

# Island style water accounting: Methodological suggestions from the case of Hawai'i

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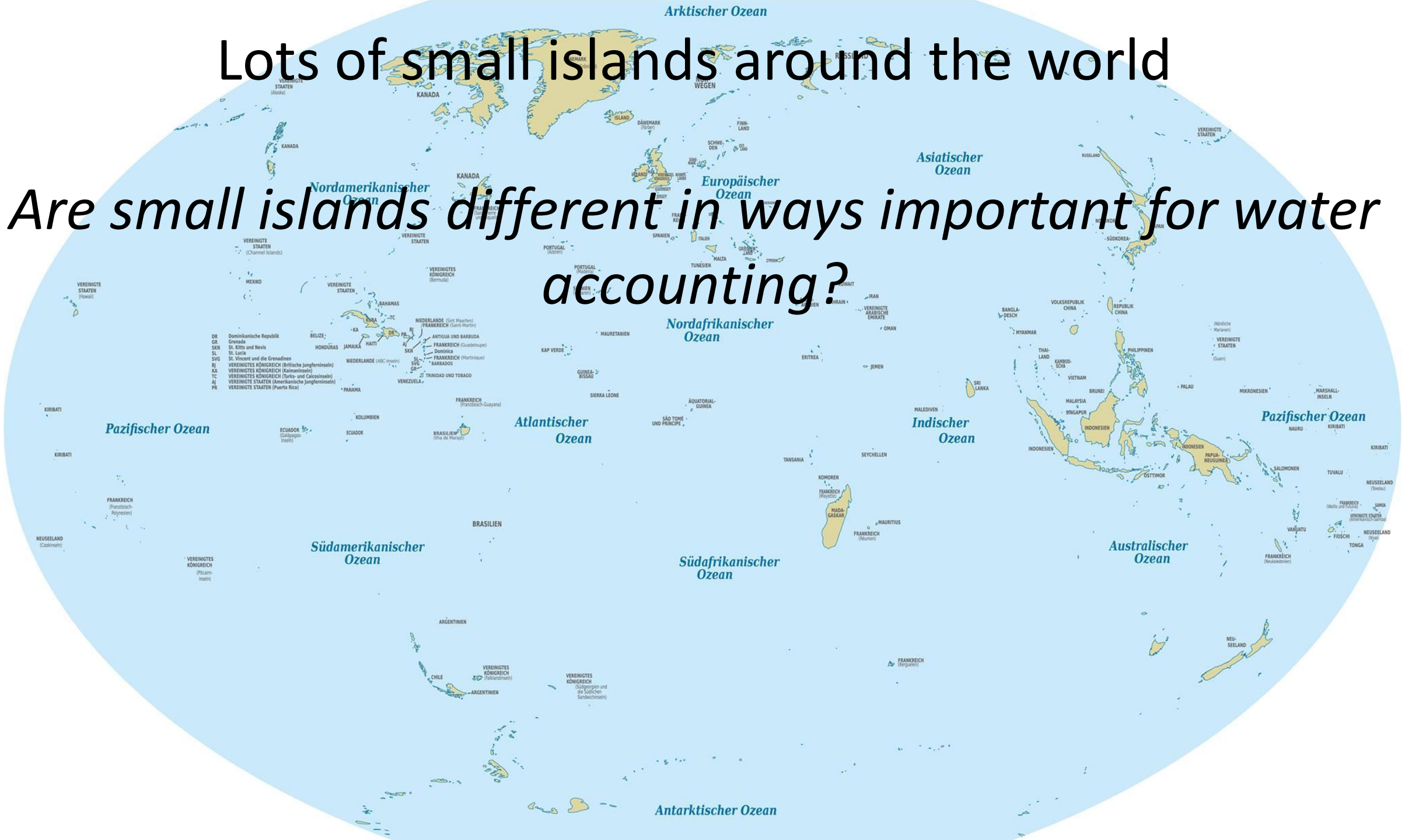
Anne-Charlotte Olivier, Emelia Von Saltza, Marine Barizien,

Whitney Goodell, Karyssa Lee



Lots of small islands around the world

*Are small islands different in ways important for water accounting?*





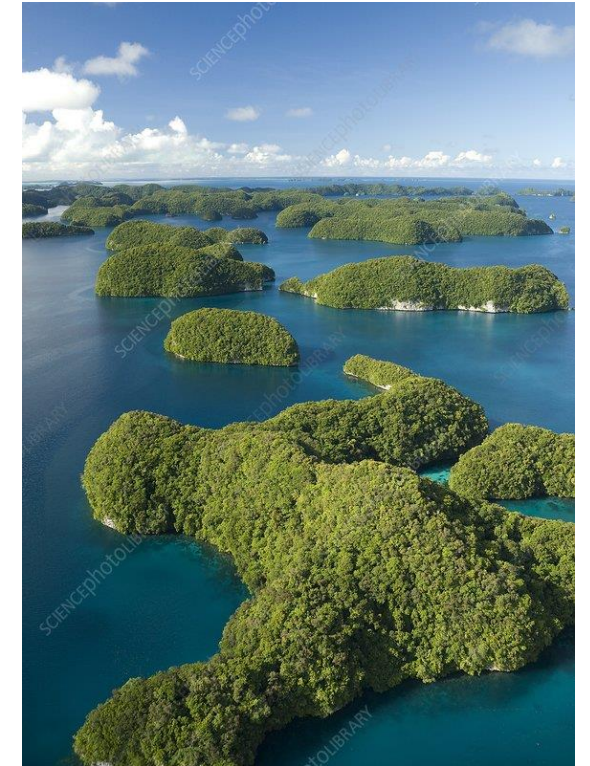
# Geomorphic characteristics of small islands affect water resources

**Lithology** — **volcanic** (igneous), limestone (calcareous and non-volcanic sedimentary), **composite** (less than 80 % volcanic and less than 80 % limestone), **reef** (unconsolidated sediment), and **continental** (non-oceanic)

**Area** — Total area

**Circularity** — Roundness

**Elevation** — >30m high &  
<30m low



### Classification of small island types

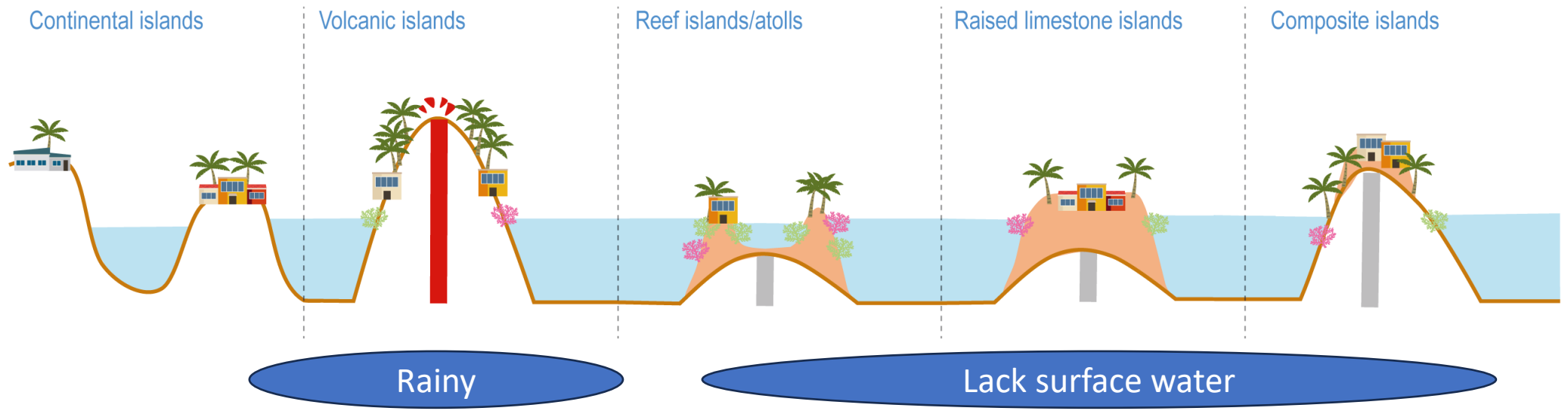
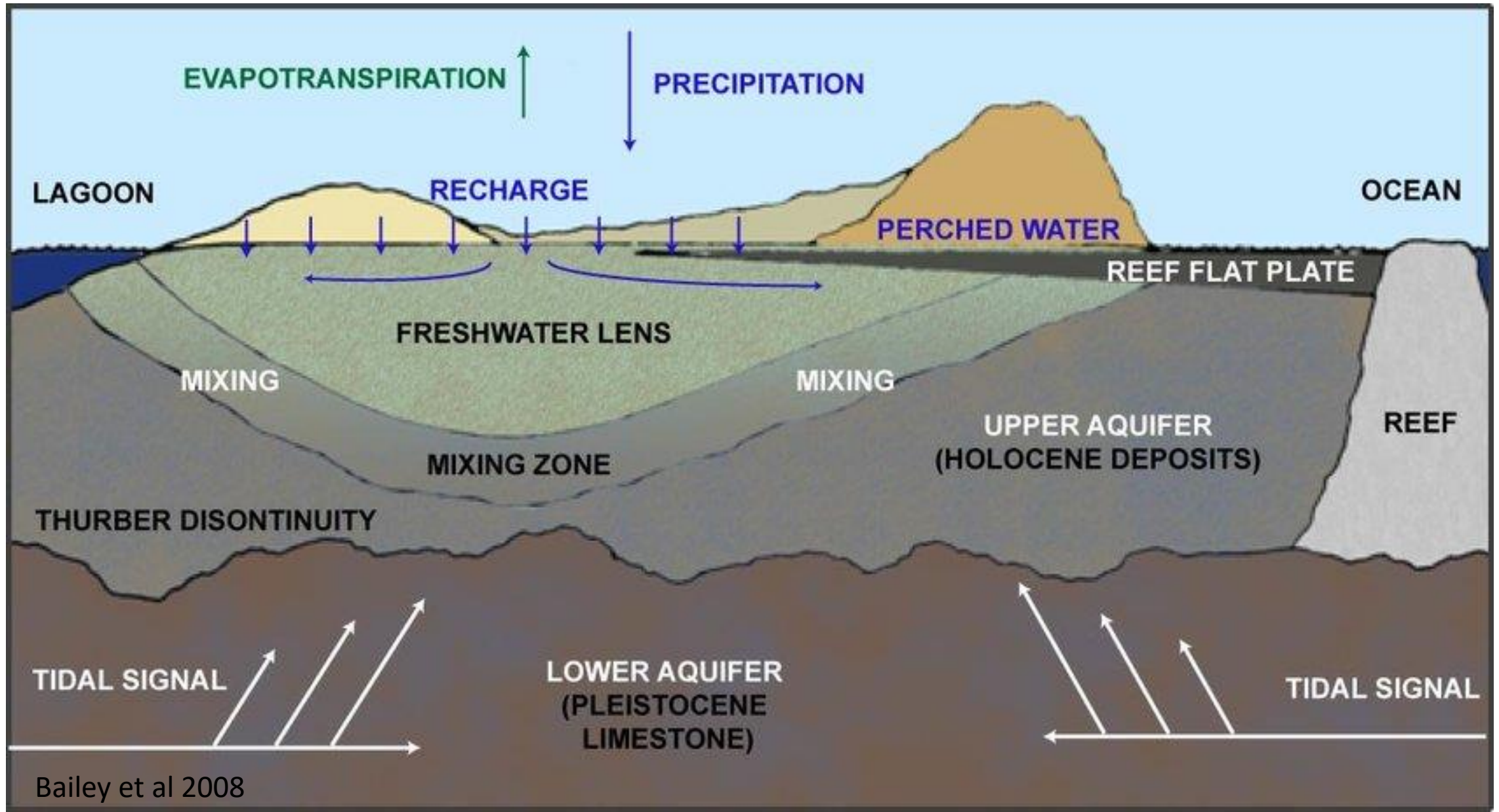


