Geographic Coordinate Systems

geocentric coordinates

- Earth-centered system of locating objects in the solar system in three-dimensions along the Cartesian X, Y and Z axes Wikipedia

geographic coordinates

- enables every location on Earth to be specified by a set of numbers, letters or symbols (Wikipedia)
- used to specify a location on a two-dimensional map
- requires a map projection

geographic poles

- defined by the rotational axis

equator

- the section perpendicular to the rotational axis and through the center of the ellipsoid

Geographic Coordinates (latitude/longitude)

Representation	Example	Description
hddd° mm ss.ss	N46°14 06.70 E008°00 55.60	degree (°), minutes ( ), seconds( ) and decimal seconds
hddd° mm.mmm	N46°14.1118 E008°00.9267	degree(°), minutes( ) and decimal minutes
hddd.ddddd°	N46.235197° E008.015445°	degree(°) and decimal degree

h = cardinal direction
d = degree
m = minutes
s = seconds

lines of latitude

- sections perpendicular to the rotational axis are parallel to the equator

- the degrees of latitude range from 90°S over 0° to 90°N (180 lines of latitude)
-

lines of longitude (meridians)

- sections through the poles
- the degree of longitude range from 180°W over 0° to 180°E
- steps are 10° (360 lines of longitude)
-

prime meridian

- the meridian through Greenwich

great circles

- sections through the center of the ellipsoid
- 1° on a great circle corresponds to about 111 km
- 360° correspond to 40073 km 2 6378 km

Wikipedia-Geographic-Coordinates

Universal Transverse Mercator (UTM) Coordinates

UTM Zone Coordinates

Example	Description
32 N 439596 / 5967780	zone, north hemisphere, easting / northing in meter

lines of longitude

- degrees range from 0° to 180°

lines of latitude

- degrees range from 80° S over 0° to 84° N
- The polar regions are excluded

zones

- 60 zones, each 6° of longitude in width
- first zone (1)
- longitude 180° to 174° W
- starts international Date Line (180°)
- zone numbering increases eastward
- last zone (60)
- longitude 174° to 180° E

central meridian

- longitude line in the middle of a zone
- steps are 6°, starts at 3°
- 3°, 9°, 15°, ..., 177°

coordinate system

- each UTM zone is regarded as an individual Cartesian Coordinate System
- intersection of the equator with the central meridian is the origin of the Coordinate System

false easting

- the easting of the central meridian is shifted by 500.000 meters
- eliminates negative numbers

false northing

- the northing on the southern hemisphere is shifted by 10.000.000 meters
- eliminates negative numbers

utm-zone

example 1

32 N 439596 / 5967780

- The coordinate is on the north hemisphere (N) in UTM zone 32
- 32 zone = central meridian is at 9° eastern longitude
- The point located *60404* meters west of the central meridian of zone 32
- 500000 m - 439596 m = *60404* m
- The point is located 5967780 meters from equator to the North

example 2

32 S 439596 / 4032220

- The coordinate is on the southern hemisphere (S) in UTM zone 32
- 32 zone = central meridian is at 9° eastern longitude
- The point located *60404* meters west of the central meridian of zone 32
- 500000 m - 439596 m = *60404* m
- The point is located *5967780* meters from equator to the North
- 10000000 m - 4032220 = *5967780* m

UTM Grid Coordinates

Example	Description
32 U 439596 / 5967780	zone, band, easting / northing in meter

band (latitude)

- indicates geographical latitude
- 8° hight

utm-grid

Wikipedia-UTM-Grid

MGRS

- UTM zones independent of the UTM bands, are divided into squares (100 km x 100 km)
- parallel to the central meridian
- denominated with letter pairs

Military Map Reading 201

- http://earth-info.nga.mil/GandG/coordsys/mmr201.pdf

Uni-Stuttgart

Gauß-Krüger-Coordinates

https://de.wikipedia.org/wiki/Gau%C3%9F-Kr%C3%BCger-Koordinatensystem

further reading and videos

Intro to coordinate systems and UTM projection

- https://www.youtube.com/watch?v=HnWNhyxyUHg

NOAA - UTM

- https://www.ngs.noaa.gov/TOOLS/utm.html

Display Formats of UTM Coordinates - How to Deal with Them? (english & german)

- http://www.killetsoft.de/t_0901_e.htm

reddit - What is the difference between UTM and MGRS coordinate systems?

- https://www.reddit.com/r/CampingandHiking/comments/124y3c/map_question_what_is_the_difference_between_utm/