Challenges in using AnnAGNPS for an Island Watershed

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Overview

- Introduction:
  - Hanalei Watershed
  - AnnAGNPS Model
  - Hanalei Modeling Project
- “Toto, I don’t think we’re in Kansas anymore.”
  - Issues in applying a continentally-derived model to an island setting
- Transition to following technical presentation

Annualized **AG**ricultural **N**on**P**oint **S**ource Pollutant Loading Model

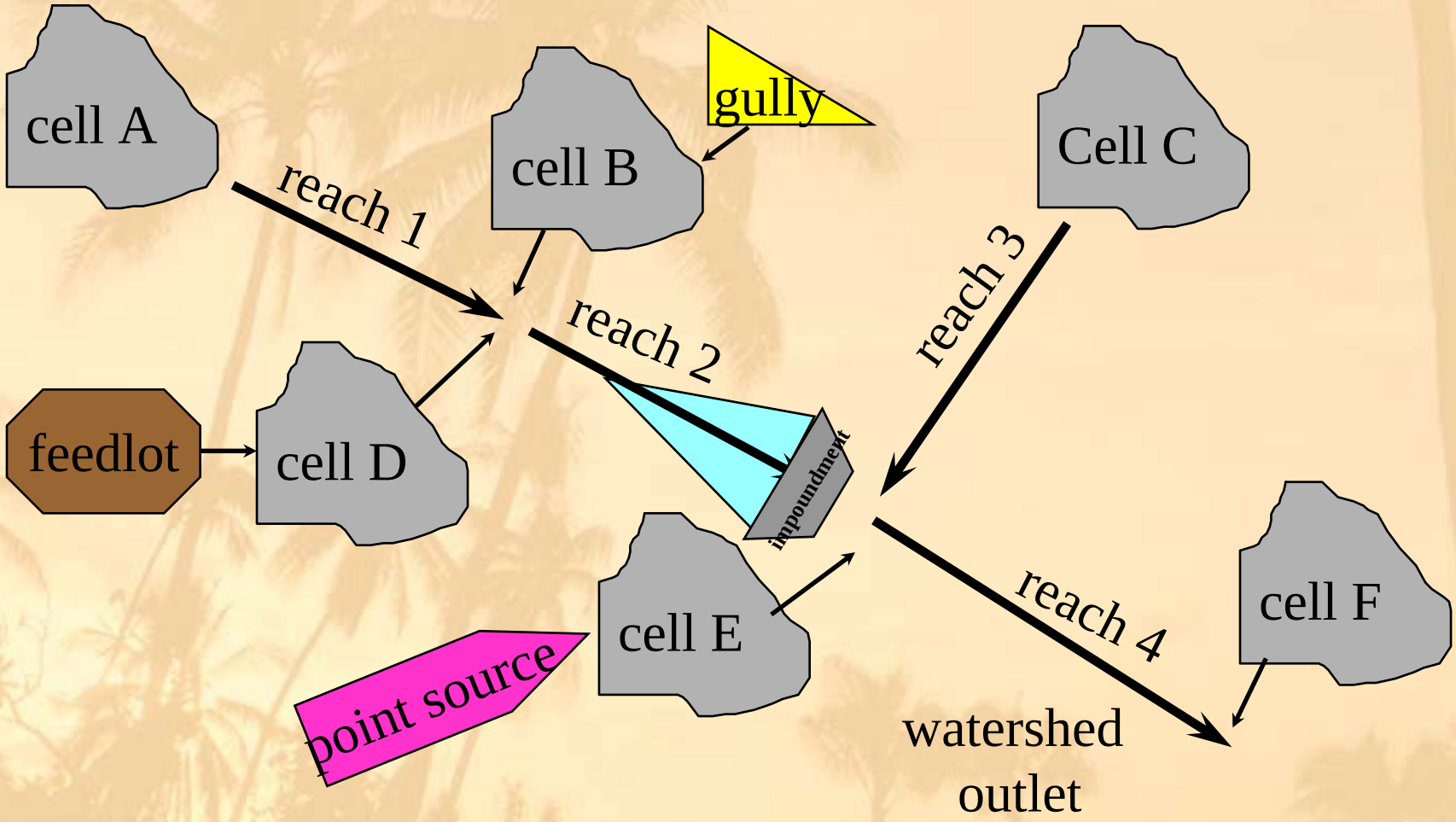
- Watershed-scale
  - Runoff
  - Erosion
  - Sediment and pollutant transport
- Cells and reaches
- Continuous simulation
  - Daily rainfall and other climate parameters

