

Coastal Geotools '11

A09 Coastal Mapping: Challenges and Solutions:

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Senior Project Manager of Geodesy
and Remote Sensing**

March 2011

Flight Overview

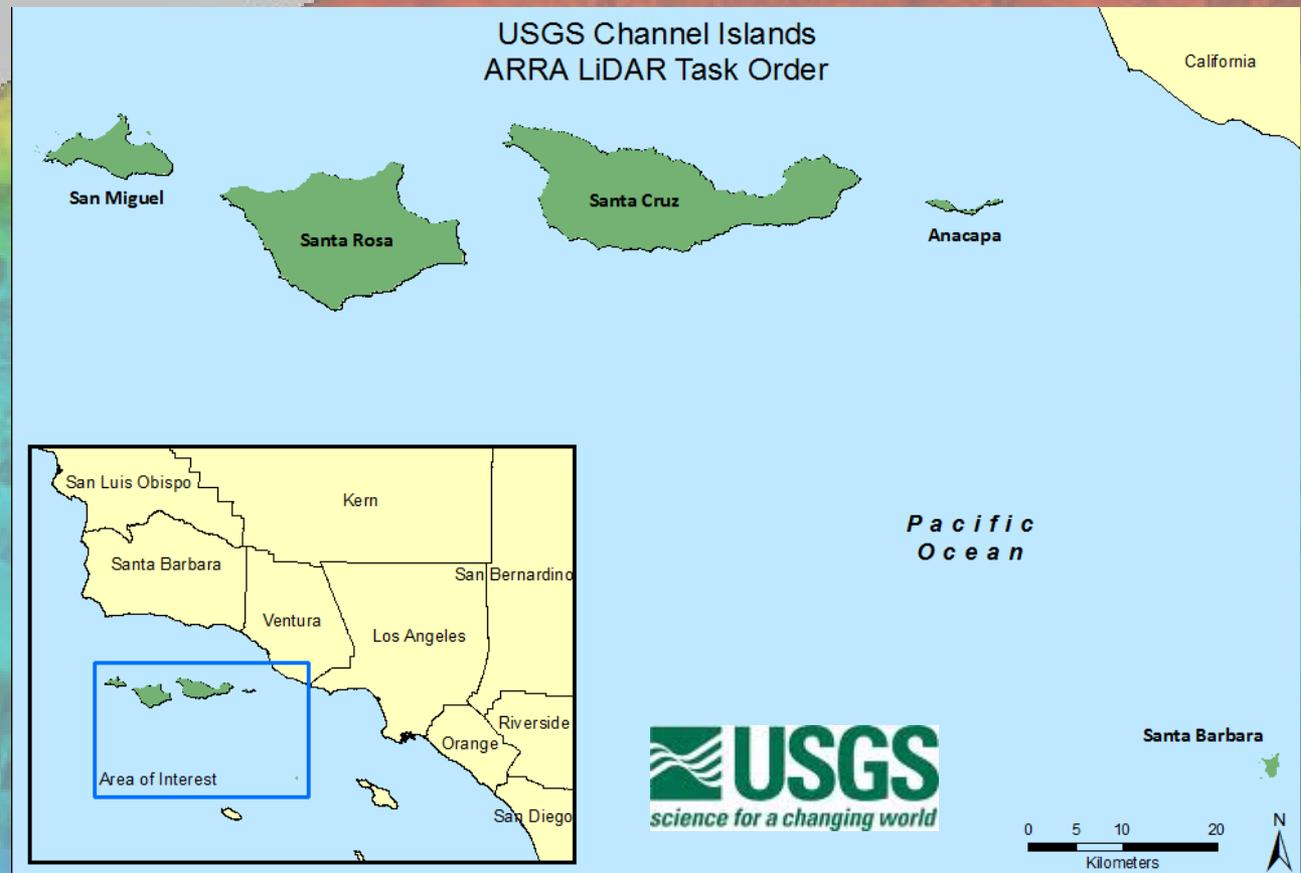
- Challenges of coordinating...
- Acquiring LiDAR and survey data...
- Processing...



