MULTI FACETED UNMANNED SYSTEM FOR DISASTER MANAGEMENT

Presented By:

VEL-TECH TECHNICAL UNIVERSITY, AVADI, CHENNAI

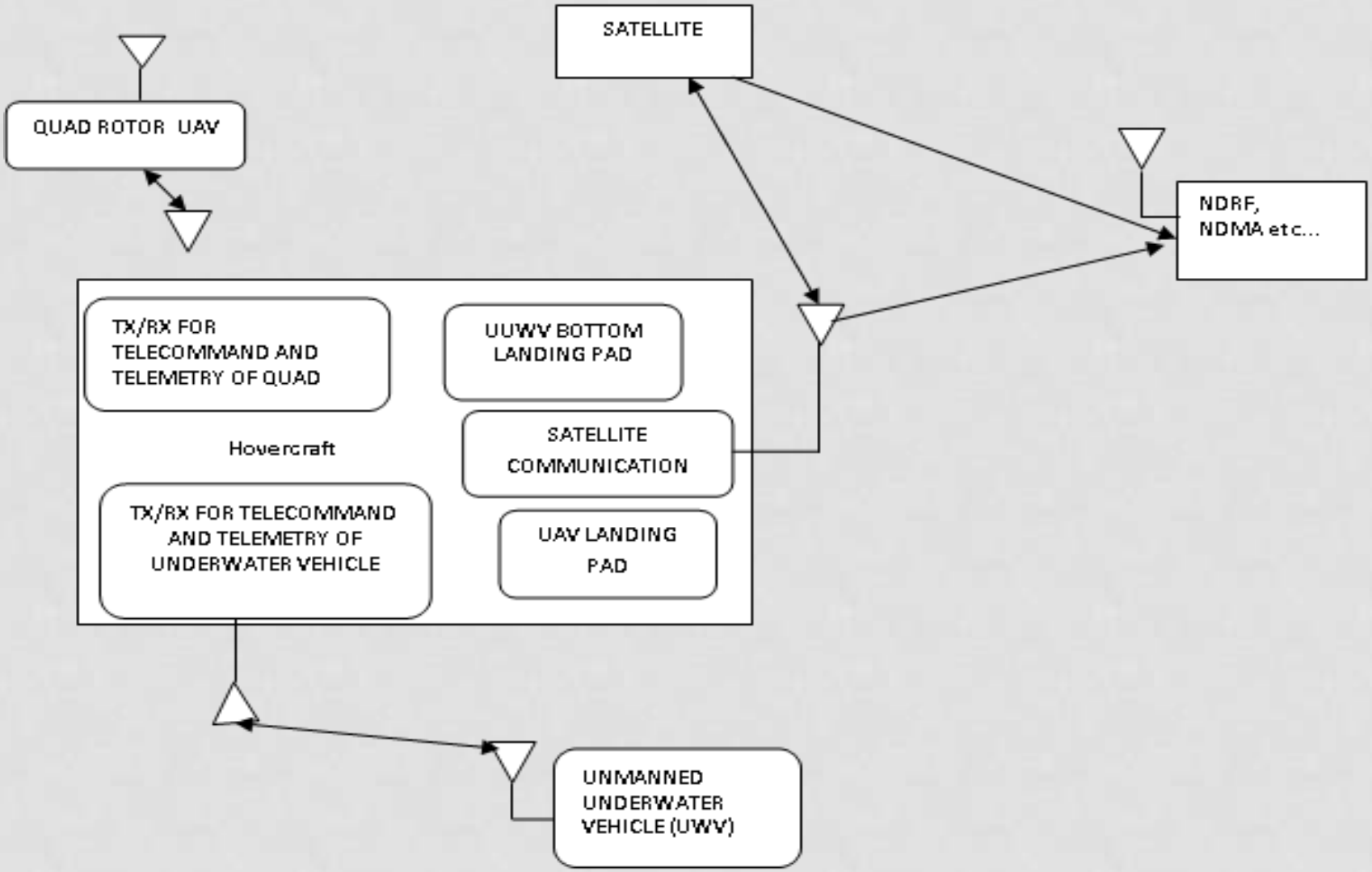
Vaidehi Paravastu
Sunil Kumar Maurya
Anmol Shukla

Under The Guidance Of:
Prof. Vasantharaj R

INTRODUCTION

- Method of disaster management using unmanned systems.
- The unmanned system consists of a hovercraft embedded with a VTOLUAV and an underwater vehicle.
- The hovercraft acts as the ground control station (GCS).
- All the data from the UAV and the UUV are sent to the hovercraft.
- The hovercraft analyses all the data and the GCS transmits all the data obtained to the available satellite, National Disaster Rescue Force (NDRF) and National Disaster Management (NDM).

