1. Identify the following acronyms; compare these platform types; provide situations where one platform may be more advantageous over another. (6 pts.)
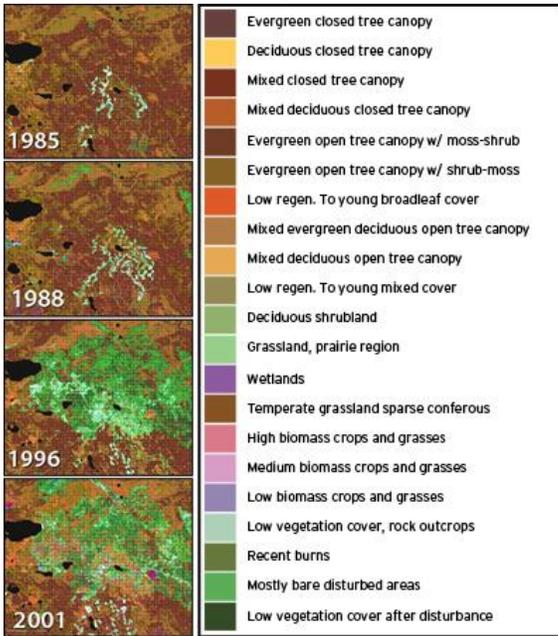
SAR

LIDAR

2. Many remote sensing studies create land use maps (As in Figure 1 below). How might someone create such a map without physically visiting all the locations on the map? (4 pts.)

Figure 1: Land cover map of Australia

3. In figure 2, what is the predominant land cover in 1985? 1988? 1996? 2001? Describe the overall disturbance. (6 pts.) **2nd Tie Breaker Question

Figure 2: Land cover change in the Prince Albert National Park

	Evergreen closed tree canopy
	Deciduous closed tree canopy
	Mixed closed tree canopy
	Mixed deciduous closed tree canopy
	Evergreen open tree canopy w/ moss-shrub
	Evergreen open tree canopy w/ shrub-moss
	Low regen. To young broadleaf cover
	Mixed evergreen deciduous open tree canopy
	Mixed deciduous open tree canopy
	Low regen. To young mixed cover
	Deciduous shrubland
	Grassland, prairie region
	Wetlands
	Temperate grassland sparse coniferous
	High biomass crops and grasses
	Medium biomass crops and grasses
	Low biomass crops and grasses
	Low vegetation cover, rock outcrops
	Recent burns
	Mostly bare disturbed areas
	Low vegetation cover after disturbance

4. Using remote sensing terminology, what is the difference(s) between the two images in Figure 3? How are these images produced? (6 pts.)

