A satellite remote sensing map of the Caribbean region. The landmasses are shown in shades of green and brown, indicating vegetation and terrain. The surrounding waters are in shades of blue and cyan, representing bathymetry and water depth. The map is centered on the Caribbean Sea, with the northern coast of South America visible on the left and the northern coast of Central America on the right. The text is overlaid in the center of the map.

*IUPUI Remote Sensing Projects
in the Caribbean:
Hispaniola and the Satellite Atlas of the Caribbean*

Jeff Wilson
IUPUI Geography
September 2005

- **Wilson, J., T. Brothers, and E. Marcano. 2000. Visual interpretation of land cover contrasts along the Haitian/Dominican border from satellite imagery. Caribbean Geography, 11(1): 7 -19. *, ****
- **Wilson, J., T. Brothers, and E. Marcano. 2001. Remote sensing of spatial and temporal vegetation dynamics in Hispaniola: A comparison of Haiti and the Dominican Republic. Geocarto International, 15(2): 5-17. ***
- **Hernández-Leal, P., M. Arbeloa, J. Wilson and A. Díaza. 2005. Analysis of vegetation patterns in the Hispaniola island using AVHRR data. Advances in Space Research, in press.**
- **Brothers, T., J. Wilson, and O. Dwyer. The Caribbean from Above: A Geographic Appreciation of an Island Mosaic. Miami: Caribbean Studies Press, in progress. ****

Funding:

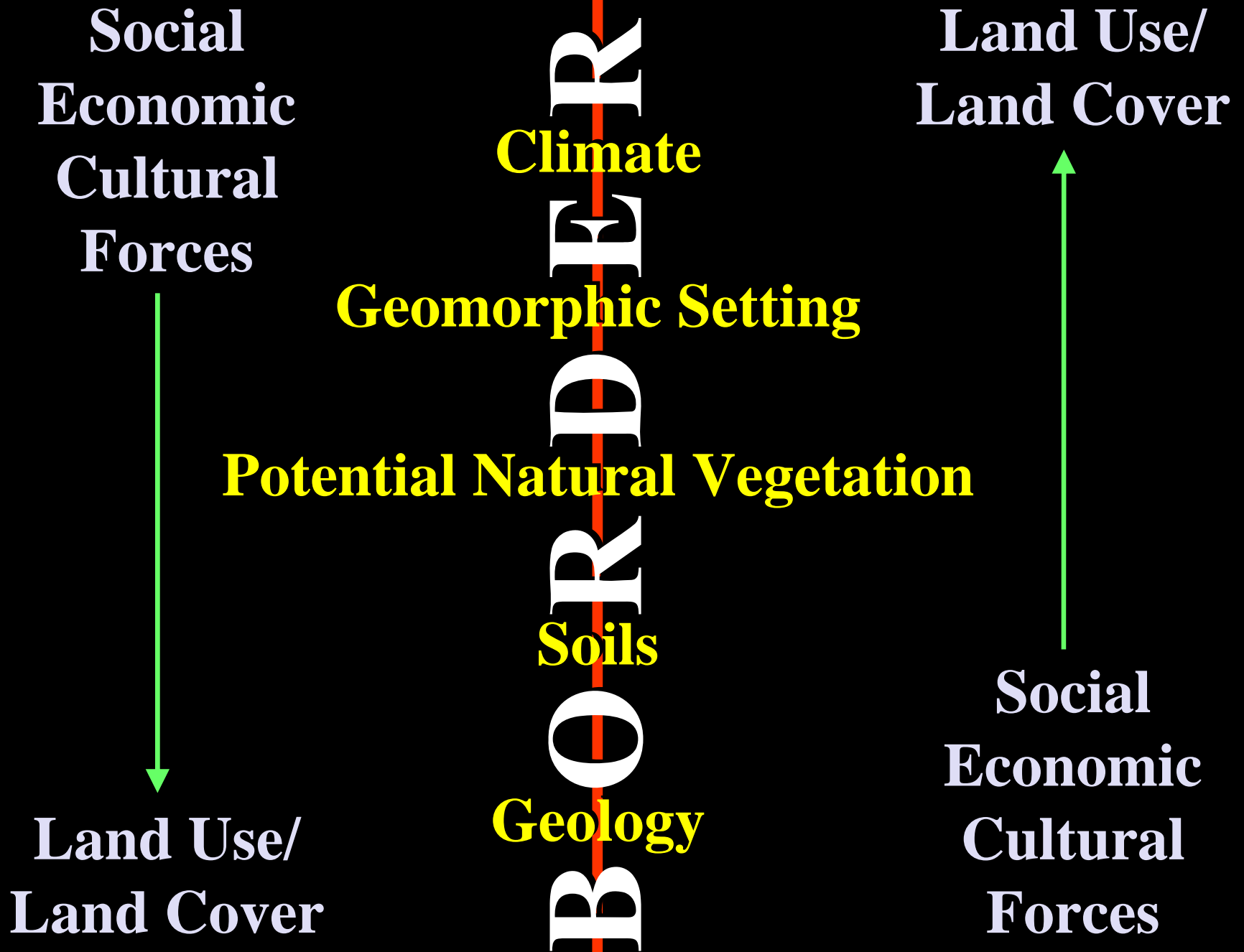
The National Geographic Society *

IUPUI Office for Professional Development **



**Cobb, Charles E. 1987. "Haiti: Against All Odds."
National Geographic, 172(5): 645-670.
Photo by James Blair**





Haiti and the Dominican Republic



There are only two Caribbean islands divided by international boundaries. The border between Dutch St. Maarten and French St. Martin is practically invisible from space, but the border between Haiti and the Dominican Republic on Hispaniola is among the sharpest in the world as illustrated by the satellite image at left. The broad scale contrasts along the border are evident as result of more vegetation cover on the Dominican side. How have the two sides of this border become so different?

The roots of this contrast extend to earliest colonial times. The Spanish colony of Santo Domingo was established very quickly after Columbus' discovery of Hispaniola in 1492. The capital, also Santo Domingo, was founded in 1497, and by 1520 the first African slaves were being imported to sugar plantations established on the southeast coast. However, discovery of Mexico in 1521 turned Spanish attention to the mainland, and Santo Domingo quickly became a colonial backwater, with declining population and an economy largely based on cattle, not sugar. Slave imports largely stopped, and the remaining African and Spanish residents, living and working together on large *hatos*, or cattle ranches, formed a mostly mulatto population.

The weakened Spanish colony lost control of western Hispaniola to French buccaneers and pirates, who established settlements on the north coast and the island of Tortuga. In 1697 France gained formal political control of the western third of the island in the Treaty of Ryswick. As Santo Domingo declined, the new French colony of Saint-Domingue grew rapidly to become the most prosperous of all French colonies, its economy based on irrigated lowland sugar plantations worked by hundreds of thousands of African slaves. The Haitian Revolution (1791-1804) eliminated most of the small white ruling class, leaving Haiti a largely African nation with a population several times larger than neighboring Santo Domingo. It also destroyed the plantation economy and scattered the former slaves to the mountains, establishing a pattern of dispersed rural settlement and small-plot hillside agriculture that remains characteristic of Haiti. Since the Revolution, Haiti has suffered increasing overpopulation, land scarcity, and poverty, exacerbated by a long string of corrupt and oppressive governments. The Dominican Republic, by no means prosperous, has prospered relative to Haiti from greater resource base, lower population density, and more stable government.

The two nations differ markedly today in the most basic aspects of human geography (Table **, at right). Haiti is more crowded, more rural, more impoverished, and more African than the Dominican Republic. Its infrastructure is less well developed, and its landscapes have been more severely degraded. These contrasts have created continual social friction between the two countries. For Haitians the Dominican Republic is a source of jobs and land, but it is also often an unfriendly place, where they suffer poor working conditions (most notoriously on the *bateyes*, or workers' settlements, of Dominican sugar plantations), abuse from the Dominican military, and racial prejudice. For Dominicans, Haiti is a source of cheap labor, but for many it remains a mysterious and threatening country; the specter of Haitian domination is constantly employed as a weapon in national political debates.

