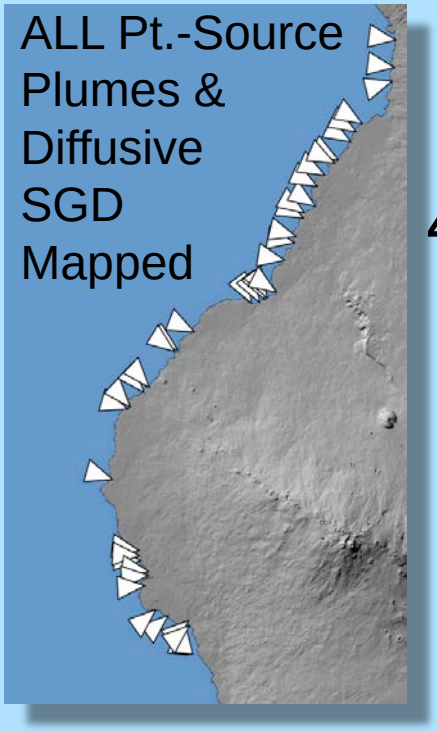
Upscale

SGD flux vs. RIVER flux



LEEWARD
Dry, No Streams

WINDWARD
Wet Tropical

TIR-UPSCALED SGD

WAILUKU RIVER

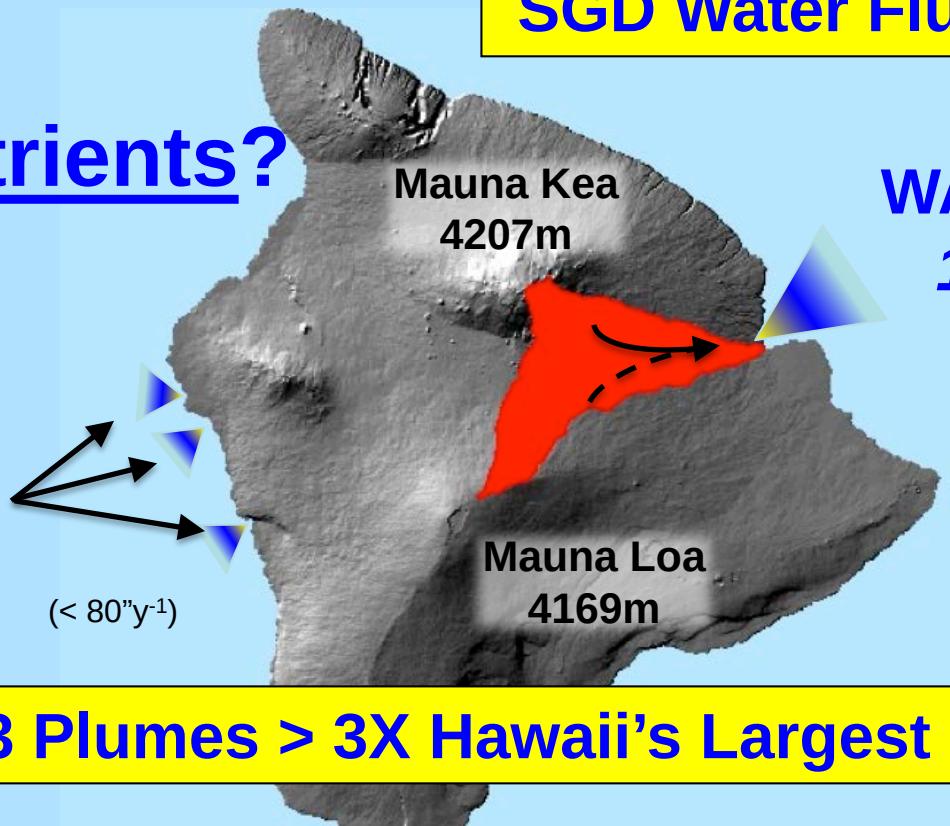
42 Large Plumes Combined vs. Hawaii's Largest River

SGD_{TOT}: 260,000 m^3d^{-1} < River: 663,500 $m^{-3}d^{-1}$

(FW:SW ~ 60:40)

SGD Water Flux < Rivers

Nutrients?



WAILUKU R.
1200 Mol NO_3 d^{-1}
(Wiegner et al., 2009)

3 LARGE PLUMES (only)
3800 Mol NO_3 d^{-1}
(SGD = 37,750 $m^{-3}d^{-1}$)

NO_3 Flux: 3 Plumes > 3X Hawaii's Largest River

Conventional Aircraft Limitations

1) What was actually occurring on the ground? Runoff from rain? Dynamic coastal processes (aquifer and waves)?

2) Time disconnect between REGIONAL TIR flight and LOCAL Rn time series, ocean monitoring & sampling, etc.

3) Expensive and weather dependent (cloud cover).

4) Overnight flights at low tide hard to coordinate.