Figure 3: Landsat images of Chesapeake Bay.
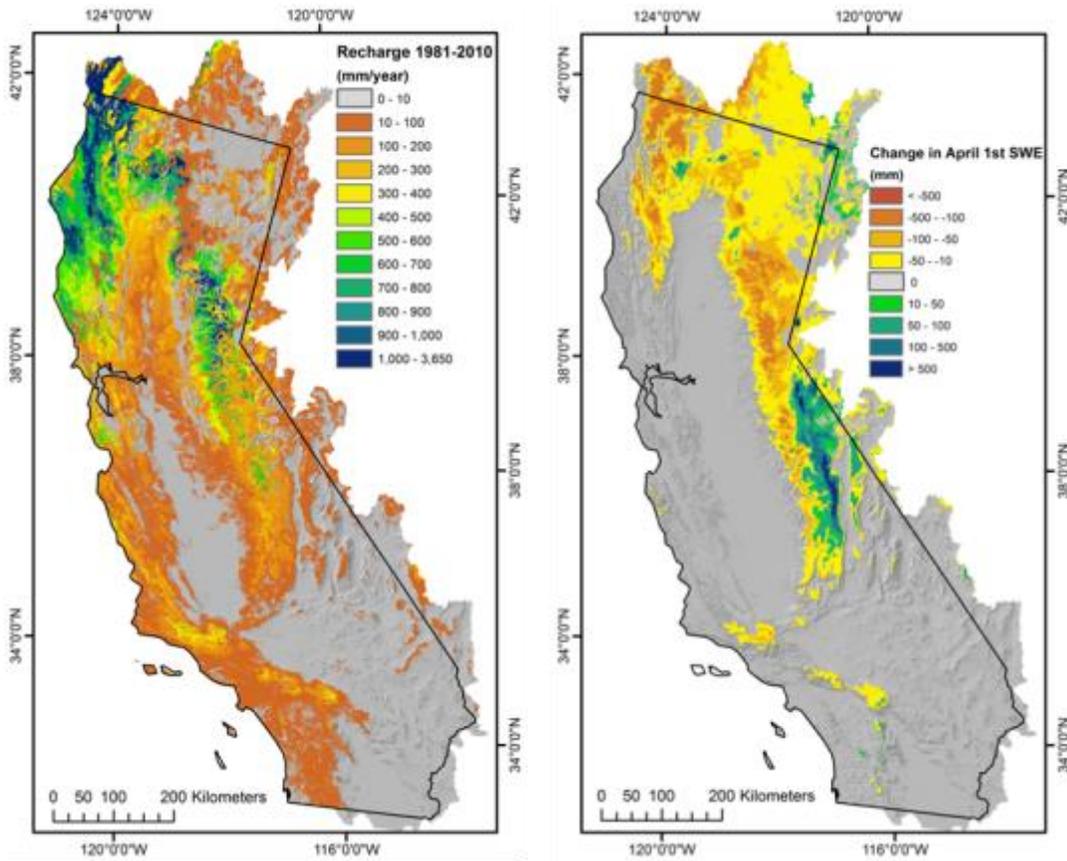
Image A: Image B:

5. Referring to the Basin Characterization Model below, describe how the follow maps are making a case for changes in climate. (4 pts.)


6. Using Figure 4, answer the following questions:
If anthropogenic activity disturbs the carbon stored in soils and 550 GtC is released into the atmosphere, calculate the final values for atmosphere, vegetation, and ocean sediments if 25% is absorbed by the atmosphere, 31% by vegetation, and the remainder by ocean sediments. (6 pts.)

Figure 4: Global Carbon Cycle (source: Hadley Centre models)
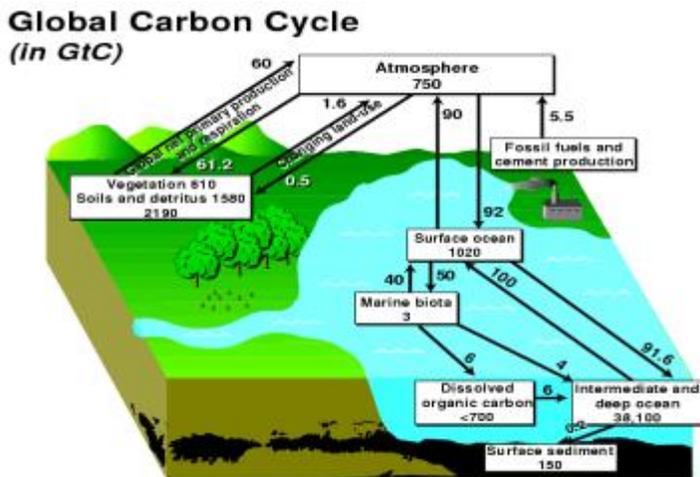
7. Describe the patterns in the AIRS image and provide a possible explanation for the patterns. (4 pts.)
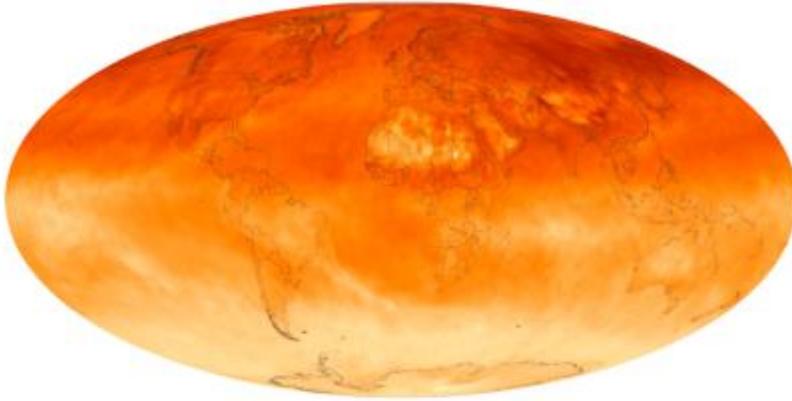
Monthly Average Atmospheric Methane for January 2016 (ppmv at 400 hPa)

