.servir.net/>

**Particulate matter in the atmosphere of Dakar, Senegal (Leon et al.; 2012)** *Pilot on monitoring of particulate matter, measurement of aerosol optical depth, specifically aimed at Sahara desert dust; combination of in-situ and EO; satellite observations can detect gradient & therefore hotspots of emission*

**Air pollution using remote sensing and GIS, Cyprus (CUT: 2011)** *Case study on the use of satellite observations for air pollution monitoring and modelling*



# Example epidemics forecasting



*Integrated Malaria Early Warning System gathering cumulative evidence for early and focused epidemic preparedness and response (Source: WHO; 2004)*



## *Epidemics forecasting*

- Earth observation provides input for **models** and **indicators for health impact**;
- Earth observation contributes to **development of early warning systems** and **decision support**;
- Earth observation is instrumental in **compliance monitoring** of agreements and regulations;
- **Cost estimate**: on case-by-case basis
- **Main challenges**: cost, complexity, capacity.



## *Examples:*

### **How satellites track a mass killer (Copernicus; 2013)**

*Brochure on how satellite data help model the prevalence and spread of malaria and the dynamics of disease outbreaks*

### **CNES strategy, satellite data and modeling for public**

**health (CNES; 2011)** *Presentation of the CNES programmes on e-health: telemedicine and tele-epidemiology*

### **A prototype Malaria Early Warning System (ECMWF; 2012)**

*Presentation on the set-up of a malaria early warning system, based on the relation between malaria and weather and climate*

## *Useful sites for early warning*

- IRI, Columbia University  
<http://iridl.ldeo.columbia.edu/maproom/.Health/> (malaria, meningitis)
- CNES RedGems <http://www.redgems.org/> (malaria, rift valley fever, dengue, vibrio diseases and cholera)
- NASA SERVIR [http://www.nasa.gov/mission\\_pages/servir/index.html](http://www.nasa.gov/mission_pages/servir/index.html)  
(general)
- ISID Pro-MED <http://www.promedmail.org/pls/otn/f?p=2400:1000>  
(diseases general)
- USAID FEWSNET <http://earlywarning.usgs.gov/adds/> (famine)

## *Example diseases and environmental factors*



*Distribution of city blocks with dengue cases, derived from Google Earth, Chetumal, Quintana Roo, Mexico, 2006 ( Source: Lozano-Fuentes et al.; 2008) 38*



## *Diseases and environmental factors*

- Earth observation supports analysis and modelling of the occurrence and spreading of infectious diseases and disease vectors by measuring environmental factors (land and water surface temperatures, rainfall, water depth, marine organisms) and changes in weather and climatic conditions;
- Earth observation facilitates improved decision support for vulnerability and adaptation assessment, operational predictions and understanding of the decision making process
- Cost estimate: on case-by-case basis
- Main challenges: complexity (from data to information, modelling), elegance, capacity.



## *Examples:*

**Use of Google Earth™ to strengthen public health capacity and facilitate management of vector-borne diseases in resource-poor environments (Lozano-Fuentes et al.; 2008)**

*Case study from Mexico; Google Earth images used to extract urban infrastructure patterns; positive aspects: easy to use and easy to learn; negative: spatial analysis and modelling capacity is limited*

**Environmental health risks (EO2HEAVEN; 2013)** *Description of relationships between environmental changes and their impact on human health, with earth observation applications as central element*

**Connecting ecosystems, biodiversity, and human health: using earth observations to reduce and prevent infectious diseases (EPA; 2010)** *Presentation on establishing links between human health and environmental factors with a call for integrated tools and approaches that link ecology to human health*





## *Growth potential for earth observation*

- Scientists, public health organizations, NGOs and the general public are the main players;
- Mainly G2G or B2G market, governments or international organizations are in virtually in all cases the paying client;
- Opportunities for businesses in developing countries: refinement of existing models for local circumstances and processing of actual data flows;
- Air quality is particularly relevant in the large, densely populated urban areas.



