

Capteurs d'observation des terres émergées dans le domaine optique

	NOAA AVHRR	SPOT VEGETATION	MERIS	MODIS	LANDSAT (MR SID)	ASTER	SPOT	IKONOS
Période mission	Depuis 1960!	1998	Mars 2002	1999 -	1972 -	1999 -	1986	1999
Couverture Spatiale	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
Répétitivité	semaine	2 jours	3 jours	3 jours	16 jours	8 min/orbite	25 jours	
Bandes	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	
Coût	GRATUIT	GRATUIT	GRATUIT	GRATUIT	GRATUIT	GRATUIT	1000 € 100 €	3000 \$

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	

Optical sensors for forestry

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

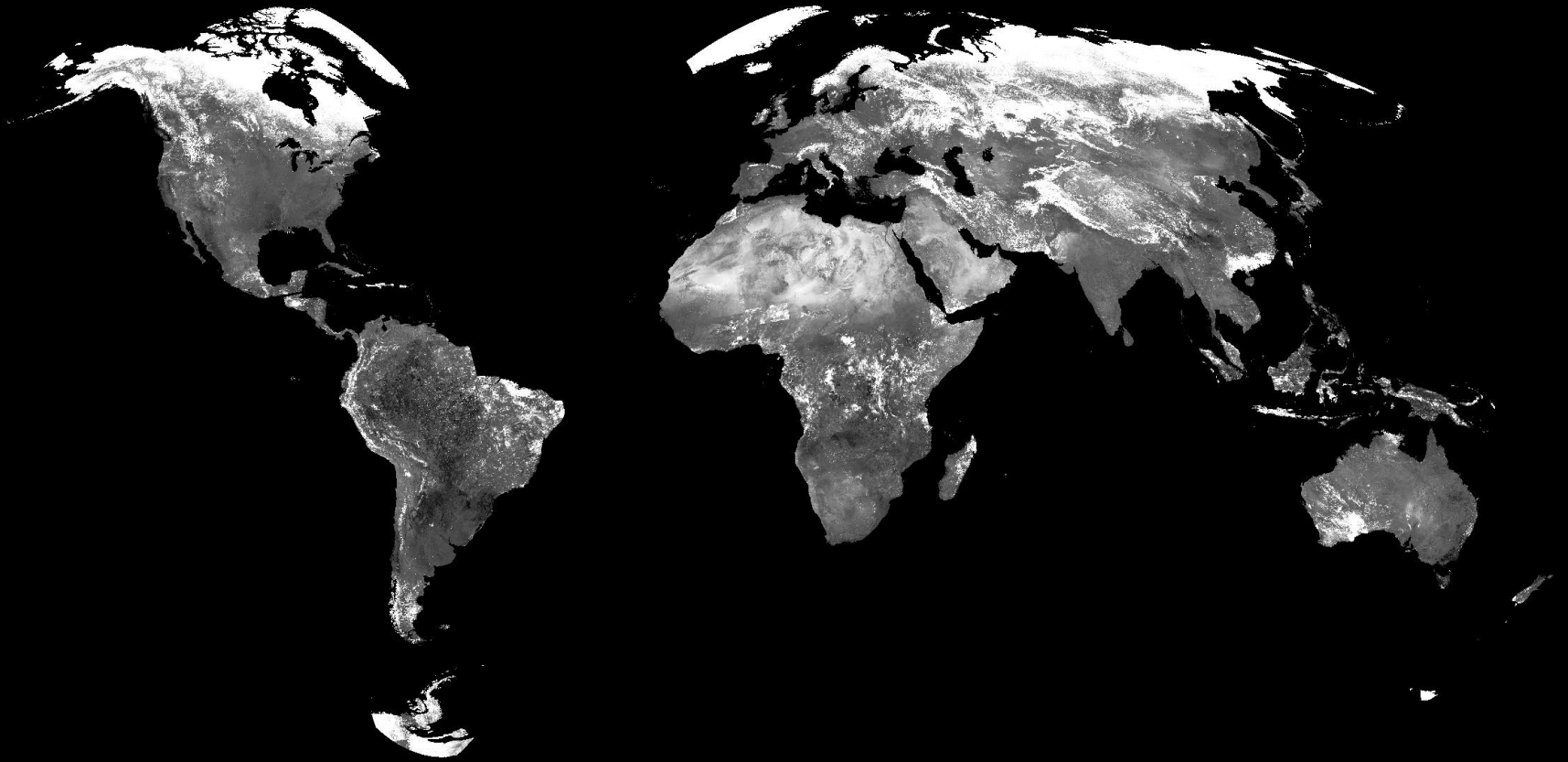


Image globale NOAA-AVHRR
Canal Proche-InfraRouge
1-10 avril 1992

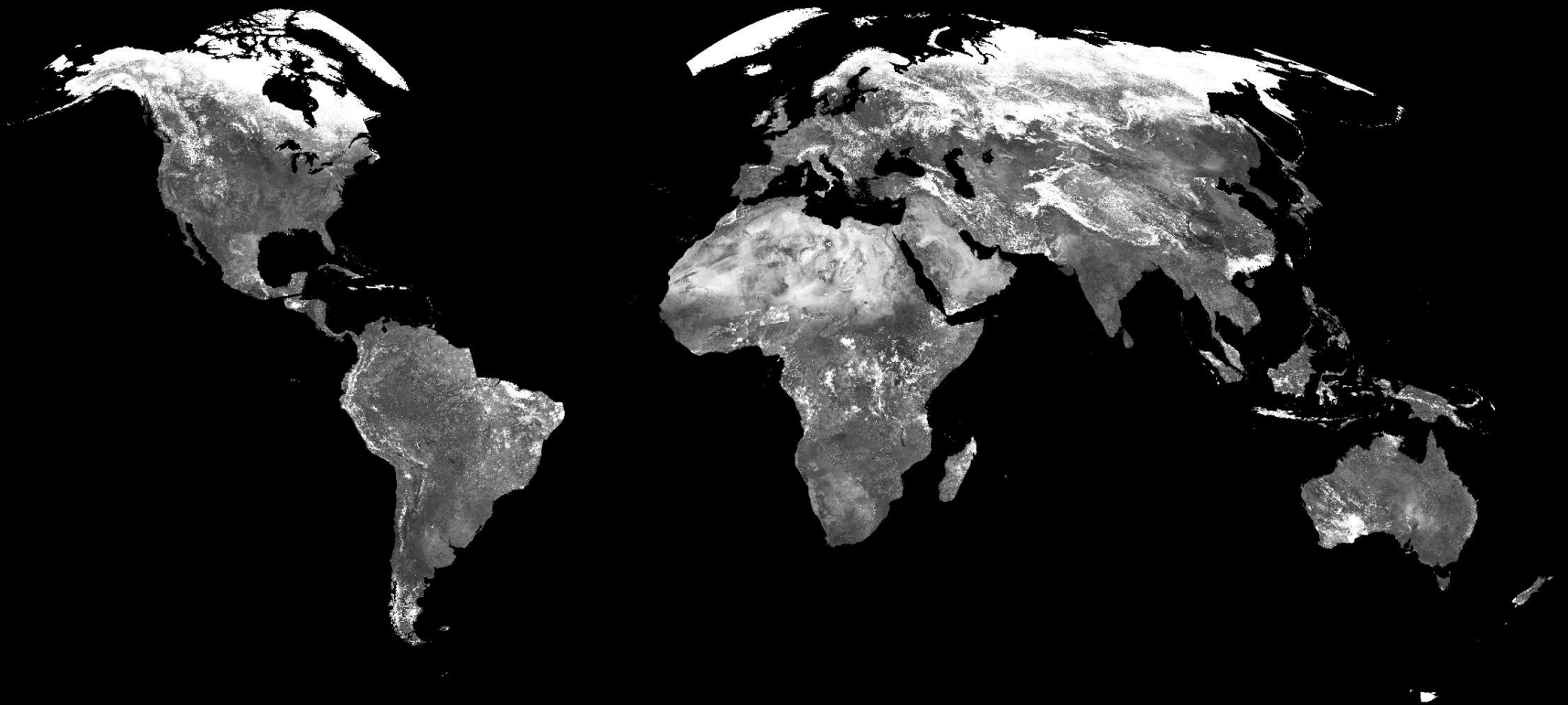
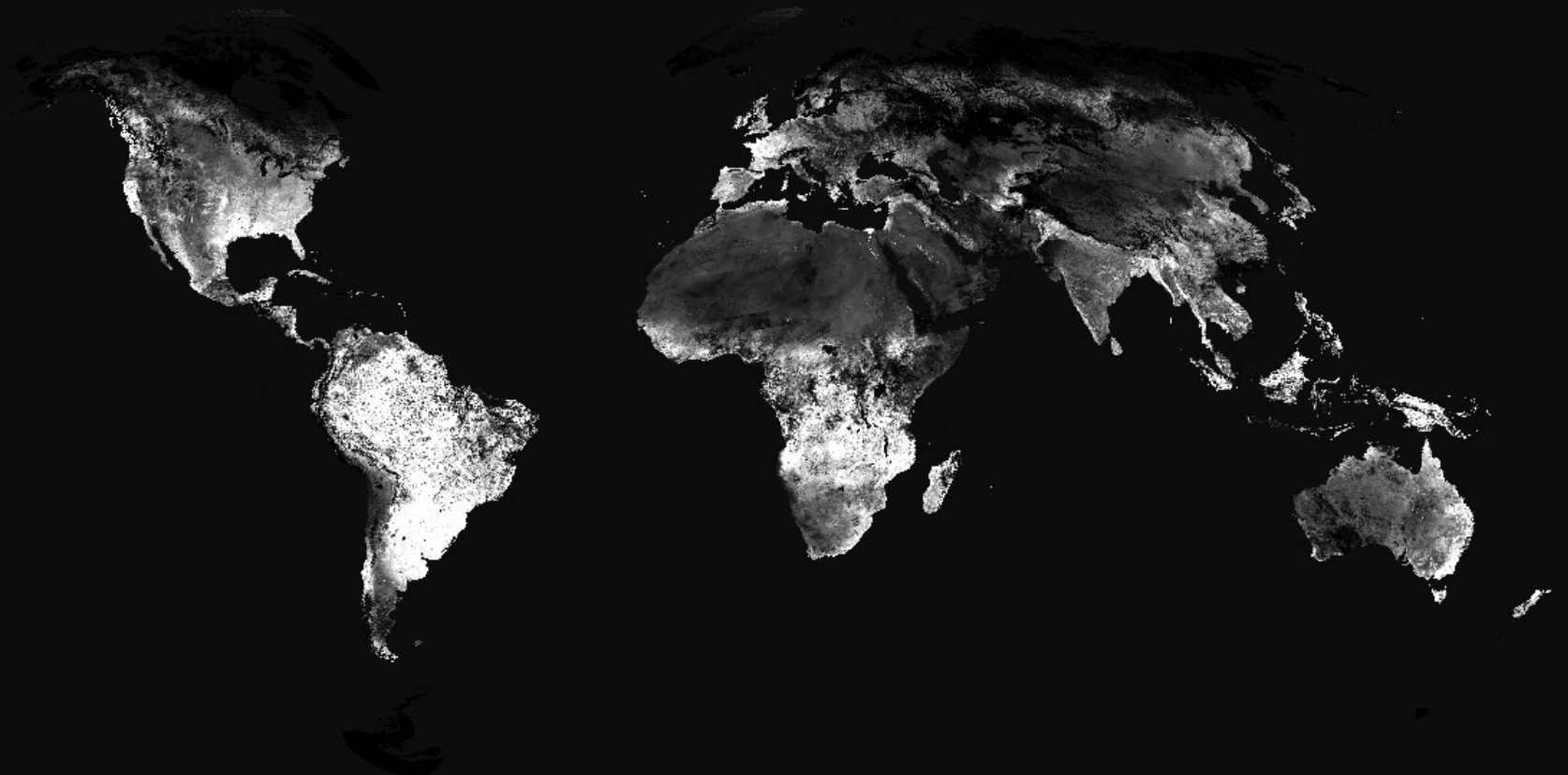
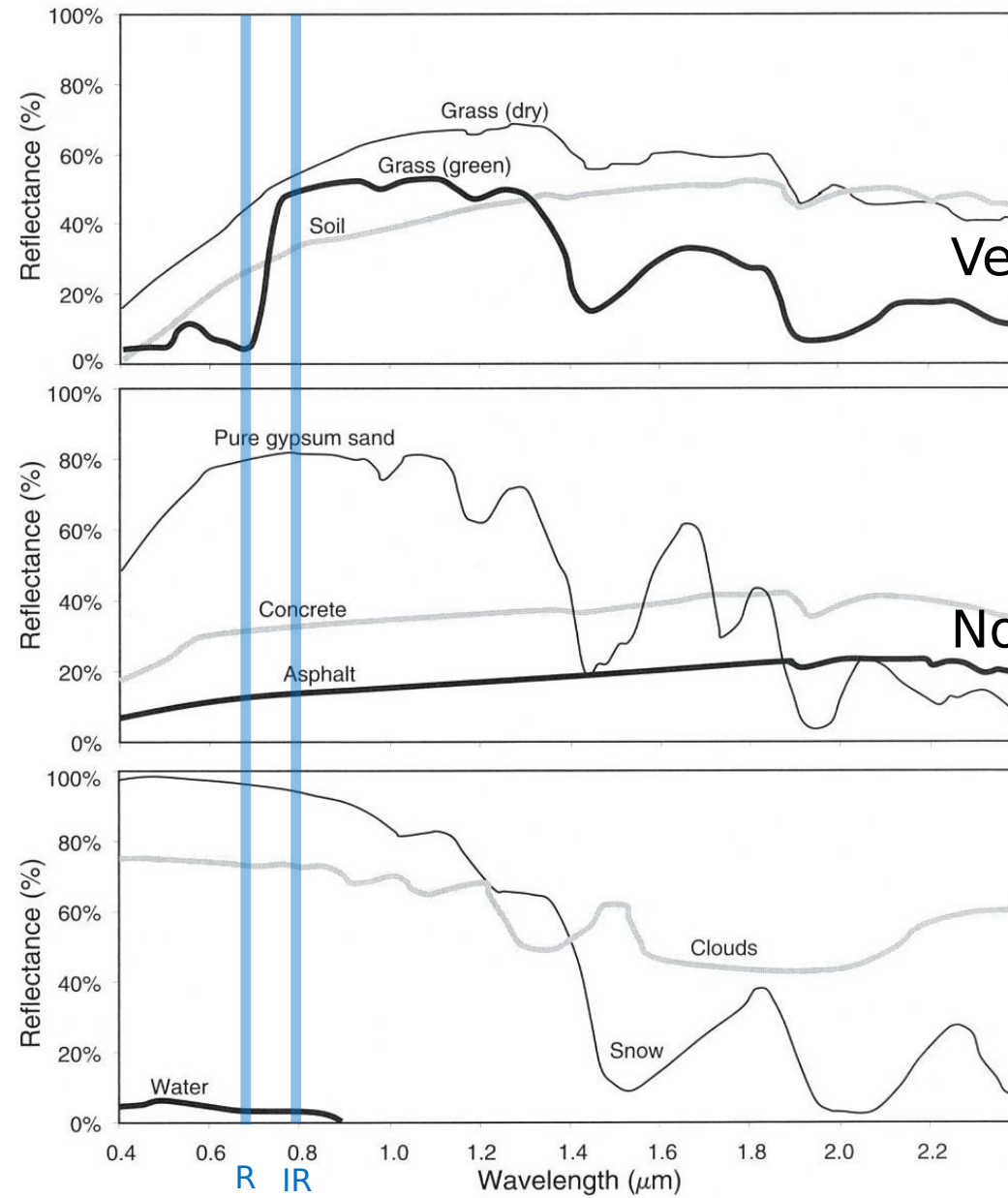


