



# **NATURAL RESOURCES ATLAS OF SOUTHERN GUAM**

**By**

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# **WERI**

**WATER AND ENVIRONMENTAL RESEARCH INSTITUTE  
OF THE WESTERN PACIFIC**

**Technical Report No. 116  
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# NATURAL RESOURCES ATLAS OF SOUTHERN GUAM

*<http://www.hydroguam.net>*

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## **NATURAL RESOURCES ATLAS OF SOUTHERN GUAM - KEY FEATURES OF THE DIGITAL VERSION**

The Natural Resources Atlas of Southern Guam is a reference and an educational tool that provides a comprehensive picture of the natural resources found within the fourteen southern Guam watersheds. The Atlas was inspired and initiated by the need for up-to-date information required for sustainable development and protection of Guam's watersheds, and was originally envisioned as a "Watershed Atlas of Southern Guam". Over the course of its development the Atlas outgrew its original scope and got to include a wealth of information related to a wider range of natural resources and came to be called "Natural Resources Atlas of Southern Guam". Nevertheless, the concern for the protection of watersheds remains the focal point of the Atlas. This is clearly reflected in its watershed-by-watershed approach, in which every portion of the Atlas deals not only with southern Guam as a whole, but also with each of the 14 southern watersheds individually.

The digital version of the Natural Resources Atlas of Southern Guam is designed as a comprehensive and user-friendly web-based information server. It is freely accessible on the Internet at [www.hydroguam.net](http://www.hydroguam.net) address and offers a wide range of textual, graphical, statistical, and geographic information to any interested user. It allows advanced operations such as viewing and manipulation of GIS data yet requires no special programs or browser plug-ins to be installed by the user in addition to the standard web browsing software. It is the foundation and an integral part of a planned series of products dedicated to dissemination of information and raising of awareness regarding the diversity, current state, sustainable use, and critical threats to natural features of southern Guam. In addition to the digital version of the Atlas, we plan to create a print version and other educational materials in the near future.

### **KEY FEATURES**

The key features of the Atlas are:

- Digital accessibility - the Atlas in its entirety is a digital creation and is 1. permanently available on the Internet
- Dedicated Internet domain - the Atlas is available at a specially created Internet 2. address: [www.hydroguam.net](http://www.hydroguam.net)
- Attractive design - eye-catching design, aesthetically pleasing and consistent 3. color schemes, quality programming and excellent color graphics make the Atlas pleasing to use and explore
- User-friendly interface - the Atlas is inherently easy to use thanks to a logical 4. series of menus and sub-menus that stay fixed on the periphery of every page while their dynamic central parts change per user requests

Easily updatable - owing to its digital format and modular structure, any current 5. part of the Atlas can be modified at any time, and any future part can be added at any time  
Rich content - the Atlas contains nearly 1,000 individual pages offering a wealth 6. of textual, graphical, numerical, geospatial, and other information related to natural resources of southern Guam

a. Textual information – informative texts about different types of southern Guam’s natural resources, educational and introductory materials, glossary of terms, user guides, etc.

b. Graphical information – educational diagrams, sketches, photographs, etc.

c. Numerical information – raw data, spreadsheets, charts, etc.

d. Geospatial information – image maps (JPEG), GIS data, KML data, etc.

Download options - much of the material offered in the Atlas, including hundreds 7. of images, pre-formatted maps, documents, PDF files, spreadsheets, and raw data are available for download

Full GIS and Google Earth integration - geospatial information served in the 8. Atlas is accessible to users in GIS and Google Earth file formats thus offering a virtually unlimited range of applications

## **DIGITAL ACCESSIBILITY**

The Atlas in its current form is completely digital. It resides on a high-speed and reliable web server. All the web pages comprising the Atlas are publicly available and their viewing requires no registration or filling of forms and has no access restrictions. The Atlas is in entirety indexed by Google and other major search engines and is thus searchable and easily accessible. The Atlas offers numerous advanced features yet requires no special software or browser plug-ins to be installed by the user. All that is required is an Internet connection and standard web browsing software. The Atlas works with any commonly used operating system and web browsing software.

## **DEDICATED INTERNET DOMAIN**

The Atlas is accessed via a dedicated domain name. As such, it is perceived by users as a stand-alone, self-contained, and comprehensive product, as opposed to merely a series of pages on an already existing website. The domain name was selected in order to be intuitive and easily remembered and reads: [www.hydroguam.net](http://www.hydroguam.net). Any Internet user can thus access the Atlas not only via standard search engines or links on existing Internet pages, but by simply typing the dedicated domain name in any web browser address bar, without having to remember any complicated addresses involving slashes (/) and page names (index.html, etc.).

## **ATTRACTIVE DESIGN**

Every page of the Atlas is designed in a consistent fashion, including a fixed layout, attractive color schemes, characteristic fonts, and unvarying appearance. This allows the users to experience it as a well-integrated product whose every page and portion is clearly part of the same “brand”. Every page is identified by a banner-type graphic that bears the name “Natural Resources Atlas of Southern Guam” and stays fixed at the top of the screen. Next to the banner on the top right hand side of the screen is a small space dedicated to changing color photographs

which showcase the natural beauty of Guam. A new photo is displayed at every re-loading of a page or opening of a new page, and is randomly selected from hundreds of high-quality color images. Below the banner and the space filled with randomly changing images is the main part of the screen. It consists of a stationary series of menus and sub-menus that stay in peripheral parts of the screen and offer quick, logical and practical gateway to information which is always displayed in the dynamic central part of the screen.

## **USER-FRIENDLY INTERFACE**

User interface of the Atlas is formatted in a consistent and convenient way that makes it inherently easy to use and requires virtually no time getting used to. The various menu and sub-menu options are available via navigation bars found at the top, bottom, left, and right hand sides of the screen. The left and right hand size menu bars are most extensive and important: the left links to pages with mostly textual information, and the right leads to pages with mostly geospatial information. The menus are organized logically and hierarchically and stay fixed no matter what page or information the user is viewing in the dynamic portion of the screen. The fact that navigation menus are stationary and identical on every page make it possible for user to jump to any page available directly from any other page, without spending time to browse. This is an especially advantageous feature considering that the wealth of information offered by the Atlas is presented via nearly 1,000 individual pages, which would otherwise be difficult to locate.

