Main optical sensors for the observation of land surfa

	NOAA AVHRR	SPOT VEGETATION	MERIS	MODIS	LANDSAT MR SID	ASTER	SPOT	IKONOS
Swath Coverage	2400 km	1600 km	1200 km	1200 km	185 km	60 km	60 km	11 km
Résolution spatiale	1km 4 km 16 km	1 km	300 m 1.2 km	250 m 500 m 1 km	30 m 15 m	15 m (Vis) 30 m (SWIR) 90 m (IRT)	10 m 5 m 2.5 m	5 m 1 m
Temporal revisit	week	2 days	3 days	3 days	16 jours	8 min/orbite	25 jours	
Bands	5 R-IR-IRT	4 VIS-PIR	15 VIS-PIR	36 VIS-IR-IRT	7 + Pan VIS-IR-IRT	14 VIS-IR-IRT	4+Pan VIS+IR	
Cost	~ 0	~ 0			600 $	~ 0	1000 € 100 €	3000 $

ain optical sensors for the observation of land surface

	SPOT	IKONOS	…	PLEIADES		SENTINEL2	
				1A	1B	2A	2B
Période mission	Fév. 1986 -	Sept. 99		Déc. 2011-	Déc. 2012	Juin 2015	2016
Swath coverage	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 days	
Bandes	4+Pan VIS+IR			4 + Pan VIS + PIR		13 bands VIS + PIR	
Coût	1000 € 100 €	3000 $		Même ordre		***GRATUIT***	

Introduction

Optical sensors for forestry

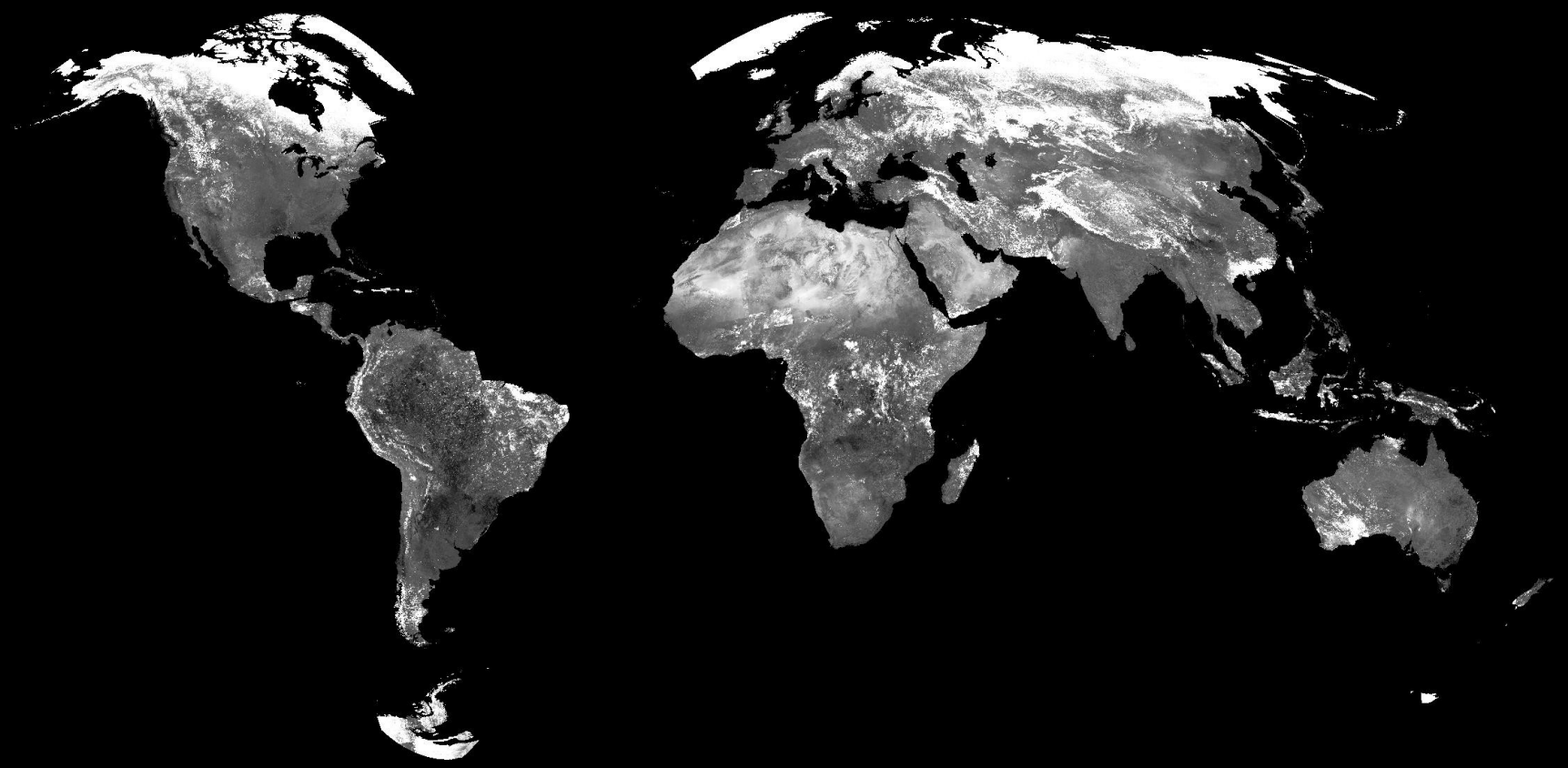
ONF International

Name	*Acquisition period*	*Acquisition type*	*Bandes*	*Spatial resolution (m)*	*Revisit time (days)*	*Scene cover or width (km)*	*Average Cost km² (€)*
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

Global image NOAA-AVHRR

Red Channel

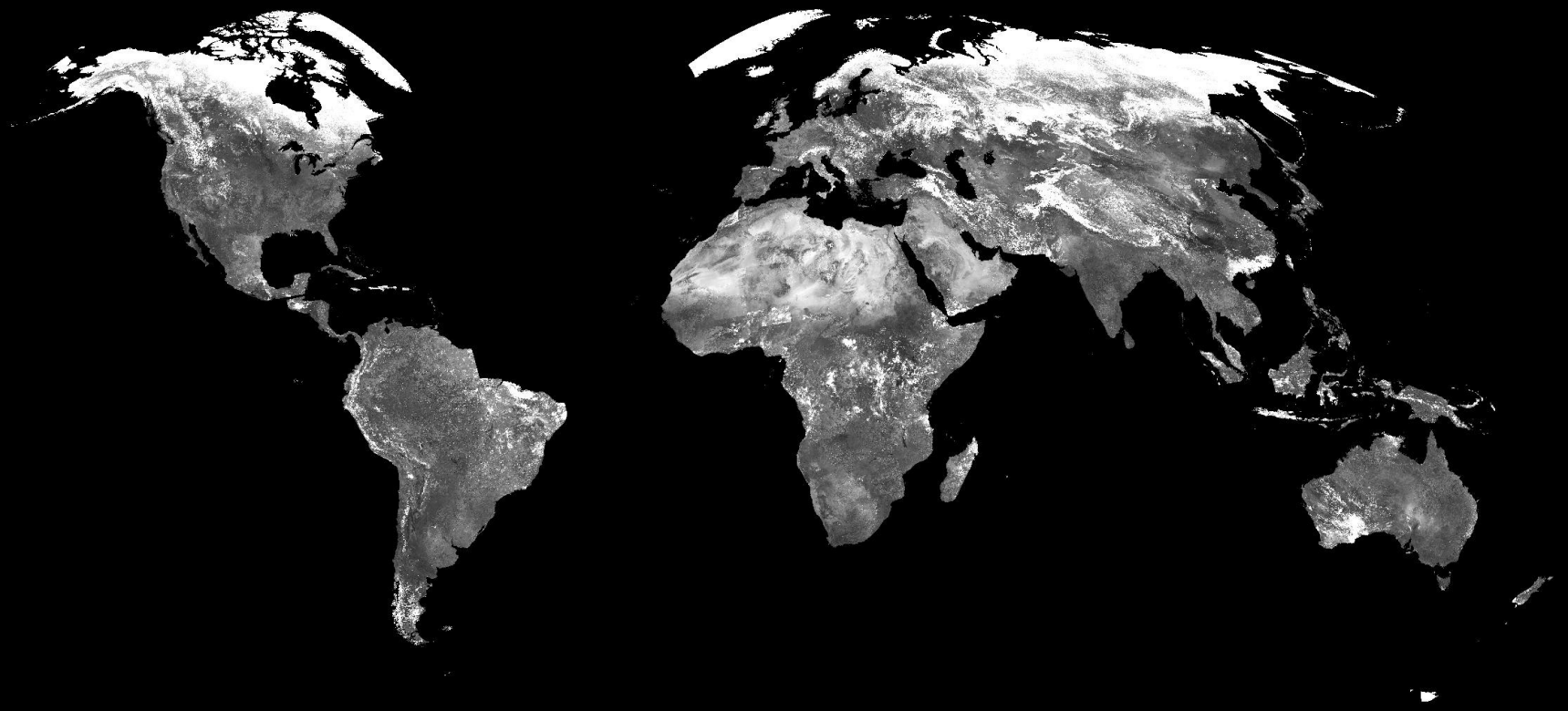
1-10 april 1992



Global image NOAA-AVHRR

Channel Near Infrared

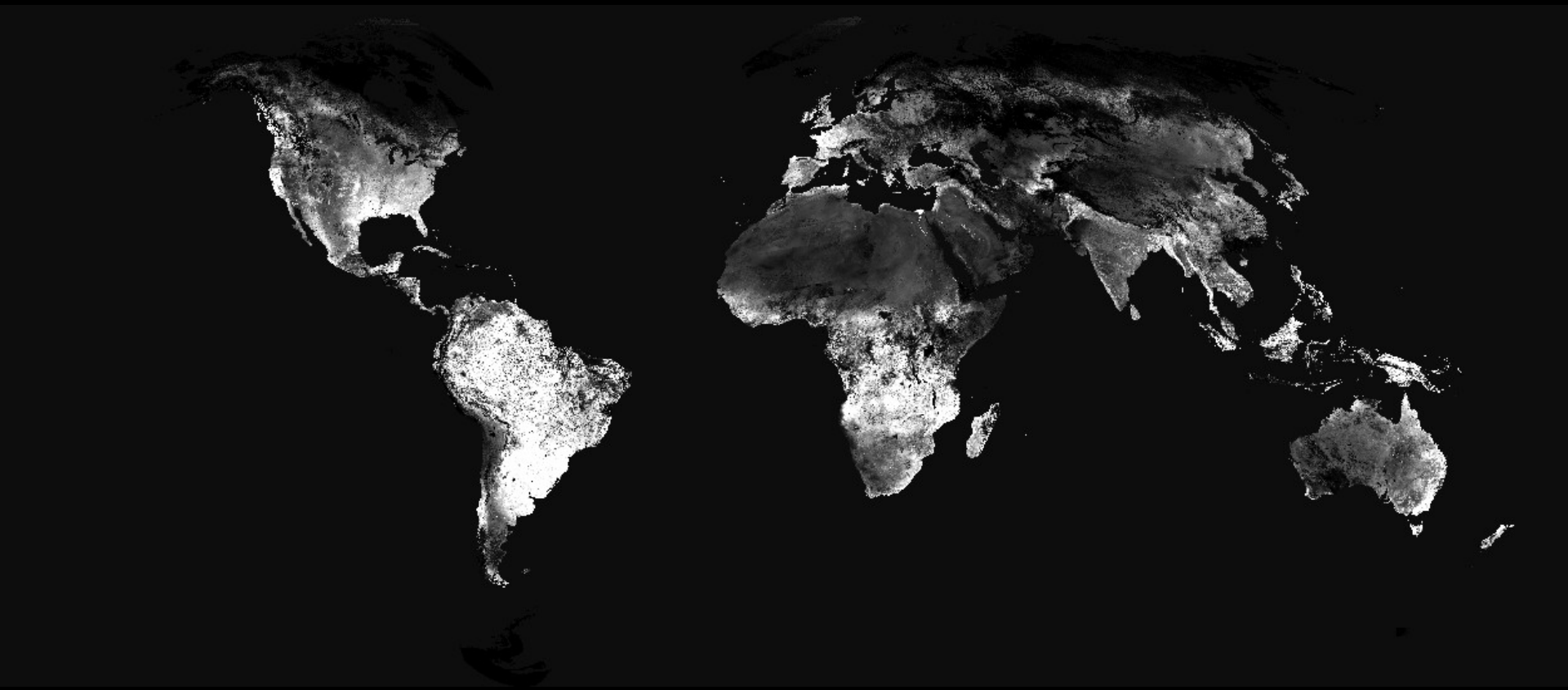
1-10 april 1992



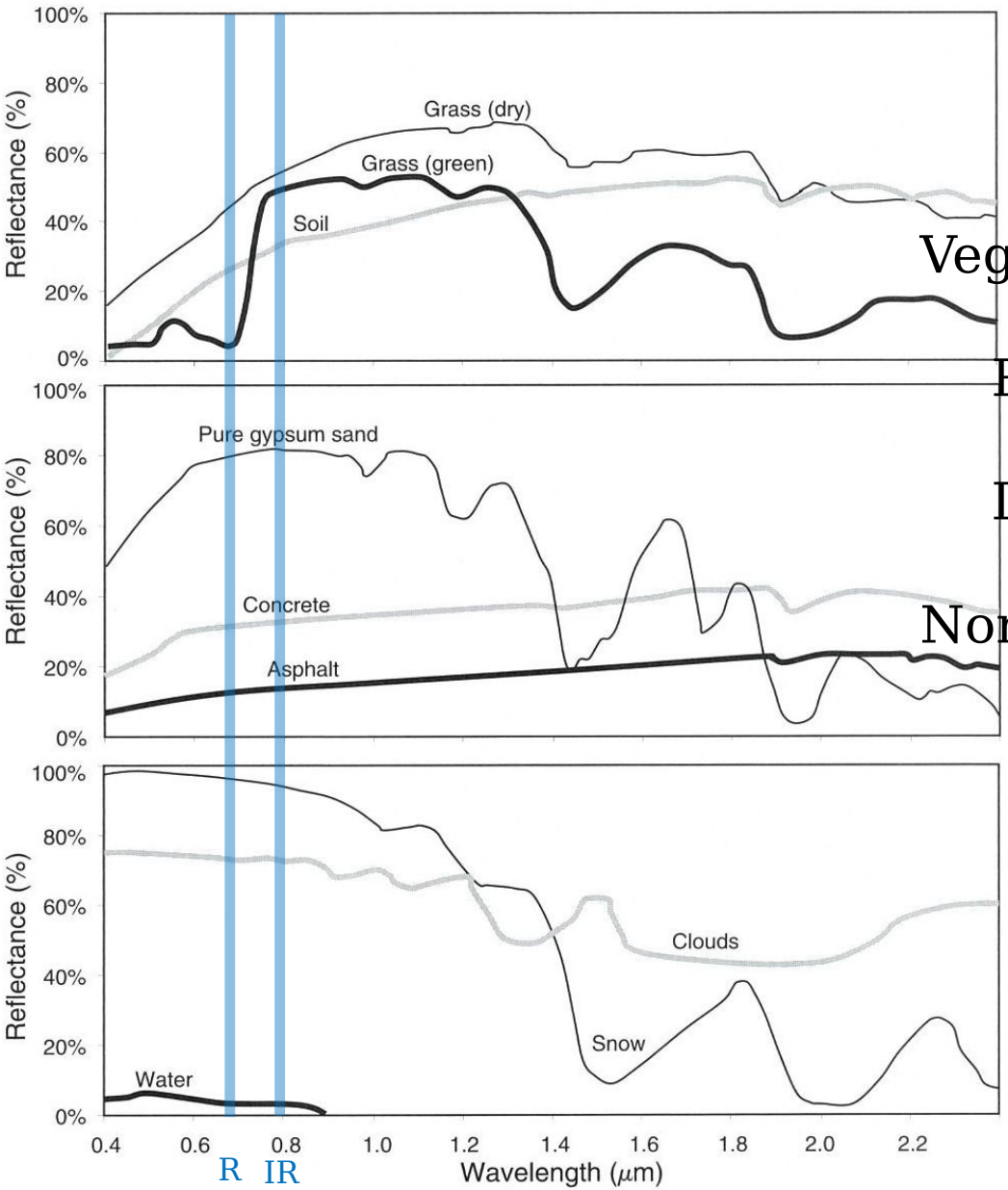
Global image NOAA-AVHRR

NDVI

1-10 april 1992



Spectral signatures of different types of surfaces



Vegetation Index

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

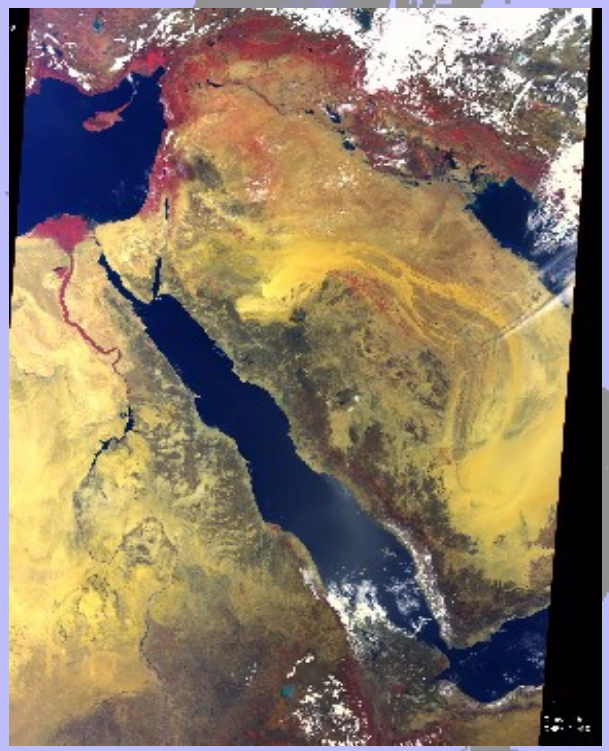
Difference: $\rho_{IR} - \rho_R$

Normalized Diff. Vegetation Index:

