Global Space Applications using the LeanSat Approach

Working Group Discussion

Tokyo, july 4th 2015

Outline for Discussion

1. Introduction
2. What is lean satellite?
   a. ISO standard Draft and IAA Working Group
   b. Reliability
   c. Cost
   d. Organizations Involved
   e. Management
   f. Components
3. Proposed Ideas
4. Discussion the ideas and time to think about new ones (analysis weakness, strength, etc.)
5. Conclusions

1. Introduction

This working group will discuss the following topics:

- Mission/satellite applications that serve global purpose
- Methods to reduce development time and reduce cost
- Human Resource Development utilizing LeanSats and new space engineers.

We will more deeply examine Pre-MIC4 ideas, or other mission ideas that could not be presented at the conference.

The group will also focus on how to sustain progress being made in technical skills, management skills, and space engineering.

2. What is lean satellite?

a. ISO standard Draft and IAA Working Group
b. Reliability
c. Cost
d. Organizations involved
e. Management
f. Components

Standards for small satellites

- Why do we need standards?
- What are the reasons for standards for small satellites?

Reasons to do standards for small satellites:

1. To protect small satellite’s development from high requirements initiated by manufactures of big satellites.

2. To determine minimal requirements for sustainable work of a satellite.

3. To prevent quick increasing of space debris by implementing a rule of satellite deorbiting.

4. To protect a launch vehicle and other space vehicles on a board from unexpectable damaging by parts of a broken satellite appeared during a launch.

ISO standards for small satellites

International standards:

- ISO/CD/17770 Cubesat
  - Important for compatibility of Cubesat launches
- ISO/CD/19683 Testing
  - Important for improving reliability of small satellites
- ISO/***** Small satellite top standard
  - Important for promotion of small satellites and harmony with traditional satellites
    - Rules to be relaxed or removed to make the best use of small satellites (e.g. frequency)
    - Criteria specific to small satellites (e.g. reliability)
    - Rules to be followed by small satellites as long as they are “satellites” (e.g. debris)
  - Either way, there is a need to define “what is a small satellite”

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- Objectives
  - Examine the definitions of small satellites
  - Identify requirements every satellite should follow regardless its size nor development philosophy definitions of small satellites
  - Reflects some of the findings to ISO draft

- Benefits
  - Promote further growth of small satellite activity by clarifying the definition and requirements of small satellites

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International Workshop on Small-Scale Satellite Standardization (IWS4)

- November 18 – November 20, 2014 at Kyushu Institute of Technology, Kitakyushu, Japan
- 88 people from 27 countries, 44 from abroad

Round Table Discussion

- Revision on ISO-19683 testing standard
- Definition of small-scale satellite (Panel discussion & brain storming)
- Agreed on
  - Using a term “Lean Satellite” to reflect the satellite development philosophy rather than satellite size
  - Collecting comments and information regarding the scale of lean satellite and requirements in each country through mailing-list

International Workshop on Small-Scale Satellite Standardization (IWS4)

- “Mass” nor “size” is not suitable for definition of the satellites of current concern
  - “Small satellite” is not an appropriate word
- Should be defined by philosophy of design, manufacturing, mission, program management, etc
- During the workshop brain storming, many ideas were proposed as the right word to express small satellites
  - Low-cost satellite
  - Experimental satellite
  - Agile satellite
  - Small-scale satellite
  - Compact satellite
  - etc
- Finally agreed on “Lean Satellite”
- Decided to define more clearly and promote the word further

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- Current stage of standard development:

