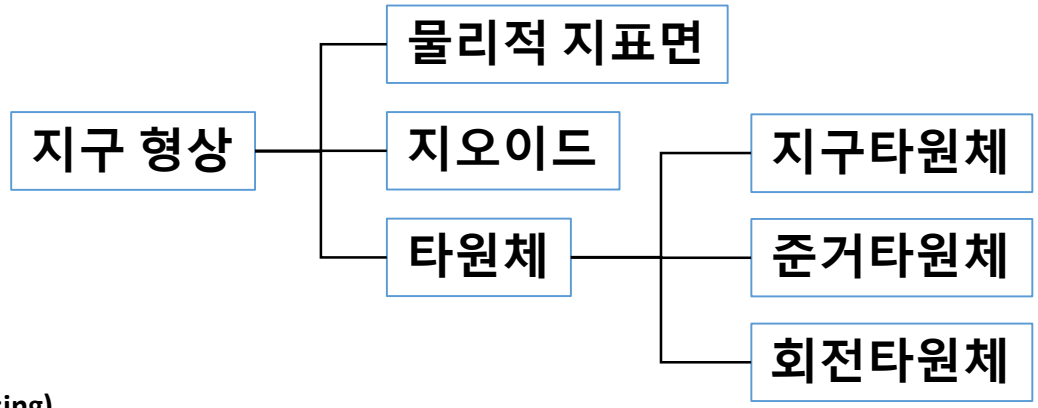
지리 좌표 체계 및 영상 획득 방법

Geographic coordinate system and

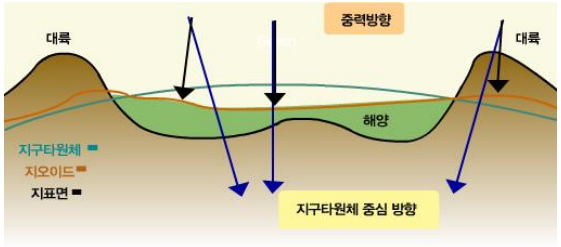
Method of image acquisition



지리 좌표 체계

지오이드 / 기준 타원체 (지구 형상 표현)

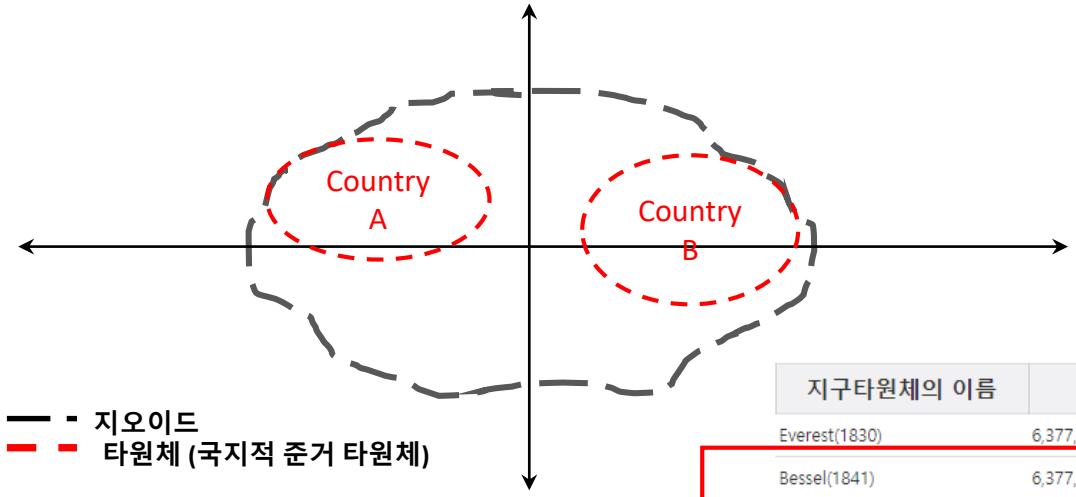
- 측량에서는 지구상 점들에 대한 절대적 / 상대적 위치 결정이 반드시 필요
- 지구 형상 표현하는 방법 : 물리적인 측면, 수학적인 측면



지리 좌표 체계

준거 타원체

- 각 나라에서 해당 지역의 지오이드면에 적합한 지구타원치 정의

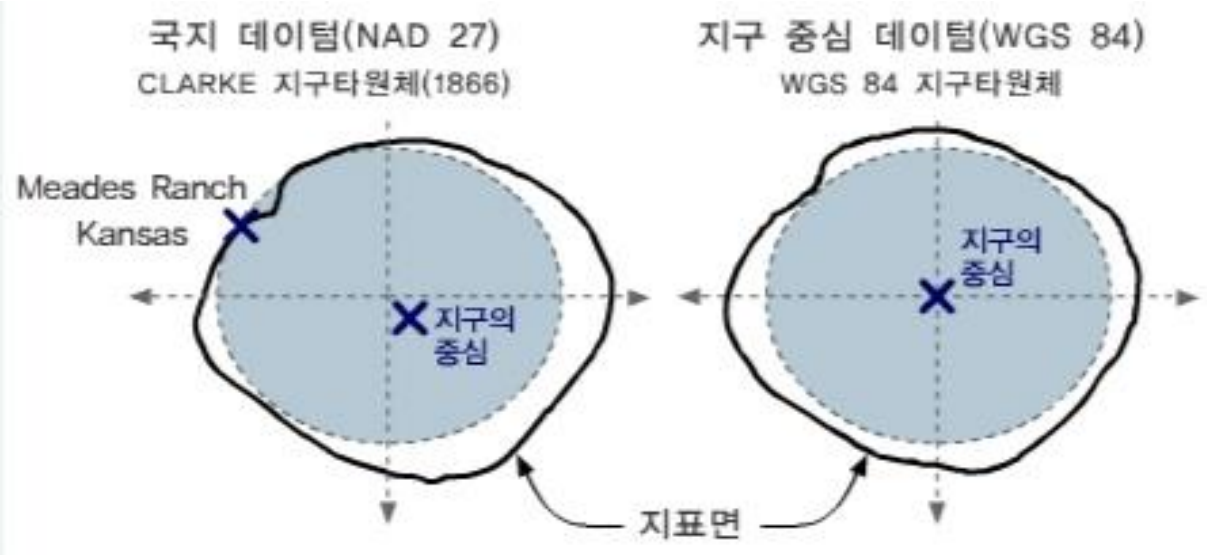


지구타원체의 이름	적도 반경(km)	편평률:(a-b)/a	사용 국가들
Everest(1830)	6,377,276	1/301	인도
Bessel(1841)	6,377,397	1/299	일본, 독일, 한국
Airy(1844)	6,377,563	1/299	영국
Clarke(1866)	6,378,206	1/295	북아메리카
Clarke(1880)	6,378,249	1/293	프랑스, 남아프리카
Hayford(1909)	6,378,388	1/297	북아프리카, 유럽
International(1924)	6,378,388	1/297	국제적으로 채택
Krasovsky(1938)	6,378,254	1/298	러시아
GRS67(1967)	6,378,160	1/298	남아메리카, 호주
WGS72(1972)	6,378,135	1/298	미국 DMA
GRS80(1980)	6,378,135	1/298	국제적으로 채택
WGS84	6,378,137	1/298	세계적으로 사용

지리 좌표 체계

타원체 위치 기준

- 데이텀 (Datum) = 측지계
- 타원체 종류, 좌표체계 기준점 / 방향 등 정의



지도 좌표체계 차이는 어떤 타원체를 사용하며, 어디에 기준점을 두는지,,,
우리나라??

