



*North
Reference*

At which North Pole does
Santa Claus live?



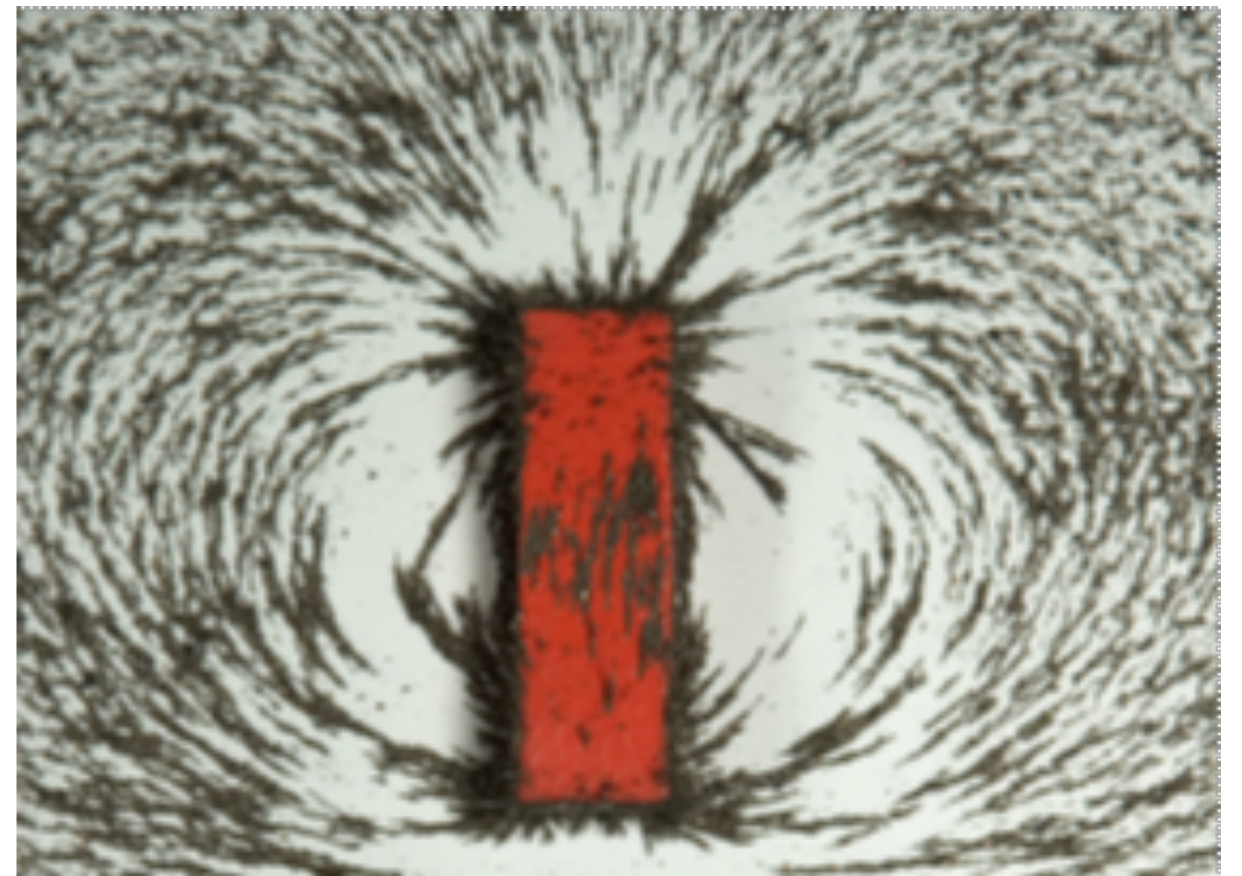
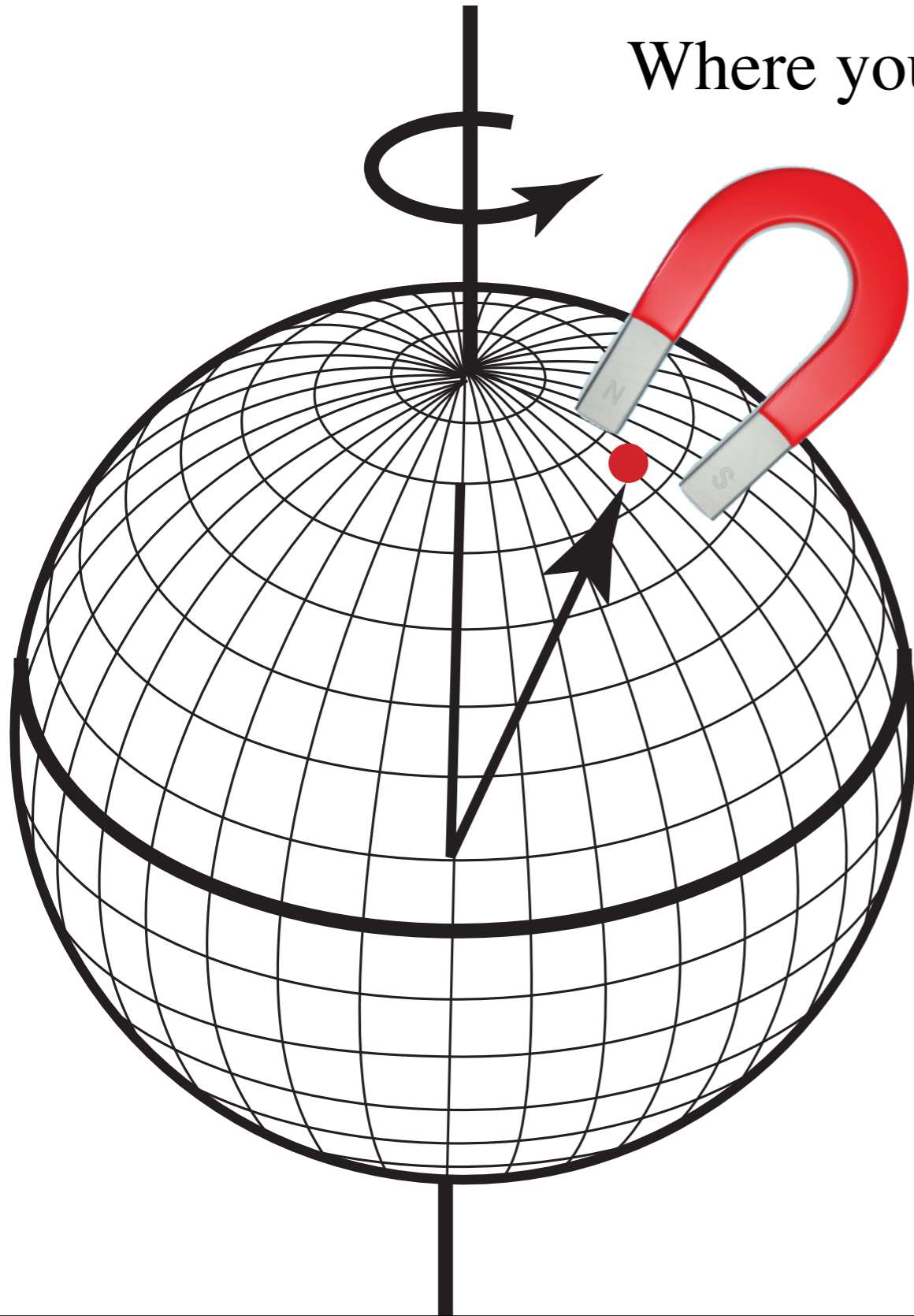
True North