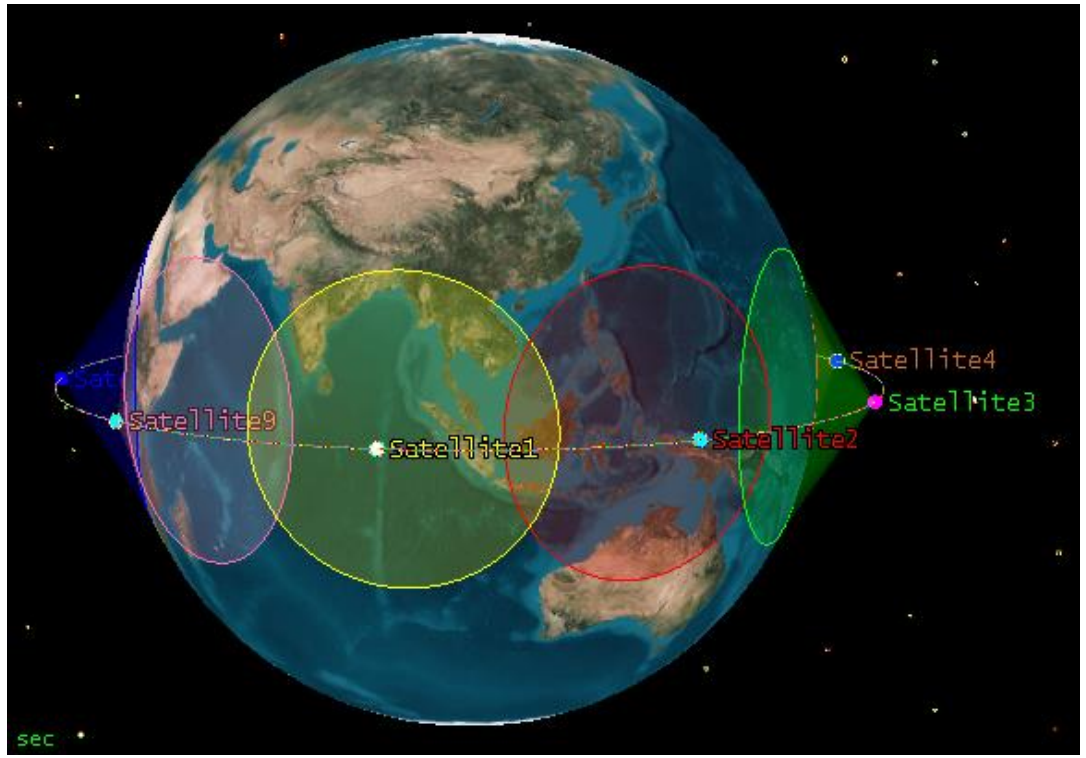
  Defining of Lean satellite requirements and scales

  - Reliability
  - Cost
  - Organizations involved
  - Management
  - Components

3. Proposed Ideas

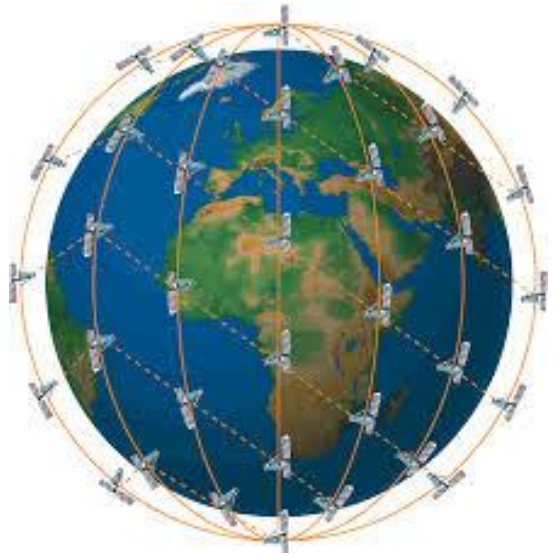
1. Communicational satellite constellations