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

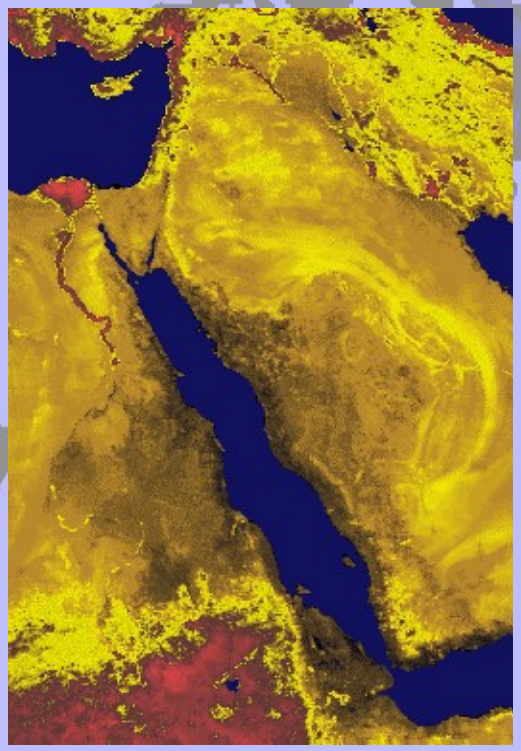
Source: Lillesand *et al.,* 20

SPOT-VEGETATION



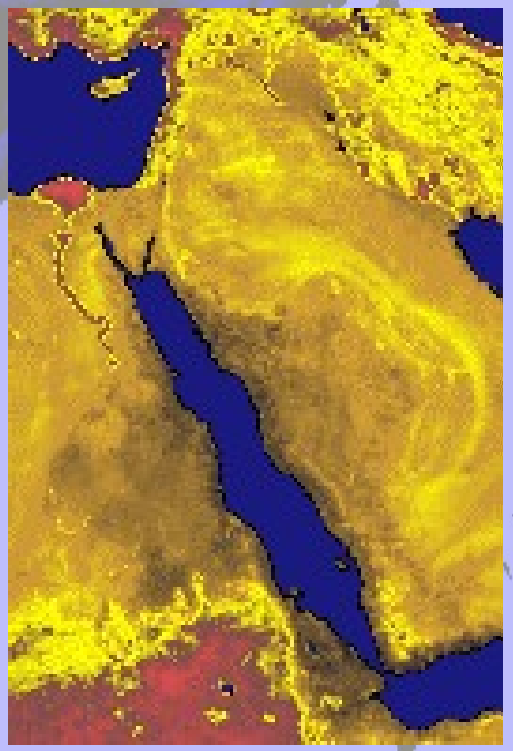
Pixel Size: 1 x 1 km²

NOAA-AVHRR

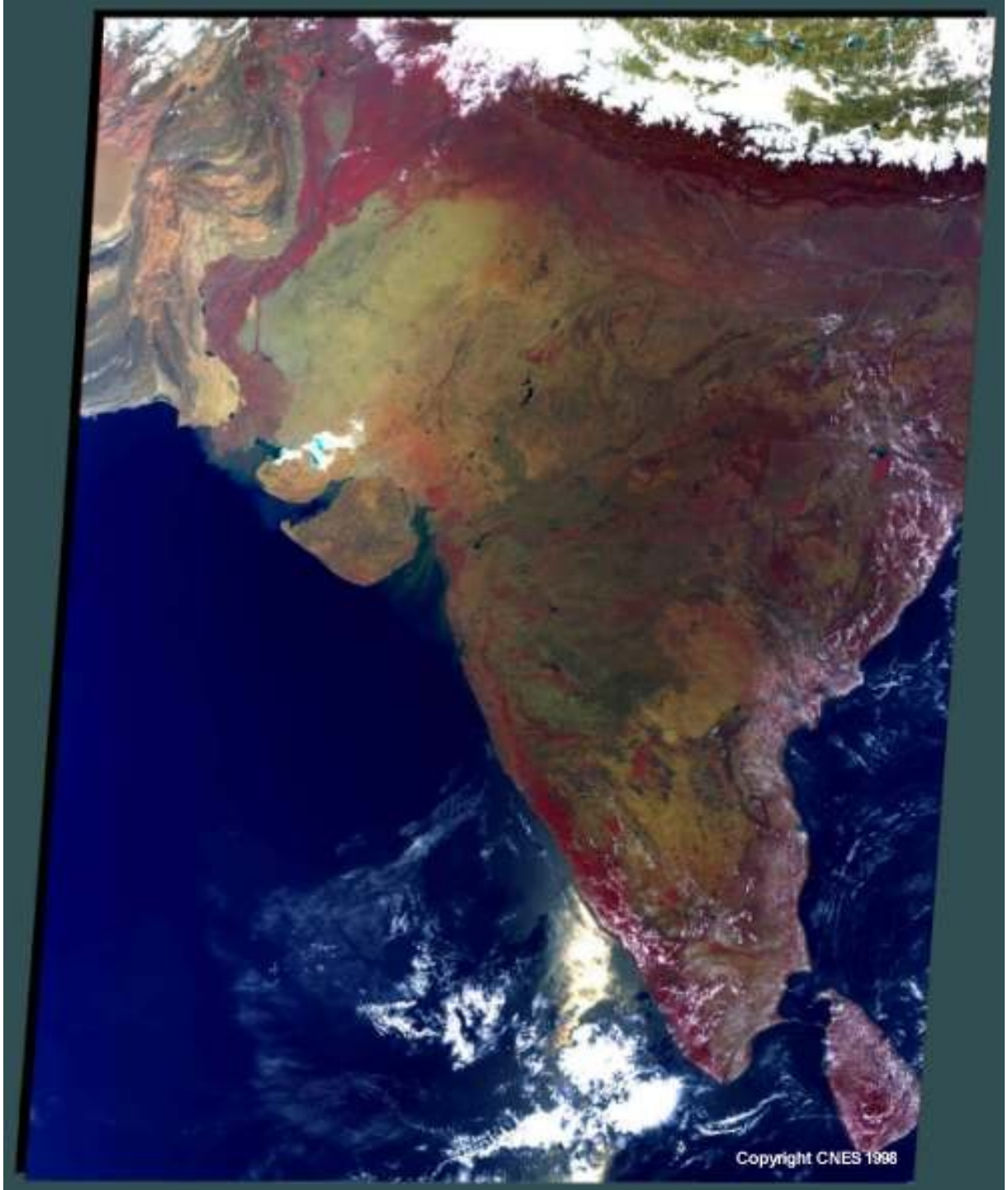


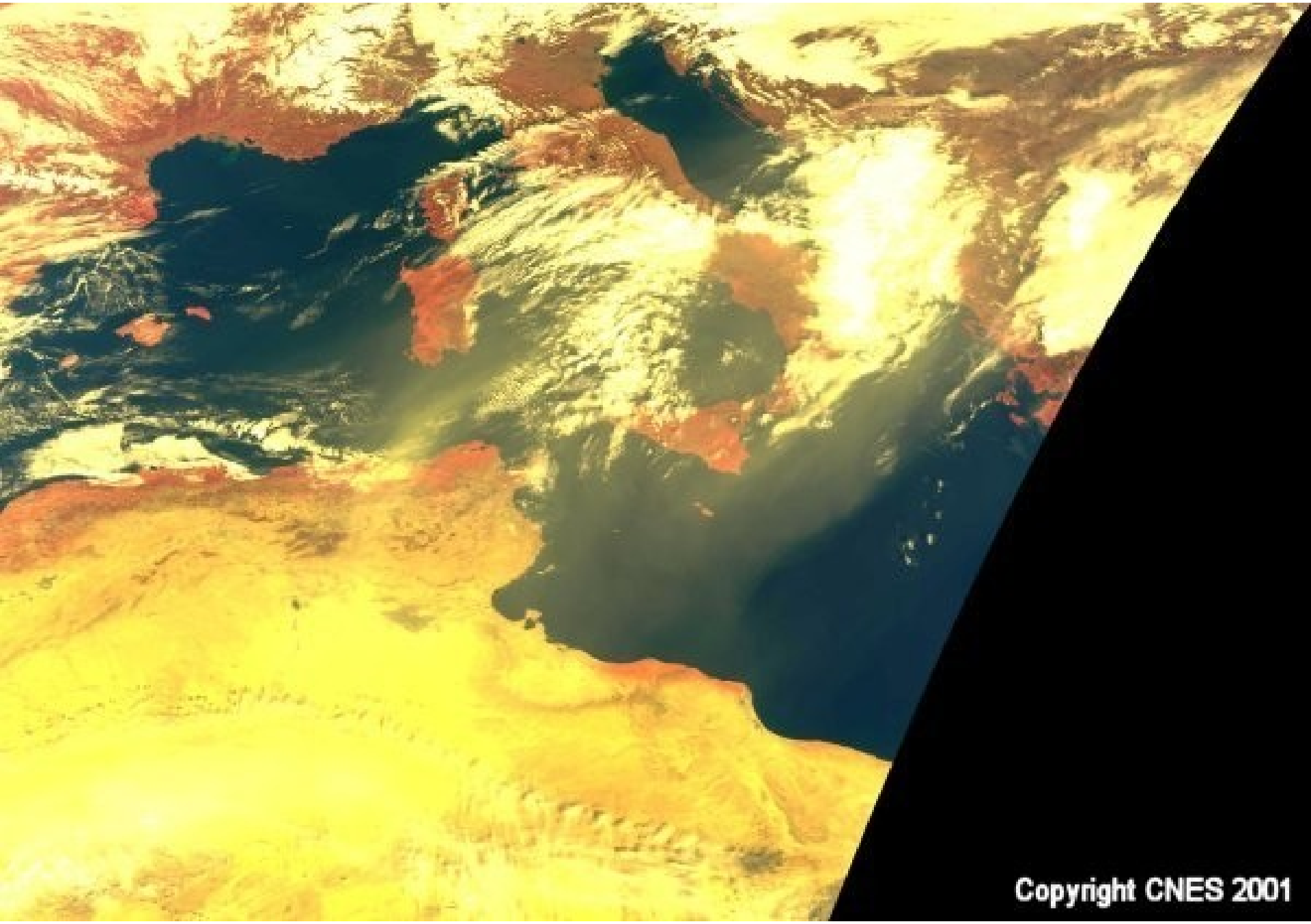
Pixel Size: 8 x 8 km²

NOAA-AVHRR

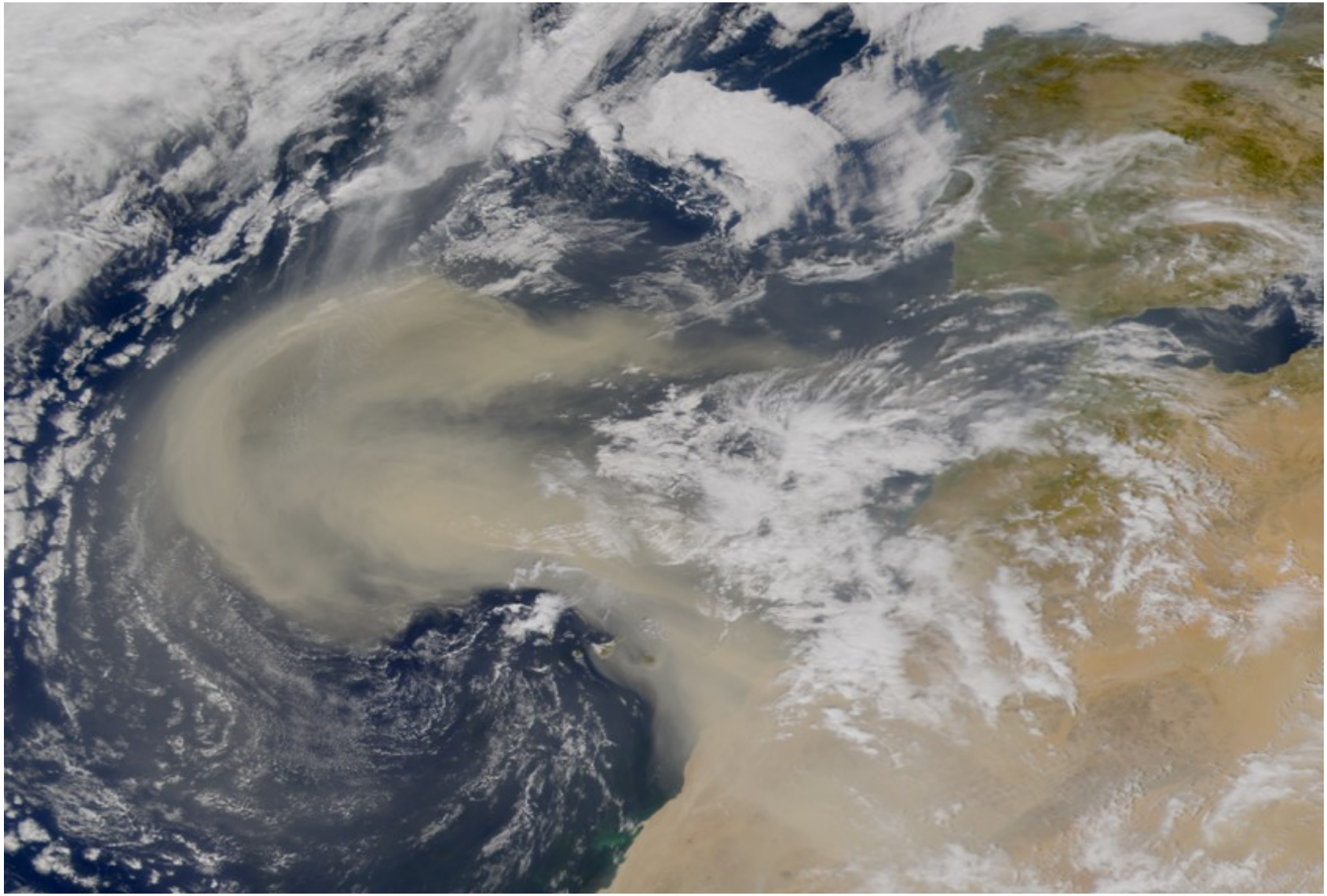


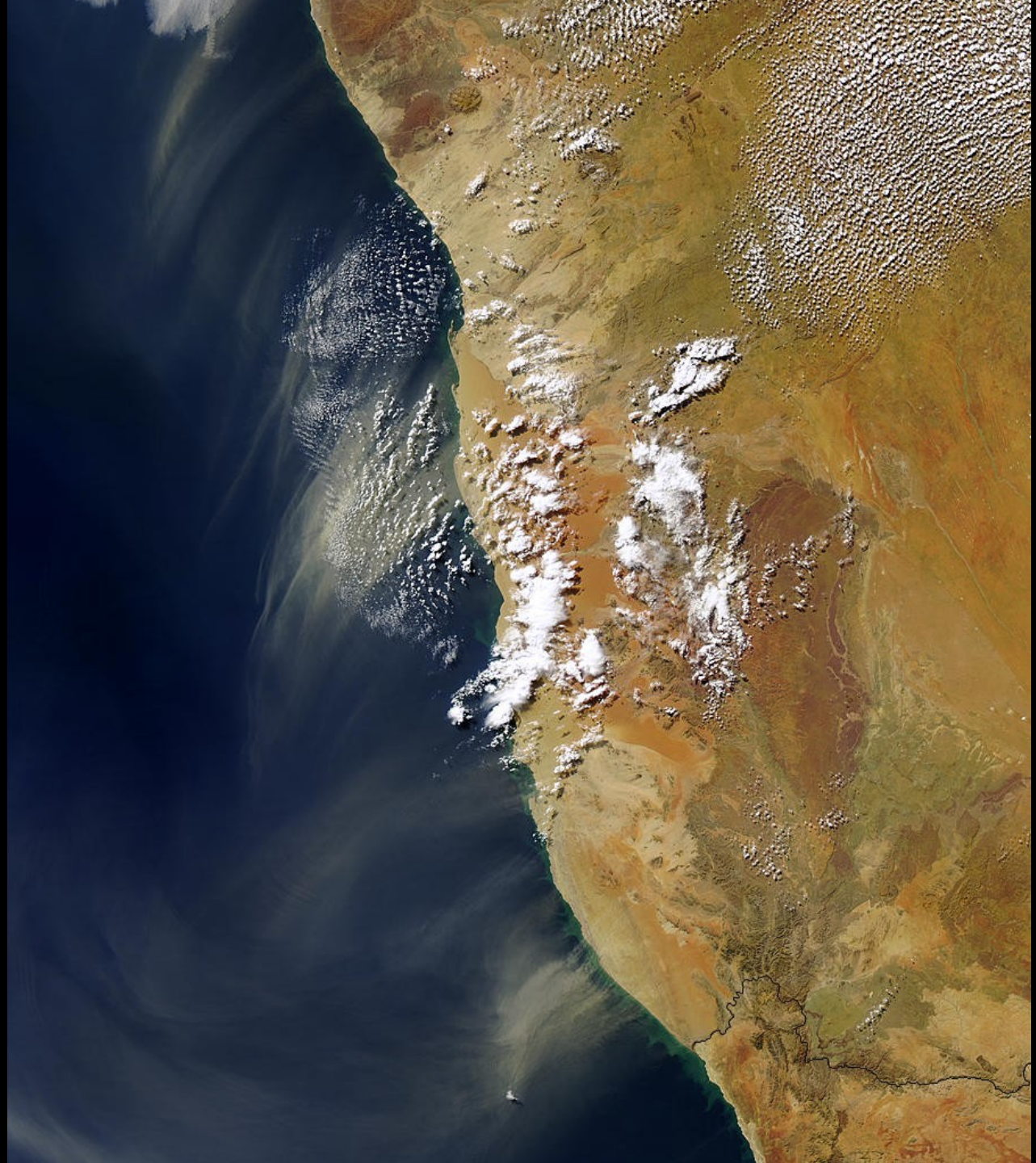
Pixel Size: 16 x 16 km²


Copyright CNES 1998

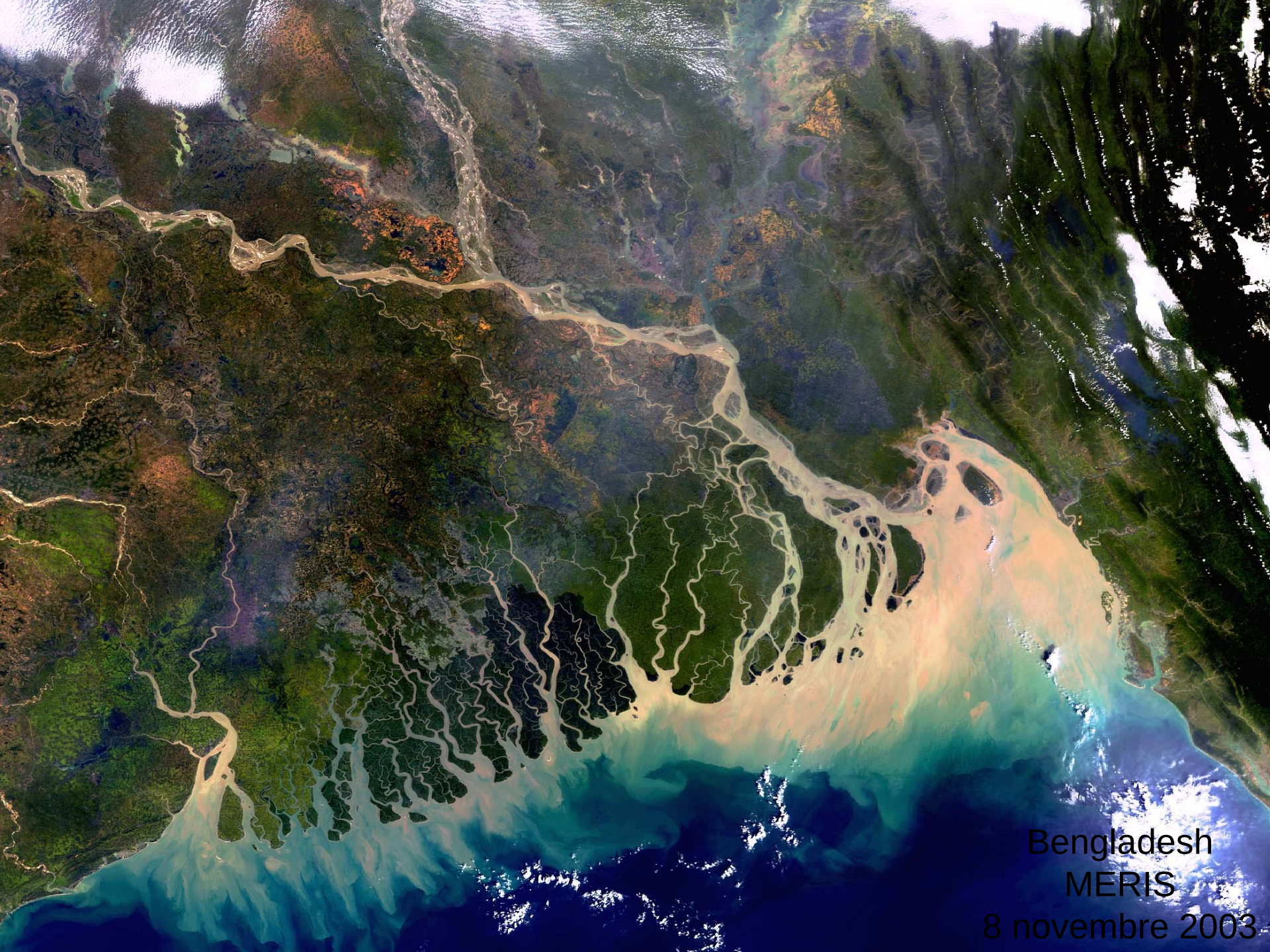

Copyright CNES 2001

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

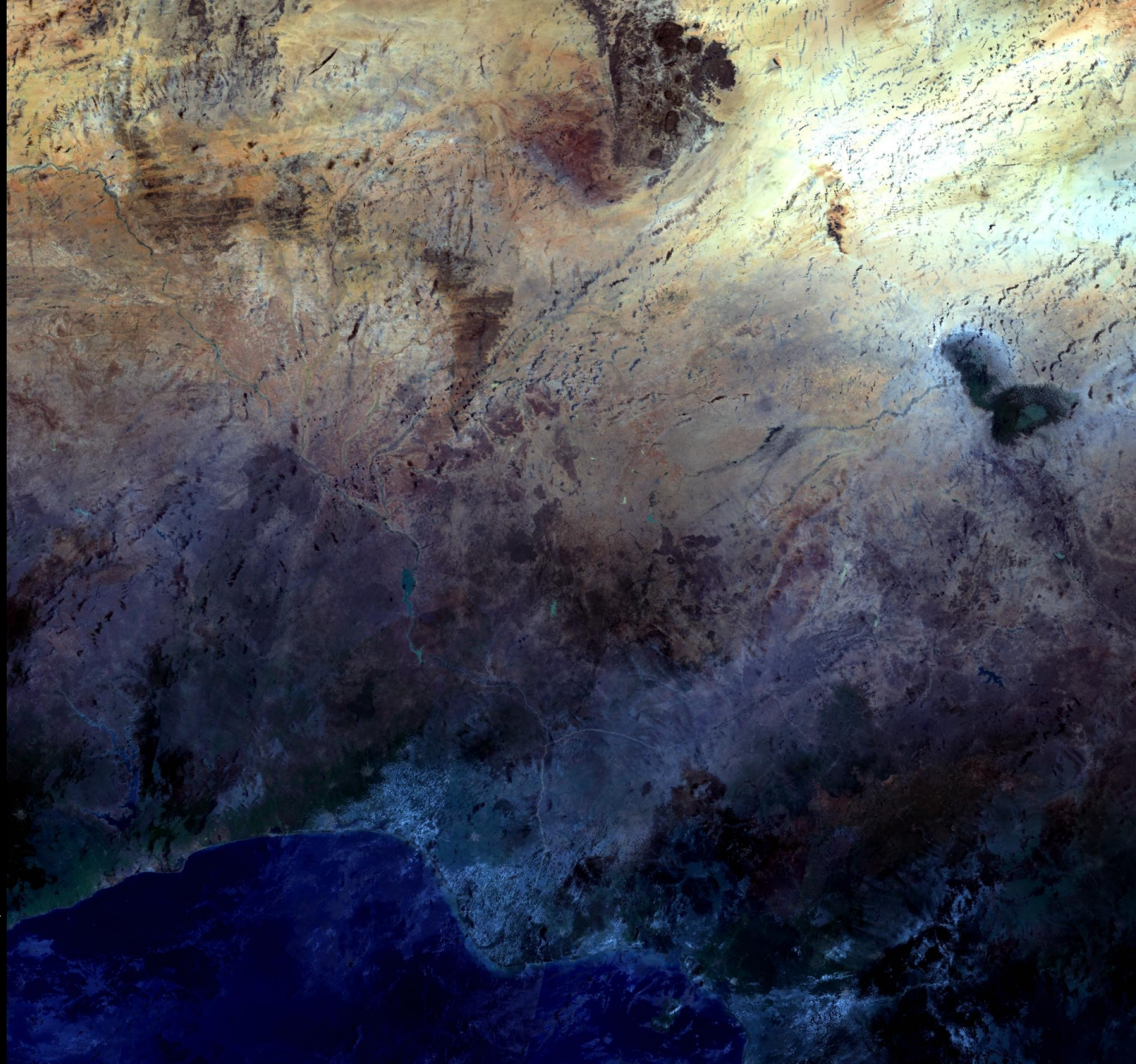




Désert de Namibie
MODIS
8 juillet 2004


Bengladesh
MERIS
8 novembre 2003


Mer Caspienne
MERIS
22 septembre 2003



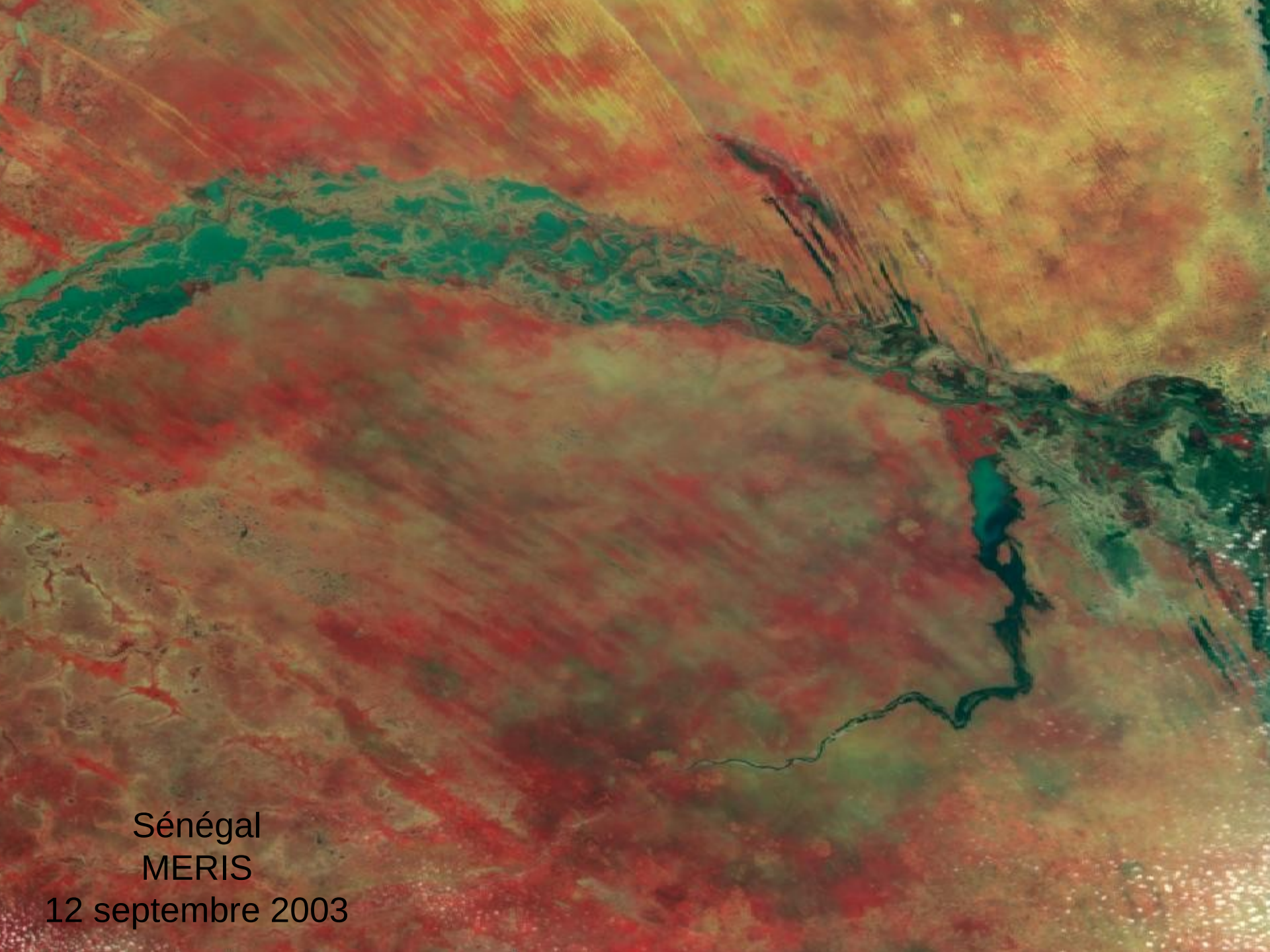
MERIS