≤1.7   1.8   ≥1.9

8. Using the figure below, indicate where the following are located:
Microwave, Visible Light, Radio, Gamma, X-ray, Ultraviolet, Infrared (1 pt each)

10^3 10^{-2} 10^{-5} 10^{-6} 10^{-8} 10^{-10} 10^{-12}
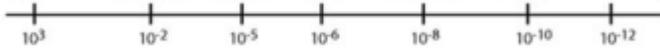
9. Deforestation occurs in many countries around the world at different times therefore it is difficult to detect the ongoing damage. Which of the following remote sensing instruments would be best suited to monitor the deforestation? Explain your answer. Choose one of these instruments (Thermal infrared, Microwave, Radar, Sonar, and Color infrared) (2pts)

10. Describe the relationship between surface air temperature and ground albedo. (2 pts)

11. Write out the full name for the following terms. (1 pt. each) ** 1st Tie breaker question
RADAR
SONAR
MODIS
GOES
GRACE
SeaWiFS
LASER
TRMM
ETM+
CERES

11. Using the diagram below, answer the following questions:
        a. What could have caused the relatively low albedo along the mountains?
        b. What could have caused the relatively high albedo along the coastal plain?
        c. When did snowmelt start along the mountains? Along the coastal plain?
        d. Estimate when complete snowmelt occurred.
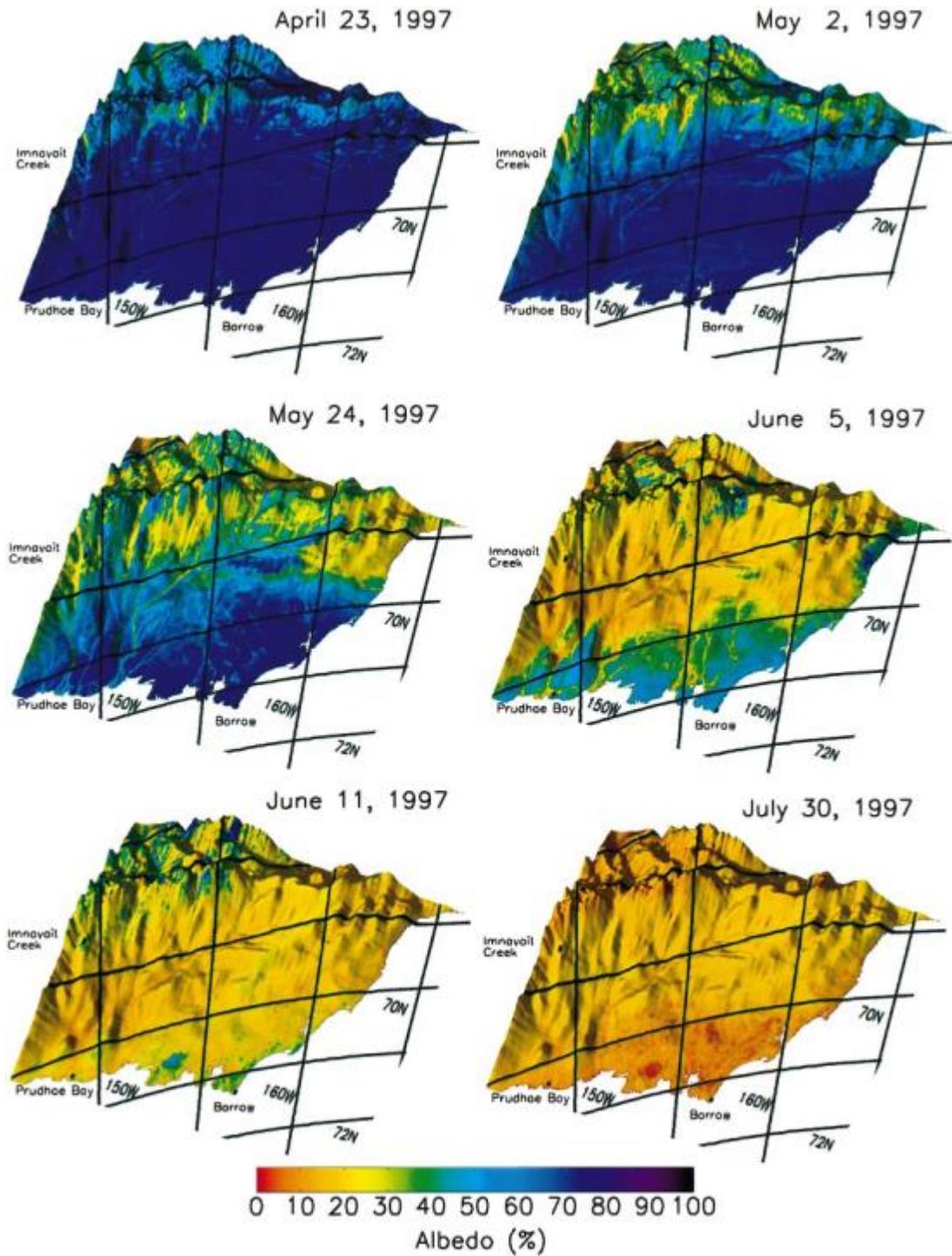
Spatial variations of surface albedo on 23 Apr, 2 May, 24 May, 5 Jun, 11 Jun, and 30 Jul 1997, respectively, on the North Slope of Alaska obtained from the AVHRR Polar Pathfinder data products at the NSIDC.