## ***3. Business development***



## *Why is marketing / promotion of earth observation needed?*

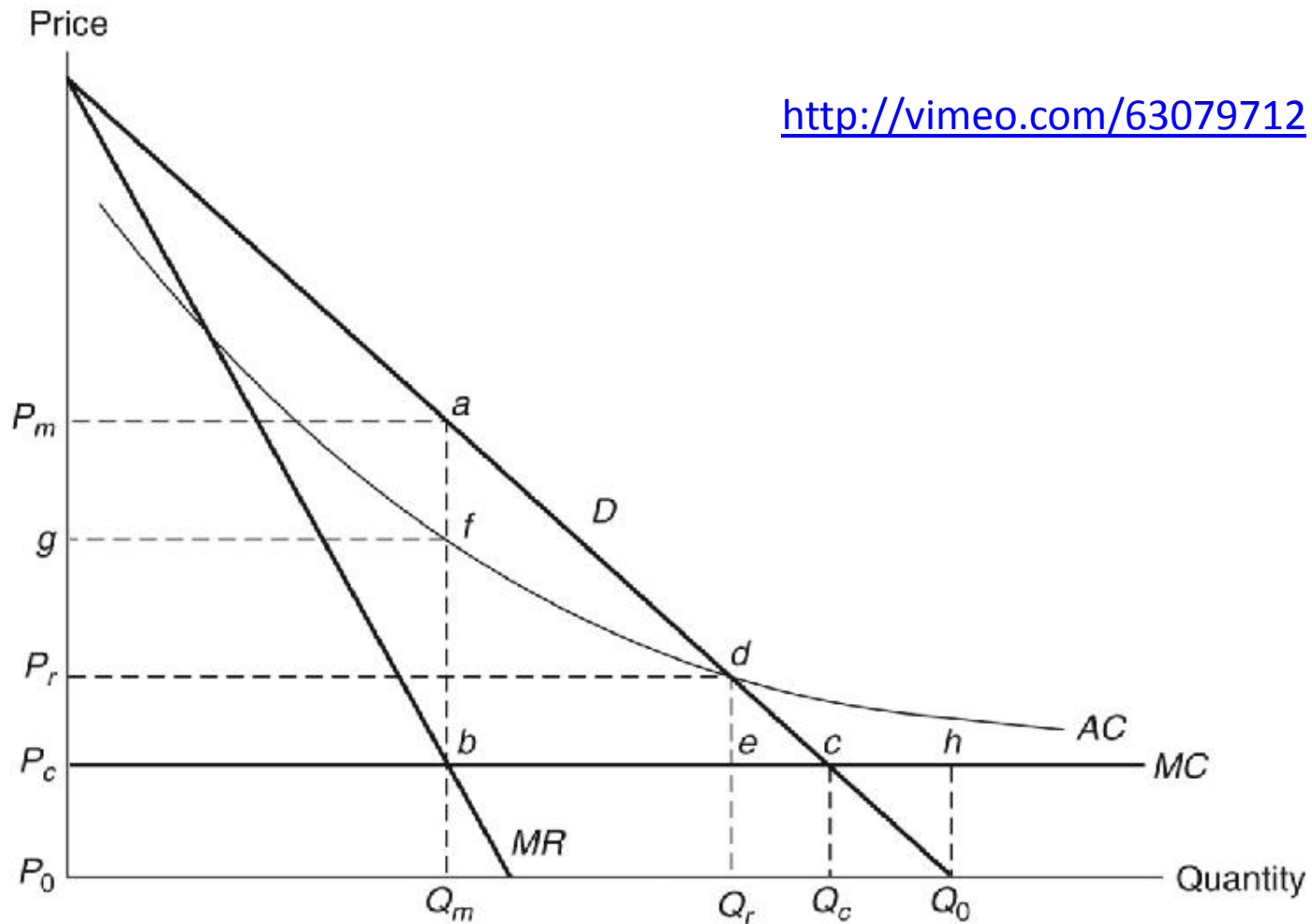
- Public sector information (PSI)
- Externalities (environmental accounting & payment for ecosystem services)
- Global datasets, open access, data sharing, compatibility (GEO)



If public sector information is made available free-of-charge, demand will increase and, in the end, government revenue also, as companies will derive income from value-added products and services, and consequently pay more taxes (see figures in following slides).