세계기준계인 ITRF2000 지구 중심 좌표계 / GRS80 타원체 적용

지리 좌표 체계

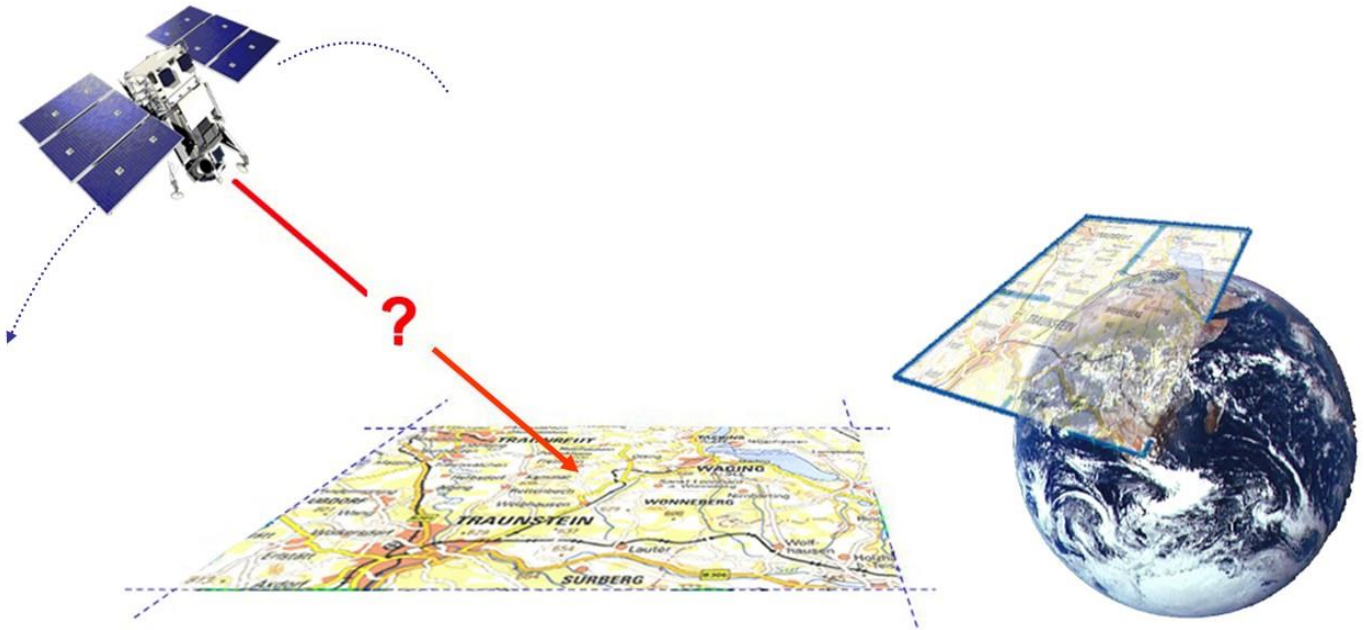
한극 측지계2002(ITFR2000) 및 세계 측지계

- 2001년까지는 동경좌표계(Bessel타원체) 사용
- 이는 일제의 잔재라는 문제만이 아니라 세계화시대의 국가간 실시되는 측위나 측량에도 통일된 기준으로 사용할 수 없다는 문제도 내포
  (해당 내용은 여러 나라에 공통적으로 나타나는 문제점...)
- 우리나라는 2001년 측량법 개정하여 한국측지계 2002 사용
- 2002년 한국 측지계는 세계 측지계(ITRF 2000) 를 근거해 구축
- 한국 측지계 2002에서 위,경도는 세계 측지계인 ITRF2000 데이텀과 GRS80 타원체를 사용해 나타냄
- 별도로 나타내는 이유는 한국 측지계에 근거한 성과와 구변하기 위한 호칭
- 2003년 1월부터 2009년까지 세계측지계/동경측지계를 병행 사용
- 2010년부터 세계측지계 사용 의무화