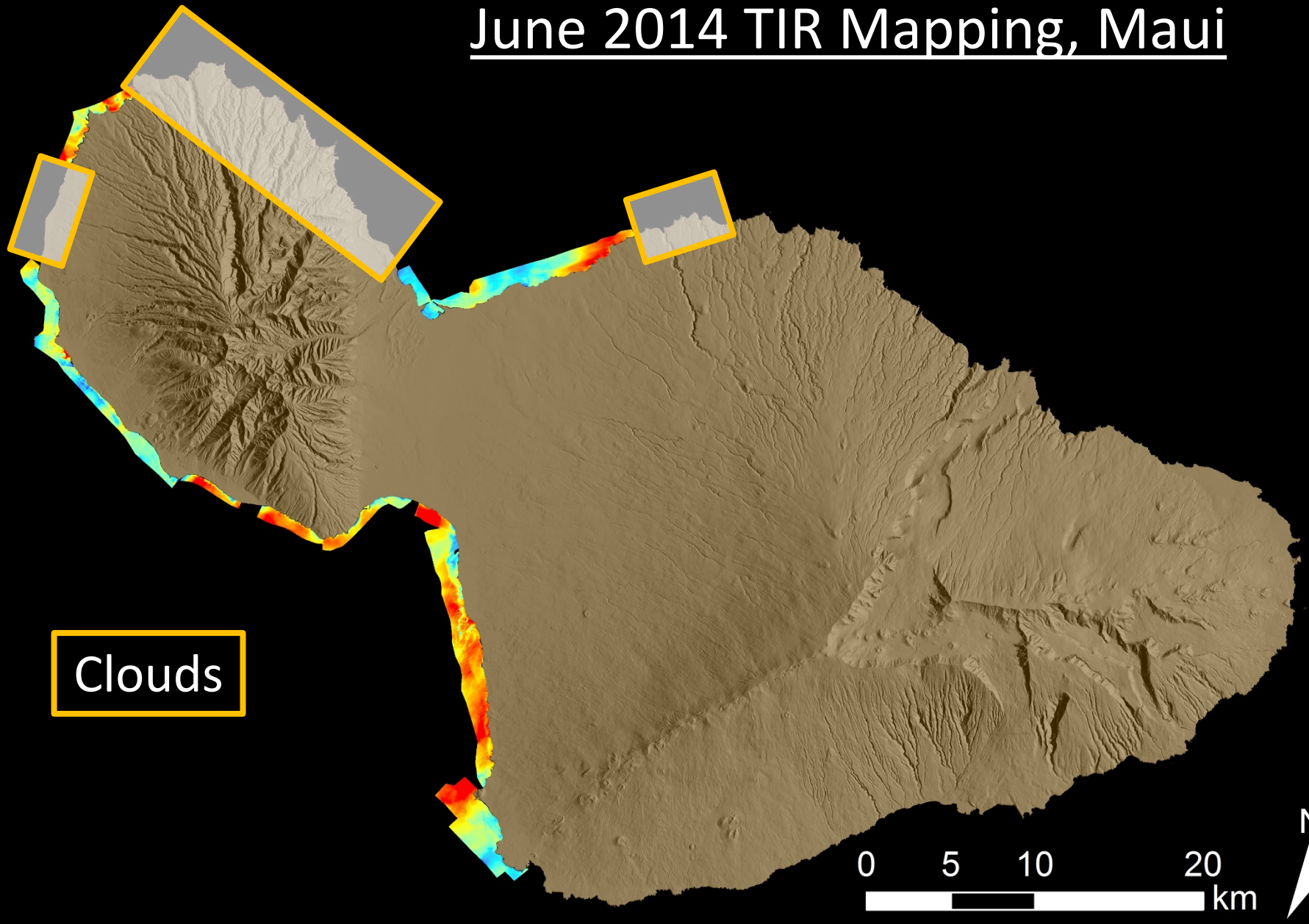
5) Resolution from High Altitude – Is it good enough?