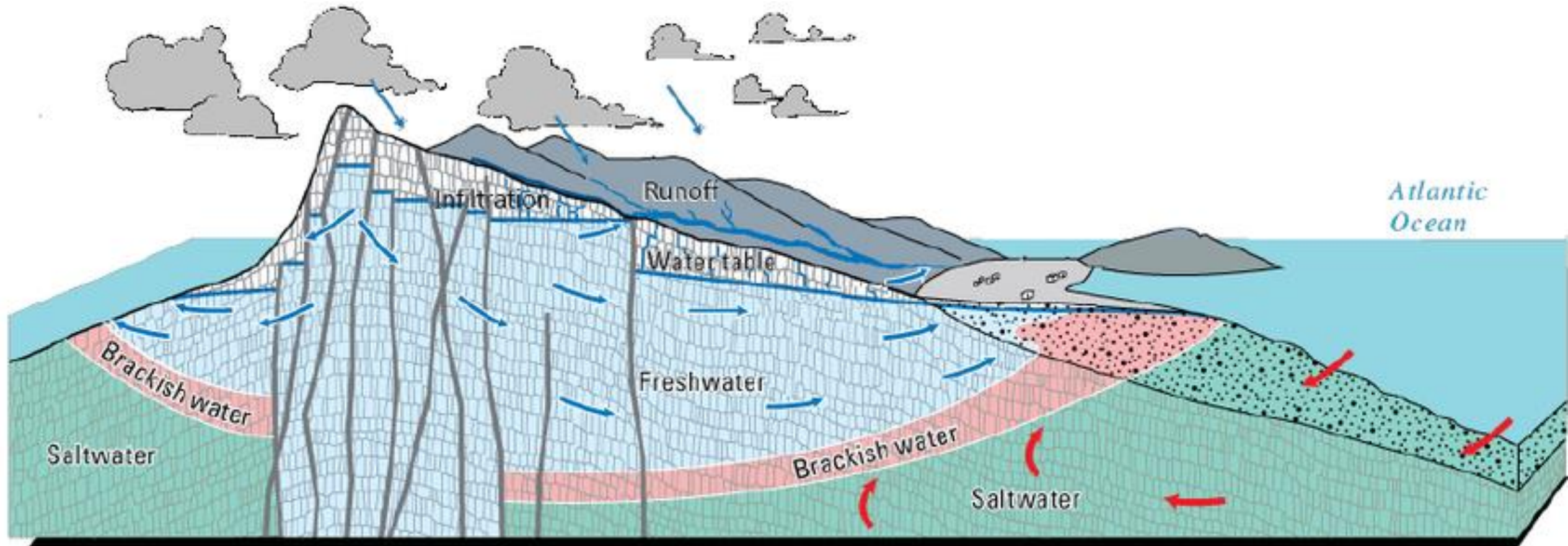
Fig 15.2 IPCC AR6 Ch 15: Small Islands

# Hydrology of atolls









# Hydrology of volcanic islands

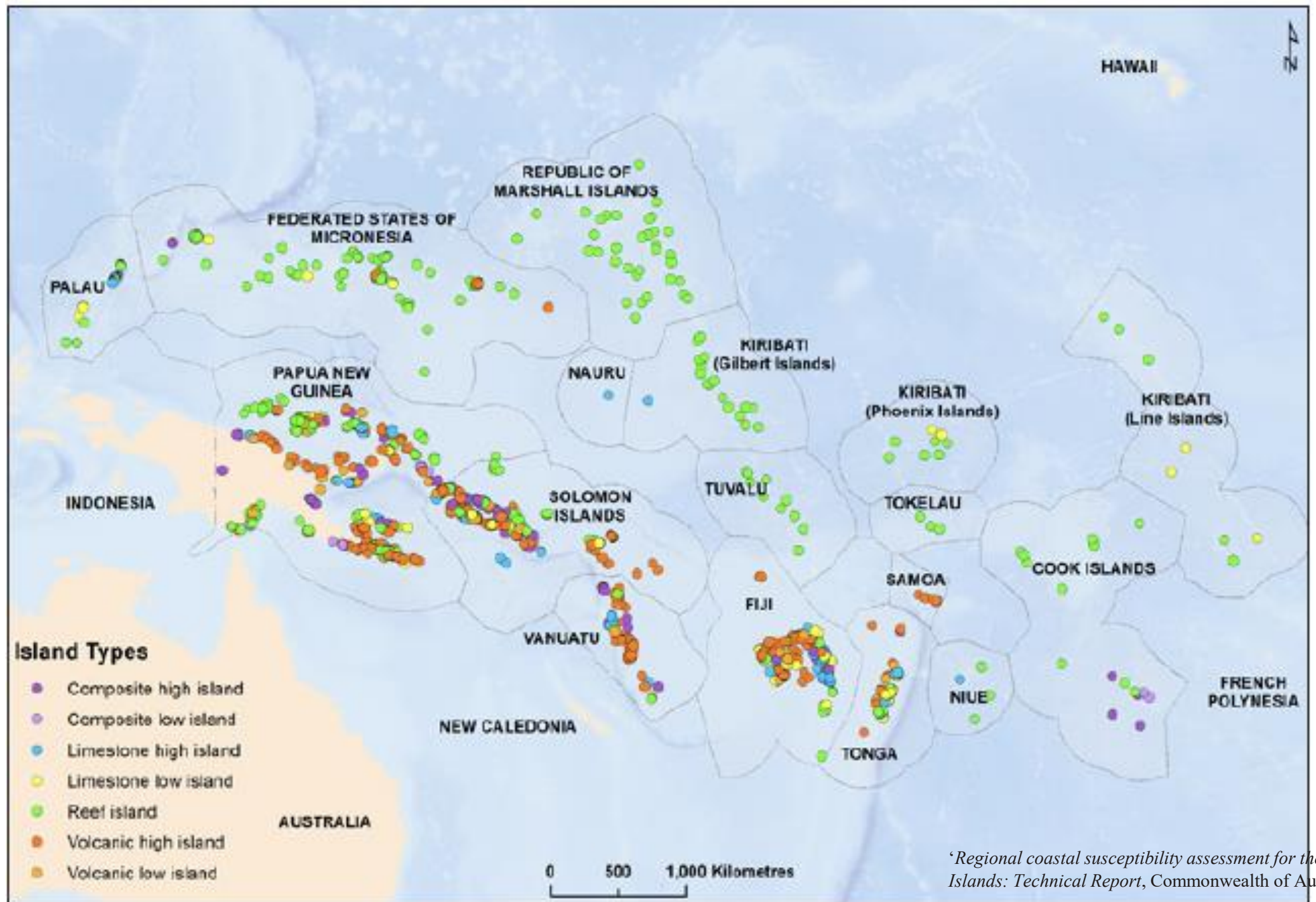


NOT TO SCALE

-  Direction of freshwater movement
-  Direction of saltwater movement
-  Fractured basalt
-  Unconsolidated materials