AnnAGNPS Model

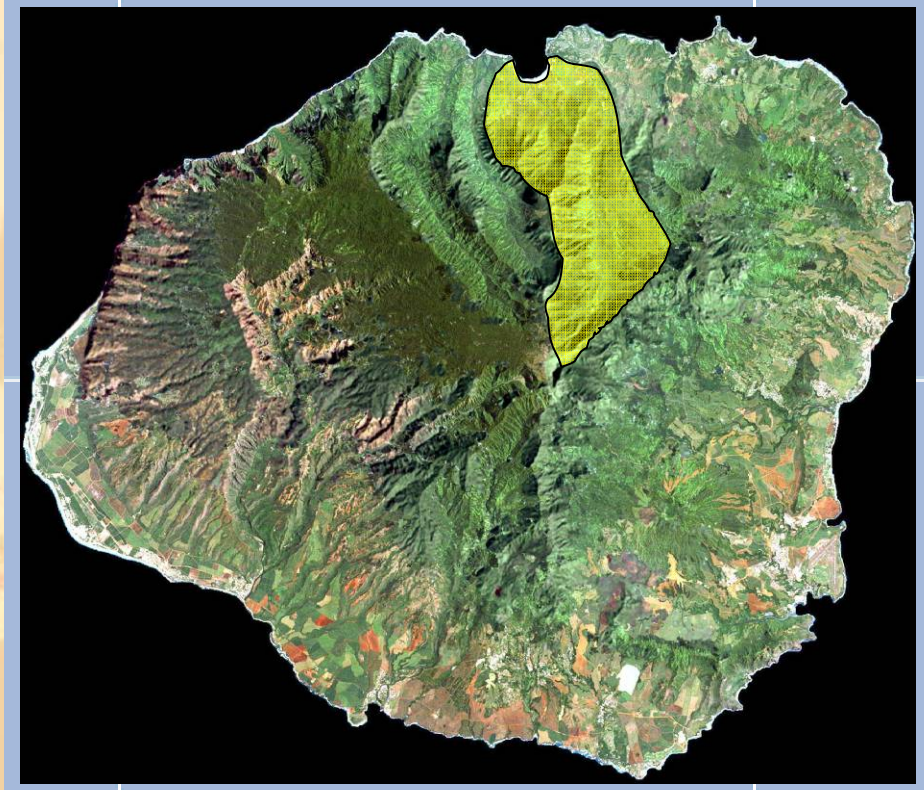
- Born as a single-event model in the mid-1980s at the Univ. of Minnesota.
- Uses widely-accepted USDA analyses methods
  - Universal Soil Loss Equation
  - Runoff Curve Number method
- ARS and NRCS support
  - Continuous simulation
  - GIS Interface and analysis