## **EASILY UPDATABLE**

The pages in the Atlas were created using PHP software technology which allows easy updates of hundreds of pages simultaneously. Any change whatsoever to the content of the Atlas is easily implemented and immediately effective. The Webmaster accesses the server hosting the Atlas via File Transfer Protocol (FTP) connection, download the page or part of the website that requires change, makes the change on local machine, and uploads the updated files back to the server. Any existing page, map, graphic, programming script, or any other portion of the site is thus modifiable. Furthermore, the modular nature of the Atlas and its menu-driven organization allows new parts and options to be added at any time without affecting its current structure.

## **RICH CONTENT**

The rich content of the Atlas is presented here in the form of an outline that exactly reflects the current menu and sub-menu structure of its user interface. It is organized in four logical groups that correspond to the menu bars found on the top, left, right, and bottom sides of the screen.

A) Top Menu Bar offers entry to the Atlas's main page and contact information:

- 1) Link to main page
- 2) "About us" page
- 3) Contact information

B) Left Menu Bar offers a wealth of textual information about southern Guam natural resources, organized in the following topics:

Background

- 1) Basic concepts
- 2) Glossary of terms

Geographic area

- 1) Overview
- 2) Geology
- 3) Hydrology
- 4) Climate
- 5) Soil
- 6) Vegetation

Drainage

- 1) Overview
- 2) Stream toponymy
  - a) Official U.S. names
  - b) Chamorro names
- 3) Stream profiles
- 4) Stream flow

Watersheds

- 1) Overview
- 2) Individual watersheds
  - a) Agat
  - b) Apra
  - c) Cetti
  - d) Geus
  - e) Inarajan
  - f) Malojloj
  - g) Manell
  - h) Pago
  - i) Telayag
  - j) Talofof
  - k) Toguan
  - l) Ugum
  - m) Umatac
  - n) Ylig

## Environment

- 1) Overview
- 2) Forests
- 3) Scrub
- 4) Grasslands
- 5) Badlands
- 6) Wetlands
  - a) Marshes
  - b) Swamps
  - c) Estuaries
  - d) Mangroves
- 7) Reefs

## Population

- 1) Overview
- 2) Municipalities
- 3) Military lands
- 4) Protected areas
- 5) Infrastructure

C) Right Menu Bar offers a wealth of graphical and geospatial information and data about southern Guam natural resources, organized as follows:

### Image maps (Pre-formatted maps)

- 1) Topography
  - a) Topographic map
  - b) Contour lines, 6 m
  - c) Contour lines, 30 m
  - d) Elevation
  - e) Shaded relief
  - f) Digital Elevation Model
  - g) Elevation and relief
  - h) Slope
  - i) Slope aspect
  - j) Physiographic divisions
- 2) Geology
  - a) Detailed geology
  - b) Simplified geology
  - c) Volcanic terrane
  - d) Limestone terrane
  - e) Faults
- 3) Climate
  - a) Rainfall distribution



- 4) Soil
  - a) Detailed soils
  - b) Simplified soils
  - c) Volcanic soils
  - d) Limestone soils
  - e) Bottomland soils
- 5) Drainage
  - a) Drainage network
  - b) Main streams
  - c) All streams
  - d) Theoretical drainage
  - e) Low gradient flow
  - f) High gradient flow
  - g) Major waterfalls
  - h) Ponds and reservoirs
  - i) Coastal discharge
  - j) Stream names
  - k) Stream lengths
- 6) Watersheds
  - a) Watersheds
  - b) Watershed divides
  - c) Watershed coastlines
  - d) Subwatersheds
- 7) Groundwater
  - a) Groundwater
  - b) Sinkholes
  - c) Caves
  - d) Springs
- 8) Environment
  - a) Detailed vegetation
  - b) Simplified vegetation
  - c) Forests
  - d) Scrub
  - e) Grasslands
  - f) Badlands
  - g) Marshes and swamps
  - h) Estuaries and mangroves
  - i) Reefs
- 9) Population
  - a) Urban buildup
  - b) Agricultural lands
  - c) Village locations
  - d) Municipal boundaries
  - e) Military areas
  - f) Protected areas

- 10) Infrastructure
  - a) Routes
  - b) Main roads
  - c) All roads and streets
- 11) Imagery
  - a) Image 1

#### Geospatial data

- 1) GIS
  - a) On-line viewer
  - b) Data download
- 2) Google Earth
  - a) Examples
  - b) Data download
- 3) Download software

#### Photo gallery

- 1) Rivers
- 2) Landscapes
- 3) Aerials

#### Publications

- 1) Project documentation
- 2) Publications

#### Media and events

- 1) News
- 2) Current issues
- 3) Events

#### Links

- 1) WERI
- 2) IREI
- 3) GovGuam
- 4) Guam BSP
- 5) NOAA
- 6) USGS

D) Bottom Menu Bar includes disclaimer and legal notices:

- 1) Copyright notice
- 2) Disclaimer notice
- 3) Privacy notice

## **DOWNLOAD OPTIONS**

One of the primary goals of the digital Atlas is to provide access to up-to-date information and data to users who need it for their own purposes and other applications. For that reason the Atlas offers a wide range of download options, through which the users can save textual, graphical, and most importantly, geospatial information on their own computers. A range of text documents, spreadsheet files, and high quality color photographs are all available. An extended series of pre-formatted and nicely designed JPG maps in high resolution covering the wide range of natural resources outlined above are all available for download and use. Each of the 58 image maps (e.g., detailed geology, or scrub vegetation, or drainage network, etc.) is available in 15 versions: full southern Guam overview and closeups for each watershed; making a total of 870 distinct maps that can be downloaded from the website. Importantly, every GIS file that was used in the creation of the Atlas and all maps included within is also available for direct download in its original form, as explained below.

## **GIS AND GOOGLE EARTH INTEGRATION**

One of the primary purposes of the digital Atlas is to act as a distribution center of GIS data. Therefore, a significant portion of it is focused on GIS information and applications. Every map presented in the atlas is accompanied by download links where users can obtain original GIS data used to create the map in question. This includes all types of GIS data (as relevant to a particular map), such as point, polyline and polygon shapefiles, grid coverages, georeferenced images, etc. Each and every data set is available in two versions: NAD83, which was specified as preferred by the Atlas planning committee, and WGS84, which is emerging as a preferred standard by the wider audience. In addition, most GIS data can be browsed and pre-viewed on-line without actually downloading it, using a java-script based mini-GIS application. Finally, in order to make a greater range of geospatial capabilities accessible to users with no GIS experience or software, most GIS data is also downloadable in KML versions for use with the increasingly popular Google Earth software. For added convenience, links where users can download free geospatial software are also provided.

