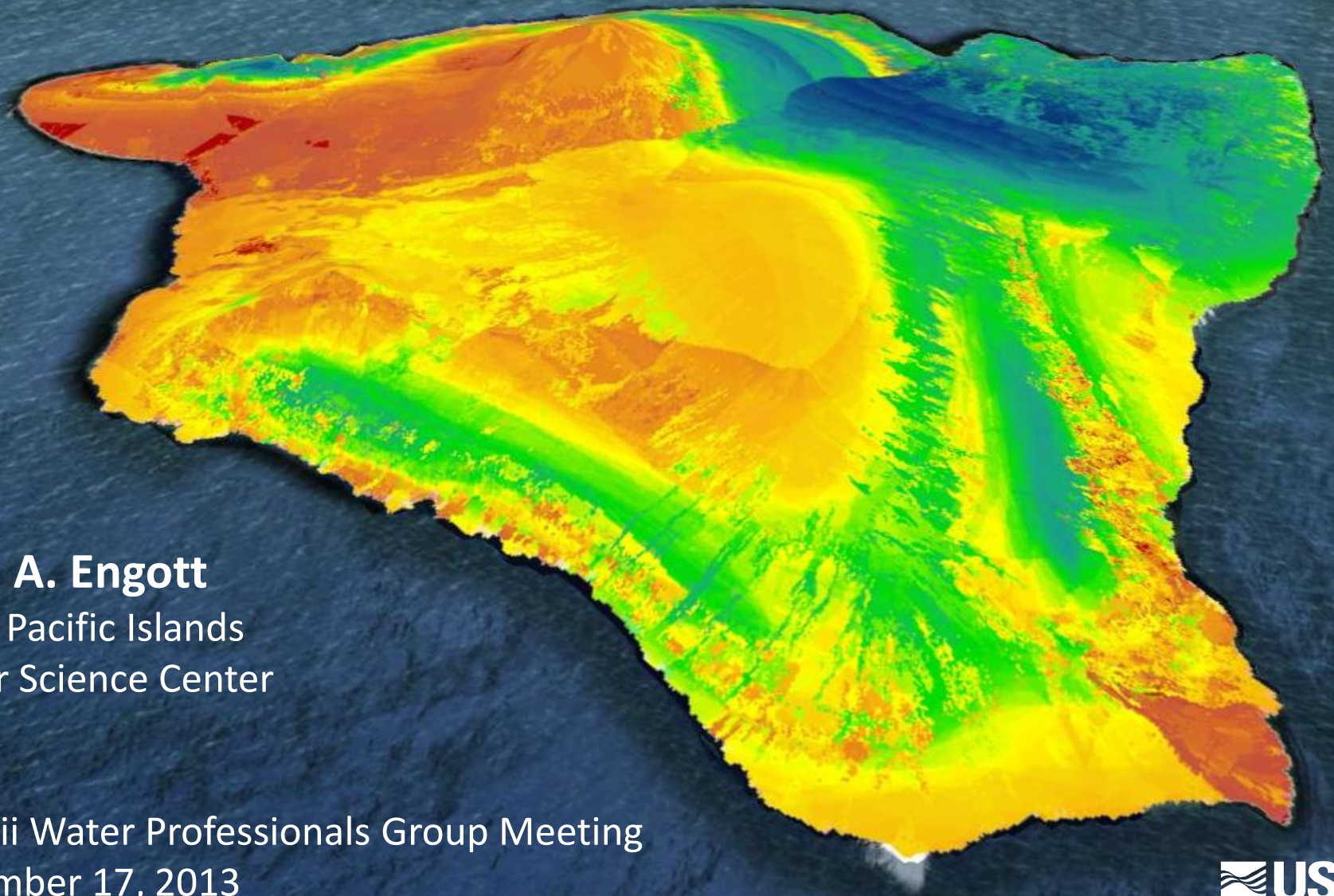
Water Budget and Recharge Estimation for the Big Island



John A. Engott
USGS Pacific Islands
Water Science Center

Hawaii Water Professionals Group Meeting
December 17, 2013

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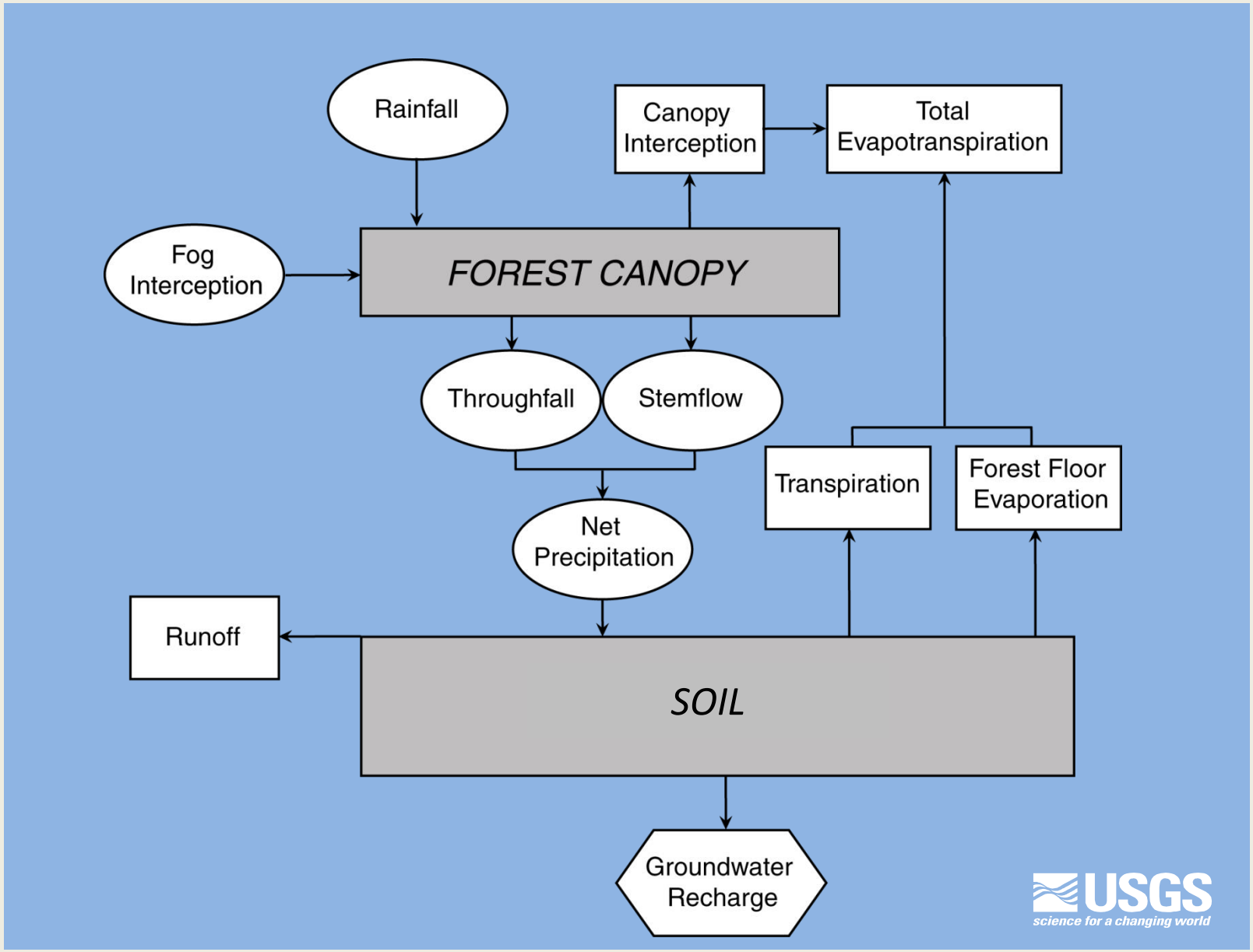
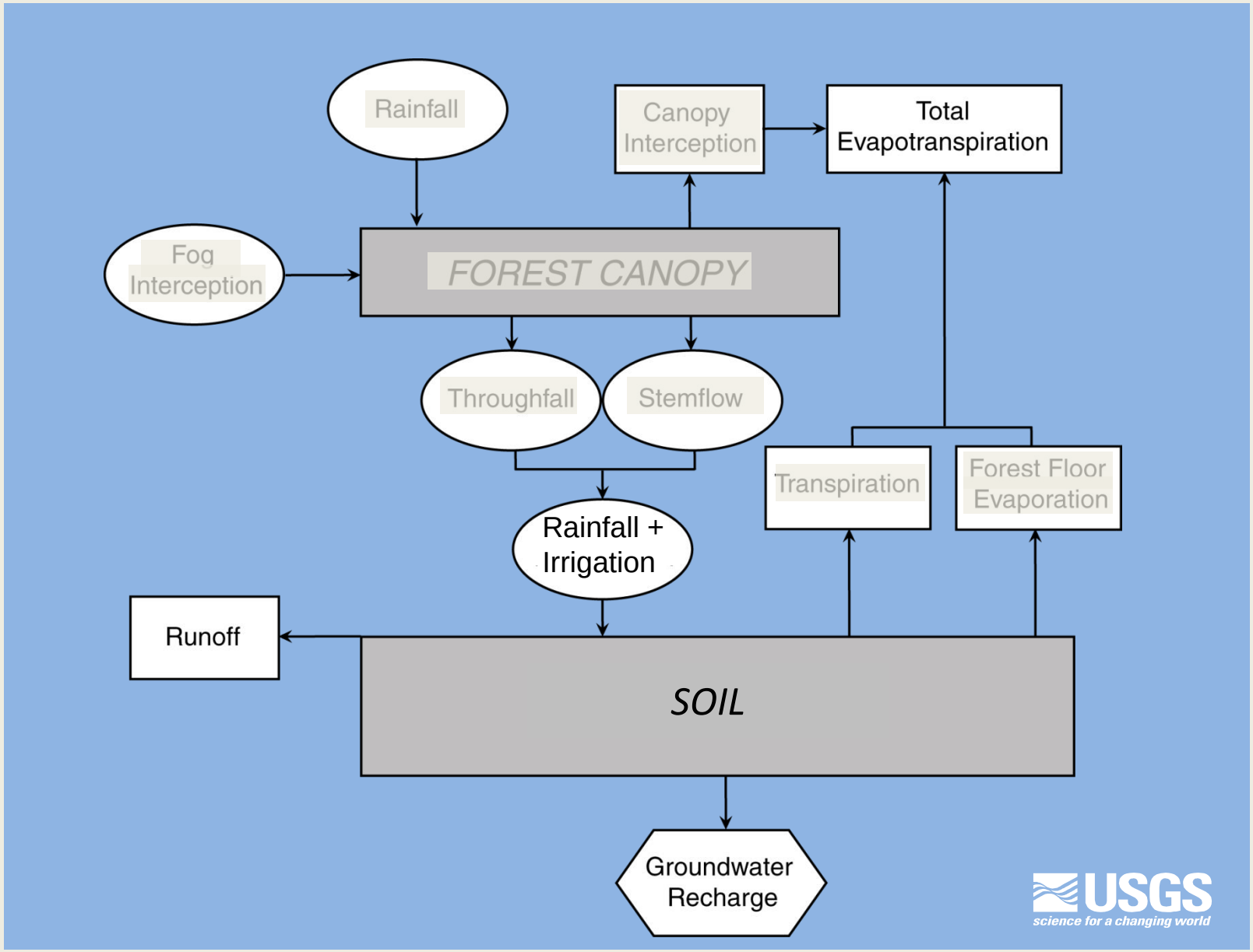
Water Budget for Forested Areas



