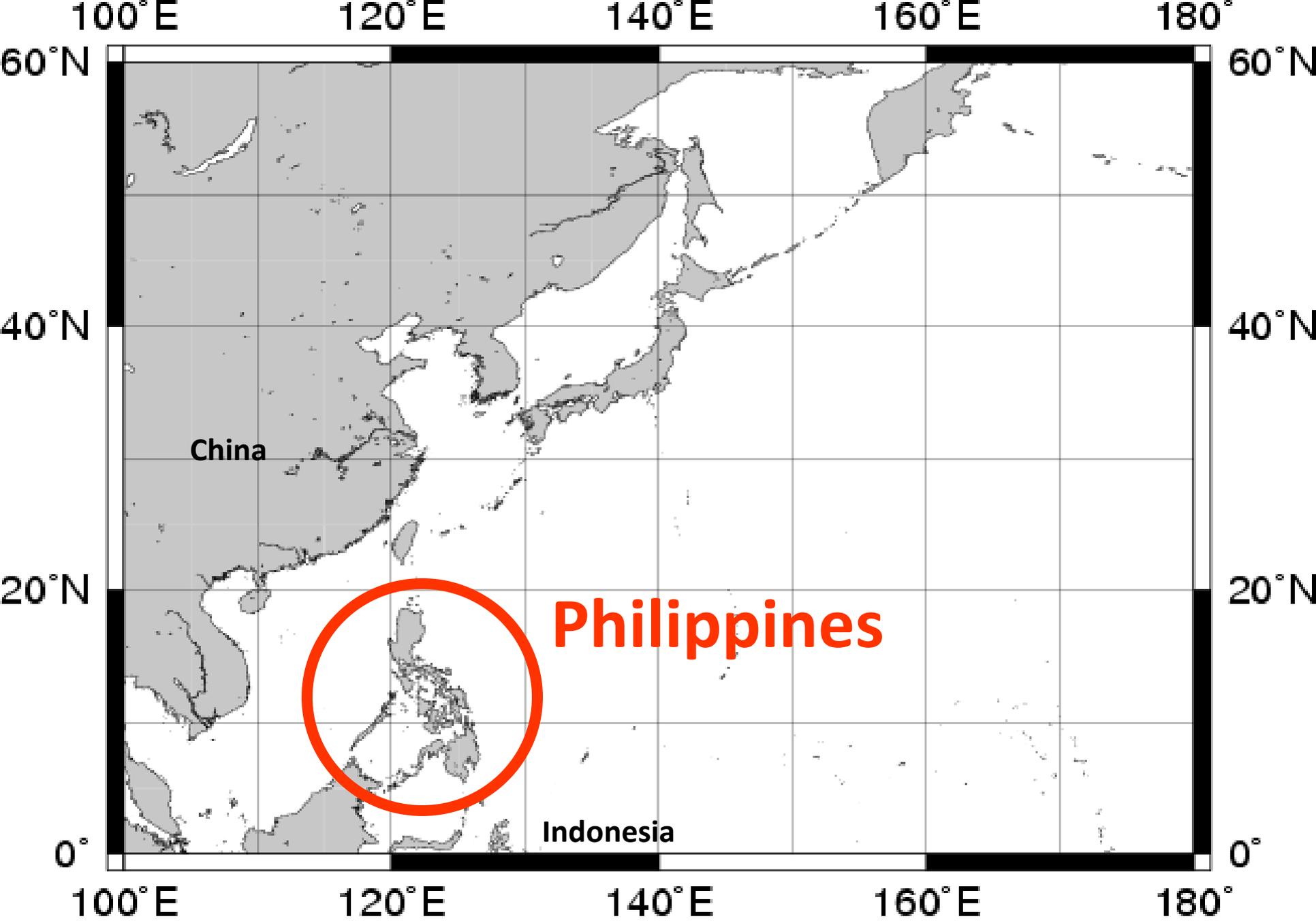


Lessons learned at the community level

John Ong, PhD
Manila Observatory

2016 International Training Workshop on Natural Disaster Reduction
27 September 2016



7,107 islands

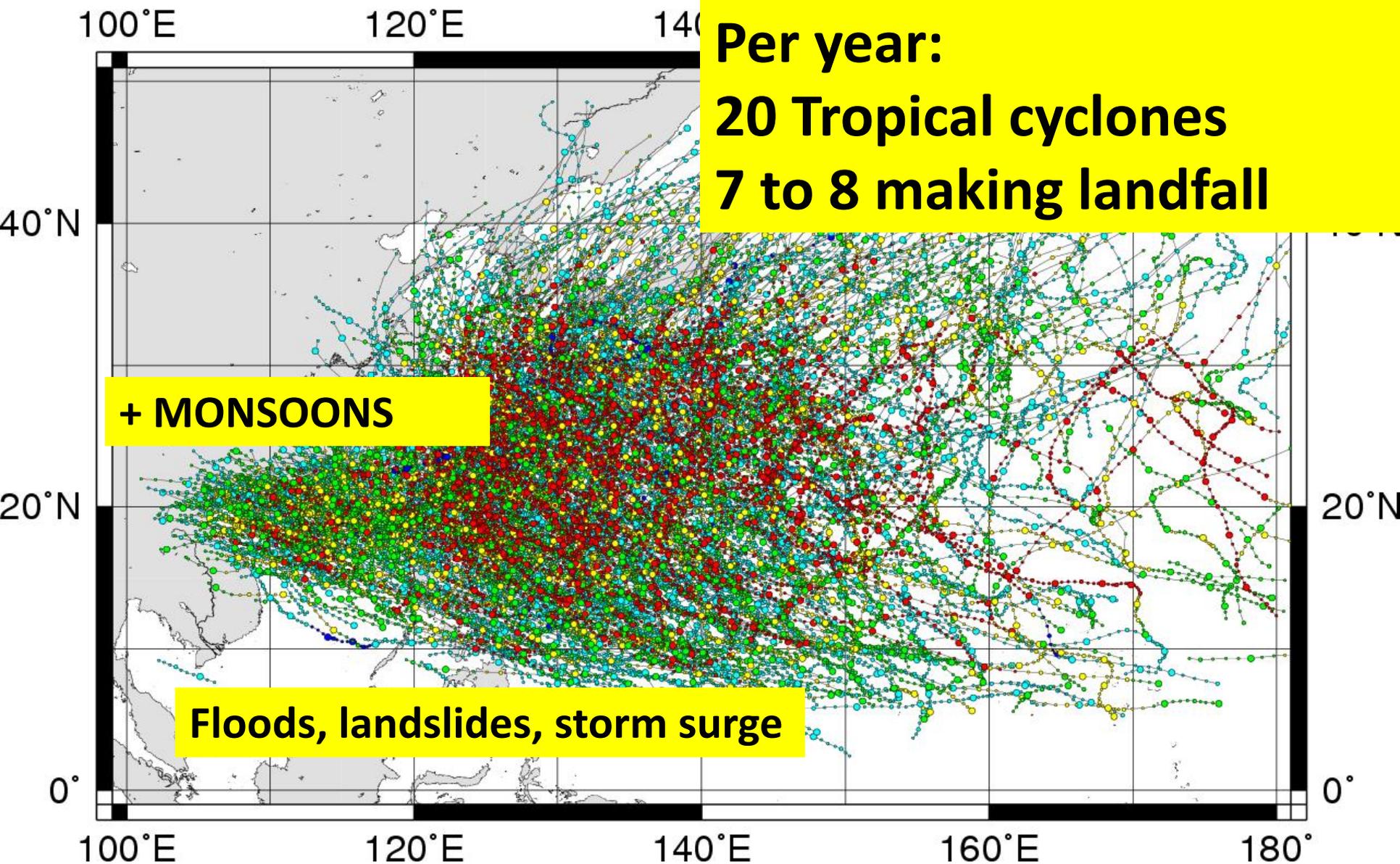


Mt. Pinatubo Crater Lake





Tropical Cyclone Tracks in the Western Pacific (1951-2003)



Volcanoes in the Phil

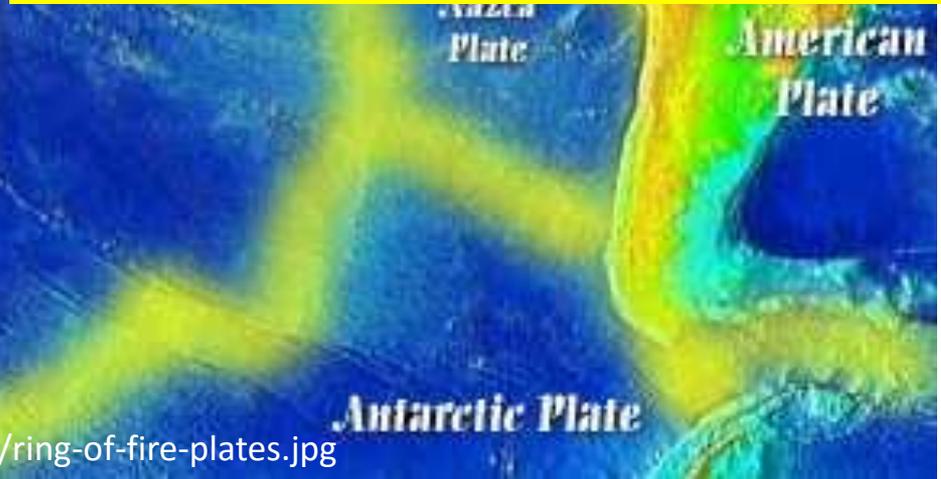
23 active

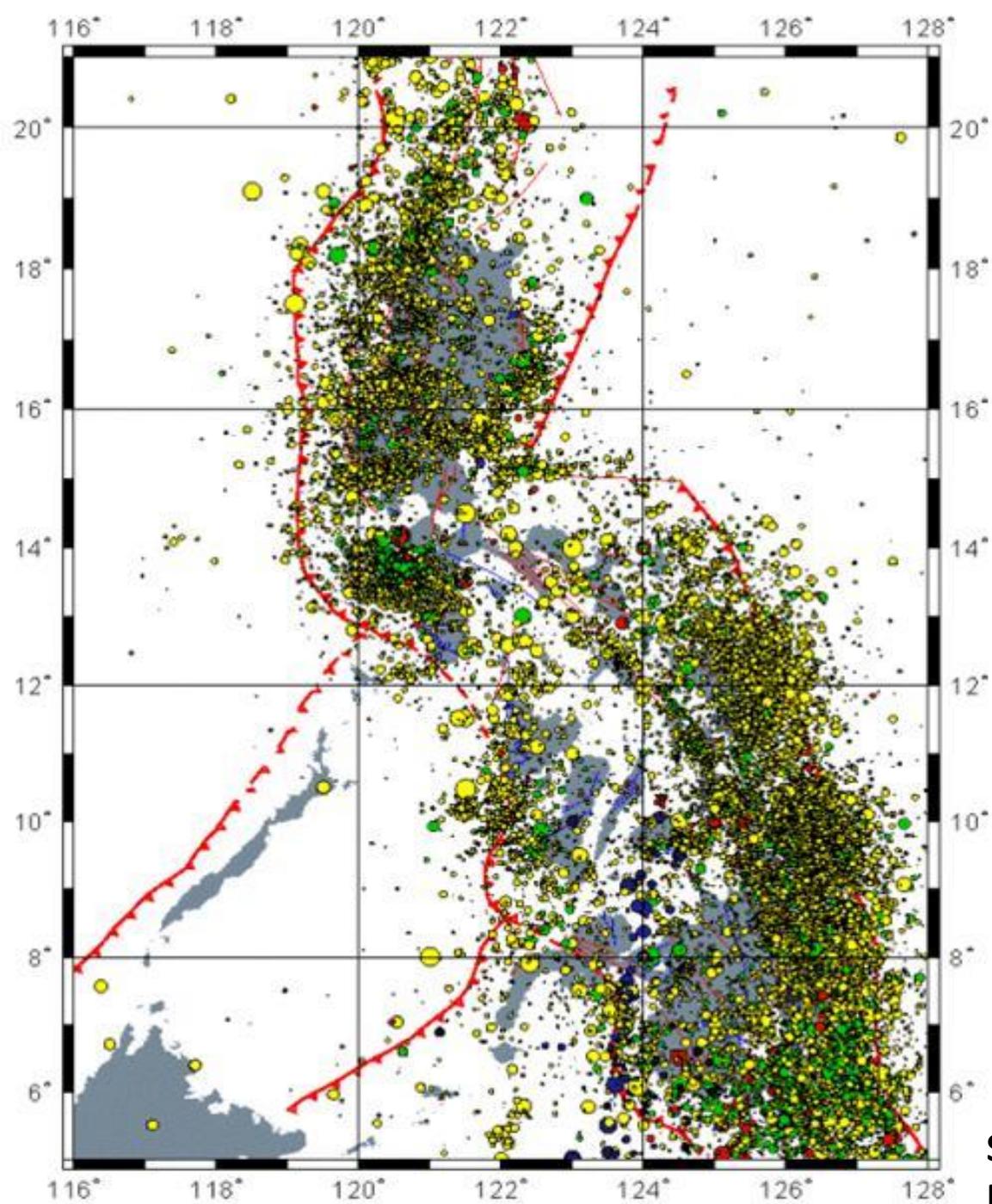
27 potentially active

358 inactive volcanoes

408 TOTAL

Official count





earthquakes

tsunami

Liquefaction

**Seismic Activity of the
Philippines (Phivolcs, 2005)**

- Physical scientist at the community level
- Humbling of science
 - Larger social reality
 - Dr. Uraywan
 - Period of environmentalism
 - (?, why people don't leave)
 - Approach
 - Communication: linear paradigm vs risk analysis framework
 - Listening (think and feel like them)
 - Sincerity



Loss of land
socio-economic deterioration
Armed Moro secessionist groups
> 4 decade of armed conflict
> 2M people displaced

MINDANAO CONFLICT

United States attacks the Spanish Squadron in Manila Bay 1898



Arab Tuan Mashaika founded first Muslim community in Sulu

1380



1400

1500

1600

1700

1800

1900

2000

1521

Spain conquers the Philippines

1946
Philippine independence









approaches

- Human security framework
 - Safeguard the basic human rights to survival, livelihood, and human dignity
- Military approach: winning hearts and minds
 - humanitarian offensive/campaign
 - Subtle characteristic: utilitarian objective (to strengthen internal security operations)
- How to address the Mindanao conflict? With sincerity.
 - sincere recognition to the crying needs of people and the sincere desire to help





– How to communicate

- Finding a common language (Mangyans)
- Understanding what happened (Leyte landslide)
- Raising awareness (fluvial systems)



Kyayat Tito, Mangyan Mission

Pinapakita ni Ginoong Reynaldo Bae na magaan ang bagong uri ng hugis bundok na mapa o 3D map, na yari sa plastic foam (Socorro, Oriental Mindoro, 8 Hunyo 2001).



Kyayat Tito, Mangyan Mission

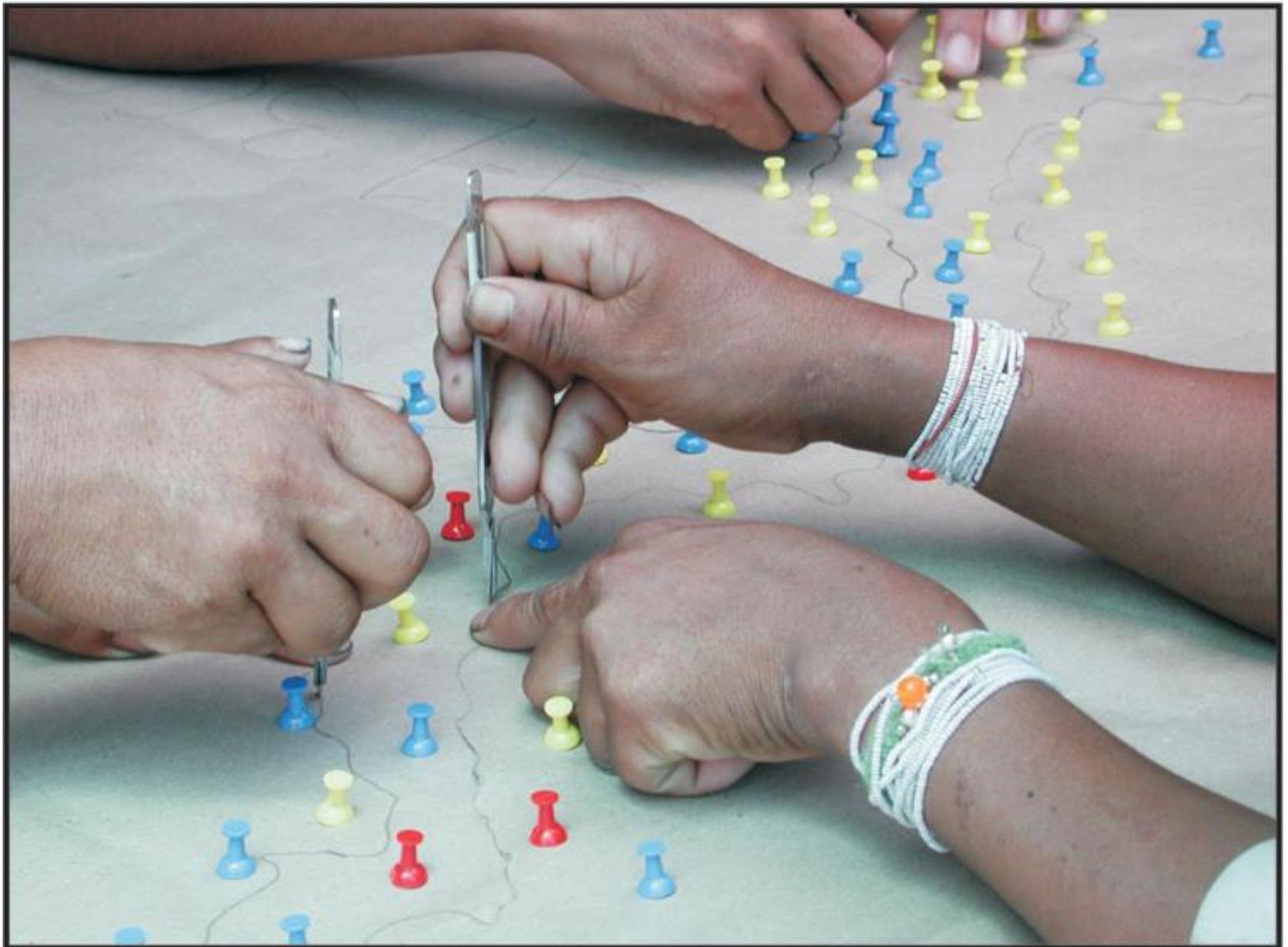
Ang hugis bundok na mapa ay mabubuo lamang sa pagtutulungan ng mga tao mula sa iba't ibang pamayanan (Bait, Mansalay, Oriental Mindoro, 23 Hulyo 2002).



Pagpapaliwanag ng mga tatlong hakbang sa paggawa ng 3D map (Bait, Mansalay, Oriental Mindoro, 24 Hulvo 2002).



Unang hakbang, ang pagbakat ng contour lines (Socorro, Oriental Mindoro, Abril 2001).



Pangalawang hakbang, pagtatapas, gamit ang surgical blade (Socorro, Oriental Mindoro, Abril 2001).



Kyayat Tito, Mangyan Mission

Isang Mangyan-Bangon, nagtatapas (Socorro, Oriental Mindoro, Abril 2001).



Kyayat Tito, Mangyan Mission

Pangatlong hakbang, ang pagdidikit (Bait, Mansalay, Oriental Mindoro, 28 Hulyo 2002).



Kyayat Tito, Mangyan Mission

Unti-unti nang nabubuo ang 3D map (Bua, Itogon, Benguet, 29 Hulyo 2001).



Kyayat Tito, Mangyan Mission

Pagtabas ng gilid ng mapa sa pamamagitan ng de koryenteng pamutol (Socorro, Oriental Mindoro 6 Hunyo 2001).



Pagpipinta ng mapa (Socorro, Oriental Mindoro, 5 Hulyo 2001).



Aparador para sa pagsasalansan ng mapa (Socorro, Oriental Mindoro 6 Hulyo 2001).



Ang 3D map ng Itogon, isinagawa upang malaman ang mga katutubong mapapahamak sa pagtayo ng San Roque Multi-Purpose Dam Project (Ampucaao, Itogon, Benguet, 5 Agosto 2001).





Kyayat Tito, Mangyan Mission

Pinag-aaralan ng mga Kankanaey ang lugar ng kanilang ari-arian na maaaring mapinsala sa pagtatayo ng San Roque Multi-Purpose Dam Project (Ampucao, Itoqon, Benquet, 7 Agosto 2001).



Kyayat Tito, Mangyan Mission

Pagtutukoy ng mga Mangyan Hanunuo sa hangganang ng kanilang lupaing ninuno (Bait, Mansalay, Oriental Mindoro).



Pagpipinta ng paggamit ng lupa ng mga Mangyan-Taw Buid.

– How to communicate

- Finding a common language (Mangyans)
- Understanding what happened (Leyte landslide)
- Raising awareness (fluvial systems)

The 17 February 2006 Guinsaugon Landslide, Leyte Island, Philippines



Alfredo Mahar A. Lagmay¹, John Burtkenley T. Ong², Dan Ferdinand Fernandez², Mark R. Lapus¹, Raymond S. Rodolfo¹, Arlene P. Tengonciang¹, Janneli Lea T. Soria¹, Eden G. Baliatan¹, Zareth P. Quimba¹, Christopher L. Uichanco¹, Engielle R. Paguican¹, Armelle Reca C. Remedio², Genevieve Rose H. Lorenzo², Francia B. Avila², and Wally Valdibia¹

¹National Institute of Geological Sciences, ²Manila Observatory



UP-Manila Observatory Team

17 Feb 2006: DAY 1 (FRI)

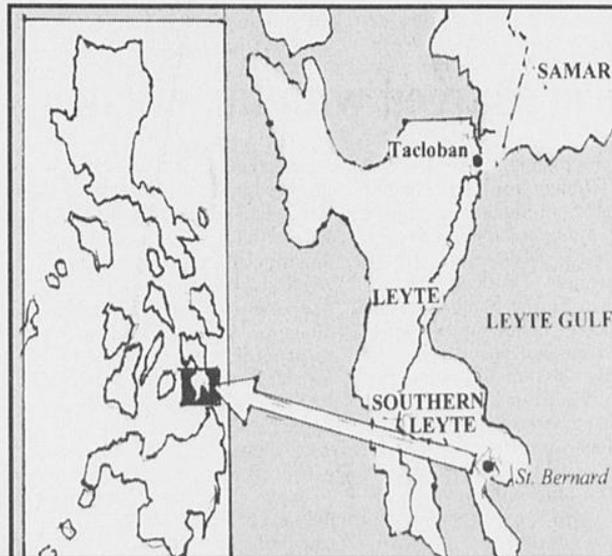
Malaya

ISSN 0115-8104 • VOL. XXV NO. 28 • SATURDAY, FEBRUARY 18, 2006

<http://www.malaya.com.ph>

2 SECTIONS • 20 PAGES • P15 IN METRO MANILA

Hundreds feared dead in Southern Leyte landslides 300 houses buried in 3 barangays



HUNDREDS were feared dead as mudslides brought about by weeks of heavy rains buried more than 300 houses in three barangays in Saint Bernard town, Southern Leyte, yesterday morning.

At least 14 bodies were recovered and brought to the municipal hall as of press time yesterday. Close to 100 were rescued alive. They are now at the Anahawan District Hospital.

The Philippine National Red Cross initially placed the numbers of those missing at 1,500.

Southern Leyte Rep. Roger Mercado said the death toll could reach 2,000 to 3,000. He told a radio interview that the town has an estimated population of 4,000.

Gov. Rosette Lerias said most of those feared dead were school children who were attending classes at the Guisajogon elementary school when the landslide occurred by

barangay was Guisajogon. Damage was not as extensive in Cabawagan and Sug-angon.

"Nagkaroon pa ng magnitude 2.6 na earthquake moments bago gumuho ang bundok papunta sa Barangay Guisajogon... Yung pagyanig na yun siguro ay dahilan na nang pagguho ng bundok," Lerias said in a radio interview.

Philippine Institute of Volcanology and Seismology director Rene Solidum said the tremor, which was recorded at 10:36 a.m., could not have possibly triggered the landslides.

He said 100 milliliters of rainfall in a day can cause a landslide.

Lerias said there were days when rainfall topped 200 milliliters in the province.

The 10-hectare town 670 kilometers southeast of Manila is dependent on fishing and farming. It has a vast coastline on one side and

10:26AM, landslide occurred

22 - 2 survivors

18 Feb 2006: DAY 2 (SAT)

The Sunday Times ★★
 Php15.00
 www.manilatimes.net

VOL. 107 NO. 132
 SUNDAY • FEBRUARY 19, 2006
 3 SECTIONS 26 PAGES

Looking for jobs abroad?
 Read the PASEI page for thousands of overseas jobs available in CAREER TIMES section of The Sunday Times today.

HAMAS-LED PARLIAMENT SWORN IN WORLDAG

BULLS TRY TO FINISH OFF GIANTS TODAY SportsA8

THE SOUND OF GENIUS IN 12 NOTES SundayTimesB1

'We're alive, dig us out!'

A desperate call from inside entombed school

A SERIES of desperate text messages spurred rescuers on after a massive landslide buried more than 1,400 people, including almost 250 students and teachers trapped in their school.

"We're still in one room, alive," read one message sent to Pamela Tiempo, whose mother is among the teachers stuck under the mire in the obliterated barangay of Guinsaugon in Saint Bernard, Southern Leyte. "We are alive. Dig us out," read another.

But the subterranean pleas for help stopped shortly after 7 p.m. Friday, at a time when there has only been silence.

"We're still very hopeful," Governor Rosette Lerias of Southern Leyte said. But the search by soldiers and volunteers using only spades and other hand tools seemed increasingly forlorn. **See ALIVE A2**

Rescuers struggle in sea of mud

BY OLIVER TEVES
 Associated Press Writer

GUINSAUGON, St. Bernard, Southern Leyte. The soldiers stepped carefully Saturday, worried that the waist-deep mud deposited by the landslide could shift and pull them under.

Hidden boulders tripped them. Downpour pelled them. Mounds of fresh debris occasionally cascaded down from a nearby mountain, remnants of the landslide Friday that wiped out the farming village of Guinsaugon and left an estimated 1,800 people dead.

Then, a whistle cut through the eerily quiet landscape. **See STRUGGLE A2**

⌚ Clockwise from top: A gash of brown running down the side of Mount Can-Abag reveals where the earth gave way and thundered toward Guinsaugon; soldiers recover a body from its murky tomb; one of the houses flattened by a torrent of mud.

PHOTOS BY AFP AND PAT ROQUEJAR

TODAY

PESO-DOLLAR RATE
 US\$1 = PHP51.80
 Closing price last Friday

EDITORIAL
Bittersweet charity
 ONE of the miserable moments in the aftermath of the Wosowee stampede is the sight of its host, Willie Revillame, a man never known for good acting, shedding tears and sobbing that he "only wanted to help people, to make them happy."

Gloria warns people in slide-prone areas

PRESIDENT Arroyo on Saturday warned residents of landslide-prone areas to be vigilant to avoid a similar calamity that struck a town in Southern Leyte Friday.

The President also ordered the creation of a multi-sectoral task force to look into the landslide in Guinsaugon, St. Bernard, Southern Leyte, and draw up a disaster preparedness program.

She mentioned Caraga in Mindanao and Antipolo City as landslide-prone areas.

"Having to compound the prospect of more landslides, the country needs to be vigilant, especially in places like Caraga and Antipolo and where the geologists tell us slides could occur," the President said.

She stressed the need for the national government to review its flood mitigation program and urged local governments to help by identifying the risk areas in their barangays, towns, cities and provinces.

"We must rally around as a people" Mrs. Arroyo called on the nation to join hands in supporting the victims' families and the survivors. "We must rally around as a people and a nation in this moment of grief. We know a better day is coming, but it is hard to imagine when the tragedy is so deep and heartfelt," she said. **See WARMS A2**

PHILIPPINE DAILY
INQUIRER
 BALANCED NEWS, FEARLESS VIEW

Monday, February 20, 2006 ★★ 5 sections / Vol. 21 / No. 4 P18 web

FORWARDED text message from the rubble: "Ma'am, we are still under the school. Please help us, ma'am. This Edilio Coquilla. Please ma'am." EDWIN BACAS

01:00 pm Edilio Coquilla texted Delia Prieto, the Central School Principal, St. Bernard:

"Maam di a pa mi lalom skol tabangi tawon mi maam. Edilio coquille ni pls maam."

250 grade school students buried

Malaya

ISSN 0115-8104 • VOL. XXV NO. 29 • MONDAY, FEBRUARY 20, 2006

<http://www.malaya.com.ph>

2 SECTIONS • 20 PAGES • P15 IN METRO MANILA

Day 3: 1,300 still missing

246 grade schoolers among them

THE death toll in last Friday's mudslides in Southern Leyte has reached 65 and the number of missing stands at 1,371, Maj. Gen. (ret.) Glenn Rabonza, administrator of the Office of the Civil Defense, said in a press briefing at Camp Aguinaldo yesterday.

He said at least five of the fatalities were children.

He said among those unaccounted for were 246 school children from the Guisajogon elementary school which was buried by mud.

Rabonza said those injured stood at 20. There are 410 survivors.

He said thousands of families from at least nine villages in St. Bernard town were taken to evacuation centers for fear of another mudslide as rains triggered by the La Niña weather pattern were expected to last until June.

"The search and rescue operations are ongoing at the moment. The primary focus of the search and rescue operations right now is at the school building," he said.

"We are hoping to recover more survivors," he said.

Lt. Col. Raul Farnacio, commander of the 43rd Infantry Battalion which is involved in search and rescue operations, said US Marines taking part in the Balikatan exercises in Basilan have been dis-



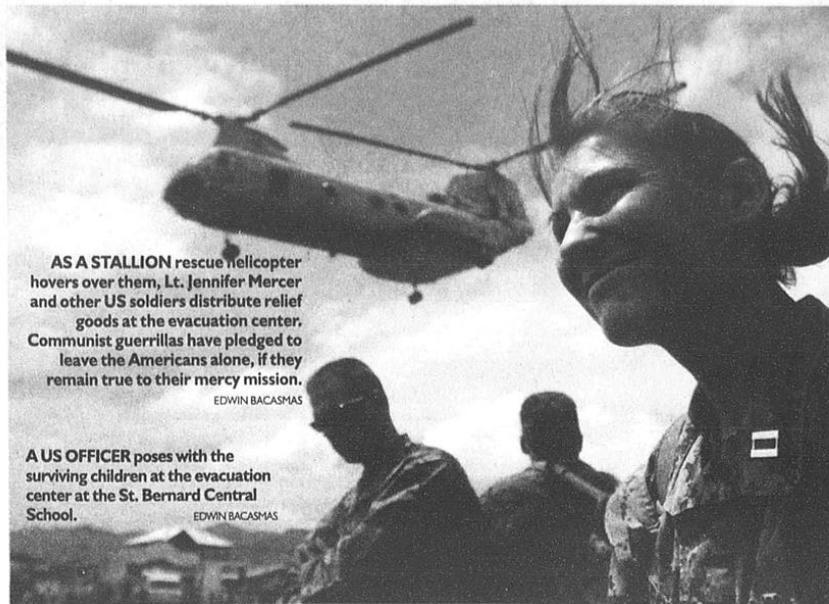
Racing against the clock. US Marines arrive in Chinook helicopters; right. Arroyo at Camp Aguinaldo.

19 Feb 2006: DAY 3 (SUN)

A22

PHILIPPINE DAILY INQUIRER

MONDAY, FEBRUARY 20, 2006



AS A STALLION rescue helicopter hovers over them, Lt. Jennifer Mercer and other US soldiers distribute relief goods at the evacuation center. Communist guerrillas have pledged to leave the Americans alone, if they remain true to their mercy mission.

EDWIN BACASMAS

A US OFFICER poses with the surviving children at the evacuation center at the St. Bernard Central School.

EDWIN BACASMAS

LANDSLIDE RESCUE MISSION

US soldiers land in Leyte

By Volt Contreras

ST. BERNARD, SOUTHERN LEYTE—Only three months ago, their image took a beating in street protests, public forums and congressional hearings after four of their men were accused of raping a Filipino woman at the Subic Freeport.

But controversy took a backseat yesterday as American soldiers taking part in the "Balikatan" exercises began arriving here to take part in rescue and relief efforts for victims of a landslide that buried an entire village.

The humanitarian contingent was mainly from the US 31st Marine Expeditionary Unit based in Okinawa, where the rape suspects were also stationed prior to being held under US Embassy

custody to face trial.

Thunderous Hilo helicopters landing near an evacuation center announced the presence of the US military volunteers in this grief-stricken town.

At least 15 US soldiers were seen setting up a command post at the municipal hall grounds.

Another group of officers, including a Filipino-American chaplain, surveyed the disaster site.

2nd Lt. Edward Rushing said his initial assessment showed that up to 75 US servicemen could be deployed to assist local rescuers.

Up to 1,000 of the 6,000 US troops taking part in the Balikatan exercises can be tapped to work here, said Lt. Col. Don Biadog, a chaplain of the brigade.

"I also did rescue operations in the 9-11 attacks but this is something

else," said Biadog, a Filipino-American originally from Bacolod City. "What I saw was mind-boggling and horrendous. I've never seen anything like this."

"I especially feel bad about the kids," said Biadog, referring to the more than 200 children feared buried in a local school.

Visibly more organized three days after the tragedy, the rescue teams are still on a "search-and-rescue mode," said Army Maj. Gen. Bonifacio Ramos, commander of the 8th Infantry Division.

They were nevertheless ready with more body bags and sacks of lime for new corpses to be found.

Amid the roar of bulldozers and choppers, Fr. Jose Labrador of the San Agustin Parish said Mass for the victims before noon.

Rebs guarantee safety of GIs on rescue mission

COMMUNIST GUERRILLAS SAID YESTERDAY they won't attack American troops sent to help a landslide-hit province, but warned them not to stray into rebel zones or commit provocative acts.

The New People's Army guerrillas are active on Leyte island, where a massive landslide buried an entire farming village Friday, triggering fears that as many as 1,800 people may have been entombed alive.

In January, the guerrillas raided a police station in Leyte's Albuera town, seizing 31 M-16 rifles and pistols.

"The NPA's, if they would not be provoked, would not take steps against them, especially in this time of calamity," rebel spokesperson Gregorio "Roger" Rosal said.

But he said the rebels would react if

the Americans took a direct role in any covert anti-insurgency operation and ventured into their strongholds under the cover of their humanitarian mission, Rosal said.

"Of course, we don't believe that they are there for purely humanitarian reasons," he said.

The guerrillas are on US and European lists of terrorist organizations. They suspended Norwegian-brokered talks with the government in 2004, saying Manila has refused to take steps to remove them from the terror blacklists.

They have escalated attacks in recent months, hoping to help bring down President Macapagal-Arroyo who survived an impeachment last year over allegations she rigged the 2004 election. The rebels have condemned her as a US lackey. **AP**

19 Feb 2006: DAY 3 (SUN)



■ A Taiwanese rescue team uses sound detecting probes to detect signs of life under the tons of mud and debris in Guinsaogon.

TAIWAN RESCUE TEAM

PHILIPPINE DAILY **INQUIRER** BALANCED NEWS, FEARLESS VIEW

Monday, February 20, 2006 ★★ 5 sections / Vol. 21 / No. 74 P18 web

Faint sign of life in buried school

Rescuers hear scratching, raise hopes for over 200 pupils

By Volt Contreras,
Vicente Labro and Jani Arnaiz
PDI Visayas Bureau

ST. BERNARD, Southern Leyte—Rescuers racing against time said yesterday they heard “scratches” indicating signs of life apparently coming from a schoolhouse buried in a landslide with over 200 children and teachers inside it.

The Guinsaogon Elementary School (GES) in this town had been the emotional focus of search and rescue operations after a deadly avalanche of mud and rocks swamped Barangay Guinsaogon and buried close to 2,000 people. Many of the villagers were feared killed.

“It went on for more than a minute. It was like a sheet of metal being scratched,” mountaineer Lt. Rtd Esguerra, a member of the Philippine Coast Guard medi-



THE LONG ANXIOUS WAIT for word on the missing is what is killing these survivors of the landslide as they stand behind the rope while rescuers do the arduous work of finding survivors and recovering the dead. So far rescuers have found no survivors.

19 Feb 2006: DAY 3 (SUN)

http://www.phinstar.com

THE PHILIPPINE
STAR

TRUTH SHALL PREVAIL

VOL. XX NO. 207 • MONDAY, FEBRUARY 20, 2006 • 8 SECTIONS, 68 PAGES P15 MM



DESPERATE SEARCH: Filipino soldiers scour the grounds of the farming village of Guinsaugon in Saint Bernard, Southern Leyte for survivors. At right, a rescue team member searches for signs of life in the mud.

No signs of life

By ROBERTO DEJON

SAINT BERNARD, Southern Leyte – After more than 48 hours of digging into what is left of Barangay Guinsaugon here, everyone speaks in hushed tones, ears to the ground, hoping the slightest sound would signal that life still stirs under tons of mud.

The search has been complicated by heavy rains, on top of the threat of another landslide from an adjacent mountain as well as the possibility that the rescuers themselves could get sucked into the soft, shifting mud.

Isidro Elumba, team leader of an emergency rescue team from Surigao City, said the possibility was remote that any more survivors could be pulled from the sea of mud and boulders that crashed down on Barangay

Guinsaugon last Friday.

"We need miracles to find (any more) survivors," he said.

Health department official Cornelio Solis, when asked if anyone could have survived this long, said, "By this time I don't think so. There is no way they could survive this by now."

"I have been to ground zero, and there is water and mud seeping through," he said.

As rescuers from all over the world

arrived in this small farming village, they also said that nobody could have survived 48 hours trapped underneath tons of mud.

An international team of rescuers joined the military and local volunteers in trekking to the site.

The situation remained so dangerous yesterday that even some volunteers were kept out of the area.

The Philippine Air Force and local

Turn to Page 12



Hope springs eternal for GMA

By PAOLO ROMERO

The government is not losing hope as it is mustering all its resources to try and unearth more survivors from the deadly mudslide in Southern Leyte last week.

Ten feared dead in Zambo mudslide

19 Feb 2006: DAY 3 (SUN)

**Manila Observatory – UP team
was mobilized**

20 Feb 2006: DAY 4 (MON)



■ Helicopters land on Monday in the Leyte barangay where almost a thousand victims of the landslide are still missing. Two thousand US Marines arrived to help in the search and rescue work. PHOTO BY RUY MARTINEZ

Bad weather clogs Leyte rescue work

MALACANANG on Monday reactivated its "situation monitoring room" where President Arroyo could constantly get the latest on relief, rescue, recovery and retrieval operations of the National Disaster Coor-

minating Council, the Red Cross and the local government units in Southern Leyte and Zamboanga.

Presidential Chief of Staff Mike Defensor in an interview at Villamor Air Base in Pasay

City said on Monday that the situation monitoring room was set up because President Arroyo wanted nothing less than the freshest picture of the calamity-stricken provinces.

See WORK A2

20 Feb 2006: DAY 4 (MON)

email: feedback@inquirer.com.ph

PHILIPPINE DAILY **INQUIRER** BALANCED NEWS, FEARLESS VIEWS

Tuesday, February 21, 2006 ★★★ 4 sections / Vol. 21 / No. 75 P18 website: www.inq7.net

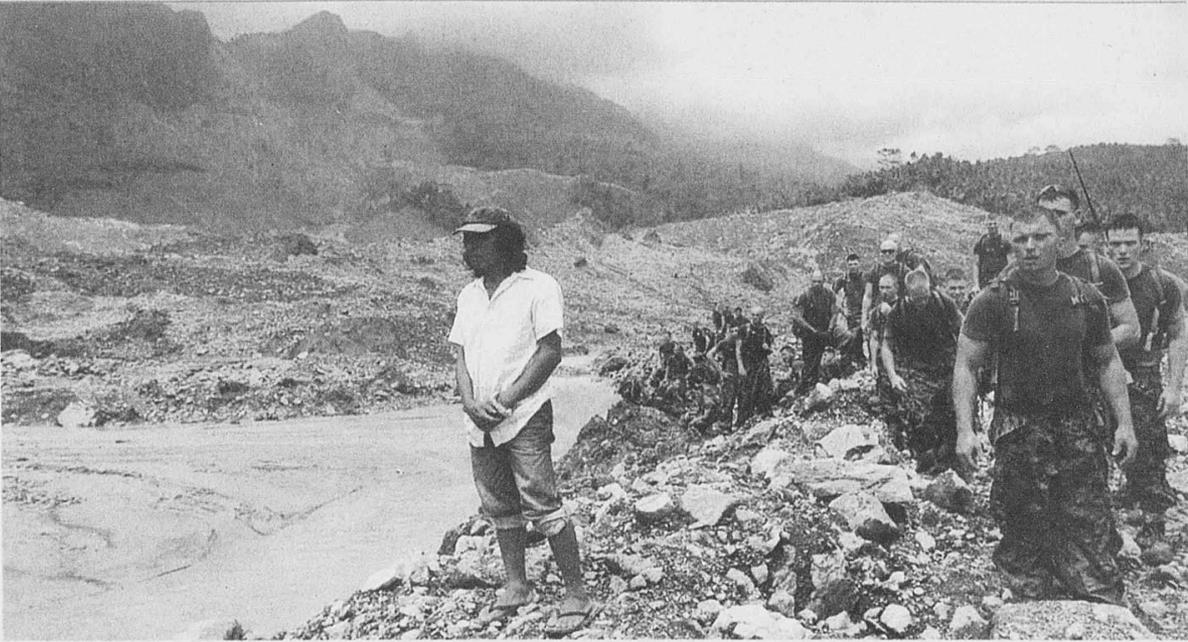
GMA sends off Spanish rescue team, dogs to Leyte

By Nikko Dizon

THREE K-9 DOGS SENT by the Spanish government to assist in the search-and-rescue operations in Southern Leyte had no less than President Macapagal-Arroyo



GMA SENDS / A16



FARMER Venancio Mencede, 50, leads US Marines to where his house once stood in Barangay Guinsaugon hoping they could find what he has lost. His daughter Chona was at the village elementary school that disappeared under the mudslides last Friday.

EDWIN BACASMAS



EDWIN BACASMAS

Voices heard below the ground

UNEXPECTED VISITOR: Business tycoon Lucio Tan surveys the wasteland on Monday. (See Page A17.)

By Volt Contreras, Jani Arnaiz and Connie E. Fernandez
PDI Visayas Bureau

ST. BERNARD, SOUTHERN Leyte—First there were “scratches” on what seemed like a metal

sheet. Then rhythmic tapping. Finally, there were sounds like human voices.

Hope was coming in trickles yesterday but it was enough to lift the spirits of rescue teams scrambling to save about 250 children and teachers feared buried in a

school that disappeared under a massive landslide.

Gov. Rosette Lerias told the *INQUIRER* at about 4 p.m. that she just got a report from a Filipino rescue team that it had just heard “very faint rhythmic tapping” at the site

VOICES / A16

Malaya

ISSN 0115-8104 • VOL. XXV No. 30 • TUESDAY, FEBRUARY 21, 2006 <http://www.malaya.com.ph> 2 SECTIONS • 18 PAGES • P15 IN METRO MANILA

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FVR DISGUSTED OVER EDSA I FLAP **OPINION P.A5** 

BENCH IS KEY IN BULLS' TITLE RUN **SPORTS P.A8**

BSP TELLS BANKS TO GO EASY ON JOINT VENTURES ON PROPERTY DEVELOPMENT **BUSINESS P.B9** 

Signs show up to 50 children are alive

Rescuers focus on schoolbuilding

SEARCH teams battled through deep, shifting mud and steady rain yesterday as retrieval operations focused on a school packed with more than 250 children and staff when mudslides erupted in Guinsaugon, a barangay in St. Bernard town, Southern Leyte last Friday.

Around 7 p.m., rescuers rushed to the school site after members of a newly arrived Taiwanese team said every rapping sound they made was answered back by noise by the sound apparently produced by knocking two pieces of rocks.

Rescuers said as many as 50 of the children could be alive. As of yesterday 81 bodies had been recovered, of which 36 were identified, the National Disaster Coordinating Council said. Those missing were still pegged at 1,350. The number of survivors remained at 415. At least 19 were injured.

There was a fresh glimmer of hope on Sunday and Monday when sensing equipment detected sounds from the school, but rescuers were not sure about what they heard.

"The signs of movement may be falling rocks or running water," said Col. Rod Ferracis, in charge of the Army's operations.

A three-year-old girl, among the first to be saved on Friday, died in the hospital from injuries, television station ANC said.

Bleated and decomposing, 50 recovered bodies were buried Sunday in mass graves sprinkled with holy water and lime.

Health Secretary Francisco Duque said this was necessary to prevent disease from spreading. "They are being buried in such a way that they can be exhumed later," he said.

President Arroyo checked relief goods and dog teams flown from a military airbase in Manila on Monday. She plans to visit the scene of the disaster tomorrow or Thursday.

International agencies have also sent supplies, but many of the emergency goods must be transported on bad roads and around washed-out bridges or tracks.

Although the President had pledged to recover all of the



Rising above the mud flood. A picture of the Sacred Heart stands as a mute witness to Guinsaugon tragedy. PHOTO: JERRY S. DELA CRUZ

Geo-hazard mapping was derailed by funds lack

FORMER Welfare Secretary Condon "Dinky" Soliman yesterday criticized the Arroyo administration for splurging on the successful complaint against President Arroyo instead of funding geo-hazard mapping which she said could have averted the landslide incident in Saint Bernard town, Southern Leyte last Friday.

"Bakit tong pinapayats na yung impeachment ang lamang penal? Bakit sa ginoo ng oras na lang naging ngayon wala pa?" Soliman said in an interview. "Inbes na unahin ang project muna pa ng gobyerno ang pulitika. Ngayon andon na raman ang charter change."

A geo-hazard map pinpoints areas which are vulnerable to natural calamities.

The areas are Isabela, Cagayan, Quirino, Aurora, Quezon, Samar, Leyte, Bicol region, Surigao, Agusan del Sur and del Norte and Davao Oriental and del Norte.