The earth's axis of rotation



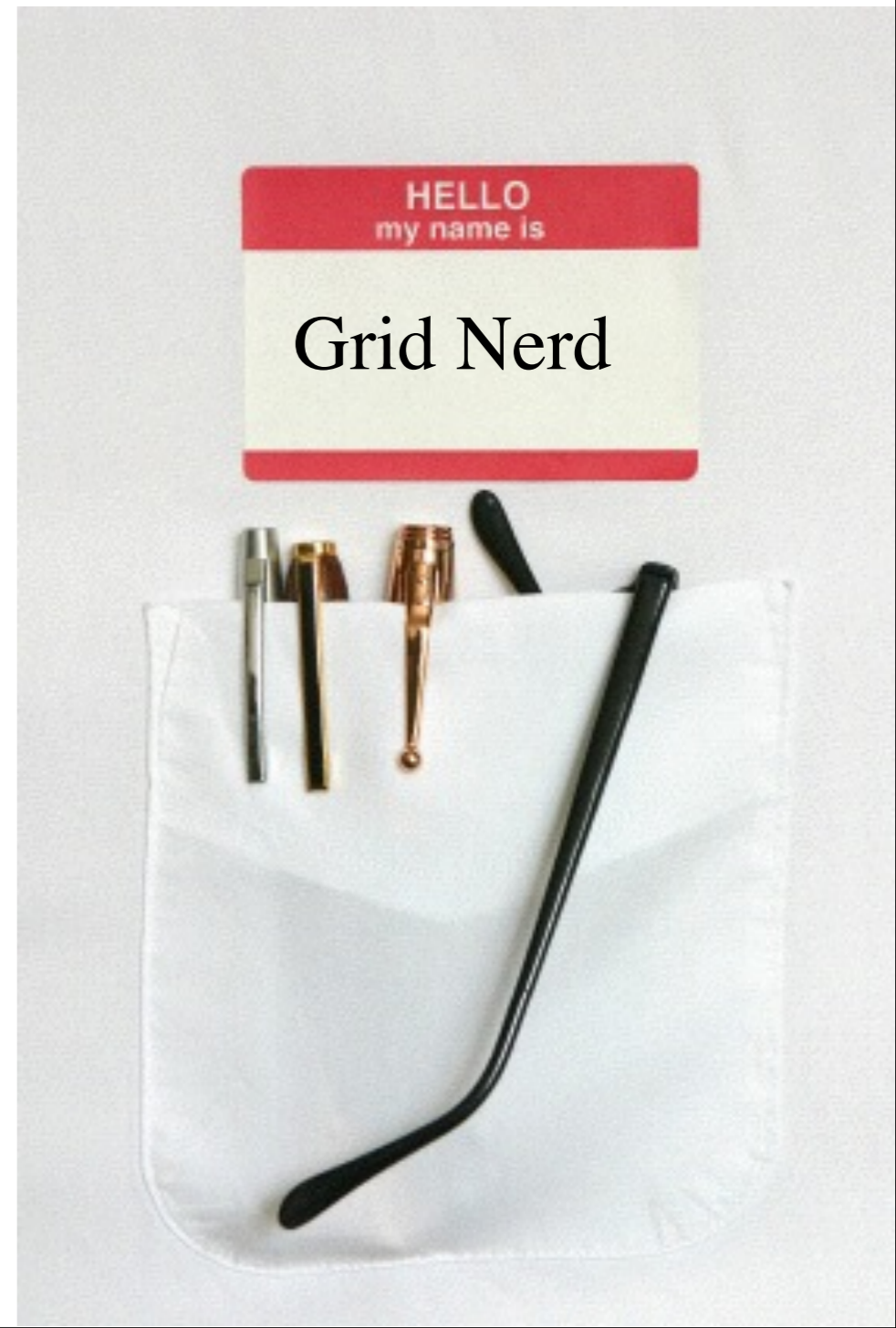
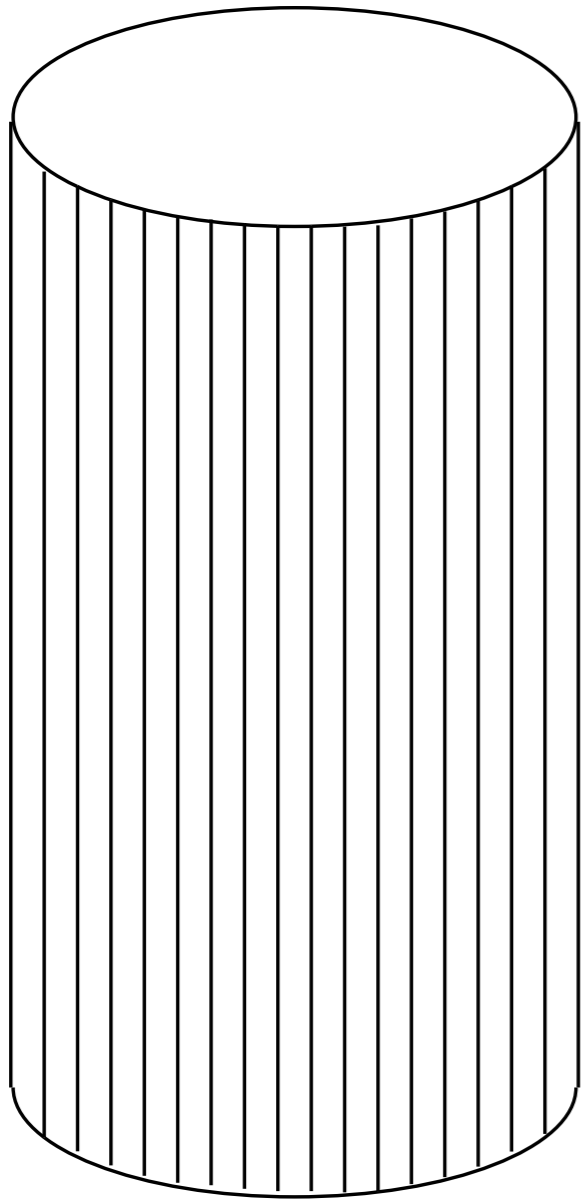
Magnetic North