Adapted from USGS, 2011

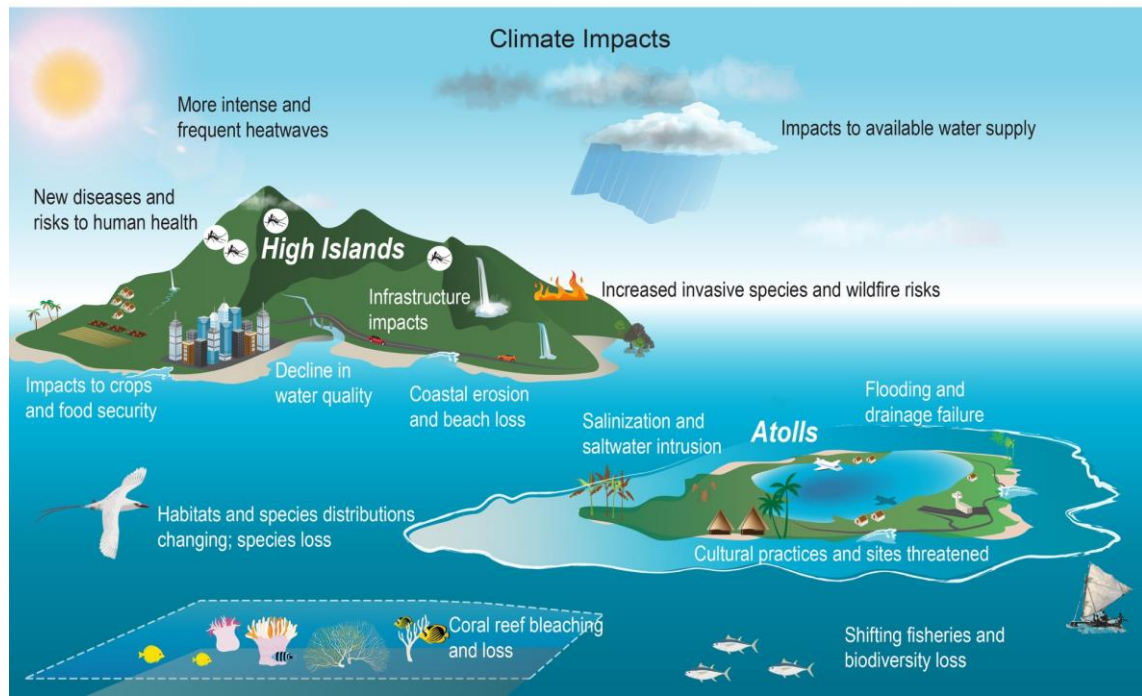
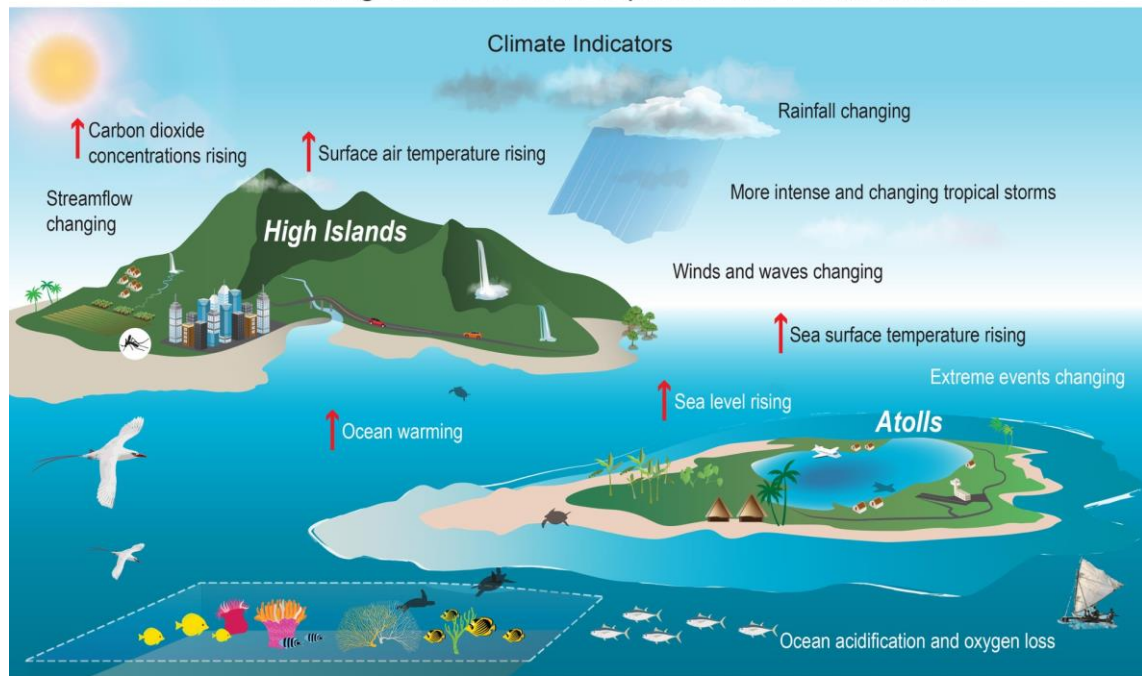
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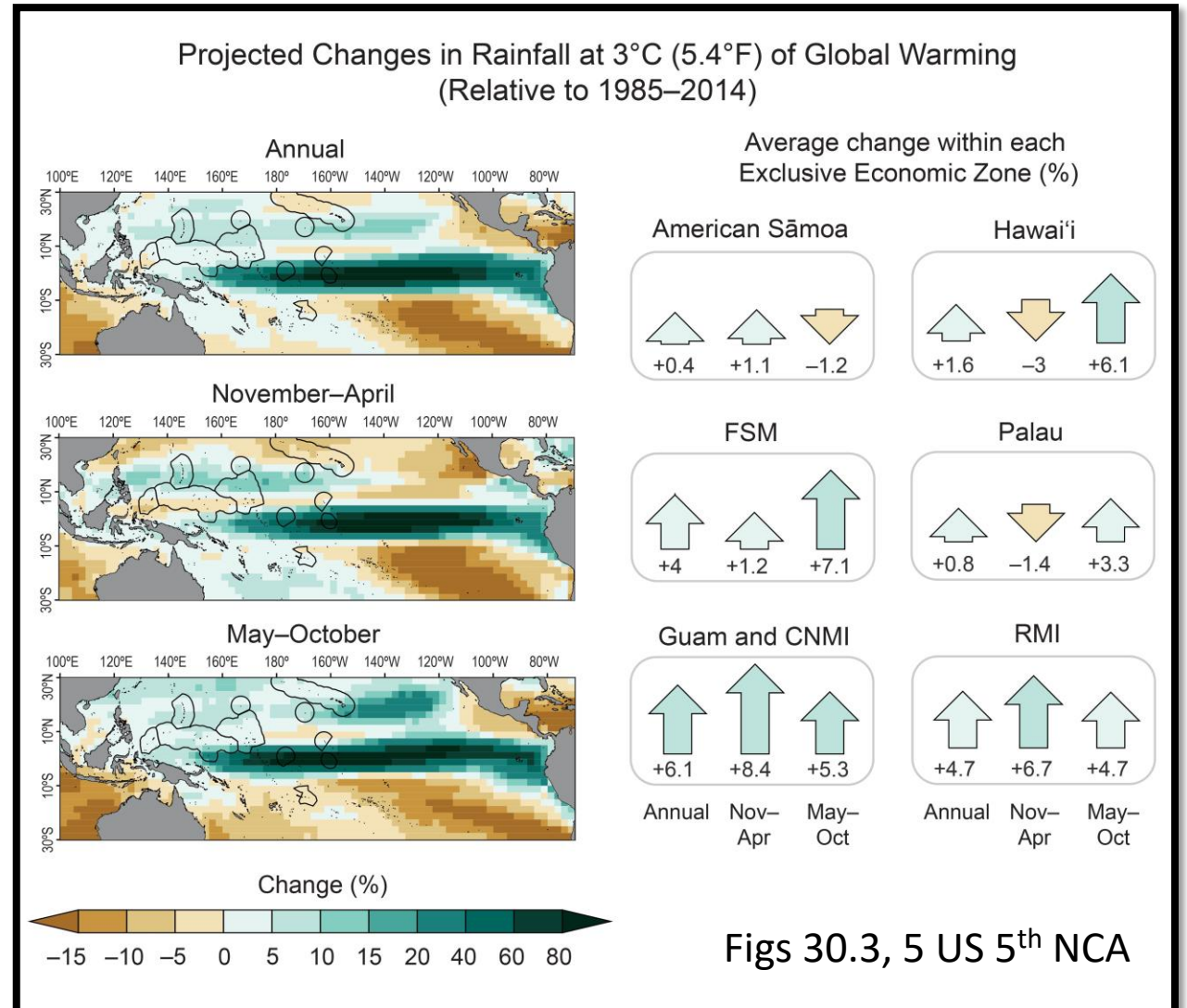
*'Regional coastal susceptibility assessment for the Pacific Islands: Technical Report, Commonwealth of Australia 2015'.*



## Climate Change Indicators and Impacts in the Pacific Islands



# Diverse impacts of climate change



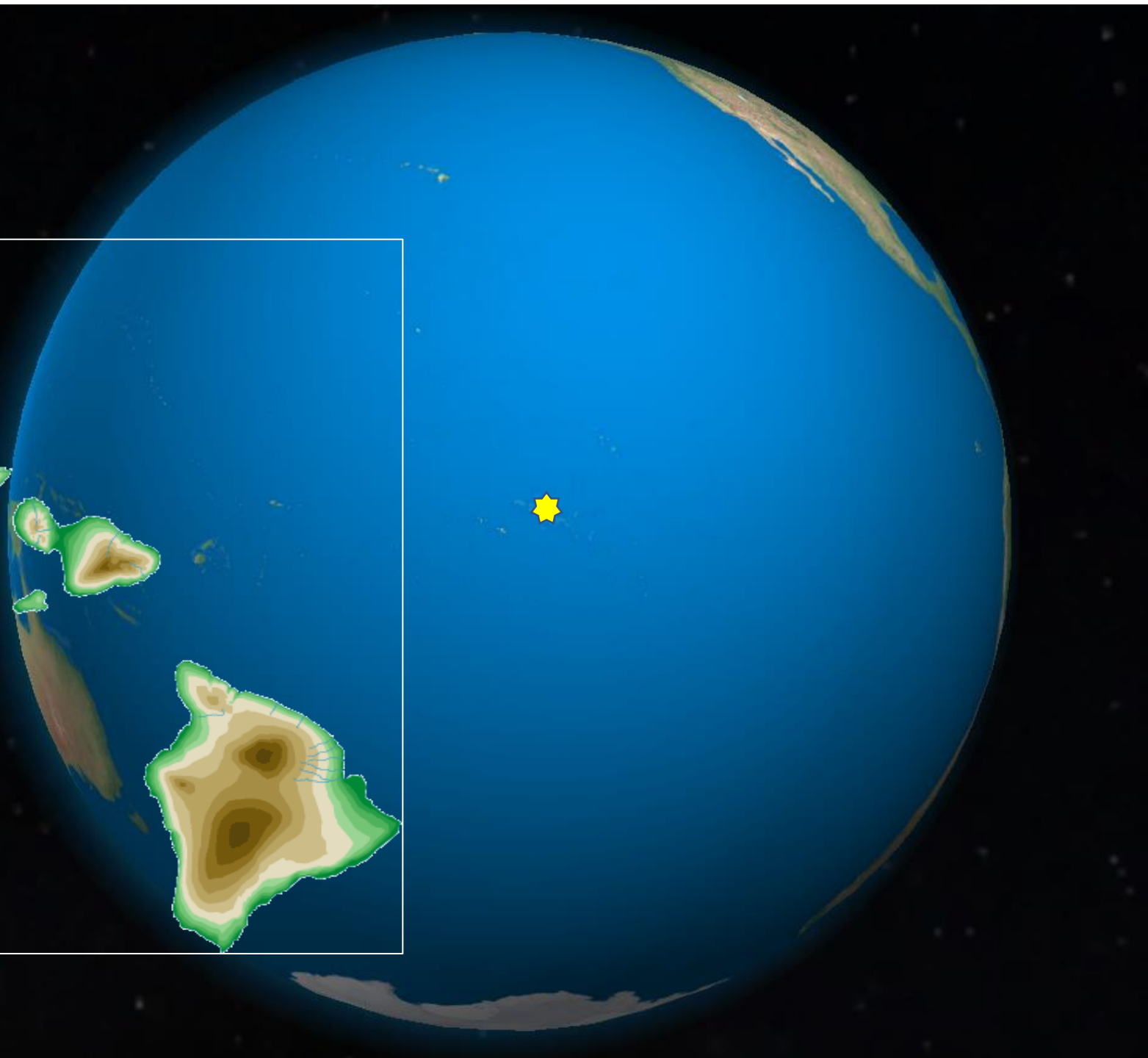
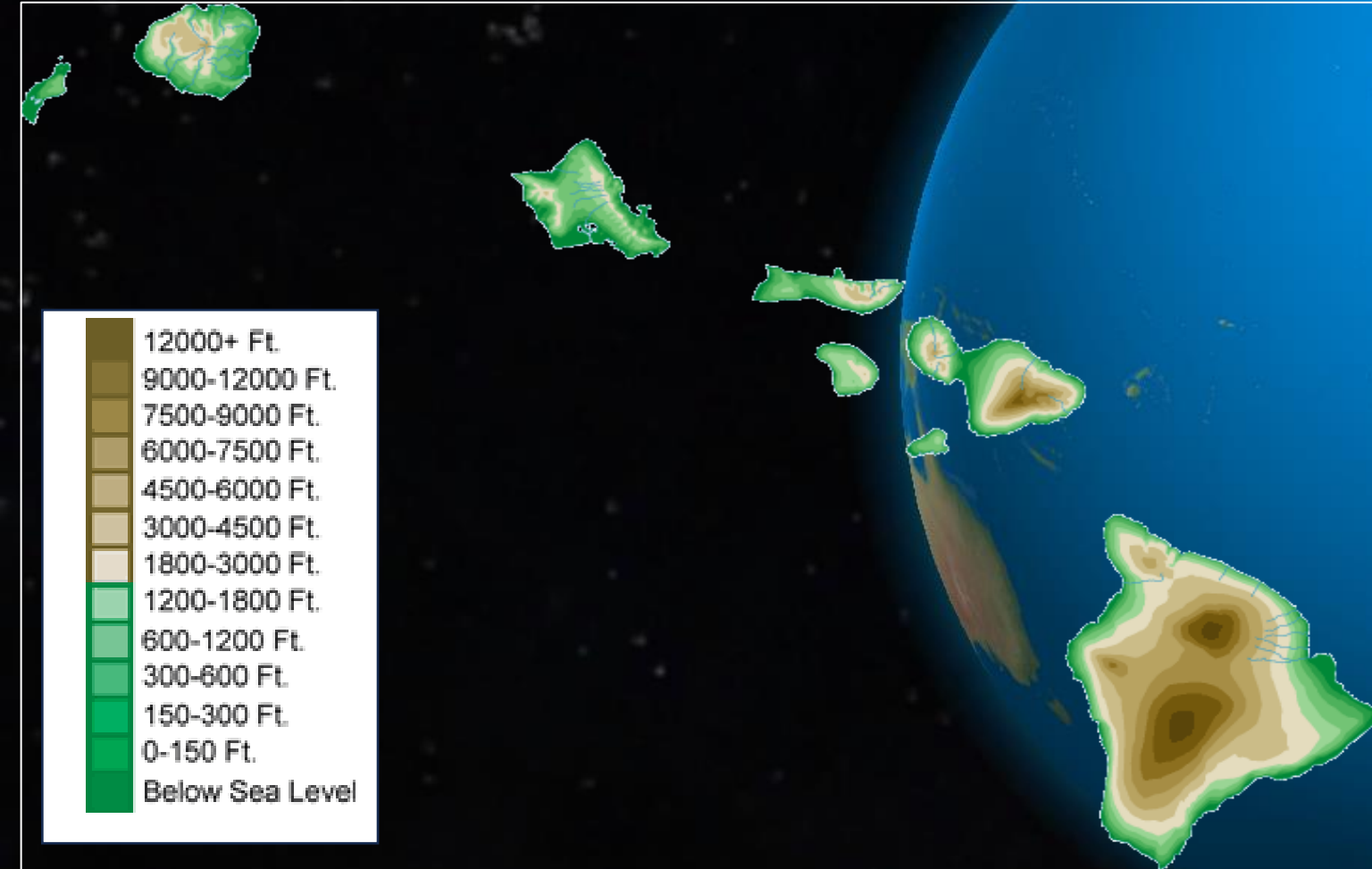