During most of its history, the border between the two countries has been more a zone than a line, poorly marked on the ground and shifting back and forth with changes in the balance of power. For example, the Treaty of Aranjuez (1777) gave Spain control of much of the present Haitian Central Plateau. This terrain was taken back by Haiti during the Revolution, but the Spanish towns remained behind under French names: Hincha became Hinche, San Miguel de la Atalaya became St.-Michel-de-l'Atalaye. During the first half of the nineteenth century, Haiti invaded Santo Domingo and occupied the entire island for more than twenty years. During intervals of peacetime, the border was more or less open, and commerce, legal or

contraband, flowed both ways. Farmers commonly sold their products on the other side of the border, because the market was nearer or the price was better there. Haitians and Dominicans worked together, intermarried, and intermingled languages, religions, and cuisines.

This situation changed in 1937, when the Dominican dictator Rafael Trujillo, fomenting anti-Haitian racism, instigated a massacre of some thousands of Haitians in the north and closed the border. A string of army posts and some two dozen agricultural colonies were established to protect Dominicans from Haitians. These events effectively segregated much of the border zone. For example, Elias Piña and Belladère, neighboring towns on opposite sides of the frontier in the Plateau Central/Valle de San Juan, were mostly Haitian towns oriented toward Port-au-Prince. The border closing emptied Elias Piña of its Haitian residents and left it at the end of a long road to markets in Santo Domingo. In the mountains, Dominican army outposts now more closely controlled agricultural clearing and charcoal making by both Haitians and Dominicans.

Today, the border is still defended by Dominican troops and most vehicle traffic is limited to a handful of border crossings. As the following images show, the border is easily visible from space, because of contrasts in population density, settlement pattern, and land use. However, the two countries remain inescapably linked across this boundary. The Dominican government cannot eliminate illegal migration and, in fact, seems to tolerate it within limits: Haitians cross the border relatively freely on market days, and Haitian day laborers commonly cross to work on Dominican mountain farms. The two sides are also tied together environmentally. Rivers such as the Massacre and Artibonite cross the border, so land-use changes in one country can affect the other. It is ironic that, in at least one respect, the two sides of the border may become more similar in the future: if deforestation continues at its present pace in the Dominican mountains, the Dominican landscape may become as bare as that of Haiti.

Table **. A selective statistical comparison of Haiti and the Dominican Republic. These data should be treated with caution, as they vary from source to source and are in some cases estimates.

	Haiti	Dominican Republic
Population		
Population density (persons/km ²), 1999 ¹	290	170
Life expectancy at birth (years), 2004 ²	51	69
GDP per capita (US\$), 2004 ²	1,600	6,200
Rural population (%), 2004 ²	64	36
Ethnicity (%) ³		
Black	95	11
White and mulatto	5	89
Agriculture, infrastructure, and environment		
Labor force employed in agriculture (%), 1998 ²	66	17
Tractors in use, 2000 ⁴	140	1,870
Irrigated land (km ²), 1998 ³	750	2,590
Vehicles per 1000 people, 2000 ²	7	47
Paved roads (km), 1999 ³	1,000	6,200
Forest as per cent of land area, 2000 ¹	3	28
Woodfuel consumption (m ³ x 1,000), 2000 ¹	1,960	560

¹ U.N. Food and Agriculture Organization. State of the World's Forests, 2003.

² Population Reference Bureau. Datafinder.

³ U.S. Central Intelligence Agency. World Factbook.

⁴ U.N. Food and Agriculture Organization. FAOSTAT statistical data base.

<u>POPULATION</u>	HAITI	DOMINICAN REPUBLIC
Population (July 1999 est., millions)	6.8	8.1
Population Density (1999, persons sq/km)	250	168
Rural Population (1999 est., %)	67%	27%
Avg. Annual Population Growth	2.1%	1.8%
Ethnic Groups (1999 est., %)		
% black	95%	11%
% mulatto plus white	5%	89%
 <u>EDUCATION AND HEALTH</u>		
Literacy (% age 15+)	45%	82%
Life expectancy	52	70
Infant mortality (1,000 live births)	97.6	42.5
Access to safe water (% population)	28%	71%
 <u>ECONOMY</u>		
GDP (1999, US\$ millions)	\$2,815	\$15,039
Per Capita GNP (1999, US\$)	\$380	\$1,750
Pop. < national poverty line (1999, %)	65.0%	24.5%

1 World Bank (1999) World Development Indicators

2 CIA (1999) CIA World Fact Book

3 World Resources Institute (1998)

AGRICULTURE AND ENVIRONMENT

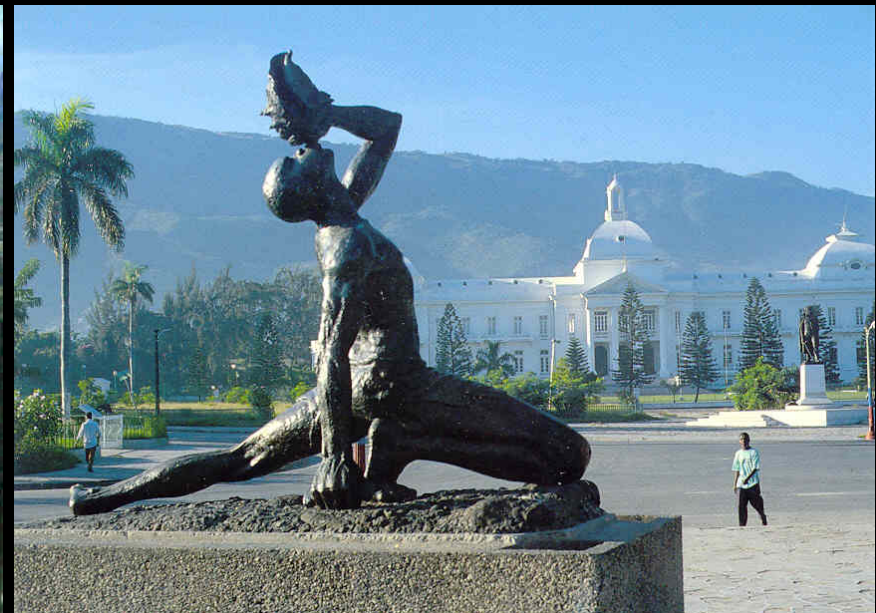
DOMINICAN
HAITI REPUBLIC

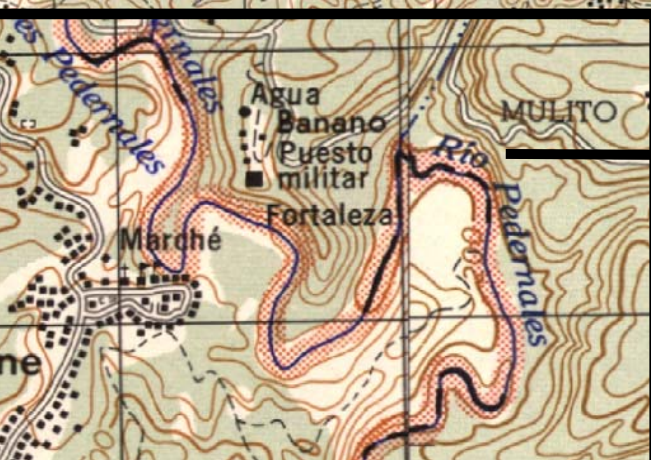
Cropland (1994, % of land area)	33.0%	37.6%
Irrigated Land (1992-94, % of total cropland)	9%	14%
Farming Tractors in Use (1992-94 annual avg.)	230	2,350
Annual Fertilizer Use (1994, kg per ha of cropland)	6	51
Average Yield Cereals (1992-94, kg per ha)	929	4,034
Average Yield Roots /Tubers (1992-94, kg per ha)	3,815	6,835
Extent of Forest (1995, 1,000s ha)	21	1,582
Avg. Annual % Change Forest Cover (1990-95)	-3.50%	-1.60%
Protected Areas (% of land area)	0.4%	31.5%

"The first and only successful slave revolution in the Americas ..."



