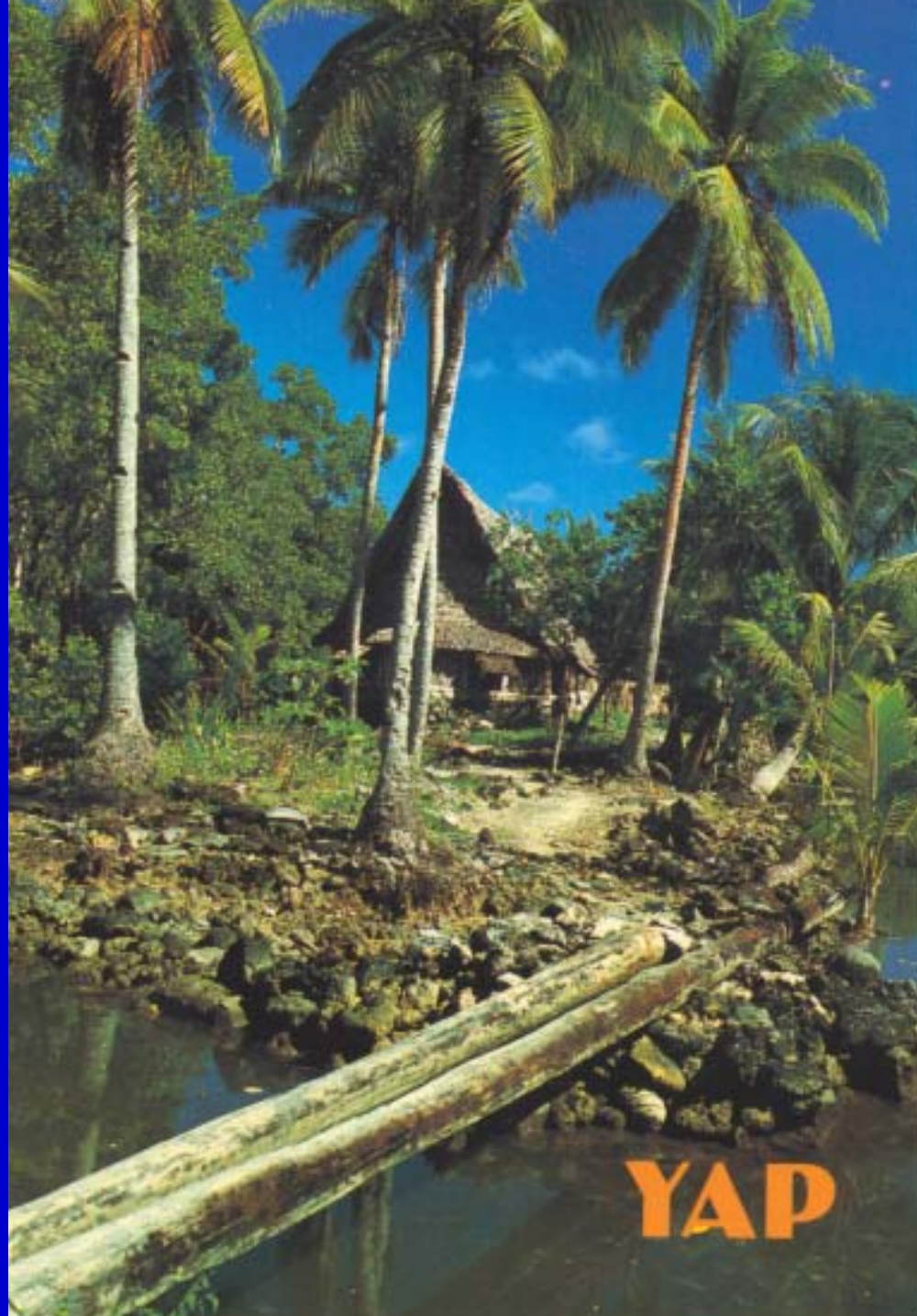
USGS
science for a changing world

USGS role in the Pacific Islands

(Resource management for environmental & economic sustainability)

April 4, 2003



Presentation Overview

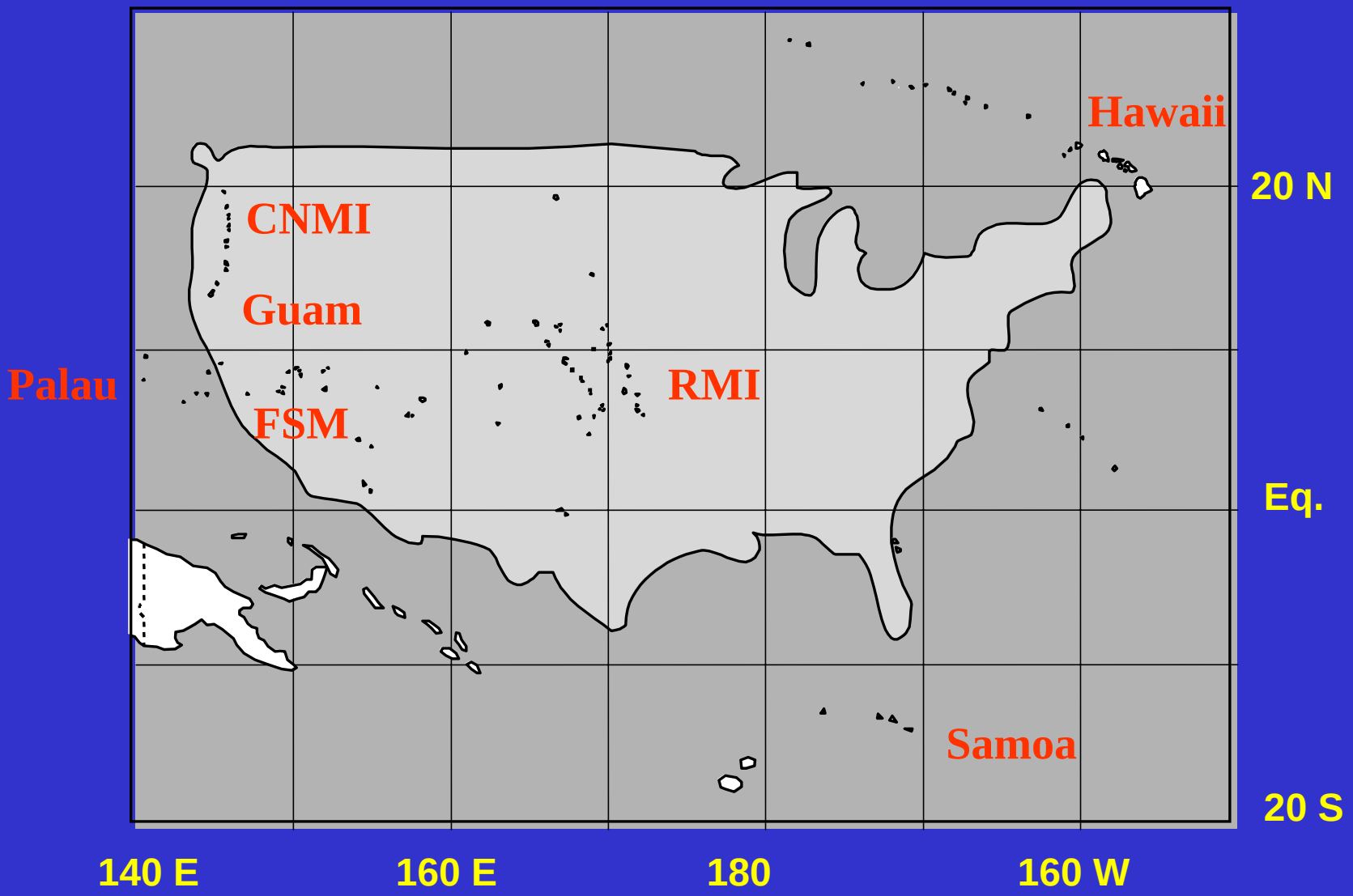
- Geography and political status
- USGS programs
- Environmental setting
- Water resource programs
- Typhoons
- Future directions