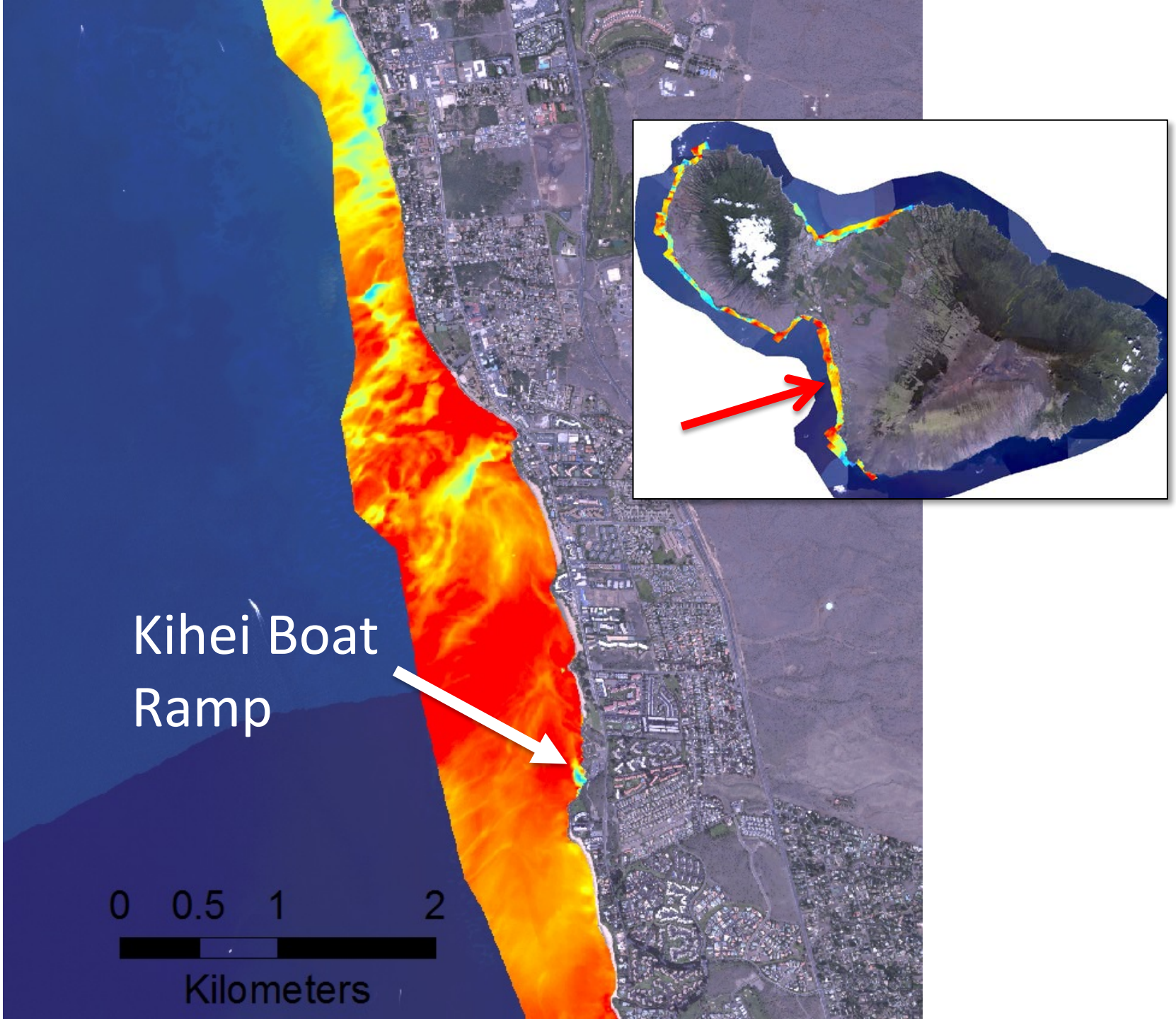

I thought you wanted high resolution...

