A satellite view of Earth showing the ocean and atmosphere. The image features a grid of white crosshairs overlaid on the scene. The ocean is a deep blue, and the atmosphere is a lighter blue with some white clouds. The landmasses are visible in shades of brown and green. The number '42' is visible on the left side of the image.

*Remote Sensing of the Ocean
and Atmosphere:*

John Wilkin

*jwilkin@rutgers.edu
IMCS Building Room 211C
732-932-6555 ext 251*

*Orbits and
Measurement Geometry*

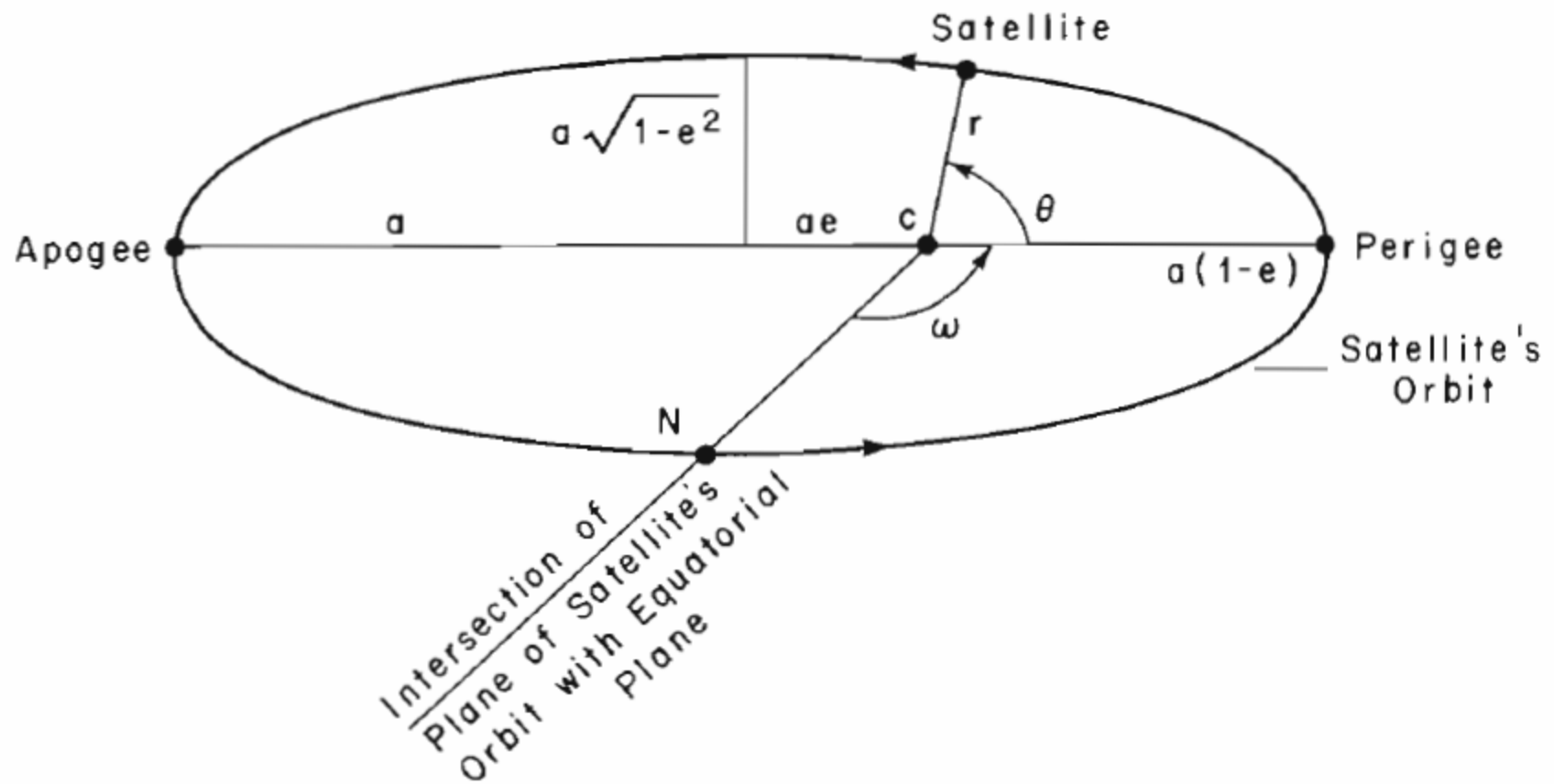


Figure 15.3 Coordinates and notation for describing an elliptical orbit.