HOW IT WORKS!


SATELLITE
QUAD ROTOR UAV
NDRF,
NDMA etc...
TX/RX FOR
TELECOMMAND AND
TELEMETRY OF QUAD
UUWV BOTTOM
LANDING PAD
Hovercraft
SATELLITE
COMMUNICATION
TX/RX FOR TELECOMMAND
AND TELEMETRY OF
UNDERWATER VEHICLE
UAV LANDING
PAD
UNMANNED
UNDERWATER
VEHICLE (UWV)

OVERVIEW

- Applicability – unmanned systems deployed in various disaster scenarios
- Status – prototypes developed for all 3 systems
- Benefits – continuous data analysis and validation of disaster
- Implementation & Collaboration
  - Dr.V.K.Dadwal, Director NRSC – ISRO India
  - Dr.CBS Duct, Deputy director ECSA, NRSC- ISRO , INDIA
  - Florida A & M University – Prof. Thomous Belamin
- Teaming – Multidisciplinary team in Autonomous systems (CASR) Lab.

HOVERCRAFT

- Hovercraft is the main functioning unit of the whole system.
- The hovercraft is equipped with a UAV and a UUV.
- The hovercraft serves as a ground base for data analysis, reception and transmission of the same data to the satellite or a remotely monitored base.
- The hovercraft is also equipped with high sensitivity real-time analysis sensors like GPS (Global Positioning System), proximity sensors, ultrasonic sensors, pressure sensors and temperature sensors.
- The high range transmission enables this setup to be used in the most remote locations.

ILLUSTRATIVE MODEL OF HOVERCRAFT

MULTI ROTOR VEHICLE (UAV)

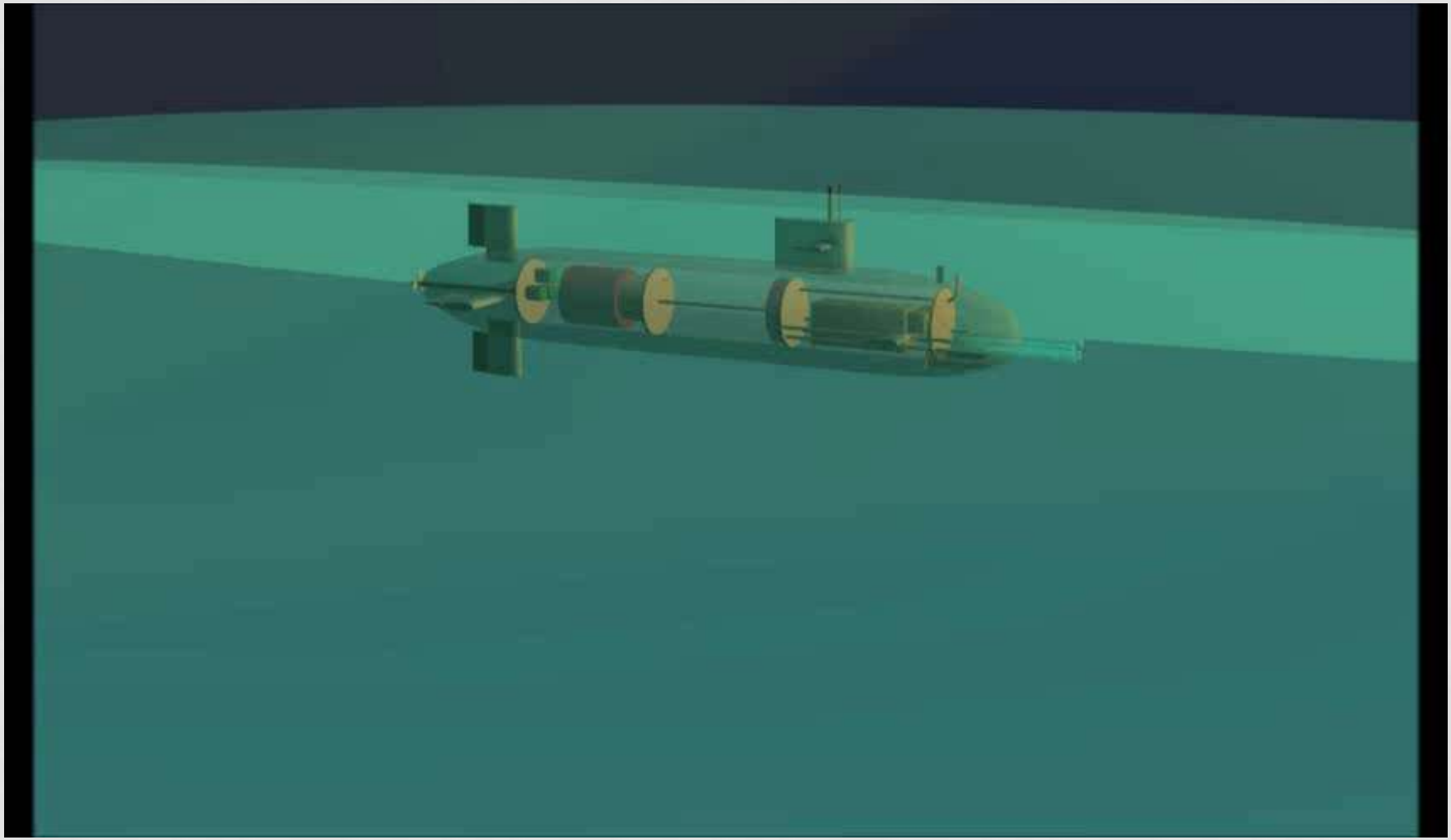
- An advanced multi rotor is equipped with a high definition camera, thermal imaging, wind flow analysis system, proximity sensors, GPS and real-time visual streaming.
- The multi rotor can perform aerial inspection of regions where of the hovercraft cannot be sent and communicate using the long distance transceiver.
- The multi rotor has a payload of 2 kg which enables it to provide tactical help on the field.
- The multi rotor can be used to drop life jackets, instant medical kit, fire proof clothes, food and many other necessities.