1. Electromagnetic waves are defined to behave in the same way of which of the following waves?
a) Longitudinal waves
b) Transverse waves
c) Compressional waves
d) Sound waves

2. What range of colors are used is for the sensing, representation, and display of images in modern electronic systems and photography?
a) Cyan, Magneta, Yellow
b) Red, Green, Blue
c) Cyan, Green, Yellow
d) Red, Green, Yellow

3. Although carbon dioxide is the most important greenhouse gas, methane molecules trap heat with an efficiency that is _____ times larger than that of a molecule of carbon dioxide
a) 20
b) 15
c) 10
d) 5

4. The refractive index of the ocean water:
a) increases with salinity
b) increases with temperature
c) decreases with salinity
d) decreases with temperature

5. The arrangement of terrain features which provides attributes: the shape, size and texture of objects, is called
a) spectral variation
b) spatial variation
c) temporal variation
d) None of these

6. The instruments which provide electromagnetic radiation of specified wave length or a band of wave lengths to illuminate the earth surface, are called
a) image sensors
b) passive sensors
c) active sensors
d) none of these

7. If 0 is the angle of scan measured from the nadir, the ground distance swept by the sensor IFOV is proportional to
a) $\sin^2\theta$
b) $\cos^2\theta$
c) $\sec^2\theta$
d) $\tan^2\theta$

8. Which one of the following helps to identify the objects on the Earth's surface?
a) atmospheric window
b) signature
c) radiometric error
d) None of these

