USGS role in the Pacific Islands

Making water resource information available for sound development and management decisions and for environmental & economic sustainability

June 24, 2004

Presentation Overview

- USGS role and programs
- Occurrence and movement of water resources—the hydrologic cycle
- Groundwater, streamflow, erosion, sediment transport
- Climate variability and natural hazards—floods and drought

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 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 stakeholders

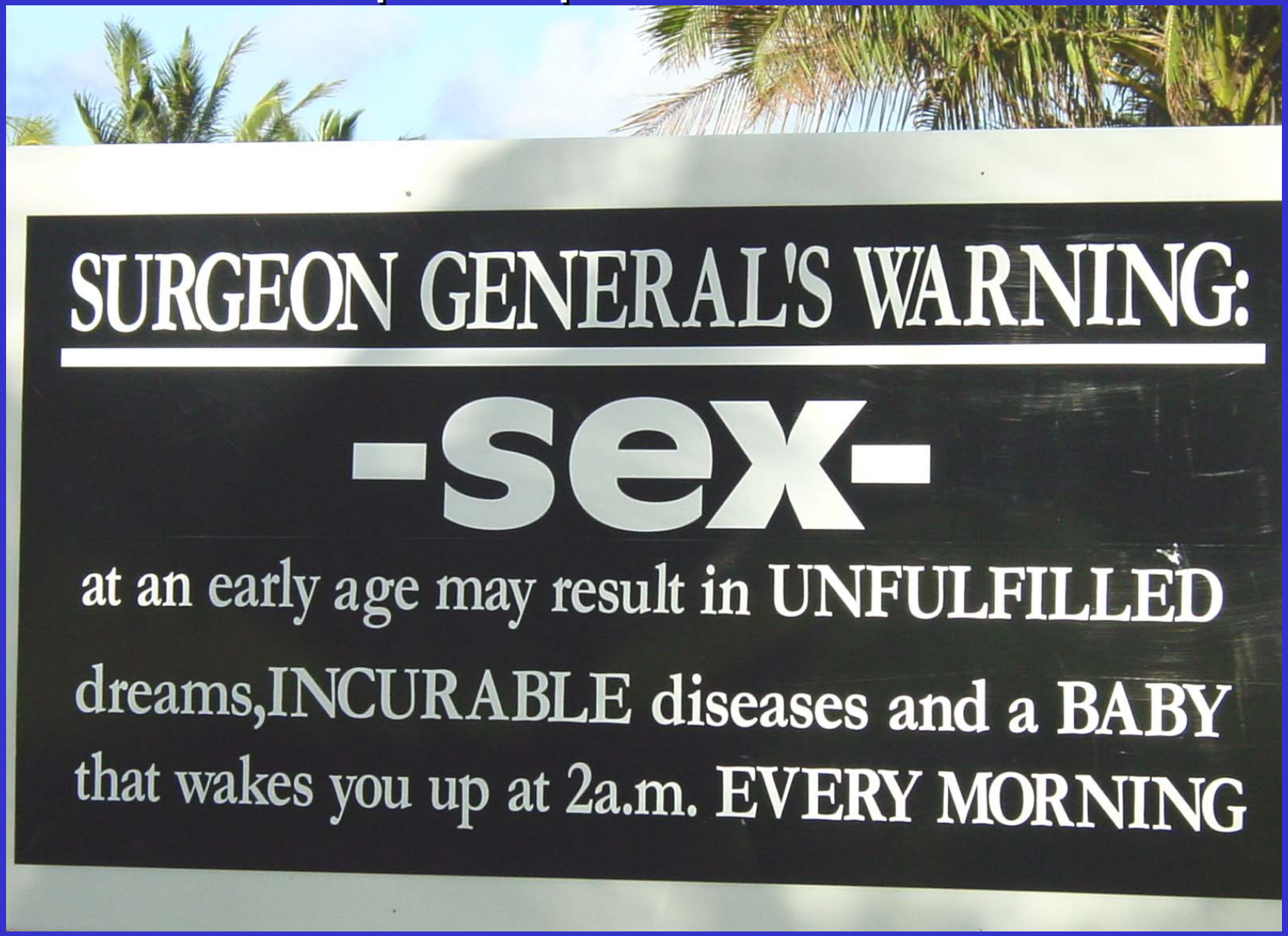
