THE RECENT SITUATION OF SPACE TECHNOLOGIES FOR MONITORING AND MANAGEMENT DISASTERS

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ABSTRACT: Space technologies can play important roles in the reduction of disasters. The use of such technologies can be particularly useful in the risk assessment, mitigation and preparedness phases of disaster management. There are now in the orbit many developed types of satellites, which can play big pole in these matters. Our study pointed out that, the main Satellites which used for monitoring and mitigation of disasters are: - Communications Satellites - Earth Observation Satellites - Navigations Satellites -Meteorological &weather satellites. Integrated works of these satellites gives optimal results for management and mitigation of disasters effects (Rukieh, 2016),through the unique data ,which, received from these Satellites ,like varies space images with resolution less one meter , till 31 cm, navigation data with one meter or less accuracy, communications data in real time . Our studies show that these data can be used very effectively, for:

1 – Quickly assessing severity and impact of damage due to flooding, earthquakes, oil spills, forests fires and other disasters;

2 -Rapidly identifying hardest-hit disaster areas in order to provide early warning of potential disasters;

3 -Pre-disaster assessments to facilitate planning for timely evacuation and recovery operations during a crisis;

4- Planning for coastal and low land areas during hurricane season.

5-Monitoring reconstruction or rehabilitation after a major disaster;

6 -Developing, maintaining or updating accurate base maps

7-Long term monitoring for Desertification and pollution,

8- Early warning for Tsunami, Locating places for shelter for victims or refugee.

In conclusion the resent space Technologies play a "prominent" role to monitorو assessment, mitigate, recovery and prevent Disasters

1-INTRODUCTION

Over the past decades, the frequency of natural disasters has grown significantly worldwide. In fact, many countries throughout the world are vulnerable to a wide variety of natural, technological, and willful hazards and disasters. These disastrous events often impact fundamental elements of a community physical infrastructure, health and social services that affect the health of its residents.

Response to such events before, when, and after they occur are matters of both hazards and disaster risk management practice at local, national and international levels.

The link between disasters and the use of space technologies for monitoring and management is now apparent to everyone. The space technology and disaster mitigation communities work together in developing effective and accurate methods for prevention, preparedness and relief measures. Disaster prevention is a long-term phenomenon, which can best be studied with the help of satellite monitoring of various relevant factors (Rukieh 2016).

Disaster preparedness focuses on warnings and forecasts of impending disasters and often entails processes, which are quite dynamic and result in "rapid onset" disasters. Disaster relief occurs after (and sometimes during) the emergency. An important aspect in terms of satellite monitoring involves assessment of the damage incurred during the disaster. Satellite technology can also help in identifying escape routes and locations for storage of temporary housing.

According to the Index of Objects Launched into Outer Space maintained by the United Nations Office for Outer Space Affairs (UNOOSA) till, Aug 22, 2018 there are 4 857 satellites currently orbiting the planet; an increase of 4.79% compared to 2017 year. So far in 2018, UNOOSA has recorded 204 objects launched into space. According to UNOOSA, in history 8 735 objects have been launched into space, and over 22% of these are within the last eight years alone. Both technology developments and improved interest in space, particularly from start-up companies, are behind the recent drive. The

Union of Concerned Scientists (UCS) keeps a record of the operational satellites and their latest update records details to the end of March 2019. Using this database together with the UNOOSA Index shows that there are currently 2062 active satellites in orbit. Whilst this is 13.92% increase over the number of active satellites in 2017, and more in 2018, it still represents only 40% of the satellites orbiting the planet. This means that there are 2 795 pieces of useless metal hurtling around the Earth at high speed! Interestingly this is meaning a number of inactive satellites either deorbited or came back to Earth or burnt up in the atmosphere.

2- HAZARDS CLASSIFICATION

Hazards by their origins broadly divided in to tow main types, Natural and Technological or Industrial Hazards. The dynamics involved measures the two as either slow or rapid onset. Hazards can originate from a single source or a combination, and can gradually emerge in a sequential pattern of slow and fast phase.