Equatorial constellation



Simulation by STK software

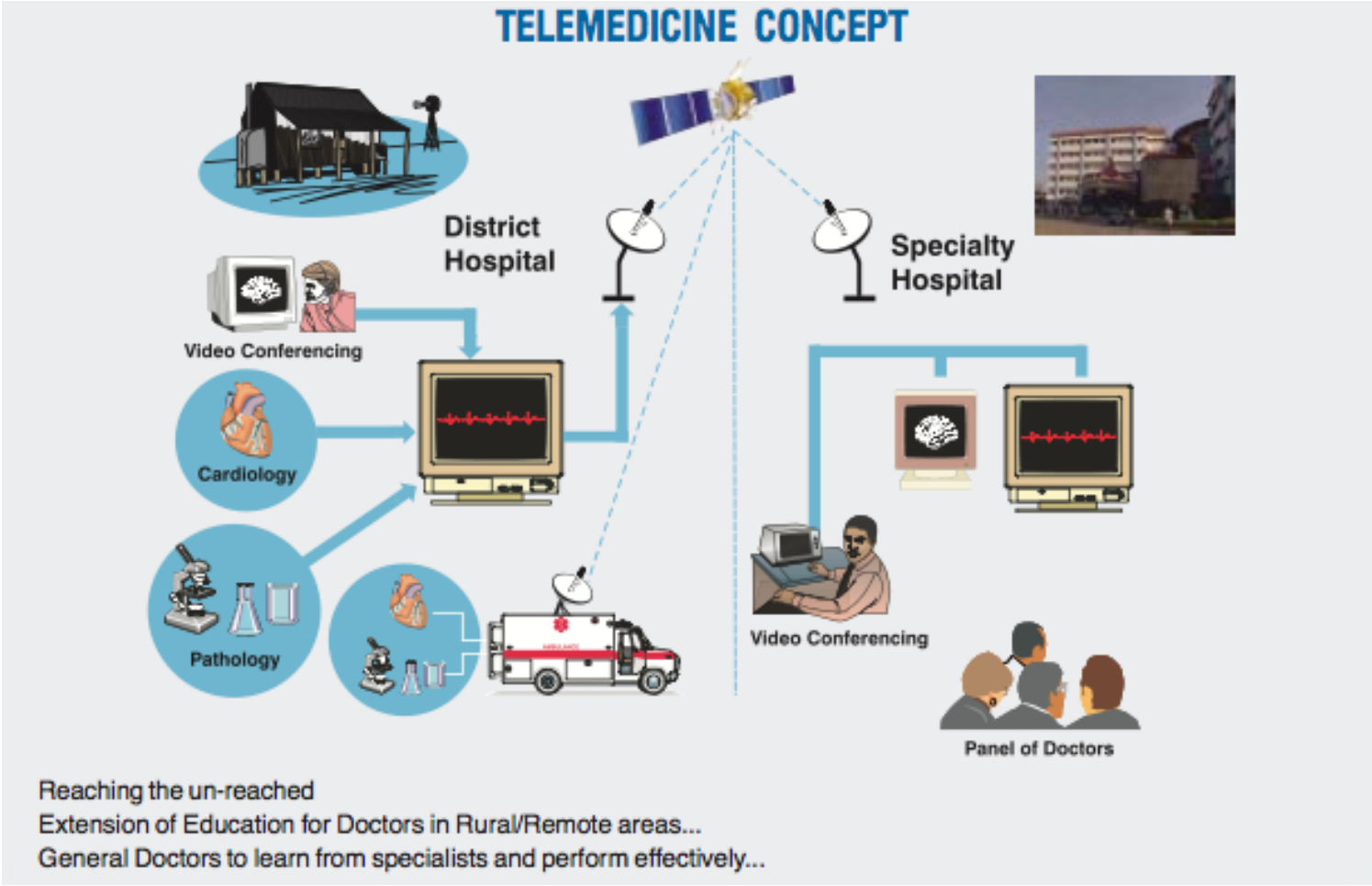
Global constellation



http://www.defenseindustrydaily.com/iridium-next-boosting-data-speeds-improving-dod-space-awareness-06161/