USGS in the Pacific

- 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

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



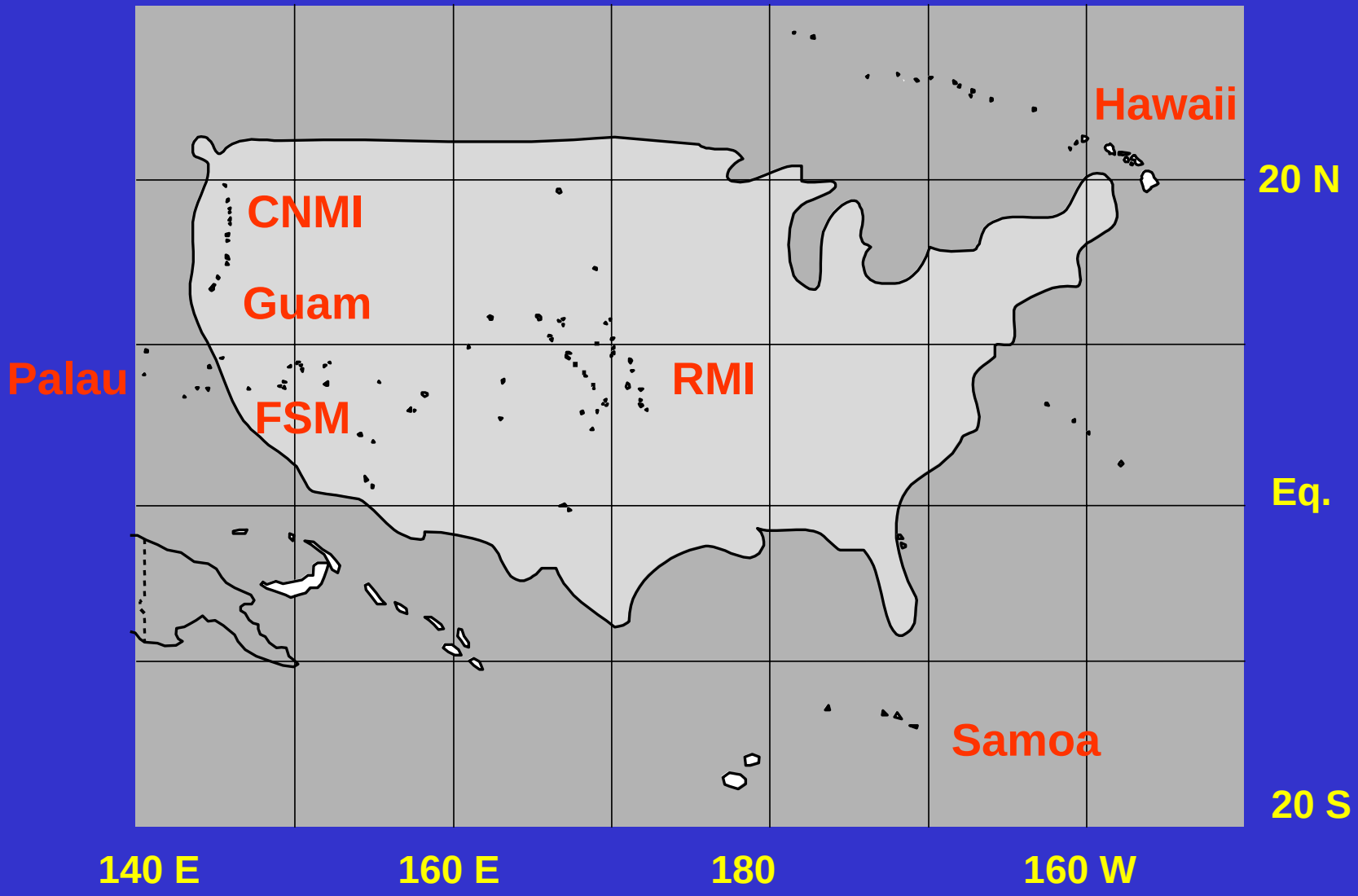
Current Water Resource Programs

- 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

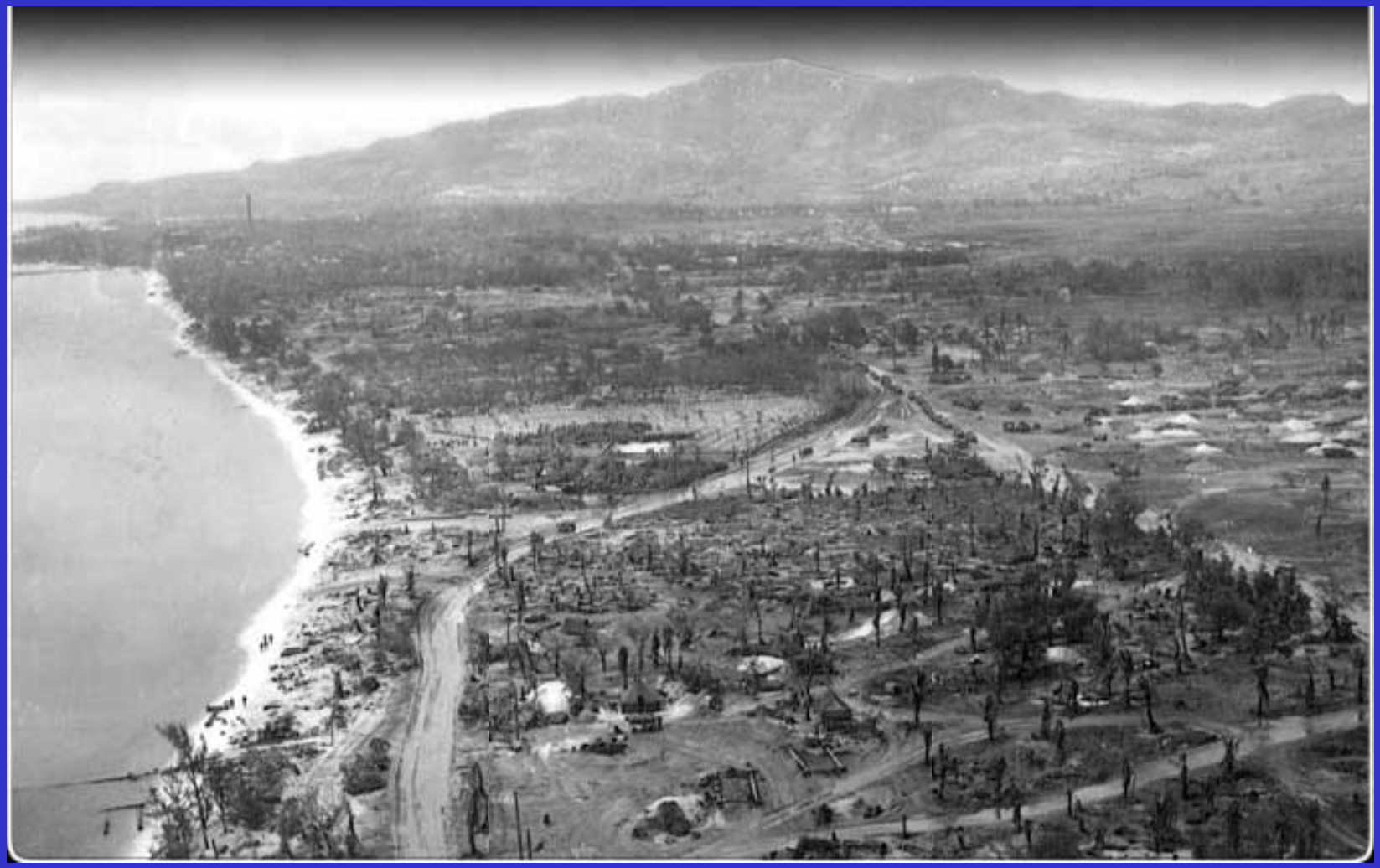
Why is this information needed?

- 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
- Fresh water supplies on small land areas are fragile and finite (rain, surface, and ground water)

Pacific in Perspective



Saipan in WW II



- This is when the geology was mapped!