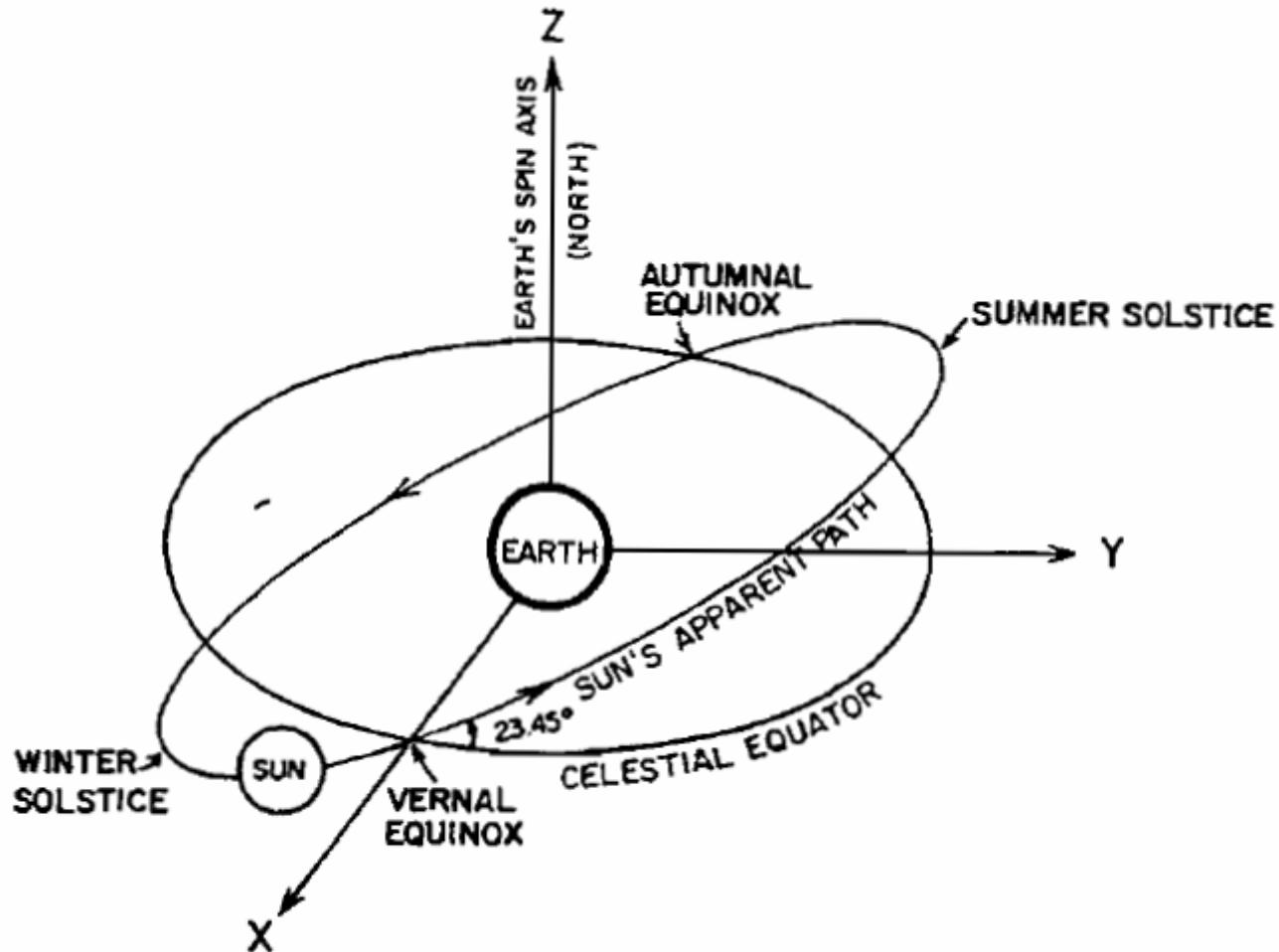


FIGURE 2.4. The right ascension–declination coordinate system.

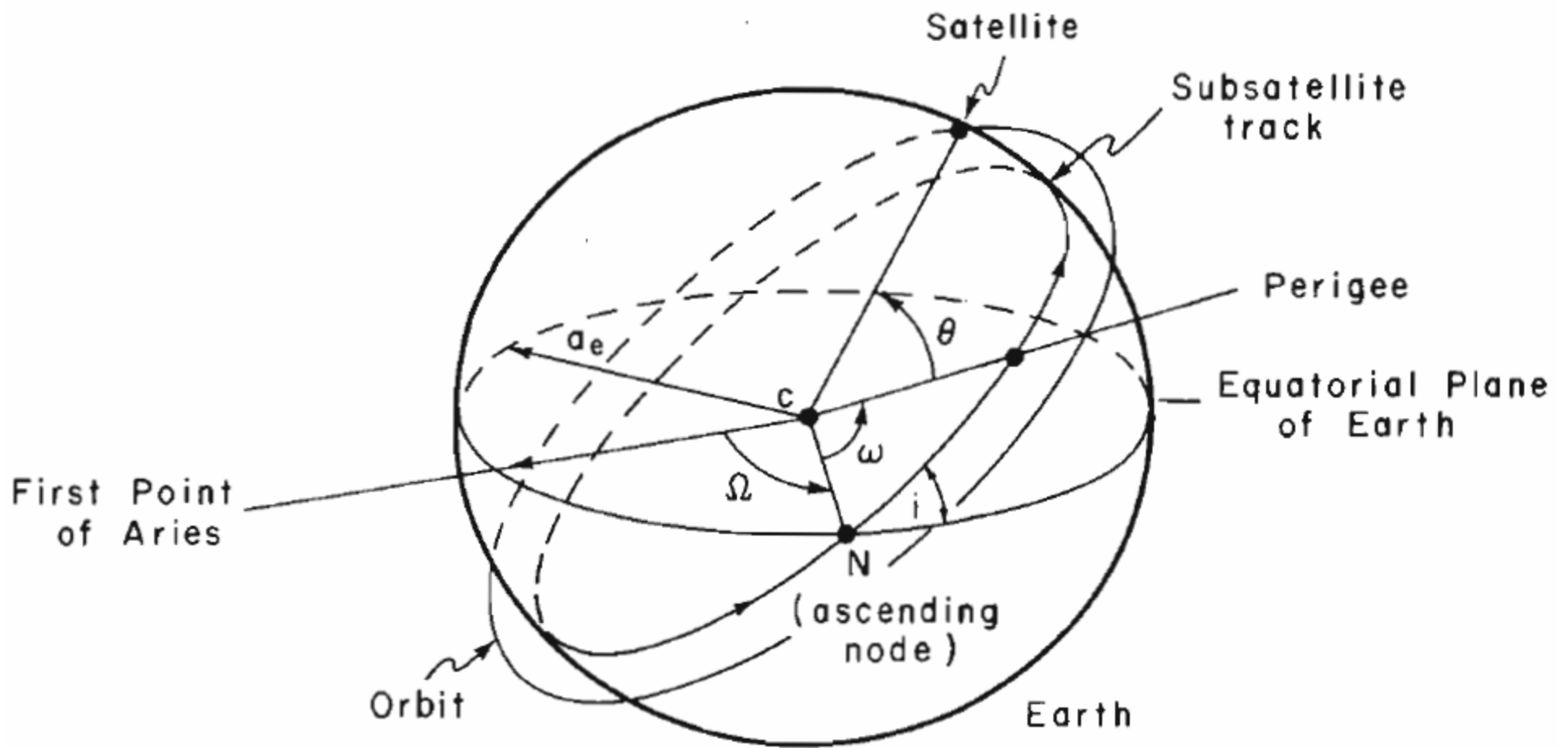
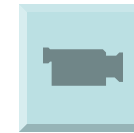
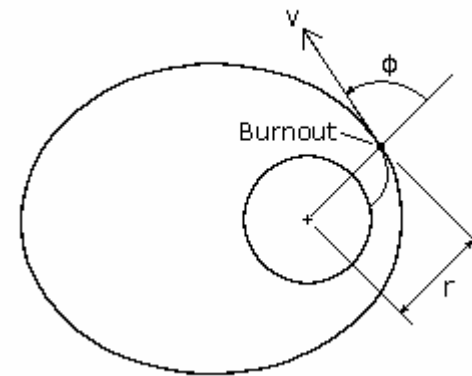


