

Capteurs d'observation des terres émergées dans le domaine optique

Capteurs d'observation des terres émergées dans le domaine optique (2)

	SPOT	IKONOS	...	PLEIADES		SENTINEL2	
				1A	1B	2A	2B
Période mission	Fév. 1986 -	Sept. 99		Déc. 2011-	Déc. 2012	Juin 2015	2016
Couverture Spatiale	60 km	11 km		20 km		300 km	
Résolution spatiale	10 m 5 m 2.5 m	5 m 1 m		2m 0.5 m		60 m 20 m 10 m	
Répétitivité	25 jours					10 jours	
Bandes	4+Pan VIS+IR			4 + Pan VIS + PIR		13 bandes VIS + PIR	
Coût	1000 € 100 €	3000 \$		Même ordre		GRATUIT	

Introduction



(cc) BY-SA

Optical sensors for forestry

Name	Acquisition period	Acquisition type	Bandes	Spatial resolution (m)	Revisit time (days)	Scene cover or width (km)	Average Cost km ² (€)
Landsat	1972 - today	Permanent	Near 8	30	16	185x185km	0
Aster	2000 – today	Permanent ?	15	15 - 90	16	60x60km	Low cost?
Spot	1986 - today	Order	3 to 4	2.5 to 20m	26	60x60km	0.2 to 1.5
Spot 6/7	Sept 2012 - today	Order	4	1.5m to 6m	1	NA	4 to 10
Pleiade	2012 - today	Order	4	0.7 to 2.8	1	100x100 max	10 to 20
RapidEye	2008 - today	Order	5	6.5	5?	77km	1?
QuickBird	2001 - today	Order	4	0.6 to 2.4	1 to 3	15x15km	16 to 40
CBERS	1999 – today ?	Permanent	5?	20	14	120km	0?
AVNIR2	2006 to 2011	Permanent	4	10	15?	70km	
Sentinel 2	2015	Permanent	13	10 to 60m	5	290km	0

Image globale NOAA-AVHRR
Canal Rouge
1-10 avril 1992

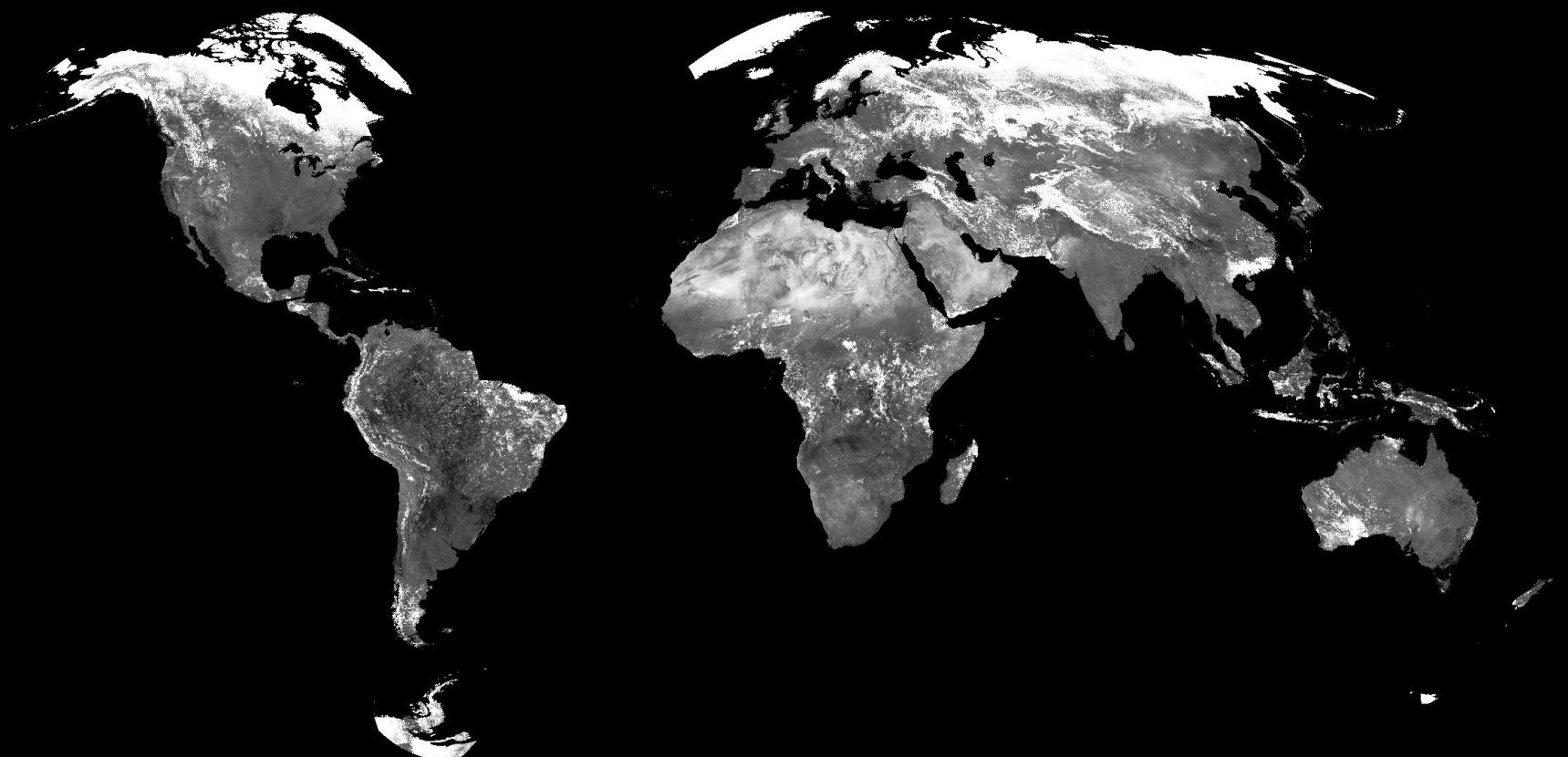


Image globale NOAA-AVHRR
Canal Proche-InfraRouge
1-10 avril 1992

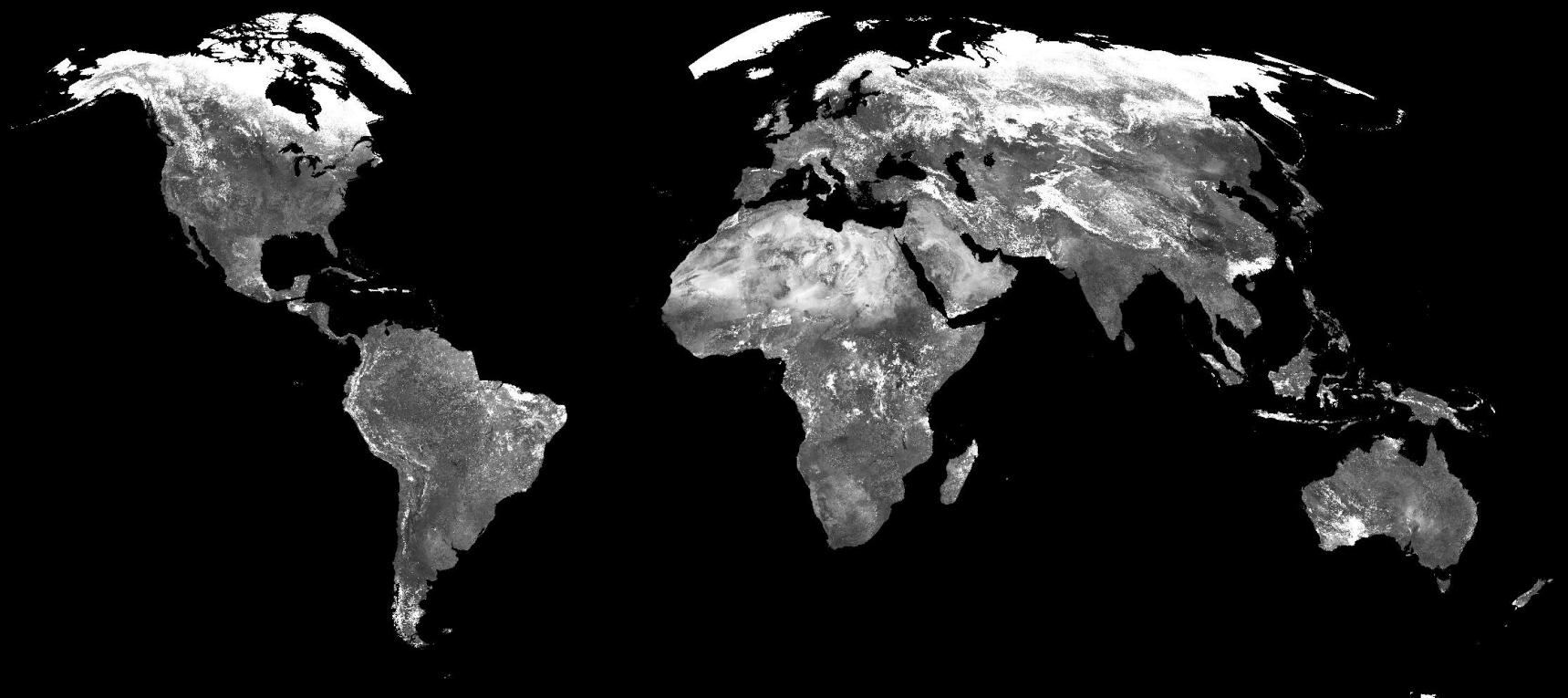
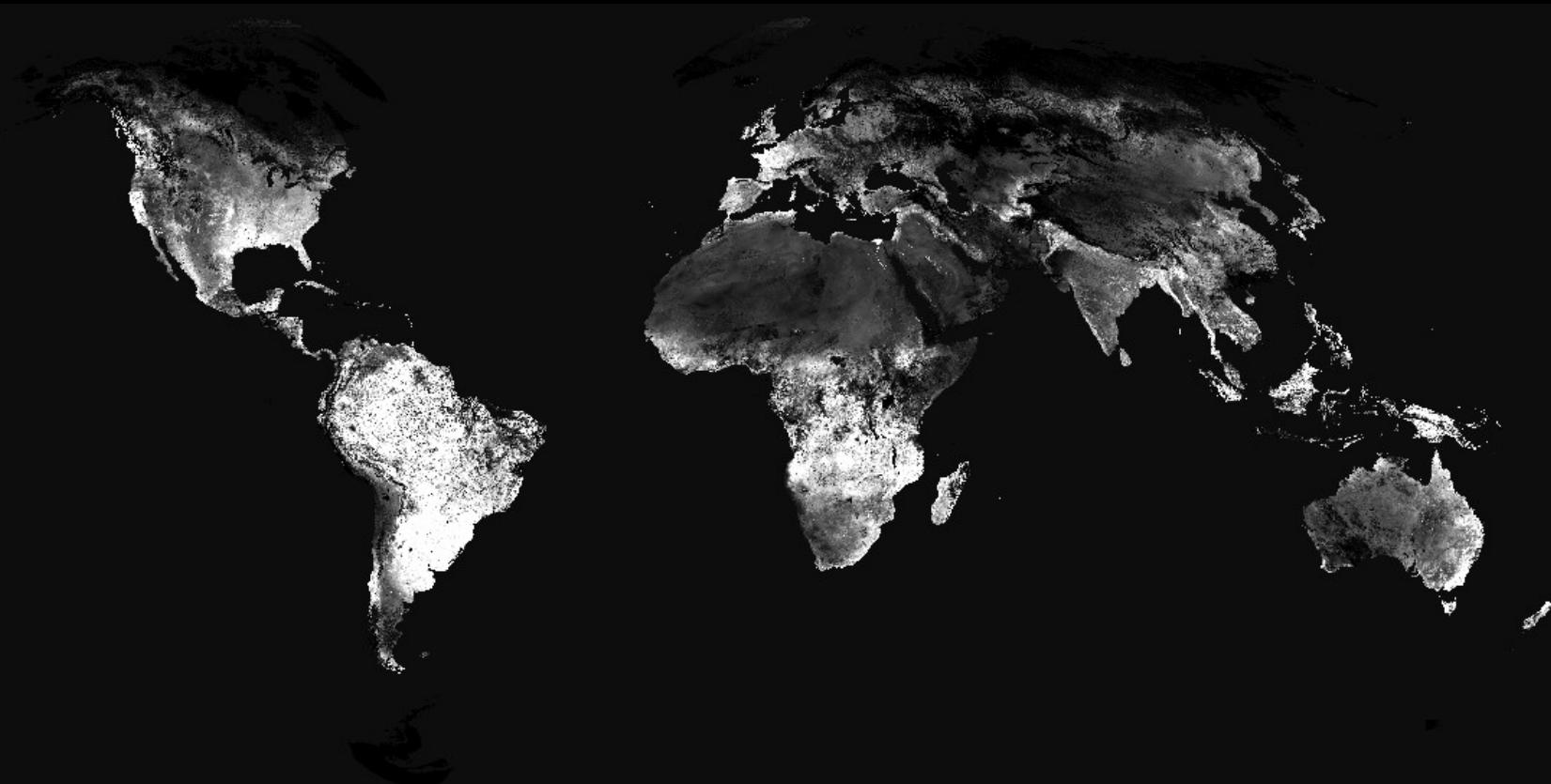
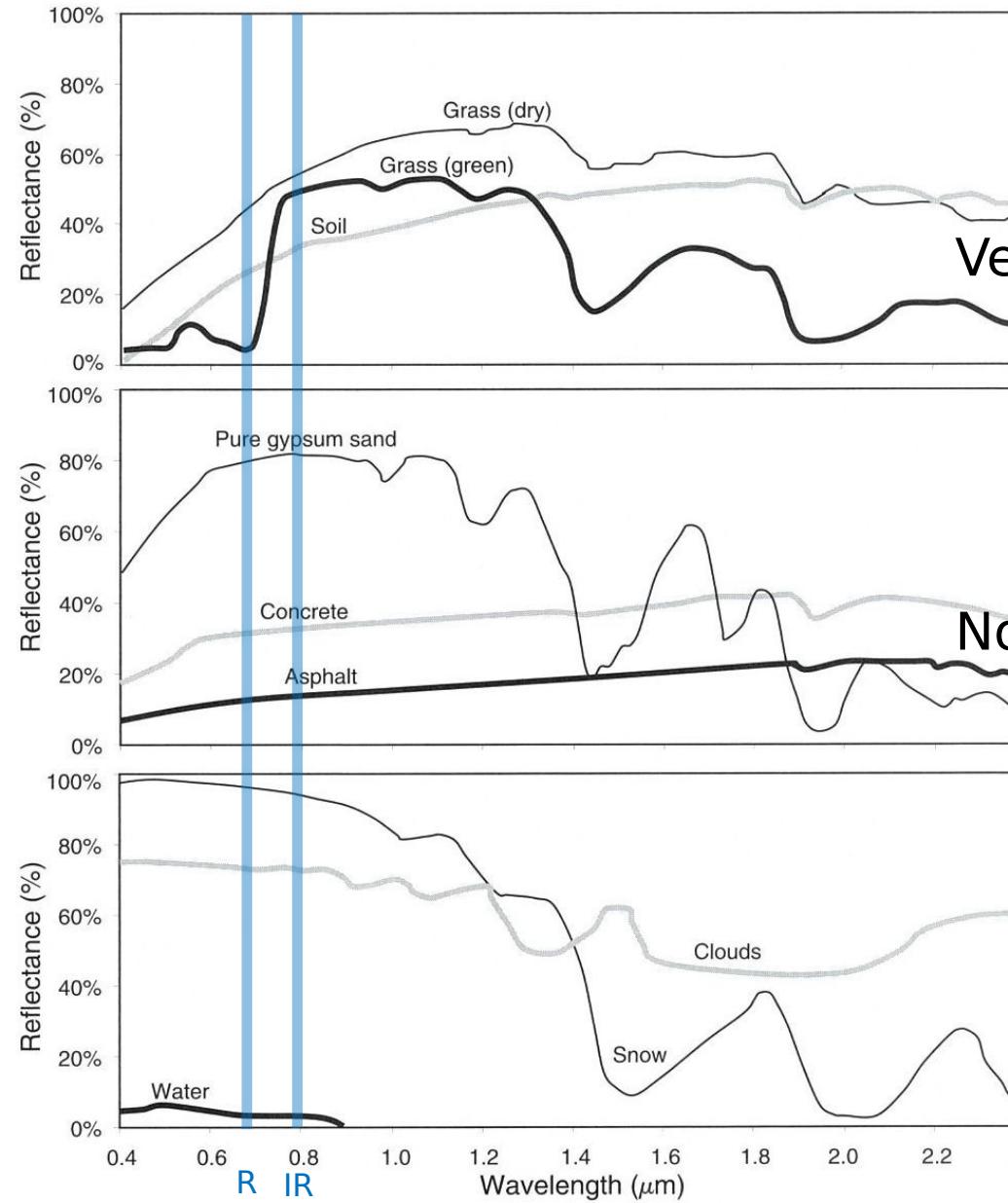