## **SCREENSHOTS**

The following pages include a couple of screenshots of select pages of the digital Atlas.

Fig. 2

### Natural Resources Atlas of Southern Guam

Water and Environmental Research Institute of the Western Pacific  
Island Research & Education Initiative

Home | About us | Contact

|   |  |   |
|---|--|---|
| <b>BACKGROUND</b>   | <b>Information server for southern Guam natural resources</b>  | <b>IMAGE MAPS</b>   |
| <ul style="list-style-type: none"> <li>Basic concepts</li> <li>Glossary of terms</li> </ul>   | <p><b>Geographic area overview</b></p>  <p>Guam (Chamorro: Guåhån) is an island in the Western Pacific Ocean, at the southern end of the Mariana Islands chain. It lies between 13.2°N and 13.7°N and between 144.6°E and 145.0°E. With an area of 209 square miles (541 km<sup>2</sup>), it is the largest island in Micronesia.</p> <p>Guam and the rest of the Mariana Islands were all created by the colliding Pacific and Philippine tectonic plates. This has also created the Marianas Trench, a deep subduction zone to the east of the islands, which contains the deepest surveyed point in the world ocean (35,797 feet / 10,911 m) deep. The highest point in Guam is Mount Lamlam (1,332 feet / 406 m). The island of Guam is 30 miles (48 km) long and 4 mi (6 km) to 12 mi (19 km) wide. Guam is not volcanically active but it does experience occasional earthquakes.</p> | <ul style="list-style-type: none"> <li>Topography</li> <li>Geology</li> <li>Climate</li> <li>Soil</li> <li>Drainage</li> <li>Watersheds</li> <li>Groundwater</li> <li>Environment</li> <li>Population</li> <li>Infrastructure</li> <li>Imagery</li> </ul> |
| <b>GEOGRAPHIC AREA</b>  |  | <b>GEOSPATIAL DATA</b>  |
| <ul style="list-style-type: none"> <li>Overview</li> <li>Geology</li> <li>Hydrology</li> <li>Climate</li> <li>Soil</li> <li>Vegetation</li> </ul> |  | <ul style="list-style-type: none"> <li>GIS</li> <li>Google Earth™</li> <li>Download software</li> </ul>   |
| <b>DRAINAGE</b>   |  | <b>PHOTO GALLERY</b>  |
| <ul style="list-style-type: none"> <li>Overview</li> <li>Stream toponymy</li> <li>Stream profiles</li> <li>Stream flow</li> </ul>                 |  | <ul style="list-style-type: none"> <li>Rivers</li> <li>Landscapes</li> <li>Aerials</li> </ul>   |
| <b>WATERSHEDS</b>   |  | <b>PUBLICATIONS</b>   |
| <ul style="list-style-type: none"> <li>Overview</li> <li>Individual watersheds</li> </ul>   |  |   |
| <b>ENVIRONMENT</b>  |  |   |
| <ul style="list-style-type: none"> <li>Overview</li> <li>Forests</li> </ul>   |  |   |

Overview

Stream toponymy

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|   |  |   |
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| <b>BACKGROUND</b>   | <b>Information server for southern Guam natural resources</b>  | <b>IMAGE MAPS</b>   |
| <ul style="list-style-type: none"> <li>Basic concepts</li> <li>Glossary of terms</li> </ul>   | <p><b>Basic concepts</b></p> <p>This page explains some basic concepts that might help you better understand information provided on this website. It will also help you recognize and interpret natural features and phenomena that can be observed on Guam.</p> <p><b>Topography:</b></p> <p>The land surface in southern Guam is very diverse. There are hills and lowlands, peaks and ridges, river valleys, coastal areas, etc. Those natural surface features are called topography. Surface features very much influence the nature of a place. They affect the vegetation, drainage, coastline, and even the weather.</p>  | <ul style="list-style-type: none"> <li>Topography</li> <li>Geology</li> <li>Climate</li> <li>Soil</li> <li>Drainage</li> <li>Watersheds</li> <li>Groundwater</li> <li>Environment</li> <li>Population</li> <li>Infrastructure</li> <li>Imagery</li> </ul> |
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| <b>ENVIRONMENT</b>  |  |   |
| <ul style="list-style-type: none"> <li>Overview</li> <li>Forests</li> </ul>   |  |   |

Drainage:

Geospatial Data

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| <b>BACKGROUND</b>   | <b>Information server for southern Guam natural resources</b>  | <b>IMAGE MAPS</b>   |
| <ul style="list-style-type: none"> <li>Basic concepts</li> <li>Glossary of terms</li> </ul>   | <p><b>Glossary of terms</b></p> <p>Here are some basic and some more specialized terms that you might want to refer to as you explore the watersheds and natural resources of southern Guam. Most definitions provided here are by United States Geological Survey (USGS).</p> <p><b>A   B   C   D   E   F   G   H   I   J   K   L   M   N   O   P   R   S   T   U   V   W  </b></p> <p><b>A &gt;</b></p> <p><b>acid</b> : a substance that has a pH of less than 7, which is neutral. Specifically, an acid has more free hydrogen ions (H<sup>+</sup>) than hydroxyl ions (OH<sup>-</sup>).</p> <p><b>alkaline</b> : sometimes water or soils contain an amount of alkali (strongly basic) substances sufficient to raise the pH value above 7.0 and be harmful to the growth of crops.</p> <p><b>alluvium</b> : deposits of clay, silt, sand, gravel, or other particulate material that has been deposited by a stream or other body of running water in a streambed, on a flood plain, on a delta, or at the base of a mountain.</p> <p><b>aquaculture</b> : farming of plants and animals that live in water, such as fish, shellfish, and algae.</p> <p><b>aquifer</b> : a geologic formation(s) that is water bearing. A geological formation or structure that stores and/or transmits water, such as to wells and springs. Use of the term is usually restricted to those water-bearing formations capable of yielding</p> | <ul style="list-style-type: none"> <li>Topography</li> <li>Geology</li> <li>Climate</li> <li>Soil</li> <li>Drainage</li> <li>Watersheds</li> <li>Groundwater</li> <li>Environment</li> <li>Population</li> <li>Infrastructure</li> <li>Imagery</li> </ul> |
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| <b>WATERSHEDS</b>   |  | <b>PUBLICATIONS</b>   |
| <ul style="list-style-type: none"> <li>Overview</li> <li>Individual watersheds</li> </ul>   |  |   |
| <b>ENVIRONMENT</b>  |  |   |
| <ul style="list-style-type: none"> <li>Overview</li> <li>Forests</li> </ul>   |  |   |