Soliman said planning, surveys and studies for the geo-hazard map were completed as early as June 2005.

"What we were waiting for at the time was the funding, which had been validated by (Defense) Secretary (Weslino) Cruz," Soliman said.

Cruz, who also chairs the National Disaster Coordinating Council, said last week in a press conference on disaster preparedness that lack of funds is the main culprit that delayed the completion of the hazard map. He added that it would cost the government about P80 million.

Soliman chided the government for its "reactive" policy when natural and man-made calamities strike, saying that they speak vol-

See GEO-HAZARD ► Page A6

MEGALOTTO 6/45

Feb. 20, 2006

11 25 30 37 10 32

P24,876,172.80

WEATHER

Metro Manila: Partly cloudy with scattered rain showers and thunderstorms.

Rest of the country: Northern and Eastern Luzon mostly cloudy with scattered rain showers. Eastern Visayas and Mindanao mostly cloudy with scattered rain showers and scattered thunderstorms. Elsewhere, partly cloudy to all times cloudy with isolated thunderstorms.

Temperature extremes: Today, 22-31 degrees Celsius; yesterday, 22-30 at 5:00 a.m., 31.2 at 2:00 p.m., Sunrise: 6:17 a.m., Sunset: 6:02 p.m. (Source: PAGASA)

THE PHILIPPINE STAR

TRUTH SHALL PREVAIL

VOL. XX NO. 208 • TUESDAY, FEBRUARY 21, 2006 • 5 SECTIONS, 48 PAGES P15 MM

'There's something down there'

Sound of life or shifting mud?

American and Malaysian officials said yesterday high-tech seismic-sensitive gear has detected sounds at the site of an elementary school in Saint Bernard, Southern Leyte that was buried by a mudslide, raising hopes on what was mostly a frustrating day for local and international rescuers.

It was unclear whether the sounds were made by survivors or whether the soft, unstable mud covering the school was shifting and settling.

The search for survivors from the landslide that swamped the farming village of Guinsaugon has focused on the school because of unconfirmed reports that some of the 250 to 300 children and teachers may have sent cell phone text messages to relatives soon after the disaster Friday.

However, no survivors have been pulled from the 40-hectare morass that used to be Guinsaugon since Friday, when a rain-drenched mountain collapsed in a hail of earth, boulders and trees — burying the school in mud believed to be up to 115 feet deep.

"We know there's something down there," US Marine Lt. Richard Nekirk said as he pointed to a spot under a big boulder, where seismic sensors detected sounds. "The farther down we went, the signals grew stronger."

A Malaysian team using sound-detection gear picked up noises, too.

"We have a sound," said Sabar Yunus of the Malaysia Disaster and Rescue Team. Turn to Page 8



HARD SLOG: US Marines trudge toward an area where an elementary school is believed to be buried under about 100 feet of mud yesterday. At right, Filipinos retrieve a body from the landslide. Incessant rains have hampered search and rescue operations. PHOTO: GUY LAWRENCE

'Balikatan' opens; US commits 3,000 troops to landslide aid

The US military said yesterday it was committing up to 3,000 troops to help after a huge landslide in a farming village in Southern Leyte, as the hunt for survivors became a grim search for bodies instead.

A Malaysian team using sound-detection gear picked up noises, too.

"We have a sound," said Sabar Yunus of the Malaysia Disaster and Rescue Team. Turn to Page 8

Man leaves Las Vegas to find 10 missing kin

SAINT BERNARD, Southern Leyte — His chubbiness by frame half buried in the thick mud, Las Vegas car salesman Norman Barrister is waging a desperate personal search for 10 members of his family buried alive by a Philippine landslide.

After sneaking past military rescue personnel before dawn yesterday, the 35-year-old Barrister navigated by memory through a sea of mud and rocks that cascaded down the slopes of Mount Canabag last Friday and buried his childhood home in the farming village of Guinsaugon.

This is the same mountain slope that once provided his family members with their livelihood — his grandfather tended a coffee plantation there. Now, it's just a heap of rubble.

Tears streamed down his mud-caked face as he alternately used his hands and a shovel to dig. Barrister said he still hopes his relatives are alive three days after the tragedy.

Seventy-two bodies have



'A rushing river of debris'

ANAHAWAN, Southern Leyte — A tree trunk saved Florencio Libaton as a flood of mud and debris swept him along, for Irena Velasco, it was a pool table.

They were among the few tales of survival after a landslide left their farming village of Guinsaugon in nearby Saint Bernard town little more than a memory.

They recounted their tales Sunday at Anahawan District Hospital, where they are recovering after being buried by the mud, boulders and trees that killed most of the village's 1,800-plus residents two days earlier.

Libaton said he was resting at home when his wife, Porfiria, rushed in, saying "The mountain has collapsed."

His first thought was his children — a son and two daughters — at the nearby elementary school, but his wife said it was too late. The school, and its 250 to 300 pupils and teachers, had been buried.

"I grabbed her by the arm and they ran," he said. The landslide quickly gained on them, rocks and boulders slamming against each other in soupy mud rushing down the slope of the mountain, heading directly for Guinsaugon.

"I said, 'God, is this how we are going to die?'" Libaton said.

The rolling debris was too fast. Overwhelmed by its

Hopes dim for montilla

By NEIL D. MORALETA and CAROL L. VENTURA
ST. BERNARD: S. Leyte — Dry humor could not perk up the low spirit of the people here on Monday as hopes dimmed for survivors among the missing, placed at 1,430 to 2,000 people, including children, in the mudslides that covered the whole village of Guinsaugon in this town.

On the second and third days, rescuers dug up 72 bodies. They found no survivors. With rains triggered by La Niña returning intermittently over the weekend, rescuers were racing against the clock.

Southern Leyte Gov. Rosette Leticia, who earlier took over all command of the operations, said "Rescue operations have been very difficult," but showed no sign of slacking up. "We are exhausting everything and we are doing the best we can under the circumstances," she said.

"Our top priority now is rescue and we are going to zero in on the school building," she said.

There were 246 pupils and six teachers who were swallowed by the sea of mud that buried the building.

Hopes there were survivors rose when a text message was

See HOPES ► Page A6

Turn to Page 8



RESCUE 505



KENTUCKY
BASKETBALL

PHIL ARMY



PHIL ARMY



RESCUE 505



The UP-Manila Observatory Team leaves for Cebu via private plane of Mr. Pangilinan.

Day 4, Mon, 20 Feb 2006

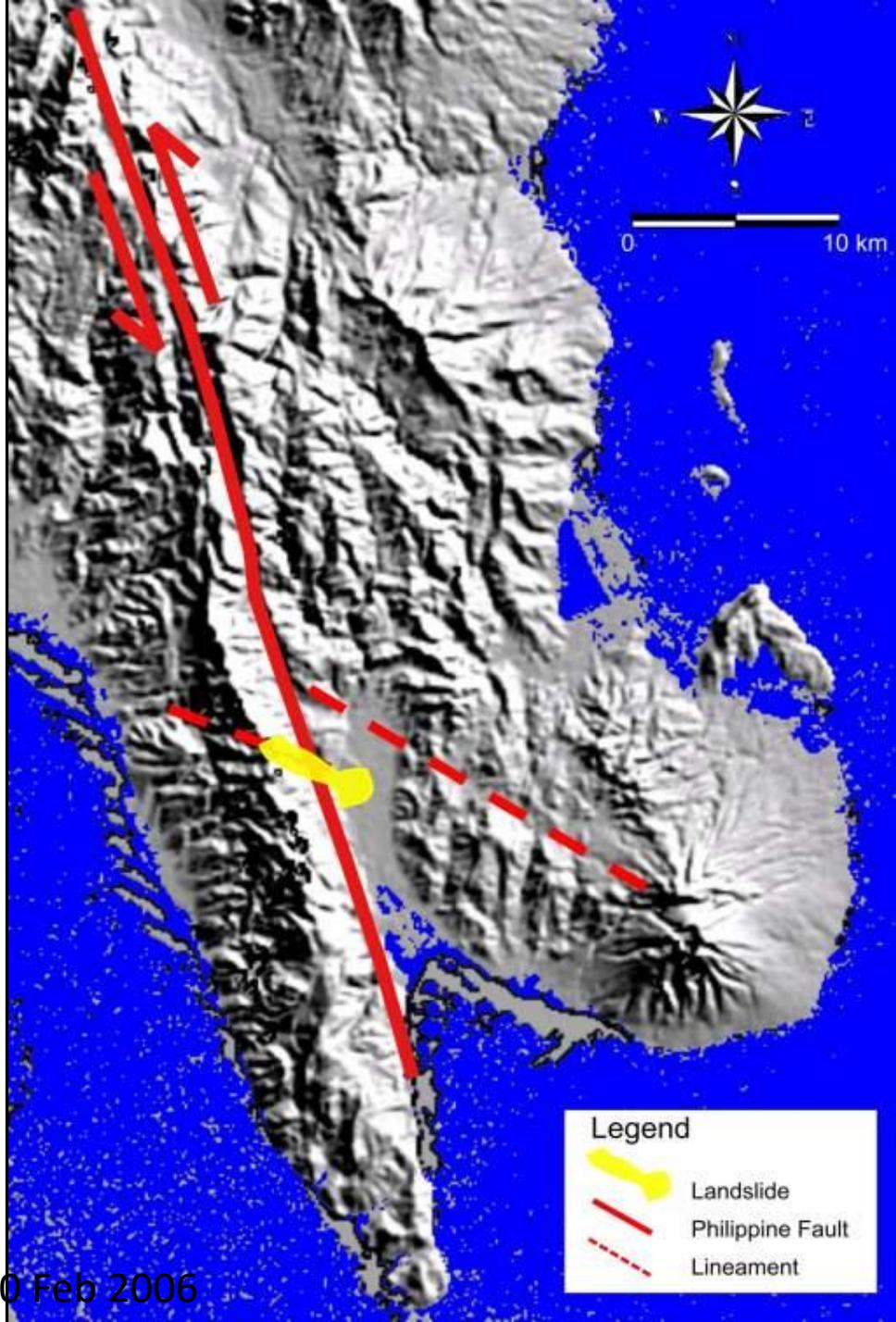


Day 4, Mon, 20 Feb 2006



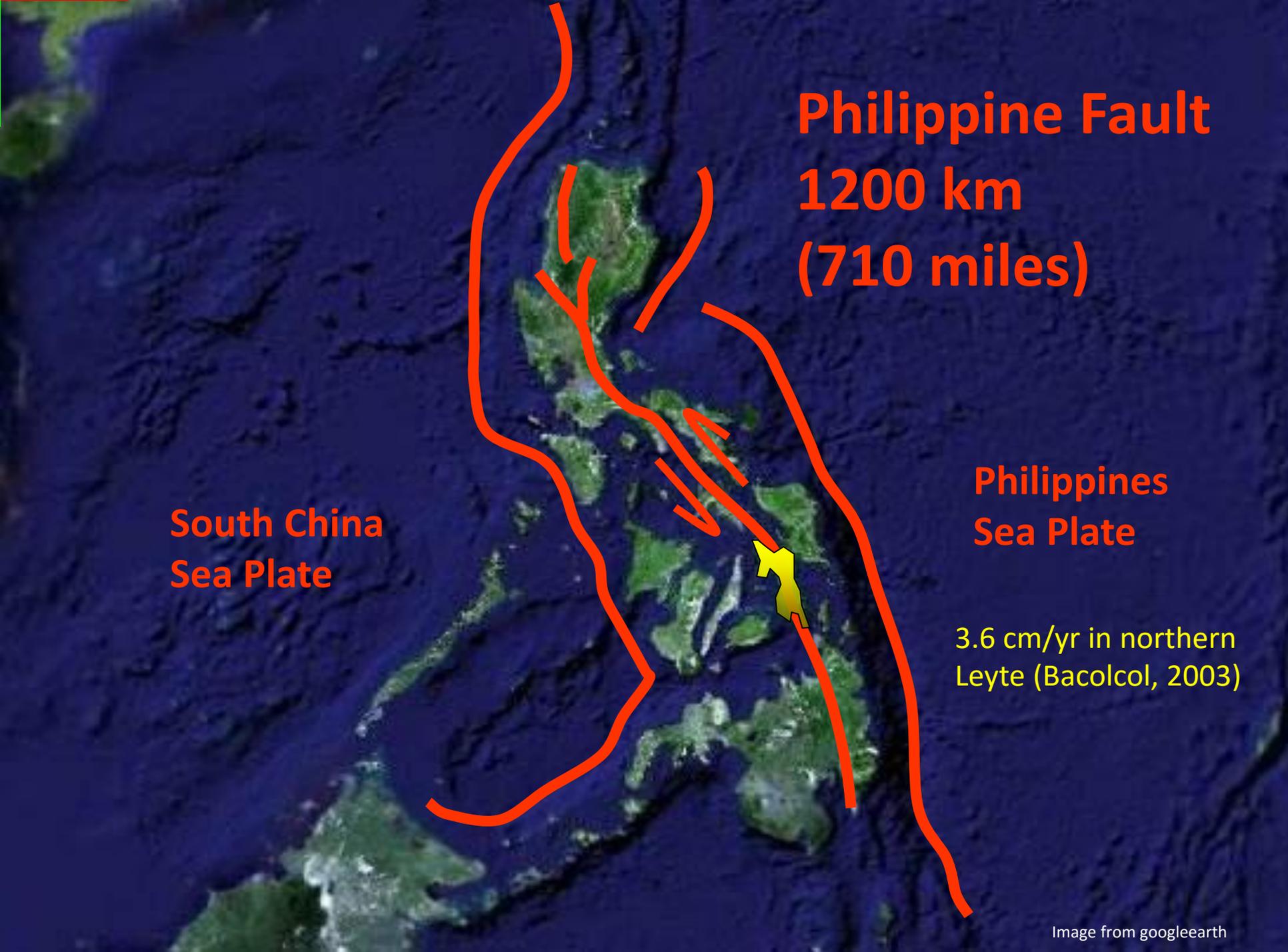
GETTY IMAGES

Day 4, Mon, 20 Feb 2006



Shaded relief image
generated from an
SRTM digital elevation
model.

Raw image data was taken
from
<http://www.landcover.org>

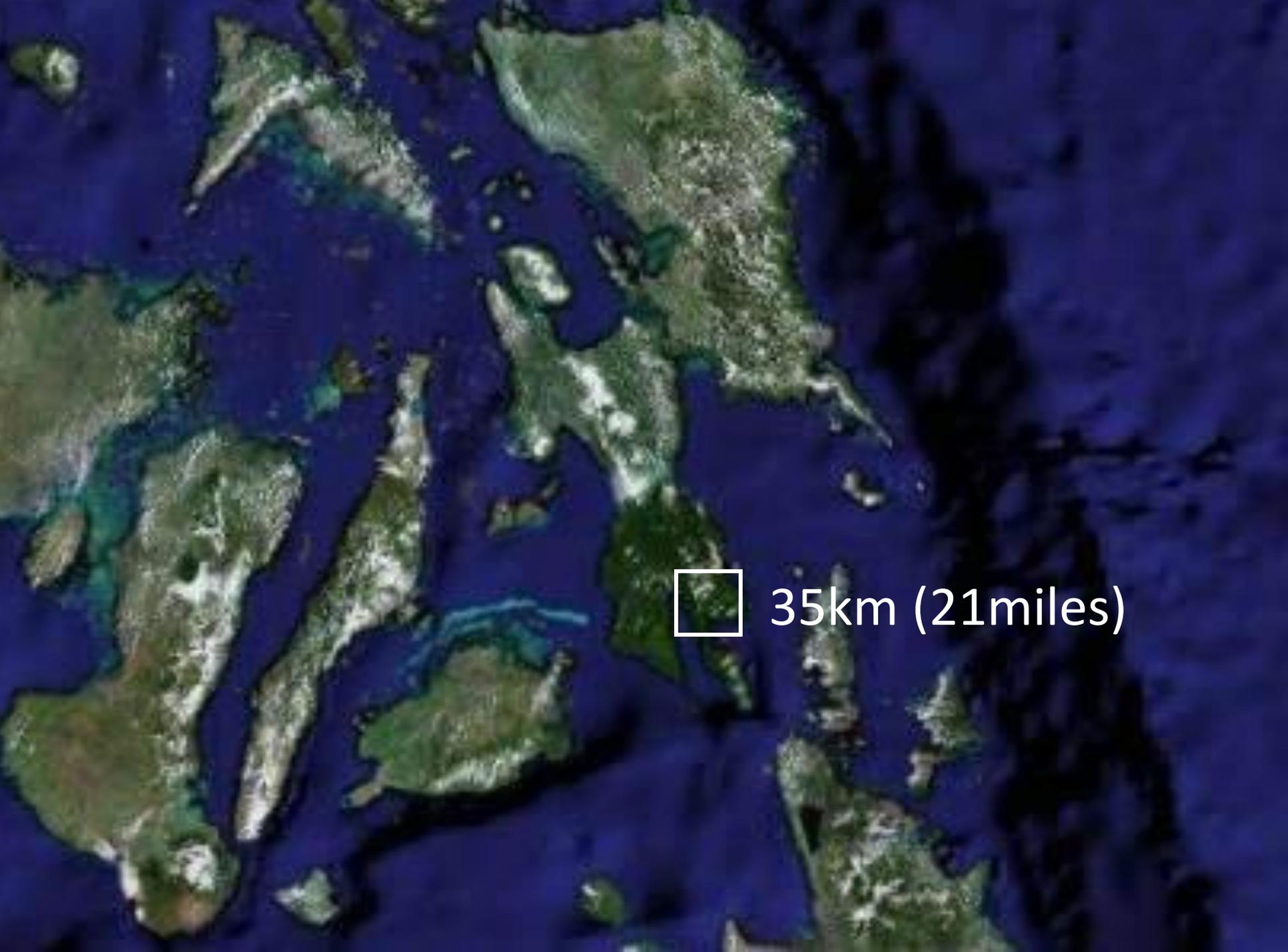


Philippine Fault
1200 km
(710 miles)

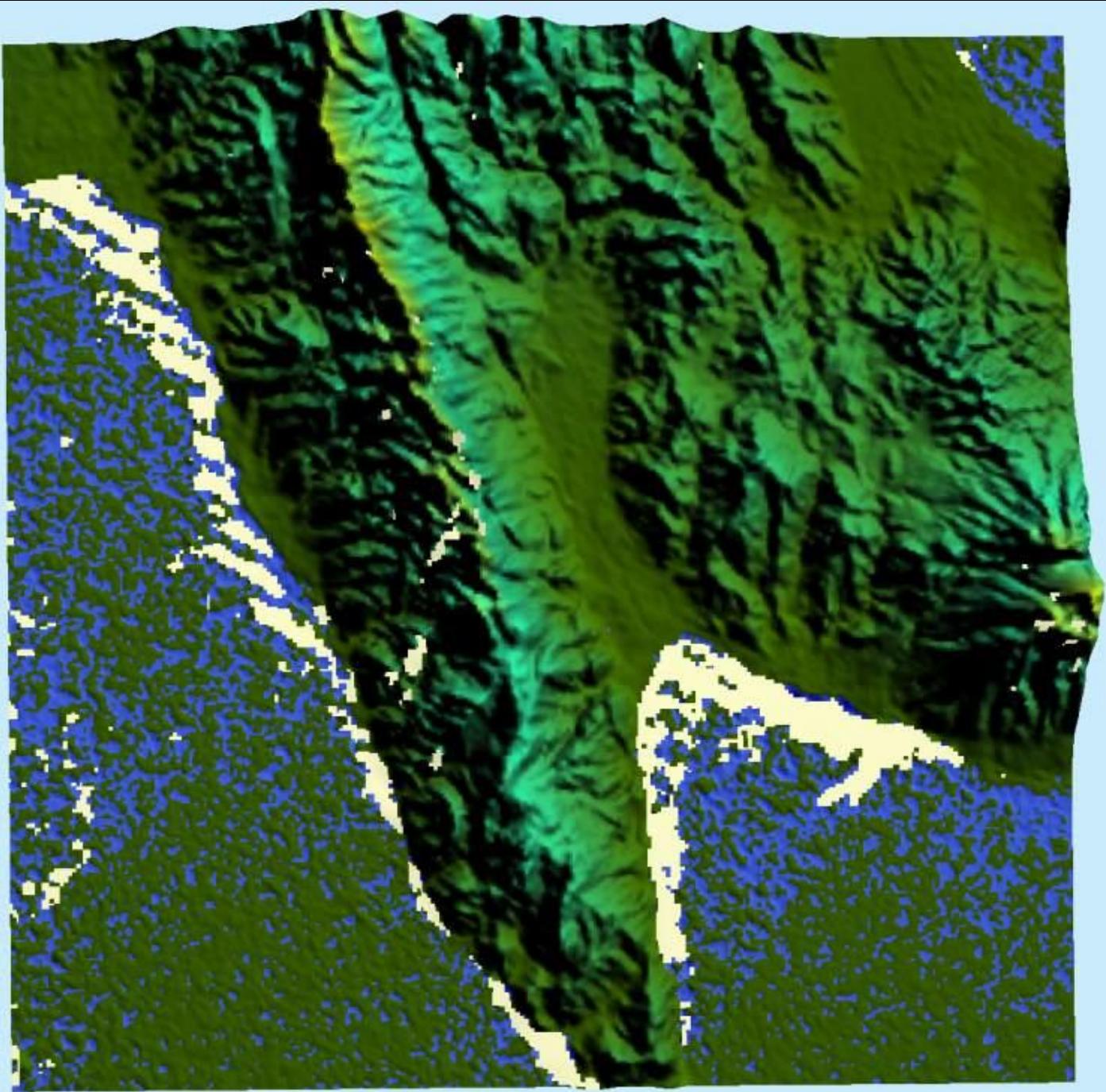
**South China
Sea Plate**

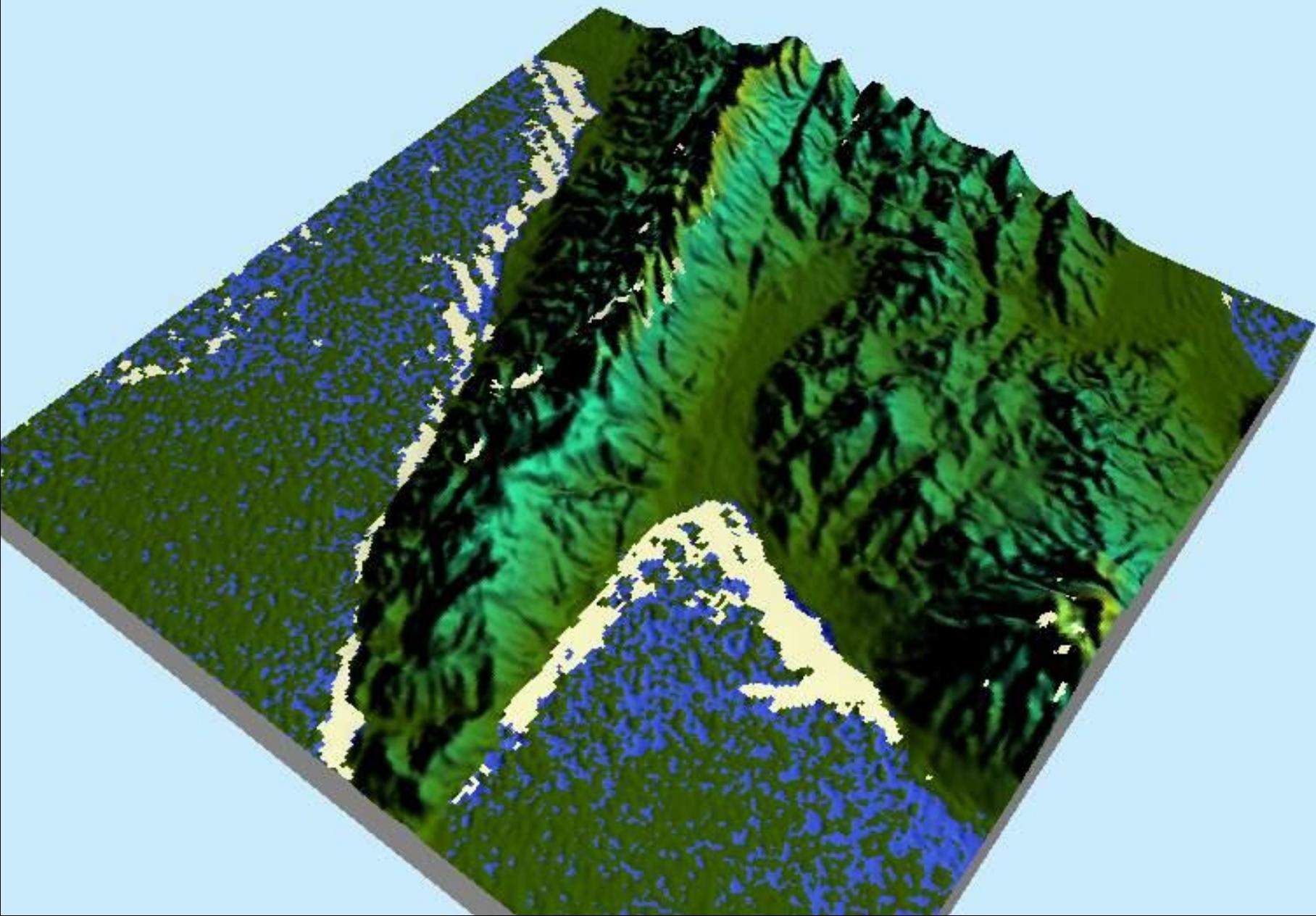
**Philippines
Sea Plate**

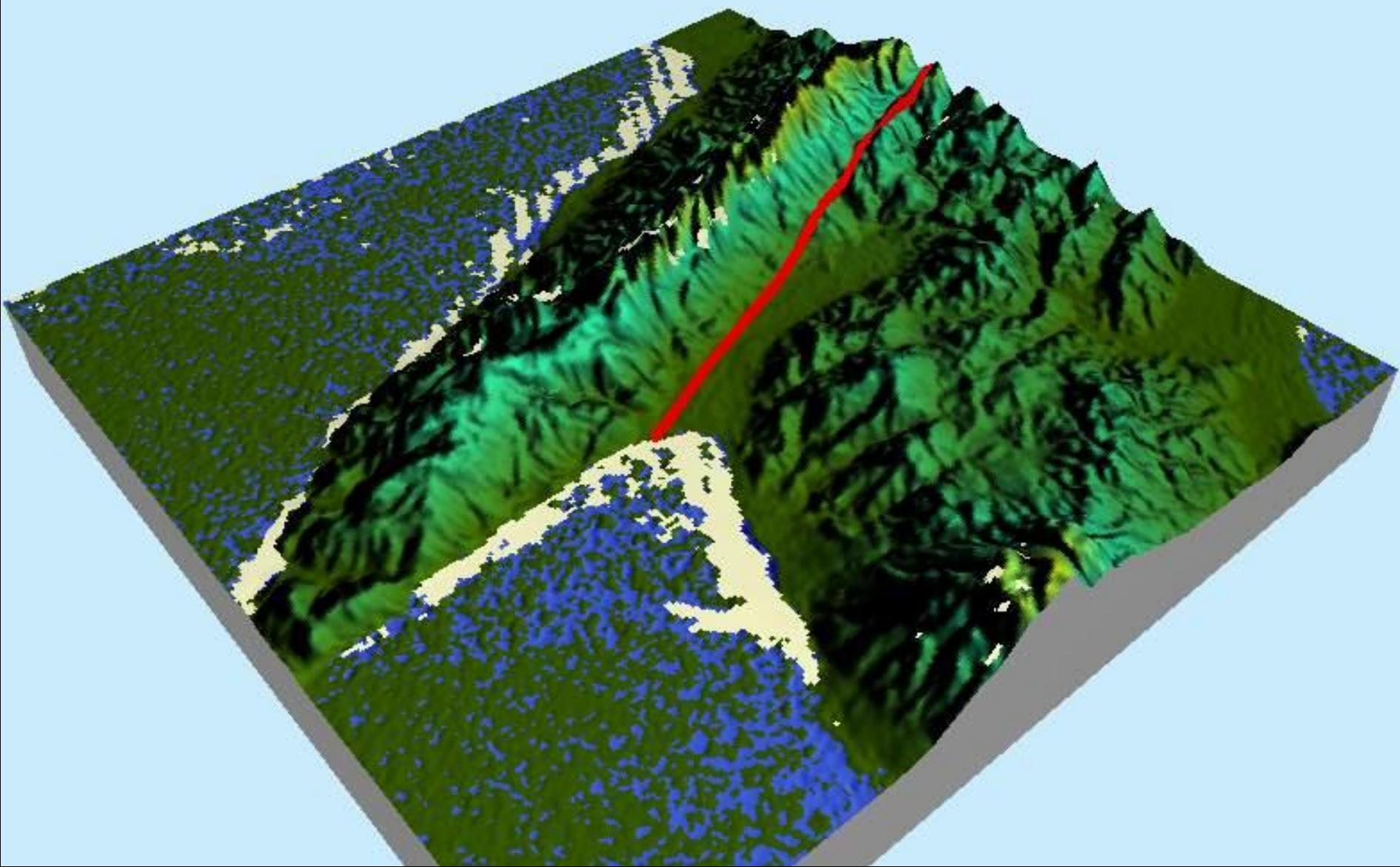
**3.6 cm/yr in northern
Leyte (Bacolcol, 2003)**

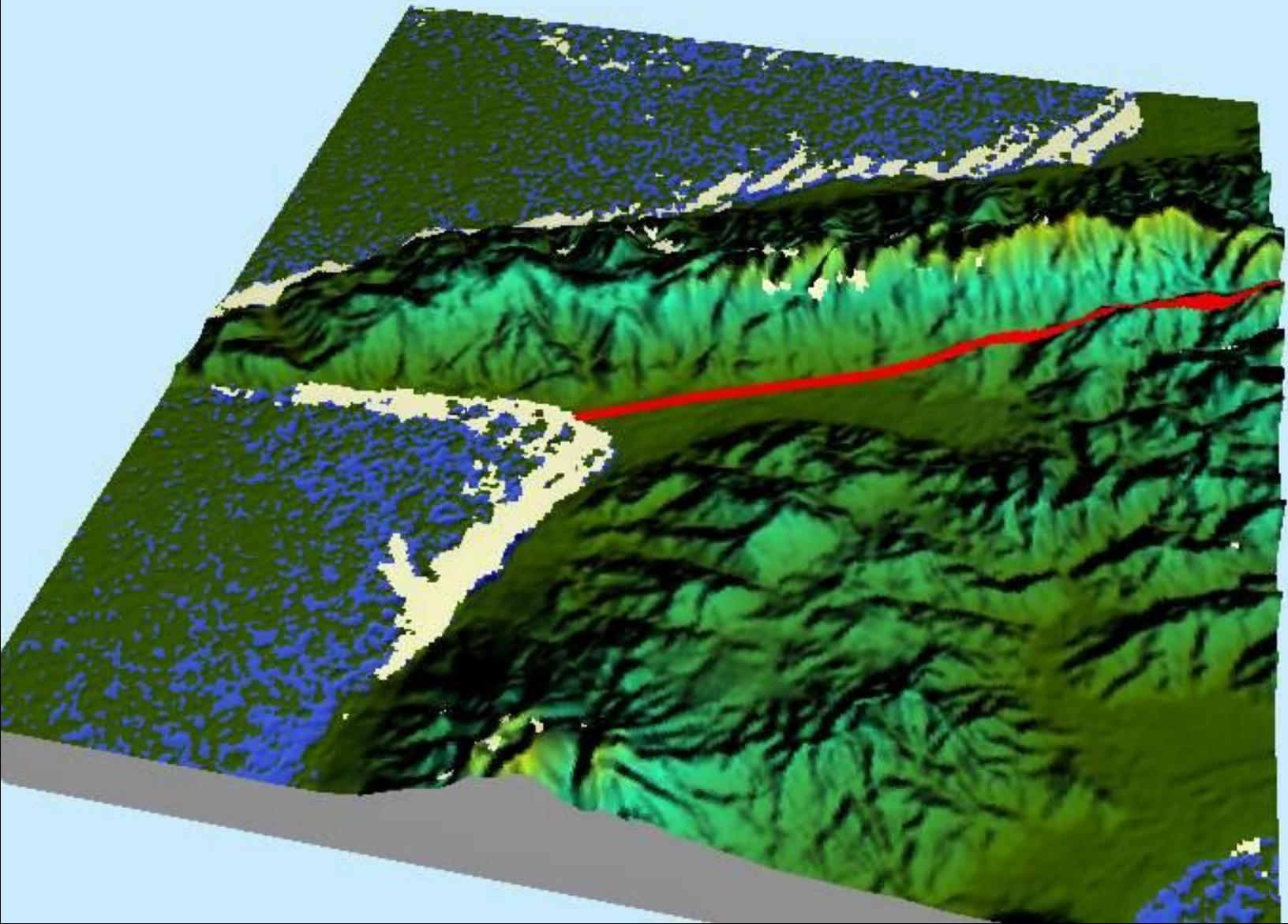


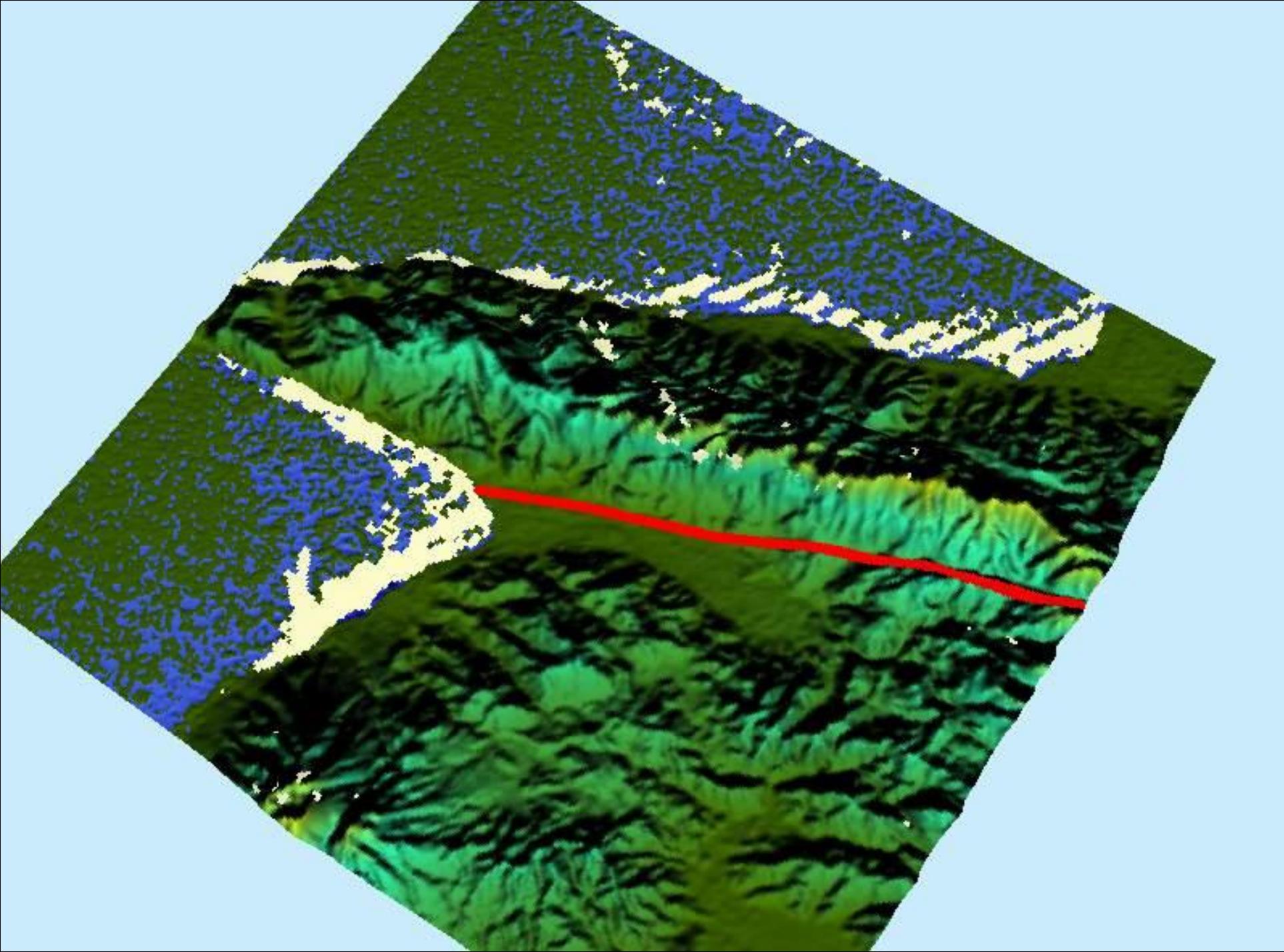
35km (21miles)