Image globale NOAA-AVHRR
NDVI
1-10 avril 1992



Spectral signatures of different types of surfaces



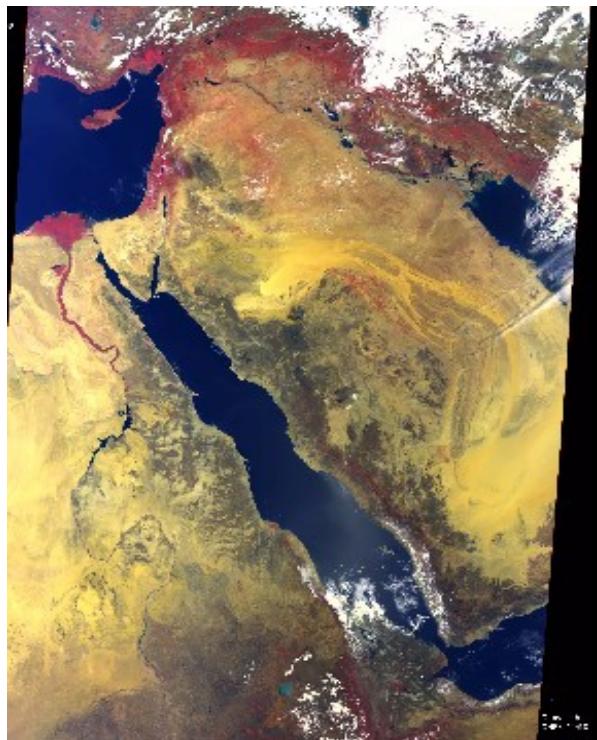
Ratio: $\frac{\rho_{IR}}{\rho_R}$

Difference: $\rho_{IR} - \rho_R$

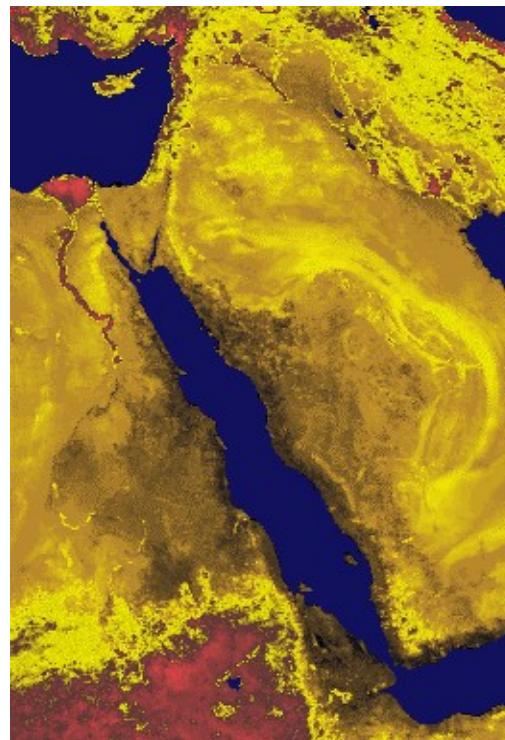
Normalized Diff. Vegetation Index:

$$NDVI = \frac{\rho_{IR} - \rho_R}{\rho_{IR} + \rho_R}$$

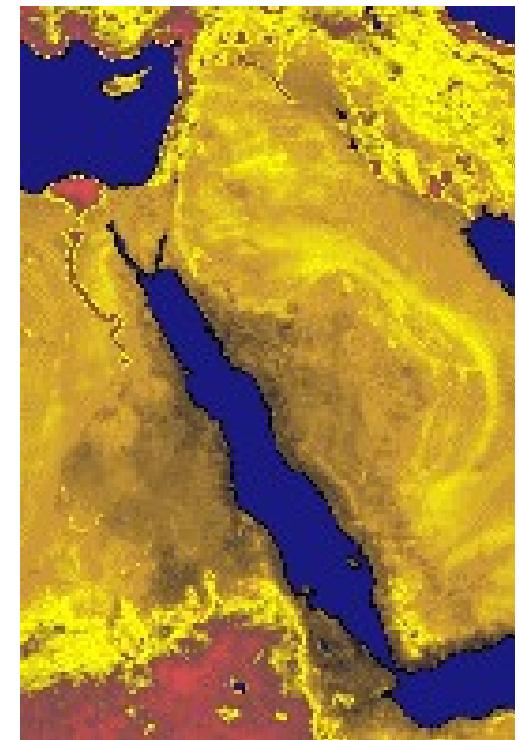
SPOT-VEGETATION



NOAA-AVHRR



NOAA-AVHRR



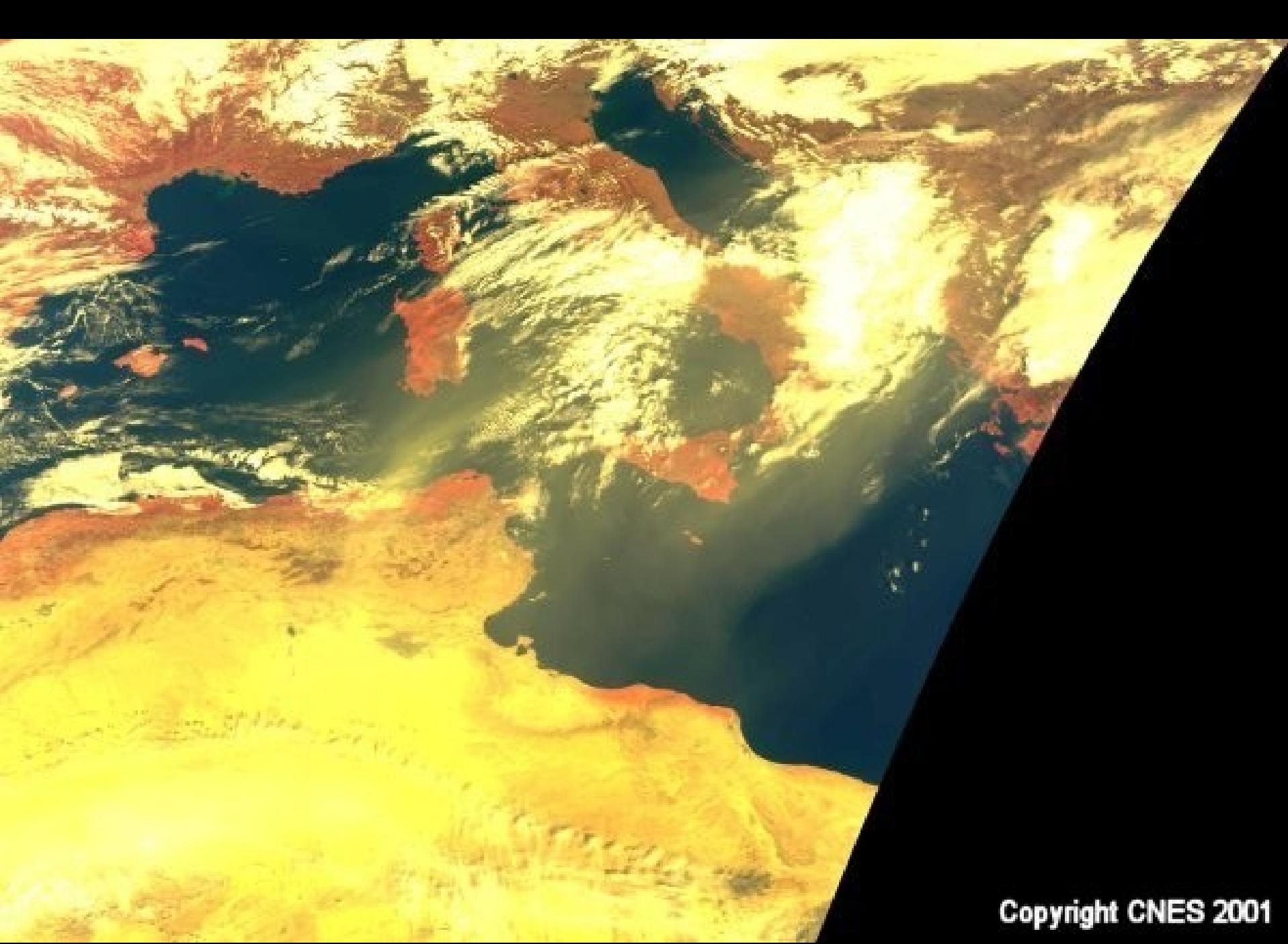
Pixel Size: 1 x 1 km²

Pixel Size: 8 x 8 km²

Pixel Size: 16 x 16 km²

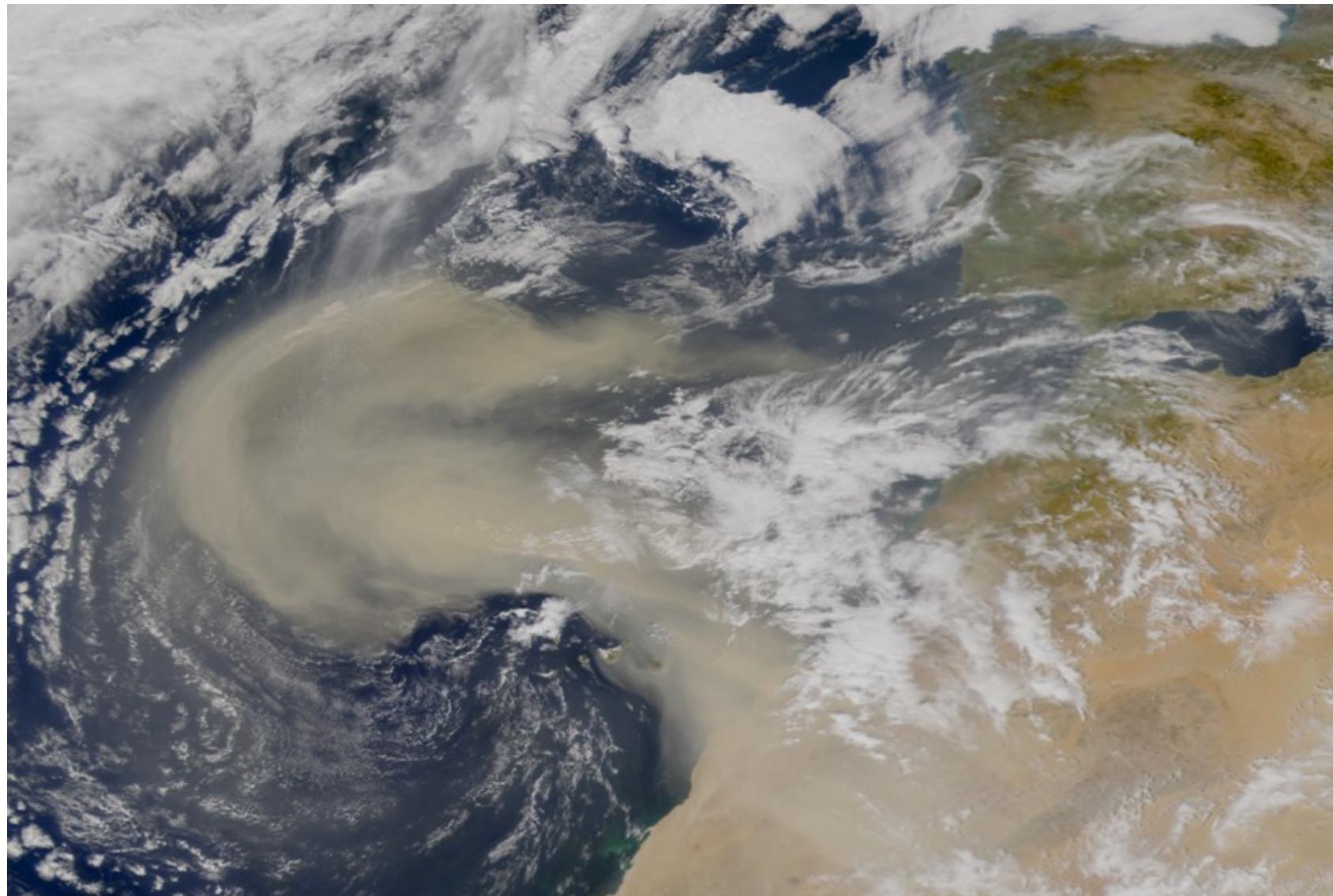


Copyright CNES 1998

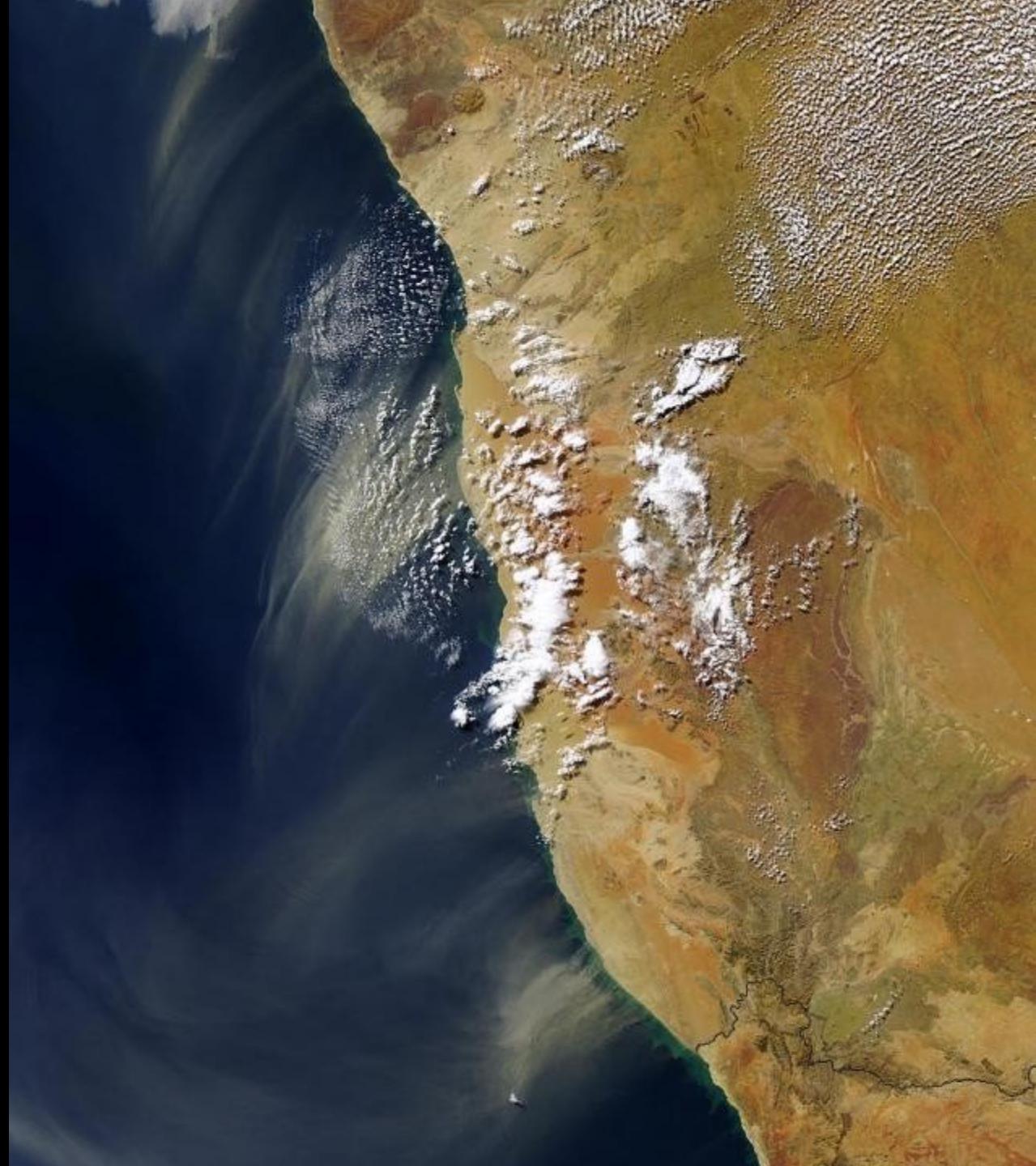


Copyright CNES 2001

SeaWiFS - 26.02.00
dust from West Africa
4 km spat. Res.