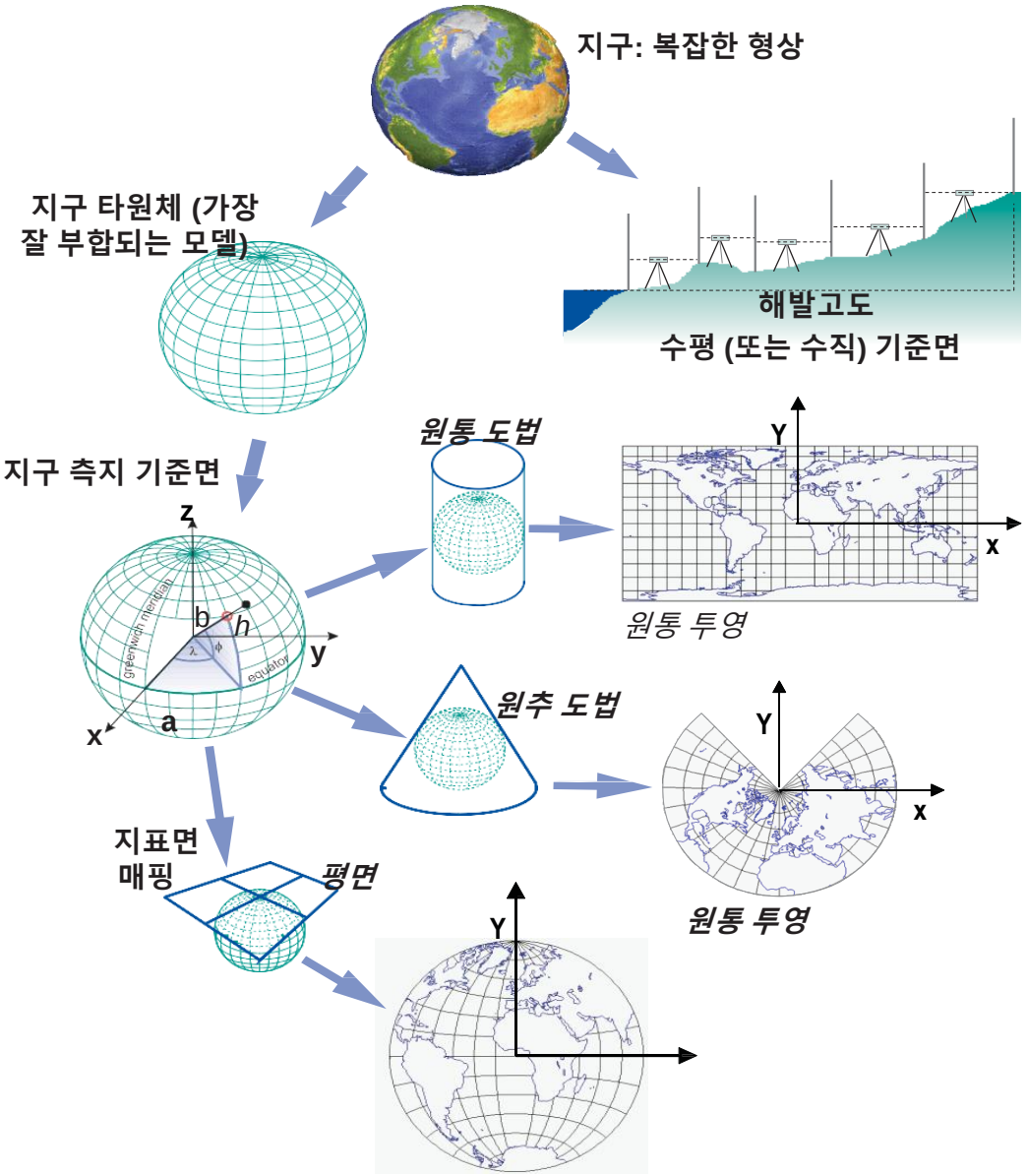
지리 좌표 체계

2차원 투영과 위치 좌표

- 지구 곡면 위에 있는 모든 점들의 위치에 대해 비틀림 현상을 최소화하여 곡면을 평면으로 옮기는 방법

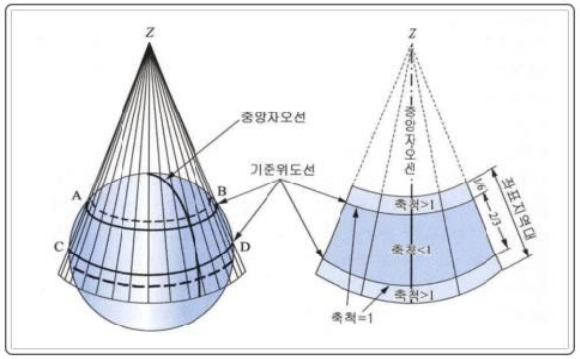


지리 좌표 체계


지구: 복잡한 형상
지구 타원체 (가장 잘 부합되는 모델)
해발고도
수평 (또는 수직) 기준면
원통 도법
지구 측지 기준면
z
y
x
b
h
a
Y
x
원통 투영
원추 도법
Y
x
지표면 매핑
평면
Y
원통 투영

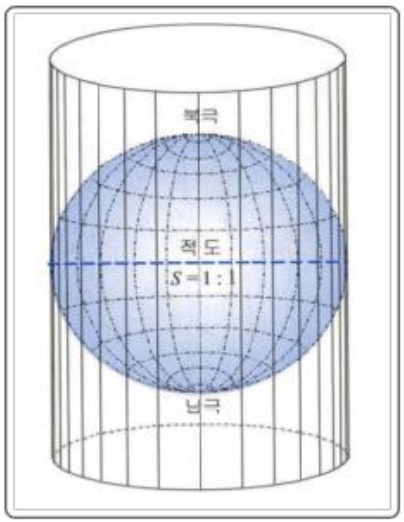
지리 좌표 체계

램버트 원뿔투영



- 지구 회전 타원체를 원뿐의 표면에 투영한 후 이를 절개
- 1772년 램버트에 의해 고안
- 남북 방향이 좁고 동서 방향이 긴 지역에 적당한 투영법

메르카토르(Mercator) 투영



- 지구를 원기둥 표면에 투영한 후 투영된 원기둥을 절개하여 평면으로 사용
- 1569년 항해용으로 고안
- 위도가 증가할 수록 축척은 점점 커져 위도 60도에 이르러서는 적도보다 2배 정도 커짐

지리 좌표 체계

TM(Transverse Mercator) 투영

- 메르카토르 투영에서 90도 회전시켜 중앙 자오선에 접하도록 원기둥 투영
- 1777년 램버트에 의해 처음 고안
- 우리나라에서도 채택된 투영법
- 동서가 좁고 남북으로 긴 지역에 적합

