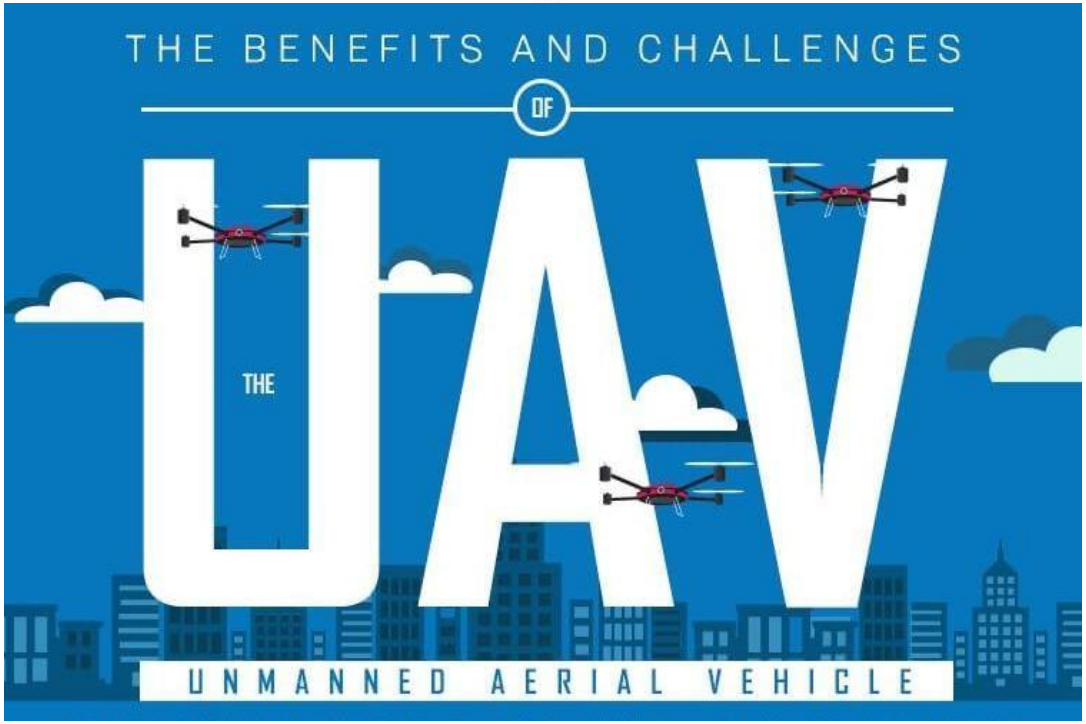
Drone mapping

Dr.C.Lakshumanan
Professor & Head
Department of Remote Sensing
Coordinator: Centre for Disaster Management and Coastal Research
Bharathidasan University
Tiruchirappalli - 620 023

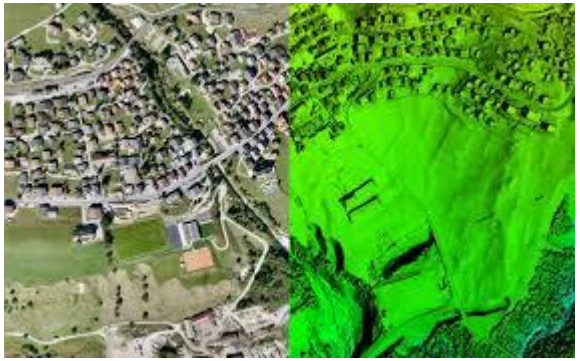
Mapping from Unmanned aerial vehicle (UAV)



unmanned aerial vehicles (UAVs)

- The advancement of **inertial sensors, microprocessors**, and GPS enables small unmanned aerial vehicles (UAVs) to fly autonomously. Many universities and research institutes are developing various types of UAVs.
- The use of small UAVs is one of the new methods of data collection that has received a lot of attention in recent years. Which have a number of advantages over aircraft.
- Small unmanned aerial vehicles could gather information by means of Capturing the images in digital that are inaccessible to the people or the ground vehicles; which is also capable of flying at low altitudes in an extreme manner and in turn gathers data that are high-resolution.
- Various other advantages are their portability, low weight and small size; include high mobility, safety, low operational cost and security.

