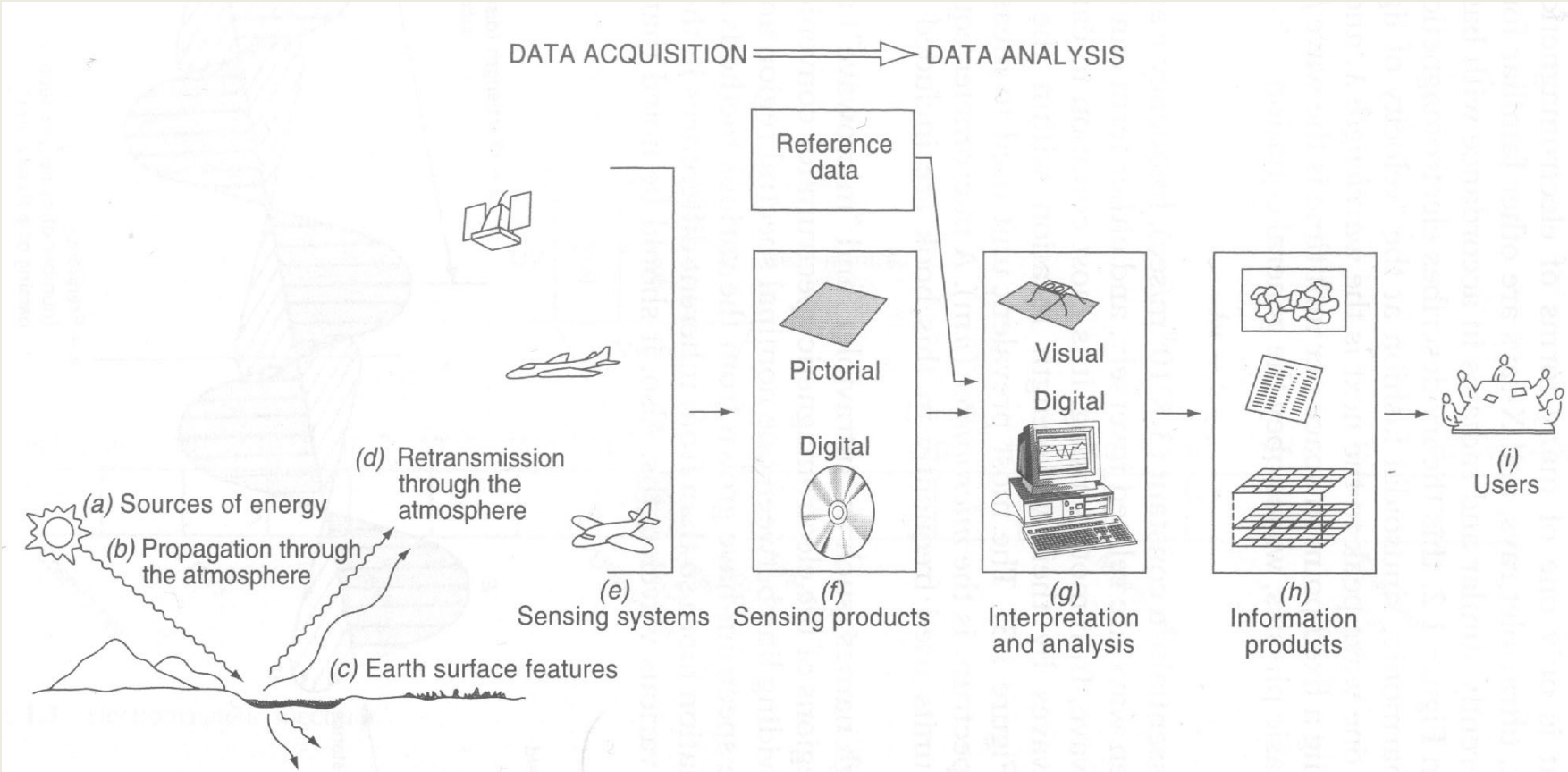
METODE PRIKUPLJANJA PODATAKA ZA IZRADU KARATA

Daljinska istraživanja,
aerofotogrametrija

Daljinska istraživanja

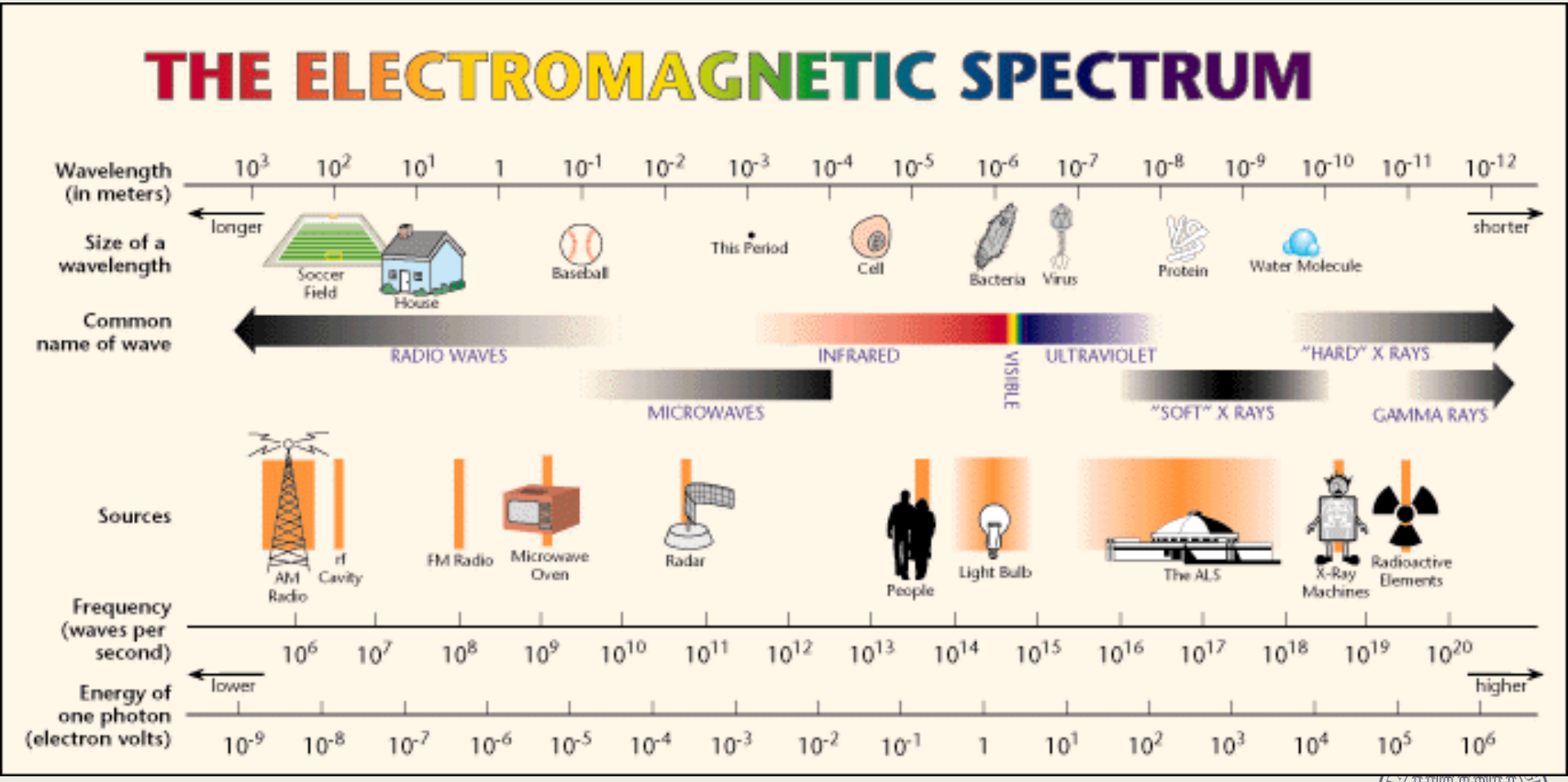
- Remote sensing (eng.), Fernerkundung (njem.), Télédétection (franc.)
- Metoda prikupljanja i interpretacije informacija o udaljenim objektima **bez fizičkog dodira s objektom**.
- Metode koje se koriste **elektromagnetskom energijom** kao sredstvom za bilježenje i mjerenje objekata
- Upotreba različitih vrsta snimaka: fotografskih, termalnih, radarskih itd.
- Uža područja daljinskih istraživanja su: ***fotogrametrija i teledetekcija***.



Electromagnetic remote sensing of earth resources.

- ***Teledetekcija*** – daljinsko istraživanje u užem smislu
- Obuhvaća prikupljanje podataka o Zemljinoj površini pomoću uređaja smještenih u satelitima i njihovu interpretaciju

THE ELECTROMAGNETIC SPECTRUM



http://www2.ucdsb.on.ca/tiss/stretton/CHEM1/elecon2.html

Rezolucija

Rezolucija: prostorna, spektralna i temporalna

- Prostorna – veličina objekta koji se može raspoznati (mjeri se veličinom piksela)
- Spektralna – odnosi se na dio elektromagnetskog spektra koji se bilježi (single band, multi-spectral)
- Vremenska – frekvencija kojom se prikupljaju snimci (dvije vrste satelita (geostacionarni i orbitalni). Orbitalni prikupljaju snimke o različitim dijelovima Zemlje u jednakim intervalima)

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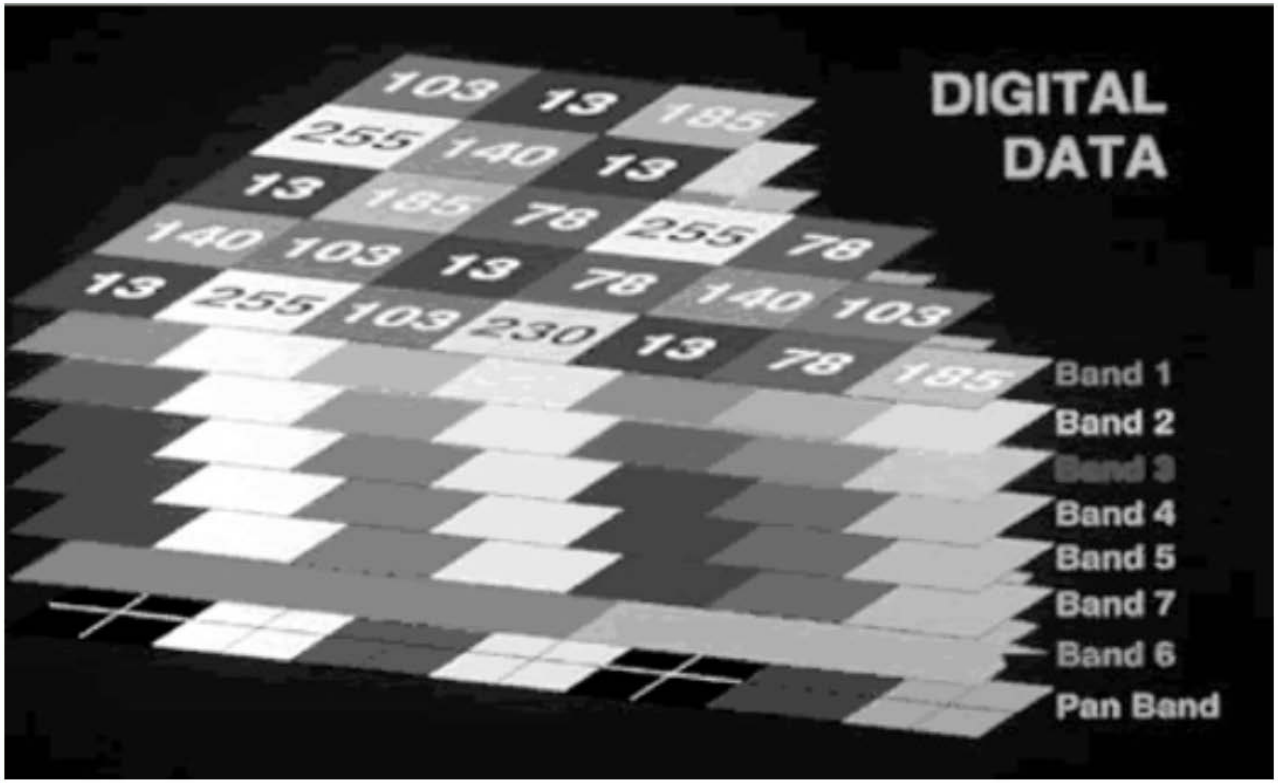
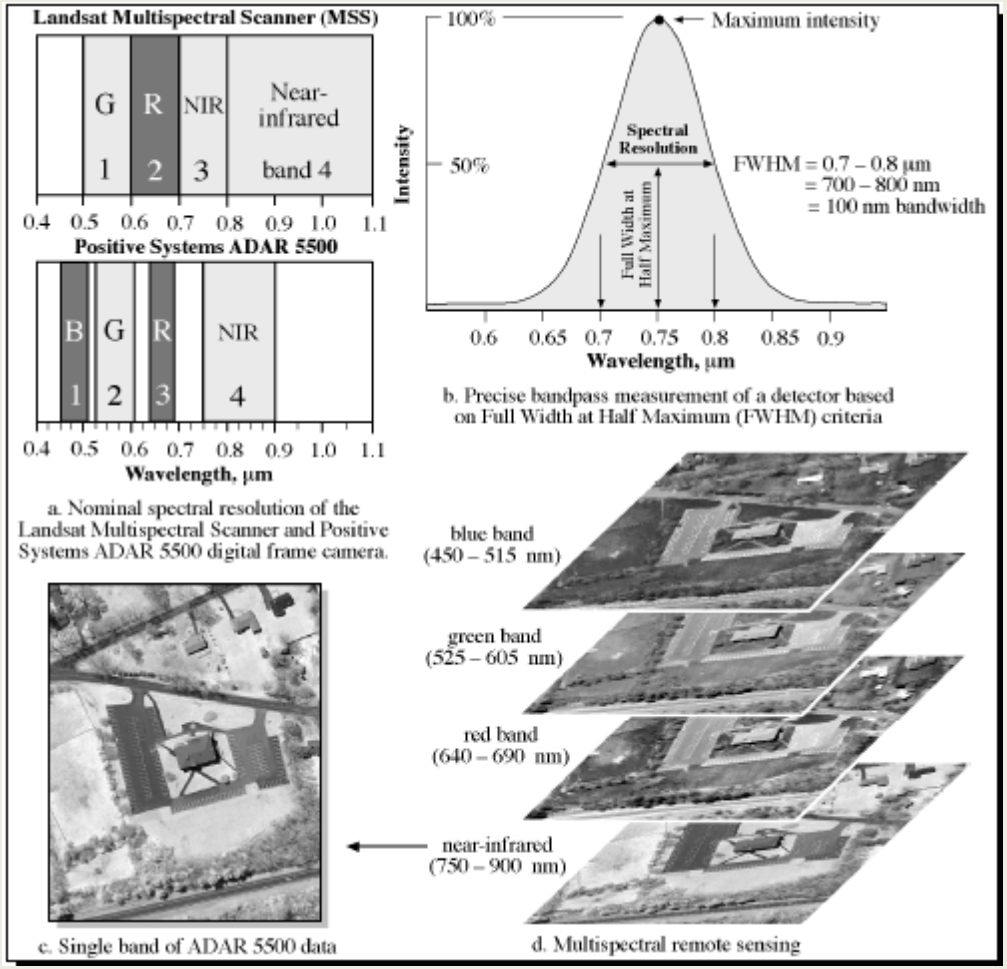
- Radiometrijska – osjetljivost detektiranja vrlo malih u elektromagnetskoj energiji



Note the wavelength intensity values from 0-255 in the band layers above. (Only the top band layer shows numbers, but in fact each of the pixels in each band layer will have single value ranging from 0-255.) Each number indicates an amount of reflected light in a specific wavelength range for a 30m x 30m area on Earth's surface.

Spektralna rezolucija



- Jednokanalni (pankromatski) snimak
- Višekanalni (multispektralni) snimak

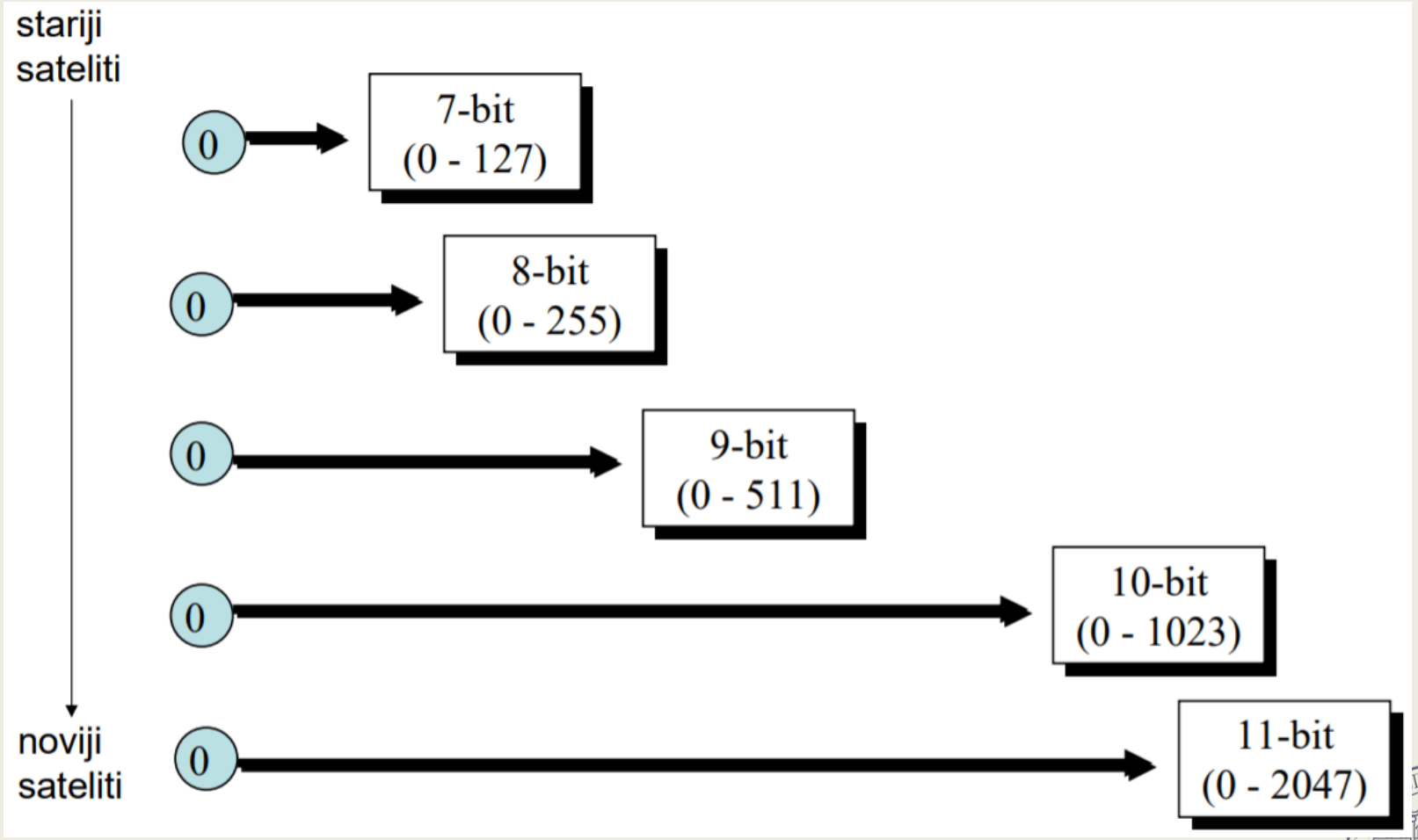
Izvor: Jensen, J.R. (2014.)