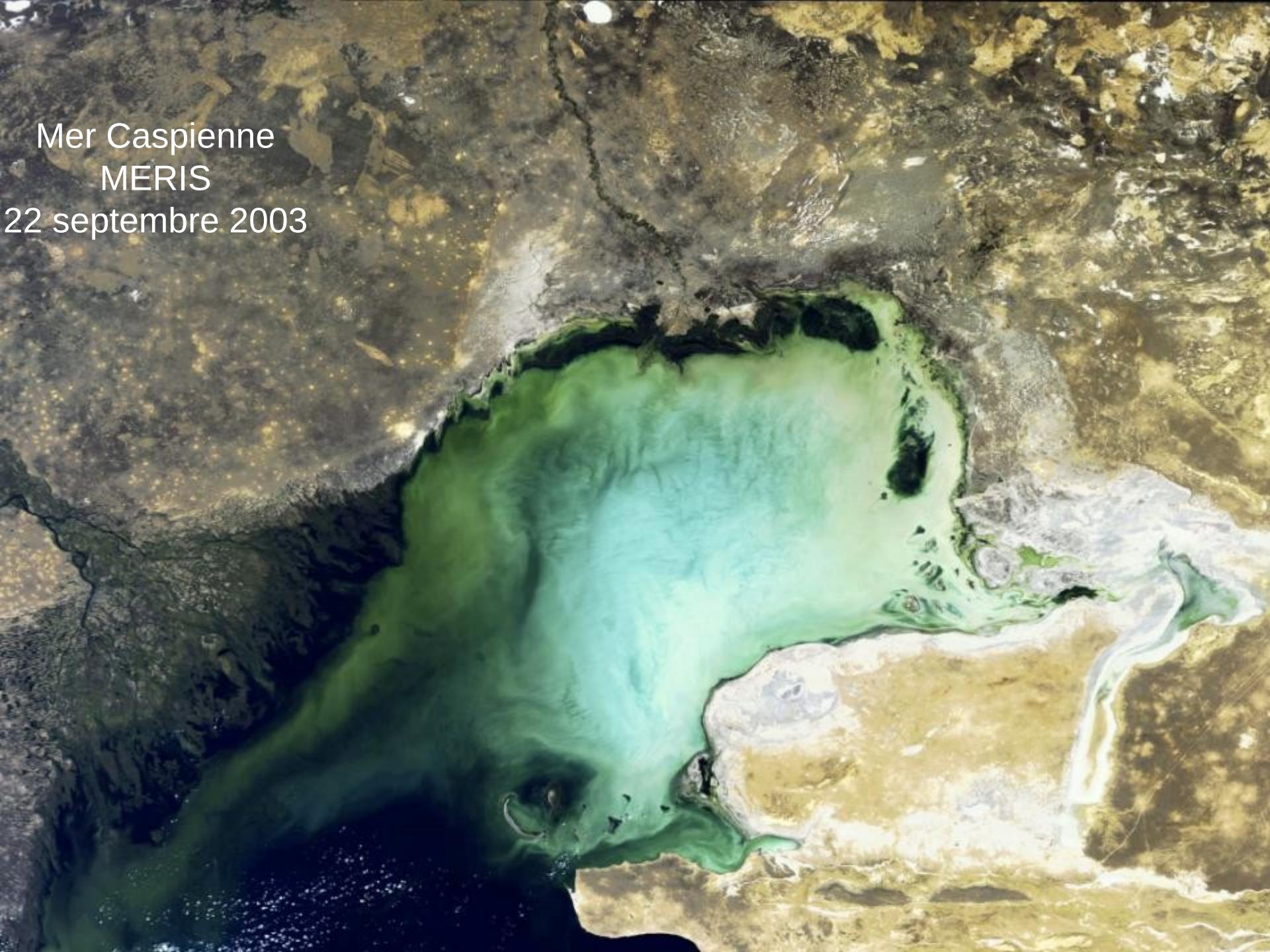


Désert de Namibie
MODIS
8 juillet 2004



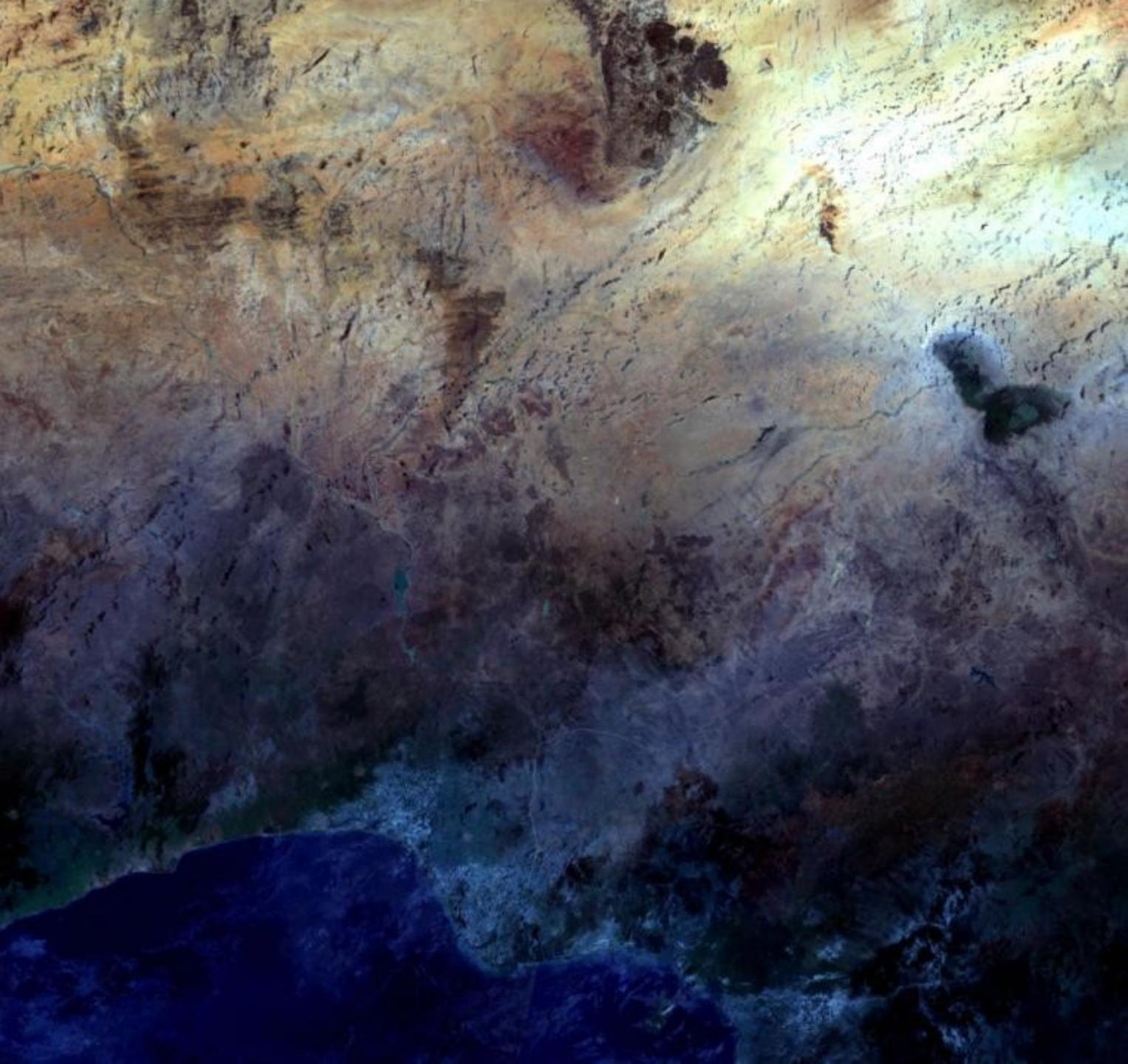


Bangladesh
MERIS
8 novembre 2003



Mer Caspienne
MERIS
22 septembre 2003

MERIS
300 m - 1200 m



MERIS
300 m - 1200 m





A satellite image showing the coastline of Senegal. The image is dominated by a light brown and tan color, representing dry land. A dark blue line, representing the coastline, starts from the bottom center and curves upwards and to the left. The water is a darker shade of blue. There are some red and purple areas along the coastline, likely indicating urban centers or industrial zones. The image has a grainy texture and some vertical streaks, typical of satellite imagery.

Sénégal
MERIS
15 avril 2003

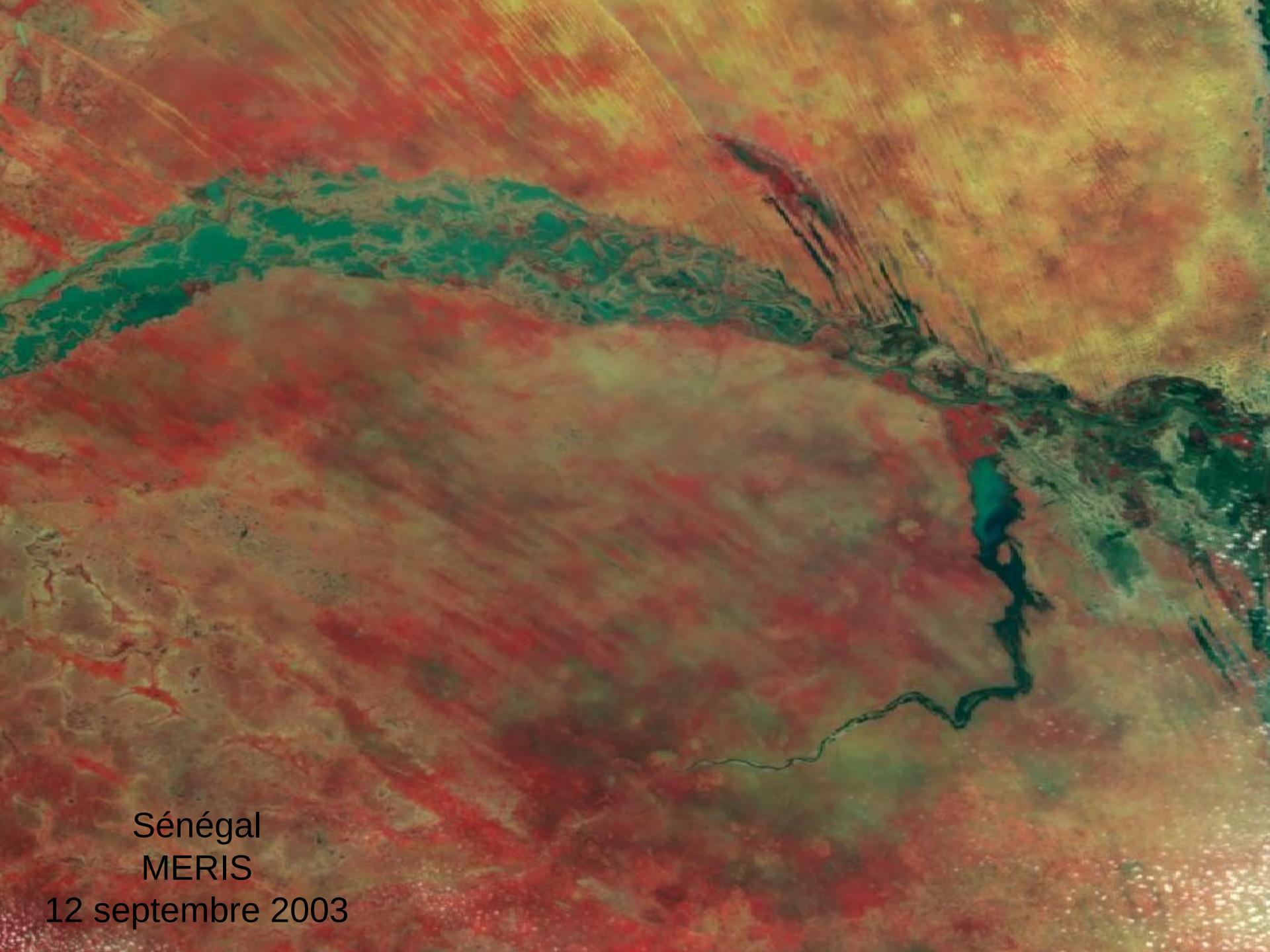


Sénégal
MERIS
30 mai 2003



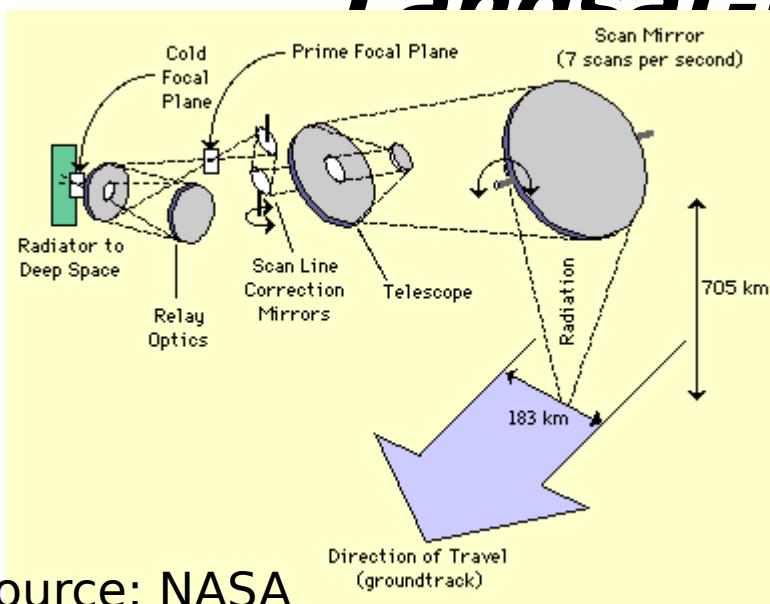
A high-resolution aerial satellite image showing the coastal region of Senegal. The image captures a long, narrow strip of land extending from the bottom right towards the top left. The coastal area is characterized by a dark, irregular line representing the shoreline, which is heavily marked with red and black. A significant concentration of red and black markings is visible near the southern tip of the landmass. The surrounding water is a light beige color, indicating shallow coastal waters. The terrain appears dry and sandy, with some darker, possibly vegetated or rocky, areas along the coast.