UAV for urban mapping



Grown interest in UAVs

- Admitted to use of UAVs in 1973
  - *"...we let the drone do the high risk flying...the loss rate is high, but we are willing to risk more of them...they save lives!"* – Gen. John C. Meyer
- Grown interest in UAVs in 1980s and 1990s
- Initial Interest
  - Surveillance aircraft
  - Search and Rescue
- Future Interests
  - Unmanned Combat Air Vehicles (UCAS) mapping unapproachable areas…etc

Mapping Urban with smart technology

- Across the cities and towns of all sizes are looking to improve connections with residents and business owners.
- UAV, as a geospatial data provider the firm provides high-resolution digital mapping products such as
- orthophoto-aerial maps,
- topographic data and models to public sector clients in local and county governments, as well as private sector clients in the engineering, construction, utilities and land surveying industries.
- UAV Business Development companies says, "As a service provider in the drone market, we're seeing a whirlwind of interest from communities interested in using aerial data for a wide variety of applications from improving asset management to programming bus routes."

UAV for urban mapping

- The UAV imagery are used to map areas of local historical interest (such as the Settler's Cemetery, where towns people were buried between the 1880s and the 1950s), and to create 3D models for publicity.
- More urgently, drones are used to capture images of trip on the district's network of rural roads, and where streams have scoured their banks to threaten the streets, allowing transport issues to be resolved faster.

drone-based mapping technology

- The urban council is responsible for both the day-to-day management of services like trash and recycling, and bigger-picture planning such as emergency management, transportation systems, and water and wastewater.
- The Govt has a long history of seeking ways to improve connections to its public — largely because of its vast service area.
- The foundation of that effort has been wireless connectivity, which facilitates all forms of current and future IoT possibilities –LIM/LIS.
- Already, urban agencies use the wireless network/GPR to capture telemetry data about water supplies, sewer systems, roads, and bridges.

drone-based mapping technology

- More recently, the Govt has been working with agencies to test and deploy drone-based mapping technology for a variety of applications.
- Aerial data are captured with drones and used to update the district-wide GIS, capture infrared photos for carbon model analysis, track construction project progress and for large bridge inspections.

Geo Job projects

- Geo Job recently completed for the owner of a resort community in Florida.
- The 9 km² property is essentially a small city with residential, commercial and recreational facilities such as golf courses along with almost a kilometer of beachfront.
- The client wanted a high-resolution map to better assess potential storm water issues.
- "It used to be that mapping contours at less than 3 meters above sea level was highly problematic because it is so flat," says. "Not with drone and advanced sensor technology.
- In areas with elevation change, we can easily achieve one foot [30cm contours]. In this case, the owner wanted 6 inch [15cm] contour maps — **and we were able to do that as well**."
- Combined with data gathered on the ground with handheld GPS units, the owner now has a comprehensive map of drainage, manhole covers and the pipes that will be used to manage the infrastructure assets.

UAV SYSTEM

- Surveying/MAPPING
  - Enemy territories
  - Areas dangerous for piloted craft
    - E.g. Fly into a hurricane and provide near-real-time data (hurricane hunters)
  - Extreme climate such as Antarctic
- Search and Rescue OPERATION
  - used for search and rescue in Louisiana and Texas during 2008 hurricanes

Drone Mapping

The drone industry is growing at an incredible speed and the technology provided by the drones is limitless.

1. UAVs are now used in a large range of commercial applications, whether it's television filming, real estates, package delivery, weddings or 3D mapping.
2. And one of these applications which is very profitable is Drone Mapping. But what exactly is drone mapping?
3. **Simply put, Drone Mapping is when you specify the area that you like to map and the drone flies around that area and makes a 3D map out of it, and this technique is called Photogrammetry.**
4. **GIS AND RS professional** you can make it so useful for things like surveying property, checking on your crops if you're a farmer, or simply charge the service to someone that need a 3D map.

Avionics in Military and Scientific

UAV based image

Classification of the Unmanned Aerial Systems

There is no one standard when it comes to the classification of UAS. (In this course, the terms UAS and UAV will be used interchangeably.)

