Wed. Feb. 14, 2018

- Reading: Start Ch. 4
  - Note most other satellite systems there are OLD
- Landsat 8 OLI vs. older TM comparison
- Landsat 8 TIR vs older thermal instruments
- See previously posted notes for:
  - Landsat interpretation
    - Bands and typical uses
    - Various display options
    - Thermopolis
    - Atlas Mountains – details
    - Arabian Arch (see also pg. 346-355)

Landsat Spacecraft

- Landsat 1, 2, 3 First generation (1972, 1975, 1978)
  - Multispectral Scanner (MSS)
- Landsat 4, 5, (6) Second generation (1981, 1984, 1993)
  - Thematic Mapper (TM)
  - #5 Will be retired shortly -- has problems.
- Landsat 7 Second+ generation (1999)
  - Enhanced Thematic Mapper ETM+
  - Still running, with some hardware glitches
- Landsat 8 (Landsat Data Continuity Mission =LDCM)
  - Launched Feb. 2013. Nominal 5 year life

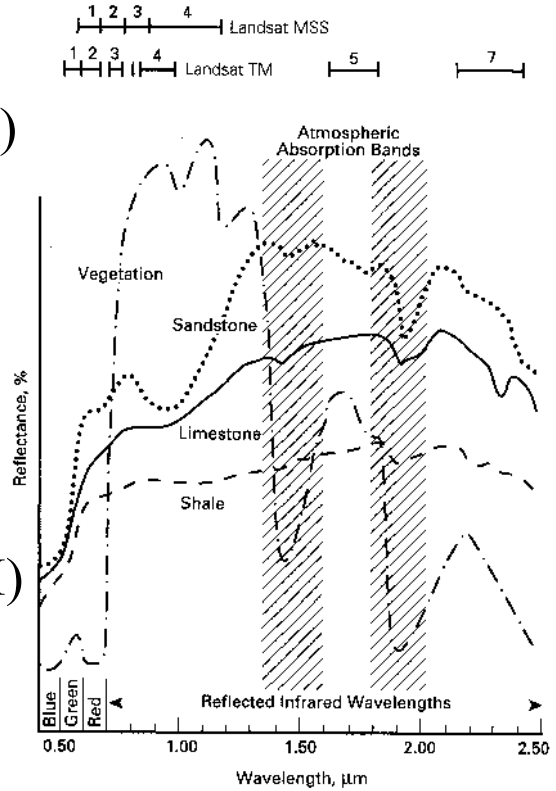
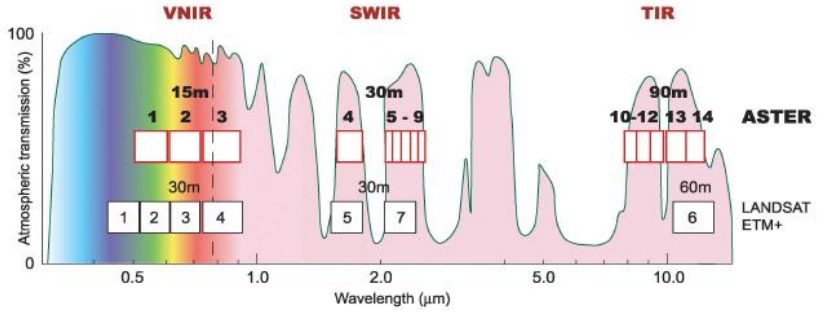
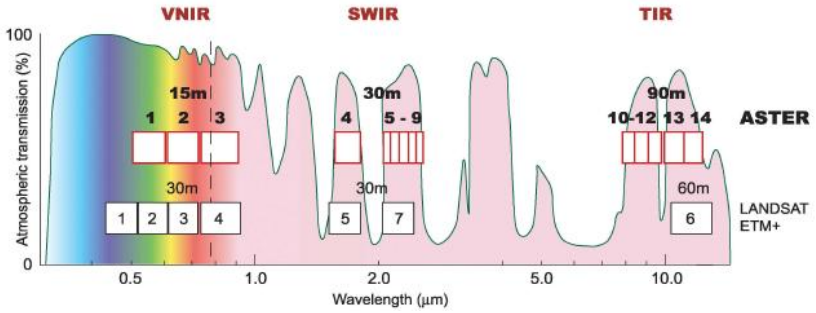


Figure 3-1 Reflectance spectra of vegetation and sedimentary rocks, showing spectral ranges of Landsat MSS and TM bands.