Extremely
challenging and
complex coastal
location

Channel Islands

- Channel Island National Park comprised of 5 Islands



Channel Islands



Challenges

- **Accurately map the diverse topography remotely**
- **No ability to land for base stations or fuel**
- **Collect during low tide conditions**
- **Collect during spring high winds**
- **Collect prior to nesting seasons for some rare birds**
- **Coordinate with stakeholder to gain limited low impact access to provide survey checkpoints**
- **Process and classify LiDAR consisting of high mountains, deep canyons, craggy coastlines**

Coordination

- **Many stakeholders and partners**
 - **USGS and State Partners**
 - **National Park Service**
 - **Nature Conservancy**
 - **Scripps Orbit and Permanent Array Center (SOPAC)**
 - **California Spatial Reference Center (CSRC)**
 - **Terrapoint USA – LiDAR Provider**
 - **Michael McGee Surveying – Checkpoint surveys**
 - **Aspen Helicopters**

Rules, Rules, and More Rules

TNC/SCI SITE ACCESS REQUEST FORM

Date(s) of Access: March 10-19, 2010; Weather, Safety and Work Progress will dictate the schedule day to day; however only one day will actually be required on Santa Cruz Island.

Contact name/phone # for person responsible for request:

Michael McGee, CA PLS3945
 McGee Surveying Consulting
 5290 Overpass Rd, Sta#107
 Santa Barbara, CA 93111
 Tel (805) 964-3520
 Fax (805) 964-3785
 Cell 805-705-8520
 michael@mcgee-ops-llc.com
 http://www.mcgee-ops-llc.com/

Company / Party:

McGee Surveying Consulting by Michael McGee; Pilot and NPS Representative to be determined prior to flight

Purpose of Access (Be specific):

The USGS on behalf of the NPS is performing a lidar mapping survey (develop a 3D model of the terrain) of all the Channel Islands. Michael McGee, under contract with Dewberry working for the USGS, will be landing for about 20 minutes at 5 locations on each Island to collect an elevation with GPS. This requires the temporary placement of an instrument on a tripod in a clear smooth level area to collect information from satellites and then be removed to the next location. This information is to be used to verifying the accuracy of the aerial mapping performed by others during the same general time frame. The landing site locations will be spread out across the island, they must be safe to land, and they must be approved by an on-board NPS resources person. If a particular location is not acceptable, then we do not land but will move to the next candidate, until 5 locations have been measured.

Method of Access:

Aspen Helicopter (Bell Ranger) piloted by Rick Throckmorton will be most of the day at various sites.

Location of Access (ID airstrip (Christy, Central Valley), ID all island locations intended to be accessed, ID access routes to and from various island locations):

Probably land at both strips and 3 other locations. Please see the attached Google KMZ file for proposed locations. Note only 5 will be used.

Form of Ground Transportation (eg. Foot or ID vehicle(s)):

None, expect to walk to within 100 feet of the landing point

List TNC staff involved with this request and their specific duties:

None

[Attach Release Forms*]

Attached

TNC Staff Authorization:

Date:

2-27-10

*Note: Only Release forms with original signatures will be accepted. Release forms are valid for the entire calendar year for the year in which they are signed

Revised 3/2006

Signature of a Minor
 (s of age):

The participant described above in the foregoing acknowledgment, release, and Indemnification in favor of The Nature Conservancy ("TNC") with respect to taking part in activities on property owned by TNC at Santa Cruz Island, I hereby acknowledge that I have read and understood such Acknowledgment, Release, and Indemnification, as well as the license, permit, lease, contract, or other agreement pursuant to which the Activities discussed therein are to be carried out (where that is applicable); and I hereby agree, individually and on behalf of my child or ward, to all of the terms of such Acknowledgment, Release, and Indemnification; and hereby give my permission to my child or ward to participate in the Activities which are referred to therein.

Signature: _____ Date: _____
 Printed Name: _____
 Address: _____
 City: _____ (street address) State: _____ ZIP: _____
 Telephone Number: _____

The Santa Cruz Island Preserve of The Nature Conservancy was established through the foresight of the late Dr. Carey Stanton and is dedicated to the preservation of the unique natural and cultural resources found on the Island. Thank you for your cooperation and for helping preserve this Island for present and future generations.