300 m – 1200 m

MERIS
300 m – 1200 m


Sénégal
MERIS
15 avril 2003

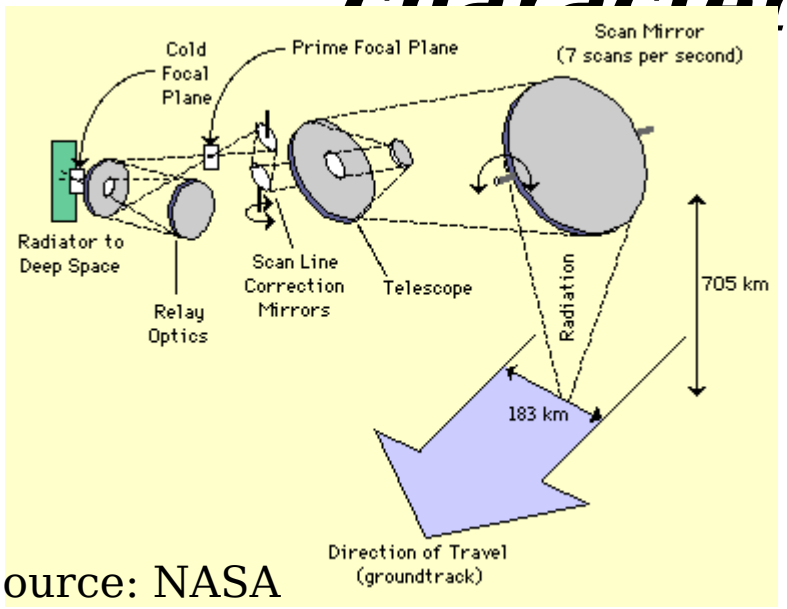

Sénégal
MERIS
30 mai 2003


Sénégal
MERIS
27 juin 2003

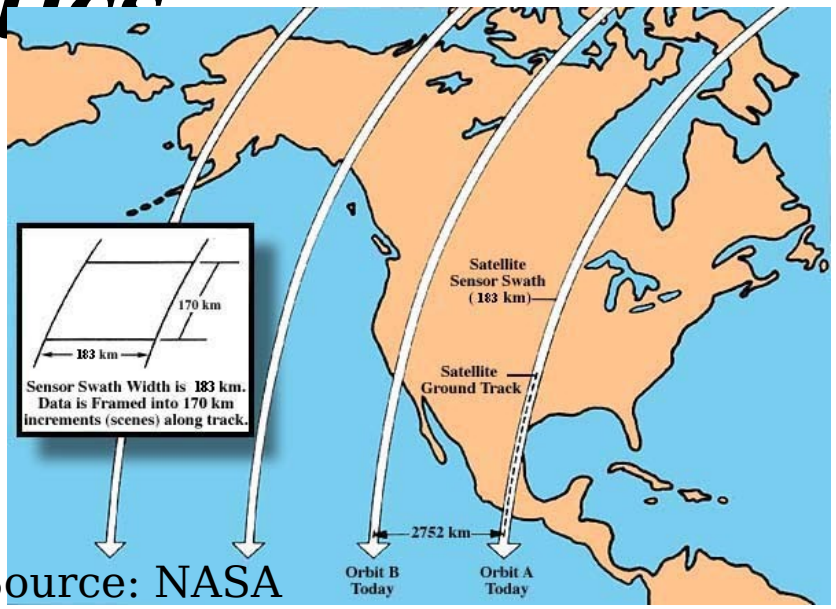


Sénégal
MERIS
12 septembre 2003

Landsat-TM7 characteristics



Source: NASA



Source: NASA

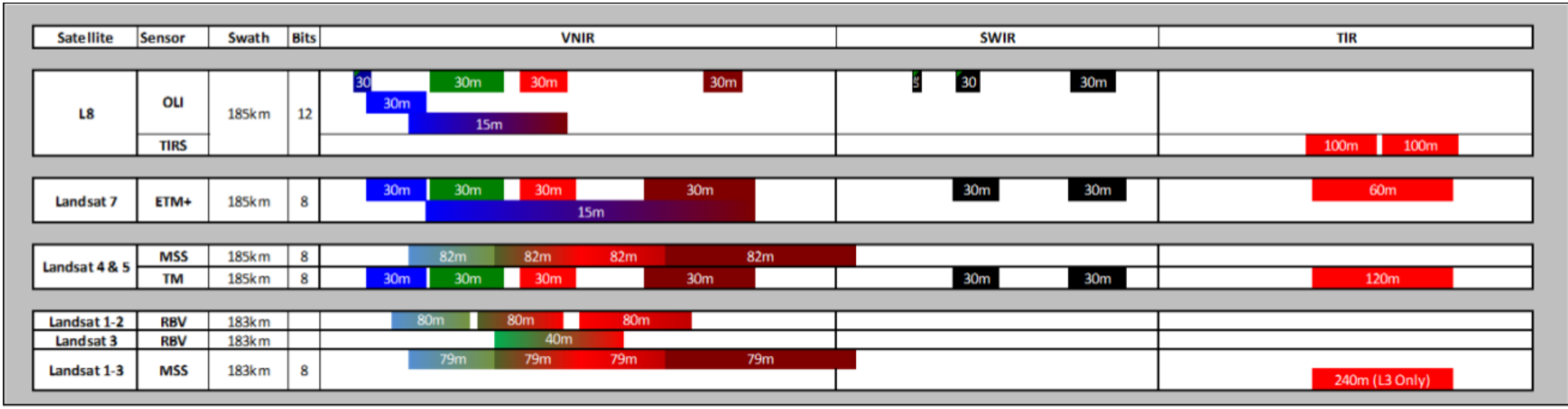
focale: f = 2.4 m
ouv. diaphragme: d = 40 cm
détect. élem.: 0.1 mm

⇒ IFOV = 10^{-4} / 2.4 = 41.7 10^{-6} rad

⇒ **δx** = IFOV H = **30 m**

Bande 1 : 0.45 – 0.52 *μm*
Bande 2 : 0.52 – 0.6 *μm*
Bande 3: 0.63 – 0.69 *μm*
Bande 4: 0.76 – 0.90 *μm (NIR)*
Bande 5 : 1.55 – 1.75 *μm (SWIR)*
Bande 7 : 2.08 – 2.35 *μm (SWIR)*
Bande 6 : 10.4 – 12.5 *μm (IRT)* ***(60m)***
PAN : 0.5 – 0.9 *μm* ***(15 m)***

The LANDSAT mission



USGS, Landsat 8 Data Users Handb