Military lands

Protected areas

Infrastructure

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| <b>BACKGROUND</b>   | <b>Information server for southern Guam natural resources</b>   | <b>IMAGE MAPS</b>   |                |              |        |             |       |               |         |              |        |              |        |               |  |                |          |               |           |                |           |            |       |                   |  |              |  |                |           |                 |  |              |  |                |  |   |
|---|---|---|----------------|--------------|--------|-------------|-------|---------------|---------|--------------|--------|--------------|--------|---------------|--|----------------|----------|---------------|-----------|----------------|-----------|------------|-------|-------------------|--|--------------|--|----------------|-----------|-----------------|--|--------------|--|----------------|--|---|
| <ul style="list-style-type: none"> <li>Basic concepts</li> <li>Glossary of terms</li> </ul>   | <p><b>Names of Guam's streams and rivers</b></p> <p>The following is a list of official toponyms (place names) for streams on Guam and their Chamorro language equivalents. Chamorro translations and spellings are courtesy of Ronald T. Laguana, Administrator, Chamorro Studies and Special Projects Division, Guam Public School System.</p> <table border="1"> <thead> <tr> <th>U.S. names</th> <th>Chamorro names</th> </tr> </thead> <tbody> <tr> <td>Achang River</td> <td>Āchang</td> </tr> <tr> <td>Agaga River</td> <td>Āgaga</td> </tr> <tr> <td>Agfayan River</td> <td>Akrāyan</td> </tr> <tr> <td>Aguada River</td> <td>Aguāda</td> </tr> <tr> <td>Ajayan River</td> <td>Āyayan</td> </tr> <tr> <td>Alatgue River</td> <td></td> </tr> <tr> <td>Almagosa River</td> <td>Atmagosa</td> </tr> <tr> <td>Aplacho River</td> <td>Applacha'</td> </tr> <tr> <td>Asalonso River</td> <td>As Alonso</td> </tr> <tr> <td>Asan River</td> <td>Assan</td> </tr> <tr> <td>Ascola Sito Creek</td> <td></td> </tr> <tr> <td>Asgado Creek</td> <td></td> </tr> <tr> <td>Aslinget River</td> <td>As Linget</td> </tr> <tr> <td>Asmafines River</td> <td></td> </tr> <tr> <td>Asaban River</td> <td></td> </tr> <tr> <td>Atantano River</td> <td></td> </tr> </tbody> </table> | U.S. names  | Chamorro names | Achang River | Āchang | Agaga River | Āgaga | Agfayan River | Akrāyan | Aguada River | Aguāda | Ajayan River | Āyayan | Alatgue River |  | Almagosa River | Atmagosa | Aplacho River | Applacha' | Asalonso River | As Alonso | Asan River | Assan | Ascola Sito Creek |  | Asgado Creek |  | Aslinget River | As Linget | Asmafines River |  | Asaban River |  | Atantano River |  | <ul style="list-style-type: none"> <li>Topography</li> <li>Geology</li> <li>Climate</li> <li>Soil</li> <li>Drainage</li> <li>Watersheds</li> <li>Groundwater</li> <li>Environment</li> <li>Population</li> <li>Infrastructure</li> <li>Imagery</li> </ul> |
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| Achang River  | Āchang  |   |                |              |        |             |       |               |         |              |        |              |        |               |  |                |          |               |           |                |           |            |       |                   |  |              |  |                |           |                 |  |              |  |                |  |   |
| Agaga River   | Āgaga   |   |                |              |        |             |       |               |         |              |        |              |        |               |  |                |          |               |           |                |           |            |       |                   |  |              |  |                |           |                 |  |              |  |                |  |   |
| Agfayan River   | Akrāyan   |   |                |              |        |             |       |               |         |              |        |              |        |               |  |                |          |               |           |                |           |            |       |                   |  |              |  |                |           |                 |  |              |  |                |  |   |
| Aguada River  | Aguāda  |   |                |              |        |             |       |               |         |              |        |              |        |               |  |                |          |               |           |                |           |            |       |                   |  |              |  |                |           |                 |  |              |  |                |  |   |
| Ajayan River  | Āyayan  |   |                |              |        |             |       |               |         |              |        |              |        |               |  |                |          |               |           |                |           |            |       |                   |  |              |  |                |           |                 |  |              |  |                |  |   |
| Alatgue River   |   |   |                |              |        |             |       |               |         |              |        |              |        |               |  |                |          |               |           |                |           |            |       |                   |  |              |  |                |           |                 |  |              |  |                |  |   |
| Almagosa River  | Atmagosa  |   |                |              |        |             |       |               |         |              |        |              |        |               |  |                |          |               |           |                |           |            |       |                   |  |              |  |                |           |                 |  |              |  |                |  |   |
| Aplacho River   | Applacha'   |   |                |              |        |             |       |               |         |              |        |              |        |               |  |                |          |               |           |                |           |            |       |                   |  |              |  |                |           |                 |  |              |  |                |  |   |
| Asalonso River  | As Alonso   |   |                |              |        |             |       |               |         |              |        |              |        |               |  |                |          |               |           |                |           |            |       |                   |  |              |  |                |           |                 |  |              |  |                |  |   |
| Asan River  | Assan   |   |                |              |        |             |       |               |         |              |        |              |        |               |  |                |          |               |           |                |           |            |       |                   |  |              |  |                |           |                 |  |              |  |                |  |   |
| Ascola Sito Creek   |   |   |                |              |        |             |       |               |         |              |        |              |        |               |  |                |          |               |           |                |           |            |       |                   |  |              |  |                |           |                 |  |              |  |                |  |   |
| Asgado Creek  |   |   |                |              |        |             |       |               |         |              |        |              |        |               |  |                |          |               |           |                |           |            |       |                   |  |              |  |                |           |                 |  |              |  |                |  |   |
| Aslinget River  | As Linget   |   |                |              |        |             |       |               |         |              |        |              |        |               |  |                |          |               |           |                |           |            |       |                   |  |              |  |                |           |                 |  |              |  |                |  |   |
| Asmafines River   |   |   |                |              |        |             |       |               |         |              |        |              |        |               |  |                |          |               |           |                |           |            |       |                   |  |              |  |                |           |                 |  |              |  |                |  |   |
| Asaban River  |   |   |                |              |        |             |       |               |         |              |        |              |        |               |  |                |          |               |           |                |           |            |       |                   |  |              |  |                |           |                 |  |              |  |                |  |   |
| Atantano River  |   |   |                |              |        |             |       |               |         |              |        |              |        |               |  |                |          |               |           |                |           |            |       |                   |  |              |  |                |           |                 |  |              |  |                |  |   |
| <b>GEOGRAPHIC AREA</b>  |   | <b>GEOSPATIAL DATA</b>  |                |              |        |             |       |               |         |              |        |              |        |               |  |                |          |               |           |                |           |            |       |                   |  |              |  |                |           |                 |  |              |  |                |  |   |
| <ul style="list-style-type: none"> <li>Overview</li> <li>Geology</li> <li>Hydrology</li> <li>Climate</li> <li>Soil</li> <li>Vegetation</li> </ul> |   | <ul style="list-style-type: none"> <li>GIS</li> <li>Google Earth™</li> <li>Download software</li> </ul> |                |              |        |             |       |               |         |              |        |              |        |               |  |                |          |               |           |                |           |            |       |                   |  |              |  |                |           |                 |  |              |  |                |  |   |
| <b>DRAINAGE</b>   |   | <b>PHOTO GALLERY</b>  |                |              |        |             |       |               |         |              |        |              |        |               |  |                |          |               |           |                |           |            |       |                   |  |              |  |                |           |                 |  |              |  |                |  |   |
| <ul style="list-style-type: none"> <li>Overview</li> <li>Stream toponymy</li> <li>Stream profiles</li> <li>Stream flow</li> </ul>                 |   | <ul style="list-style-type: none"> <li>Rivers</li> <li>Landscapes</li> <li>Aerials</li> </ul>           |                |              |        |             |       |               |         |              |        |              |        |               |  |                |          |               |           |                |           |            |       |                   |  |              |  |                |           |                 |  |              |  |                |  |   |
| <b>WATERSHEDS</b>   |   | <b>PUBLICATIONS</b>   |                |              |        |             |       |               |         |              |        |              |        |               |  |                |          |               |           |                |           |            |       |                   |  |              |  |                |           |                 |  |              |  |                |  |   |
| <ul style="list-style-type: none"> <li>Overview</li> <li>Individual watersheds</li> </ul>   |   |   |                |              |        |             |       |               |         |              |        |              |        |               |  |                |          |               |           |                |           |            |       |                   |  |              |  |                |           |                 |  |              |  |                |  |   |
| <b>ENVIRONMENT</b>  |   |   |                |              |        |             |       |               |         |              |        |              |        |               |  |                |          |               |           |                |           |            |       |                   |  |              |  |                |           |                 |  |              |  |                |  |   |
| <ul style="list-style-type: none"> <li>Overview</li> <li>Forests</li> </ul>   |   |   |                |              |        |             |       |               |         |              |        |              |        |               |  |                |          |               |           |                |           |            |       |                   |  |              |  |                |           |                 |  |              |  |                |  |   |