Water Budget for Unforested Areas



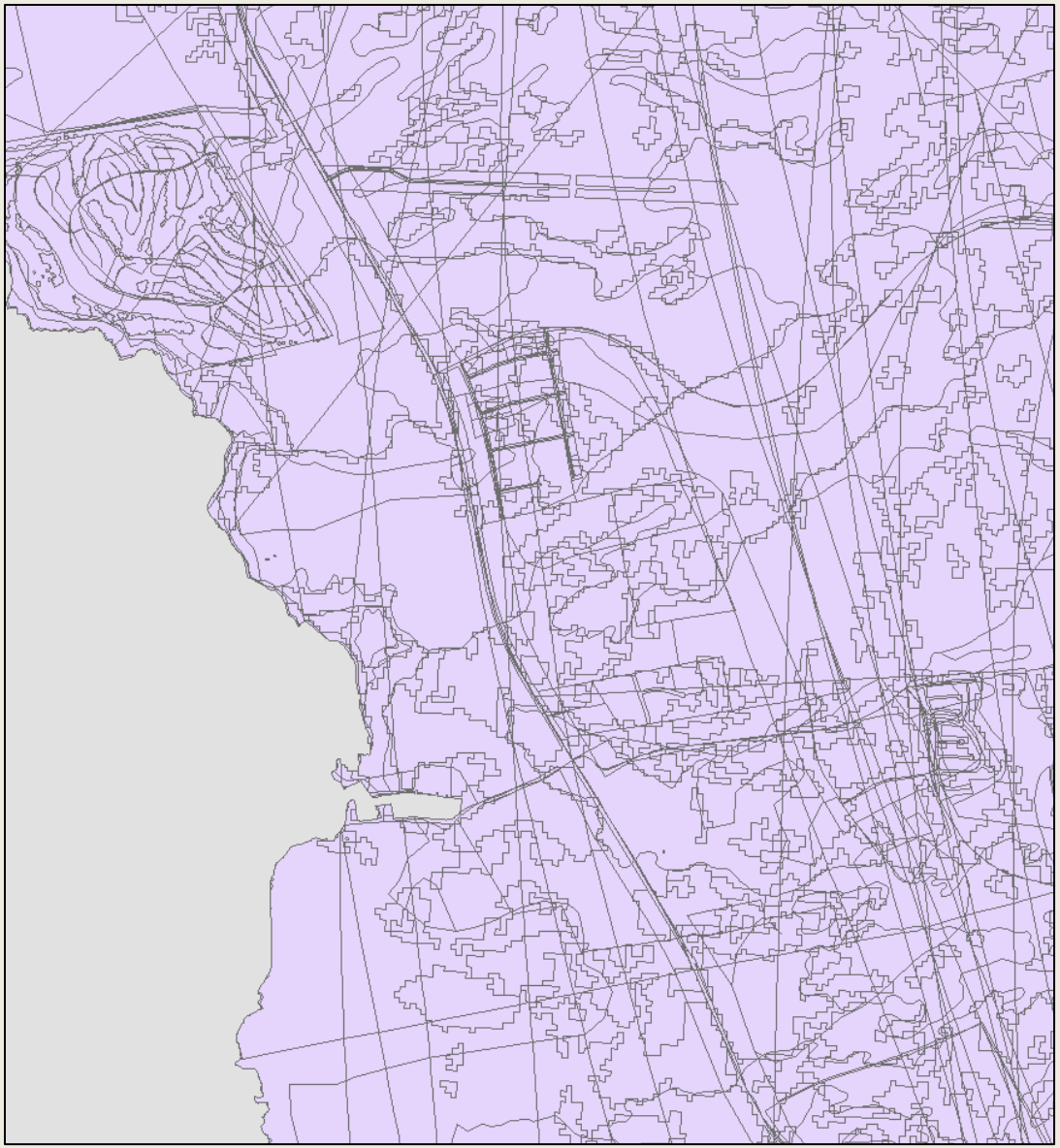
Water-Budget Subareas

Water budget calculated independently on subareas

Subareas have unique sets of input parameters (rainfall, fog, irrigation, pan evaporation, land cover, soil, etc.)

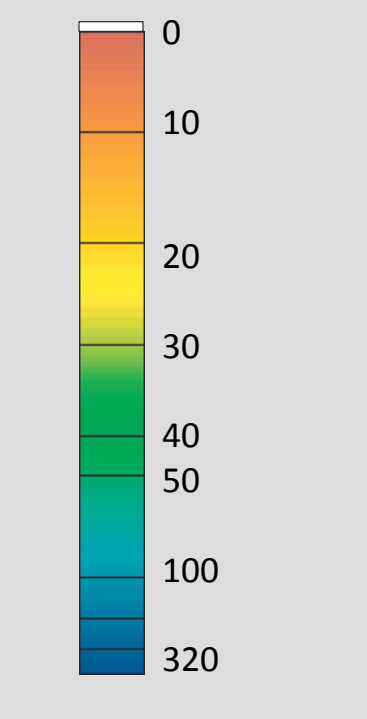
GIS data layers are merged to determine subareas