9. The spectral region of the electromagnetic radiation which passes through the atmosphere without much attenuation is known as
a) ozone hole
b) atmospheric window
c) ozone window
d) black hole

10. The most widely used antenna in GPS is
a) Parabolid antenna
b) Microstrip antenna
c) Horn antenna
d) Slotted antenna

11. Which one of the following parameters is considered to determine the reflectance of a vegetation canopy
a) Solar zenith angle
b) Azimuth angle
c) Number and arrangement of leaves
d) All of these

12. The interaction of the electromagnetic radiation produced with a specific wave length to illuminate a target on the terrain for studying its scattered radiance, is called
a) passive remote sensing
b) active remote sensing
c) neutral remote sensing
d) None of these

13. In case of reflection and refraction of electromagnetic radiation,
a) angle of incidence = angle of refraction
b) angle of incidence = angle of reflection
c) angle of refraction = sum of the angles of incidence and refraction
d) All of the above

14. For interpolation of satellite data used for monitoring dynamic changes that occur on the earth surface, the most suitable orbit for the satellite is
a) sun-synchronous orbit
b) circular orbit
c) near polar orbit
d) None of these

15. The ratio of the total solar radiant energy returned by a planetary body to the total radiant energy incident on the body, the called
a) reflectance
b) reflectance factor
c) albedo
d) sun glare

16. The reflectance from a surface is called specular reflection if it follows
a) Snell's law
b) Lambert's cosine law
c) Planktan's law
d) all of these

17. In sun light, water rich in phytoplankton appears
a) red
b) green
c) brown
d) blue

18. What is the most *prevalent* greenhouse gas in the earth's atmosphere?
a. Carbon Dioxide
b. Water Vapor
c. Methane
d. Nitrous Oxide
e. Ozone

19. Images sometimes appear slightly to the west of each previous scan due to the eastward rotation of the Earth. This is due to:
a. Skew distortion
b. Relief displacement
c. Tangential scale distortion
d. Foreshortening
e. None of the above

20. A pulse of light is sent down from a sensor (using lidar) toward Earth. The sensor is orbiting the earth from a distance of approximately 80 km. The pulse is intended to measure the height of a mountain. If the pulse takes .0005 seconds to reach the mountain and get back (to the sensor), how high is the mountain (take the speed of light to be 3 x 105 km/s)?
a. 1.8 km
b. 2.0 km
c. 3.0 km
d. 5.0 km

21. What does a *dichroic grating* do in satellite systems?
a. Separates thermal and nonthermal energy
b. Separates incident energy into bands 1 and 2
c. Disperses the thermal energy through a prism
d. B and C

22. An orthophoto is useful because of its:
a. High spatial resolution
b. Enhanced topographic relief
c. Camera tilt
d. Uniform scale
e. None of the above

23. An object with an emissivity less than 1 is called a:
a. Blackbody
b. Graybody
c. Selective Radiator
d. All of the above
e. None of the above

24. Which of the following has the lowest albedo?
a) forest
b) ocean
c) asphalt
d) glaciers
e) desert

25. The gas that shows the most variation from place to place and from time to time in the lower atmosphere
a) ozone (O3)
b) carbon dioxide (CO2)
c) water vapor (H2O)
d) methane (CH4)
e) argon (Ar)

26. In the atmosphere, tiny solid or liquid suspended particles of various composition are called
a) aerosols
b) carcinogens
c) greenhouse gases
d) microbes

27. The combined albedo of the earth and the atmosphere is approximately
a) 4%
b) 10%
c) 30%
d) 50%
e) 90%

28. The albedo of the earth's surface is only about 4%, yet the combined albedo of the earth and the atmosphere is higher. Which set of conditions below best explains why this is so?
a) high albedo of clouds, low albedo of water
b) high albedo of clouds, high albedo of water
c) low albedo of clouds, low albedo of water
d) low albedo of clouds, high albedo of water