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**Using this site:**

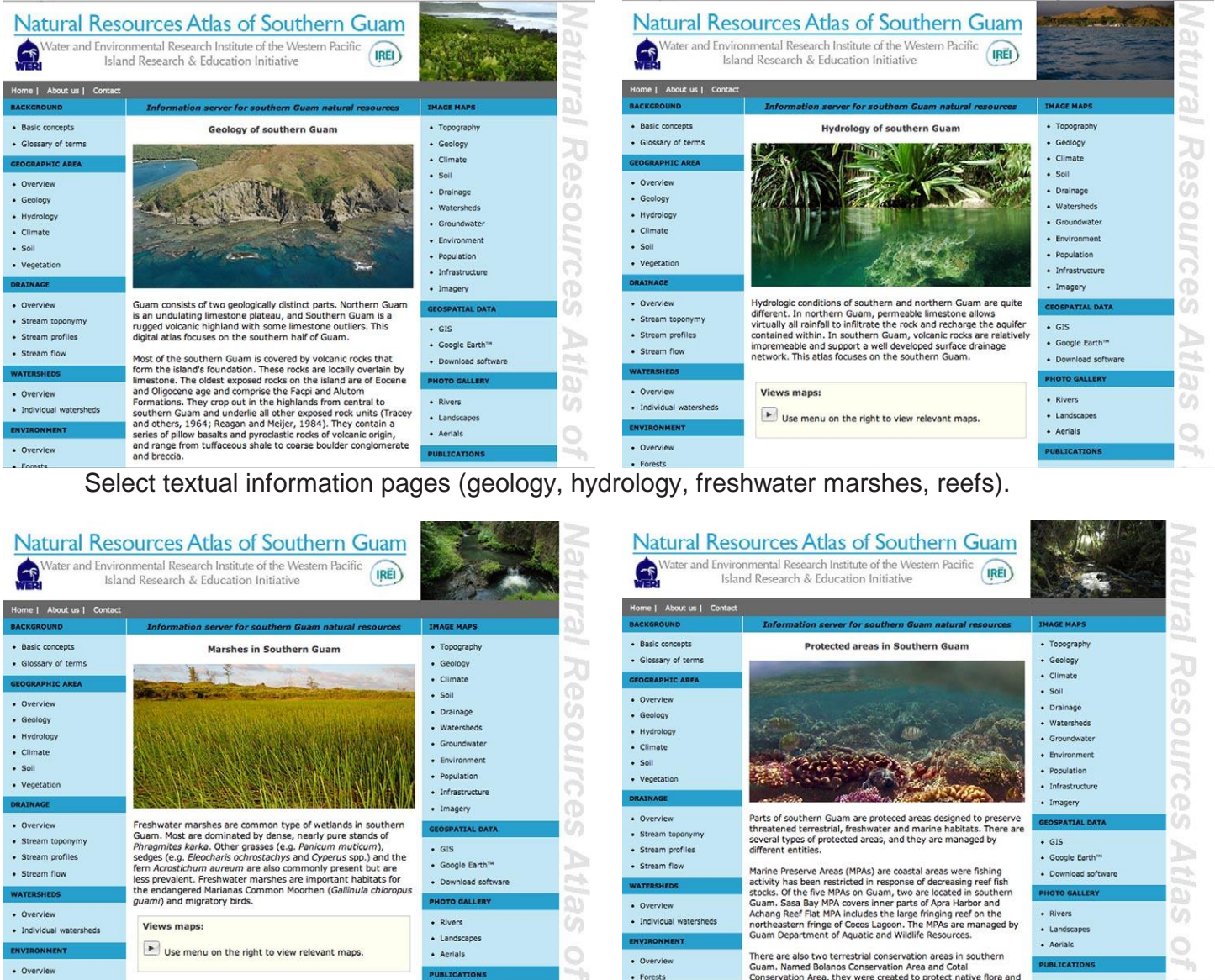
Quick and easy access to every page and bit of information contained by this digital atlas is provided by means of two menu bars. The menu on the left hand side of the screen leads up to mostly textual information. The menu on the right hand side of the screen leads up to mostly geospatial information. Textual information is divided into logical topics (geographic aspects, drainage, watershed, environment, and population). Geospatial data is offered as formatted and designed maps ("image maps"), raw GIS data, and data derived for use in increasingly popular Google Earth™ software. The right hand side menu also gives access to relevant documents and web resources.