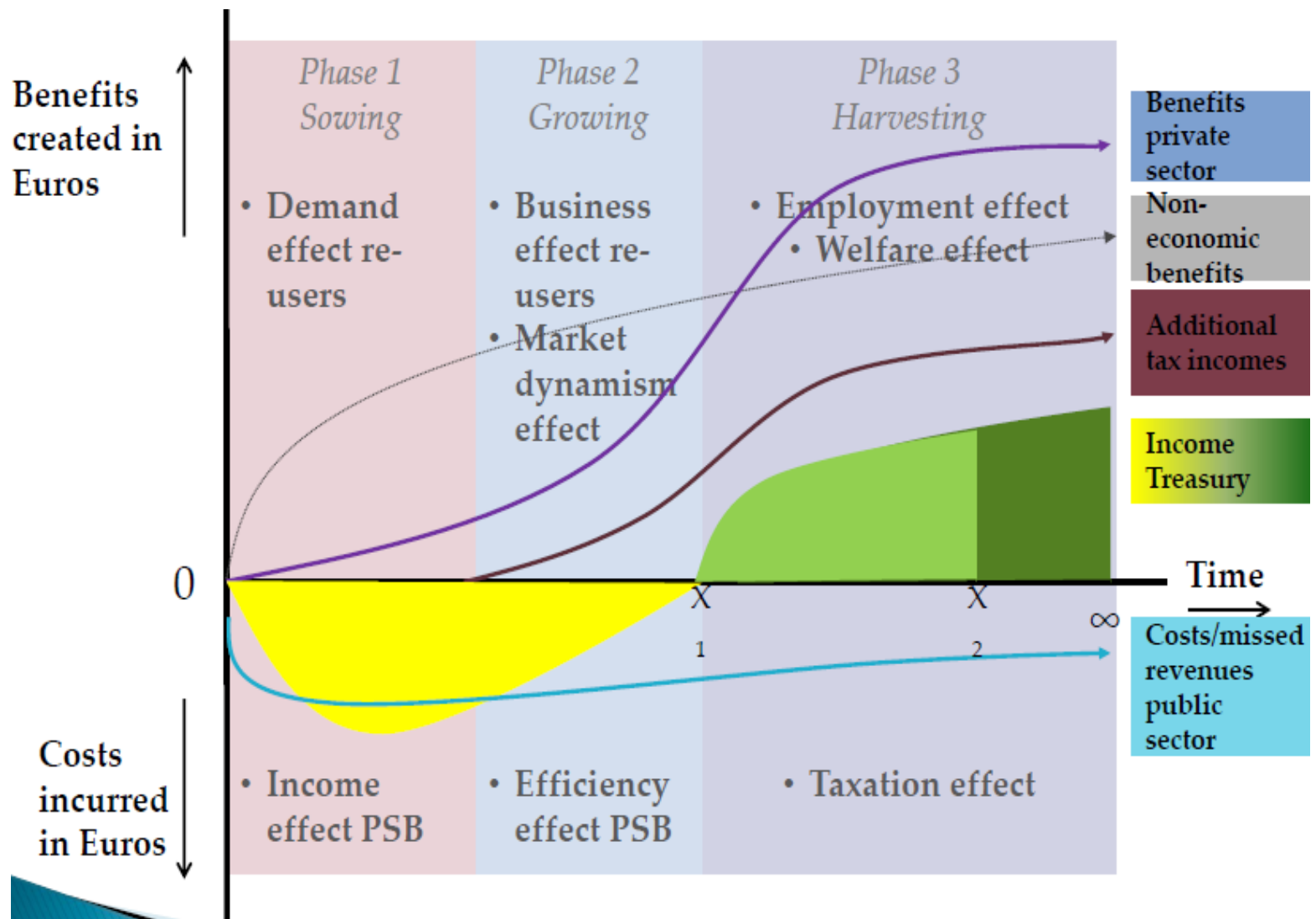
# Supply & Demand Public Sector Information

<http://vimeo.com/63079712>



Source: *About GMES and data: geese and golden eggs* (Sawyer, de Vries 2012)

# Cost-benefit Public Sector Information



Source: About GMES and data: geese and golden eggs (Sawyer, de Vries 2012)

# Re-use of Public Sector Information



Source: About GMES and data: geese and golden eggs (Sawyer, de Vries 2012)



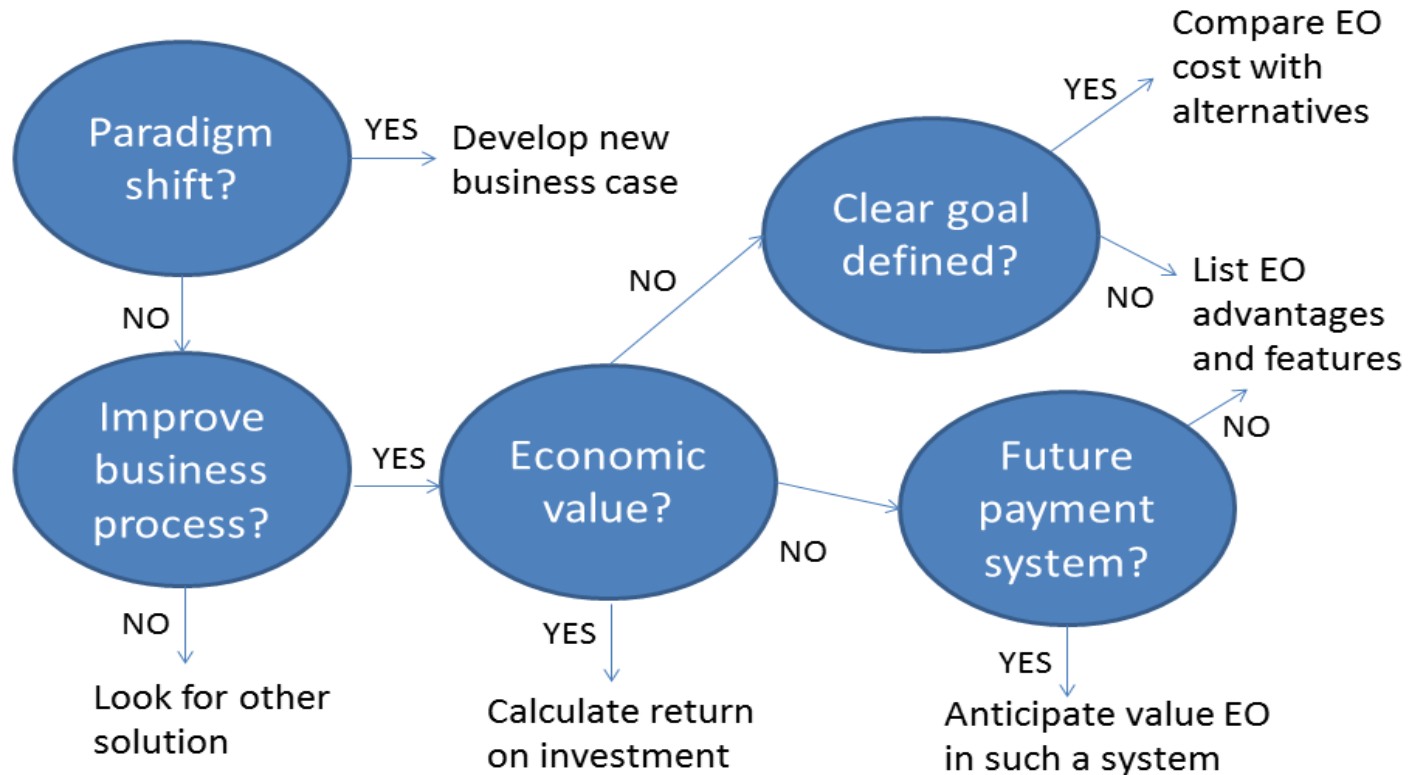
Most earth observation applications deal with so-called externalities, such as impact on the environment. It is difficult to capture these in terms of conventional cost-benefit models.