1.2. Telemedicine with the use of satellite communication system

Medical care from space: telemedicine

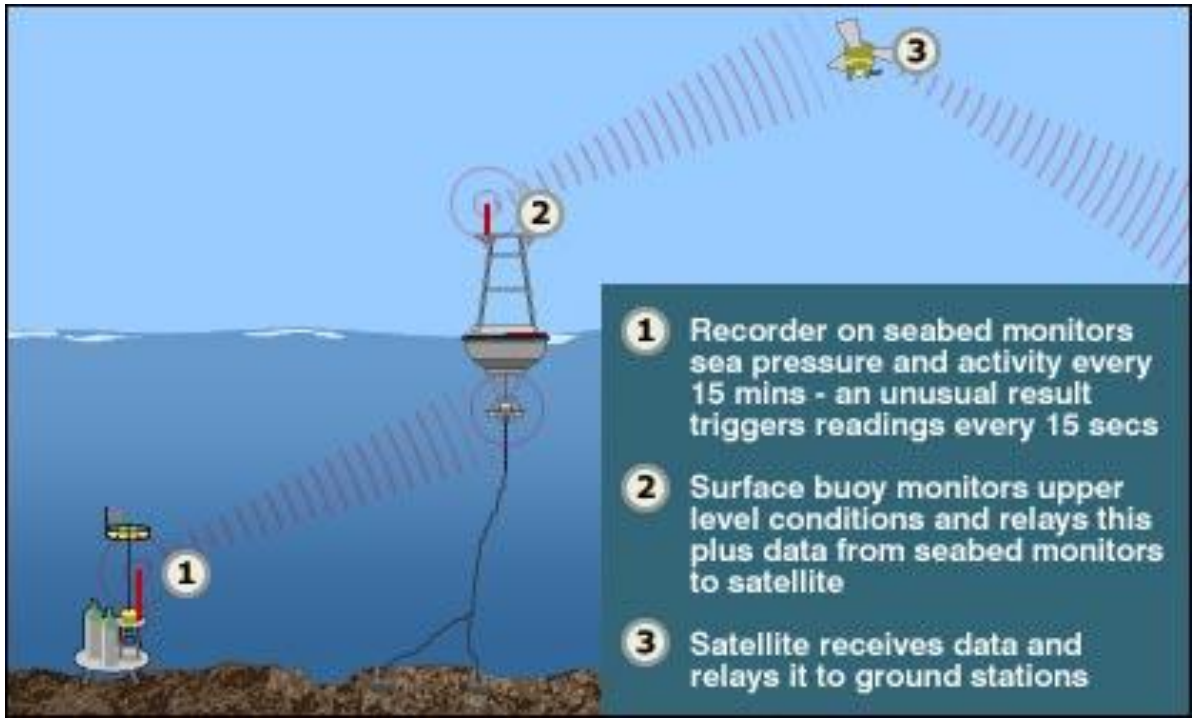


http://www.it24hrs.com/2012/telemedicine-with-google-hangouts/

1.2. Early warning system application for remote areas with satellite constellation

A satellite-based communication system is aimed to give early warning of tsunamis, earthquakes and volcanos by direct measurement of tsunamis in the open ocean and s-waves followed using sensors by real-time reporting to warning centers (ground stations).