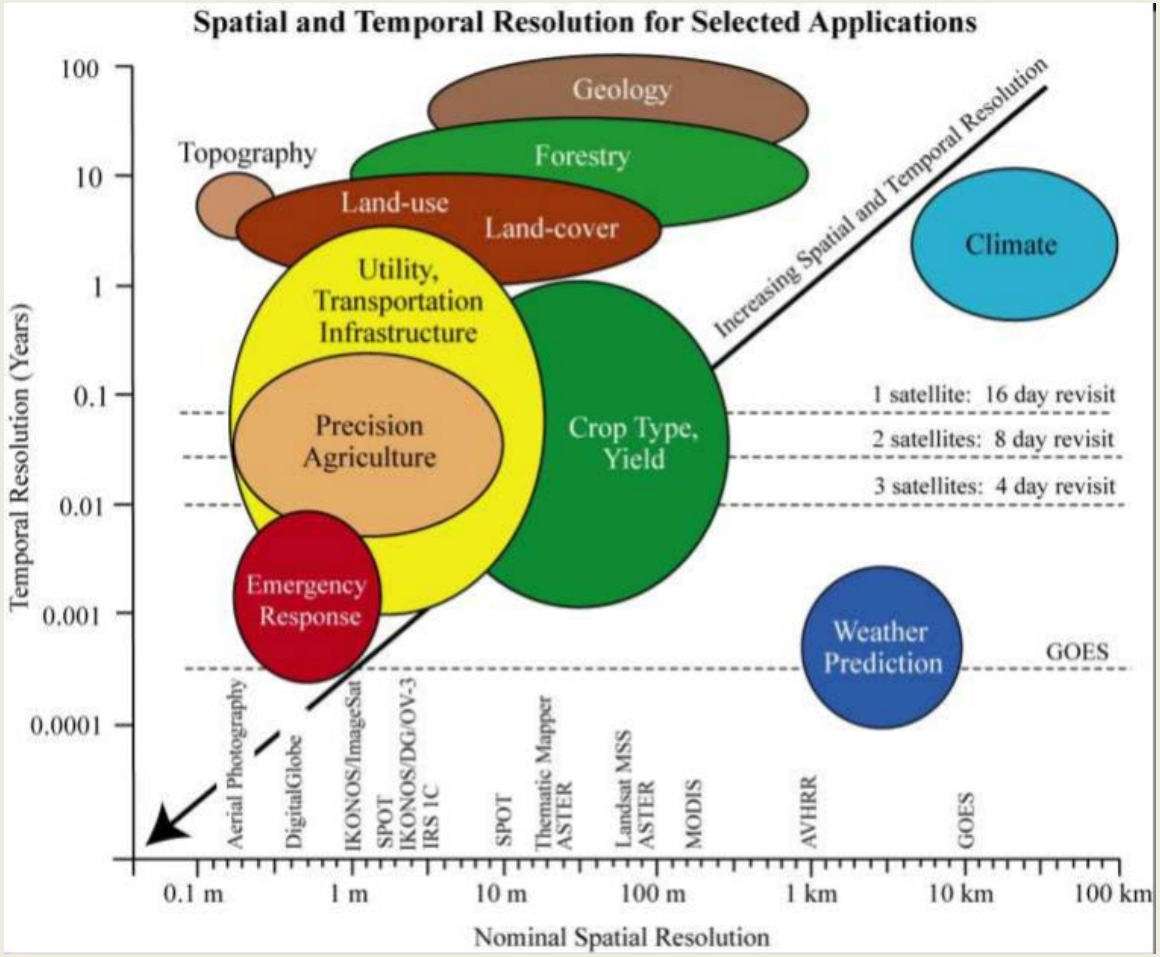
Spektralna rezolucija

- Bjelogorica i crnogorica na istom snimku Spatial Emerge digitalna kamera, prostorna rezolucija 1x1 m u crvenom, zelenom i near IR spektralnom kanalu

Prostorna rezolucija

Radiometrijska rezolucija





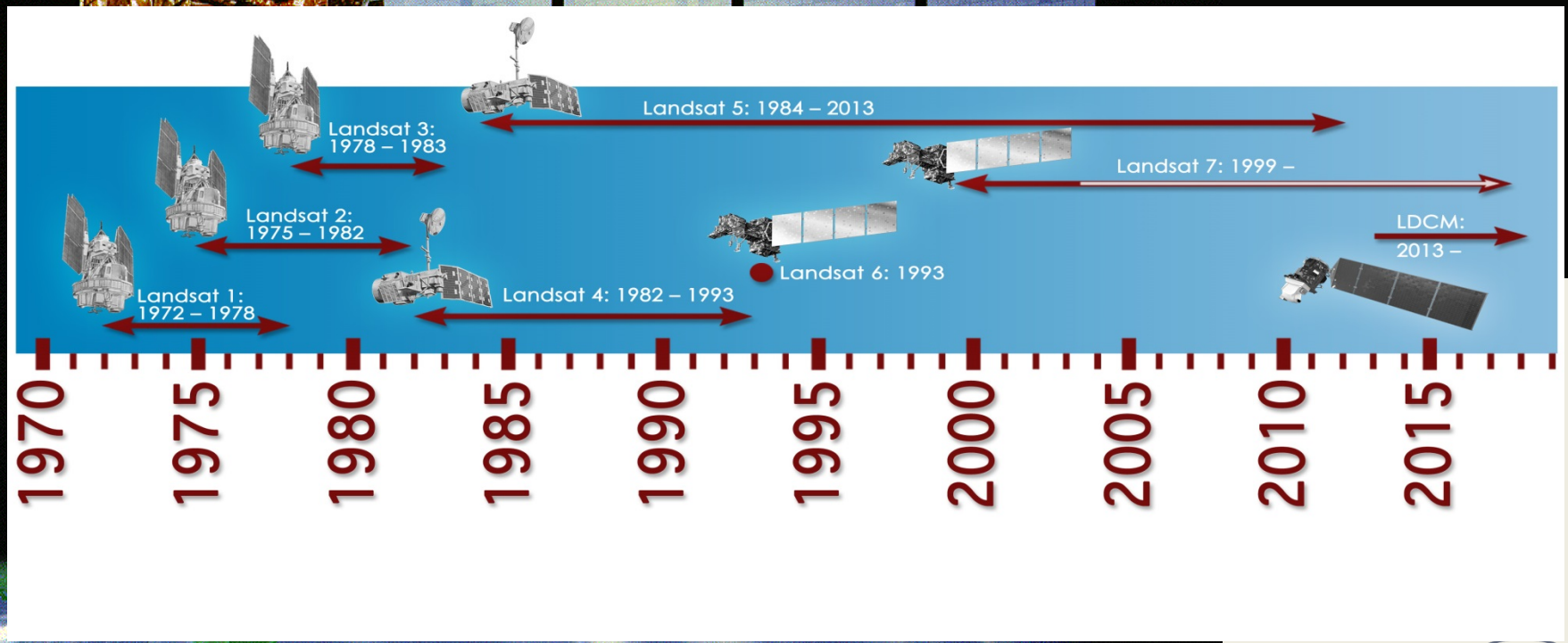
Izvor: Jensen, J.R. (2014.)

SPOT 5

- **S**ystème **P**robatoire d'**O**bservation de la **T**erre
- 822 km, prolazi istu točku nakon 26 dana
- Više senzora
  - Pankromatski senzor (mjeri zračenje u vidljivom spektru elekromagnetskog zračenja rezolucije 2,5x2,5 m)
  - Multispektralni senzor (mjeri zeleni, crveni i IR spektar zračenja, prostorna rezolucija 10x10 m)
  - Kratkovalni spektar i blizak IR spektru rezolucije 20x20 m
  - Vegetacijski senzor (4 kanala – rezolucije 1x1 km)
  - Snimka pokriva 60x60 km
  - SPOT 6 (9. rujna 2012.) i SPOT 7 - 2014.

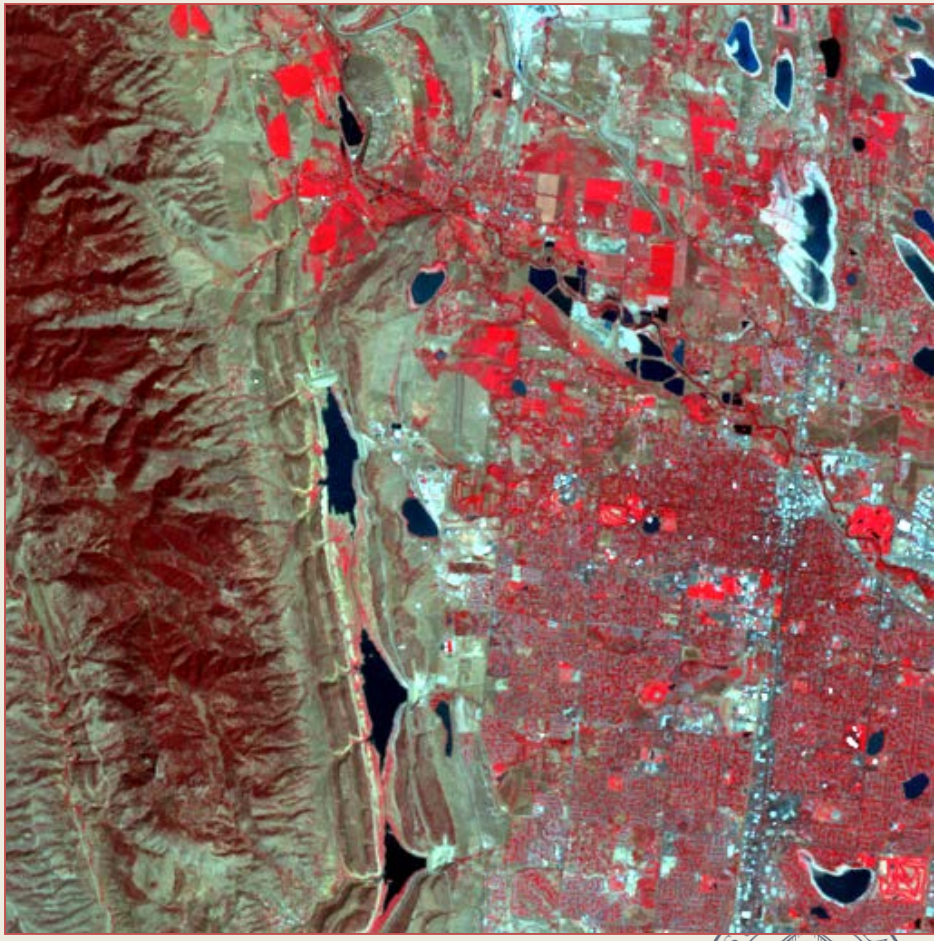
- 2 new satellites 2012-2014
- Secured continuity on the High Resolution market until 2023 with 1.5 meter (ortho colour) products

Landsat sateliti



Landsat snimak: Ft. Collins, CO
Prikupljeno: 26-08-2002

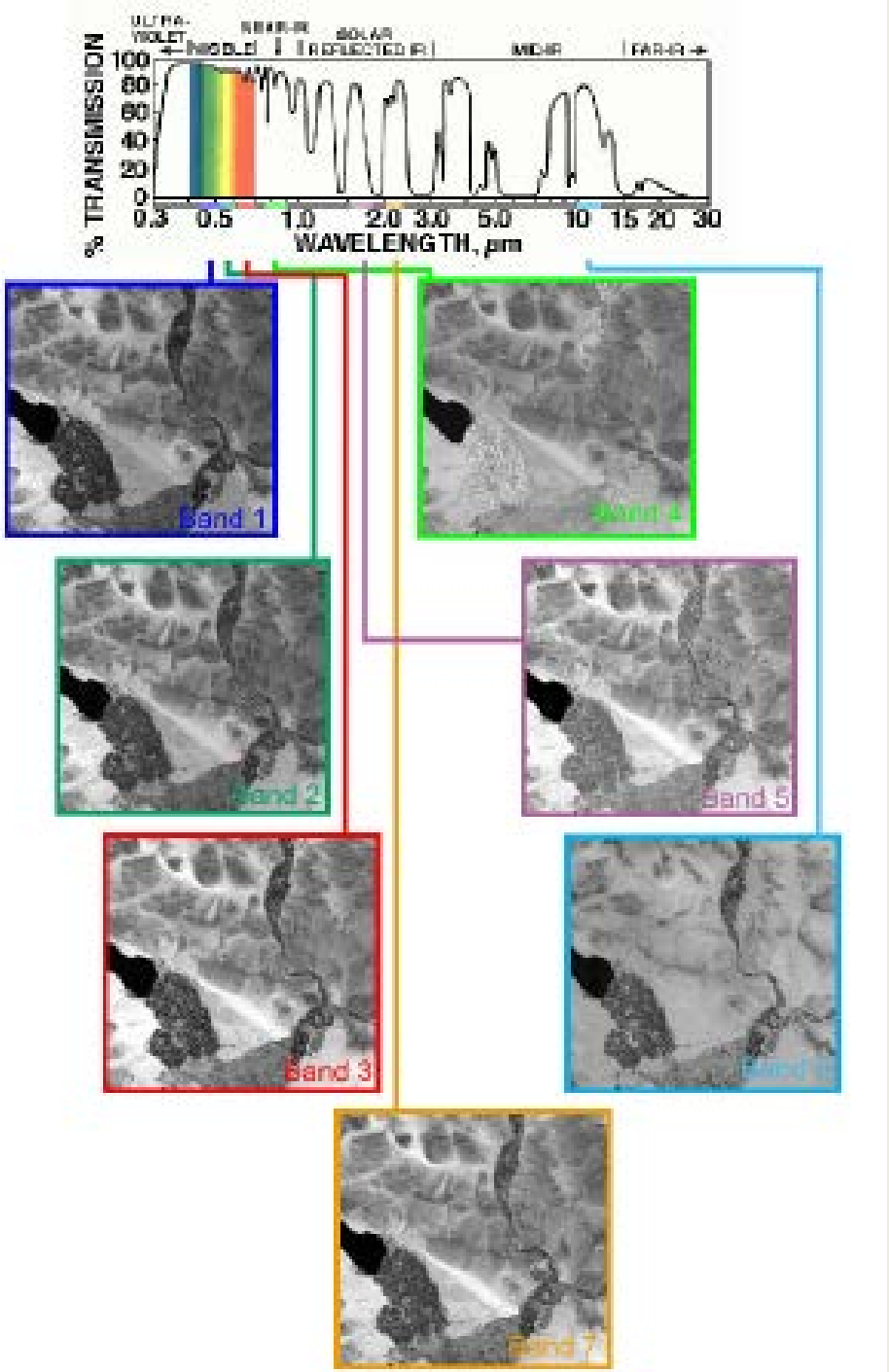
Bands: 3,2,1
(True Color)



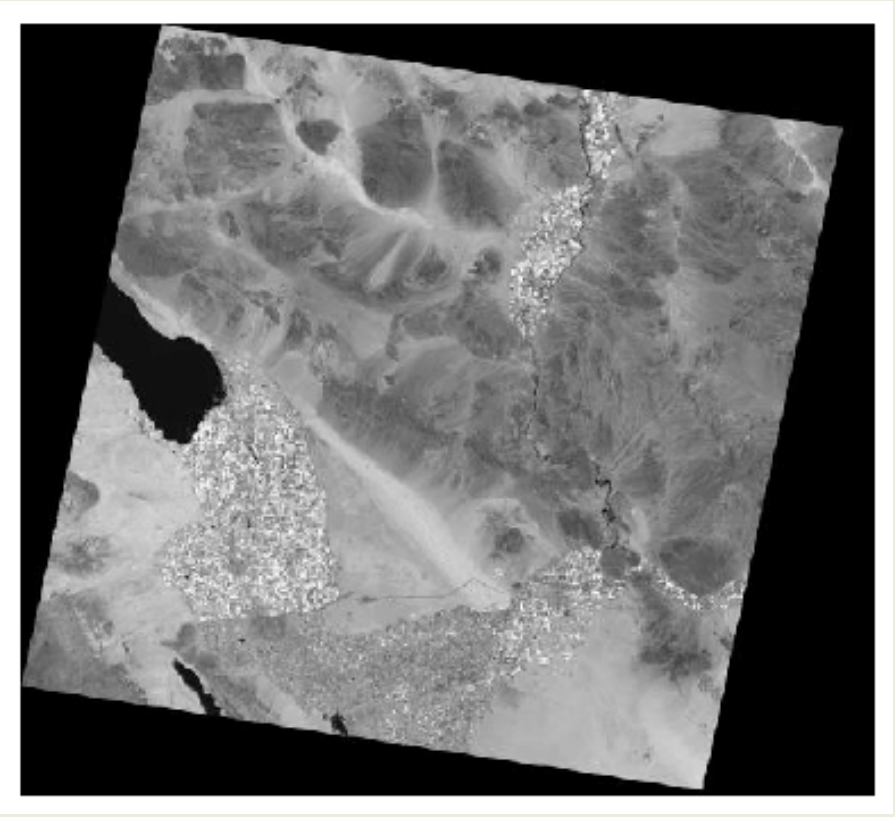
Bands: 4,3,2
(False Color)

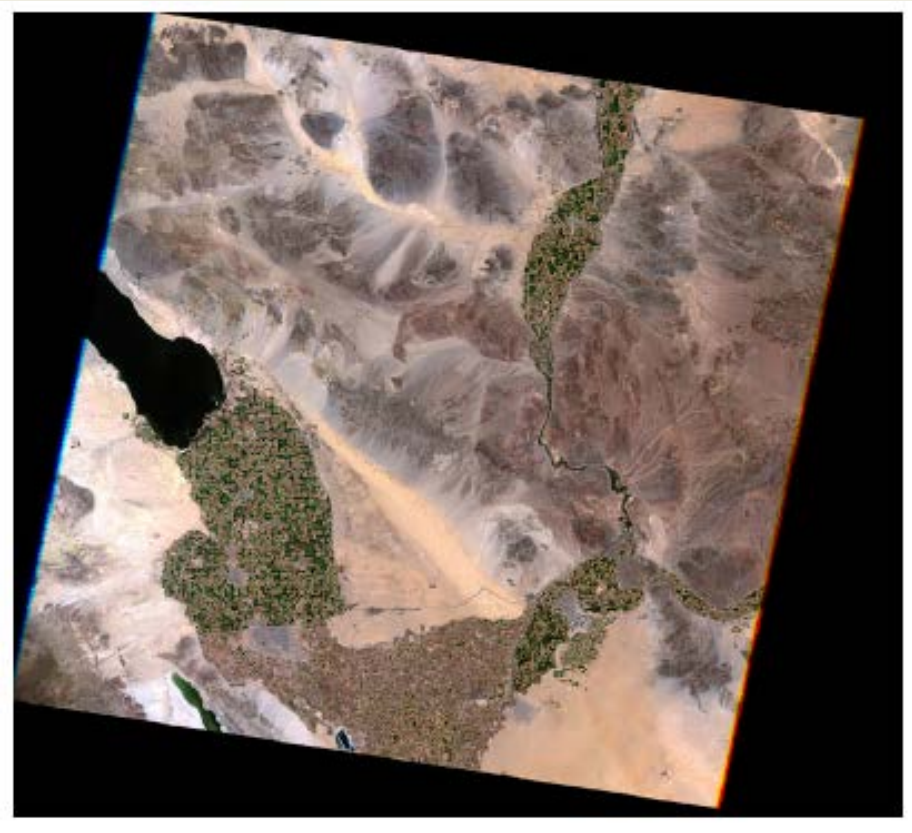
Spectral sensitivity of Landsat 7 Bands.