- **Defense agencies have their own standard, and civilians have their ever-evolving loose categories for UAS.**
- **People classify them by size, range and endurance, and use a tier system that is employed by the military.**

For classification according to size, one can come up with the following sub-classes:

- **Very small UAVs**
  - **Micro or Nano UAVs**
- **Small UAVs**
  - **Mini UAVs**
- **Medium UAVs**
- **Large UAVs**

UAVs also can be classified according to the ranges they can travel and their endurance in the air using the following sub-classes developed by the US military:

- **Very low cost close-range UAVs**
- **Close-range UAVs**
- **Short-range UAVs**
- **Mid-range UAVs**
- **Endurance UAVs**

Types of professional drones

- There are four main physical types of professional drones:
- **multi-rotor, fixed-wing, single-rotor helicopter, and fixed-wing hybrid VTOL**.
- The different body styles of each type of drone contribute to the amount of weight they can carry (payload), efficiency and duration of the flight

How to do a drone survey?

- Check the local regulations and make sure that you are allowed to fly your drone at the planned location. ...
- Plan your flight. ...
- Set up your flight in the field. ...
- Fly and collect images. ...
- Geotag your images.
- Orthophoto

The Best Drone for Land Surveying

Our Top Pick / Best Overall:

- DJI Phantom 4 RTK.
- The DJI Phantom 4 RTK remains the best overall drone for land surveying in the market right now.

Best Entry-Level: DJI Phantom 4 Pro V2. ...

- DJI Mavic 2 Pro. ...
- DJI Mini 2 | Mavic Air 2 | ...
- Inspired Flight IF750.

Unmanned Aerial Systems

Category	Size	Maximum Gross Takeoff Weight (MGTW) (lbs)	Normal Operating Altitude (ft)	Airspeed (knots)
Group 1	Small	0-20	<1,200 AGL*	<100
Group 2	Medium	21-55	<3,500	<250
Group 3	Large	<1320	<18,000 MSL**	<250
Group 4	Larger	>1320	<18,000 MSL	Any airspeed
Group 5	Largest	>1320	>18,000	Any airspeed

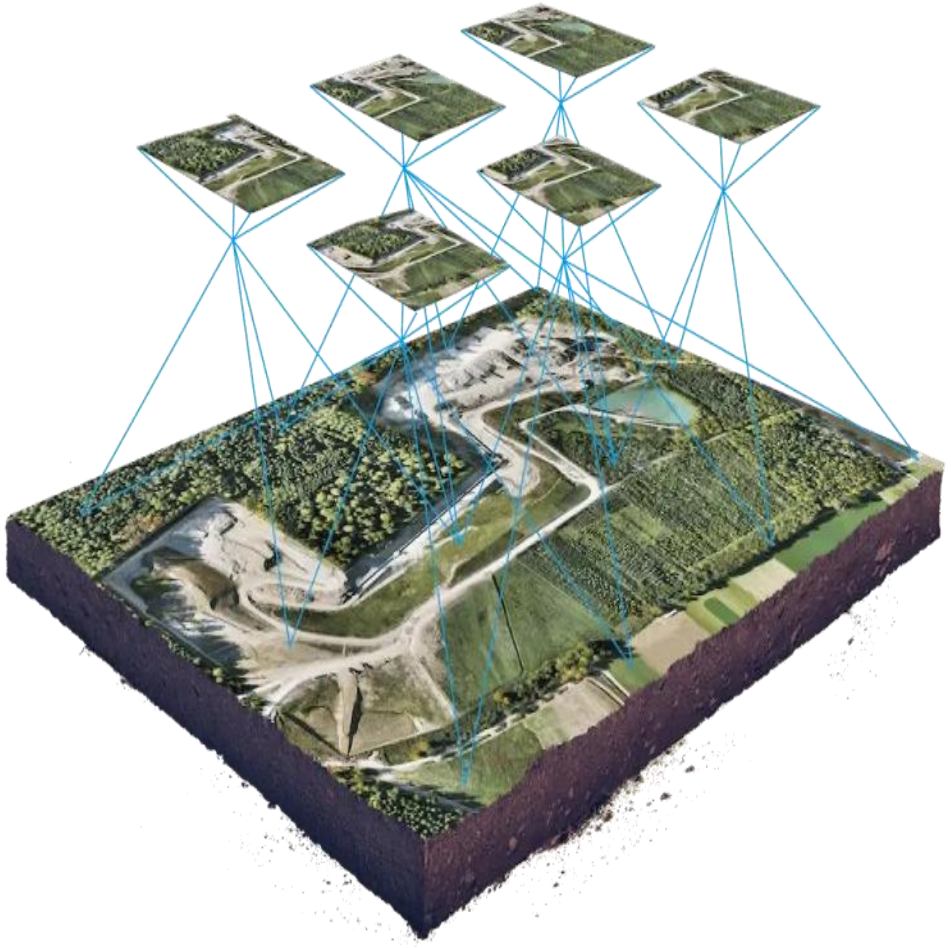
Why WE need to consider a UAV technology for Urban mapping project or 3D model creation-just 10 of the many reasons to consider