Natural hazards can be classified according to their **geological**, such, as Earthquakes, Tsunami , Volcanic activity and emissions Mass movements, landslides, rockslides ,liquefaction, sub-marine slides, surface collapse, geological fault activity. **hydro meteorological**, Such as (Floods, debris and mudflows, Tropical cyclones, storm surges ,wind, rain and other severe storms, blizzards, lightning Drought ,desertification, wild land, fires, temperature extremes, sand or dust storms, Permafrost, snow avalanches, **or biological origins**, those conveyed by biological vectors, including exposure to pathogenic micro-organisms, toxins and bioactive substances.(Rukieh M. 2016)

The Technological Hazards is, Danger associated with technological or industrial accidents, infrastructure failures or certain human activities, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Sometimes referred to as anthropogenic hazards which, include industrial pollution, nuclear release and radioactivity, toxic waste, dam failure, transport, industrial or technological accidents (explosions, fires, and spills).

3-RESULTS AND DISCUSSION

3-1- Space Technology and risk management

Our searches 2009 -2016 show that, since the first Earth Resource satellite, LANDSAT-1, was launched in 1972, we have come a long way in terms of improved sensors with better spatial, spectral and temporal resolutions. Different satellites and sensors can provide unique information about properties of the surface or shallow layers of the Earth. Although none of the existing satellites and their sensors has been designed solely for the purpose of observing natural hazards, the variety of spectral bands in VIS (visible), NIR (near infrared), IR (infrared), SWIR (short wave infrared), TIR (thermal infrared) and SAR (Synthetic Aperture Radar) provide adequate spectral coverage and allow computer enhancement of the data for this purpose. Repetitive or multi-temporal coverage is justified on the basis of the need to study various dynamic phenomena whose changes and hydrologic and geologic characteristics of the region (Rukieh M.2009, 2011, 2016).

In disaster management, the aim of these Technology and the experts has been to monitor the situation, simulate the complicated natural phenomenon as accurately as possible so as to come up with better prediction models, suggest appropriate contingency plans and prepare spatial databases.

From the inherent characteristics, namely, spatial continuity, uniform accuracy and precision, multi-temporal coverage and complete coverage regardless of site location. The remotely sensed data can be used very effectively, (Nirupama, Slobodan P. Simonov 2002, and Rukieh 2016) for:

-Quickly assessing severity and impact of damage due to flooding, earthquakes, oil spills, forests fires and other disasters;

- Planning for coastal and low land areas during hurricanes season

-Charting quickest routes for ambulances to reach victims;

-Calculating population density in disaster-prone areas;

-Rapidly identifying hardest-hit disaster areas in order to provide early warning of potential disasters;

-Pre-disaster assessments to facilitate planning for timely evacuation and recovery operations during a crisis;

-Long term monitoring for Desertification and pollution,

-Early warning for Tsunami, Locating places for shelter for victims or refugee.

-Monitoring reconstruction or rehabilitation after a major disaster;

-Developing, maintaining or updating accurate base maps

3-2- Monitoring Satellites for Disasters

Satellites which used for monitoring and mitigation of disasters are:

- **Communications Satellites**
- **Earth Observation Satellites**
- **Navigations Satellites**
- **Meteorological &weather satellites**

Integrated works of these satellites gives optimal results for management and mitigation of disasters effects. (Rukieh M. 2009, 2011, 2016)

The use of synoptic earth observation methods has proven to be especially suitable in the field of disaster management. In a number of countries, where warning systems and building codes are more advanced, remote sensing of the earth has been found successful to predict the occurrence of disastrous phenomena and to warn people on time

3-2-1-Communications satellites, Application of communication technology has a role in all the four distinct phases of disaster management namely, mitigation, preparedness, response and recovery,.(Rukieh 2009)

Deploying wireless communications is typically among the first priorities in any emergency response, rescue, or relief situation. However, terrestrial wireless equipment (cellular phones or land mobile radios), is only useful when communications towers and other fixed equipment are in place to connect wireless equipment to the local and global communications backbone. In the majority of emergency situations, this infrastructure has either been destroyed by the disaster (e.g. New Orleans after Hurricane Katrina) or was not available before the disaster (e.g. the earthquake in Pakistan). This reality makes it critical for local government and emergency workers to have access to a wireless communications network that is not dependant on terrestrial infrastructure.