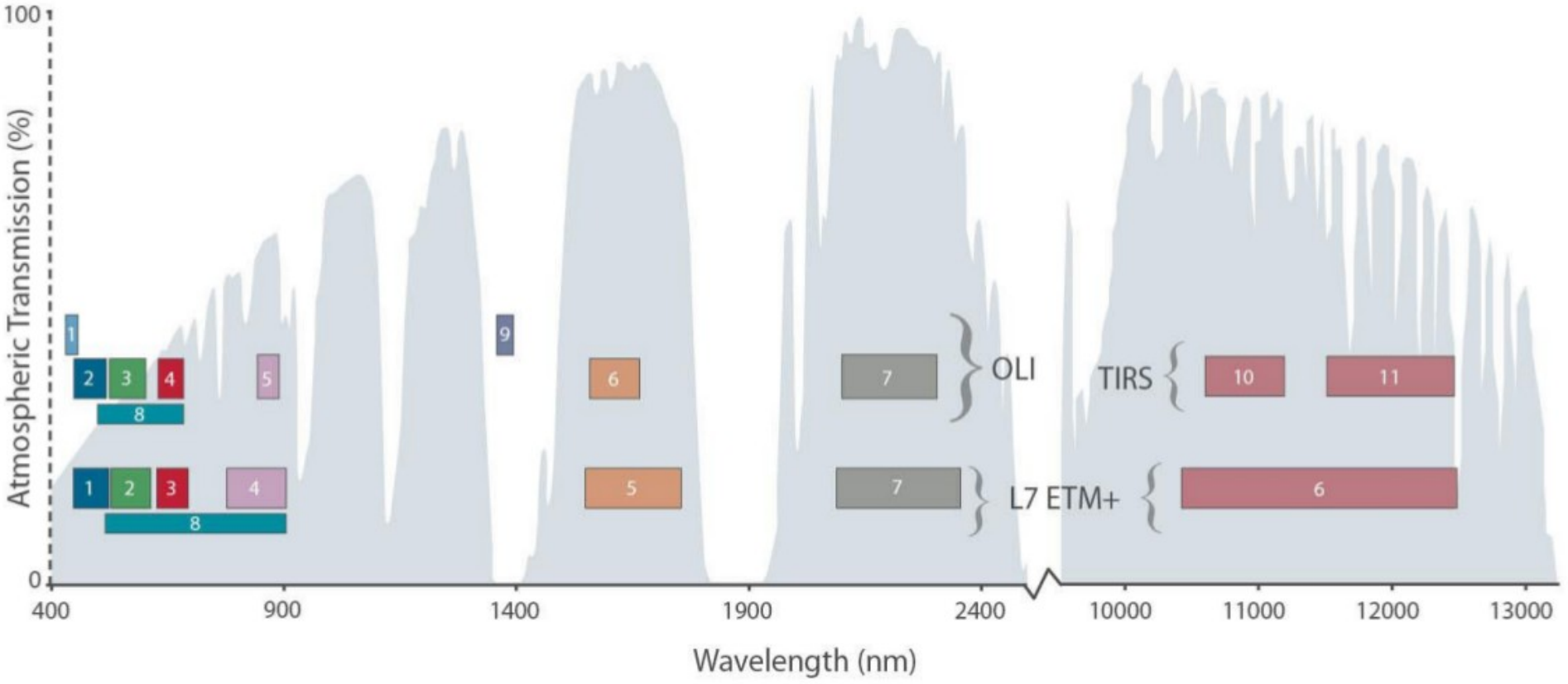
LANDSAT characteritics

OLI and TIRS Spectral Bands *vs* ETM+ Spectral Bands

Landsat-7 ETM+ Bands (µm)			Landsat-8 OLI and *TIRS* 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	*100 m TIR-1*	*10.60 – 11.19*	Band 10
			100 m TIR-2	*11.50 – 12.51*	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

USGS, Landsat 8 Data Users Handb

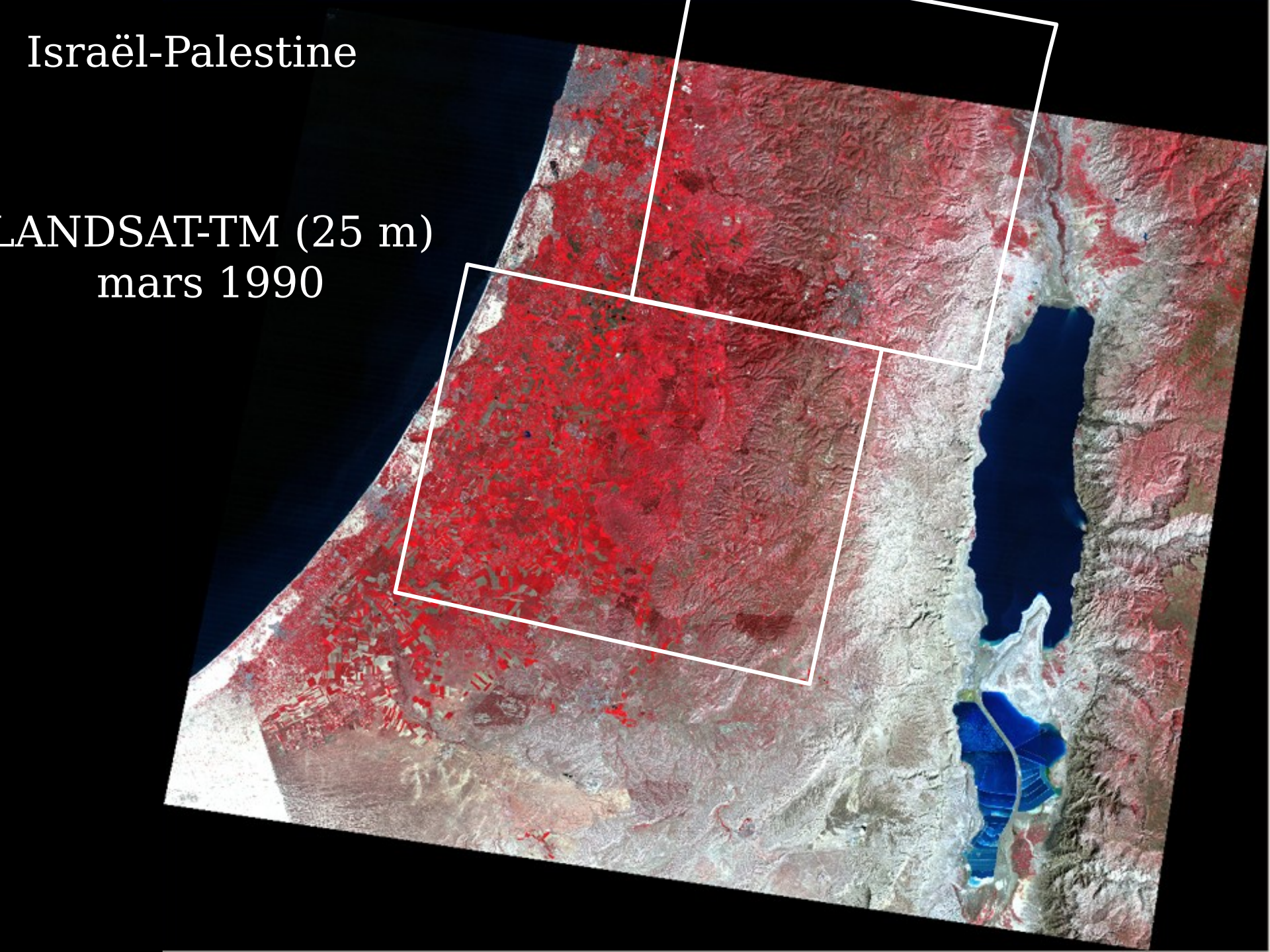
Landsat 8 *vs* Landsat 7 ETM+ Spectral Bands

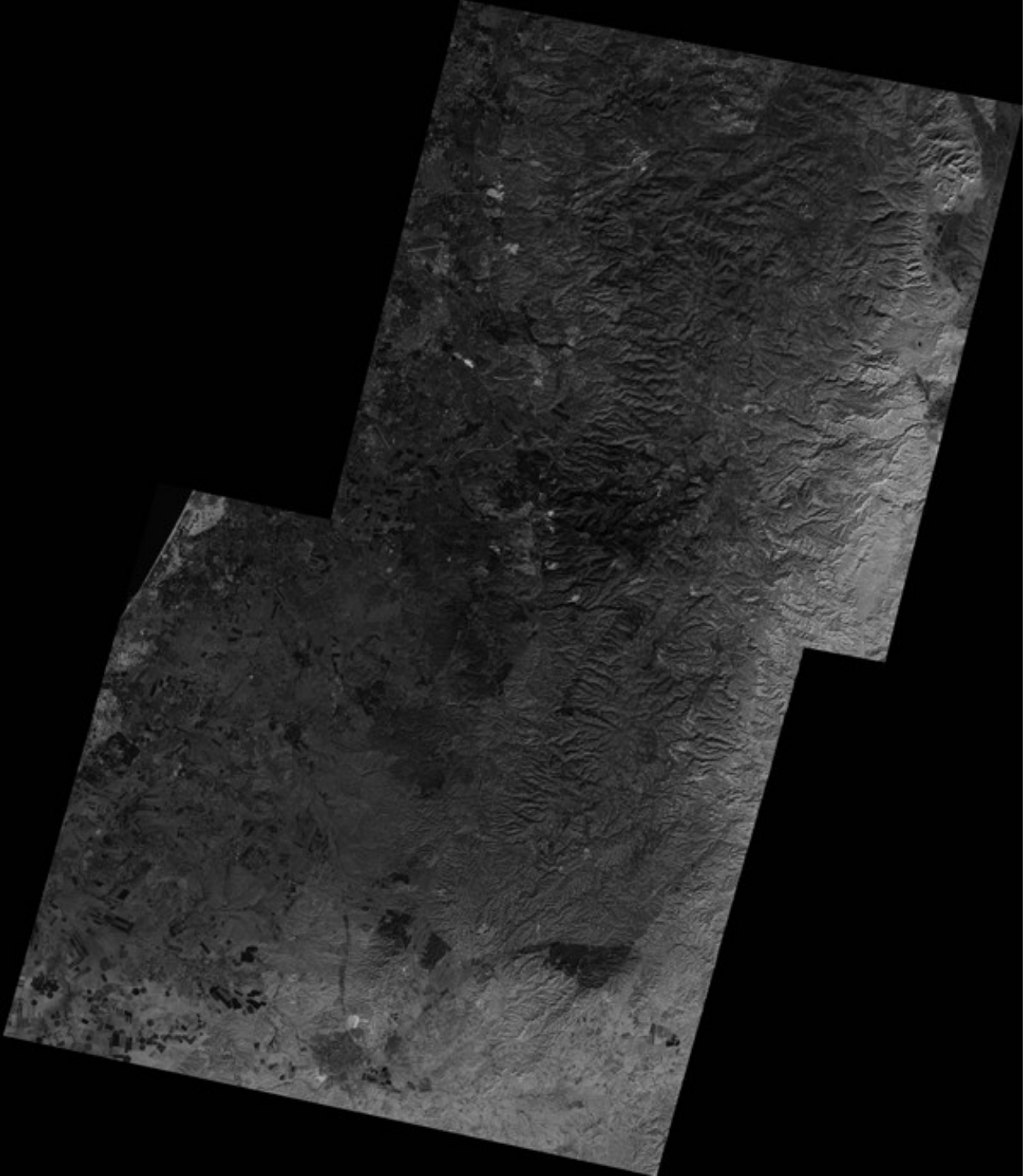


USGS, Landsat 8 Data Users Handb

Israël-Palestine

LANDSAT-TM (25 m)
mars 1990





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

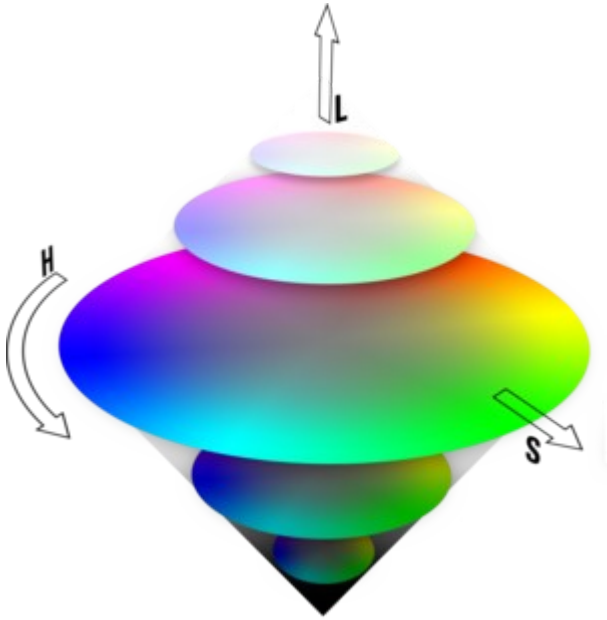
30 décembre 2004

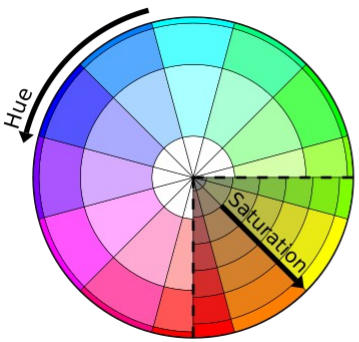
SPOT 5
rés. spatiale: 10 m
Banda Aceh, Indonésie