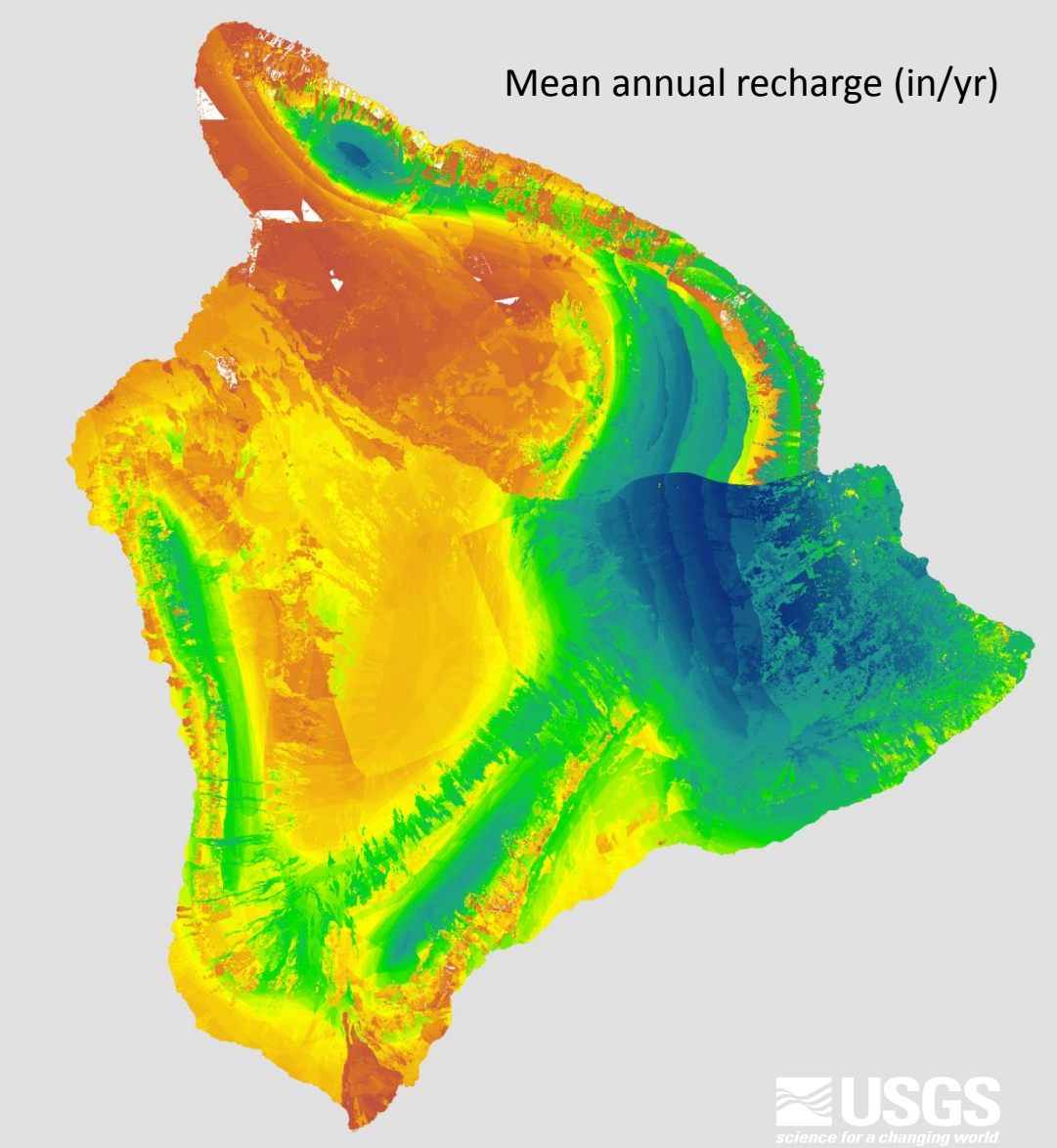
467,805 subareas in the Big Island water budget



Estimated Baseline Recharge Distribution

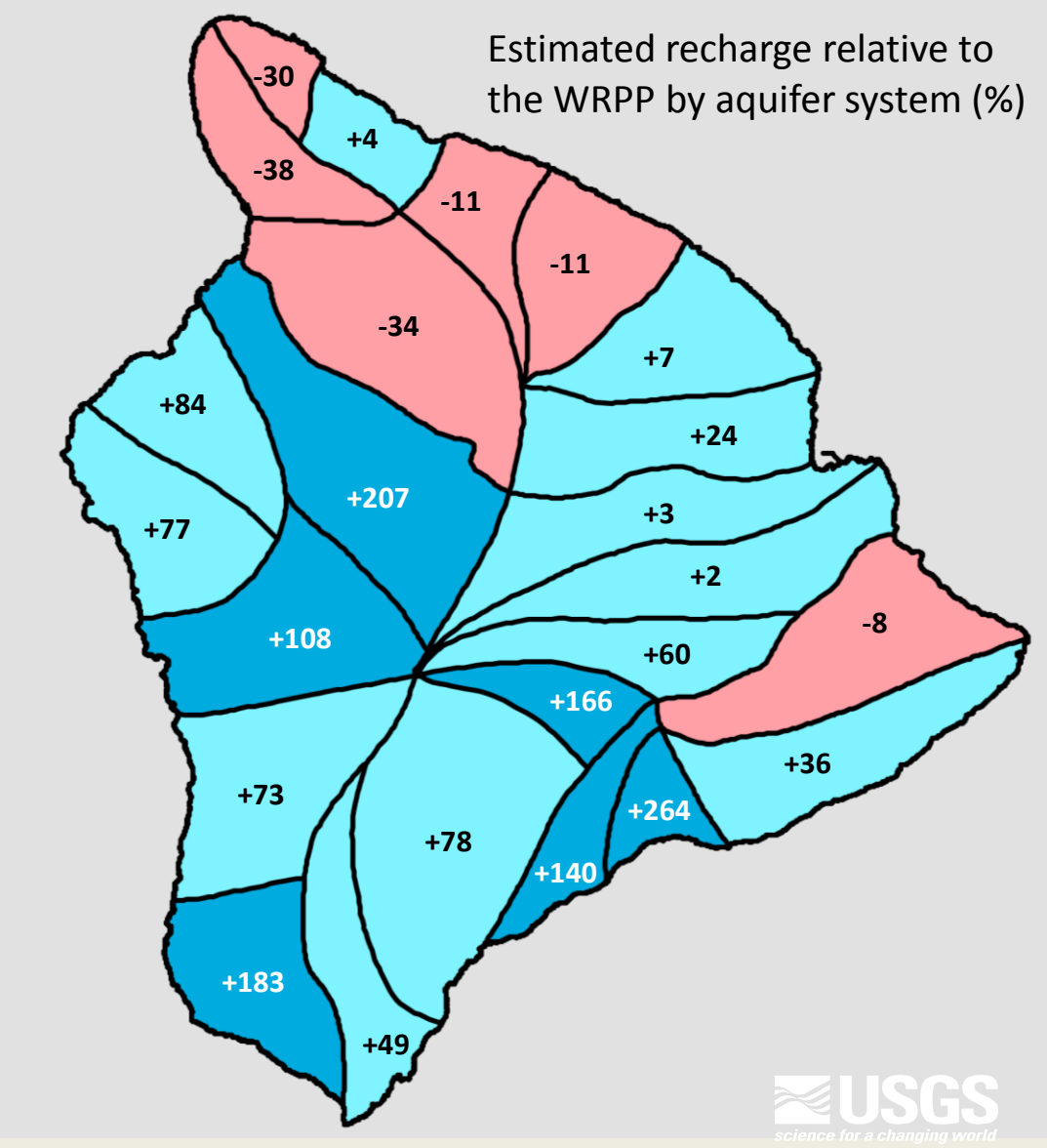
- 2008 land cover
- Mean rainfall from 1916-83 (Giambelluca and others, 1986)
- Mean pan evaporation (Ekern and Chang, 1985)





Recharge Difference Relative to WRPP

- 2008 land cover
- Mean rainfall from 1916-83 (Giambelluca and others, 1986)
- Mean pan evaporation (Ekern and Chang, 1985)

