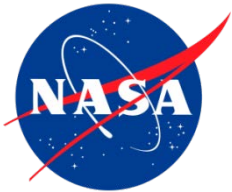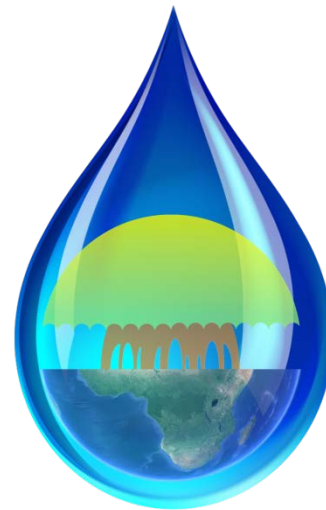# Space Studies Program 2013
Team Project Koastal

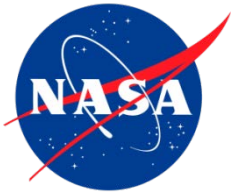## Integrated Applications for Sustainable Use of Coastal Regions

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NASA

Presented by
Charlotte Kiang

Introduction

- International Space University (ISU)
- Space Studies Program (SSP) 2013 was moved from Brazil to France
- Kenya, east Africa
- Project sponsored by NASA
- Team Koastal consisted of 30 members from 12 countries

  + Project Chair: Olga Zhdanovich (Russia)

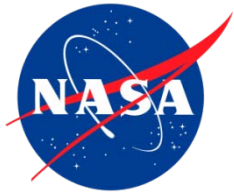 + Teaching Associate: Scott MacPhee
  (Canada)

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Background

- Kenya has a 500 km coastline bordering the Indian Ocean to the East

- Despite abundance of natural resources, almost 50% of population lives on less than $1 a day, and the country's GDP is one of the lowest in the world at $1,800 per year.

- Tourism is an important industry in Kenya, and 10% of the country's population lives along the coastline.

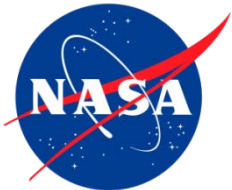- Over 2/3 of Kenyans have mobile phones, and the country has 84% network coverage.

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# Coastal regions: Interaction between society and environment

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Mission Statement

To suggest cost-effective solutions for managing resources and activities conducted in Kenya's coastal zones. This will be achieved by exploring space-integrated technologies, policy recommendations, and activities related to environmental monitoring and sustainable resource management.
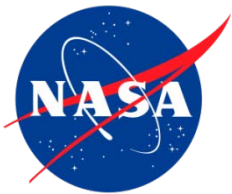
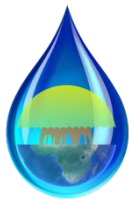Sponsored by NASA

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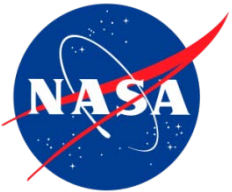
Methodology

- First we **define and understand** the natural and human-induced problems and challenges in the coastal region.

- Then we **look at existing resources** to detect and monitor marine and terrestrial water pollution.

- Afterwards, we **investigate the gaps** from a policy, socioeconomic, environmental, and technological perspective.

- Lastly, we **present our affordable space and ground integrated solutions** for water pollution monitoring and management.