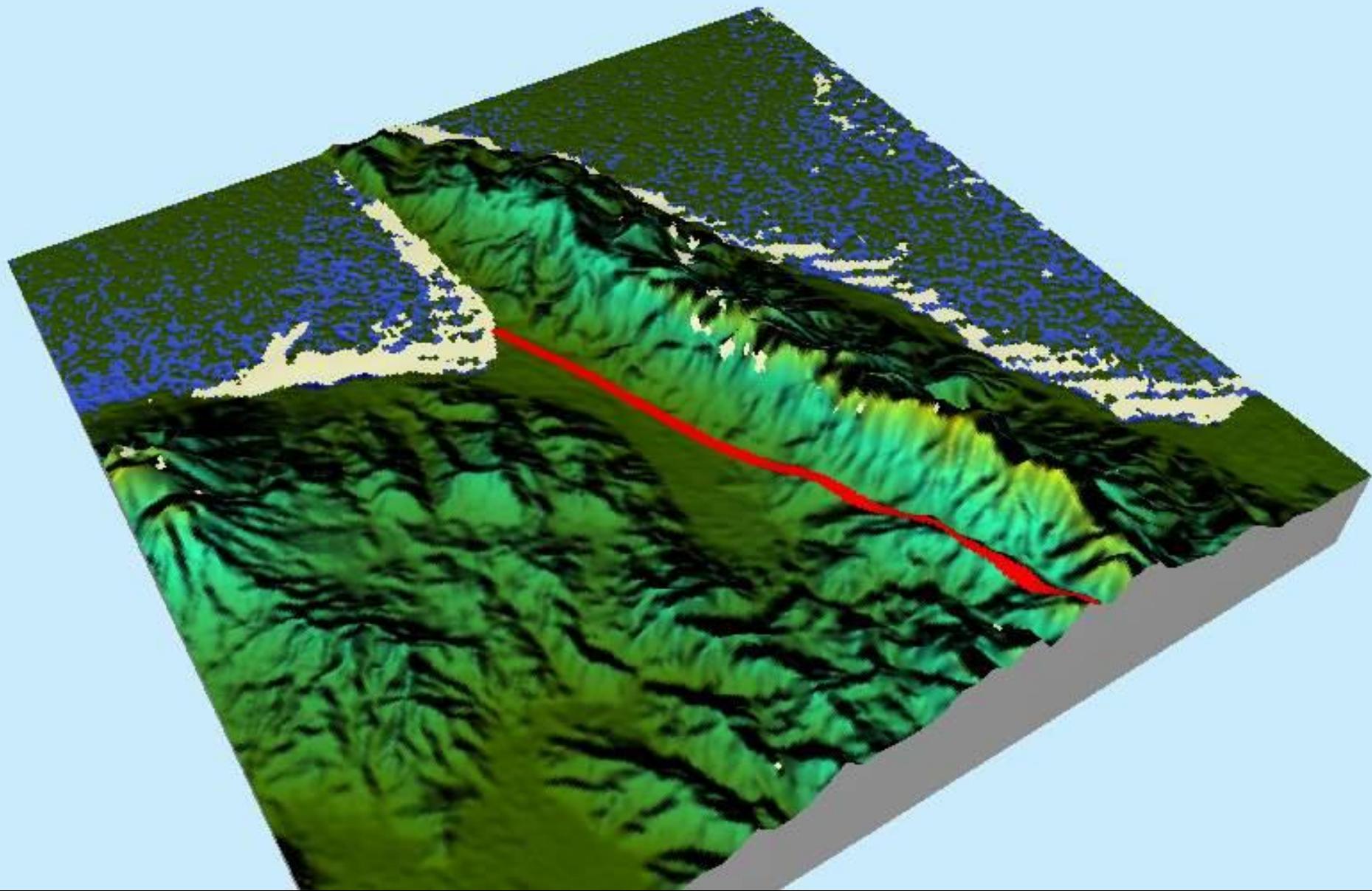


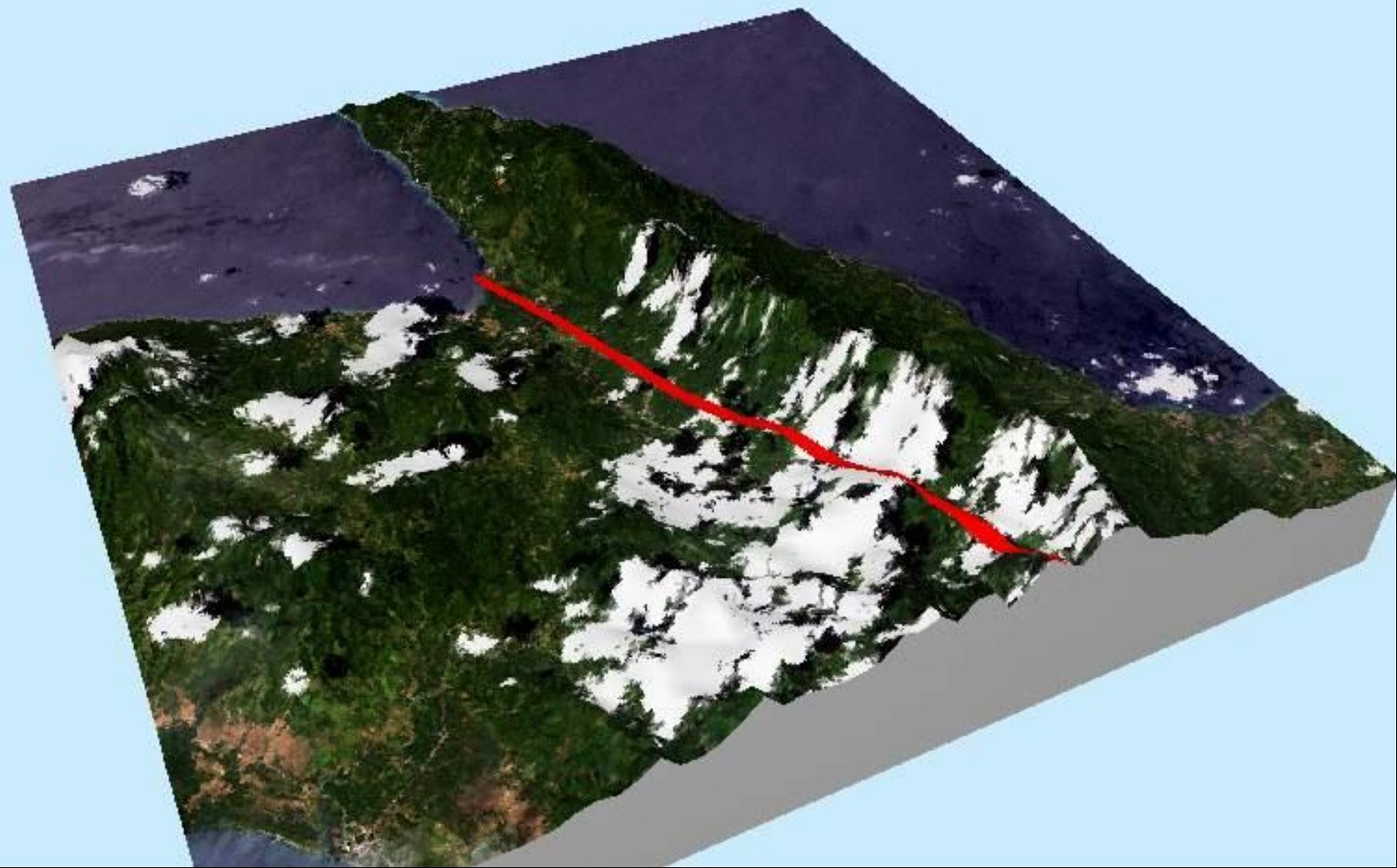


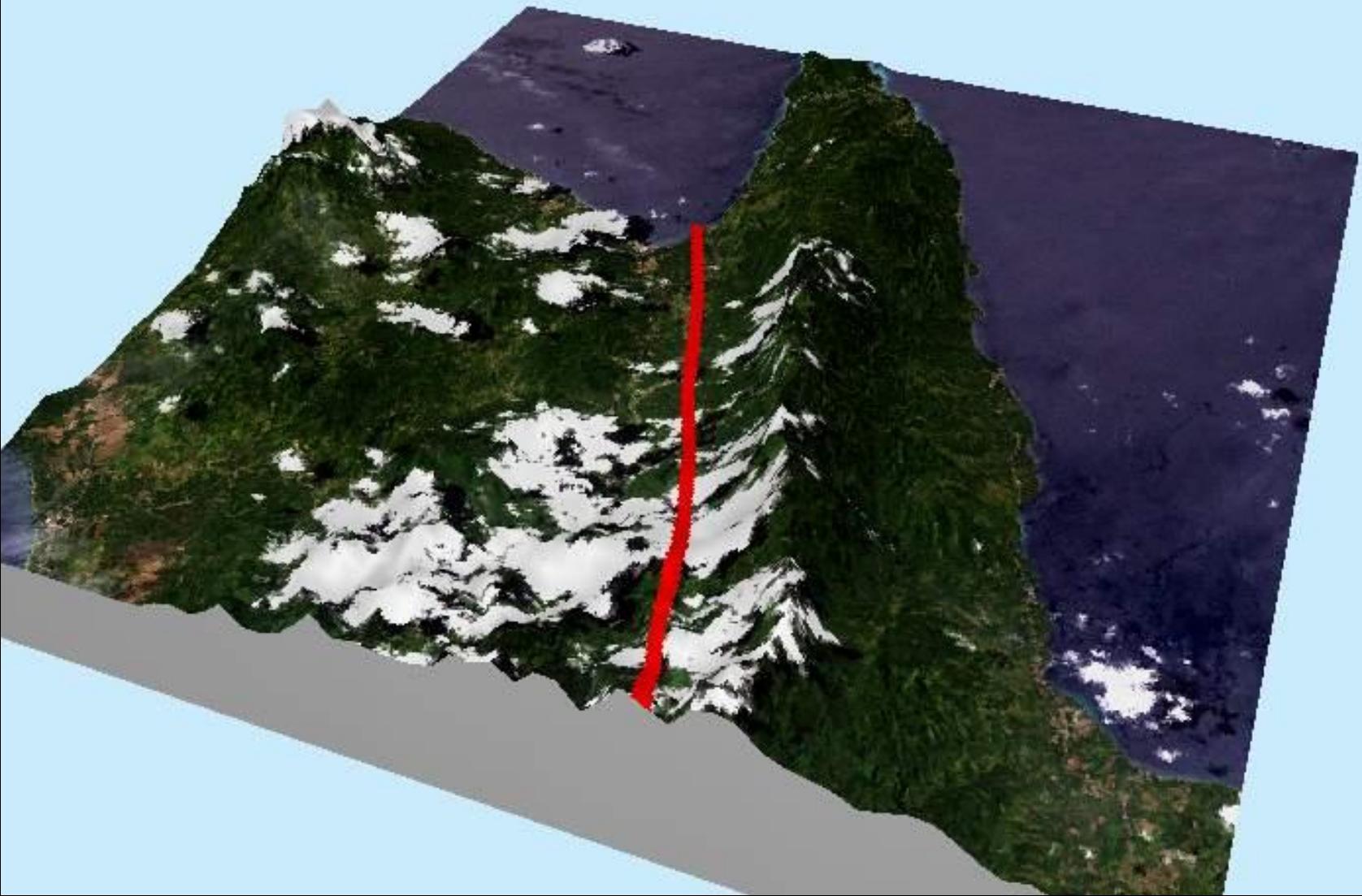


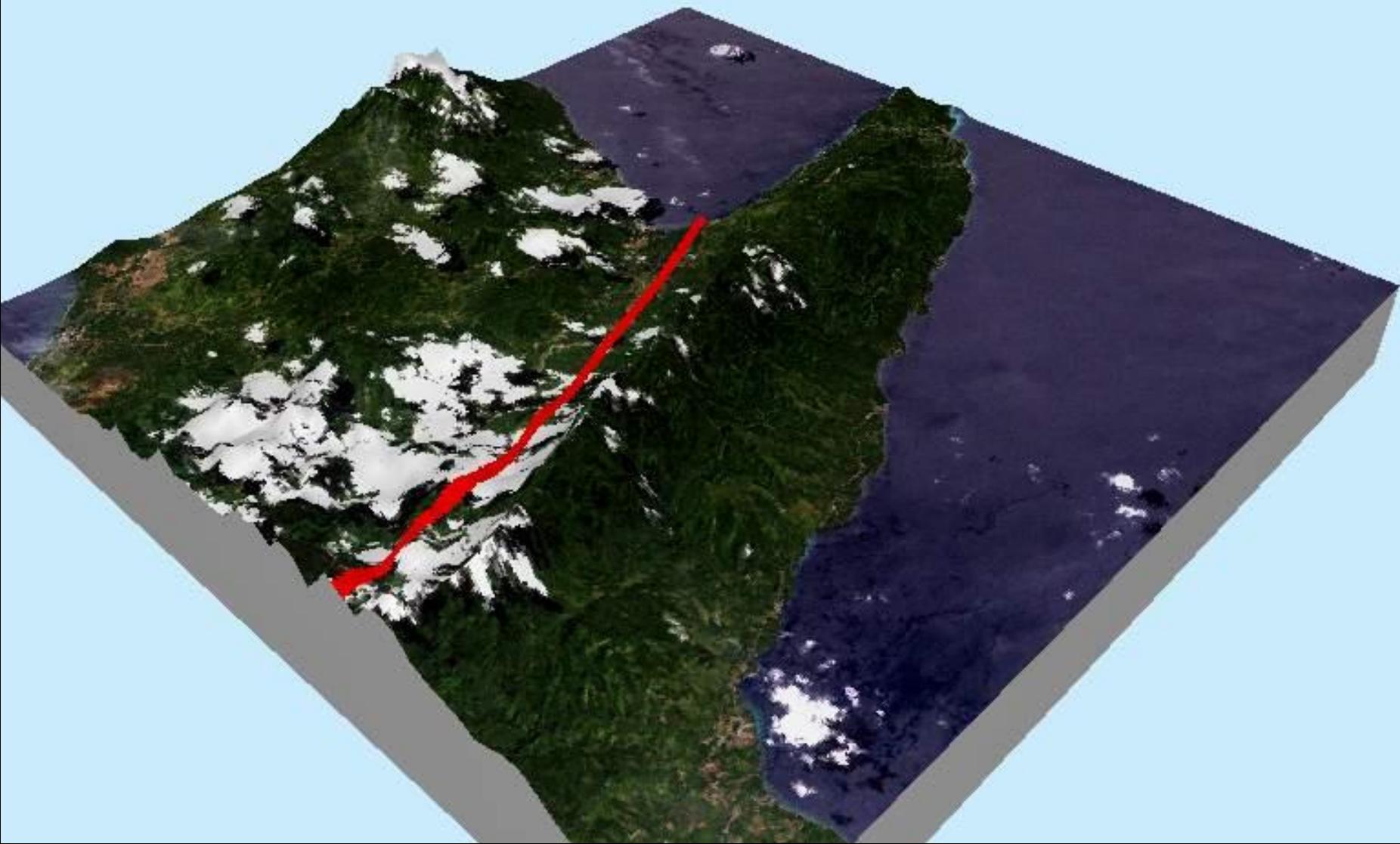


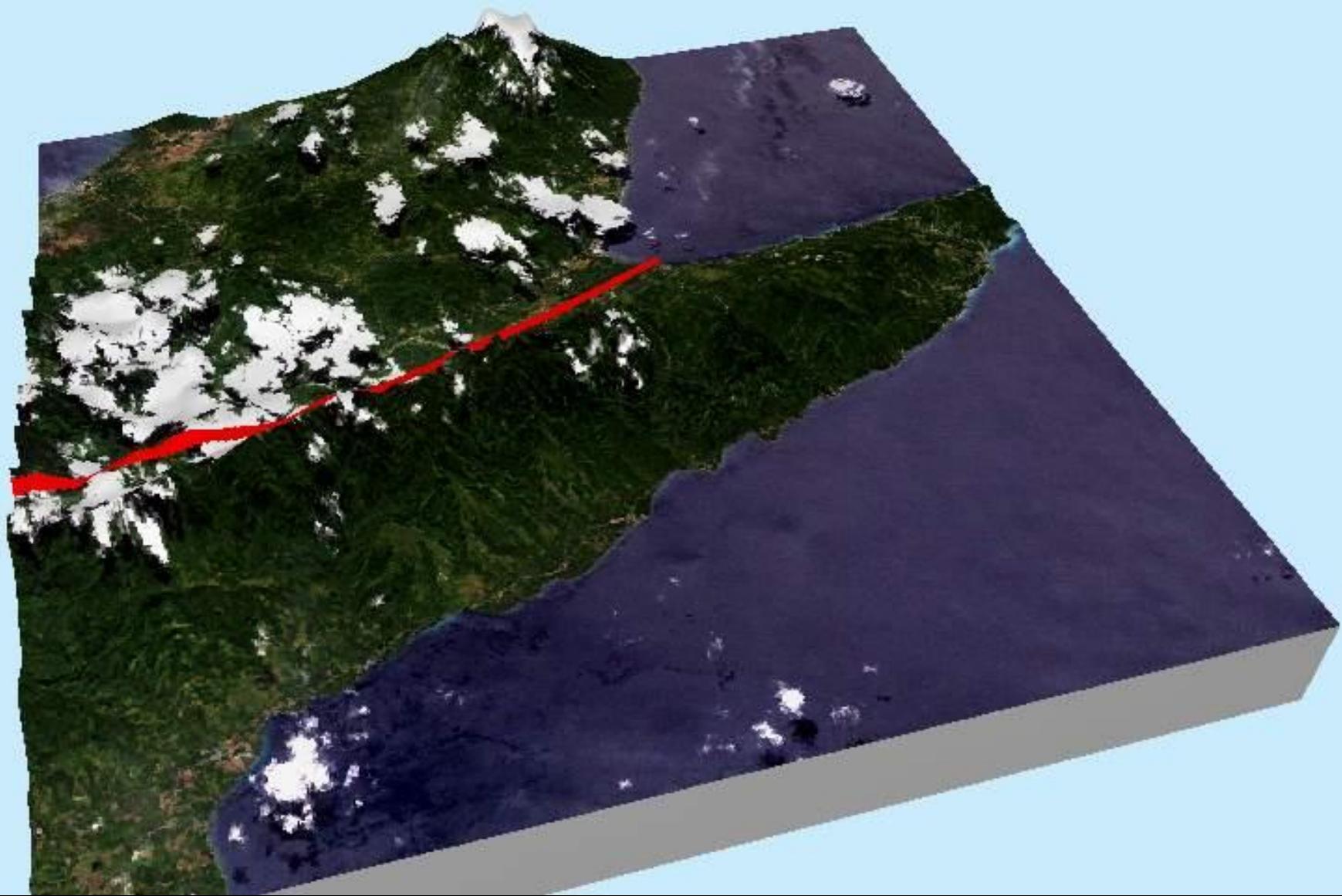


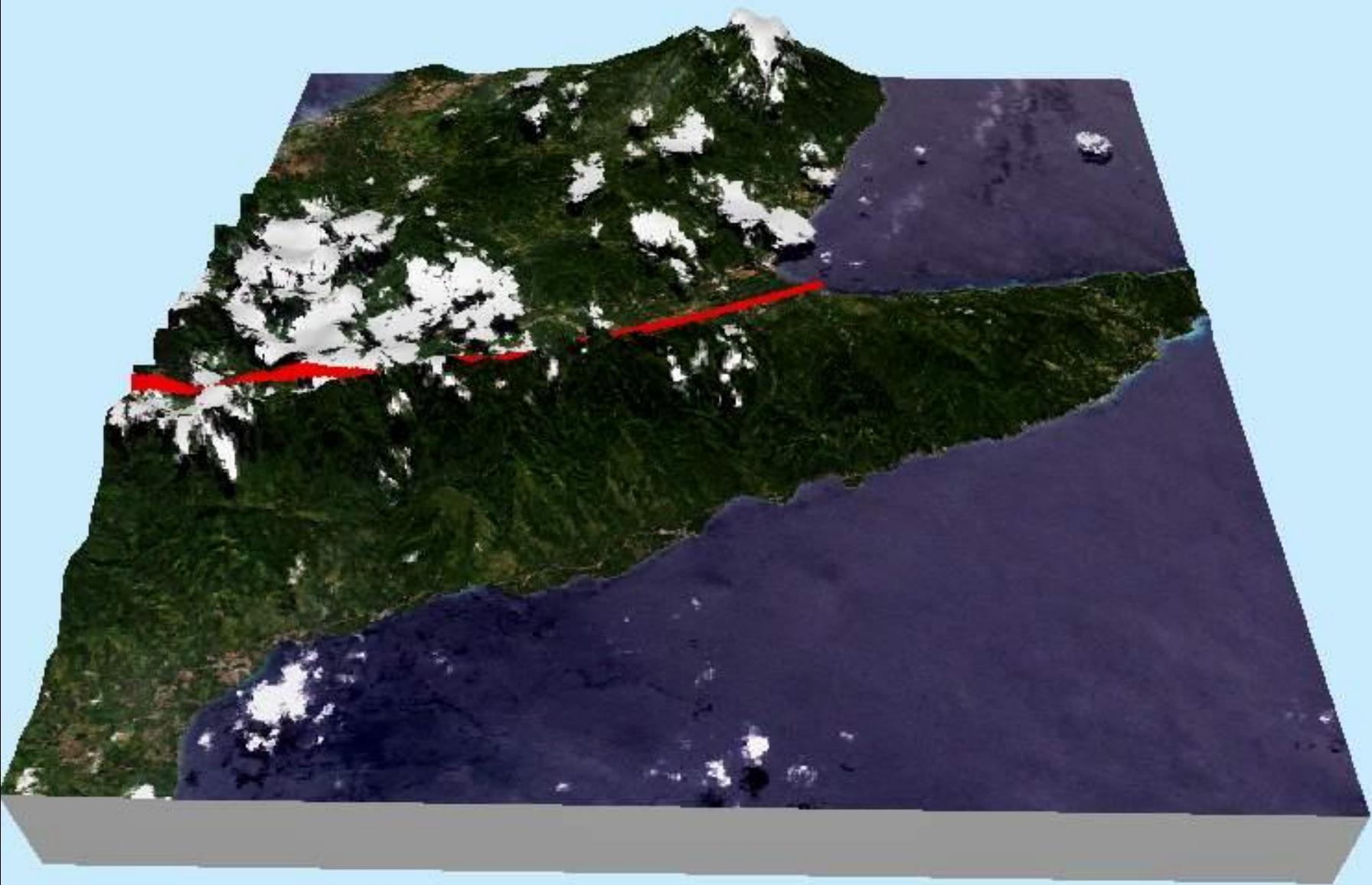


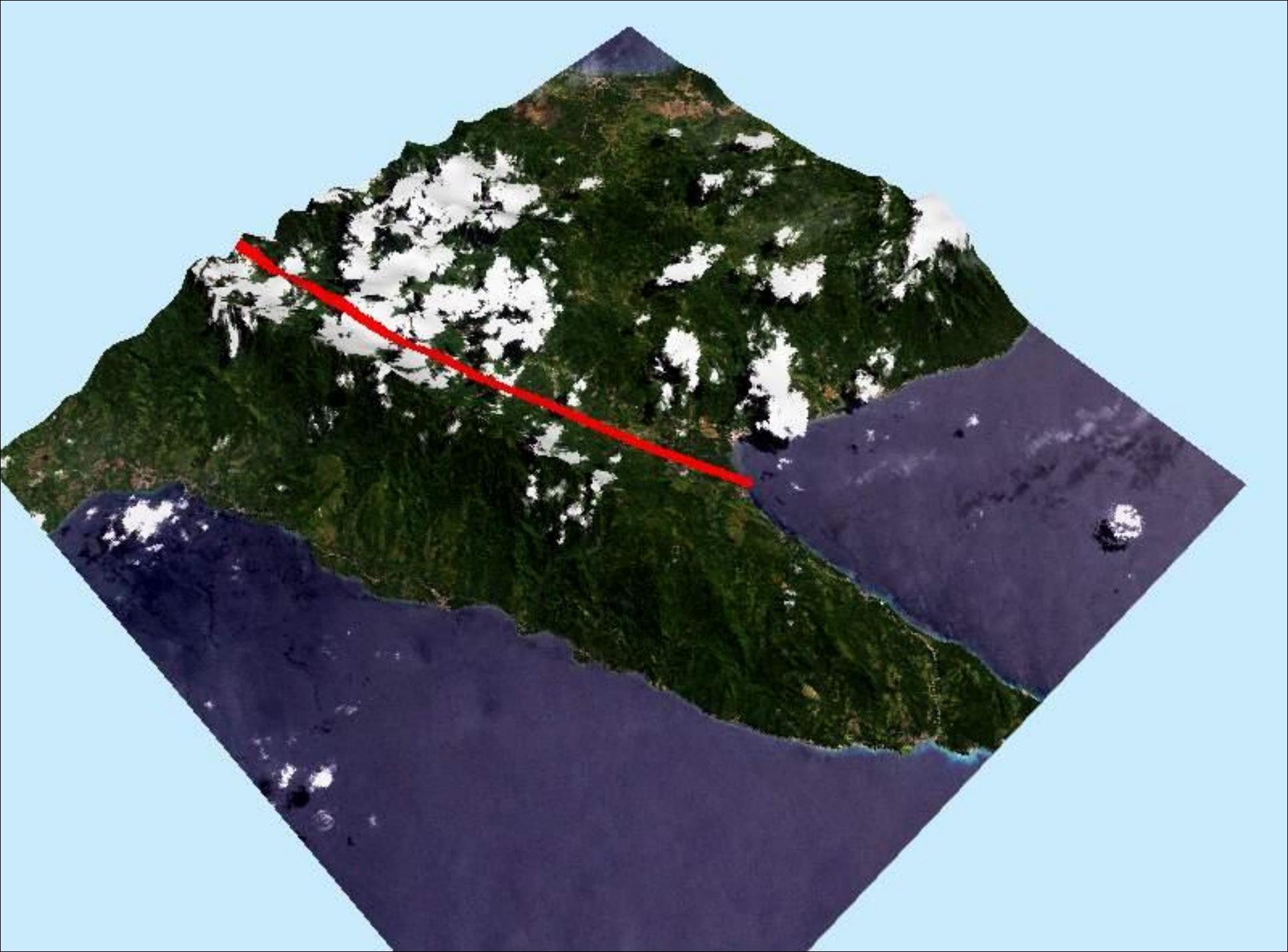


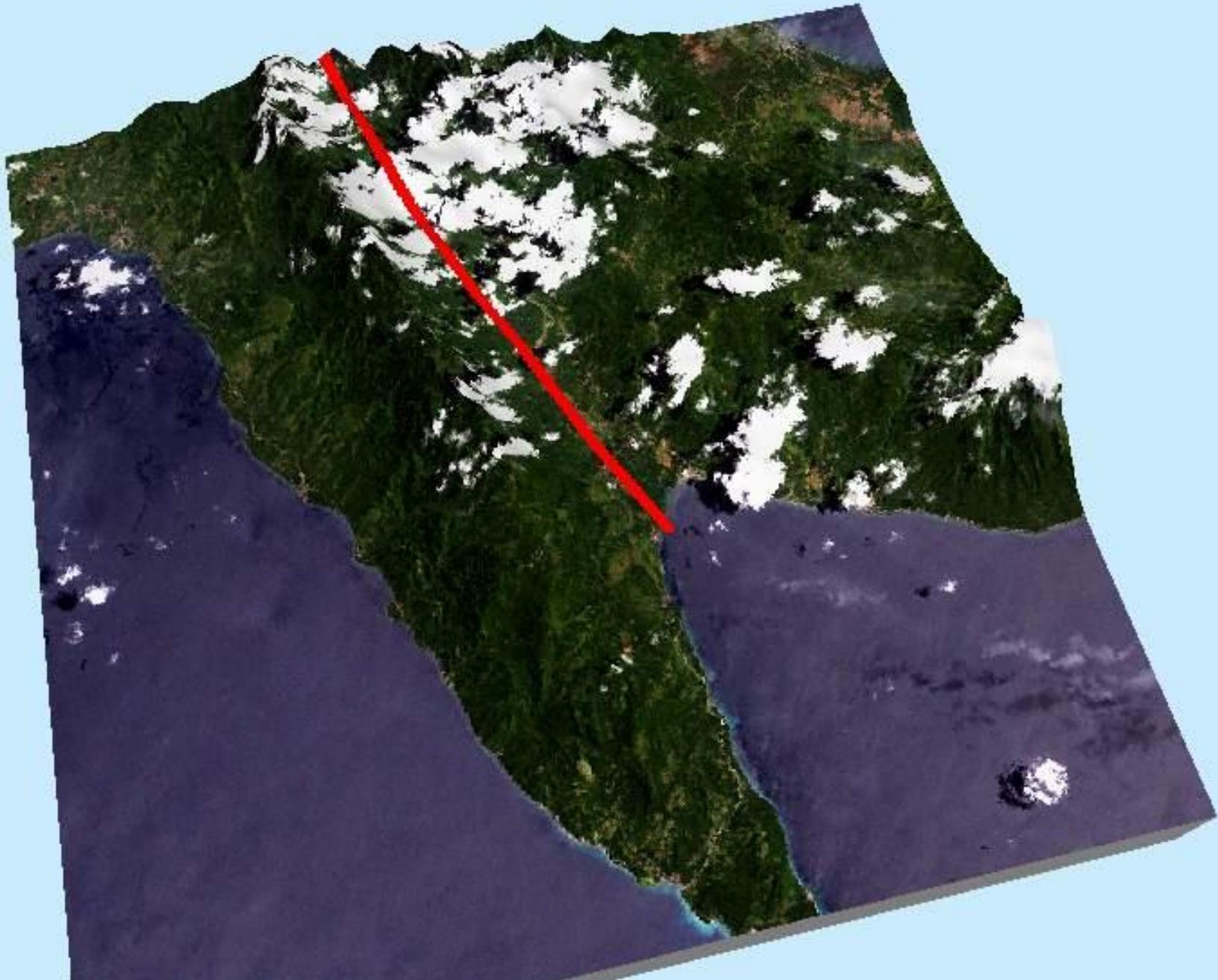


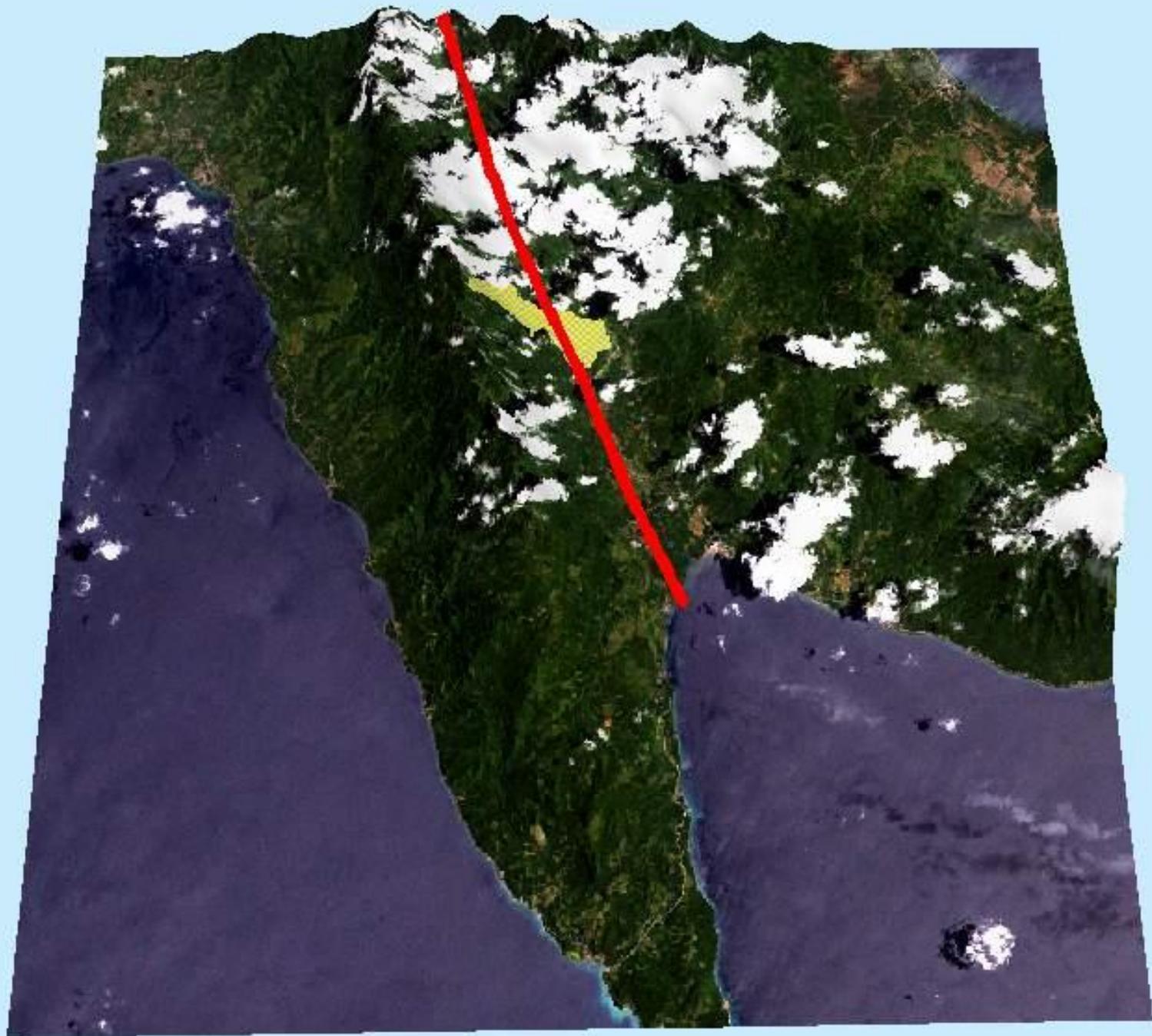


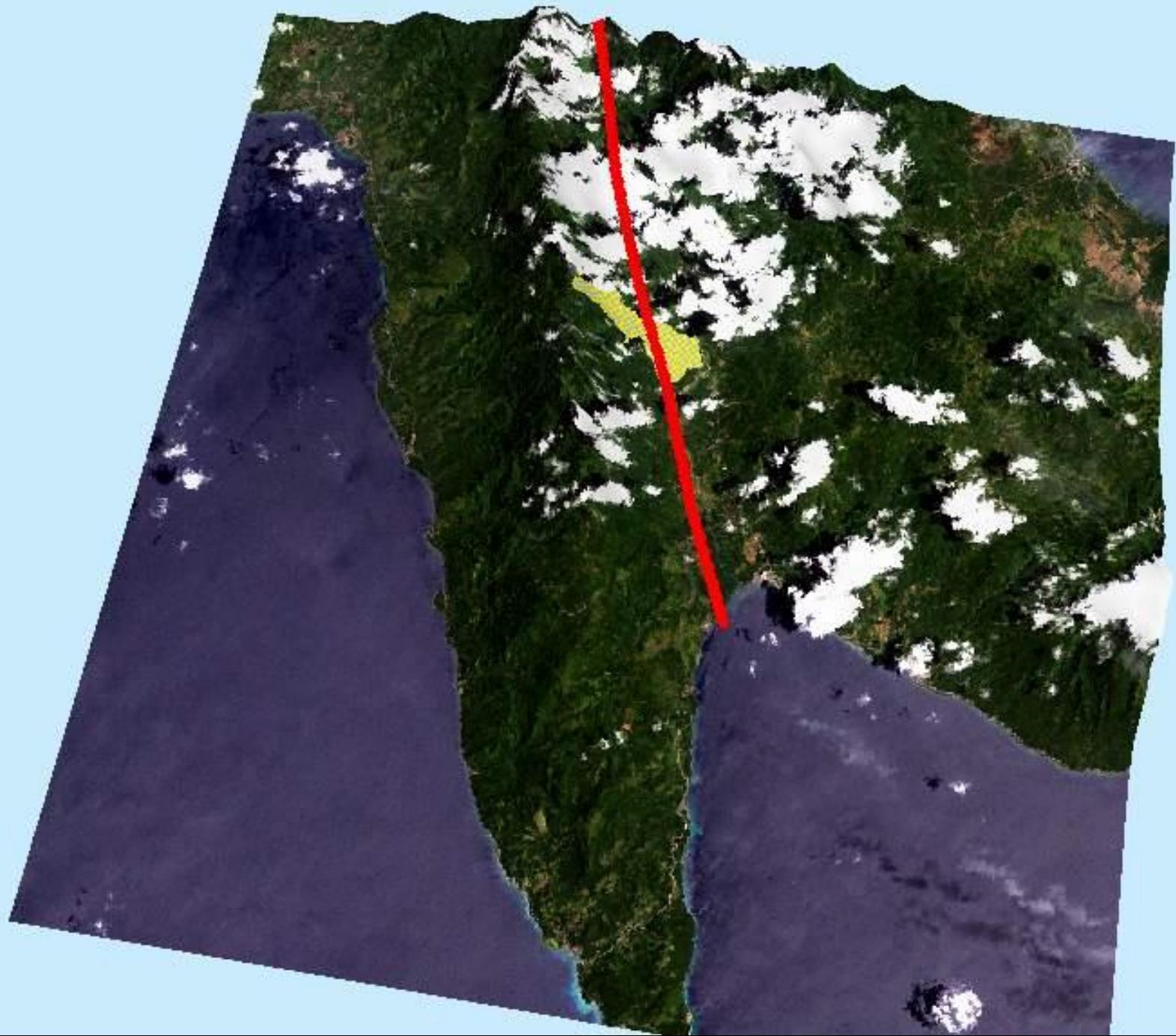


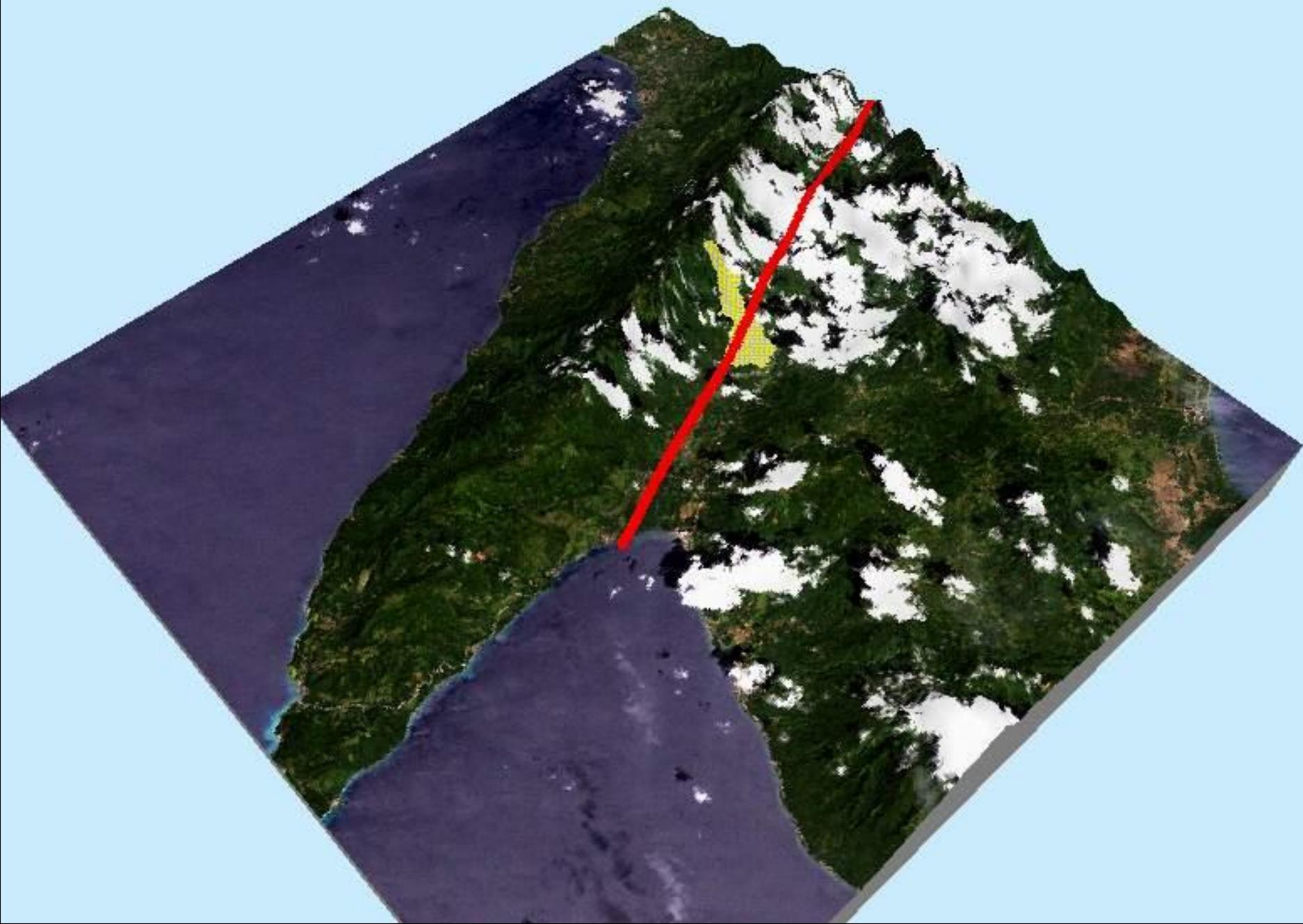


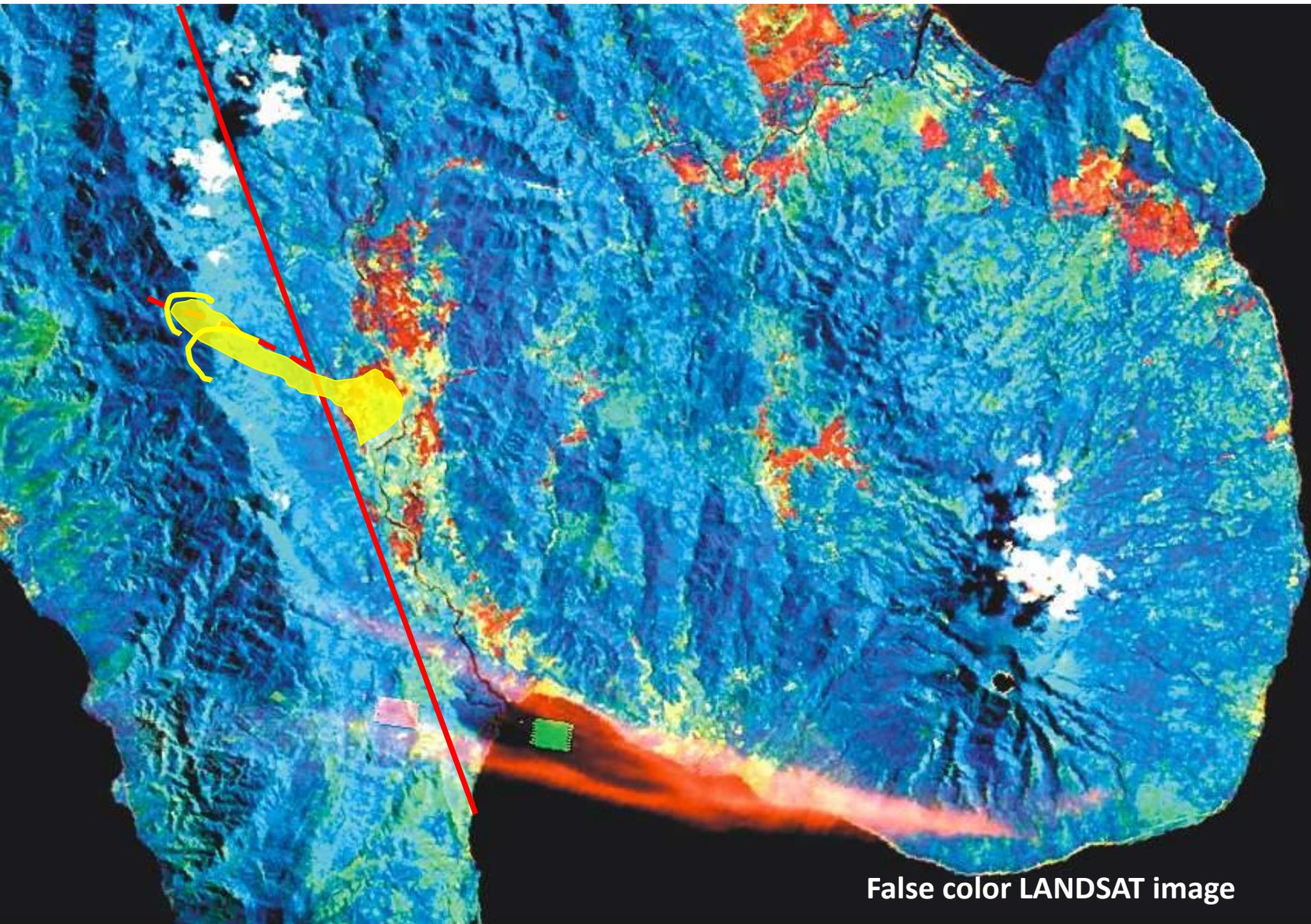












False color LANDSAT image

An aerial photograph showing a steep, forested mountain slope. A white rectangular text box is overlaid on the image, containing the text "old landslide materials" in red. Two red arrows point downwards from the text box to a specific area on the forested slope. The foreground on the left shows a portion of a dark, textured surface, likely the side of an aircraft or a vehicle. In the bottom right corner, there is a yellow digital timestamp "2 19 08".

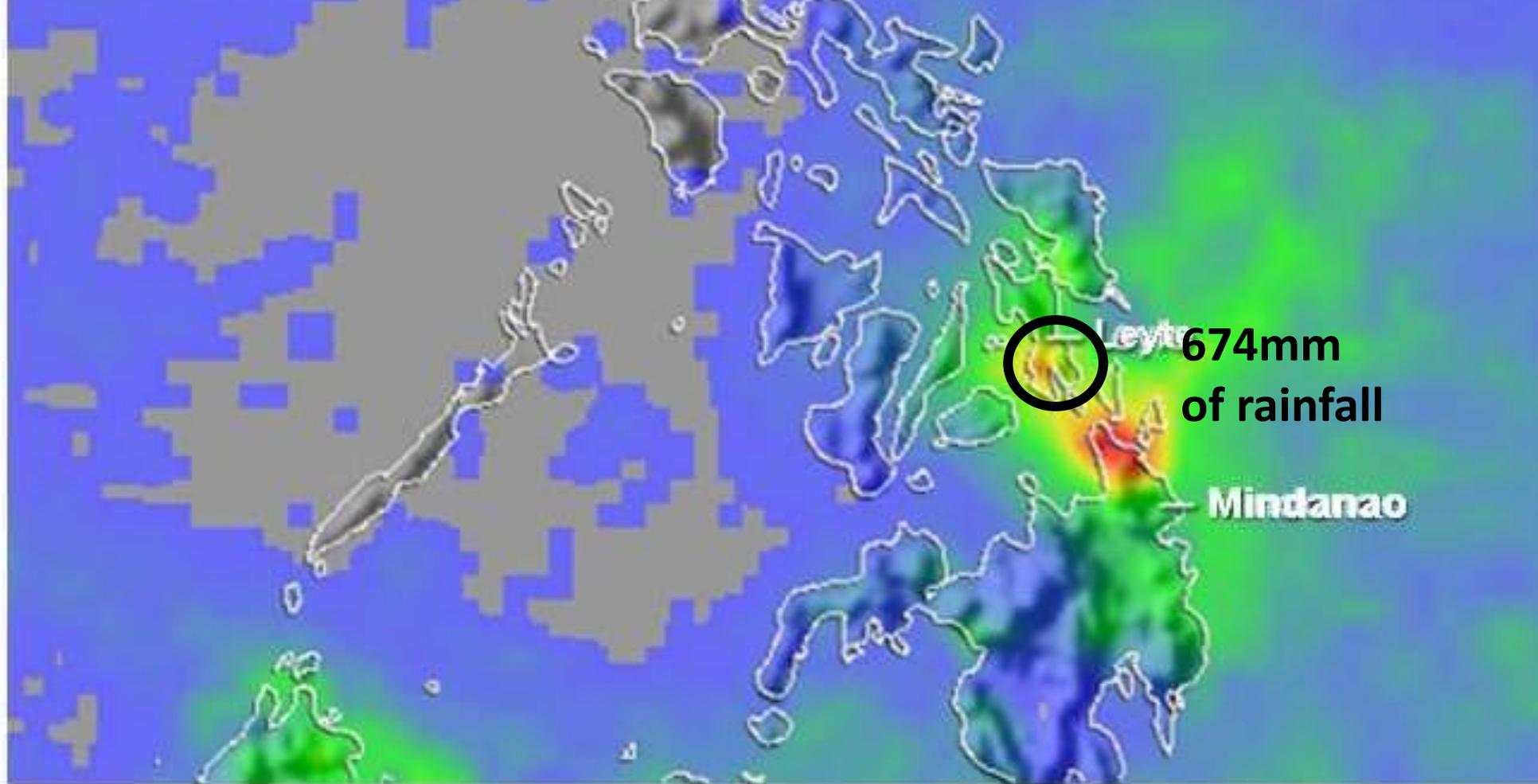
old landslide materials



Area = 320 hectares
Volume = 15 – 20 million m³
Velocity = 100-140 km/hr
Thickness = 30m base
7m toe

1000 m



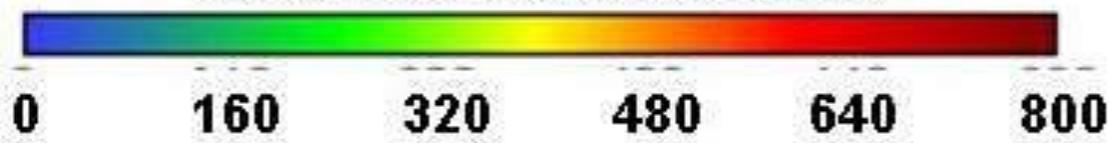


674mm
of rainfall

Mindanao

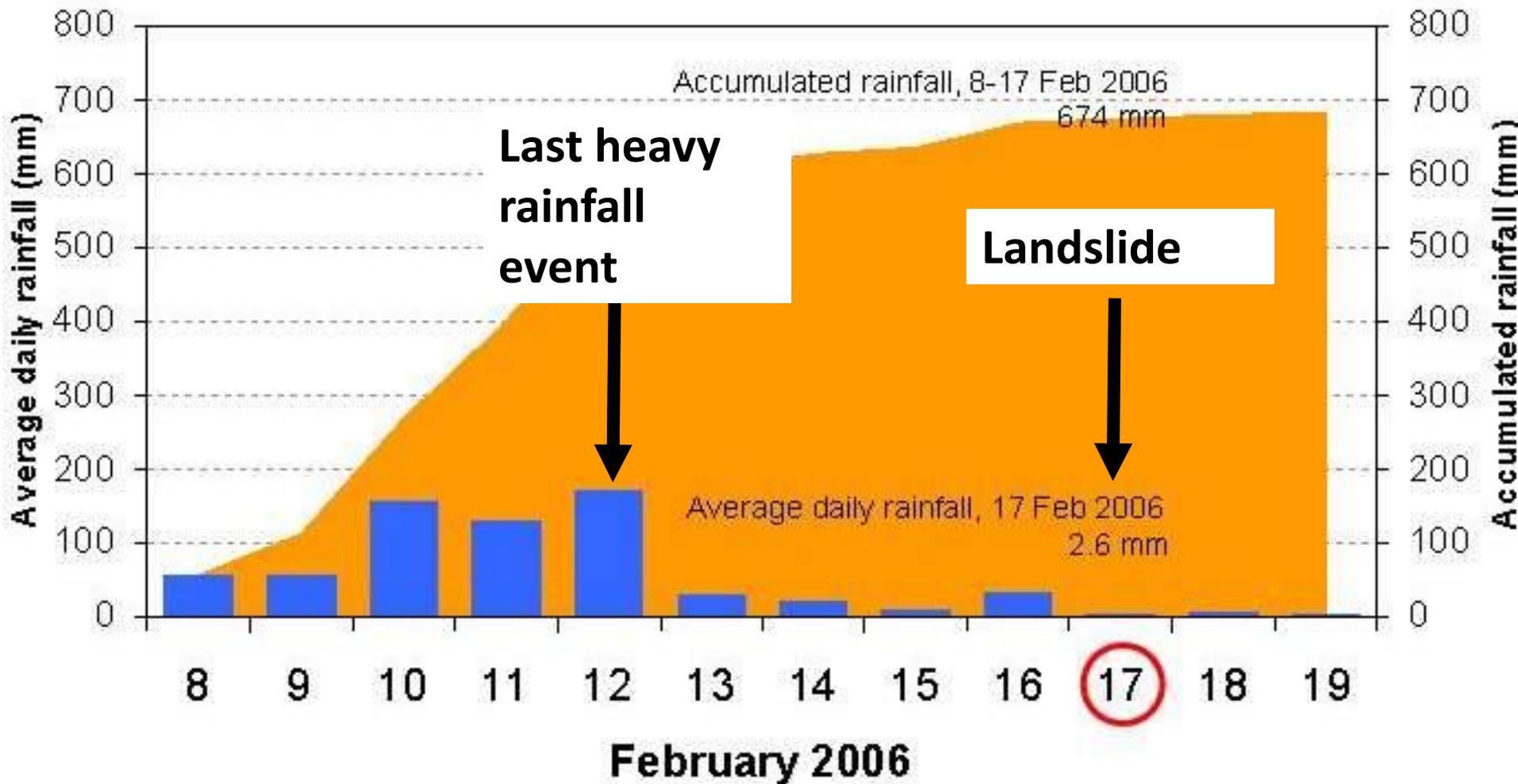
February 4-17, 2006

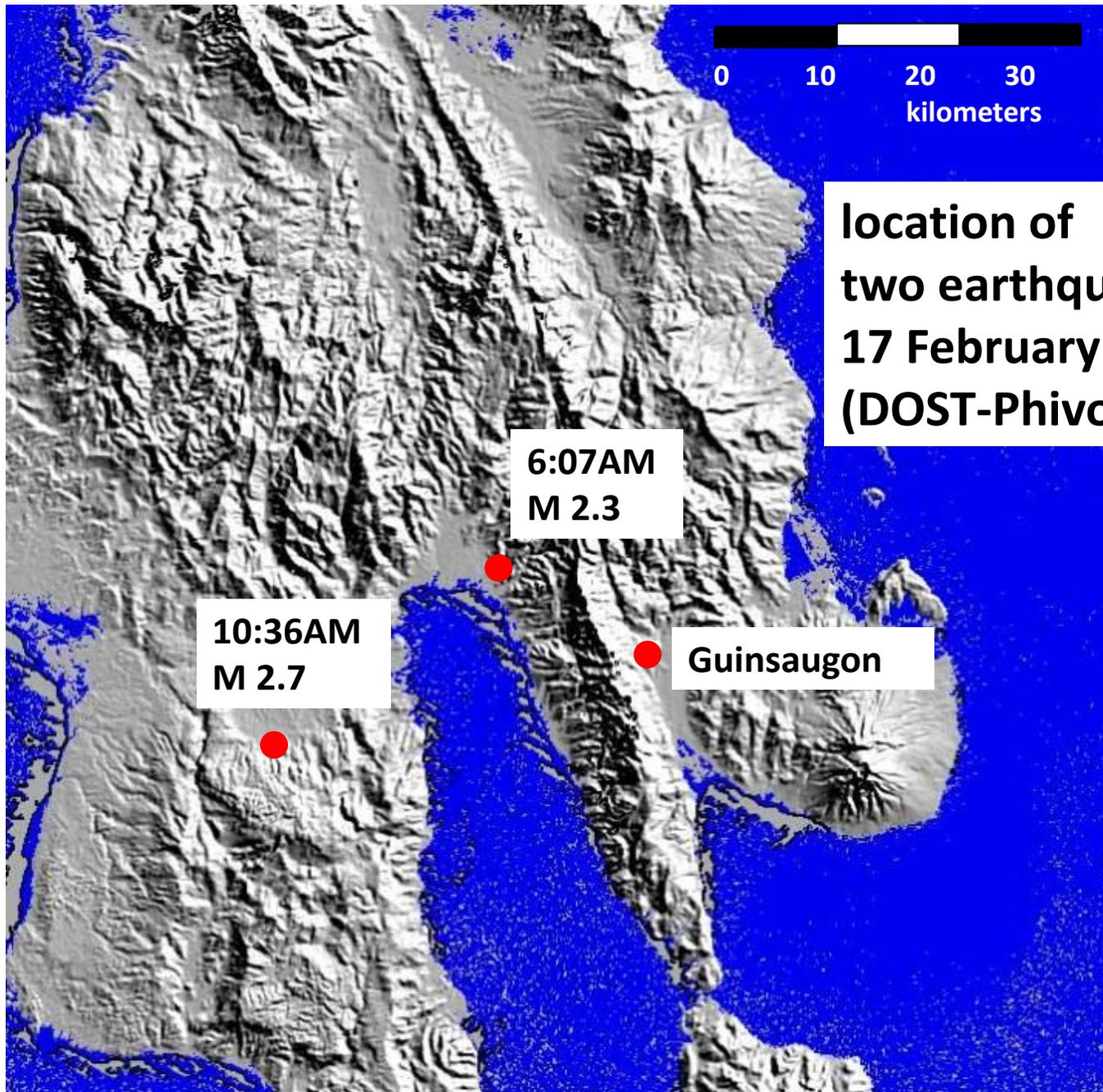
Accumulated rainfall (mm)



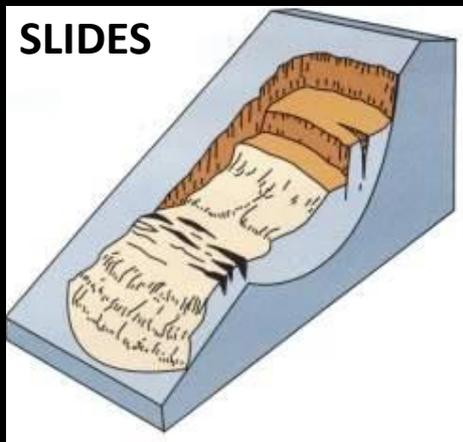
Cumulative rainfall in the region based on the Multi-satellite Precipitation Analysis of the Tropical Rainfall Measuring Mission.