The Black Jacobians, History of Negro Revolt - C.L.R Jones



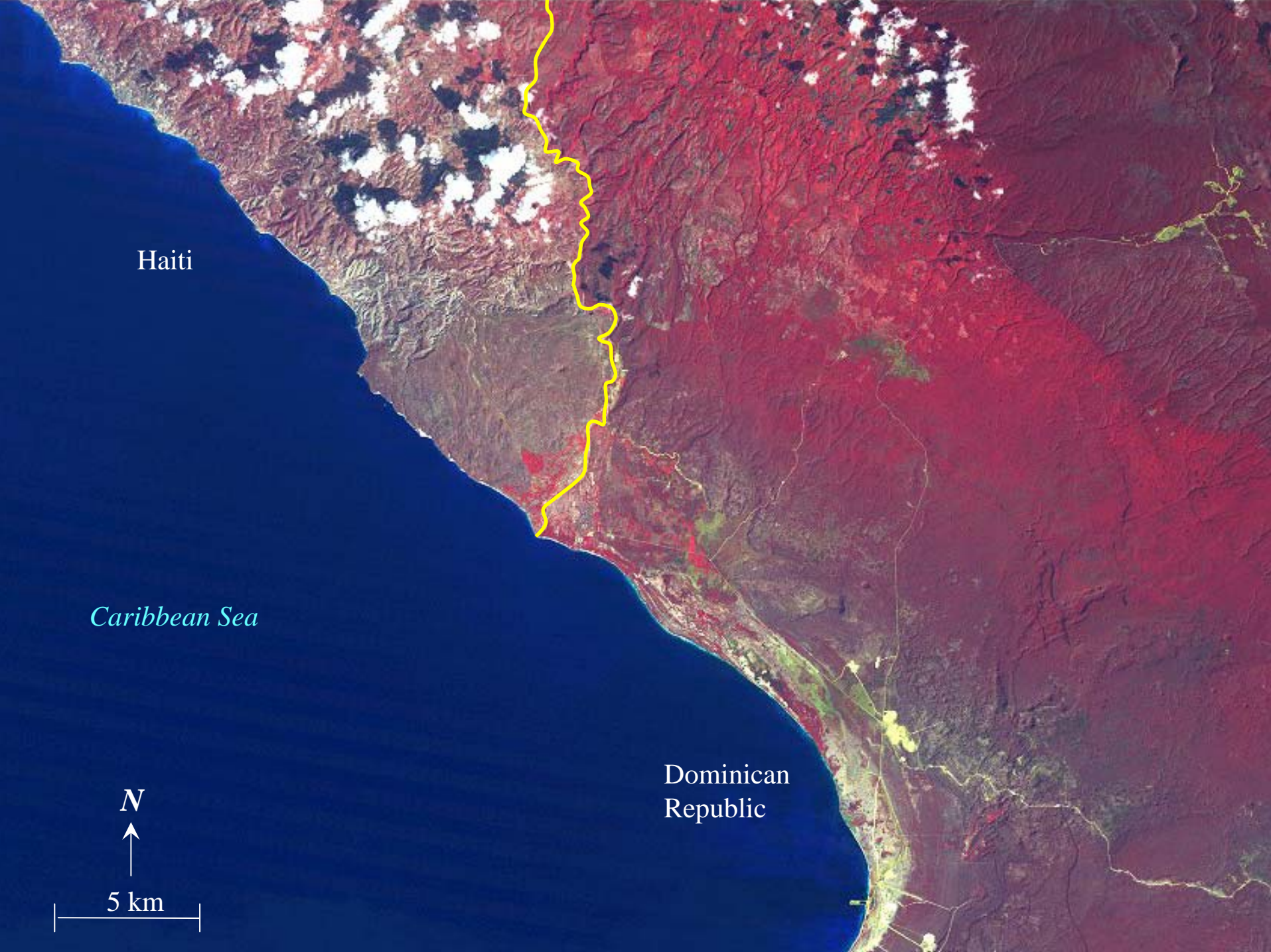








**Bosque Seco
(dry forest)**



Haiti

Caribbean Sea

Dominican
Republic

N

5 km







Wood Use, Anse-A-Pitres





GCP #38



Lago Enriquillo