Saipan now

Geologic Settings

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

Pohnpei

Data network

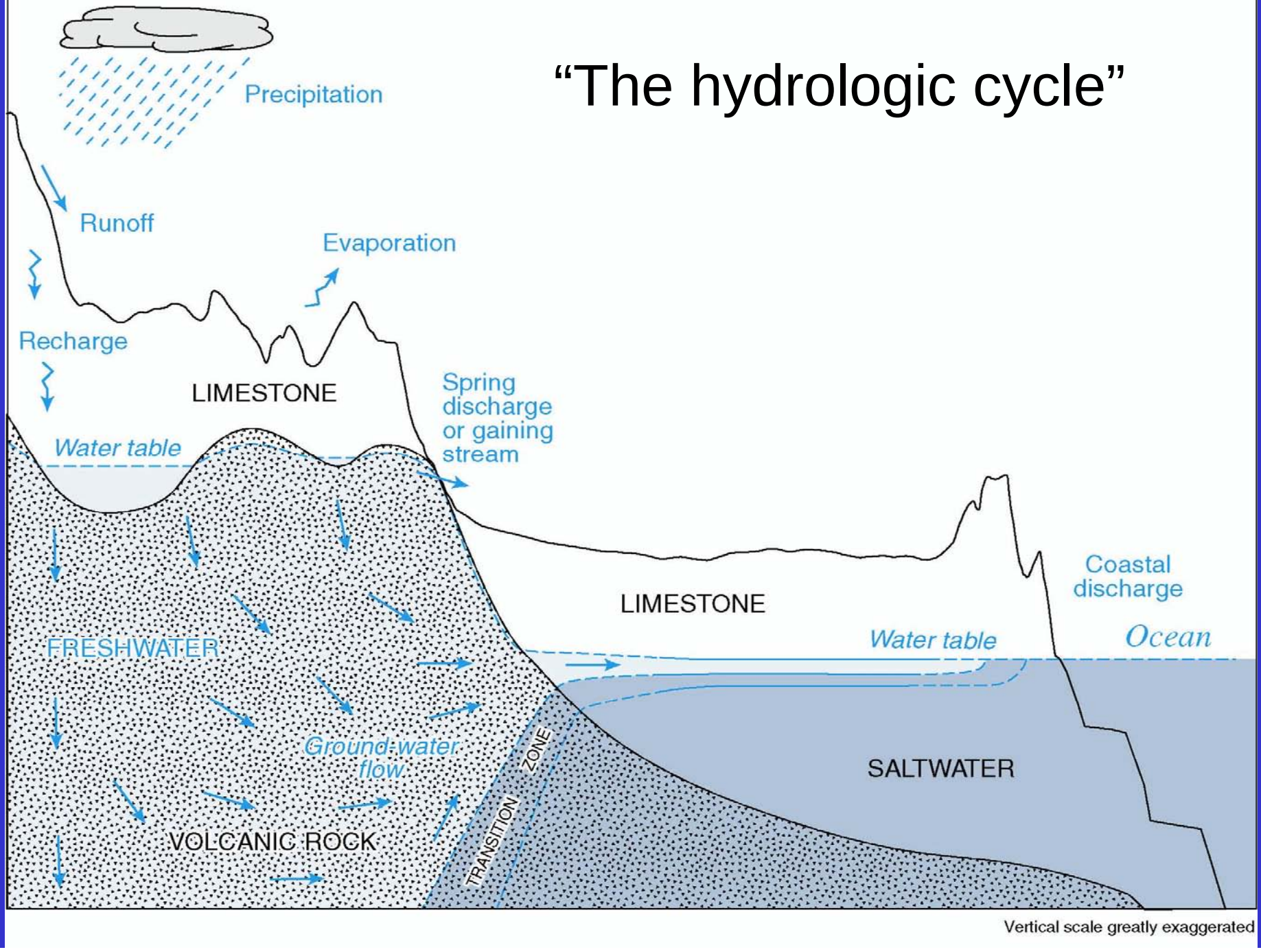
- Consistent & long-term data is necessary to:
  - Assess sustainability of water resources
  - Plan and design for flood control measures
  - Evaluate possible changes in climate
- Technology is improving operations
- Local agencies lack cooperative funding

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

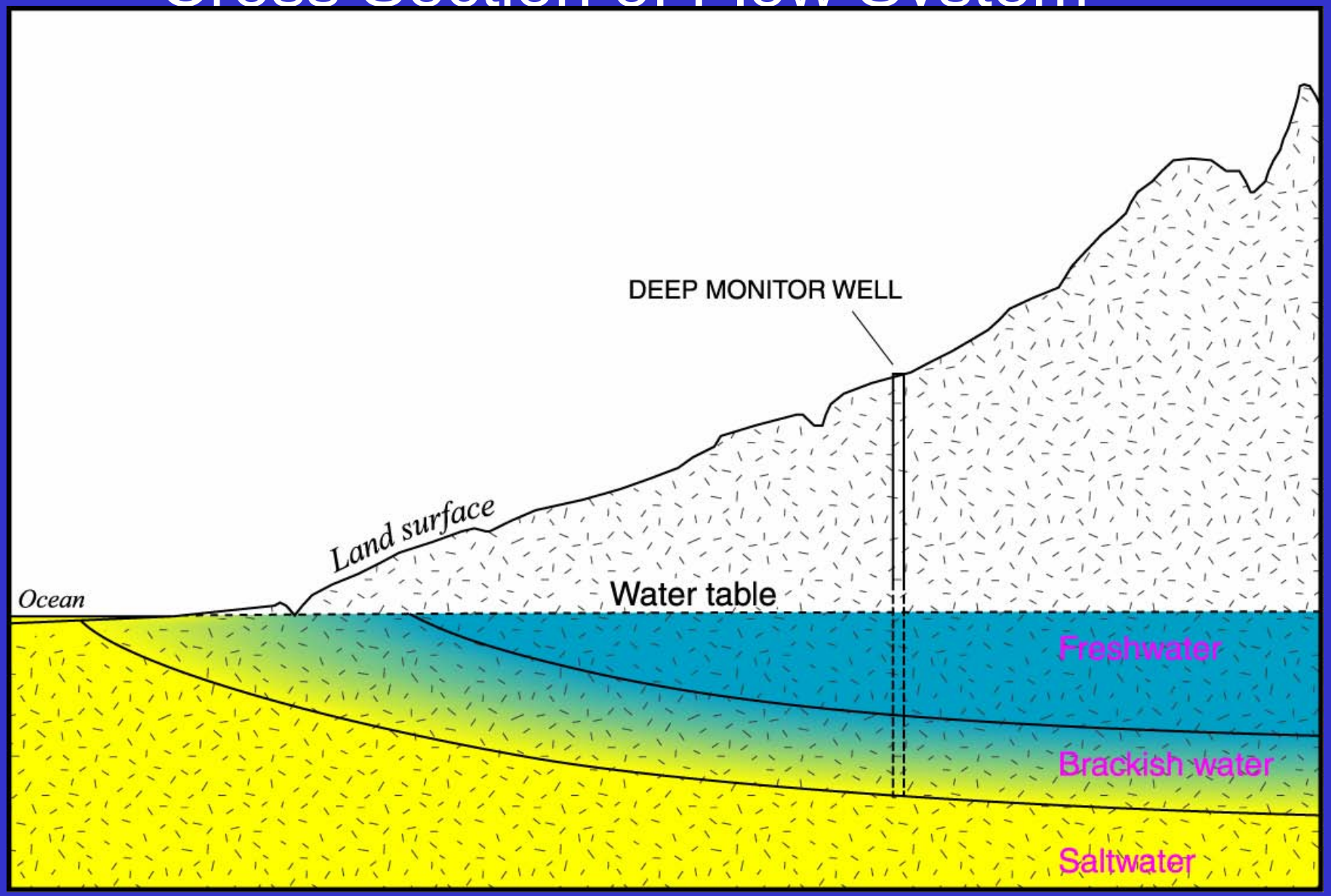
Climate Stations for Estimating Evapotranspiration, American Samoa