Image globale NOAA-AVHRR
NDVI
1-10 avril 1992



Spectral signatures of different types of surfaces



Vegetation Index

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

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

Normalized Diff. Vegetation Index:

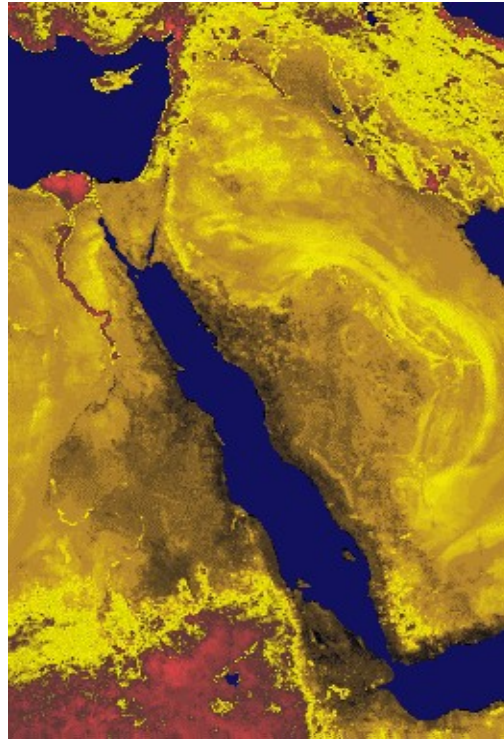
$$NDVI = \frac{\rho_{IR} - \rho_R}{\rho_{IR} + \rho_R}$$