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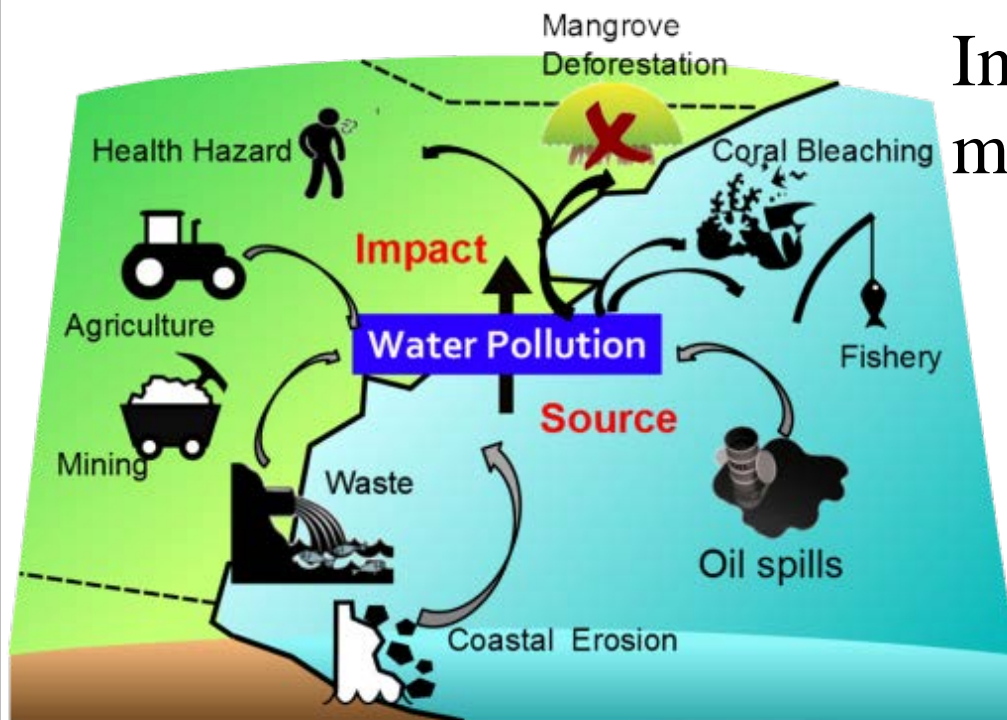
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Marine and terrestrial water pollution

High impact

Interdependency

Integrated coastal management
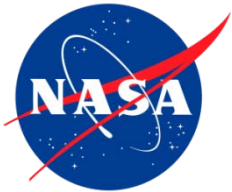
Space integrated solution

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Interdependency

Definitions (1)

Coastal areas are where land and sea meet, extending up to 100 km inland and within 200m depth isopleth. (Pernetta and Milliman, 1995)
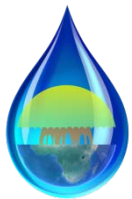

Water pollution is any chemical change in the quality of water that has a harmful effect on organisms that use water. Polluted water often has serious effects on human health and can make water unsuitable for use. (Water Treatment Solutions)
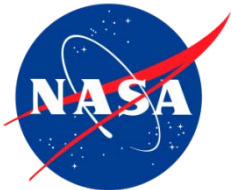
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Definitions (2)

Integrated coastal management coordinates policies in coastal zones. It contributes to sustainable development by respecting natural resources and ecosystems, and covers information collection, planning, decision-making, management, and monitoring. (European Commission)

Space integrated applications are services that combine space-based telecommunications, Earth observation, and navigation systems into a complete solution for the end user. (European Space Agency)

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Existing infrastructure: SERVIR

- Joint environmental monitoring program between NASA and USAID

- "Provides analyses and applications from space-based remotely sensed information to help developing nations' decision making regarding natural disasters, climate change, and other environmental threats." (NASA)

- Uses International Space Station SERVIR Environmental Research and Visualization (ISERV) system to acquire image data.
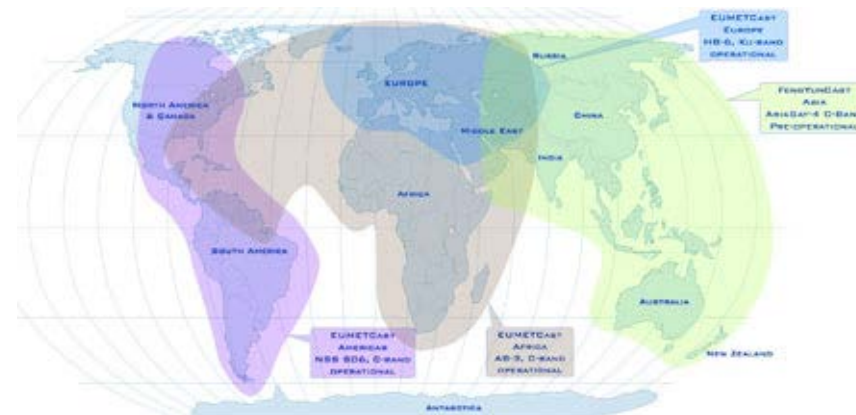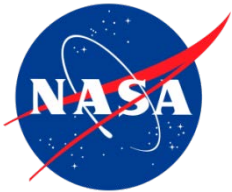
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Existing infrastructure (2)

- GEONETCast: Source of meteorological satellite data used for cyclone detecting and tracking. (EUMETSAT, World Meteorological Organization)