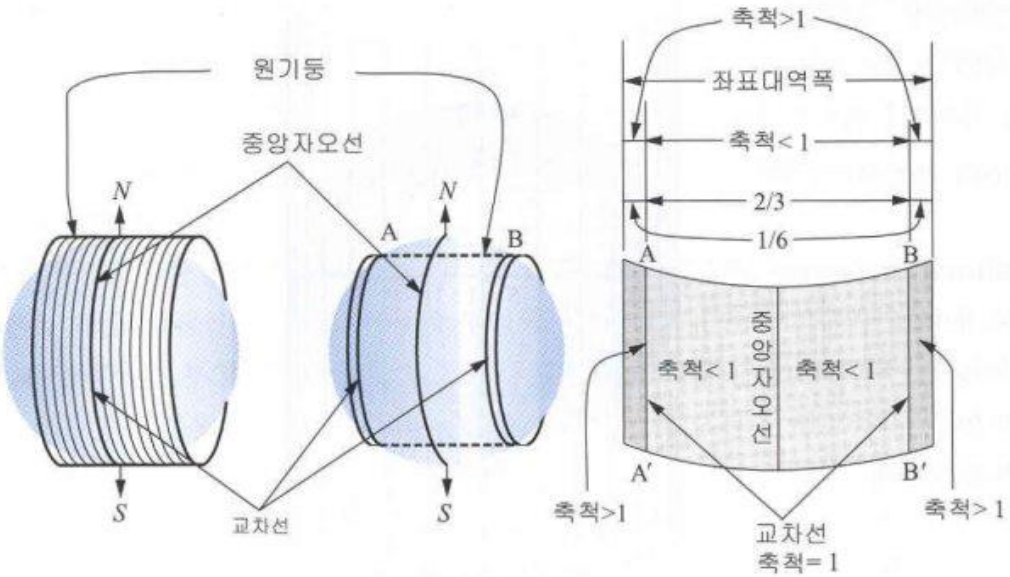
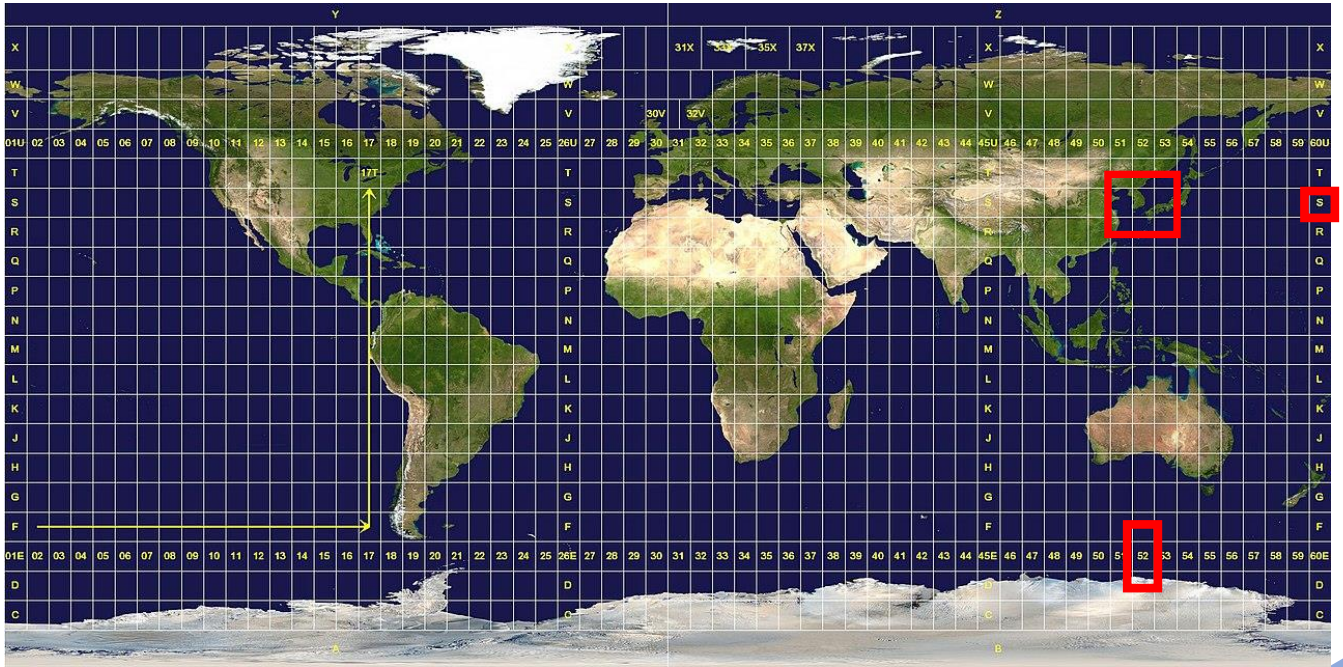


그림 1.18 TM 투영

지리 좌표 체계

UTM(Universal Transverse Mercator) 투영

- 전 지구상 점들의 위치를 통일된 체계로 나타내기 위한 격자 좌표 체계
- 경도 6도 간격으로 세로 띠로 나누어 횡축 메르카토르 도법으로 그림
- 위도 8도간격으로 총 60x20 개의 격자로 나누어 각 세로 구역마다 설정된 원점에 대한 종,횡 좌표로 위치를 나타냄
- UTM좌표계는 극지방으로 가도 직사각형 모양을 유지