Sénégal
MERIS
27 juin 2003

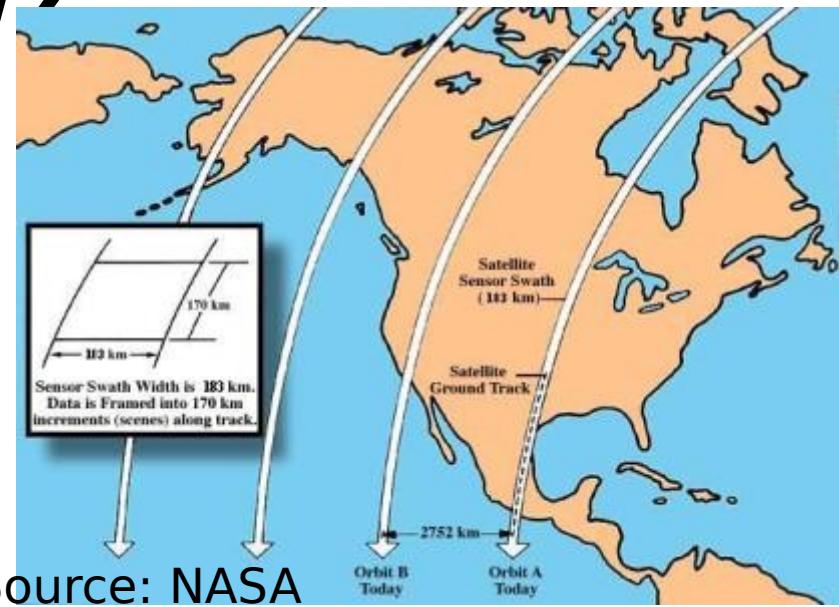


Sénégal
MERIS
12 septembre 2003

Caractéristiques de Landsat-TM7



Source: NASA



Source: NASA

focale: $f = 2.4 \text{ m}$

ouv. diaphragme: $d = 40 \text{ cm}$

déTECT. élém.: 0.1 mm

$$\Rightarrow \text{IFOV} = 10^{-4} / 2.4 = 41.7 \cdot 10^{-6} \text{ rad}$$

$$\Rightarrow \delta x = \text{IFOV} H = \mathbf{30 \text{ m}}$$

Bande 1 : $0.45 - 0.52 \mu\text{m}$

Bande 2 : $0.52 - 0.6 \mu\text{m}$

Bande 3 : $0.63 - 0.69 \mu\text{m}$

Bande 4 : $0.76 - 0.90 \mu\text{m (NIR)}$

Bande 5 : $1.55 - 1.75 \mu\text{m (SWIR)}$

Bande 7 : $2.08 - 2.35 \mu\text{m (SWIR)}$

Bande 6 : $10.4 - 12.5 \mu\text{m (IRT)}$ (**60m**)

PAN : $0.5 - 0.9 \mu\text{m}$ (**15 m**)

The LANDSAT mission

Satellite	Sensor	Swath	Bits	VNIR				SWIR			TIR		
L8	OLI	185km	12	30m	30m	30m	30m	30m	30m	30m			
	TIRS			30m	30m	15m					100m	100m	
Landsat 7	ETM+	185km	8	30m	30m	30m	30m	15m		30m	30m		60m
Landsat 4 & 5	MSS	185km	8		82m	82m	82m	82m					
	TM	185km	8	30m	30m	30m	30m	30m		30m	30m		120m
Landsat 1-2	RBV	183km		80m	80m	80m							
Landsat 3	RBV	183km			40m								
Landsat 1-3	MSS	183km	8	79m	79m	79m	79m						240m (L3 Only)

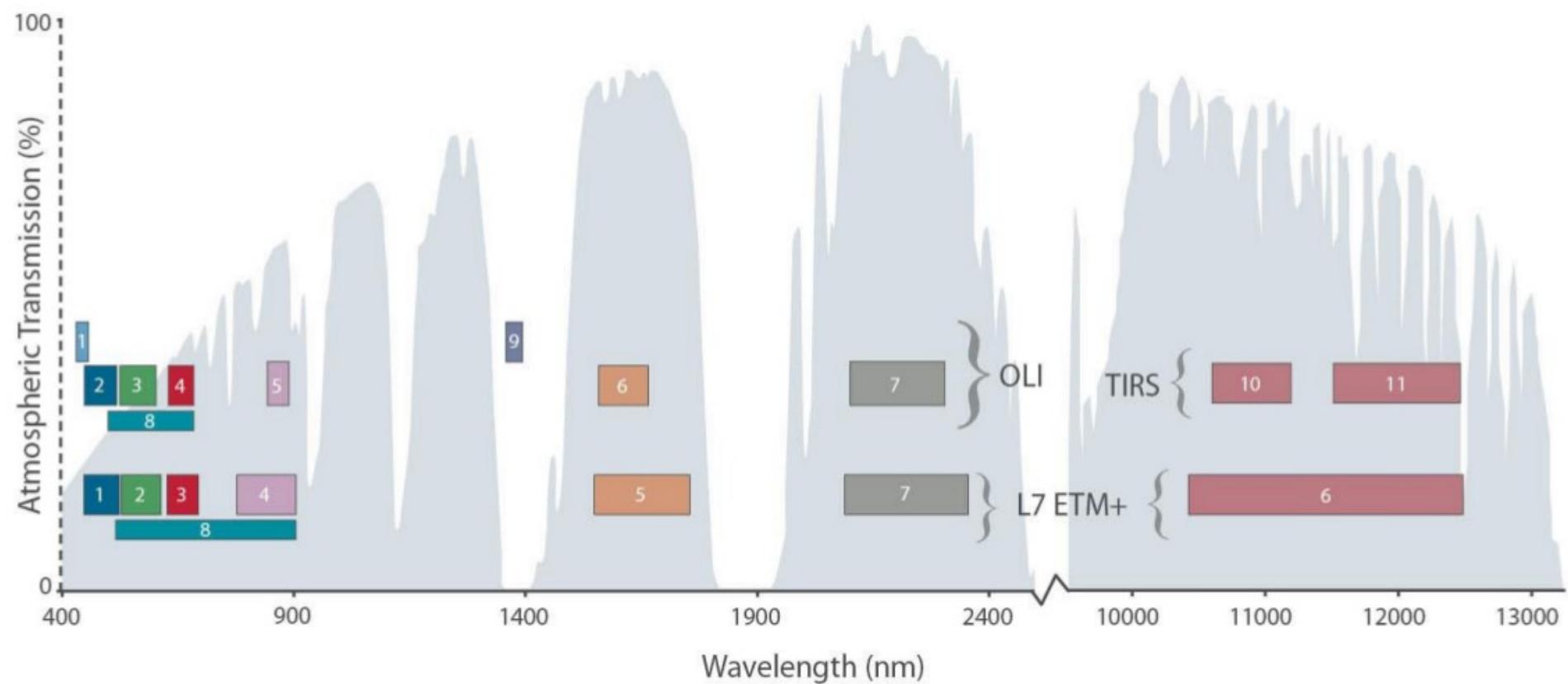
USGS, Landsat 8 Data Users Handbook

LANDSAT characteristics

OLI and TIRS Spectral Bands vs ETM+ Spectral Bands

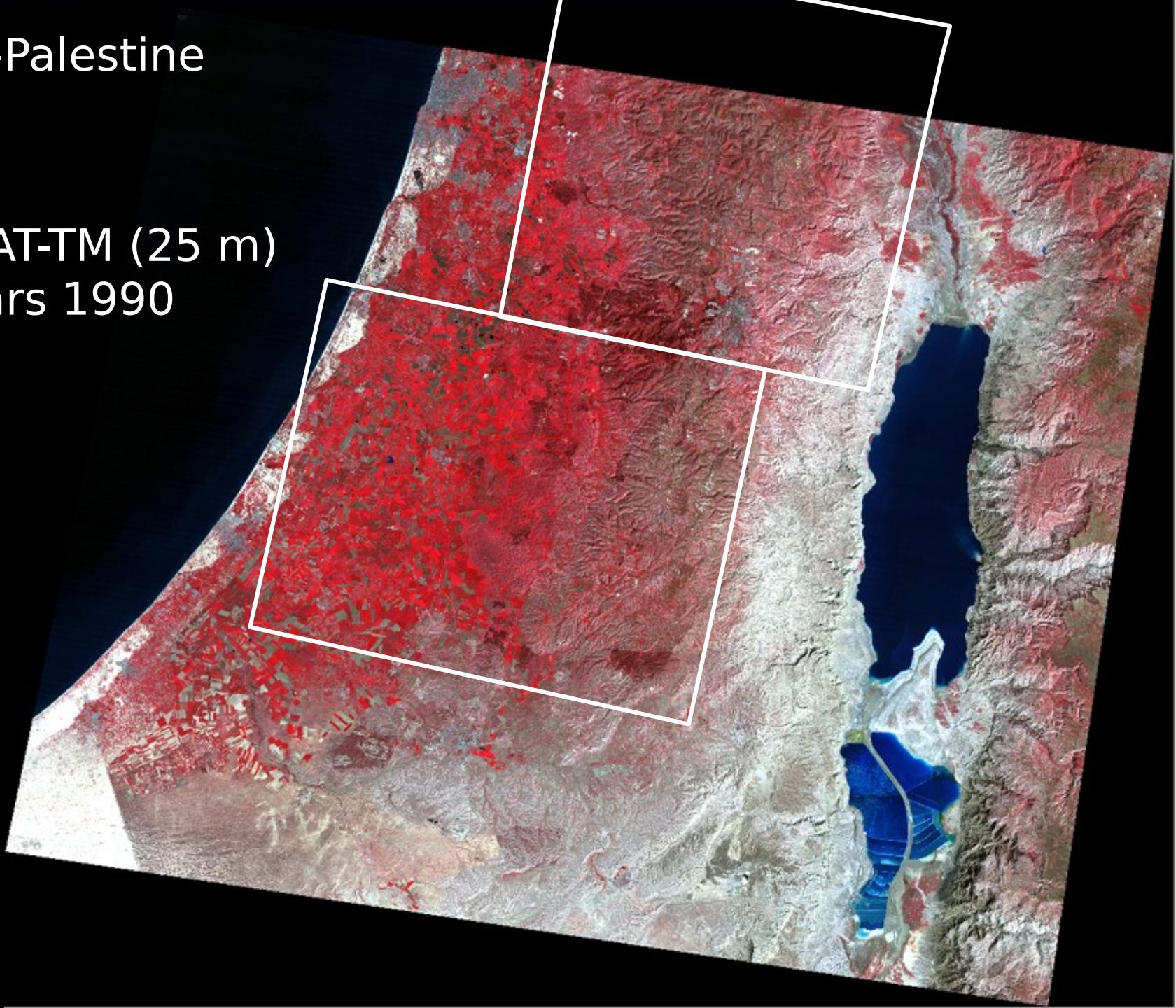
Landsat-7 ETM+ Bands (μm)			Landsat-8 OLI and <i>TIRS</i> Bands (μm)		
			30 m Coastal/Aerosol	0.435 - 0.451	Band 1
Band 1	30 m Blue	0.441 - 0.514	30 m Blue	0.452 - 0.512	Band 2
Band 2	30 m Green	0.519 - 0.601	30 m Green	0.533 - 0.590	Band 3
Band 3	30 m Red	0.631 - 0.692	30 m Red	0.636 - 0.673	Band 4
Band 4	30 m NIR	0.772 - 0.898	30 m NIR	0.851 - 0.879	Band 5
Band 5	30 m SWIR-1	1.547 - 1.749	30 m SWIR-1	1.566 - 1.651	Band 6
Band 6	60 m TIR	10.31 - 12.36	<i>100 m TIR-1</i>	<i>10.60 – 11.19</i>	Band 10
			<i>100 m TIR-2</i>	<i>11.50 – 12.51</i>	Band 11
Band 7	30 m SWIR-2	2.064 - 2.345	30 m SWIR-2	2.107 - 2.294	Band 7
Band 8	15 m Pan	0.515 - 0.896	15 m Pan	0.503 - 0.676	Band 8
			30 m Cirrus	1.363 - 1.384	Band 9

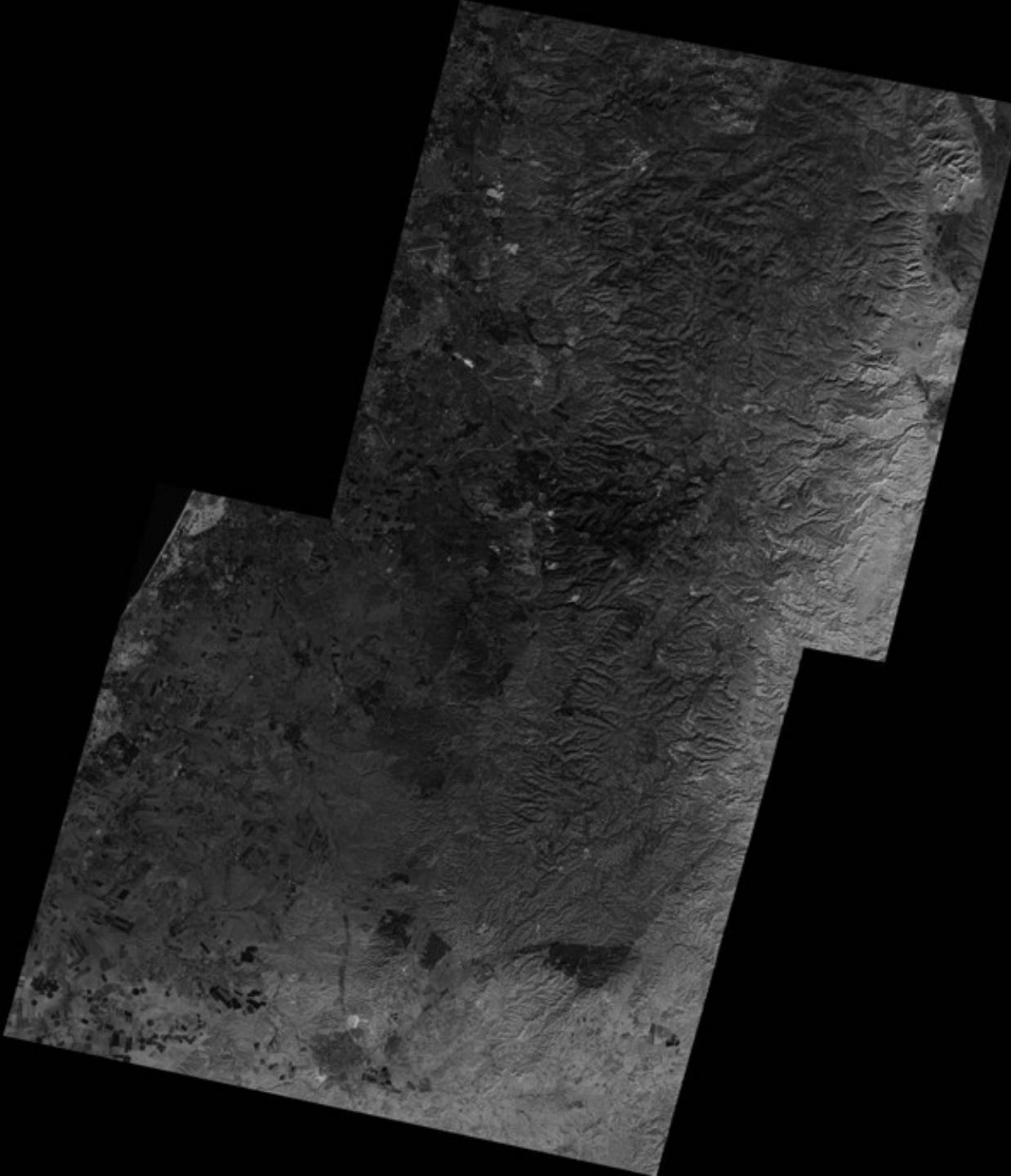
Landsat 8 vs Landsat 7 ETM+ Spectral Bands



Israël-Palestine

LANDSAT-TM (25 m)
mars 1990



A grayscale satellite image showing a coastal region with a mix of urban and rural landscapes. The image is oriented diagonally and is set against a black background.