- Indian Ocean Tsunami Warning System: Source of tsunami-related raw data and alerts that are used by the Kenyan Meteorological Department to detect tsunamis. (UNESCO)

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Gap analysis (1)

5 categories:

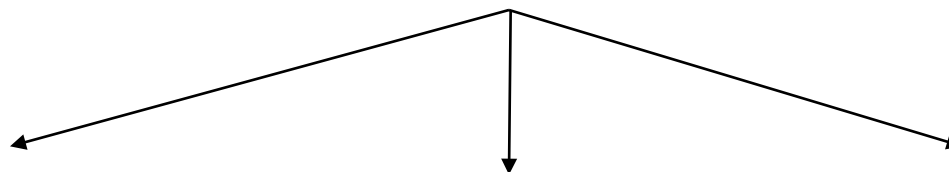| Data availability | Data processing | Data flow | Public awareness | Policy, law and education |

3 groups of gaps:

Presence
Koastal developed solution

Partial gap
Enhanced by Koastal's solution

Absence
Integrated in Koastal's solution

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Gap analysis (2)

Data availability

Earth observation	Water pollution data
Gap: No	Gap: Yes

Data processing

Earth observation	Products
Gap: No	Gap: Partial

Disaster information	Water pollution
Gap: Partial	Gap: Yes

Data flow

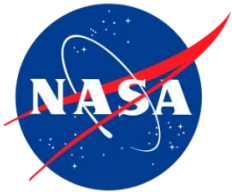| National broacasting	Terrestrial mobile communication
Gap: No	Gap: Yes

Satellite communication
Gap: No

Public awareness

Pollution control and environment management
Gap: Partial

Policy, law and education

| Awareness about water pollution |
|---|
| Gap: Partial |

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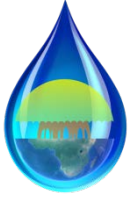
Koastal's solution: Overview

Detection: Both space and ground based sensors are used to detect marine and terrestrial water pollution. Predicting natural disasters like tsunamis, floods, and cyclones is included here because of their role in causing water pollution.

Response: Team Koastal suggests data processing and a decision support system (DSS) that triggers alarms for the response subsystem which will manage the situation and contact state authorities. It also issues alerts to public through mobile phones and other mass communication channels.

Regulation: Koastal introduces policies and laws that need to be formulated and executed with the help of Kenya's government.
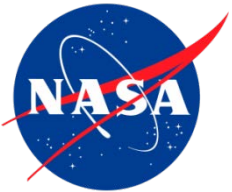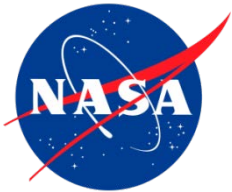
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Koastal's solution

Integrated marine and terrestrial water pollution management and livelihood support system for Kenyan coastal regions

| PROBLEMS		SOLUTION	STAKEHOLDERS
CAUSES	1. Chemical industrial discharge 2. Thermal industrial discharge 3. Sewage 4. Solid waste 5. Pesticide and fertilizer pollution 6. Radioactive pollution 7. Pollution from natural disasters 8. Oil spills 9. Lack of awareness		
EFFECTS	1. Health hazards 2. Fish population decline 3. Land degradation 4. Coral bleaching 5. Algal bloom 6. Mangrove degradation		