Band Number	Wavelength Interval	Spectral Response
1	0.45-0.52 μm	Blue-Green
2	0.52-0.60 μm	Green
3	0.63-0.69 μm	Red
4	0.76-0.90 μm	Near IR
5	1.55-1.75 μm	Mid-IR
6	10.40-12.50 μm	Thermal IR
7	2.08-2.35 μm	Mid-IR



Electromagnetic Spectrum Image from Virtual Tutorial.





- Band (spektralni kanal) 4 – valne duljine 0,76-0,90 nanometara
- NIR spektar – svjetlo - vegetacija

Landsat 7 Band Number	Applications
1	coastal water mapping, soil/vegetation discrimination, forest classification, man-made feature identification
2	vegetation discrimination and health monitoring, man-made feature identification
3	plant species identification, man-made feature identification
4	soil moisture monitoring, vegetation monitoring, water body discrimination
5	vegetation moisture content monitoring
6	surface temperature, vegetation stress monitoring, soil moisture monitoring, cloud differentiation, volcanic monitoring
7	mineral and rock discrimination, vegetation moisture content

For more details see: Lillesand, T. and Kiefer, R., 1994. *Remote Sensing and Image Interpretation*. John Wiley and Sons, Inc., New York, p. 468.

RGB = NRG

Landsat 7 images are color composites, made by assigning the three primary colors to three bands of the Enhanced Thematic Mapper (ETM+) sensor. These images are not color photographs, they are "false color" images (green fields won't necessarily look green in the image).

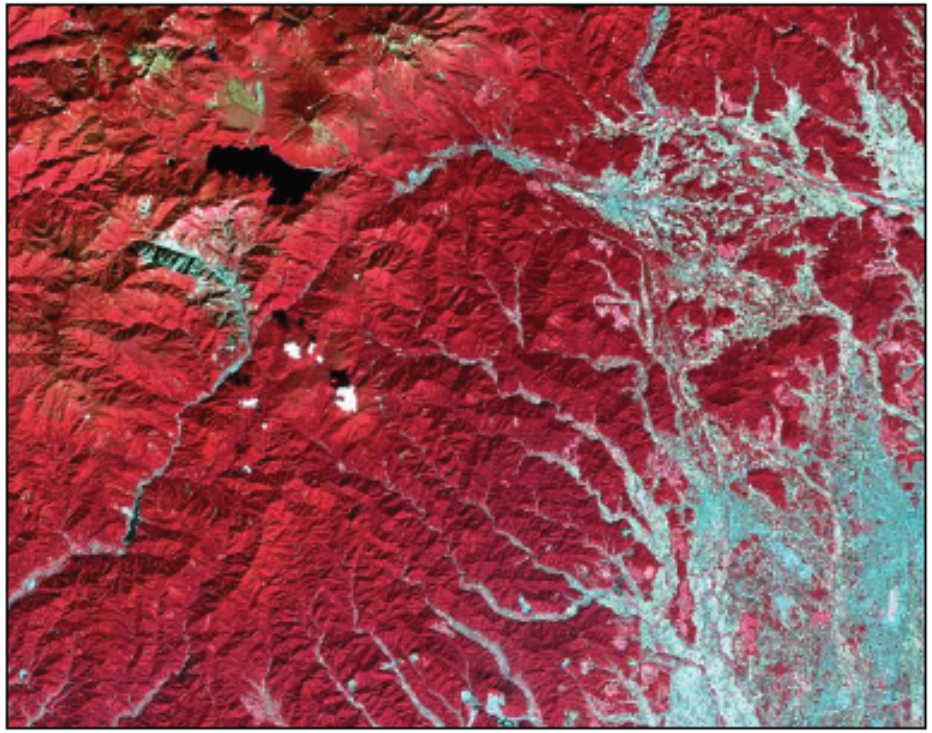
One common way that primary colors are assigned to bands can be easily remembered using the mnemonic -

RGB = NRG (Red, Green, Blue = Near Infrared, Red, Green, or "energy")

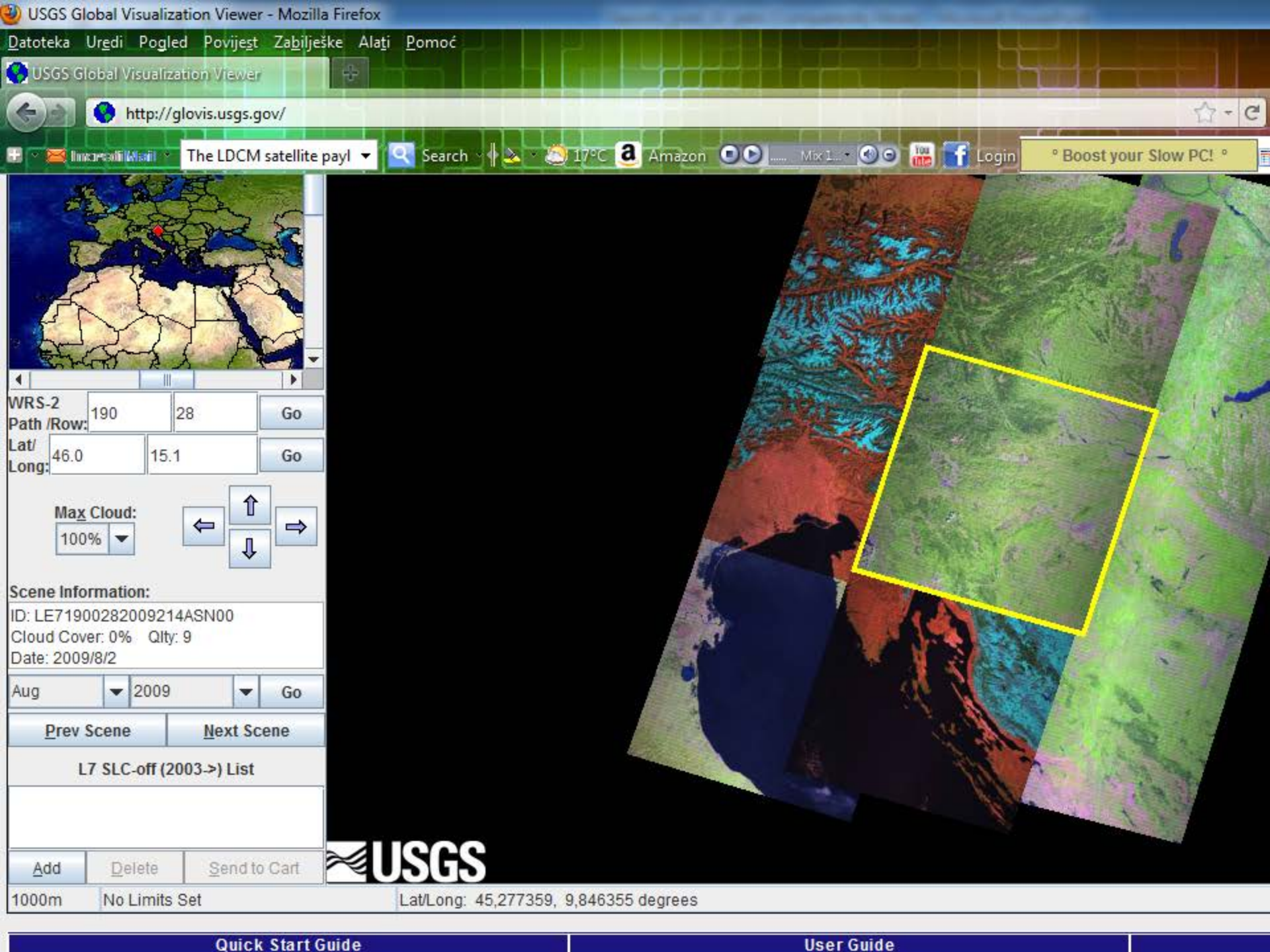
Red = Near IR (ETM+ band 4)

Green = Red (ETM+ band 3)

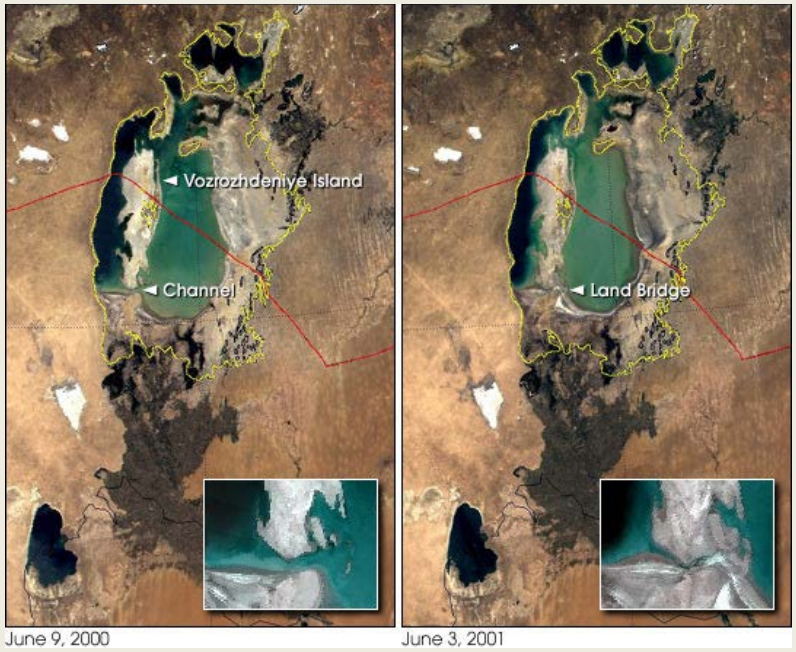
Blue = Green (ETM+ band 2)



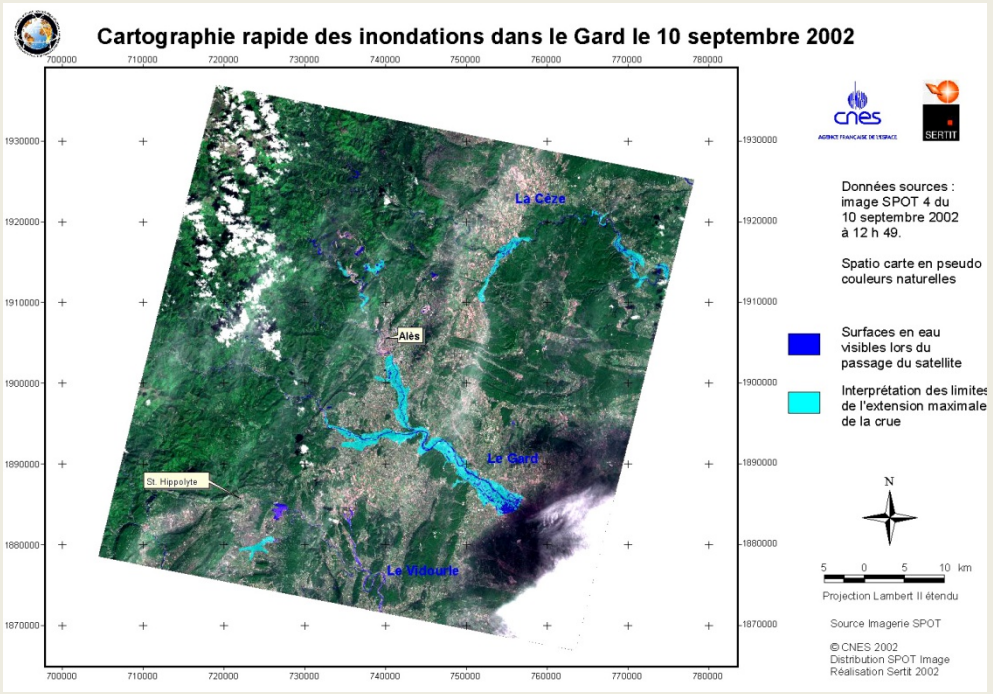
This image uses Landsat ETM+ Bands 4,3,2. The image depicts an area just north of Tokyo, Japan.

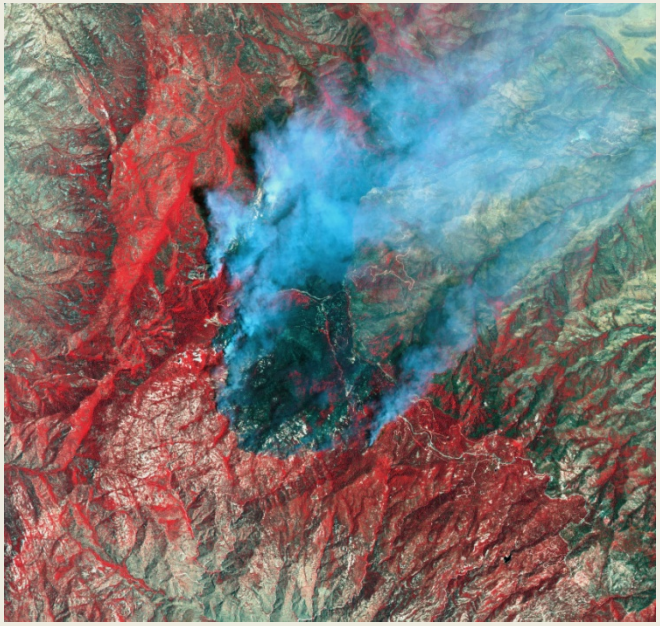

USGS Global Visualization Viewer - Mozilla Firefox
Datoteka Uredi Pogled Povijest Zabilješke Alati Pomoć
USGS Global Visualization Viewer
http://glovis.usgs.gov/
The LDCM satellite payl
Search
17°C
Amazon
Login
° Boost your Slow PC! °
WRS-2 Path /Row:
190
28
Go
Lat/ Long:
46.0
15.1
Go
Max Cloud:
100%
Scene Information:
ID: LE71900282009214ASN00
Cloud Cover: 0% Qlty: 9
Date: 2009/8/2
Aug
2009
Go
Prev Scene
Next Scene
L7 SLC-off (2003->) List
Add
Delete
Send to Cart
USGS
1000m
No Limits Set
Lat/Long: 45,277359, 9,846355 degrees
Quick Start Guide
User Guide

MODIS


Vozrozhdeniye Island
Channel
Land Bridge
June 9, 2000
June 3, 2001

SPOT 4


Cartographie rapide des inondations dans le Gard le 10 septembre 2002
La Cèze
Alès
Le Gard
St. Hippolyte
Le Vidourle
Données sources : image SPOT 4 du 10 septembre 2002 à 12 h 49.
Spatio carte en pseudo couleurs naturelles
Surfaces en eau visibles lors du passage du satellite
Interprétation des limites de l'extension maximale de la crue
Projection Lambert II étendu
Source Imagerie SPOT
© CNES 2002
Distribution SPOT Image
Réalisation Sertit 2002



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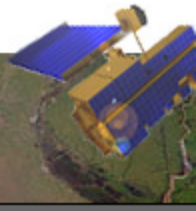
Global Land Cover Facility



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- L1B Imagery

IKONOS
- Fine Resolution Imagery

Landsat
- GeoCover
- Landsat ETM+
- Landsat MSS
- Landsat TM
- Global Land Survey

MODIS
- 32-day Composites
- 16-day Composite

QuickBird
- Fine Resolution Imagery

OrbView
- Fine Resolution Imagery

SRTM
- 30m Elevation Imagery
- 90m Elevation Imagery
- 1km Elevation Imagery

Products Derived from Satellite Imagery

•Slobodno “skidanje” podataka GeoCover Landsat sa web stranice: Global Land Cover Facility.