Sierra de Bahoruco

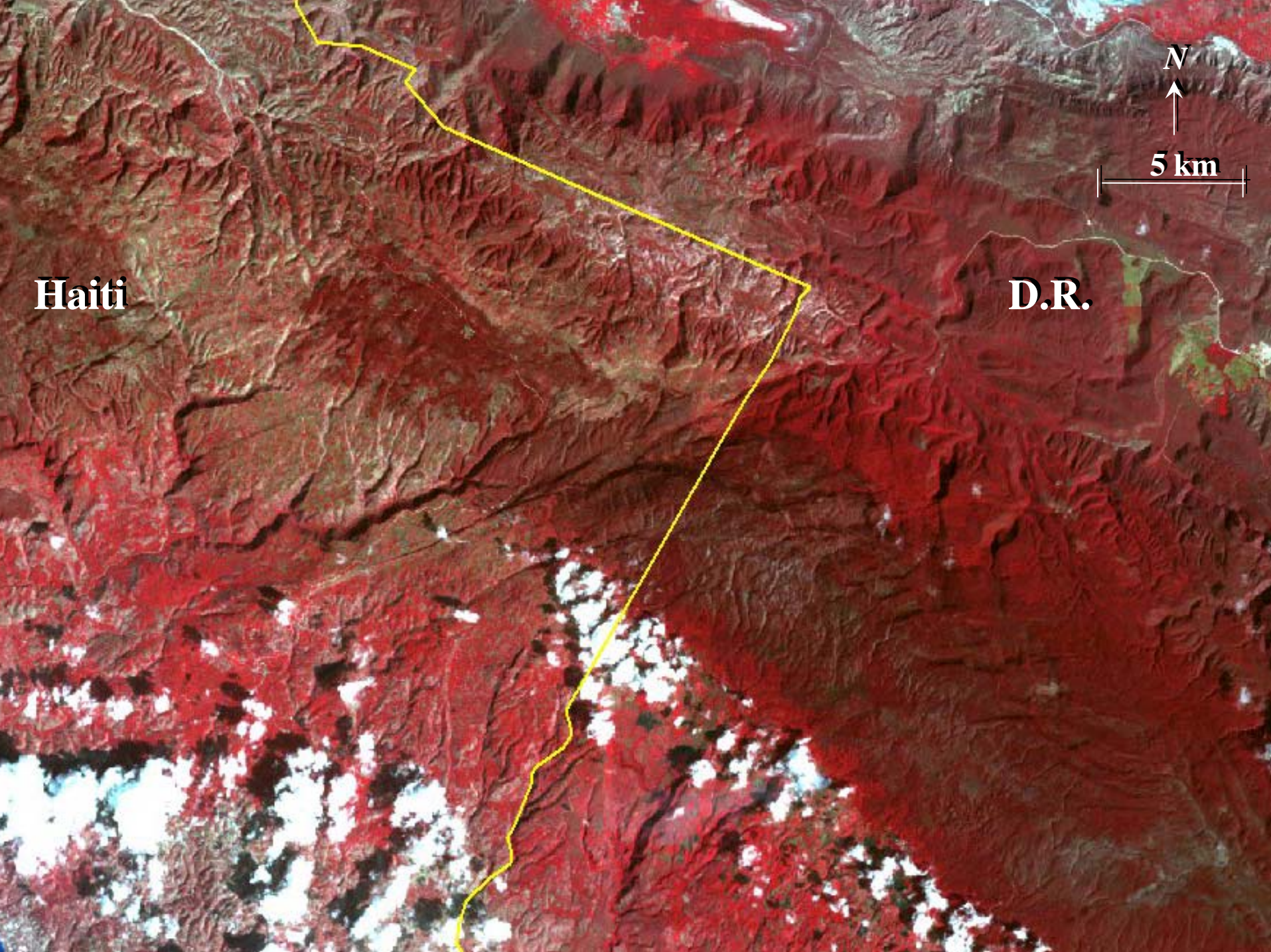
Massif de la Selle

Pedernales

Anse-A-Pitres



Montane Pine Forest, Crest of Massif de la Selle

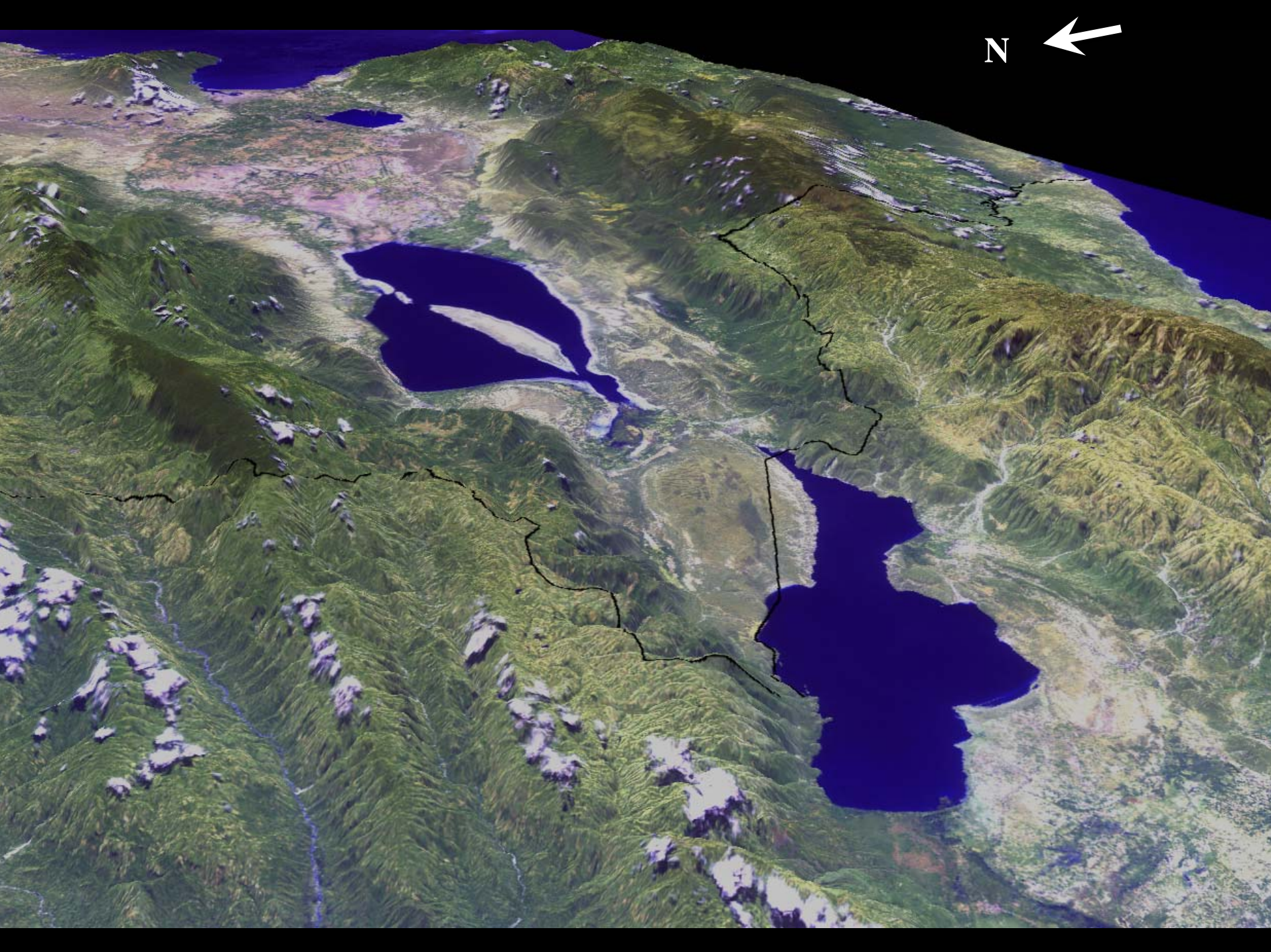


Haiti

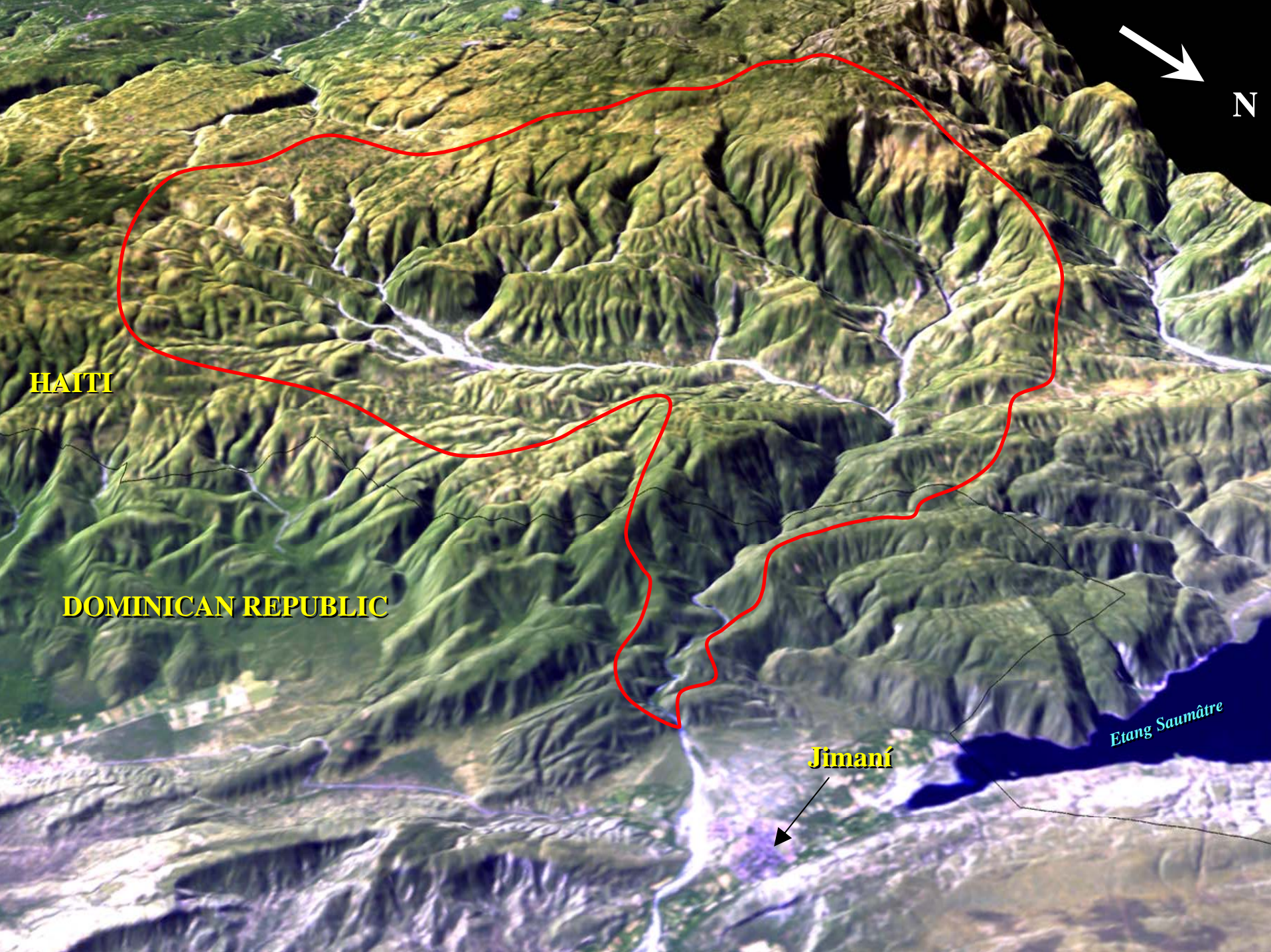
D.R.