지리 좌표 체계

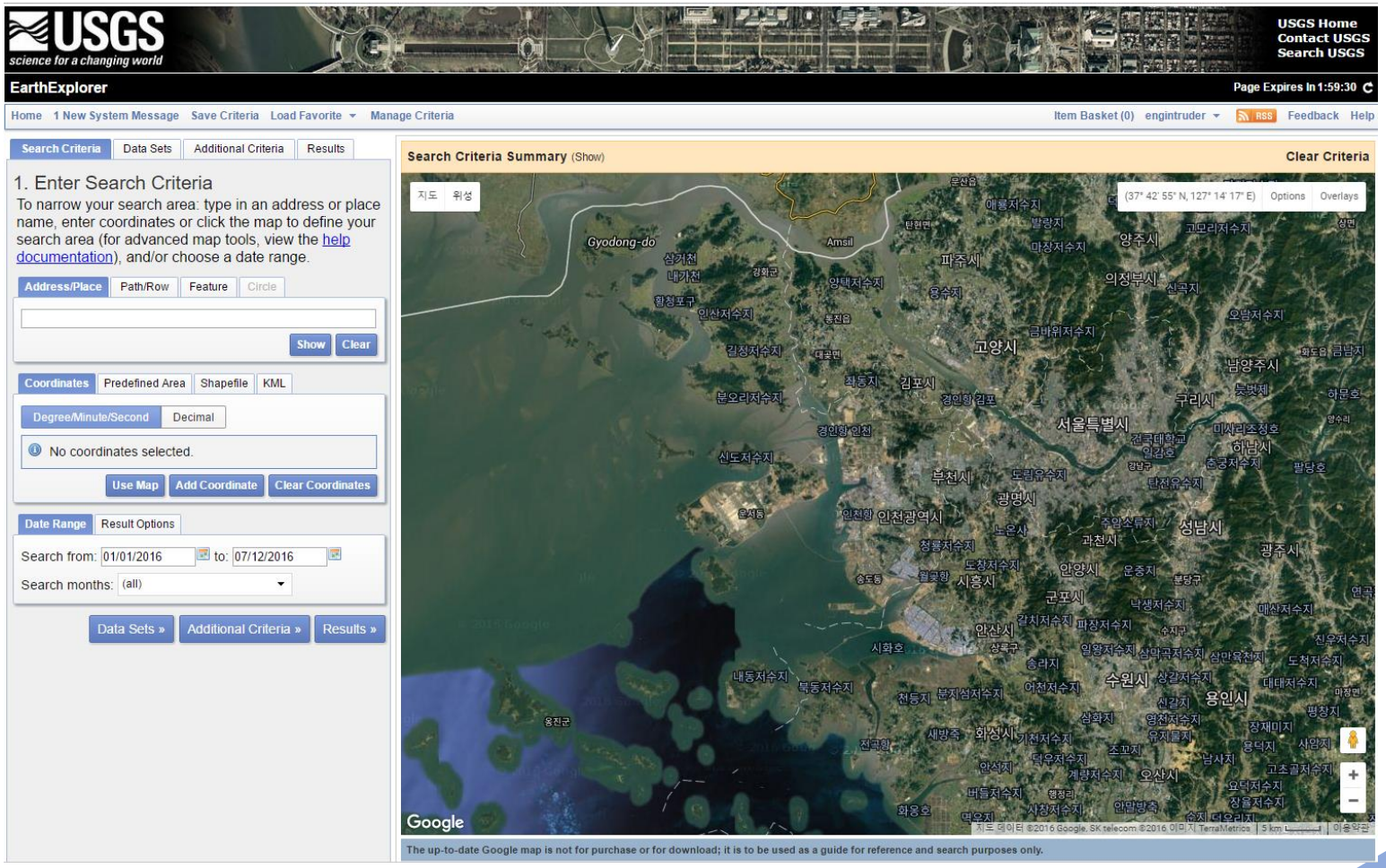
■ 좌표계 정리

Spheroid	Division		Code	System	Name	Datum Name	Projection	Central Meridian	Latitude of Origin	False Northing	False Easting	Scale Factor	비고
Bessel1841	경위도		EPSG:4004	GCS	Bessel 1841	Bessel 1841	-	-	-	-	-	-	세계공통명칭
			EPSG:4301	GCS	Tokyo	Tokyo	-	-	-	-	-	-	일본사용명칭
			EPSG:4162	GCS	Korean Datum 1985	Korean Datum 1985	-	-	-	-	-	-	한국사용명칭
	직각좌표	구좌표	EPSG:2096	PCS	Korean 1985 Korea East Belt	Korean Datum 1985	TM	129	38	500,000	200,000	1	동부원점
			EPSG:2097	PCS	Korean 1985 Korea Central Belt	Korean Datum 1985	TM	127	38	500,000	200,000	1	중부원점
			EPSG:2098	PCS	Korean 1985 Korea West Belt	Korean Datum 1985	TM	125	38	500,000	200,000	1	서부원점
		단일원점	EPSG:102040	PCS	Korean 1985 Korea Unified Coordinate System	Korean Datum 1985	TM	127.5	38	2,000,000	1,000,000	0.9996	UTM(K)
		구좌표 (10.405' 보정)	EPSG:102085	PCS	Korean 1985 Modified Korea West Belt	Korean Datum 1985	TM	125.0028902777778	38	500,000	200,000	1	서부원점
			EPSG:102086	PCS	Korean 1985 Modified Korea Central Belt	Korean Datum 1985	TM	127.0028902777778	38	500,000	200,000	1	중부원점
			EPSG:102087	PCS	Korean 1985 Modified Korea Central Belt Jeju	Korean Datum 1985	TM	127.0028902777778	38	550,000	200,000	1	제주원점
			EPSG:102088	PCS	Korean 1985 Modified Korea East Belt	Korean Datum 1985	TM	129.0028902777778	38	500,000	200,000	1	동부원점
			EPSG:102089	PCS	Korean 1985 Modified Korea East Sea Belt	Korean Datum 1985	TM	131.0028902777778	38	500,000	200,000	1	동해원점
		네이버	NHN:128	PCS	Korean 1985 Katech(TM128)	Korean Datum 1985	TM	128	38	600,000	400,000	0.9999	비공식 기준
WGS1984	경위도		EPSG:4326	GCS	WGS 1984	WGS 1984	-	-	-	-	-	-	세계공통명칭
			EPSG:4166	GCS	Korean Datum 1995	WGS 1984	-	-	-	-	-	-	한국사용명칭
	직각좌표	세계공통	EPSG:32651	PCS	WGS 1984 UTM Zone 51N	WGS 1984	UTM	123	0	500,000	0	0.9996	
			EPSG:32652	PCS	WGS 1984 UTM Zone 52N	WGS 1984	UTM	129	0	500,000	0	0.9996	
GRS1980 (ITFR2000)	경위도		ESRI:104124	GCS	ITRF 2000	ITRF 2000	-	-	-	-	-	-	세계공통명칭
			EPSG:4737	GCS	Korea 2000	Korea 2000(KGD2002)	-	-	-	-	-	-	한국사용명칭
	직각좌표	단일원점	EPSG:102080	PCS	Korea 2000 Korea Unified Coordinate System	Korea 2000(KGD2002)	TM	127.5	38	2,000,000	1,000,000	0.9996	UTM(K)
		구좌표 (2010년 이전기준)	-	PCS	Korea 2000 Korea West Belt	Korea 2000(KGD2002)	TM	125	38	**500,000**	200,000	1	서부원점
			-	PCS	Korea 2000 Korea Central Belt	Korea 2000(KGD2002)	TM	127	38	**500,000**	200,000	1	중부원점
			-	PCS	Korea 2000 Korea East Belt	Korea 2000(KGD2002)	TM	129	38	**500,000**	200,000	1	동부원점
			-	PCS	Korea 2000 Korea East Sea Belt	Korea 2000(KGD2002)	TM	131	38	**500,000**	200,000	1	동해원점
		신좌표 (현재기준)	EPSG:102081	PCS	Korea 2000 Korea West Belt 2010	Korea 2000(KGD2002)	TM	125	38	**600,000**	200,000	1	서부원점
			EPSG:102082	PCS	Korea 2000 Korea Central Belt 2010	Korea 2000(KGD2002)	TM	127	38	**600,000**	200,000	1	중부원점
			EPSG:102083	PCS	Korea 2000 Korea East Belt 2010	Korea 2000(KGD2002)	TM	129	38	**600,000**	200,000	1	동부원점
			EPSG:102084	PCS	Korea 2000 Korea East Sea Belt 2010	Korea 2000(KGD2002)	TM	131	38	**600,000**	200,000	1	동해원점
		네이버	NHN:128	PCS	Korea 2000 Katech(TM128)	ITRF 2000	TM	128	38	600,000	400,000	0.9999	비공식 기준