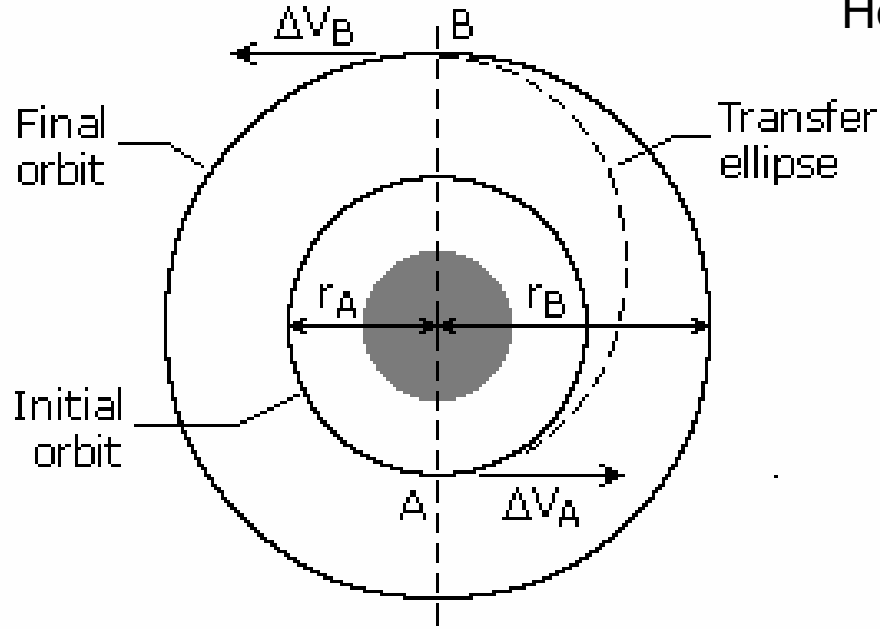
Figure 15.1 Coordinates for describing the orbit of a satellite orbiting around the Earth.

- http://www.jason.oceanobs.com/html/missions/jason/lancement_uk.html
Jason-1 launch from Vandenberg Airforce Base, California.

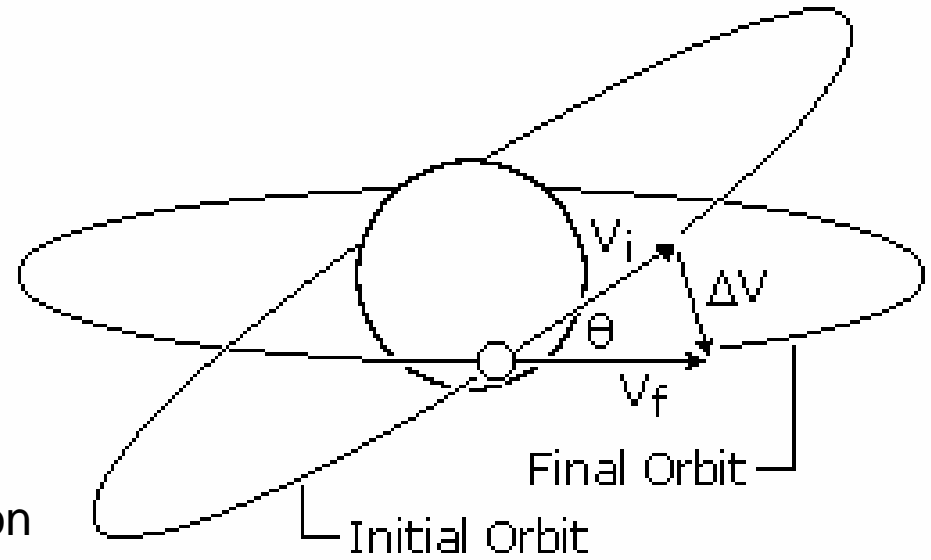


Topex/Poseidon launched with Ariane rocket
<http://sealevel.jpl.nasa.gov/gallery/videos.html>