N

5 km







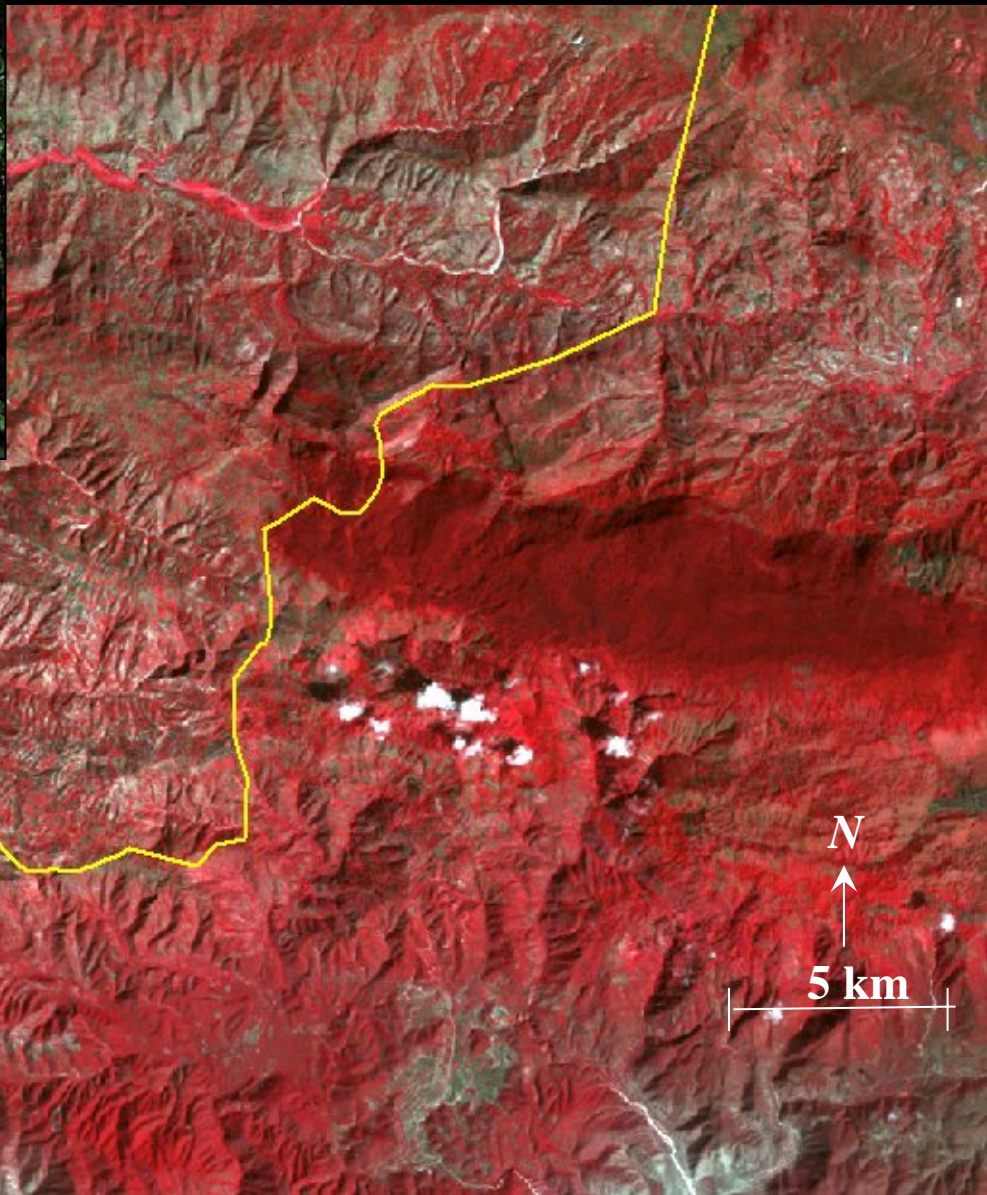
HAITI

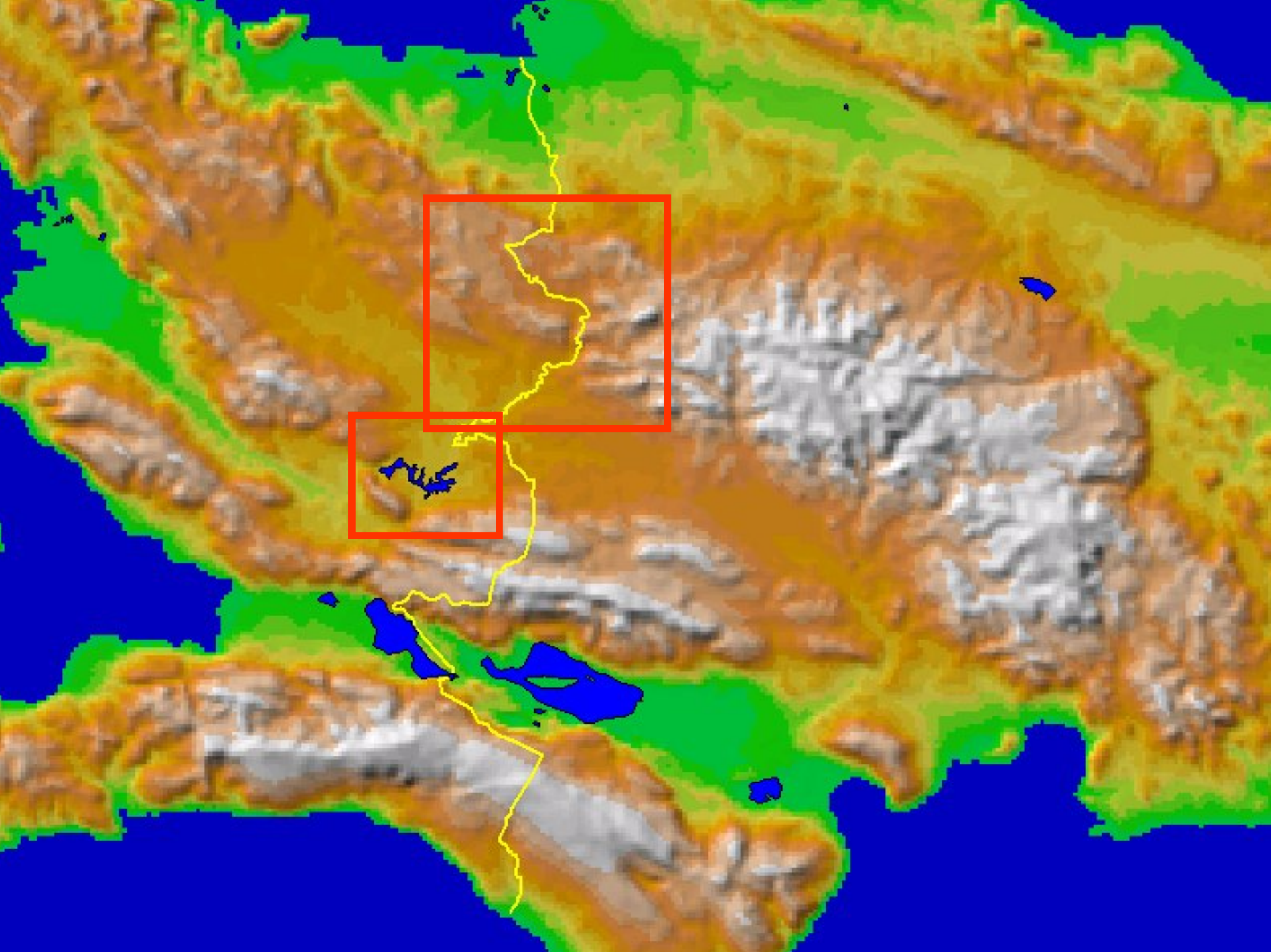
DOMINICAN REPUBLIC

Jimaní

Etang Saumâtre

N