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

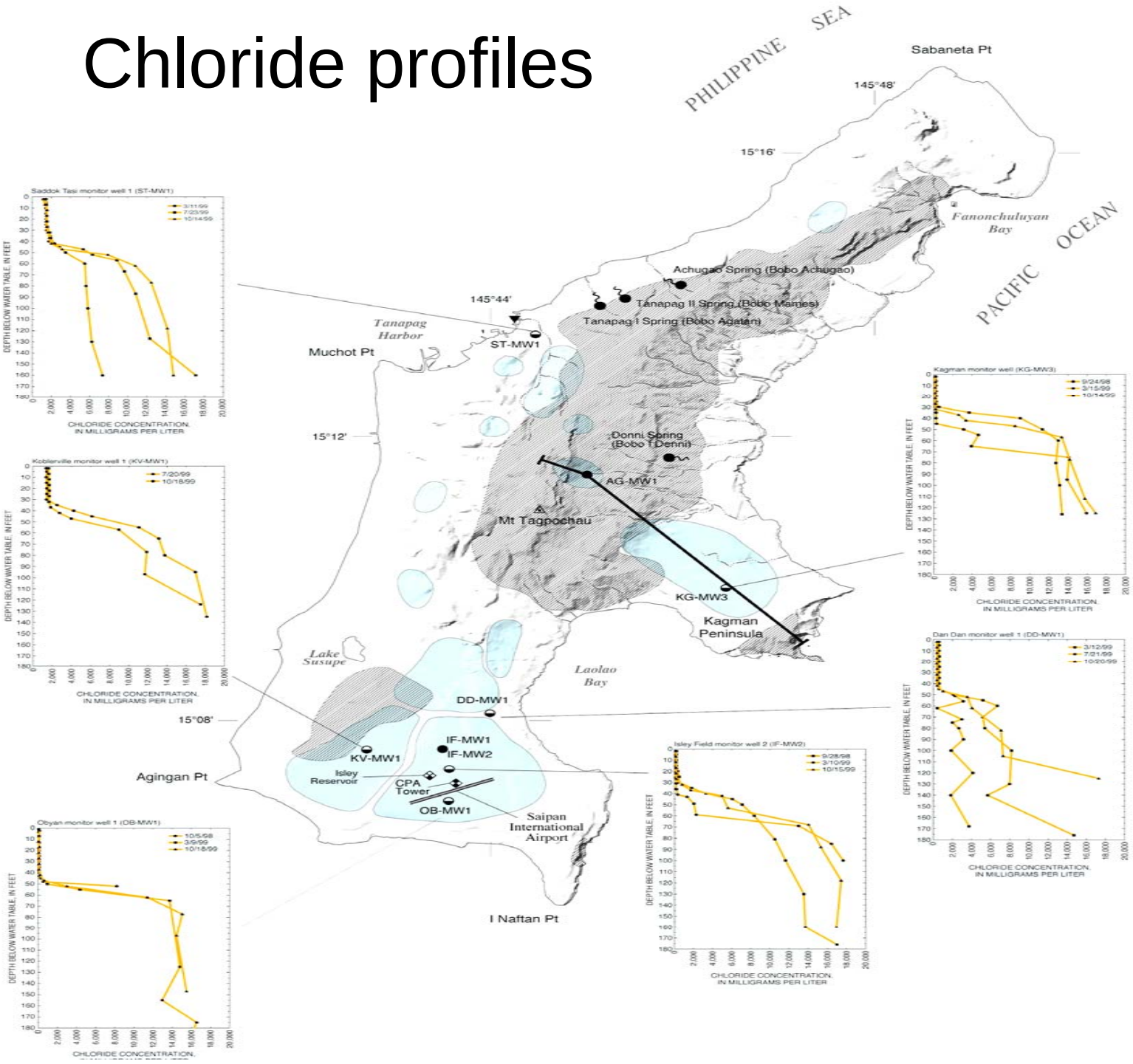
“The hydrologic cycle”



Cross Section of Flow System



Chloride profiles



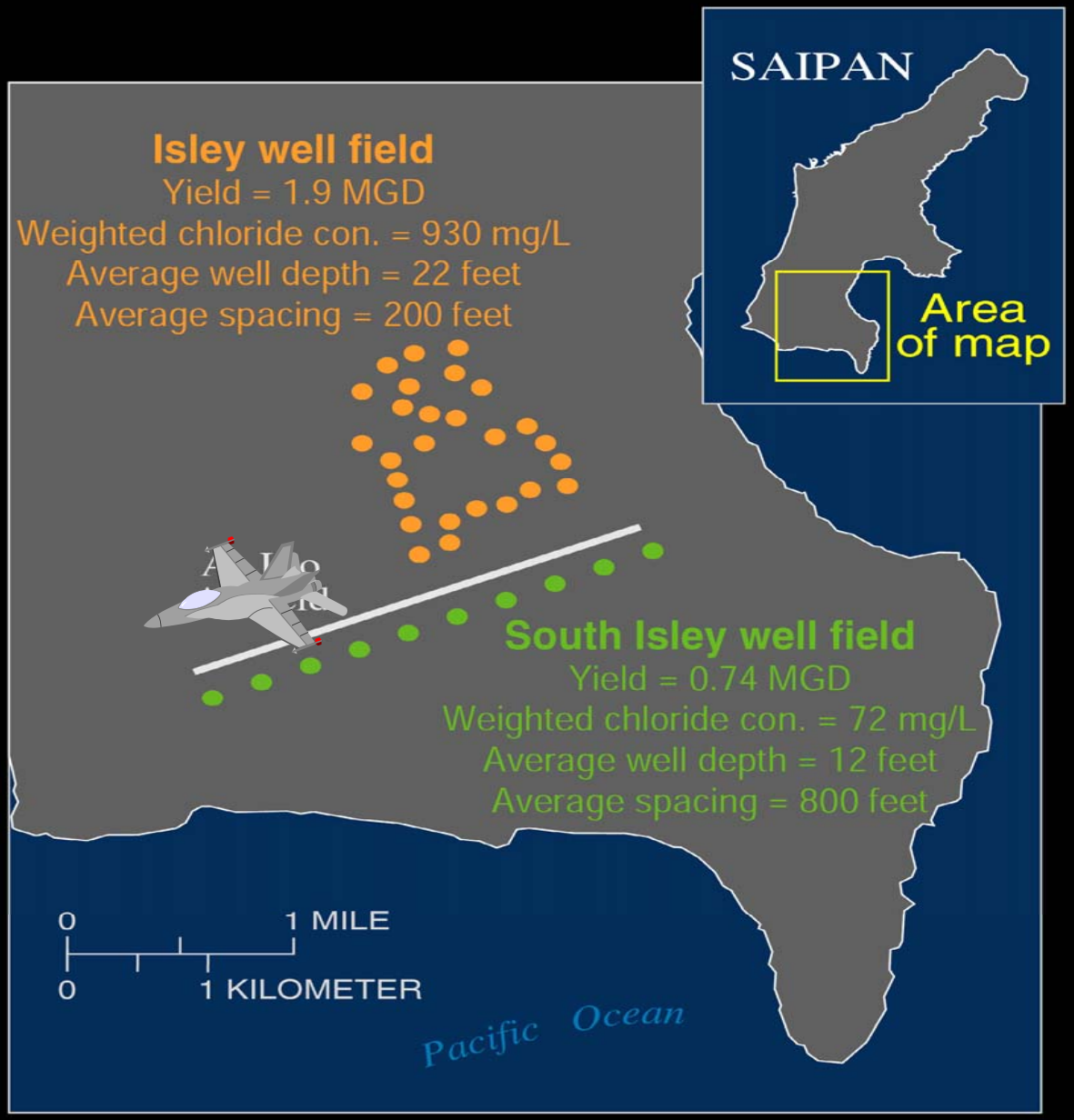
Ground Water Availability

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

Ways to find groundwater

- **Blind luck** (frequently results in salty wells)
- **Information from existing wells**
- **Geological & geophysical data**
- **Exploratory drilling**
- **Computer models**