# Local threats to island water resources



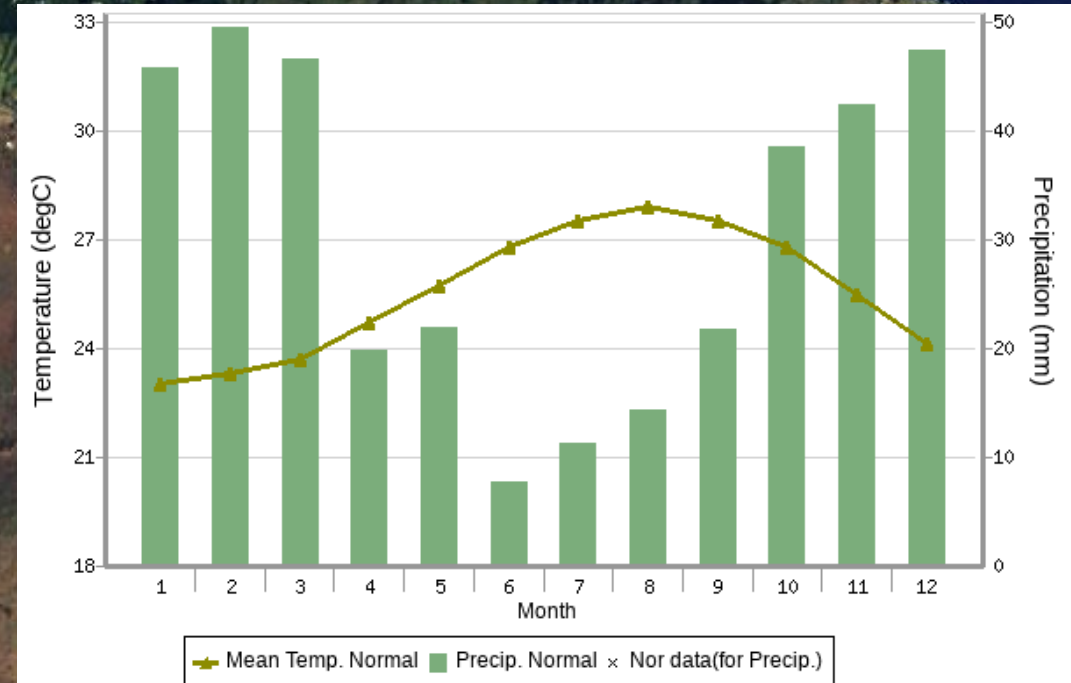
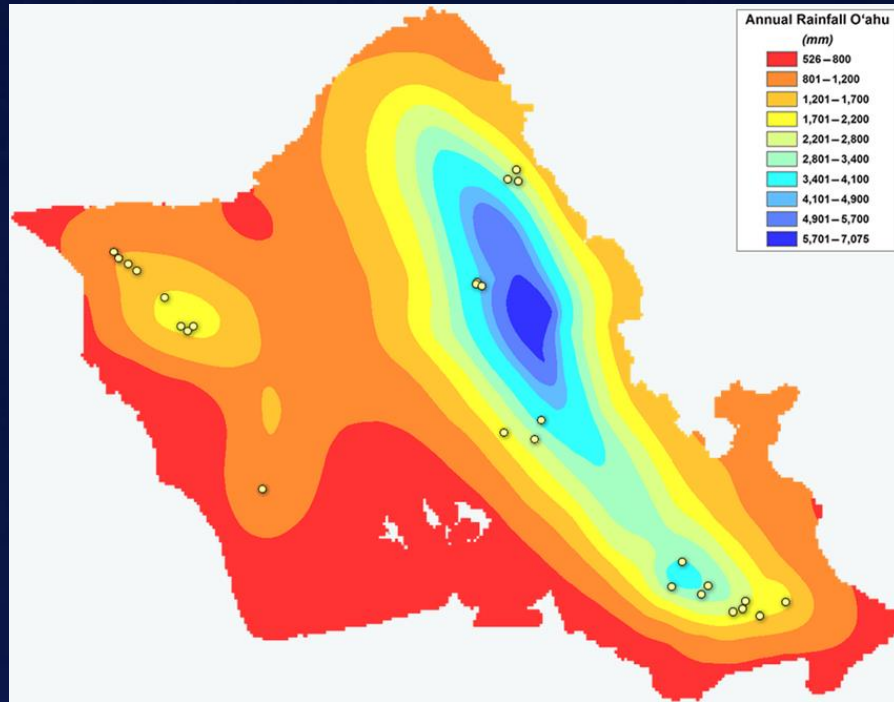


# The Hawaiian Islands





# Extreme rainfall gradients; seasonal variation





# Water as a public trust

## Chapter 174C - STATE WATER CODE

### WATER RESOURCES

**Section 7.** The State has an obligation to protect, control and regulate the use of Hawaii's water resources for the benefit of its people.

“[T]he right of the people to have the waters protected for their use [which] demands adequate provision for traditional and customary Hawaiian rights, wildlife, maintenance of ecological balance and scenic beauty, and the preservation and enhancement of the waters . . .”

– *Hawaiian Supreme Court describing the Public Trust Doctrine*



# Water management/data institutions in Hawai'i

## HAWAII WATER PLAN COMPONENTS



Commission: Protect ground & surface water resources



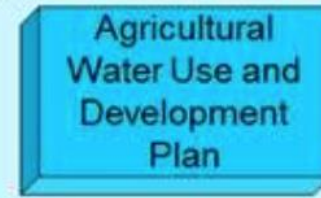
Dept of Health: Regs, standards & policies



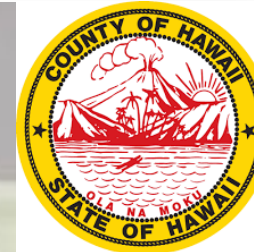
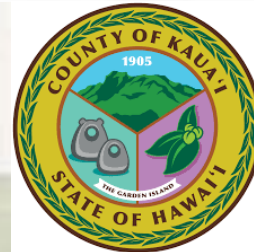
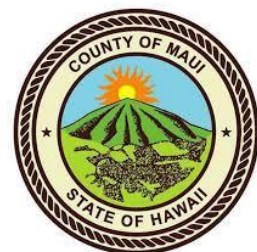
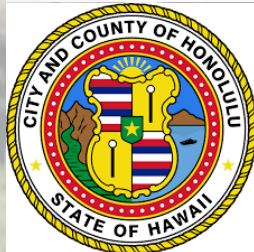
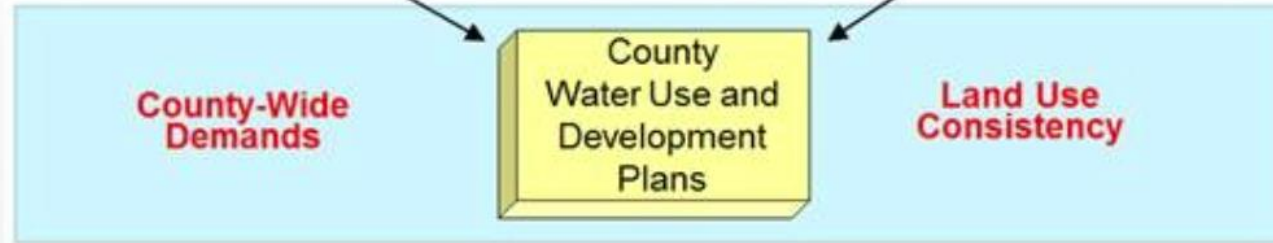
Engineers: Water development



