Application of Remote Sensing Technology in Different Natural Disasters

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Abstract. Flood, typhoon and heat wave are common natural disasters in the world. Satellite remote sensing technology has become an effective method for geological hazard assessment due to its wide coverage, large imaging area and high time resolution. Based on introducing the research progress of flood disaster remote sensing monitoring, this paper compares and summarizes the research progress of principle and method of multi-source remote sensing flood monitoring, and analyses the advantages and disadvantages of various data. We also analyze the comprehensive application of remote sensing technology in typhoon monitoring from the perspectives of conventional observation data, satellite remote sensing data and unmanned aerial vehicle remote sensing data. In this paper, remote sensing technology is also used to monitor urban heat island and other climatic problems through machine learning, starting from solving heat wave problems in the climatic field by remote sensing. At the same time, the existing problems of various data resources in the analysis of various disasters are summarized, and the remote sensing technology which needs to make comprehensive use of multi-source data, the construction of climate monitoring system and other aspects are summarized to study the remote sensing information system in the field of natural climate disasters. The development trend of this technology is also summarized and prospected.

Keywords: remote sensing, flood, typhoon, heat, disaster.

1. Introduction

The rapid increase of the harmful natural hazard is related to the enhanced anthropogenic force of greenhouse and surface modification, inducing challenges shared by emergence departments across the world. The most prominent hazard includes the heat waves, tropical cyclone, or typhoon and hurricane depending on the locations, and the increase in the potential of river flooding led by the increase of the farmland causing deforestation, the agricultural silt sedimentation to decrease the bank full discharge and the unknown and unevaluable impact of the southern oscillation, or El Nino occurrence to produce prolonged rainfall[1]. The need for effective and manageable way of the monitoring of the background is currently the focus. The crucial cycle of the water and the atmosphere in relation to the temperature and precipitation is constantly influencing the human life and its development. The monitoring of the long-term changes in the ice cover and the source of water in the mountainous regions is an example of economic aspect of climate issue[2].

Every year the data report of the loss from climate impact sees an increase in the severity. For example, in the California heat wave in 2006, as much as 16166 emergency department visits were implemented, and the hospitalization reached new heigh of 1182, Zhang et al[3]. Global Health Research and Policy (2017). Besides the mortality and casualties, the loss in terms of economic production is also significant. For example, in China for the last half century, the total natural disaster loss is about 4.5billion Chinese yuan, while the flood-induced impact in the country alone would lead to as much as 52.3% of the total loss in the economy, Zhang et al. The remote sensing as a convenient and accurate measuring tool to provide long-term check and short-term supervision of the specific breaking emergency[4].

The advantage of the remote sensing is that the monitoring range is broad, so continuous data is available for a large region analysis. Tradition method heavily relies on human expedition and the local trip to take samples of the soil, river silt and record of the humidity and short-term temperature. These actions have two main draw backs[5]. Firstly, the time given for the reaction of the emergency service is short, so the human force is hard to arrive in time to catch the first-hand observation of

flooding or typhoon for example. The second reason is that, for chronic monitoring of the environmental trend such as temperature and rainfall, the continuous data is impractical to be obtained by the human-led observation.

This essay will be focusing on the detailed approach of using remote sensing to deal with the three representative hazards led by the creased human enhanced climate change. The first is one is the tropical cyclone, typhoon in the East Asia. The second hazard will be flood, putting threaten to local industrial and agricultural activity. The third hazard is the heat, powered by the increase in certain extreme temperature. Use remote sensing technology to monitor relevant climate data according to different needs, so as to make corresponding adjustment and prediction for the prevention and control of natural disasters in cities and human settlements.

2. Monitoring and forecasting of flood disaster

Flood disaster is one of the most frequent and most serious natural disasters in China. The development of remote sensing technology, with its macroscopic, fast and accurate characteristics, provides a new means for large-scale, objective and real-time monitoring and forecasting of flood disasters, and provides strong technical support for flood control monitoring and evaluation. Fig. 1 is the satellite image of Netherlands flood control project. At present, remote sensing technology has the following methods for flood research and analysis[6].