ARS AnnAGNPS Site -
http://www.ars.usda.gov/Research/docs.htm?docid=5199

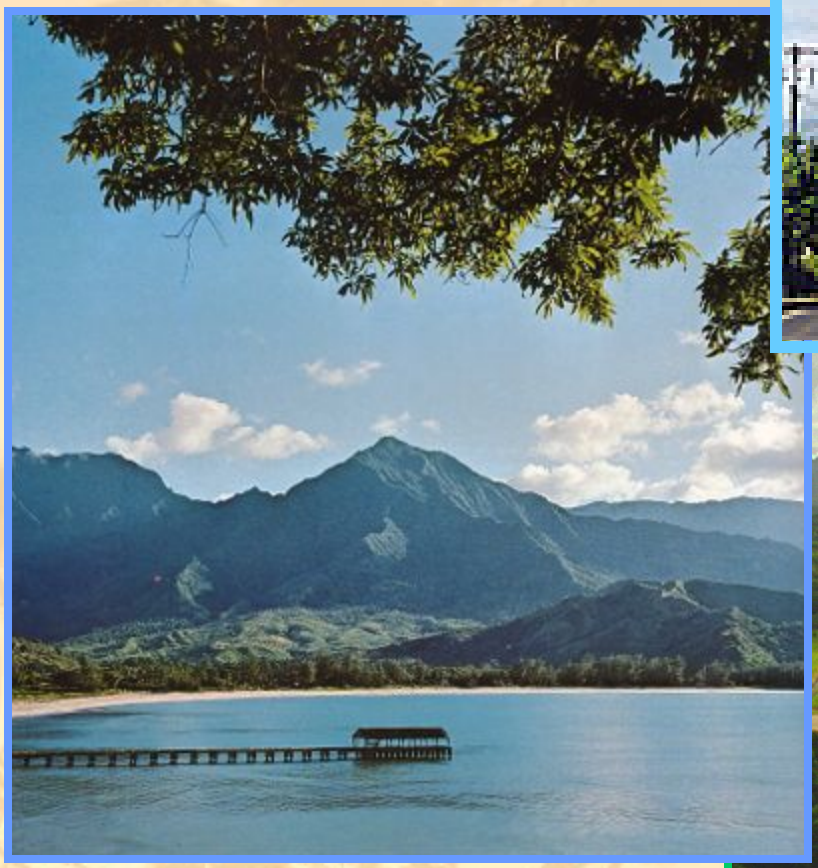
AnnAGNPS: major processes



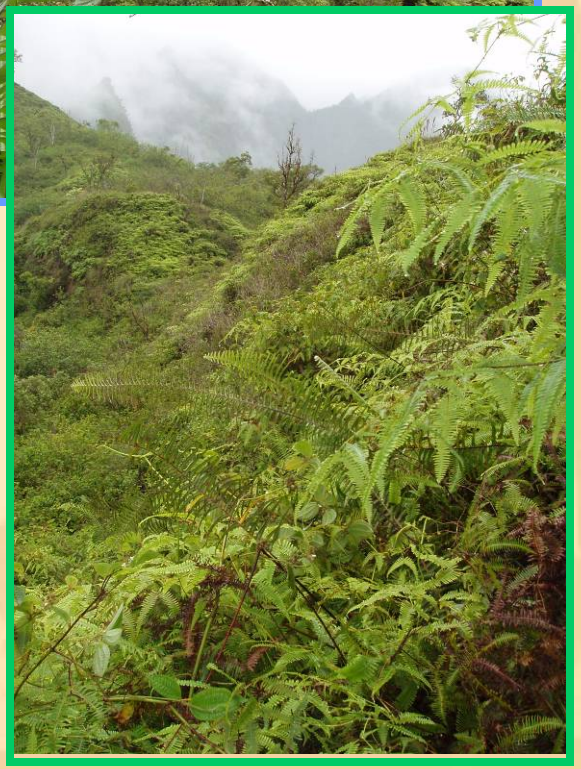
Hanalei Watershed
Kauai, Hawaii

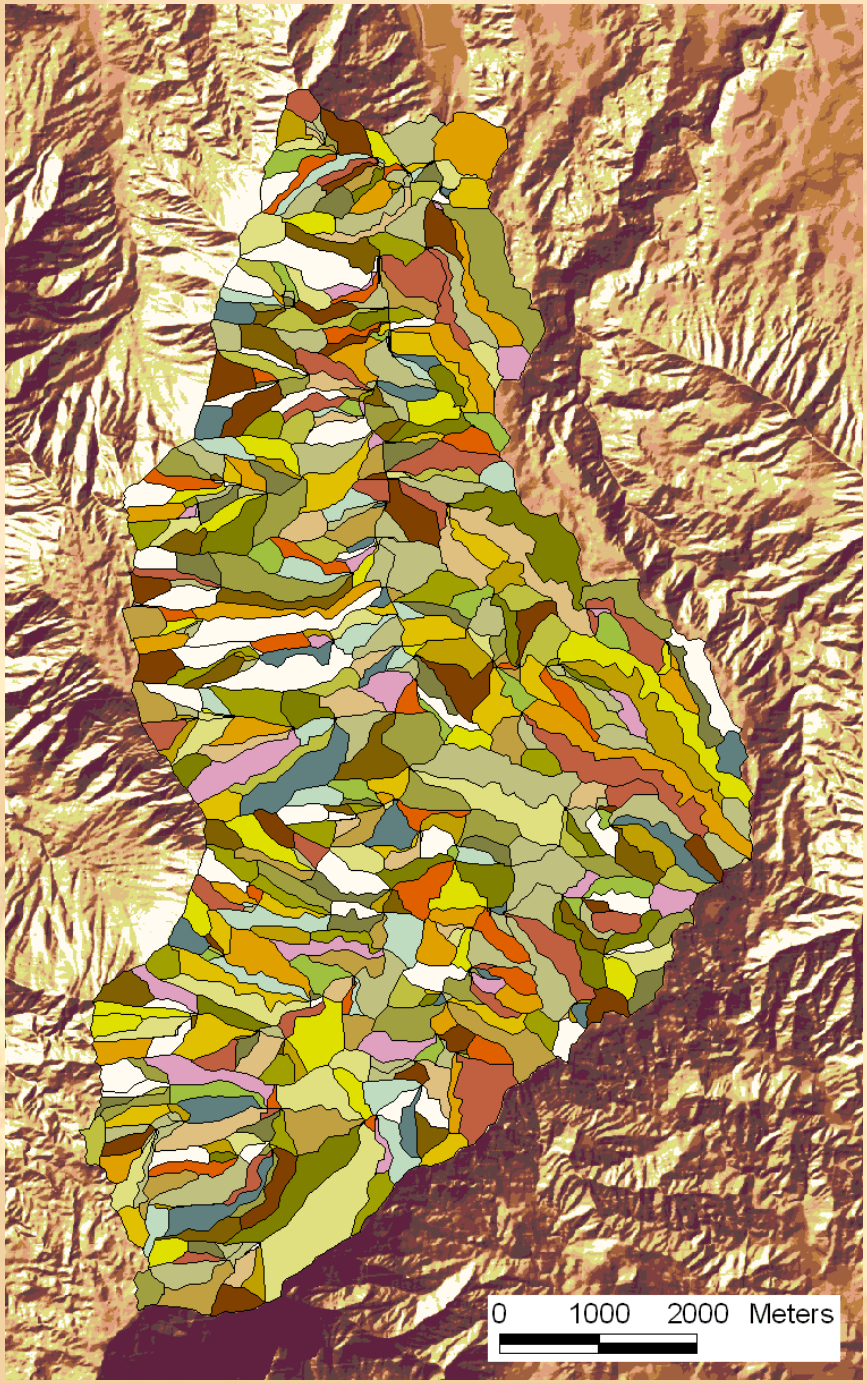


Lower Hanalei Watershed



Upper Hanalei Watershed





Cell Map for Pilot Model

- Hanalei Stream Watershed
- Model outlets at USGS Gage Station

560 cells

- Based on 10-meter DEM
- Reach threshold – 130 m
- Cell threshold - 8 ha

Modeling Project Organization

- Hanalei Watershed Hui
  - American Heritage River
  - EPA Watershed Initiative Grant
- NRCS
  - Cooperative River Basin Study
  - AnnAGNPS expertise
- USGS
  - Water Resources
  - Biological Resources
- University of Hawaii, Dept. of Natural Resources and Environmental Management
  - Modeling contractor
  - Modeling expertise

NRCS

USGS
science for a changing world

UNIVERSITY OF HAWAI'I
1907
MĀNOA

Project Objectives

- Model Hanalei Watershed Processes
  - Hydrology and sediment, not nutrients or pathogens
  - Develop treatments for upper watershed that reduce sediment yield
- Develop a watershed analysis tool that can be applied to other tropical and subtropical watersheds
- Advance tropical watershed science
  - Runoff
  - Erosion
- Foster interagency cooperation and coordination

Advantages of Hanalei Watershed

- USGS stream gage with 50 years of record
- USGS suspended sediment gage with 2 years of record
- All upper watershed owned and managed by the State of Hawaii
- No agricultural or residential land use in upper watershed
- Interested community partner with technical and financial capacity

The Challenge (in a nutshell)