State Needs



Dept of Ag: Ag water use, supply, irrigation systems

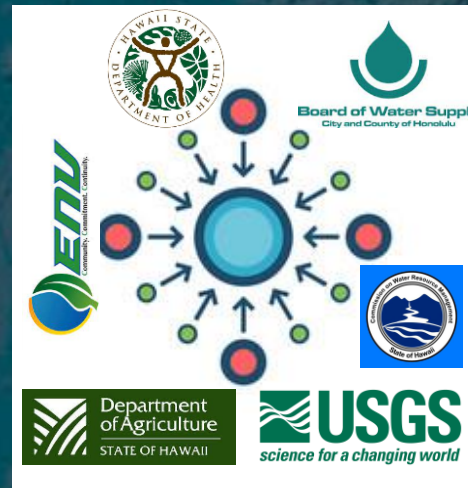


# O'ahu supply and use



## O'ahu

- Population: 1 million  
Tourists: 6.2 million (2019)  
State capitol: Honolulu  
GDP: \$74.4 billion (2020)  
Major economic sectors:
- Tourism
  - Real estate
  - Government
  - Military

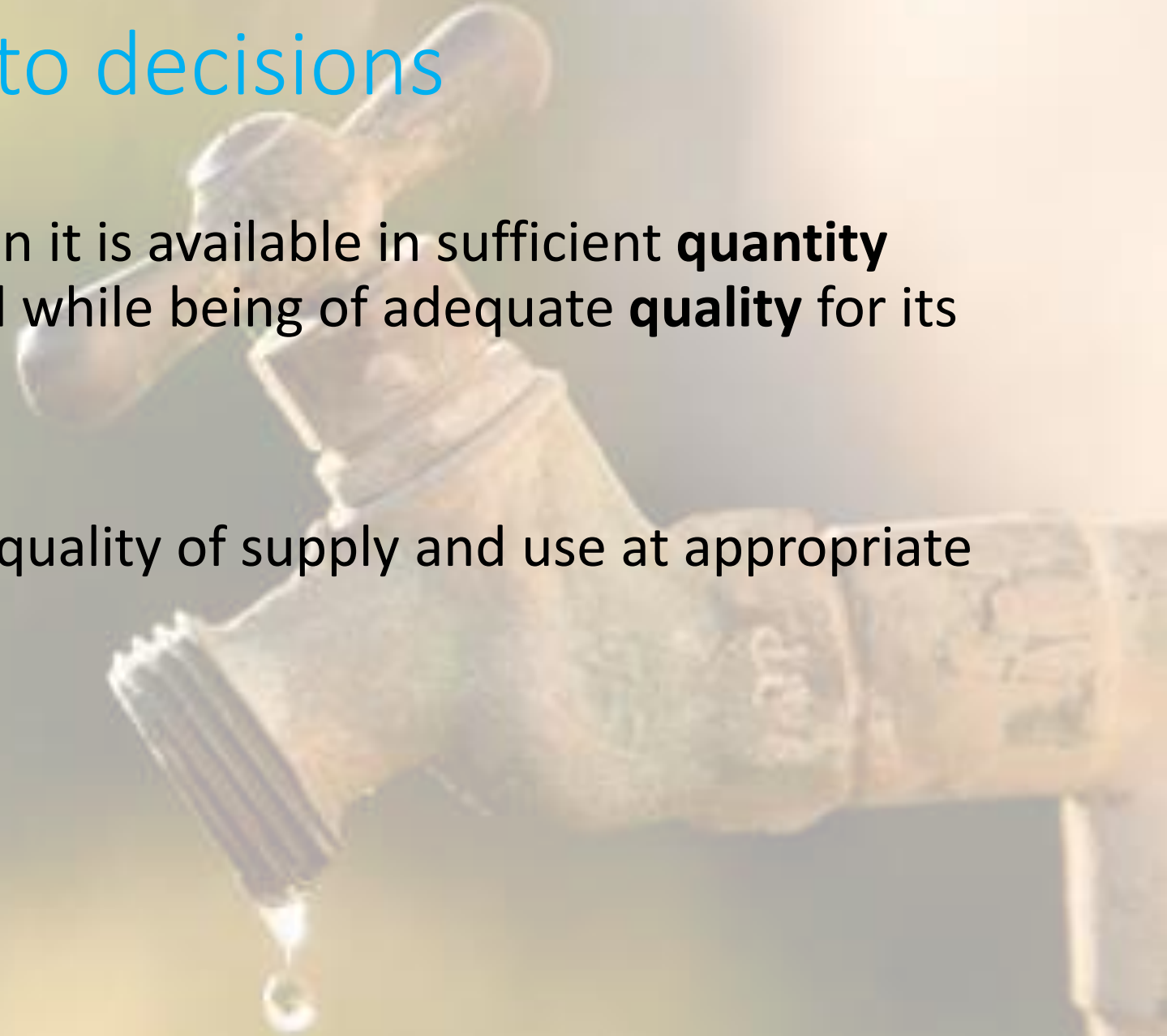


Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



# 1: Scaling accounts to decisions







- Water is useful/valuable when it is available in sufficient **quantity** **where** and **when** it is needed while being of adequate **quality** for its intended use
- Need to report quantity and quality of supply and use at appropriate spatial and temporal scales

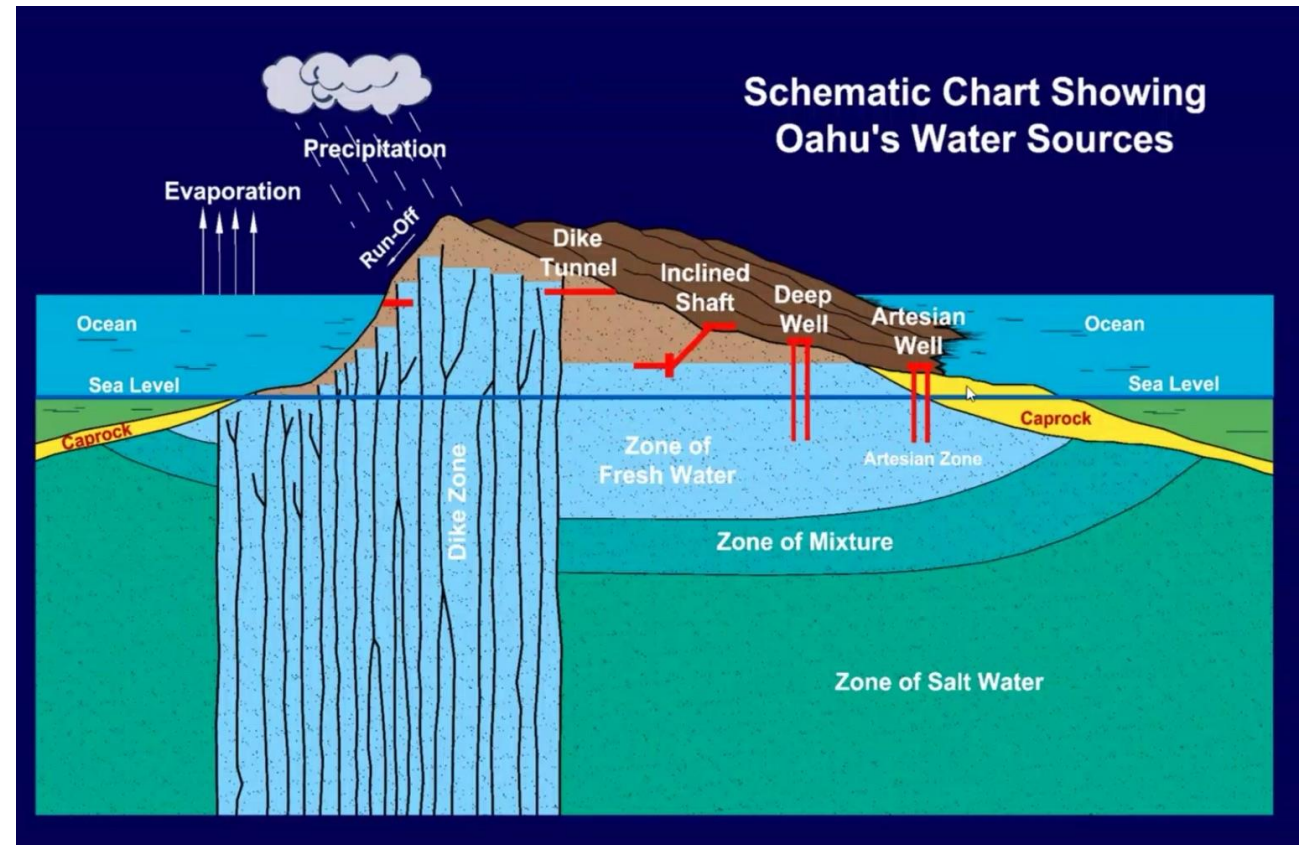
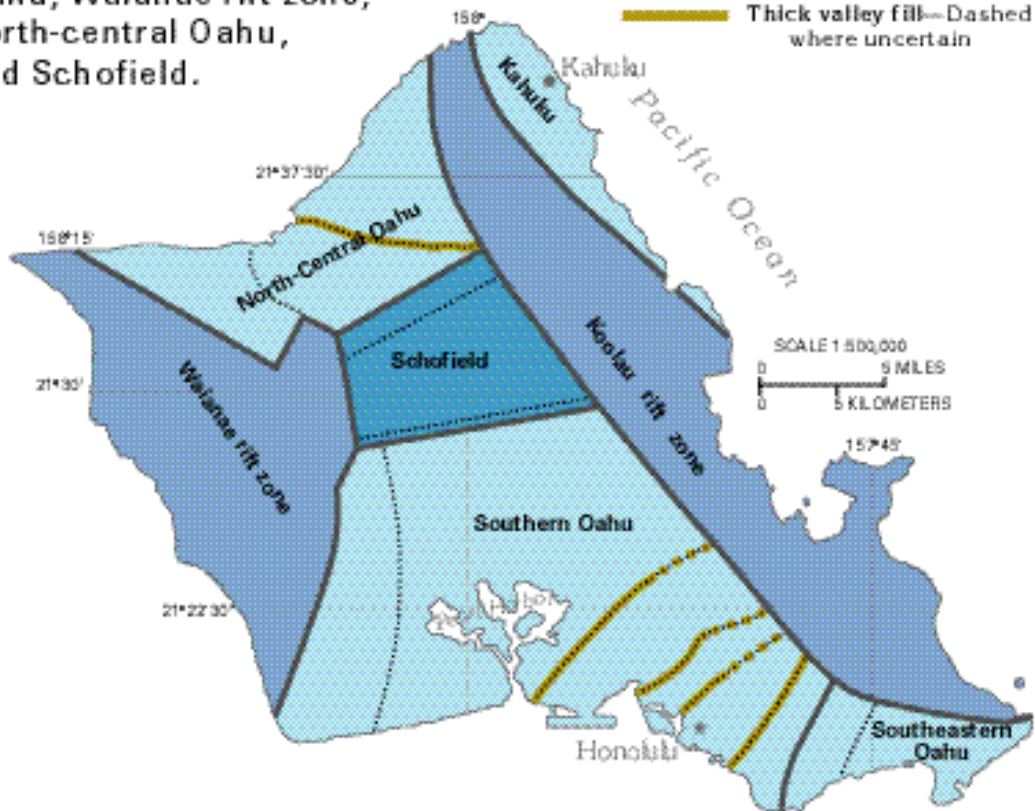