Where your compass points

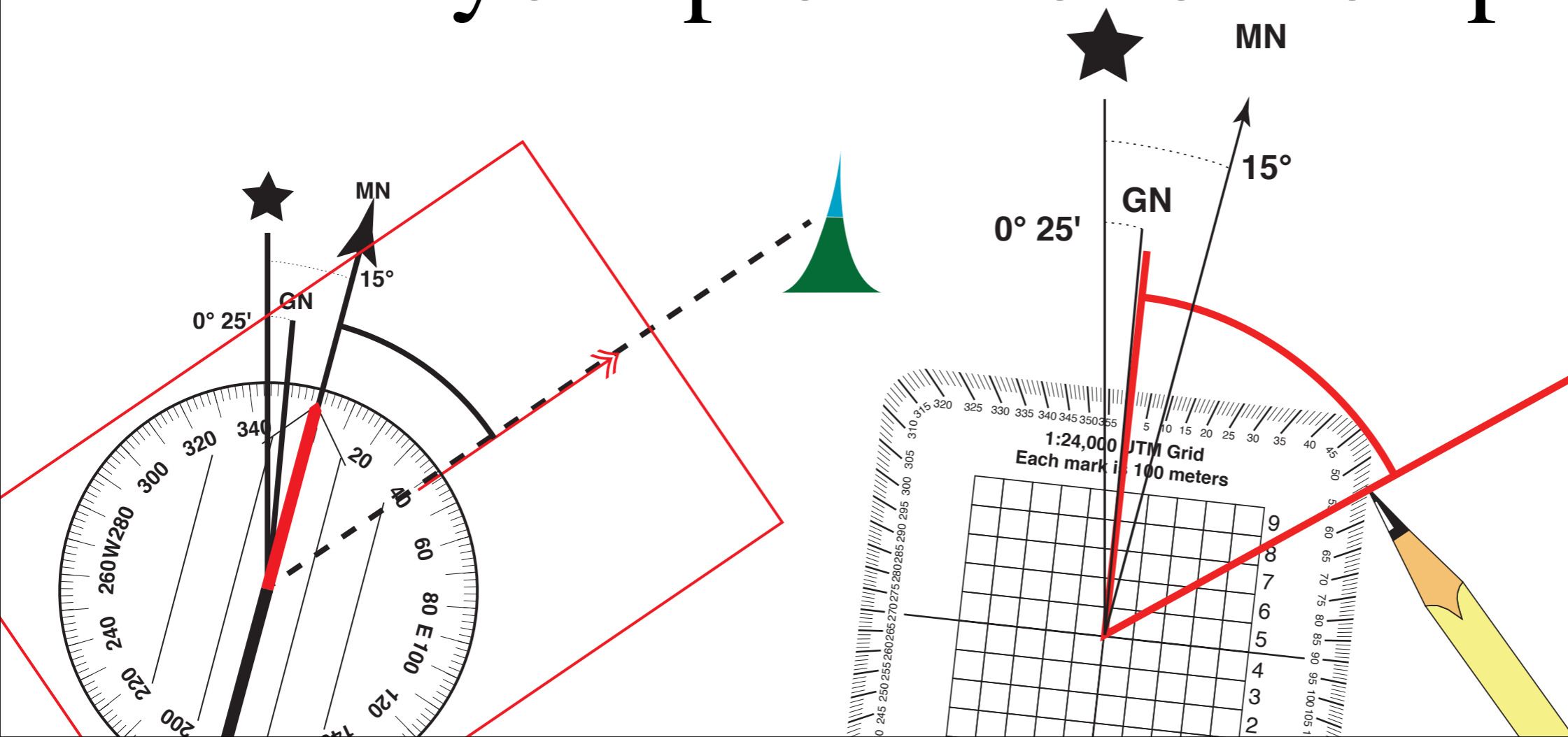


Grid North

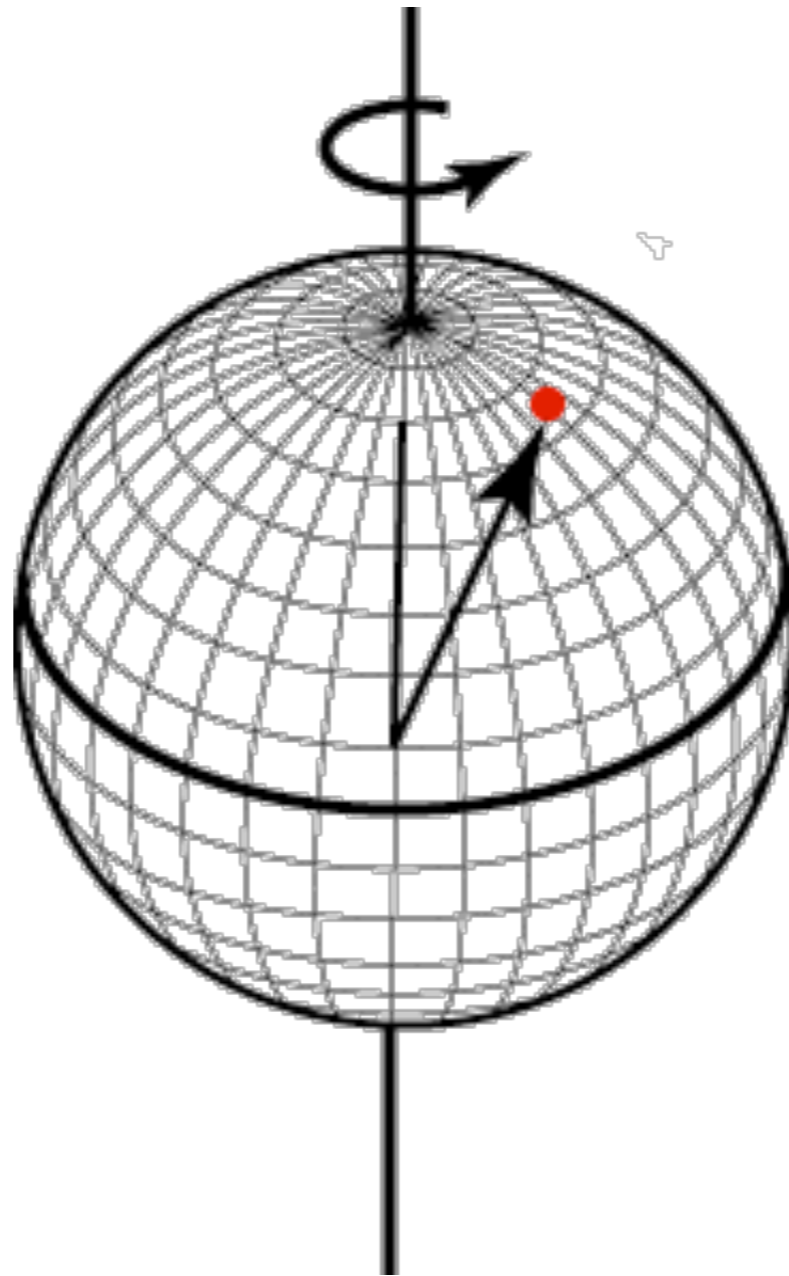
Where the UTM grid lines “point” to



The North Reference
you choose
determines where 0° is
when you measure an angle
with your protractor or compass.