ILLUSTRATIVE MODEL OF MULTIROTOR

UNMANNED UNDERWATER VEHICLE (UUV)

- The unmanned underwater vehicle (UUV) is used as an underwater probe.
- The UUV can be used to analyze underwater changes like tectonic plate movements, pre mature tremors, earthquake and underwater volcanic activities.
- The UUV is equipped with sea current analysis system, host positioning system or inertial navigation system , underwater imaging camera and thermal variation analysis system.
- Hence the UUV proves to be helpful in analyzing the underwater activities and preventing sea related calamities.

UNMANNED UNDERWATER VEHICLE (UUV) ILLUSTRATION



SALIENT FEATURES

- Autonomous
- Return to home
- Homing signal
- Fuel cells as an alternative power supply

- Navigation in GPS denied locations
- Stability of vehicle using gyro-sensors

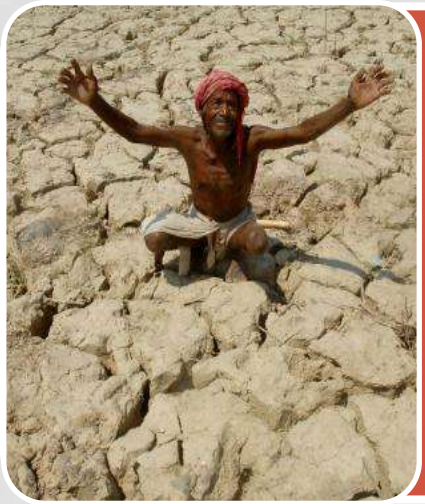
- IR & thermal imaging
- Real time communication
- Wireless charging by mutual induction

NATURAL DISASTER SCENARIOS

- Forest fire
- Pollution
- Volcanic eruptions
- Drought
- Floods
- Radioactive Hazard