Geologic Settings

- High volcanic islands
- High limestone islands
- Low-lying coral atolls

Pohnpei

Pacific in Perspective



US Affiliates

• Guam:	153,000	209 mi^2
American Samoa:	59,000	77 mi^2
N. Mariana Is:	68,000	182 mi^2

(1996 pop.)

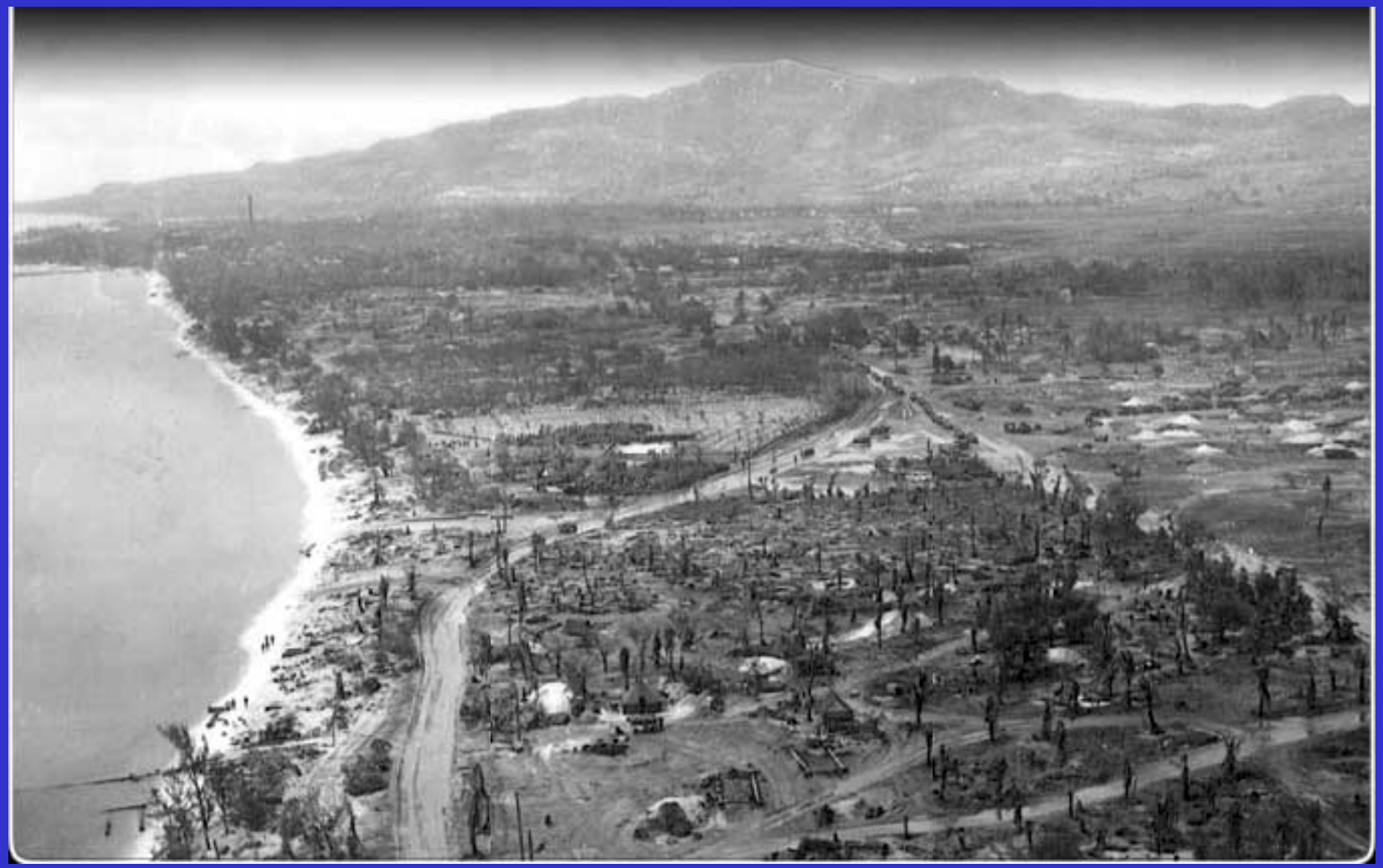
- Natives are full US citizens
- Delegates elected to US Congress

Former Affiliates

- Palau: 18,000 188 mi^2
  RMI: 57,000 70 mi^2
  FSM: 109,000 271 mi^2
  (1996 pop.)