Satellite communications provide such a solution. Satellites are the only wireless communications infrastructure that is not susceptible to damage from disasters, because the main repeaters sending and receiving signals (the satellite) are located outside of the Earth’s atmosphere. Users today have two kinds of satellite communications networks available to support emergency response activities: geostationary satellite systems (**GEO**) and low Earth orbit satellites (**LEO**).(Rukieh 2009, 2016)

Geostationary (**GEO**) satellites are located 36,000 km above the Earth in a fixed position and provide service to a country or a region covering up to one third of the globe. They are capable of providing a full range of communications services, including voice, video and broadband data. There are currently more than 300 commercial GEO satellites in orbit operated by global, regional and national satellite carriers. Even before disasters strike, these networks are used in many countries to provide seismic and flood sensing data to government agencies to enable early warning of an impending situation. Also, they broadcast disaster-warning notices and facilitate general communication and information flow between government agencies, relief organizations and the public.

LEO satellites operate in orbits between 780 km and 1,500 km (depending on the system) and provide voice and low speed data communications. There are now many communications systems for disasters, from LEO Satellites, like: INMARSAT, IRIDIUM, GLOBALSTAR, ITU, EMERCOM, EUMETCast, and THURAYA

3-2-2-Earth Observation Satellites, The Earth observation using satellite remote sensing technique has made it possible to obtain uniform data covering the whole globe in a relatively short time, and has also made it possible for these observations to be continued for a long time in the future (fig1)**.** It has many types of Satellites used for Earth observation, , its polar-orbits which various at(250-300km),till(1000-1300km) (fig.1,2), and have Different sensors such as multispectral scanners(visible, near infrared Spectral bands), thermal scanners, microwave sensors, TV, and laser scanners, with deferent resolutions at tens meters until (31 cm). This can provide unique information about properties of the surface or under surface of the Earth, and disasters events. (Rukieh M. **2010)**

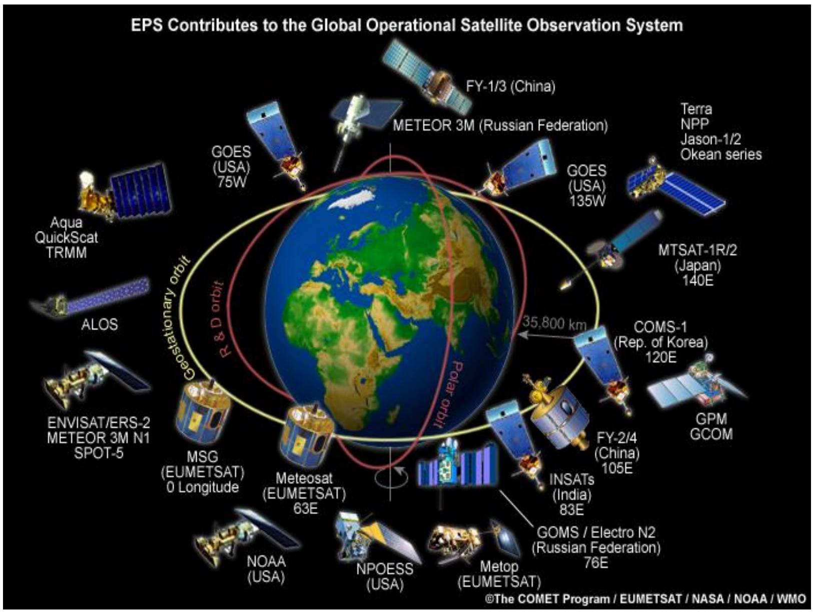

Fig. 1, Orbit of various types of satellites (NASA)