Israël-Palestine

SPOT - Panchro (10m)
janvier 2000

SPOT - XS
Brest, France - 20 m rés. spatiale





SPOT - Panchro
rés. spatiale: 10 m

Brest, France

SPOT 5
rés. spatiale: 10 m



Banda Aceh, Indonésie
17 juillet 2003

SPOT 5
rés. spatiale: 10 m



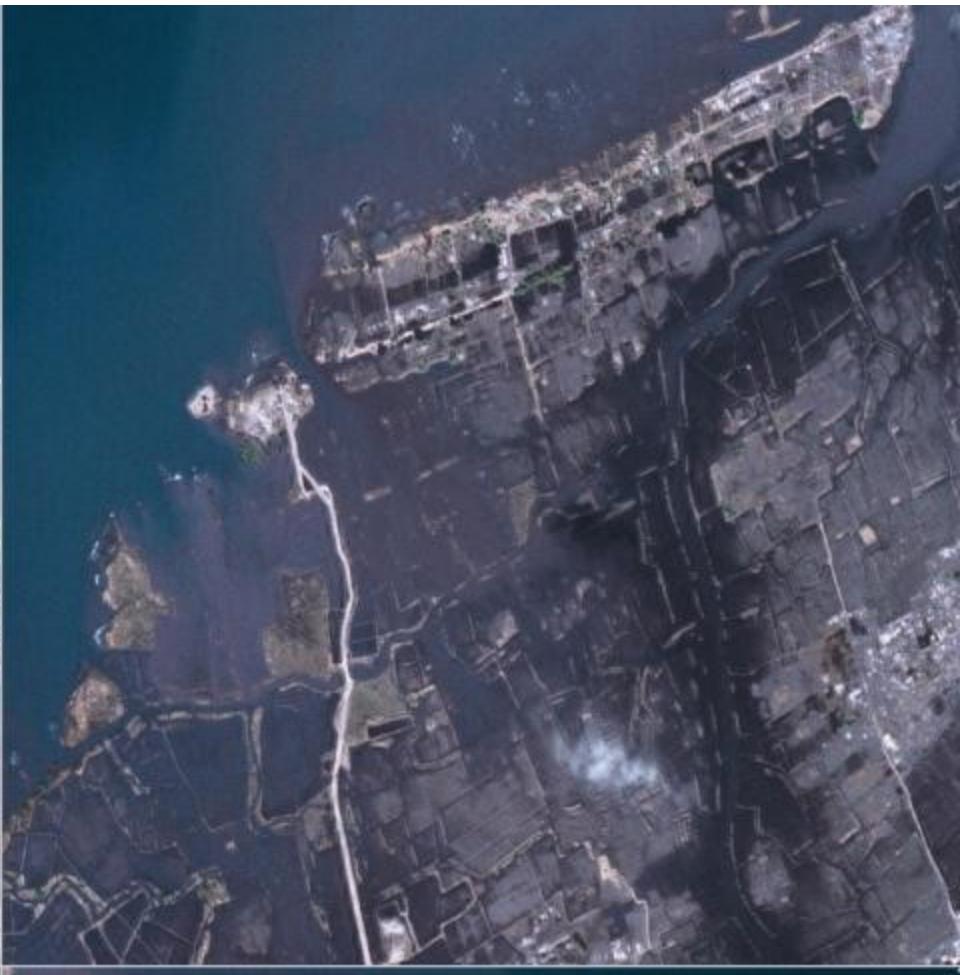
Banda Aceh, Indonésie
17 juillet 2003

SPOT 5
rés. spatiale: 10 m
Banda Aceh, Indonésie

17 juillet 2003



30 décembre 2004



SPOT 5
rés. spatiale: 10 m
Banda Aceh, Indonésie

17 juillet 2003



30 décembre 2004



SPOT 5
rés. spatiale: 10 m
Banda Aceh, Indonésie

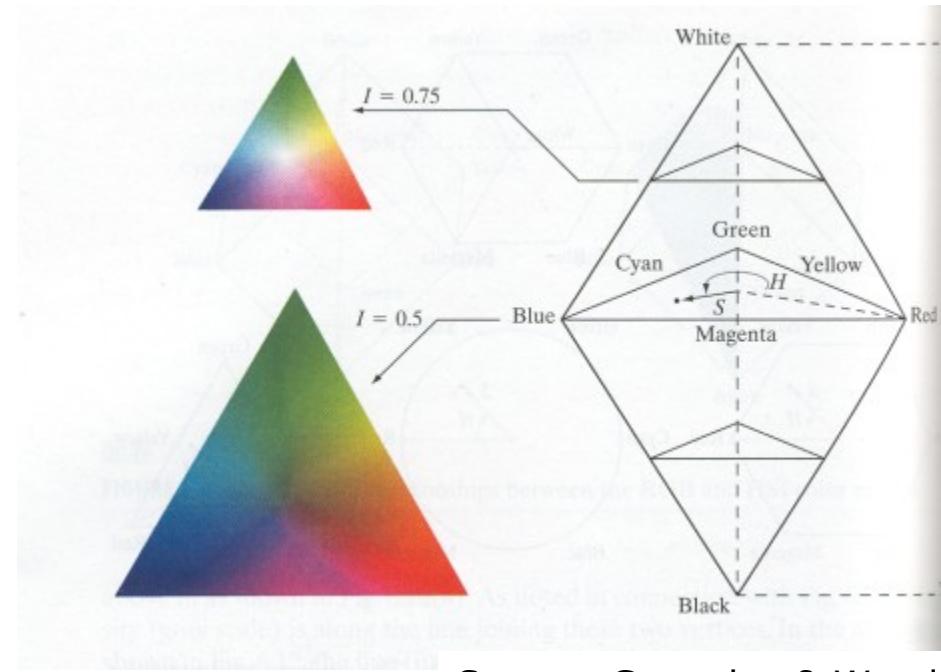
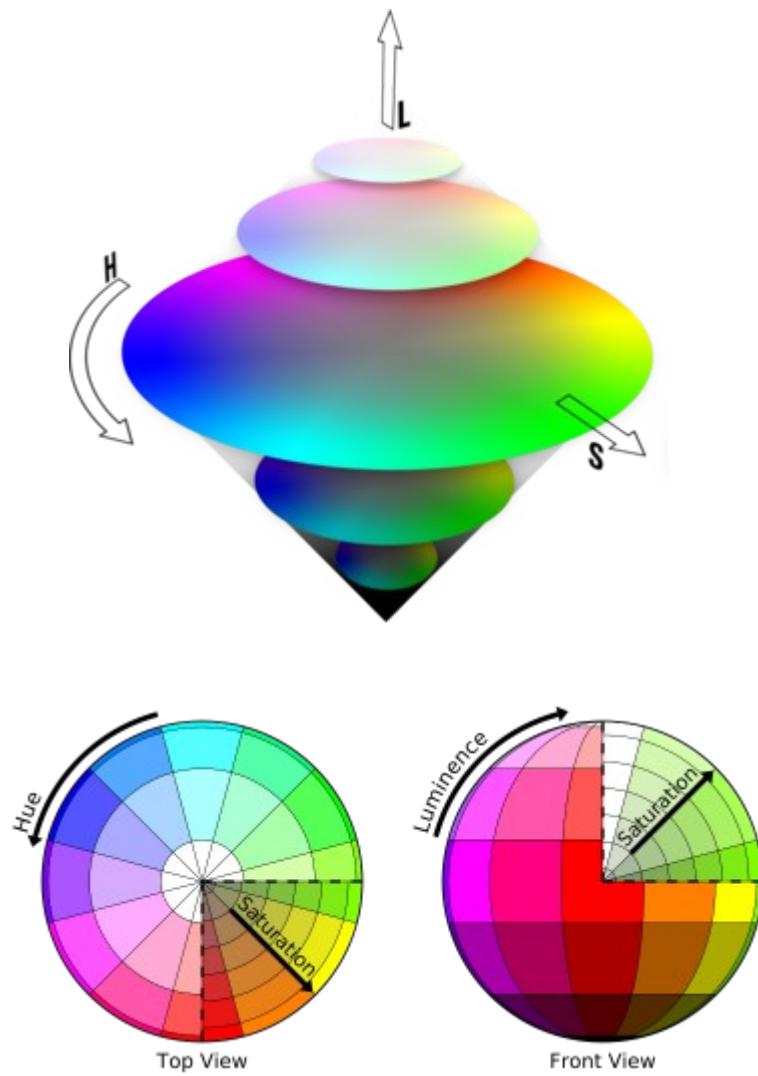
17 juillet 2003



30 décembre 2004



Modèle TSL (HSL) TSI (HSI)



Source: Gonzales & Woods

image originale



canal rouge



canal vert



canal bleu



canal teinte



canal saturation



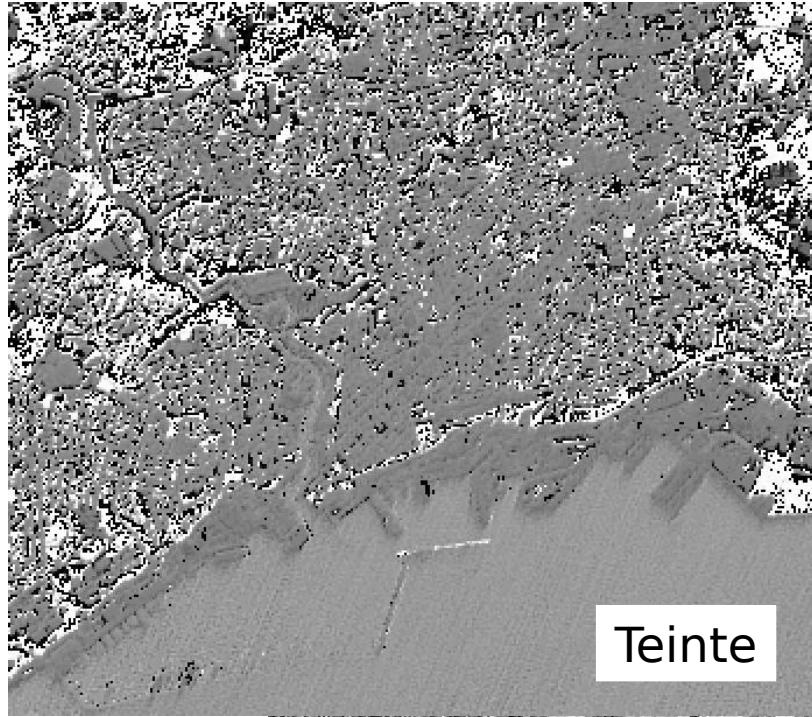
canal intensité



SPOT - XS
Brest, France - 20 m rés. spatiale



SPOT - XS
20 m rés. spatiale: rééchantillonage x 2



RGB ☐ HSI

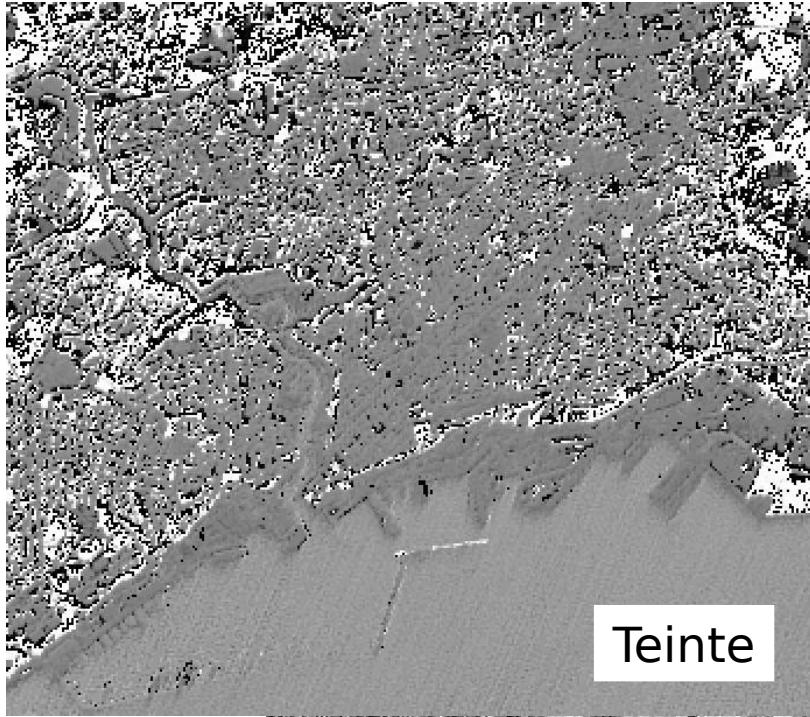


Saturation



Intensité

SPOT - XS
20 m rés. spatiale: rééchantillonage x 2



HSI ☐ RGB.....



SPOT - XS
Brest, France - 20 m rés. spatiale





SPOT - Panchro
rés. spatiale: 10 m

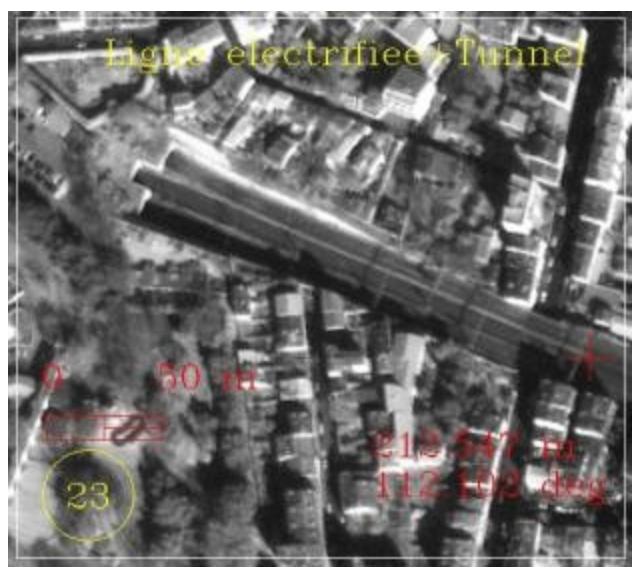
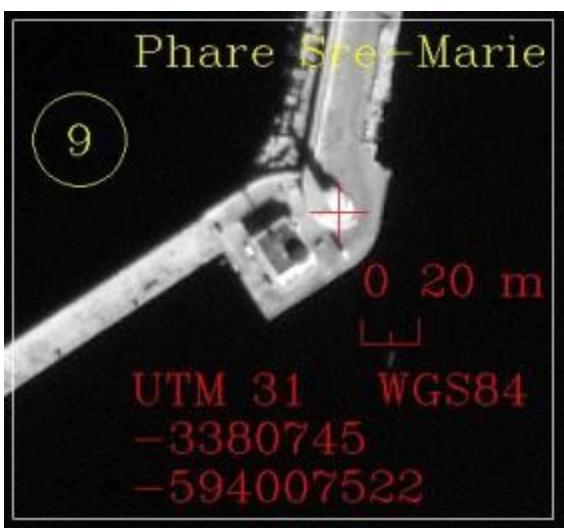
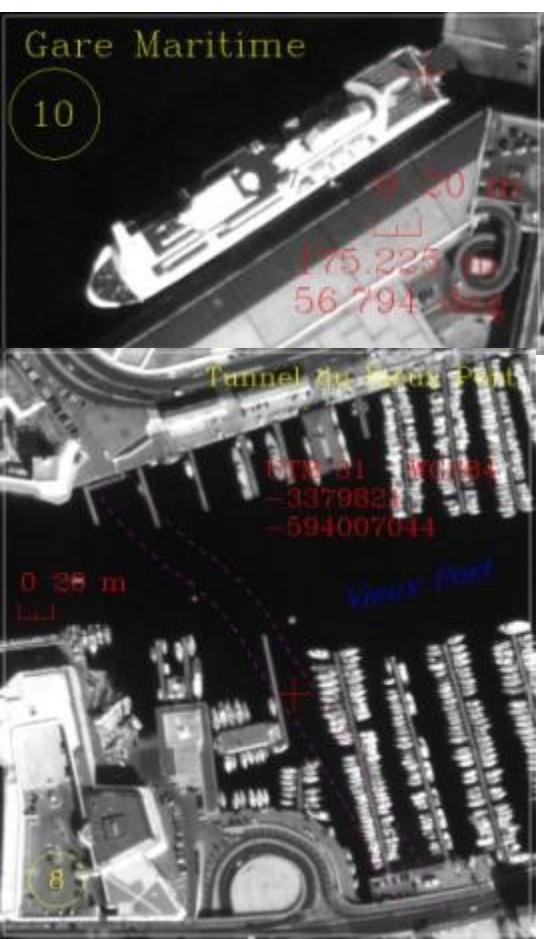
Brest, France