- Natives citizens of sovereign country
- Compact of Free Association defines US relations
- Compact permits travel and work in US
- Compact gives high priority to US assistance

Saipan in WW II

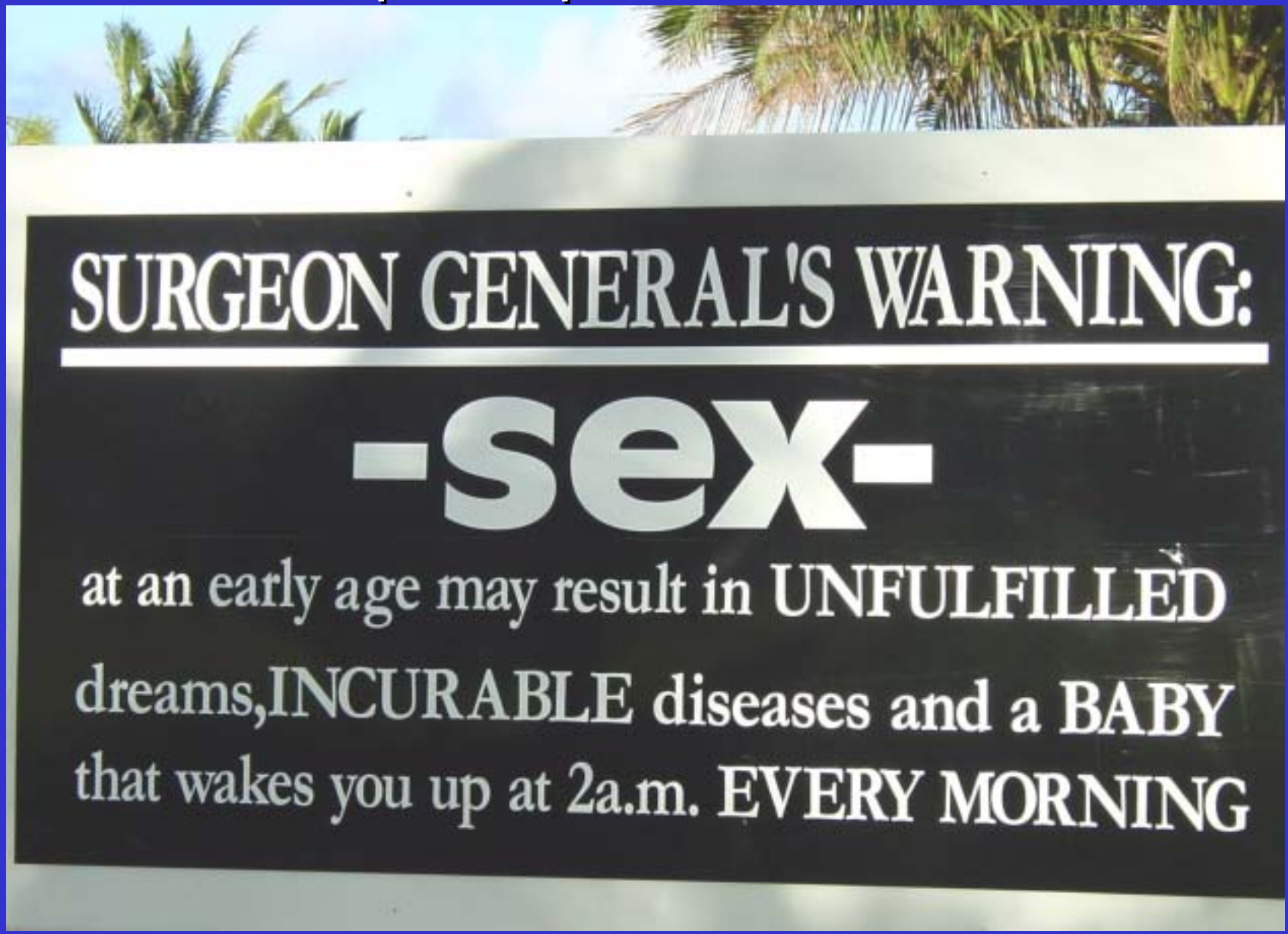


Saipan now

Sustainability of island ecosystems and economies

- Stresses on environmental sustainability
  - Population growth
  - Higher living standards
  - Climate instability and sea-level rise
- Promote economic growth and maintain environmental quality through resource planning
- Self-sufficiency linked to environmental health
- Basic knowledge lacking for many resources

Rapid Population Growth



Traditional Islands

Atoll Islands

Bikini Atoll

Kwajalein Atoll

Islands in transition

USGS Role

- USGS is a world leader in the natural sciences through scientific excellence and responsiveness to society's needs
- USGS serves the Nation by providing reliable and impartial scientific information to:
  - describe and understand the Earth
  - minimize loss of life and property from natural disasters
  - manage water, biological, energy, and mineral resources
  - enhance and protect our quality of life

USGS in the Pacific

- Region is lacking basic information that exists for most of United States
- Provide information to protect human health
- Information to manage natural and cultural resources, and plan economic growth
- USGS working in the region since WW II
- Four disciplines with a common goal