•GeoCover – relativno visoke rezolucije u usporedbi s ostalim podacima na globalnoj razini

- GeoCover – dostupan u GeoTIFF formatu
- Obaveza – navesti izvor

Global Land Cover Facility

Earth Science Data Interface

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Welcome to the Earth Science Data Interface (ESDI) at the Global Land Cover Facility

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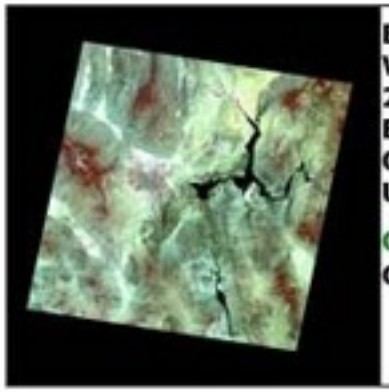

ETM+
WRS-2, Path 039, Row 035
2000-05-03
EarthSat
Ortho, GeoCover
United States

Online: 043-415
Compressed Size: 334 MB; Actual Size: 664 MB

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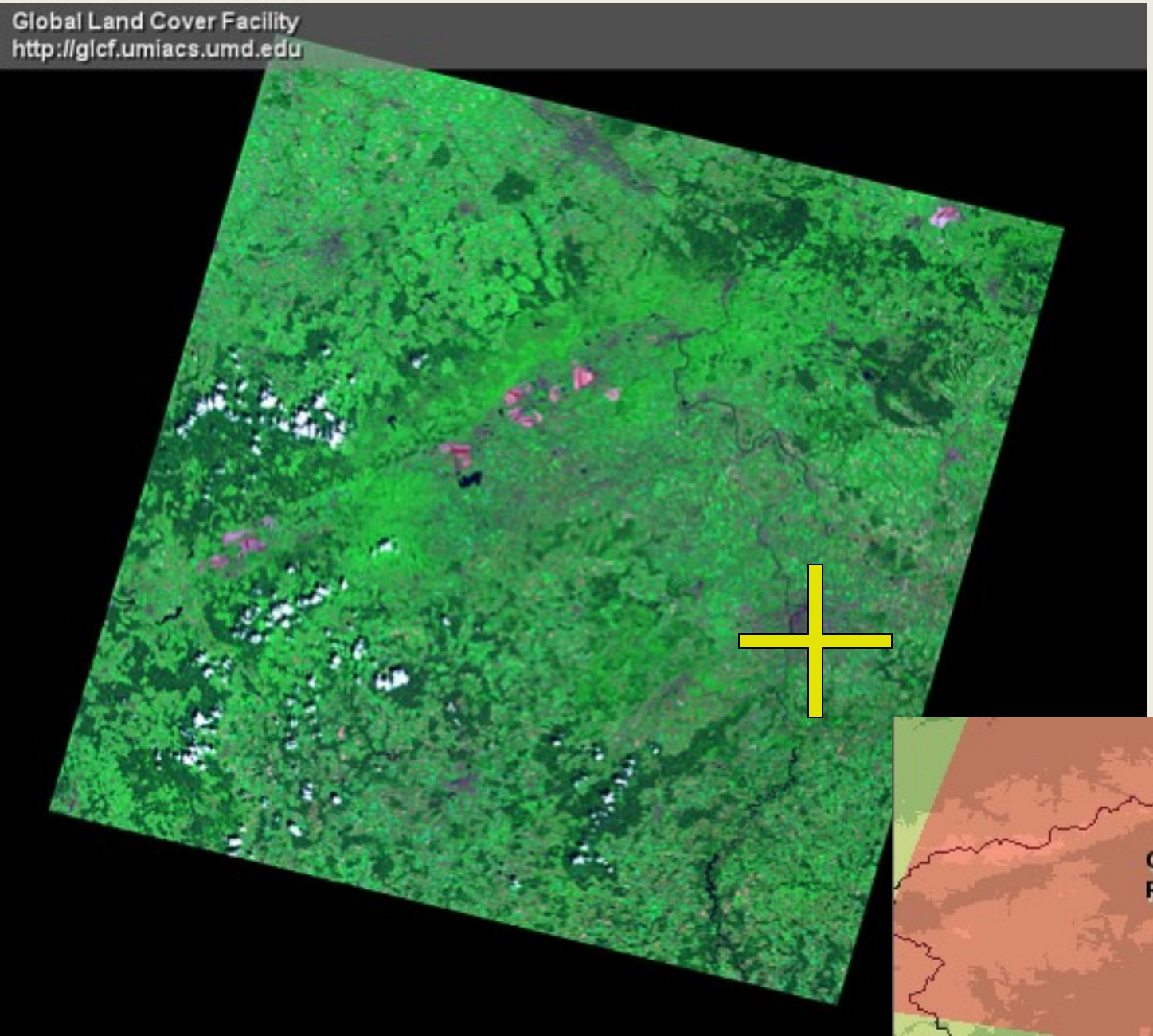
043-415	Online	2: 039/035	2000-05-03	ETM+	EarthSat	Ortho, GeoCover	Ge

Landsat podaci



Ortho, GeoCover

Landsat 7, ETM+

Czech Republic, Germany, Poland

2000-06-20

Shuttle Radar Topography Mission - Internet Explorer provided by Dell

http://www2.jpl.nasa.gov/srtm/

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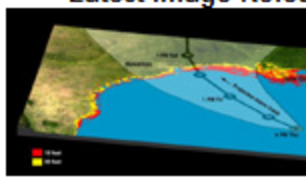
Site Index

This is the SRTM home page. The Shuttle Radar Topography Mission (SRTM) obtained elevation data on a near-global scale to generate the most complete high-resolution digital topographic database of Earth. SRTM consisted of a specially modified radar system that flew onboard the Space Shuttle Endeavour during an 11-day mission in February of 2000.

Latest Image Relea



View North America in the ima

SRTM is an international project spearheaded by the National Geospatial-Intelligence (NGA) and the National Aeronautics and Space Administration (NASA).

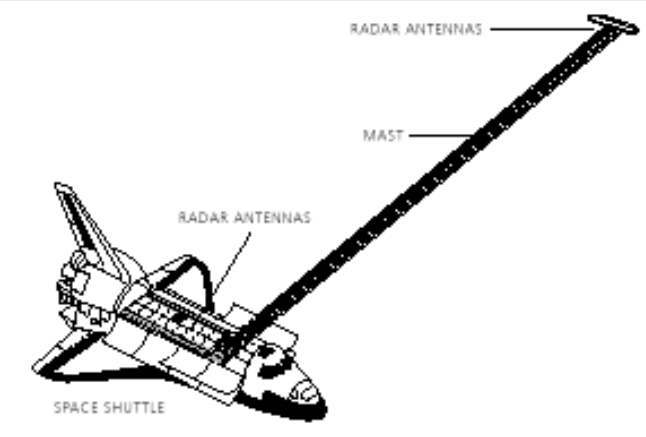
SRTM Publication

An edited version of "The Shuttle Radar Topography Mission, Rev. Geophys., 45, RG2

Shuttle Radar Topography Mission (SRTM)

- Cilj: točni podaci o površini Zemlje
- Obilježja podataka:
  - 30 x 30 m za SAD (kao i DEM iz USGS 7.5” kvadrata), 90 m za cijeli svijet
  - Točnost: 16 m apsolutna vertikalna, 20 m horizontalna
  - Područje: 56°S - 60°N; 80% površine Zemlje; 90% stanovništva
- NASA, NGA (bivša NIMA), German Aerospace Center (DLR), Italian Space Agency (ASI)

- Tehnologija: interferometrija dva radarska uređaja



Fotogrametrija

- Umjetnost, znanost i tehnologija dobivanja pouzdanih kvantitativnih informacija o fizičkim objektima i okolišu, procesom zabilježbe, mjerenja i interpretacije fotografskih slika i scena elektromagnetskog zračenja dobivenih senzorskim sustavima.

- Snima se postojeća prostorna situacija i dobiva se dvodimenzionalni (ravninski) ili trodimenzionalni (prostorni) prikaz.

FOTOGRAMETRIJA

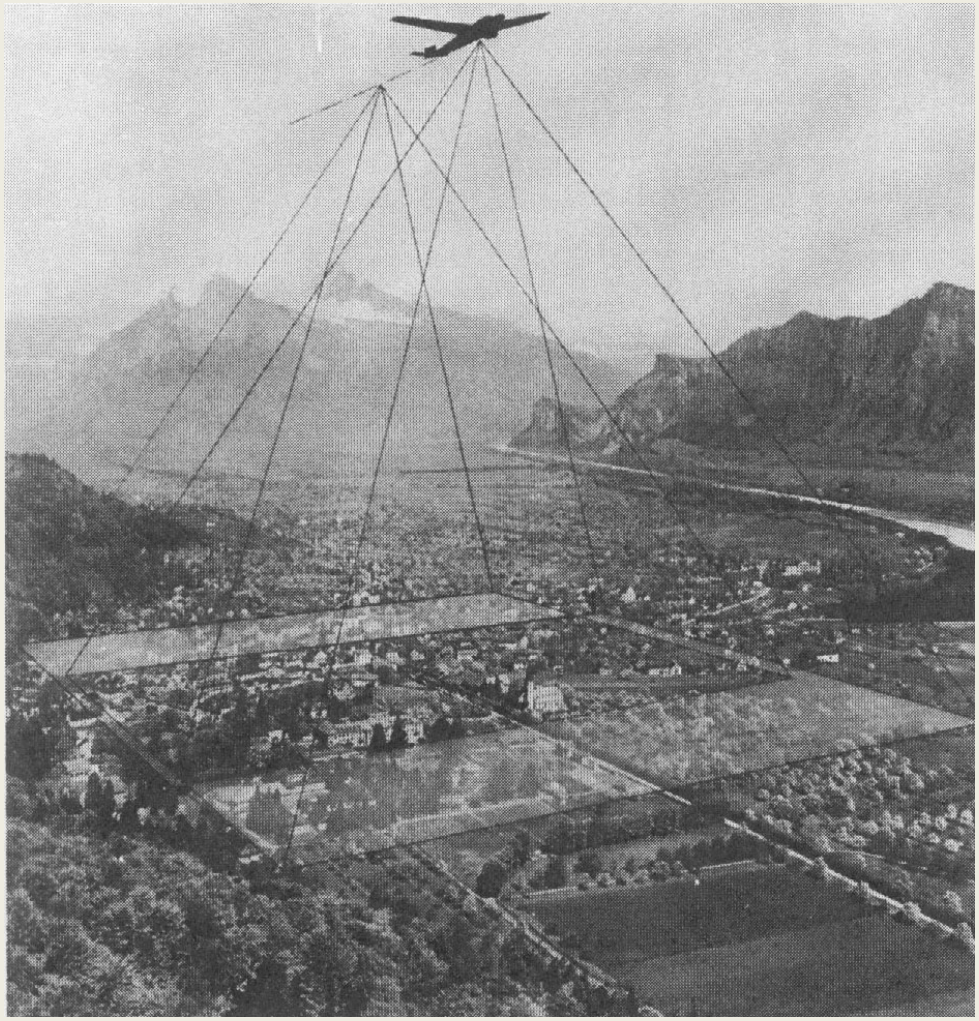
- ***Terestrička fotogrametrija*** (snimanje sa Zemlje)
- **Aerofotogrametrija** (snimanje iz zraka)


ĐAKOVAČKI BISKUP
J. J. STROSSMAYER DAO JE
1866. U ĐAKOVU GRADITI
STOLNU CRKVU.
KATEDRALA JE DOVRŠENA
1882. PO NACRTIMA POZNA-
TOG BEČKOG GOTIČARA
F. SCHMIDTA.
NJENA NAROČITA VRIJED-
NOST 43 SU FRESKE
BIBLIJSKIH MOTIVA.

Aerofotogrametrijska metoda geodetske izmjere

- Najčešće korištena metoda za izradu planova i karata (posebno za veća područja)
- Prednosti metode: smanjenje terenskog rada, skraćivanje vremena izrade, smanjenje troškova

Aerofotogrametrija

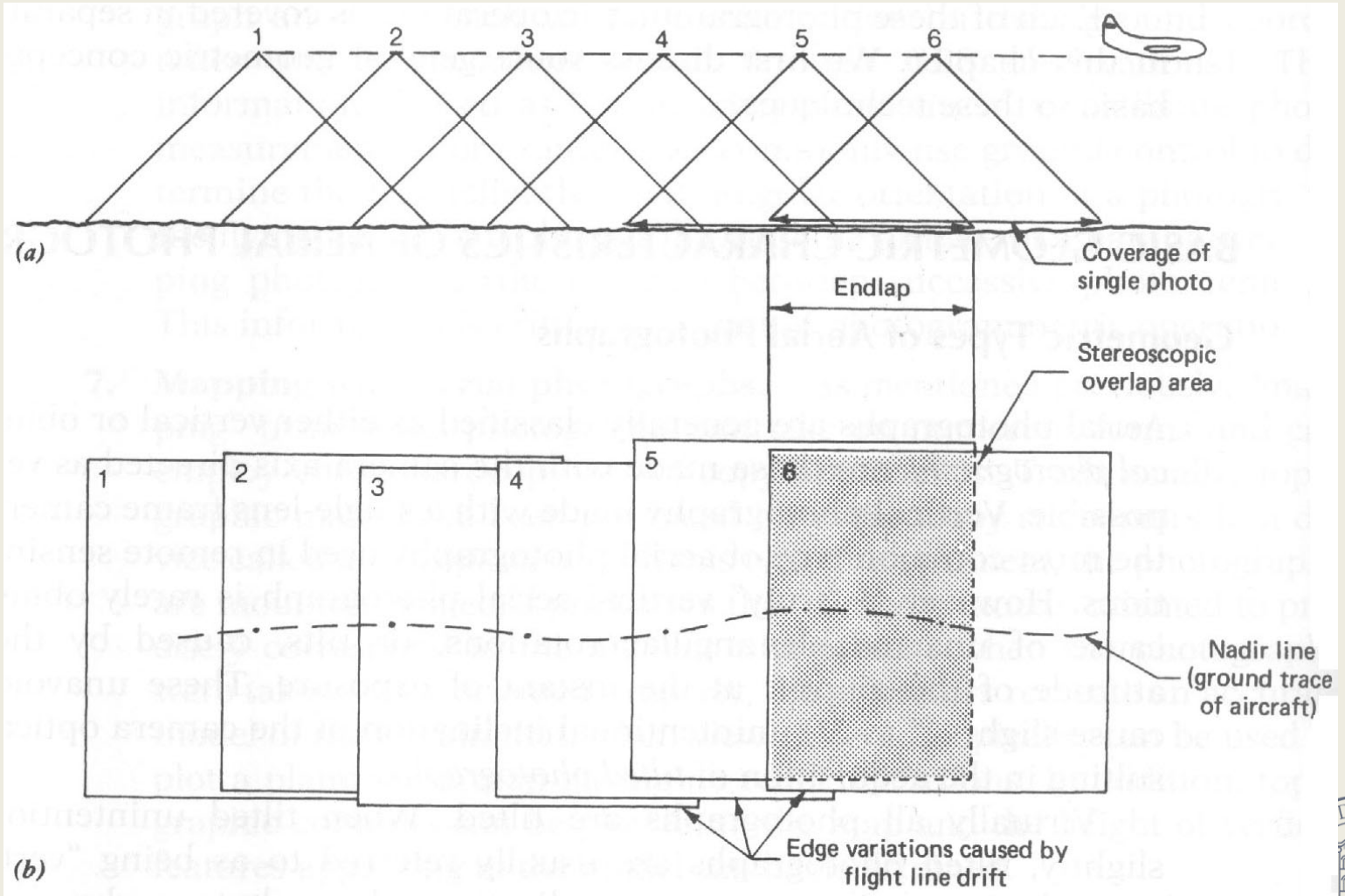


Aerofotogrametrija

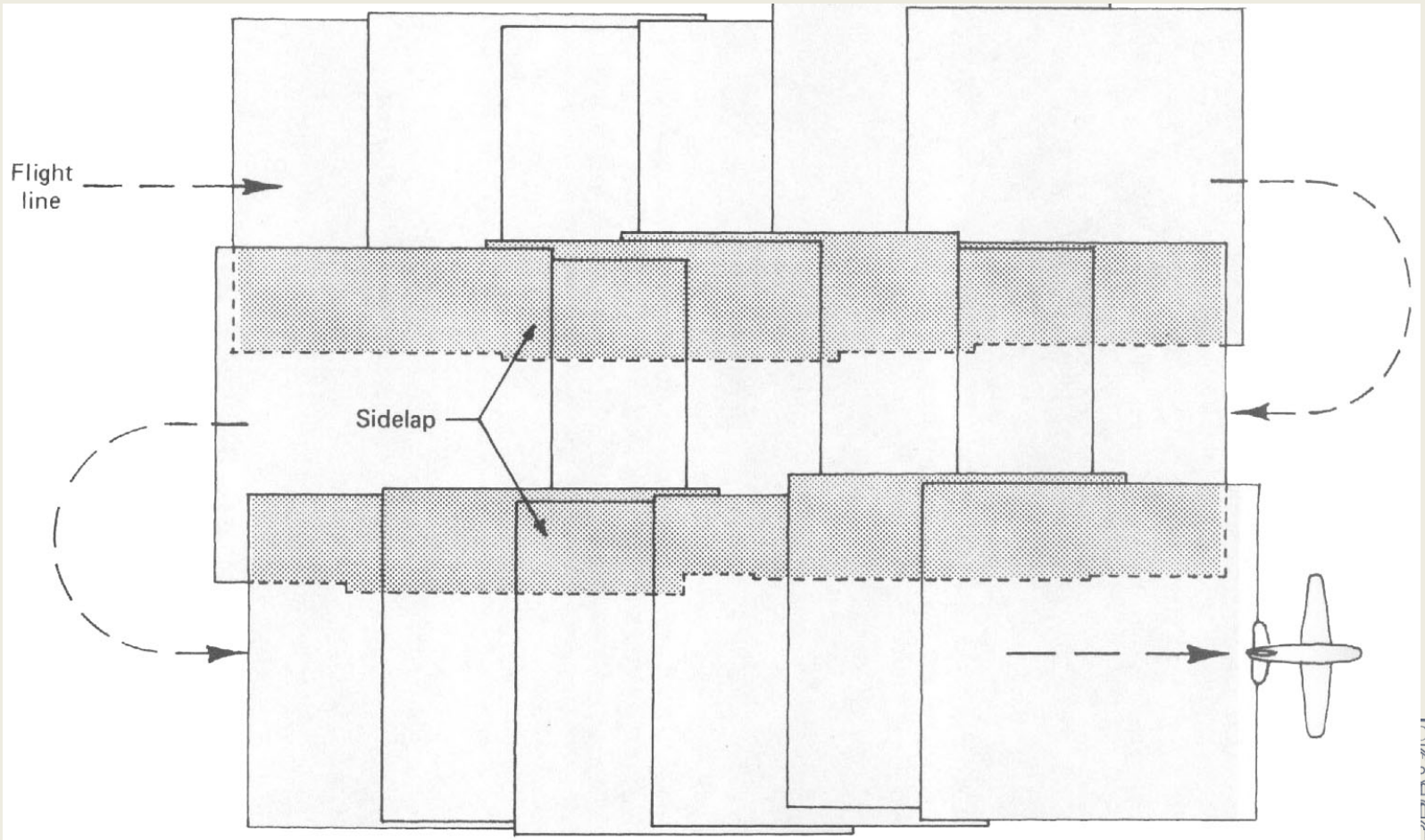
- Izrada plana leta,
- fotosignalizacija,
- snimanje iz zraka,
- određivanje orijentacijskih točaka, kartiranje (restitucija),
- dešifriranje podataka koji se ne mogu raspoznati na snimku,
- izrada izdavačkih originala