AnnAGNPS was developed for Midwestern agricultural watersheds

We want to use it to evaluate natural, tropical watersheds like this

Some Differences

Relative Homogeneity:
Soils
Gradient
Land Cover

Available:
Runoff Curve Numbers
RUSLE Coefficients
Detailed Soil Survey

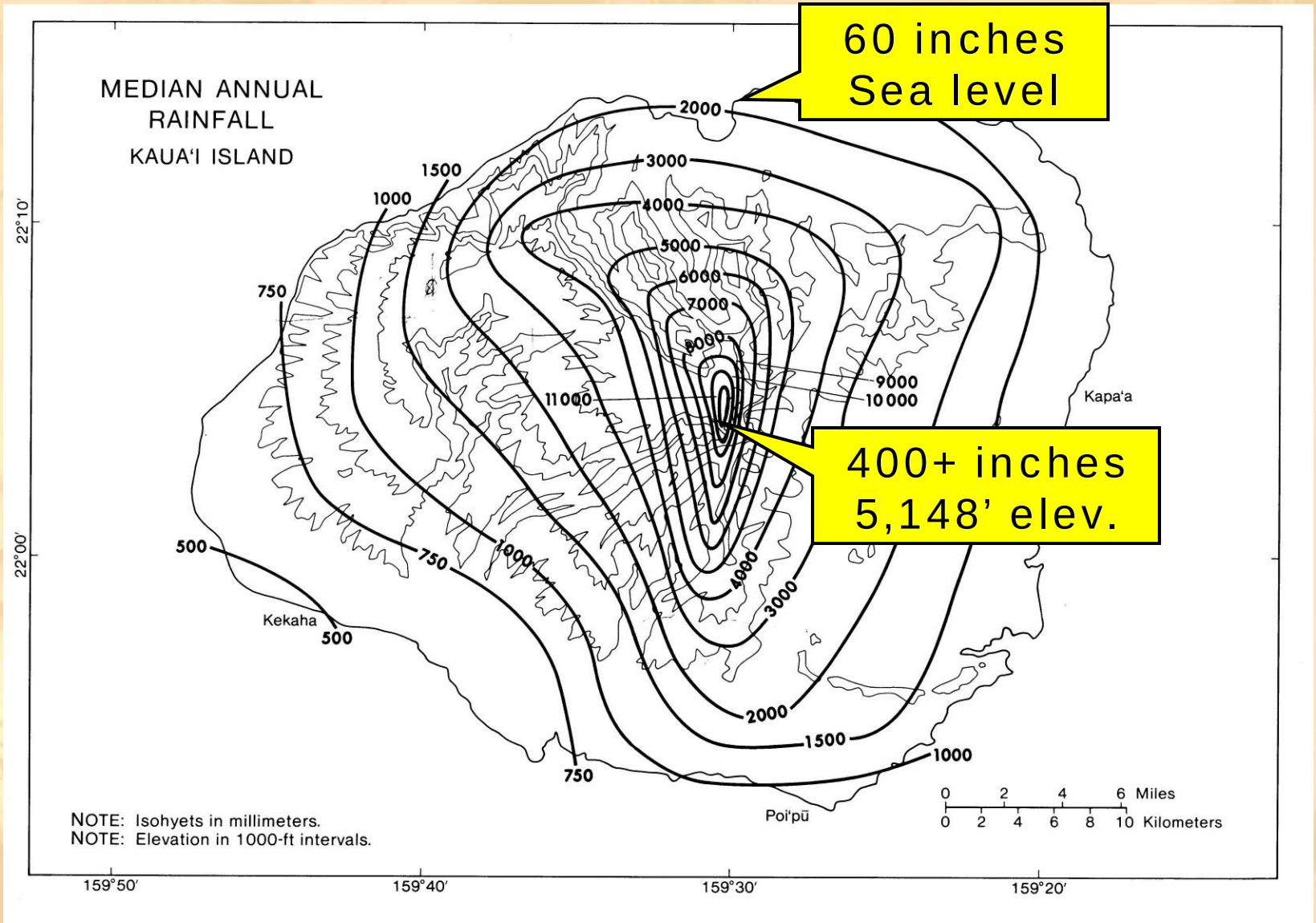
Great Variability:
Soils
Gradient
Land Cover