Rainfall at Otikon Station, Libagon, Leyte

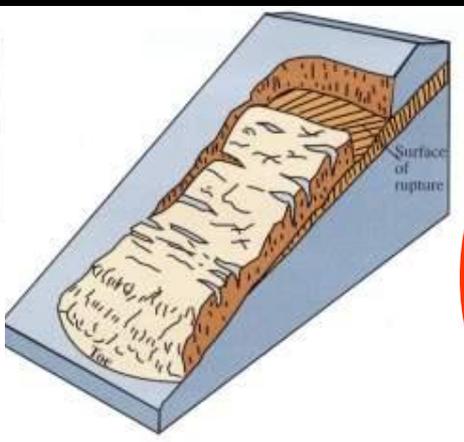




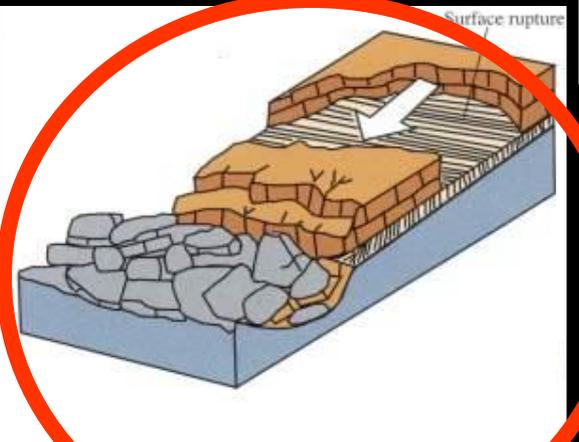
SLIDES



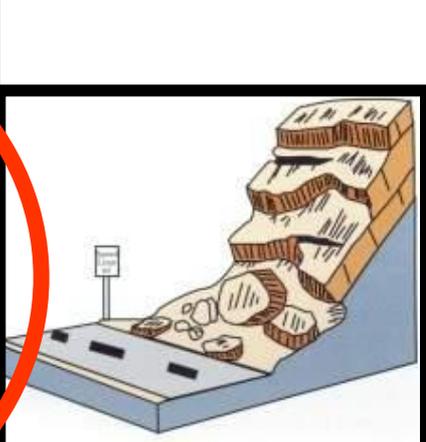
Rotational landslide



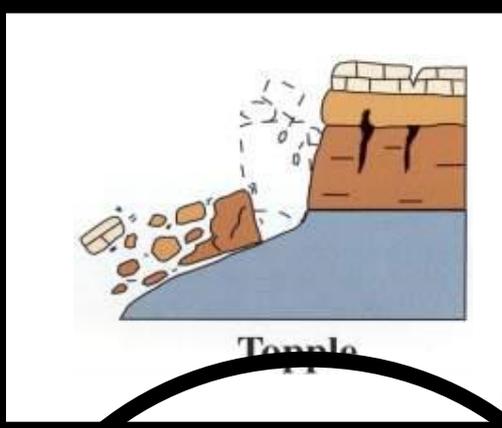
Translational landslide



Block slide

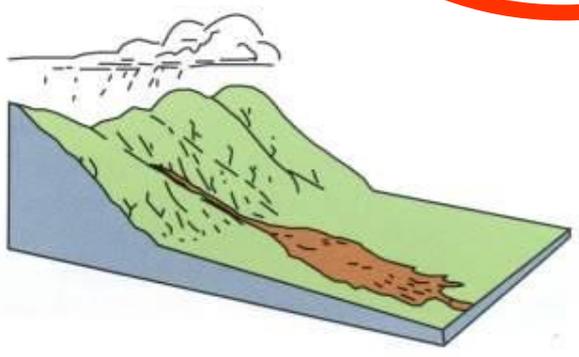


Rockfall

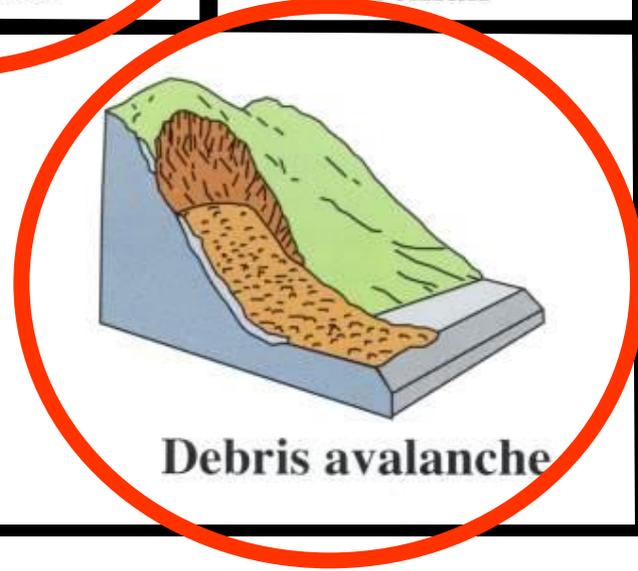


Topple

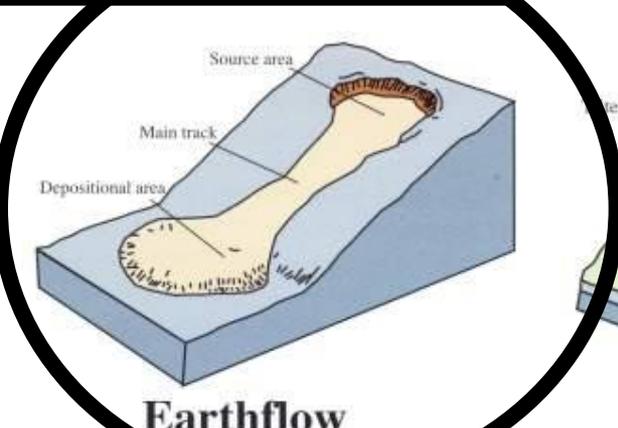
FLOW



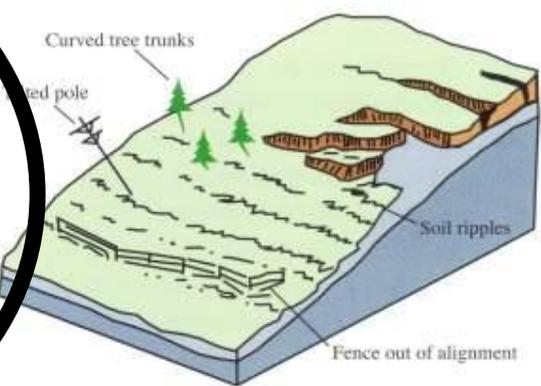
Debris flow



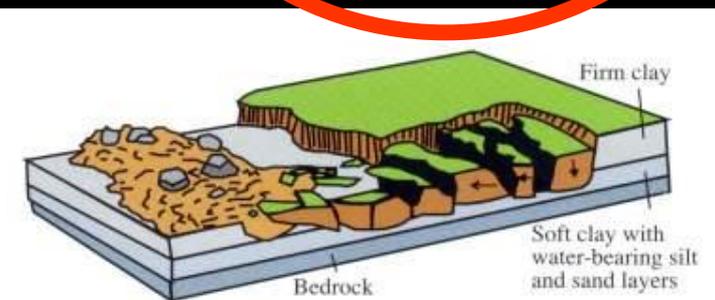
Debris avalanche



Earthflow

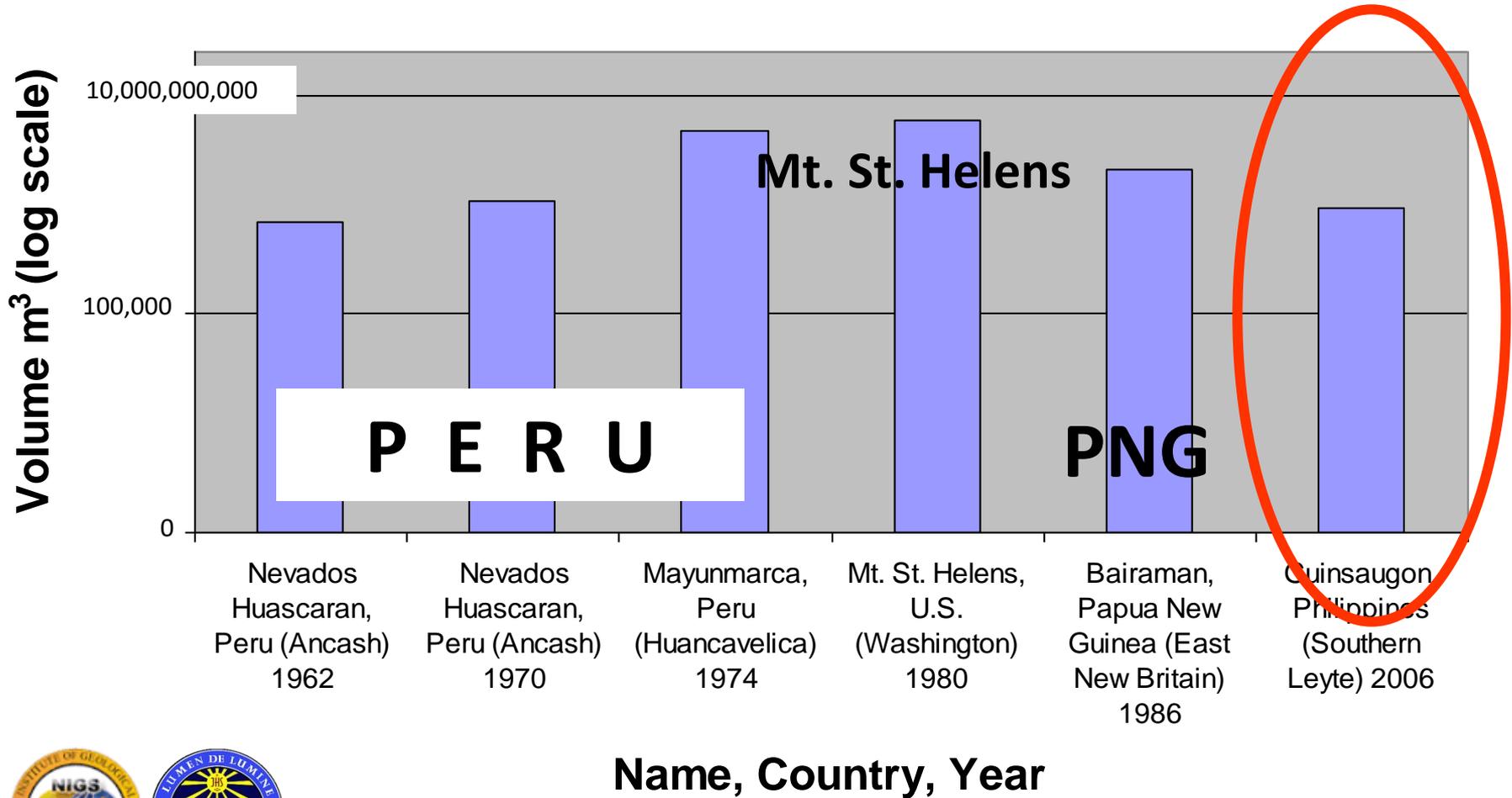


Creep



Lateral spread

Major Debris Avalanches in the 20th and 21st Century



Major rockslide-debris avalanches in the 20th and 21st centuries. Source: Proceeding of the 8th International Conference and Field trip on landslides, Granada, Spain, 27-28 September, Rotterdam: Balkema, 1996.



Day 4, Mon, 20 Feb 2006

Day 5, Tues, 21 Feb 2006



Day 5, Tues, 21 Feb 2006



Day 5, Tues, 21 Feb 2006



Day 5, Tues, 21 Feb 2006



KAMPUNG TAIN

P. GC. BIPYM 303418

LICEP CHURCH

ROAD

BRG



- MIL
- 4318
- 5218
- 1918
- 8018
- 8048
- 8108
- 8158
- 8208
- 8258
- 8308
- 8358
- 8408
- 8458
- 8508
- 8558
- 8608
- 8658
- 8708
- 8758
- 8808
- 8858
- 8908
- 8958
- 9008
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- 9758
- 9808
- 9858
- 9908
- 9958

Day 5, Tues, 21 Feb 2006



Day 5, Tues, 21 Feb 2006



Day 5, Tues, 21 Feb 2006



Rocks.... not muds

Day 5, Tues, 21 Feb 2006



Day 5, Tues, 21 Feb 2006



Day 5, Tues, 21 Feb 2006



Day 5, Tues, 21 Feb 2006



GPR (Ground Penetrating Radar)

Day 5, Tues, 21 Feb 2006



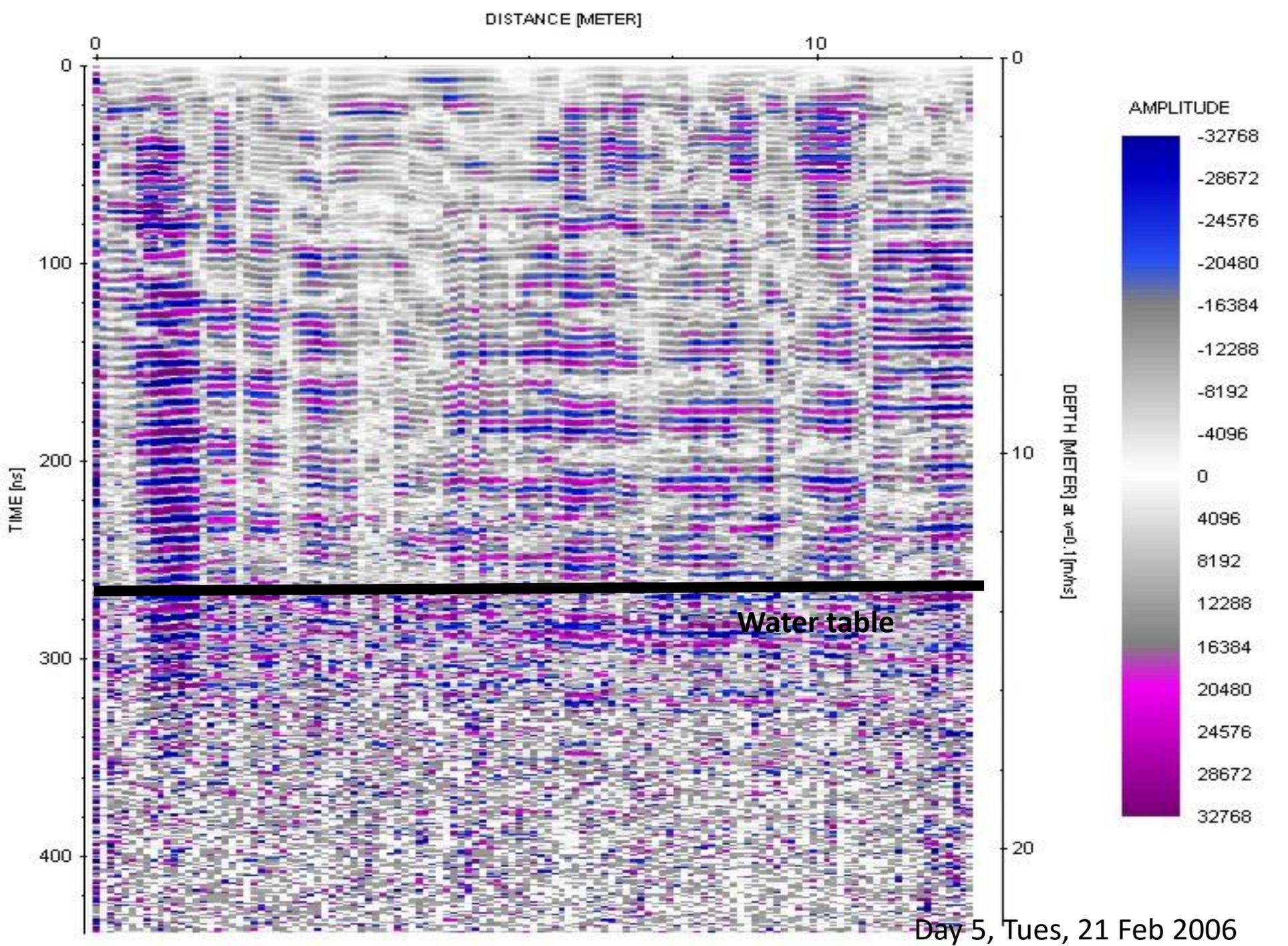
Day 5, Tues, 21 Feb 2006



Day 5, Tues, 21 Feb 2006



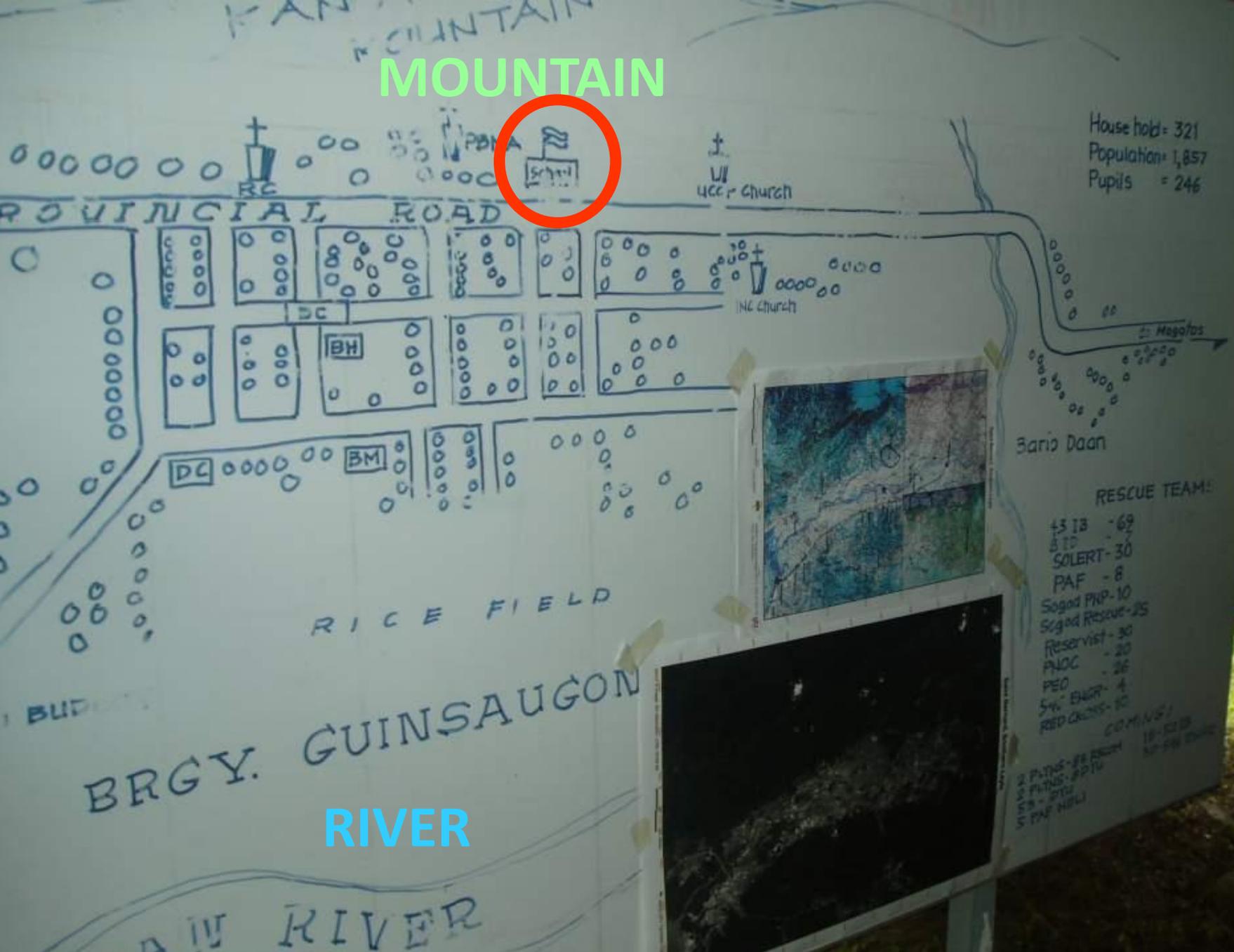
Day 5, Tues, 21 Feb 2006





Day 5, Tues, 21 Feb 2006

MOUNTAIN



House hold = 321
 Population = 1,857
 Pupils = 246

Baris Daan

RESCUE TEAM:

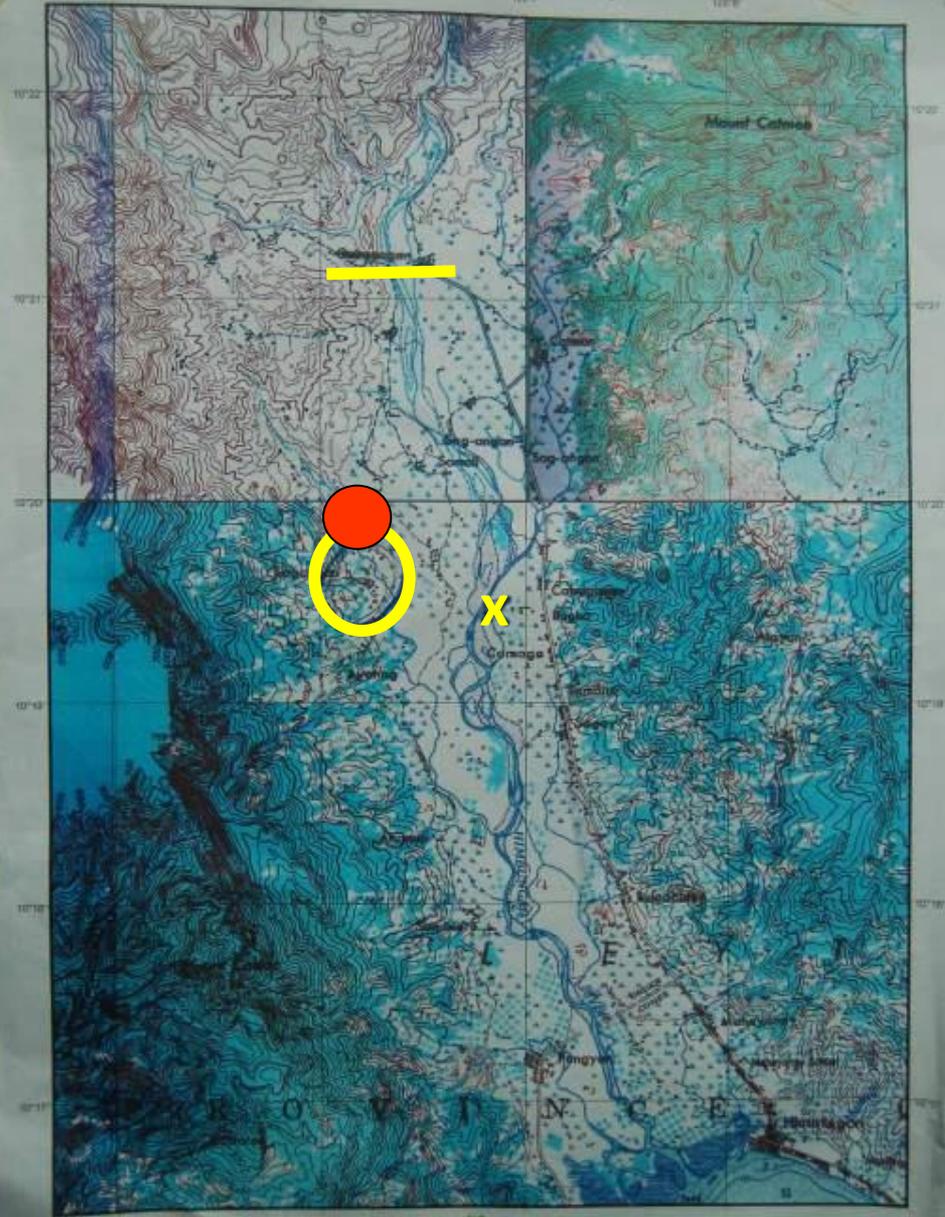
- 45 IB - 69
- 8 TD
- SOLERT - 30
- PAF - 8
- Sogad PHP - 10
- Sogad Rescue - 25
- Reservist - 30
- PNOC - 20
- PEO - 26
- SW - ENR - 4
- RED CROSS - 10

COMING:

- 2 PAF - 28 BSM
- 2 PAF - 28 BSM
- 5 PAF - 28 BSM
- 18 - 28 BSM
- 18 - 28 BSM

RIVER

Saint Bernard, Southern Leyte



Day 5, Tues, 21 Feb 200

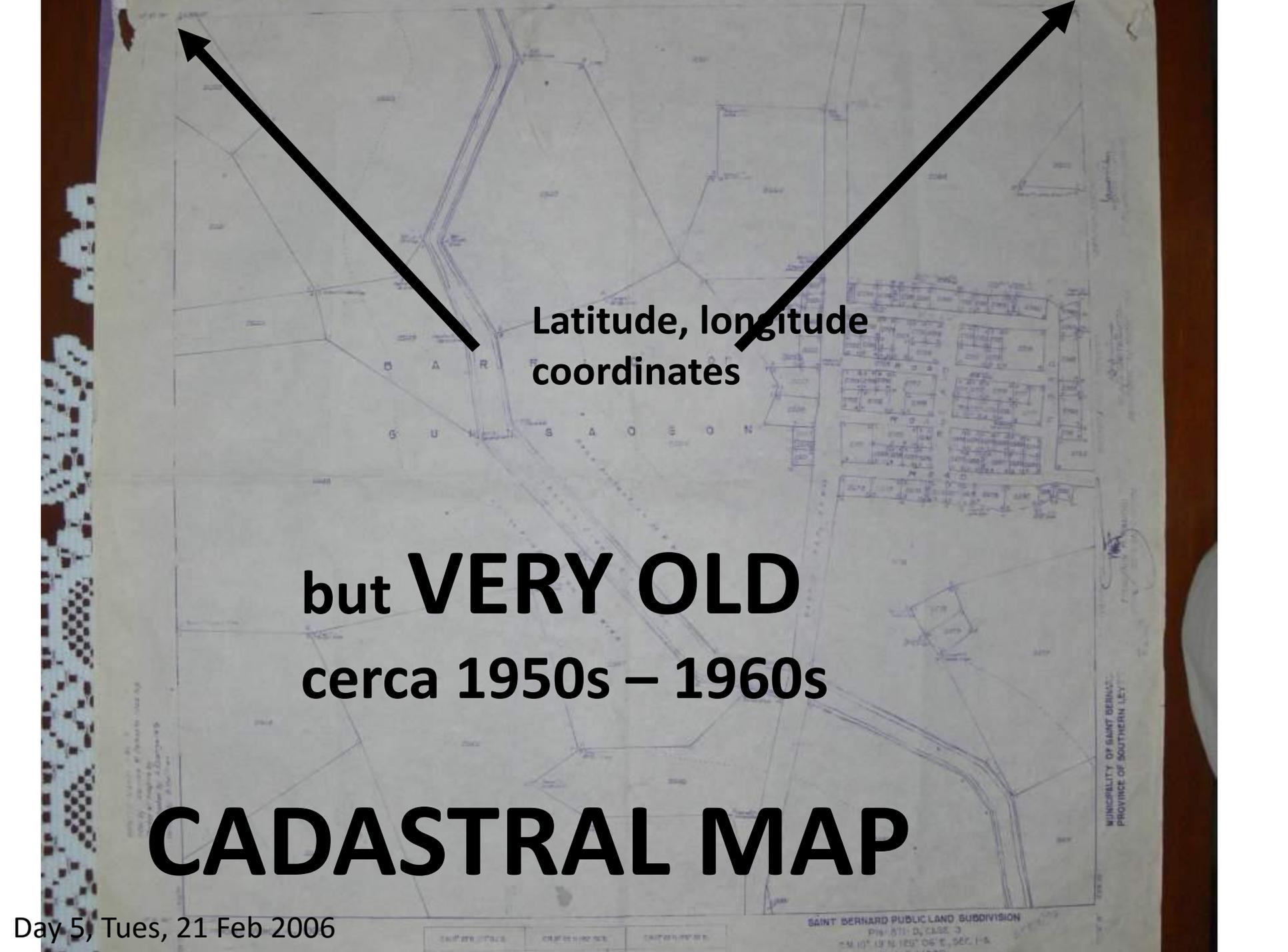
San Bernardino, Southern Leyte



Day 5, Tues, 21 Feb 2006



Day 5, Tues, 21 Feb 2006



Latitude, longitude
coordinates

but **VERY OLD**
cerca 1950s – 1960s

CADASTRAL MAP



UPDATED

SECTION 04



SECTION 03

TAX MAP

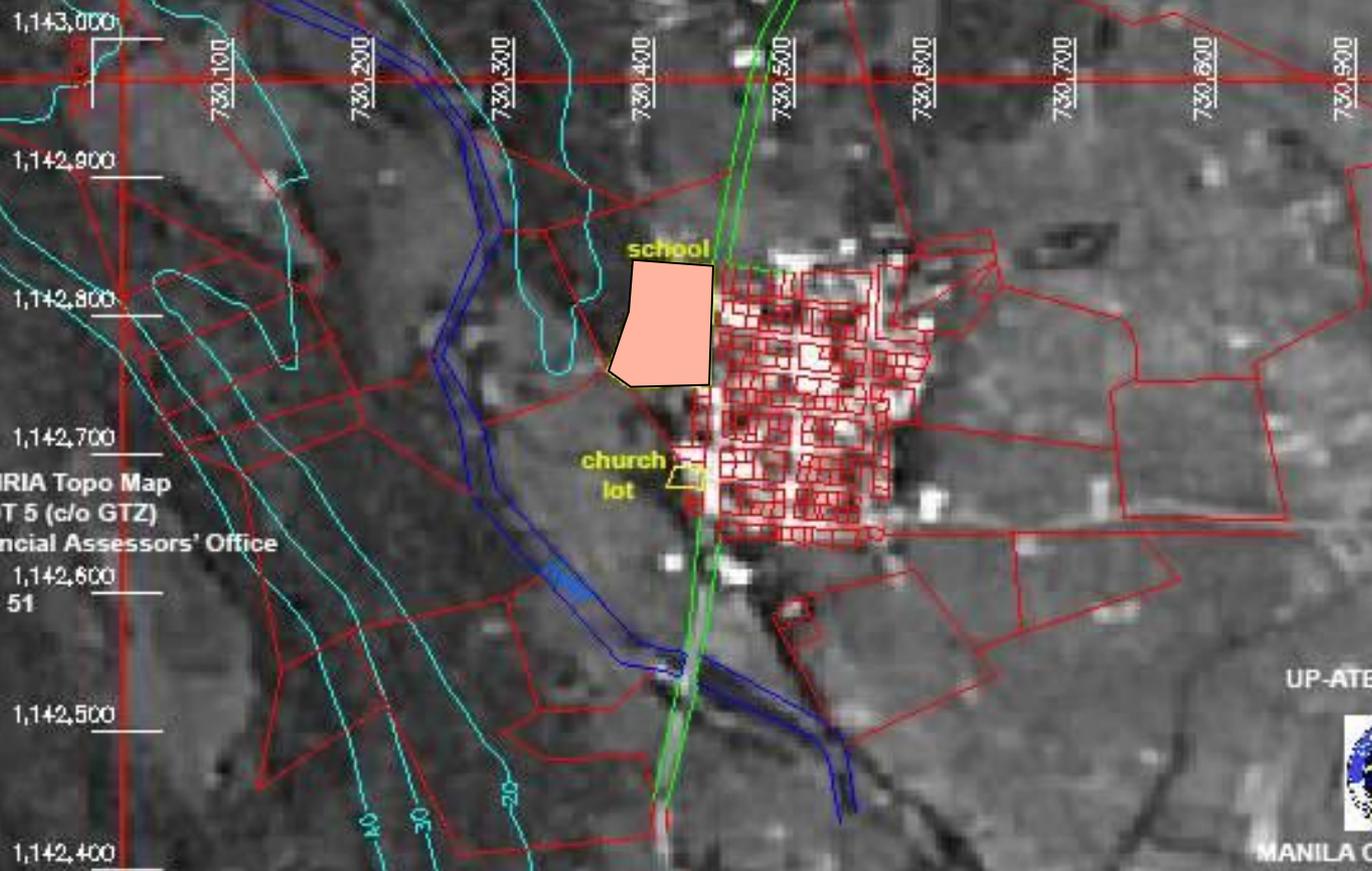
PROPERTY IDENTIFICATION MAP
 SCALE: 1"=1000'
 PREPARED: *WILSON & PALAC*
 VERIFIED: *MARILYN S. SUNDLAK*
 THIS MAP IS PREPARED FOR TAXATION PURPOSES ONLY AND SHALL NOT BE CONSIDERED AS EVIDENCE FOR SETTLEMENT OR BOUNDARY DISPUTES.
 APPROVED: *WILSON & PALAC*
 PLOTTED: *WILSON & PALAC*



Day 6, Wed, 22 Feb 2006

MOUNTAIN

RIVER



Data Sources:
partial contours: NAMRIA Topo Map
Satellite Imagery: SPOT 5 (c/o GTZ)
Cadastral maps: Provincial Assessors' Office

Projection: UTM Zone 51
WGS84

Note: Map overlay is approximate

UP-ATENEO TEAM



MANILA OBSERVATORY
ATENEO DE MANILA UNIVERSITY



Day 6, Wed, 22 Feb 2006



Day 6, Wed, 22 Feb 2006



Day 6, Wed, 22 Feb 2006



- 60m auger
- Total station

Day 6, Wed, 22 Feb 2006

Day 7, Thurs, 23 Feb 2006



Heavy rainfall

.....no on site rainfall information



Day 7, Thurs, 23 Feb 2006





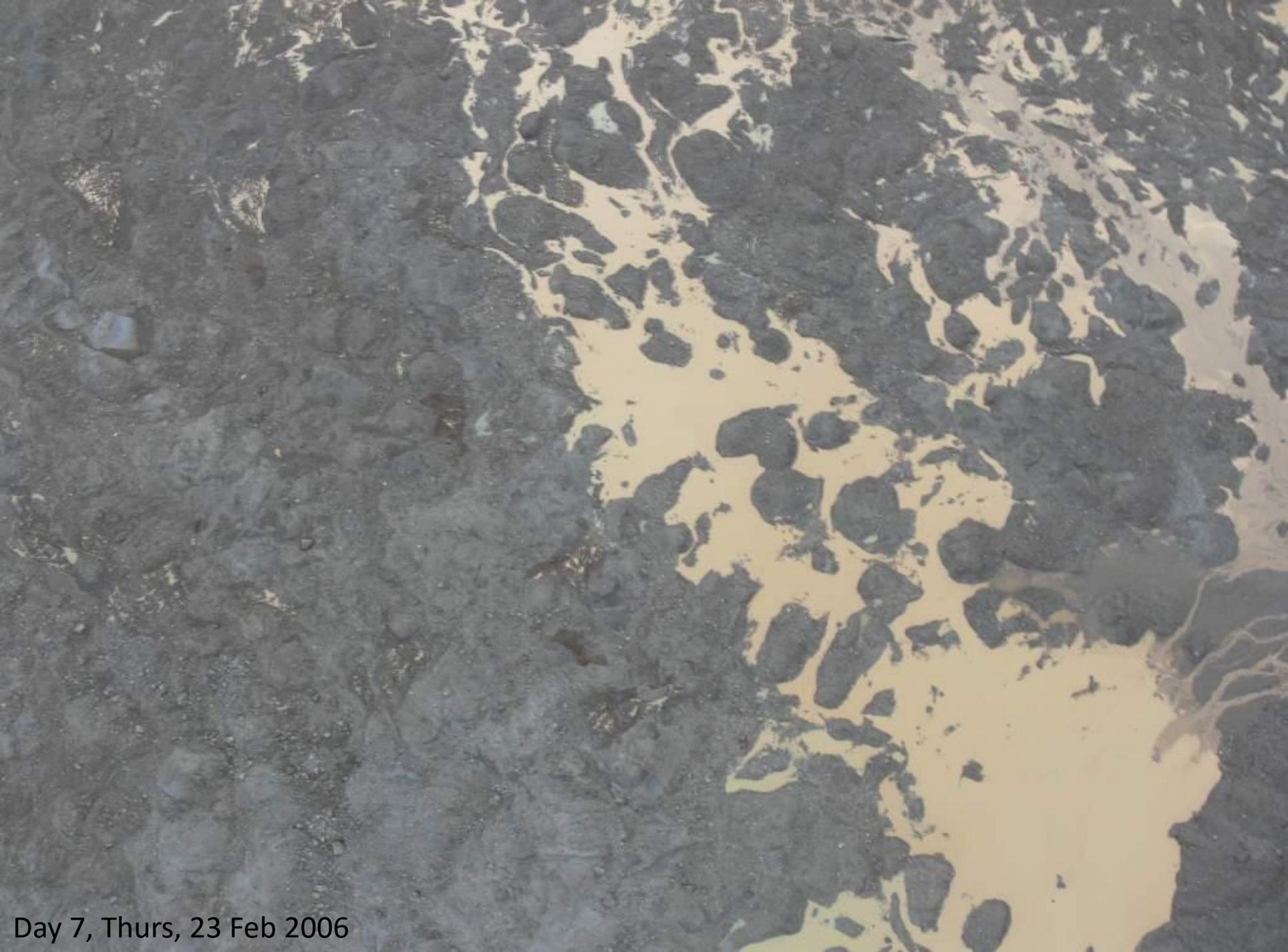
Day 7, Thurs, 23 Feb 2006



Day 7, Thurs, 23 Feb 2006



Day 7, Thurs, 23 Feb 2006



Day 7, Thurs, 23 Feb 2006



Day 7, Thurs, 23 Feb 2006



Day 7, Thurs, 23 Feb 2006



Day 7, Thurs, 23 Feb 2006



School perimeter

Day 7, Thurs, 23 Feb 2006



US Marines Access Road

Chicken revives flagging spirits; 15 bodies dug up yesterday

From page A1

meters deep, had cracked into a structure, or what was left of it, in the ravaged barangay.

But Ramos said that in all likelihood, the structure was not part of the Guinsaugon Elementary School,

where more than 200 pupils and teachers were believed to have been buried alive in the avalanche of mud and boulders on Feb. 17.

Ramos said the structure was in a relatively "shallow" portion of the tragedy site, quite far from where the school once stood.

The spot is now marked with a flag to guide rescuers.

He said the textbooks found inside were "religious" in nature, indicating that they belonged, not in a school, but to a family of Iglesia ni Cristo followers.

As of yesterday, Ramos said,

seismic sensors were picking up "rhythmic patterns" from underneath the muck.

But these were not enough to suggest the presence of human activity, he said.

Fifteen bodies were dug up yesterday bringing to 111 the number

of fatalities so far, and 11 body parts.

On Tuesday, some rescuers were quoted as saying that it was time to concede that there were no more human survivors.

Abdul Asis Ahmad, head of the 67-member Malaysian team, yesterday said a person buried under mud

also had a mud pump.

The Americans also brought in fresh legs to join the rescue operation involving Philippine authorities and teams from Taiwan, Malaysia and Spain.

Parmer said the Gulf Company, which had been on site since Satur-



Day 7, Thurs, 23 Feb 2006

RESCUE 505



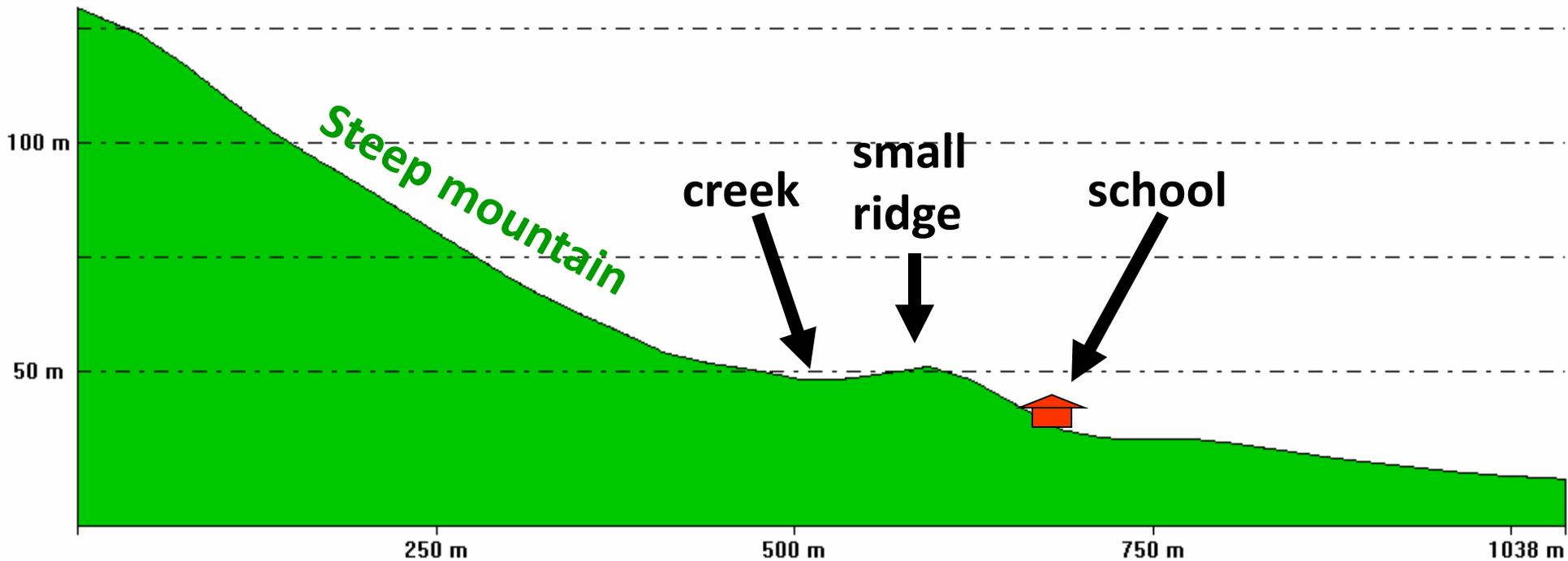
RESCUE 505

Day 7, Thurs, 23 Feb 2006

- 
- Air space
 - Transport vs burial
 - GIS

From Pos: 729931.62, 1142878.87

To Pos: 730947.68, 1142667.20



Day 8, Fri, 24 Feb 2006

Search and Rescue Operation
24 February 2006
Target Sites



Prepared by the
UP-Ateneo Team

Day 8, Fri, 23 Feb 2006



Day 8, Fri, 23 Feb 2006

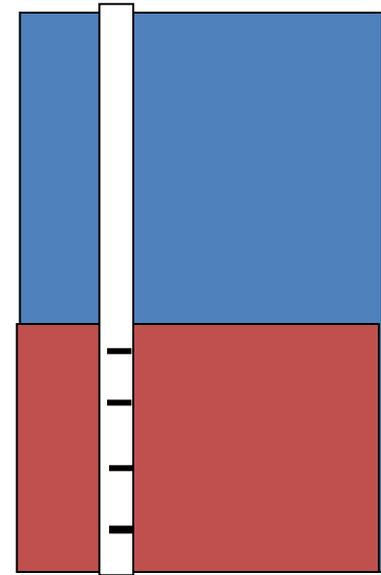
RESCUE 505



IMPROVISED RAIN GAUGE



MEASURED IN mm



Straight can

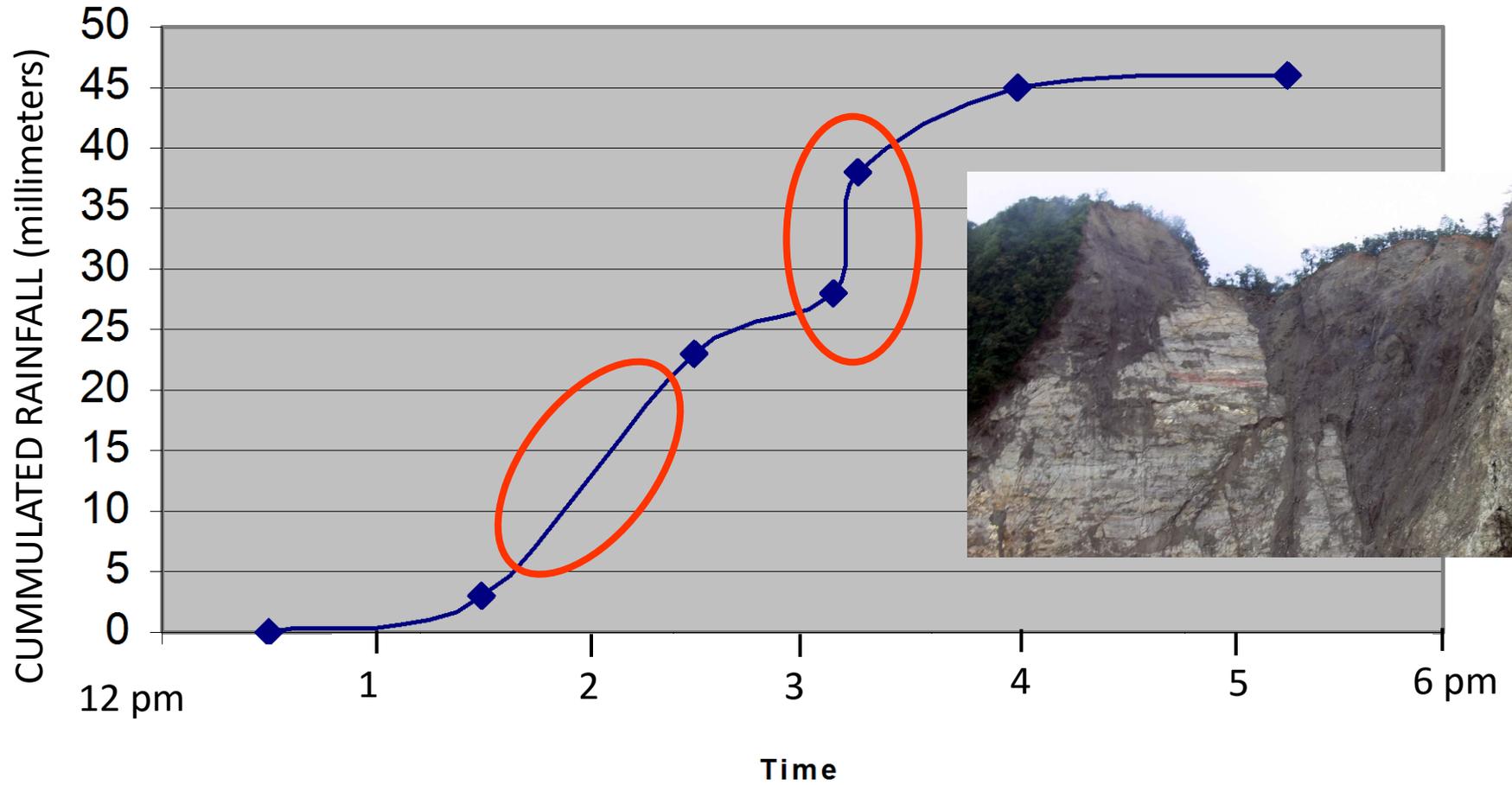


Day 8, Fri, 23 Feb 2006



Day 8, Fri, 23 Feb 2006

Base Camp





HAX-641
ICE PHILIPPINES 2000 DEC

- 20 rescued on 17 Feb 2006
- As of 24 Feb 2006 12:00 noon (DOH)
 - 37 identified dead bodies
 - 74 unidentified bodies
 - 11 body parts
 - 122 TOTAL
- Missing 1,328 people

Account from the Tiempo siblings



Day 8, Fri, 23 Feb 2006

CADASTRAL MAP OF BRGY. SAINT BERNARD (Proper), SOUTHERN LEYTE

Account from the Tiempo siblings

SCHOOL COMPOUND

Legend:

 Dead



UP-ATENEO TEAM

MANILA OBSERVATORY
 ATENEO DE MANILA UNIVERSITY
 KATIPUNAN ROAD, LOYOLA HEIGHTS
 QUEZON CITY
 TEL: 426 -5921



NORTH



Day 8, Fri, 23 Feb 2006





Day 8, Fri, 23 Feb 2006

FR: Jackylyn

Monghit

130 April 3 San Mateo St.

Plaridel T, Malabonias P.C.

