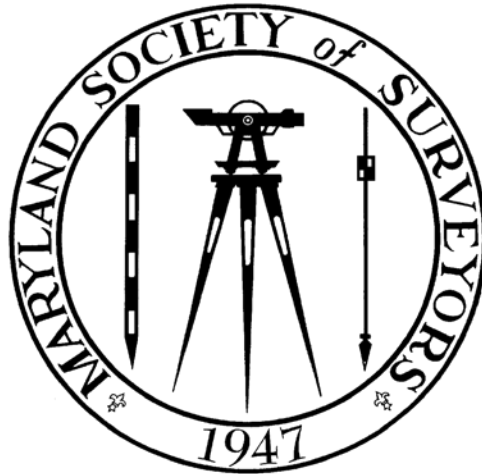


Grid and Ground Coordinate Systems



Maryland Society of Surveyors
Spring Technical Conference

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March 2, 2015
Maritime Institute of Technology
Training and Conference Center
Linthicum Heights, Maryland

Grid and Ground Coordinate Systems



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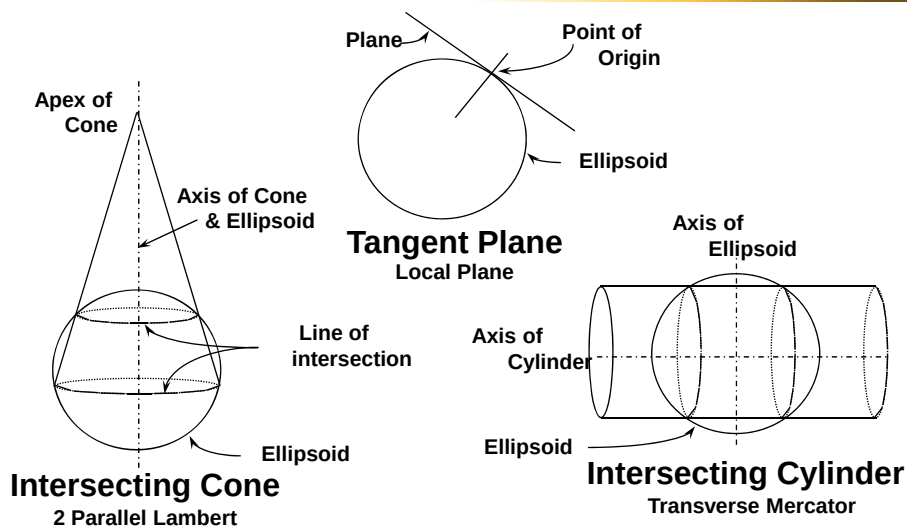


Agenda

- Understanding Mapping Projections
 - Tangent Plane at
 - Lambert Conformal
 - Transverse Mercator Conformal
 - Local Transverse Mercator
 - Other Types
- Grid and Ground Discussion



What Projection



What Items Are Needed For a Projected Coordinate System

- Ellipsoid
- A developable surface
 - A curved surface that can be made flat without stretching, or compressing it. (you can cut it)
 - Cone
 - Cylinder
 - Plane
- Geoid (optional)



What Type of Projection

- Lambert Conformal
 - For areas that are oriented in an east west direction.
- Transverse Mercator Conformal
 - For areas that are oriented in a north south direction.



What is the First Step

- Decide on a coordinate system
 - State Plane Coordinates
 - Develop your own coordinate system
 - Local Transverse Mercator Projection
 - Approximate Latitude
 - Approximate Longitude
 - Average Elevation
 - Local Ground Level Projection
 - Approximate Latitude
 - Approximate Longitude
 - Average Elevation