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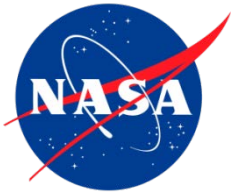
Koastal's solution: data collection
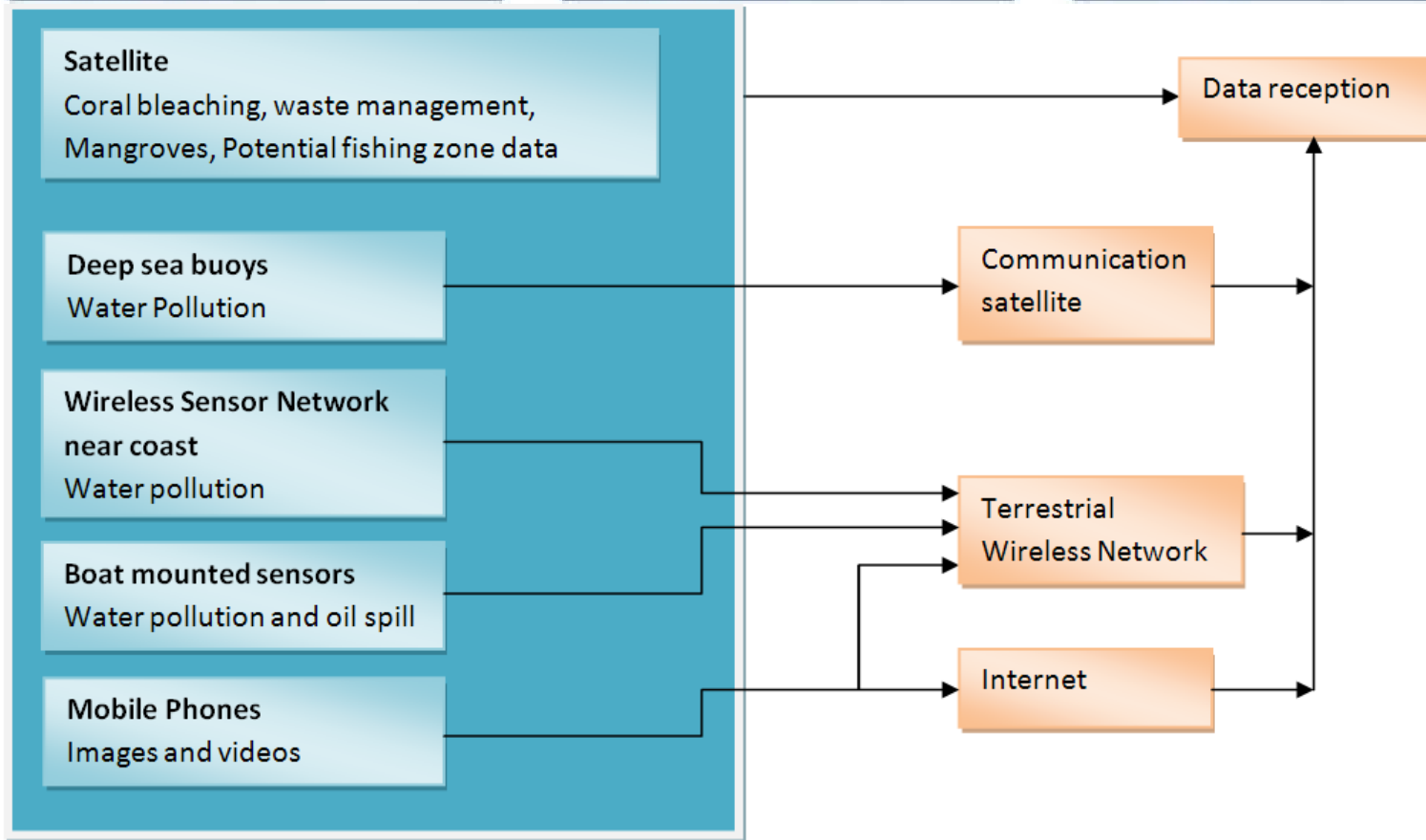
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Koastal's solution: Earth observation data

- Used for deriving sea surface temperature, mangrove degradation, coral bleaching, waste dumpsites, algal blooms, ocean wind and currents etc.

- Earth observation data from space use existing infrastructure to be cost-effective