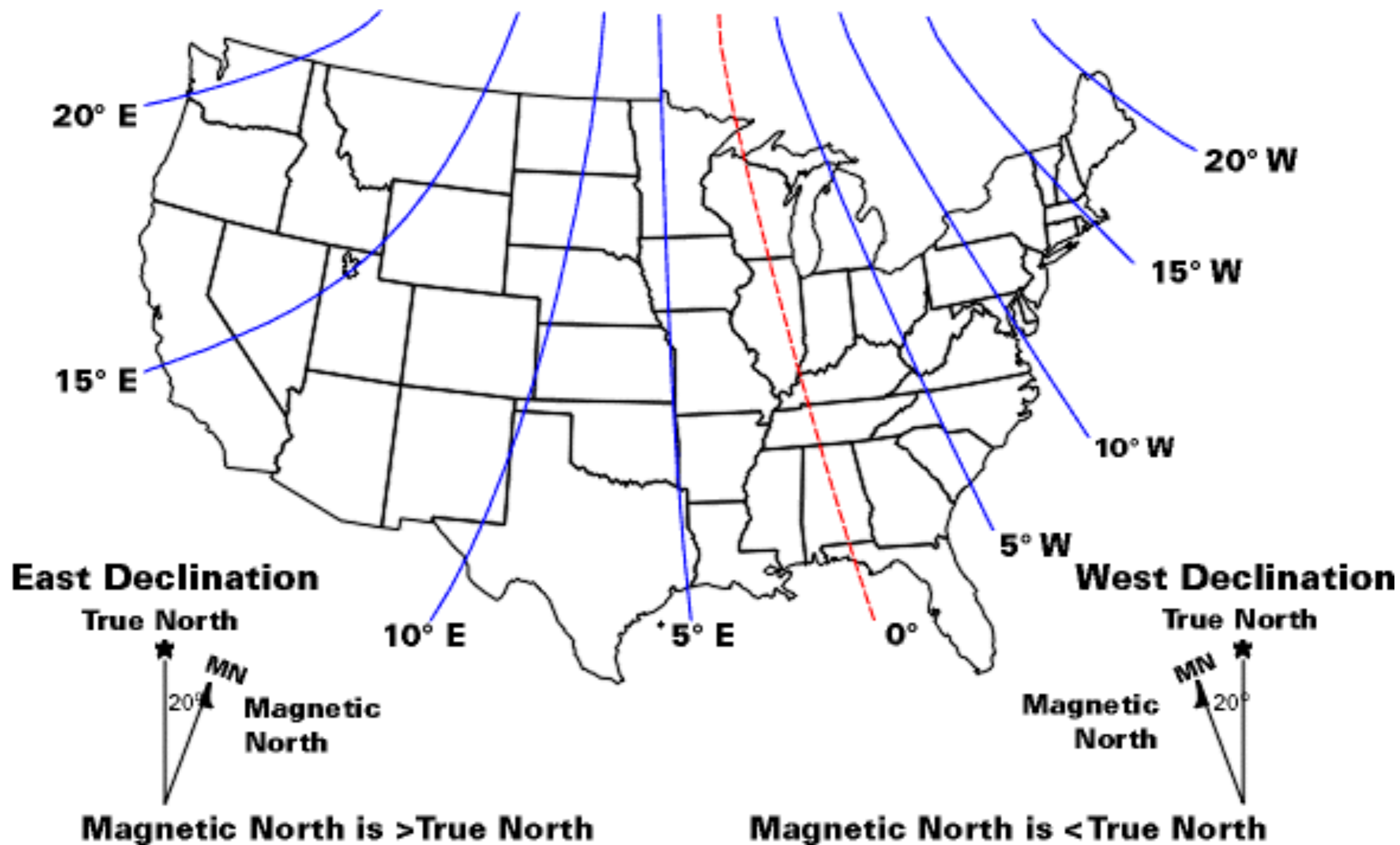


True v.s. Magnetic North



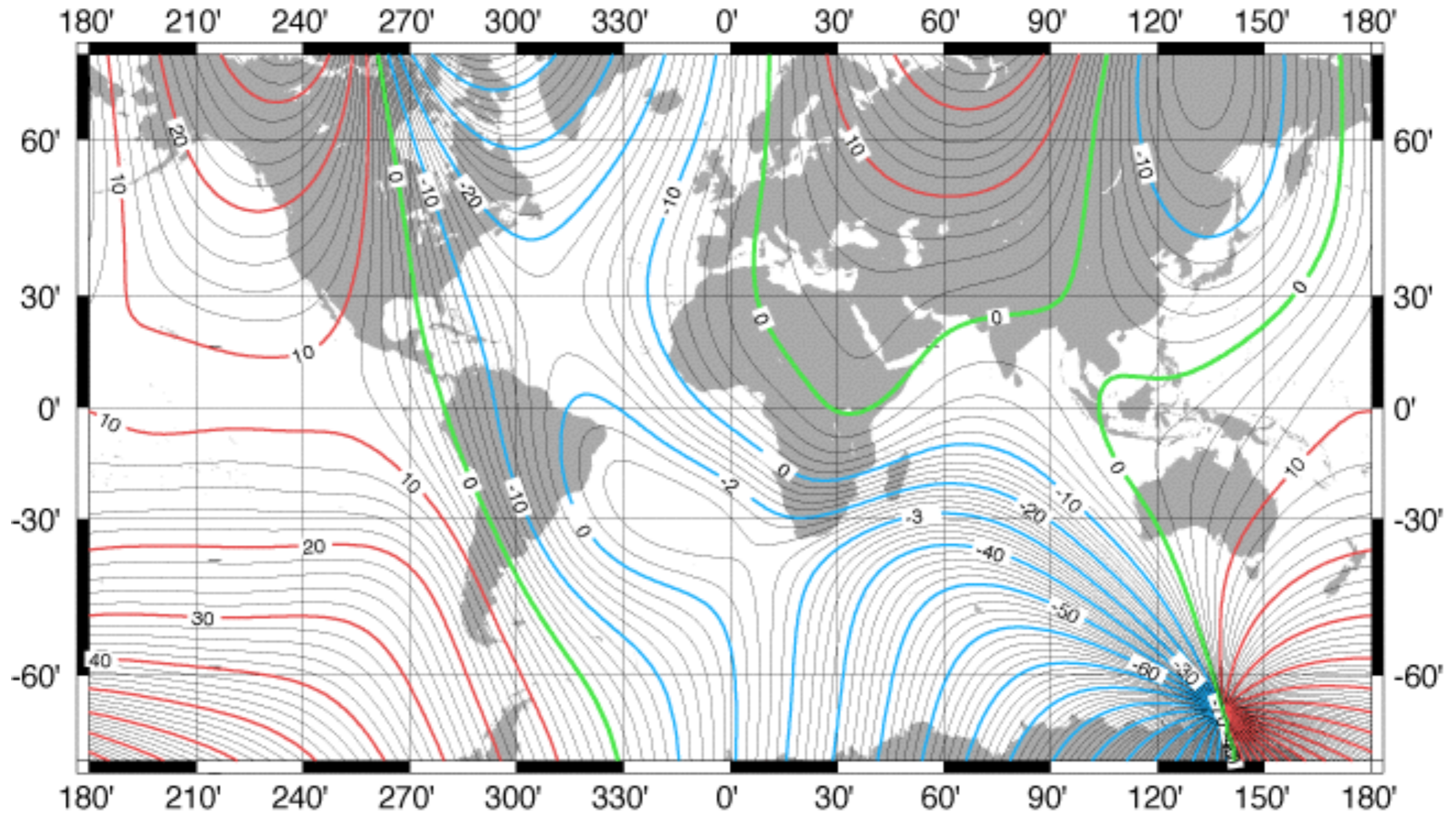
What is the difference here?

- Fruitvale Ave. is aligned with True North.
- So are the edges of parking lots 4 & 5.