SPOT-VEGETATION



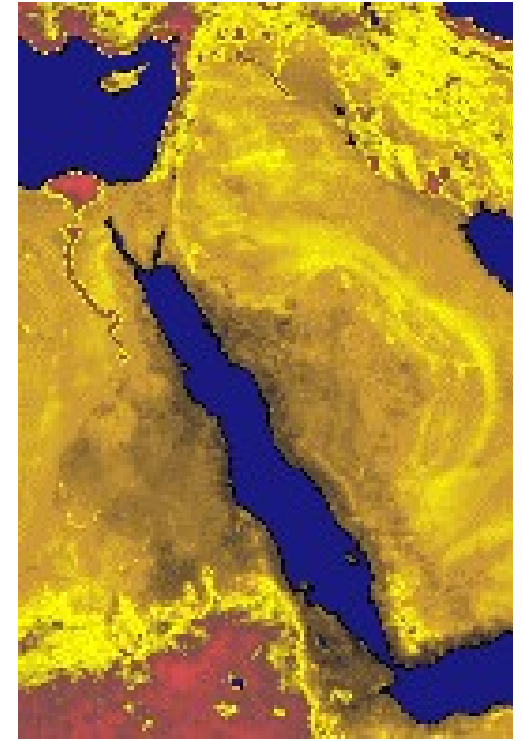
Pixel Size: 1 x 1 km²

NOAA-AVHRR

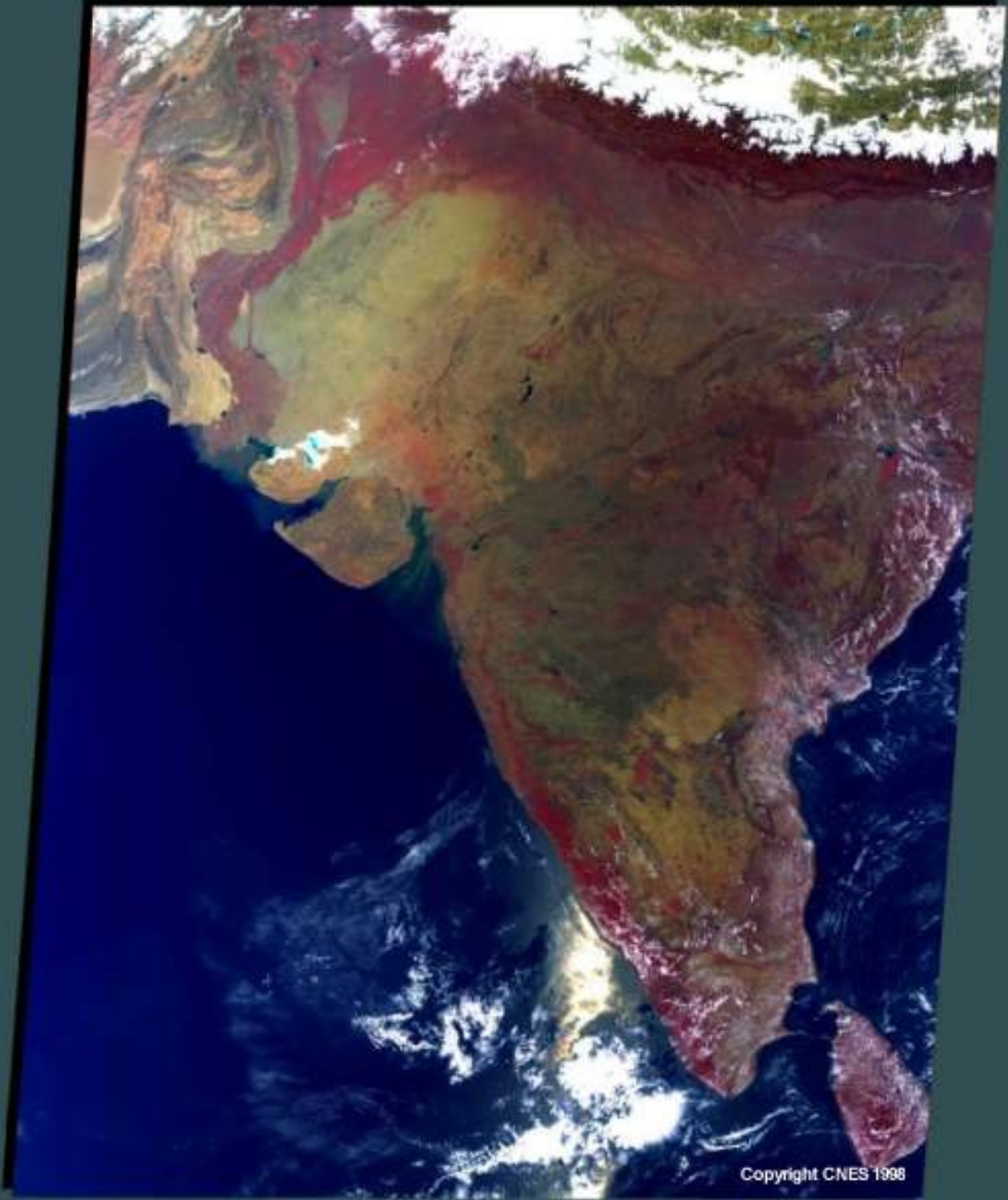


Pixel Size: 8 x 8 km²

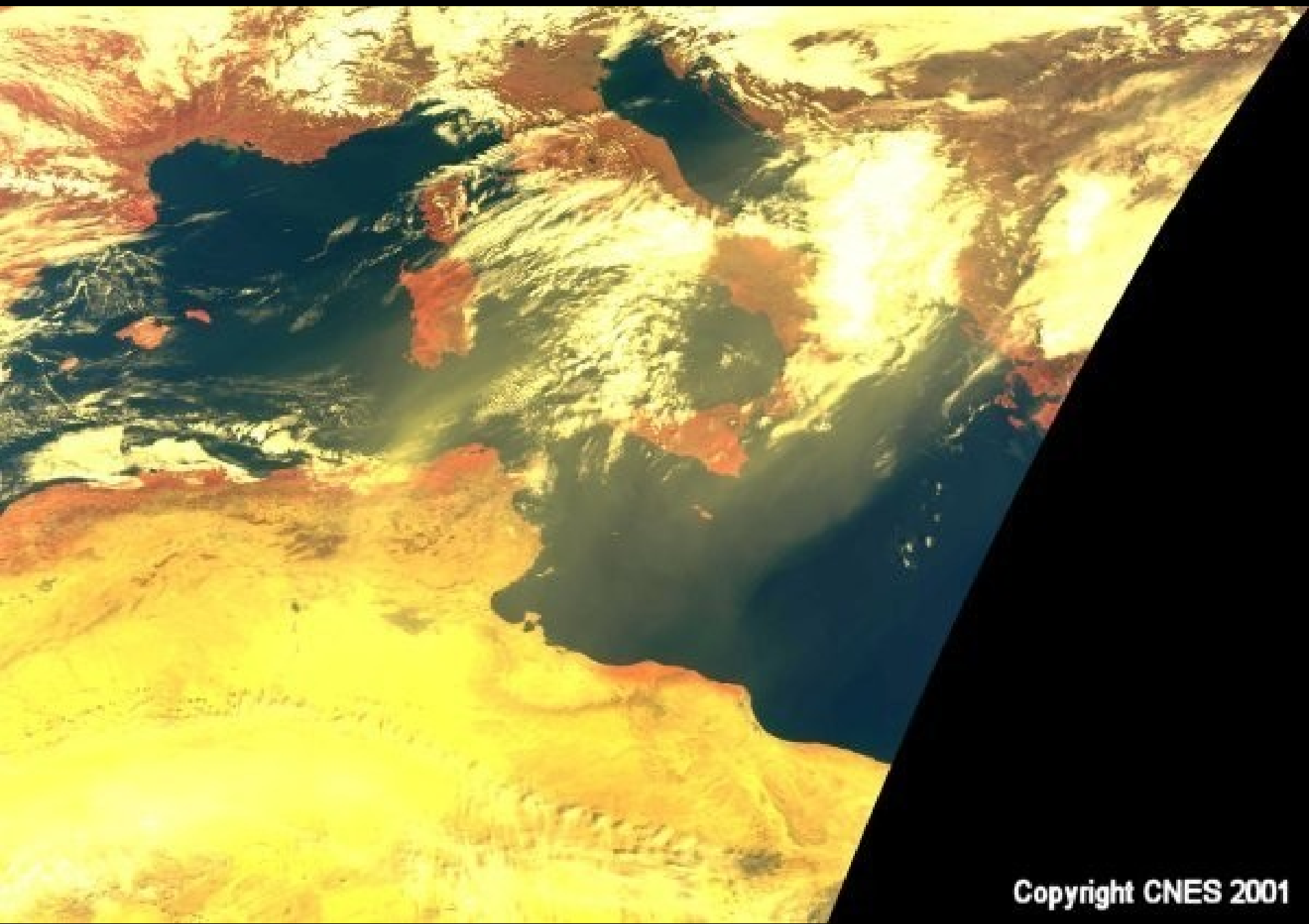
NOAA-AVHRR



Pixel Size: 16 x 16 km²

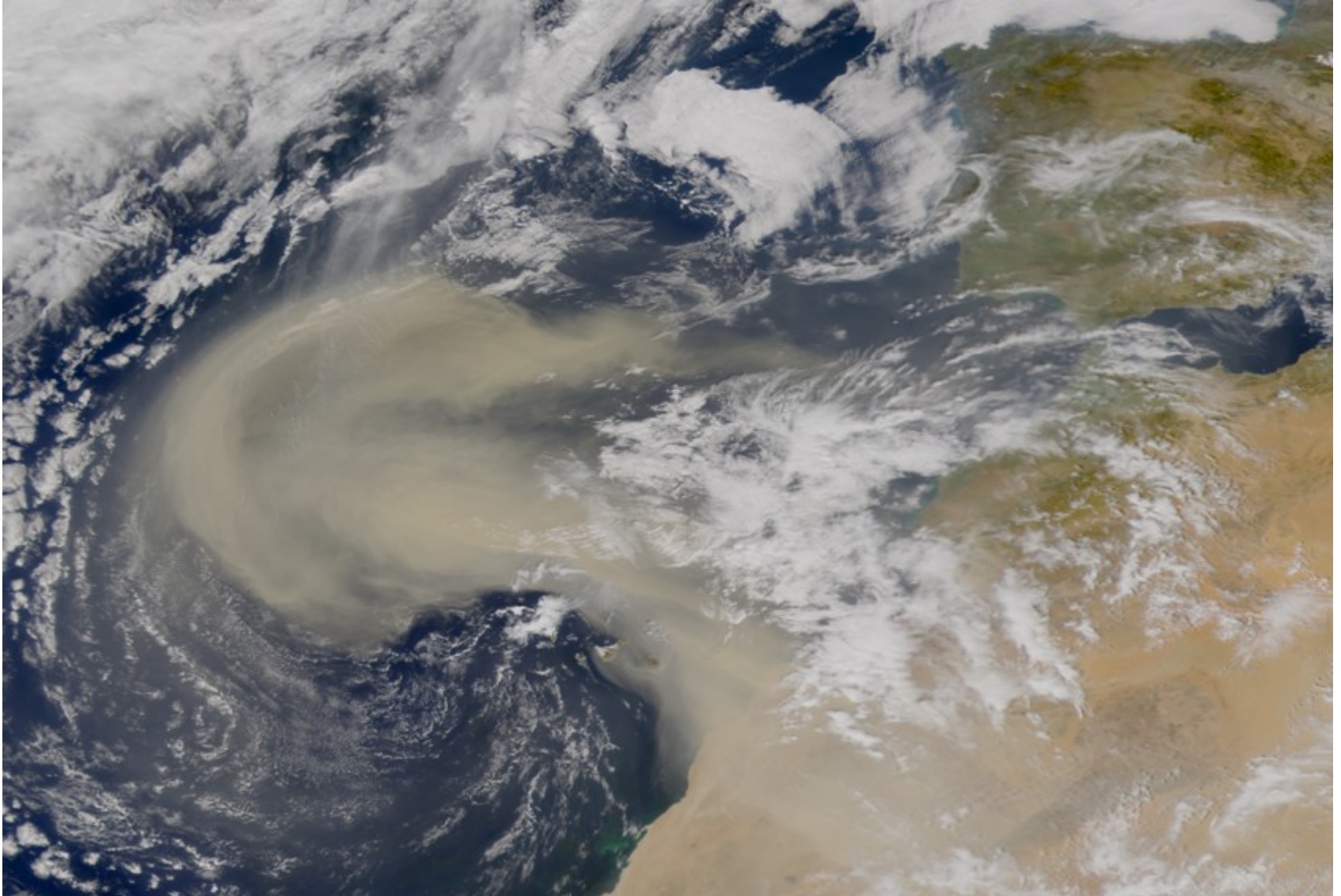


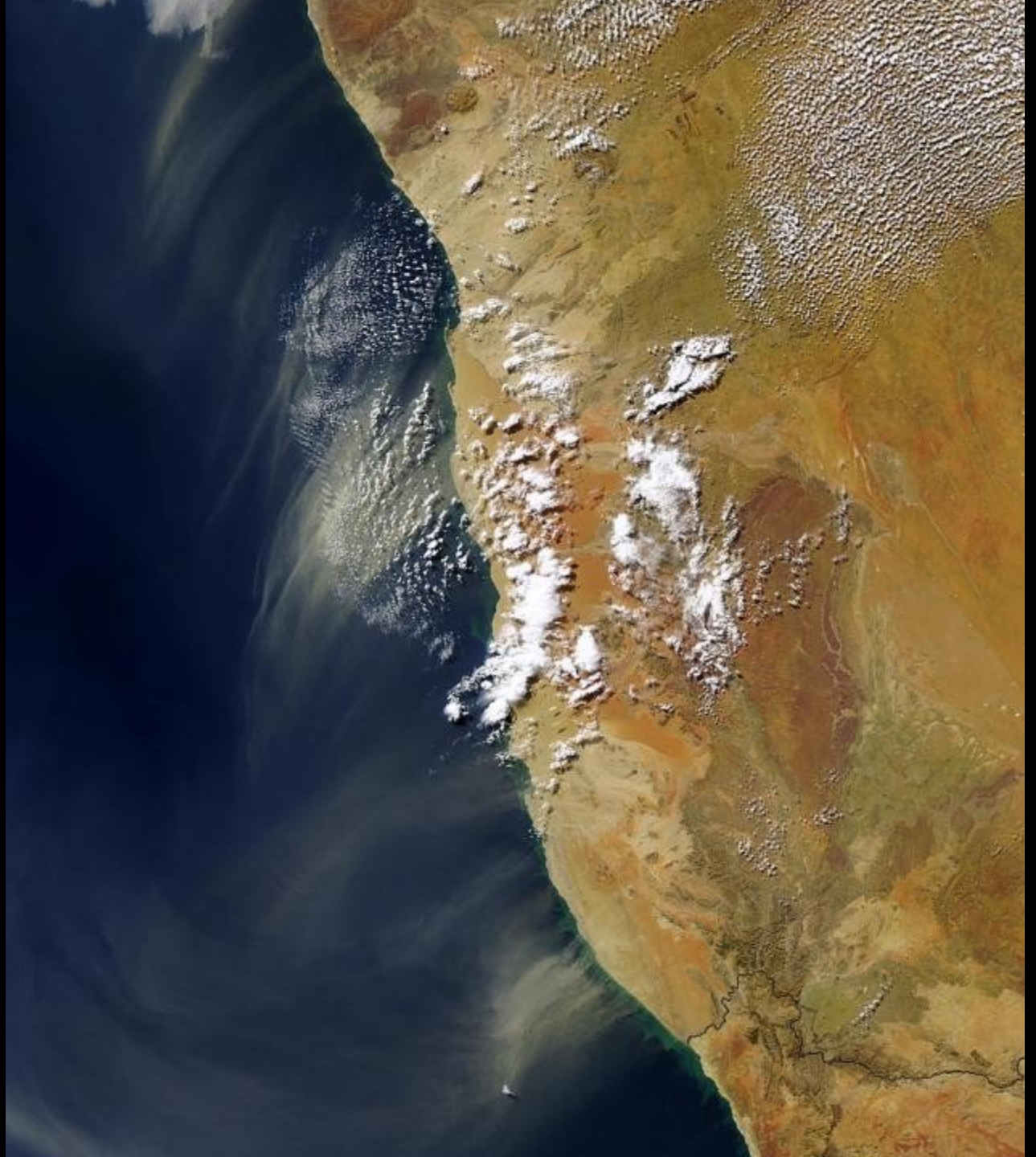
Copyright CNES 1998



Copyright CNES 2001

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





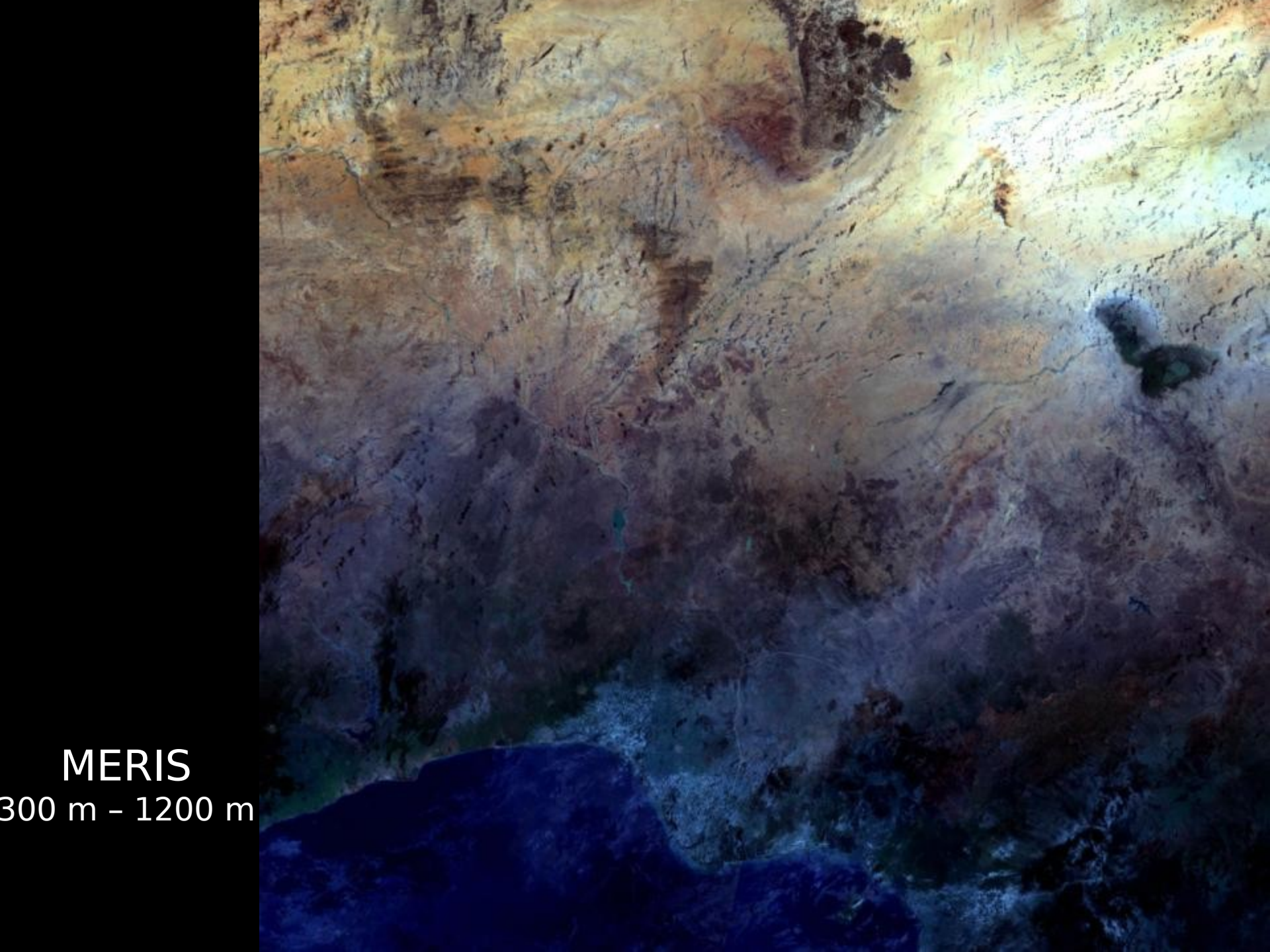
Désert de Namibie
MODIS
8 juillet 2004



Bengladesh
MERIS
8 novembre 2003

Mer Caspienne
MERIS
22 septembre 2003





MERIS

300 m - 1200 m



MERIS

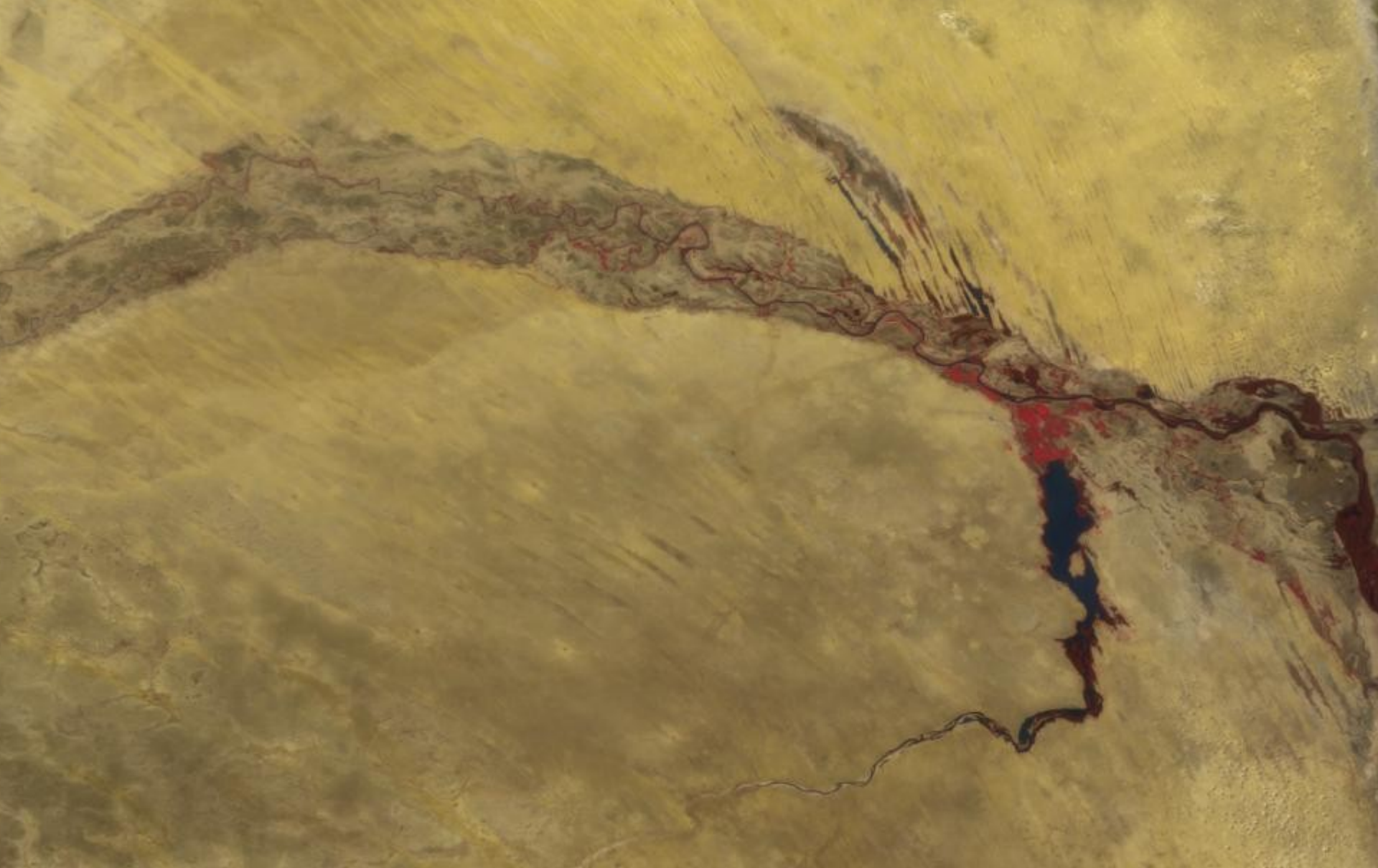
300 m - 1200 m



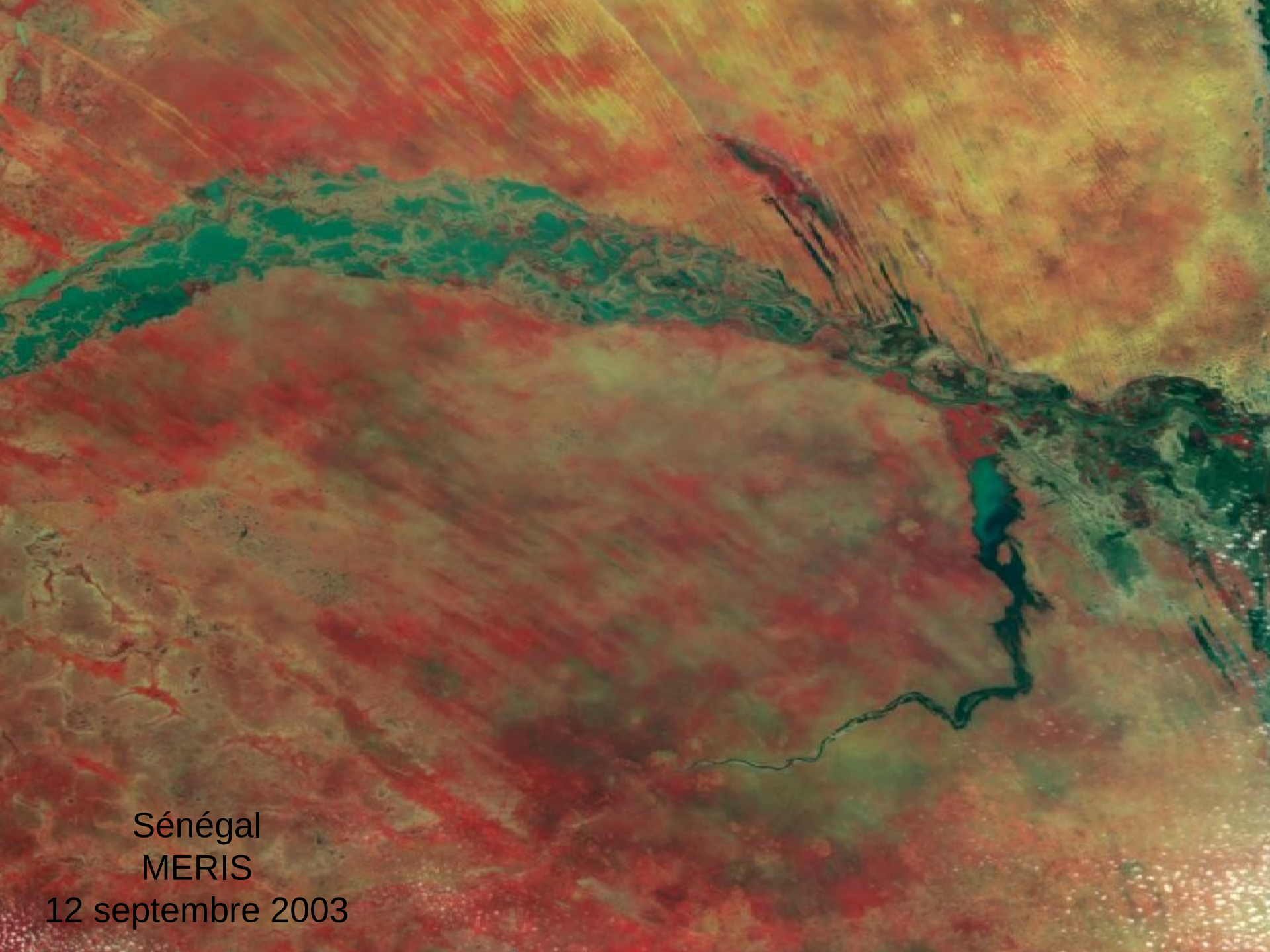
Sénégal
MERIS
15 avril 2003



Sénégal
MERIS
30 mai 2003

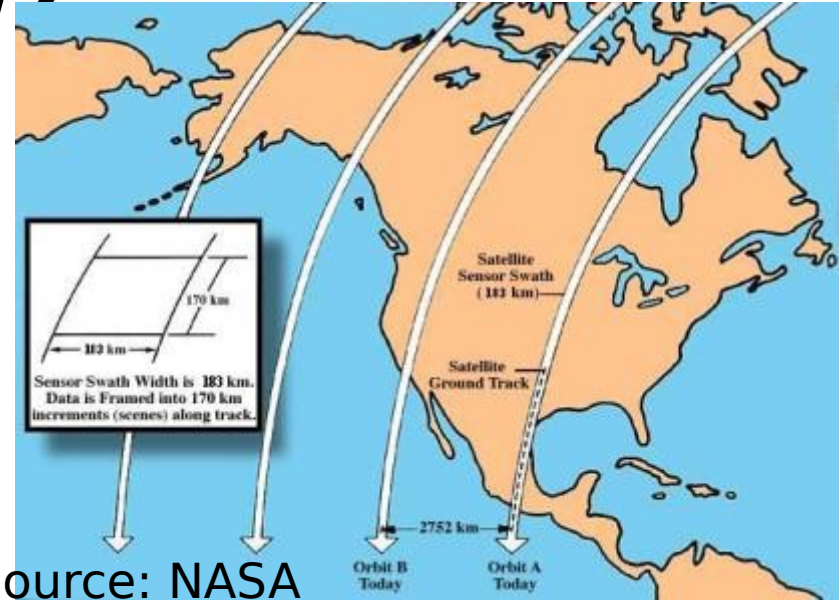
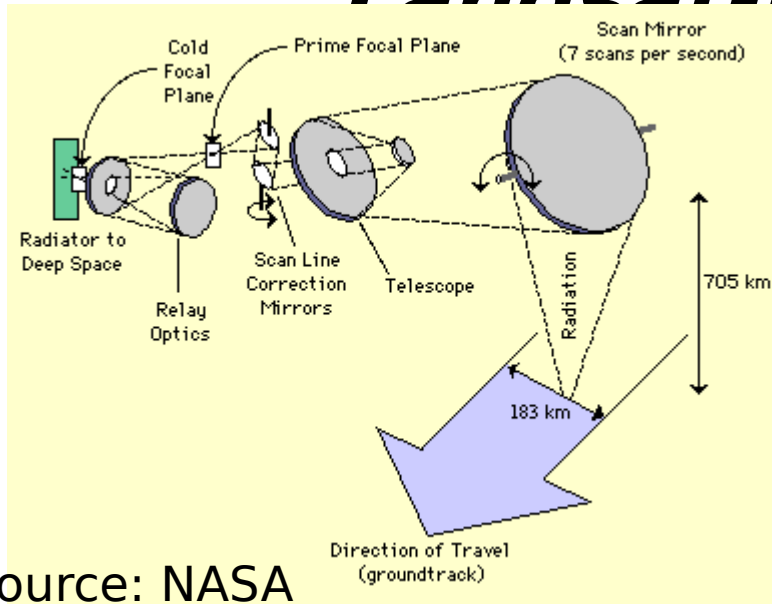


Sénégal
MERIS
27 juin 2003



Sénégal
MERIS