Landsat 8 Changes

- Operational Land Imager (OLI) replaces TM and ETM+ for visible and NIR
  - Pushbroom rather than crosstrack (wiskbroom) sensor
  - A few extra bands -- and high SNR on all
  - Does NOT have TIR channel -- separate instrument for that:
- Thermal Infrared Imager (TIR) replaces the old channel 6 on TM
  - Also a pushbroom sensor
  - Had two bands instead of TM's one

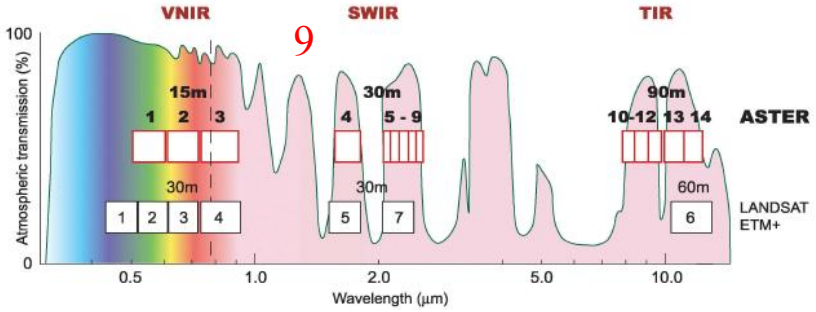


OLI vs. ETM+ bands

- New blue band (for ocean color work)
- New NIR band (1.360-1.390 µm) deliberately in water vapor band, for cirrus cloud detection.
- Minor adjustments to others (Panchromatic narrower for better veg./non-veg. constrast)
  -

Table 1. OLI and ETM + spectral bands.

OLI spectral bands			ETM + spectral bands		
#	Band width (µm)	GSD (m)	#	Band width (µm)	GSD (m)
1	0.433–0.453	30			
2	0.450–0.515	30	1	0.450–0.515	30
3	0.525–0.600	30	2	0.525–0.605	30
4	0.630–0.680	30	3	0.630–0.690	30
5	0.845–0.885	30	4	0.775–0.900	30
6	1.560–1.660	30	5	1.550–1.750	30
7	2.100–2.300	30	7	2.090–2.350	30
8	0.500–0.680	15	8	0.520–0.900	30
9	1.360–1.390	30			

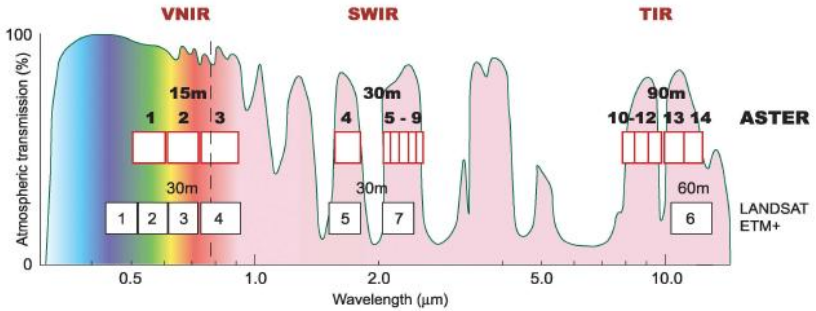


OLI vs. ETM+ SNR

- Greater dwell time (and better detector) provides high signal-to-noise ratios
- Better dynamic range too -- so it will not saturate on very bright scenes

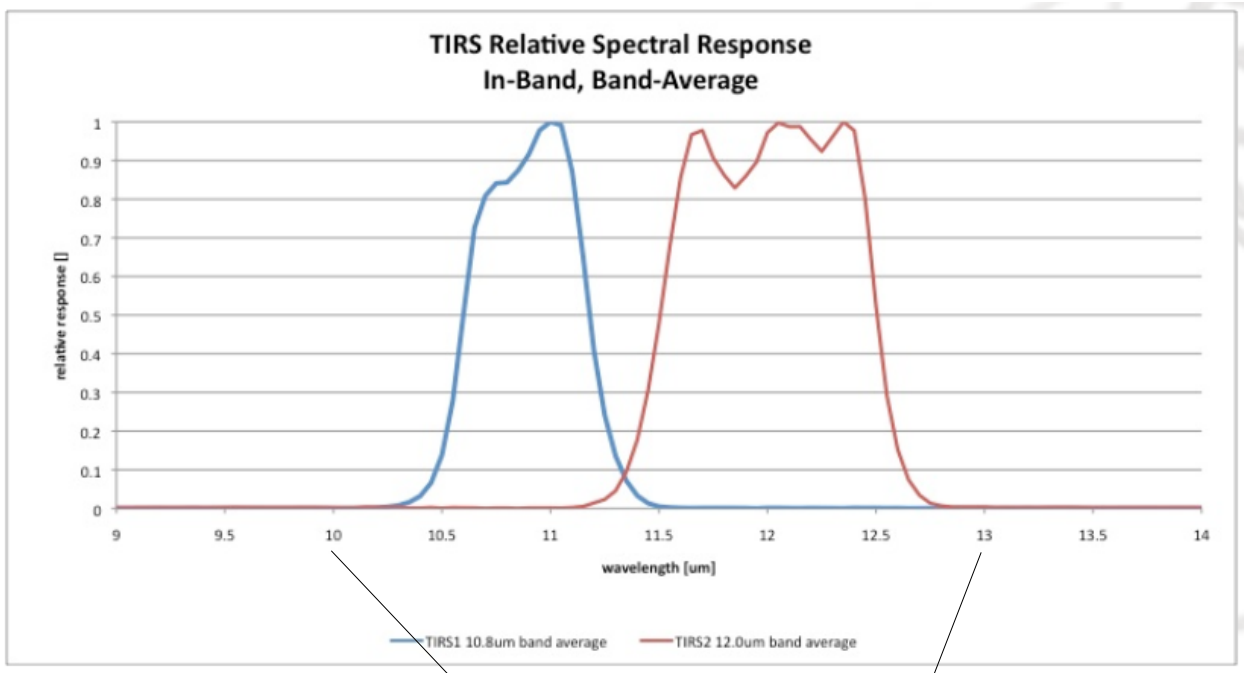
Table 2. Specified OLI signal-to-noise ratios (SNR) compared to ETM + performance.