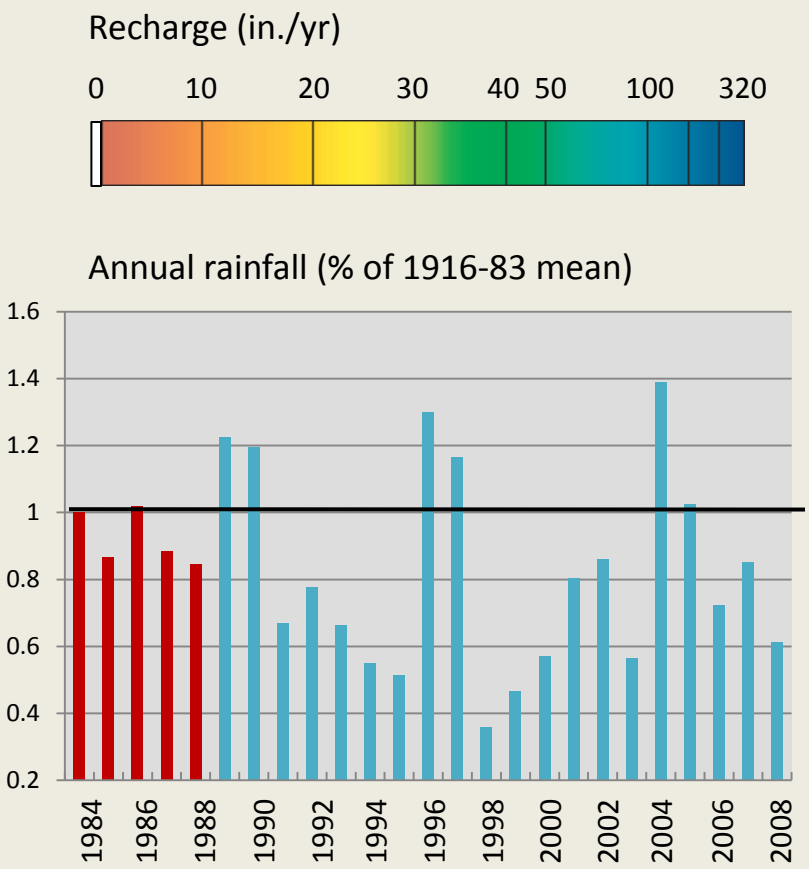


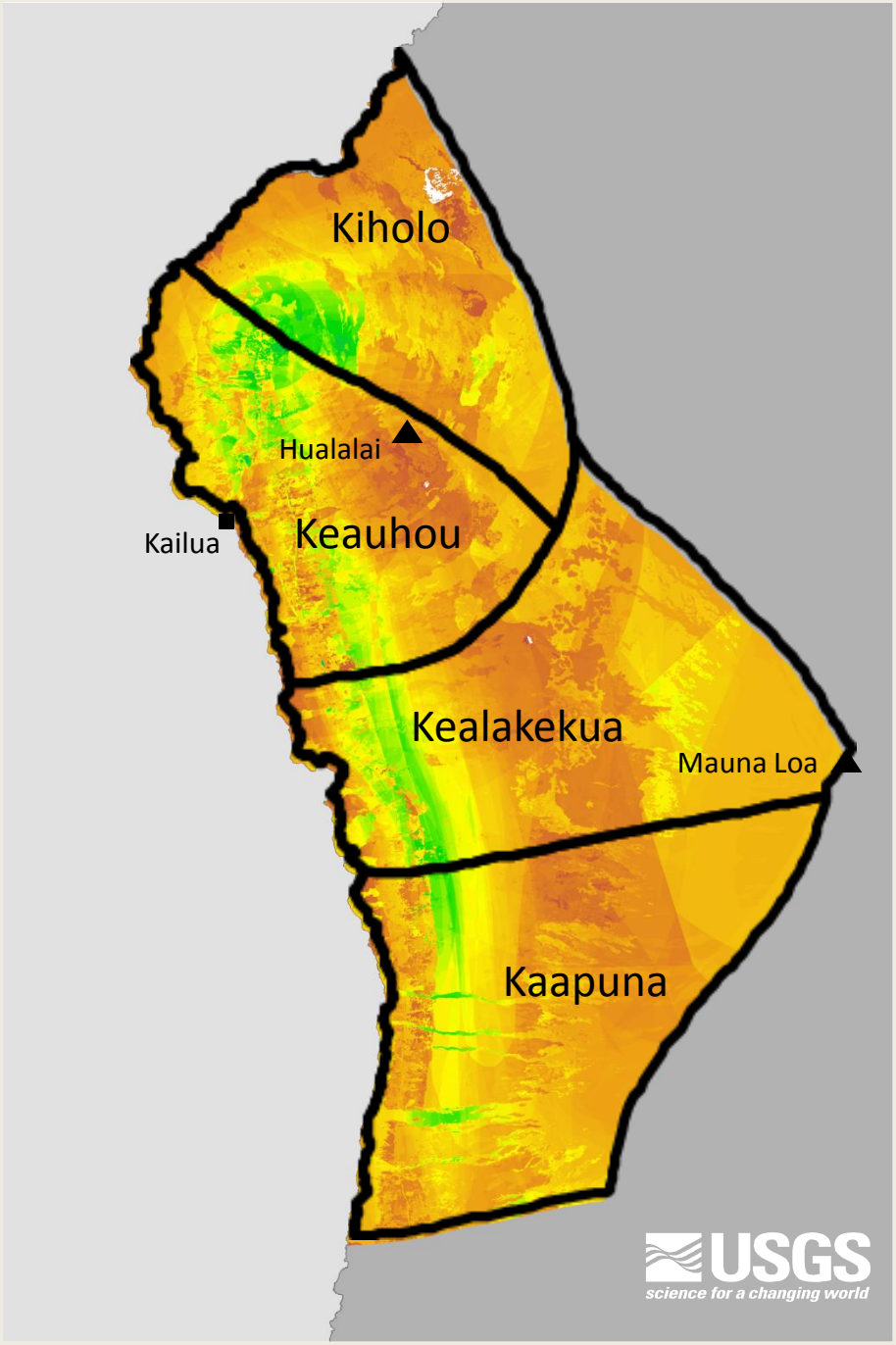
Reasons for Difference

	This study	WRPP (1990)
Time step	Daily	Annual
Fog interception	Included	Not included
Runoff	Subtracted baseflow	Did not subtract baseflow
Evapotranspiration	Calculated from soil moisture, land cover, and soil type	Equal to potential (maximum)