12 septembre 2003

Caractéristiques de Landsat-TM7



focale: $f = 2.4 \text{ m}$
 ouv. diaphragme: $d = 40 \text{ cm}$
 détect. élem.: 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			
	TIRS					
Landsat 7	ETM+	185km	8			
Landsat 4 & 5	MSS	185km	8			
	TM	185km	8			
Landsat 1-2	RBV	183km				
Landsat 3	RBV	183km				
Landsat 1-3	MSS	183km	8			

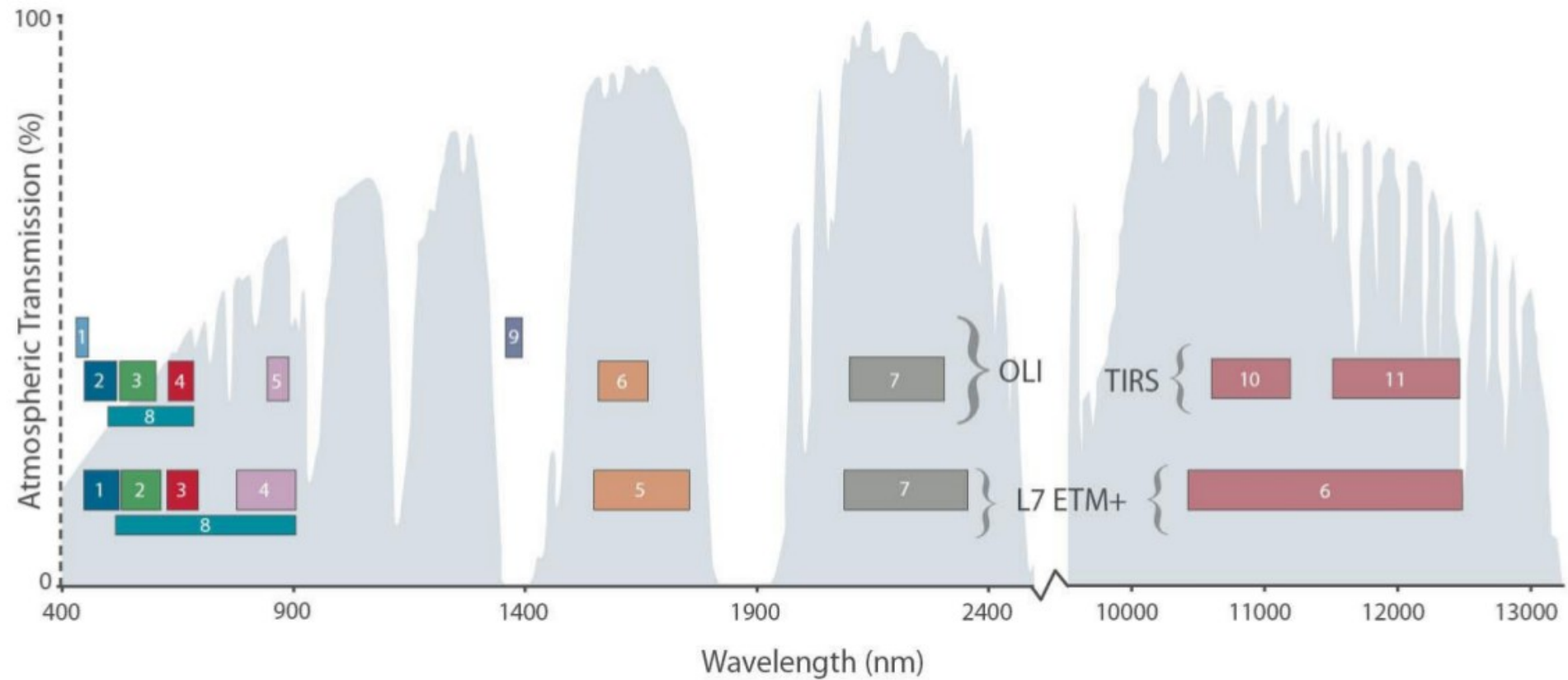
USGS, Landsat 8 Data Users Handbook

LANDSAT characteristics

OLI and TIRS Spectral Bands vs ETM+ Spectral Bands

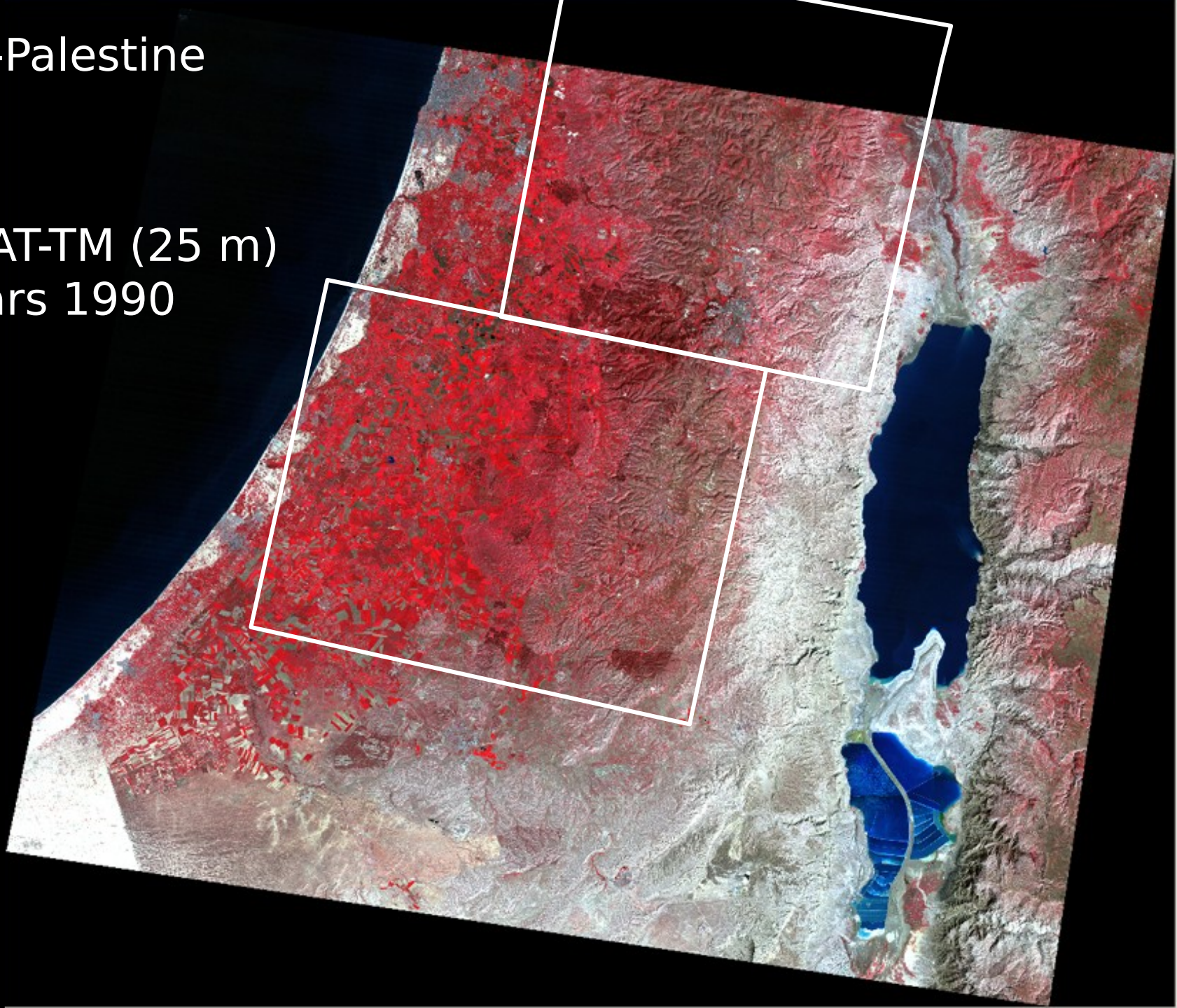
Landsat-7 ETM+ Bands (μm)			Landsat-8 OLI and <i>TIRS</i> Bands (μm)		
			30 m Coastal/Aerosol	0.435 - 0.451	Band 1
Band 1	30 m Blue	0.441 - 0.514	30 m Blue	0.452 - 0.512	Band 2
Band 2	30 m Green	0.519 - 0.601	30 m Green	0.533 - 0.590	Band 3
Band 3	30 m Red	0.631 - 0.692	30 m Red	0.636 - 0.673	Band 4
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