17 juillet 2003

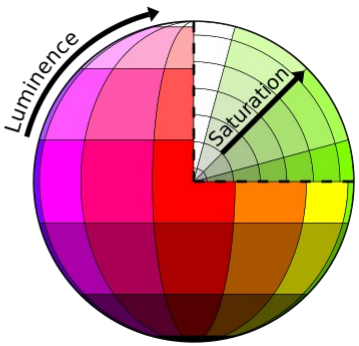
30 décembre 2004

Modèle TSL (HSL)
TSI (HSI)

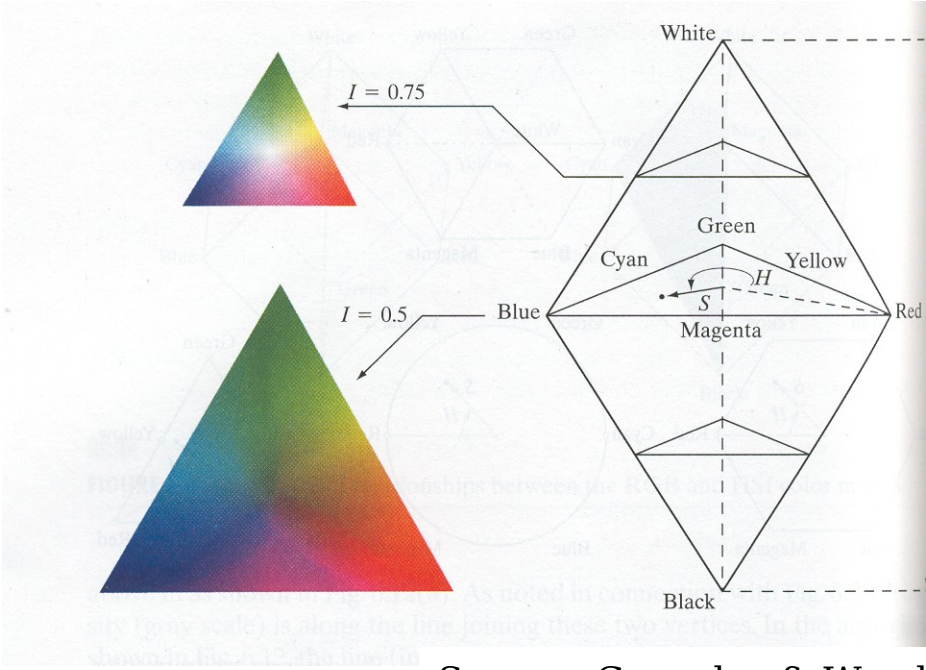




Top View



Front View



Source: Gonzales & Wood

image originale

canal rouge

canal vert

canal bleu

canal teinte

canal saturation

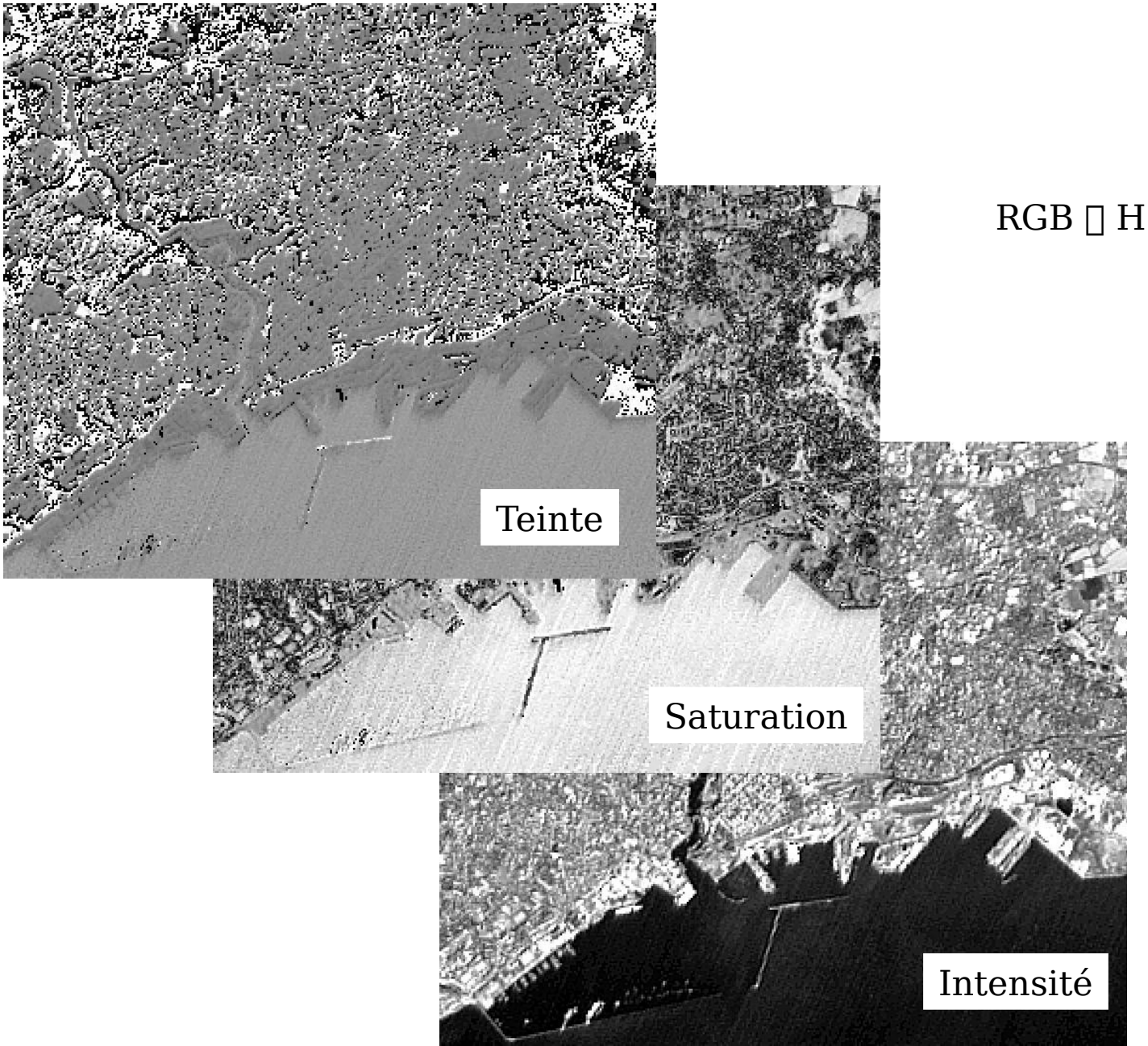
canal intensité

SPOT - XS

Brest, France - 20 m rés. spatiale

SPOT - XS

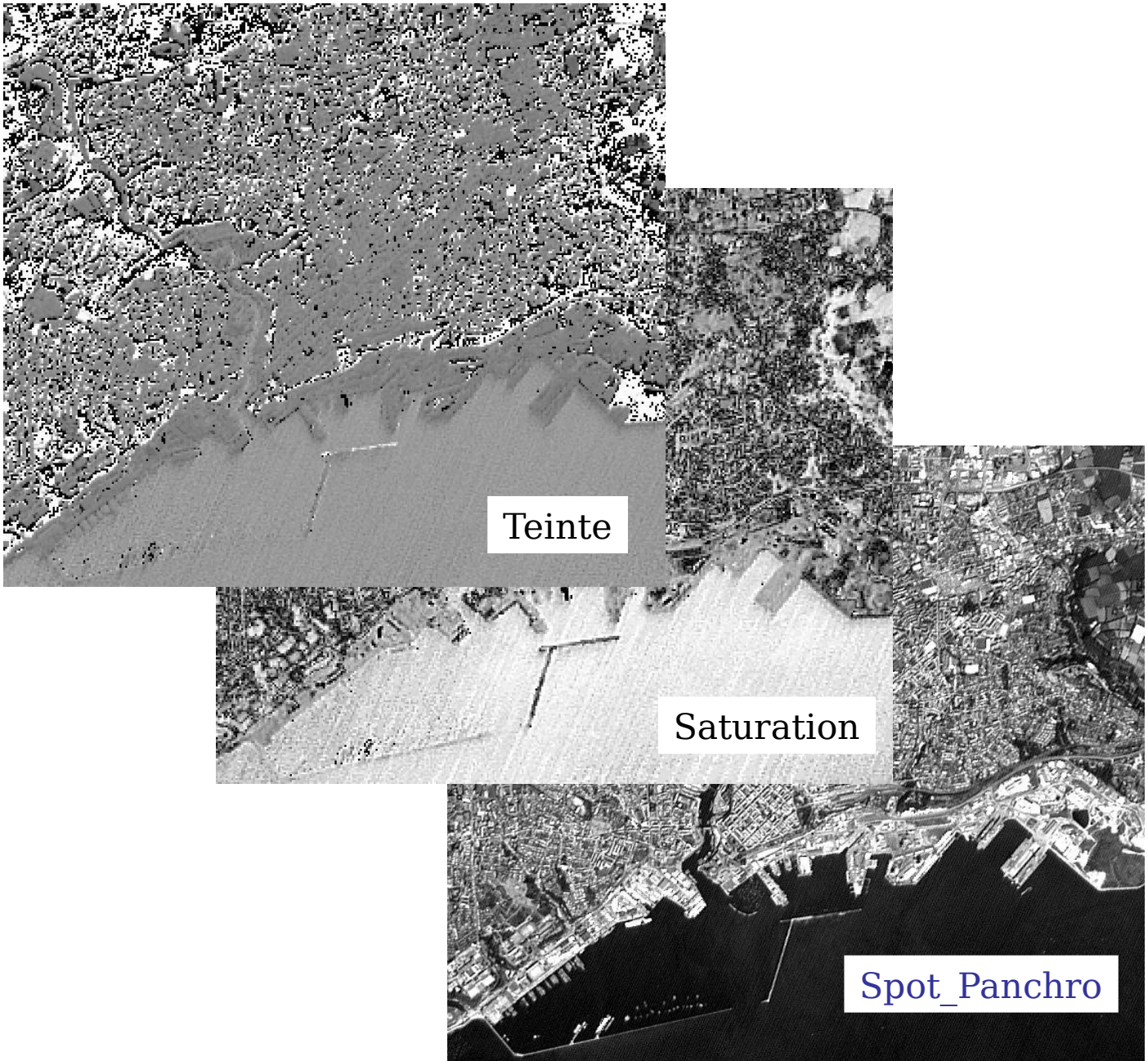
20 m rés. spatiale: rééchantillonage x 2



RGB ⇒ HSI

SPOT - XS

20 m rés. spatiale: rééchantillonage x 2



HSI RGB.....