1. UAV flights provide eyes that can reach and hover above specific sites
2. Equipped with sensors, they can measure, transmit and store data – quickly!
3. Data can be used to produce or update topographic and hydrographic maps, volumetric calculations for stockpiles, and flood insurance maps, among other
4. overhead perspective and 360° panoramas relay a real-time scenario.
5. Data can be used and rendered in Esri's ArcGIS online web service and integrated into ArcGIS (or other systems) for further processing
6. Images are high resolution and serve a variety of users (and can be integrated into any enterprise GIS platform).
7. Drones present no safety risk for the operator and eliminate risks to ground and air personnel
8. Surveying firm estimates Around **60% cost savings** using Drone - Map over conventional survey techniques.
9. UAS improved accountability, saved taxpayer money, did not disrupt construction operations
10. Agencies and city managers can employ affordable orthophotography update projects, by flying and updating only the areas where change has like occurred rather than a costly update project that covers an entire region, territory, or county.

What is meant by drone Mapping?

- A drone survey refers to the use of a drone, or unmanned aerial vehicle (UAV), to capture aerial data with downward-facing sensors, such as RGB or multispectral cameras.

- During the drone survey with an RGB camera, the ground is photographed several times from different angles, and each image is tagged with coordinates.



Unlike manned aircraft or satellite imagery, drones can fly at a much lower altitude, making the generation of high-resolution, high-accuracy data, much faster, less expensive.

What are the benefits of drones in surveying?

Reduce field time and survey costs

- Capturing topographic data with a drone is up to five times faster than with land-based methods and requires less manpower.
- You ultimately deliver your survey results faster and at a lower cost

Provide accurate and exhaustive data

- Total stations only measure individual points. One drone flight produces thousands of measurements, which can be represented in different formats (Ortho mosaic, point cloud, DTM, DSM, contour lines, etc..)

Mapping inaccessible areas

- An aerial surveying drone can take off and fly almost anywhere. You are no longer limited by unreachable areas, unsafe steep slopes or harsh terrain unsuitable for traditional measuring tools.

How drones are used for in surveying?

Land surveying / cartography

- Survey drones generate high-resolution Ortho mosaics and detailed 3D models of areas where quality, and data are not outdated.
- They enable high-accuracy cadastral maps to be produced quickly and easily, even in complex or difficult to access environments.
- Surveyors can also extract features from the images, such as signs, curbs, road markers, fire hydrants and drains.