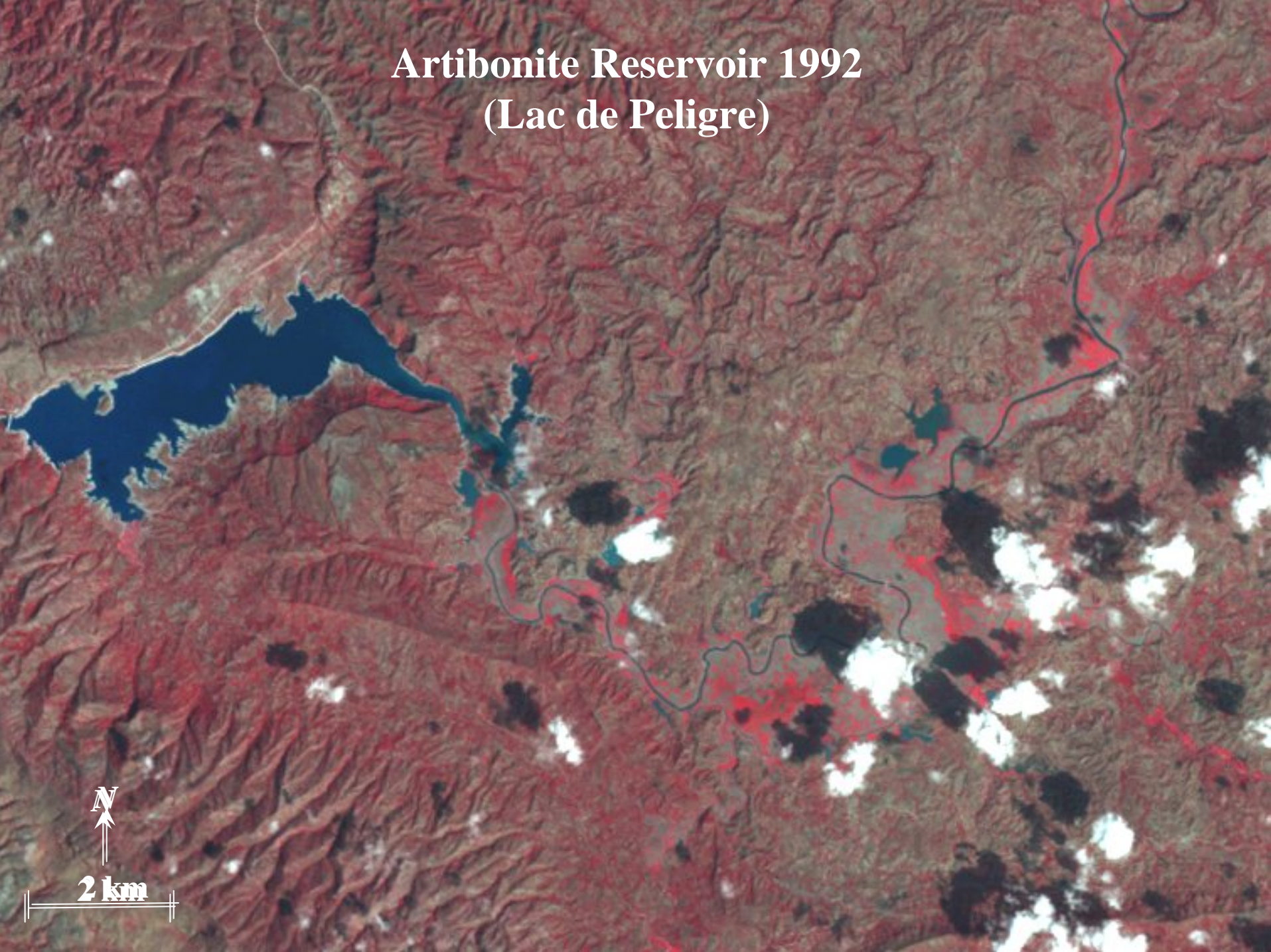




**Artibonite Reservoir 1986
(Lac de Peligre)**



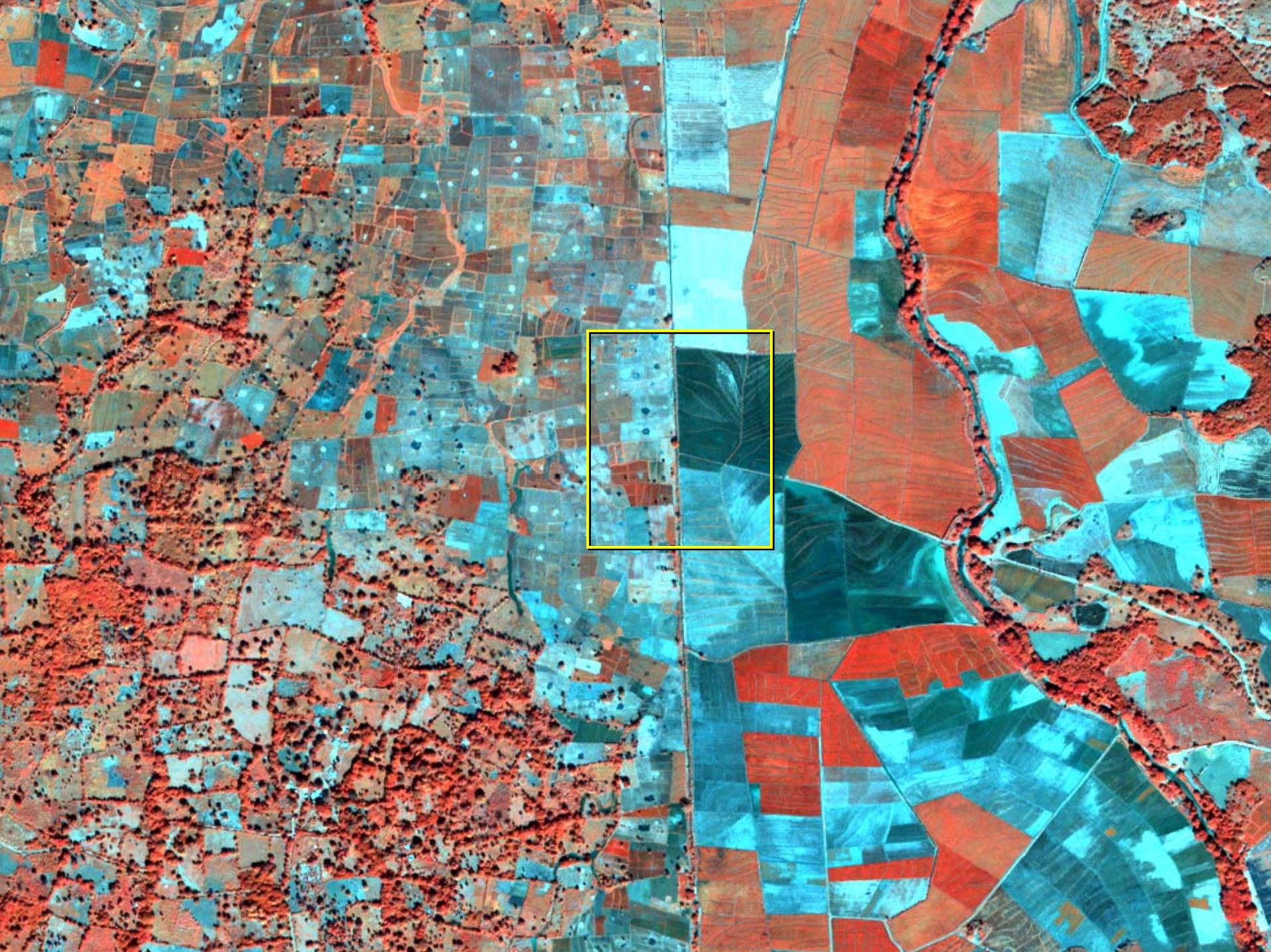
Artibonite Reservoir 1992 (Lac de Peligre)