Fig.2, Earth Observation Satellites

In Remote Sensing Satellites used two types of Sensors: passive sensors and Active Sensors. Passive sensors measure the amount of EMR emitted from the sun that is reflected at the earth's surface and received at the sensor, whereas active sensors emit a pulse and measure the intensity and the time it takes to be received back at the sensor. Sensors are designed to be sensitive to a particular range of EMR frequencies. For instance, optical sensors are sensitive mainly to the EMR in the range of 0.4 μm to 2.5 μm. Other types of sensors used in remote sensing include Radar (Radio Detecting and Ranging), thermal, hyper spectral and LIDAR (Light Detection and Ranging). RADAR and LIDAR sensors are active sensors. Thermal sensors are passive sensors that measure the EMR in the thermal region.
Hyper spectral sensors, also called imaging spectrometers, are sensors that measure the EMR in the infrared, visible and ultraviolet regions. Using continues very narrow bands (1- 10 nm) this characteristic becomes useful in distinguishing between various materials on the earth's surface, which often have very narrow absorption windows.
a new generation of satellite borne hyper spectral sensors are available (e.g. Hyperion on ALOS operated by NASA). Approximately 50 studies have applied remotely sensed data acquired through these sensors to earthquake damage assessment.
Many countries have Earth observation satellites. I mention to some of it: (Rukieh M. 2009, 2010, 2013, 2016, N2YO.com. 2019 Radar sat 2019, space skyrocket 2019,)

USA have many types of these Satellites such as: Series-LANDSAT(1-8)with resolution (15-30 ,80 m), TERRA 1999, AQUA ,2002 , AURA 2004, CALIPSO 2006, CLOUD SAT 2006 , OCO-1,2009, CLORY,2011, ACUARIVS, 2011, ATTREX 2011,.JASON-3, measure the height of the ocean surface. Launched on January 2016,CARVE 2012,HS3 2012 , IKONOS-2,1999, which gave images ,with resolution -82-cm , QUICK BIRD,2001, with resolution 61-cm ,WORLDVIEW-1 ,in 2007, with resolution,50-cm , **WorldView-2** provides panchromatic imagery of .,46 m resolution,. It was launched October, 2009. **World view- 3**was launched on August, 2014. Its provides 31cm panchromatic resolution, 1.24 m multispectral resolution. **GeoEye -1**, which launched in 2008, provides 41cm, panchromatic .**GeoEye-2** Gave34cm Resolution imagery, Operational in 2013, **ICESAT-2,** 2018

RUSSIA: Series of cosmos satellites with resolution at 45m ,till -1-m. MIR RUSSIAN SPACE STATION (1986-2001), Series Resource 1-4 , PARTICLE DETECTOR, its interested for Earthquakes, ,RESOURS DK 2006 with 1m resolution .CANOPUS-V,2012 with 1-2 m resolution. RESOURS-P1, 2013, RESOURS-P2, 2014.RESOURSP3, 2016 with 1m resolution panchromatic, COSMOS 2517(GEO-IK), 2016

CHEINA: It has series FY.For Environmental and disasters, the last one FY-3D launched in the end of 2017, and YAOGAN series for Earth resources. The lasts YAOGAN 32 launched on October 2018.FORMSAT-5, 2017, **Gaofen-6**, for disaster monitoring, June 2018, ZHANGHENG-1 carries six instruments to measure the electromagnetic effects of earthquakes above 6 magnitude in China and quakes above magnitude seven all over the world.2018

FRANCE: Series SPOT Satellites (1-7) from 1986 till 2012, SPOT-5 give images with, Resoluion-2.5m. Spot 6 and 7 gives Images, with 1, 5 m resolution for panchromatic .Pleiades1A 2011, and Pleiades 1B, 2012, provide, multi. Pan. Stereo images with Resolution, 0, 7 – 2,8m, **Pleiades-Neo**, (**VHR-2020**), with 30 cm Resolution

INDIA: Has many Satellites in orbit like as., IRS P1-P7,(1993-2007) CARTOSAT2B 2010, OCEANSAT -2009, CLIMATSAT, and RESOURCE SAT 2,3(2011.2013) RISAT1,2 (2009, 2012).SARAL 2013. CARTO SAT- 3, 2013, RESOURCESAT-2A, 2016, CARTO SAT- 2E, June 2017. HysIS, 2018, Cartosat-2 Series Satellite, 2018, RISAT-2B, 2019, Resolution of space images from these satellites variation between 72 m and less 40 cm.