LANDSAT 영상

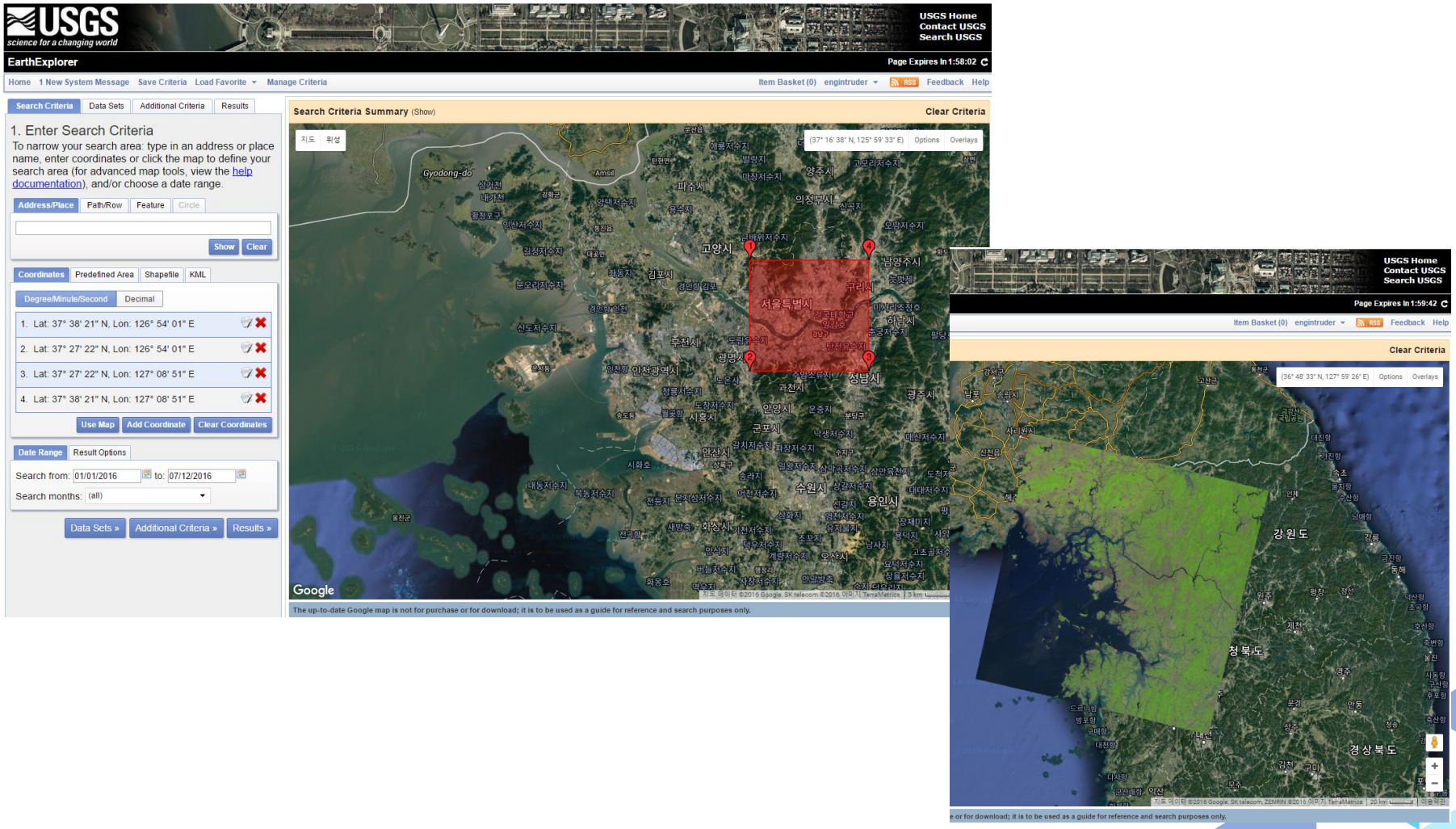
USGS Earthexplorer

- Landsat 데이터 검색 및 다운로드 (무료)



LANDSAT 영상

USGS Earthexplorer



LANDSAT 영상

USGS Earthexplorer

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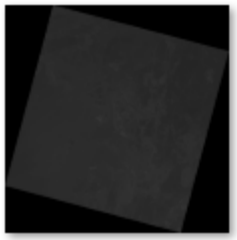
tar



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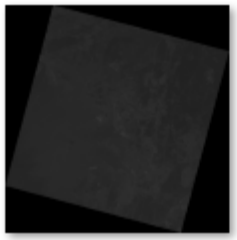
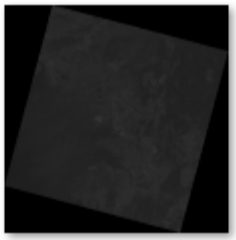
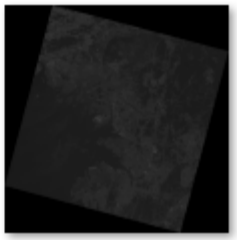


LC81160342016140L
GN00_B2



LC81160342016140L
GN00_B3



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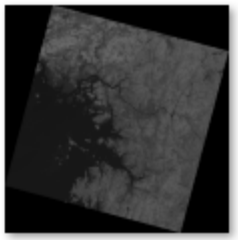
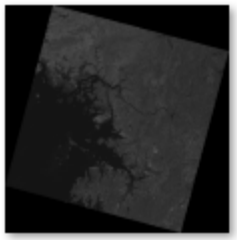


LC81160342016140L
GN00_B5



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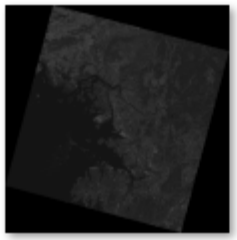

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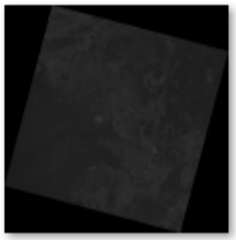

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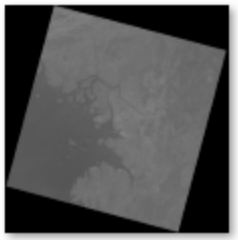
LC81160342016140L
GN00_B9



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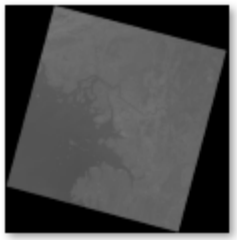

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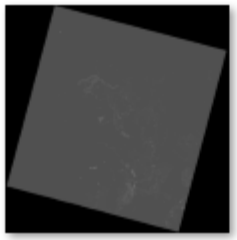

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LC81160342016140L
GN00_MTL

LANDSAT 영상

History & Future of Landsat: 1~9

- **Landsat 1**

  Landsat-1 was never meant to be named Landsat-1.
  It was actually first named *Earth Resources Technology Satellite (ERTS)*.
  But we now call it Landsat-1. In 1972, Landsat-1 paved the way as being the **first Earth observation satellite** of the Landsat program – which is THE longest running space-based Earth observation program on the planet.

Launch date: July 23, 1972

Deactivated: January 6, 1978

What was the name of the island discovered by Landsat-1 in Canada?

It was named ***"Landsat Island"*** shortly after it was found by Landsat-1.

It was found off the northeast coast of Labrador during analysis of Landsat-1 imagery

LANDSAT 영상

History & Future of Landsat: 1~9

- **Landsat 2**

  Landsat-2 was the second mission of the Landsat program and was launched on January 22, 1975. It was equipped with a Return Beam Vidicon (RBV) and a Multispectral Scanner (MSS). The MSS collected data in green, red and two near- infrared bands. The swath width was 185 km with 18 day repeat coverage.

Launch date: January 22, 1975

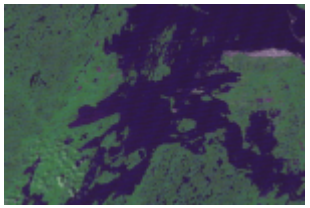
Deactivated: February 25, 1982

What is the resolution of Landsat-1 imagery?

The green, red and near-infrared bands have a resolution of 60 meters representing a single pixel.

LANDSAT 영상

History & Future of Landsat: 1~9



- **Landsat 3**

  Landsat-3 was the first satellite of the Landsat program to be **equipped with a thermal band**.
  Although, this instrument failed shortly after the launch, Landsat-3 was able to collect multispectral data in green, red and two near-infrared bands.
  In total, it took Landsat-3 about 18 days to scan the entire Earth.