Other Choices for a Coordinate System

- No Projection Scale Factor of 1.000000



What is Needed for No Projection Scale Factor of 1.000000

- Starting Coordinate
- Starting Azimuth



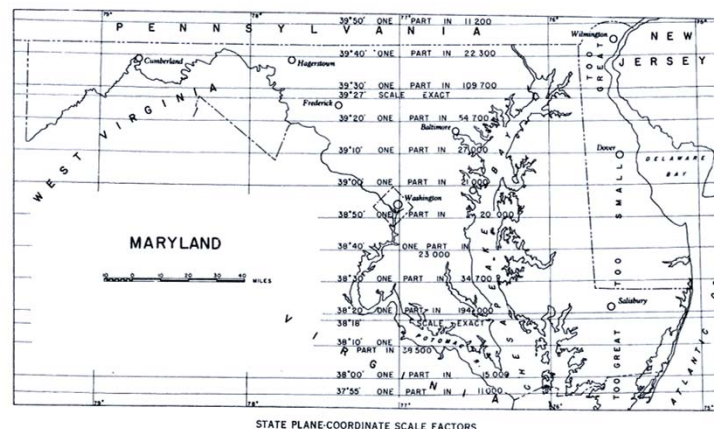
Combining GPS and Conventional Measurements

- Using No Projection Scale Factor of 1.000000
- As the size of your project gets larger the differences in grid coordinates and their measurements on the ground get larger.
- Because of this GPS (grid) and conventional measurements (ground) can only be used in a project that has no projection over a relatively small area.



How Big is a Small Area?

- How much distortion (error) can you allow?



So You Are Going to Use a Projection

- State Plane Coordinates
- Local Transverse Mercator Projection
- Local Ground Level Projection



Using A Projection

- Establish your projection at the start of your project.
- Base your projection on your GPS work if you have GPS work.
- You do this first because if you do it later any coordinates that you calculate will not change to your new coordinate system if you change it later.

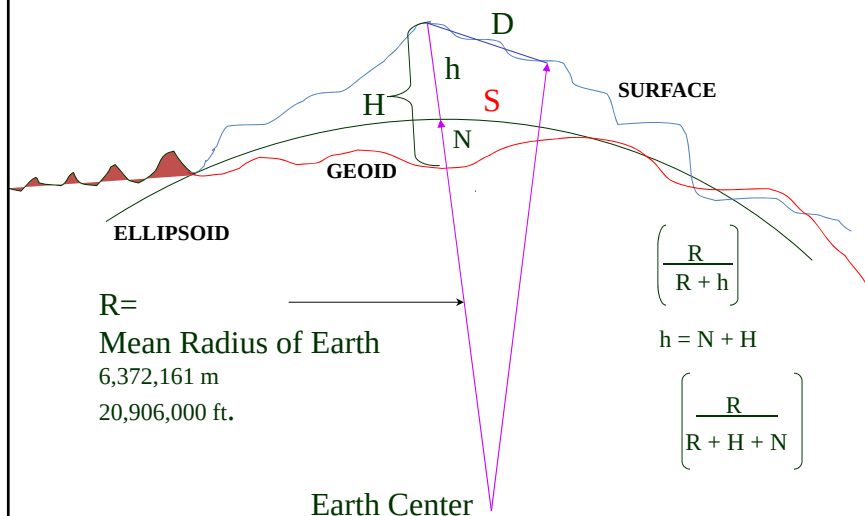


How Much Difference Will Mixing Grid and Ground Make

- Use the combined factor and multiply it by your longest distance.
- This will be the differences between your longest ground and grid distance.



Calculation of Elevation Factor



Calculations For Elevation Factor Shady Grove To Rockville

Changes Horizontal Distances to Ellipsoid Distances

• Elevation of Beginning Point	<u>706.0</u>	Feet
• Elevation of Ending Point	<u>515.6</u>	Feet
• Elevation or Mean Elevation	<u>610.8</u>	Feet
– (To Be Used For Reduction Factor)		
• Geoid Height	<u>-104</u>	Feet
– (Montgomery County)		
• Mean Radius of the Earth	<u>20,906,000</u>	Feet

$$\text{ELEVATION REDUCTION FACTOR} = \frac{\text{MEANRAD}}{\text{MEAN RADIUS} + \text{ELEV} + \text{GEOID HEIGHT}} = \underline{0.999975}$$



Determination of Scale Factor

- Use CORPS Con
- Get it off an NGS Datasheet
- Get it from the NGS Tables



What Causes The Scale Factor to Change?