- Let's go take a bearing along the edge of lot 4 and see what we get...



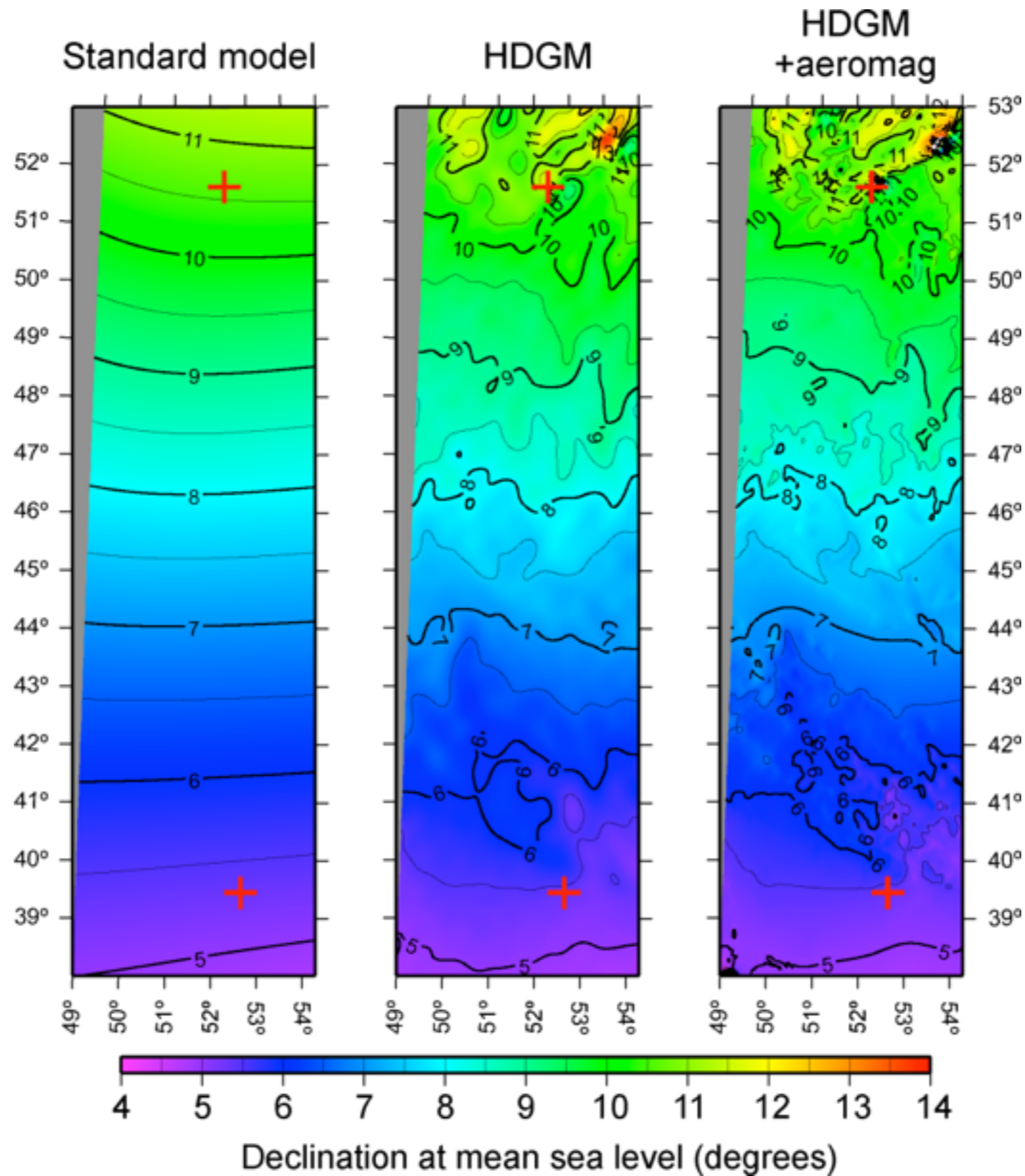
US/UK World Magnetic Chart -- Epoch 2000

Declination - Main Field (D)