Time Series TIR Imaging

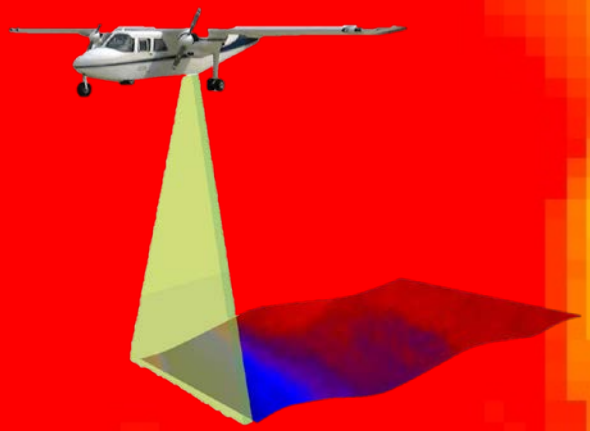
28 April, 2015

June 2014 TIR Mapping, Maui



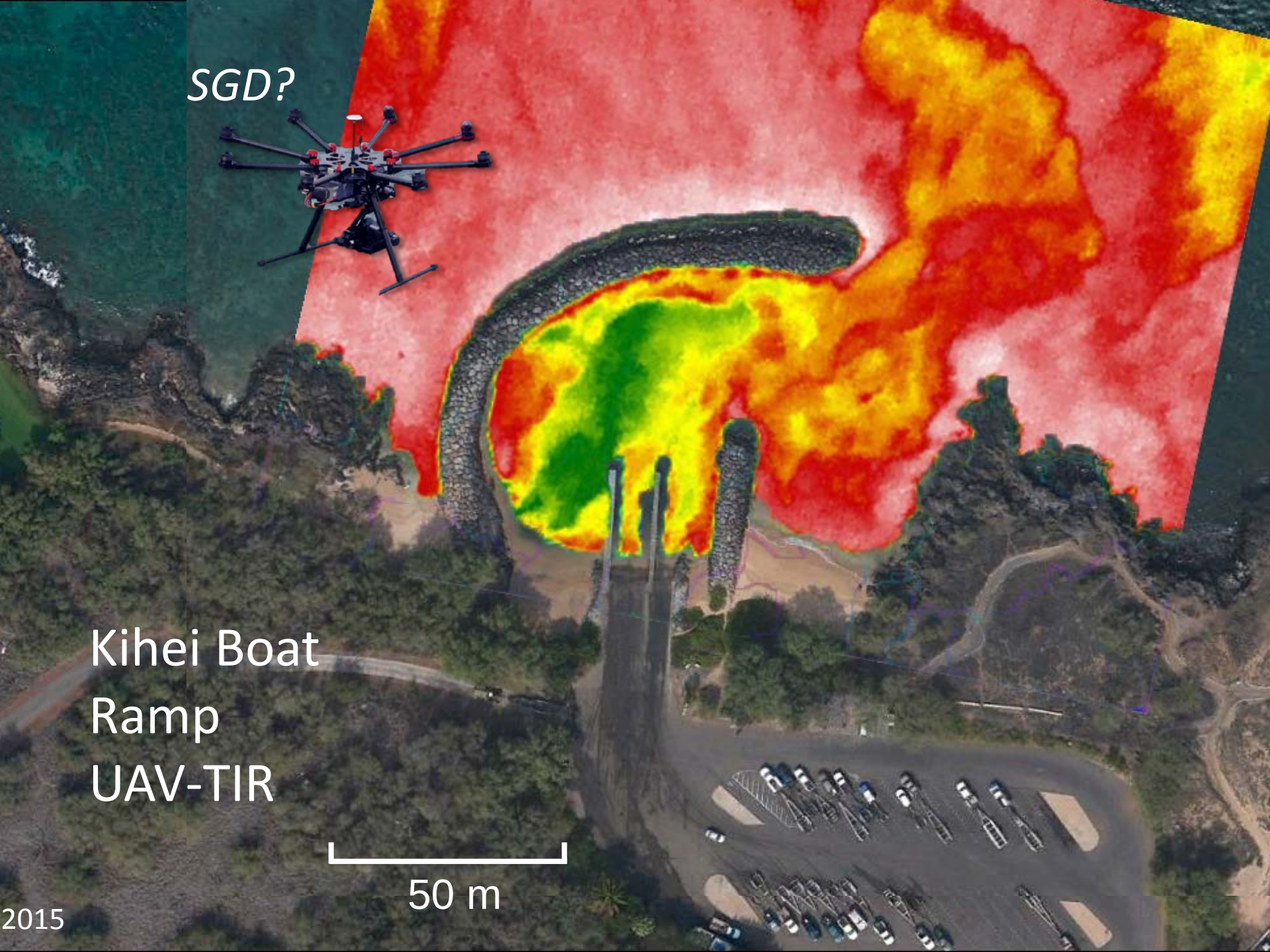

Kihei Boat Ramp
0 0.5 1 2