JAPAN: many satellites, the resent is ALOS-1, 2006, ALOS-2 2014 with 1-3 m. resol. Prepared Topographic Maps scale 1/ 25000.Used for monitoring disasters.Gosat-2009, On December, 2017, the "GCOM-C1" was lunched, GOSAT-2, 2018 they observe levels of carbon dioxide, methane, ozone, water vapor, carbon monoxide and nitrogen dioxide levels in the atmosphere. ASNARO-2, 2018, radar imagery 1 m resolution.

EUROPEAN SPACE AGENCY (ESA),it has ERS-1, 2, and ENVISAT, 2002. GRYO SAT-2, launched in 2010. It measured changes sickness of ice with resolution 1, 3 cm**. Sentinel missions:** ESA is currently developing seven missions under the Sentinel programme. The first **Sentinel -1A** satellite was launched on April 2014, the second **Sentinel-1B** satellite was launched on April 2016.Its provide Disaster Monitoring for Emergency services, and all-weather, day and night radar imaging for land and ocean services. **Sentinel -2** .was launched on 2 June 2015, **Sentinel -3A** satellite was launched on 16 January 2016 it provide ocean and global land monitoring services. **Sentinel** 5P, 2017. **Sentinel** 3P, April, 2018, European Data Relay System (EDRS), 2019

CANADA:, RADARSAT-2, with resolution (1m, 3, m15and 100 m.) RADARSAT Constellation Mission (RCM) was launched in 2019,

GERMANY: It has many resent satellites ,as, TERRA-SAR-x (with resolution 1 ,3 , 15 , m) 2007, ,RAPIDEYE 2008 , (5m) GASE 2009, En Map , Hyper spectral (420 – 2450nm) with 30 m resolution, 2010. Tan-Dem –X, 2010, its Radar Satellite to provide 3-D digital models of the Earth.

Our studies (Rukieh 2009, 2010, 2016) for Earth observation satellites pointed out to the following;

1-Ingreasing the Countries which launched satellites to 11 countries, Soviet Union , Russia ,1957, , United States , 1958 , France, 1965 , Japan, 1970 , China ,1970 , United kingdom, 1971,India 1980, Israel, 1988 , Ukraine ,1995, North Korea 1998 ,Iran, 2009, and ESA.

2- Increase numbers of countries which have own satellites in to 57 countries, till May 2018. The last one it was Bangladesh

2- Increasing number of satellites to hundreds, its kinds, and its capacity.

3- Varied weights of these Satellites from several tons to tens of kilograms, till less than one kilogram.

5- It has many types of scanning devices and has developed its capabilities in terms of both spectral range and a multiplicity of channels and there for the accuracy of spectral resolution, spatial resolution, which reached 31 cm in spectral images, and one meter in the radar images.

6- Massive Development in the field of manufacturing space shuttles, especially in USA, or space stations as, Mir Soviet station, or ISS currently circulating around the Earth, as well as the rapid development of software on the interpretation of Space Images and other systems.

3-Develop form integrated systems between countries for sustainable following, and exchange information about disasters, and building early warning systems.

3-2-3-Weather Satellites, A **weather satellite**s is a type of satellites that is primarily used to monitor the weather and climate of the Earth .Satellites can be either polar orbiting, seeing the same swath of the Earth every 12, 6, 1, 1/2, hours, and 15 minutes, Like TEROUS 1-10, NOAA 1-20, METOUR series 1-3, FY(Feng Yun)1-3series. MetOp-A, B., CALIPSO, CloudSAT, Suomi, POES, SciSAT, Megha-Tropique, SeaStar, QuickSCAT, IceSAT. Ice Sat has made over 904 million measurements of the Earth's surface. In fact, it was the first space-borne laser altimeter (GLAS) to capture everything from forest heights to ice thickness. Or geostationary hovering over the same spot on Earth by orbiting over the equator while moving at the speed of the Earth's rotation, Like; METEOSAT 1-11, GOES 1-15, FY 2, 4 series. INSAT, GMS. Himawari 6-9. These meteorological Satellites see more than clouds and cloud systems, City lights, fires, effects of pollution, auroras, sand and dust storms, snow cover, ice mapping, boundaries of ocean currents, energy flows, El-Nino and its effects, storms and hurricanes, tropical cyclones, oil spill, detected changes in the Earth's vegetation, sea state, ocean color, mapped the Antarctic ozone hole. Etc. Weather satellite images helped also in monitoring Desertification, in synoptic coverage the volcanic ash and volcanic activity and Smoke from fires. NDVI, NDSI. Palmer drought index, Standardized Precipitation Index (SPI), soil moisture model index and remote sensing drought index. Weather satellites have been our eyes in the sky for over 50 years, ever since the April, 1960 launch of Tiros I. Today, satellite images showing the advance of weather fronts are regular elements of the evening news. Observation is typically made via different 'channels' of the Electromagnetic spectrum, in particular, the Visible and near infrared (0.4 μm - 1.6 μm) far infrared and Thermal (2, 5 μm - 6 μm, 8-14 μm) portions.(Rukieh2007, 2009, 2011)