DROUGHT

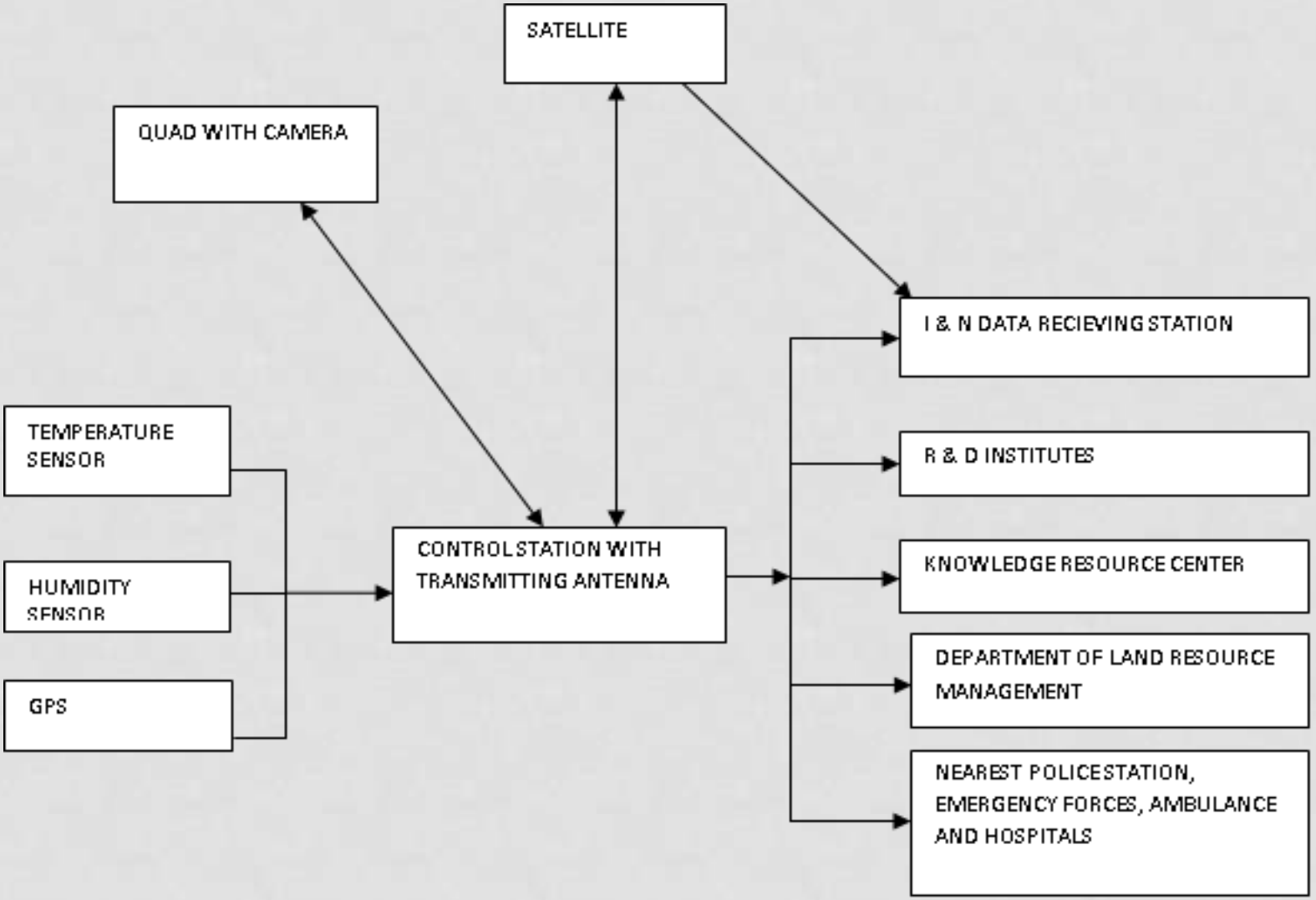
Generally, rainfall is related to the amount and dew point [determined by air temperature] of water vapour carried by regional atmosphere, combined with the upward forcing of the air mass containing that water vapour. If these combined factors do not support precipitation volumes sufficient to reach the surface, the result is a drought.



CAUSES:

- **high level of reflected sunlight**
- **above average prevalence of high pressure systems**
- **winds carrying continental air masses**
- **ridges of high pressure areas**