SPOT - XS

Brest, France - 20 m rés. spatiale

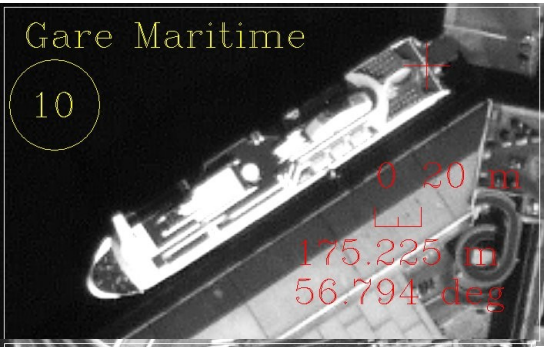
SPOT - Panchro
rés. spatiale: 10 m

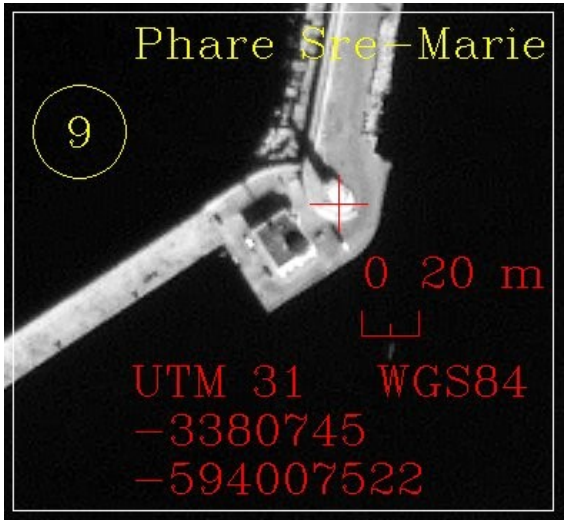
Brest, France

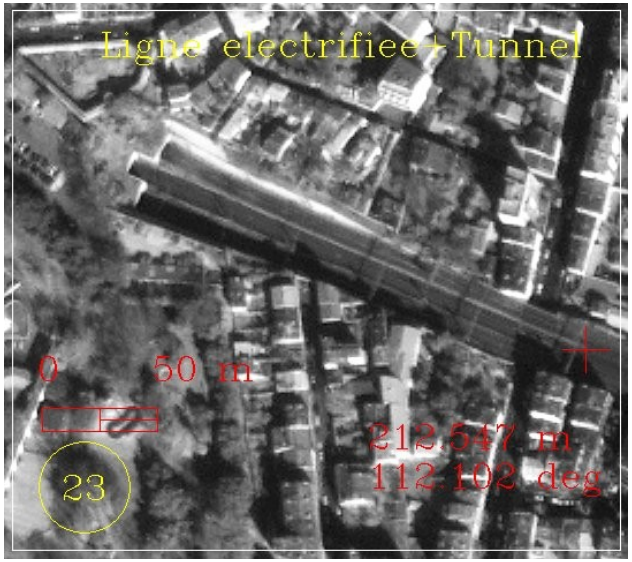
FUSION
XS - PANCHRO

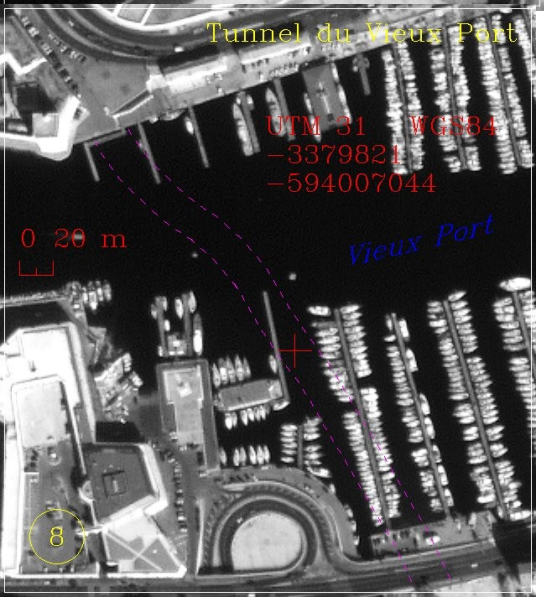
3 canaux - 10 m

Brest, France









IKONOS 1 x 1 m²

Donnée QUICK BIRD, Paris, 27 mars 2002

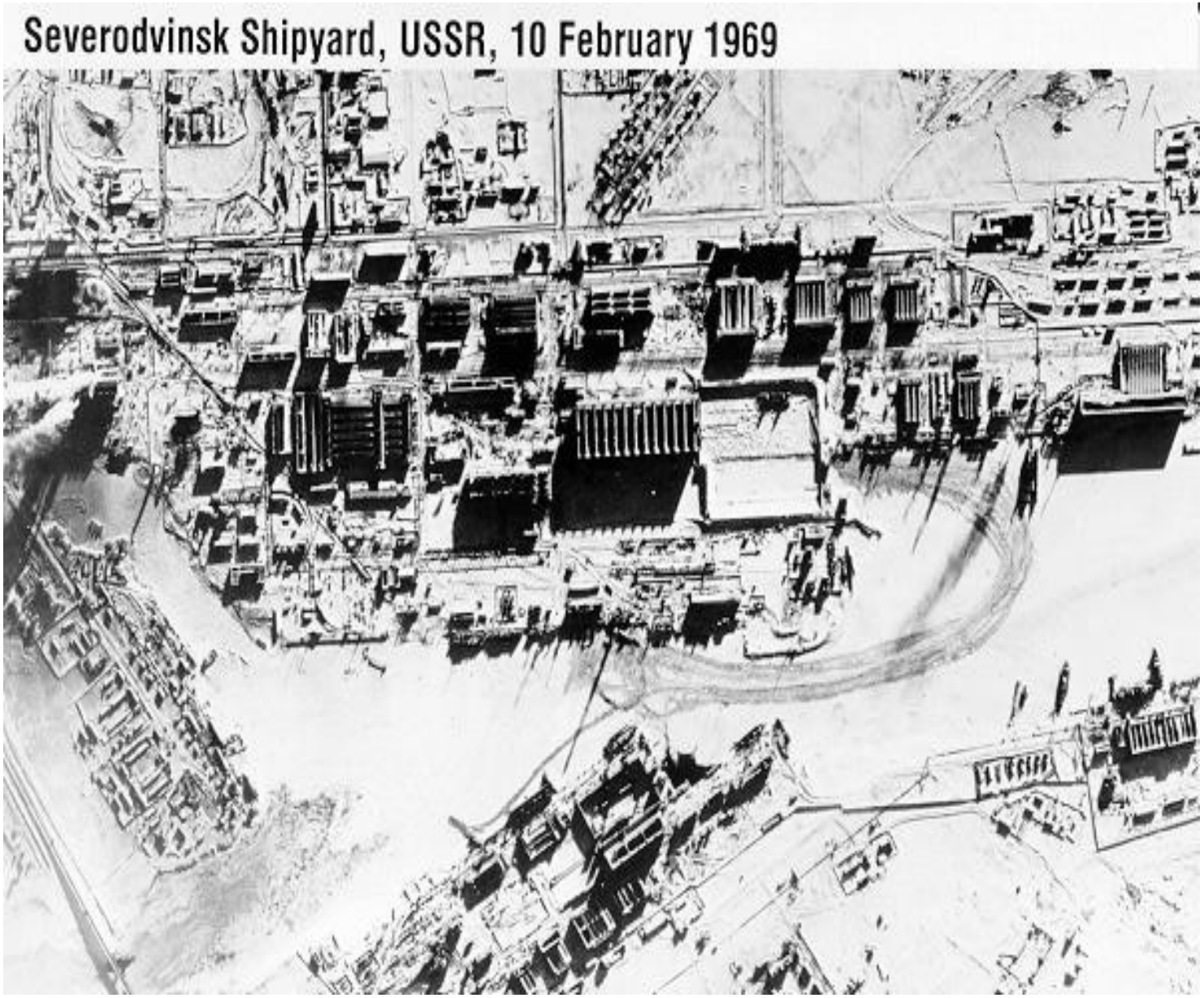

PLEIADES


PLEIADES

Renseignement stratégique

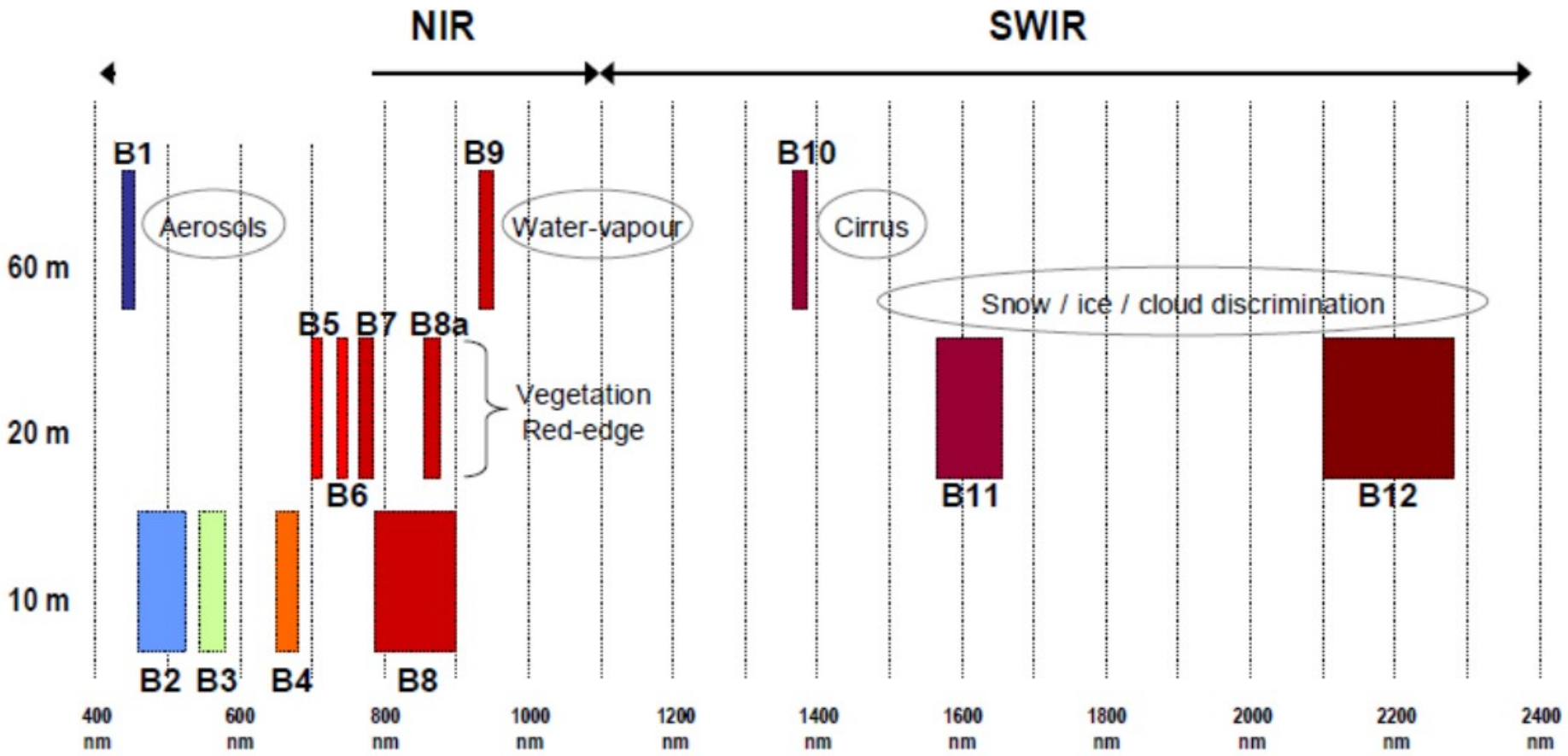
▲ REBUILDING TERROR? The al-Sharqat chemical plant in northwest Iraq; intelligence sources say Saddam is creating new facilities there

Renseignement stratégique

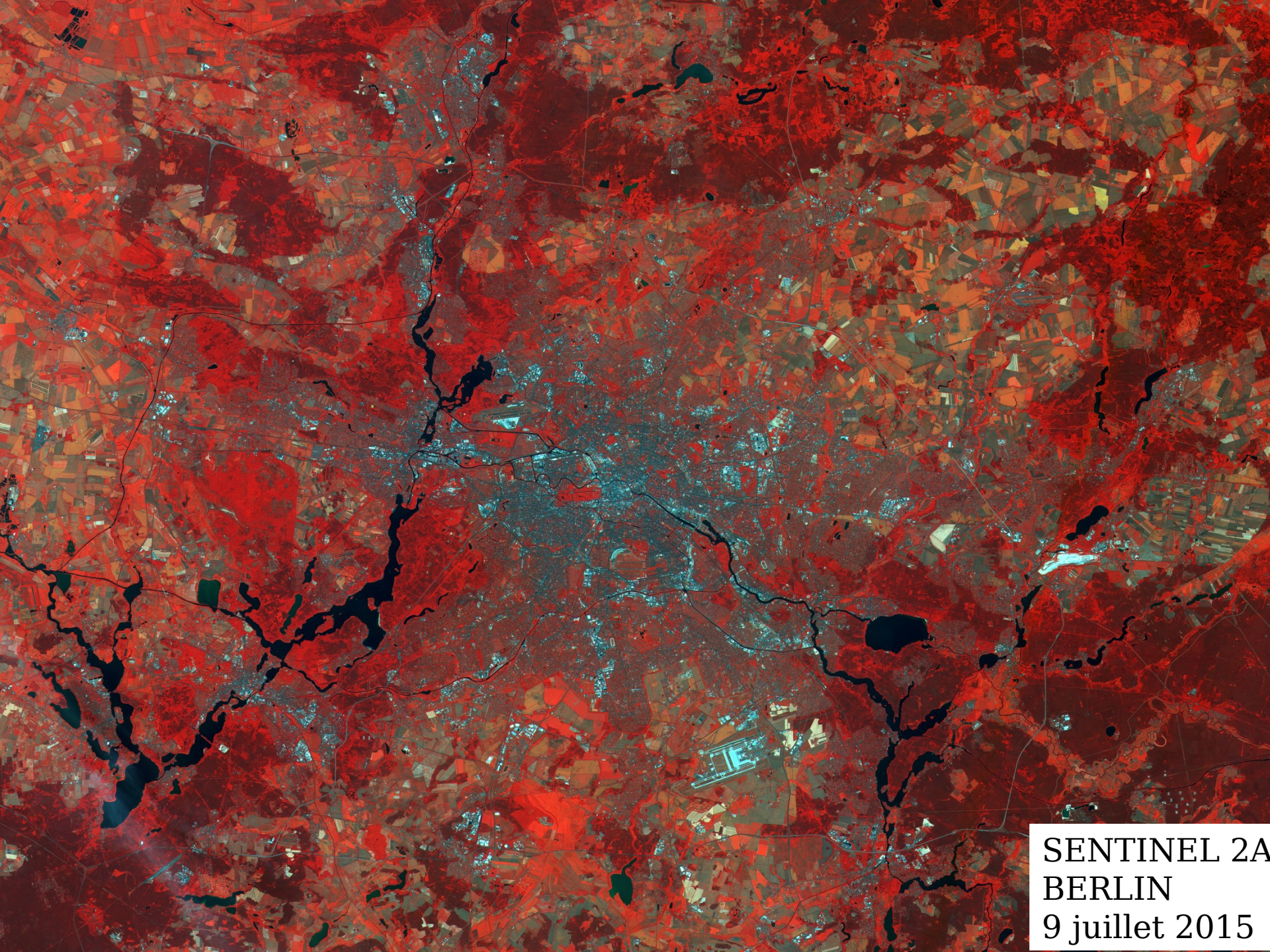


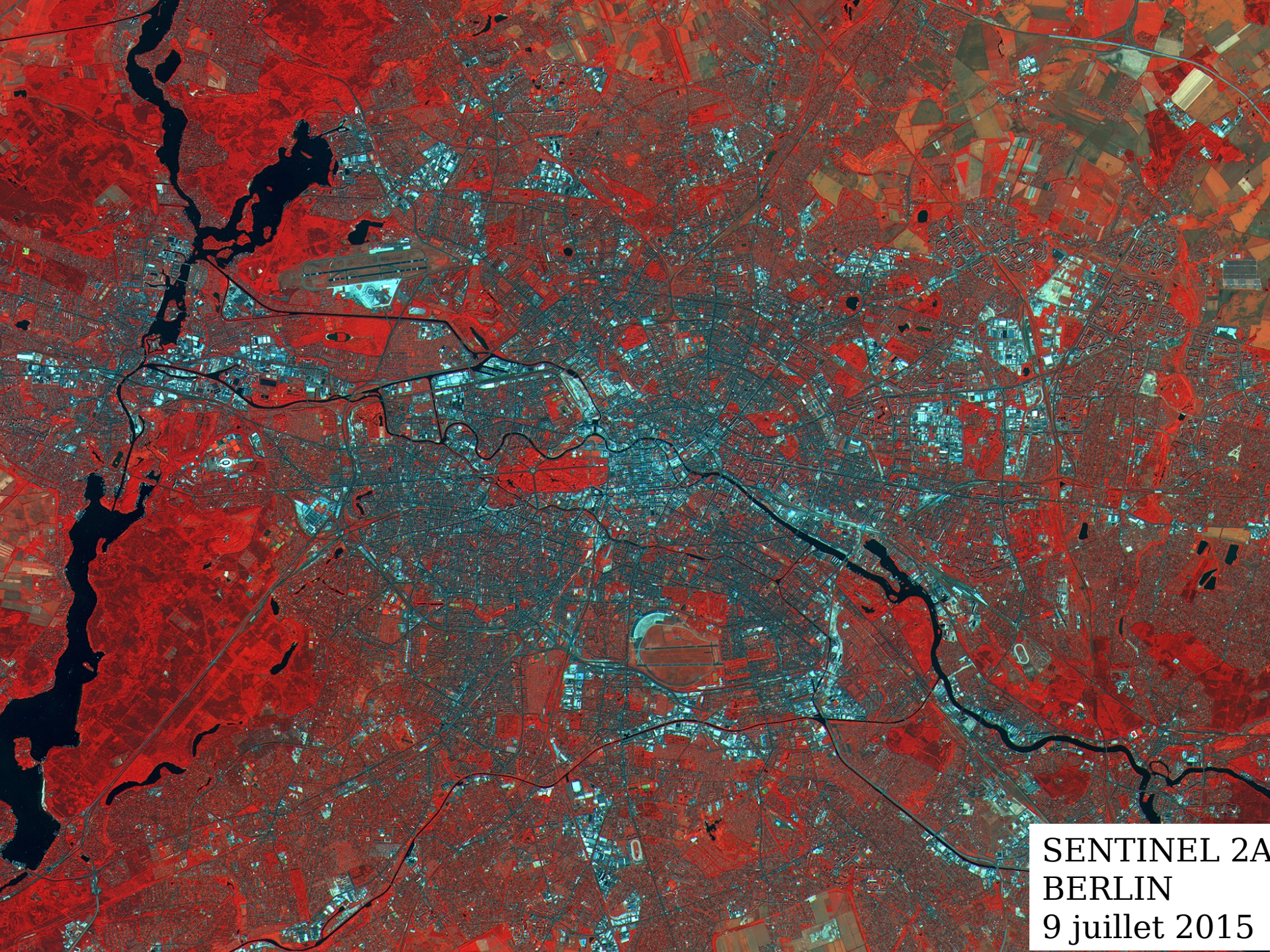
SENTINEL-2 MSI

Spatial resolution *vs* Spectral bands



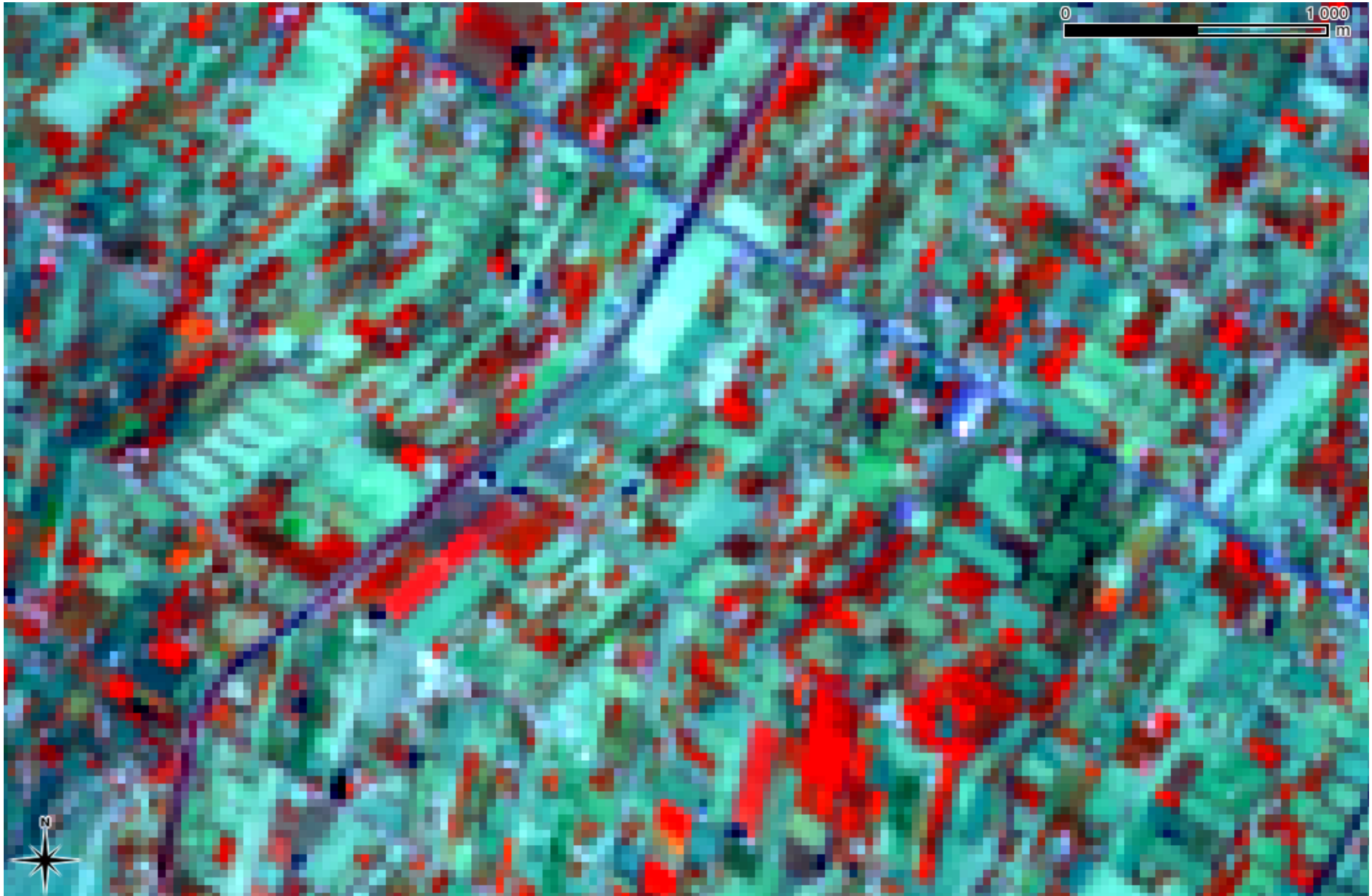
ESA, Sentinel-2 Products Specification Document