Fig 1. Satellite image of Netherlands flood control project

2.1.Monitoring Research Based on Medium Resolution Sequence Data

Medium resolution series images mainly include TM and ETM+, spot and CBERS images. TM, spot and CBERS images have multi-band, multi-temporal features and medium resolution (TM is 30m, spot is 20m, CBERS is 19.5m). They can effectively obtain surface characteristics and flood information. They are effective data for flood simulation monitoring and extracting water body, and are effective data for flood simulation monitoring and extracting water body. However, they have low time resolution and are difficult to obtain large-scale synchronous monitoring data. In 2006, Yang Zhonghua and others successfully monitored the ice flood of the Yellow River in 2003 and 2004 by using the earth resource satellite data of China and Brazil[7]. They believe that the data is an ideal data source and lays a foundation for remote sensing monitoring of the flood of the Yellow River. At the same time, it also has good reference value for monitoring natural disasters such as pollution of the Yellow River and landslide.

2.2.Monitoring Research Based on Low Resolution and High Phase Data

Low resolution and high time-phase data are widely used in flood monitoring. Low resolution and high temporal data refer mainly to NOAA-AVHRR and MODIS image data. Zhou Chenghu and Du Yunyan firstly put forward a water body description model for water body automatic recognition by analyzing the characteristics of water body in NOAA/AVHRR images and their differences with other environmental factors[8]. Zhang Shuyu and others analyzed and studied the spectral characteristics

of vegetation, water body, soil and other different terrain using MODIS data, put forward the processing process of remote sensing data for flood disaster monitoring, quantitative identification index and estimation method of inundation area, and applied it in the dynamic monitoring of flood disasters in the Weihe River basin in 2003, made dynamic change image and special map of water regime, estimated inundation area with good effect[9].

2.3.Research on Data Monitoring Based on Microwave Image

Microwave image is a remote sensing image, which is obtained by side-view imaging radar. It is different from the polar coordinate expression radar image which was scanned in azimuth and centered on radar in the early time. Mainly including SAR image, microwave image has the characteristics of fast imaging speed, large coverage area and clear and identifiable ground targets, so it can achieve good results in flood monitoring. The Microwave Imager based on Tropical Rainfall Measuring Satellite monitors the flood disasters in the Jianghuai River Basin in summer 1998 by means of dynamic clustering, soil moisture index, polarized brightness temperature difference index and polarized brightness temperature ratio index[10]. The method is effective and accurate compared with the airborne and spaceborne radar images and the methods based on surface daily rainfall data.

2.4.Based on high-precision DEM data

Digital Elevation Model (DEM) is a digital simulation of terrain (digital representation of terrain surface morphology) by means of limited terrain elevation data. It is an entity terrain model which represents terrain elevation in the form of a set of ordered numerical arrays and a branch of digital terrain model from which various other terrain characteristic values can be derived[11]. Fig. 2 takes a place in North China Plain as an example, the digital elevation model image of this area is displayed. DEM resolution is not only an important indicator of DEM's accuracy in characterizing terrain, but also a major influencing factor in determining its application range. DEM resolution refers to the length of the smallest cell in the DEM. For high-precision DEM data, a flood disaster monitoring model based on DEM is established based on rainfall data and high-precision DEM data of medium-scale automatic weather station[12].