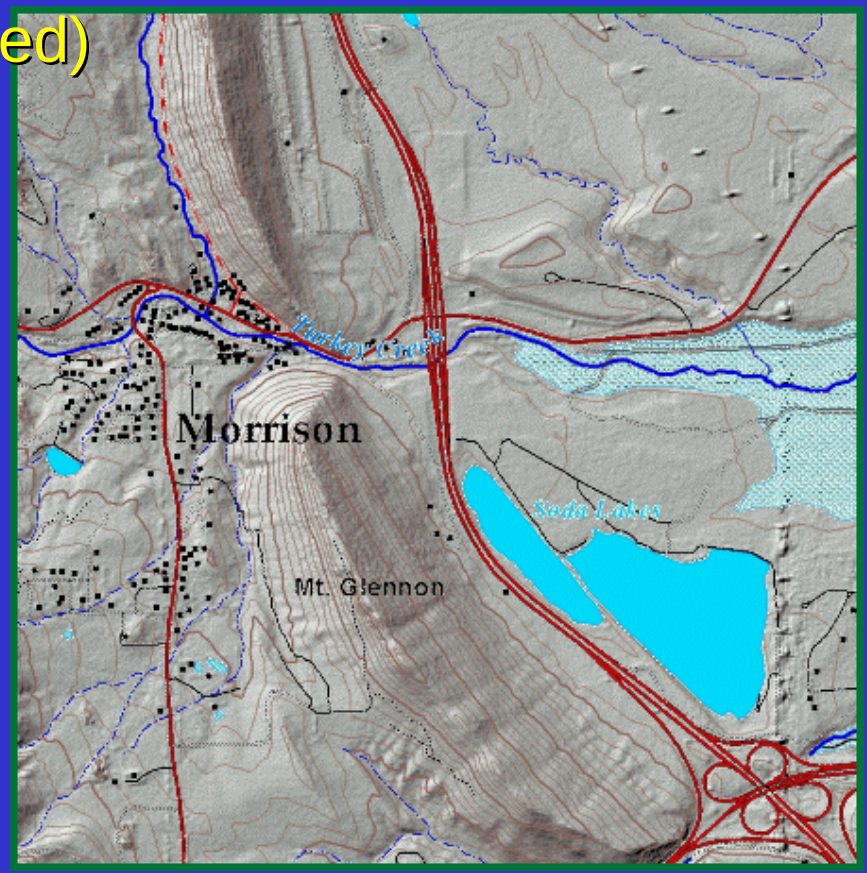
Geographic Projects and Products

New maps for Pacific Islands

- Revised maps include
  - –Traditional paper (“topo”) maps
  - –Digitized topographic maps
  - –Digitized elevation maps
  - –Geo-referenced aerial photographs
- Status of Pacific Islands
  - –Guam: maps completed
  - –CNMI: drafts by end of FY
  - –Am. Samoa: drafts in review
  - –Palau: partially completed
- Coral reef maps for CMNI & Am. Samoa (NOAA)

The National Map: Information for decisions

- Aerial imagery (referenced)
- Land characterization
- Elevation
- Vector layers:
  - Transportation
  - Hydrography
  - Structures
  - Boundaries
- Geographic names



Provide information for land use decisions

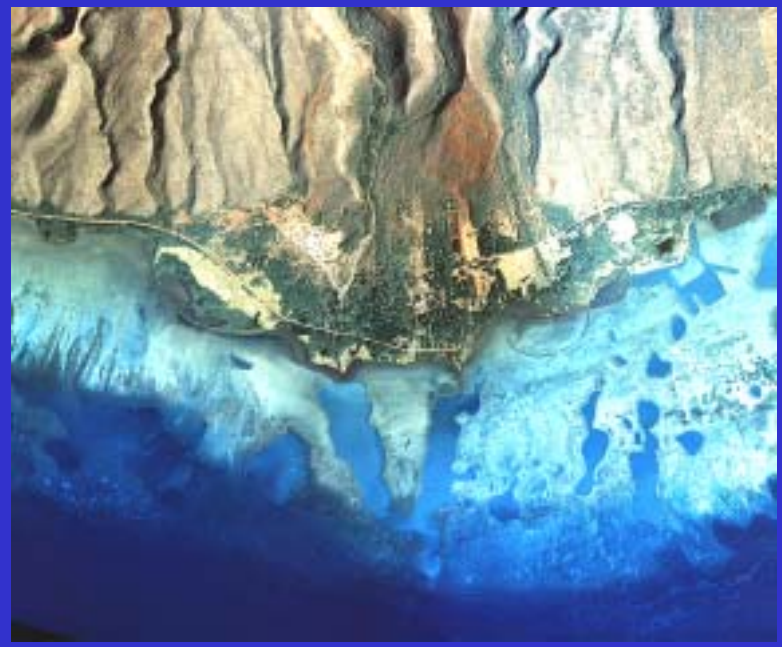
Oahu is first test-site, other islands will follow

Geologic Projects and Products

- Guam Seismic Observatory
- Volcanic hazards (CNMI, PI, PNG)
- Landslide response (Chuuk)
- Tsunami response in PNG
- Coastal hazard maps and planning studies

Coral reef study, Hawaii

- Mapping reefs in Hawaii
- Evaluation of reef health
- Sediment movement on reefs
- Planning work on other Islands



Biologic Projects and Products

- Inventories of native species
- Genetic analysis & conservation strategies for endangered species
- Alien species control (including BTS)
- Palmyra surveys for FWS
- Environmental assistance to DoD
- Coral reef work with NRCS & EPA

Avian Malaria in American Samoa

- Native birds in American Samoa have low levels of avian malaria
- Ongoing studies to determine extent of disease
- Is the disease new?
- What is the mosquito vector?

Brown Tree Snake

- Introduced to Guam in ~ 1950, causing great effect on birds and other animals
- Population and distribution studies on BTS and native birds
- Ecologic studies to develop snake control methods and reduce power outages
- Genetic analysis of threatened bird species
- Work in Guam, CMNI & FSM

Palmyra Atoll FWS Refuge

Coral reefs are in excellent condition, and offer a pristine control for studies of human impacts on reefs

Palmyra Atoll


Undisturbed *Pisonia* forest


Coconut crab

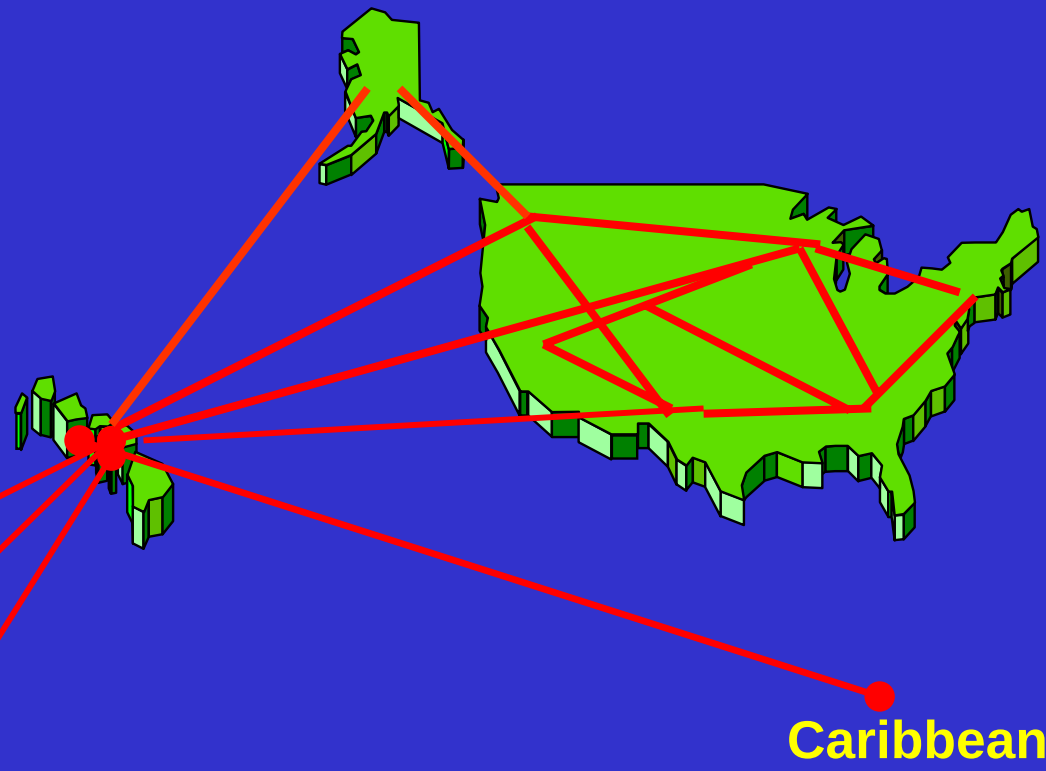

29 species of birds

- Palmyra has some of the last intact atoll island ecosystems
- Nutrients from the island fertilize the lagoon
- Importance of watershed-to-reef nutrient flow not known