SENTINEL 2A
BERLIN
9 juillet 2015


SENTINEL 2A
BERLIN
9 juillet 2015

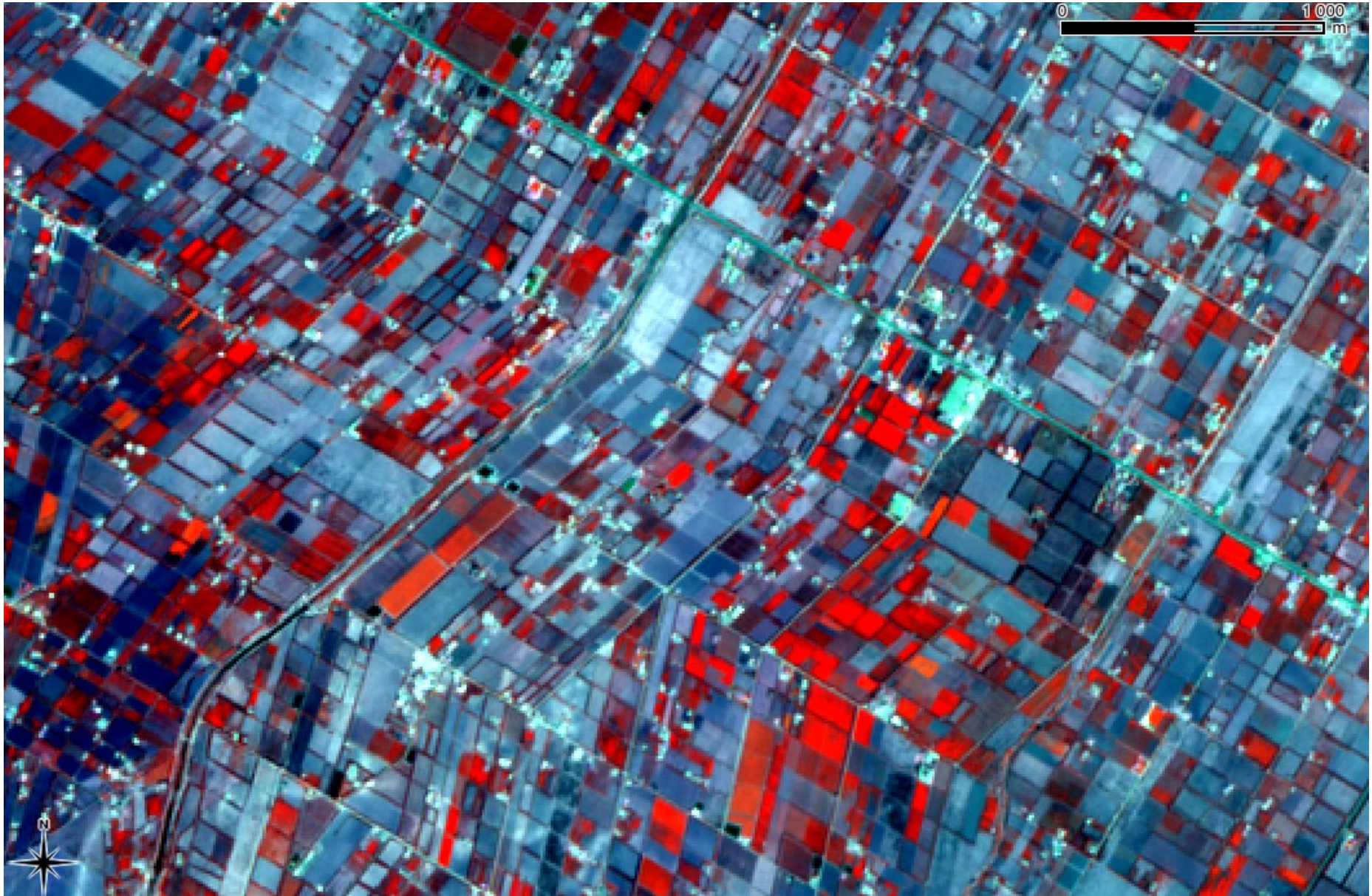
Nador Region, Marroco

LANDSAT 8 (spat. res. 30 m)



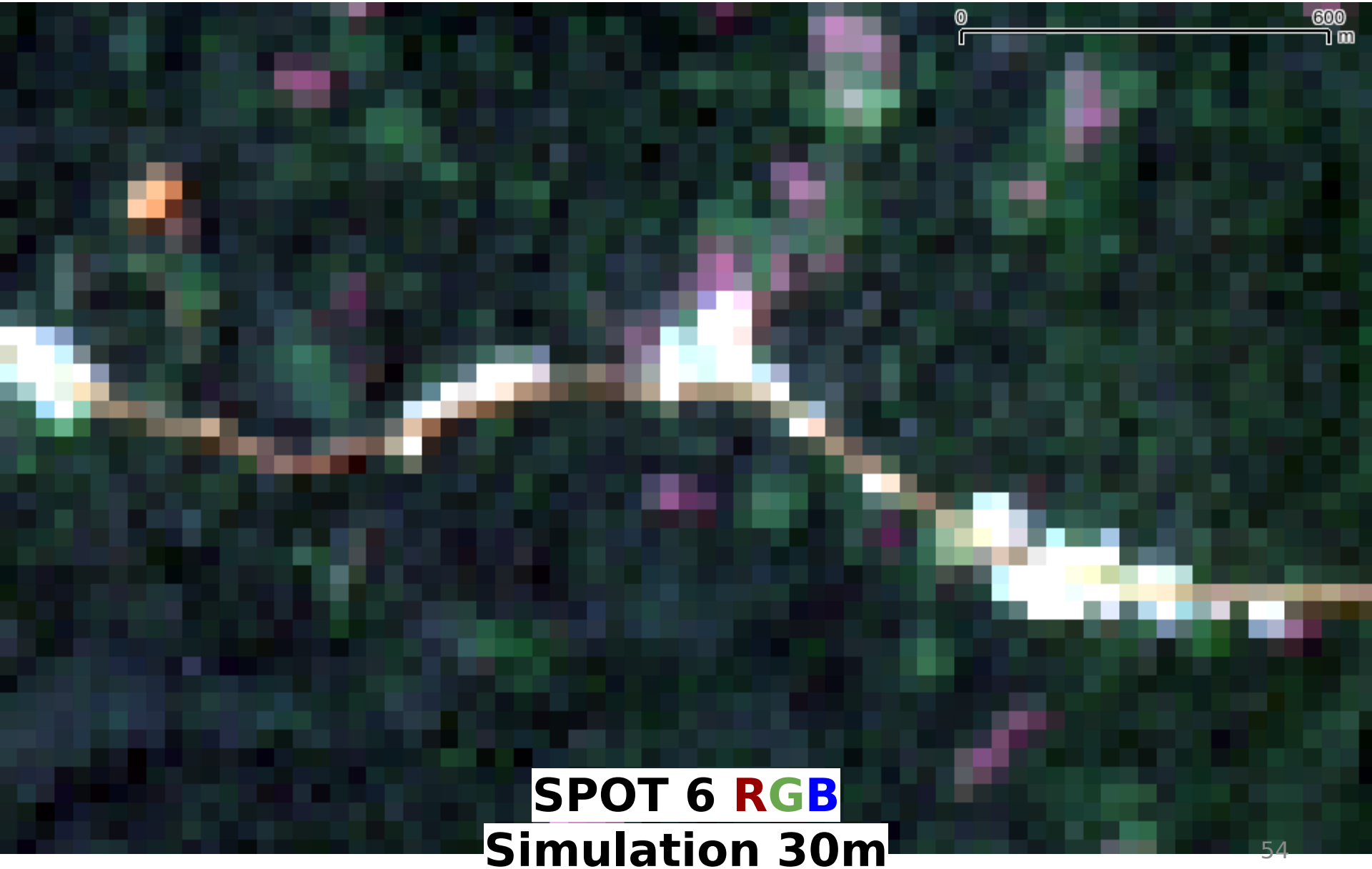
Nador Region, Marroco

Sentinel-2 (spat. res. 10 m)