ISLEY WELL FIELDS, SAIPAN



USGS helps to improve 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 75-300 ppm
- New Kagman Well Field
- Exploration in central uplands near Mt. Tagpochau


SAIPAN TRIBUNE

Dedicated to the interests of the Marianas

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

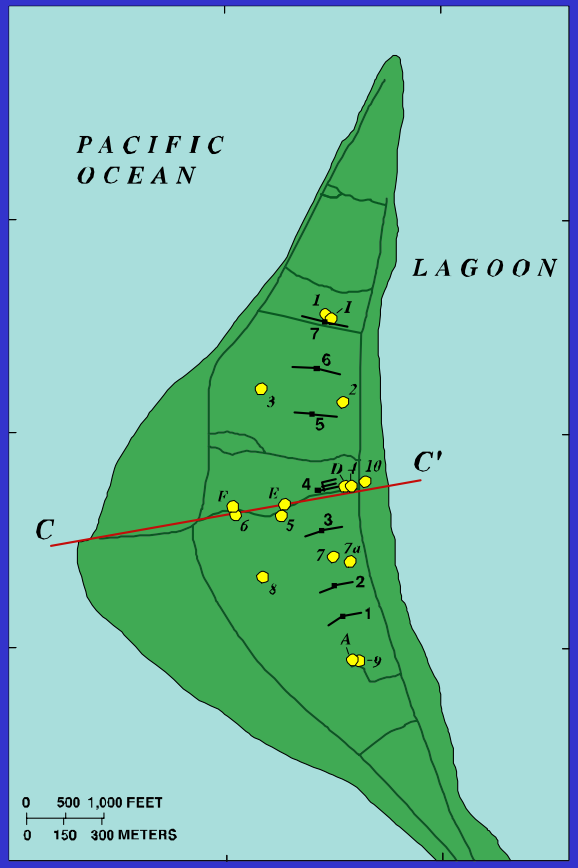
Potable water for Saipan residents

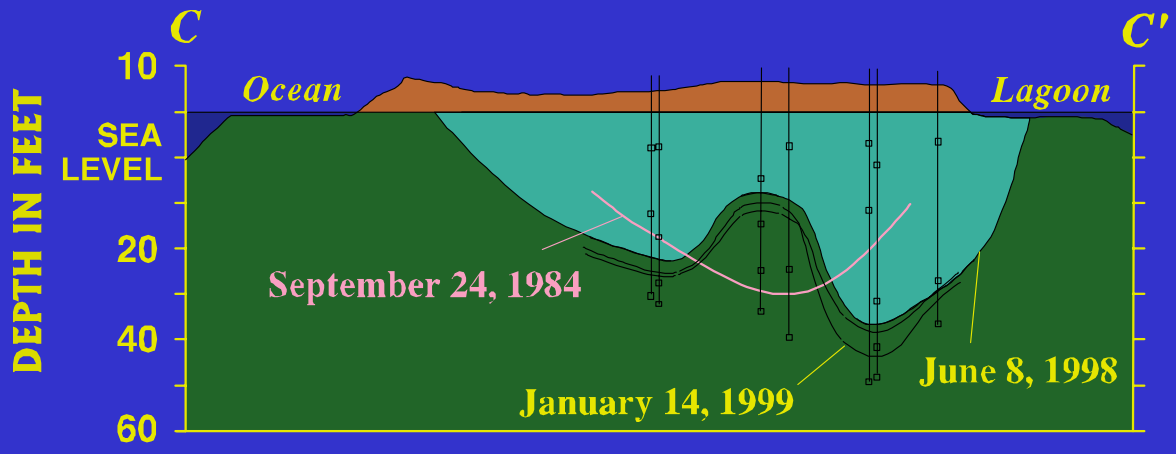
Ground Water Availability
Pingelap Atoll, FSM

Pingelap
Atoll, FSM
(1990's)

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

Ground water resources during drought on Majuro Atoll





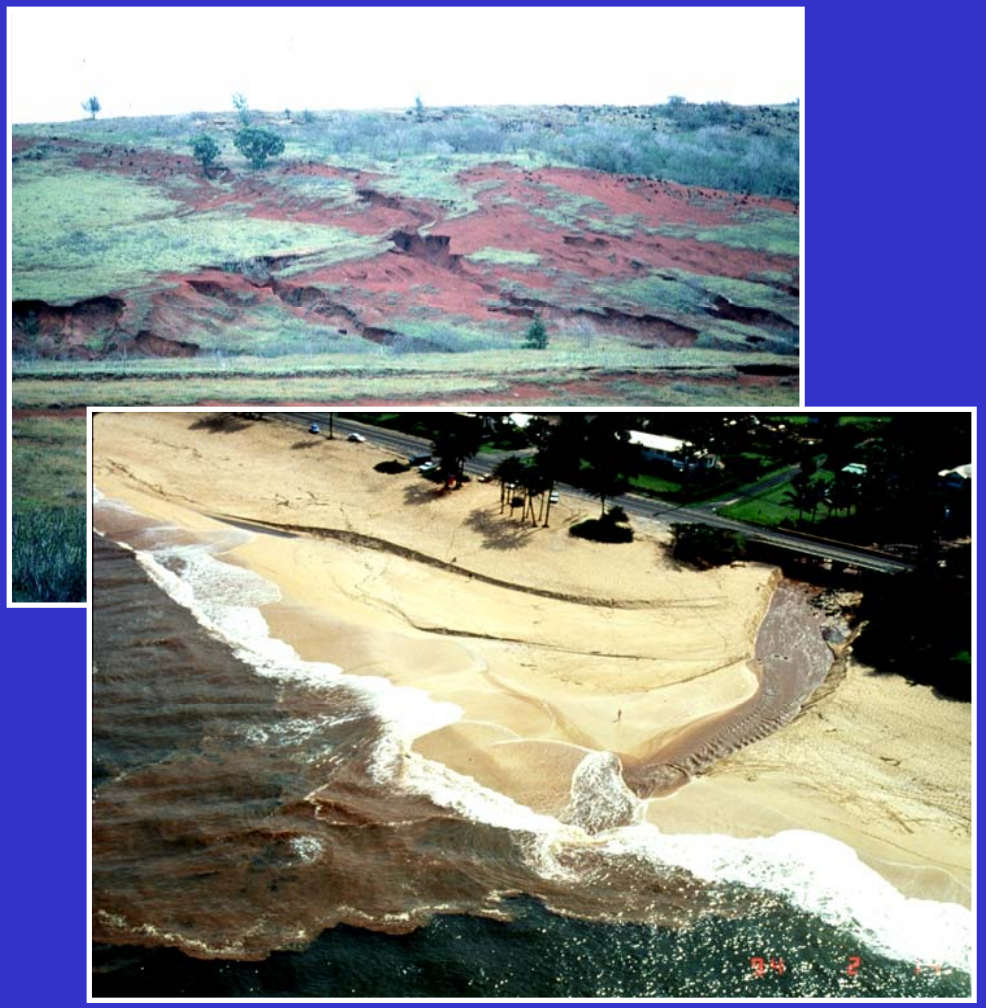
Using streamflow and rainfall data for reservoir management in Guam