Pampanga 2009

TO: Johnson Monghit

Guinsaugon Sairit

Bernard So. Leyte

0616

PUP LBC-40640

RECEIPT NO. _____

DATE RECEIVED _____

I CERTIFY THAT THERE IS NO CASH
CHECK OR PAYABLE INSIDE.


SIGNATURE

LBC Airvelop

Of 100 on to...
send to 333 (Cebu) of...
your non package...
1200

...the for the ... of the wed
...age...

The Wedding Liturgy

...in the name of the Father and of the Son and of the Holy
Spirit.

Amen **Judy Q. Labis**

...May the grace of our Lord Jesus Christ and the love of
the Holy Spirit be with you all

Venus P. Baylan

And also with you.

...Judy and Venus God is love and have in some
mysterious ways drawn you together in love. But He
leaves you free to make that love grow or let it wither
or die. The Lord will help you forge a future for your
love if you do share. When you do stand to the
commitment to love one another in good times and bad.

St. Rosary Chapel, Guinsaugon
St. Bernard, Southern Leyte
Philippines

...day of June, 2003
... 10 : 30 A.M

CADASTRAL MAP OF BRGY. SAINT BERNARD (Proper), SOUTHERN LEYTE

Account from the Tiempo siblings

SCHOOL COMPOUND

Legend:

-  Dead
-  Personal articles



UP-ATENEO TEAM

MANILA OBSERVATORY
 ATENEO DE MANILA UNIVERSITY
 KATIPUNAN ROAD, LOYOLA HEIGHTS
 QUEZON CITY
 TEL: 426 -5921



NORTH





Day 8, Fri, 23 Feb 2006

CADASTRAL MAP OF BRGY. SAINT BERNARD (Proper), SOUTHERN LEYTE

SCHOOL COMPOUND

Legend:

-  Dead
-  Personal articles
-  3-storey building

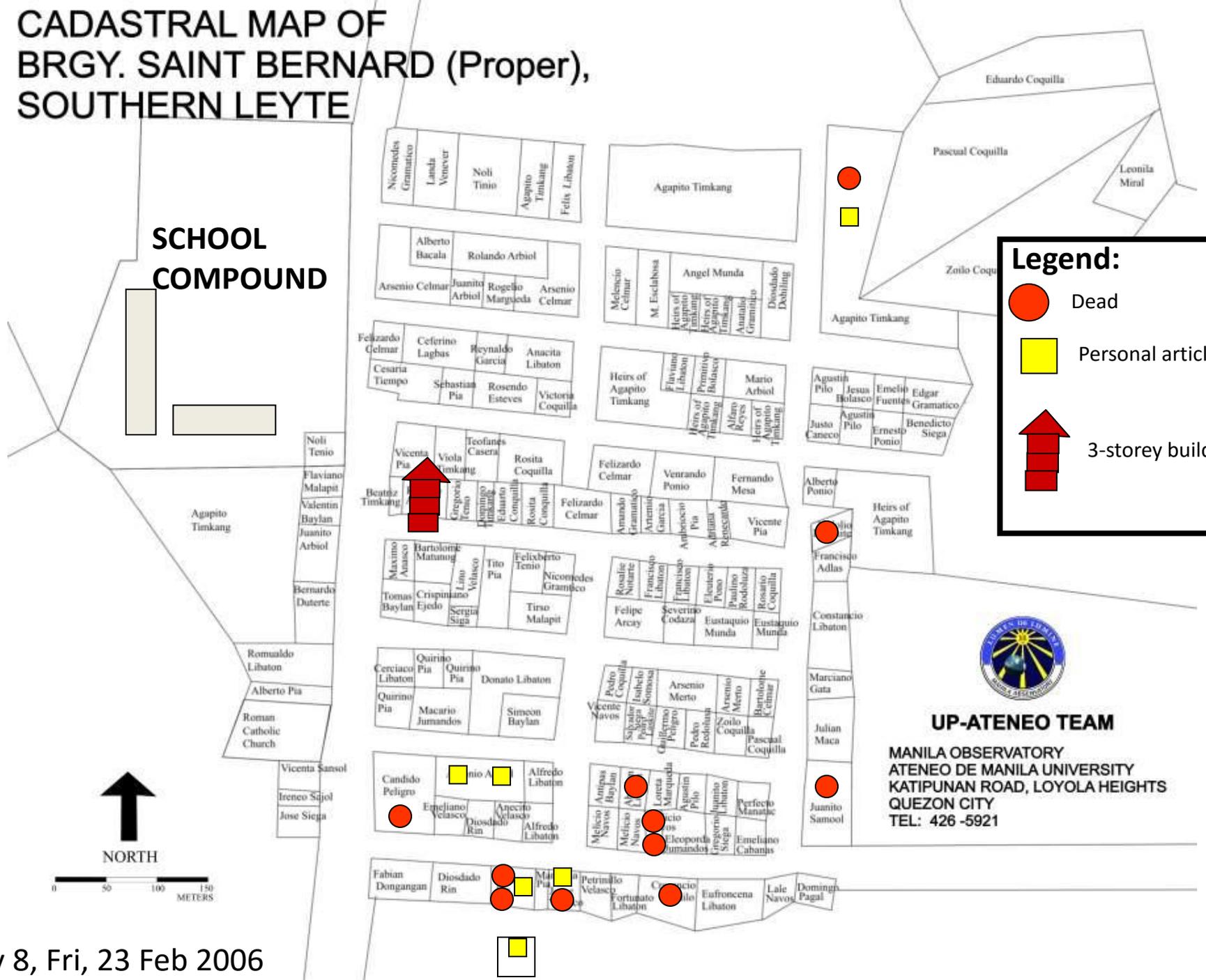


UP-ATENEO TEAM

MANILA OBSERVATORY
 ATENEO DE MANILA UNIVERSITY
 KATIPUNAN ROAD, LOYOLA HEIGHTS
 QUEZON CITY
 TEL: 426 -5921



NORTH



Search and Rescue Operation
24 February 2006
Target Sites

3-storey building of
Rogelio Araullo (old
owner)

Transported 565m



Prepared by the
UP-Ateneo Team

Day 8, Fri, 23 Feb 2006



Day 8, Fri, 23 Feb 2006



Day 8, Fri, 23 Feb 2006



Day 8, Fri, 23 Feb 2006



RESCUE 505

Day 8, Fri, 23 Feb 2006

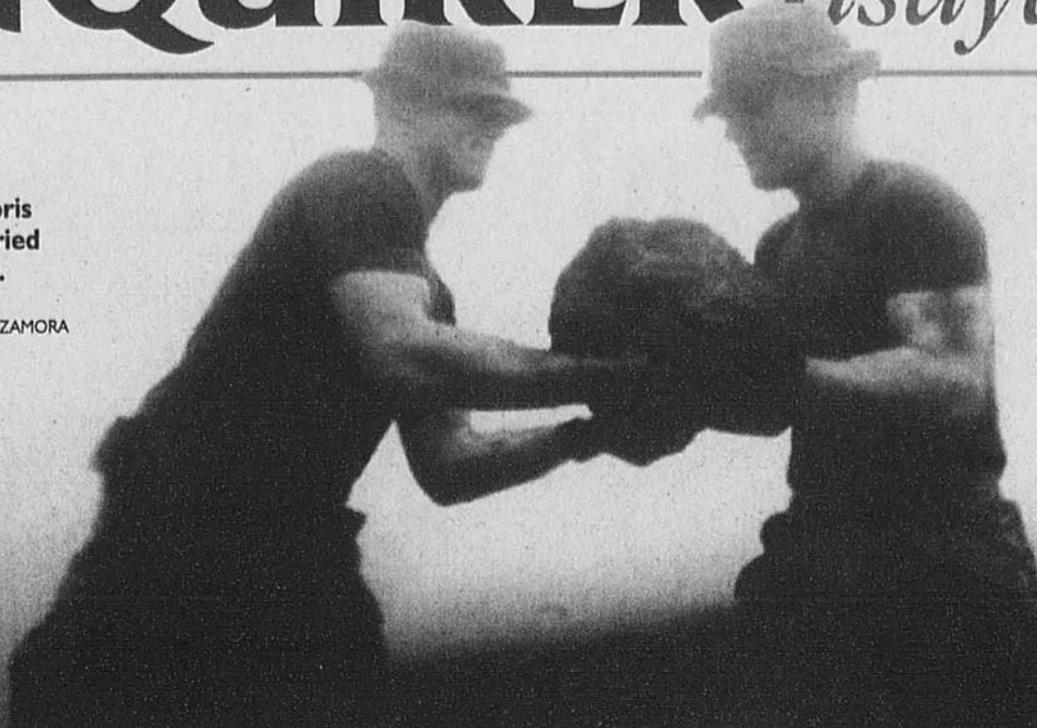
E-mail: inq_cebu@inquirer.com.ph

INQUIRER *Visayas*

Editor Jun Bandayrel
Bureau Chief Edralyn L. Benedicto

US MARINES clear the debris left by a landslide which buried Barangay Guinsaugon in St. Bernard, Southern Leyte.

REM ZAMORA



‘What we have seen has been horrendous’

Lessons learned from a thousand lives

- Speed, accuracy, max. use of resources
- Identify landslide type
- Importance of base maps
- Rapid aerial survey
- GIS of data gathered
- on-field meteorological data
- Technical team to provide guidance
- Hazard assessment at ground zero
- Develop mobile phone technology for emergency situations (method, technology, and guidelines)
- Need for early warning systems and disaster preparedness

– How to communicate

- Finding a common language (Mangyans)
- Understanding what happened (Leyte landslide)
- Raising awareness (fluvial systems)

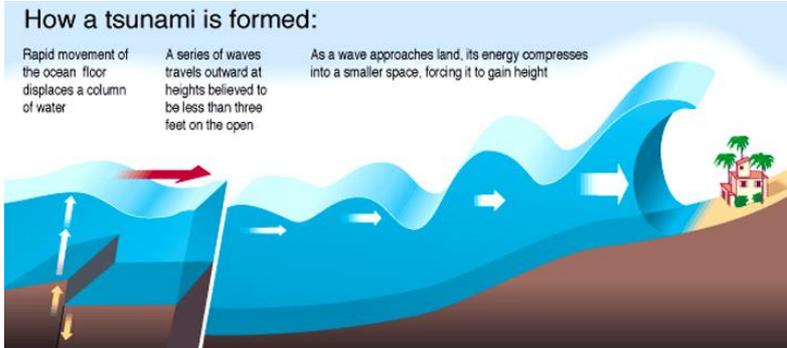
Tsunami vs storm surge

How a tsunami is formed:

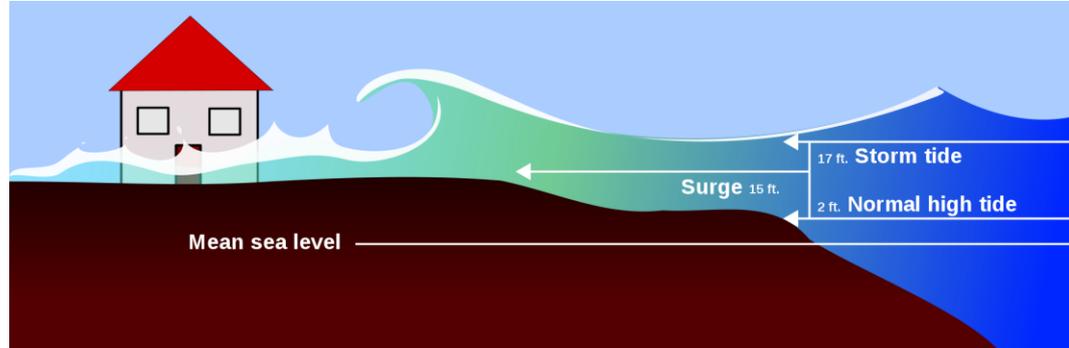
Rapid movement of the ocean floor displaces a column of water

A series of waves travels outward at heights believed to be less than three feet on the open

As a wave approaches land, its energy compresses into a smaller space, forcing it to gain height

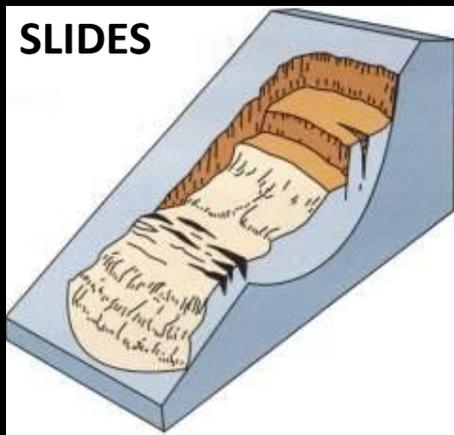


https://tc120.files.wordpress.com/2014/09/434571_orig.jpg

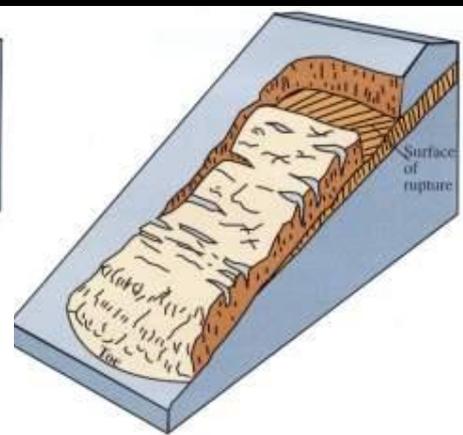


<https://upload.wikimedia.org/wikipedia/commons/thumb/3/32/Surge-en.svg/2000px-Surge-en.svg.png>

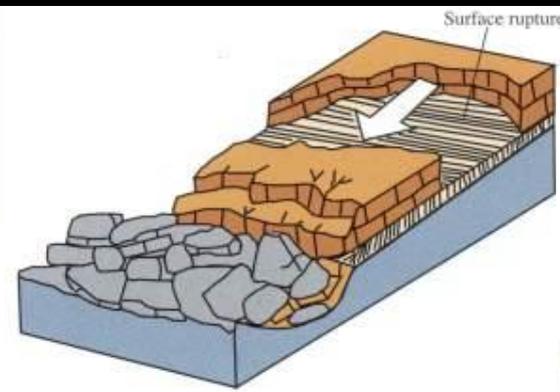
SLIDES



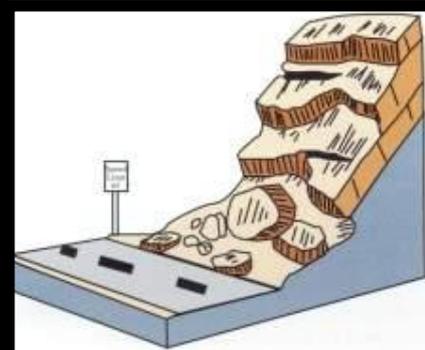
Rotational landslide



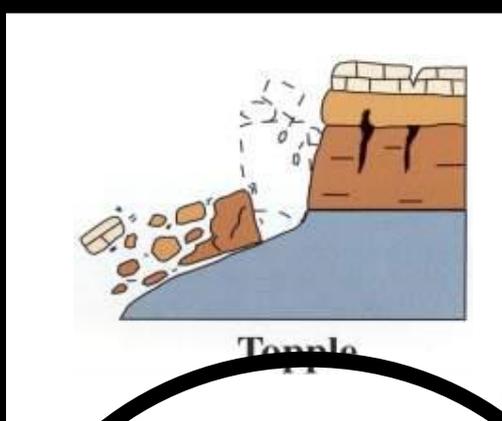
Translational landslide



Block slide

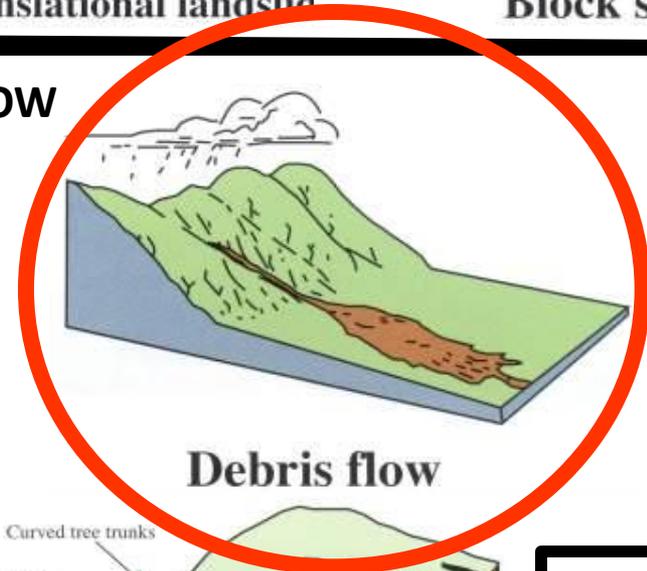


Rockfall

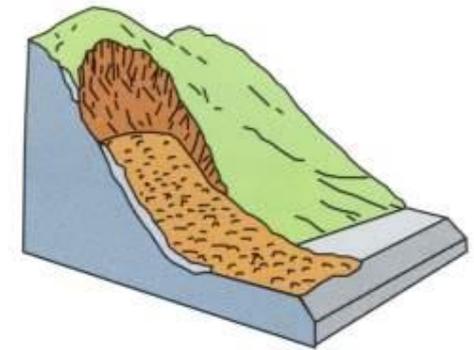


Topple

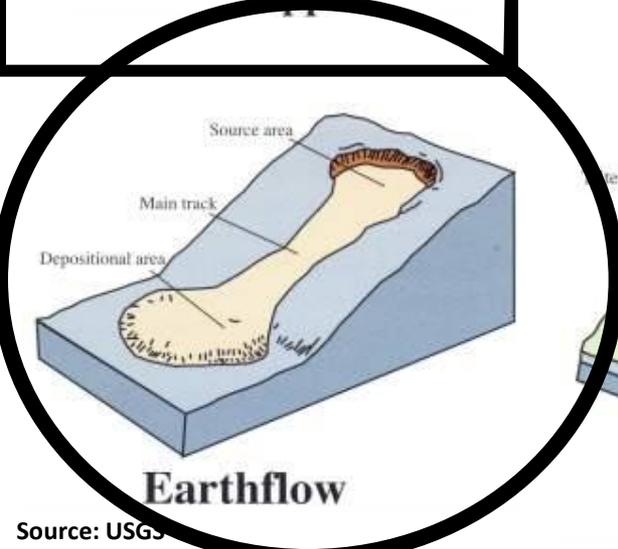
FLOW



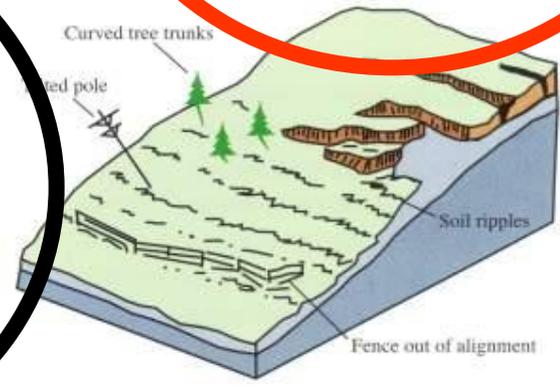
Debris flow



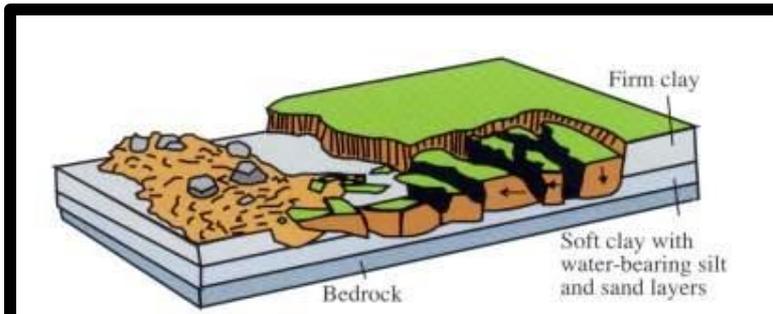
Debris avalanche



Earthflow

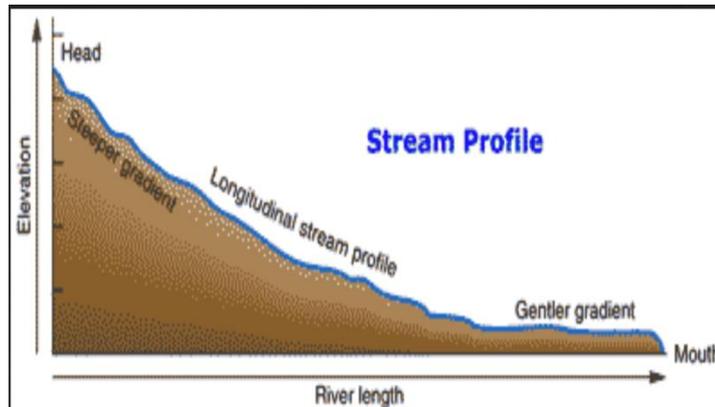
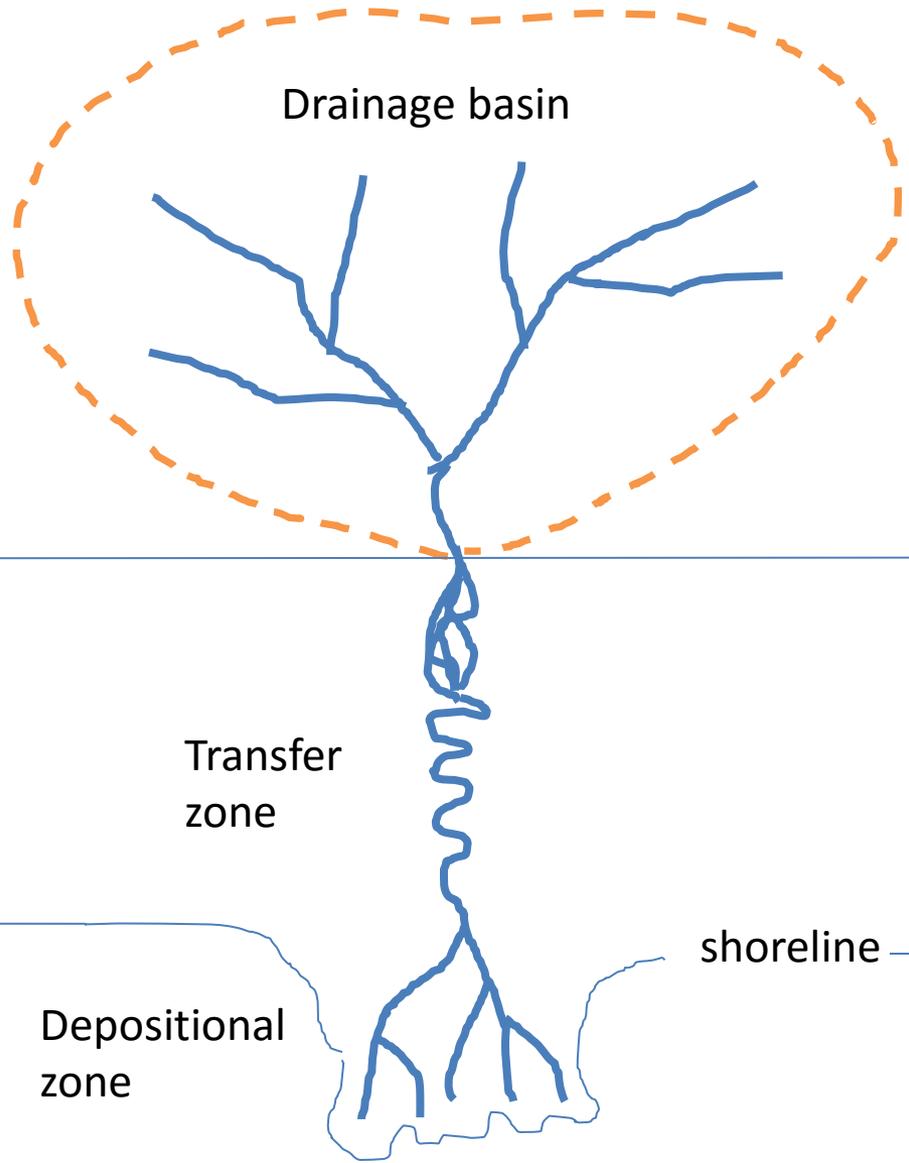


Creep



Lateral spread

Components of a Fluvial System



Drainage pattern

TRIBUTARIES

BRAIDED

MEANDERING

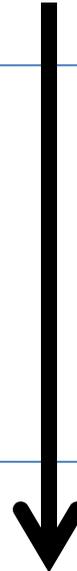
DISTRIBUTARY

Grain size

Energy

COARSE

HIGH

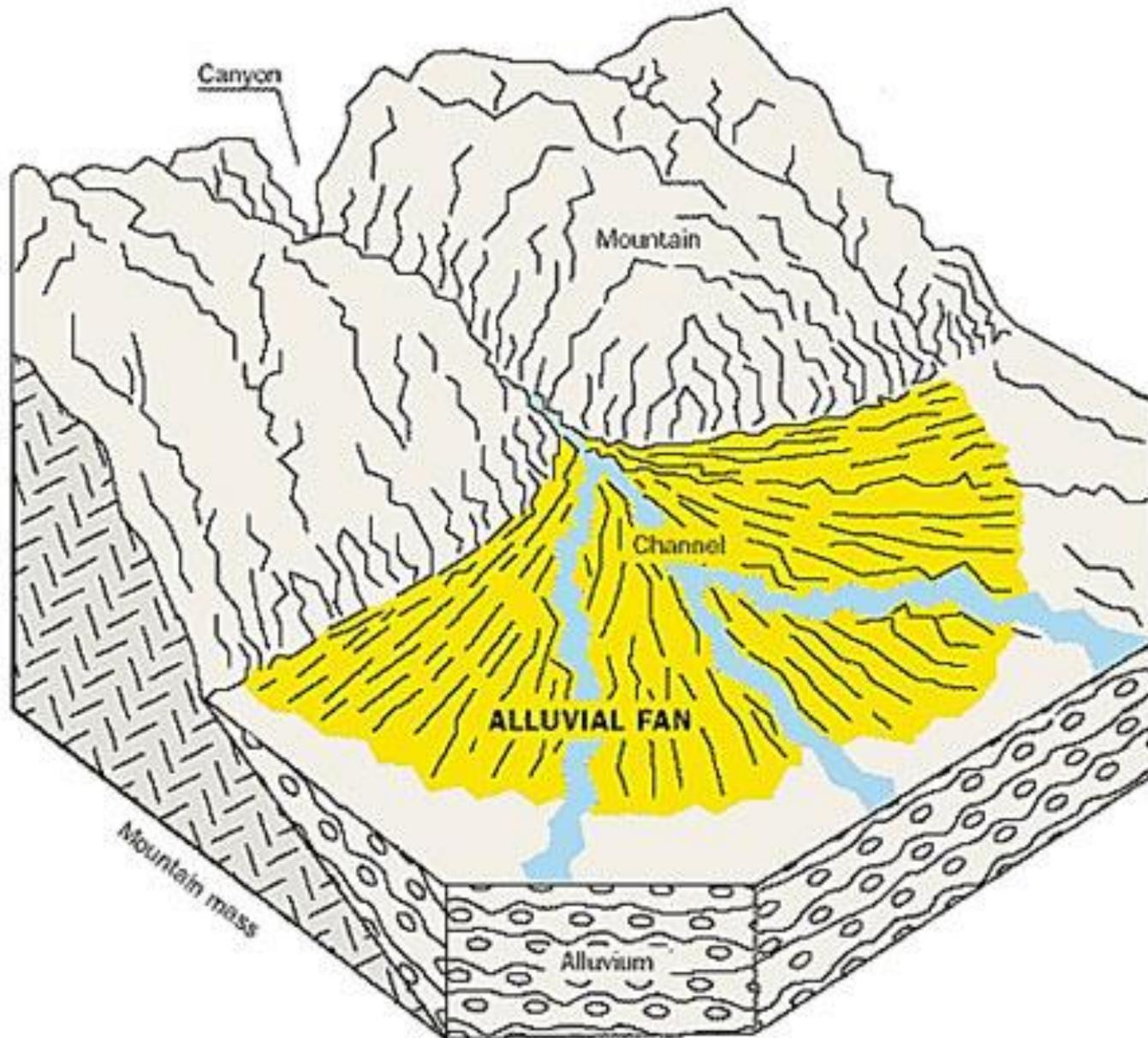


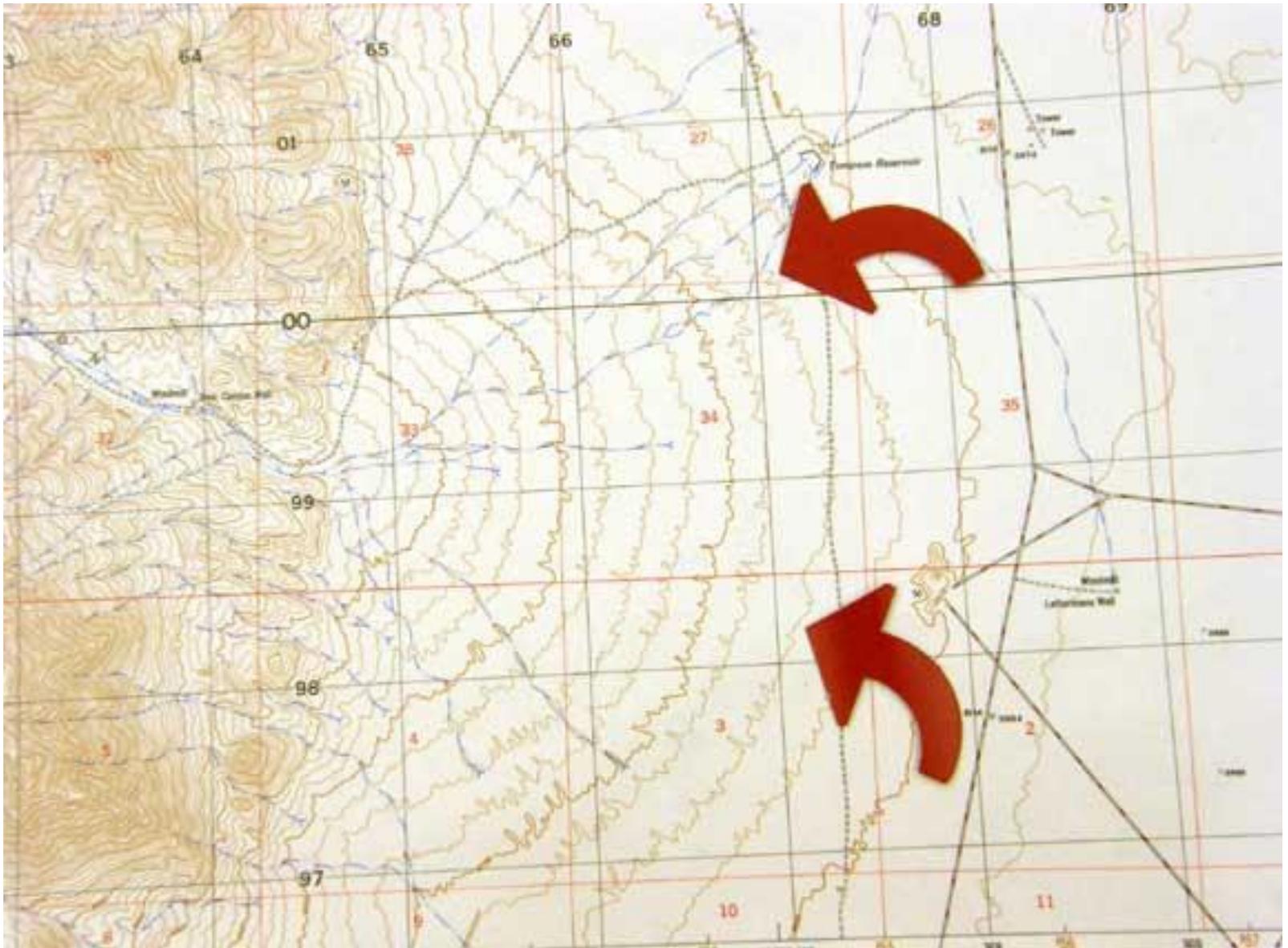
FINE

LOW

http://www.windows.ucar.edu/earth/geology/images/alluvial_fan_lg.jpeg

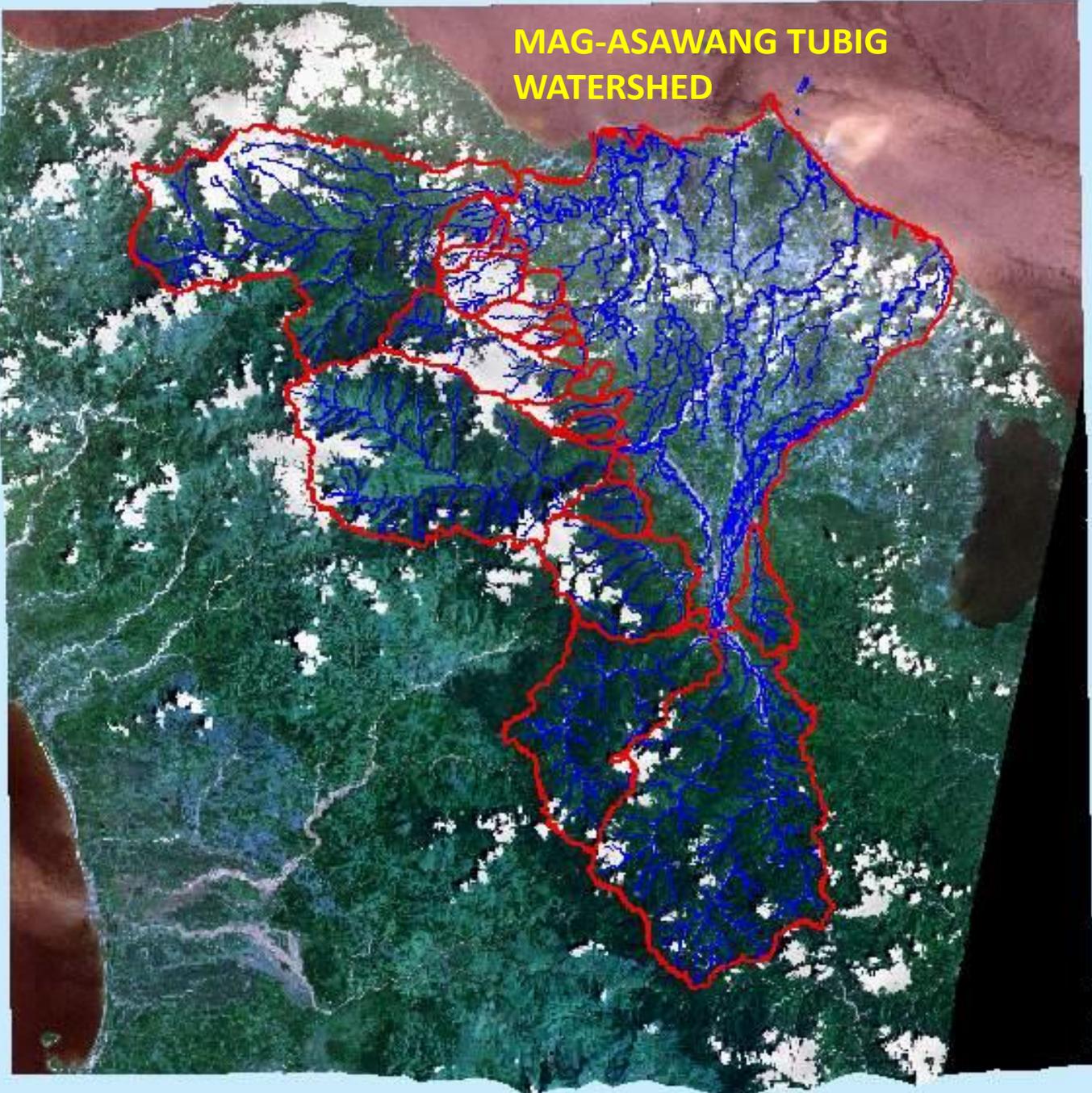


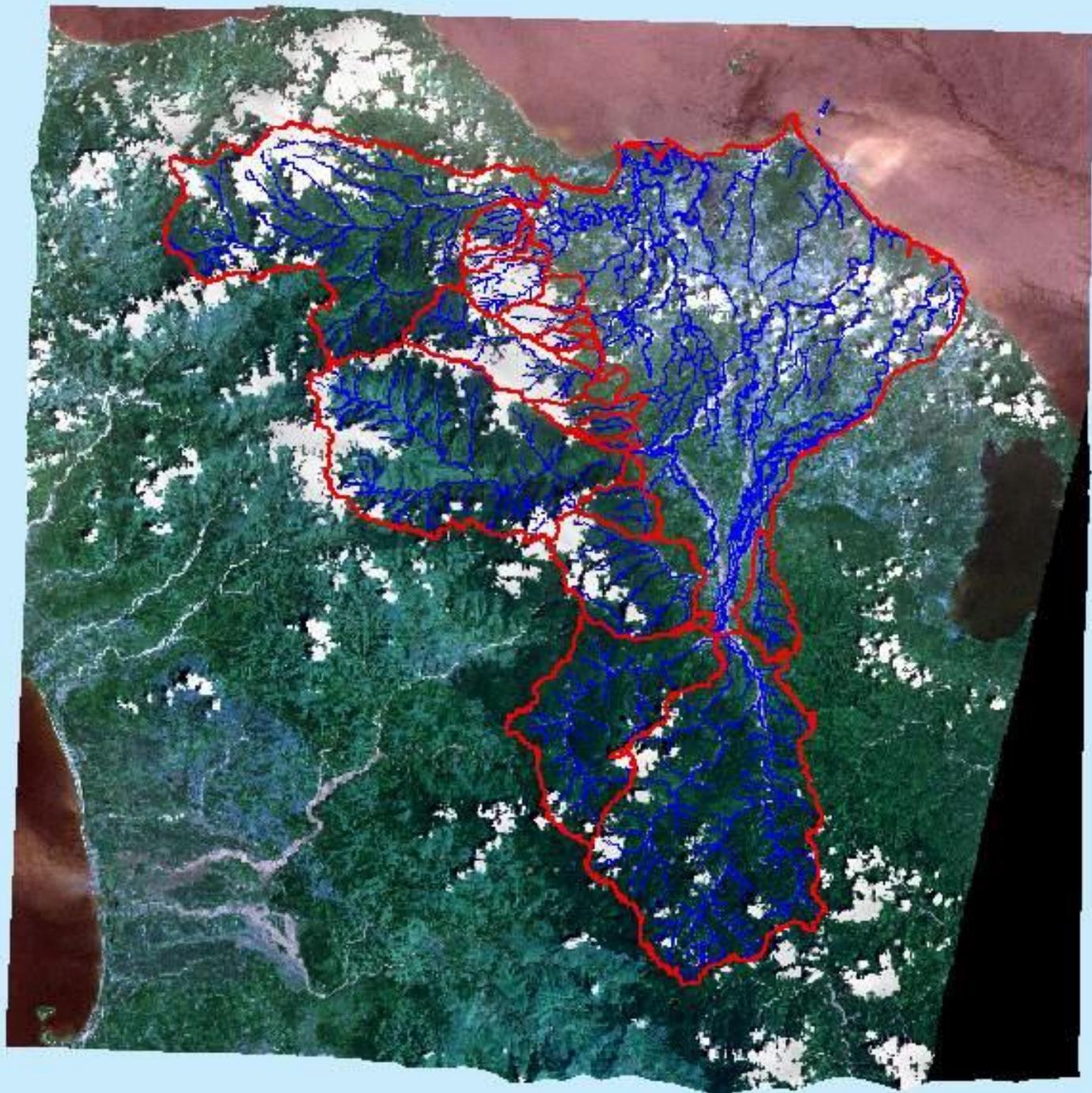


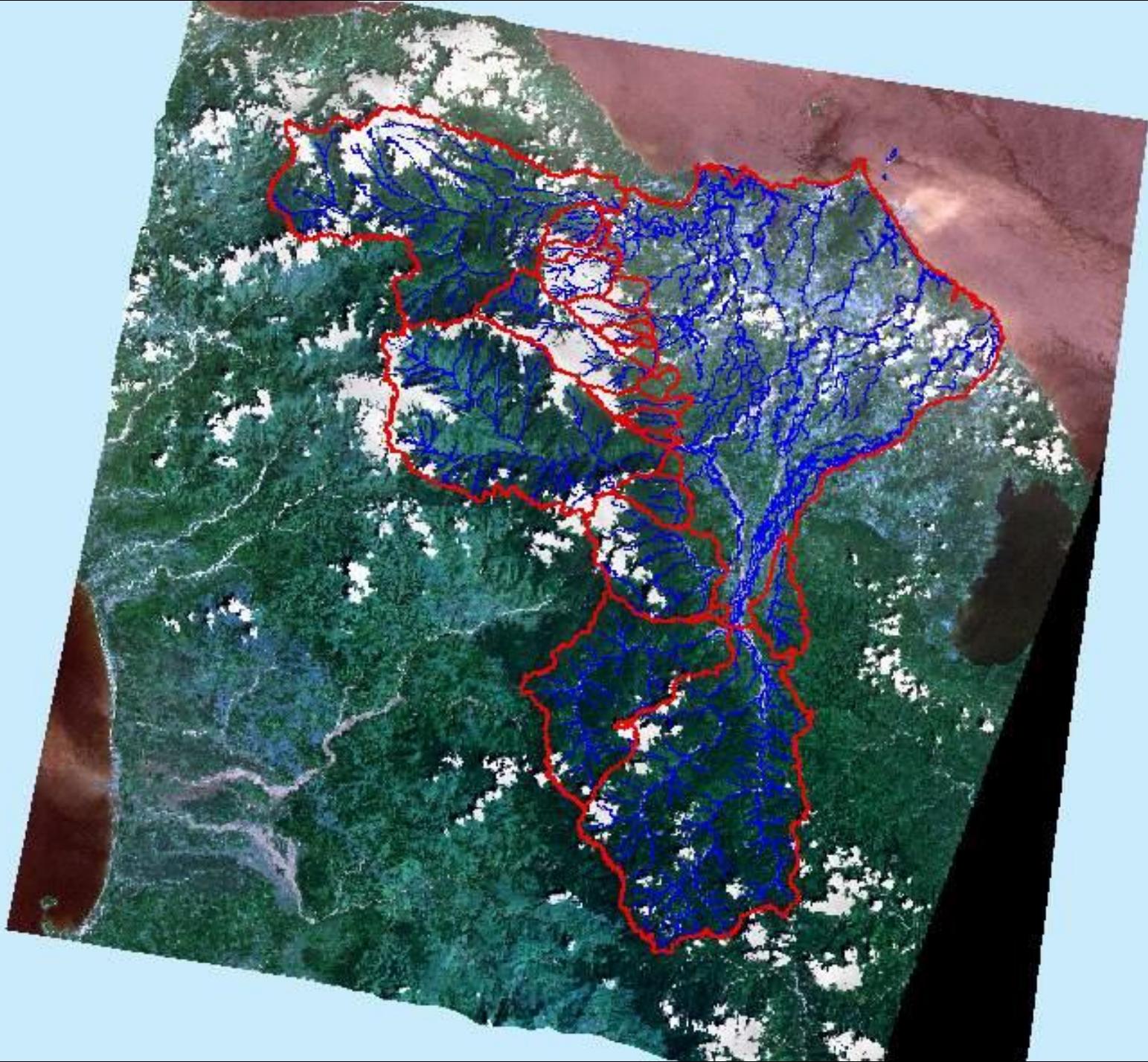


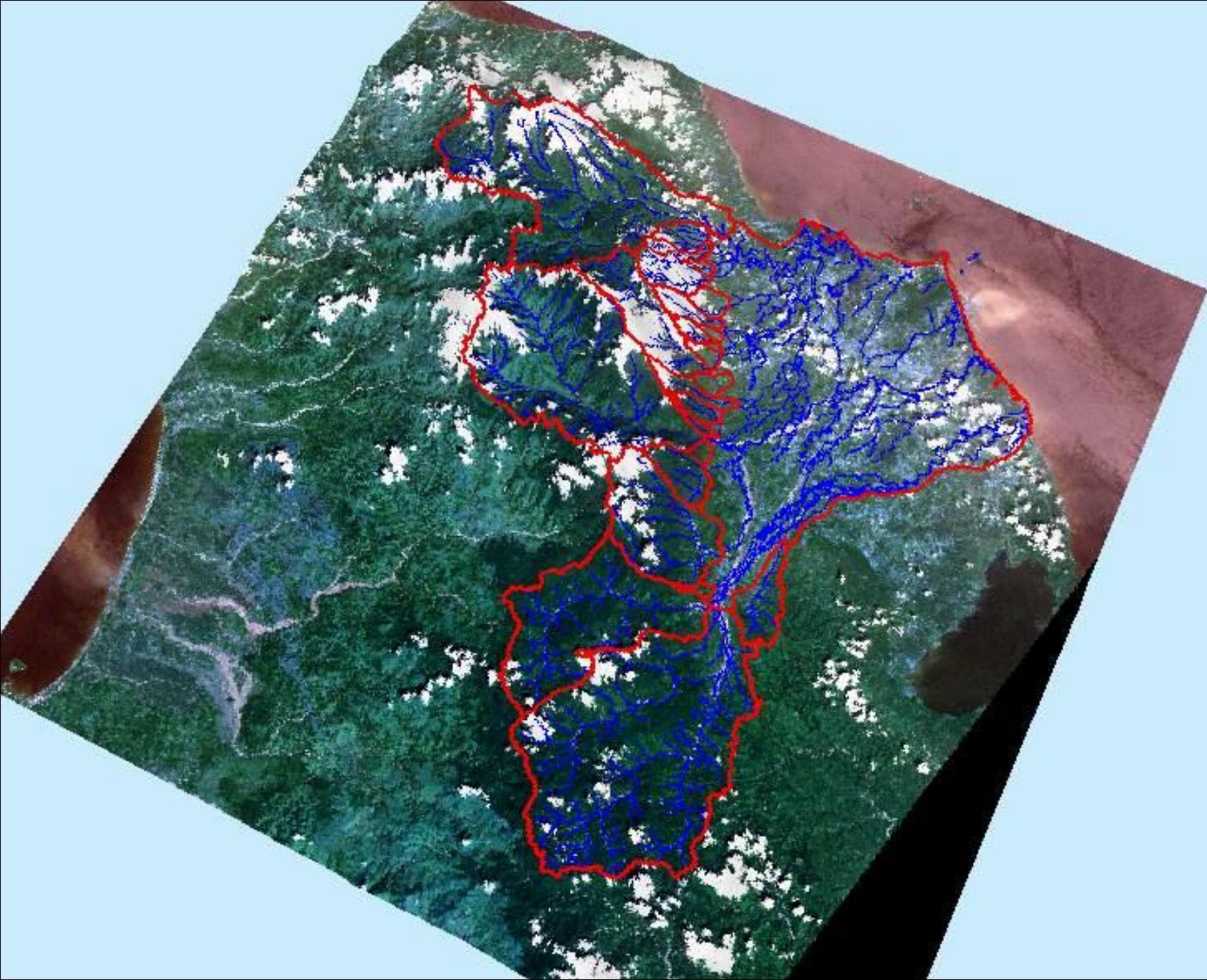
http://home.moravian.edu/users/phys/mejig01/geology/geology%20pages/geo_map_folder/geo_map_images/m_alluvial_fanB1.jpg