# Scaling:

# Link GW supply to aquifers

**Figure 55.** Oahu has been divided into seven major ground-water areas, primarily on the basis of geologic or hydrologic differences. Each area contains one or both of the island's two principal volcanic-rock aquifers—the Koolau Basalt and the Waianae Volcanics. The ground-water areas are Kahuku, Koolau rift zone, southeastern Oahu, southern Oahu, Waianae rift zone, north-central Oahu, and Schofield.

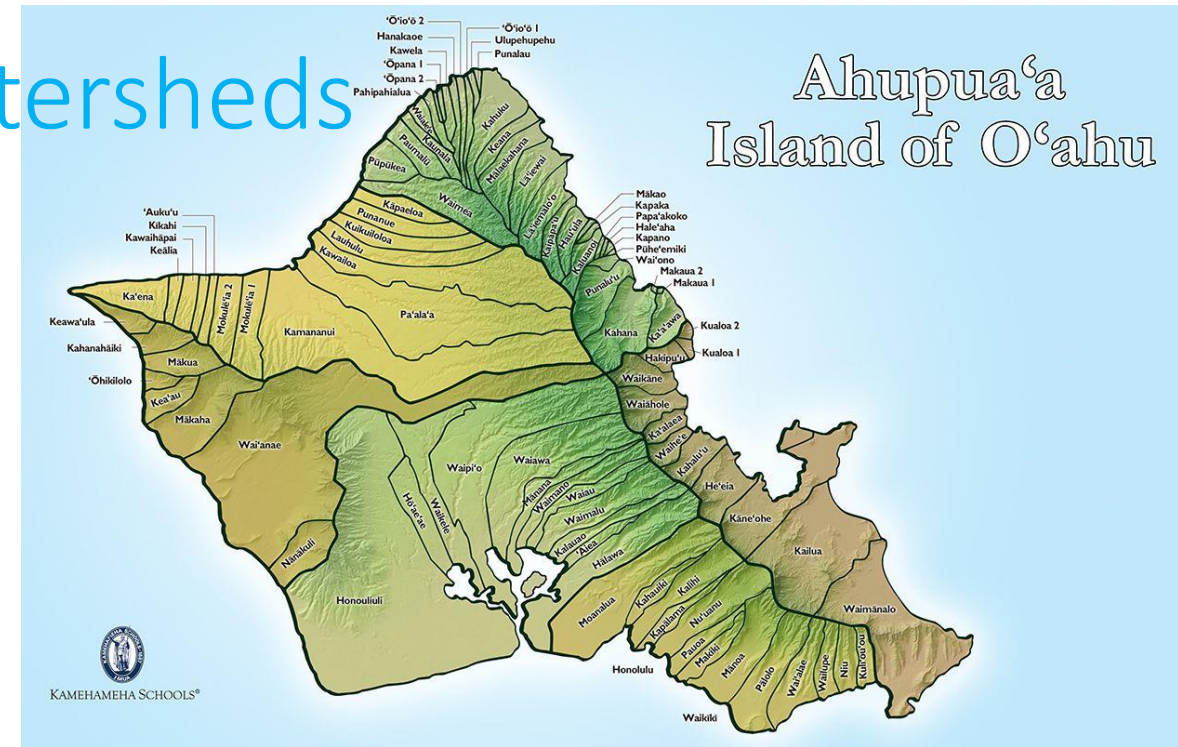
- EXPLANATION**
-  Dike-impounded water
  -  Schofield area of high-level water—impounded by dikes or buried ridges
  -  Freshwater lens
  -  Boundary of ground-water area
  -  Boundary of ground-water subarea
  -  Thick valley fill—Dashed where uncertain



Modified from Nichols, W.D., Shade, P.J., and Hunt, C.D., Jr., 1996, Summary of the Oahu, Hawaii, regional aquifer-system analysis: U.S. Geological Survey Professional Paper 1412-A, 61 p.  
Base modified from U.S. Geological Survey digital data



# Scaling: Link SW supply to Watersheds

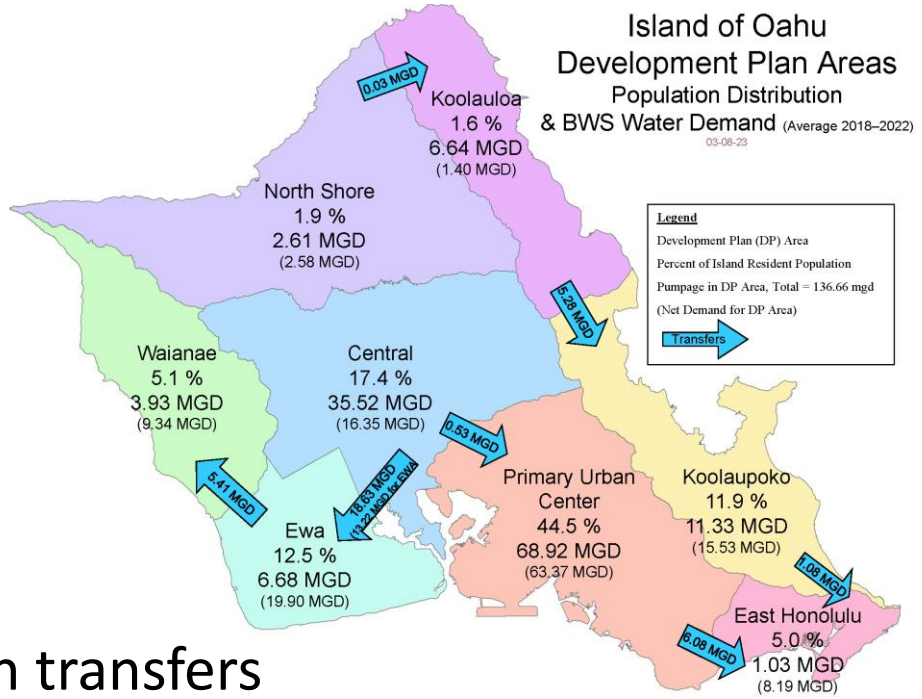
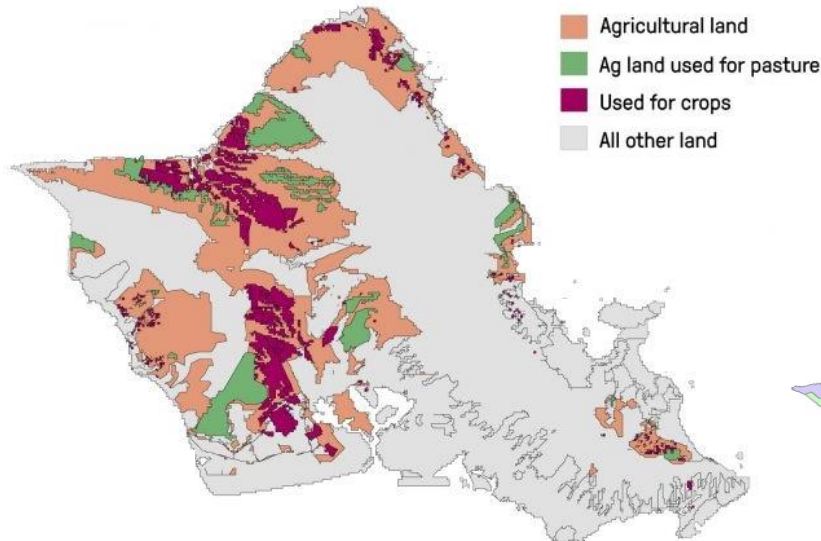
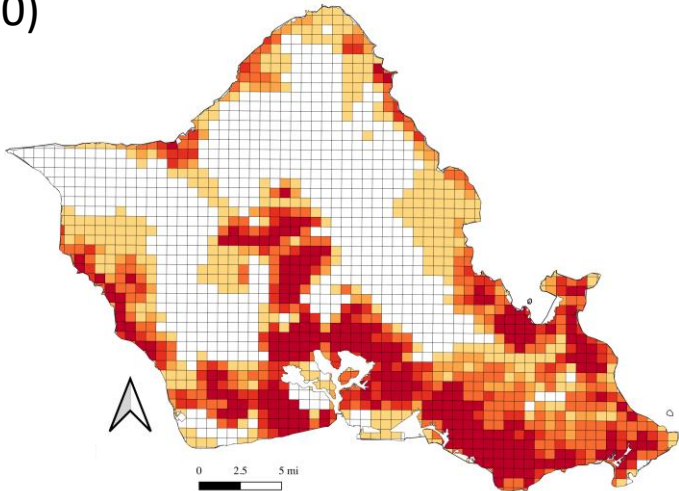
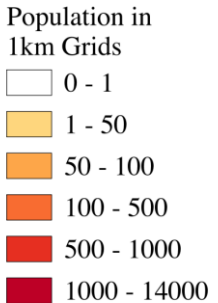


- Aquifers (groundwater) and watersheds (surface) do not correspond (though interact)
- Watersheds resonate with traditional management institution “ahupua’a”