- SERVIR, GEONETCast, Indian Ocean Tsunami Warning System etc.
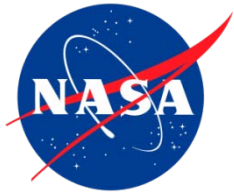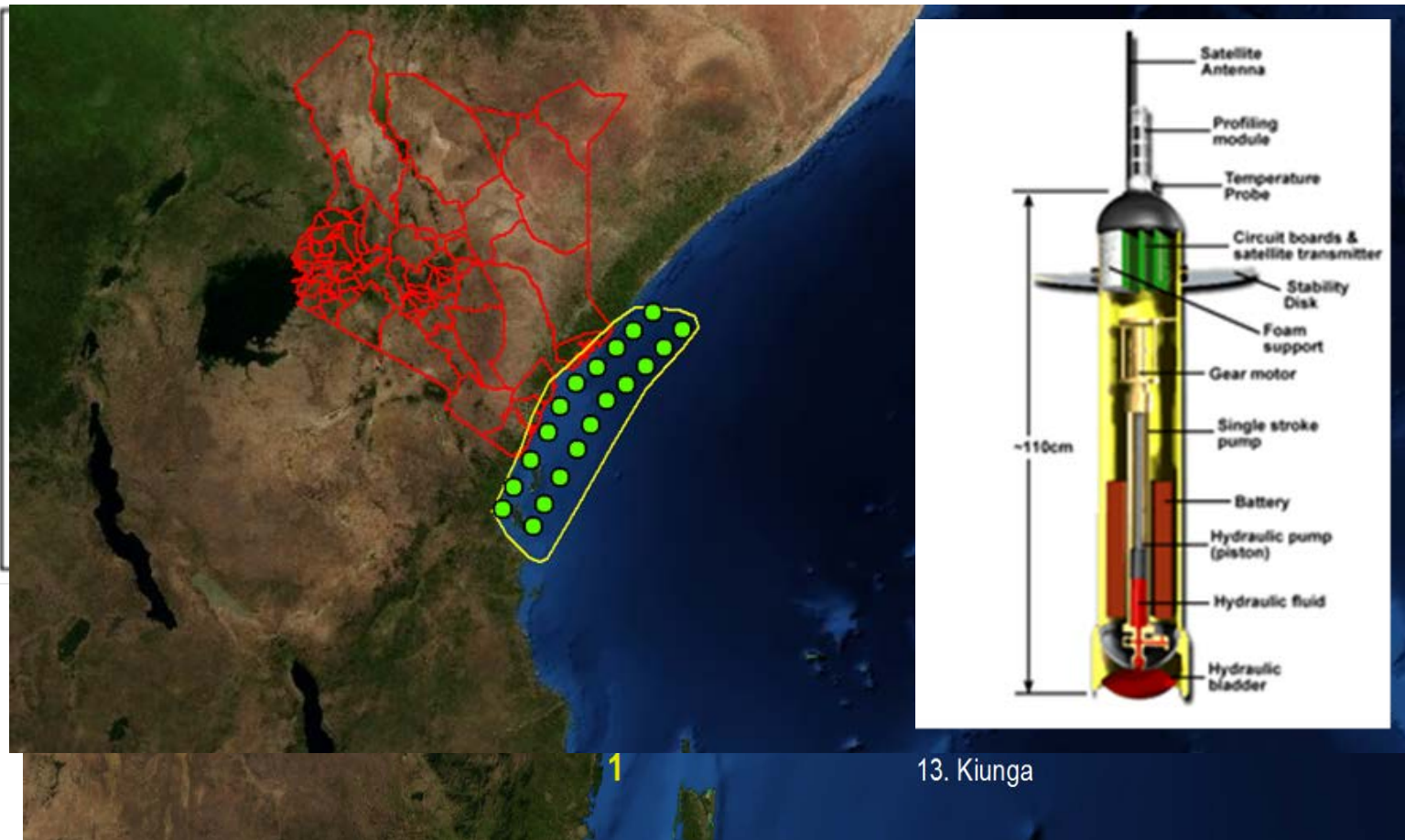
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Koastal's solution: deep sea wireless sensor network
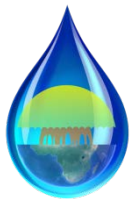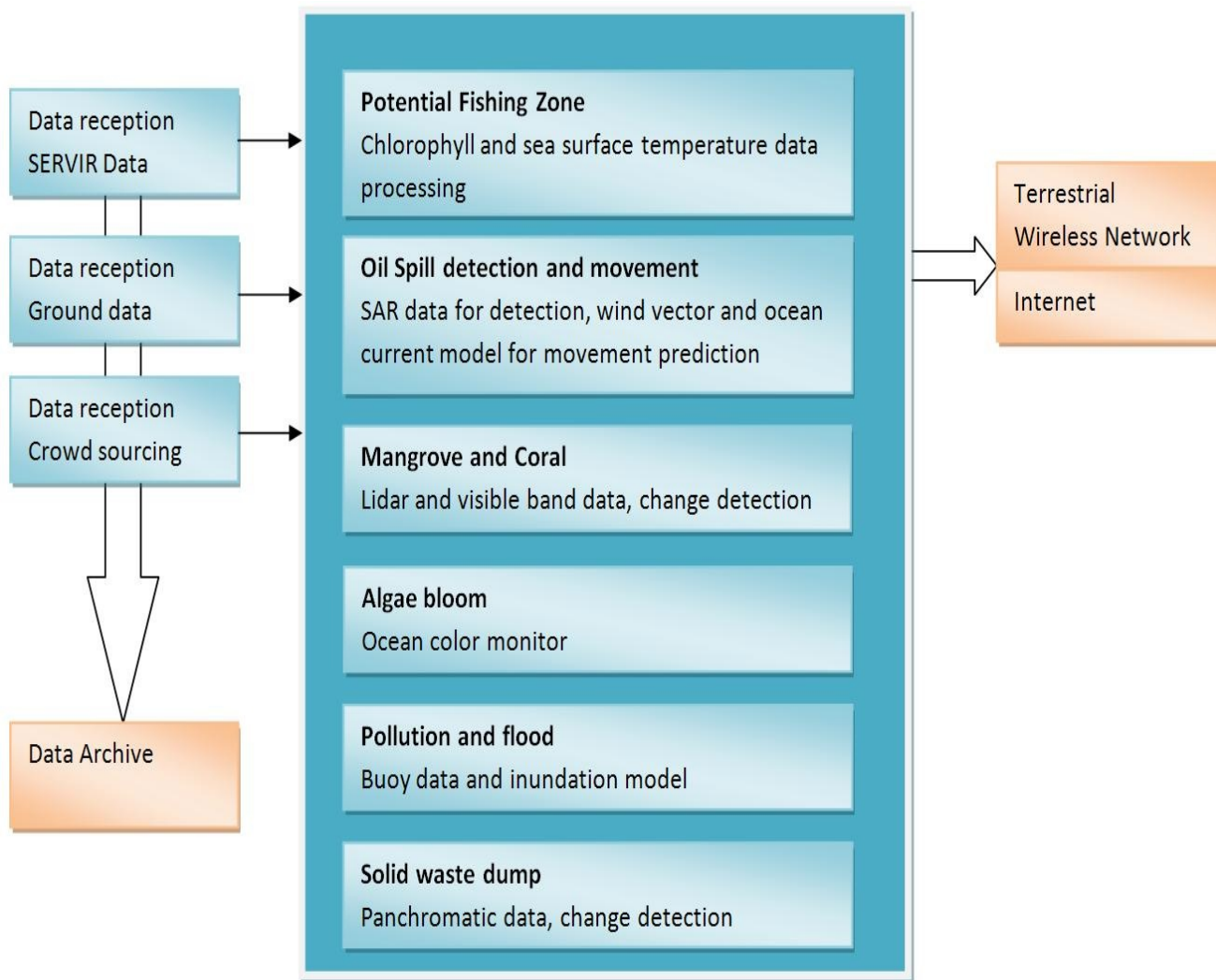
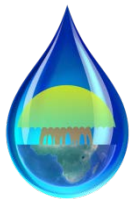## Pollution monitoring / Locations