USGS Support to DoD Missions in the Pacific

- Department of Defense must balance mission readiness with environmental stewardship and regulation
- Training Areas biologic work is ongoing or planned
  - Hawaii (Joint Forces)
  - Guam / Marianas (Joint Forces)
  - Diego Garcia (Indian Ocean, Navy)
- USGS monitors the status and facilitates ecosystem management on DoD sites
- USGS provides research for prevention, detection, and control of invasive species

Pacific Basin Information Node



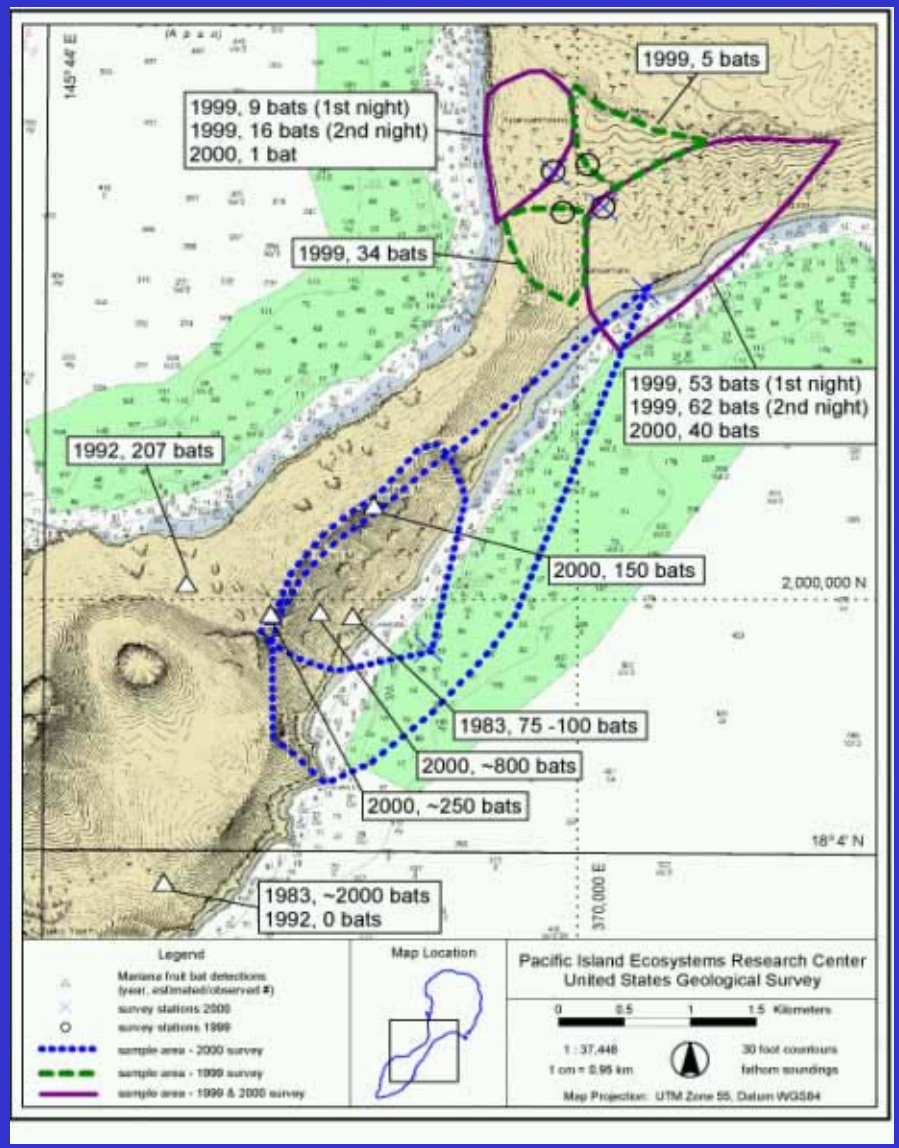
- Clearinghouse for biologic data
- Terrestrial and marine biodiversity information
- Global invasive species data

Pagan Is. Relocation
(USGS survey in 2001)

- 1981 eruption forced relocation
- Residents need safety network, viable infrastructure, and economic opportunities
- Interdisciplinary survey of hazards and natural resources to plan relocation

Example: Bat Surveys

- Bats are rare on most islands, relatively abundant on Pagan
- Federally protected
- Cultural food source
- Economic value (tourism)
- Biologic surveys and mapping to determine population trends
- Balance reoccupation with biologic protection



USGS Water Mission

- Information to manage, protect, and enhance water resources
- Address water-related hazards
- Non-regulatory role
- Provide information that is reliable, impartial, and timely to all parties

Where is the money spent?
(FY03 estimate)

• Guam:	$ 410,800	7.1 %
• Samoa:	$ 211,000	3.7 %
• CNMI:	$ 353,000	6.1 %
• Palau:	$ 84,000	1.5 %
• FSM:	$ 36,400	0.6 %
• RMI:	No program	

Based on total funding of $ 5.7 Mill.

~ 80% of funds to address Hawaii issues

Why should we be working there?

- Technical capability focuses on natural processes on Pacific Islands
  - Tropical watersheds small, steep, wet
  - Salinity controls ground water availability
- Location and logistic experience
  - Over 50 years of work in Pacific
  - Offices in Hawaii and Saipan reduce travel
- Most Pacific Islands do not have the basic information and studies that exist for most of US
- Experience with local culture
  - Ability to work with local officials
  - Sensitive to local traditions and history
  - Assist islanders in building local capacity

Current Water Resource Programs

- Investigations
  - Ground water availability
  - Rainfall/runoff modeling
  - Erosion and sediment transport
- Data Collection
  - Rainfall
  - Surface water
  - Ground water
  - Water quality
- Cooperators
  - Republic of Palau
  - WERI, University of Guam
  - U.S. Navy, Guam
  - Am. Samoa Power Auth.
  - Am. Samoa EPA
  - CNMI Utilities Corporation
  - US Army COE
  - FEMA

Why is this information needed?