- 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

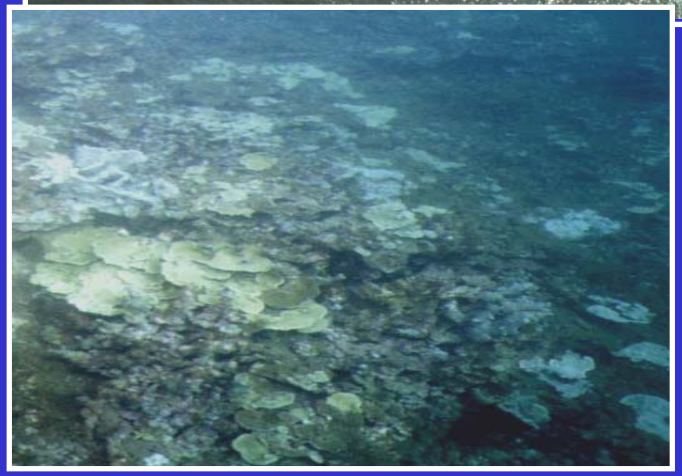
Erosion and Sediment Transport

- Streamflow and sediment monitoring for assessing best management practices
- Information for watershed managers and partnerships
- Effects on aquatic communities
- Effects on coastal resources



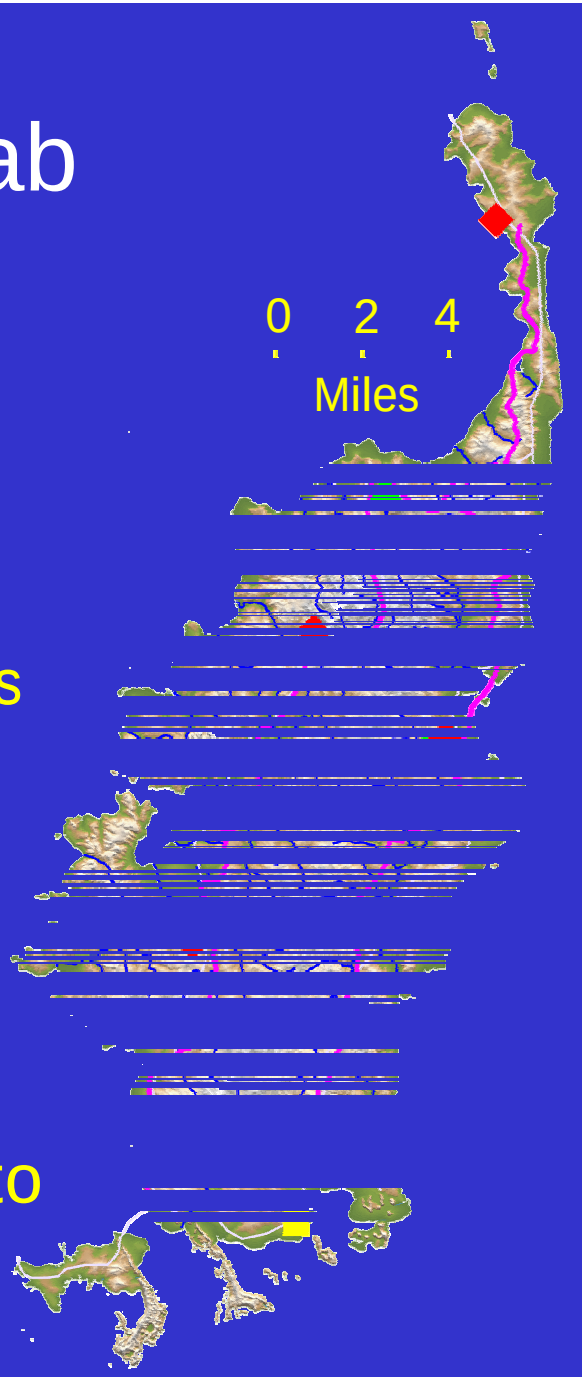
Linked Problems in Watersheds

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



Compact Road for Babeldoab

- 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

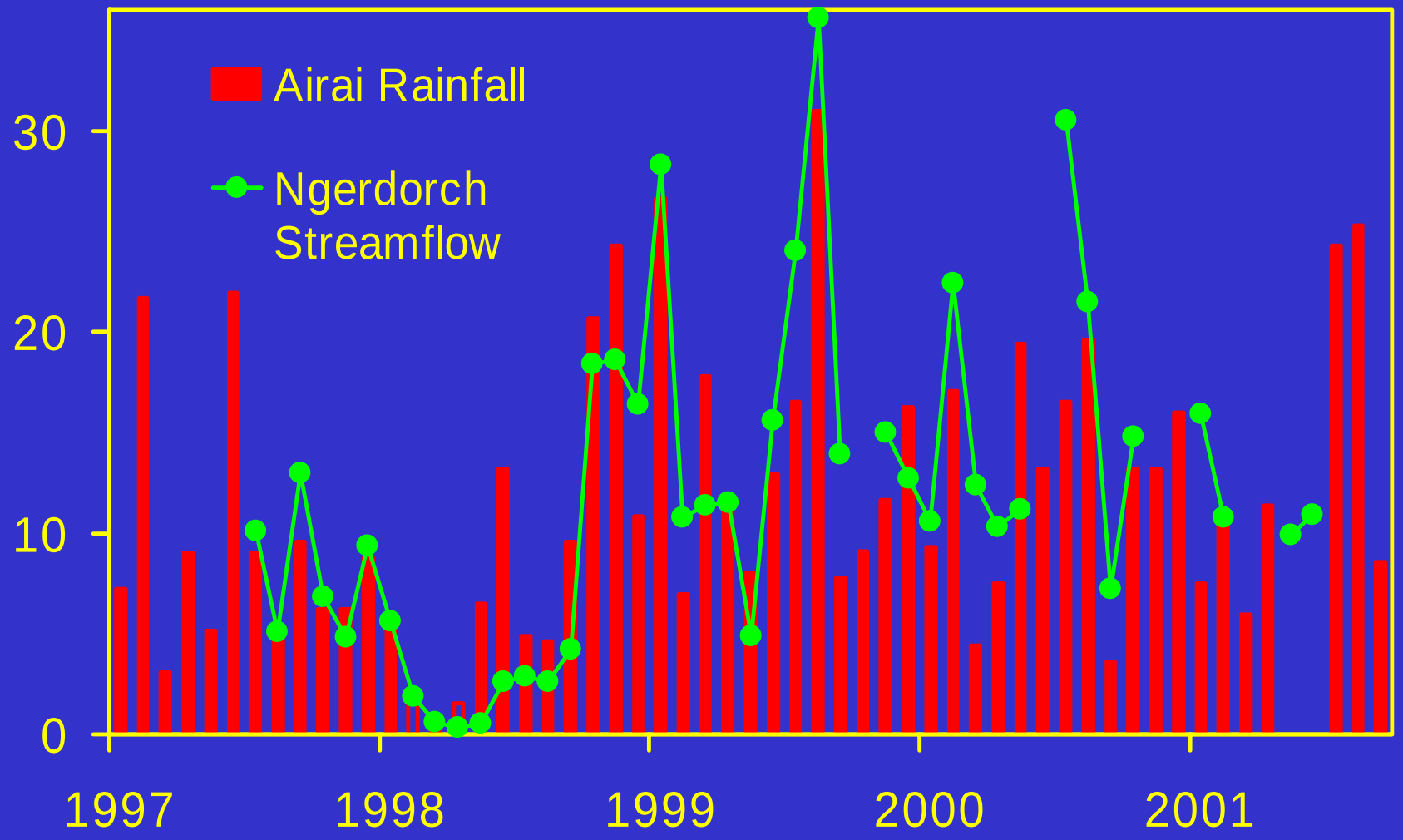


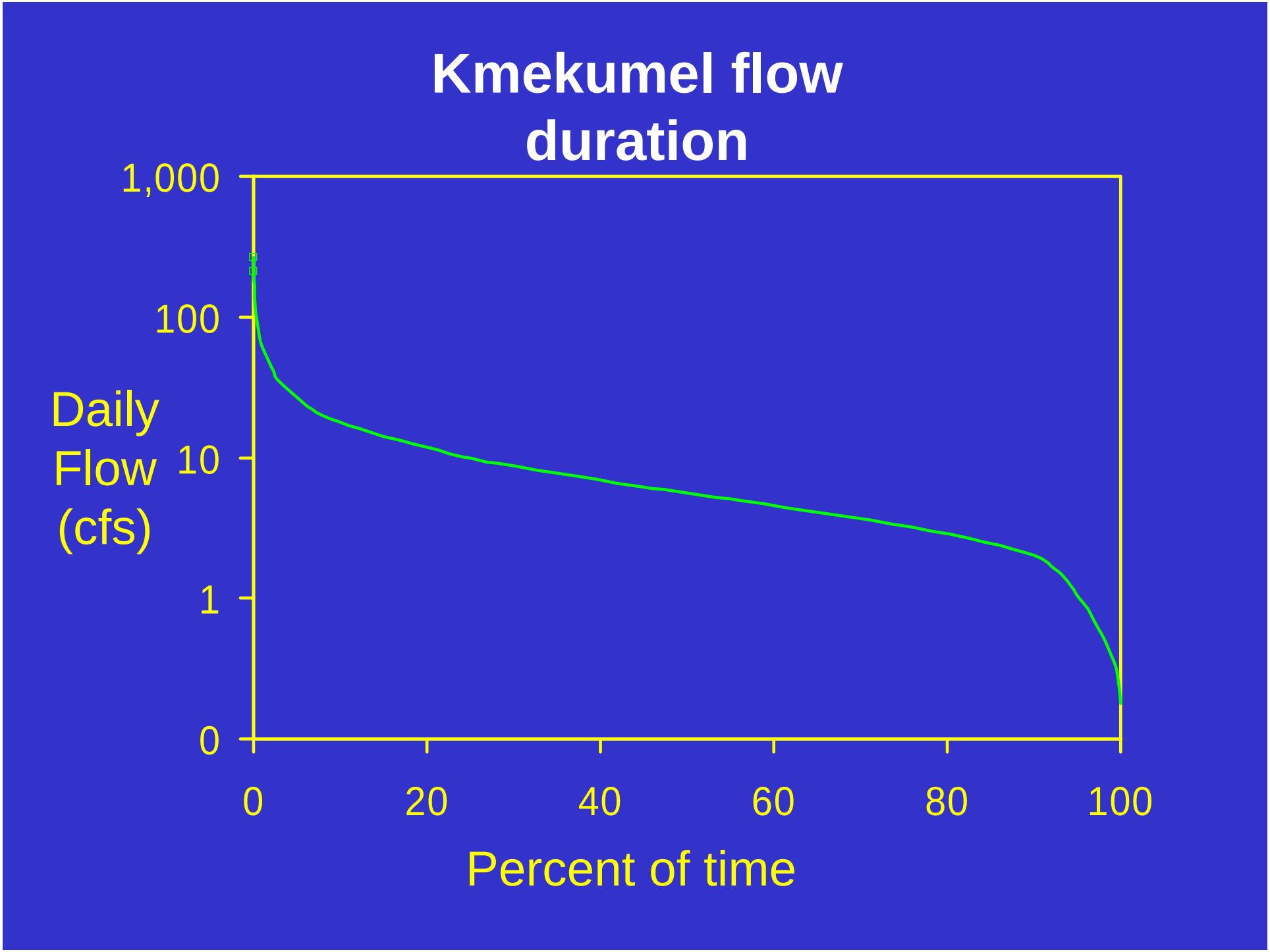
Erosion during Palau road construction