To tackle this, the following framework for analysis of earth observation applications is developed:



# Framework for analysis

## Step-by-step benefit EO



Step-by-step analysis of the benefits of earth observation (source: GEONetCab, 2013)



## *Key questions*

- Does the new application cause a paradigm shift?
- Is the current business or organization process improved?
- Does the application provide economic value that can be quantified?
- Is a clear measurable goal defined to which the earth observation application contributes?
- Is a future payment scheme or other economic mechanism foreseen in which the earth observation application fits?



# *Assessment of geospatial solutions*

Rating of **characteristics** of geospatial solutions:

- fit-for-purpose
- comparative advantage
- complexity to user / ease- of-use
- elegance
- cost-benefit,
- sustainability
- resilience
- reproduction capacity / flexibility
- acceptance
- level of knowledge transfer required
- ethics, transparency, public accountability, objectivity & impartiality

Rating of **business environment**:

- **Willingness to pay** (by clients)
- **Embedding** (in organizational processes)
- **Openness** (transparency and ease of doing business, access to markets)
- **Institutions** (is the institutional environment conducive to doing business, acceptance of new solutions?)



## *Fit-for-purpose*

An important, but often forgotten requirement:  
Does the product or service do what it is supposed to do to solve a certain problem?

In other words: is it really a solution or just an attempt towards a solution?

- **Quantitative:** not applicable
- **Qualitative (on scale of 1 to 5):** based on description of what the EO solution actually does



## *Comparative advantage*

What it does significantly better than other solutions to the same problem.

For earth observation usually the comparative advantages of greater accuracy, better resolution in time and space, comprehensive overview of large areas and near real-time information provision are mentioned as comparative advantages.

- **Quantitative:** calculation of degree in which the EO solution is better than alternatives
- **Qualitative (on scale of 1 to 5):** based on listing of comparative advantages



## *Complexity (to user) / ease-of-use*

At all levels in the value chain the users (professionals and end-users) are able to work with the product or service.

- Quantitative: not applicable
- Qualitative (on scale of 1 to 5): based on user testimonials and user surveys



## *Elegance*

Once you get the idea behind this product or service, you want to be part of the community that uses it.

This sense of belonging facilitates the formation of user groups that provide valuable feedback.

- **Quantitative:** none, or it should be the size of the user community
- **Qualitative (on scale of 1 to 5):** based on user testimonials and user surveys



## *Cost-benefit*

The cost-benefit of the product or service is quantified and sufficiently attractive, also in the long-term.

- Quantitative: cost-benefit calculation
- Qualitative (on scale of 1 to 5): based on quantitative assessment





## *Sustainability*

The product or service can be delivered when it is needed.  
There is a long-term perspective that guarantees delivery.

Sustainability concerns the following aspects:

- ✓ Long-term data availability
- ✓ Availability of finance/funds to provide the solution continuously for present and future use
- ✓ Long-term institutional / governmental interest and support
- ✓ Long-term user interest for a solution that addresses real needs
  
- **Quantitative:** not applicable
- **Qualitative (on scale of 1 to 5):** based on sensitivity analysis of the EO solution



## *Resilience*

In case of extremes or breakdown in the value chain, the product or service can still be delivered at an acceptable level. Alternatives (plan B) are available (and developed).

- **Quantitative:** cost-benefit calculation of plan B
- **Qualitative (on scale of 1 to 5):** based on risk analysis of the EO solution



## *Reproduction capacity / flexibility*

The product or service can be easily applied or adapted for use in another region or another situation, while still providing the solution without (too much) extra cost.

- **Quantitative:** calculation of reproduction costs for application in other regions or situations; measurement of spreading of actual use
- **Qualitative (on scale of 1 to 5):** based on quantitative assessment and description of EO solution



## *Acceptance*

The users intuitively get what the product or service is about and are interested. They accept it as a solution to their problem.

- **Quantitative:** none, or survey results about acceptance. After introduction of the solution: number of clients and/or users
- **Qualitative (on scale of 1 to 5):** based on user testimonials and user surveys



## *Level of knowledge transfer required*

The training requirements for professionals and other users along the value chain are clear and associated costs and efforts are acceptable.