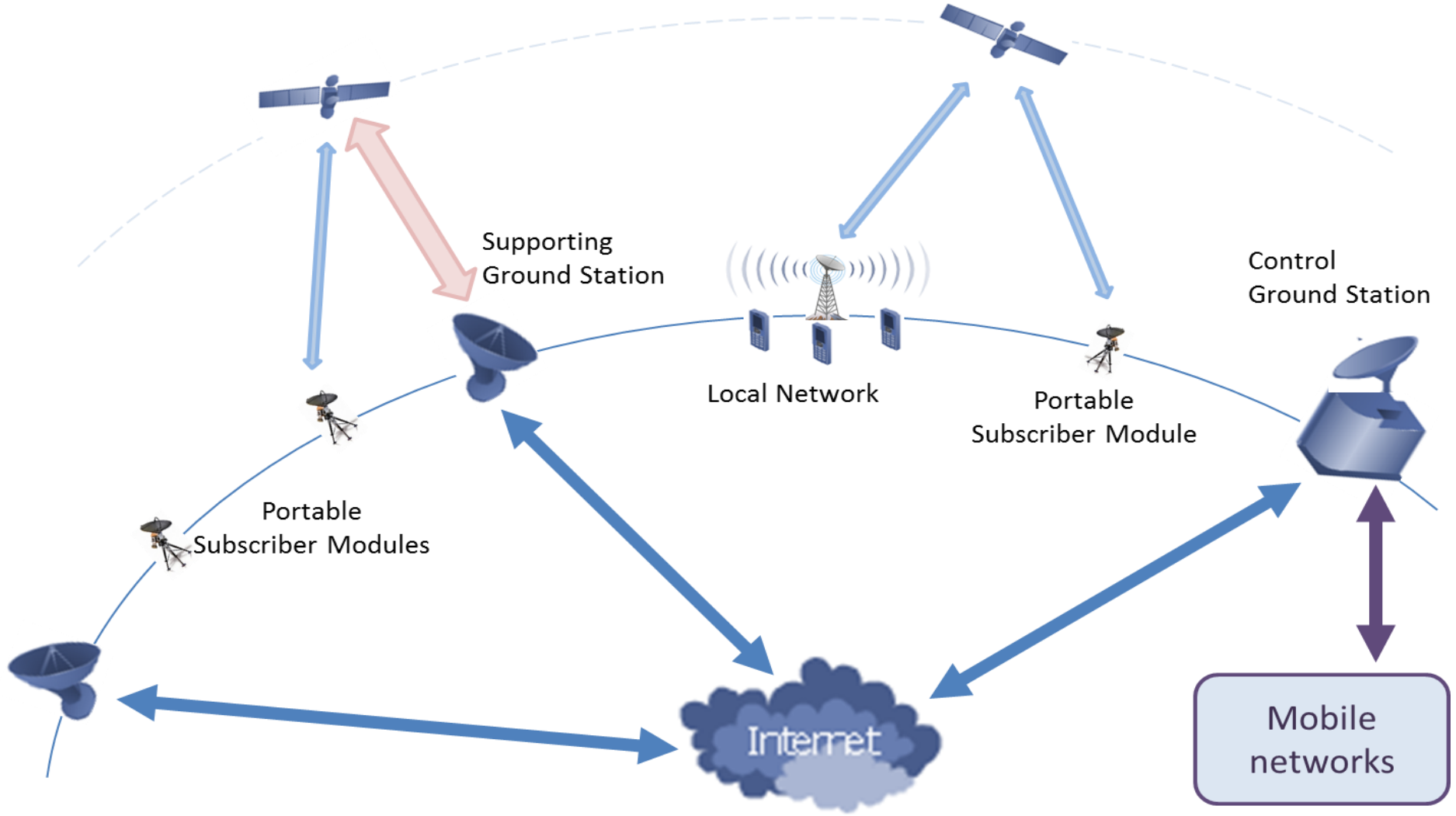
Tsunami alert technology



Monitoring of volcano´s activities

http://news.bbc.co.uk/2/hi/science/nature/4373333.stm

1.3. Low-cost communication system for equatorial region



2. Tracking oasis in desert

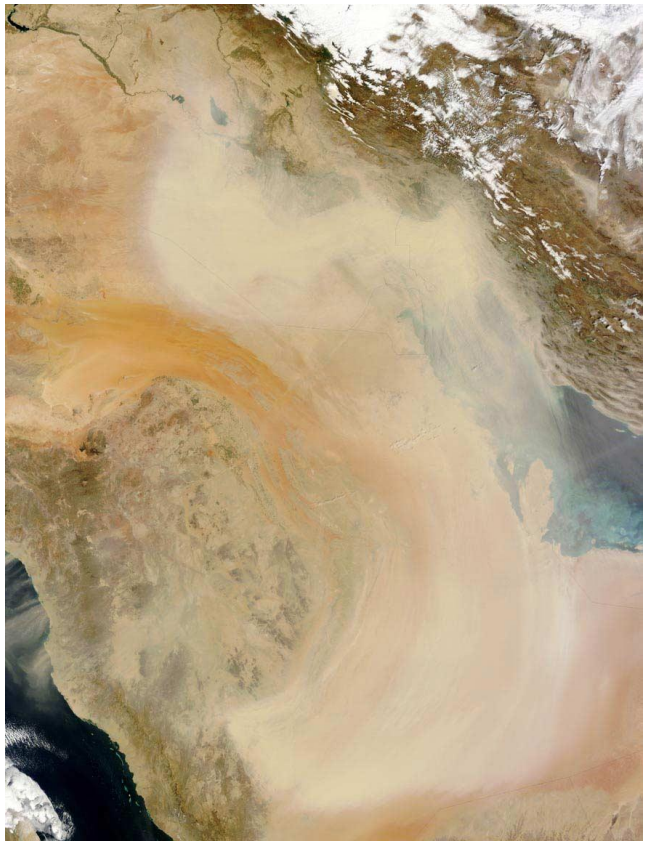
- A desertification monitoring is very needed because green land is absorbed inch by inch form year to year. People do arboretum and plant it for prevent desert movements.
- United Nations Convention to Combat Desertification (UNCCD), starting 1 October 2013, and space agencies of some countries started programs for monitoring deserts.