Hohmann Transfer



Maneuver to different inclination



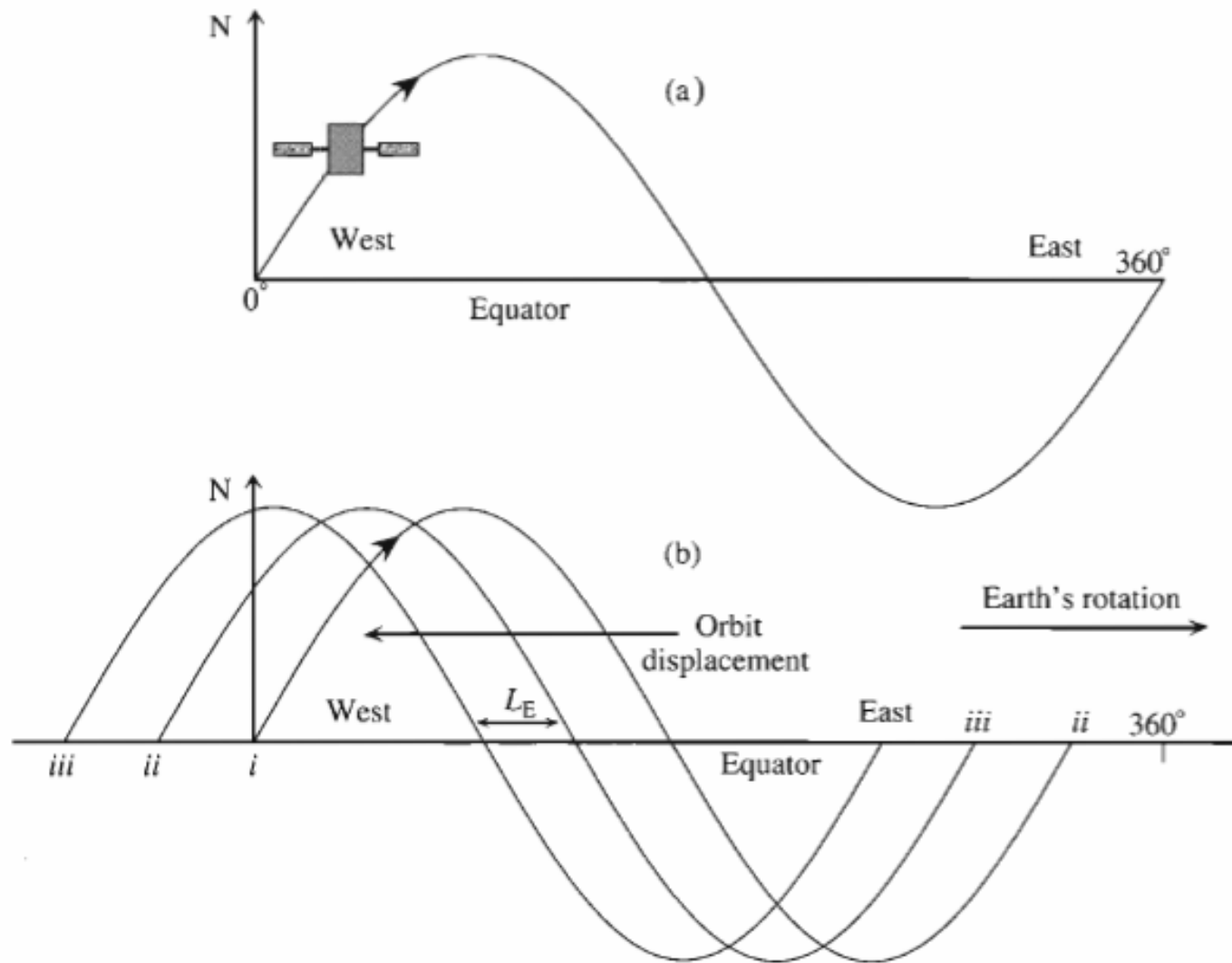


Figure 1.2. Mercator map of the satellite ground track for the orbit in Figure 1.1 and for (a) non-rotating Earth; (b) rotating Earth. See text for further description (Adapted from Elachi, 1987, Figure B-6).

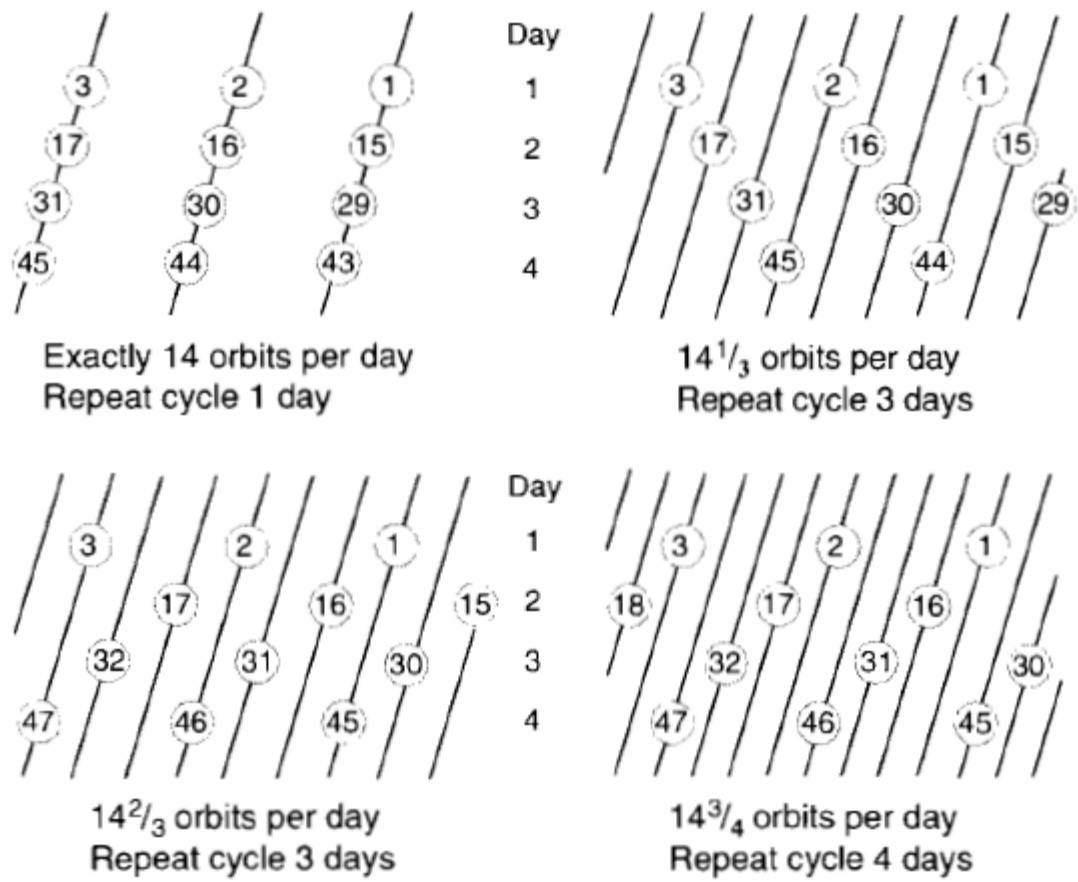
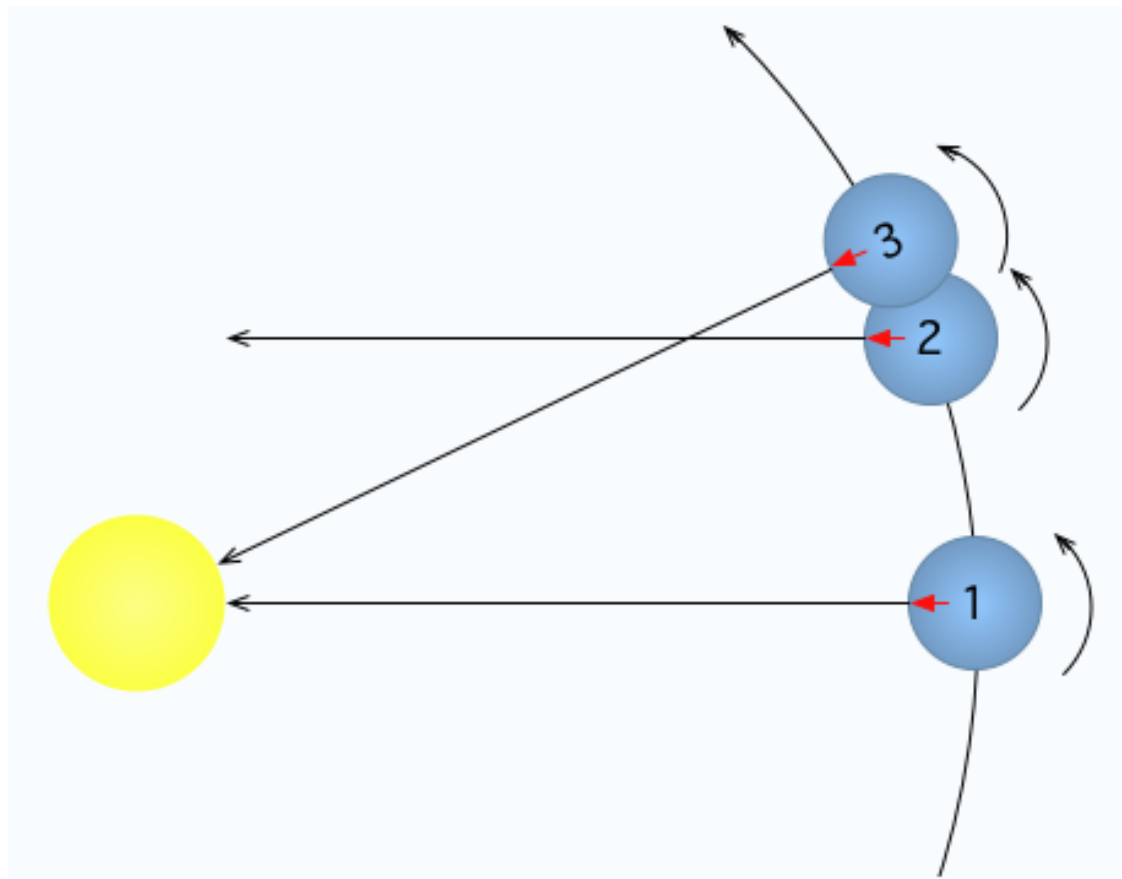