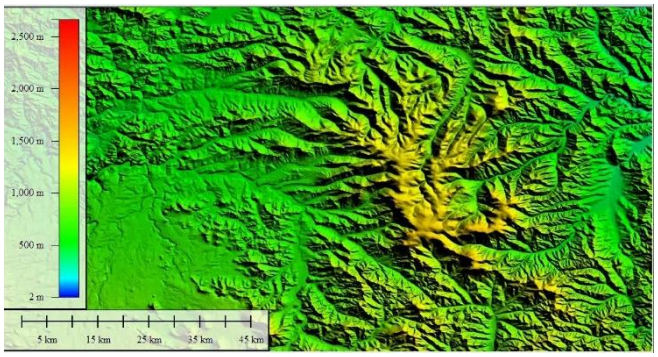


Fig 2. An example of diagram of Digital Elevation Model

2.5.Seed Point Diffusion Algorithm

Seed point diffusion algorithm is one of the main methods for flood routing simulation. Among them, the parameters of flood routing model change due to different geographical environments and have certain uncertainty, which leads to low reliability of flood simulation results[13]. With the launch of the high-resolution satellite 4, its high time resolution image will become the first-hand data for flood simulation and disaster assessment.

3. Acquisition of different information sources and application in flood

In flood disaster monitoring and disaster evaluation, flood inundation scope and flood water depth are important information. It includes extraction of flood water body and calculation of inundated

area. Satellite remote sensing data can be used to build a data model for various flood information and provide important help for disaster assessment and post-disaster relief[14].

3.1. Extraction of flood water body

The basic principle of water body extraction using remote sensing data is that water body is different from other ground objects such as vegetation and soil, and there are certain differences in spectral reflectance between visible and near infrared bands. The extraction methods mainly include threshold method and inter-spectrum relation method.

3.2. Calculation of Flood Submerged Area

There are also many methods for estimating flood water area by satellite remote sensing. In emergency, the number of flood pixels on satellite image is often multiplied by the area of a single pixel for simple estimation. This method assumes that the area of each pixel is equal and can be applied when the flood inundation range is small.

3.3. Calculation of Flood Submergence Depth

Remote sensing technology can monitor the flood inundation area quickly and efficiently, but the research on obtaining flood inundation depth from remote sensing data is still lacking. The application of GIS technology provides a new idea for estimating water depth. GIs is used to calculate water depth, usually based on DEM. Seed points are used for neighborhood search and comparison. Boundary and internal depression are judged according to certain conditions, and water body range and water depth of a certain watershed are obtained.

3.4. Research on Flood Disaster Impact Assessment

Flood disaster assessment is an important basis for comprehensively reflecting flood disaster, timely rescue and disaster relief, and determining decision-making for disaster reduction[15]. Because there are many factors affecting flood disasters and the basic data used for disaster loss research is too weak, no evaluation method has been widely used and promoted at present, but some evaluation models are still worth learning. Fig. 3 is space distribution images of Yongji County before and after flood period.

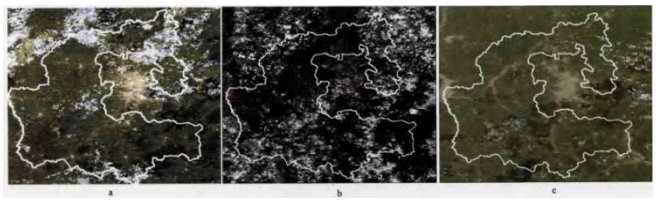


Fig 3. MODIS color images of Yongji County before(a) during(b) and after(c) flood disaster

The combination of remote sensing and GIS technology provides a platform for flood design. Using flood data, disaster levels can be assessed in the first place before a flood. By analogous analysis with disasters at the same level and combining with practice, disaster relief measures can be formulated quickly and accurately to assess losses. With the rapid development of remote sensing technology, various satellite resources are very rich, and flood remote sensing monitoring technology is relatively perfect[16]. With the gradual improvement of satellite resolution, flood disaster monitoring will gradually develop to high resolution, and the accuracy of monitoring and assessment will be further improved. Remote sensing flood monitoring can provide the most basic and necessary evaluation data for post-disaster assessment. Spatial distribution data such as land use type distribution, flood inundation depth, duration and scope are important components of remote sensing flood monitoring and evaluation. The development of GPS and GIS technology has provided accurate positioning data and abundant background information of underlying surface for flood disaster monitoring, and played an important role in flood disaster monitoring and evaluation. Therefore, full use of rich remote sensing data lays a foundation for quantification, dynamics and practicability of

remote sensing, provides intuitive change information for flood dynamic monitoring and takes flood monitoring to a new level[17].