3-2-4- Global Navigation Satellite System (**GNSS**) is the standard generic term for satellite navigation systems that provide autonomous geo-spatial positioning with global coverage. GNSS allows small electronic receivers to determine their location (longitude, latitude, and altitude) to within a one meter using time signals transmitted along a line of- sight by radio from satellites. Receivers on the ground with a fixed position can also be used to calculate the precise time as a reference for scientific experiments.

It has now many systems from these satellites; the main is in USA (GPS), Russia (GLONASS), Europe and ESA (GALILO), China, (COMPASS). (Rukieh 2009).India (IRNSS**)** Japan (QZSS**)** developed new their systems.(Rukieh 2016)

The GPS system consists of 24 satellites with 7 Satellites in reserve. There are six orbital planes (with nominally four SVs in each),in high/ 20200km / GLONASS had achieved 100% coverage of Russia's territory and in October 2011, the full orbital constellation of 24 satellites was restored, enabling full global coverage. Accuracy for latitude and longitude were 4.46–7.38 meters. The accuracy will reach to 0.6 m or better by 2020. The satellites are located in middle circular orbit at 19,100 kilometers altitude.(Official GLONASS web page, 2016)

CHINA has indicated they intend to expand their regional navigation system, called Beidou, into a global navigation system; has been called Compass in China's official news agency The Compass system is proposed to utilize 30 medium Earth orbit satellites and five geostationary satellites. the global navigation system should be finished by 2020, and the free civilian service has 10-meter accuracy. (.beidou.2016)

The Indian system consists of a constellation of seven satellites and a support ground segment. Three of the satellites in the constellation are located in geostationary orbit (GEO) .The other four are inclined geosynchronous orbit (GSO).

The Quasi-Zenith Satellite System (QZSS),is consists of three satellites placed in periodic Highly Elliptical Orbit (HEO) and a fourth in a geo-stationary orbit. For the satellites in HEO the perigee altitude is about 32000 km and apogee altitude about 40000 km, and all of them will pass over the same ground track. (JAXA 2015)

4-Early warning systems

The Early Warning component is aimed at producing risk maps that indicate areas that are susceptible to disasters as well as installing real-time alert system for high risk area. The Detection and Monitoring component is being carried out via earth observation and meteorological satellites and airborne remote sensing system, and ground surveillance to provide near real time information on the exact locations and extent of the disaster to the disaster coordinating authority.

4-1 Early warning systems for tsunami

A **tsunami warning system** (**TWS**) is a system to detect Tsunami and issue warnings to prevent loss of life and property. It consists of two equally important components: a network of sensors to detect tsunamis and a communications infrastructure to issue timely alarms to permit evacuation of coastal areas.
There are two distinct types of tsunami warning systems: international and regional. Both depend on the fact that, while tsunamis travel at between 500 and 1,000 km/h (around 0.14 and 0.28 km/s) in open water, earthquakes can be detected almost at once as seismic waves travel with a typical speed .This gives time for a possible tsunami forecast to be made and warnings to be issued to threatened areas, if warranted. The Fig. 3, Show type of early warning system for Tsunami, with help of space technology