Kilometers

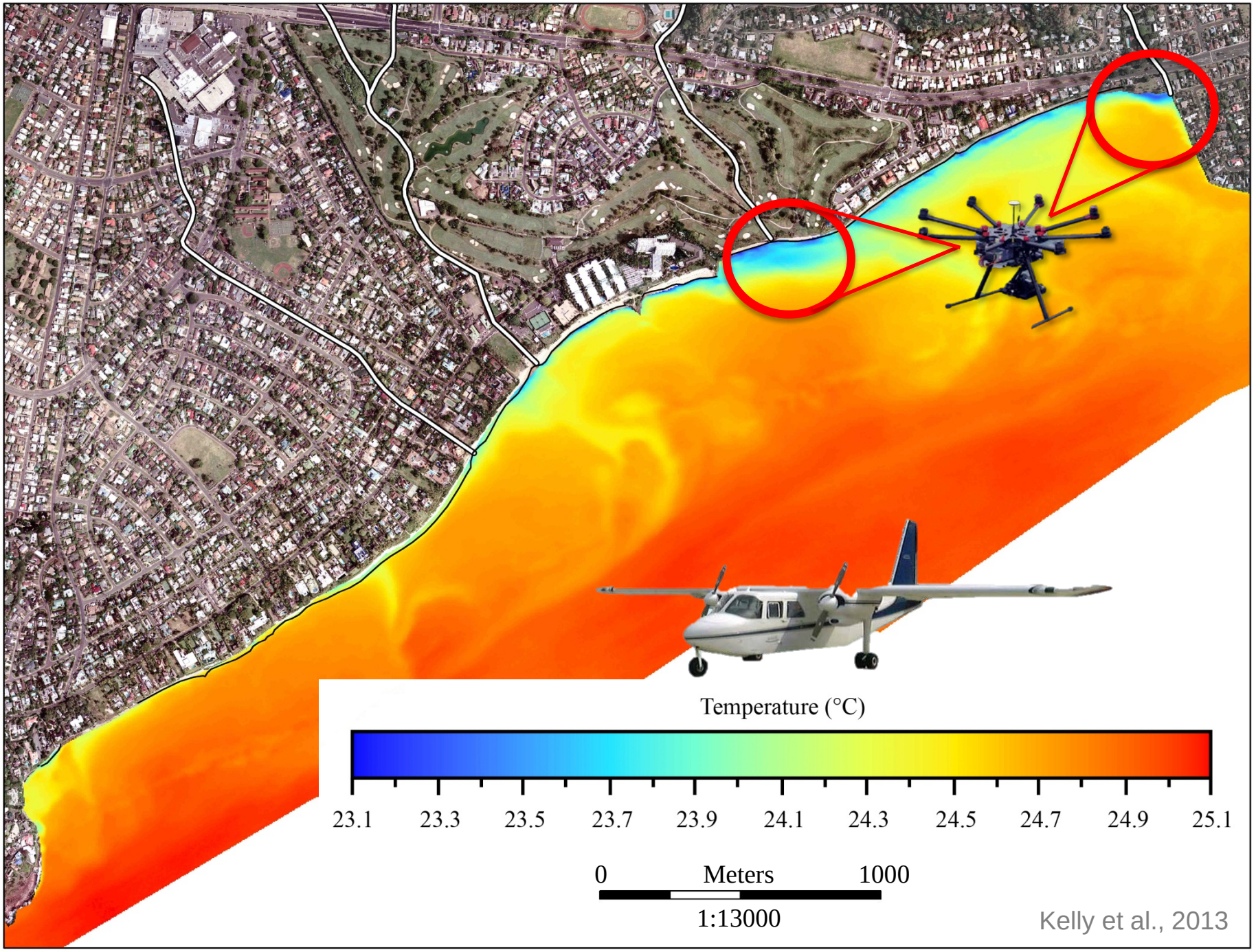
Kihei Boat Ramp High Altitude TIR



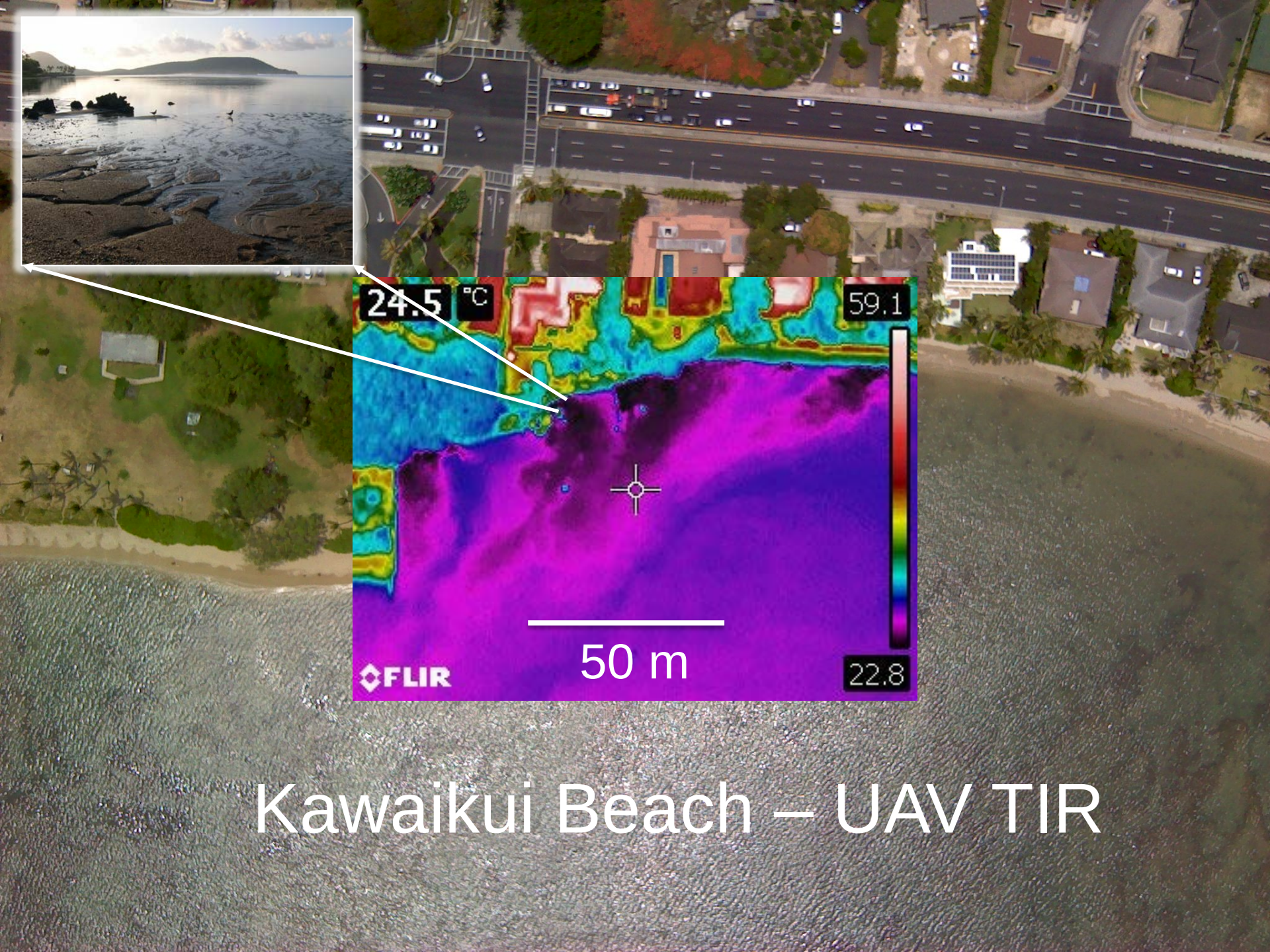
Altitude = 7000 feet
= 2134 m
Pixel Size = 3.2 m