4. Remote sensing technology and typhoon disaster monitoring

The influence of typhoon disasters has always been paid attention by relevant departments. It is a hot issue to study and master the laws of typhoon activities and effectively resist the disasters caused by typhoon. The analysis and Research on the causes of typhoon disasters are mainly carried out by means of numerical simulation and physical quantity methods. However, due to the scarcity of statistical and observation data, it is difficult to correctly reflect the distribution of various elements of typhoon by the objective analysis results made only by conventional observation data, which brings great difficulties to typhoon forecasting[18].

The observation of typhoon by satellite remote sensing technology includes the following aspects: typhoon monitoring based on conventional observation data, typhoon monitoring based on meteorological satellite remote sensing and typhoon monitoring based on microwave remote sensing. Satellite remote sensing can compensate for the shortage of on-site measurement and statistical data, and can play a good role in complex weather conditions such as cloud and fog. It has the feature of continuous observation, and has the ability of all-weather observation and is not affected by cloud and rain. Fig. 4 shows the track of typhoon Jolina by remote sensing satellite.

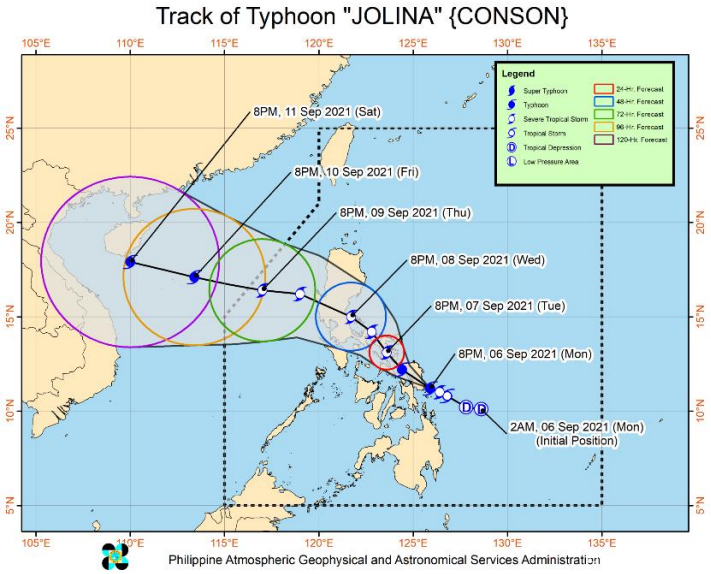


Fig 4. The track of Typhoon Jolina with the intensities marked in different colors (Data are provided by National Meteorological Center)

Synthetic Aperture Radar (SAR) remote sensing satellite is an active microwave radar remote sensing satellite. With the characteristics of all-weather, all-day, large-area and high-resolution detection, it is an important technology in marine monitoring by using microwave imaging technology. The sea surface wind field inversion algorithm using the same polarization remote sensing image under low and medium wind speeds has been basically mature. However, in the sea surface wind field inversion algorithm under high wind speeds, the normalized backscattering cross-section value of the same polarization remote sensing image is easy to reach saturation, while the backscattering cross-polarization remote sensing image is not easy to reach saturation. Typhoon wind field inversion algorithm based on cross-polarized remote sensing image is of great significance. In wave numerical simulation, the third generation wave numerical model (wave 3) has developed into one of the mature wave numerical models in the world. It has many input and dissipation source function terms. Considering the significant characteristics of wave interaction and wave-current interaction, it is of great significance to simulate typhoon using wave numerical model (wave 3) for accurate typhoon and typhoon wave prediction.

5. Feasibility of UAV Remote Sensing System in typhoon disaster

Unmanned aerial vehicle remote sensing system is widely used in natural disaster investigation and emergency response due to its fast response, convenient take-off and landing, low-altitude operation and high resolution.