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Select introductory pages (general introduction to Guam, basic concepts, glossary, river toponymy).



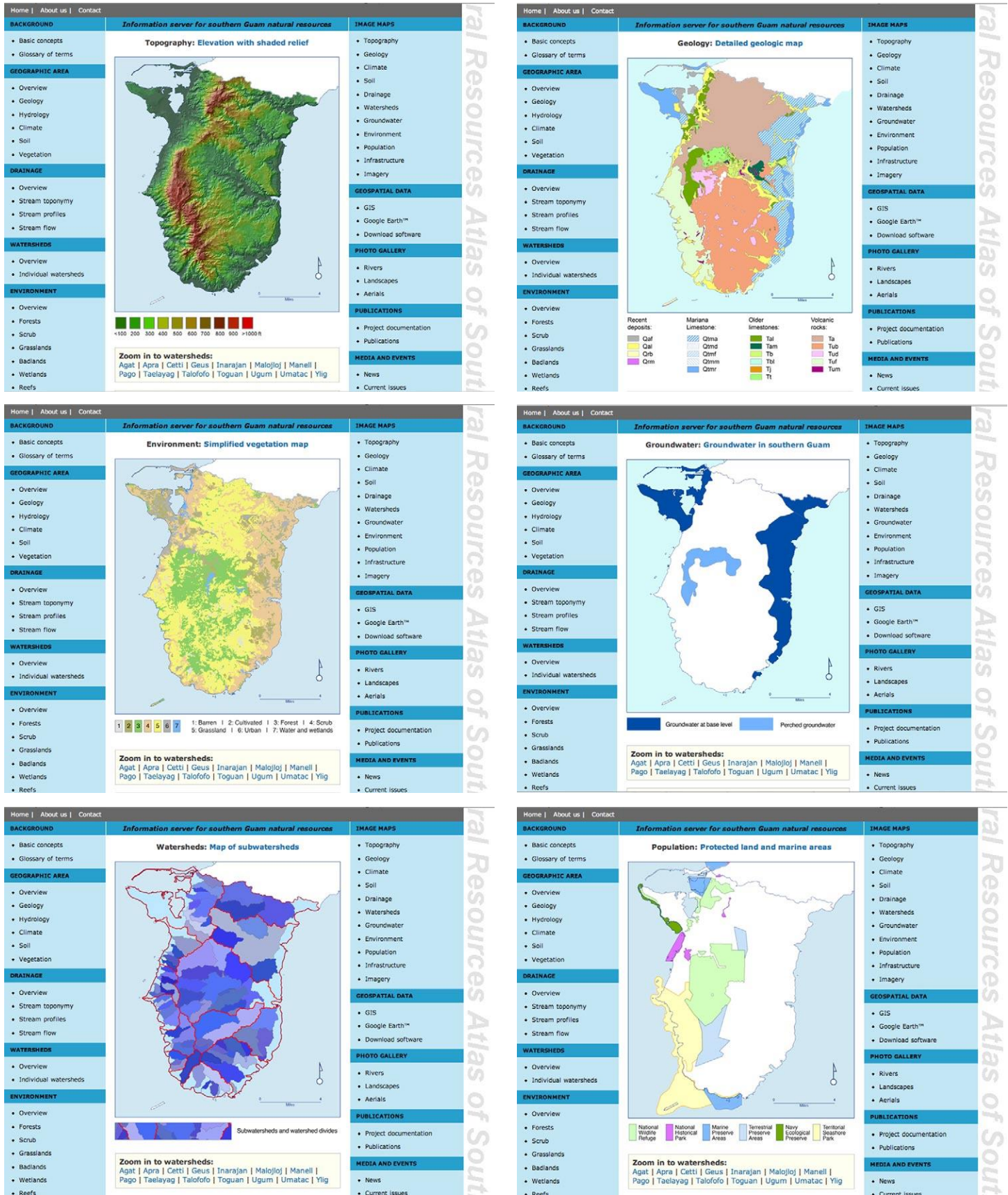
Fig. 3



Select textual information pages (geology, hydrology, freshwater marshes, reefs).