- **Quantitative:** cost and time required to get the users at the desired knowledge and skill level
- **Qualitative (on scale of 1 to 5):** based on knowledge transfer plans and evaluation of training activities



## *Ethics, transparency, public accountability, objectivity & impartiality*

Application of Earth observation increases the level of objectivity and impartiality in decision-making processes, including conflict resolution. The application improves transparency and public accountability. It raises no ethical issues or if it does, as in the case of privacy concerns, these are resolved in a satisfactory way for all parties concerned.

- **Quantitative:** not applicable
- **Qualitative (on scale of 1 to 5):** based on user testimonials and user surveys



Several attempts have been made to introduce environmental accounting and to enlarge the sphere of the conventional economy to include and quantify impact on ecosystems.

The following slides give some examples:

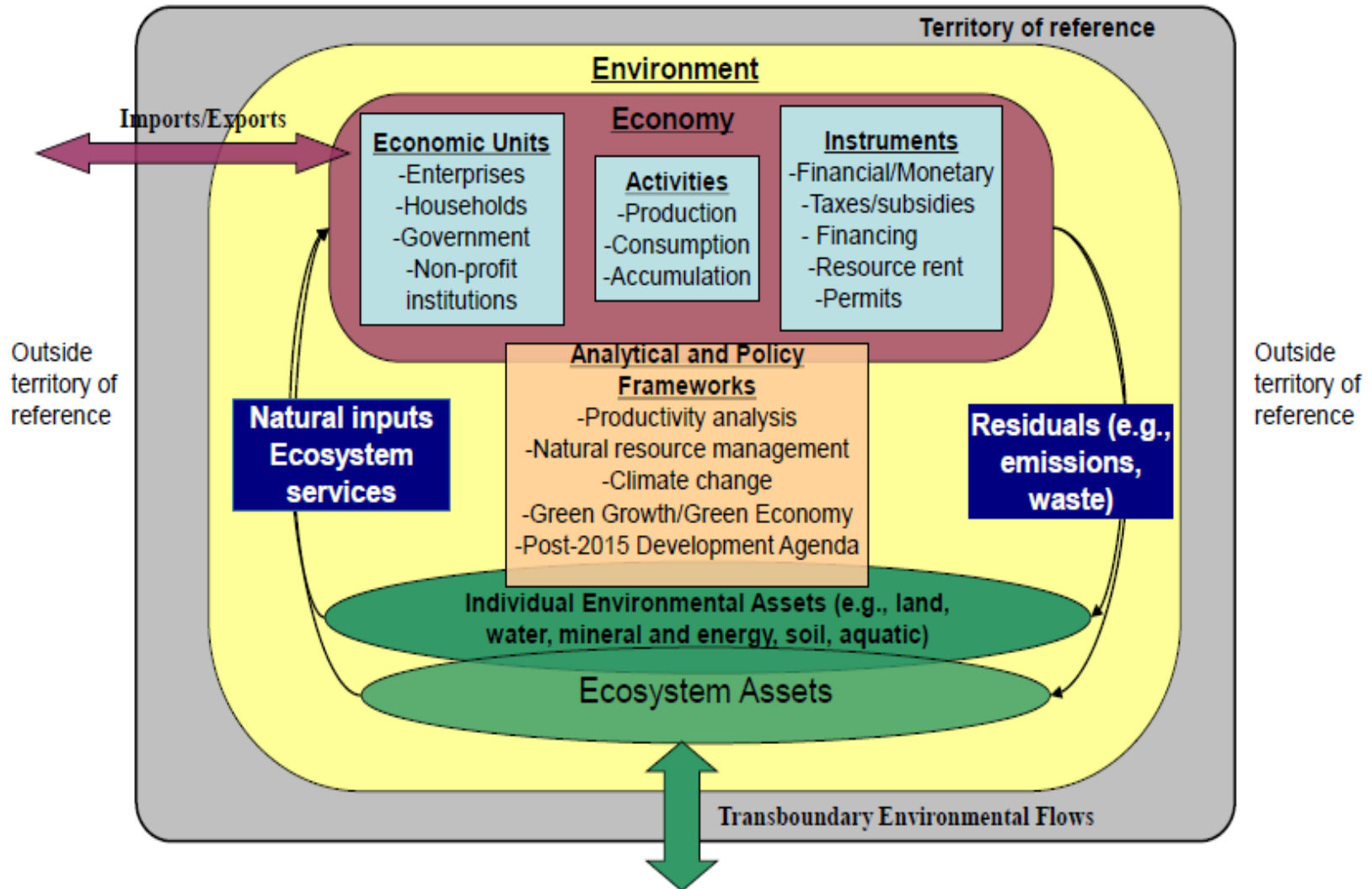


# *Environmental accounting & payment for ecosystem services*

- **SEEA:**  
System of Environmental-Economic Accounts  
(EC, FAO, IMF, OECD, UN, WB )
- **WAVES:**  
Wealth Accounting and the Valuation of Ecosystem  
Services (global partnership, led by World Bank)
- **TEEB:**  
The Economics of Ecosystems and Biodiversity  
(group led by UNEP)