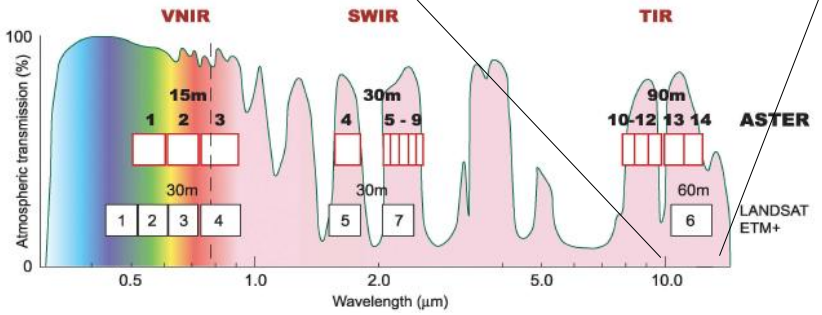
OLI band	Ltypical SNR		Lhigh SNR	
	ETM + performance	OLI requirements	ETM + performance	OLI requirements
1	N/A	130	N/A	290
2	40	130	140	360
3	41	100	186	390
4	28	90	140	340
5	35	90	244	460
6	36	100	183	540
7	29	100	137	510
8	16	80	90	230
9	N/A	50	N/A	N/A



Thermal Infrared Sensor (TIR) now separate instrument

- Separate from OLI because it's detectors need to be cooled
- Also a pushbroom design
- Will have two TIR channels instead of TM's single channel, but won't have ASTER's 5 channels





TM band combinations

Table 3-4 Landsat thematic mapper (TM) spectral bands

Band	*Wavelength, μm*	*Characteristics*
1	0.45 to 0.52	Blue-green. Maximum penetration of water, which is useful for bathymetric mapping in shallow water. Useful for distinguishing soil from vegetation and deciduous from coniferous plants.
2	0.52 to 0.60	Green. Matches green reflectance peak of vegetation, which is useful for assessing plant vigor.
3	0.63 to 0.69	Red. Matches a chlorophyll absorption band that is important for discriminating vegetation types.
4	0.76 to 0.90	Reflected IR. Useful for determining biomass content and for mapping shorelines.
5	1.55 to 1.75	Reflected IR. Indicates moisture content of soil and vegetation. Penetrates thin clouds. Provides good contrast between vegetation types.
6	10.40 to 12.50	Thermal IR. Nighttime images are useful for thermal mapping and for estimating soil moisture.
7	2.08 to 2.35	Reflected IR. Coincides with an absorption band caused by hydroxyl ions in minerals. Ratios of bands 5 and 7 are used to map hydrothermally altered rocks associated with mineral deposits.

*Display colors**	*Advantages*	*Disadvantages*
1-2-3	Normal color image. Optimum for mapping shallow bathymetric features.	Lower spatial resolution due to band 1. Limited spectral diversity because no reflected IR bands are used.
2-3-4	IR color image. Moderate spatial resolution.	Limited spectral diversity.
4-5-7	Optimum for humid regions. Maximum spatial resolution.	Limited spectral diversity because no visible bands are used.
2-4-7	Optimum for temperate to arid regions. Maximum spectral diversity.	Unfamiliar color display, but interpreters quickly adapt.

*TM bands are listed in the sequence of projection colors: blue-green-red.