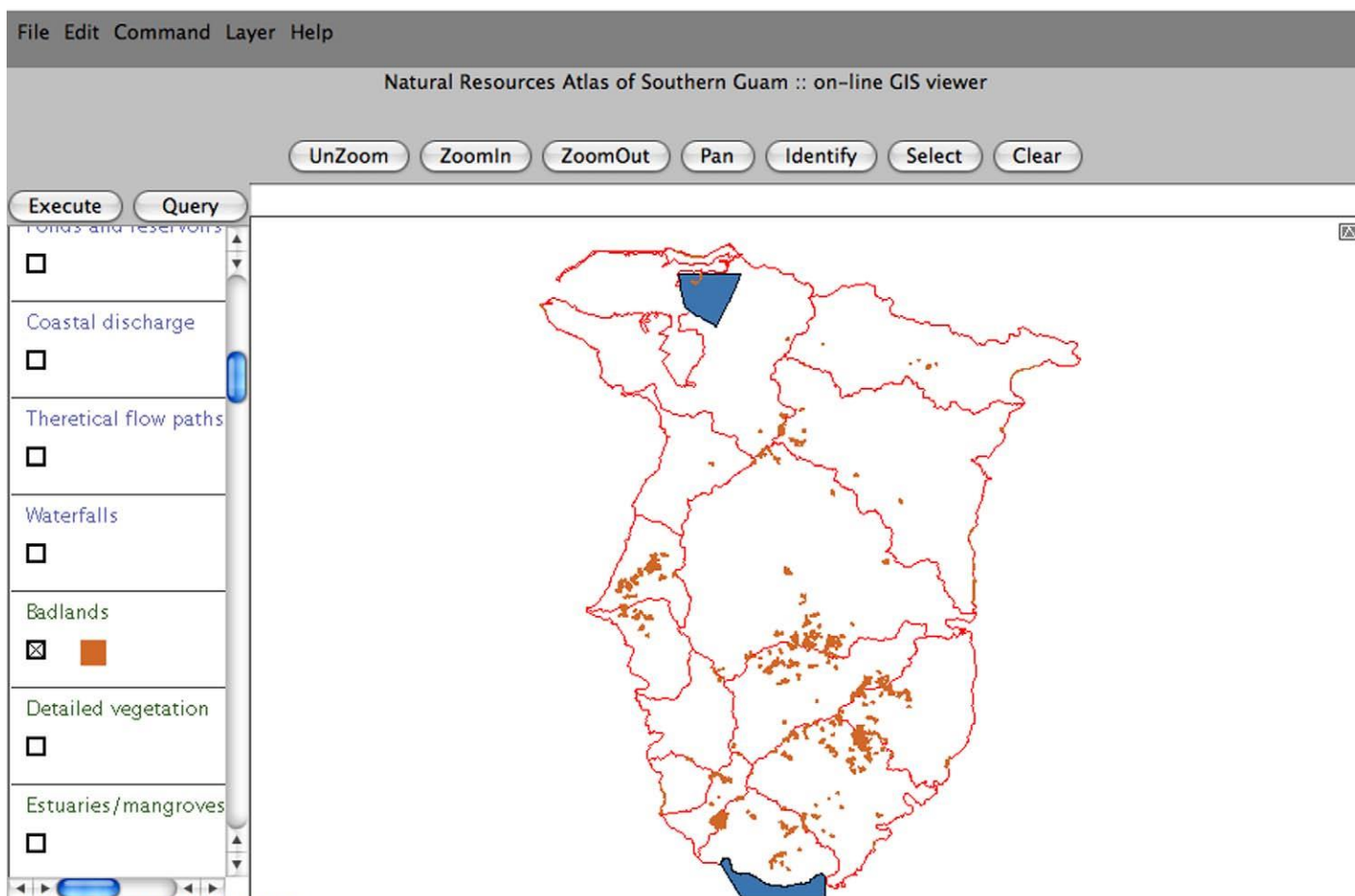
Fig. 4



Select image map pages (shaded relief topography, detailed geology, simplified vegetation, groundwater, sub watersheds, protected areas).



Fig. 5



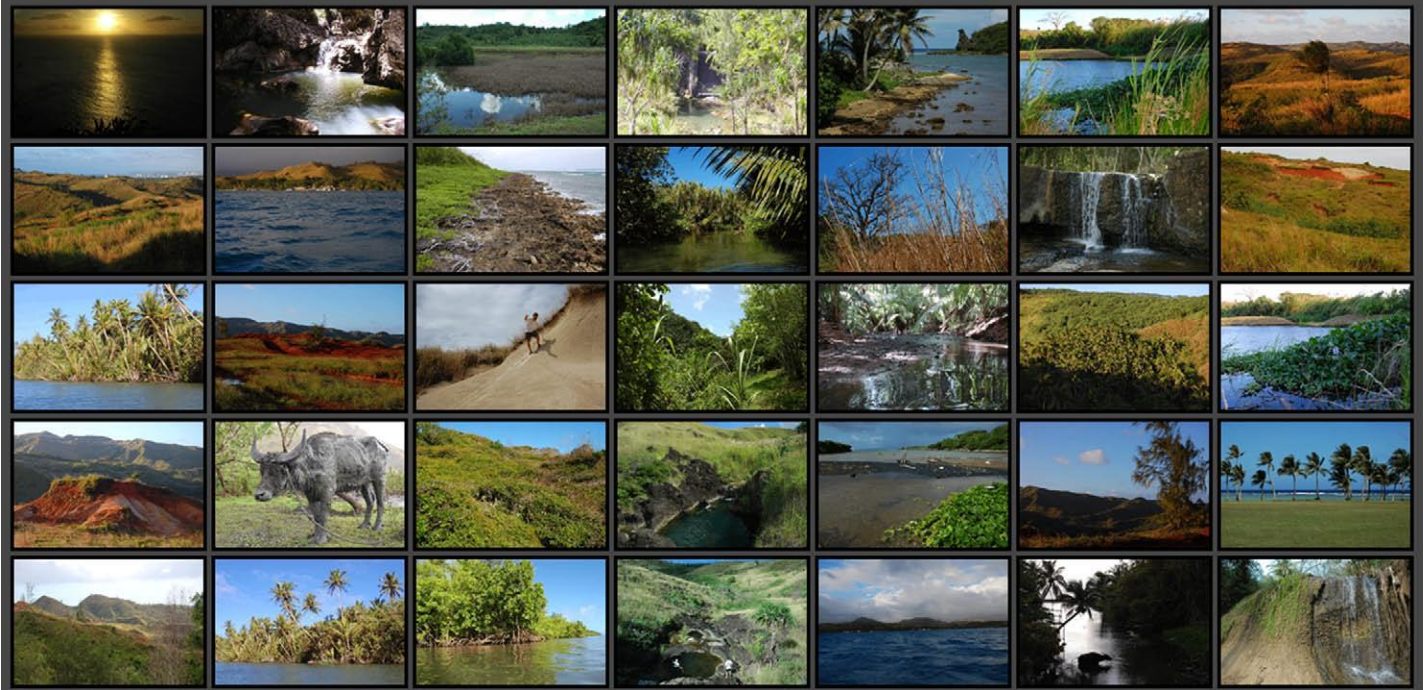
Select geospatial information pages (on-line GIS data viewer, GIS data dowload page, Google Earth application page).