Introduction à la télédétection

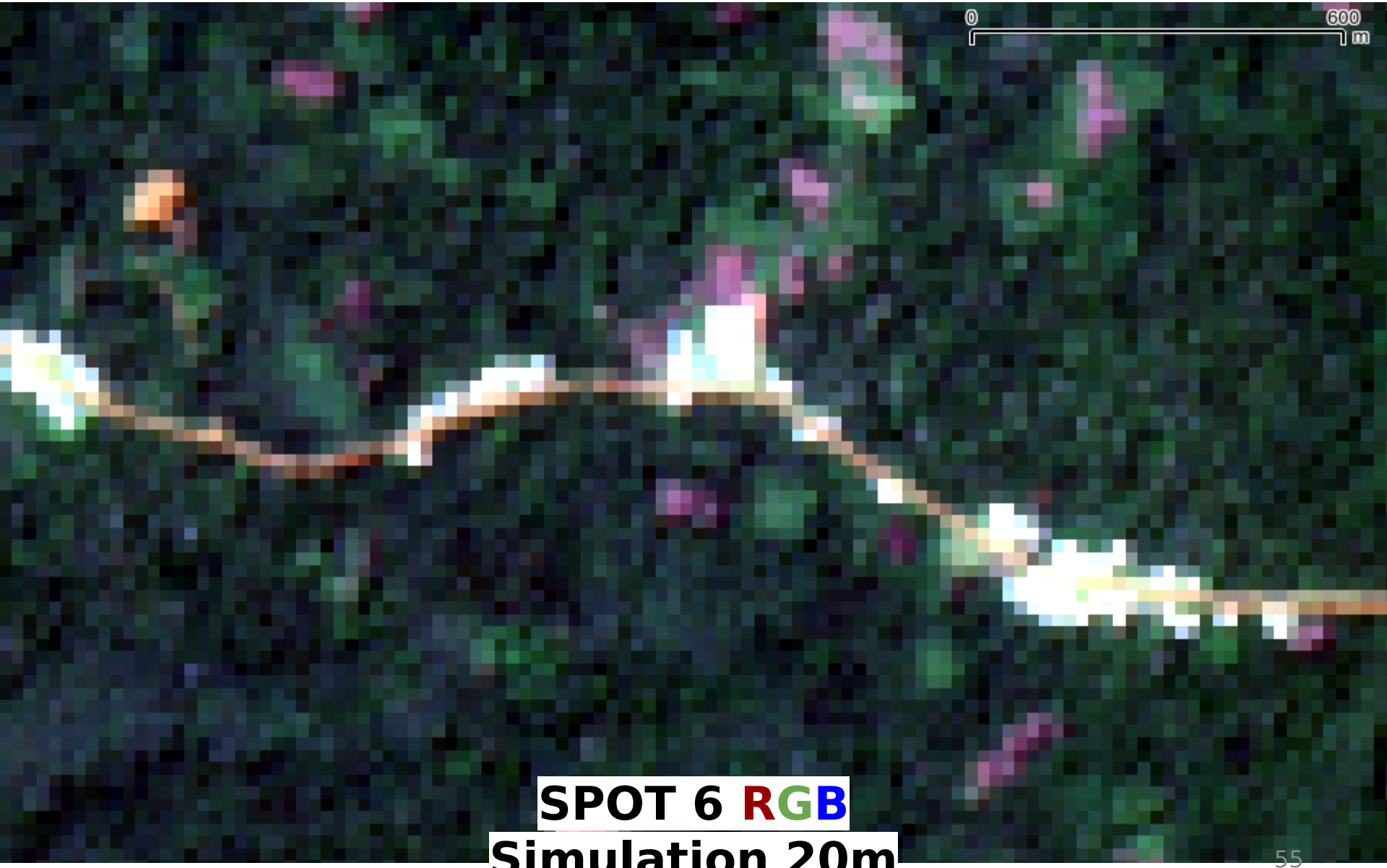
Résolution spatiale



SPOT 6 RGB
Simulation 30m

Introduction à la télédétection

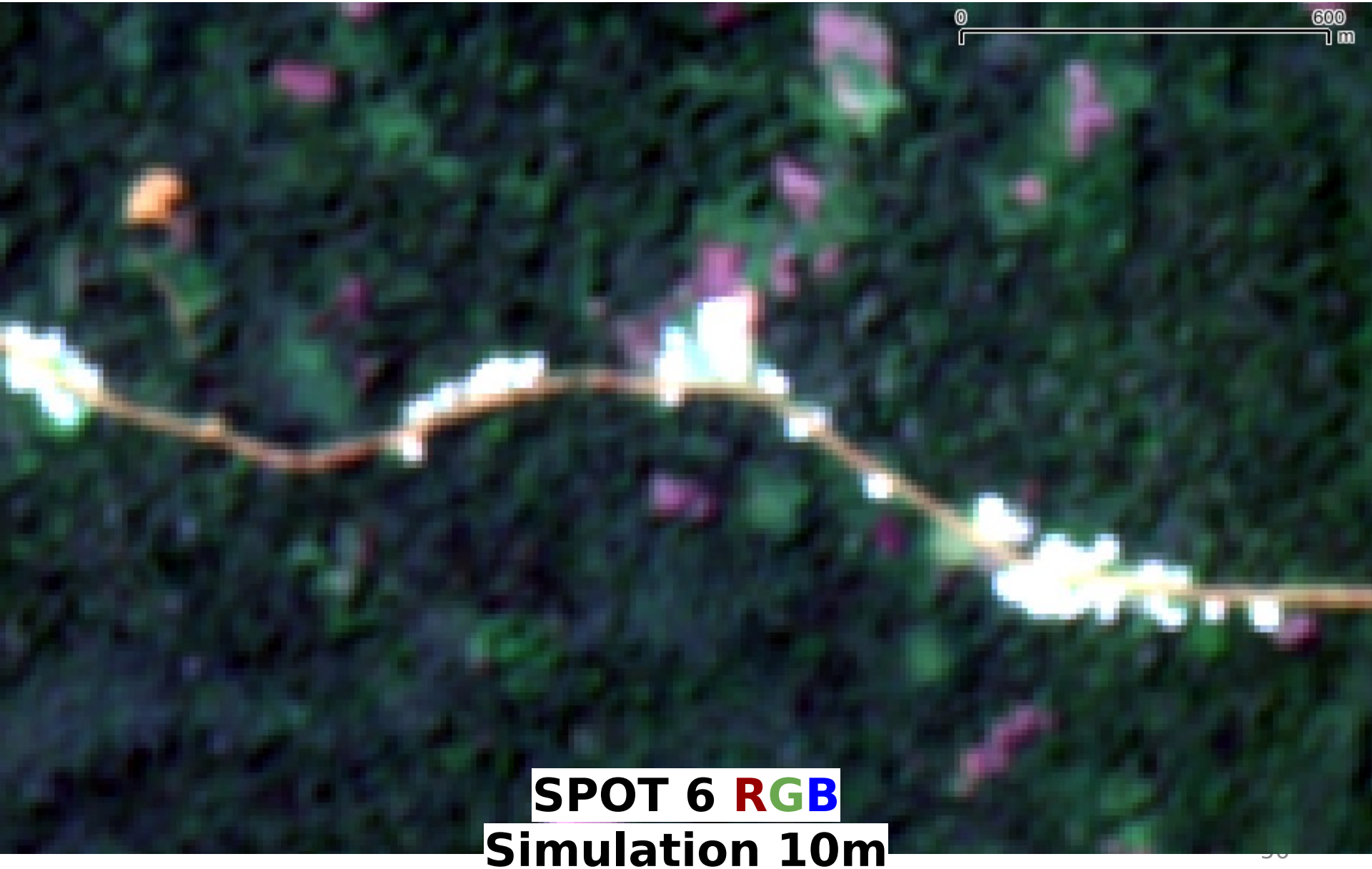
Résolution spatiale



SPOT 6 RGB
Simulation 20m

Introduction à la télédétection

Résolution spatiale

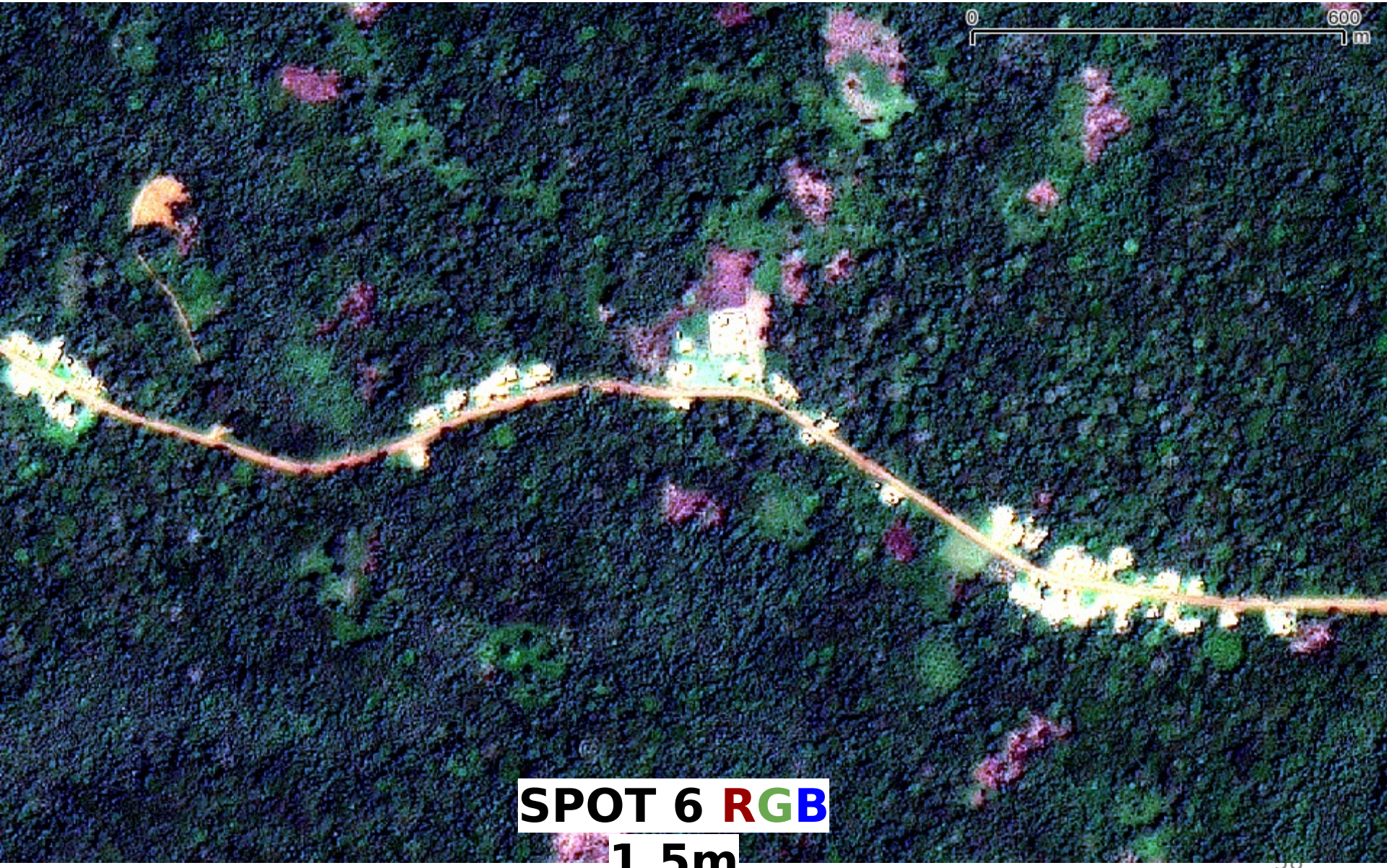


Introduction à la télédétection

Résolution spatiale

Introduction à la télédétection

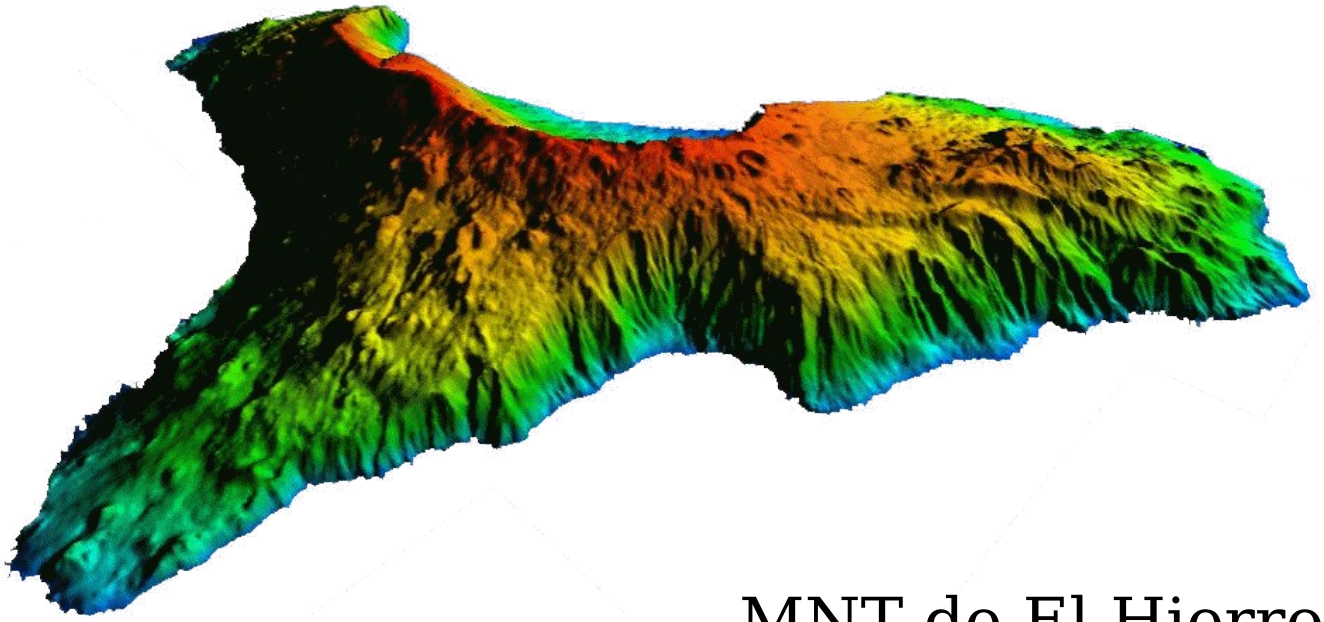
Résolution spatiale



umentation optical data (Sentinel-2) processi

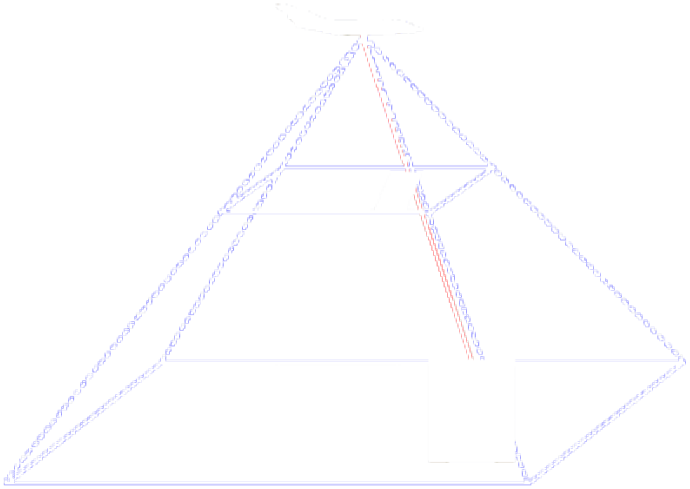
http://www.onfinternational.com/data/technical/tutorials/Sentine

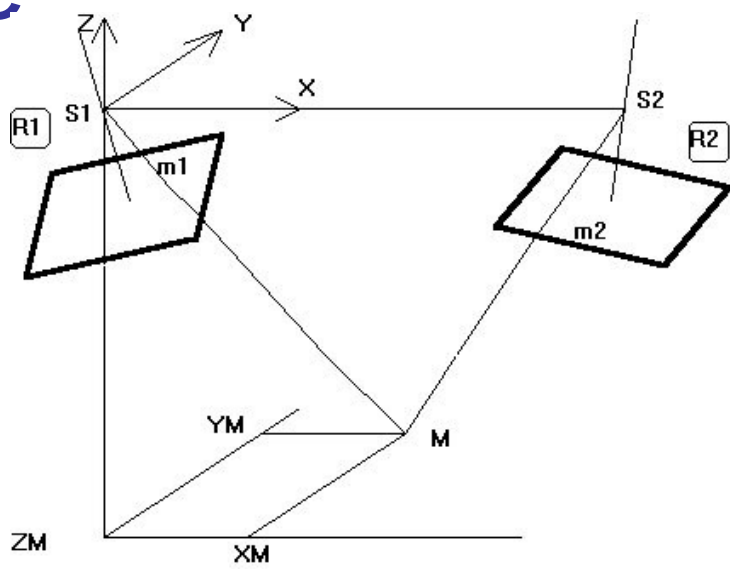
STÉRÉOSCOPIE: Accès au relief

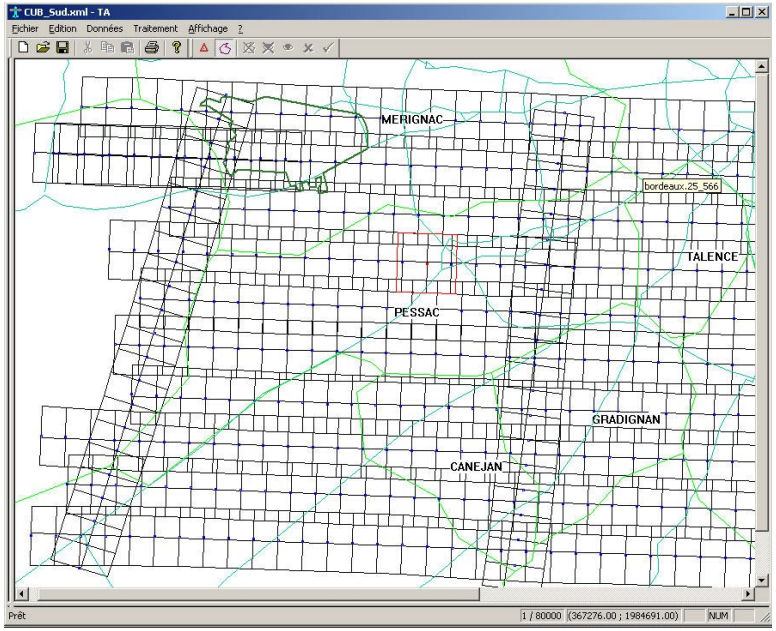


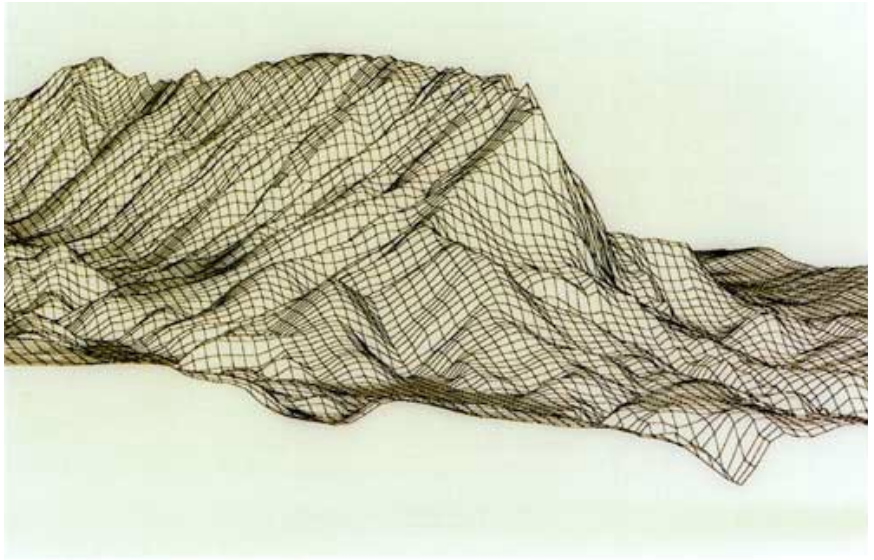
MNT de El Hierro, Canari
IGN Espag

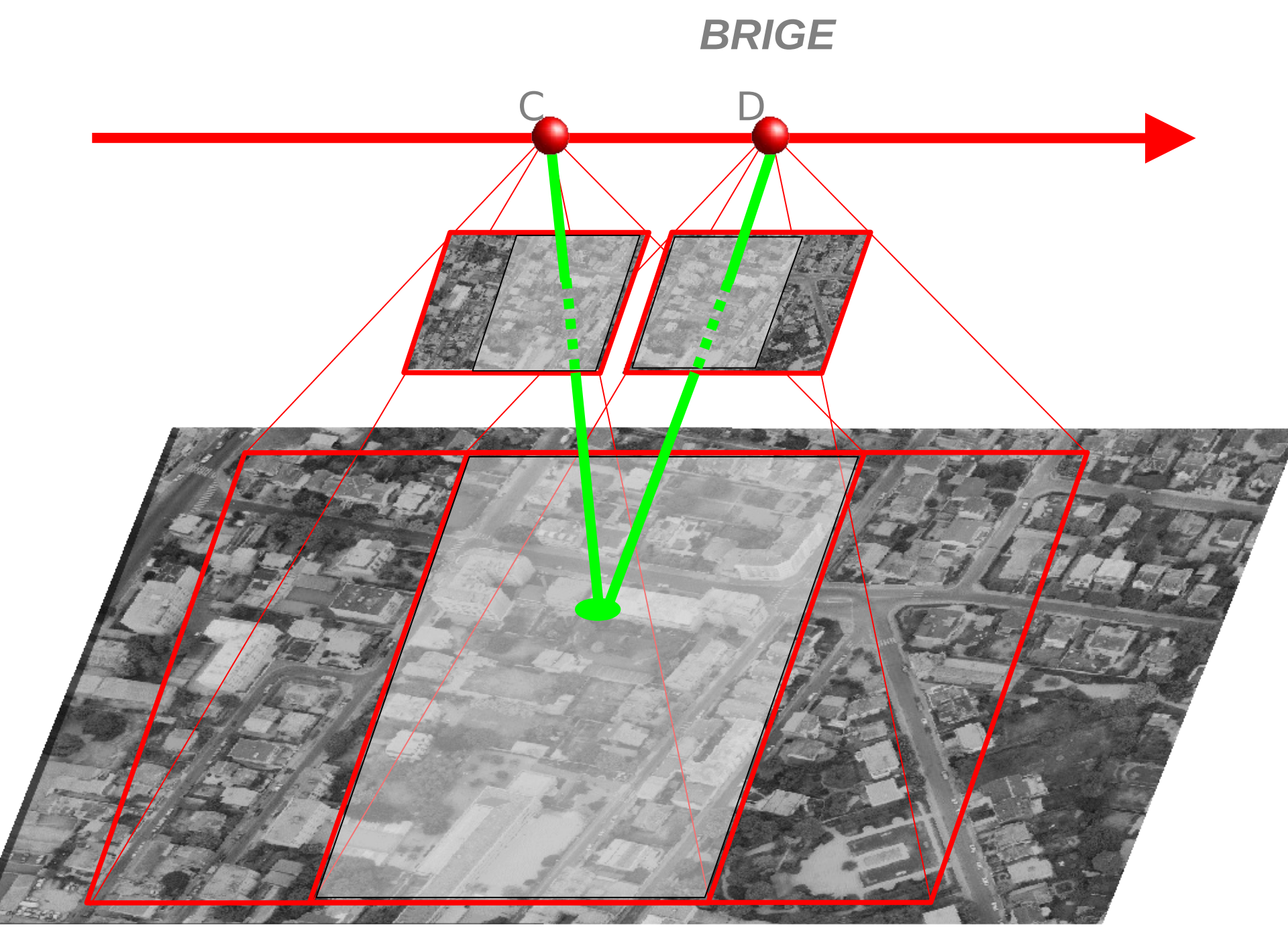
Photogrammétrie










BRIGE
C
D