- Existing water supply inadequate or unsafe
- Water shortages limit economic growth
- Need increased capacity for drought relief
- Changes in watersheds can affect coral reefs and nearshore fisheries
- Lack of storage capacity contributes to water problems (rain, surface, and ground water)

Data network

- Consistent & long-term data is necessary to:
  - Assess sustainability of water resources
  - Plan and design for flood control measures
  - Evaluate possible changes in climate
- Technology is improving operations
- Local agencies lack cooperative funding

	All Islands	Guam	Longest record
Rain	29	8	1973
Stream	28	11	1952
Wells	31	17	1954

Reservoir Management in Guam

- Water for Navy and Guam Water Authority in S. Guam
- Monthly status of reservoir stage and storage
- Use El Nino forecast to predict reservoir status
- Allows proactive rather than reactive management

Fena Reservoir, Guam

Climate Stations for Estimating Evapotranspiration, American Samoa

- Needed to estimate sustainability of groundwater resources
- Collaboration with Univ. of Hawaii
- Cooperation with Am. Samoa EPA & ASPA

Ground Water Availability, CNMI

- Acute water problems from rapid growth and outdated facilities and planning
- USGS Micronesian Field Office in Saipan operates with support from local govt (CUC)
- Ground-water exploration and modeling by USGS
- USGS provides advice to improve quality and quantity of municipal water

USGS improves water quality

- Isley Well Field (1970's)
  - Wells 15 – 45 ft below water table
  - Pumped 50 – 120 gallons/min.
  - Chloride 1100 ppm
- Obyan Well Field (1990's)
  - Wells 6 – 10 ft below water table
  - Pumped 35 – 50 gallons/min.
  - Chloride 400 ppm
- Advise on Kagman Well Field
- Exploration of water near Mt. Tagpochau


SAIPAN TRIBUNE

Dedicated to the Interests of the Marianas

POTABLE WATER: Gov. Ficlian C. Tenorio drinks water from a newly-installed well in Obyan, which benefits residents of Susupe, Obyan Kanoa, San Antonio and San Jose, during the formal inauguration of one of the 15 water wells on the island.

Potable water for Saipan residents

Ground Water Availability
Pingelap Atoll, FSM

Pingelap
Atoll, FSM
(1990's)

- Determine fresh water resources
- Local education
- Some wells available for drought relief

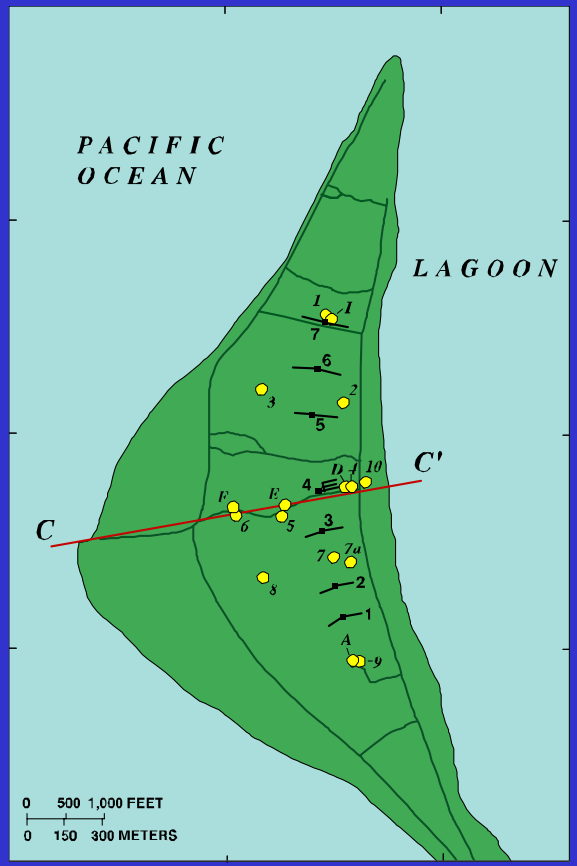
Ground Water Availability Kwajalein Atoll, U.S. Army

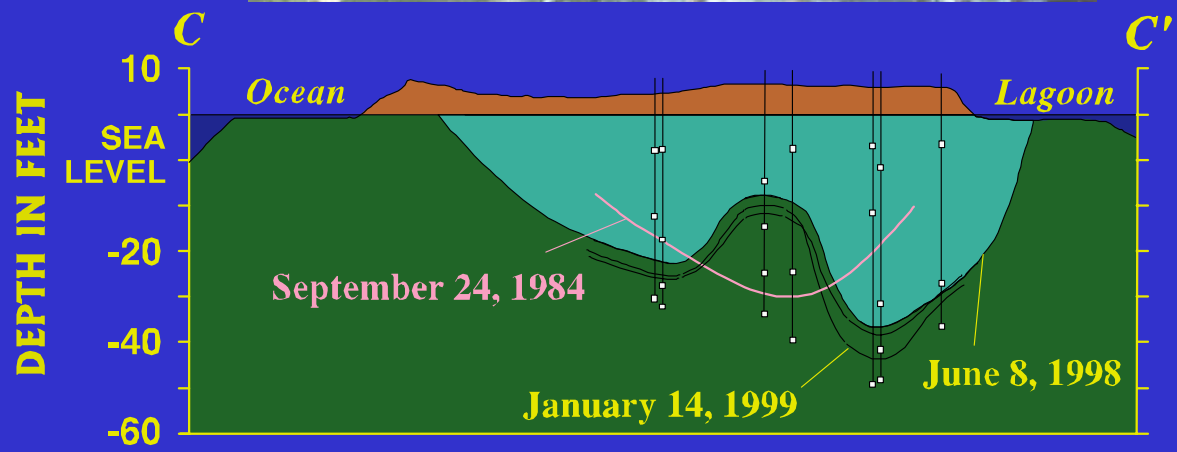
- Define ground water resource
- Baseline data and wells to observe future changes
- Flow paths for contaminants
- US Army cooperation (1991)

El Nino-related drought in the Pacific: Majuro Atoll, Marshall Islands - 1999

- Household rain catchments dry
- Municipal water served 12 hours every 2 weeks
- Average daily consumption was 2.5 gallons per person