Ouanaminthe

Dajabón







Atlas of the Caribbean

- ~ 80 – 100 pages
- Spring 2007
- Full Color – Soft Cover (\$)
- English, Spanish, French, Creole?
- Variety of remote sensing and GIS data
 - Landsat, MODIS, Space Shuttle/Station Astronaut Photography, QuickBird, SRTM, etc...
- Part I – Introduction
 - The Caribbean as a Region
 - Interpretation and Sources of Imagery
- Part II – Physical Environment
 - Terrain, Climate, Soils, Oceanography, Marine and Terrestrial Natural Communities, Natural Hazards
- Part III – Human Environment
 - Rural/Agricultural, Urban Landscapes, Commerce/Industry/Tourism, Borders
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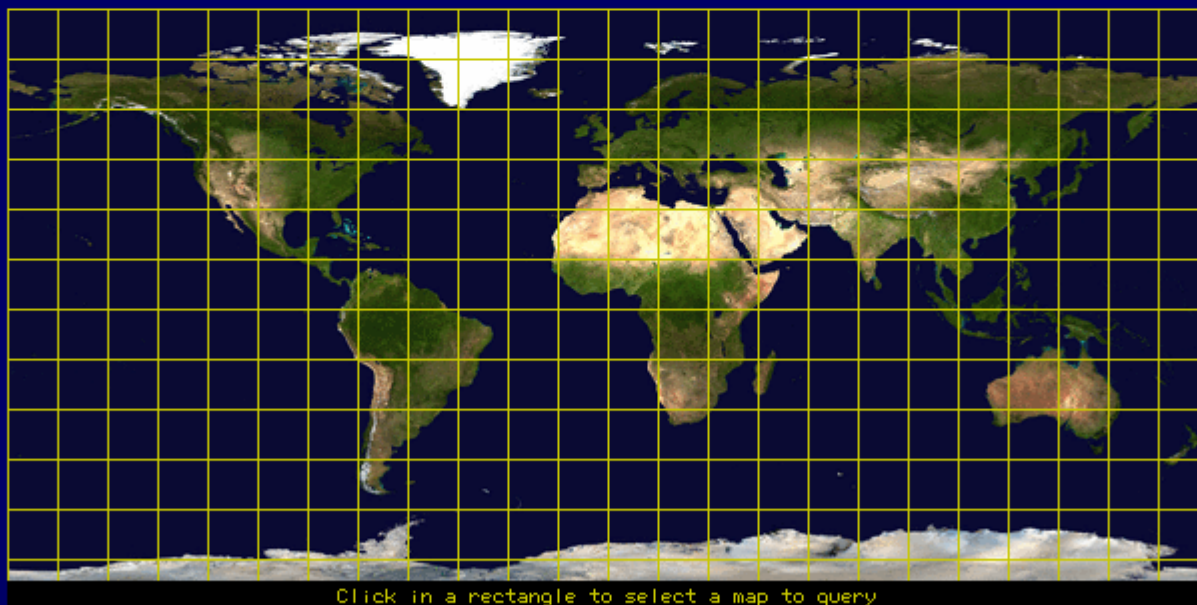
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International Space Station Photograph

ISS006E38024



International Space Station Photograph – color enhanced













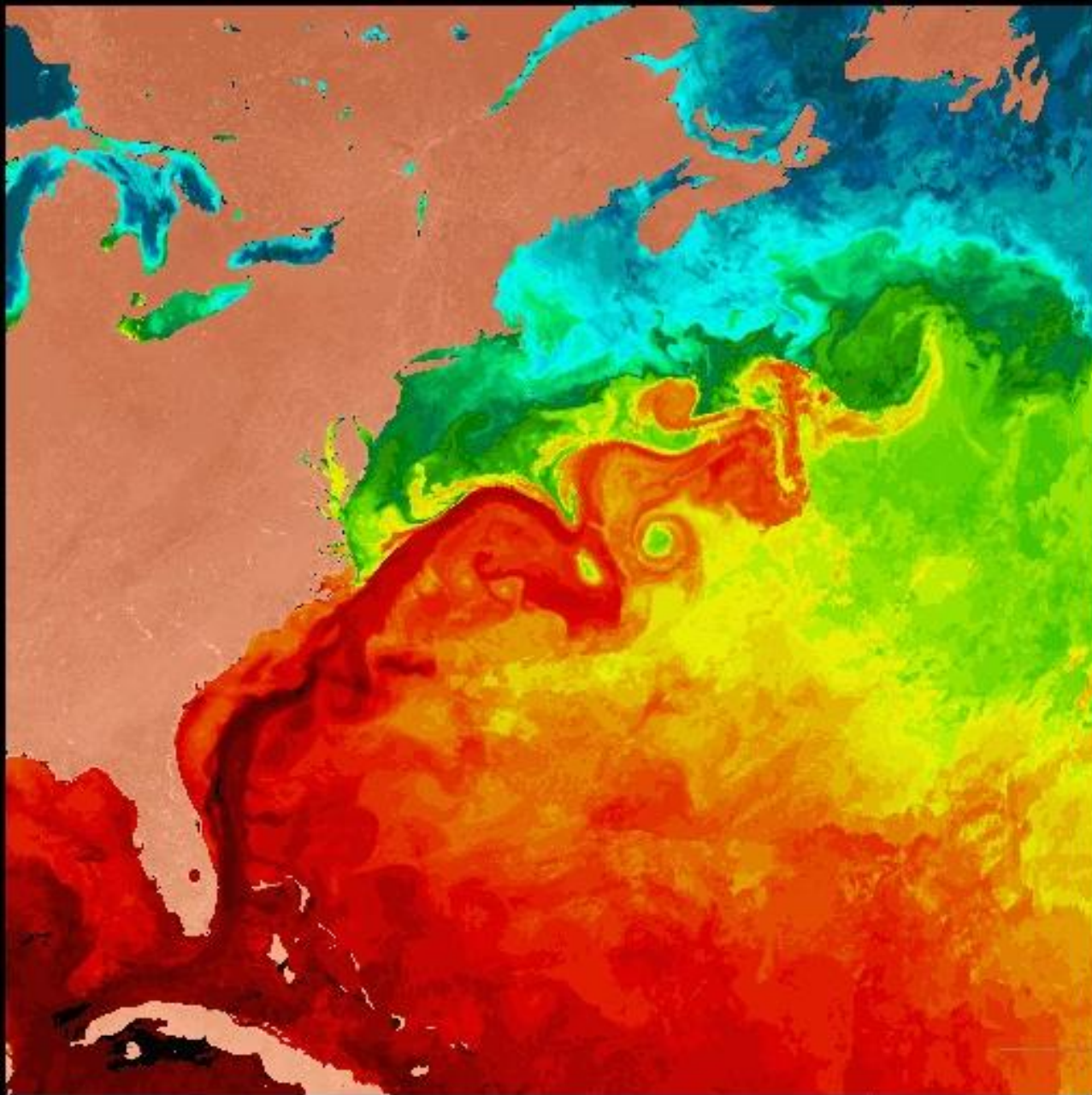
PLAN GÉNÉRAL DE L'ENCEINTE et des Ouvrages projetés pour Fortifier la Place de S.^{TO} DOMINGO