Figure 3.9. The ordering of orbit numbers on successive days for four different numbers of orbits per day. The width of each region is about 75° longitude.

Sidereal day = time it takes for Earth to rotate 360° slightly which is slightly shorter than a solar day (24 hours)

There 365.25 solar days in a year but 366.25 sidereal days

Sidereal day = $365.25/366.25 \times 24 = 29.93$ hours



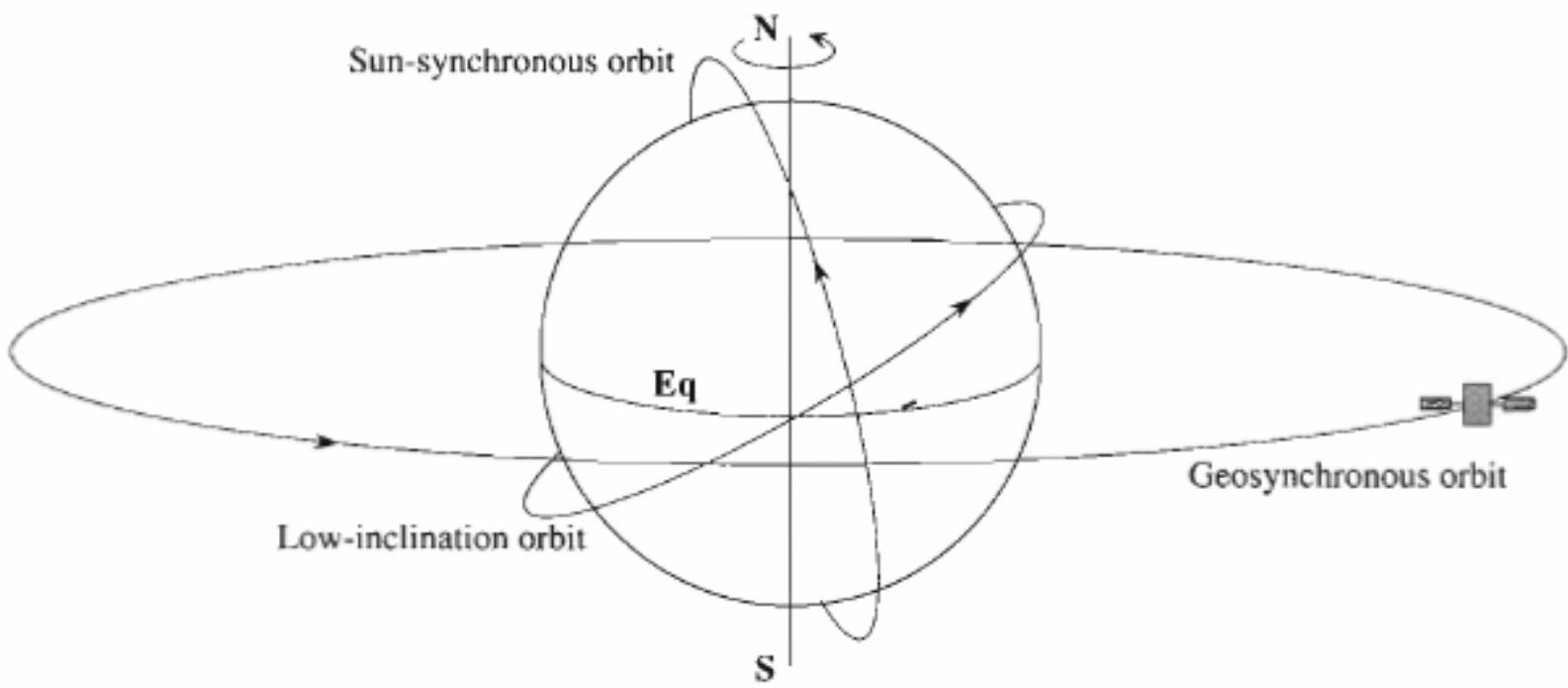
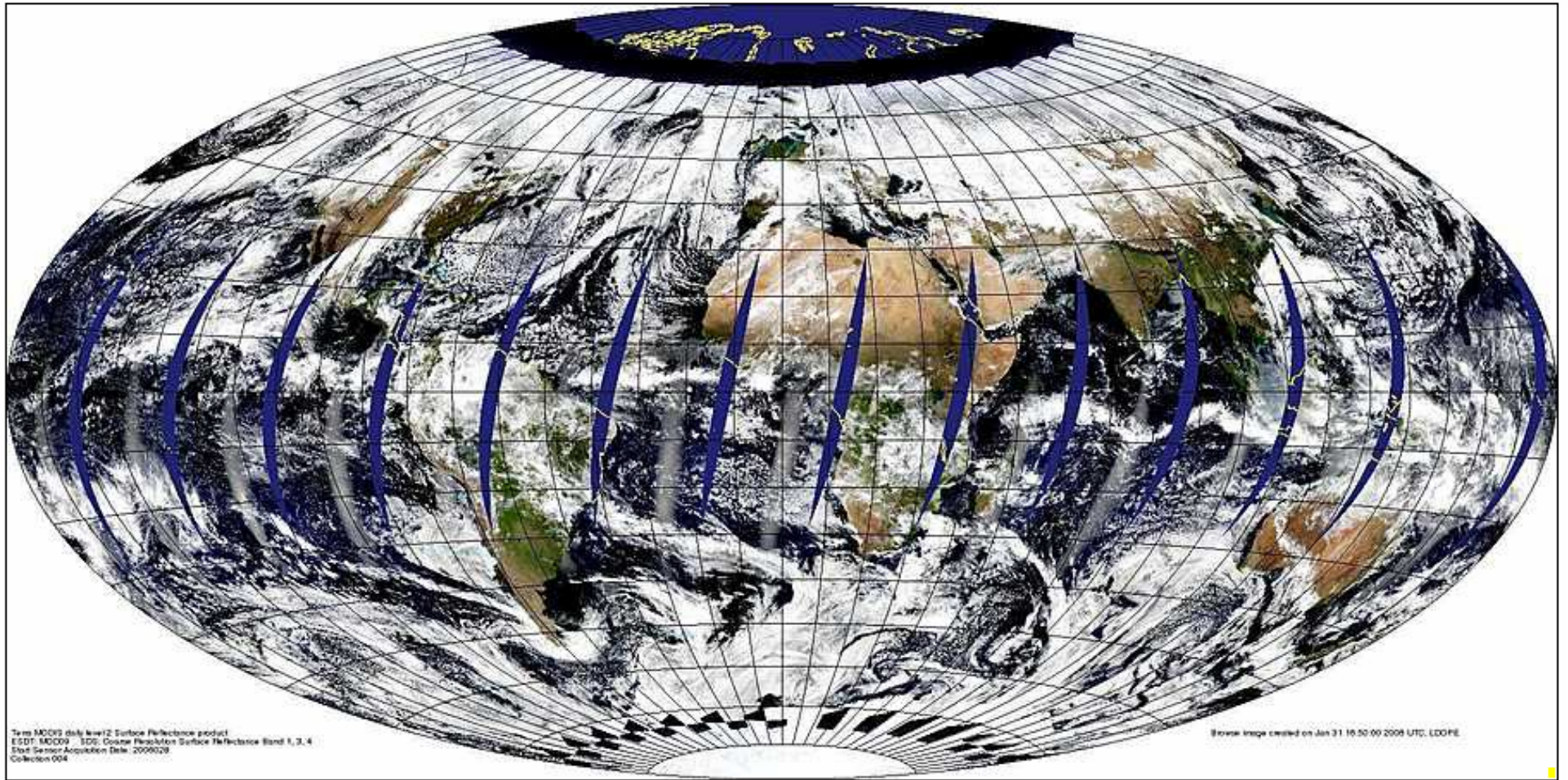