Land surveying / cartography

Cadastral map overlayed on aerial images

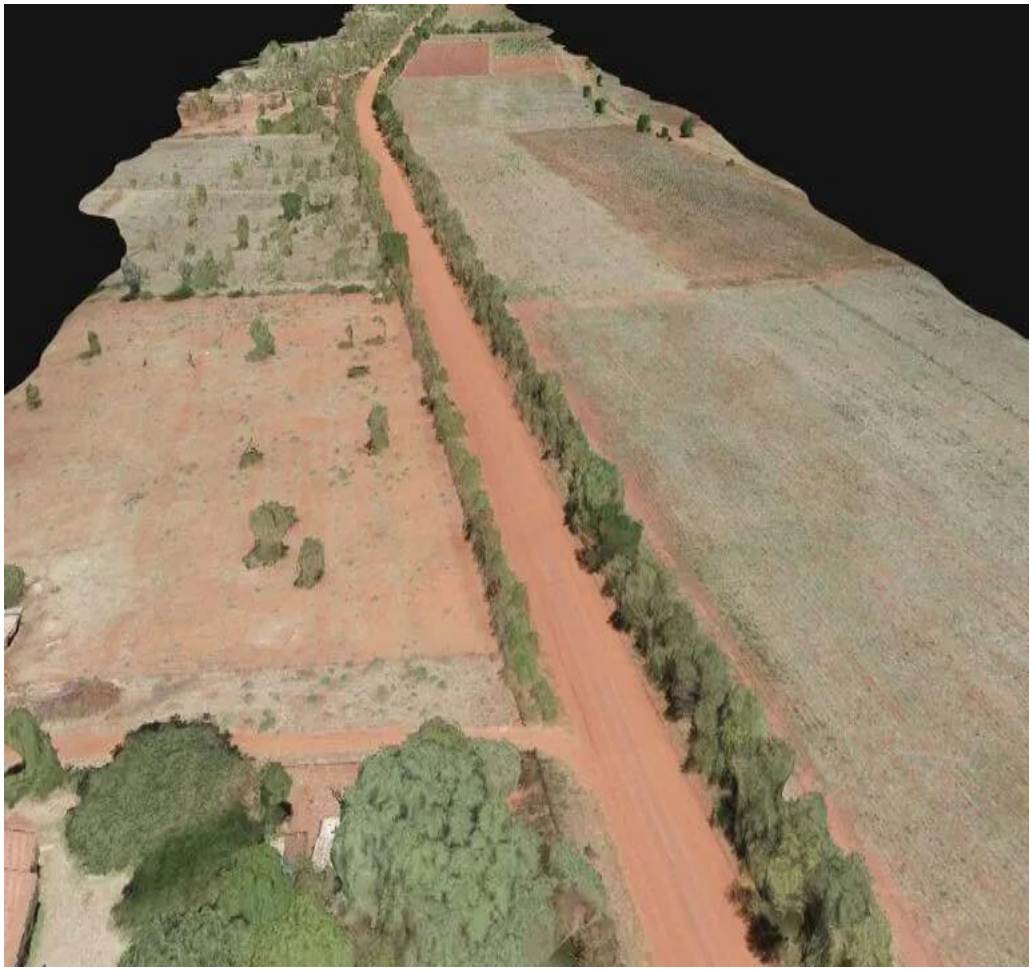
How drones are used for in surveying?

Land management and development

- Aerial images taken by drones greatly accelerate and simplify topographic surveys for land management and planning.
- This holds true for site scouting, allotment planning and design, as well as final construction of roads, buildings and utilities.

As data collection by drones is easily repeatable at low cost, images can be taken at regular intervals and overlaid on the original blueprints to assess whether the construction work is moving according to plan specifications.

Land management and development



Survey - Road before construction planning

How drones are used for in surveying?

Stockpile volumetric measurements

- With a drone, surveyors can capture many more topographic data points, hence more accurate volume measurements.
- This fast and inexpensive method of volume measurement is particularly useful to calculate stocks in mines and quarries for inventory or monitoring purposes.

Stockpile volumetric measurements

Volumetric measurement of a landfill

How drones are used for in surveying?

Slope monitoring

- By Knowing the steepness of the ground's surface, the areas can be classified and used for slope monitoring purposes, including landslide mitigation and prevention.
- With Ortho mosaics taken at different times, it is possible to detect changes in earth movement and to measure its velocity.
- This data can help predict landslides and prevent potential damage to roads, railways and bridges.

Slope monitoring

The length of the strokes represents the velocity of the earth movement. Longer the stroke - Faster the earth movement
Smaller the stroke - Lower the earth movement

How drones are used for in surveying?

Urban planning

- The development of increasingly dense and complex urban areas requires intensive planning and therefore time-consuming and expensive data collection.
- The images produced in this way allow planners to examine the existing social and environmental conditions of the sites and consider the impact of different scenarios.
- Thanks to drones, urban planners can collect large amounts of up-to-date in a short period of time.

Urban planning

Aerial Map with projected buildings in 3D on top

Products of drone mapping?

Orthomosaic maps

- Drone images are corrected for image distortion and stitched together during post-processing to create a highly-accurate orthomosaic map.
- Each pixel contains 2D geo-information (X, Y) and can directly procure accurate measurements, such as horizontal distances and surfaces

Orthomosaic maps

Products of drone mapping?

3D point cloud

- A densified point cloud can be generated from drone images. Each point contains geospatial (X, Y, Z) and color information.
- It provides a very accurate model for distance (slant and horizontal), area and volume measurements.

3D point cloud

Products of drone mapping?