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| <b>BACKGROUND</b> <ul style="list-style-type: none"> <li>Basic concepts</li> <li>Glossary of terms</li> </ul>  | <b>Download GIS data</b><br>Geographic Information Systems (GIS) is a computer support system composed of software, hardware, data, people, and procedures, connected to each other by a network. It has been a popular and powerful technique for urban planning, environmental modeling and decision making, coastal resource management, hydrological applications, etc.<br><br>This page provides access to geospatial data formatted as shape and grid files suitable for use in GIS applications. To download any of the files listed below, click the link with your preferred projection (NAD83 or WGS84). Open the files on your hard drive using GIS software. If you have no GIS software on your computer, download and install free ArcGIS Explorer first. | <b>IMAGE MAPS</b> <ul style="list-style-type: none"> <li>Topography</li> <li>Geology</li> <li>Climate</li> <li>Drainage</li> <li>Watersheds</li> <li>Groundwater</li> <li>Environment</li> <li>Population</li> <li>Infrastructure</li> <li>Imagery</li> </ul> |
| <b>GEOGRAPHIC AREA</b> <ul style="list-style-type: none"> <li>Overview</li> <li>Geology</li> <li>Hydrology</li> <li>Climate</li> <li>Soil</li> <li>Vegetation</li> </ul>             | <b>Topography:</b> <ul style="list-style-type: none"> <li>Topographic map (USGS): NAD83   WGS84</li> <li>Contour lines, 6m: NAD83   WGS84</li> <li>Contour lines, 30m: NAD83   WGS84</li> <li>Elevation: NAD83   WGS84</li> <li>Shaded relief: NAD83   WGS84</li> <li>Digital Elevation Model: NAD83   WGS84</li> <li>Elevation and relief: NAD83   WGS84</li> <li>Slope: NAD83   WGS84</li> </ul>  | <b>GEOSPATIAL DATA</b> <ul style="list-style-type: none"> <li>GIS</li> <li>Google Earth™</li> <li>Download software</li> </ul>  |
| <b>DRAINAGE</b> <ul style="list-style-type: none"> <li>Overview</li> <li>Stream toponymy</li> <li>Stream profiles</li> <li>Stream flow</li> </ul>                                    |   | <b>PHOTO GALLERY</b> <ul style="list-style-type: none"> <li>Rivers</li> <li>Landscapes</li> <li>Aerials</li> </ul>  |
| <b>WATERSHEDS</b> <ul style="list-style-type: none"> <li>Overview</li> <li>Individual watersheds</li> </ul>  |   | <b>PUBLICATIONS</b> <ul style="list-style-type: none"> <li>Project documentation</li> <li>Publications</li> </ul>   |
| <b>ENVIRONMENT</b> <ul style="list-style-type: none"> <li>Overview</li> <li>Forests</li> <li>Scrub</li> <li>Grasslands</li> <li>Badlands</li> <li>Wetlands</li> <li>Reefs</li> </ul> |   | <b>MEDIA AND EVENTS</b> <ul style="list-style-type: none"> <li>News</li> <li>Current issues</li> </ul>  |

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| <b>BACKGROUND</b> <ul style="list-style-type: none"> <li>Basic concepts</li> <li>Glossary of terms</li> </ul>  | <b>View data in Google Earth™</b><br>Most geospatial data served through this website can be downloaded in KMZ versions for use with Google Earth™ software. Users with no GIS training or access to specialized software are recommended to take this approach. Google Earth™ is popular software that is free to download and easy to use, and offers geographic visualization in intuitive satellite imagery context, excellent zoom and 3D ability, and many other applications. Some examples of data provided on this site viewed in Google Earth™ are shown below: | <b>IMAGE MAPS</b> <ul style="list-style-type: none"> <li>Topography</li> <li>Geology</li> <li>Climate</li> <li>Soil</li> <li>Drainage</li> <li>Watersheds</li> <li>Groundwater</li> <li>Environment</li> <li>Population</li> <li>Infrastructure</li> <li>Imagery</li> </ul> |
| <b>GEOGRAPHIC AREA</b> <ul style="list-style-type: none"> <li>Overview</li> <li>Geology</li> <li>Hydrology</li> <li>Climate</li> <li>Soil</li> <li>Vegetation</li> </ul>             | <b>Example 1: Southern Guam watersheds</b><br><p>Southern Guam watersheds superimposed on Google Earth™ background imagery. Users can turn specific labels and map elements on/off. In this example, Talofolo watershed has been made transparent.</p>  | <b>GEOSPATIAL DATA</b> <ul style="list-style-type: none"> <li>GIS</li> <li>Google Earth™</li> <li>Download software</li> </ul>  |
| <b>DRAINAGE</b> <ul style="list-style-type: none"> <li>Overview</li> <li>Stream toponymy</li> <li>Stream profiles</li> <li>Stream flow</li> </ul>                                    |   | <b>PHOTO GALLERY</b> <ul style="list-style-type: none"> <li>Rivers</li> <li>Landscapes</li> <li>Aerials</li> </ul>  |
| <b>WATERSHEDS</b> <ul style="list-style-type: none"> <li>Overview</li> <li>Individual watersheds</li> </ul>  |   | <b>PUBLICATIONS</b> <ul style="list-style-type: none"> <li>Project documentation</li> <li>Publications</li> </ul>   |
| <b>ENVIRONMENT</b> <ul style="list-style-type: none"> <li>Overview</li> <li>Forests</li> <li>Scrub</li> <li>Grasslands</li> <li>Badlands</li> <li>Wetlands</li> <li>Reefs</li> </ul> |   | <b>MEDIA AND EVENTS</b> <ul style="list-style-type: none"> <li>News</li> <li>Current issues</li> </ul>  |

**Fig. 6**

### Southern Guam landscapes and natural features:



Select photo gallery page (landscapes and natural features of southern Guam).