Figure 1.3. Examples of the sun-synchronous, geosynchronous and low-inclination orbits, where 'Eq' is the equator (Adapted from Asrar and Dozier, 1994, Figure 3).



Terra satellite, Modis instrument, day 01/28/2006

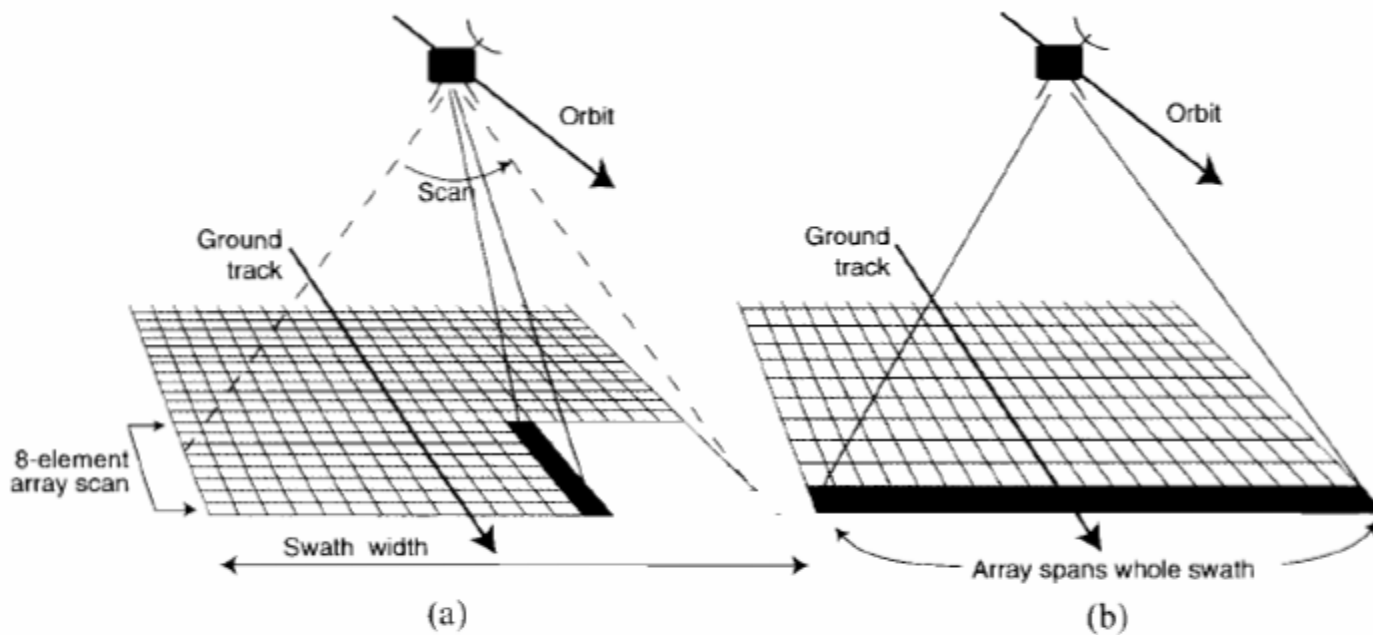


Figure 4.7. Scanning with a linear array detector. (a) With the elements aligned along-track several scan lines are swept out in parallel (whisk-broom mode). (b) With the elements aligned across-track each row of data is acquired without mechanical scanning by sampling across the array (push-broom mode).