After typhoon reached land, unmanned aerial vehicle remote sensing system is used to acquire remote sensing images of severely affected areas in time and verify the feasibility of unmanned aerial vehicle remote sensing system in storm disaster. However, the following problems are also found in work.

(1) Wind and rainwater accompanied by typhoon transit cause great inconvenience for UAV image data acquisition.

(2) The selection of research area should be beneficial to UAV flight operation and include many typical types of storm surge disaster-bearing bodies. Before typhoon landing, the location of landing point is always uncertain and the selection of research area is difficult.

(3) The results of disaster loss information extraction based on UAV remote sensing images are uncertain, and some disaster losses need to be confirmed on-site. Unmanned aerial vehicle (UAV) remote sensing images have limited coverage and can not be used for full coverage survey of affected areas. They can only be used as a supplementary means for storm surge disaster investigation.

As a supplementary means of satellite remote sensing and aerial remote sensing, UAV remote sensing system has the advantages of strong real-time, convenient take-off and landing, high resolution and low-altitude operation, and can operate in high-risk areas. It is widely used in natural disaster emergency rescue. UAV remote sensing system has certain practicability in storm surge disaster investigation and disaster loss assessment.

6. Heat events and remote sensing

One of the most serious resultant hazards due to the pattern of global climate change is the heat waves. The trends in the past century are that heat waves frequency, intensity and duration has been all increasing. The remote sensing, including different phases and different resolutions sensor, successfully monitor the surface albedo, surface rock texture, biological cover, water body and water depth, as much as the possible influence by surface natural physical feature and anthropogenic trait on the localized characteristics of urban settlement. Therefore, the problem of heat waves is a practical target for the application of remote sensing in the field of climate change. This section will mainly deal with the method required to monitor the heat event using remote sensing different from traditional stations.

6.1.The first property of remote sensing is the wide cover of data source.

The sensors of satellites from orbits have a much wider cover of the temperature data of the surface compared to traditional observational station. Remote sensing in the current field had been employed to measuring one of the critical indicators of the air temperature Ta —the temperature of the air. The temperature of the air is directly related to the heat waves in terms of its damage and severity, and consequently, the research and rectification that should be allocated to the monitoring and prevention action. The duration, intensity, magnitude and impact should be directly correlated with Ta, Wu Et al. Thus, the collection of Ta from targeted area is usually the first step of heat wave prediction. What Ta can determine is the recurring period of the heat event. For example, if the temperature of a city rises above 38 ℃ three times a month, we can deduce that the frequency is three per month, so we are able to rank the hazard potential. However, the previous challenge of getting the Ta precisely is that observation station only produces discrete point data of Ta. It focuses on a specific point of a small circle of areas in map[19].

The main focus of the research is now on expand the Ta source available, using the remote sensing. The role of remote sensing is this part is the deduction of air temperature from the land-surface temperature, LST, which can be abundant and easy to deduce from satellites sensors. With the current

level of radiation resolution and the machine processing of the computers, getting large map of LST is completely possible. The LST transformation to Ta has multiple models that have been practiced and proved by the research currently. It can give direct air temperature at a region without any blank point or empty data. The distribution of heat and the related hazard through analysis of these LST is the classic step for hazard evaluation. (Wu, Xiaohan; Xu, Yongming; Chen, Huijuan,2020). There have been a lot of studies which focus on the urban heat event by remote sensing, since the retrieval of LST data from remote sensing through some mathematical algorithm is direct and efficient. Some have been studying the heat waves change and response to the land use in Nanjing city in China based on the LST, (Liu et al). These past examples use the LST data to deduce the possible centre of heat wave and the danger intensity. The urban landcover has been proved to be related to the LST. The remote sensing technique works well in the spatial variation analysis and to determine the factor which induces heat wave. The vegetation cover relationship to the intensity of extreme heat waves event is also verified by Peng et al using similar approach. The remote sensing provides direct index such as normalized difference vegetation index, NDVI, as well, besides using the temperature data. NDVI is not temperature indicators but it can partially predict the approach of the heat wave by monitoring the activity of vegetation instead. The current progress in relating the LST to the air temperature and the biological diversity is also effective. For example, in the central region the belt of high heat intensity index, heat intensity index, HII is clear. The increase in heat events is thus connected to the population density and economic output. If the data is solely based on the observatory data alone, the data would be discrete and further algorithm is needed to interpolate the air temperature variation, like the figure using the point data below[20].