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

New sediment and stream gages

Rainfall and streamflow



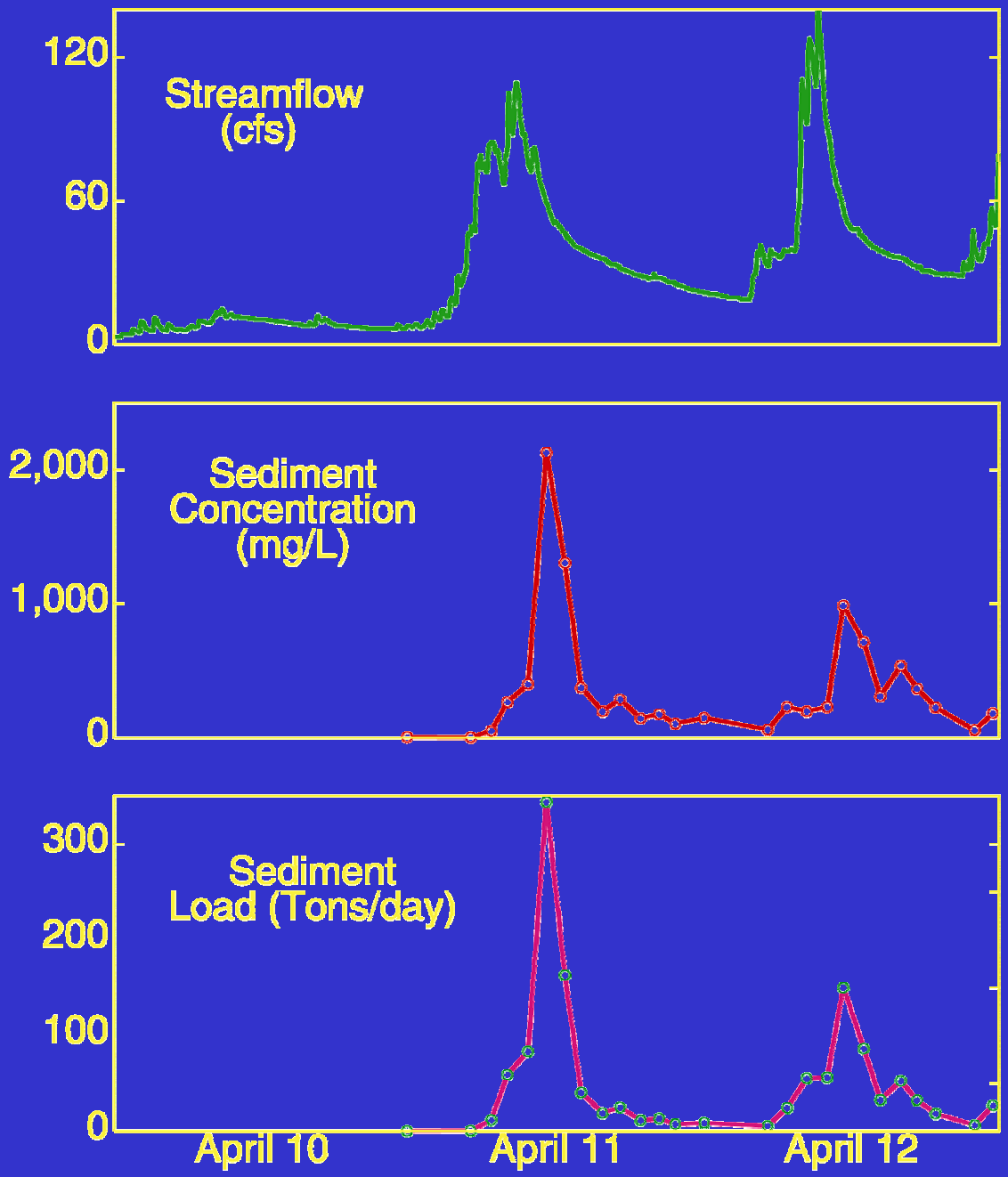

Kmekumel flow duration
1,000
100
10
1
0
Daily Flow (cfs)
0
20
40
60
80
100
Percent of time

Compact Road impacts

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

Sediment loads

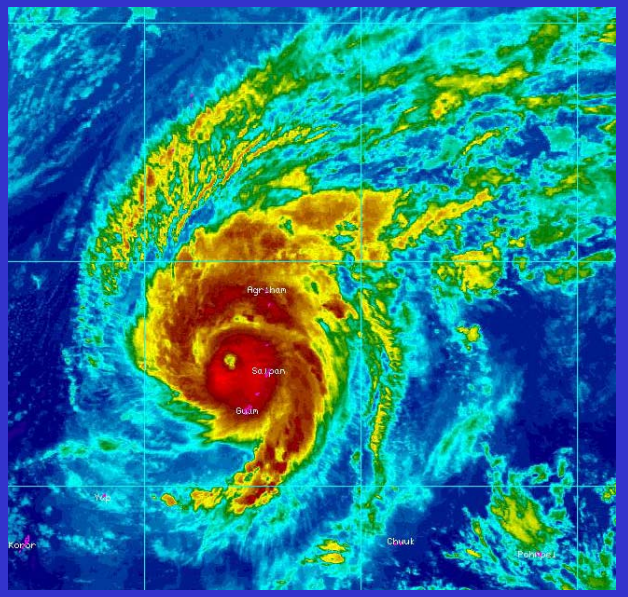
- **Need continuous record of flow and lots of sediment samples**
- **Loading is very episodic**
- **Almost impossible without automatic samplers**
- **The work is time-consuming, and expensive**



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