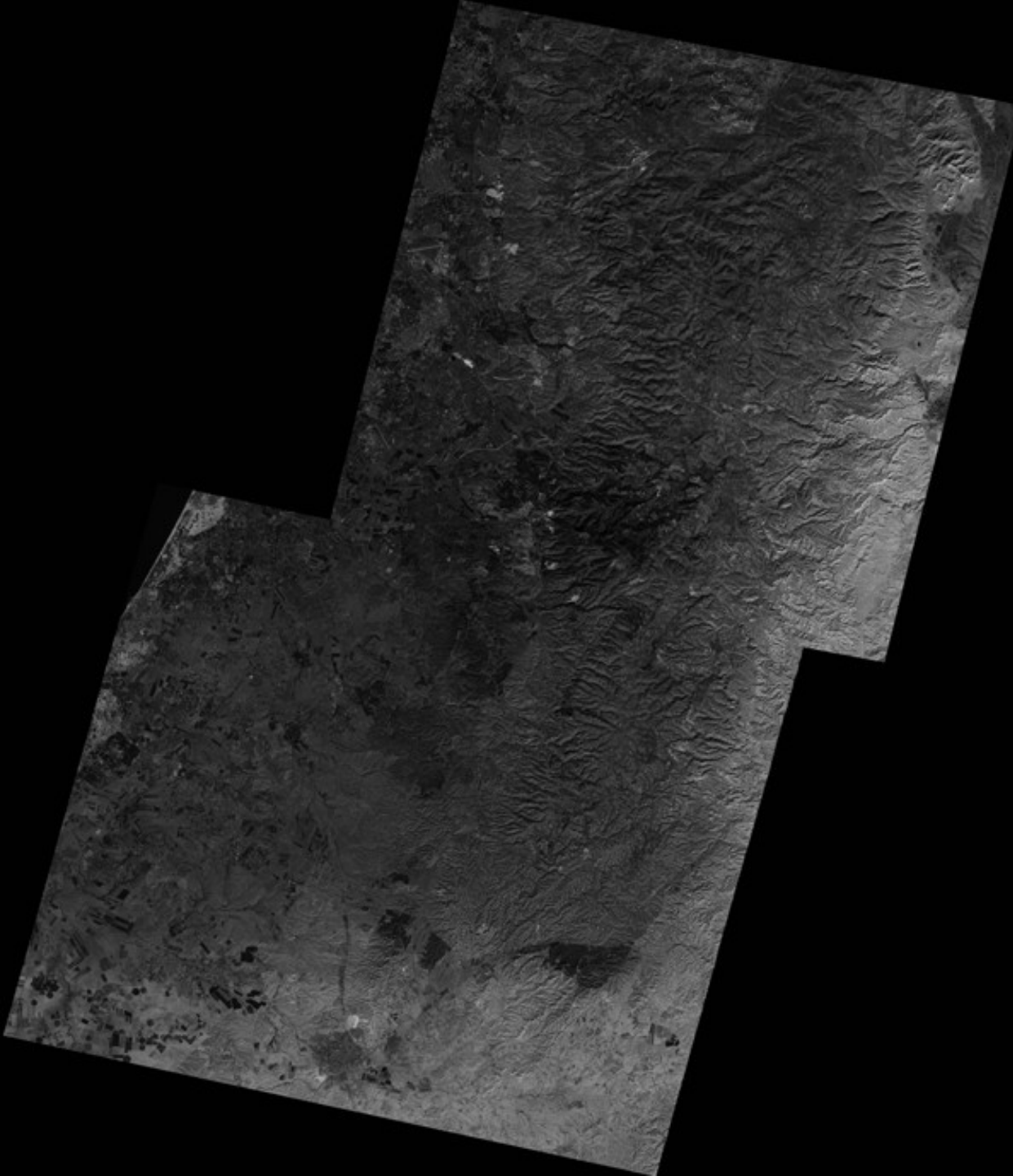


Israël-Palestine

LANDSAT-TM (25 m)
mars 1990



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

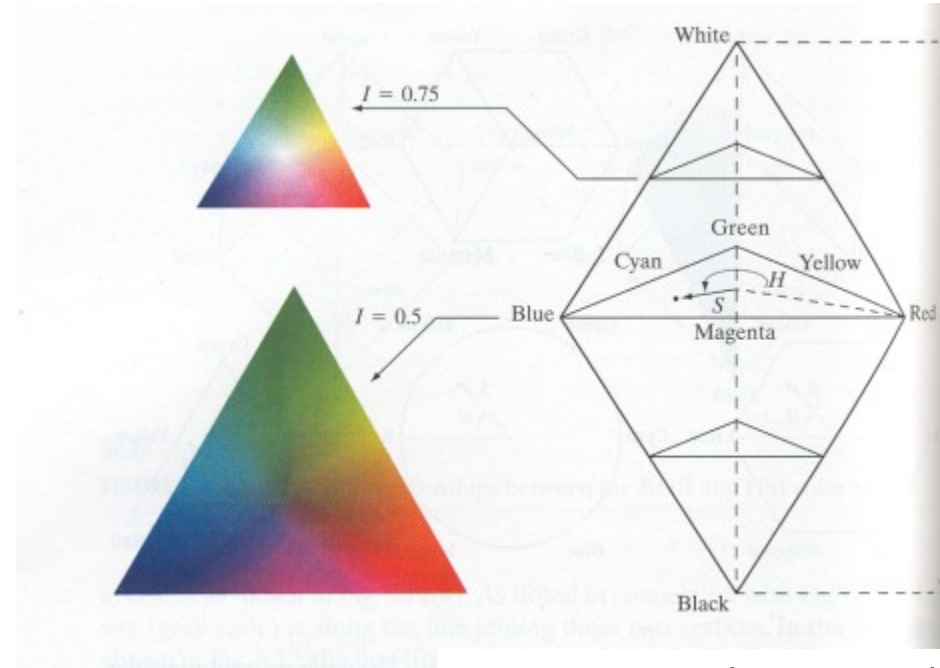
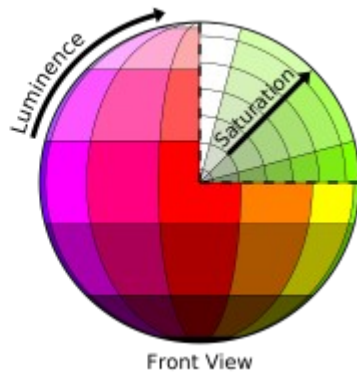
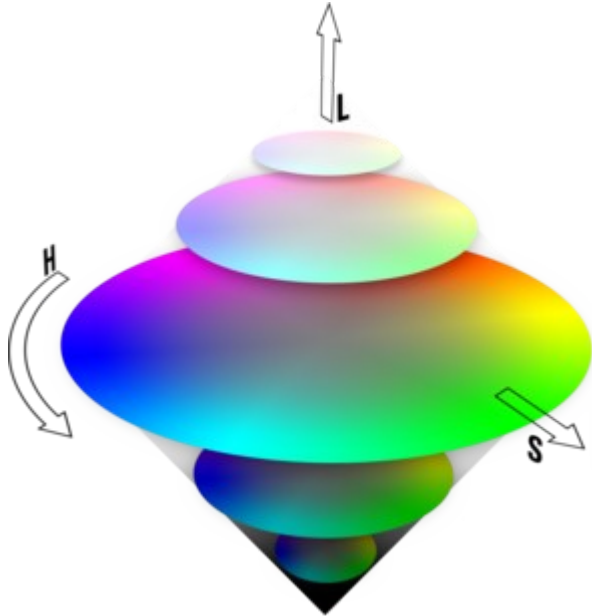
17 juillet 2003



30 décembre 2004



Modèle TSL (HSL) TSI (HSI)



Source: Gonzales & Wood

image originale



canal rouge



canal vert



canal bleu



canal teinte



canal saturation



canal intensité

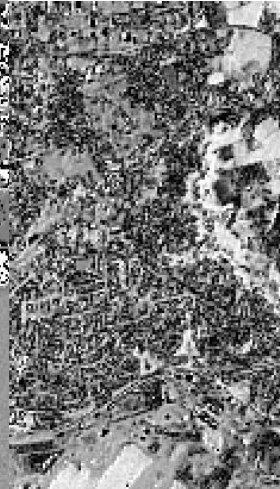
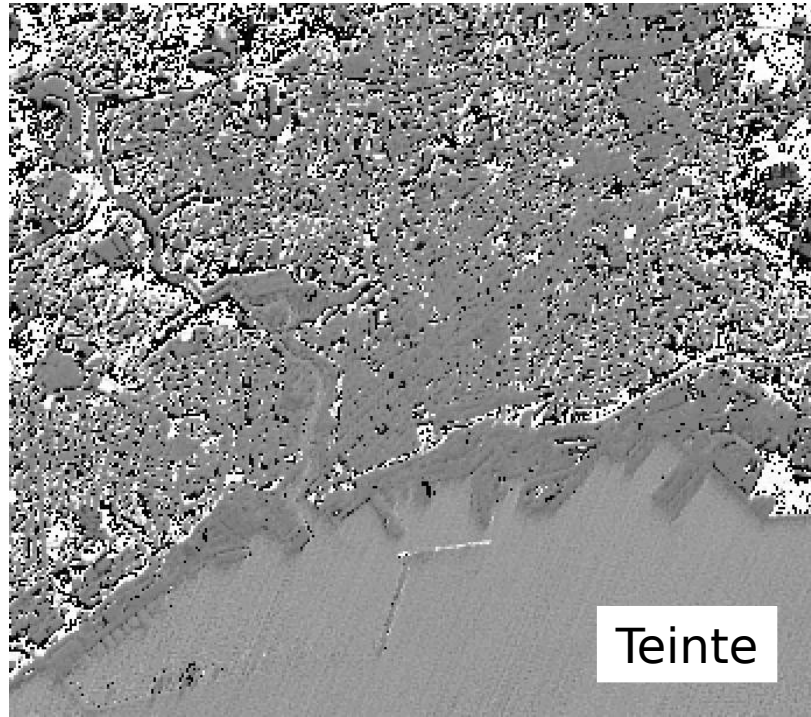


SPOT - XS
Brest, France - 20 m rés. spatiale

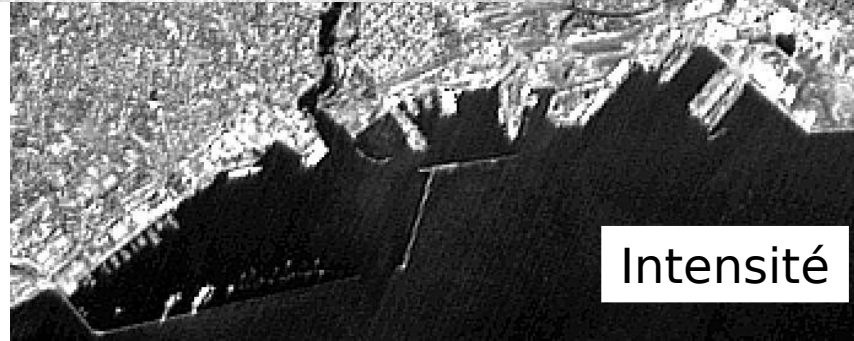


SPOT - XS

20 m rés. spatiale: rééchantillonnage x 2

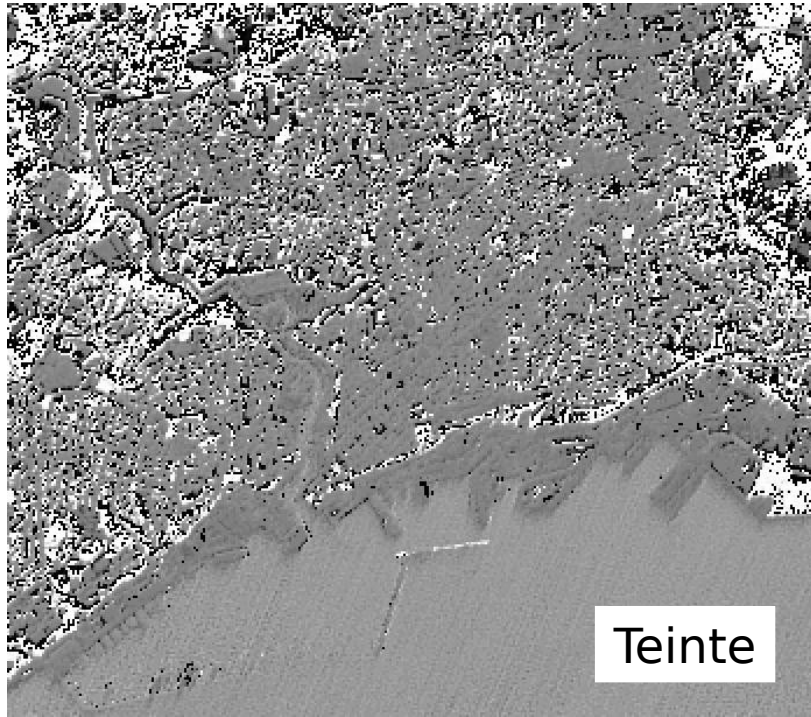


RGB \square HSI

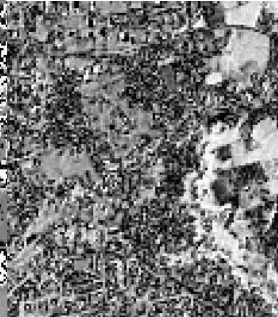


SPOT - XS

20 m rés. spatiale: rééchantillonnage x 2



Teinte



Saturation



Spot_Panchro

HSI \square RGB.....

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





SPOT - Panchro
rés. spatiale: 10 m

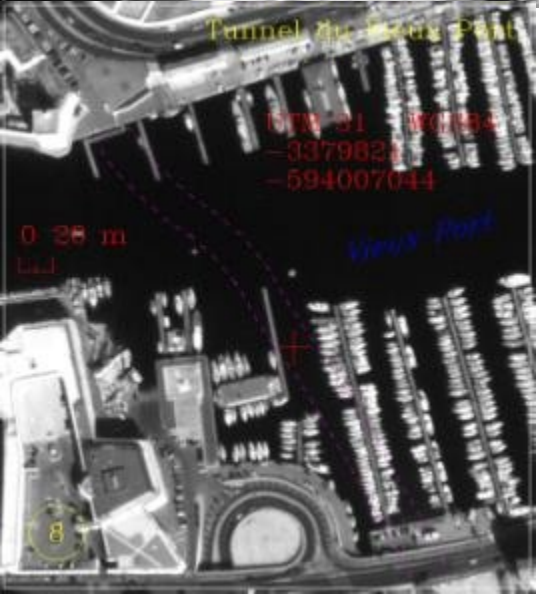
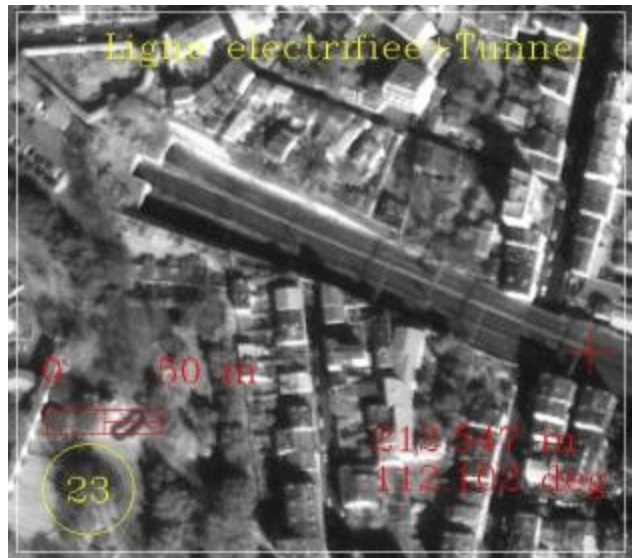
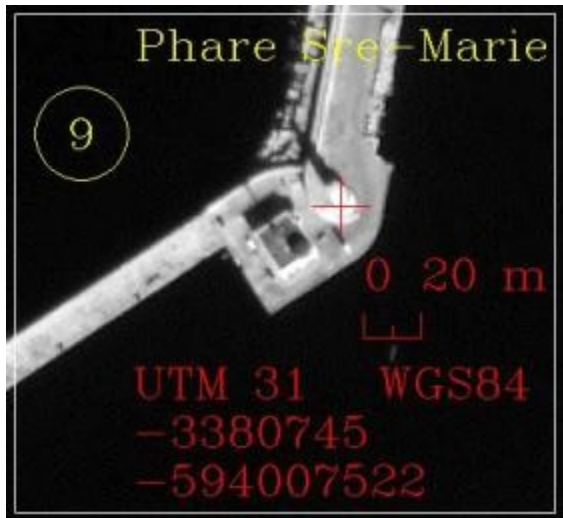
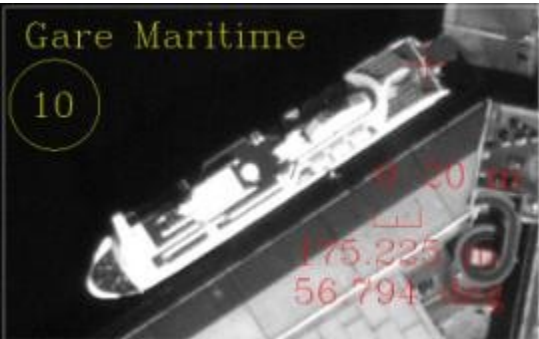
Brest, France