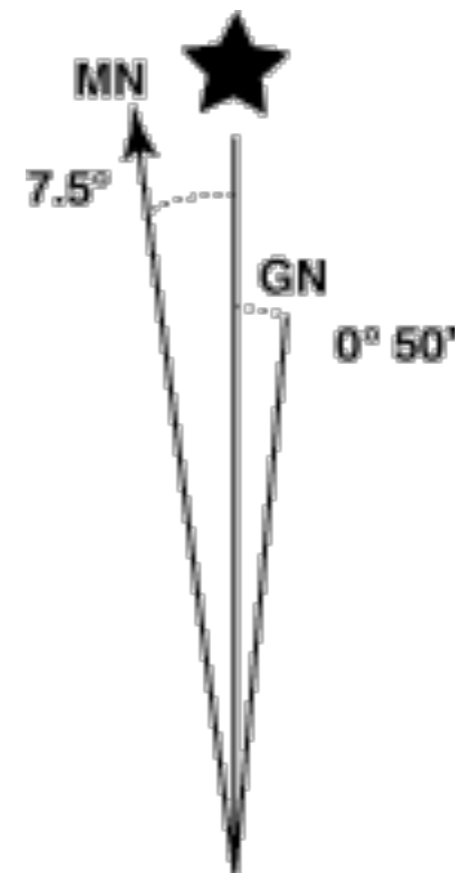
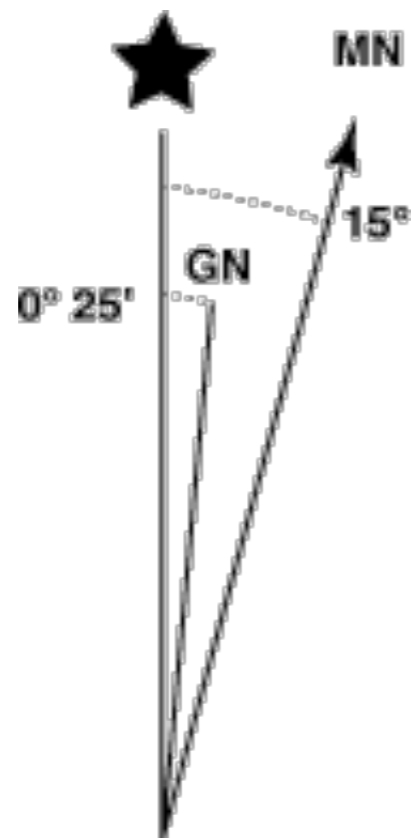


Units (Declination) : degrees
Contour Interval : 2 degrees
Map Projection : Mercator