# Scaling: Use (& losses, returns) location, timing

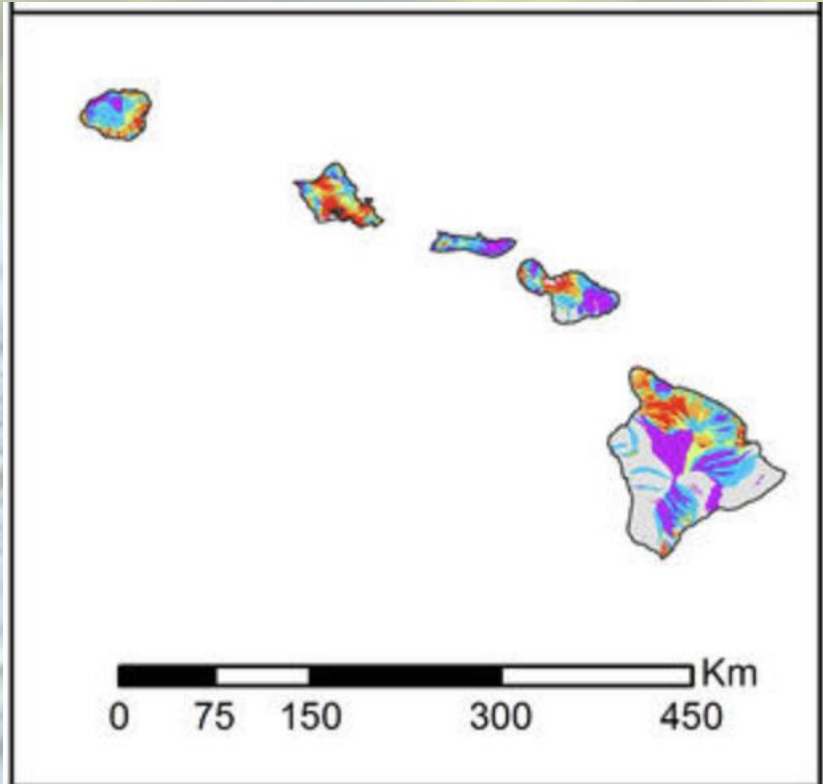
O'ahu population density (2020)



- Capture inter-basin transfers
- Highlight vulnerabilities



## 2. Information clarity, granularity, consistency: Returns

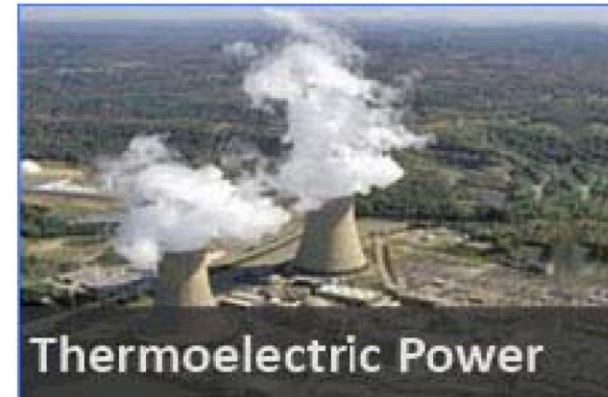
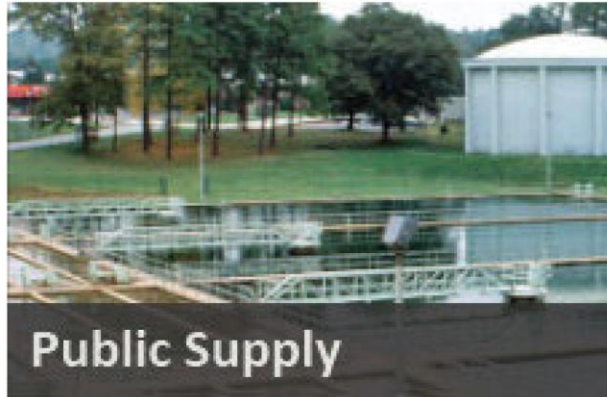


**Risk of Current Habitat Degradation**



- Returns can be important for water supply
- Vary in quality, may pose risk to receiving environments
- Knowing which type of return, where, & quality could help guide source protection, recharge estimates, circular economy, conservation

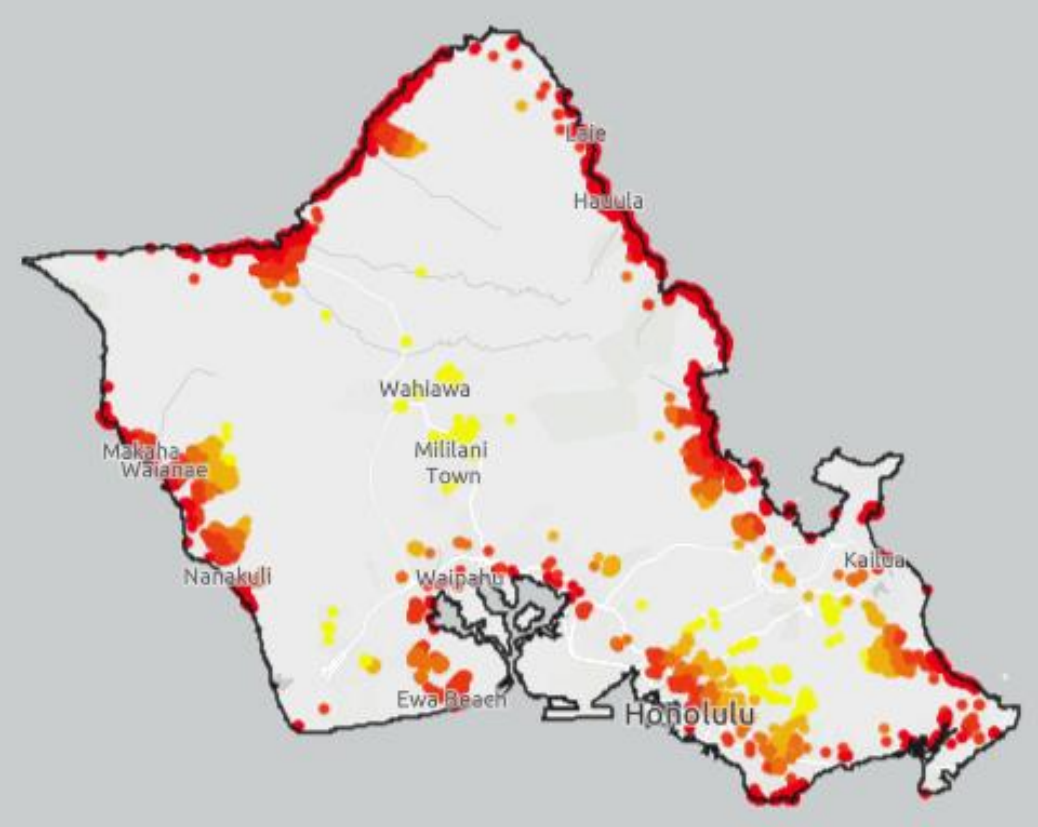
# Information: Use categories, quality standards



- Break down domestic user category
- Standardize categories, quality thresholds across agencies



# Information: Comprehensiveness



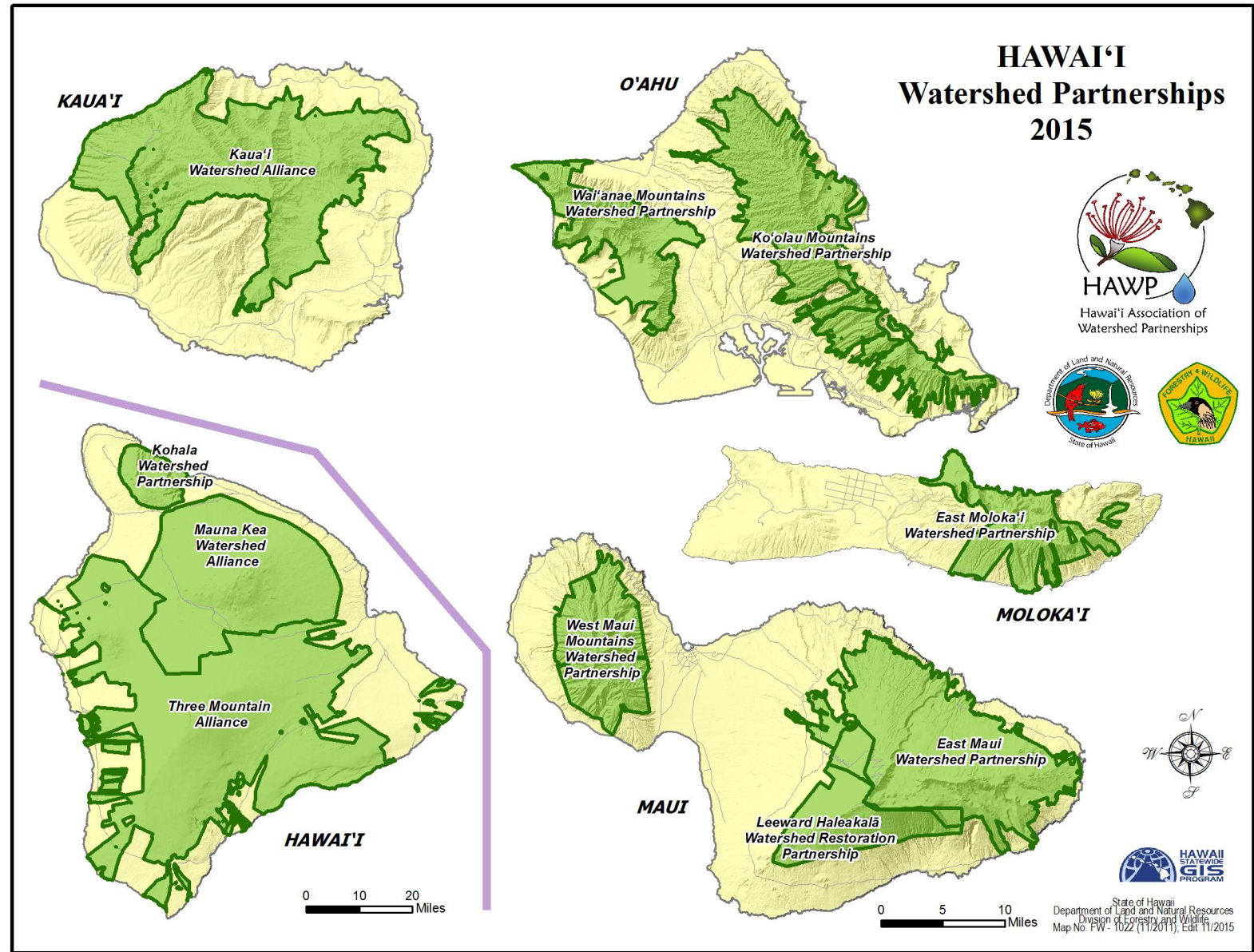


# 3. Managed aquifers as produced assets

- Water asset accounts measure stocks of water, and include two components, (1) produced assets (used for abstraction, mobilization, and treatment of water), and (2) water resources (SEEA-Water para 2.37).
  - Produced assets: “non-financial assets that have come into existence as outputs from production processes that fall within the production boundary of the SNA” (SNA para. 10.9)
- Efforts in Hawai‘i to protect natural storage of water assets – a production activity?
  - An activity, carried out under the responsibility, control, and management of an institutional unit, that uses inputs of labour, capital, and goods and services to produce outputs of goods and services (SNA para 6.2)