Launch date: March 5, 1978

Deactivated: March 31, 1983

Are there any differences between Landsat-1/2 and Landsat-3?

Yes. The key difference is that Landsat-3 had a thermal band.

The thermal band malfunctioned during the start of the mission.

LANDSAT 영상

History & Future of Landsat: 1~9

- **Landsat 4**

Landsat-4 is the fourth mission of the Landsat program and was the first satellite in the Landsat program to incorporate **the Thematic Mapper (TM) sensor**.
The Landsat TM sensor gathers seven bands of data.
This is superior to the four bands of data collected from the multispectral scanner in Landsat-1, 2 and 3.
In addition to the three additional bands, spatial resolution has also improved.
Bands 1–5 and 7 each have a spatial resolution of 30 meters.
Band 6 (Thermal infrared band) has a maximum spatial resolution of 120 meters.
It took Landsat-4 approximately 16 days with a 185 km swath to scan the entire surface of the Earth.

Launch date: July 16, 1982

Deactivated: December 14, 1993

LANDSAT 영상

History & Future of Landsat: 1~9

- **Landsat 5**

I don’t think there is anyone who can explain why Landsat-5 was so durable. Landsat- 5 is recognized in the Guinness World Records for the longest operating Earth observation satellite in history operating for nearly 30 years.
With a three-year design life, no one could have imagined its longevity a quarter of a century after. Landsat-5 collected imagery for major events including Chernobyl, the devastating tsunami in South Asia, devastating snowstorms in Quebec, the Birmingham Tornado in 1998 and deforestation in tropical regions.

Launch date: March 1, 1984

Deactivated: June 5, 2013

What are the spectral bands and resolution of Landsat-5?

The blue, green, red, mid-infrared and near-infrared bands have a resolution of 30 meters.

LANDSAT 영상

History & Future of Landsat: 1~9

- **Landsat 6**

  Unfortunately, Landsat-6 was the only satellite in the Landsat program that **failed to reach orbit**. A press release from NOAA attributes a ruptured manifold to be the primary reason for its failure.
  This rupture prevented fuel from reaching the satellites stabilizing engines.
  Landsat-6 was supposed to scan the Earth with the upgraded version of TM – Enhanced Thematic Mapper (ETM). This would add a 15 meter panchromatic band.
  The other 7 spectral bands remained 30 meters ground resolution.

Launch date: -

Deactivated: -

LANDSAT 영상

History & Future of Landsat: 1~9

- **Landsat 7**

  Landsat-7 is the 7th satellite of the Landsat program.
  Landsat-7's primary instrument is the Enhanced Thematic Mapper (ETM+).
  ETM+ added a panchromatic band with 15 m ground resolution (band 8).
  Landsat-7 continues to capture visible (reflected light) bands in the spectrum of blue, green, red, near-infrared (NIR) and mid-infrared (MIR) with 30m spatial resolution (bands 1-5, 7). Landsat-7 also has a thermal infrared channel with 60m spatial resolution (band 6).
  In May 2003, there was a mechanical failure in the Scan Line Corrector (SLC).
  Landsat-7 images resulted in partially missing data because of the SLC failure.

Launch date: April 15, 1999

Deactivated: Remains in orbit

LANDSAT 영상

History & Future of Landsat: 1~9

- **Landsat 8**

Landsat-8 has also been named the **Landsat Data Continuity Mission** because the continuity of observations of Earth from space is a critical part of the science of land use and climate change of our transforming planet.
Landsat-8 was launched on February 11, 2013 from the Vandenberg Air Force Base in California.
Landsat-8's primary two sensors are the **Operational Land Imager (OLI)** and **Thermal Infrared Sensor (TIRS)**. These two instruments combine to generate 11 total spectral bands. Seven of the eleven spectral bands are basically consistent with ETM+ found on Landsat-7. Landsat-8 bands are coastal, blue, green, red, NIR, SWIR-1, SWIR-2 and cirrus. These 8 bands have a ground resolution of 30 meters. The panchromatic band spans a larger spectral range and has a resolution of 15 meters. Two new bands (band 10 & 11) from TIRS are long wavelength infrared. These bands have a coarser resolution of 100 meters.

Launch date: Frebruary 11, 2013

Deactivated: Remains in orbit

LANDSAT 영상

History & Future of Landsat: 1~9

- **Landsat 9**

NASA and USGS are working on Landsat 9 for an expected launch in 2023.
The launch of Landsat-9 will extend Landsat program's record length to half a century. Because Landsat provides consistent images of the Earth, Landsat-9 will largely replicate its predecessor Landsat 8.

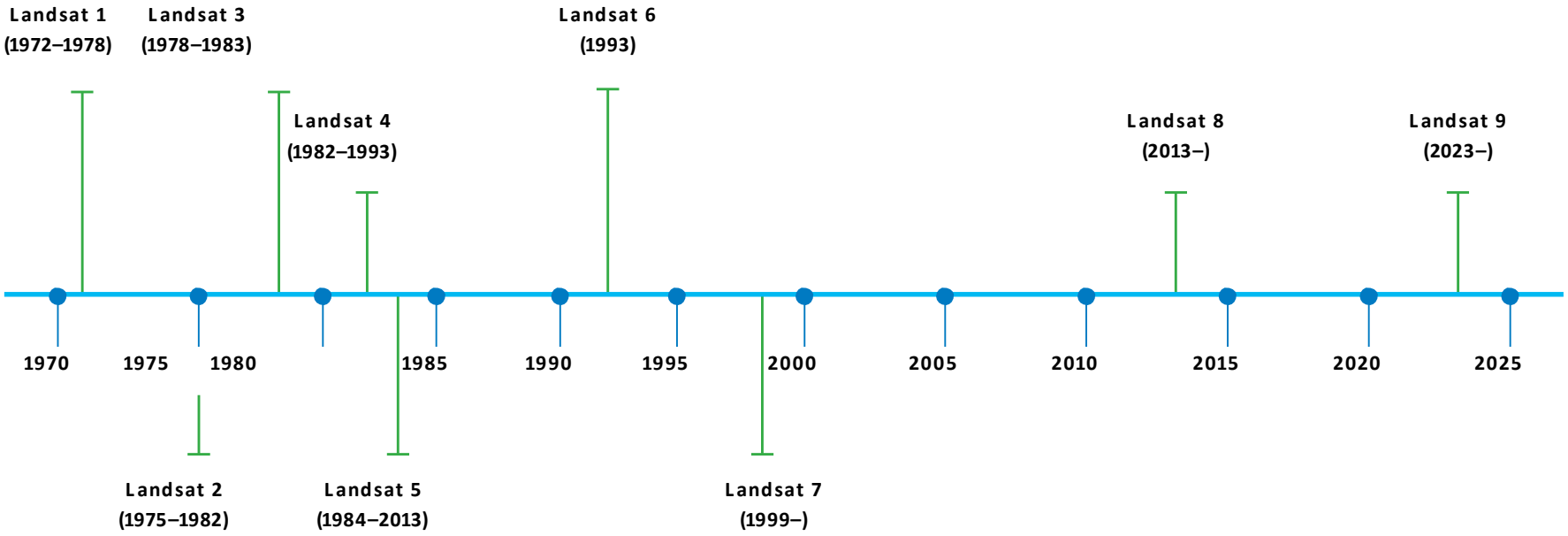
Expected Launch Date : 2023

What spectral bands and other details are there on Landsat-9?