# SEEA Conceptual Framework

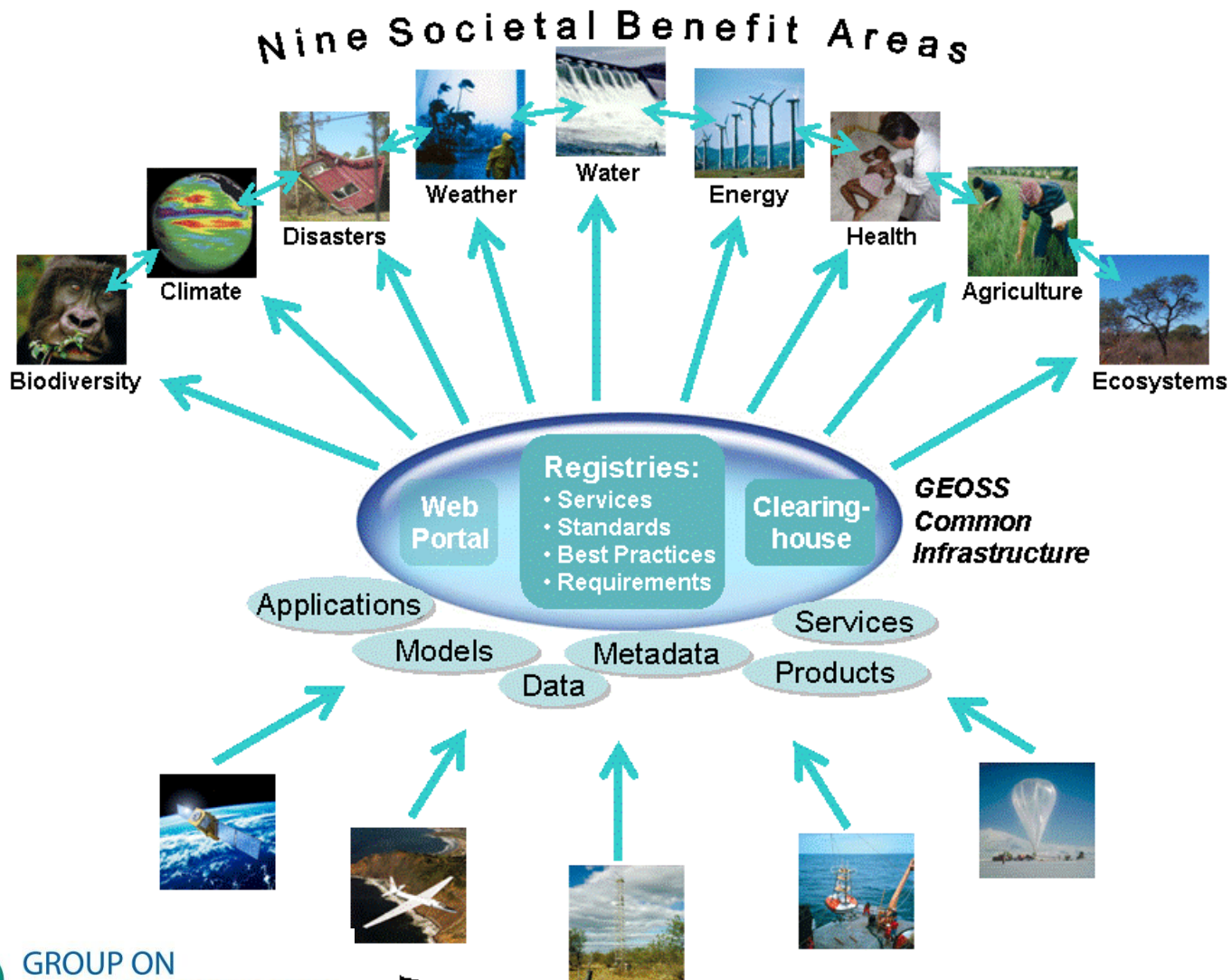


Source: SEEA conceptual framework report (EC, FAO, IMF, OECD, UN, WB 2012)



For earth observation the work of the Group on Earth Observations (GEO) is essential to achieve the goal of a Global Earth Observations System of Systems (GEOSS), resulting in the shared GEO common infrastructure (GCI):

# Group on Earth Observations





## *Marketing elements*

- Customer value propositions
- Crossing the technology chasm
- Creating shared value
- Promotion tools



Customer value propositions capture the unique value of a product or services as perceived and appreciated by the customer.