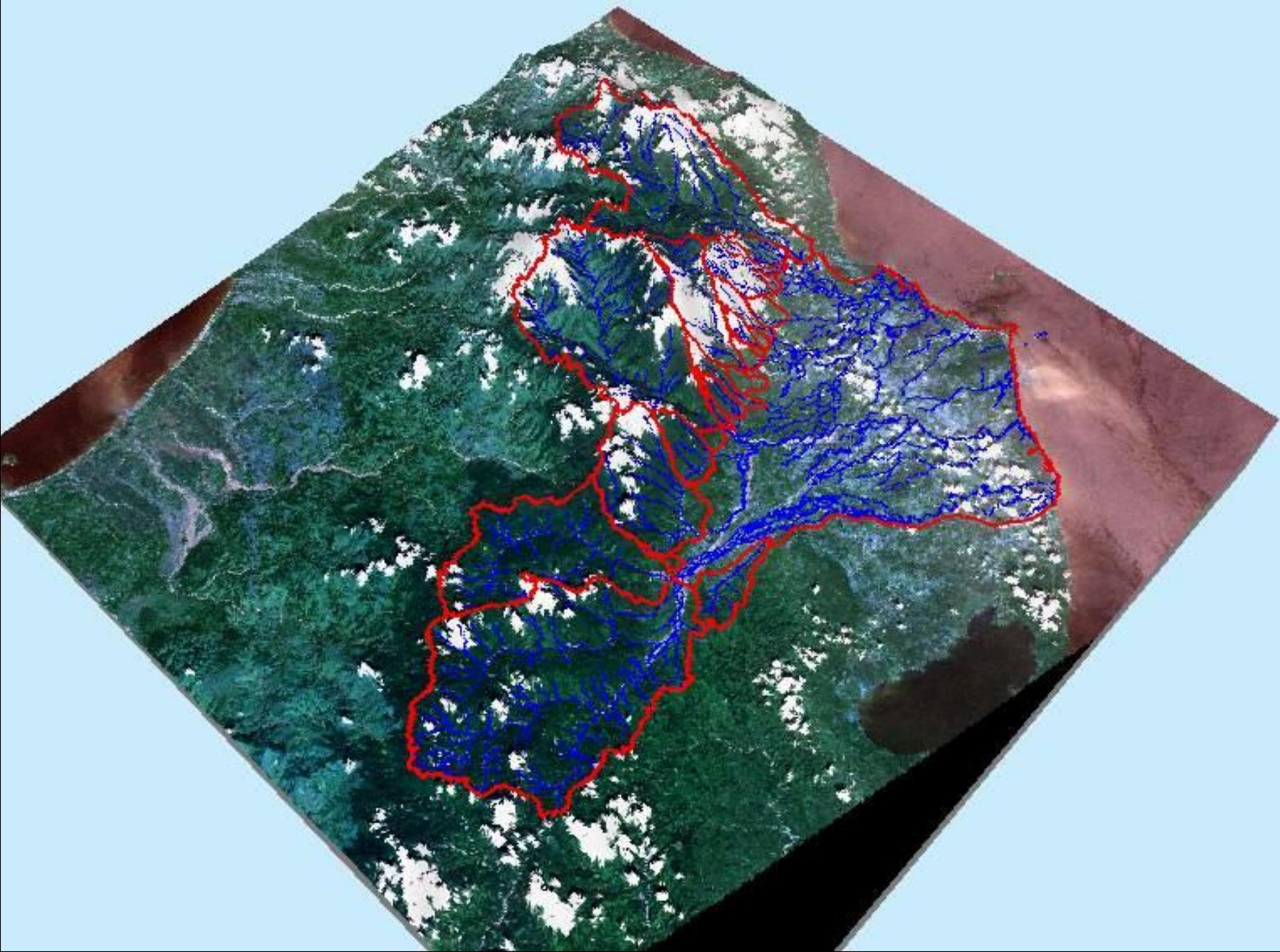
**MAG-ASAWANG TUBIG
WATERSHED**

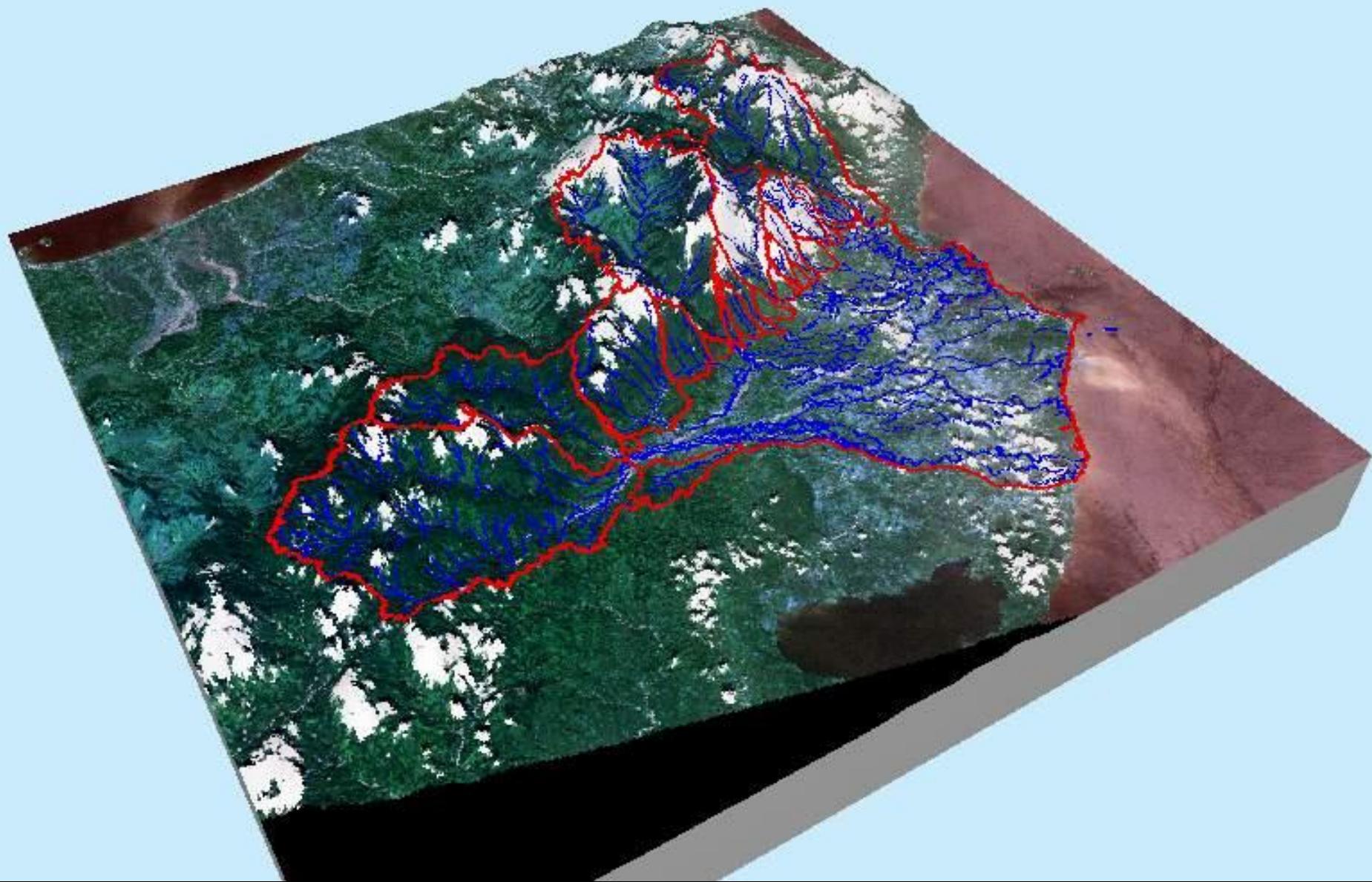


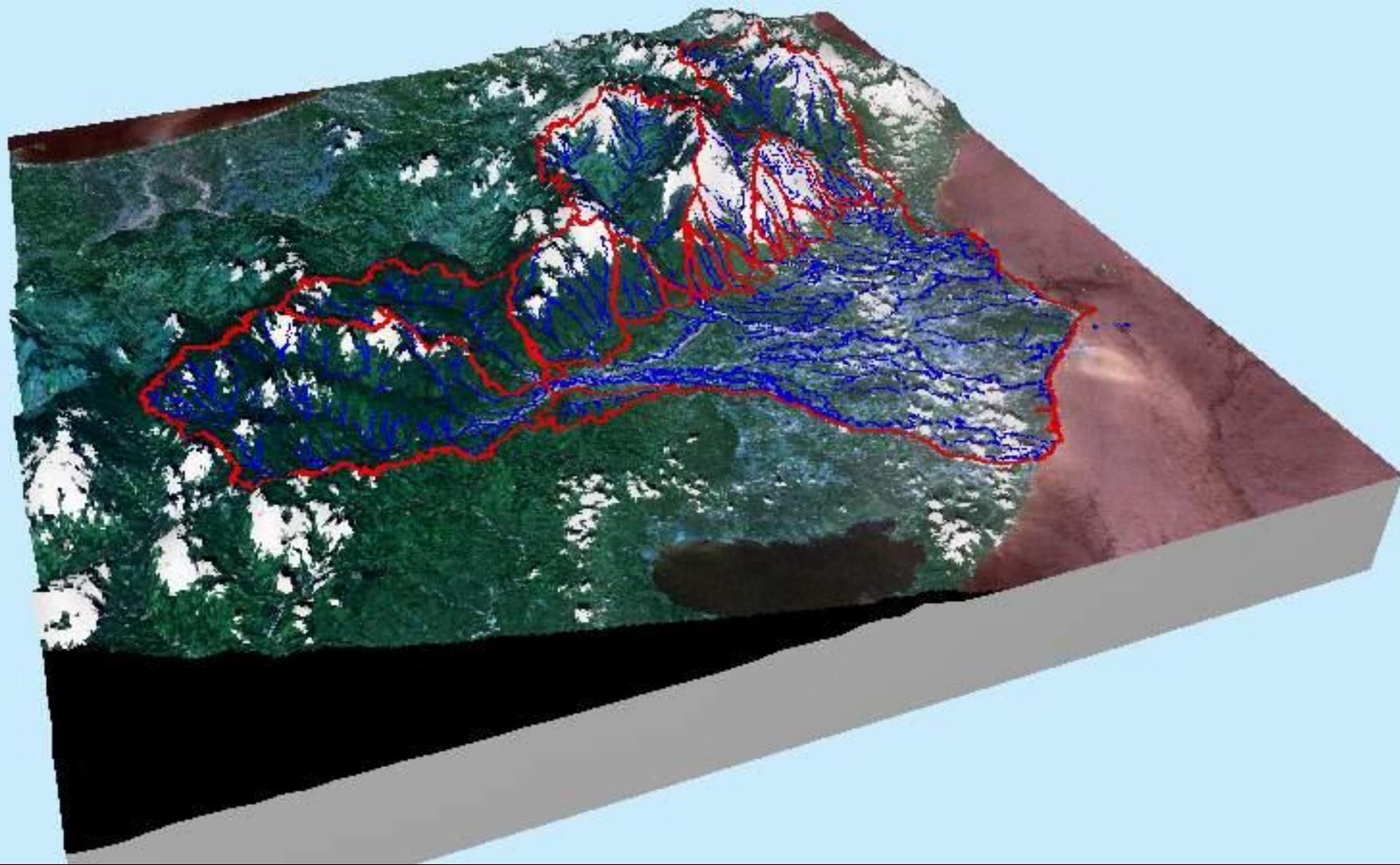


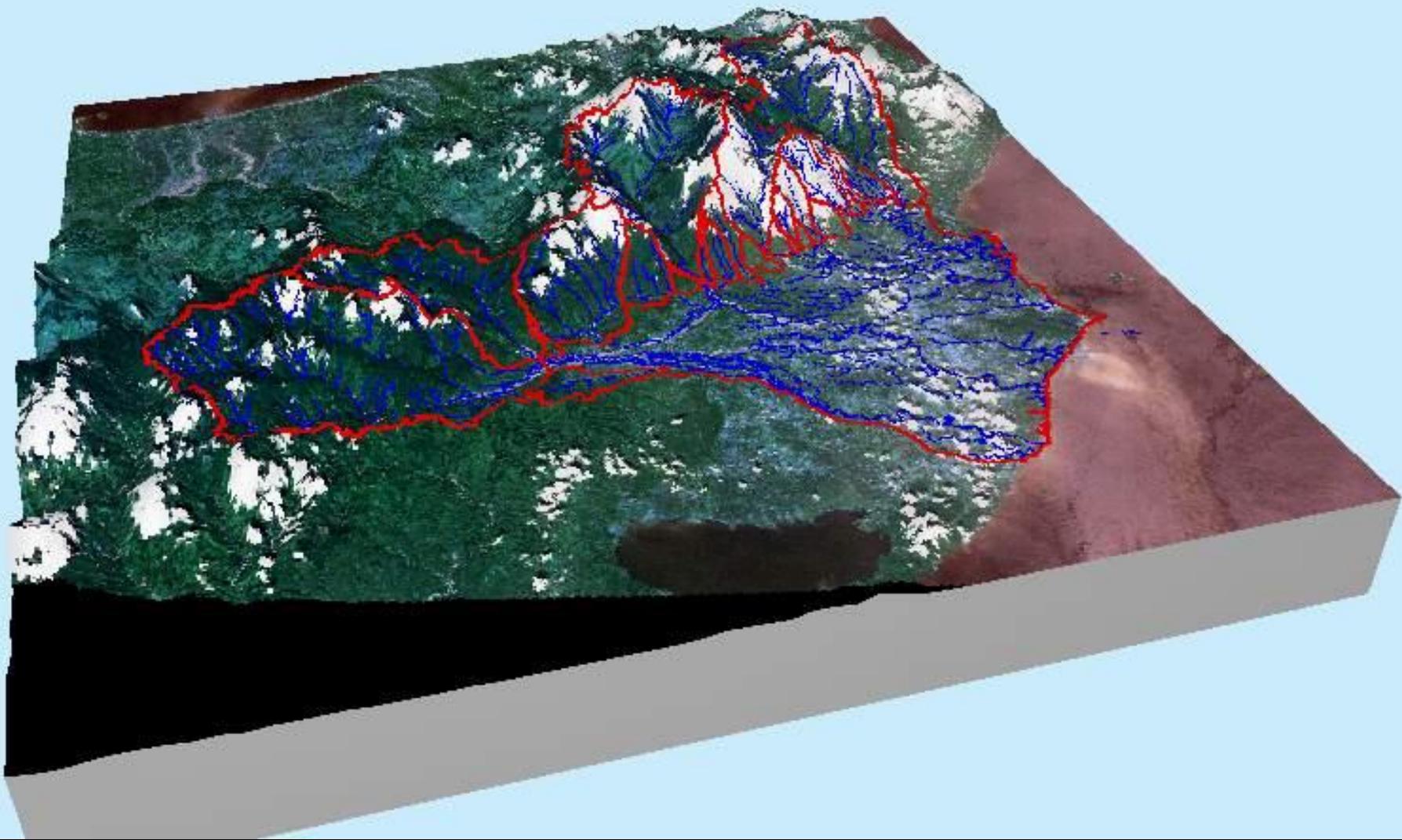


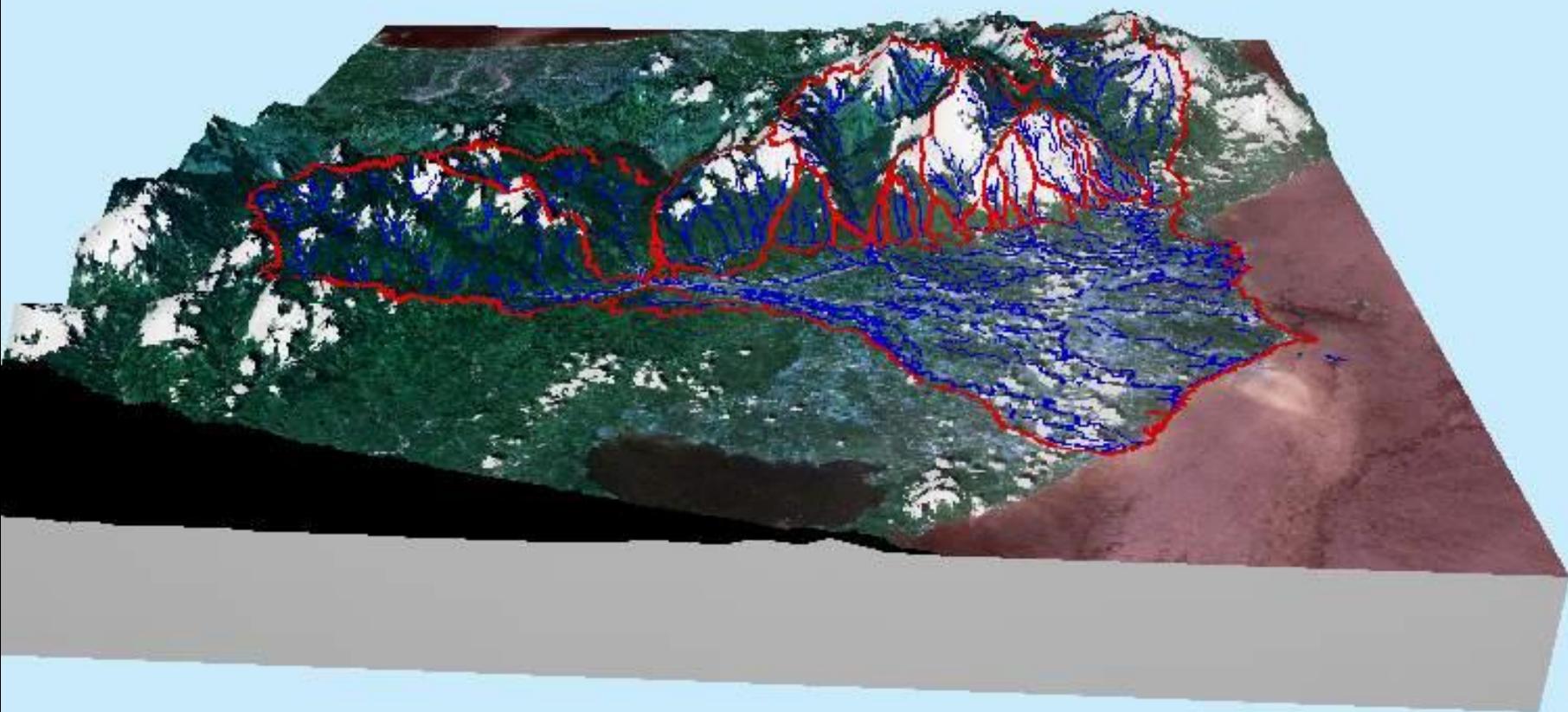


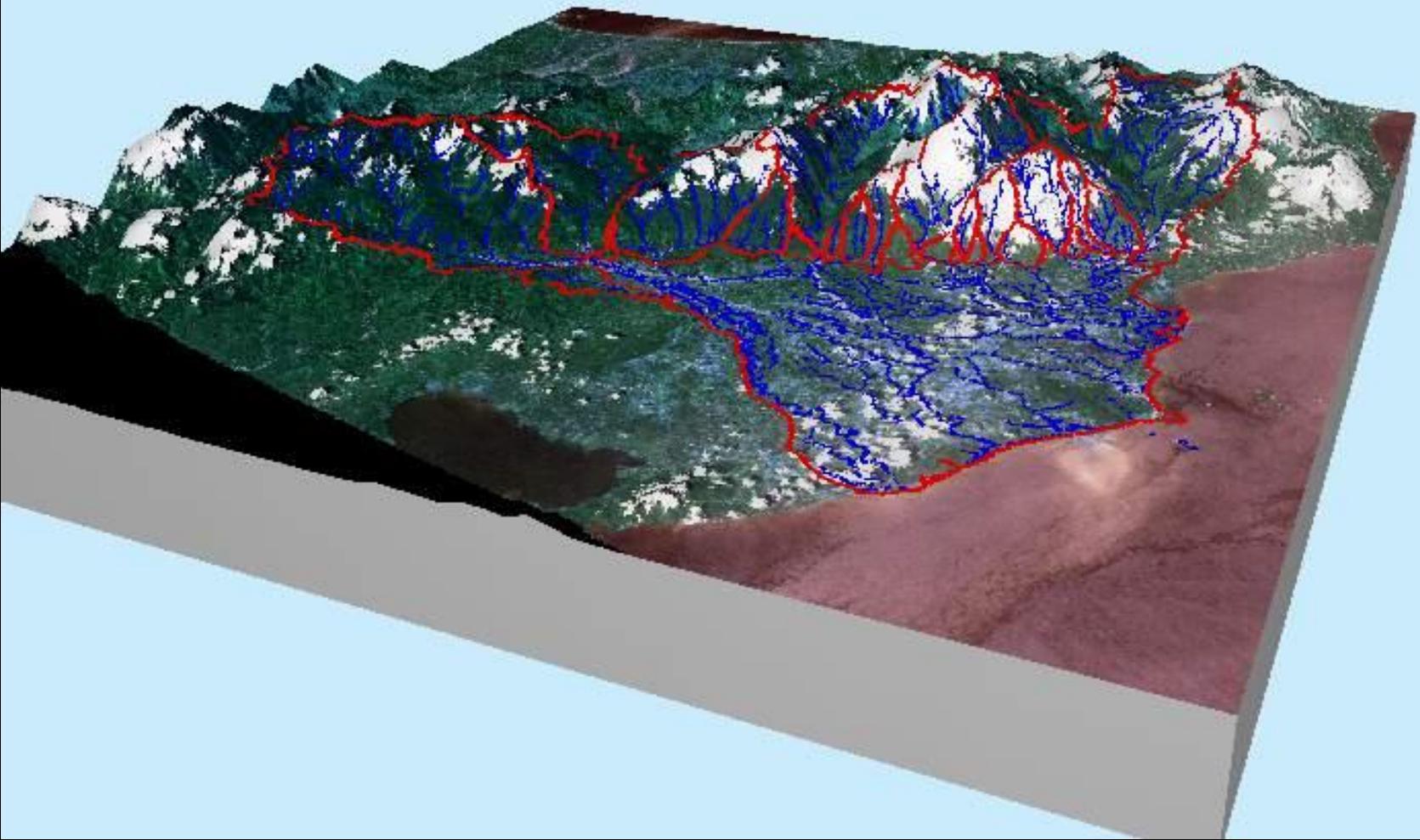


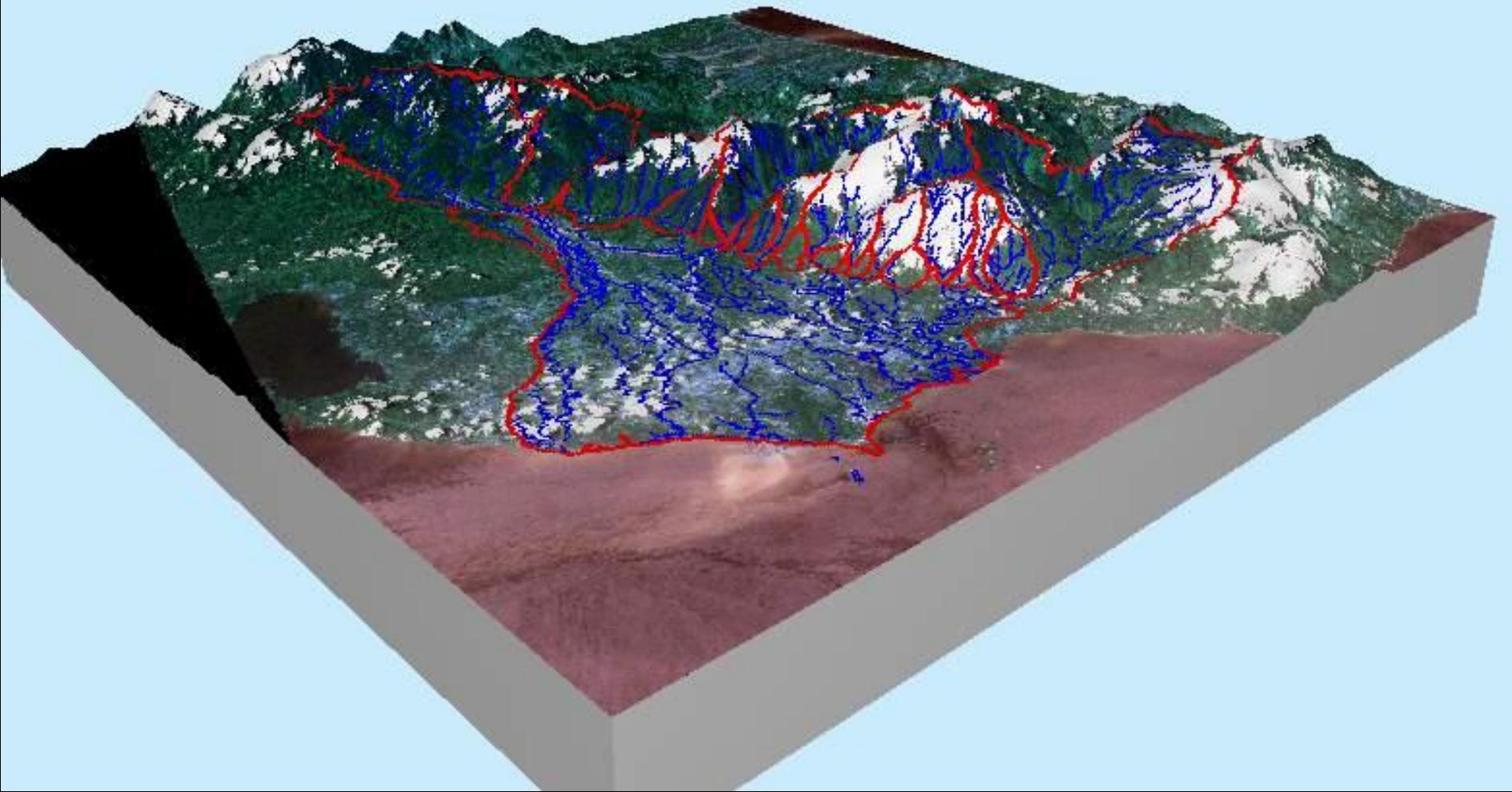


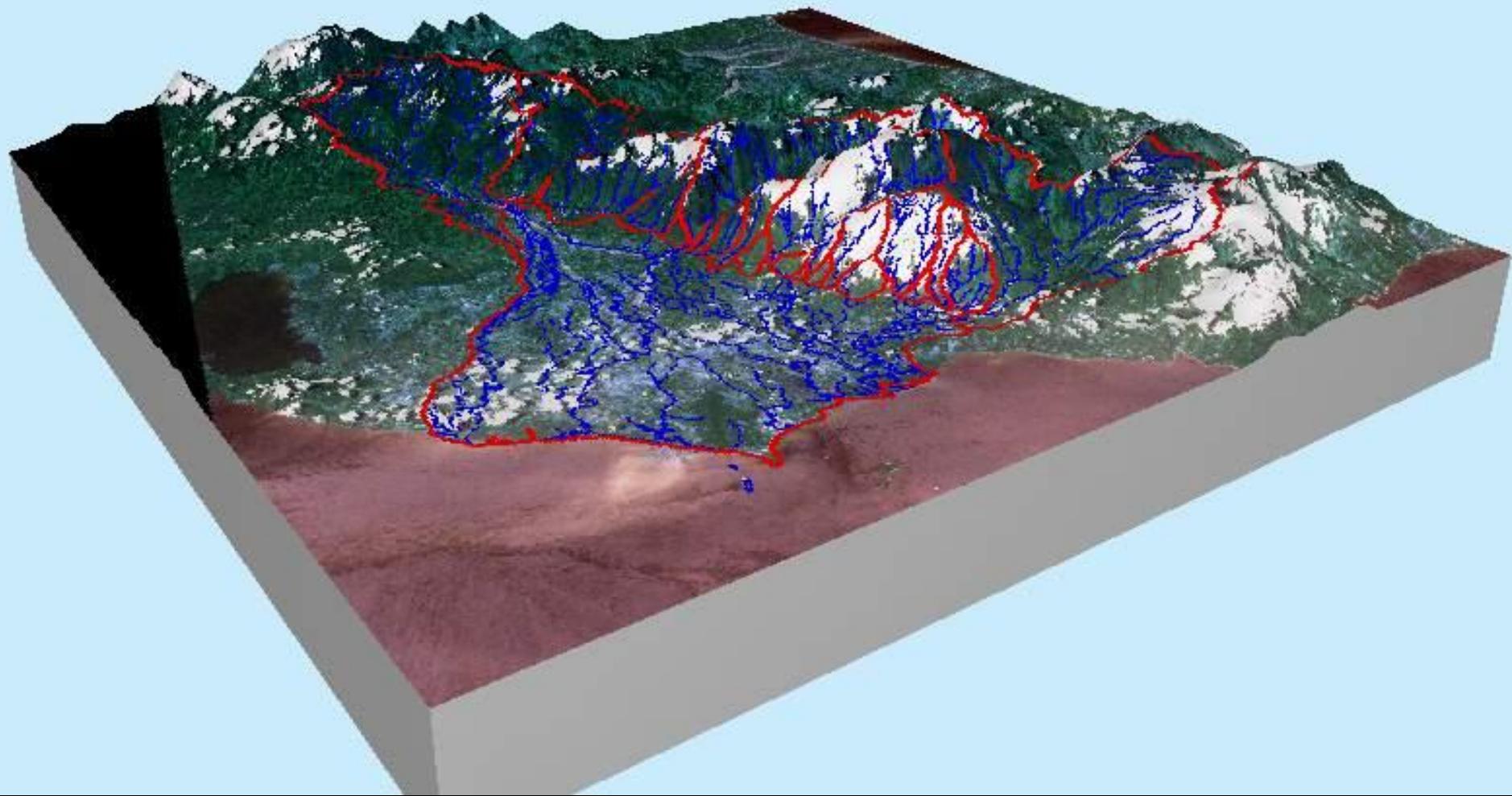


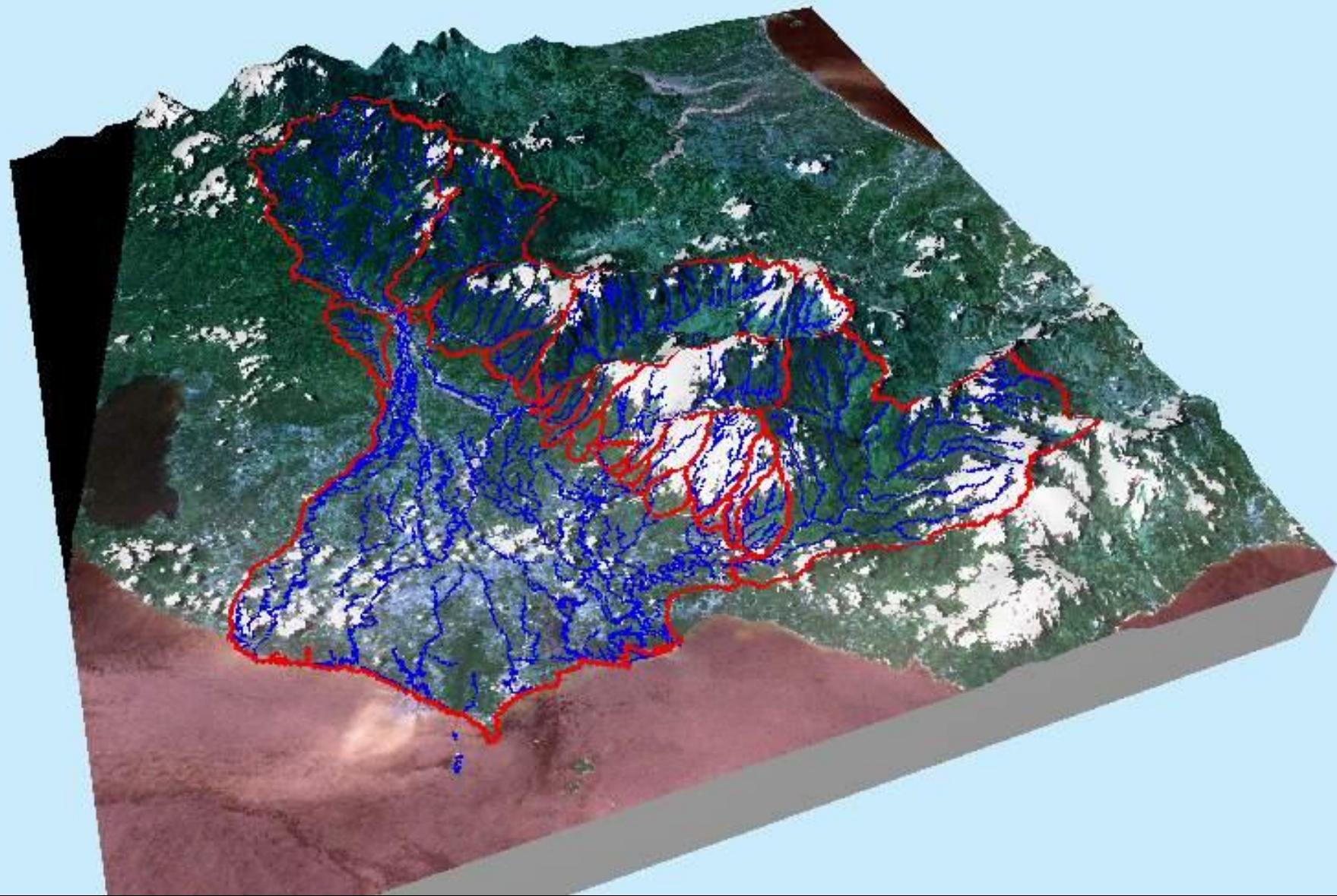


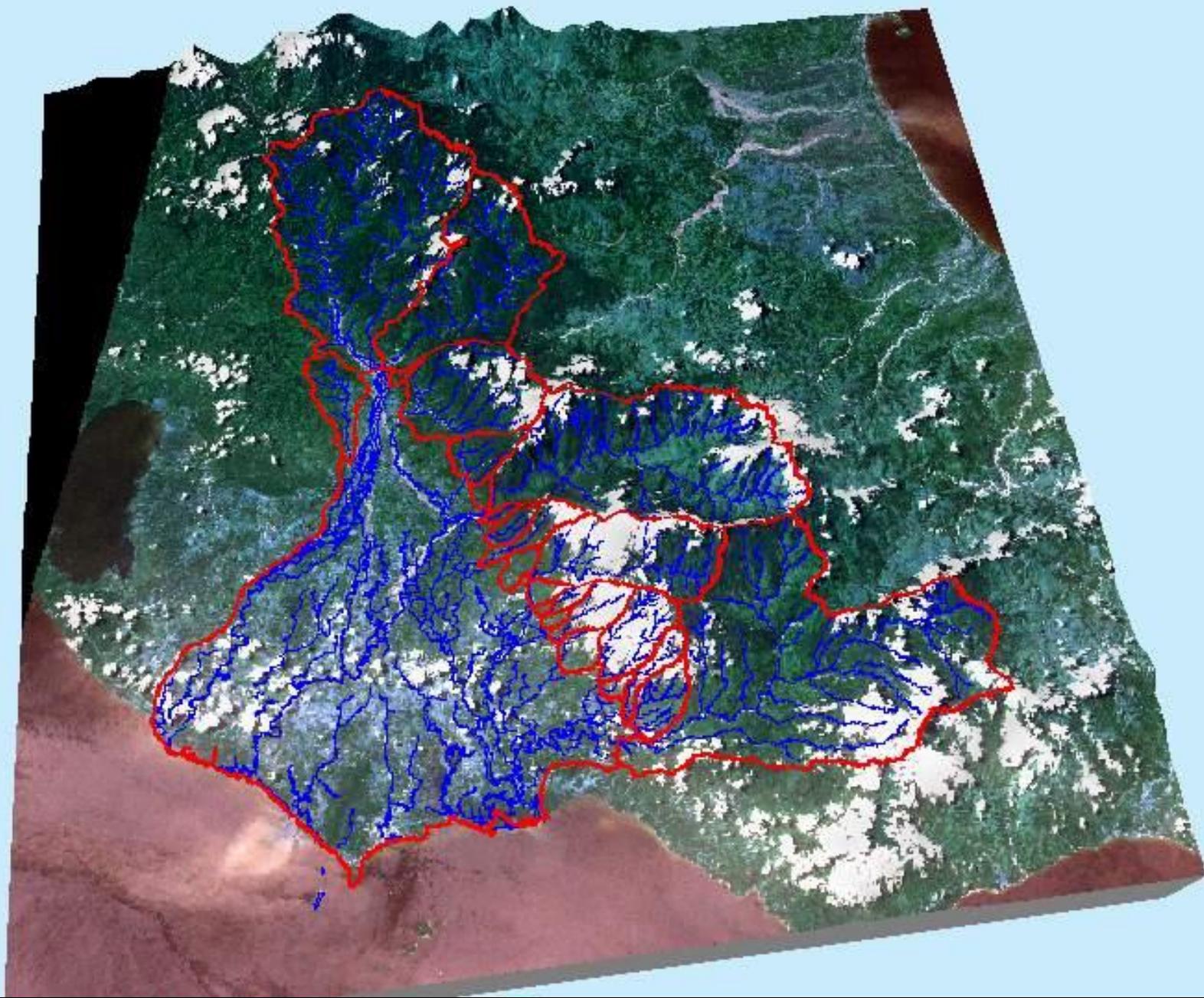


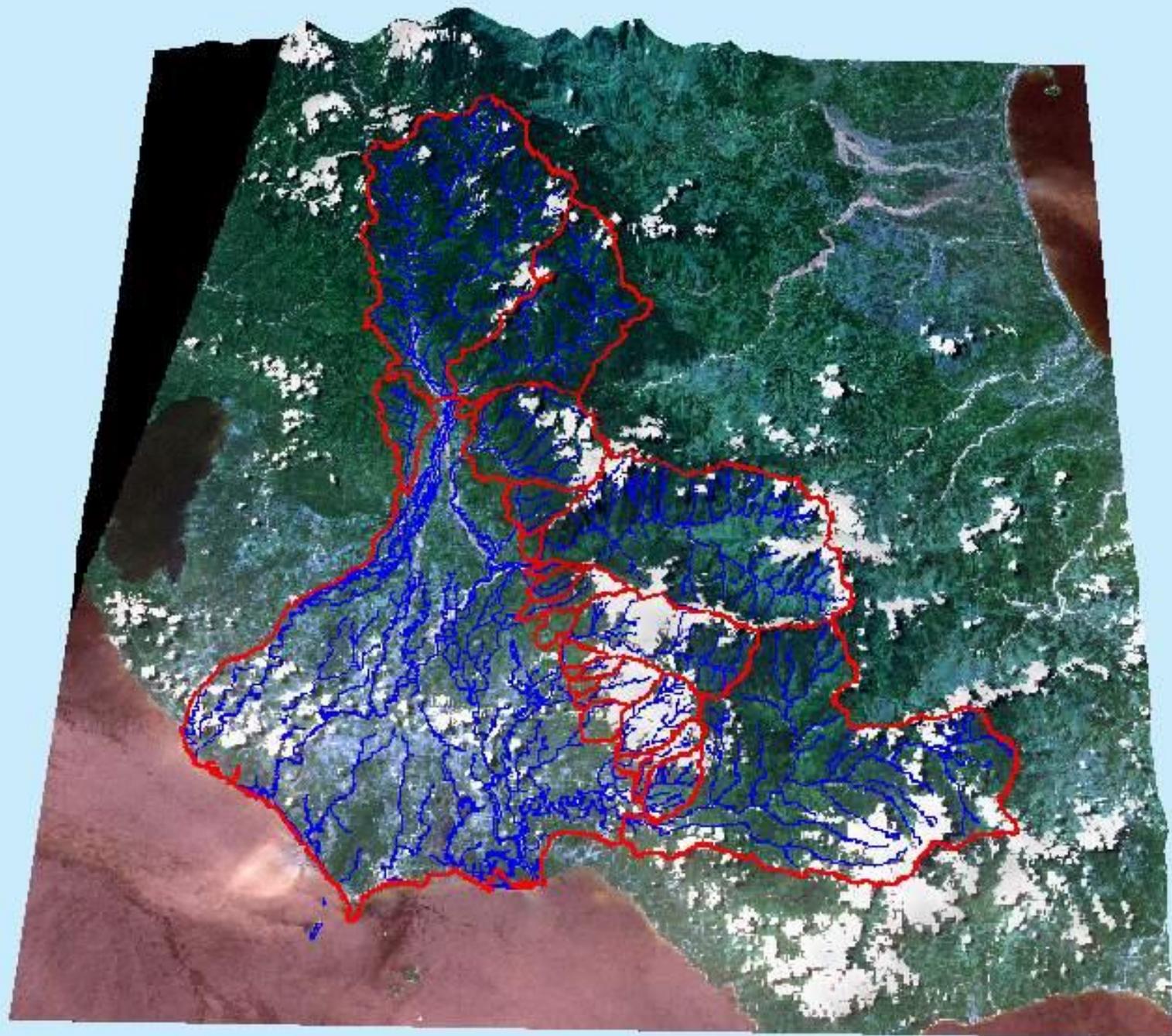


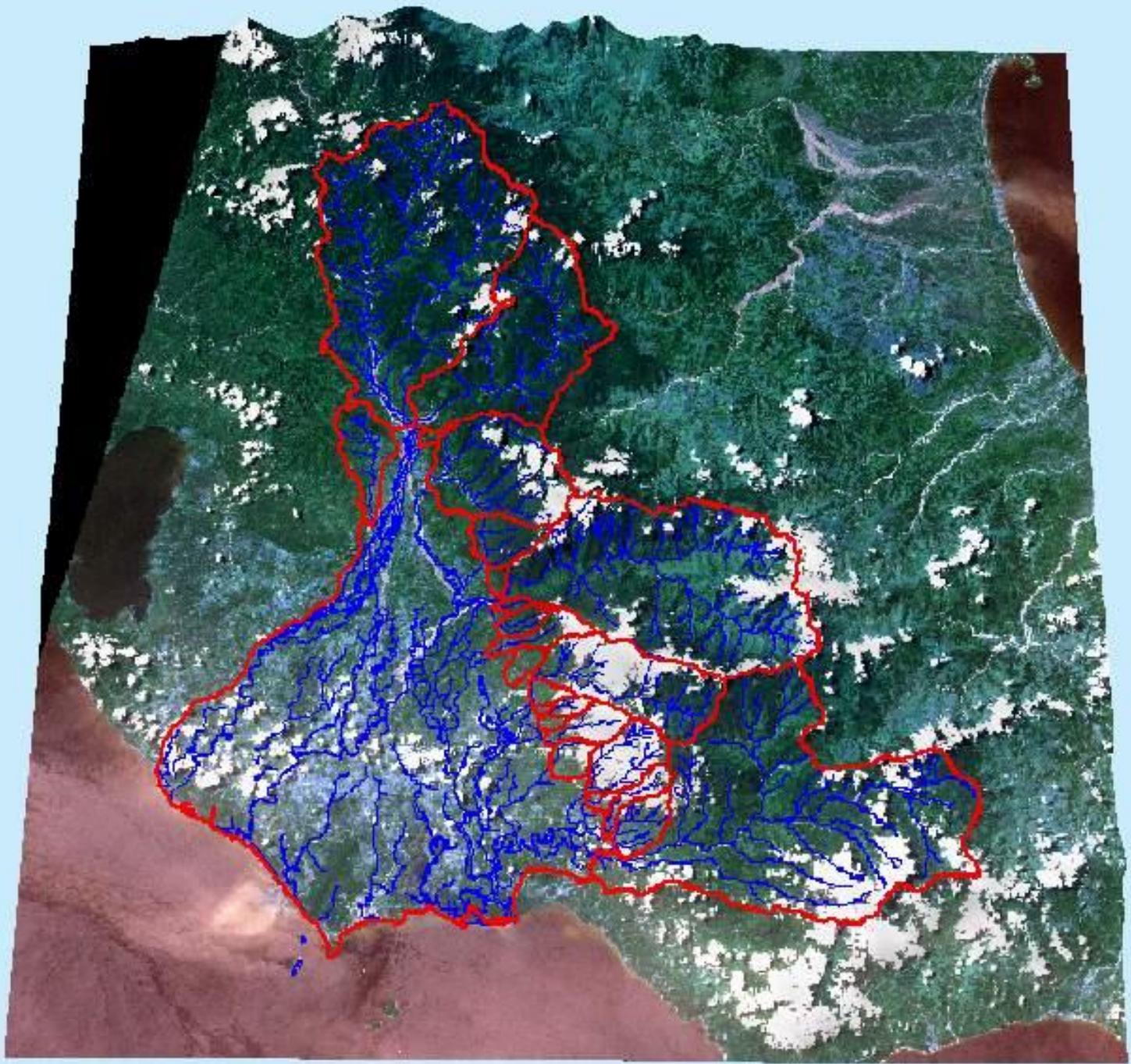


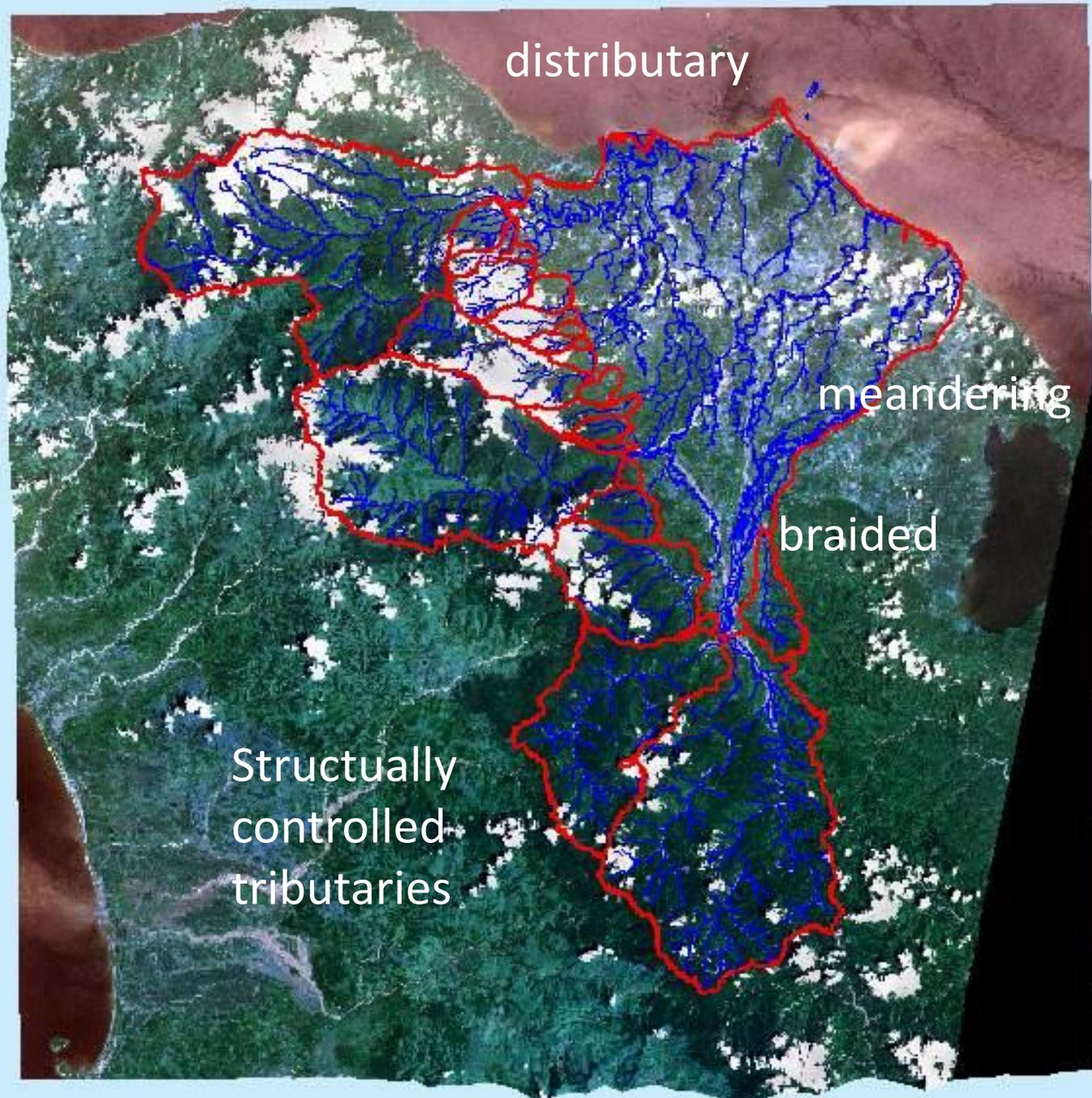










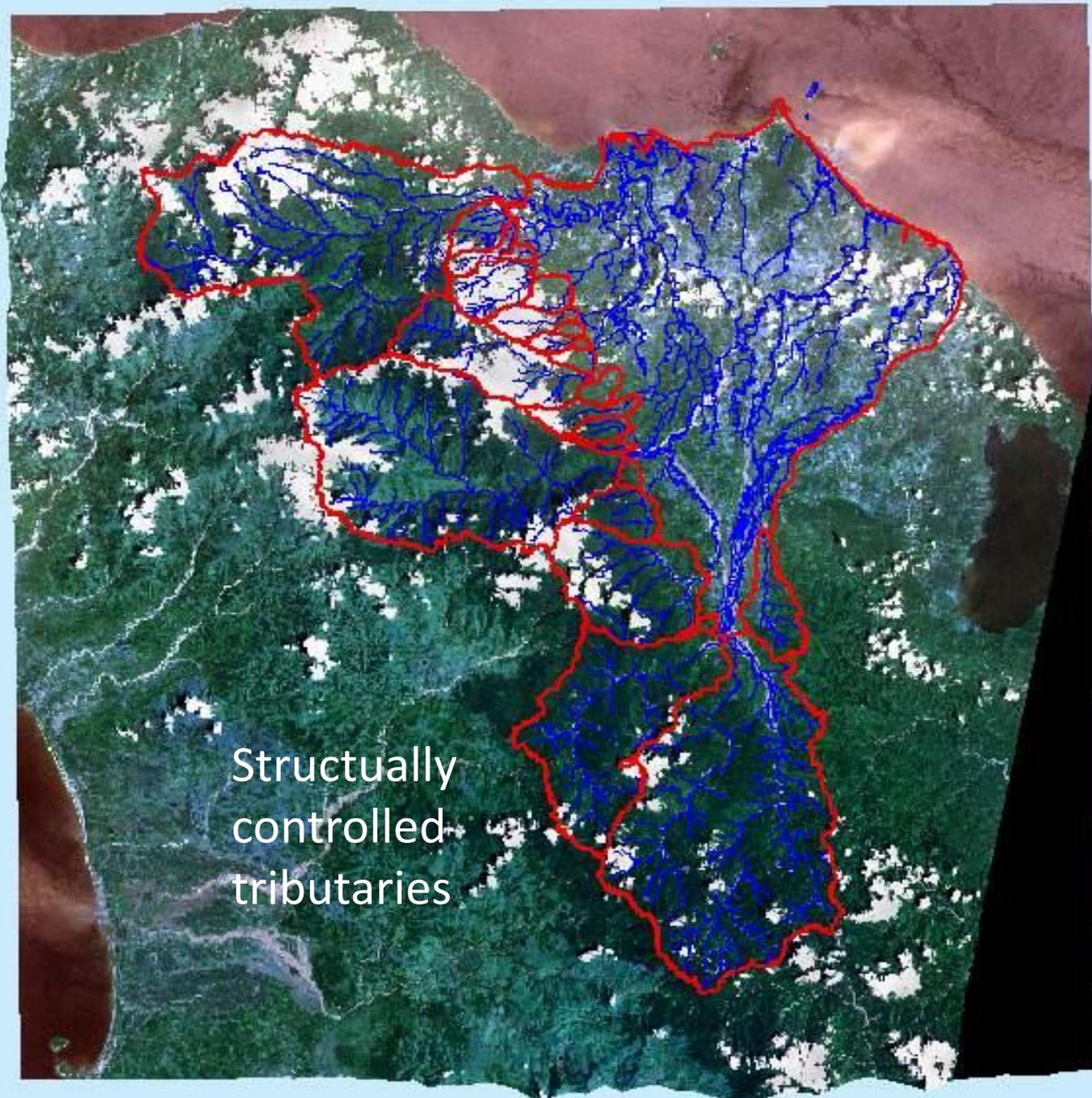


distributary

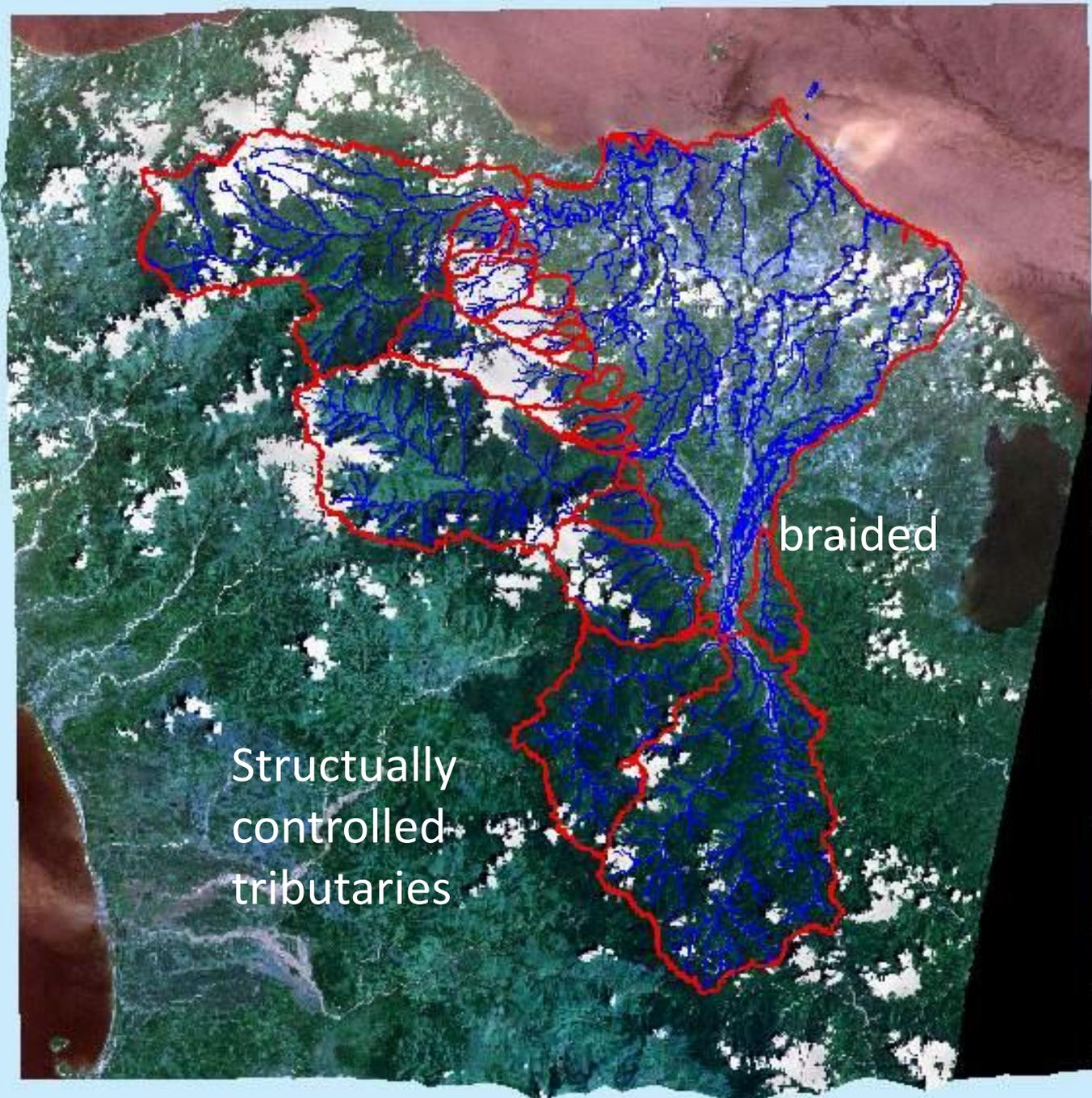
meandering

braided

Structurally
controlled
tributaries



Structurally
controlled
tributaries



braided

Structurally
controlled
tributaries

Mag-asawang Tubig

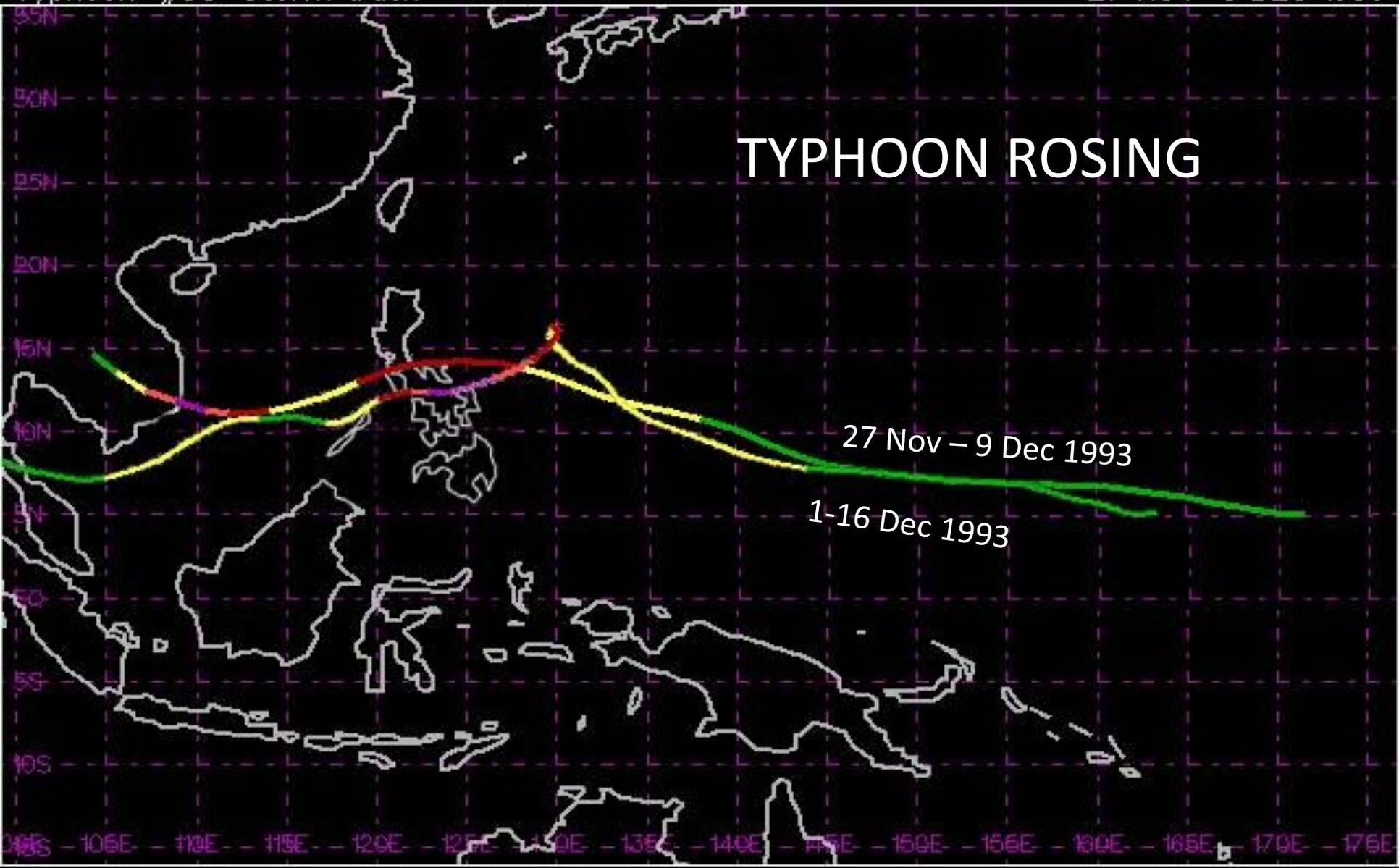