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)

Damage to stream gage from typhoon

Imong Stream Gage
1961-2002 RIP
(rebuilt in 2003)

Flooding in S. Guam

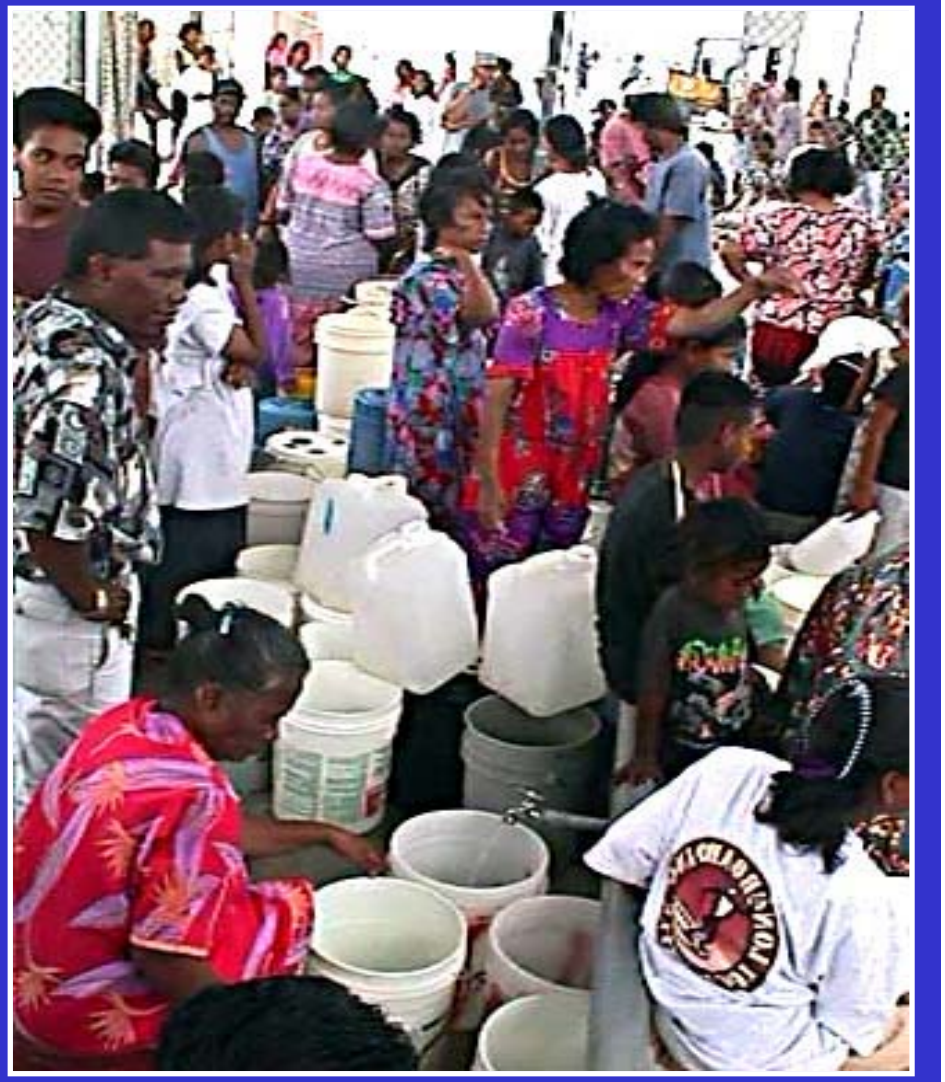
Gage	Year Started	Flow	
		Previous	Chata'an
La Sa Fua	1954	1,400	2,100
Maulap	1972	2,400	5,300
Ugum	1977	5,900	14,700

Typhoon damage assessment: Chuuk Atolls

Typhoon damage assessment: Chuuk Atolls

Climate Variability

- Affects rain water supplies
- Affects ground-water quality
- Effects streamflow and flood frequency
- Working with FEMA, Navy



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

Si yu’us masi—Adios, Talofa, Mechikung