FUSION
XS - PANCHRO

3 canaux - 10 m

Brest, France



IKONOS

1 x 1 m²



Donnée QUICK BIRD, Paris, 27 mars 2002

PLEIADES



PLEIADES



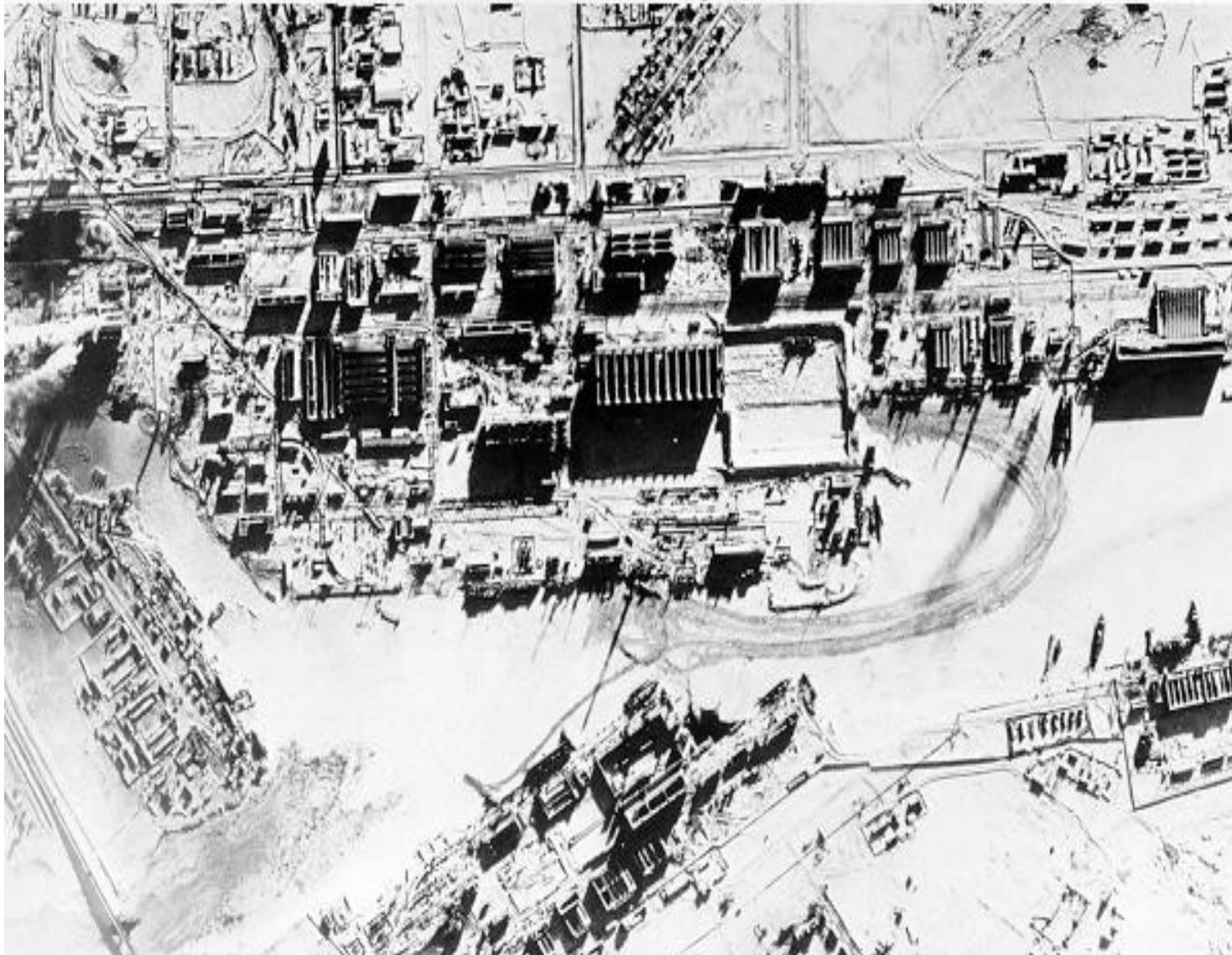
Renseignement stratégique



▲ REBUILDING TERROR? The al-Sharqat chemical plant in northwest Iraq; intelligence sources say Saddam is creating new facilities there

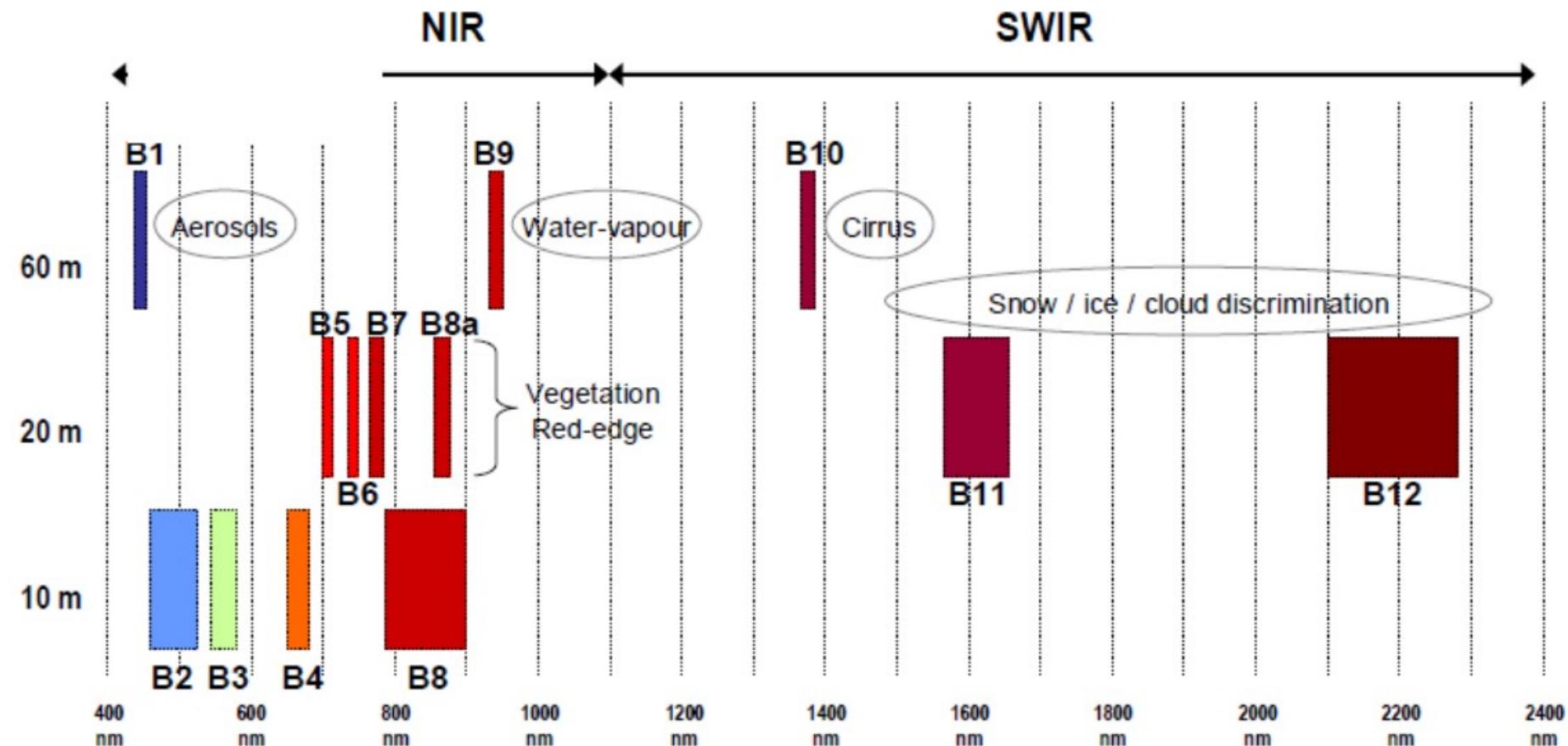
Renseignement stratégique

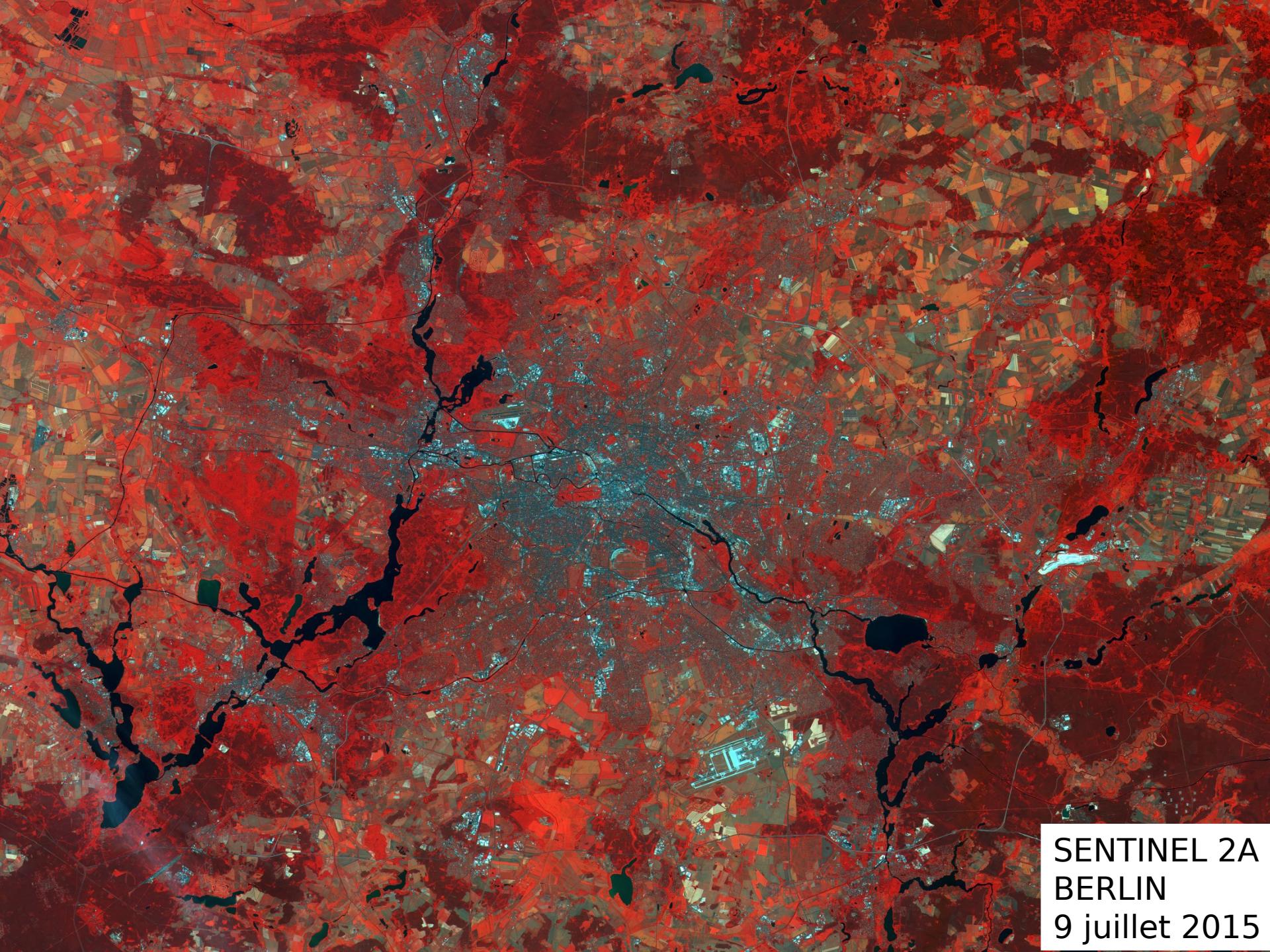
Severodvinsk Shipyard, USSR, 10 February 1969