APPLICABILITY IN DROUGHT

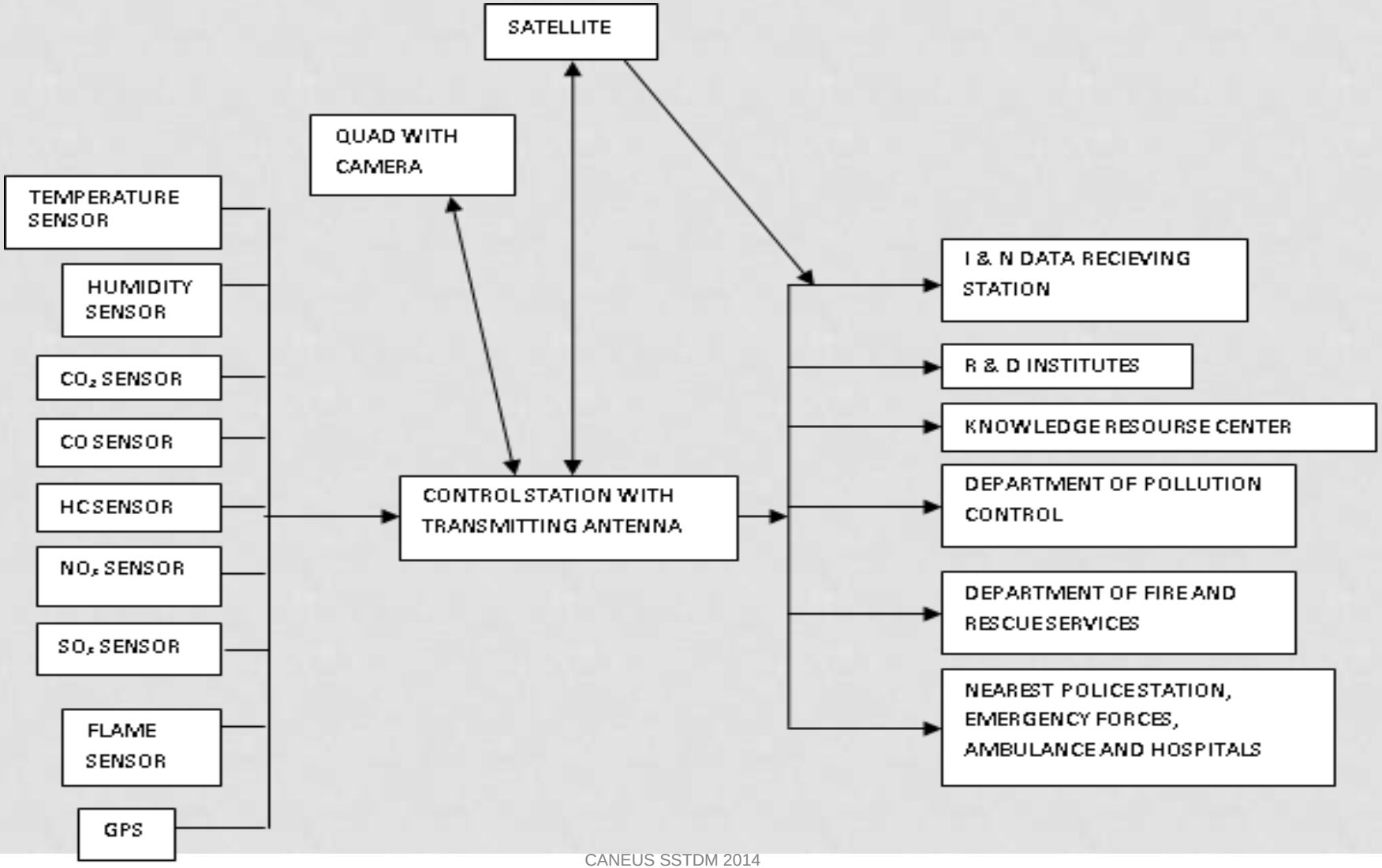


FOREST FIRES

CAUSES
Lightning
Human related causes
Volcanic eruptions
Sparks from rock fall
Spontaneous combustion

INDICATORS
Increase in temperature
Flames
Increase in sulphur content in air
Increase in oxides of carbon