Kona-Area Recharge 1984 through 2008

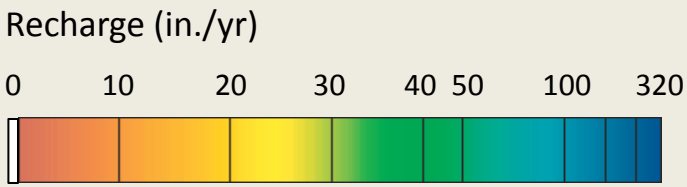
1984-1988

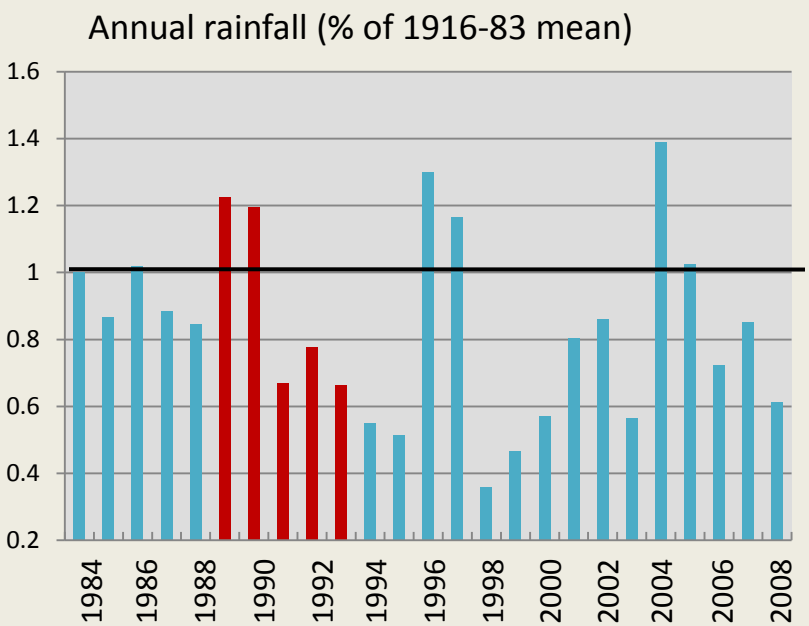


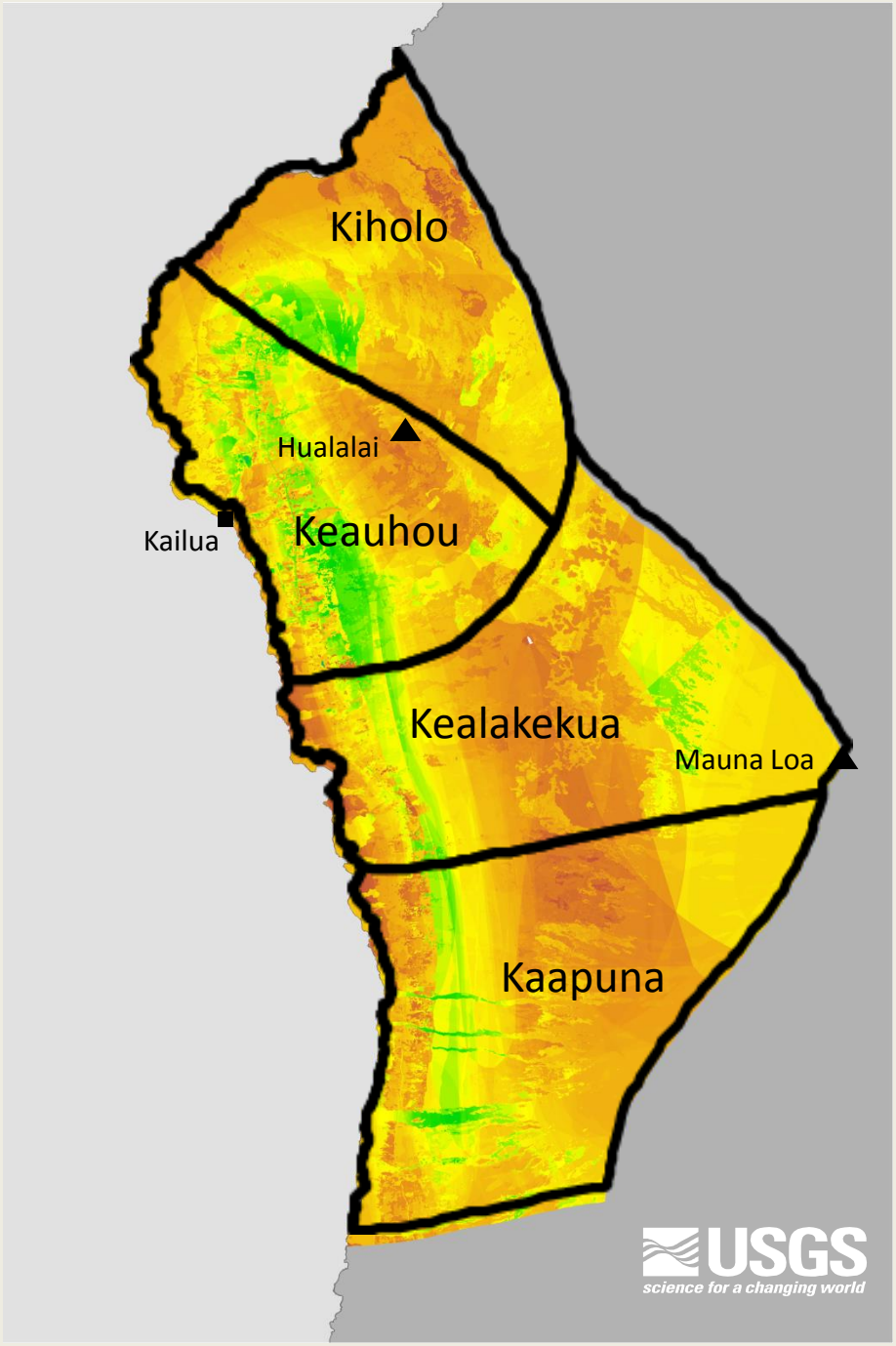


Kona-Area Recharge 1984 through 2008

1989-1993

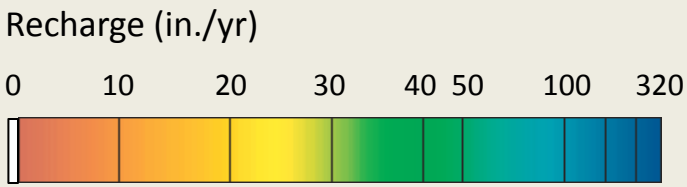


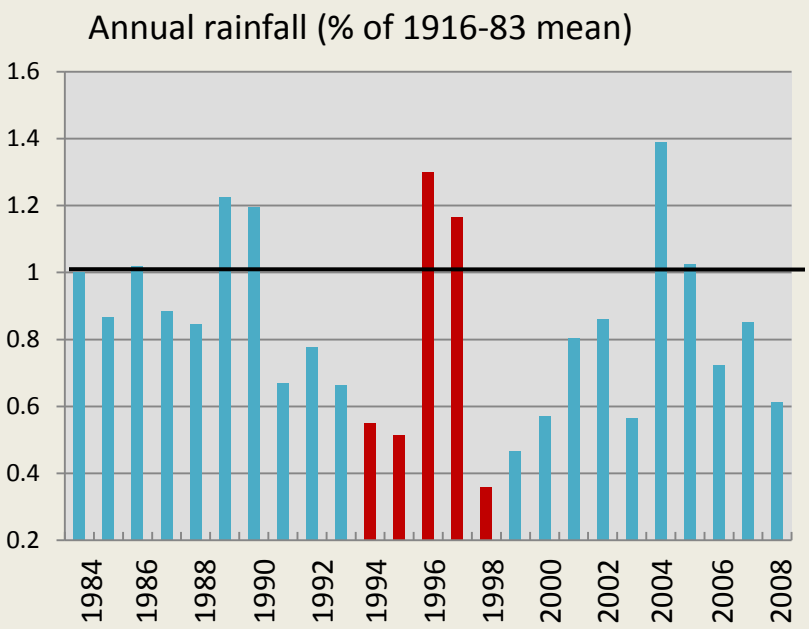