0 25 50 100
Meters


SGD?
Kihei Boat
Ramp
UAV-TIR
50 m
2015



Kelly et al., 2013



Kawaikui Beach – UAV TIR

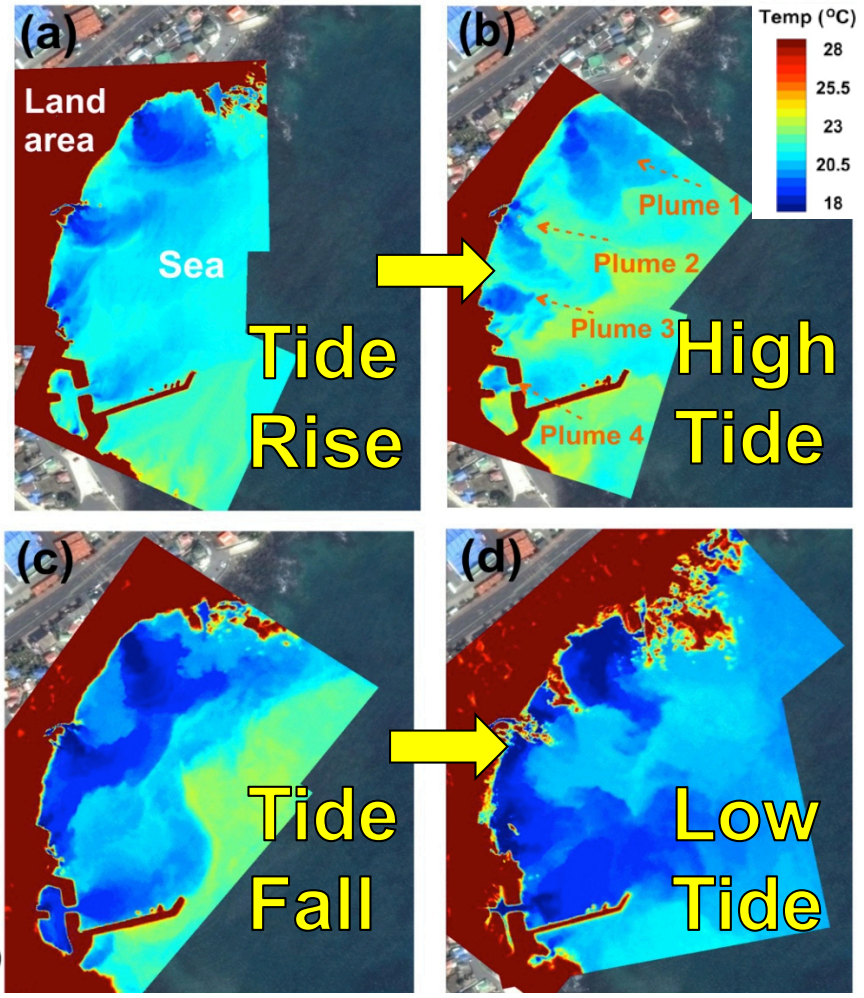
TIR SGD Mapping by Aircraft

- Regional Scale Detection/Mapping
- Upscaling & Downscaling
- Nutrient and Other Integrations

DJI S1000/FLIR 450sc

TIR SGD Mapping by UAV

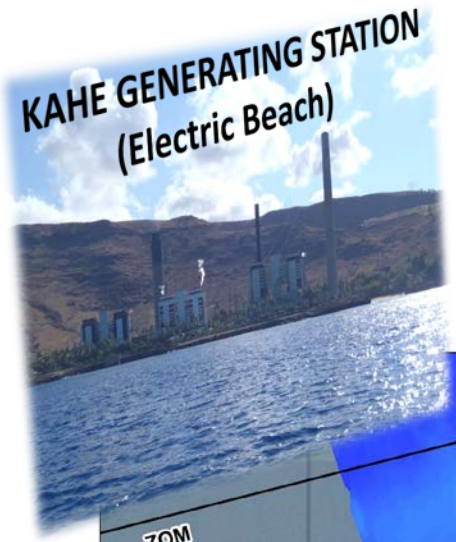
- Real Time
- Concurrent Ocean and Groundwater Studies
- TIR Time Series
- Extremely High Resolution
- No Cloud Block Out
- Cost Effective