Interestingly, they can differ completely from the features that the provider considers most important:

# Customer Value Propositions

VALUE PROPOSITION	ALL BENEFITS	FAVOURABLE POINTS OF DIFFERENCE	RESONATING FOCUS
Consists of:	All benefits customers receive from a market offering	All favourable points of difference a market offering has relative to the next best alternative	The one or two points of difference whose improvement will deliver the greatest value to the customer
Answers the customer question:	“Why should our firm purchase your offering?”	“Why should our firm purchase your offering instead of your competitor’s?”	“What is <i>most</i> worthwhile for our firm to keep in mind about your offering?”
Requires:	Knowledge of own market offering	Knowledge of own market offering and next best alternative	Knowledge of how own marketing offering delivers value to customers, compared with next best alternative
Has the potential pitfall:	Benefit assertion	Value presumption	Requires customer value research

Source: Customer value propositions in business markets (HBR 2006)

# Buyer behaviour & motivation

Type	Buyer behaviour	Motivation
Transactional sales	Intrinsic value buyers: “keep it cheap and easy to do business”	Understands the product Perceives it as substitutable Cost focus Resents time ‘wasted’ with sales people
Consultative sales	Extrinsic value buyers: “I don’t know the answer: help me analyse and solve the issue	Focus on how the product is used Interested in solutions and applications Values advice and help Needs the sales person

Source: *Rethinking the sales force* (Rackham, de Vincentis 1999)



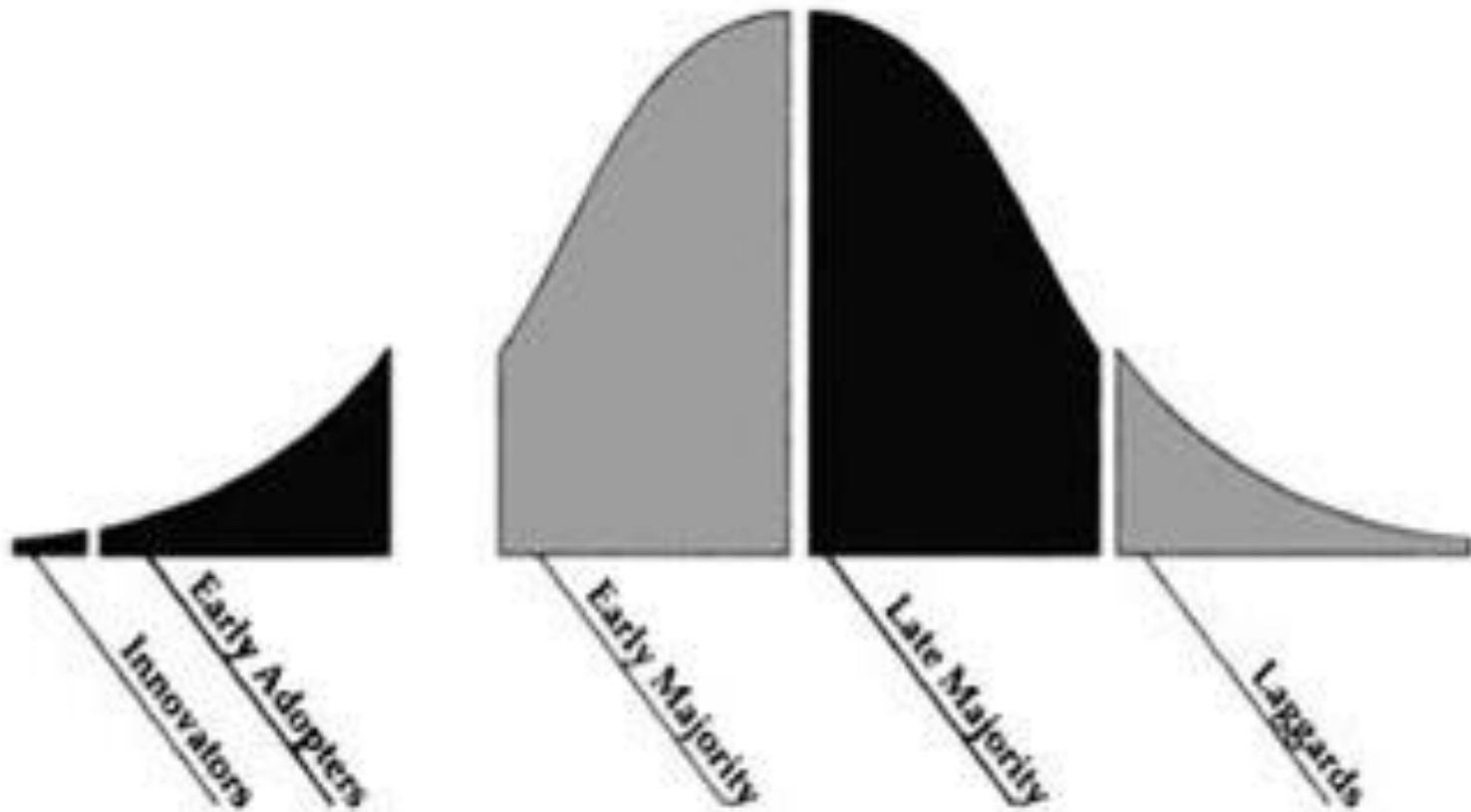
Even when customer value propositions are well captured and formulated, introduction of solutions that involve new technology will have to overcome some hurdles.

This is called “crossing the technology chasm”:



# *Crossing the technology chasm*

## **The Revised Technology Adoption Life Cycle**



*Source: Crossing the chasm (Moore 1991)*



## *Crossing the technology chasm*

- Most clients of EO products and services belong to the early and late majority,
- They are pragmatists and are not prepared or willing to take substantial risk: the solution should work and be reliable.
- Once convinced, the pragmatists will be long-term clients.