APPLICABILITY IN FOREST FIRE AND POLLUTION



VOLCANIC ERUPTIONS

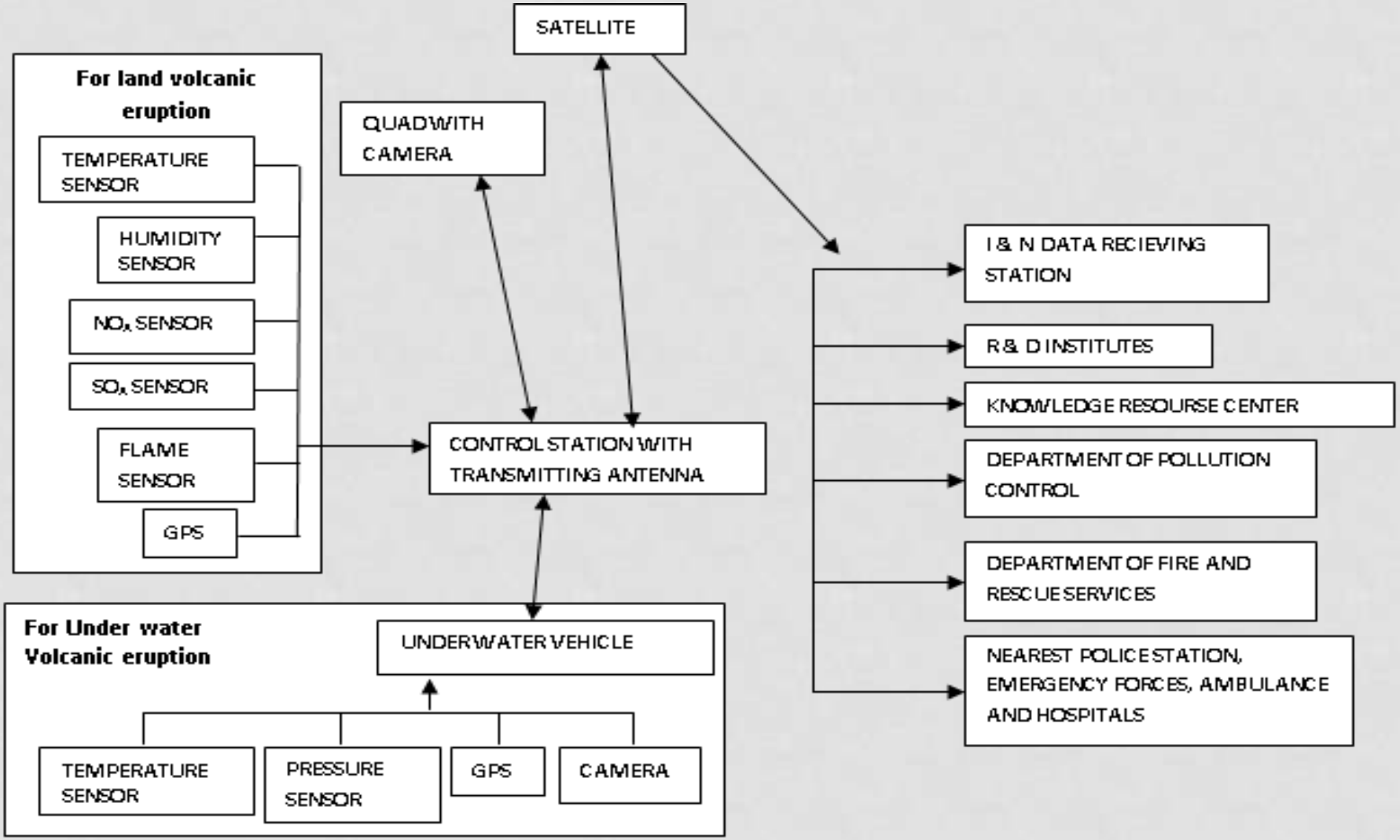
Although there are several factors triggering a volcanic eruption, three predominate:

- **The buoyancy of the magma.**
- **The pressure from the exsolved gases in the magma.**
- **The injection of a new batch of magma into an already filled magma chamber.**

INDICATORS:

- Increase in temperature
- Emission of sulphur dioxide
- Emission of water bubbles and steam

LAND AND UNDER WATER VOLCANIC ERUPTION:



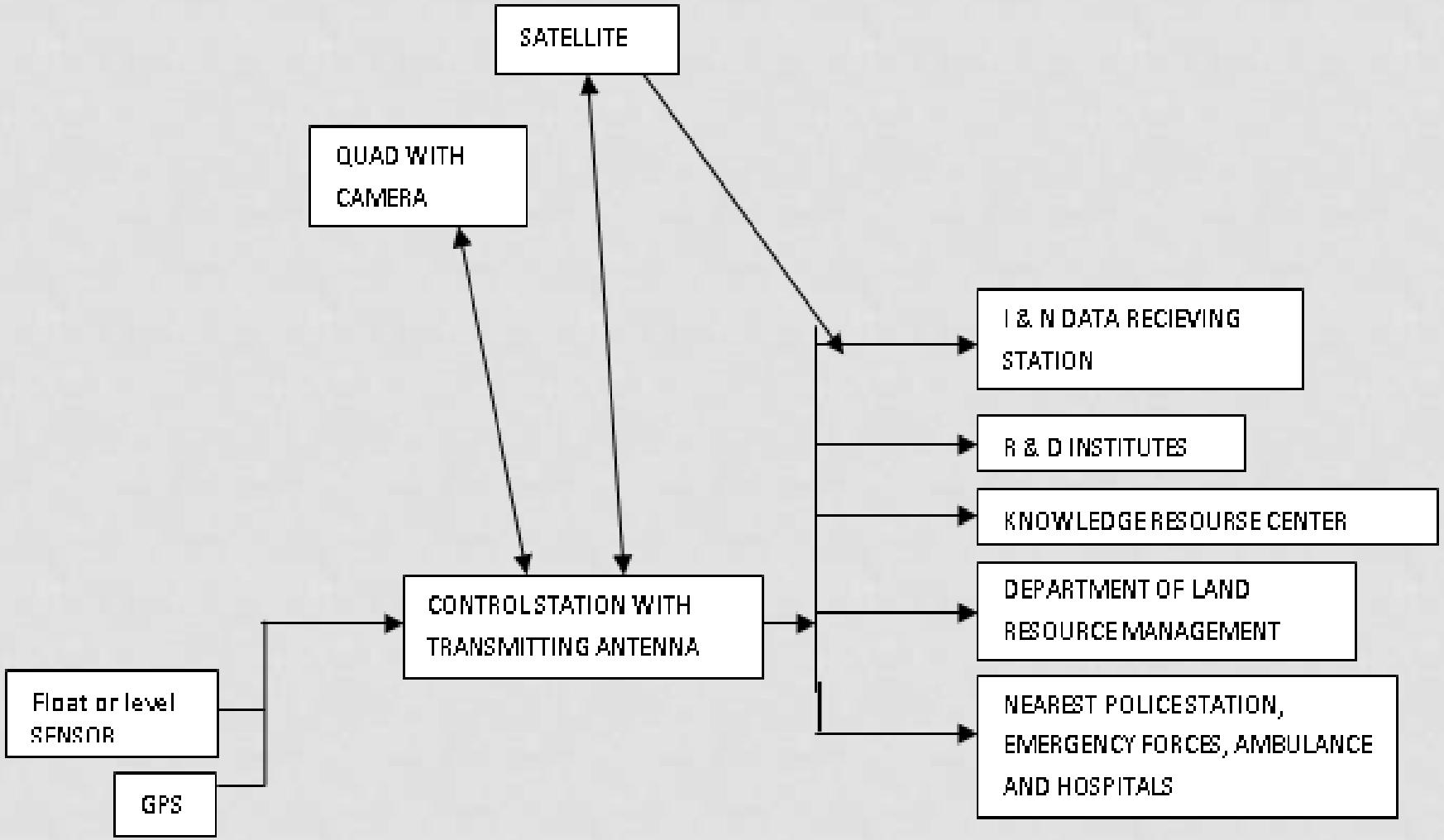
FLOODS

Cloud bursts and sudden torrential rain

Overflowing of a dam or river

Sea tidal surges in estuaries – due to winds and low barometric pressure

APPLICABILITY IN FLOODS



NUCLEAR HAZARD

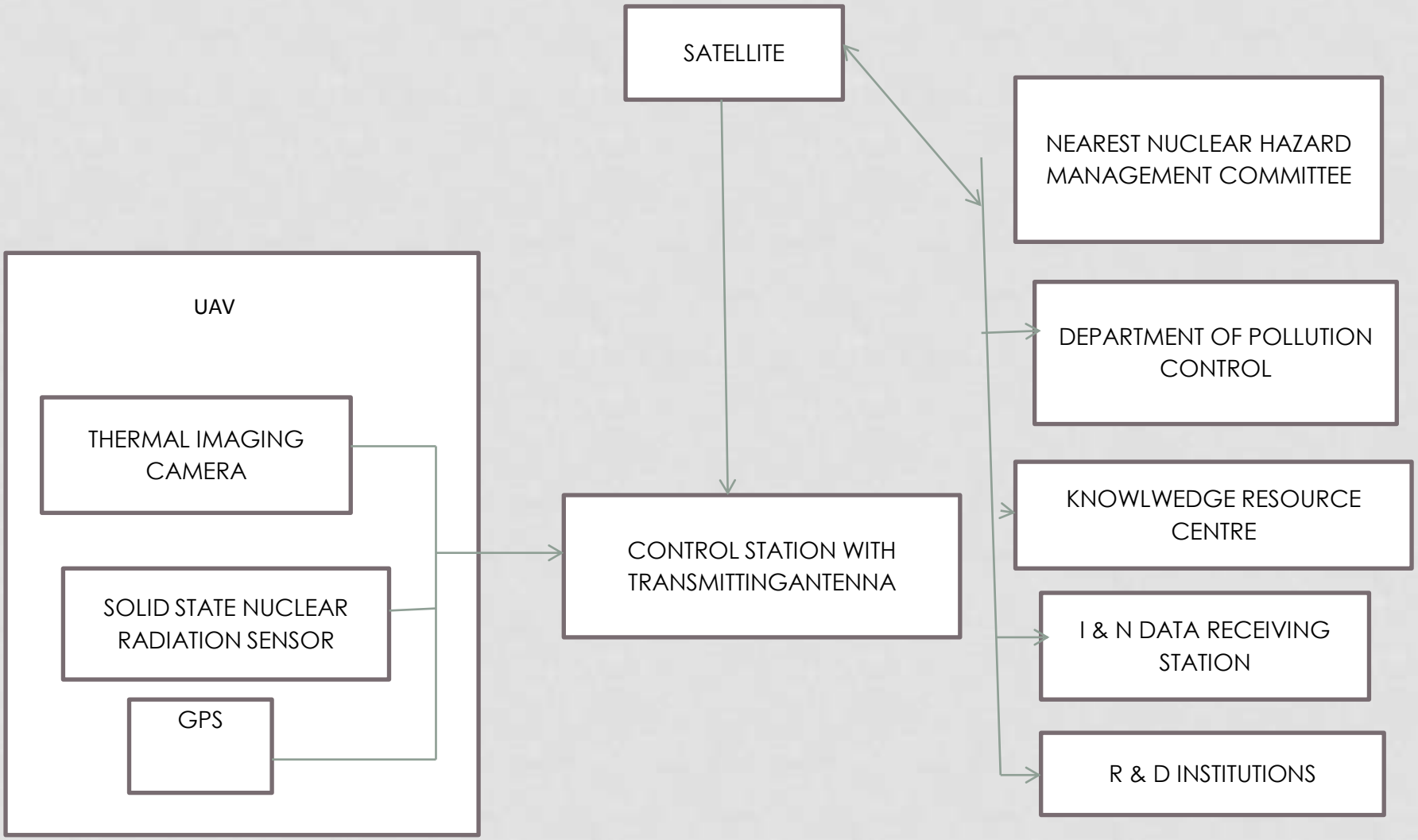
In case of a nuclear radiation leak the intensity of the radiation in the surroundings has to be accurately measured.