FUSION
XS - PANCHRO

3 canaux - 10 m

Brest, France



IKONOS

1 x 1 m²



Donnée QUICK BIRD, Paris, 27 mars 2002

PLEIADES



PLEIADES



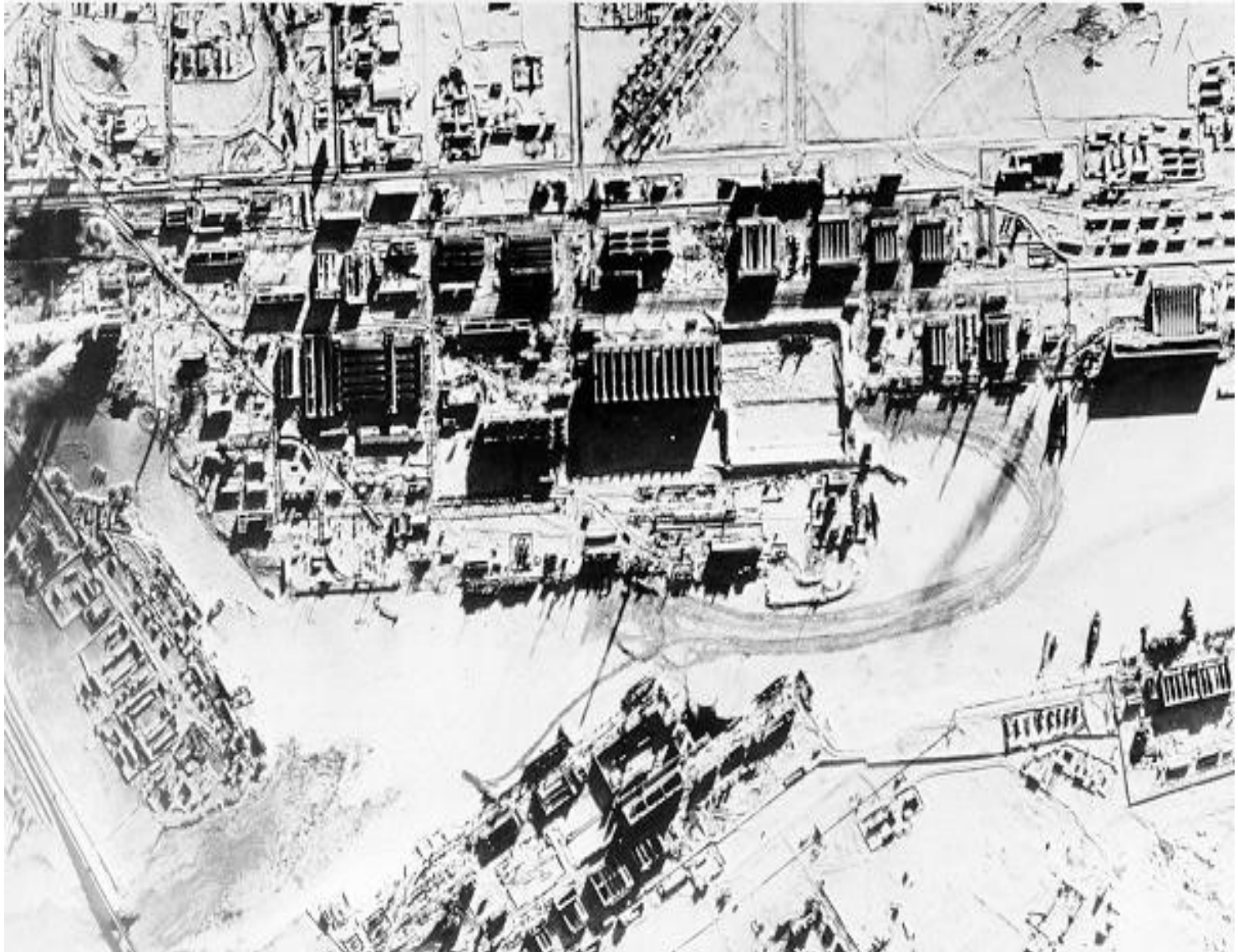
Renseignement stratégique



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

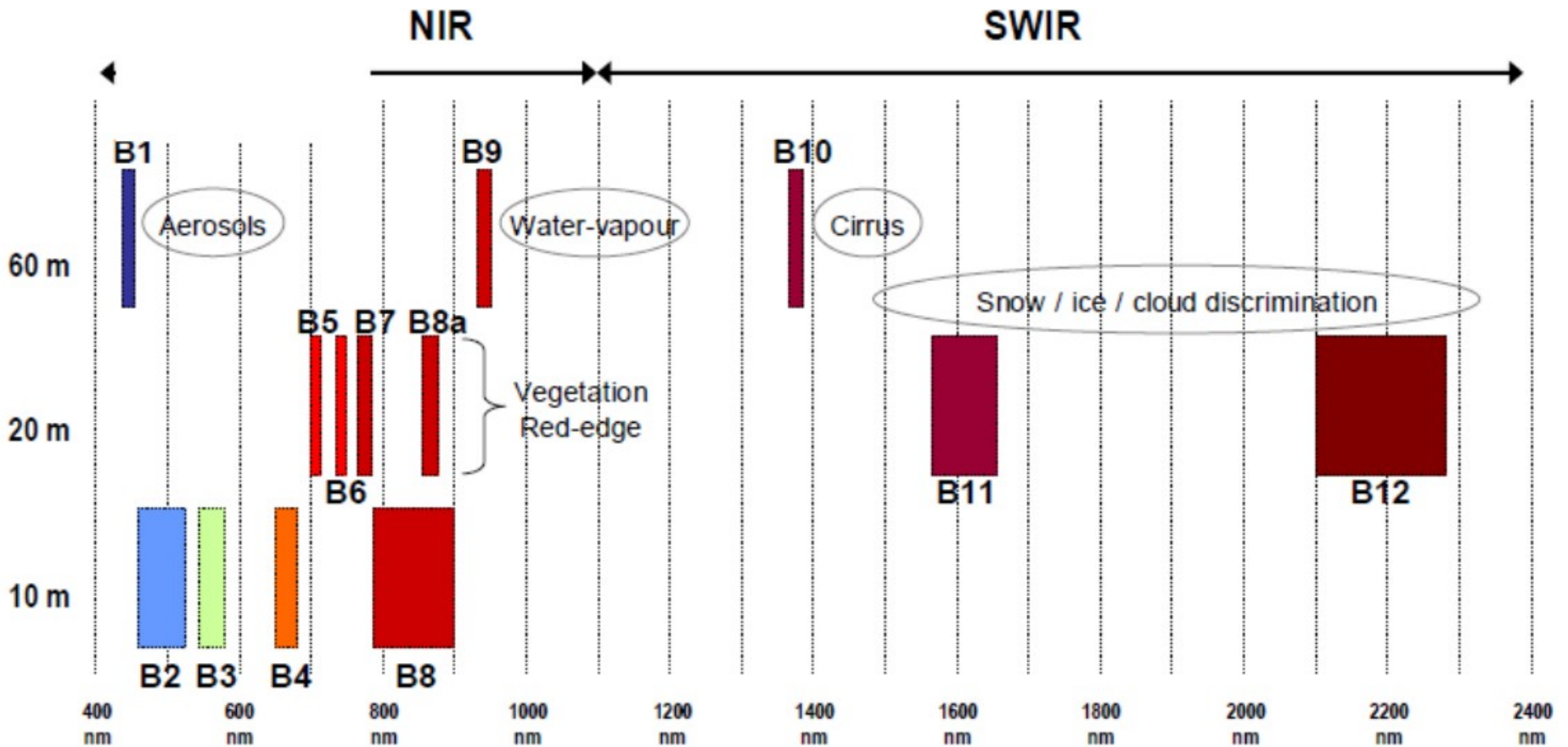
Renseignement stratégique

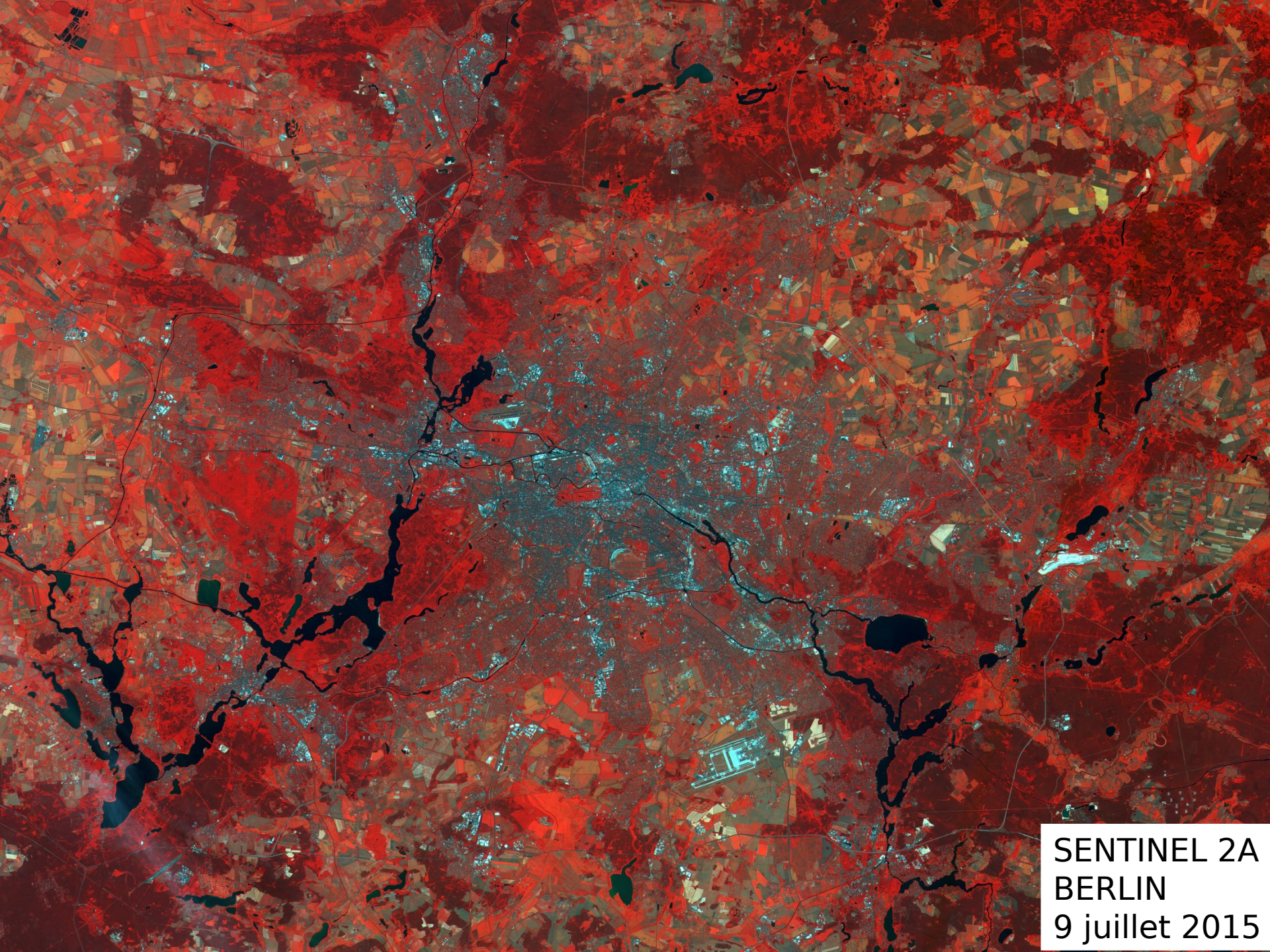
Severodvinsk Shipyard, USSR, 10 February 1969