Izrada plana leta

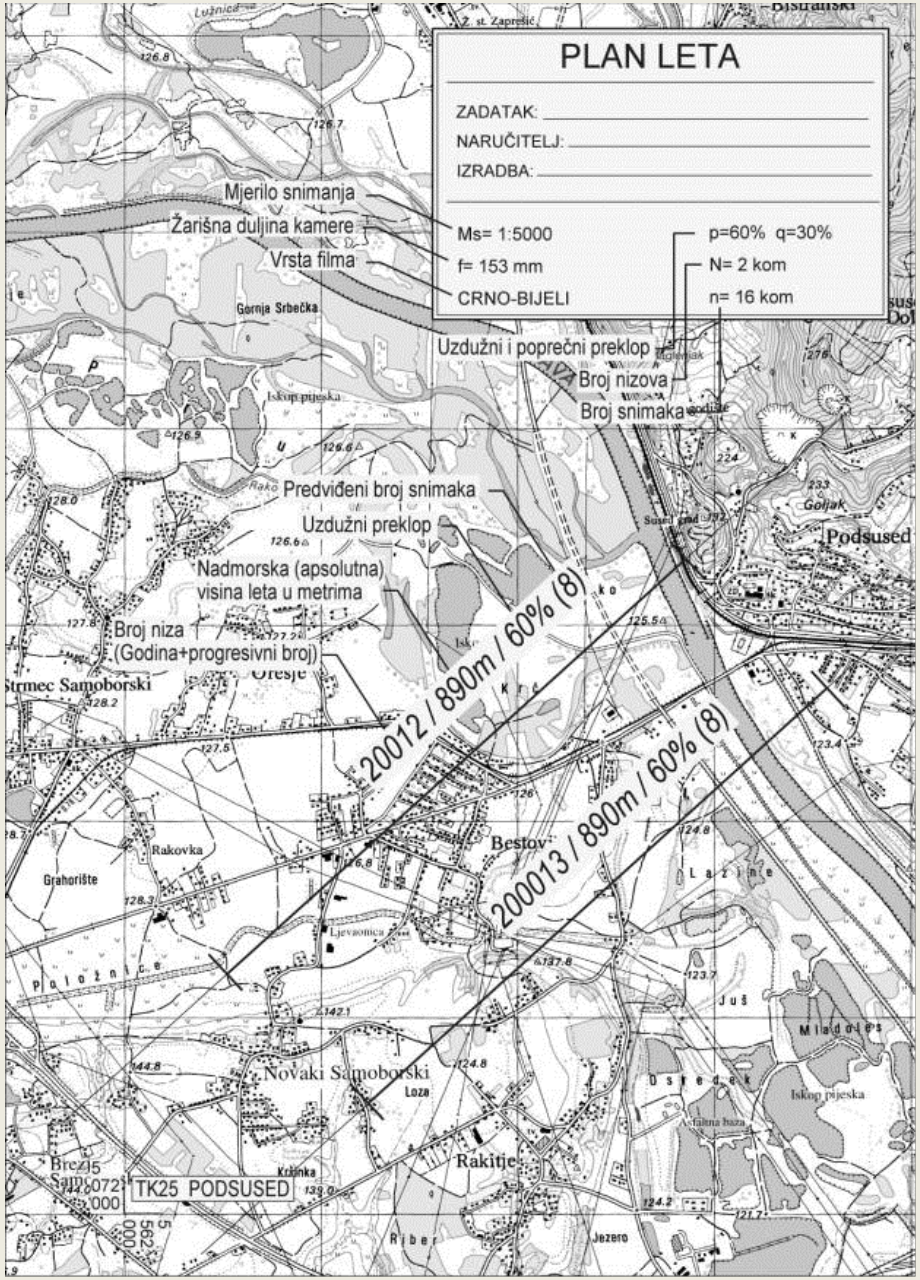
- Određuje se mjerilo snimanja
  - Na temelju mjerila kartiranja i zahtijevane točnosti karte
  - Npr. Za kartiranje u mjerilu 1:1000 služe snimci u mjerilu 1:4000 (1:5000 i 1:10 000 – snimci u mjerilu od 1:15 000 do 1:20 000)
- Određuju se preklopi snimanja (uzdužni preklop 60-80%, poprečni 10-30%)
  - Uzdužni preklop nužan za dobivanje stereomodela
  - Redovi snimanja planiraju se na karti u mjerilu 1:100 000 ili 1:50 000 (upisuje se pravac, broj reda snimanja i apsolutna visina leta aviona)



Photographic coverage along a flight strip: (*a*) conditions during exposure; (*b*) resulting photography.



Adjacent flight lines over a project area.



Fotosignalizacija

- Fotosignali se postavljaju na ravnim mjestima koja su otvorena prema osi reda snimanja
- Te su točke vidljivo označene na terenu
- Služe lakšem uočavanju stalnih geodetskih i važnijih detaljnih točaka na snimcima

Snimanje

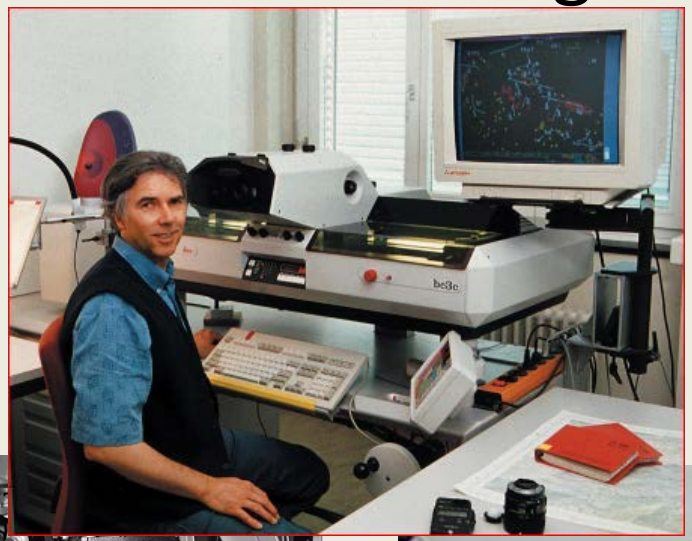
- Vrši se pri vedrom i tihom vremenu,
- u umjerenim geografskim širinama u rano proljeće ili kasnu jesen (zašto?)
- U određeno doba dana (zašto?)
- Treba izbjegavati oblačno i maglovito vrijeme te razdoblja s jakim isparavanjem

Određivanje orijentacijskih točaka

- Služe za apsolutnu orijentaciju stereomodela
- U praksi se određuju položajno i visinski četiri točke u kutovima stereomodela i jedna točka u sredini

Kartiranje iz snimaka (restitucija)

- Izvodi se pomoću stereoautografa



Dešifriranje

- Neki podaci o prostoru se ne mogu prikupiti upotrebom snimaka iz zraka
- Npr. Vrsta kulture, namjena objekta i dr.
- Dešifriranja se odvija prije kartiranja ili se kartirano stanje provjerava poslije

fotogrametrijsko dešifriranje

- uz pomoć (fo)toskica se na terenu dopunjuju podaci, koji sa snimaka ne bi mogli biti jasno i jednoznačno registrirani

dešifriranje nakon restitucije

- suvremeniji pristup - potrebno je manje vremena za dešifražu
- maksimalno se nastoje interpretirati snimci, a korigira se samo ono što je pogrešno izmjereno ili interpretirano

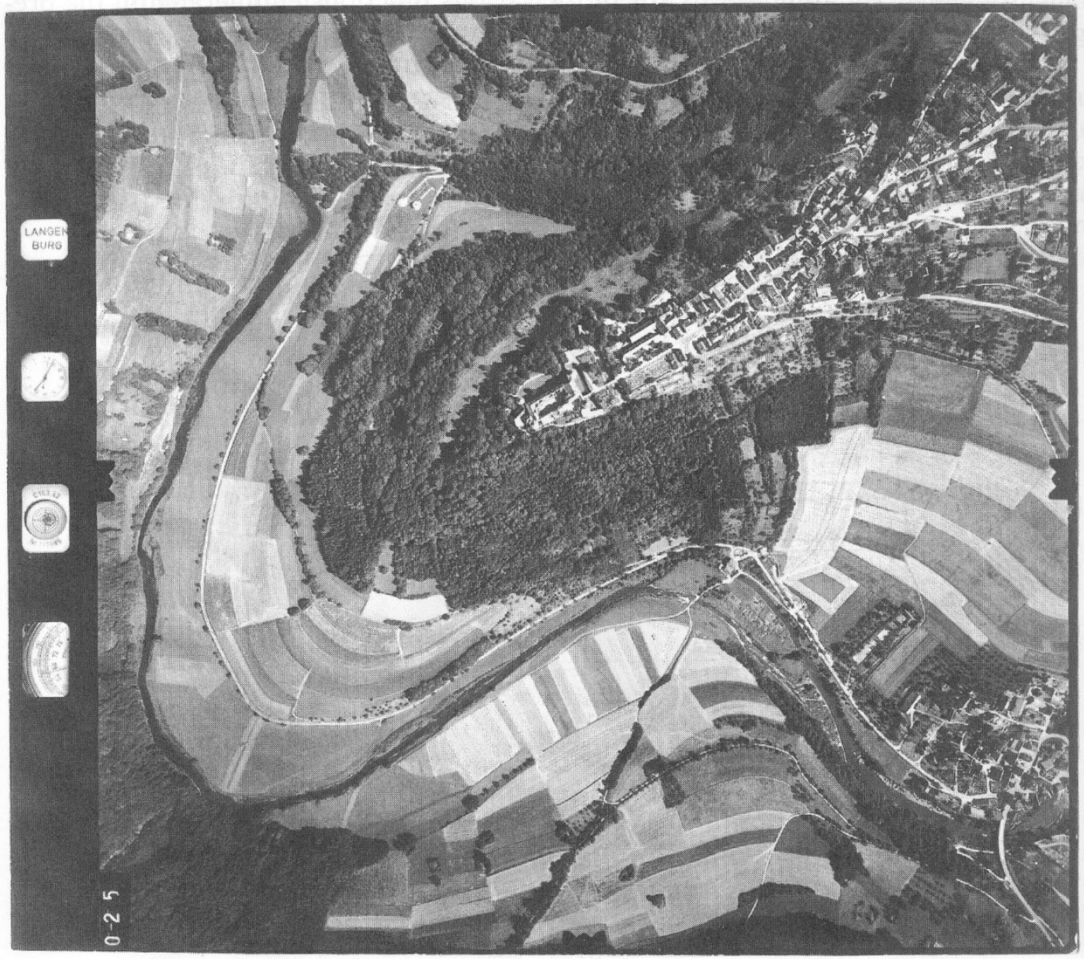


Figure 2.29 Vertical aerial photograph taken with a 230 × 230-mm precision mapping film camera showing Langenburg, Germany. Note the camera fiducial marks on each side of image. Data blocks (on left of image) record image identification, clock, level bubble, and altimeter. Frame number is recorded in lower left corner of image. Scale 1:13,200. (Courtesy Carl Zeiss.)

- Prije upotrebe snimci se moraju prekontrolirati i ispraviti (redresirati)
- Redresiranje – postupak prijenosa snimka (centralna projekcija) u perspektivu strogo vertikalnog snimka
- To su ispravke zbog toga što os snimanja nije najčešće okomita na površinu Zemlje ili reljefa (zbog različite visine ne vrijedi svugdje jedinstveno mjerilo)

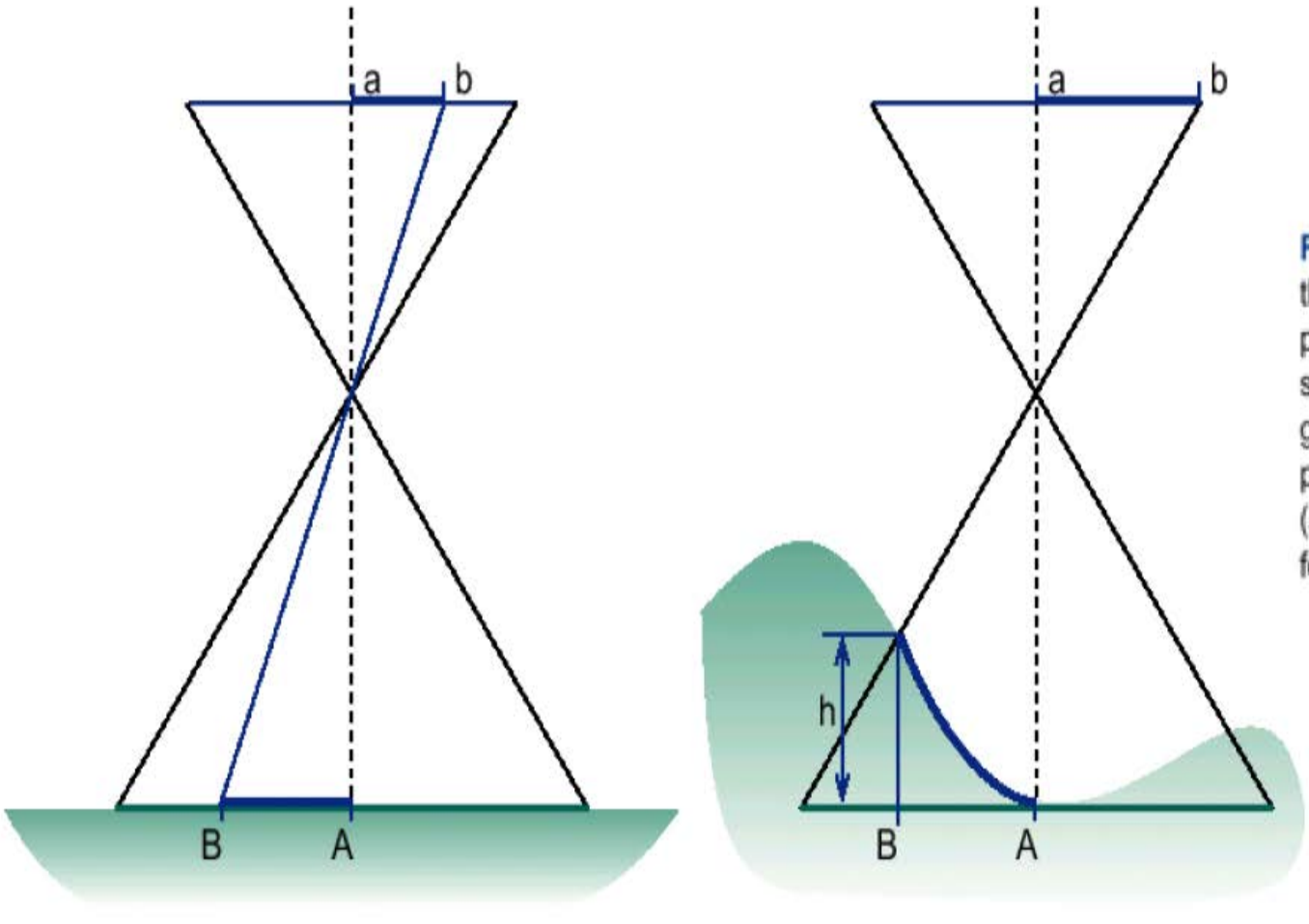


Figure 9.1: Illustration of the effect of terrain topography on the relationship between A–B (on the ground) and a–b (on the photograph). Flat terrain (a); significant height difference (b).

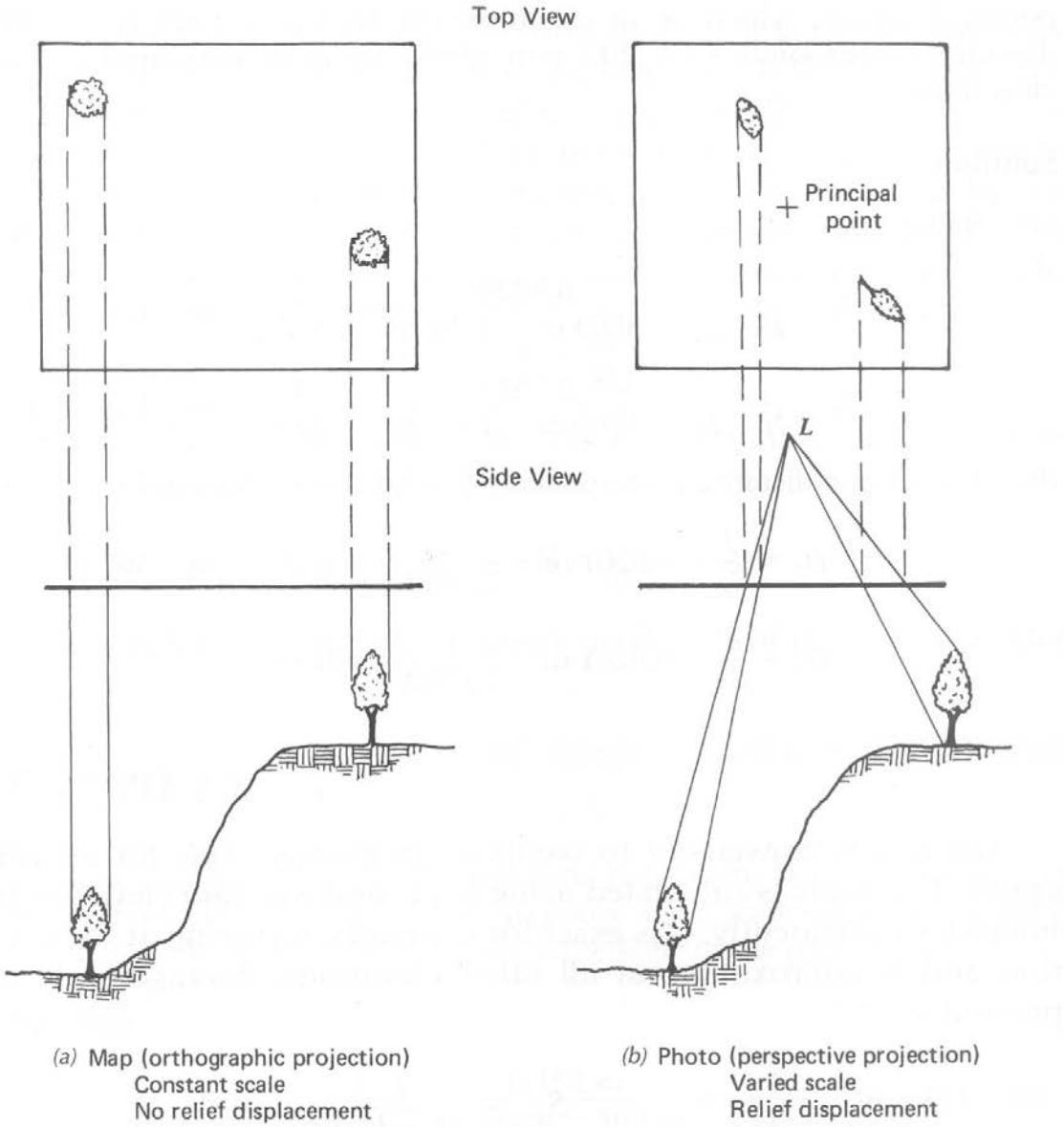


Figure 3.8 Comparative geometry of (*a*) a map and (*b*) a vertical aerial photograph. Note differences in size, shape, and location of the two trees.