# Aquifers: Watershed partnerships





# Aquifers: High opportunity costs

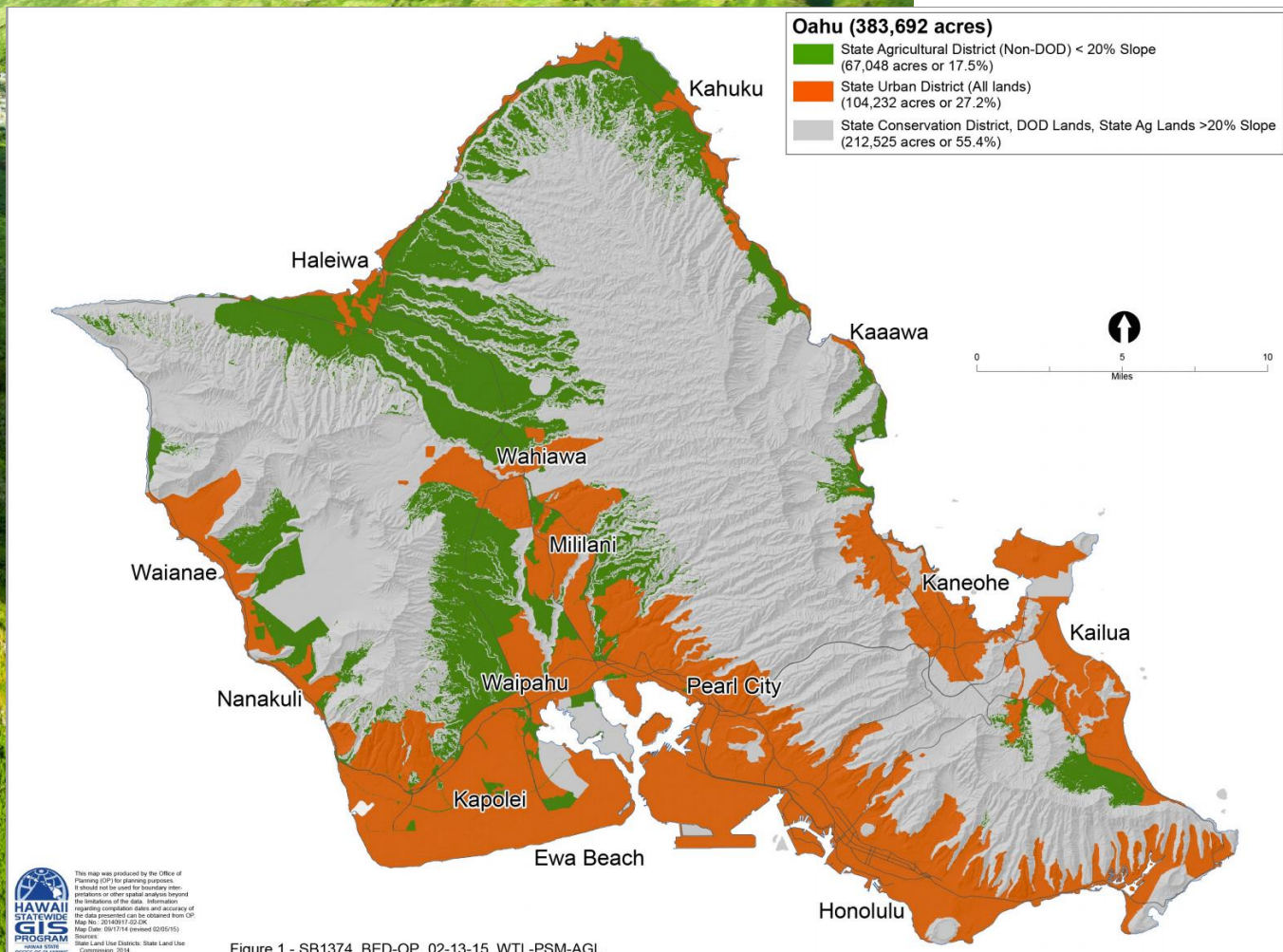


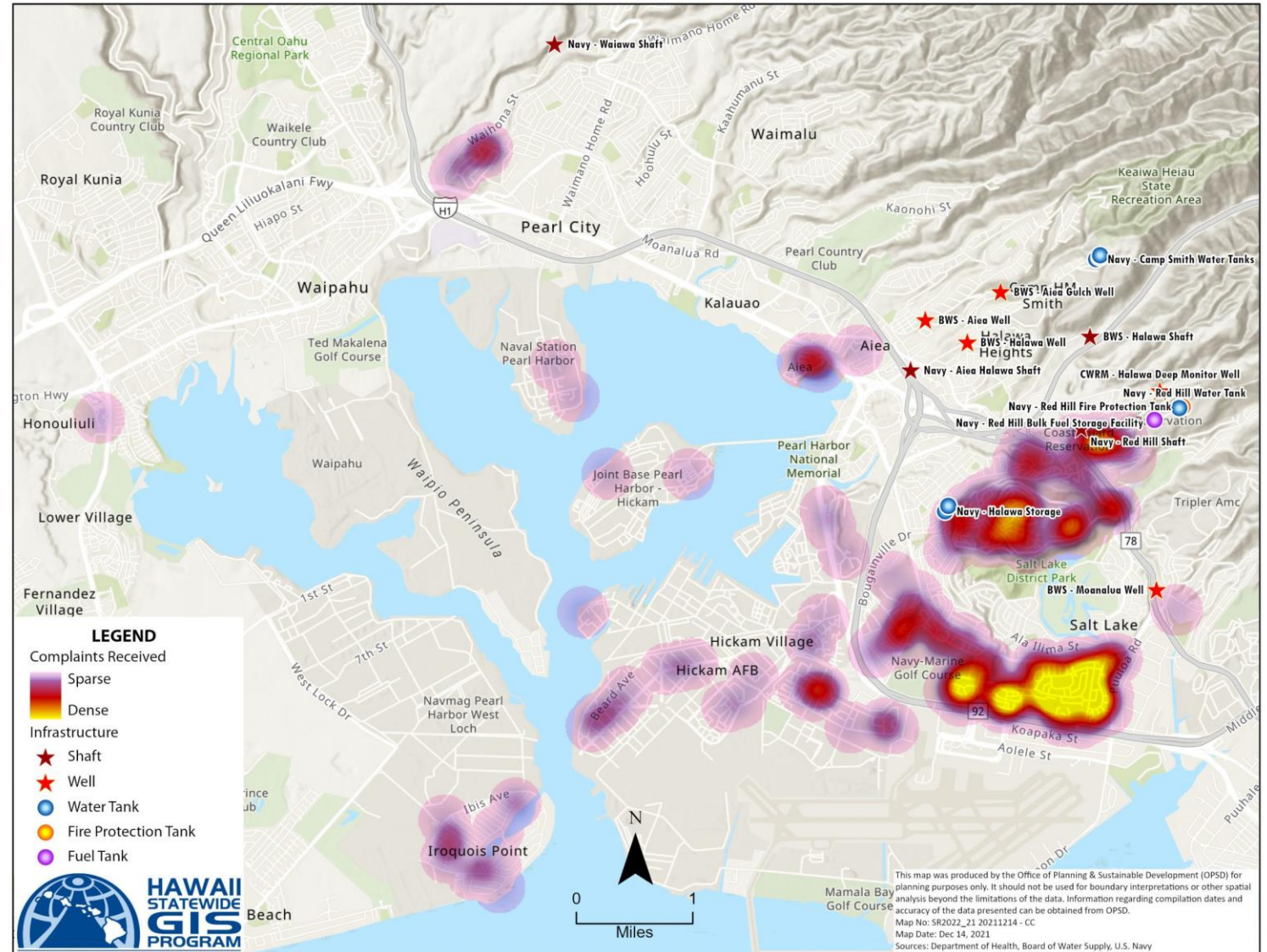
Figure 1 - SB1374\_BED-OP\_02-13-15\_WTL-PSM-AGL



# Aquifers: Quality and supply crises



- Earlier intervention if aquifer valued as a produced asset?
- Damage assessment





# Aquifers: Privatization

- Lack of data puts power in the hand of private developers
- Indigenous worldview: kinship, love of land





## 4. Water valuation

- Critical need to price water
- Water leases extremely undervalued



**Water**

### Maui's Contentious Water Saga Is Bubbling Up This Week

The state Board of Land and Natural Resources is considering granting a 30-year water lease in East Maui, possibly to a single large private company.

By Paula Dobbyn   / September 24, 2024

🕒 Reading time: 7 minutes.

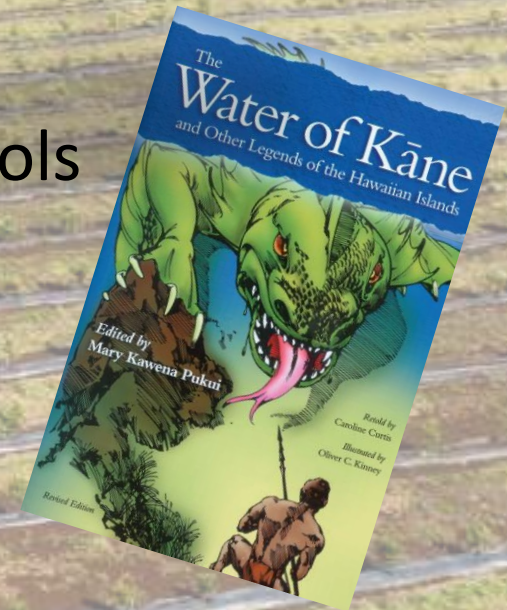
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 6



# Non-market benefits

- Balance multiple uses of water
  - Focus on economic use leads to loss of other uses
- Exchange value useful, but
  - Precludes consideration of many non-market benefits
  - Perpetuates colonialism, power imbalances
  - Antithetical to Indigenous worldviews
- Legitimacy will depend on alternative valuation, decision tools





# Concluding thoughts

- Pilot effort generated interest, sparked coordination
- Uncovered potential island-specific accounting needs:
  - Pinpoint to aquifer & watershed (at least)
  - Integrate quality & season
  - Disaggregate returns, use categories
  - Aquifers (principal water source) as produced asset
  - Indigenous worldview suggests broadening values to increase policy/decision-making relevance



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