Digital surface models (DSM)

- Drone images can also be used to create DSM models of the area.
- Each pixel contains 2D information (X, Y) and the altitude (Z value) of the highest point for this position.

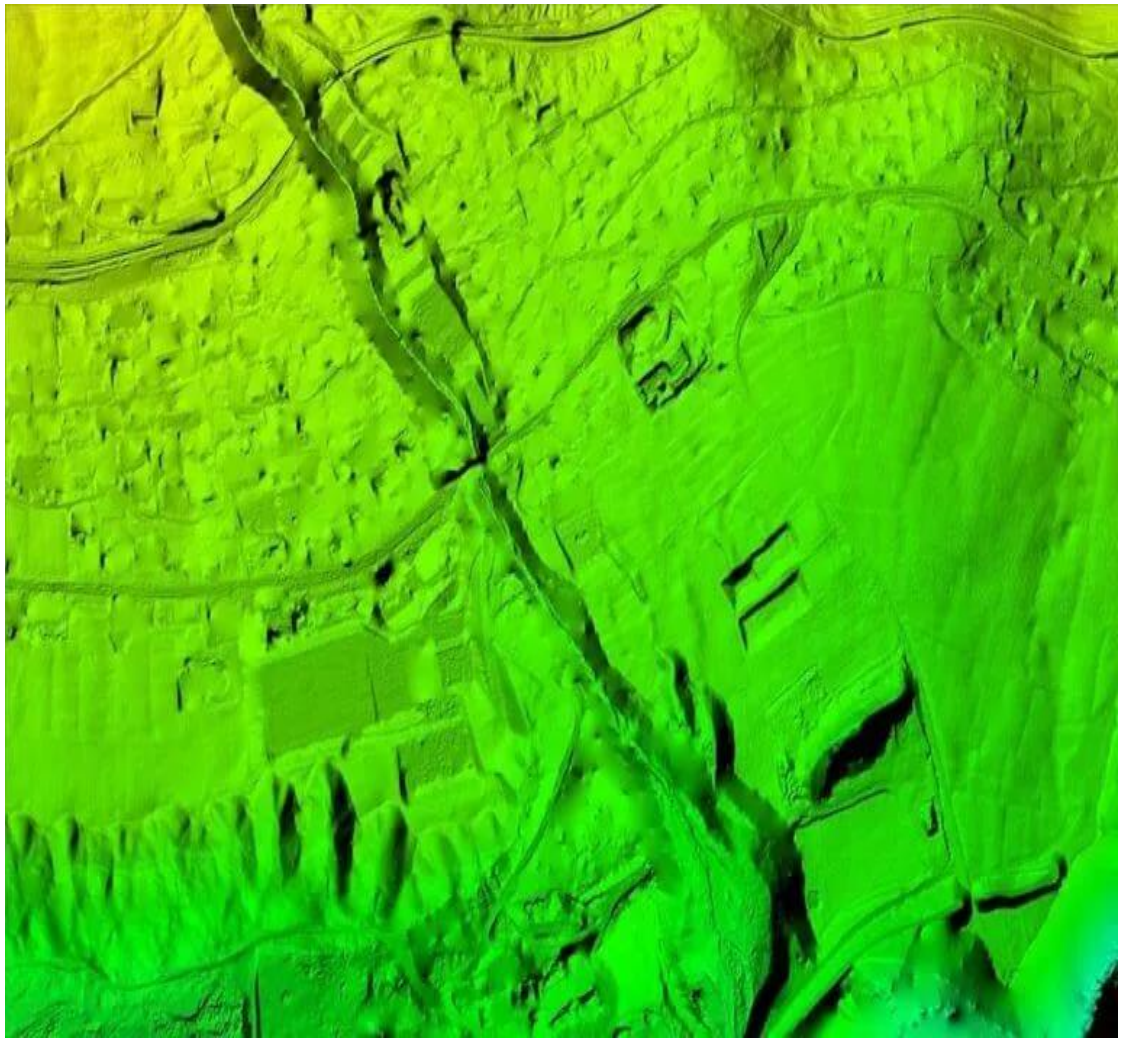
Digital surface models (DSM)

Deliverables of drone mapping?

Digital terrain model (DTM)

- After filtering objects such as buildings, the drone images can be used to create DTMs with each pixel containing information (X, Y, and Z value of the highest altitude).

Digital terrain model (DTM)




THANKS