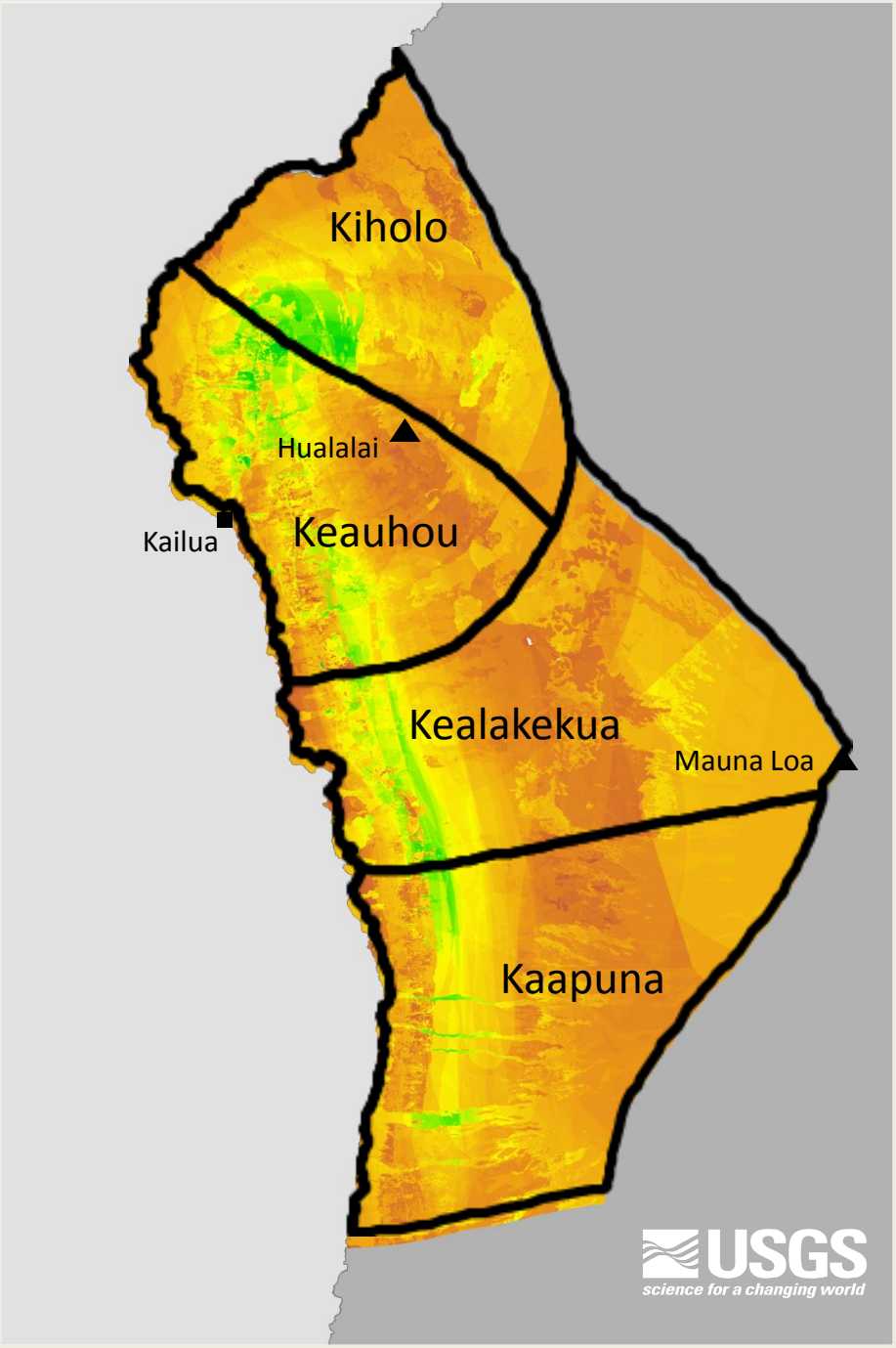


Kona-Area Recharge 1984 through 2008

1994-1998

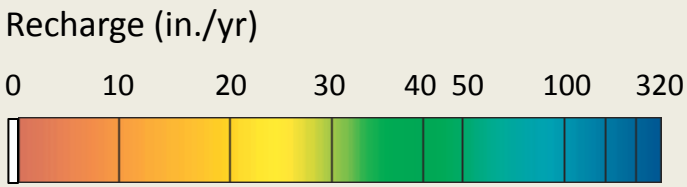


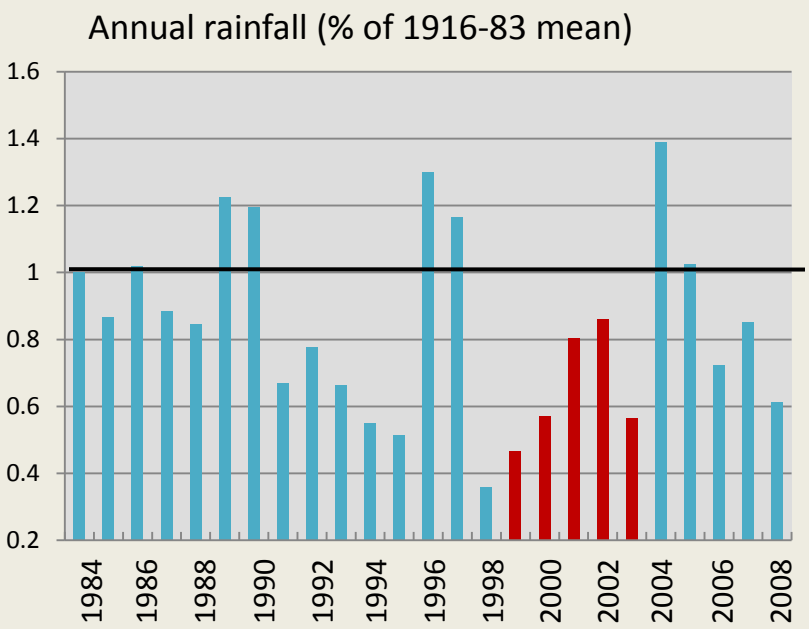


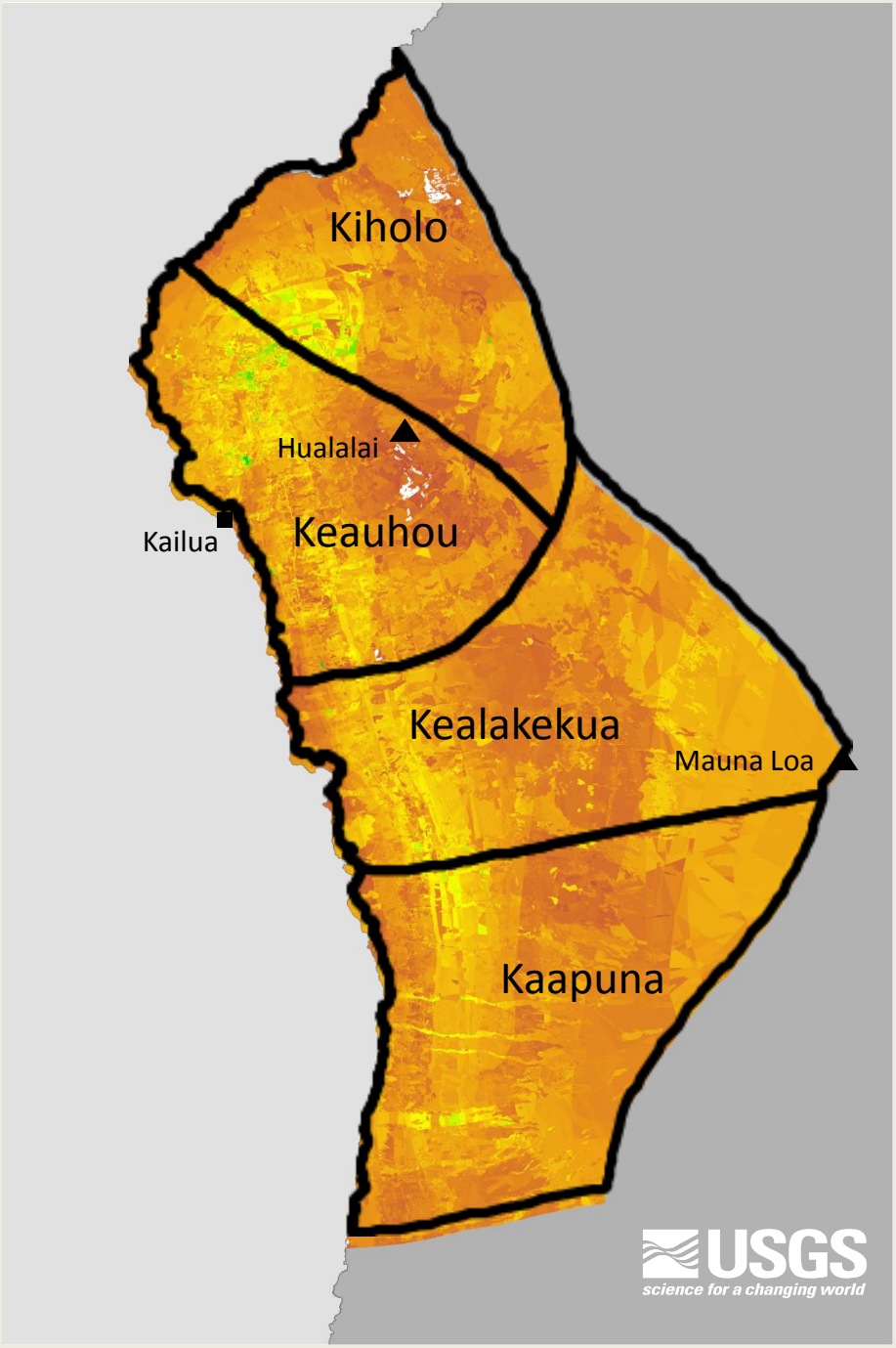


Kona-Area Recharge 1984 through 2008

1999-2003

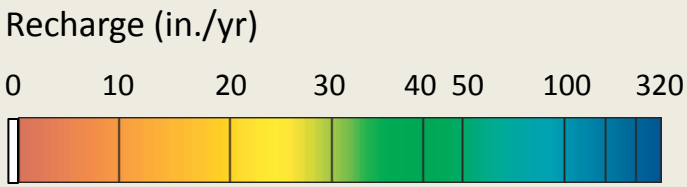