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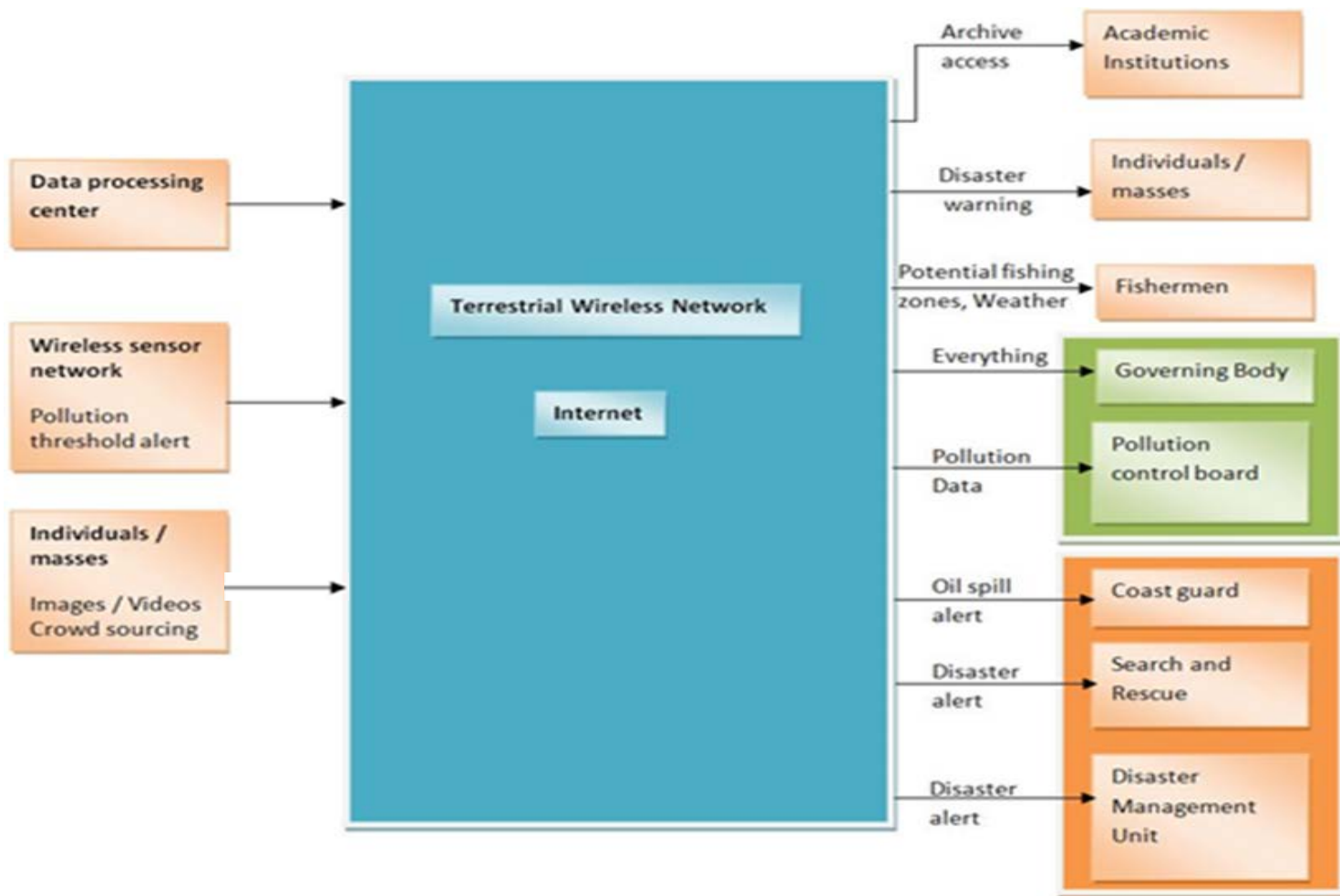
13. Kiunga