Ground water resources during drought on Majuro Atoll





FEMA / USGS Disaster Assistance

“Make-Water” Solution

- Desal. units flown by charter transport
- Operated by contract workers for 3 months
- Produced 130,000 gal./day
- Cost $6 million

“Ground-Water” Solution

- Landowner concerns prevent use of existing wells
- Monitor wells installed by USGS help alleviate concerns
- Produced 200,000 gal./day
- Cost $250,000

Assisting Palau with resource management

Environmental monitoring for sustainable resources planning and increasing self-sufficiency

Erosion during Palau road construction

- Road contracted by DOI under Compact of Free Assoc.
- Rainfall (~150”) & geology cause engineering adventure
- Sediment mitigation methods are overwhelmed

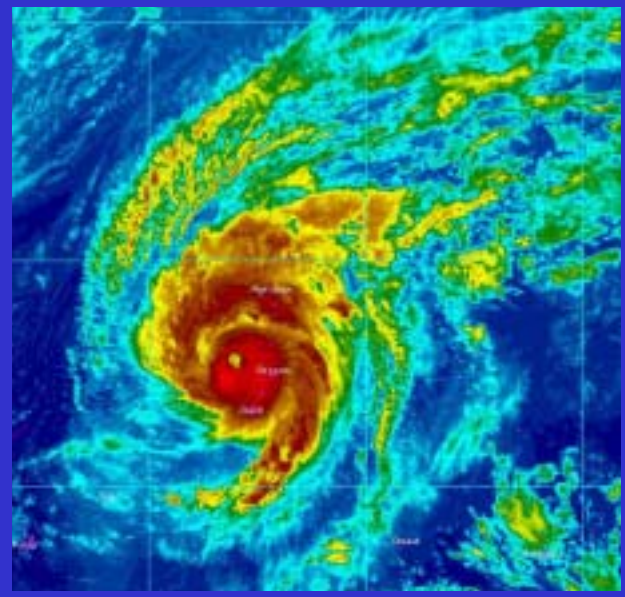
Compact Road impacts

- Changes water quality
- Potential coral reef & fisheries degradation
- Promotes development in watersheds
- Decisions on blending economic growth with environmental sustainability

Compact Road for Babeldo

- Contractor monitoring at 100+ sites weekly but this misses most run-off
- Existing USGS gages upgraded in 2002 to:
  - Measure effect of road on runoff & reefs
  - Establish baseline for the future
- USGS installs sediment monitoring network, Palau operates gages with USGS advice
- Many challenges, but effort is needed to produce national self-sufficiency

2002: Year of the Typhoon



- Chata'an (July 4)
  - 20+ inches of rain (15" in 3 hours)
  - Landslides kill 43 in Chuuk
  - Record streamflows in Guam
  - 100 + year recurrence interval
  - All 11 stream gages flooded, 5 completely gone
  - 6 gages "fixed"
- Pongsona (Dec 7)
  - 180+ mph winds (225 mph on Rota)
  - 20+ inches of rain in center of Guam
  - Office flooded and vehicle battered
  - 2 rain gages gone, 1 stream & 1 spring gage flooded
  - Power & water restored ~mid Jan, must boil water

Typhoons (1)

Typhoons (2)

Typhoon Chata'an Landslides in Chuuk

- 20+ inches of rain
- 43 killed, much damage
- FEMA⇨COE⇨USGS

Landslide on Tonoas (Dublon) Island

- 14 fatalities
- Much damage to buildings
- Few options for relocation
- Advise on hazards and stabilization

Damage to stream gage from typhoon

Imong Stream Gage
1961-2002 RIP

Flooding in S. Guam

Gage	Year Started	Flow	
		Previous	Chata'an
La Sa Fua	1954	1,400	2,100
Maulap	1972	2,400	5,300
Ugum	1977	5,900	14,700