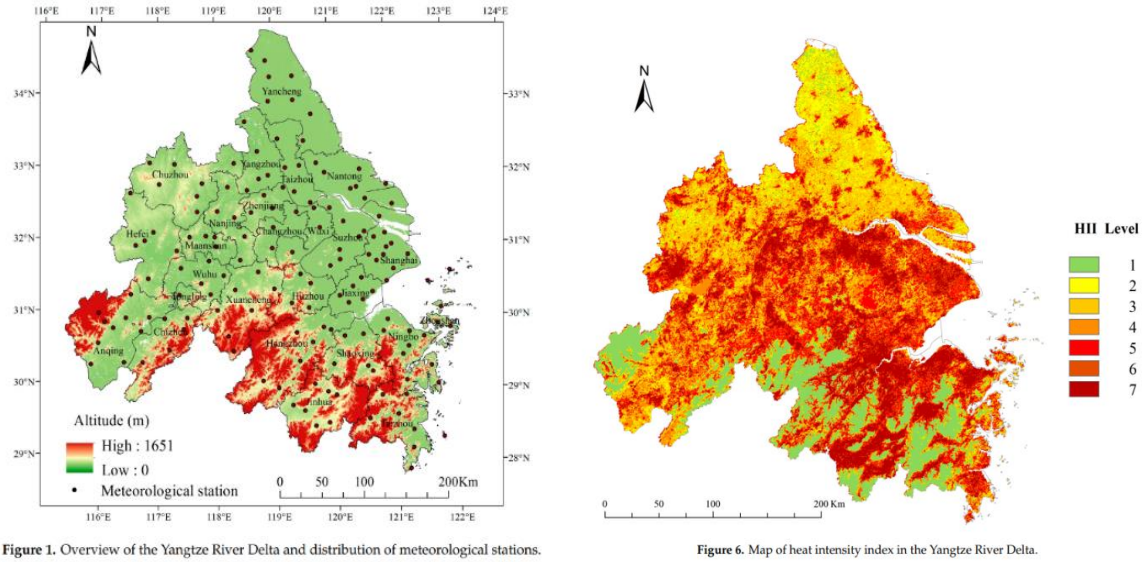


Figure 1. Overview of the Yangtze River Delta and distribution of meteorological stations.

Figure 6. Map of heat intensity index in the Yangtze River Delta.

Fig 5. Yangtze River delta distribution of the observatory and heat intensity index

Fig. 5 demonstrates the increase in the crucial continuity of the meteorological data map of heat intensity using the remote sensing radar from air comparing against the possible data available in the map of discrete observatory. The clear relationship is that discrete station provides less representative pattern as graph and extrapolation will be far less accurate than larger phase and time resolution of satellites. And urban development often develops in large cluster producing radiative heating effect, so graph of distance versus Extreme Temperature ET can be mapped.

6.2.The time resolution and long-term cover of the urban heat island effect.

The human-enhanced urban heat islands is also an important part of anthropogenic-induced climate changes in a regional scale. The remote sensing has been effective at record the variation of surface temperature. The human change of the urban temperature average annually can also be detected with the same approach. The urban heat island (UHI) can be classified into two types, the surface urban heat island SUHI and the urban heat island UHI in the air. The latter is particularly