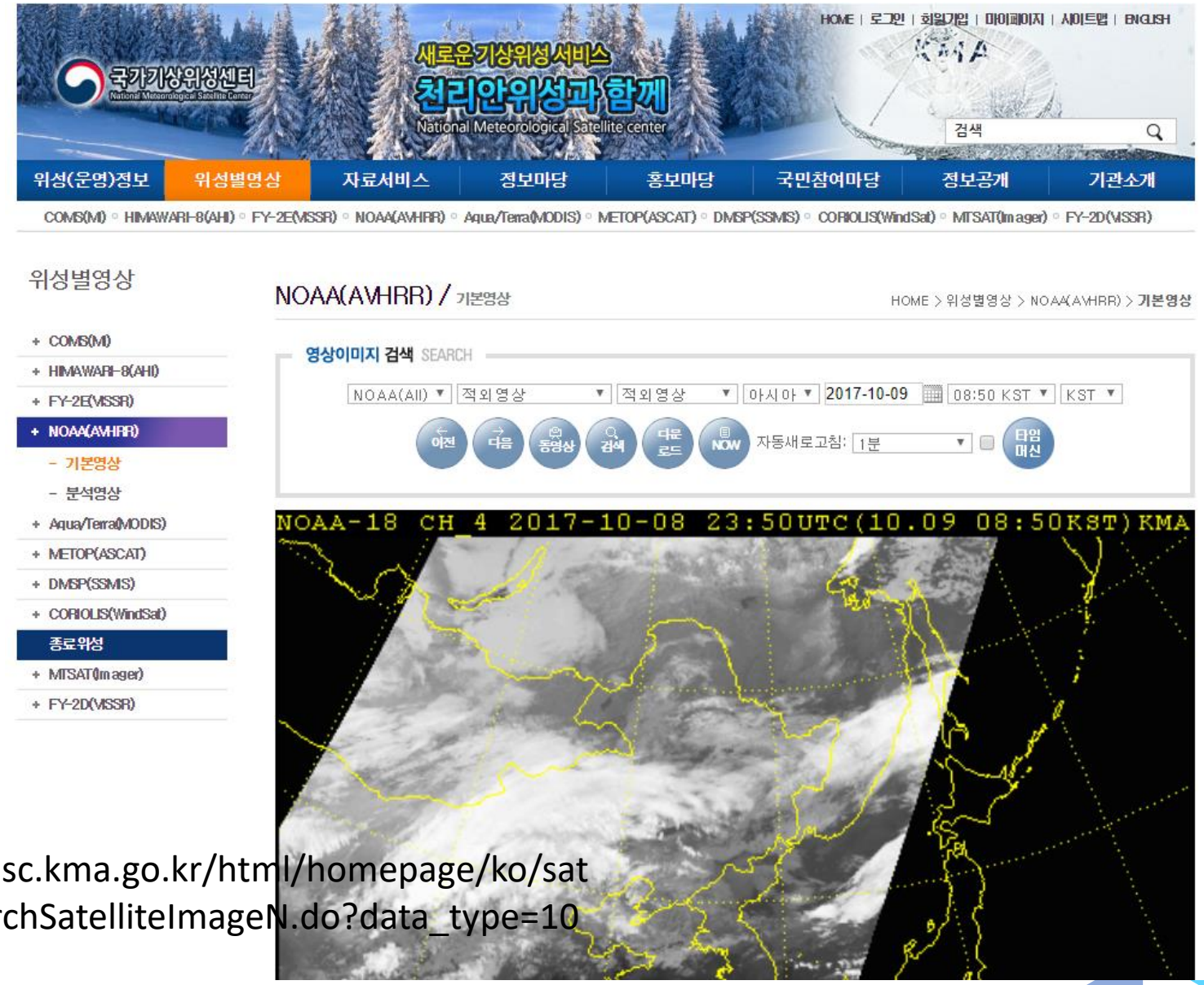
Landsat-9 will consist of optical and thermal sensors comparable to the OLI and TIRS instruments.

LANDSAT 영상

History & Future of Landsat: 1~9



국가기상위성센터 (KMA)



http://nmsc.kma.go.kr/html/homepage/ko/satellite/searchSatelliteImageN.do?data_type=1077

NASA Reverb – Satellite Data from the Masters

Earthdata

There's a lot to like about NASA's Reverb Data Hub.
It has a fresh new look and interface for discovering Earth Science data, NASA Reverb contends First off – the choices of satellite data is incredible:

Aqua, Terra, Aura, TRMM, Calipso, NASA DC, JASON, ENVISAT, ALOS, METEOSAT, GOES, ICESAT, GMS, Landsat, NIMBUS, SMAP, RADARSAT, NOAA satellites, GPS

satellites, the list goes on…

Admittedly, it takes a bit of practice to navigate. There are 30 ways to narrow down your data. Our suggestion is to start with a simple search. Change the time range criteria. Narrow it down, and download your free satellite imagery.

https://search.earthdata.nasa.gov/

Earth Observation Link (EOLi)

EOLi

EOLi (Earth Observation Link) is the European Space Agency's client for Earth Observation Catalogue Service.

Using EOLi, you can browse the metadata and preview images of Earth Observation data acquired by the satellites ERS and Envisat and download products of various processing levels.

Earth Observation data from Envisat, ERS, IKONOS, DMC, ALOS, SPOT, Kompsat, Proba, IRS, SCISAT.

https://earth.esa.int/web/guest/eoli

JAXA's Global ALOS 3D World

JAXA's Global ALOS 3D World

The ALOS World 3d is a 30-meter spatial resolution digital surface model (DSM) constructed by the Japan Aerospace Exploration Agency's (JAXA). Recently, this DSM has been made available to the public.

The neat thing about is that it is the most precise global-scale elevation data at this time using the Advanced Land Observing Satellite "DAICHI" (ALOS) – PALSAR's L-band.
JAXA's SAR mosaics is an exciting development for global elevation.

In order to obtain this highly accurate DSM, you'll have to register online through the JAXA Global ALOS portal to download it.

https://www.eorc.jaxa.jp/ALOS/en/aw3d30/