Typhoon damage assessment: Chuuk Atolls

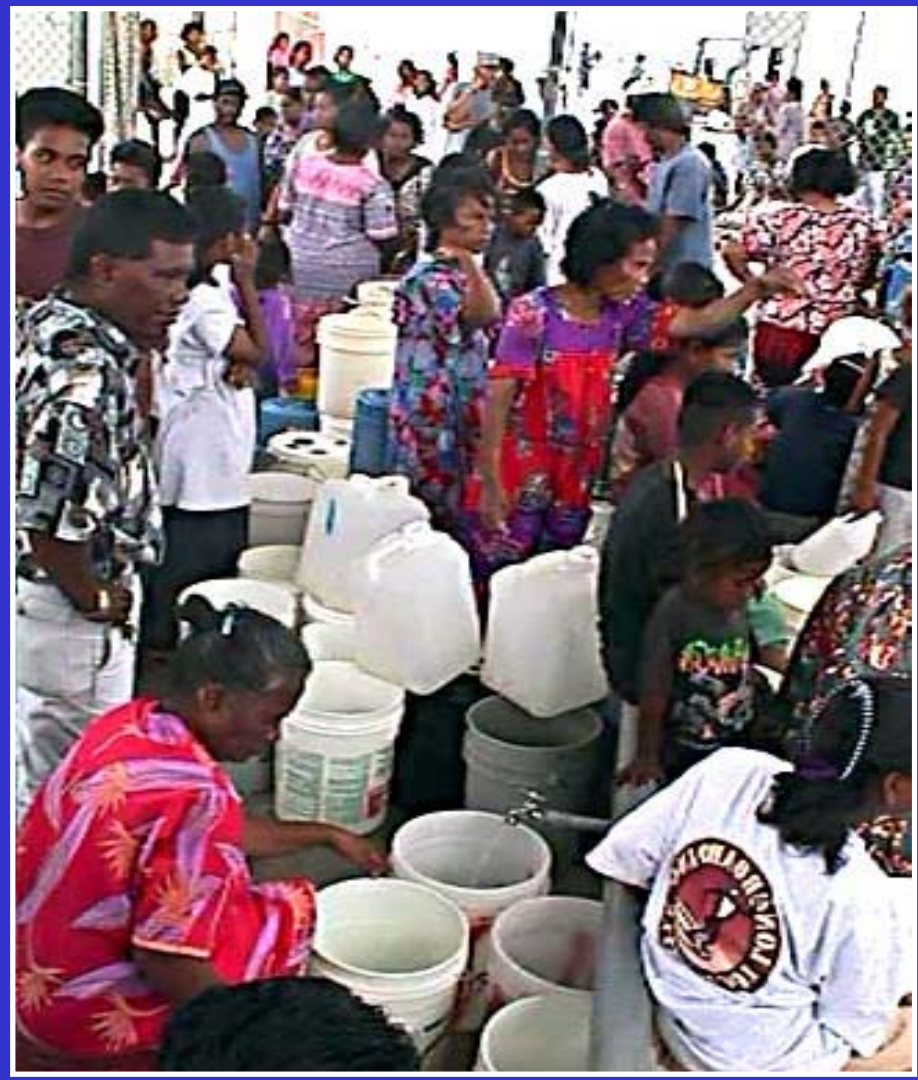
Typhoon damage assessment: Chuuk Atolls

Summary: Rain, wind, and drought

- El Nino (ongoing)
  - Predict ~60% of normal rainfall through summer
  - Many municipal systems need maintenance, plus damage by typhoons
  - Outer atolls rely on rain catchment, but need gutters to connect new roofs to storage tanks, more storage, and backup groundwater sources
- We are in a cycle of flood and drought
- The cycle is natural, but may be getting more extreme

Climate Variability

- Affects rain water supplies
- Affects ground-water development
- Effects streamflow and flood frequency
- Currently in a “moderate” El Nino event
- Working with FEMA, Navy



Long-term Climate Changes
[CO_2 doubles by 2050]

- Sea level rises about 1 foot
- Reef growth slows 30%
- Climate instability & variability (more & meaner El Ninos) will increase:
  - Floods & droughts
  - Wave inundation and saltwater overwash
  - Coastal erosion
- Costs to water resources = 0.5% GNP

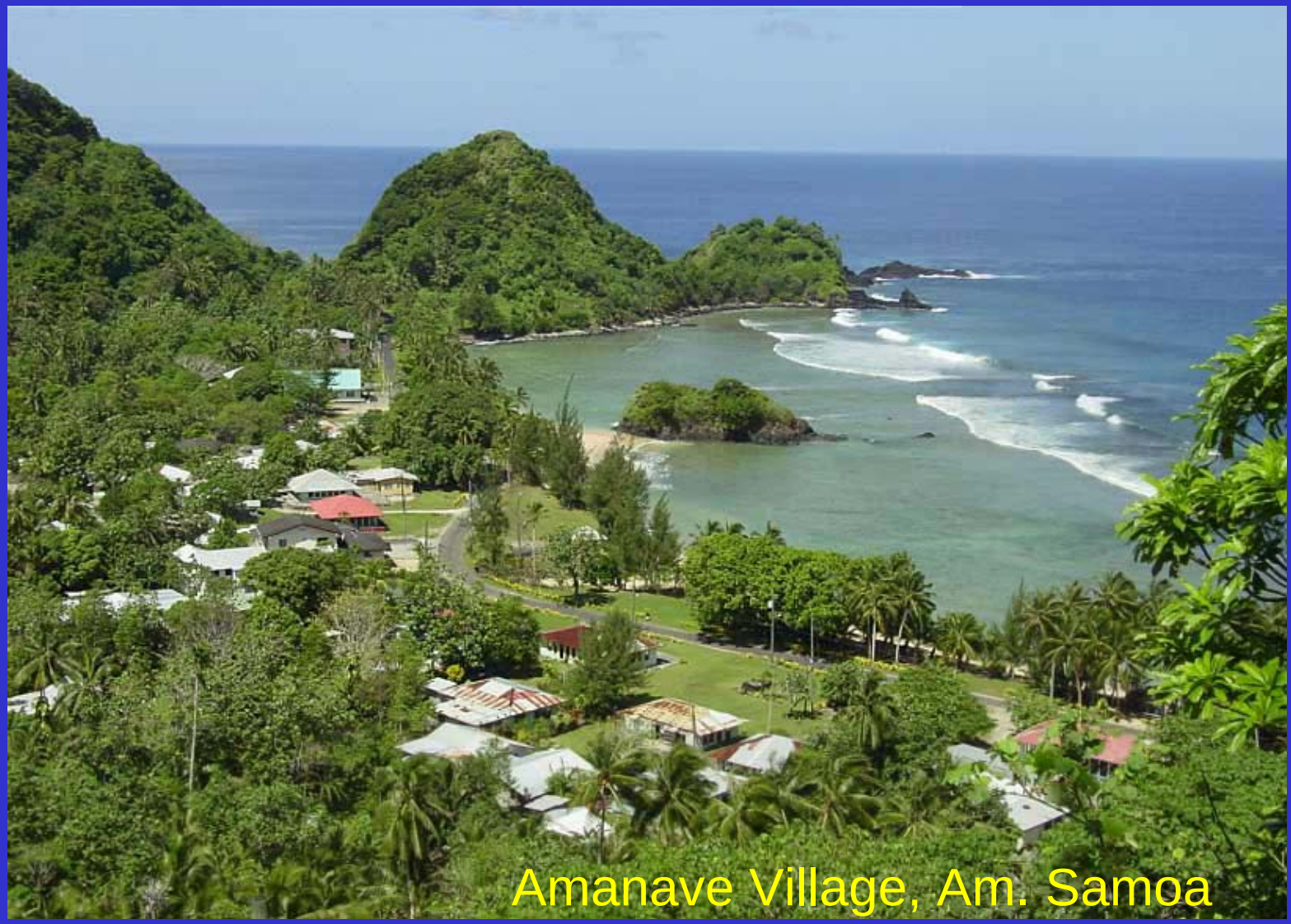
What are we doing now?
(Baby Steps to address climate variability)

- Better collection & distribution of data
- Statistical analysis of data (= trends)
- More sophisticated tools & better models
- Build climate variability & change into studies
  - Reservoir storage model uses El Nino forecasts
  - Groundwater models includes drought scenarios

Linked Problems in Watersheds

- Watershed degradation
- Alien species
- Erosion & loss of habitat
- Threatened and endangered species
- Ecosystem sustainability
- Coastal sedimentation
- Reef degradation
- Fisheries collapse

Balancing growth with sustainability



Tropical Watershed Program
Goals and Products

- Develop *GIS-based models of watershed response* to ecosystem changes
- Provide *Decision Support System tools* to managers to prioritize restoration efforts
- Measure the *effectiveness of watershed restoration* on marine communities
- Show how various *types of ecosystem disturbances* contribute to coastal loadings
- Promote *economic and biologic sustainability*

Uma