Questions for vendor team on Channel Islands NP Lidar

Answers by Michael McGee of McGee Surveying Consulting

[General Statement of Work: The survey will fly to five locations on each island to collect measurements with a GPS receiver on a tripod. The location will be a clear, level smooth surface used to validate the accuracy of the lidar elevations. A spike set flush with the ground will be left to preserve the location. The plan is to set the helicopter down at an acceptable location, set the spike and collect data from satellites for 20 minutes, and fly to the next location. Some locations may be visited a second time to collect a check measurement or pick up a receiver left on the first visit. The general locations for proposed points will be circled on a map and submitted in advance to the NPS. The final locations will be determined in real time by satisfying the concerns of the pilot in regard to safety, the NPS representative in regard to environmental and bird nesting issues and the uses below for more details.]

it all five islands. [The surveyor will visit all five or budgetary reason to eliminate Santa Barbara Island to location.]

any particular order? [No, however, the present plan is eastward.]

measurements be done at once [weather permitting] or will this and is expected to be completed in one day, however, the survey may not be completed in consecutive

islands have to be visited? [5 points are planned with 1 and a point located in the east, south, west and north 1/4 say override this plan.]

is to each of the different points on any given island or helicopter will fly one person to each point.]

survey team that will land on the islands? [One surveyor]

is in the survey team. [Michael R. McGee, CA n, pilot]

it stays on the island? [None planned]

helicopter to refuel on the island? [None expected unless maintains a fuel cache on Santa Rosa Island.]

Schedule 1

Rules for Use of the Site

few if any safety or communications facilities available to visitors. The natural studies, and resource management. There are a wide array of not found elsewhere and may be unique in the world, so the introduction could be extremely detrimental to the flora and fauna at the Site. The I by Licensor for the Site:

pe is allowed at the Site for any reason, due to fire danger. ✓

food is allowed at the Site, although the consumption of previously prepared but all trash resulting from such activity is completely removed from the Site

to be brought onto, discharged, or used at the Site. ✓

animals or pets of any kind (including, but not limited to, cats and dogs) are

to be brought to

o temporary or

o any fish or

o vegetation is

o the Site, nor is

o brought onto or used

o to garbage or

o tenants,

o topography taken,

o carefully read this Acknowledgment, Release, and

o signed Participant of his/her own free will.

Acknowledgment, Release, and Indemnification

Please Read Carefully Before Signing!

Participant) is being allowed by The Nature Conservancy, a District of Columbia non-profit (the "Activities") at Santa Cruz Island (including the surrounding under the terms of a license, permit, lease, contract, or other agreement which Licensor has ther Participant, or some other person or entity under whose auspices Participant will be volunteer of Licensor. In consideration for being given permission to enter the Site and part (acting through and/or with the consent of his/her legal guardian, if the Participant is a hip), agrees as follows:

I understand and agree that the Activities include my travel (whether over land or water, or by air) familiarize myself with, and comply with the terms of, the license, permit, lease, contract, I am being permitted to enter the Site and participate in the Activities (where that is arrangement under which I will be participating in the Activities as a guest or volunteer of I, and to restrict my use of the Site to the Activities which are permitted under such license, program, or arrangement (as applicable).

I fully recognize the dangers of participating in the Activities, and I voluntarily my participation in the Activities. I understand that the dangers that I may encounter in lude, by way of example only and without limitation: Hantavirus Pulmonary Syndrome, soils, sea sickness, boating accidents, high surf, strong ocean currents, steep cliffs, cactus jackets, bees, mice and other rodents carrying certain diseases, marine animals, harsh and ns, risks of landslides or other earth movement, poison oak, stinging nettles, ticks, falling les, and rugged road conditions. In addition, I acknowledge that the structures located on liance with seismic stability laws, and are susceptible to damage in the event of seismic

I realize that, in participating in the Activities, there is a risk of my n an area remote from medical care, and that Licensor cannot guarantee the availability of agency transportation to medical facilities.

I have familiarized myself with the rules applicable to use of the Site which are to which is incorporated herein by this reference, and of which I have been or will be given y such rules at all times while I am at the Site. I acknowledge that such rules apply to me in mission to deviate from the rules has been given by Licensor, and I agree that I will not ch permission has allegedly been given, until and unless I have read and understand fully nor. I also agree to comply with all instructions posted on signs at the Site.

I have been properly instructed in, and understand any equipment which I am to use in the Activities. I also realize that my participation in the Activities may require strenuous physical activity, and I represent to and assure Licensor that I am in good health, and am not aware of any medical condition that might endanger me or any other participants in the Activities.