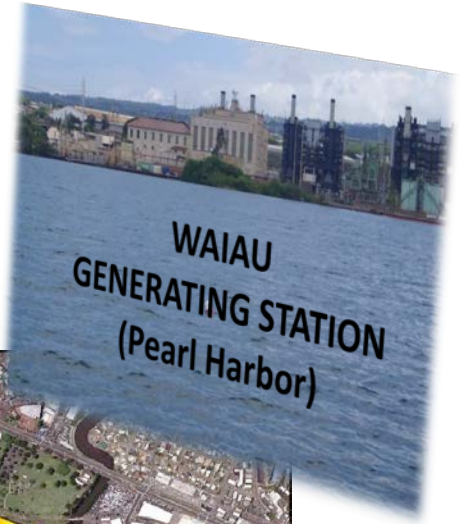


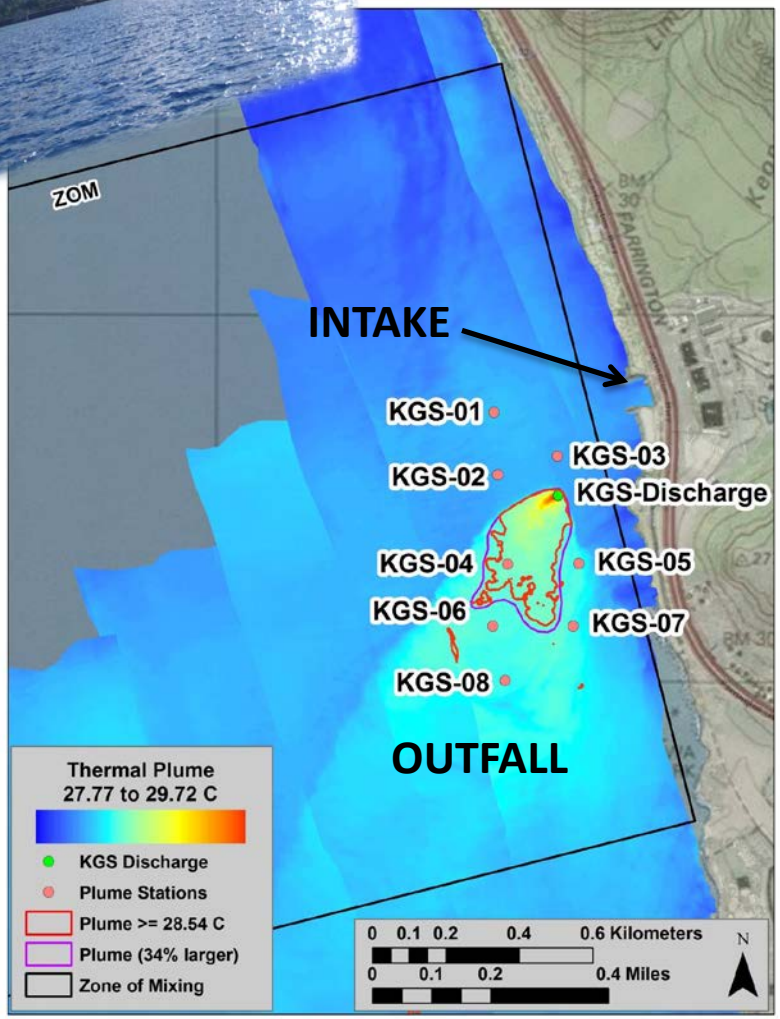
Jeju Is,. Koera (E. Lee)

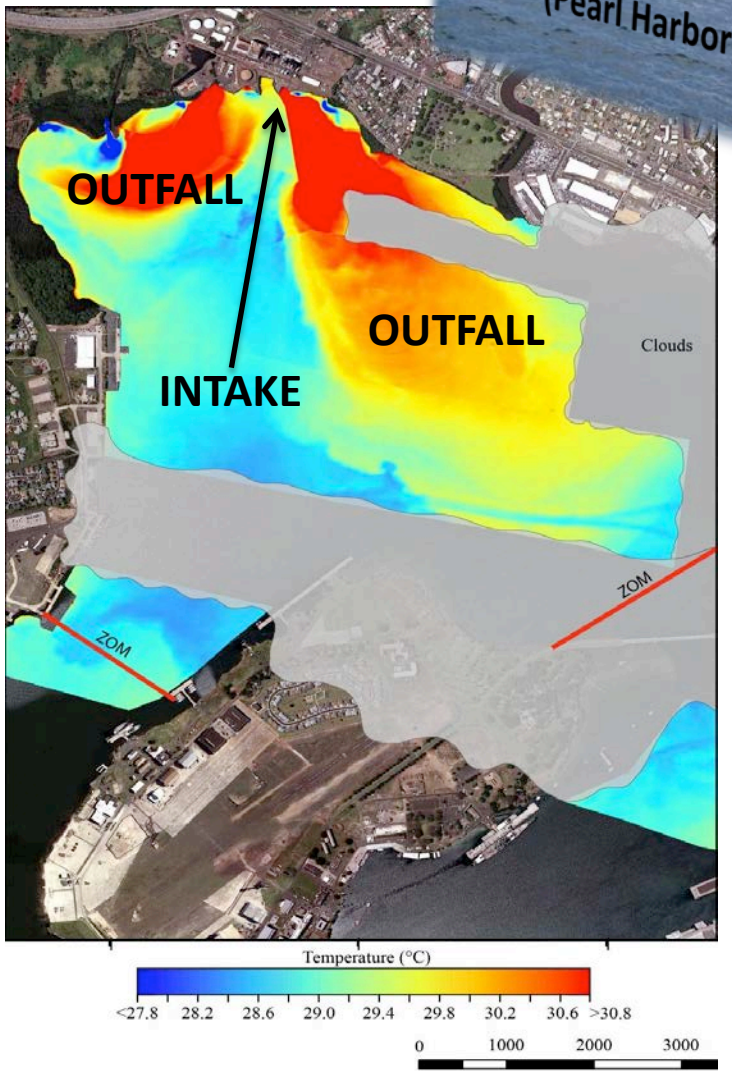
Thank You!