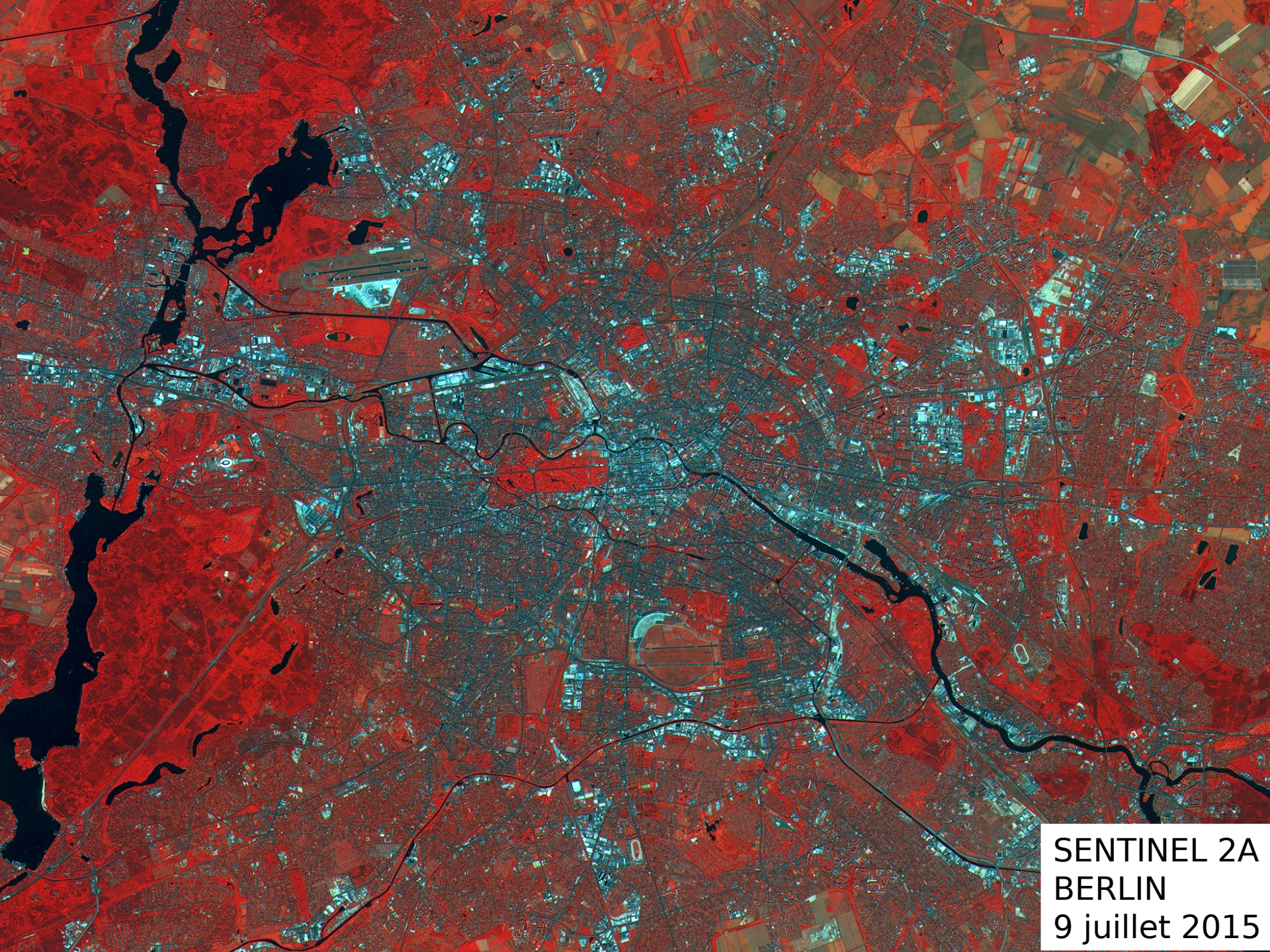
SENTINEL-2 MSI

Spatial resolution vs Spectral bands





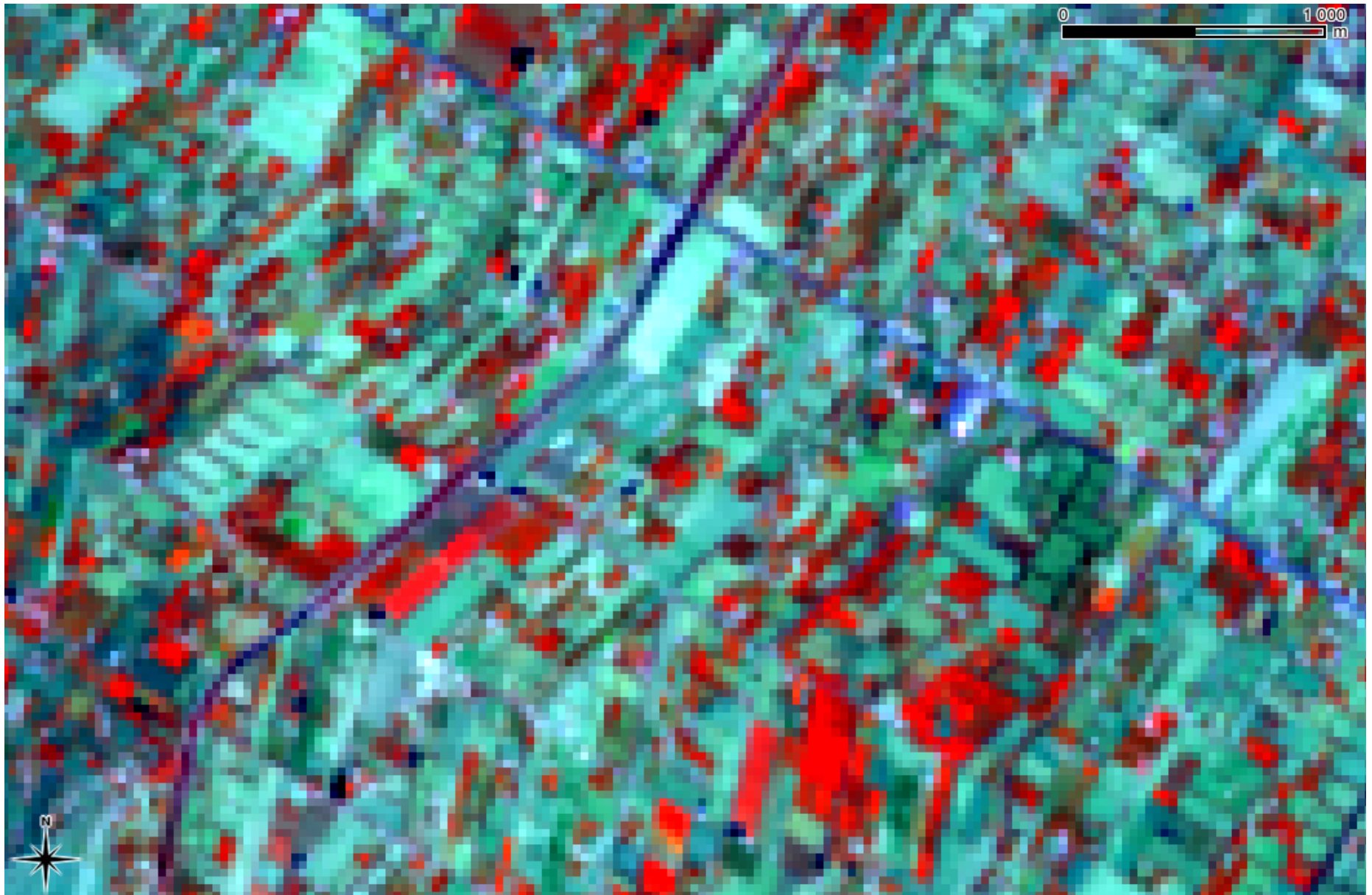
SENTINEL 2A
BERLIN
9 juillet 2015



SENTINEL 2A
BERLIN
9 juillet 2015

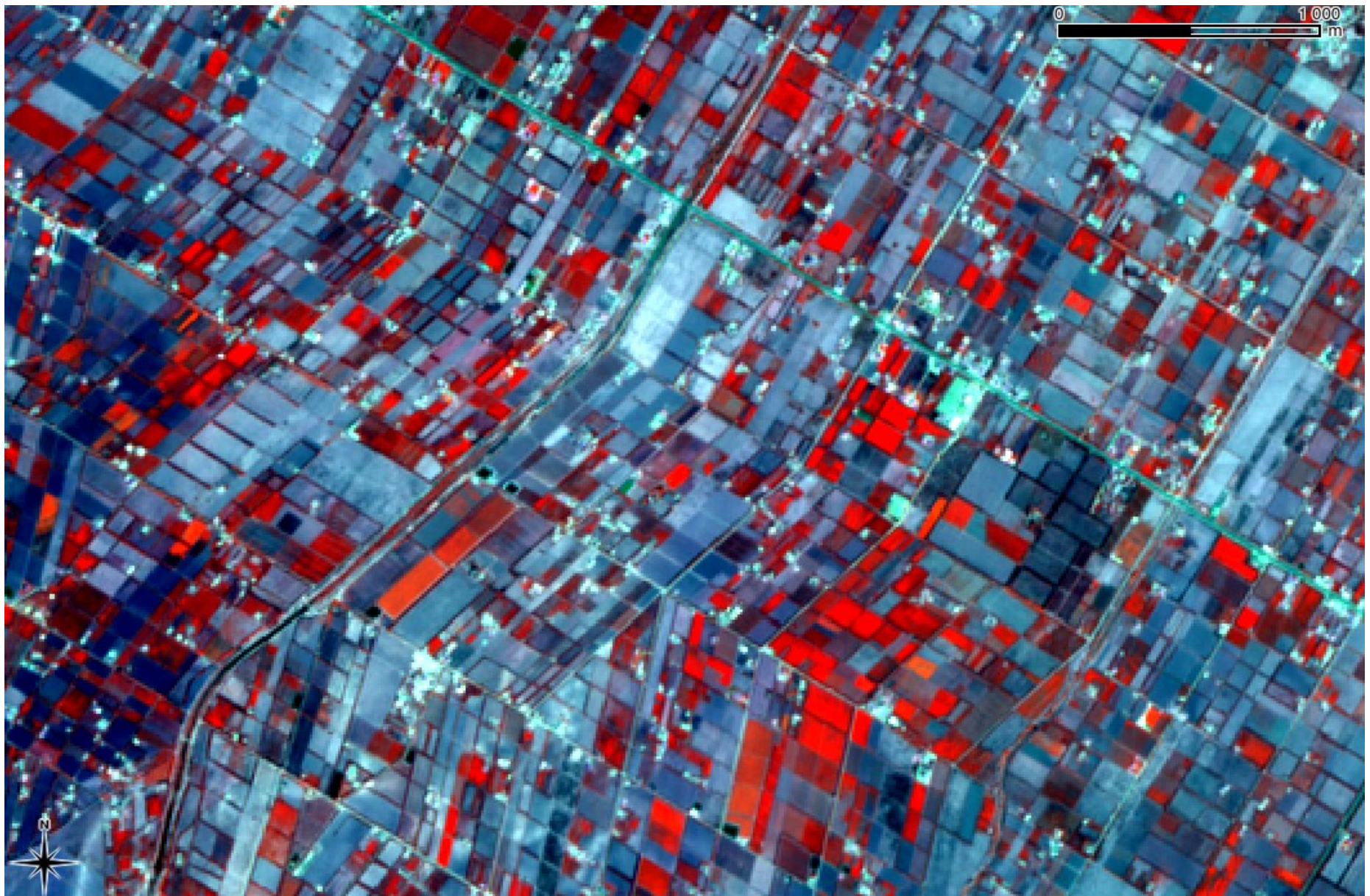
Nador Region, Marrocco

LANDSAT 8 (spat. res. 30 m)



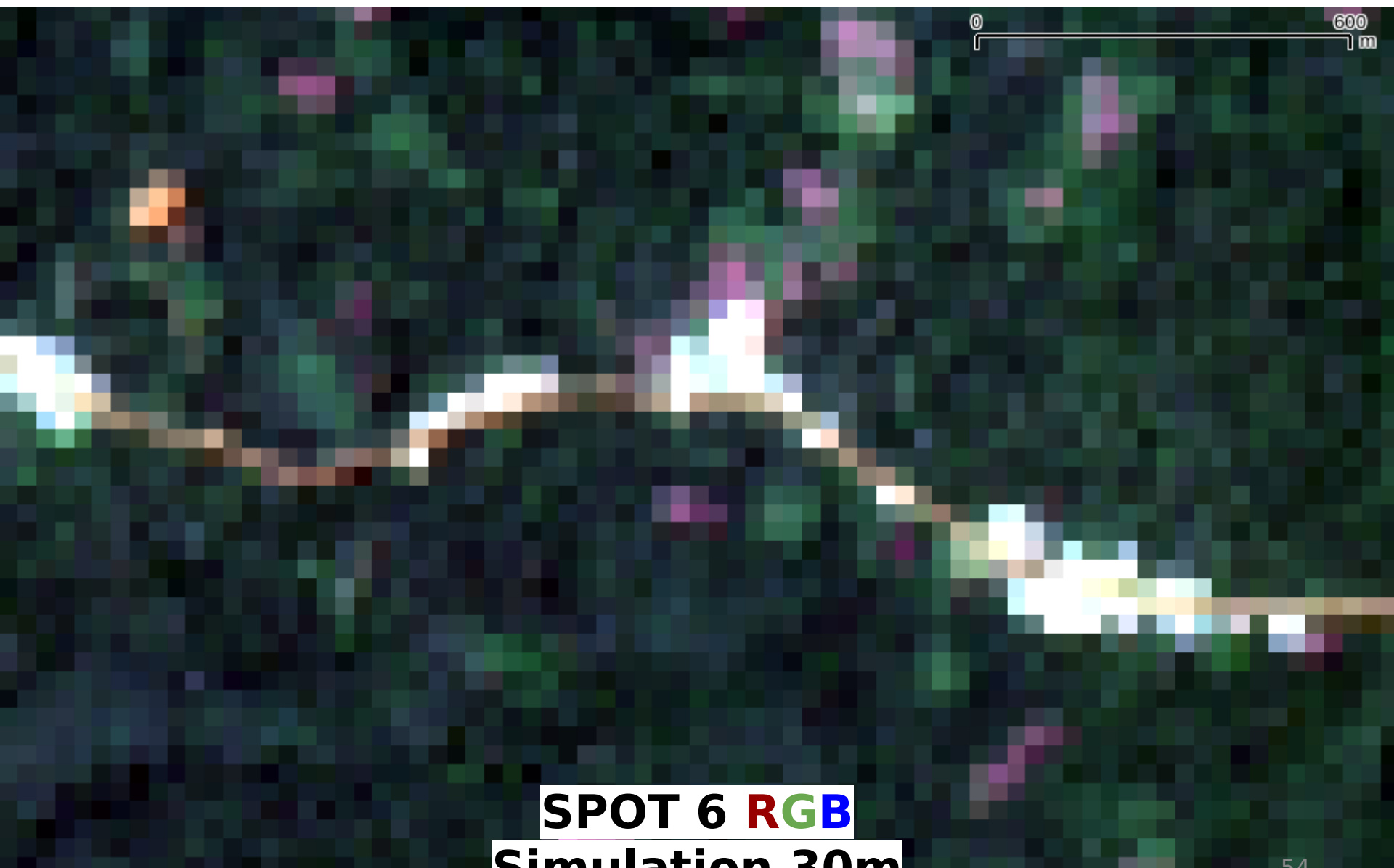
Nador Region, Marrocco

Sentinel-2 (spat. res. 10 m)



Introduction à la télédétection

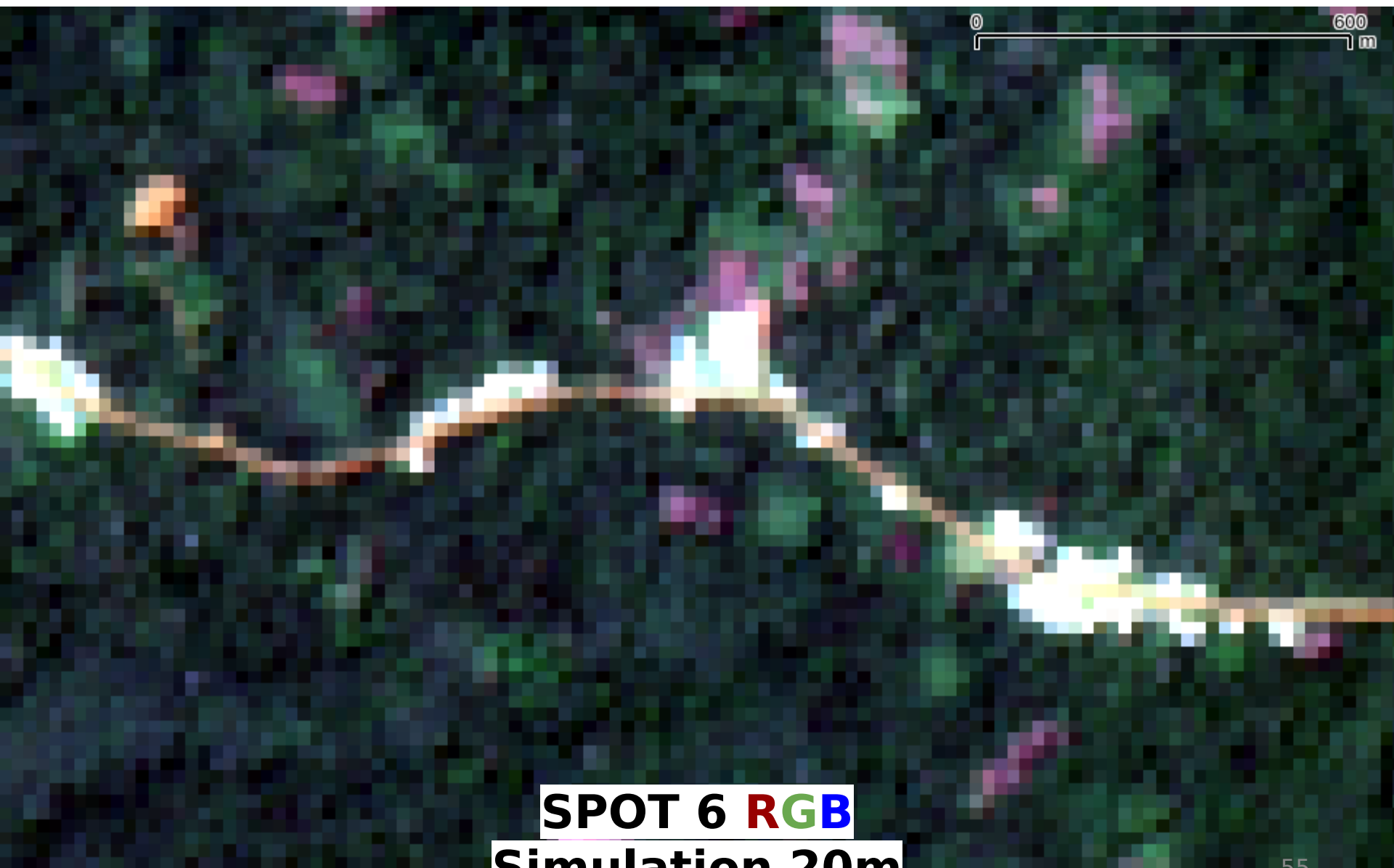
Résolution spatiale



SPOT 6 RGB
Simulation 30m

Introduction à la télédétection

Résolution spatiale



SPOT 6 RGB
Simulation 20m

Introduction à la télédétection

Résolution spatiale



SPOT 6 RGB
Simulation 10m

Introduction à la télédétection

Résolution spatiale



SPOT 6 RGB
Simulation 5m

Introduction à la télédétection

Résolution spatiale



SPOT 6 RGB

1.5m

Exemple de l'effet de la résolution au Maroc

Sentinel-2 ($\approx 10m$)