*Source: Crossing the chasm (Moore 1991)*



## *More information:*

### **Creating & delivering your value proposition**

*– managing customer experience for profit*  
**(Barnes, Blake, Pinder; 2009)**

### **Customer value propositions in business markets**

**(Anderson, Narus, van Rossum [Harvard Business Review]; 2006)**

### **Rethinking the sales force:**

*refining selling to create and capture customer value*  
**(Rackham, de Vicentis; 1999)**

### **Crossing the chasm**

*– marketing and selling high-tech products to mainstream customers*  
**(Moore; 1991)**



Creating shared value is a key element of successful implementation of earth observation solutions.

To achieve this, in most cases earth observation applications have to be integrated into more general (business or organizational) processes:



## *Create shared value*

Involves cooperation between:

- **Public sector**
- **Private sector**
- **Social sector**

Opportunity for earth observation (integrated) solutions:

- Integrate EO in general business / organizational process
- Integrate different EO (and GIS and navigation) functionalities



Based on all considerations dealt with in the previous slides, there are some practical approaches that can be applied in combination to promote earth observation applications:

## *Tools for earth observation marketing:*

- Success stories (in non-technical language, feasible, replication capacity, sustainable)
- Marketing toolkits (international trends, earth observation examples, references)
- Pilot projects, innovation funds, quick-wins (demonstration that EO actually works)
- Promotion outside EO community (fairs, seminars, lunch-bag meetings, magazines)
- Resource facilities for reference and capacity building (distributed, but connected, in different languages)



## *Business elements*

### **Business elements:**

- **Proposal writing**
- **Business procedures**





Proposal writing is an art in itself.

During the GEONetCab and EOPOWER projects templates have been developed for writing successful proposals:



## *Proposal outline*

1. Introduction / relevance
  2. Objective(s)
  3. Activities
  4. Output
  5. Management & evaluation
  6. Risk assessment
  7. Time schedule
  8. Budget
- Annexes

*(more detailed version in separate document,  
see [www.eopower.eu](http://www.eopower.eu) or [www.hcpinternational.com](http://www.hcpinternational.com))*



THE REGIONAL ENVIRONMENTAL CENTER  
*for Central and Eastern Europe*



## *Other guides that may be useful:*

- Civicus: writing a funding proposal
- Michigan State University: guide for writing a funding proposal
- ESRI: writing a competitive GRANT application
- REC: project proposal writing



If you run a company, compete for assignments and manage projects, a structured approach towards responsibilities, tasks, implementation and documentation is needed.

The following business procedures may be helpful:



## *Business procedures*

1. On acquisition
2. On offers
3. On negotiation
4. On contracts
5. On project management
6. On travel & deployment
7. On deficiencies & complaints
8. On internal organization
9. On finance

*(more detailed version in separate document,  
see [www.eopower.eu](http://www.eopower.eu) or [www.hcpinternational.com](http://www.hcpinternational.com))*



*Again:*

- **SHARED PROBLEM**
- **SHARED LANGUAGE**
- **SHARED SOLUTION**



## ***4. Capacity Building***



*General*

Marketing is promotion + capacity building.

Especially for the introduction of new technologies capacity building is important at all levels.

Capacity building is the instrument to increase self-sufficiency and make solutions work.





# *General references for capacity building, open data and success stories*

**GEO Portal:** [www.earthobservations.org](http://www.earthobservations.org)

**Capacity building resource facility** [www.eopower.eu](http://www.eopower.eu)  
*compilation of tutorials, references, open-source software, etc.*

**Satellites going local:** *share good practice* **(Eurisy handbooks)**  
[www.eurisy.org](http://www.eurisy.org)

**Earth observation for green growth (ESA, 2013)**



# *General references for capacity building, open data (2)*

## **Bringing GEOSS services into practice:**

*how to use data from the GEO portal and how to provide input*

[www.envirogrids.net](http://www.envirogrids.net)

## **Science education through earth observation for high schools:**

*basic tutorials on all kind of subjects*

[www.seos-project.eu](http://www.seos-project.eu)

## **Copernicus briefs:**

*information on satellite applications for different topics*

[www.copernicus.eu/pages-secondaires/publications/copernicus-briefs/](http://www.copernicus.eu/pages-secondaires/publications/copernicus-briefs/)



# *Capacity building resources for health:*

**Environmental health risks (EO2HEAVEN; 2013)** *Description of relationships between environmental changes and their impact on human health, with earth observation applications as central element and attention for stakeholder involvement and capacity building*

**Approaches to GIS programs in health education (ESRI; 2011)** *Short examples from different universities (no EO as such, but related)*

**Optical remote sensing for measurement and monitoring of emission flux (EPA; 2011)** *Again, not strictly EO, but the handbook explains remote sensing techniques with similar underlying processes, including optical, LIDAR and thermal infrared*

**SERVIR and public health (SERVIR; 2012)** *Examples of projects and capacity building activities that use EO to support public health initiatives in developing countries*

**IMPACTMIN project** *Information on health aspects related to mining*  
<http://www.impactmin.eu>



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