- Tamo gdje je energija reljefa mala (ravni teren) redresiranjem se zračni snimak prevodi u određeno jedinstveno mjerilo.
- Postupak se izvodi pomoću optičkog instrumenta koji se naziva redreser.
- Tamo gdje je energija reljefa veća (raščlanjeni reljef) potrebno je provesti redresiranje dio po dio (diferencijalno redresiranje pomoću ortoprojektora)

- Prijenosom u perspektivu strogo vertikalnog snimka nastaje ***fotoplan***
- Fotoplan ⟶ ***fotokarta*** (kartografska izražajna sredstva)
- U područjima izvan nadira na fotoplanu su prisutne položajne pogreške (zašto?)
- fotografski snimak rezultat je centralne projekcije (viši dijelovi se preslikavaju u krupnijem mjerilu nego niži)

- Diferencijalnim redresiranjem iz fotoplana nastaje ***ortofotoplan***
- Diferencijalnim redresiranjem iz fotokarte nastaje ***ortofotokarta***
- Fotoplan i fotokarta – predstavaljaju centralnu projekciju terena
- Ortofotoplan i ortofotokarta predstavljaju ortogonalnu projekciju terena

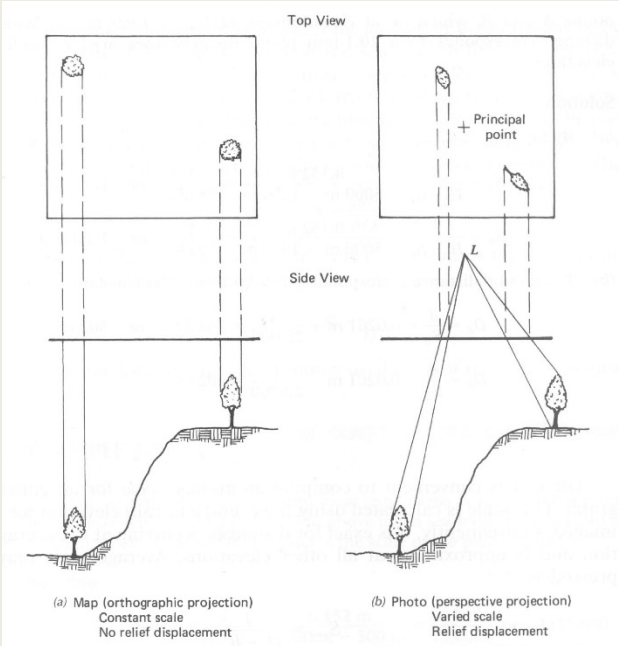
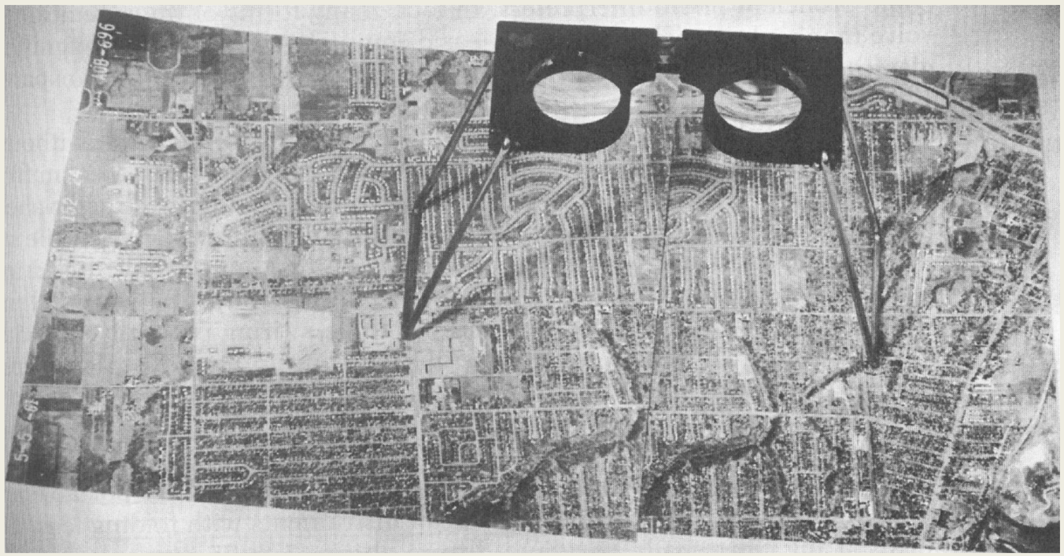
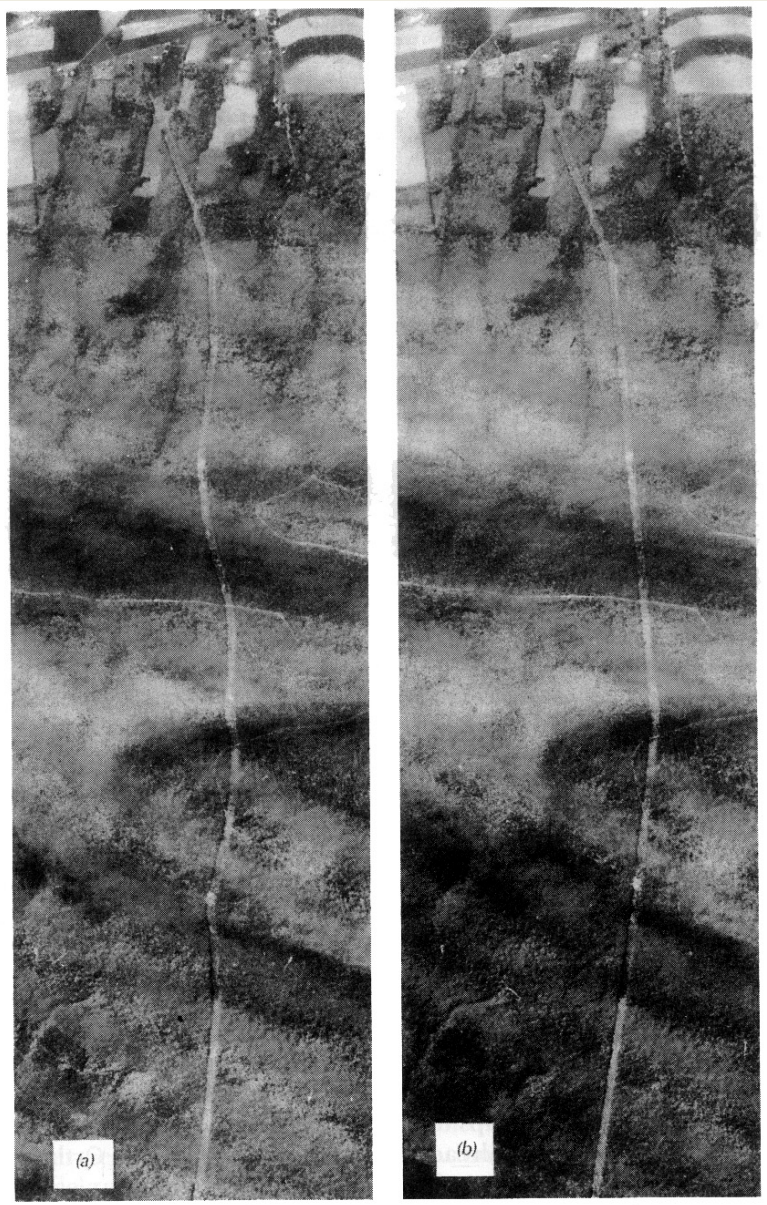


Figure 3.8 Comparative geometry of (*a*) a map and (*b*) a vertical aerial photograph. Note differences in size, shape, and location of the two trees.

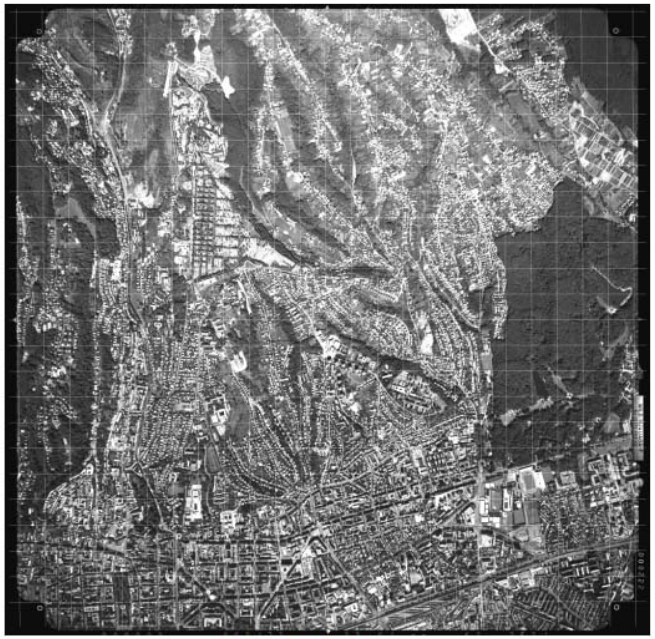
- Kod rekonstrukcije trodimenzionalnih elemenata (reljef) nužno je stereoskopski snimati teren (dva snimališta)
- Reljef se, dakle, rekonstruira pomoću stereopara snimaka
- Stereoskopsko snimanje i stereoskopsko promatranje omogućuju izradu plana u fotografskom obliku s prostornom komponentom (3D) – ***stereofotoplan ili anaglifski plan.***



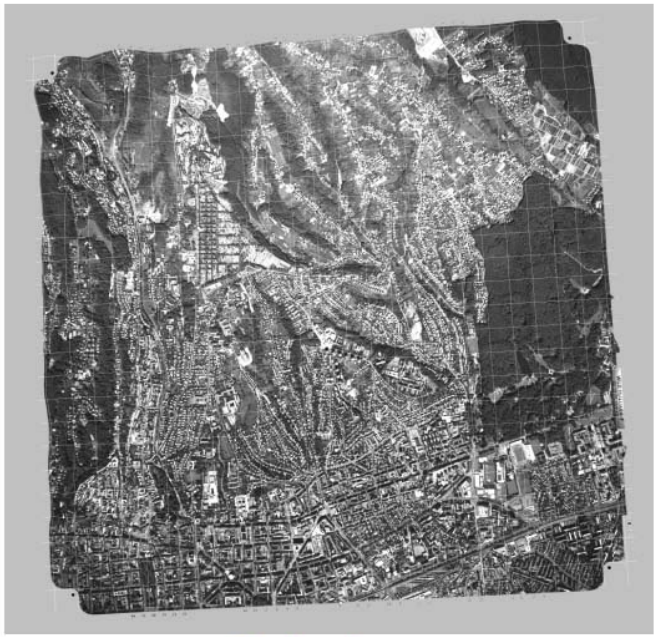

WILD



Portion of (*a*) a perspective photograph and (*b*) an orthophoto showing a power line clearing traversing hilly terrain. (Note the excessive crookedness of the power line clearing in the perspective photo that is eliminated in the orthophoto.) (Courtesy USGS.)



Aerial photo



Orthophoto

Topografska ortofotokarta

Portion of a 1 : 4800 topographic orthophotomap. Photography taken over the Fox Chain of Lakes, IL. (Courtesy Alster and Associates, Inc.)

Digitalni ortofoto

5J22-24

ZAGREB - 24

© Gradski zavod za planiranje razvoja Grada i zaštitu okoliša Grada Zagreba
Državna geodetska uprava Republike Hrvatske
Gradski zavod za katastar i geodetske poslove Grada Zagreba