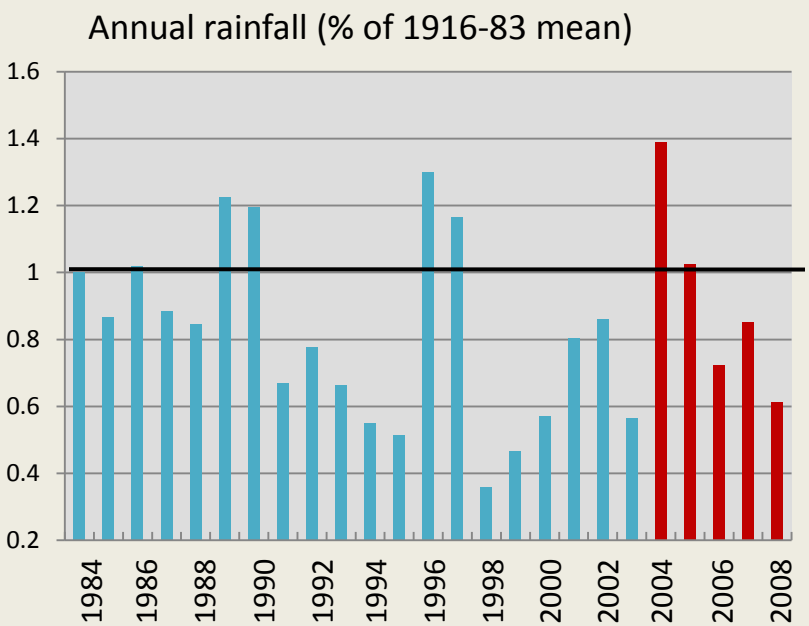


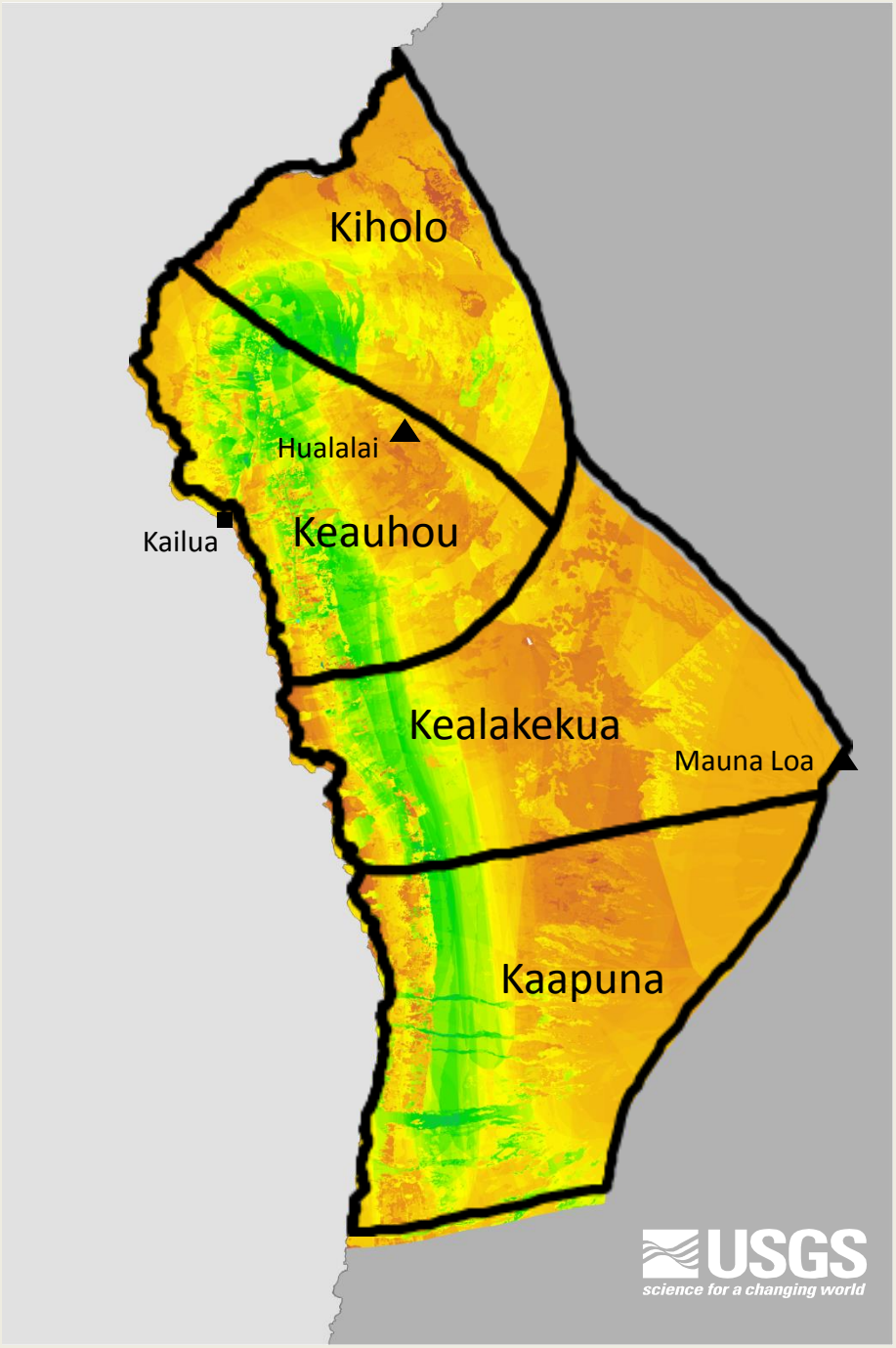


Kona-Area Recharge 1984 through 2008

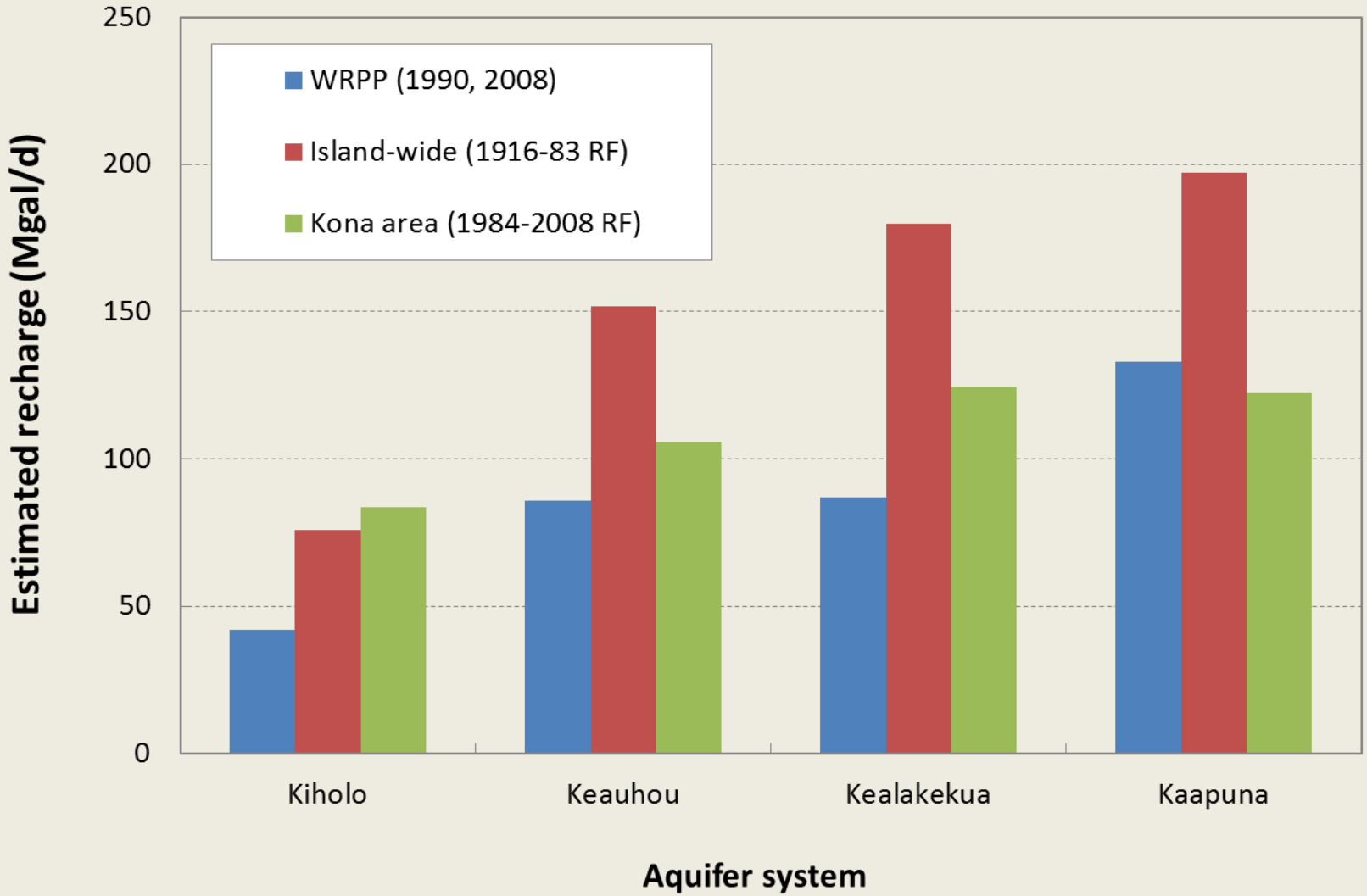
2004-2008







Kona-Area Recharge



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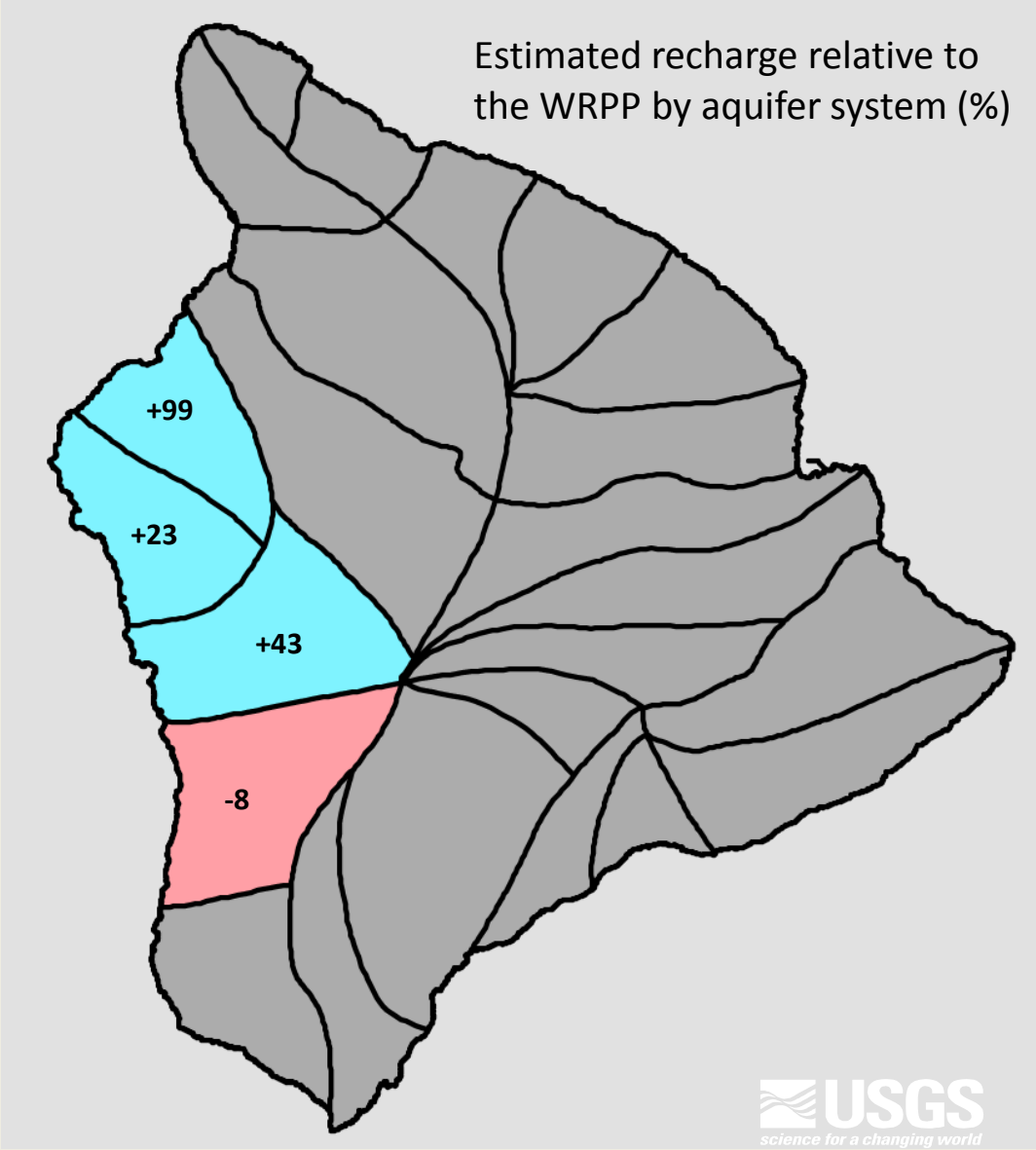
Recharge Difference Relative to WRPP