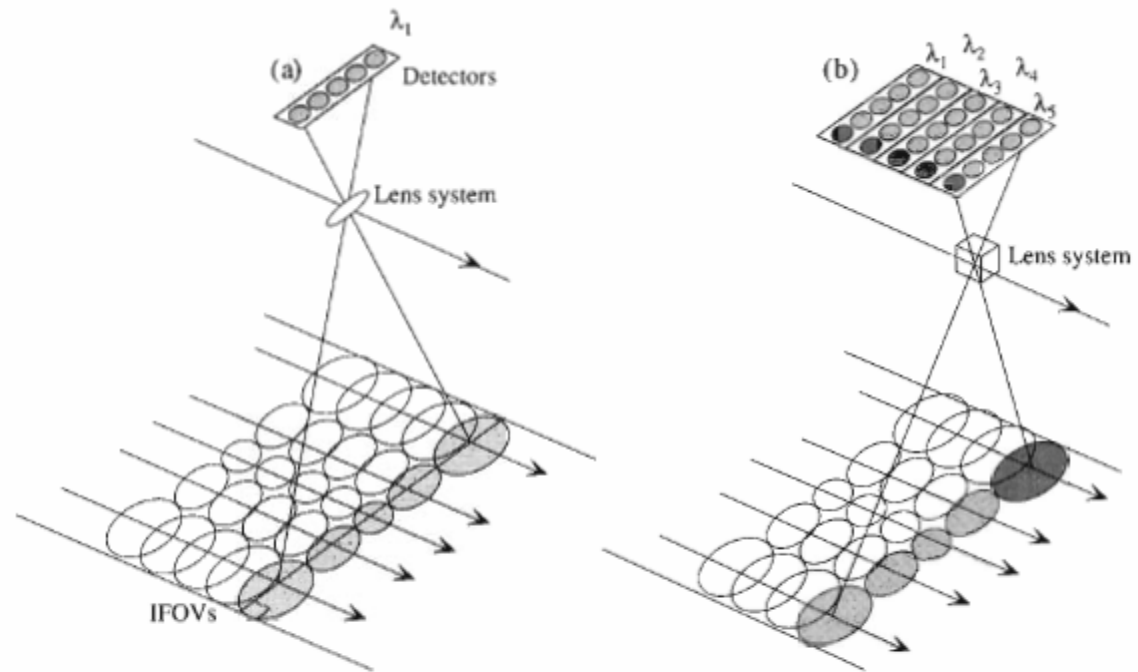


Figure 1.11. Schematic of the along-track or pushbroom scanner. (a) Single wavelength scanner; (b) multi-wavelength scanner. The ellipses show the FOVs; the gray ellipses are simultaneously viewed by the strip of detectors. (b) shows how the dark gray ellipse is viewed at multiple bands by the strip of dark gray detectors. See text for further description.

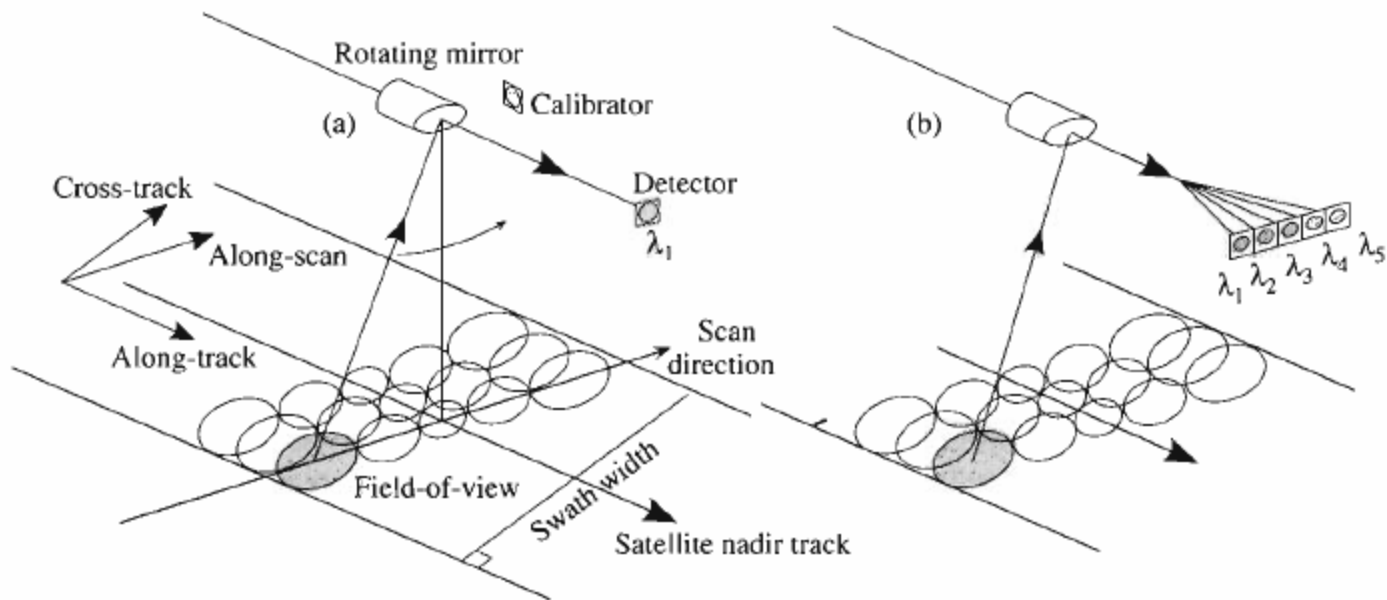


Figure 1.10. Schematic drawing of a cross-track or whiskbroom scanner. The circles show the fields-of-view; the gray ellipse shows the instrument FOV; the radiation from the FOV is focused on the detector, also shown in gray. (a) Single wavelength scanner; (b) multiwavelength scanner. The λ_i are the center wavelengths of the detectors.