Hango kay:
Lagmay (2006)

Hango kay:
Ramos (2006)

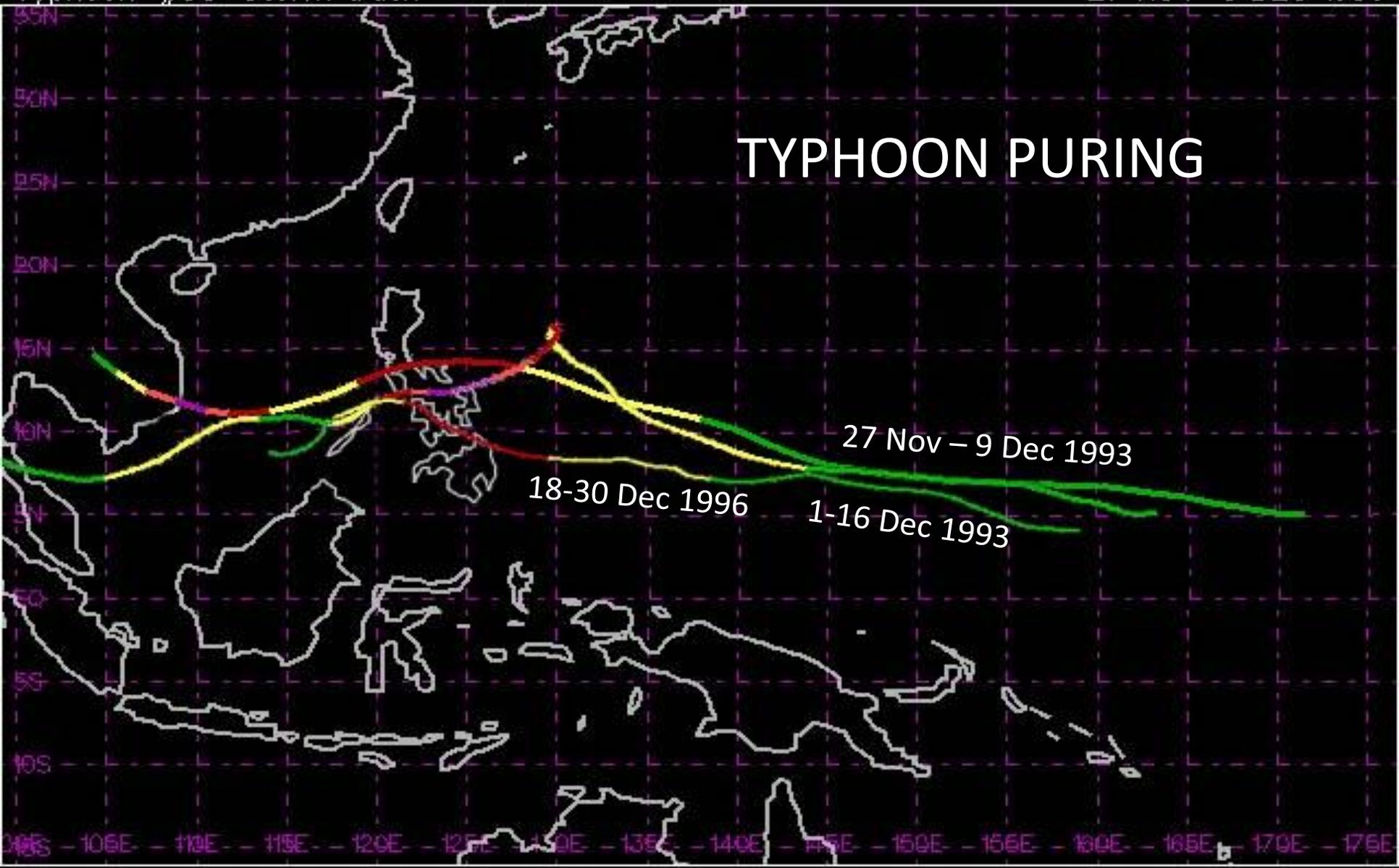
Typhoon #35—Storm track

TYPHOON ROSING

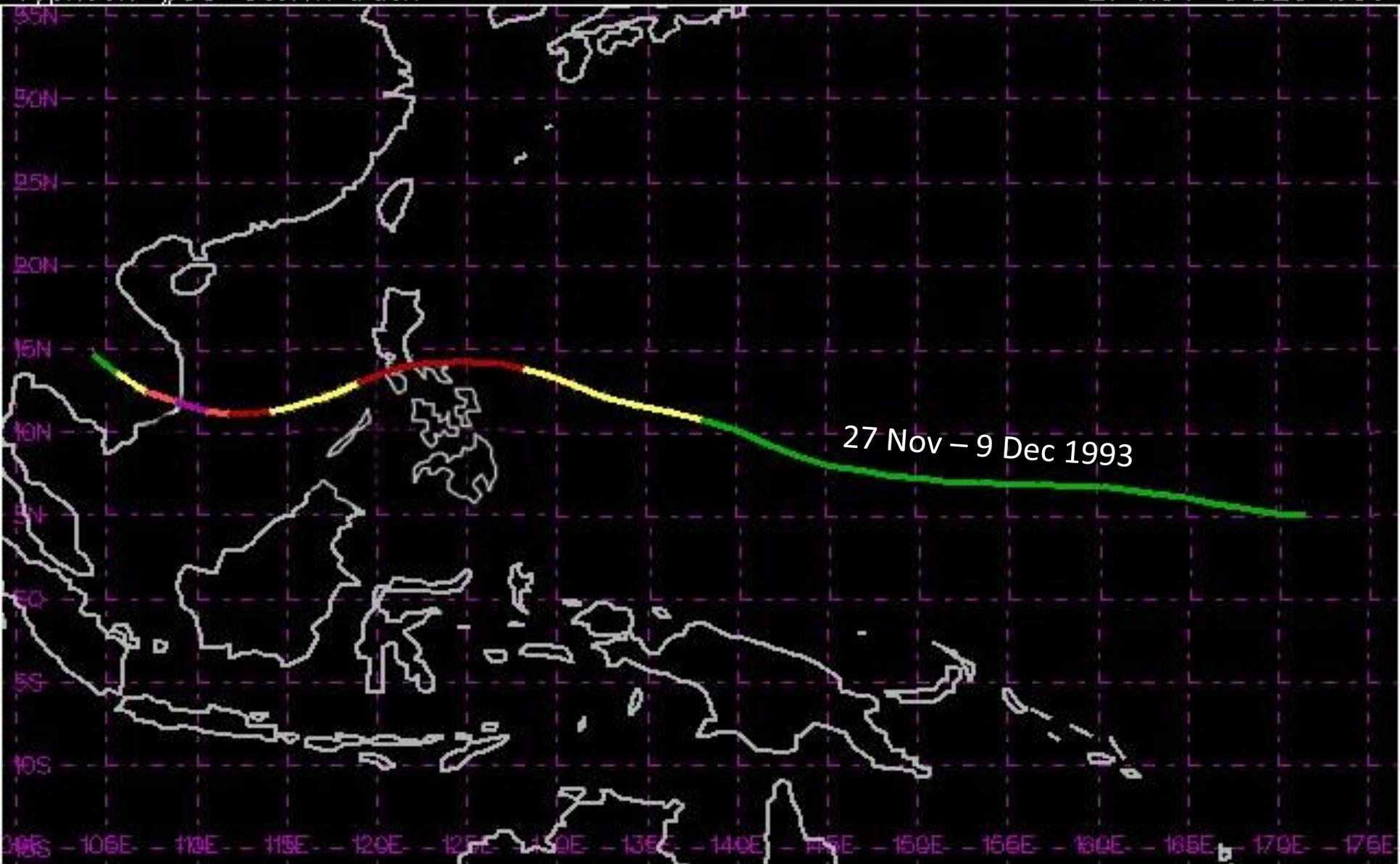


Typhoon #35—Storm track

TYPHOON PURING

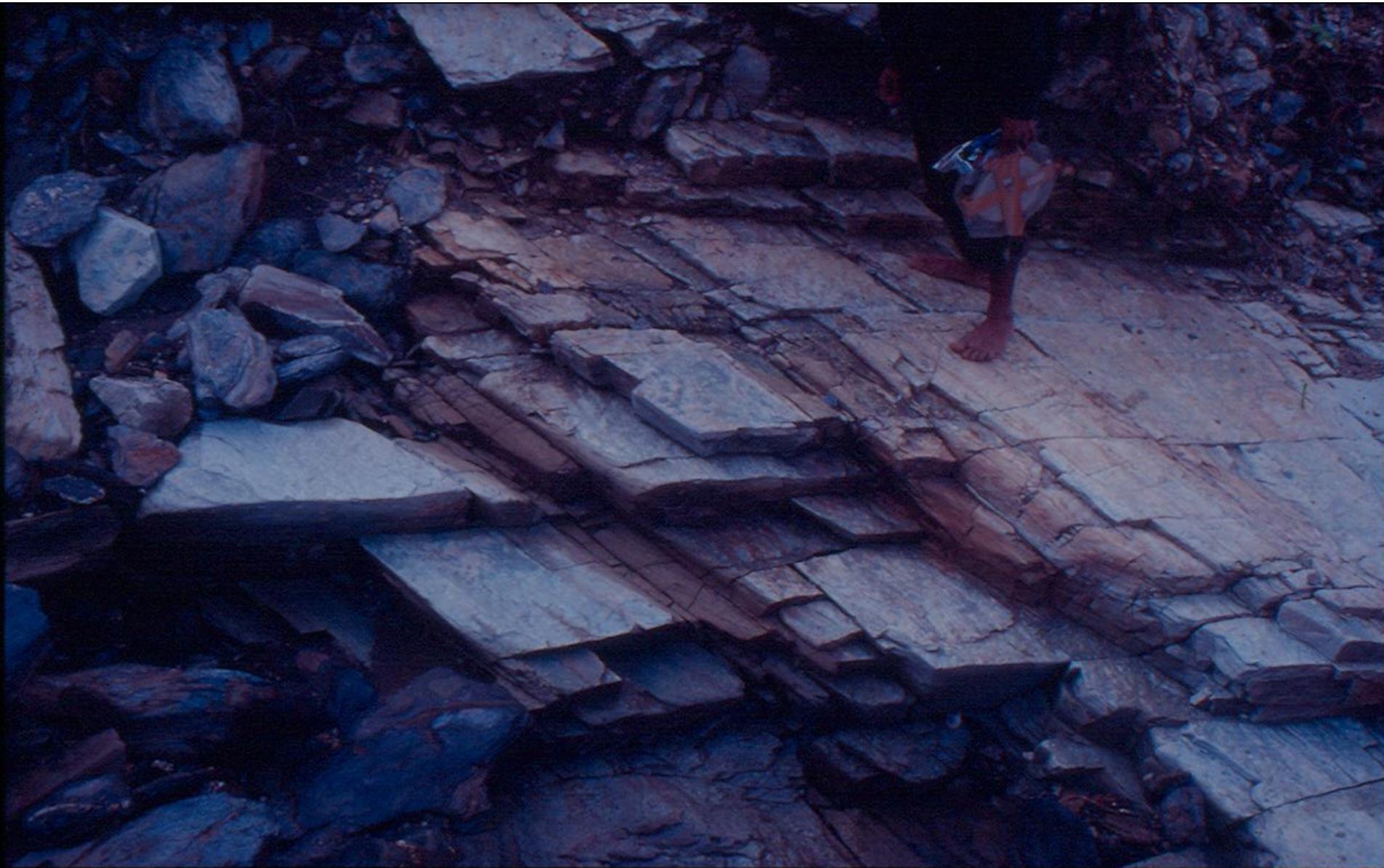


Typhoon #35—Storm track





















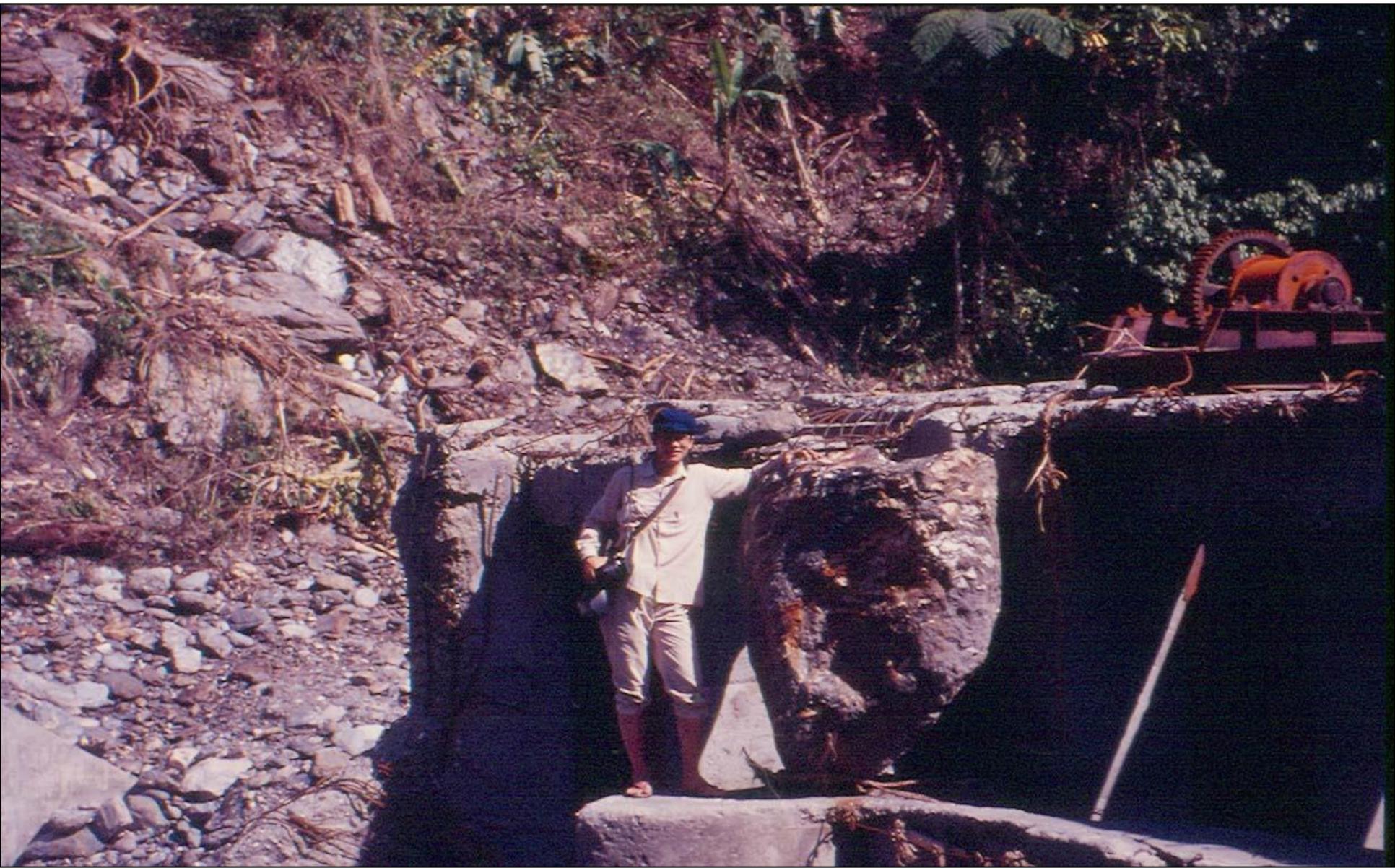






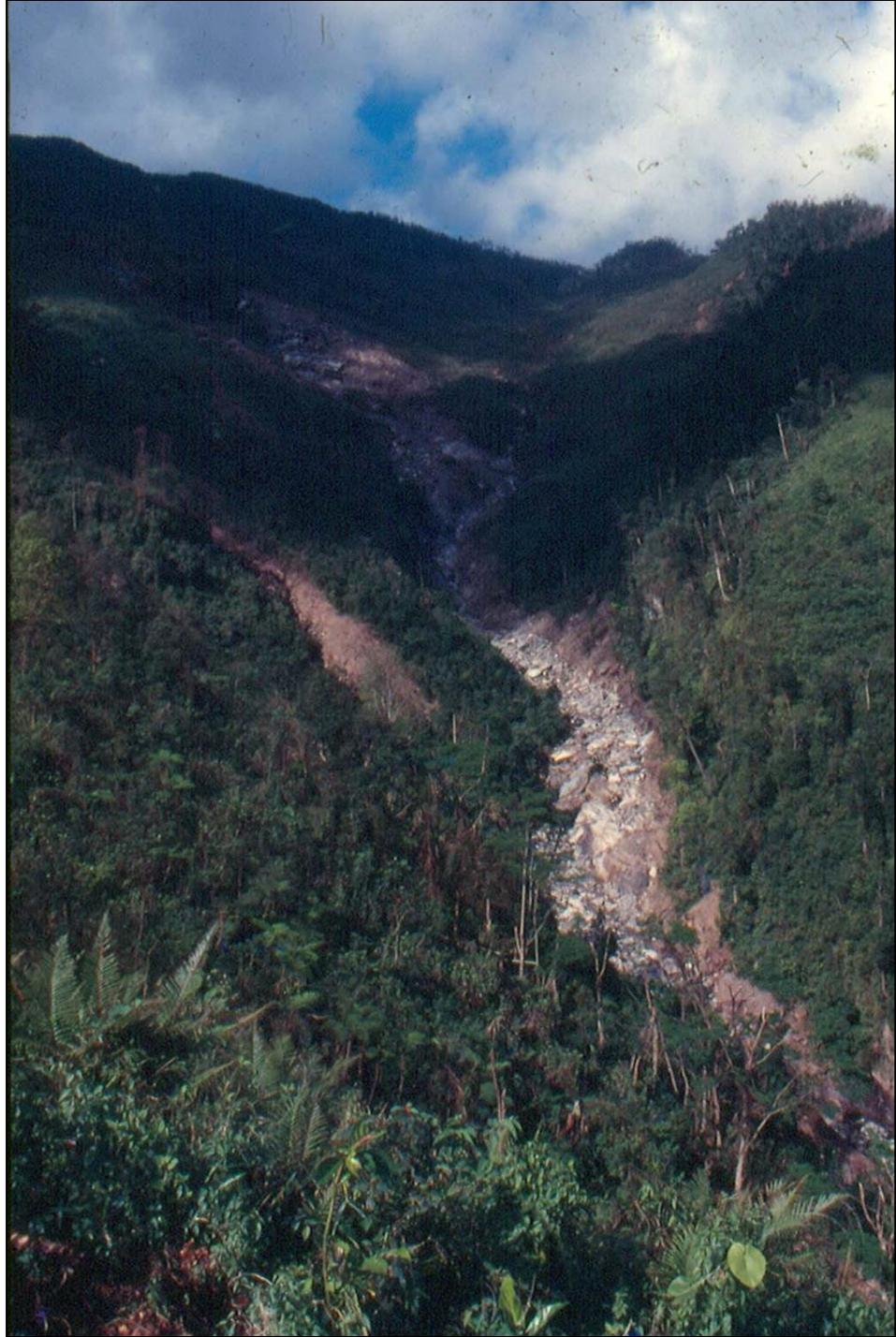


















29 Nov 1993

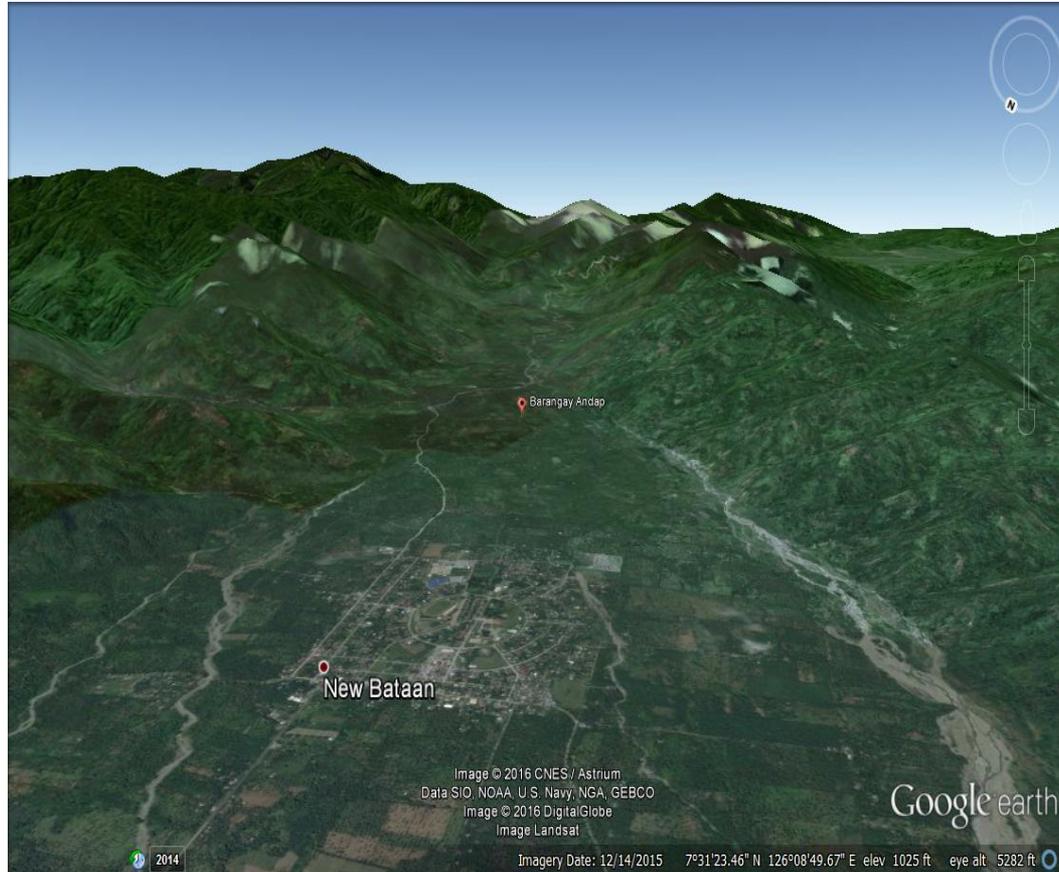




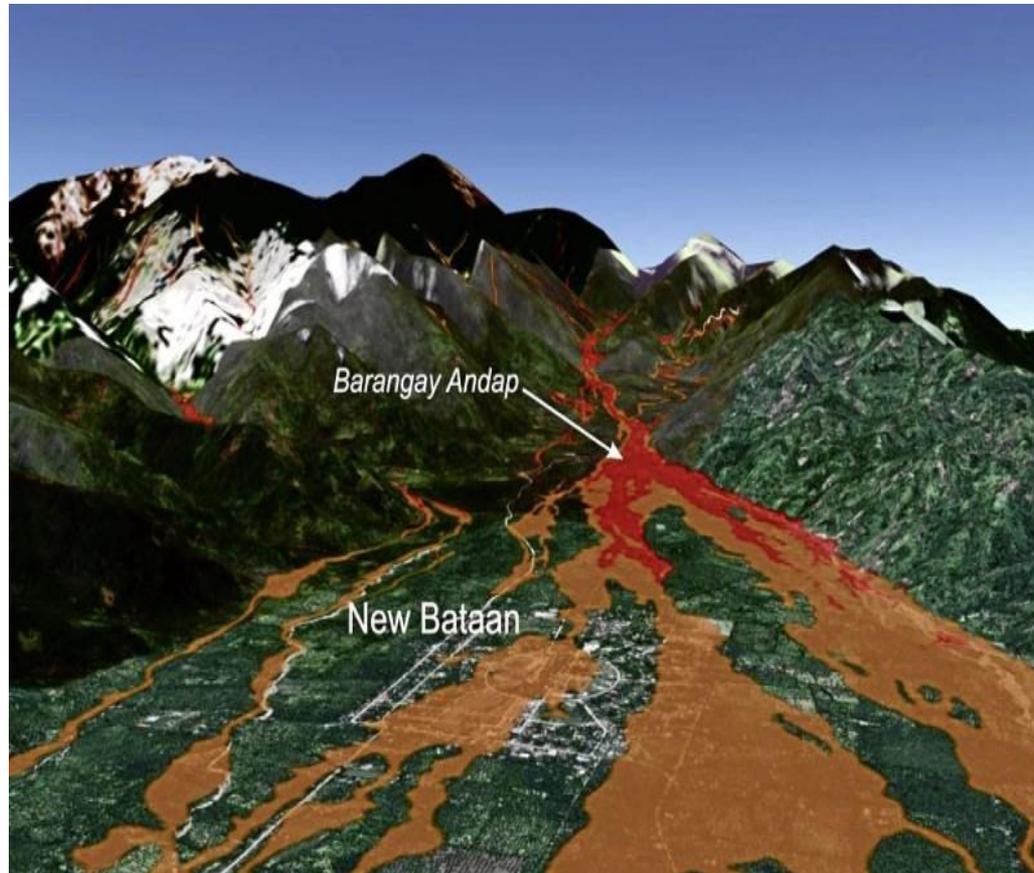
Reverse grading



New Bataan, Compostela Valley



New Bataan, Compostela Valley

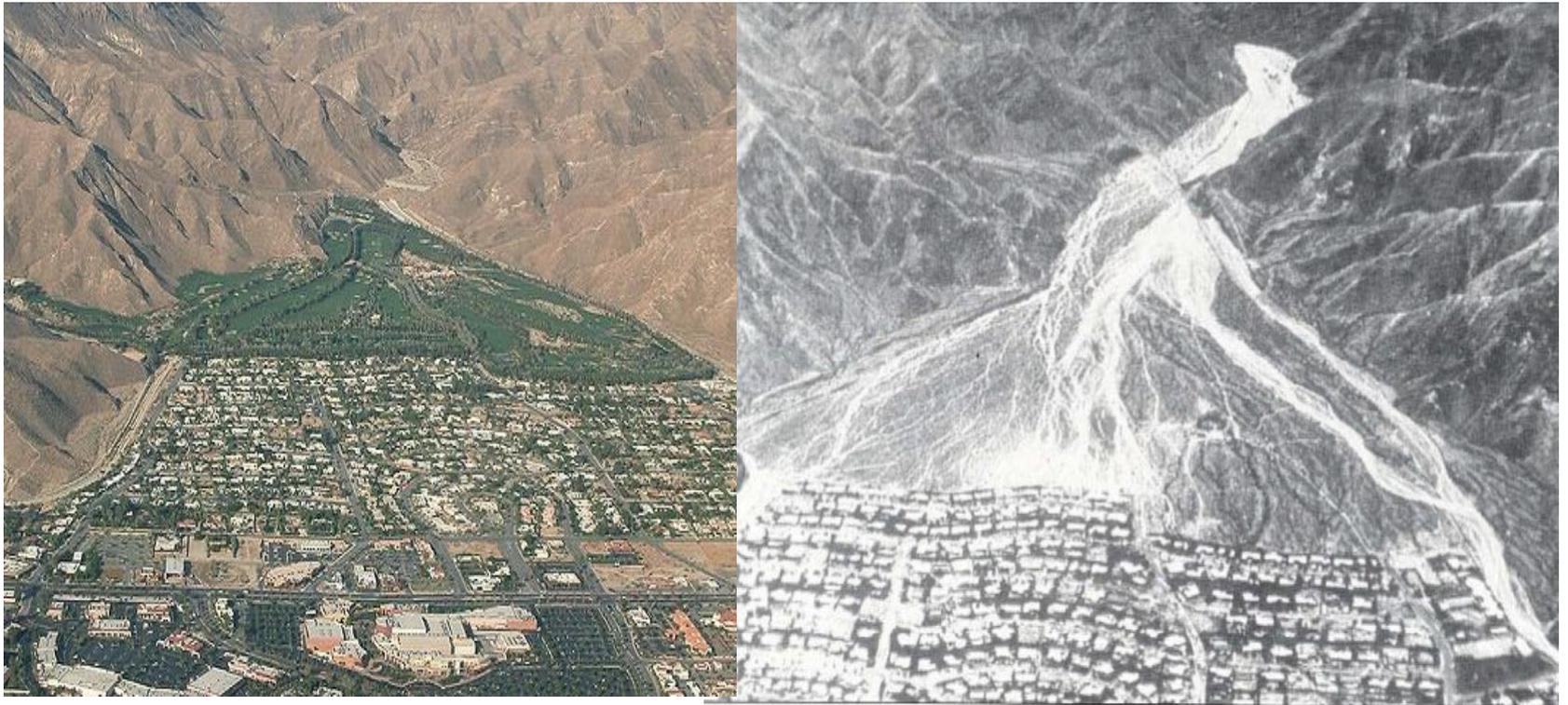


Nat. Hazards Earth Syst. Sci. Discuss., doi:10.5194/nhess-2016-102, 2016

Venezuela Debris flow 1999



California, USA Debris flow 1979



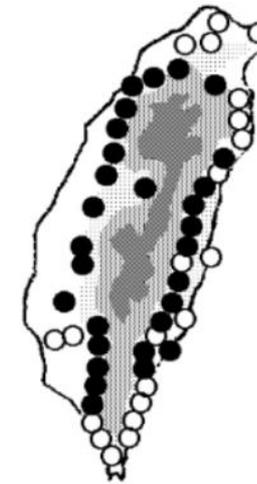
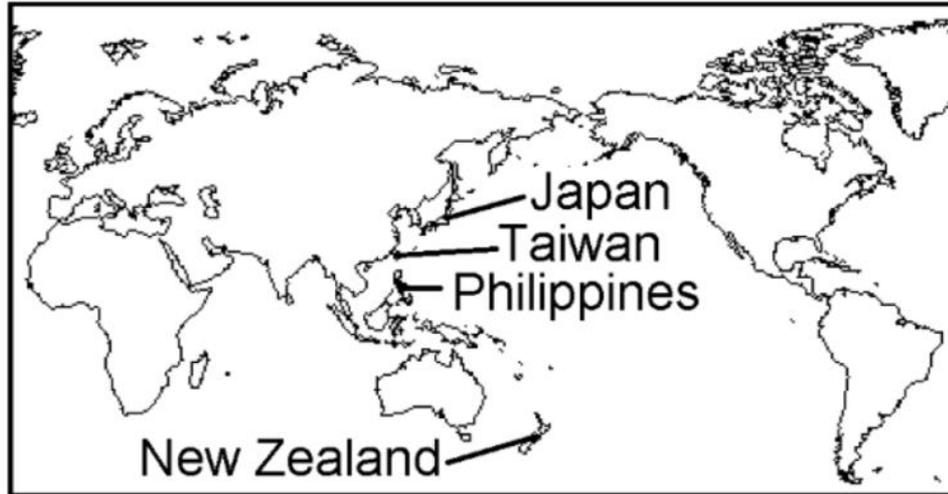
Magnesia Spring Canyon, CA.