Koastal's solution: data processing

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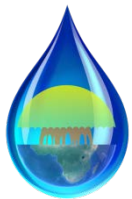
Koastal's solution: data dissemination

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Koastal's solution: new software: mobile phone applications

M-Fishing
- Potential fishing zones
- Maps, navigation, weather, etc.

M-Eye
- Collects geo-tagged pictures and video

M-Collect
- Extracts data from instruments on boats

M-Spill
- Alerts coast guard
- Maps, navigation, weather etc.

KENYA

# Koastal's solution: Policy Recommendations

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- Greater observance of international treaties and UN resolutions, including the 1967 Outer Space Treaty and the 1986 UN Remote Sensing Principles Declarations
- UN Charter for Space and Major Disasters should be modified to include access to Earth Observation data to prepare for natural disasters
- Legal framework should exist for local decision- makers to acquire and process foreign-owned satellite data domestically
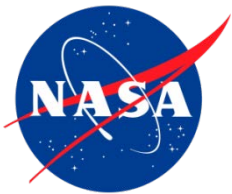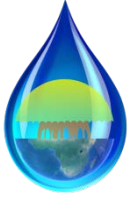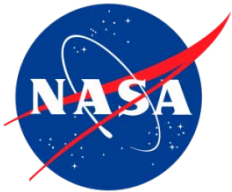
Koastal's solution: Educational Outreach

- Clean drinking water, hygiene to avoid spreading water-borne diseases, etc.
- Disaster preparedness training for the population of the coastal regions.
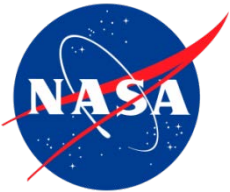
Koastal's solution: cost

Koastal suggests an integrated marine and terrestrial water pollution management and live (Mondas) support system for Kenyan coastal regions.

Implemented in phases:
- Start by focusing on highly populated areas (Mombasa port, Malindi)
  - Start-up cost: $1.1M
  - Running cost: $0.89M per year

Creation of a new ground and maritime based wireless network of sensors to relate ground and space observations for the coast of Kenya.

To develop the coast: $7.15M as starting costs and annual running cost of $4.5M

Decision support system to improve response to water pollution, floods, and tsunamis.