- The scale factor changes as the north coordinate changes.



Determination of Combined Factor

- Multiply the Elevation Factor by the Scale Factor.
- Get it from CORPS Con
- Get it off a NGS Datasheet



The Difference Between Grid and Ground is To Large?

- Develop a ground level projection to use your ground measurements and change your GPS positions to ground level.
- Use Maryland State Plane Coordinates and convert your ground measurements to grid and use grid.



How Do We Handle GPS

- Develop a ground level projection and scale the GPS coordinates up to ground
- Use grid and scale our distances or coordinates down to grid.
- Do a calibration or localization to ground level coordinates.
- Use your data collector to develop a ground level coordinate system.



How to Create a Local Ground Level Projection From State Plane Coords

- Do the Math by determining the distance between two points across your project.
$$\frac{\text{Ground Distance}}{\text{Grid Distance}} = \text{Scaling Factor}$$
- Scale your entire project by this amount from a central point.
- Offset or truncate your new coordinates so you don't think they are State Plane Coordinates later.
- TEST IT !!!



Caution:

- Remember if you are using Maryland State Plane Coordinates and you raise them to a ground level system they are no longer Maryland State Plane Coordinates.
- If you do a calibration or localization to grid coordinates you are on the grid.

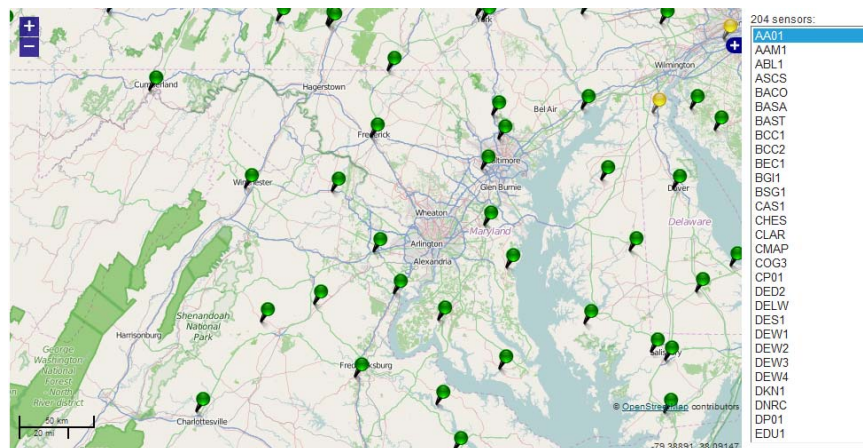


Advantage of Using a Fully Developed Projection

- There is no distortion (error) between GPS and conventional measurements.



What If We Use Network RTK



<http://vrs.keynetgps.com/Map/SensorMap.asp>



Network RTK Uses Latitude and Longitude And Ellipsoid Heights

- Your data collector changes this to coordinates base on its settings.
- It also uses a geoid model to change the ellipsoid heights to orthometric heights.



Should You Do a Calibration For Network RTK

- You should calibrate to ground coordinates if you want to be in a ground coordinate system.
- You can also set your data to use a ground level coordinate system.



So What Do We Put On Our Plats

- If we are using Maryland State Plane Coordinates.
 - Show the datum and epoch.
 - Show the values for the control points used.
 - State that the survey is based on Maryland State Plane Coordinates.
 - State that the meridian for the document is Maryland State Plane Coordinates.



So What Do We Put On Our Plats

- If we are using some other ground level projection.
 - Origin point of scaling
 - Scale Factor used for scaling
 - Any offsets applied after the scaling
 - State the meridian that the azimuths and bearings are based on.
 - Control points used



Discussion and Questions?