APPLICATION
POWER PLANT
DISCHARGE MONITORING



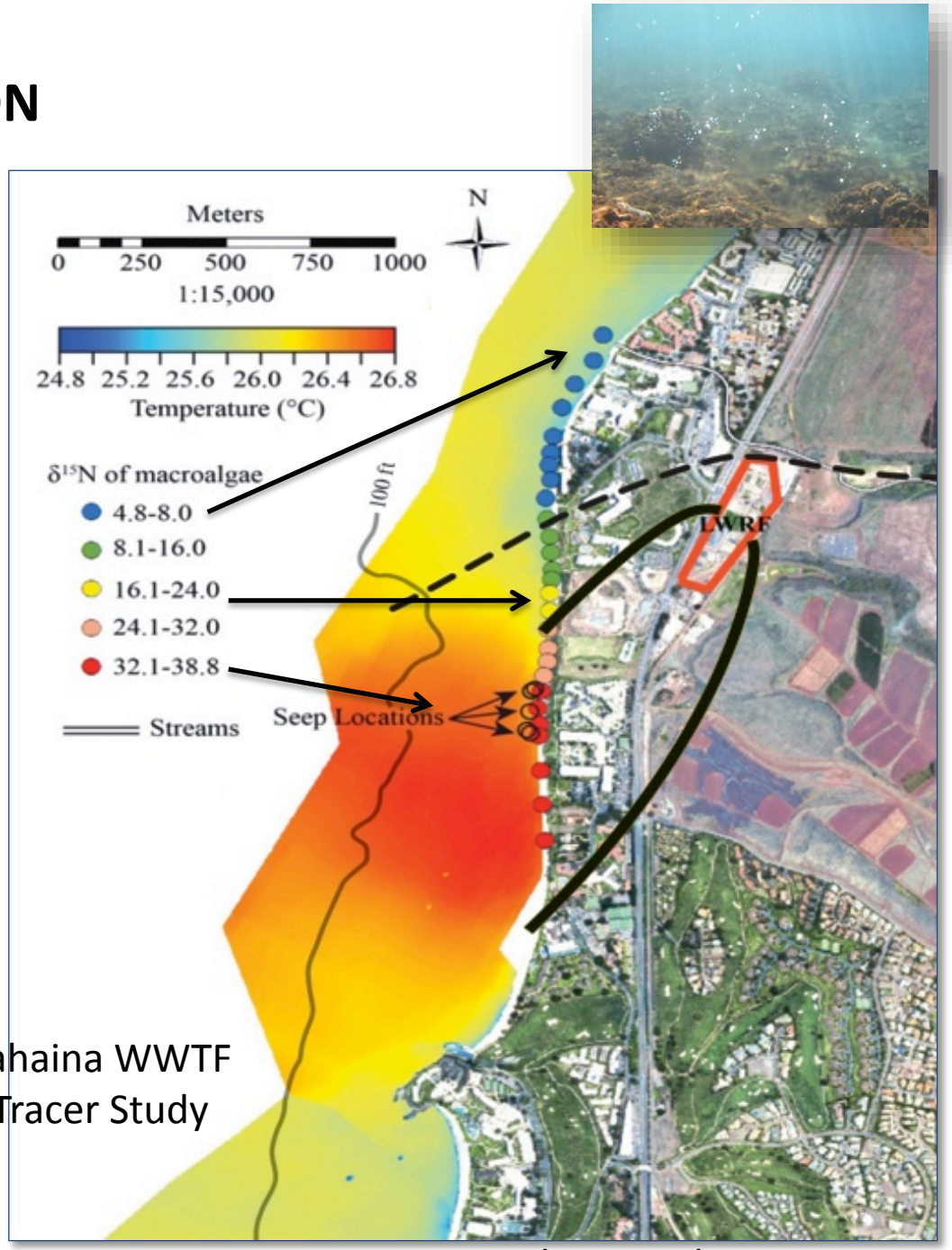






APPLICATION
DEEP WASTERWATER INJECTION DISCHARGE TO THE OCEAN

- WWTP Effluent daytime Temp = 30°C
- Known seep locations correspond to hot water “boils”
- Vents 28.8°C
- TIR Plume = 166+ acres
- TIR Plume boundary temperature = 26.5°C
- Modeled plume correlates w/ all parameters



Glenn et al., 2012, 2013