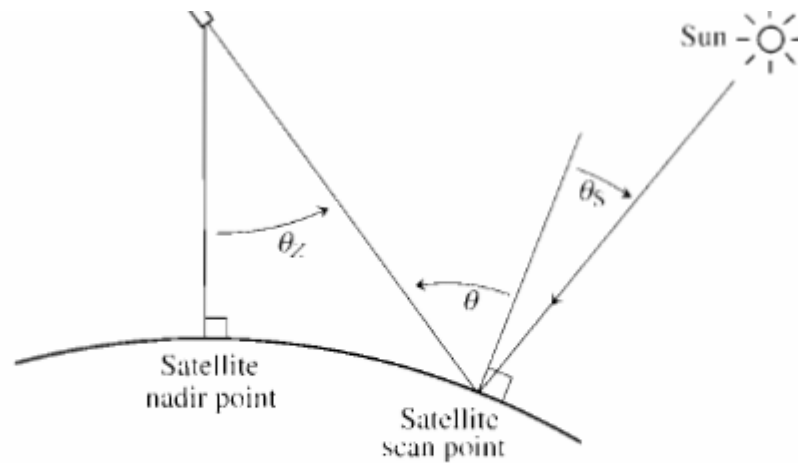


Figure 1.8. The angles used to describe the sensor view direction and the solar angle relative to a spherical Earth. The angle θ_z is the zenith or view angle associated with the satellite sensor and is defined relative to satellite nadir. θ is the incidence or look angle and θ_s is the solar zenith angle, both defined relative to the local vertical at the satellite scan point.

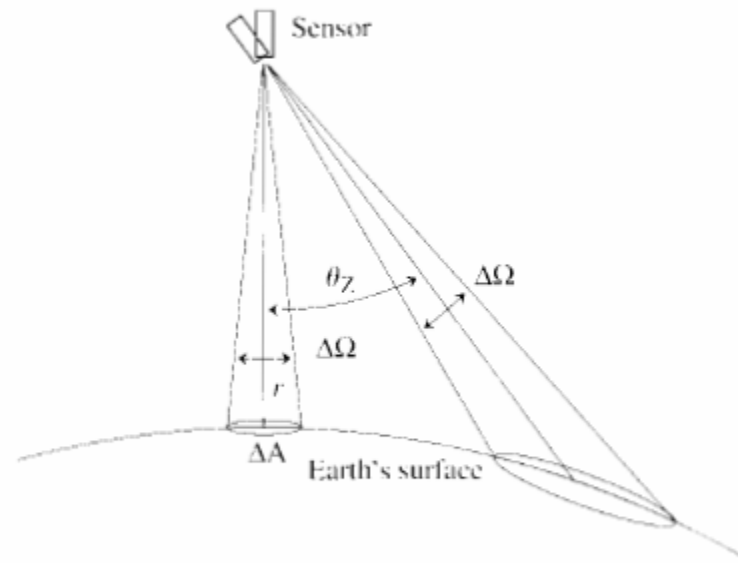


Figure 1.9. The surface area observed by an optical instrument with a constant solid angle field-of-view, for nadir and off-nadir view angles.

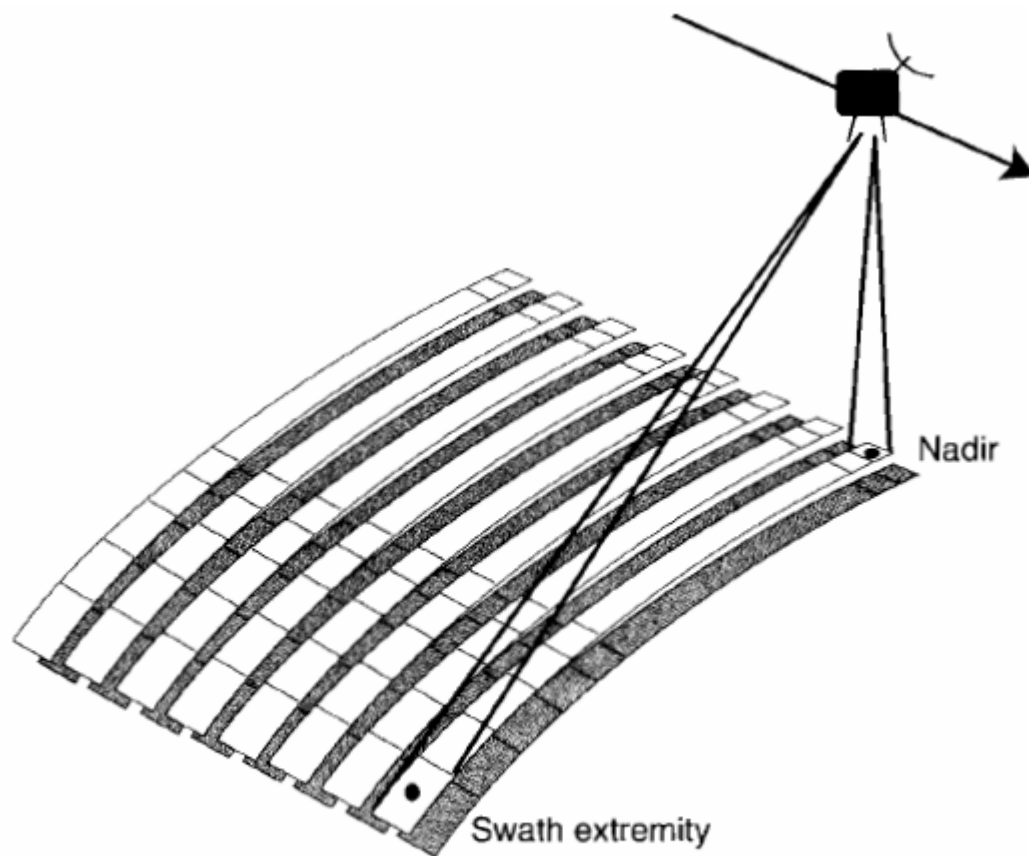


Figure 4.6. Variation of spatial resolution with view angle. Every second scan line has been lowered and shaded to clarify the overlap. Note the contiguous square pixels at nadir and the overlapping, distorted rectangular pixels at the swath extremity.

Internet resources on orbits and launches

- <http://science.nasa.gov/realtime/jtrack/Spacecraft.html>
Shows ground tracks and 3-D orbits for all satellites
 - Notice the clusters of satellites in the major categories or orbits
 - Geostationary
 - Polar orbiting (NOAA, Topex, ERS, Envisat)
 - Low Earth orbit (Iridium, HST, ISS)
 - GPS
 - Unusual orbits (especially ground track)
 - Chandra
 - IMAGE
 - CRRES (in a geosynchronous transfer orbit)
- <http://heavens-above.com>
Shows predicted orbits and visibility magnitudes and star charts of pass trajectories for all satellites
 - See Homework 2
- http://www.jason.oceanobs.com/html/missions/jason/lancement_uk.html
Jason-1 launch from Vandenberg Airforce Base, California.