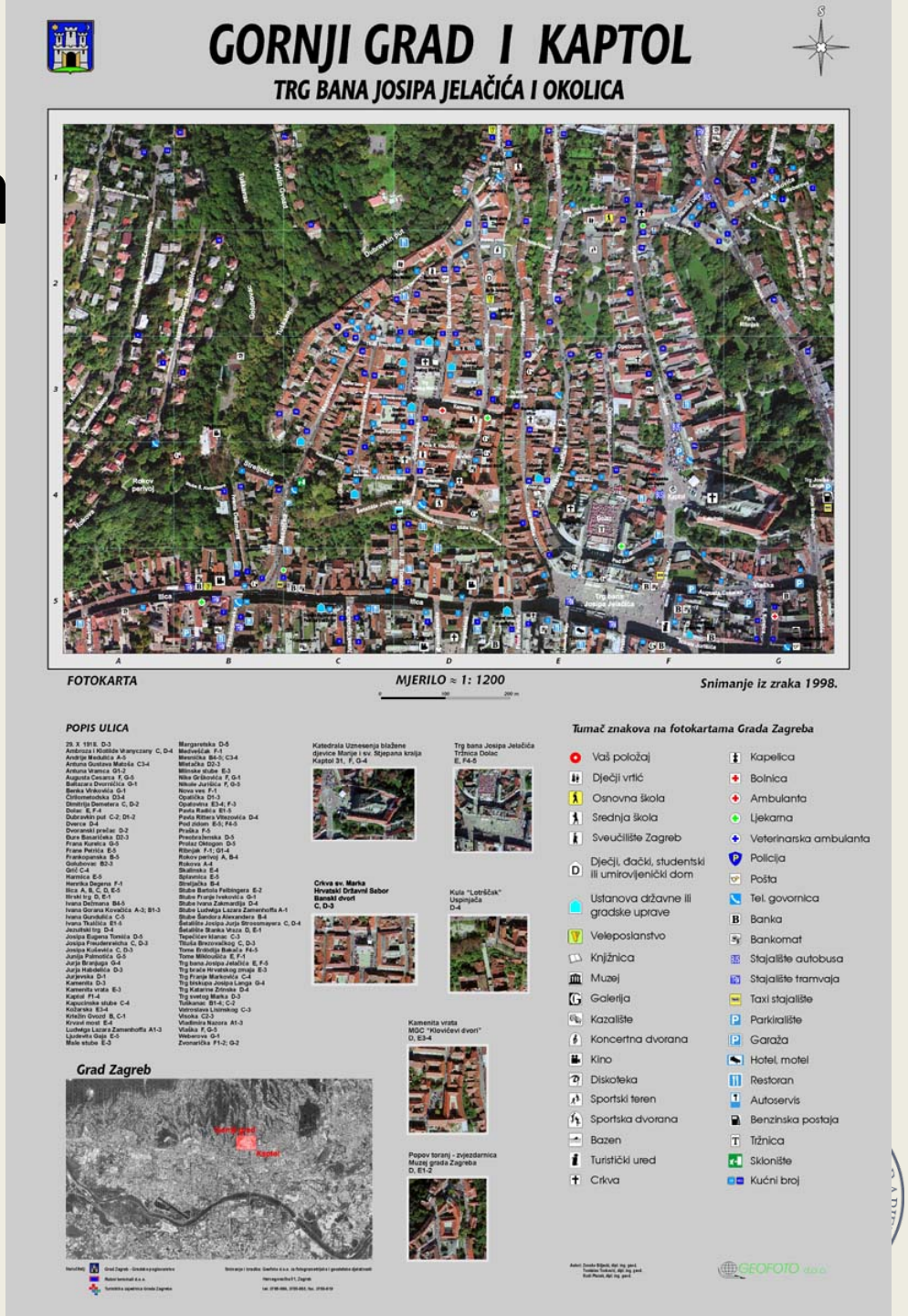
Mjerilo 1 : 5000

Izradba: Geofoto - Zagreb

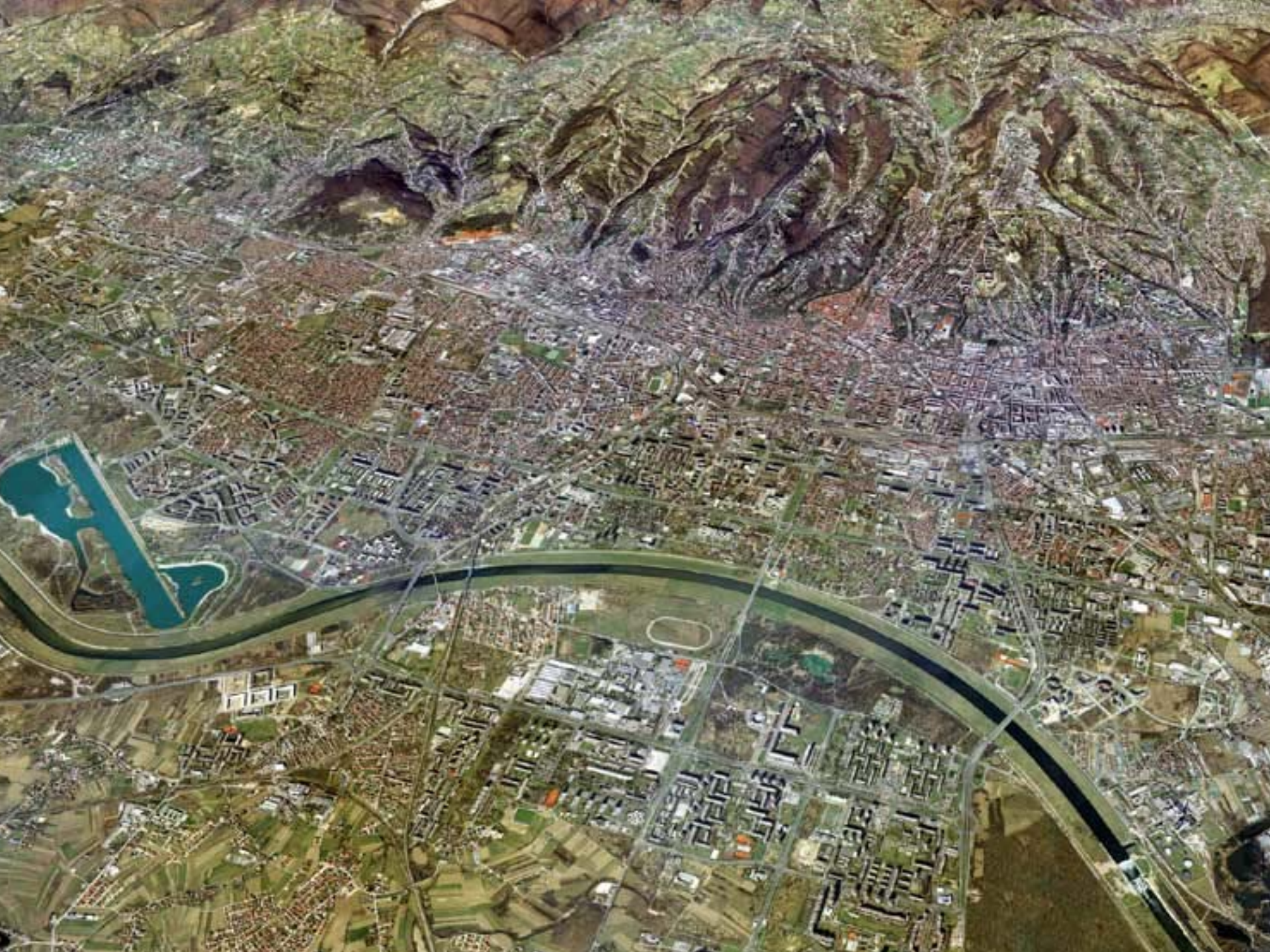
ZAGREB - 24

Ekvidistancija 5 m

Fotoka

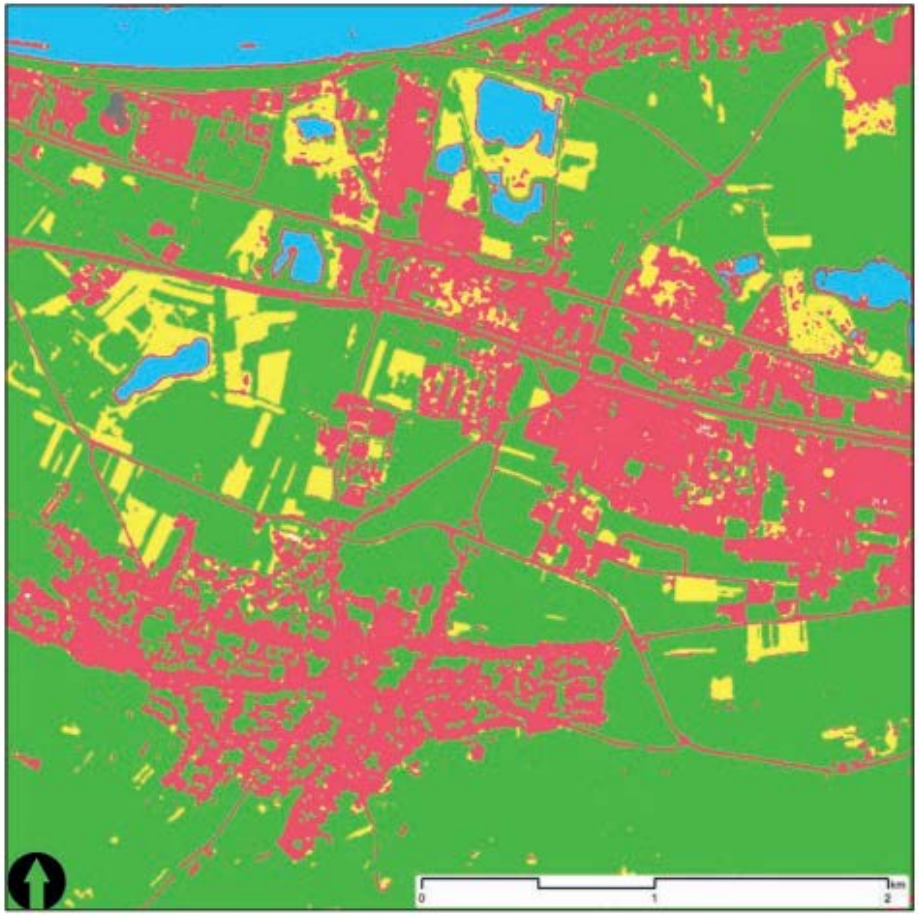

GORNJI GRAD I KAPTOL
TRG BANA JOSIPA JELAČIĆA I OKOLICA
FOTOKARTA
MJERILO ≈ 1: 1200
Snimanje iz zraka 1998.
POPIS ULICA
Tumač znakova na fotokartama Grada Zagreba
Vaš položaj
Dječji vrtić
Osnovna škola
Srednja škola
Sveučilište Zagreb
Dječji, đački, studentski ili umirovljenički dom
Ustanova državne ili gradske uprave
Veleposlanstvo
Knjižnica
Muzej
Galerija
Kazalište
Koncertna dvorana
Kino
Diskoteka
Sportski teren
Sportska dvorana
Bazen
Turistički ured
Crkva
Kapelica
Bolnica
Ambulanta
Ljekarna
Veterinarska ambulanta
Policija
Pošta
Tel. govornica
Banka
Bankomat
Stajalište autobusa
Stajalište tramvaja
Taxi stajalište
Parkiralište
Garaža
Hotel, motel
Restoran
Autoservis
Benzinska postaja
Tržnica
Sklonište
Kućni broj
Grad Zagreb
GEOFOTO

Dio fotokarte Gornjeg Grada i Kaptola



Tab. 2. Zastupljenost klasa zemljišnog pokrova prema površinama
Tab. 2 Land cover classes by area

KLASA	Površina (ha)	Površina udio (%)
Izgrađene površine	433,49	28,43
Sjene	2,08	0,14
Tlo	113,66	7,45
Neklasificirano	0,27	0,02
Vegetacija	904,02	59,28
Voda	71,38	4,68
UKUPNO	1524,90	100,00

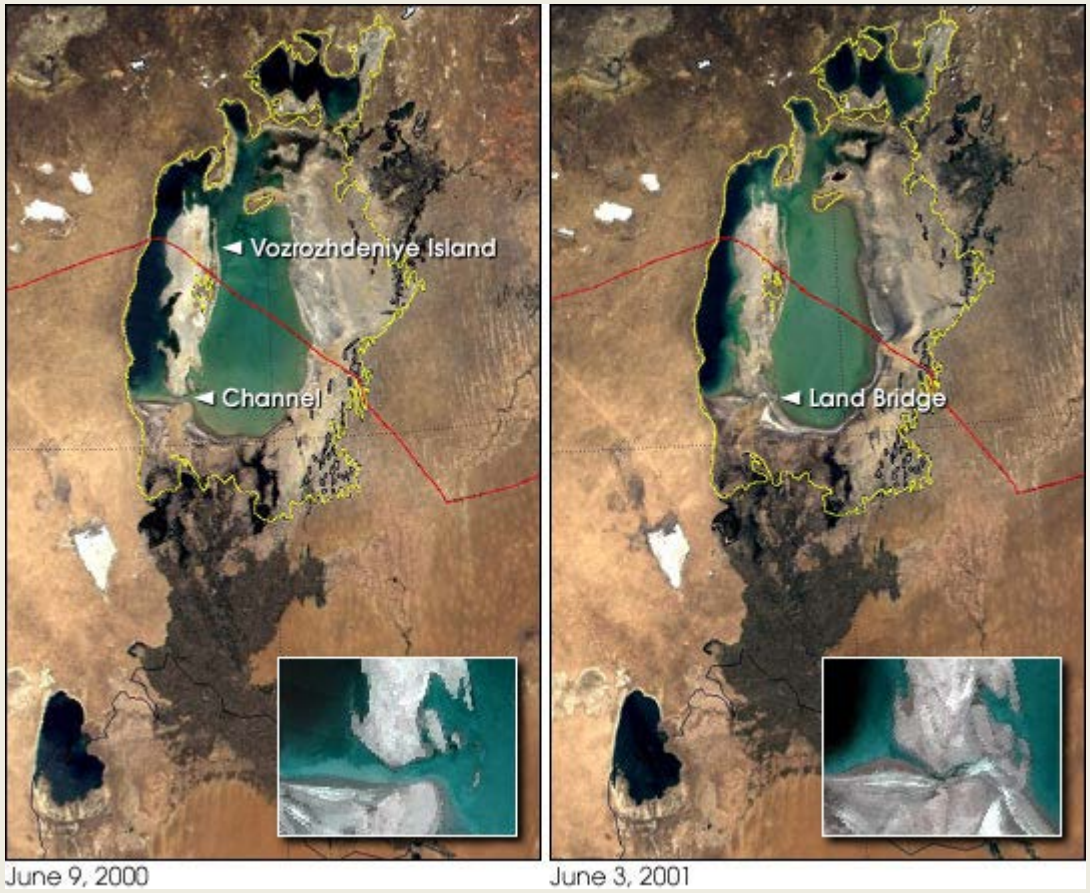


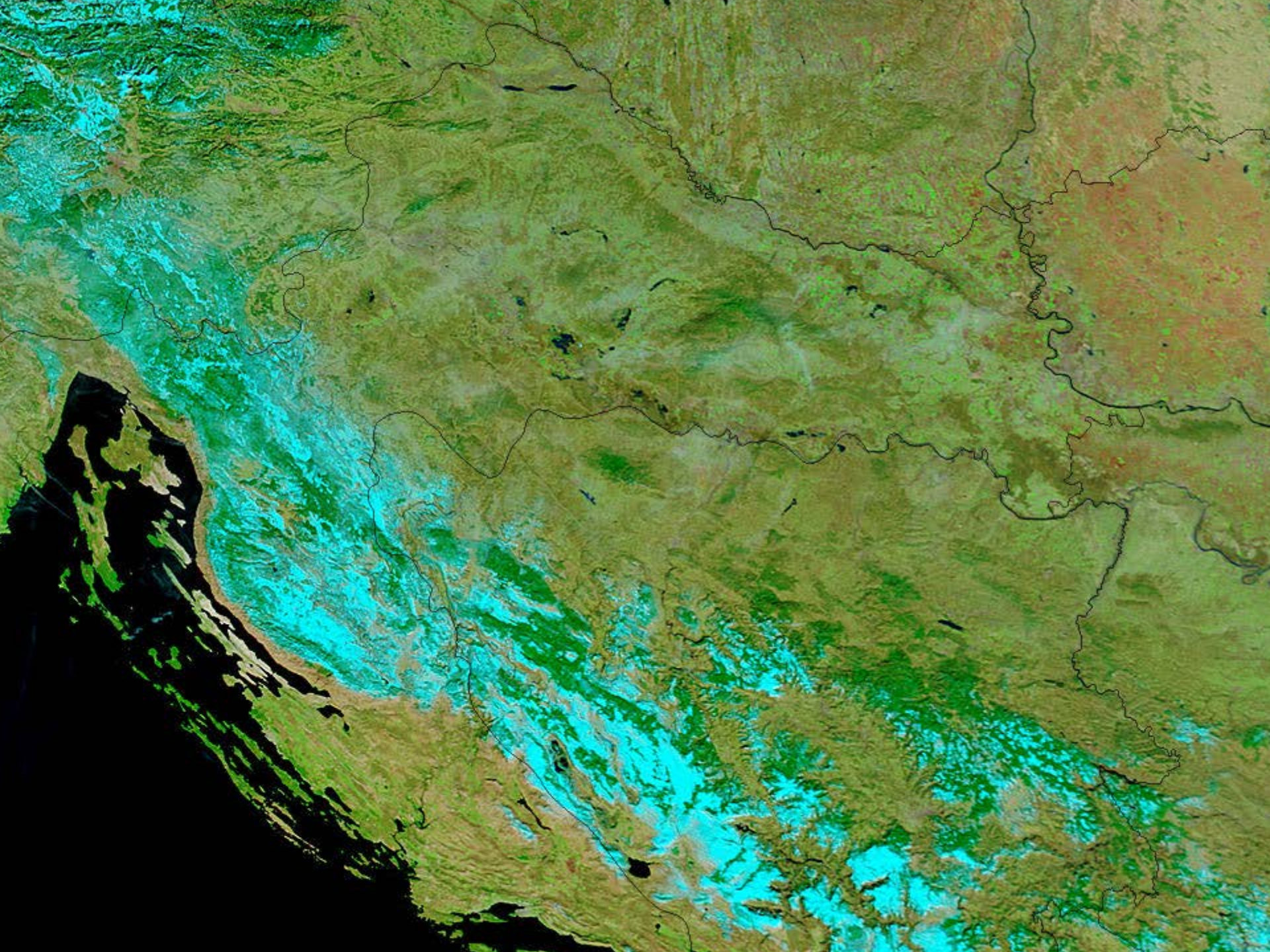
Sl. 2. Tematska karta zemljišnog pokrova (zeleno = vegetacija, crveno = izgrađene površine, žuto = tlo, plavo = voda, sivo = sjene)
Fig. 2 Thematic map of land cover classes (green = vegetation, red = built-up, yellow = soil, blue = water, gray = shadows)

Izvor: Valožić, L. (2014.)