VS

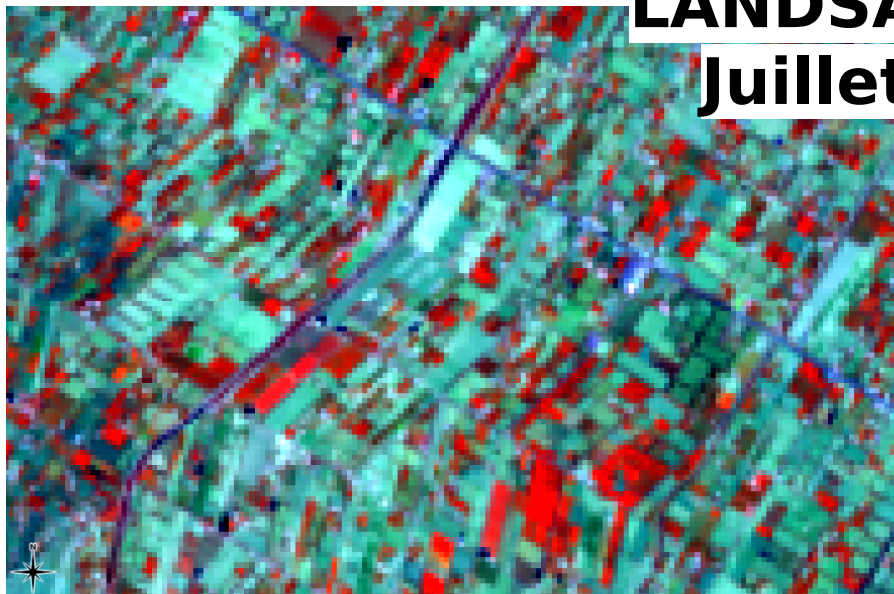
Landsat ($\approx 30-15m$)

Introduction à la télédétection

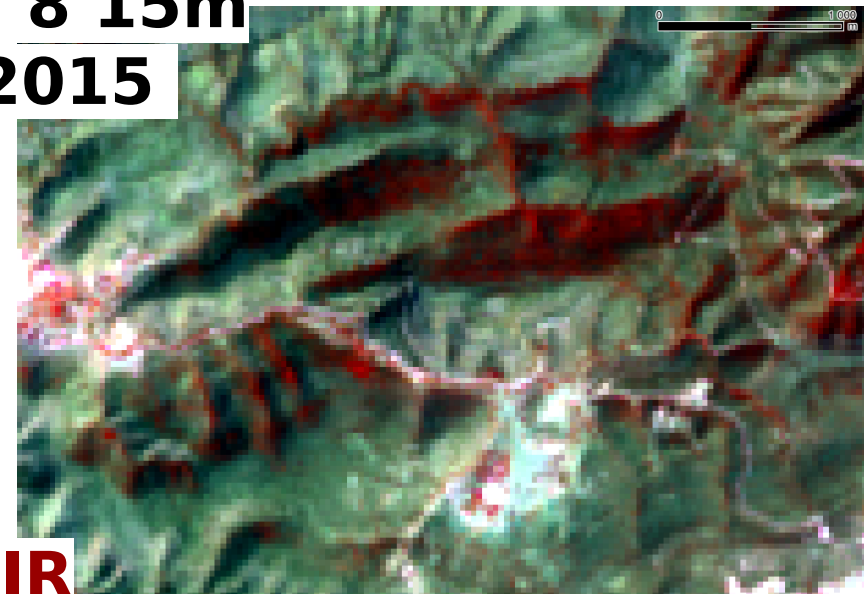
Résolution spatiale

LANDSAT 8 15m

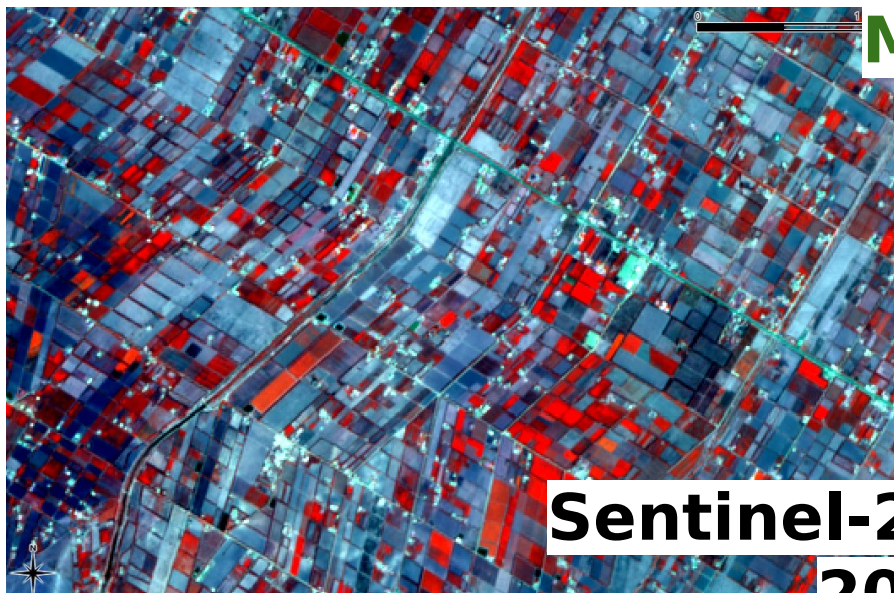
Juillet 2015



NIR

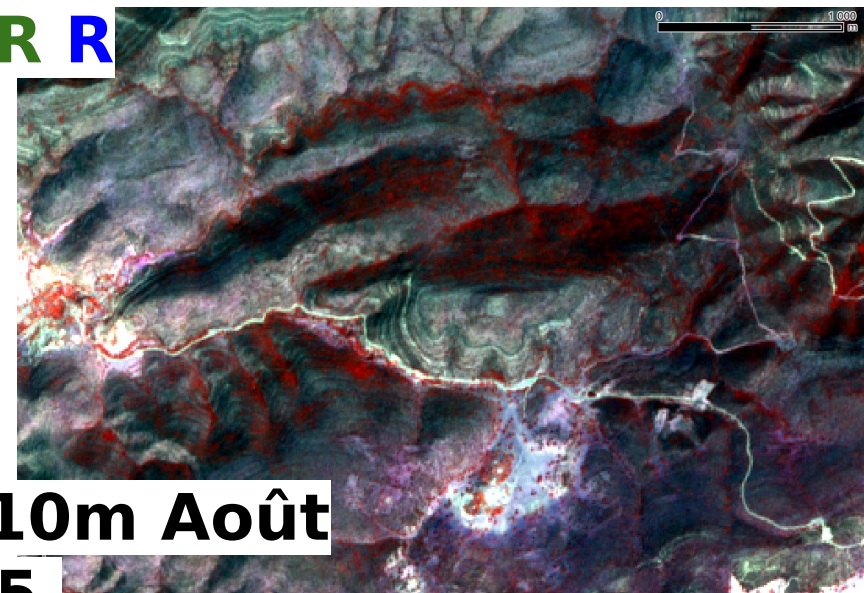


MIR R



Sentinel-2 10m Août

2015



Exemple de l'effet de la résolution en Colombie

Spot 6 ($\approx 6-1.5m$)

VS

RapidEye ($\approx 6.5m$)

VS

Landsat ($\approx 30-15m$)

Résolution spatiale

6.5m Rapid Eye
08/2013

- **30/15m**

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

- **<6m**

- Capable de détecter des petites déforestation

1.5m SPOT6
09/2014

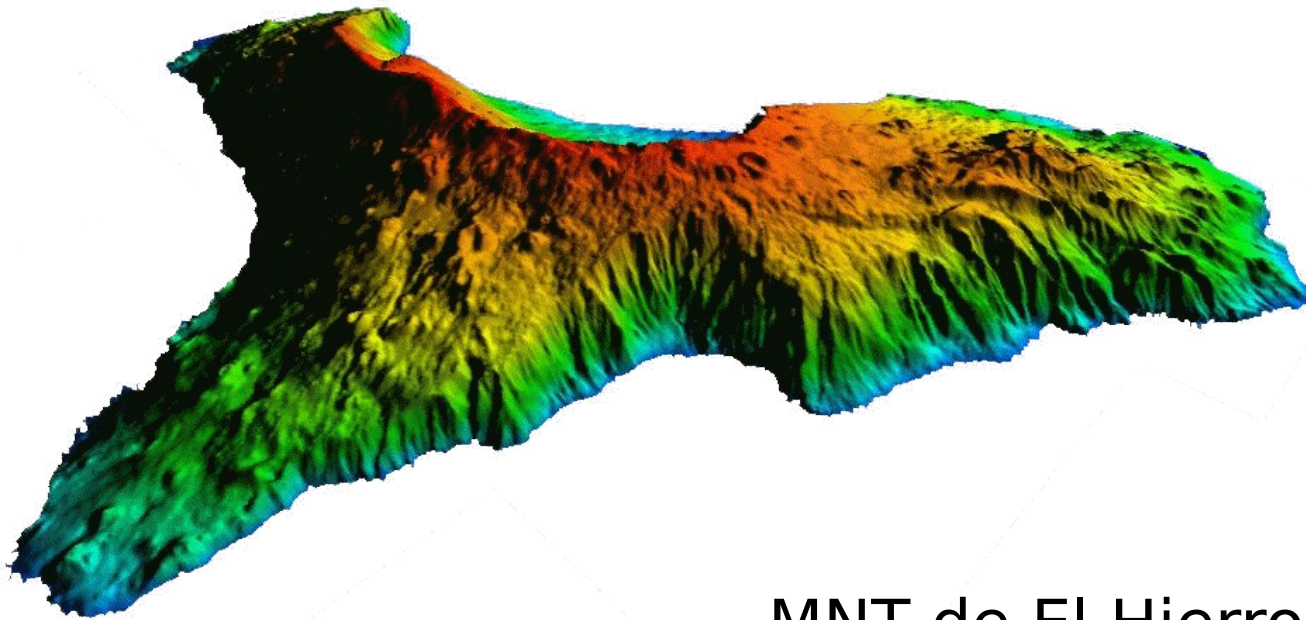
- Quantifier l'impact de déforestation

30m Landsat 8
09/2014

documentation traitement données optiques:

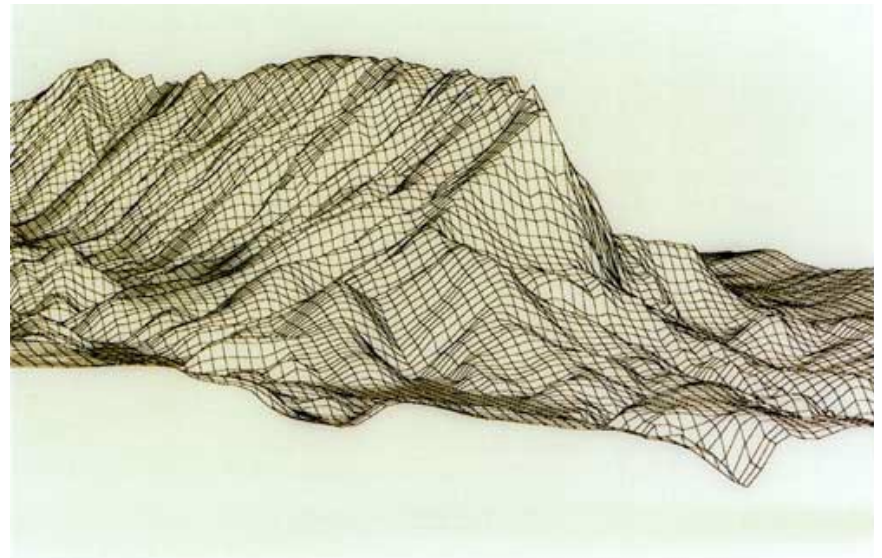
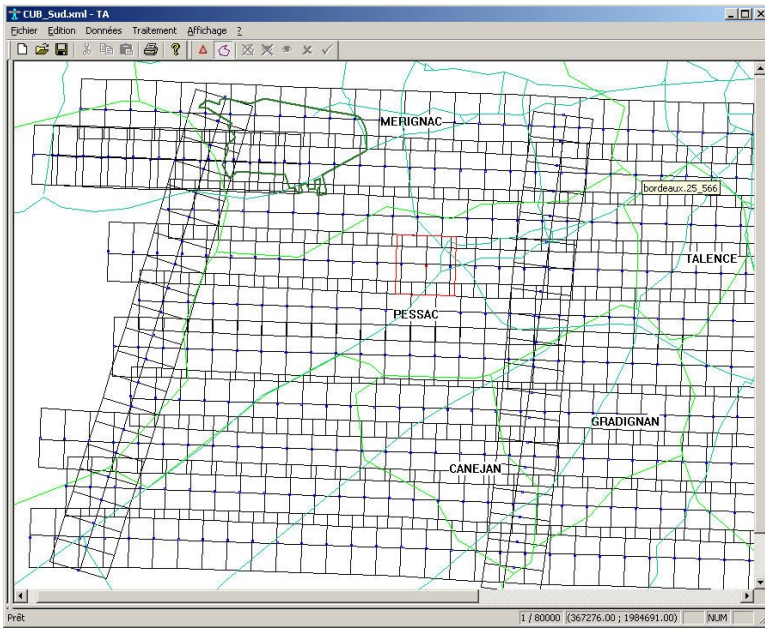
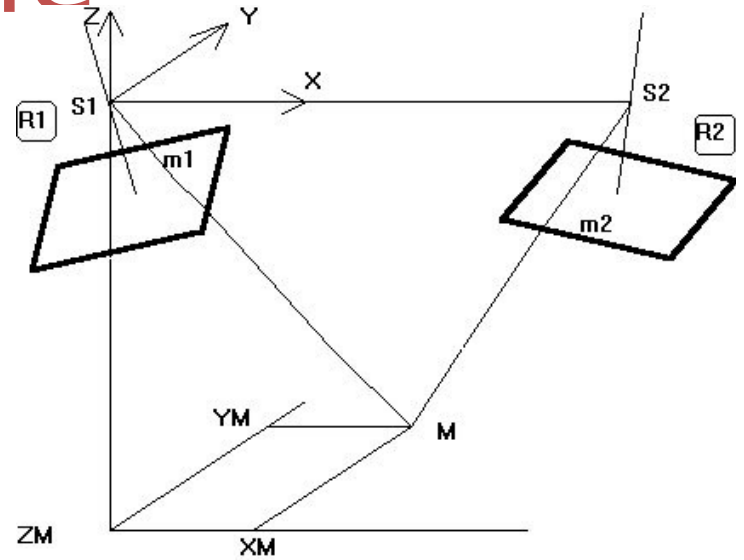
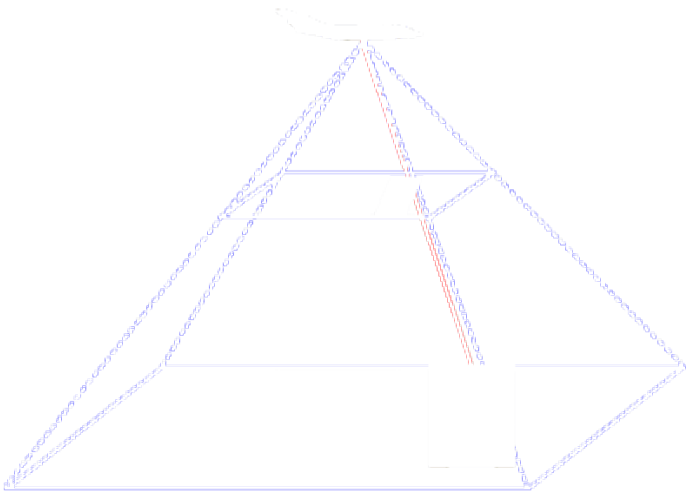
<http://www.onfinternational.com/data/technical/tutorials/Sentin>

STÉRÉOSCOPIE: Accès au relief



MNT de El Hierro, Canaries
IGN Espagne

Photogrammétrie



BRIGE