Human accessibility of the location is highly dangerous and strictly prohibited.

The radiation is easily absorbed by the surrounding plant life and moves up the food chain through biological magnification.

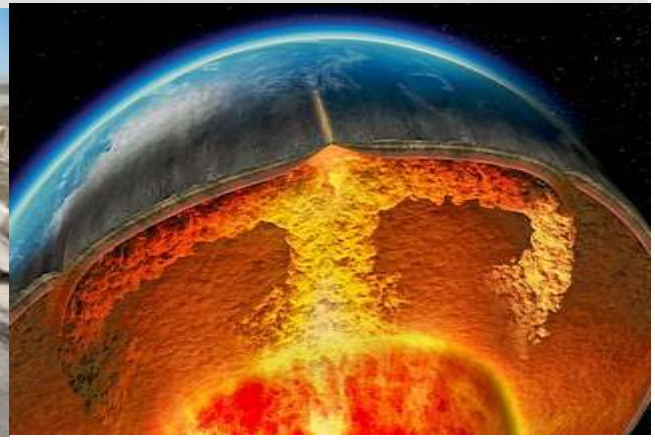
An unmanned vehicle equipped with a Geiger counter and Solid State Nuclear Radiation Sensors can be sent for the same

SURVEILLANCE OF NUCLEAR FALLOUT



APPLICABILITY IN INSTANTANEOUS DISASTERS

- Certain disasters like earthquakes, landslides and cloudbursts happen in an instant and cannot be predicted reasonably in advance.
- The unmanned system can be used for surveillance and reconnaissance of the disaster affected areas.
- Real time damage analysis, casualty mapping, strategy planning , relief (priority) distribution and evacuation progress monitoring.

CONCLUSION

The multi-rotor and underwater vehicle battery will be recharged using mutual induction method. The coverage range of the system will be extended through multiple hover craft GCS. The operation and required time also minimized by extending SWARM feature among the vehicles. The system not only provides the solution of disaster forecasting also used to rescue human. Material required for emergency situations like airbag, fireproof cloth, first-aid kit, food etc. are transported using the unmanned system. Based on the requirements of National Disaster Response Force (NDRF) advice and National Disaster Management Authority (NDMA) the features of the unmanned system can be extended.

- **Matrix for assessing progress**
  - Definition of problem statement
  - Determining requirements
  - Physical specifications of UAV, UUV and payload calculation
  - Specification of UGV
  - Acquiring hardware
  - Development of prototypes
  - Testing and validation
- **Challenges & transition to full scale mechanism**
  - Integrating the vehicles into a single system
  - Range of communication system
  - Procuring appropriate high quality sensors
  - Developing a fleet of systems with SWARM co-ordination
  - Reconfigurable design
  - Micro aerial vehicles

THANK YOU!