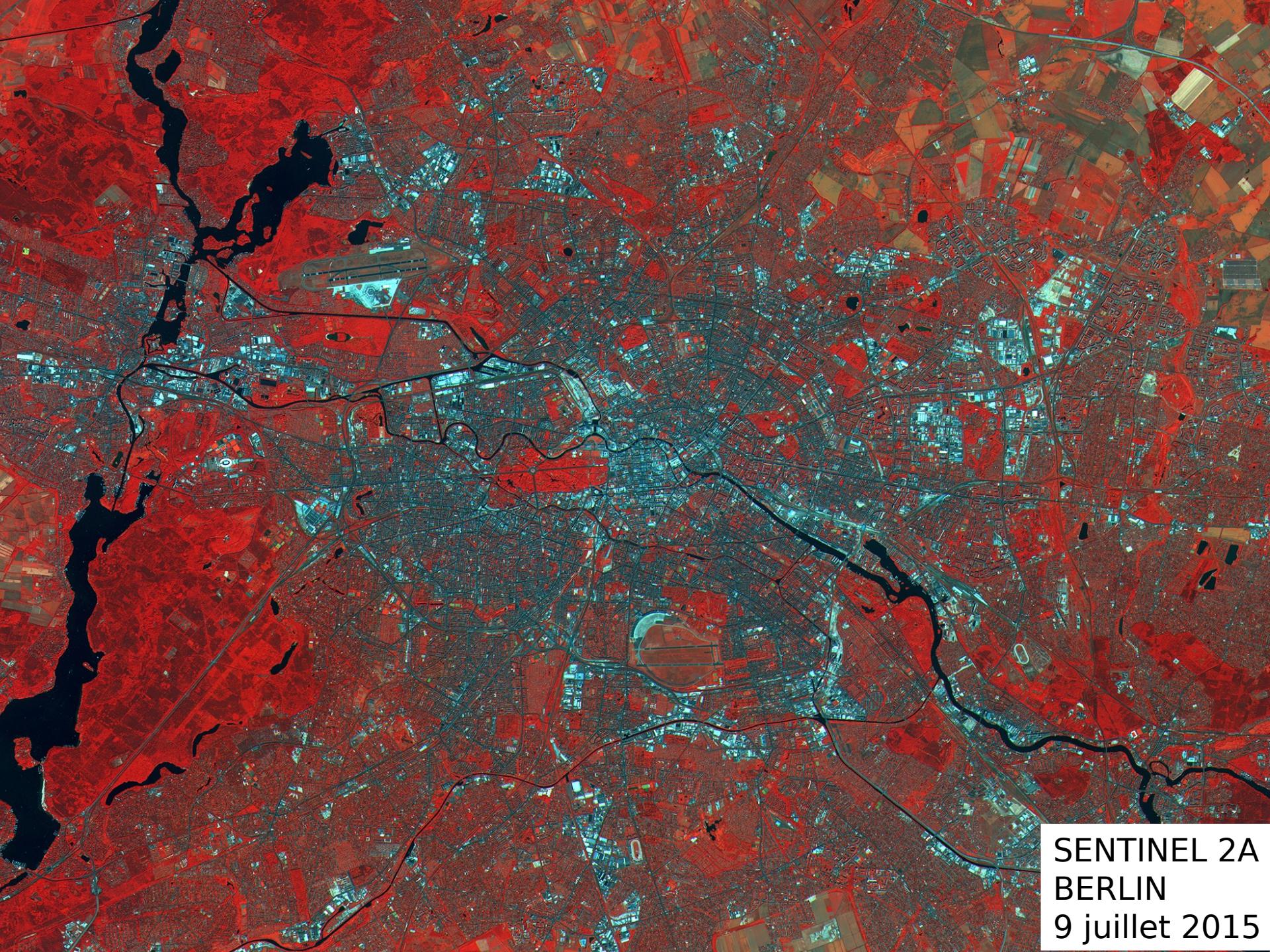
SENTINEL-2 MSI

Spatial resolution vs Spectral bands





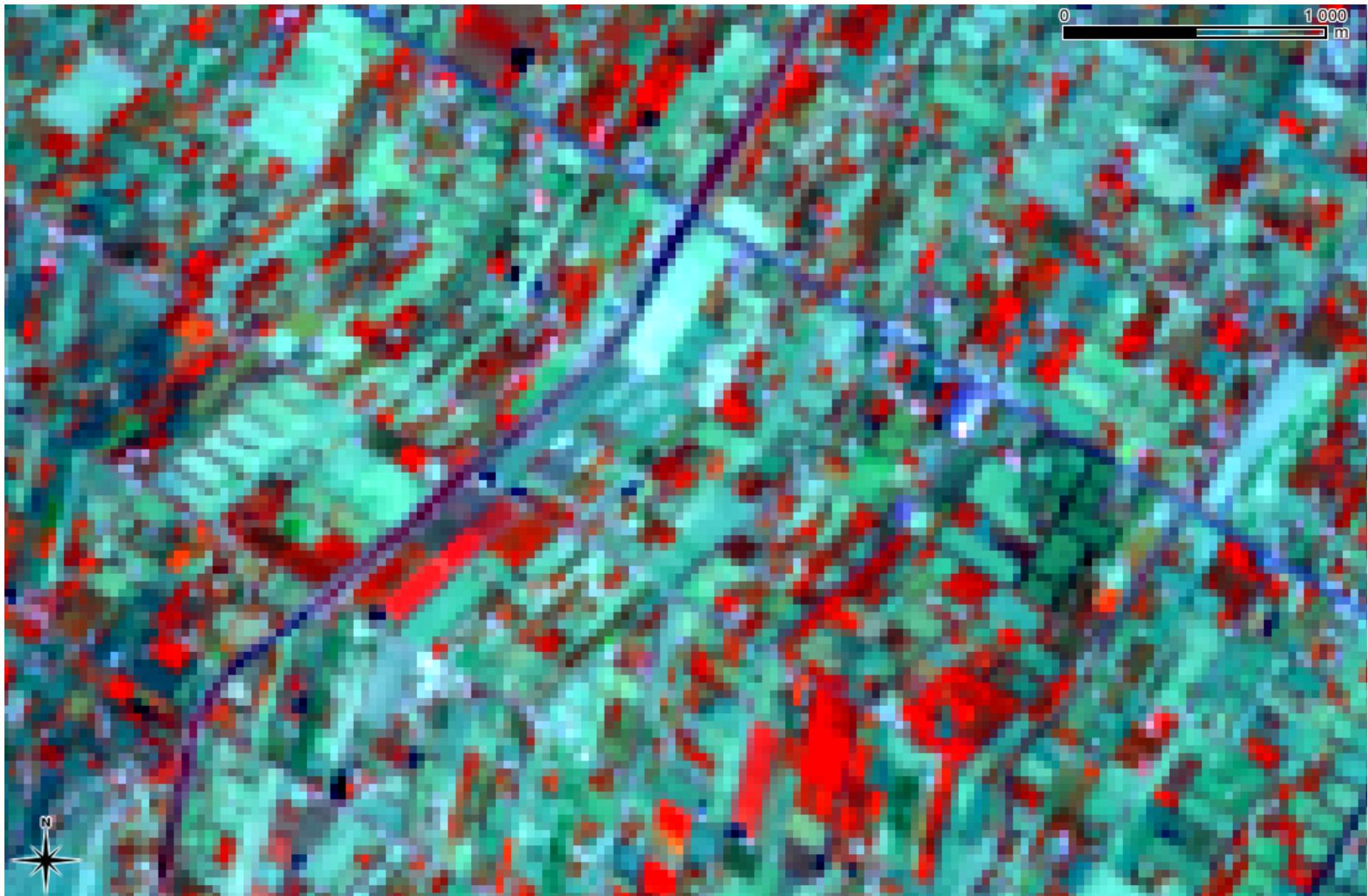
SENTINEL 2A
BERLIN
9 juillet 2015



SENTINEL 2A
BERLIN
9 juillet 2015

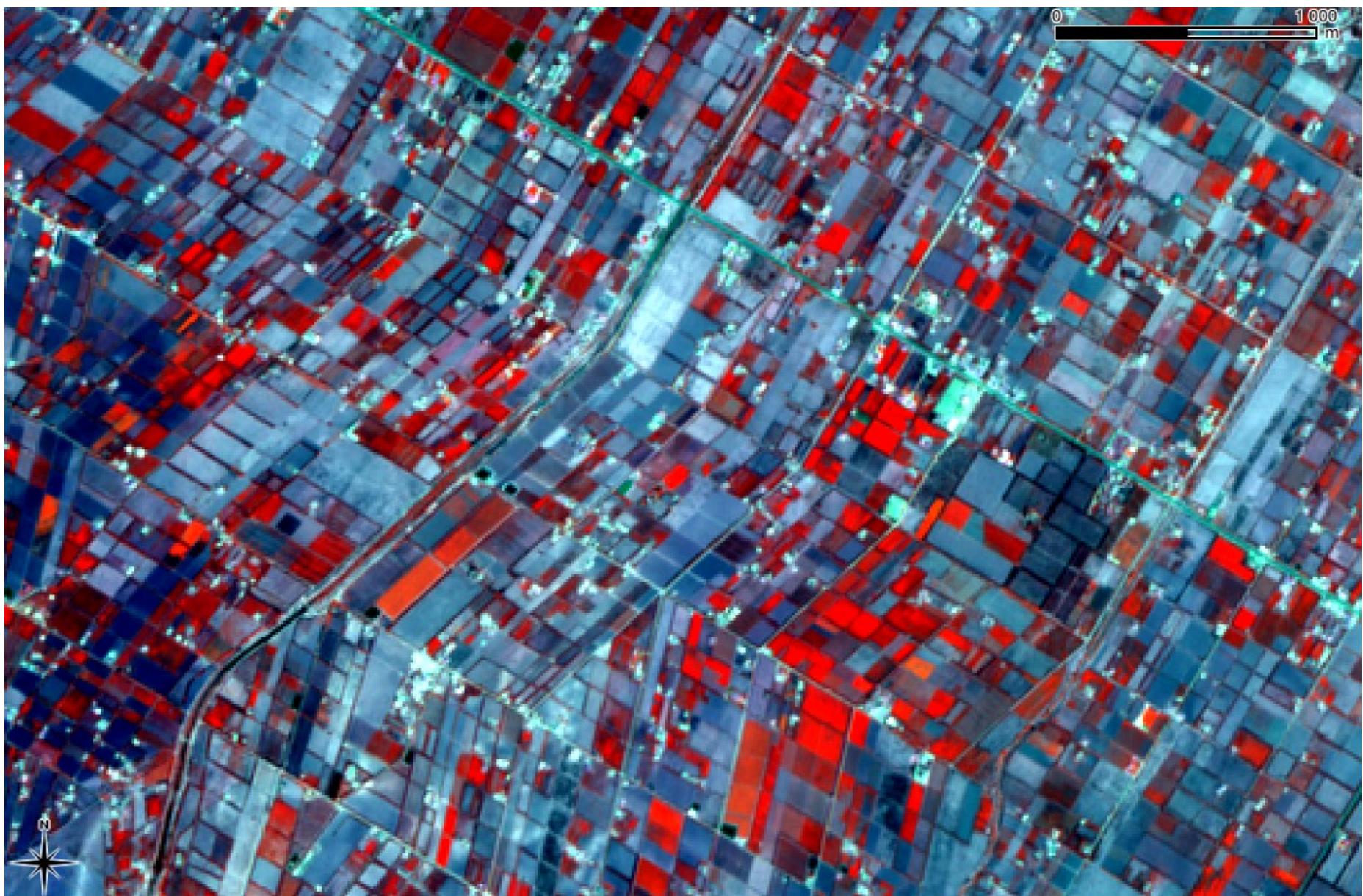
Nador Region, Marroco

LANDSAT 8 (spat. res. 30 m)



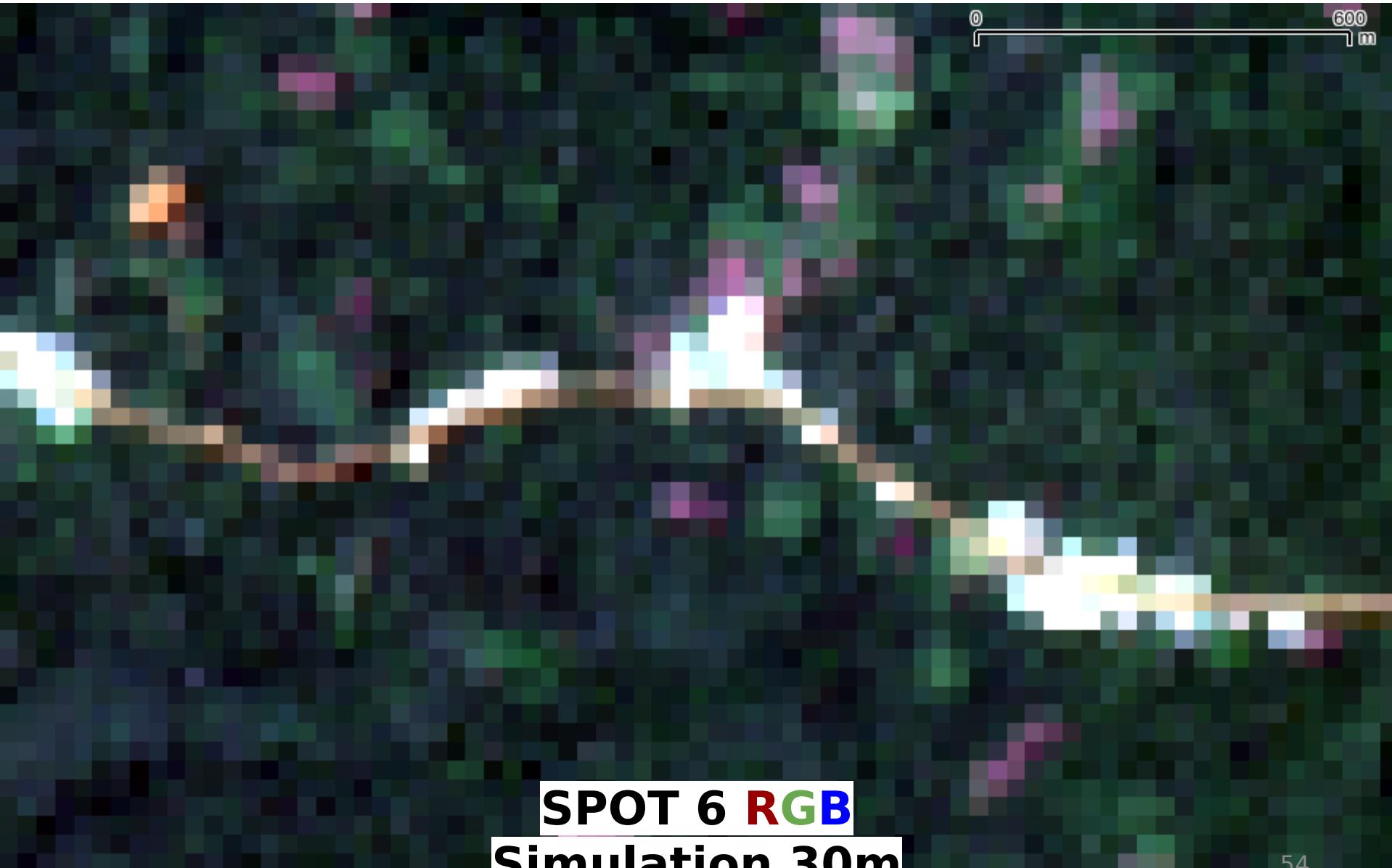
Nador Region, Marocco

Sentinel-2 (spat. res. 10 m)