difficult to investigate due to the lack of available monitoring air balloons or air ships. The SUHI is comparatively easy to record as the satellite source using remote sensing provides the temporally wide data and consistent and repeated observation on different scale, from single city to national cluster of different cities. The advantage of remote sensing in keeping a non-stop data variation helps the research of city urban island. These studied areas of UHI shows world-wide influence of human urban heat island in multiple nations. The use of remote sensing data has been improving the global scale attention of research in the domain of human force of the chronic environmental transformation, showing an excelling precision of remote sensing. This is another property of remote sensing monitoring. Researchers across the globe share the same data and can exchange research progress easily so the result can arise world-wide focus. Cities such as Beijing, Shanghai, Paris, Indianapolis, San Paulo have been the cases of example for different SUHI studies including the heat distribution response to the land use pattern and the health-related impacts of changes in recorded temperature. These parts are similar to the Nanjing study before, in order to investigate how much impact the city land type have on temperature. The remote sensing is introduced to employ its large dataset for different cities and populated regions. Researchers in Beijing can access data for San Paulo and the data retrieval is fast and convenient. Different data set from different satellites can deal with different aspects of heat islands, including the NDVI, and even the NDWI, normalized difference water index. The sensors are capable of receiving both the non-thermal band radiation from ultraviolet and visible band coming from the insolation, and also the thermal band radiation that is from cold body long wave radiation of Earth, giving other indexes to explore and other relationship to suggest. Nonetheless, all the sensors are exploited in one common application, the passive mode of radiation detection, so the algorithm is common and the research is transparent and appreciable. Zhou Et al emphasize the relationship between the urban average temperature and urbanization progress.

6.3.Remote sensing technology can be applied to urban planning

The underlying advantage of remote sensing to decoding the land composition or land use cover can analyze the influence of city planning. Taking some sensors for a detail function explanation. Landsat, for example is one popular choice of image source that is freely available and spatially extensive and temporally refined. The reasons of popularity are as following. Firstly, the time range for Landsat program is especially long in leading satellites available. Basically, all satellites providing fine resolution of images cannot provide as wide time operation as Landsat. Secondly, the Landsat archives have been open to access of public due to policy change in 2008, increasing the research intensity and horizontal cover of countries from different continents. Thirdly, the temporal resolution and the swath coverage are just suitable for the processing of urban heat island. The returning period is not that long and the swath can meet the investigation selection of different urban zone. This Landsat property increases the wide applicability of remote sensing in different climactic zone in different continents and countries (Zhou Et al). The regionalized analysis of Landsat is usually effective and shows a clear result. For example, in the research by Wei Chen Et al, the regional analysis around a road or certain urban construction uses Landsat[21]. Basically, the NDVI, the LST and the development number DN, representing the level of development in terms of light intensity in visible band range are three indexes in charge. Results is clear and the time range also reflects the availability of data for long term change detection and the fine spatial resolution of data in situ without changing the swath of the satellite orbit. The temperature distribution analysis is then allowed by comparing the three parameters using GIS model to perform further analysis depending on the rate of change and pattern of UHI[22]. Fig. 6 is a practical example what remote sensing has showed in urban temperature trend data regression. This model encompasses various wavelengths ranging from microwaves, synthetic aperture radar, SAR, which permeates the obstacles of the buildings and the clouds to derive land surface temperature LST, and also NDVI, with Landsat 8 satellites sensors of near infrared wavelengths to capture various water concentration in the impermeable back environment with barely extinct water rills or temporary water track with seasonal river channel[23]. The decrease in the vegetation is due to the human land planning to expand factories and facility such

as underground railways, apartment buildings and large park or shopping district. The increase in the heat production is due to increase in combustion of fossil fuel in factories, fossil fuel for urban electricity of civilians, gasoline for transportations and coal for civilian heating. The bricks and concrete also do a better job at keeping the sun's radiation. DN increases leads to the increase in total heat production, and the ability to retain heat, decreasing the average reflectivity. The first two parts can be measured quantitatively through DN, LST, the exterior factors of vegetation are at NDVI[24]. The quantity of total reflection comes from albedo, the percentage of reflection for a single wavelength of UV or infrared light, timing the pixels of surface area timing the total number of pixels using end corrections and coordination integration in case of undefined boundary[25]. There may be other specific factors such as the precipitations, also influenced by the surface permeability index, SPI, water body coverage percentage, and even the condensation nuclei in the air, which exerts subtle steering on evaporation and vegetation transpiration rate, addressed in other topics in specified terms[26].