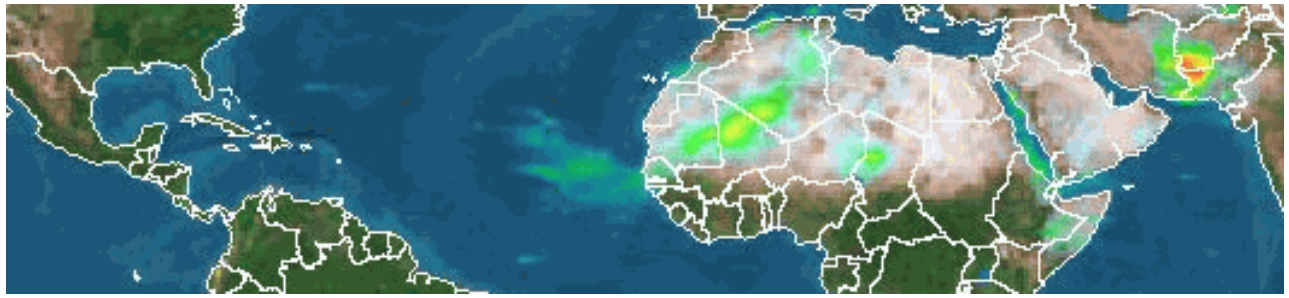
http://www.esa.int/Our_Activities/Observing_the_Earth/Space_for_our_climate/Satellite_data_instrumental_in_combating_desertification

3. Tracking sandstorms

Dust and sand storms cause soil loss from the dry lands, and worse, they preferentially remove organic matter and the nutrient-rich lightest particles, thereby reducing agricultural productivity. Also the abrasive effect of the storm damages young crop plants. Dust storms also reduced visibility affecting aircraft and road transportation. In addition dust storms also create problems due to complications of breathing in dust.

Tracking of the storms can give an opportunity to reduce human and economical losses.





http://phys.org/news/2015-06-powerful-pressure-sand-storms.html

4. Rental satellite for Space Technology Education

Benefits:

- To provide sustainable “real” practical training for Space Engineering courses syllabus
- To contribute to decrease Space debris
- Low-cost and fast usage of satellite for users
- To increase collaboration between Space developed country and Space emerging countries

4. Discussion the Ideas and think about new ones

- Example ideas: SAR (Syntethic Aperture Radar) for oil Spillage detection & Monitoring

	Strength	Weakness
Originality	Near real-time monitoring	Not new idea (TerraSAR-X and PAZ radar satellite)
Rationale	Fast response to ecological disaster crucial worldwide applicability	
Technical Feasibility	Auto mode, manual mode	How to point and track spills? SAR technology not yet realized for small-sat class
Complexity		- High field of view - Accurate AODS - High power consumption

Idea 1:

	Strength	Weakness
Originality		
Rationale		
Technical Feasibility		
Complexity		

Idea 2:

	Strength	Weakness
Originality		
Rationale		
Technical Feasibility		
Complexity		

Idea 3:

	Strength	Weakness
Originality		
Rationale		
Technical Feasibility		
Complexity		

Idea 4:

	Strength	Weakness
Originality		
Rationale		
Technical Feasibility		
Complexity		

Idea 5:

	Strength	Weakness
Originality		
Rationale		
Technical Feasibility		
Complexity		

5. Conclusion