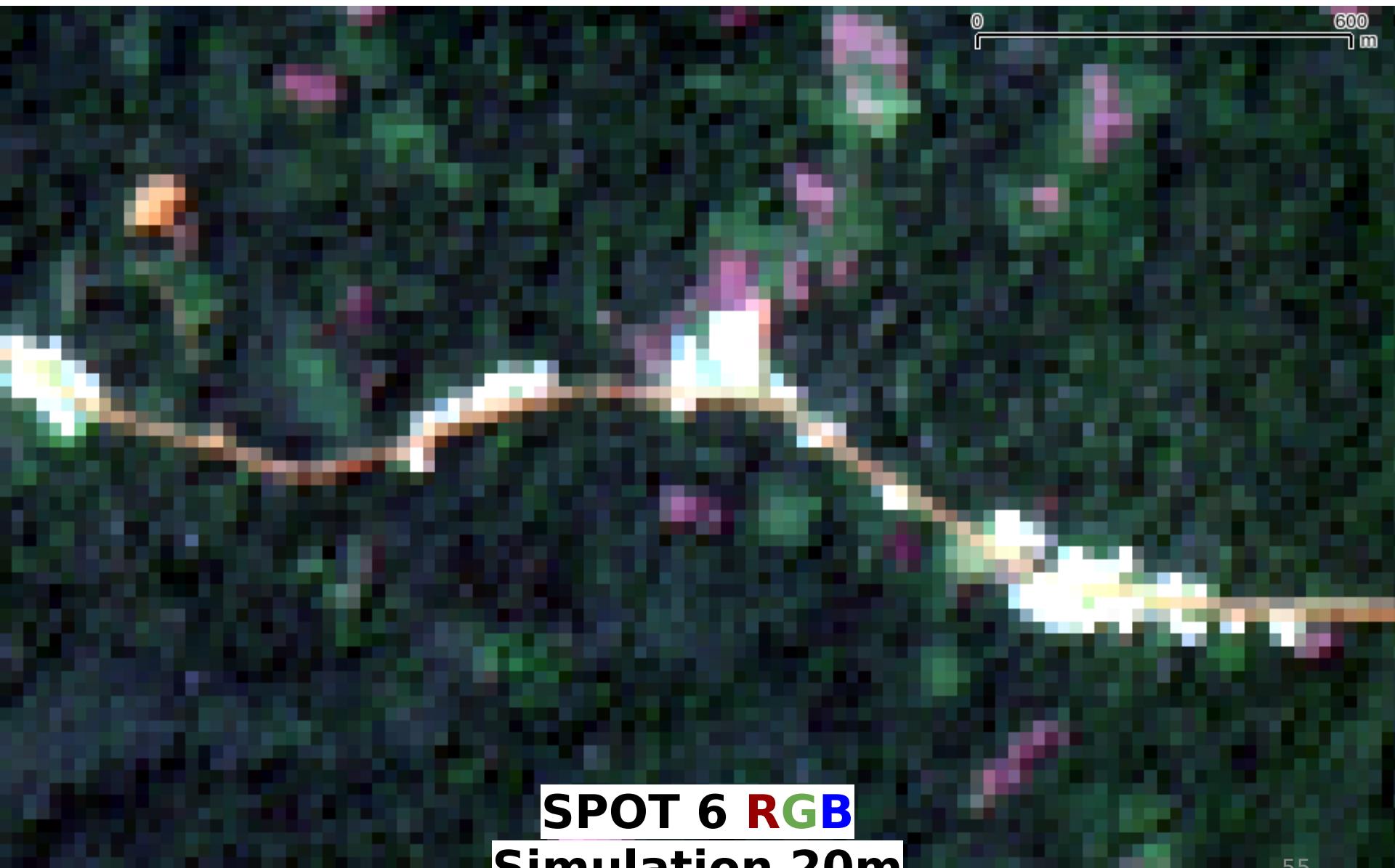
Introduction à la télédétection

Résolution spatiale



Introduction à la télédétection

Résolution spatiale



Introduction à la télédétection

Résolution spatiale



SPOT 6 RGB
Simulation 10m

Introduction à la télédétection

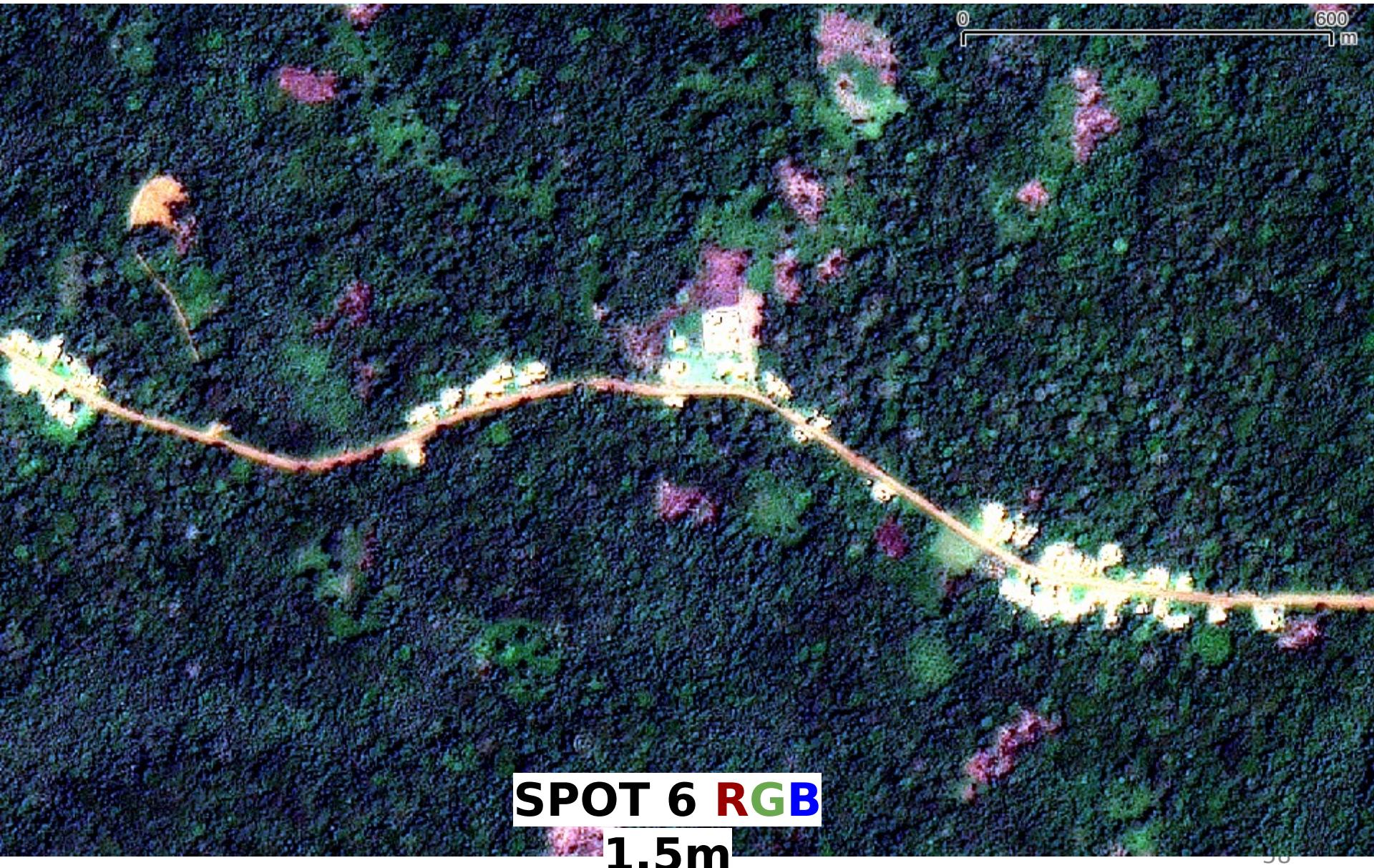
Résolution spatiale



SPOT 6 RGB
Simulation 5m

Introduction à la télédétection

Résolution spatiale



Introduction à la télédétection

Résolution spatiale



**Exemple de l'effet de la
résolution au Maroc**

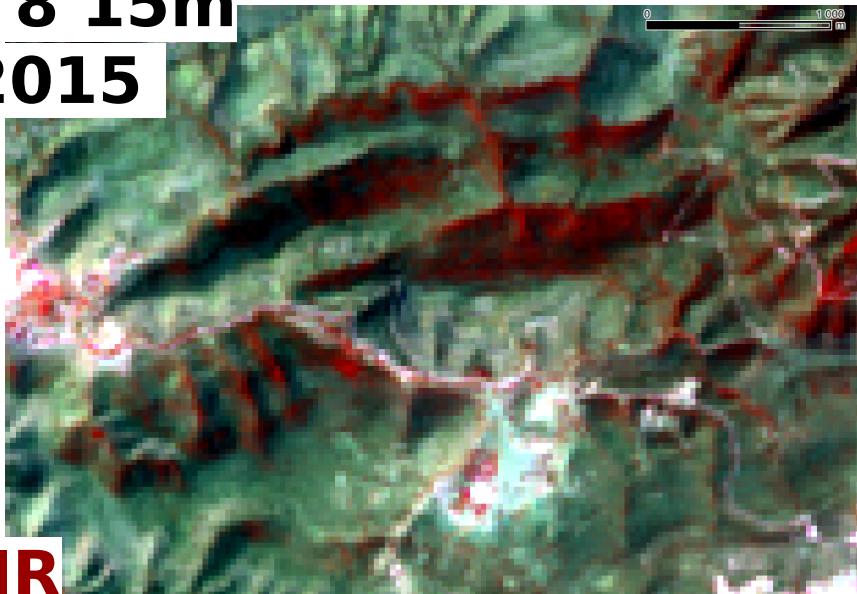
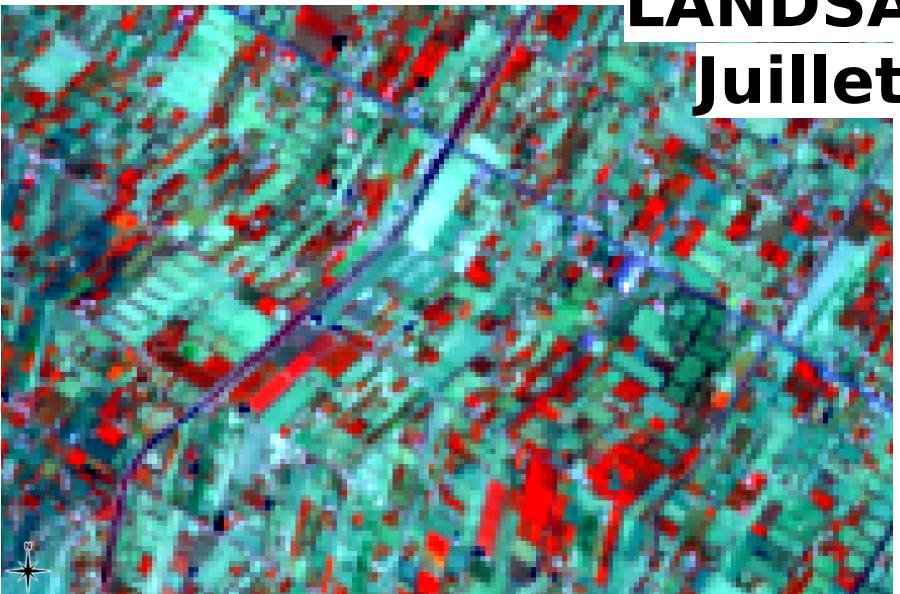
***Sentinel-2* ($\approx 10m$)**
VS
***Landsat* ($\approx 30-15m$)**

Introduction à la télédétection

Résolution spatiale

LANDSAT 8 15m

Juillet 2015



NIR



MIR R



Sentinel-2 10m Août
2015

Introduction à la télédétection

Résolution spatiale

Exemple de l'effet de la résolution en Colombie

***Spot 6*(≈6-1.5m)**

VS

***RapidEye*(≈6.5m)**

VS

***Landsat*(≈30-15m)**

Introduction à la télédétection

Résolution spatiale

6.5m Rapid Eye

08/2013



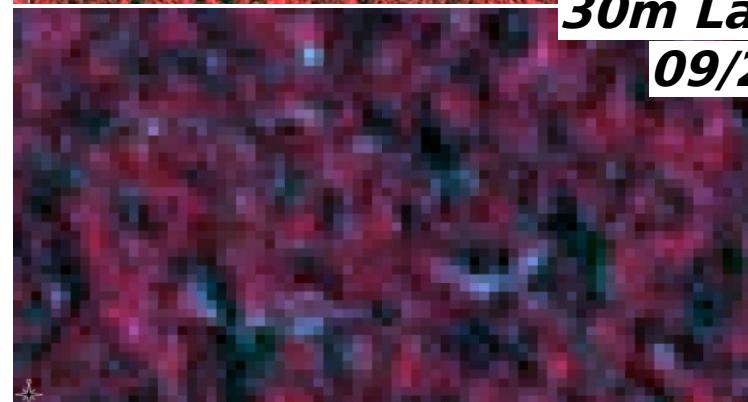
1.5m SPOT6

09/2014



30m Landsat 8

09/2014



● **30/15m**

- Déetecte correctement les grandes activités
- Inadapté au petite déforestation
- Analyse rapide

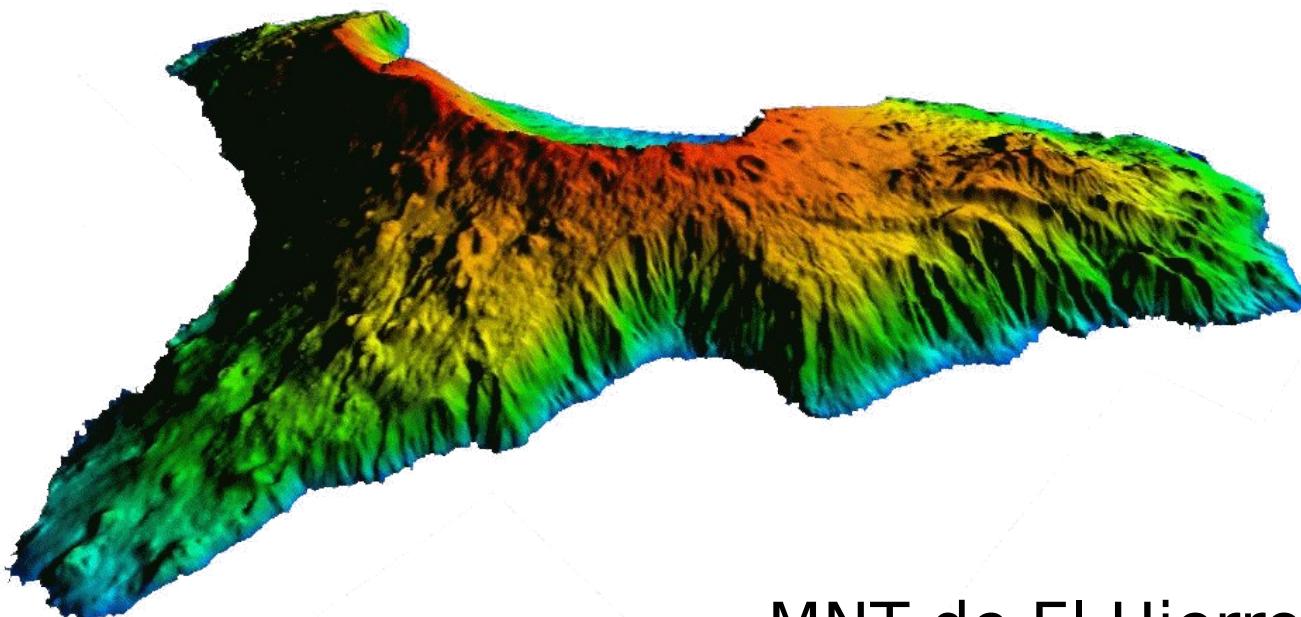
● **<6m**

- Capable de détecter des petites déforestation
- Quantifier l'impact de déforestation

cumentation traitement données optiques:

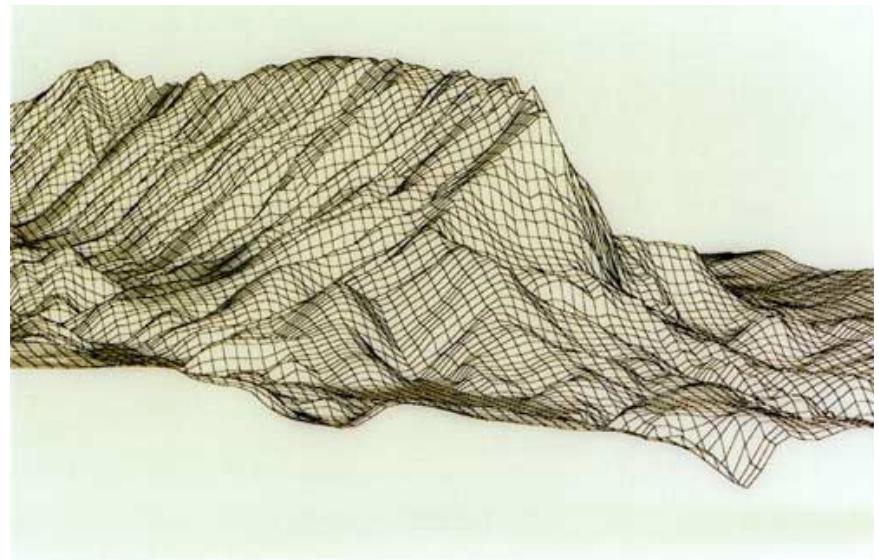
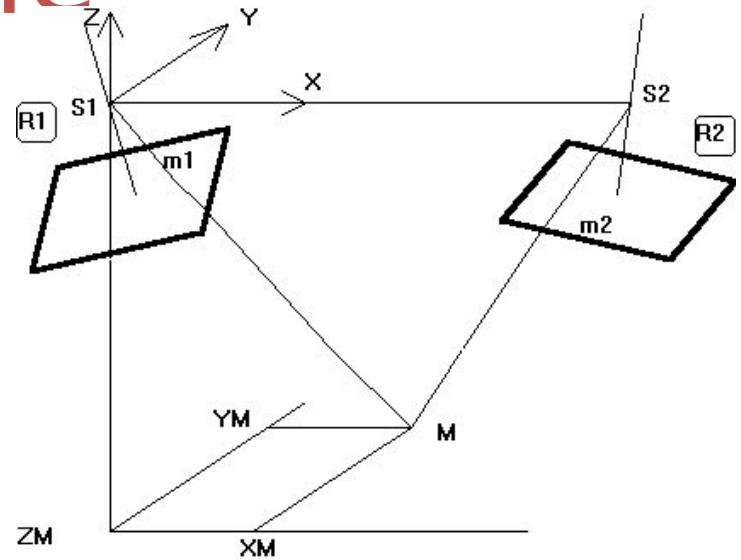
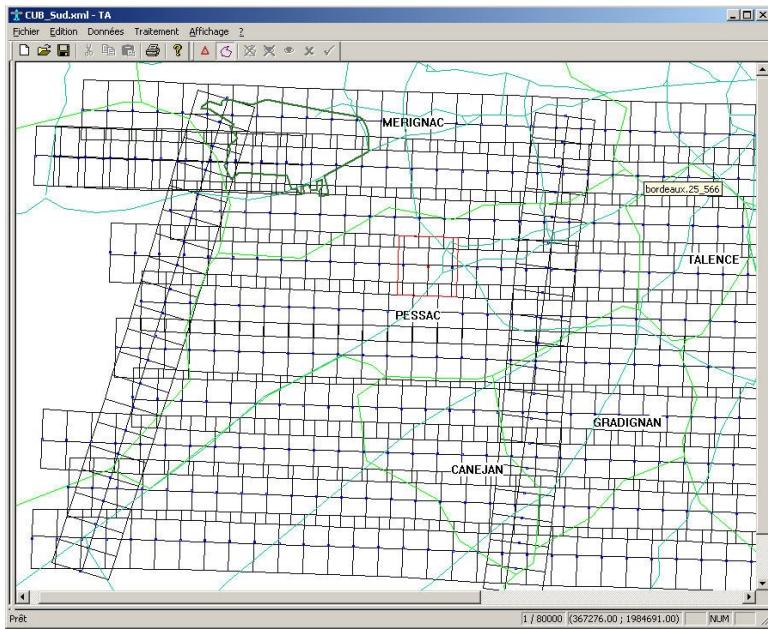
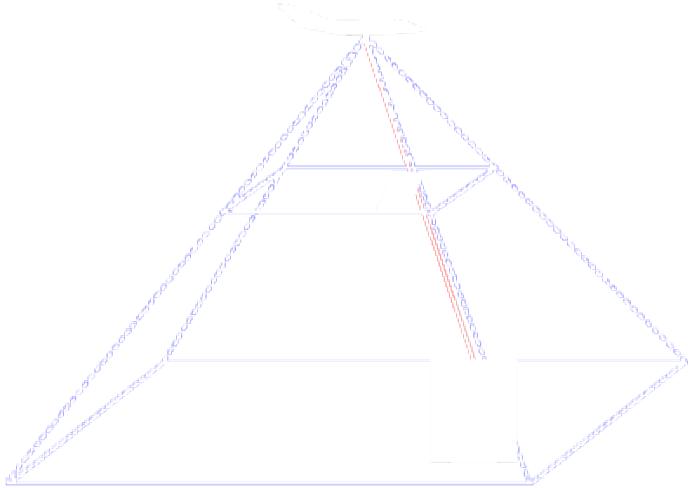
<http://www.onfinternational.com/data/technical/tutorials/Sentinel-1-Optical-Processing-Workshop.pdf>

STÉRÉOSCOPIE: Accès au relief



MNT de El Hierro, Canarie
IGN Espagn

Photogrammétrie



BRIGE