Aralsko jezero

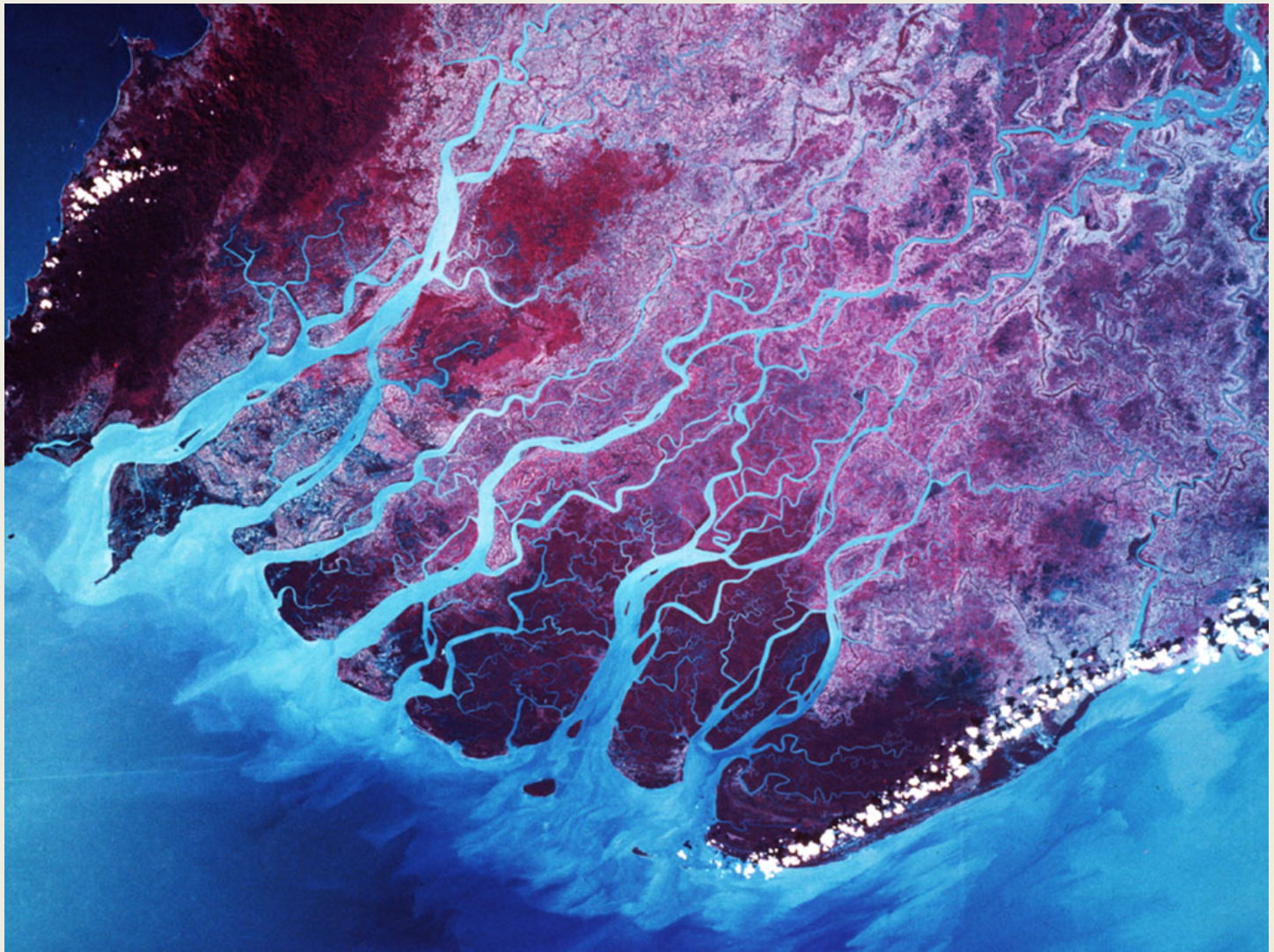
- Smanjivanje površine Aralskog jezera



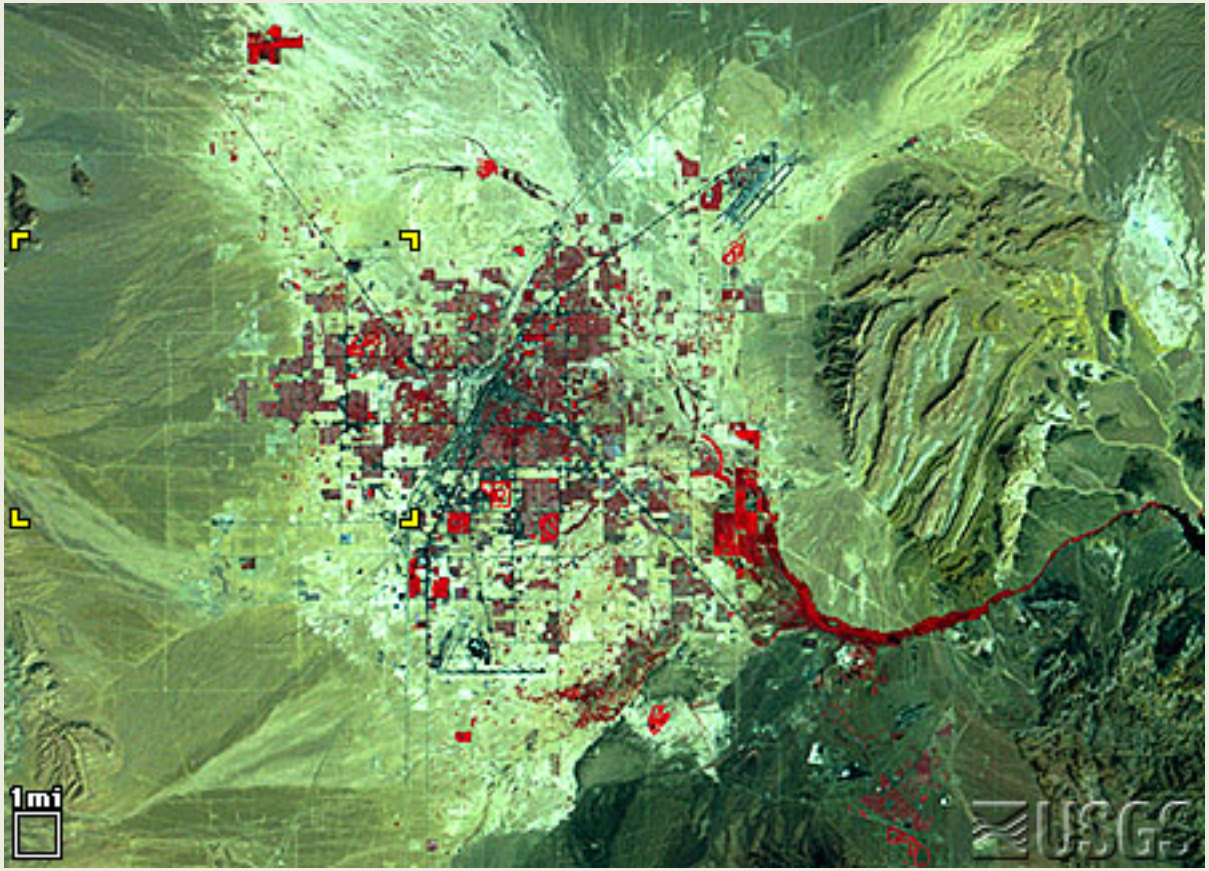


Madagaskar – akumulacija materijala u delti

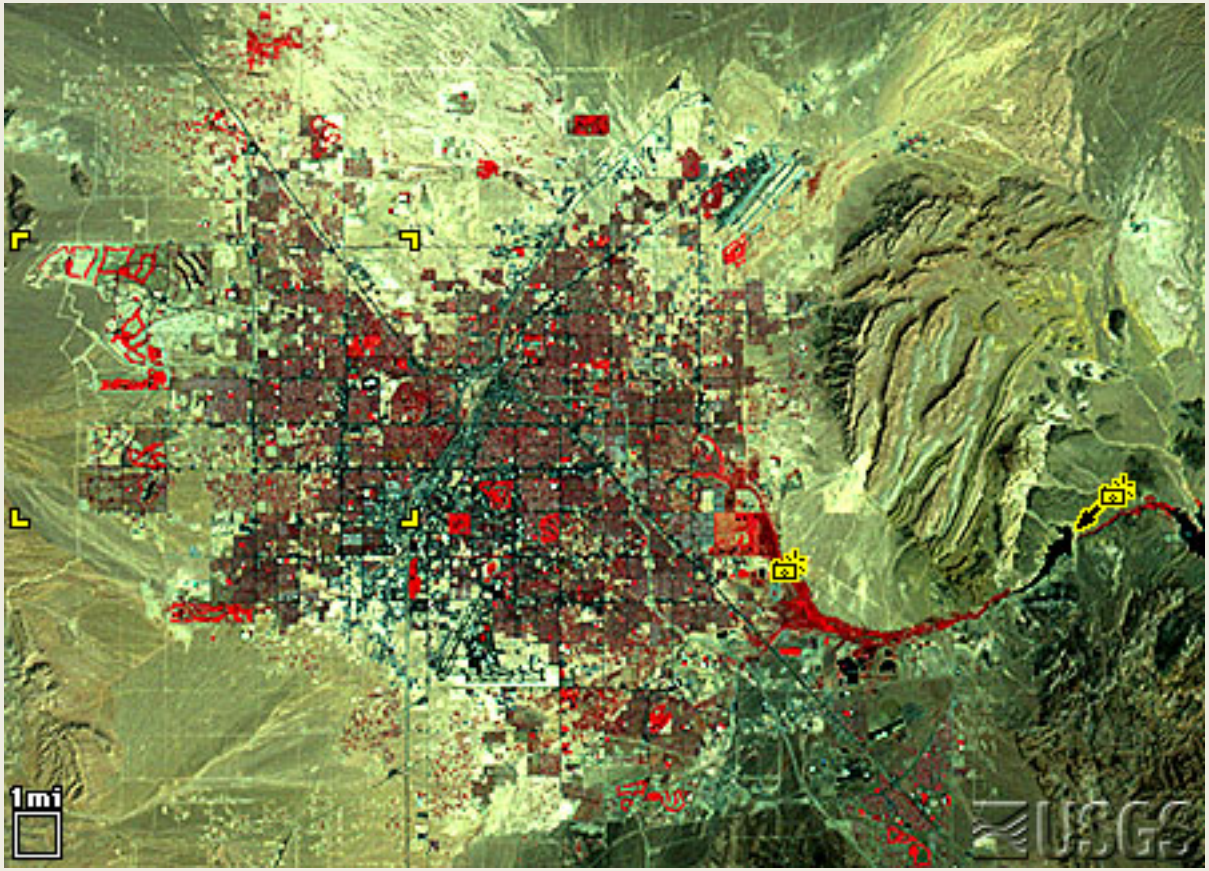
Irrawaddy (Mianma)

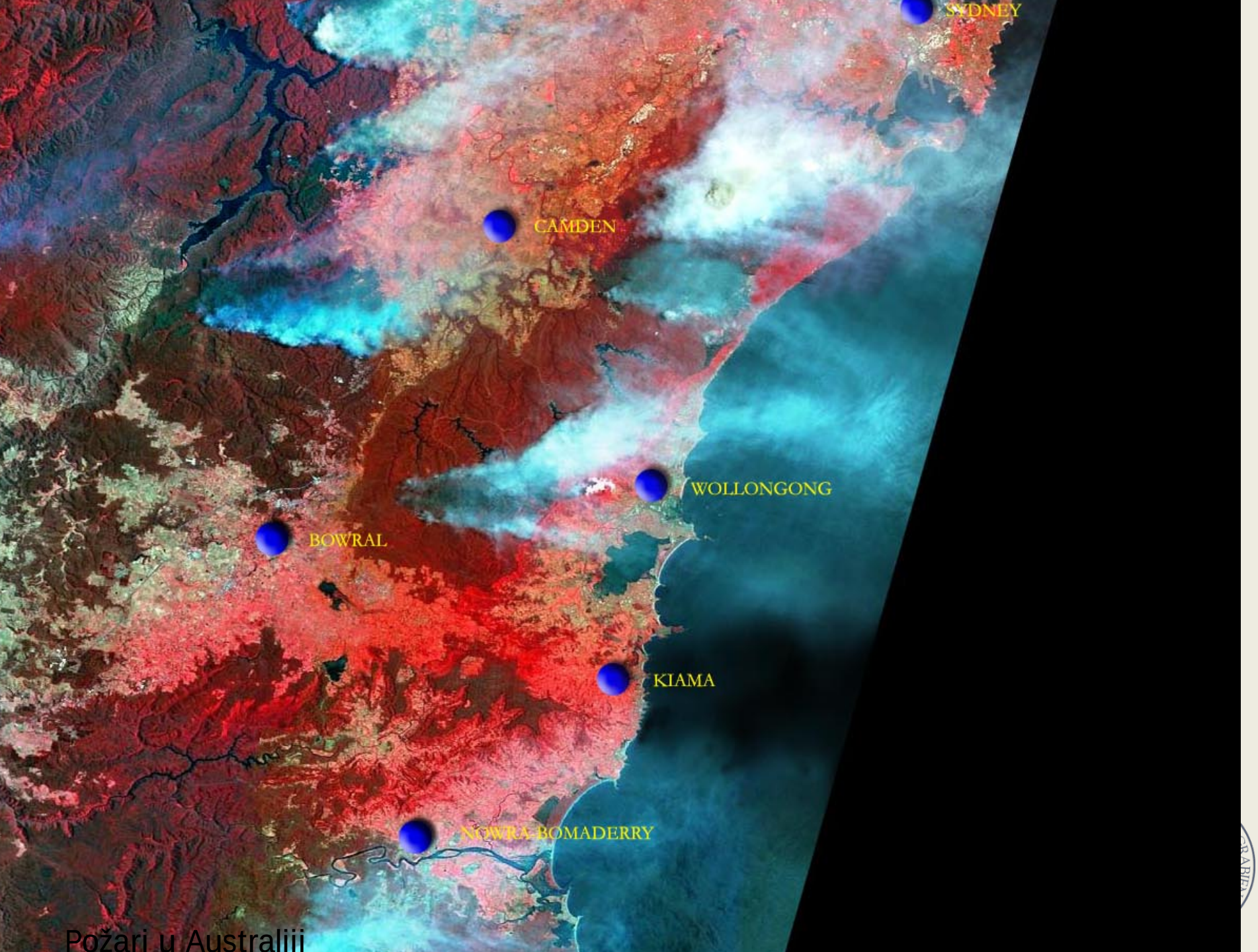


Las Vegas 1972.g.

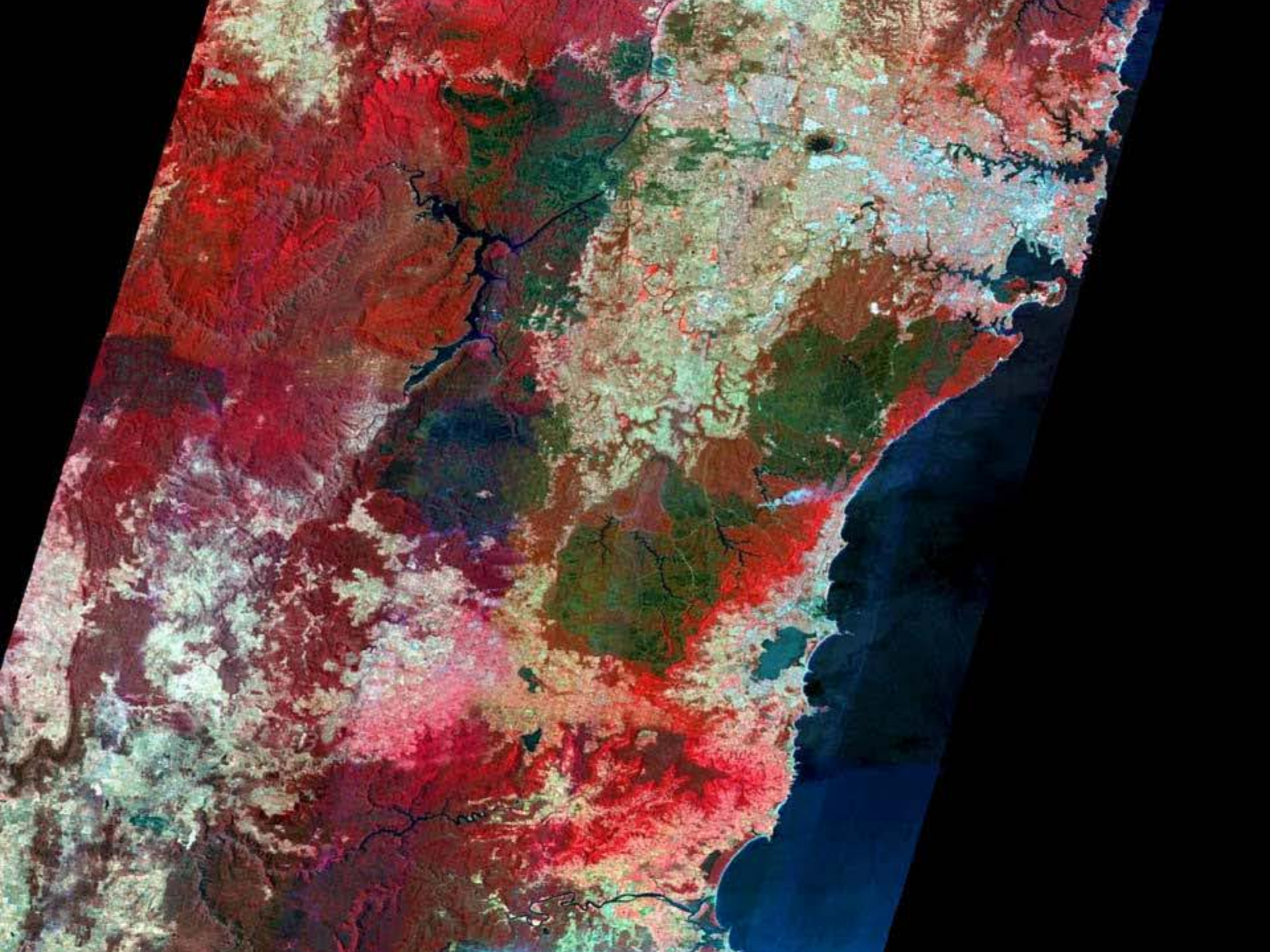


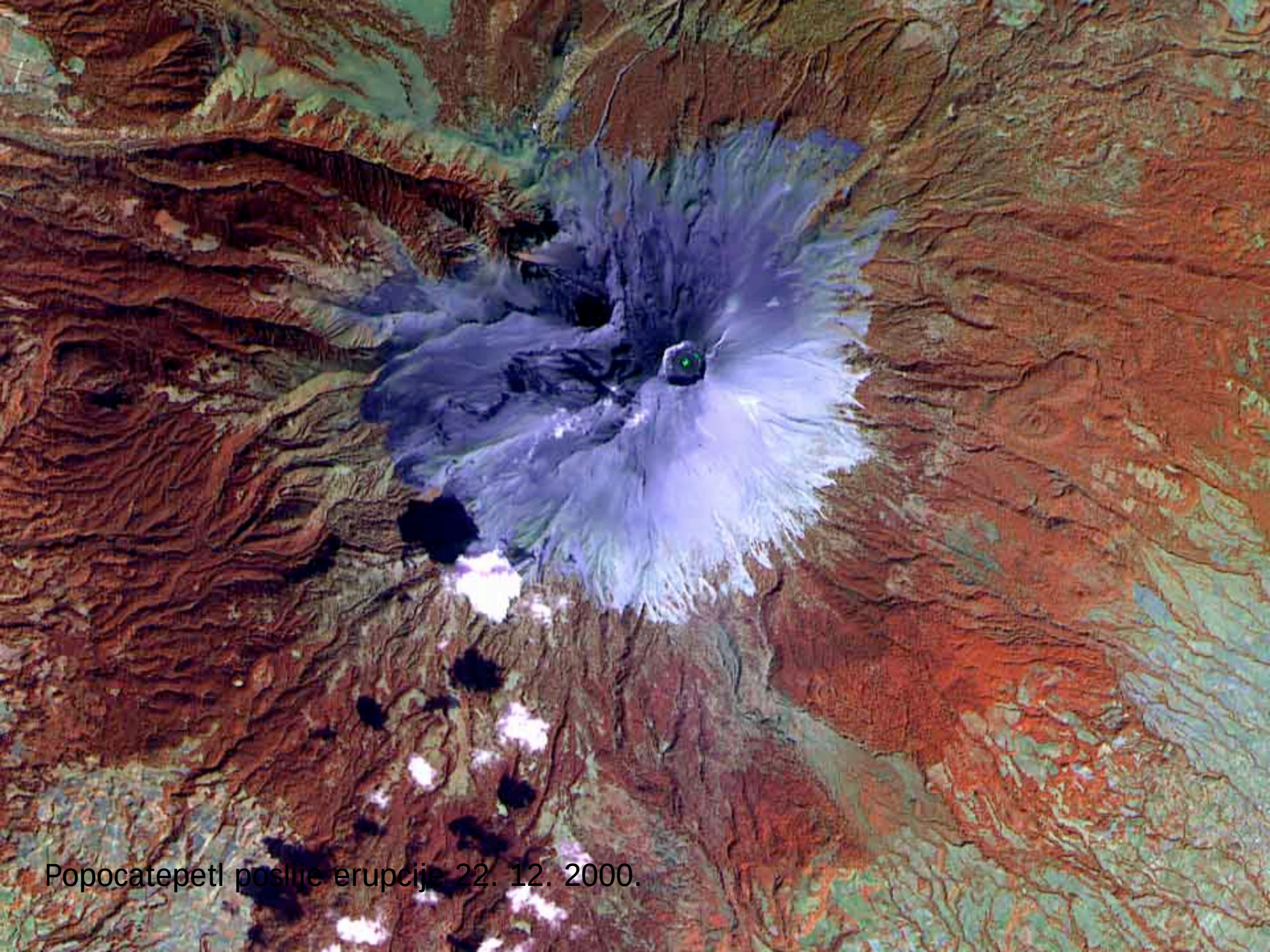
Las Vegas 1992.g.





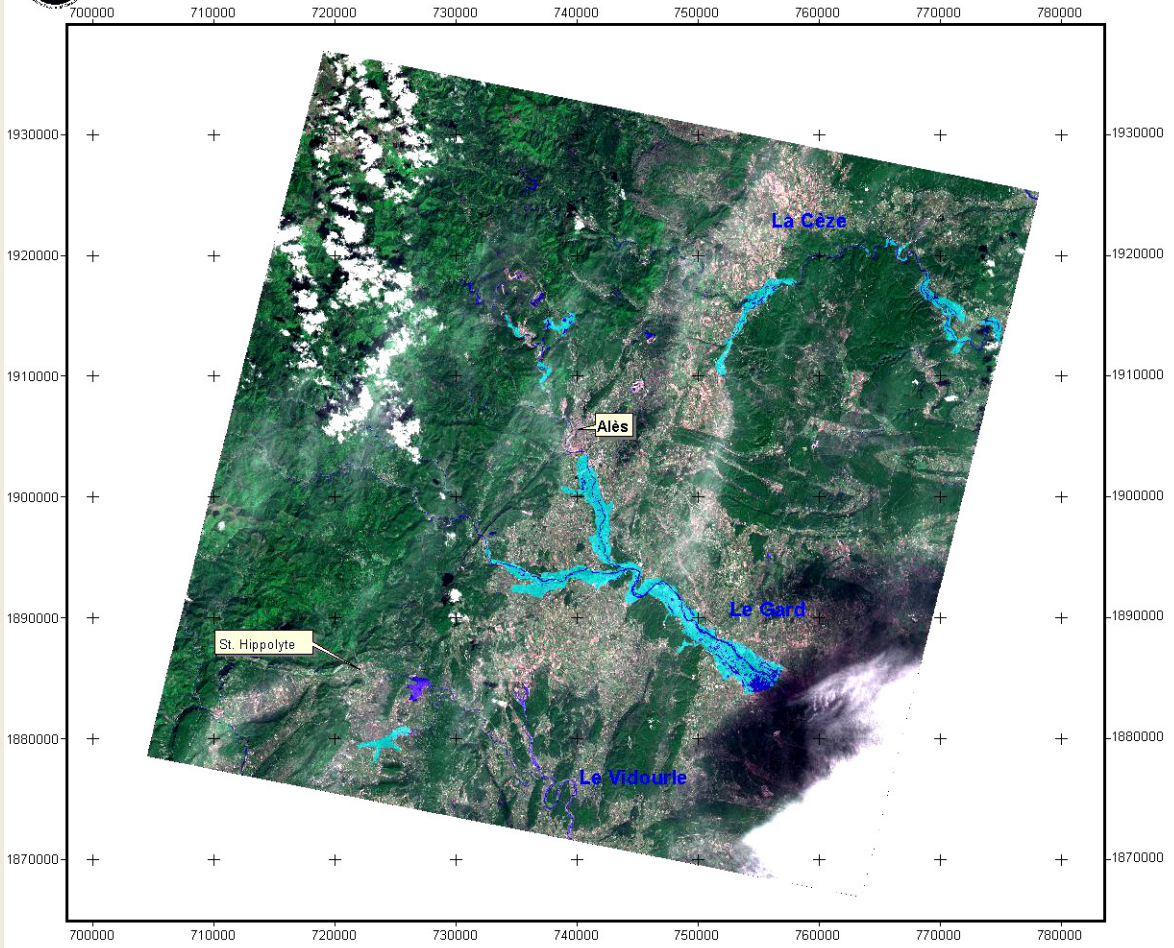
Požari u Australiji





Popocatepetl poslije erupcije 22. 12. 2000.

Cartographie rapide des inondations dans le Gard le 10 septembre 2002



cnes
AGENCE FRANÇAISE DE L'ESPACE

SERTIT

Données sources :
image SPOT 4 du
10 septembre 2002
à 12 h 49.

Spatio carte en pseudo
couleurs naturelles

Surfaces en eau
visibles lors du
passage du satellite

Interprétation des limites
de l'extension maximale
de la crue

N

5 0 5 10 km

Projection Lambert II étendu

Source Imagerie SPOT

Réalisation Sertit 2002

- http://www.abc.net.au/news/events/japan-quake-2011/beforeafter.htm

- Digitalni ortofoto je avionski snimak tla, u digitalnom (rasterskom) obliku koji je posebnim postupcima "ortorektificiran". Ortorektifikacija je postupak obrade fotografije koji uključuje uklanjanje geometrijskih netočnosti zbog perspektive, utjecaja reljefa, leće fotoaparata i sl., kao i uklanjanje razlika u svjetlini i osobinama boja pojedinih fotograma (pojedinačnih avionskih snimaka).