High Definition Geomagnetic Model



Declination Diagrams

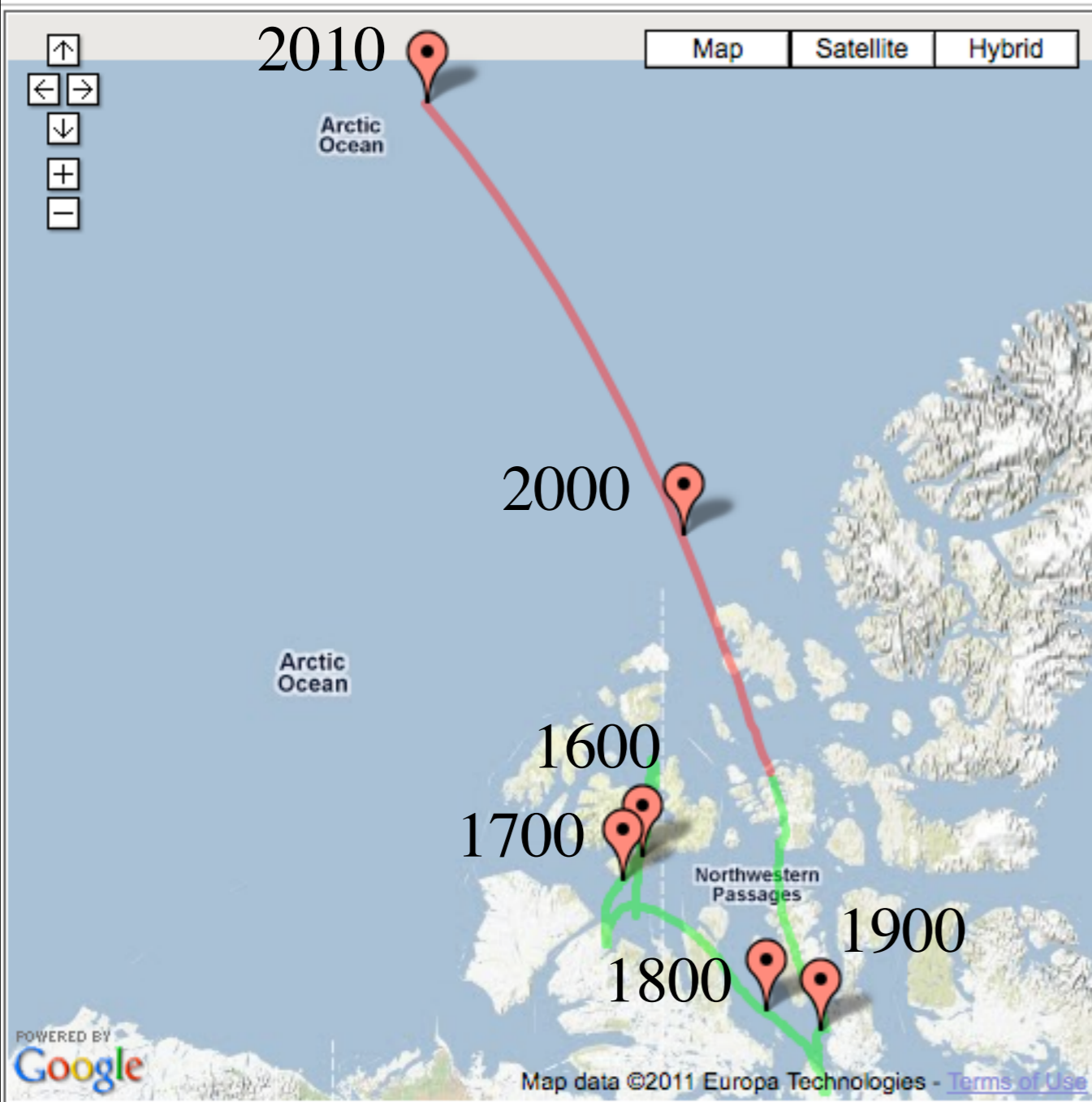


Declination changes over time

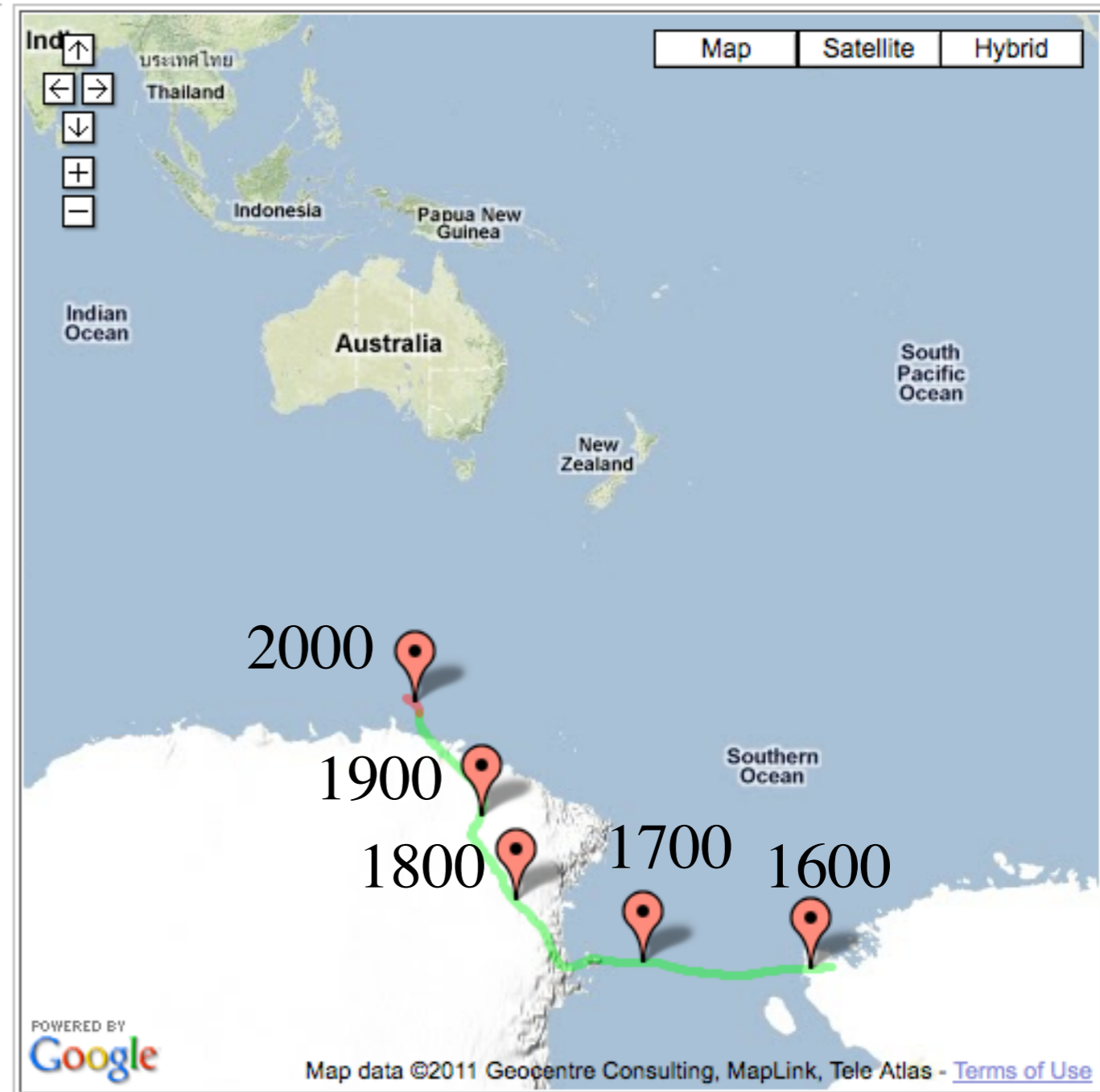
- Here in Northern California it changes by about 1° every 20 years.
- The declination shown on your topo map may be out of date.
- What about declination displayed by my GPS?
 - It probably correct as of the date of manufacture.

Magnetic Poles

North Pole



South Pole



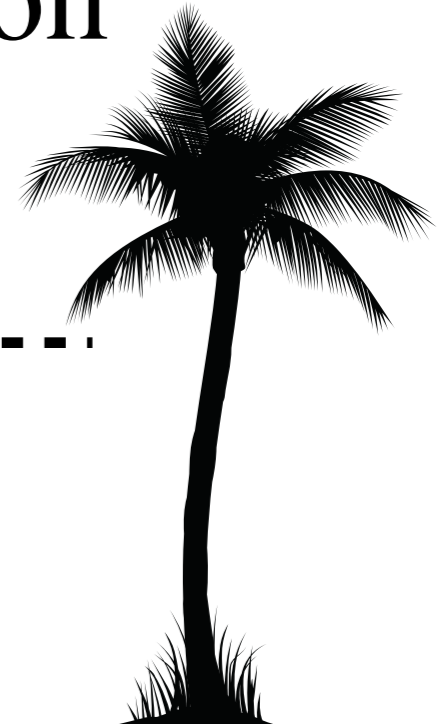
Declination Calculator
at www.ngdc.noaa.gov

Local Anomalies

- May be as much as 90 degrees
 - 3-4 degrees is common
- North of Kingston, Ontario; 90° of anomalous declination.
- Kingston Harbor, Ontario; 16.3° W to 15.5° E of anomalous declination over two kilometers (1.2 miles); magnetite and ilmenite deposits.
- Savoff, Ontario (50.0 N, 85.0 W). Over 60° of anomalous declination.
- Ramapo Mountains, northeastern New Jersey; iron ore; compass rendered useless in some areas.
- Near Grants, New Mexico north of the Gila Wilderness area; Malpais lava flows; compass rendered useless.