100 200 300 400 500 Toises
Echelle d'un pouce pour 100 Toises

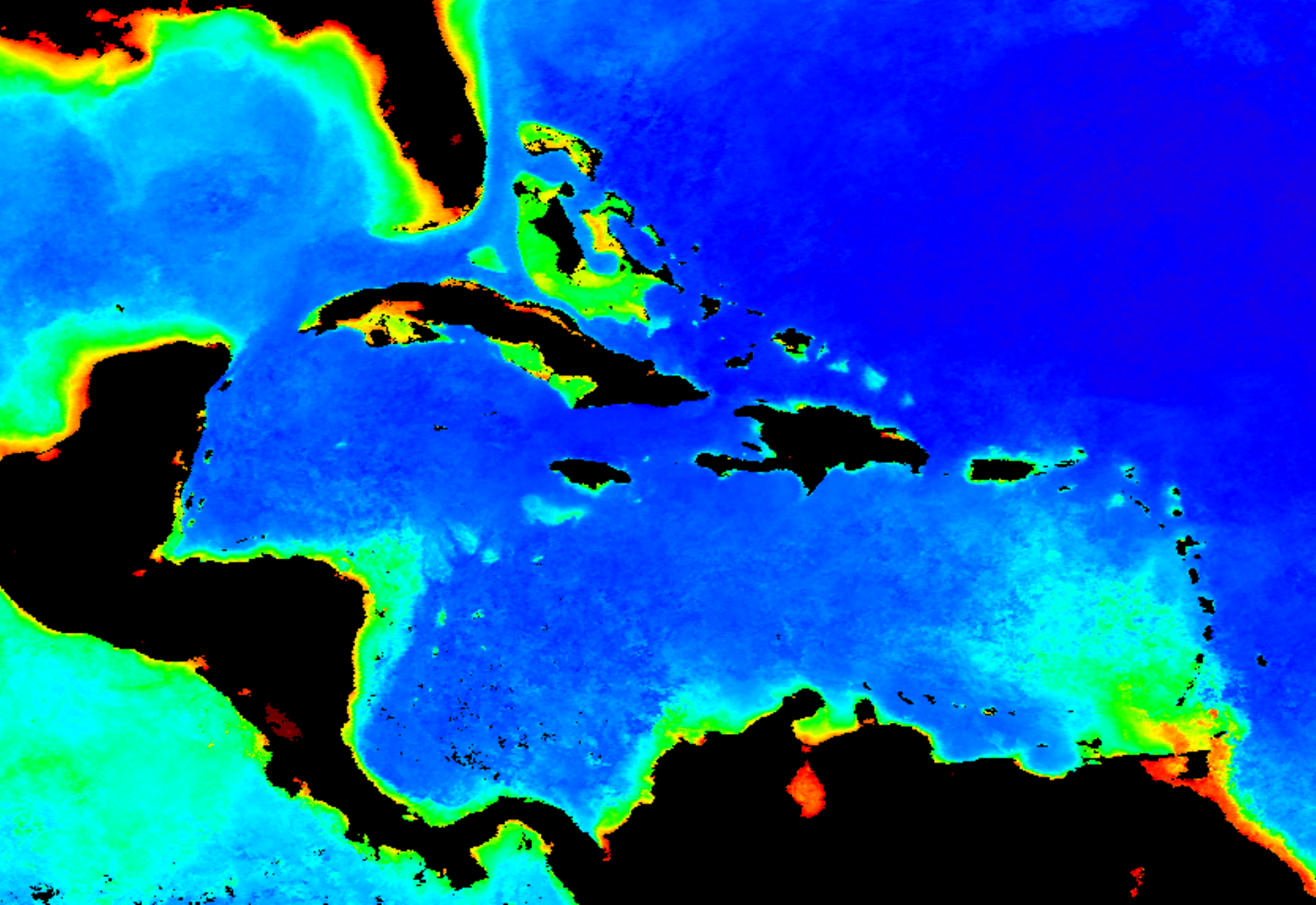








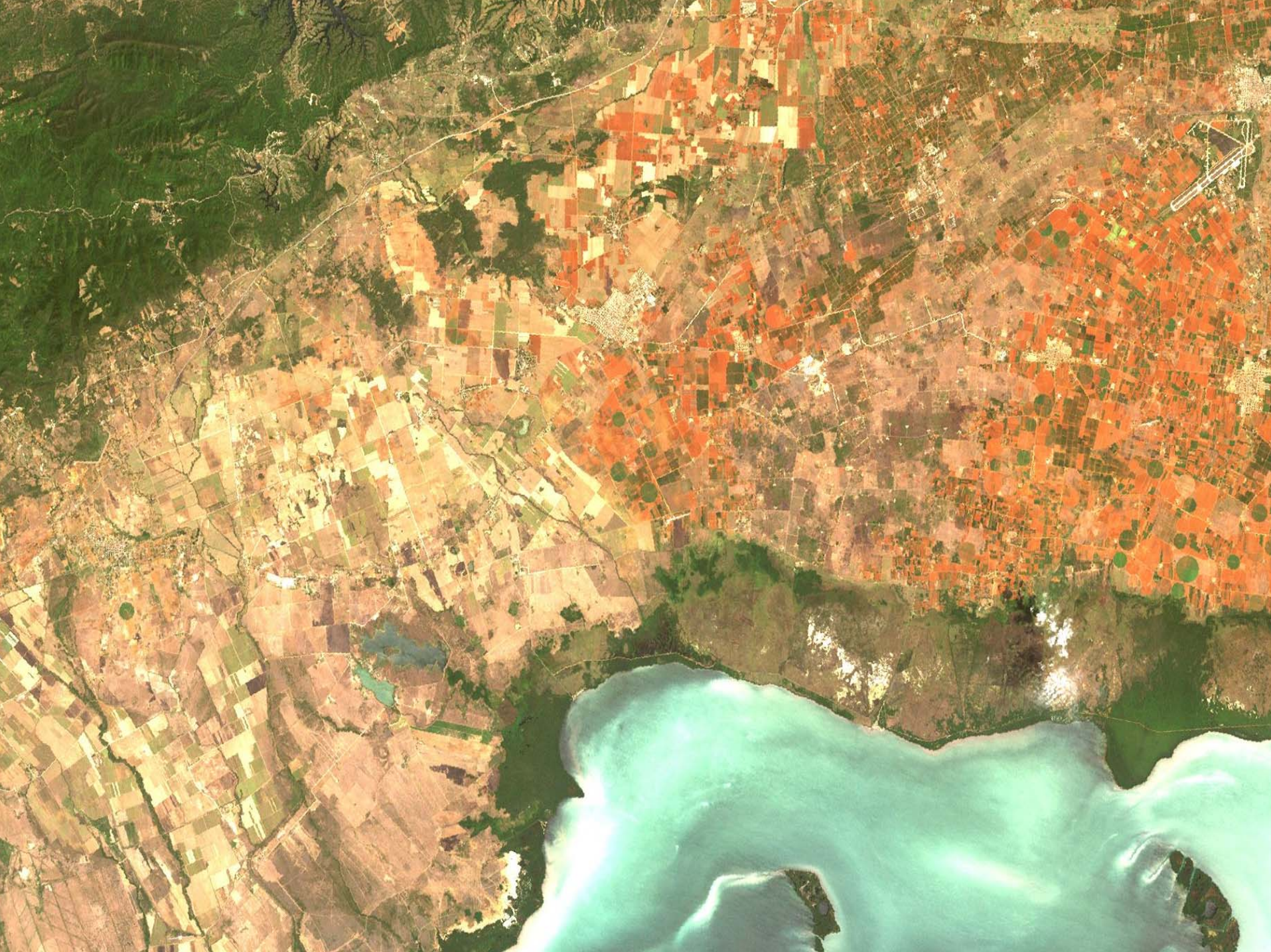
AQUA/MODIS SST



AQUA Chlorophyll Concentration



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