Unavailable:
Runoff Curve Number
RUSLE Coefficients
Detailed Soil Science

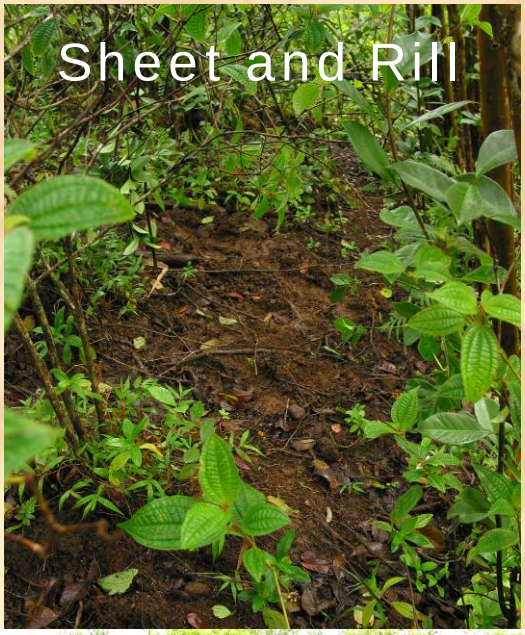
Climate Issues

- No complete climate record available
  - Required daily input:
    - Precipitation – most important
    - Max-min temperature
    - Sky cover
    - Dew point temperature
    - Wind speed
- Extreme spatial variation in precipitation
- Two rainfall records at top and bottom of watershed with no correlation
  - How do we develop a synthetic climate file?

Annual Rainfall



Sediment Sources

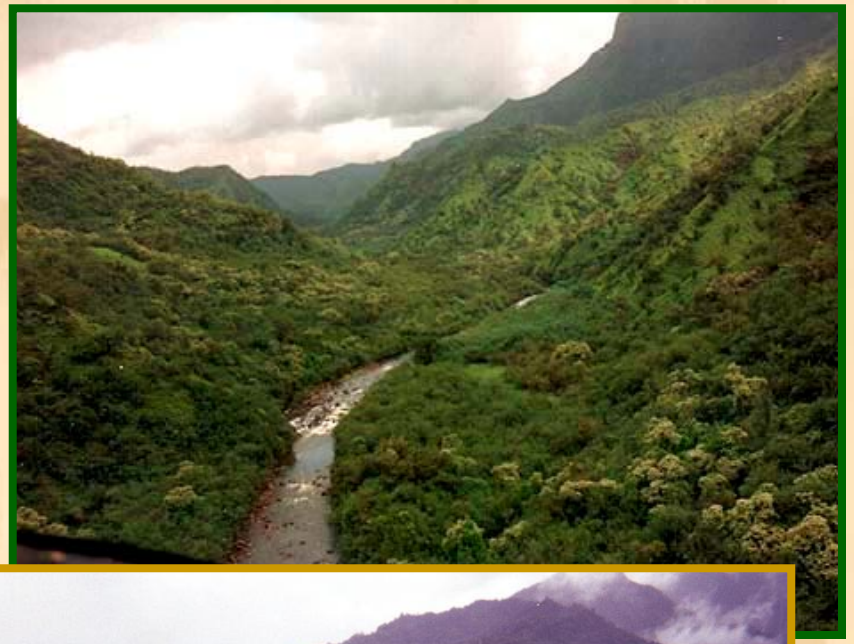


Sediment Issues

- What is the contribution of each source to watershed sediment yield?
- Landslides
  - What is the physical process?
  - What is the sediment delivery?
- Feral pigs appear to be a major culprit
  - Nature's rototilling machine
  - Model erosion using crop cultivation factors

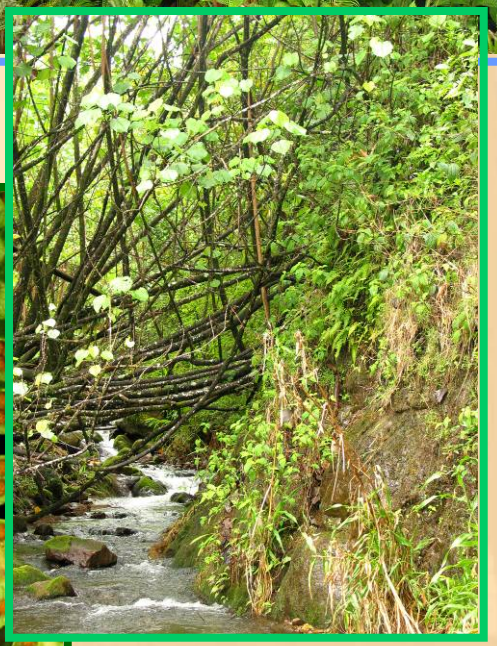
Runoff Issues

- Runoff Curve Numbers?
- Interaction of surface and subsurface flows
  - Quick return flows
  - Springs
- Lack of baseflow in model
- Modeling of taro fields in lower watershed
- Tidal influence