Using your GPS & compass to measure current local magnetic declination

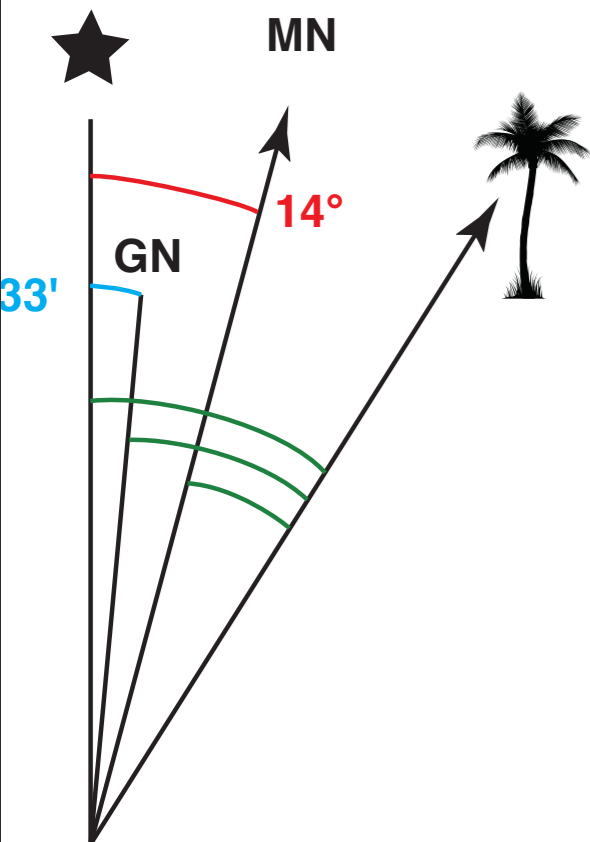
$d > 300\text{m}$



WPT001

GPS	Compass
GOTO WPT001	Bearing to Palm
Bearing 214° True	200° Magnetic

Current Local Magnetic Declination is
14° East of True North



Angular Error in GPS Bearing to Waypoint



$$\tan(\alpha) = \frac{5}{\frac{d}{2}} = \frac{10}{d}$$

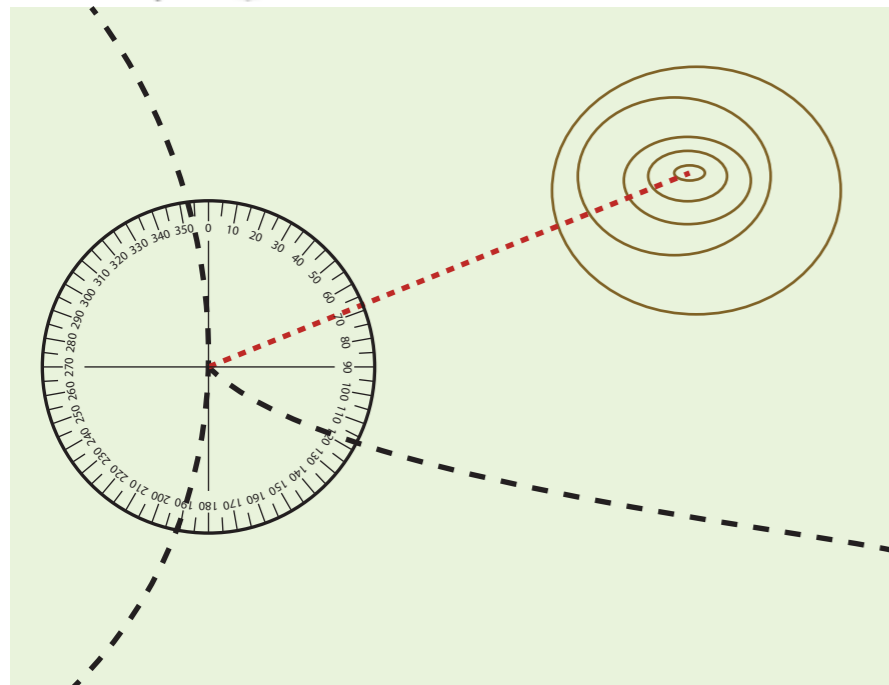
$$\alpha = \tan^{-1}\left(\frac{10}{d}\right)$$

d	α
100m	6°
200m	3°
300m	2°
400m	1.4°
500m	1.1°
600m	1.0°
700m	0.8°
800m	0.7°
900m	0.6°
1000m	0.57°

Using your map & compass to measure current local magnetic declination

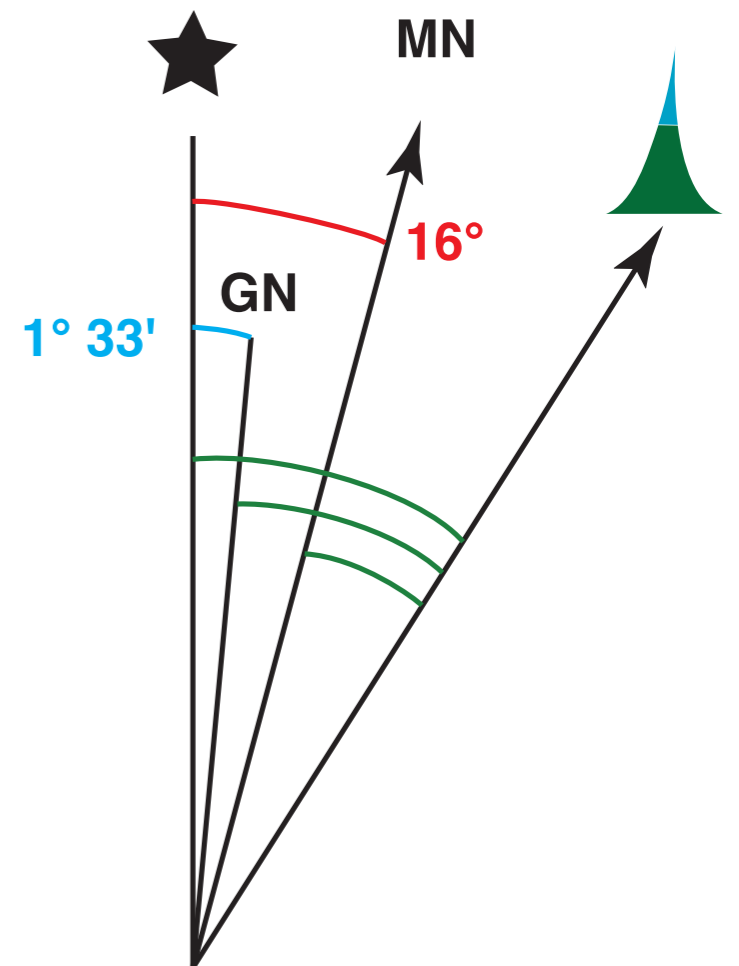


Compass
Trail Jct -> Peak
52° Mag.



From the map
Trail Jct -> Peak
68° True

Current local
magnetic declination
is (68 - 52)
16° E. of True North



Check your compass & sighting technique using these methods and the declination for the area

- Find some place near your home to establish your personal compass testing location.
- Identify several features, at least 1km away, that you can sight on.
- Use a map to determine True bearings to these features. Convert these bearings to Magnetic using the calculated declination for the area.
- Check your compass and technique. Experiment with your gear to see if it influences your compass.
- Keep notes, so you can repeat this in the future.