- 2008 land cover
- Estimated rainfall time series from 1984-2008
- Mean pan evaporation (Ekern and Chang, 1985)



New Datasets

(Not used in Big Island recharge report)

- Rainfall Atlas of Hawaii (2011) (T. Giambelluca and others)
  - 1978-2007 base period
- Gridded dataset of historical monthly rainfall (A. Frazier and others) *unpublished*
  - 1920-2007 (soon to be through 2010)
- New ET datasets are being finalized (T. Giambelluca and others

Updated Methods

(Not incorporated in Big Island recharge report)

- Runoff
  - Method uses regression equations based on new climate data and soil properties in ungaged basins
- Canopy interception
  - Method uses a published (Gash) model calibrated using new ET dataset

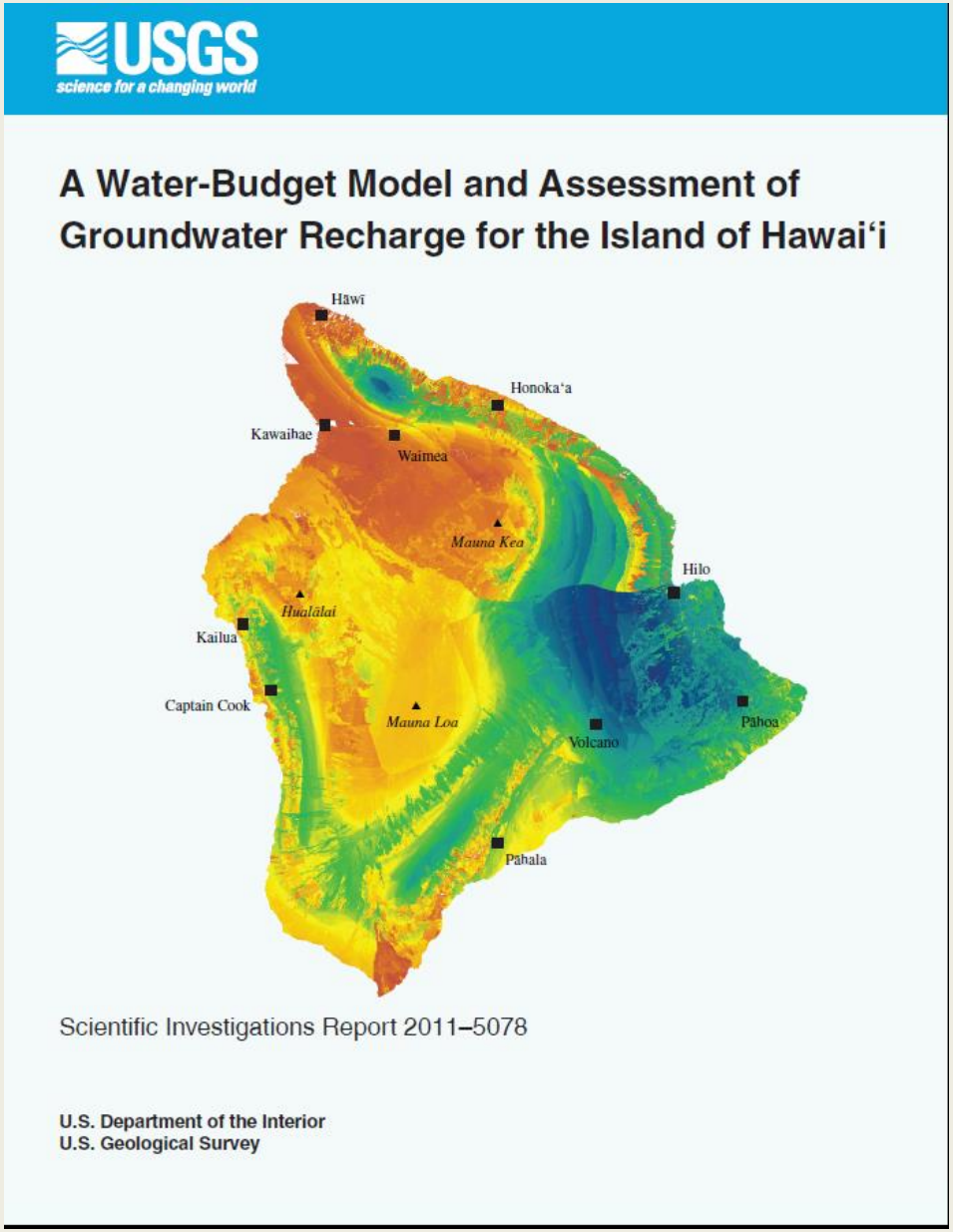
Ongoing Recharge-Estimation Projects

Island	1870	1978-2007	2001-2010	Other	Cooperators	Completion
Kauai	-	X	X	-	USGS GWRP	2015
Oahu	X	X	X	1900-2010 in 10-yr periods, future climate	USGS GWRP, CWRM, HBWS	2014-15
Maui	-	X	X	Drought, future climate	USGS GWRP, CWRM, MDWS, Pacific RISA	2014-15
Molokai	-	-	-	1940-2010 in 10-yr periods	OHA, DHHL, MDWS	2014

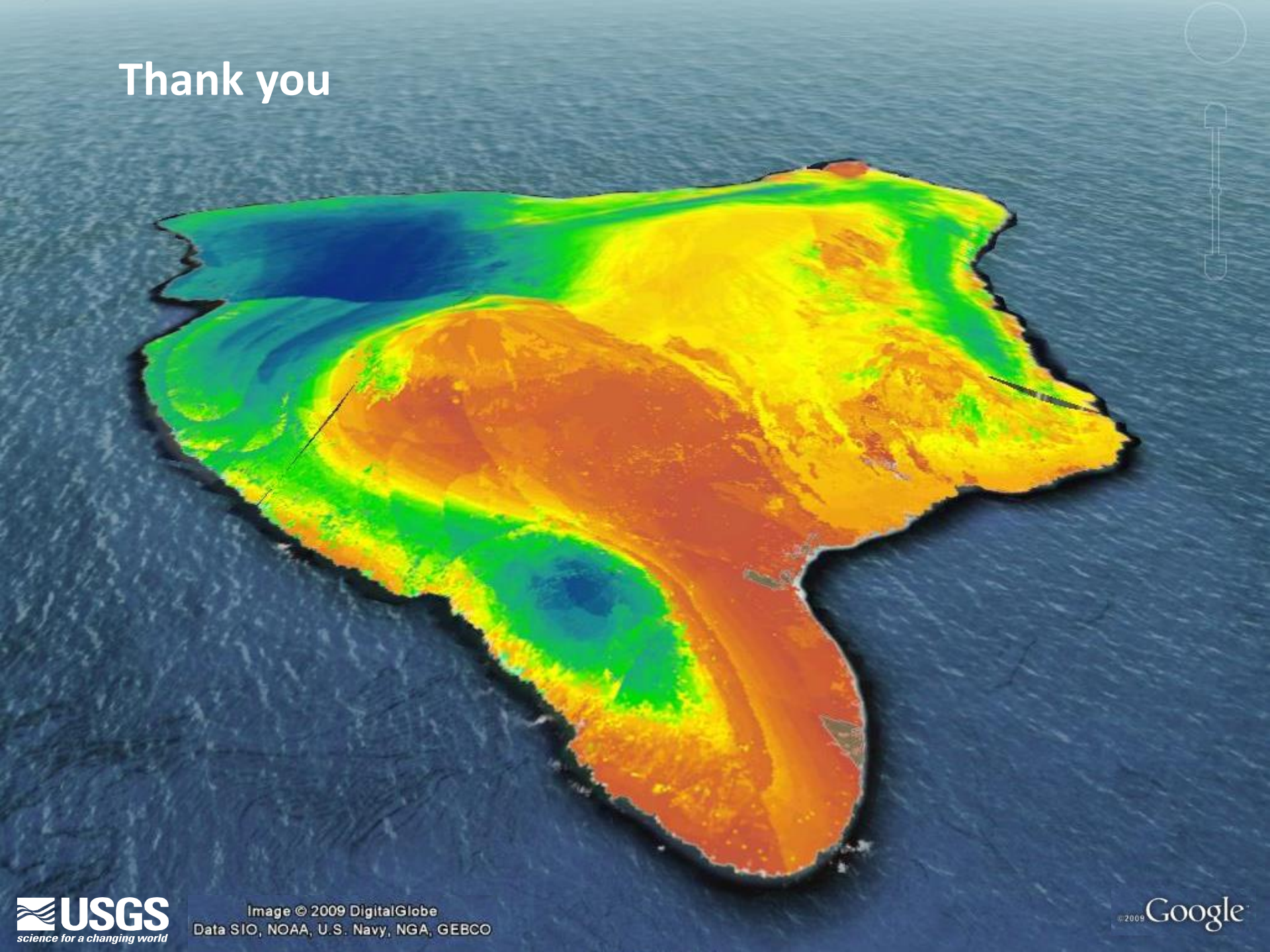
Report Available Online

USGS Scientific Investigations Report 2011-5078

http://hi.water.usgs.gov/



Thank you



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