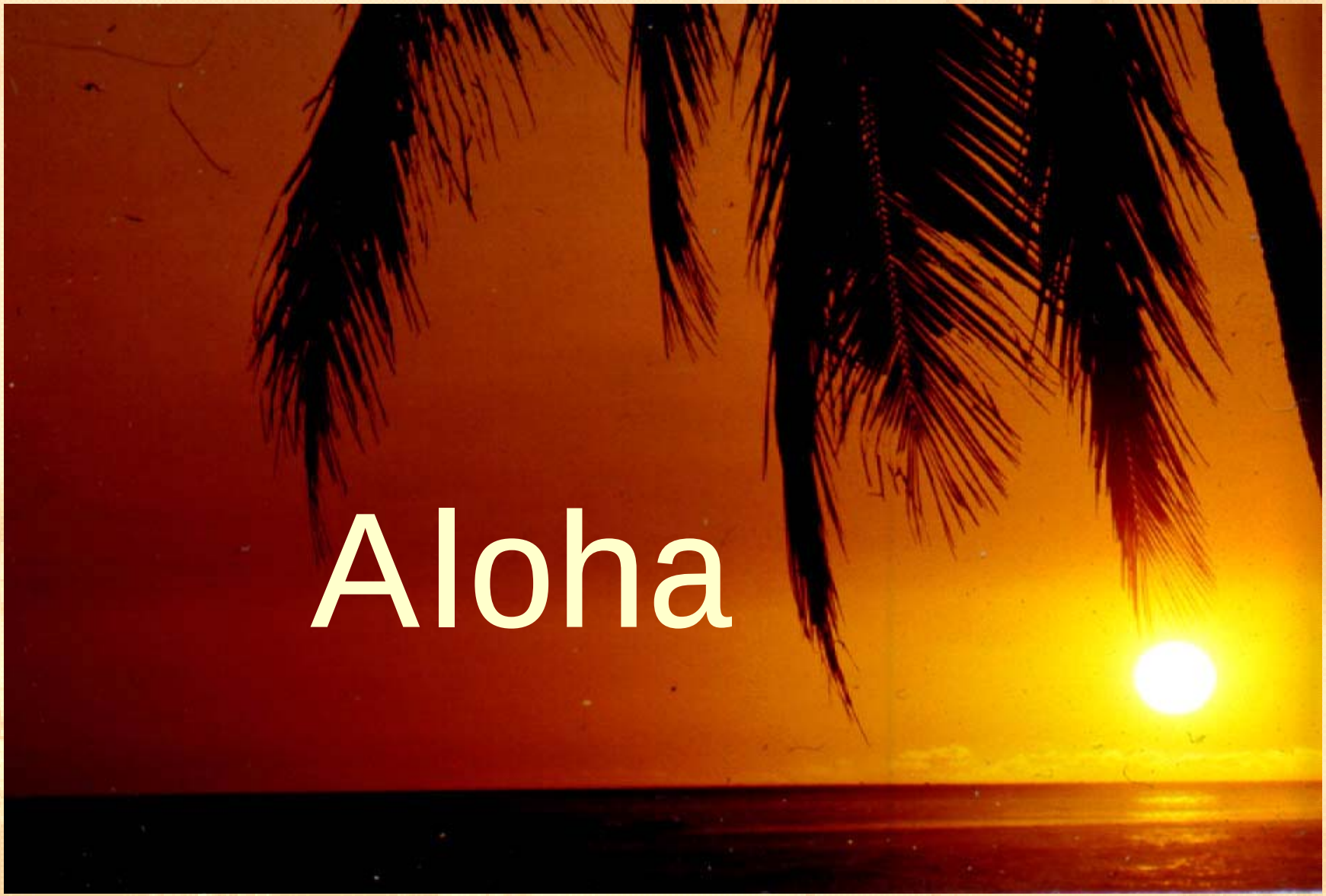


Vegetative mapping

- Native communities vs. Alien, invasive communities
- How do different plants affect runoff, erosion?
  - Root mass
  - Rainfall interception
  - ET
- New technologies
  - Imagery
  - GPS



The progress that we have made is due the tremendous support of scientists and staff


Aloha