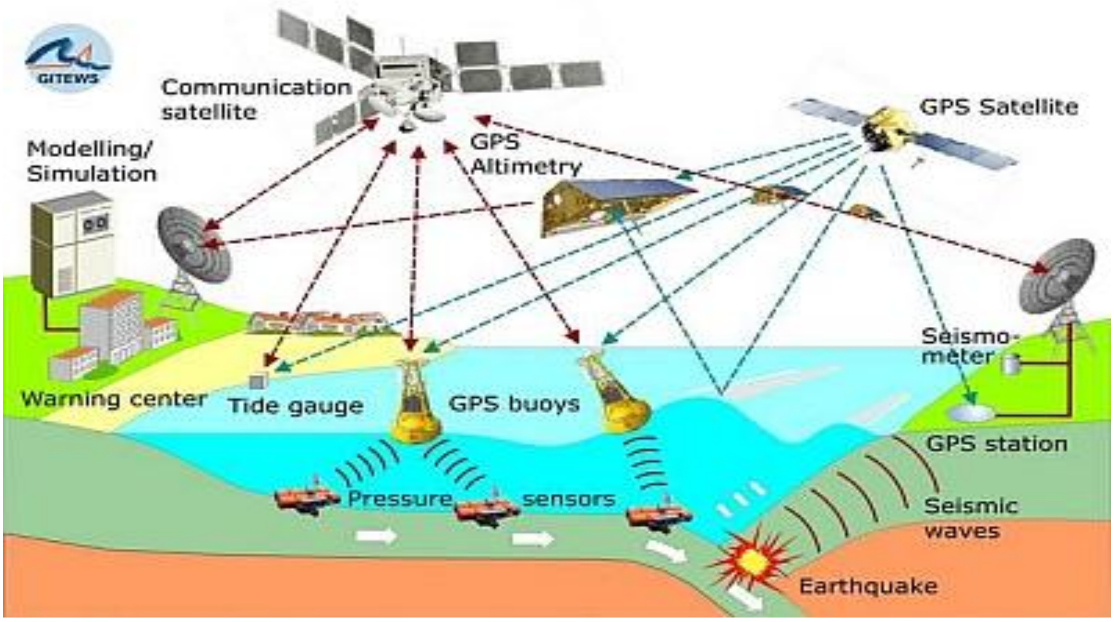

Fig. 3, show type of early warning system for Tsunami

4-2- Early Warning Systems for Forest Fires

Space borne remote sensing technologies have improved the capability to identify fire activities at local, regional and global scales by using visible and infrared sensors on existing platforms for detecting temperature anomalies, active fires, and smoke plumes. Geosynchronous satellites such as GOES and polar orbiting sensors such as the NOAA AVHRR have been used successfully to establish calendars of vegetation state (fire hazard) and fire activities. Other satellites with longer temporal sampling intervals, but with higher resolution, Such as Landsat, Ikonos, Quick bird, Geo-eye and SPOT, Indian, Russian Chinese satellites and space borne radar sensors, deliver accurate maps of active fires, vegetation state and areas affected by fire. Providing an effective response to wild land fires requires four stages of analysis and assessment (P.S.Roy 2004)
1- Determining fire potential risk
2- Detecting fire starts
3- Monitoring active fires
4- Conducting post-fire degradation assessment

The technological advancement in space remote sensing has been widely experimented in last three decades to obtain the desired information. For that, require an early warning system to identify critical periods of extreme fire danger in advance of their potential occurrence. Normally, these systems provide a 4- to 6-hour early warning of the highest fire danger for any particular day that the weather data is supplied. However, by using forecasted weather data, as much as 2 weeks of early warning can be provided. There are now so many Early warning Systems for forest fires; in many Countries, and some of these countries cooperate with each other to launch successive satellites to monitor permanently the disasters on the earth and determine its effects, including forest fires.

4- Conclusion

There are now in the orbit thousands developed types of satellites, which can play a "prominent" role to monitor, assessment, mitigate, recovery and prevent Disasters and build early warning systems. Our study show that, the main Satellites which used for that are: - Communications Satellites - Earth Observation Satellites - Navigations Satellites -Meteorological &weather satellites. Integrated works of these satellites gives optimal results, for management and mitigation of disasters effects, through the unique data ,which, received from these Satellites, like continues varies space images with resolution less one meter , navigation data with one meter or less accuracy, communications data in real time.

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