Pamulaan, USEP Mintal, Davao City



Photo by Errol Lumibao

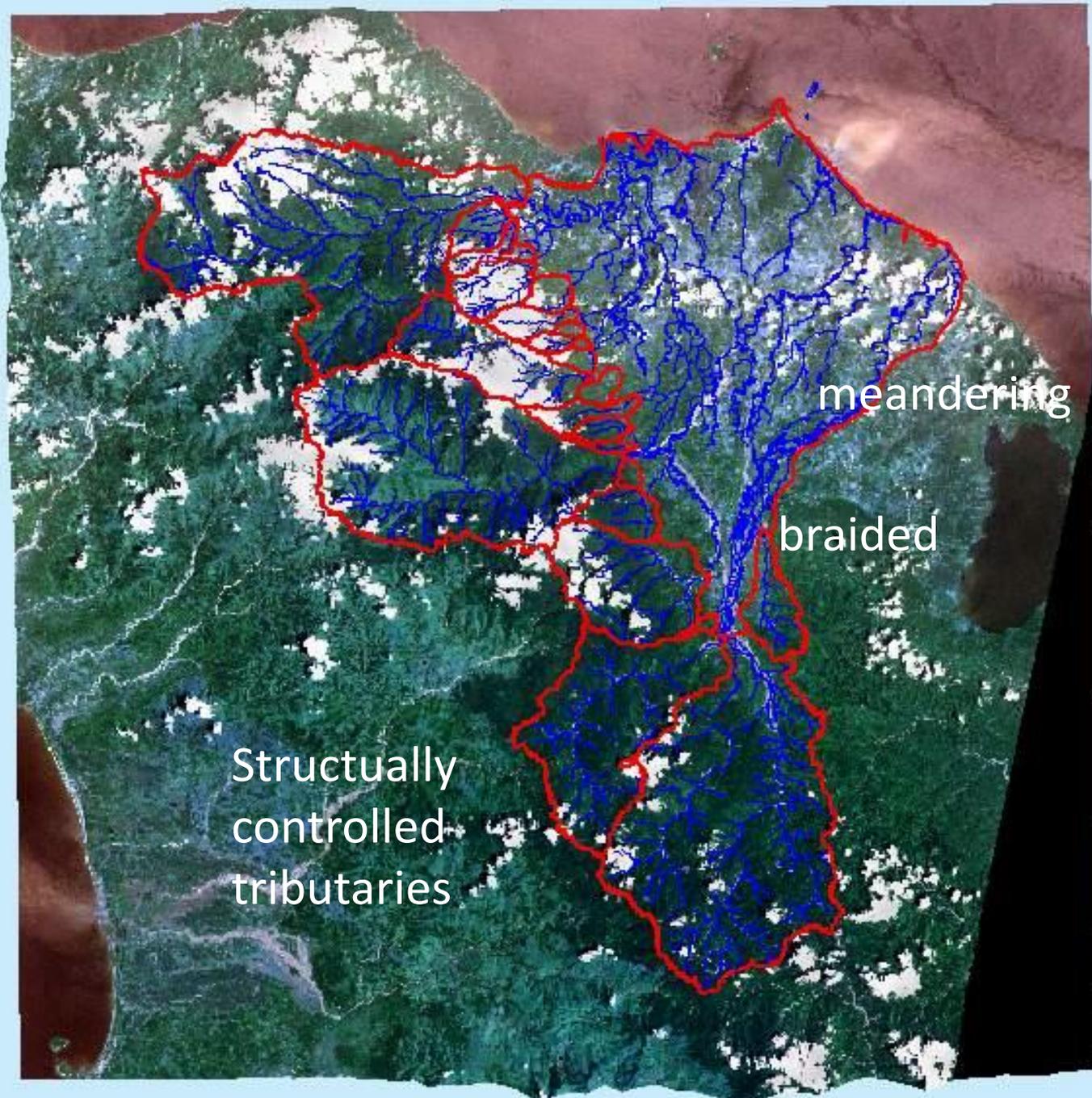
TAIWAN



Taiwan

- Valley mouths of rivers with alluvial fans
- Valley mouths of rivers without alluvial fans

Rivers with drainage basins over 100 km²

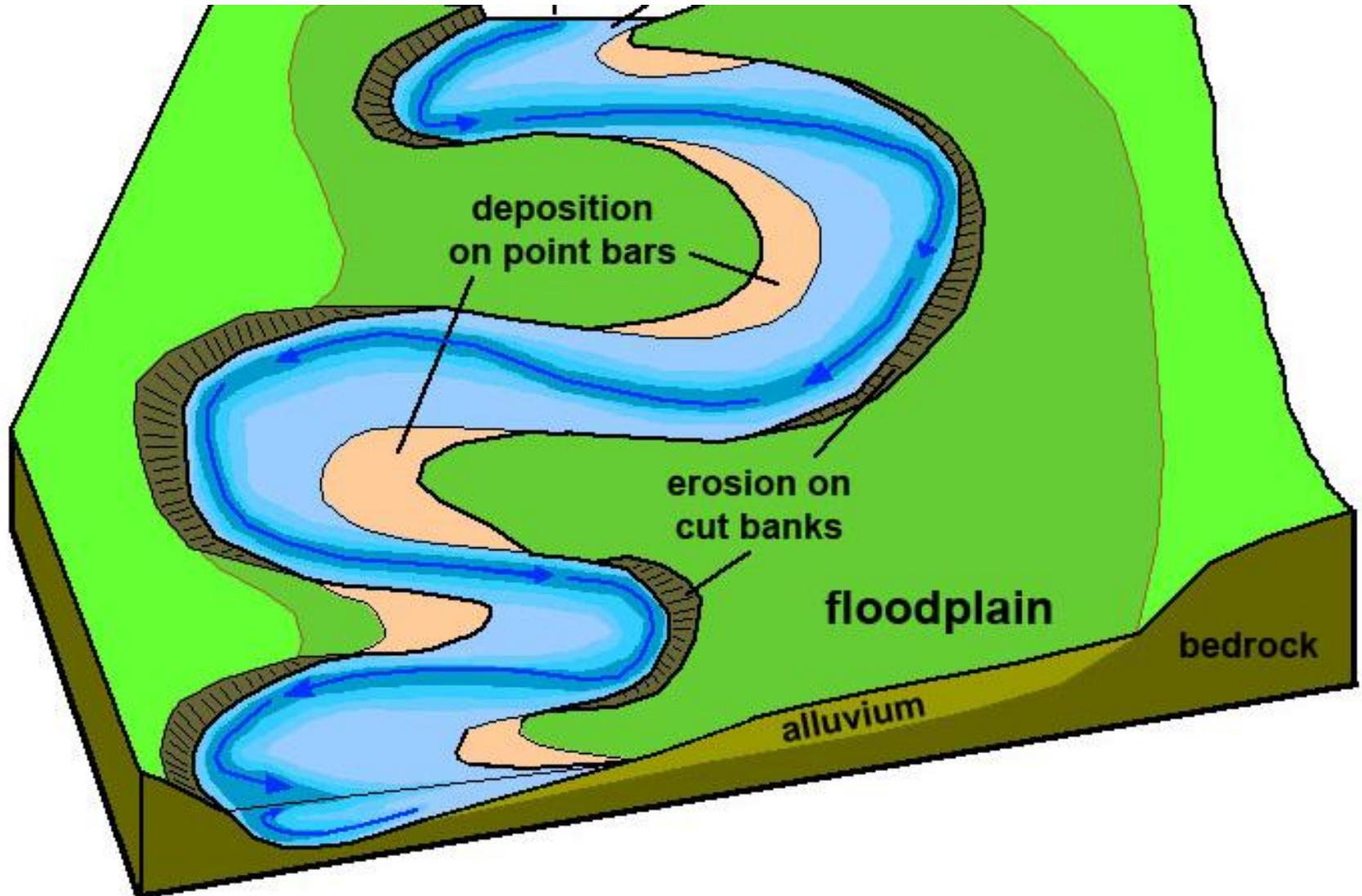


meandering

braided

Structurally
controlled
tributaries

River: A Dynamic System

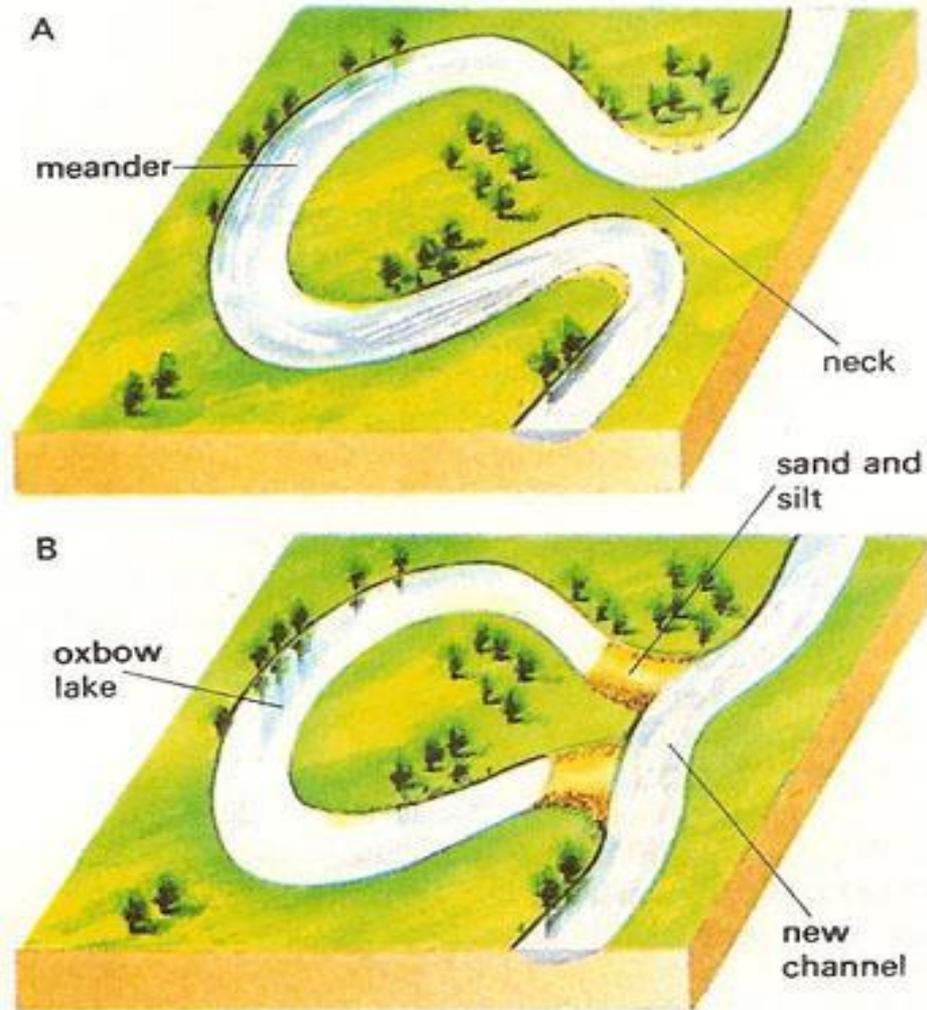


Point bar

Meandering River

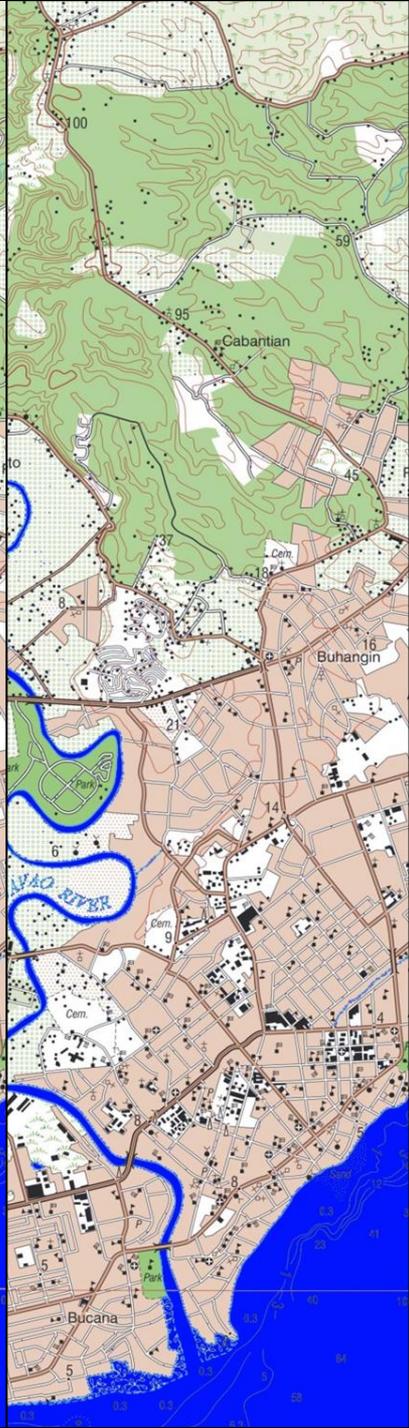
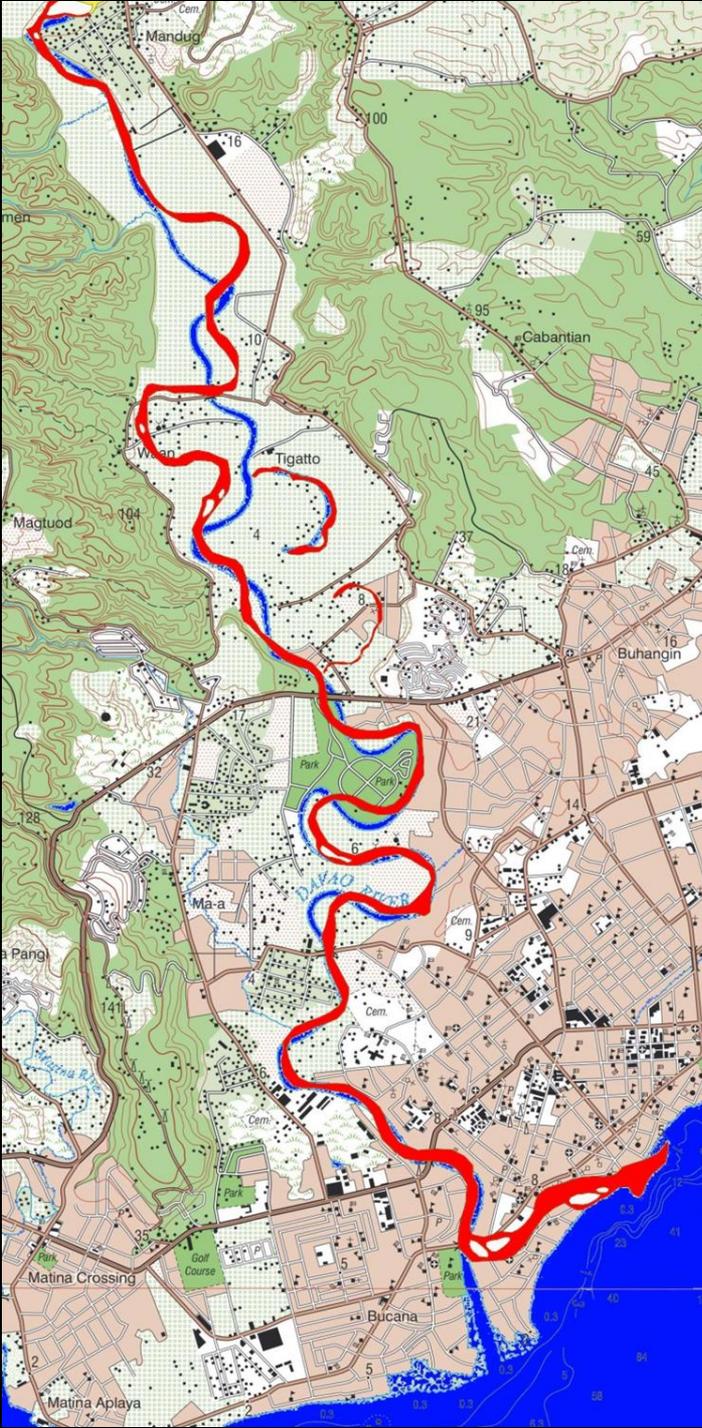
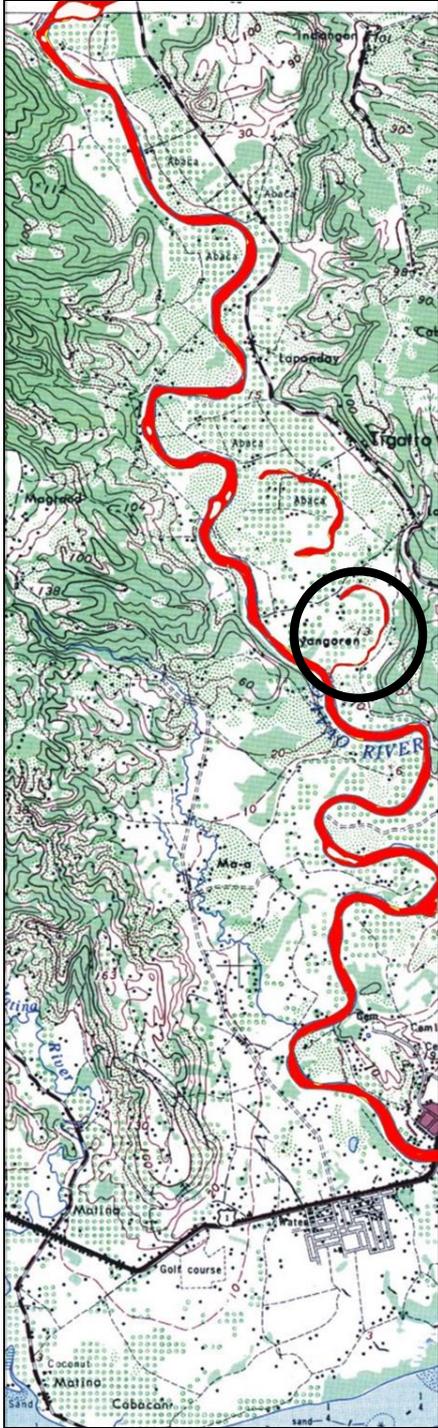


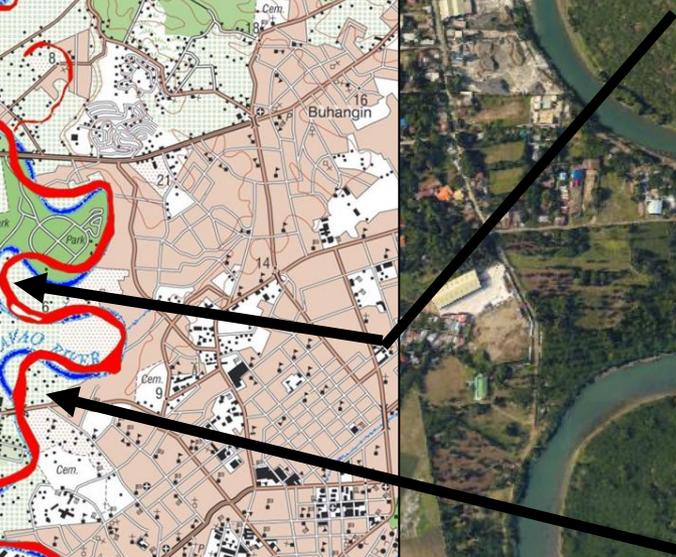
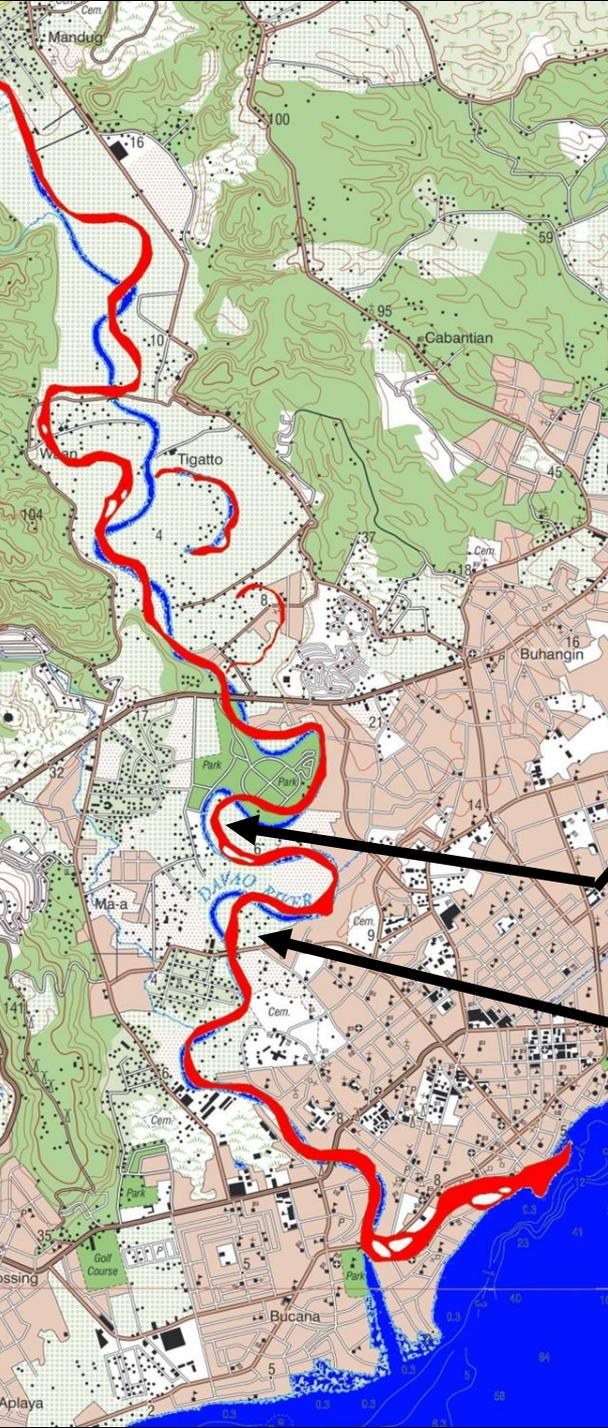
Formation of an Oxbow Lake



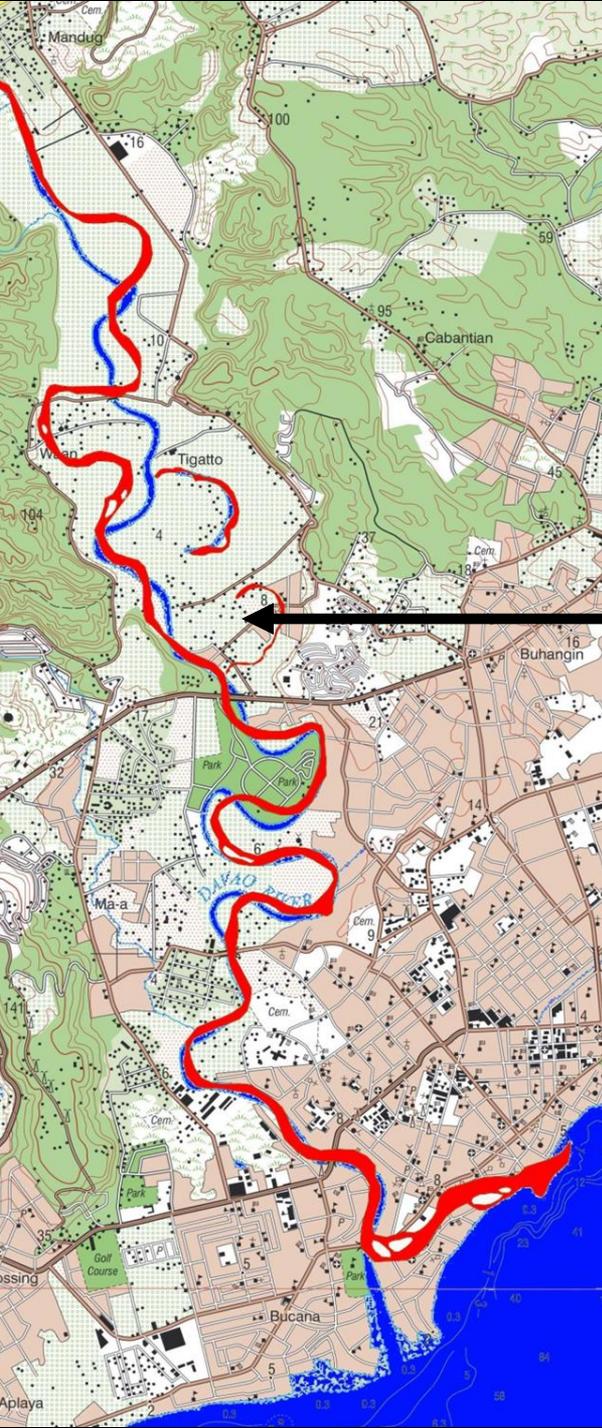
1950s

2000





Jade Valley

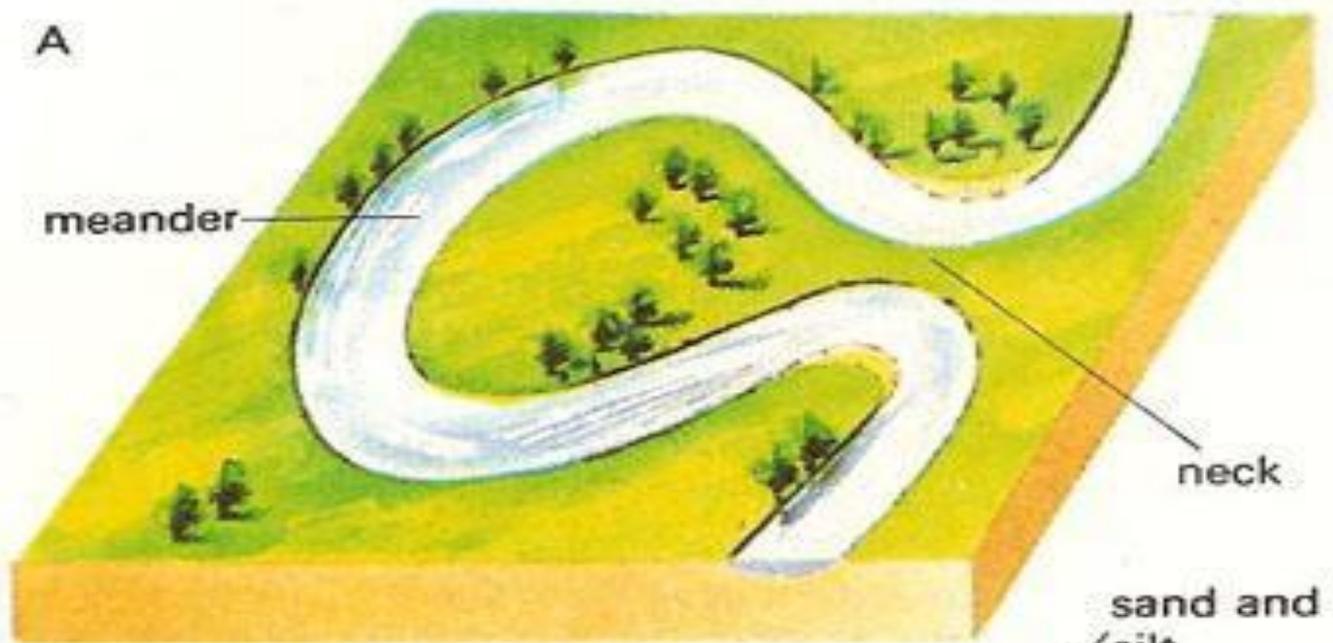


Jade Valley Flooding



January 20, 2013



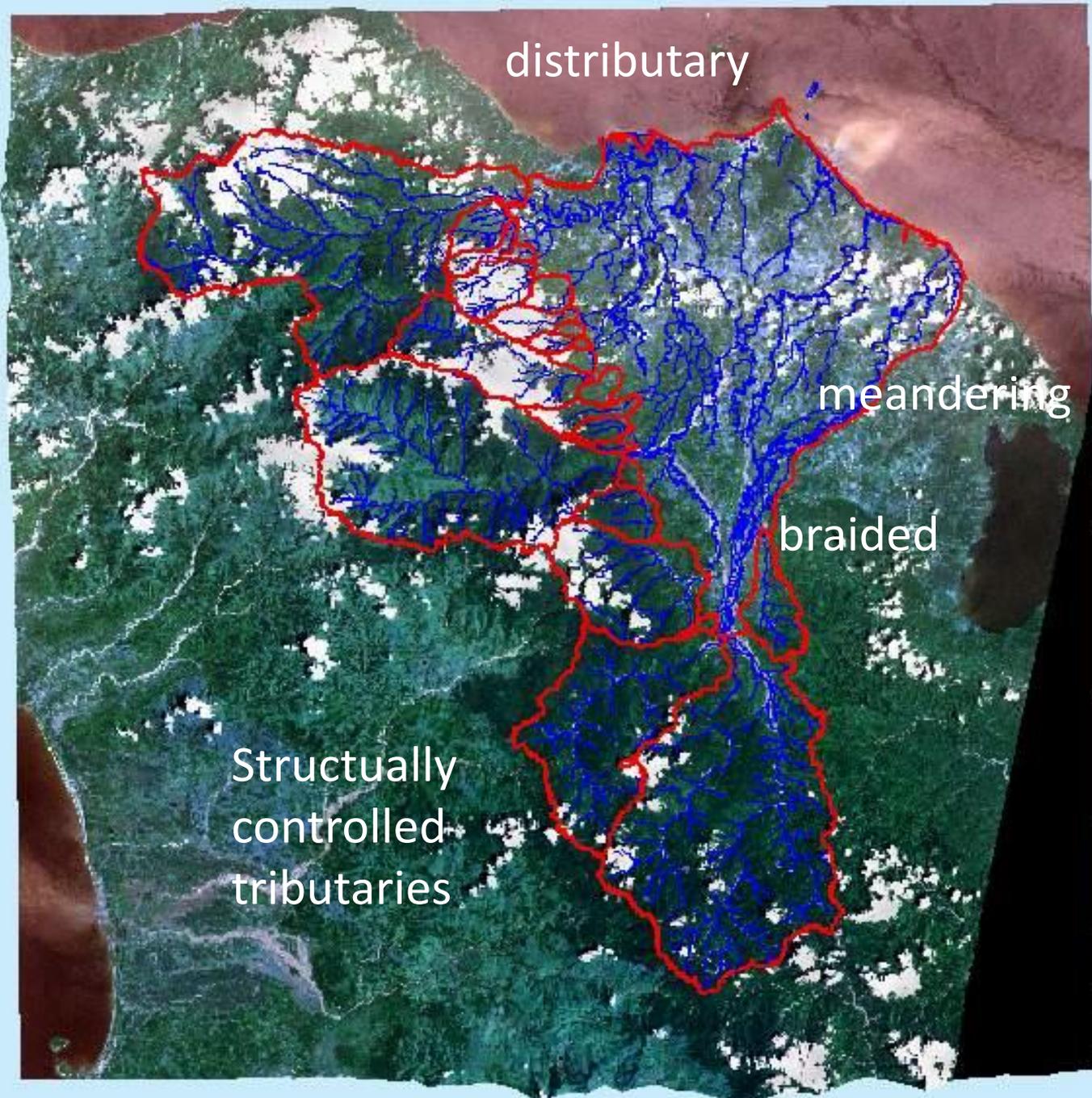


Cagayan de Oro



Typhoon Sendong



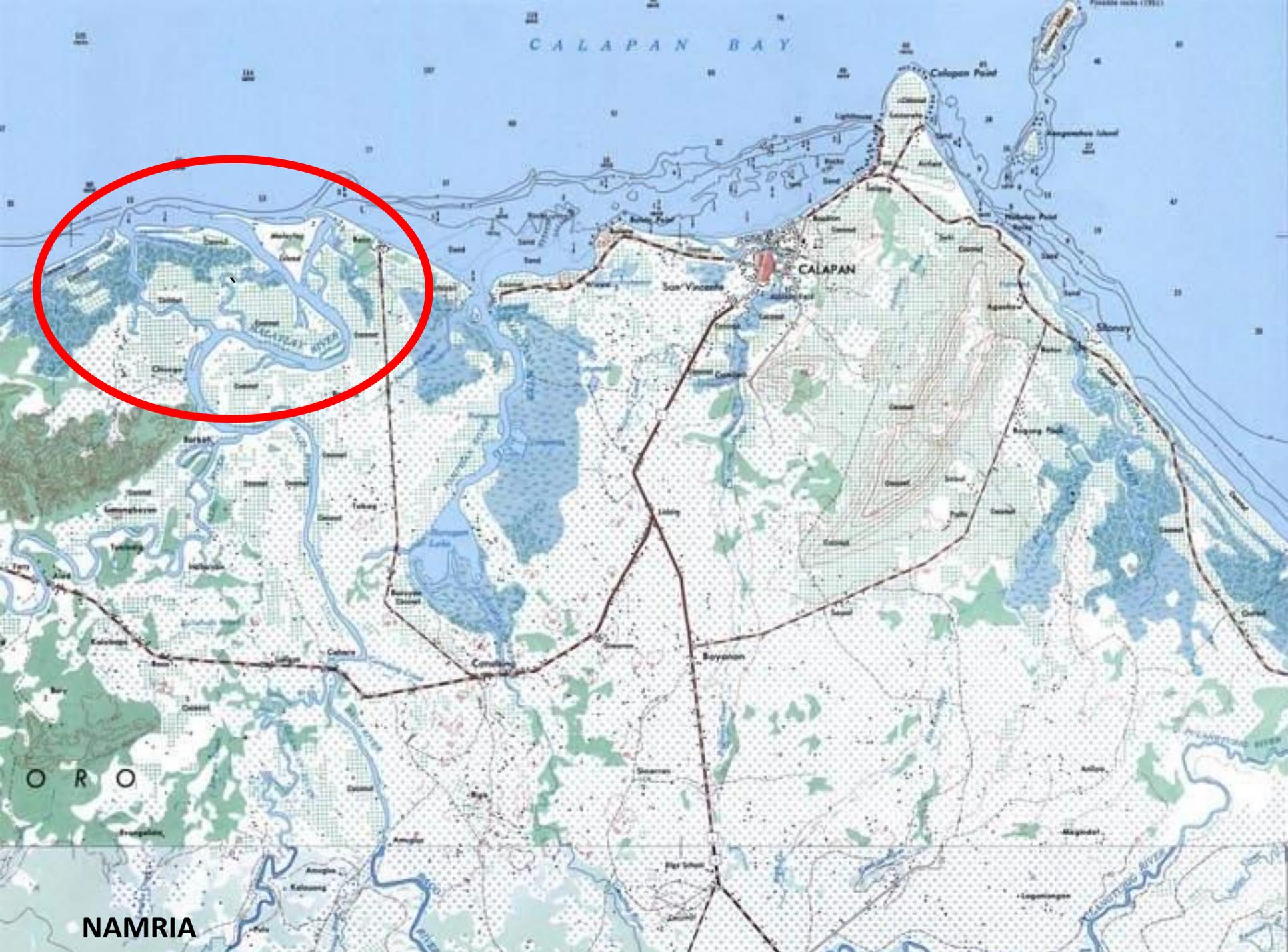


distributary

meandering

braided

Structurally
controlled
tributaries



CALAPAN BAY

CALAPAN



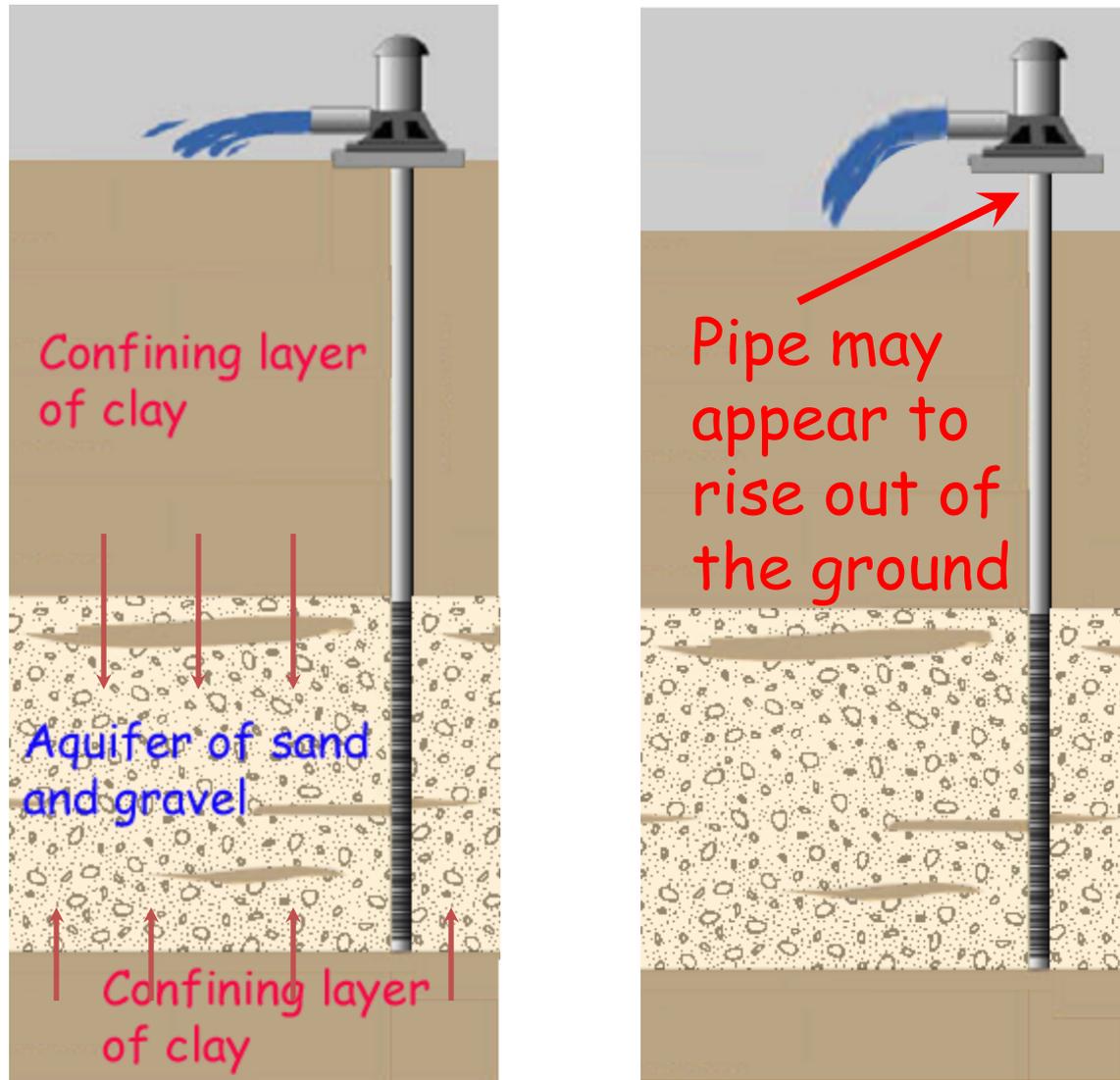
ORO

NAMRIA

Dagupan, Pangasinan 1990

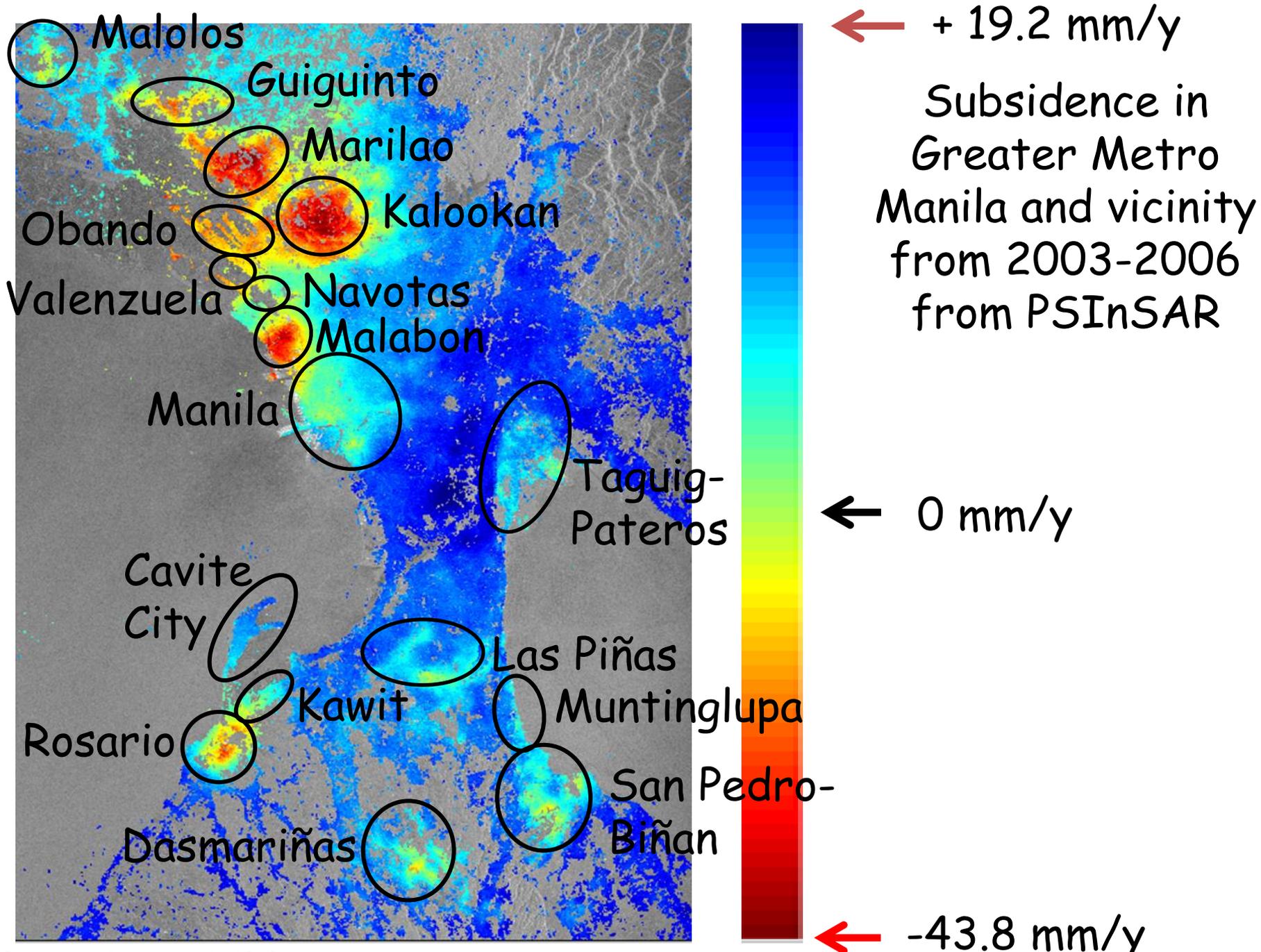


How groundwater withdrawal causes land to subside





Candaba, Pampanga



from Kelvin Rodolfo's ppt