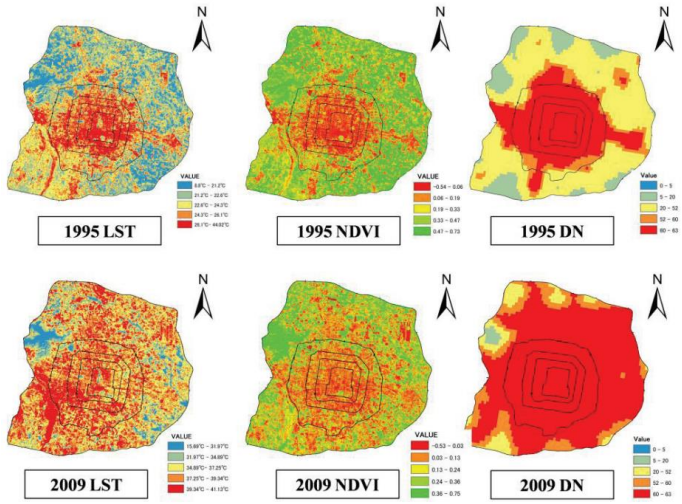


Fig. 11. Regional Analysis within 6th ring road in 1995and2009.

Fig 6. Region Analysis within 6th ring road in 1995 and 2009

7. Conclusion

This essay addresses the how and why the current issue led by the anthropogenic-induced climate change should be confronted by the remote sensing technology, with the example demonstration of three specification, the river flood, the typhoon, and the urban heat waves. The advantage of the remote sensing has been repeatedly demonstrated in its spatial cover, the temporal data range and the efficiency in the collection and the processing of the data, making the foundation for the in-time evaluation of the impact and the upcoming rectification or the redressal for the impacted regions.

The typhoon is tackled by the SAR, providing obstacles-free data for the typhoon track, the speed of the air currents and the precipitation and pressure level at the near ground level. UAV, unmanned aerial vehicle may be equipped for location field sampling, while the algorithm may provide future evolution of the intensity of the typhoon and its influence radius. The flood is attended by the multiple-phase and resolution sensors from the low resolutions to medium to high, such as TM, ETM, CBERS, MODIS and SAR. Tools such as DEM model will provide source data for inundation simulation, which constitutes the base-level casualties prediction and the economic loss supervision for the flooded areas. The local topography may be analyzed through machinery algorithm as well, which may indicate a higher level of prevention instead of remedial action. The extraction of the water bodies and the surface runoff density will directly impact the level of flood risk and thus the investment in engineering of flood.

The third hazard, the heat waves, is going to analyzed both in terms of its short-term influence and prediction, and long-term trends in the climate evolution of the region induced by artificial

modification. The first method is to build up correlation between the air temperature and the land surface temperature, making the indexes such as development number and the vegetation index, and water coverage ratio as input to be processed, pointing the changing level of hazard of extreme heat caused by urban activity. The second main method used is the systematic approach of the heat island caused by human in urban areas, urban heat island UHI. The system includes output and input, and also exterior factors. Input may be the incoming solar radiation from the sun, insolation, the level of surface reflectivity as albedo, the material's specific heat capacity, the conductivity of heat index and the industrial and economical heat production. Exterior factors are the level of permeability of surface, the water coverage and the hygroscopic nuclei as pollution particles, adding to evaporation in water cycle.

With the vigorous development of global aerospace technology, new sensors will continue to emerge. Carry out the research on the fusion technology between multi-source, multi temporal and multi-resolution remote sensing images, and combine meteorological satellite data, optical satellite data and microwave remote sensing data. At the same time, give play to their respective advantages and provide richer remote sensing monitoring information, which plays an important role in improving the dynamic monitoring level of natural disasters such as typhoons and floods.

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