I am acting for myself and my heirs, personal representatives, assigns, and guardians *ad litem*. I hereby release Licensor and all of Licensor's employees, agents, representatives, s, contractors, officers, and directors from any and all claims and liabilities of any kind or nature whatsoever for or set to, and I agree not to make a claim of any kind or nature whatsoever against, or sue or attach the property of such r or with respect to, any damage or injury to me or my property, or my death, arising from my participation in the r during my presence on or travel to or from the Site, howsoever caused and whether or not arising in whole or in the negligence or alleged negligence of, or any other act or omission of or by, Licensor or any of Licensor's s, agents, representatives, volunteers, contractors, officers, and/or directors.

I am acting for myself and my heirs, personal representatives, executors, assigns lains *ad litem*. I agree to indemnify and defend Licensor and all of Licensor's employees, agents, representatives, s, contractors, officers, and directors against, and to hold the same parties harmless of and from: (a) any and all



Rules, Rules, and More Rules

(10) No item(s) brought to the Site are allowed to be left at or adjoining the Site, including (but not limited to) garbage or food.

Rules, Rules, and More Rules

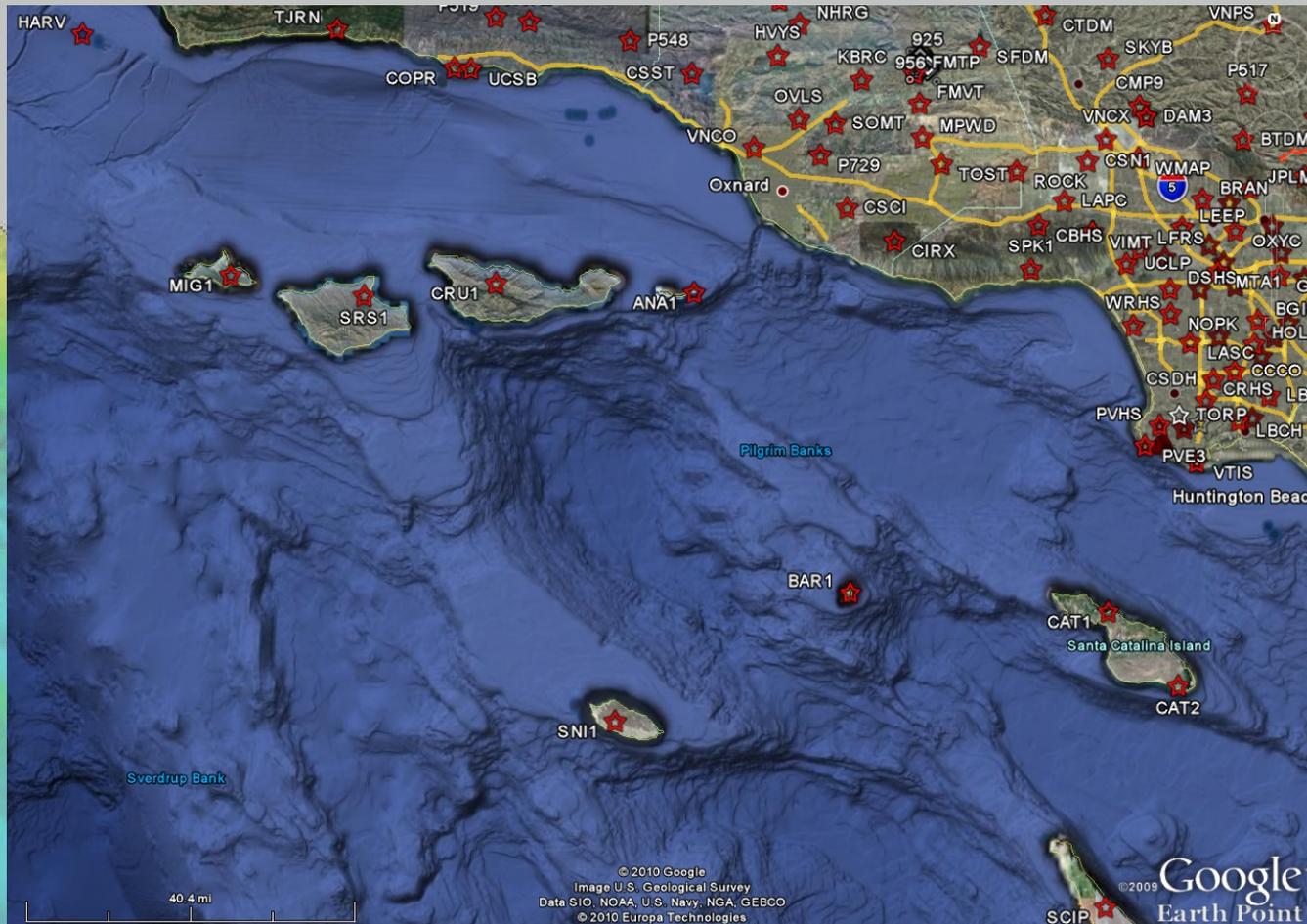


Dewberry

Rules, Rules, and More Rules

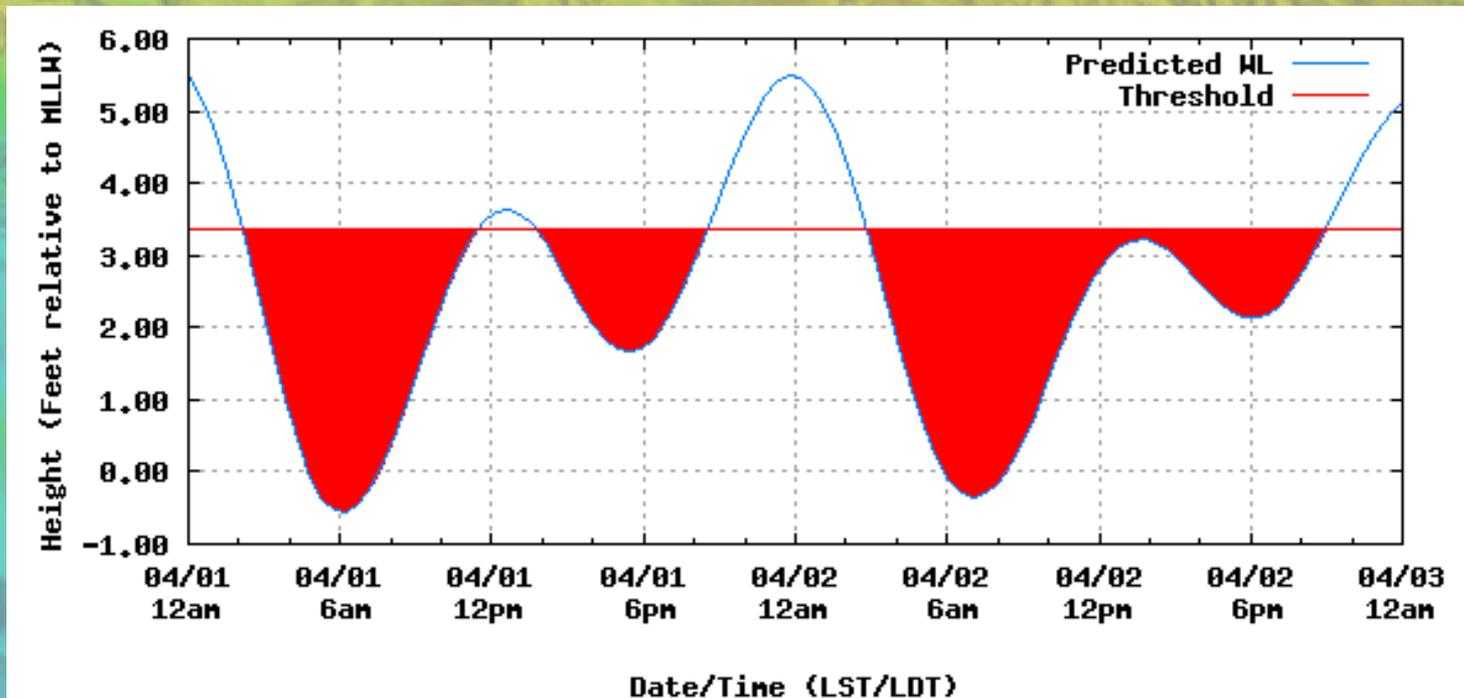


GPS Control

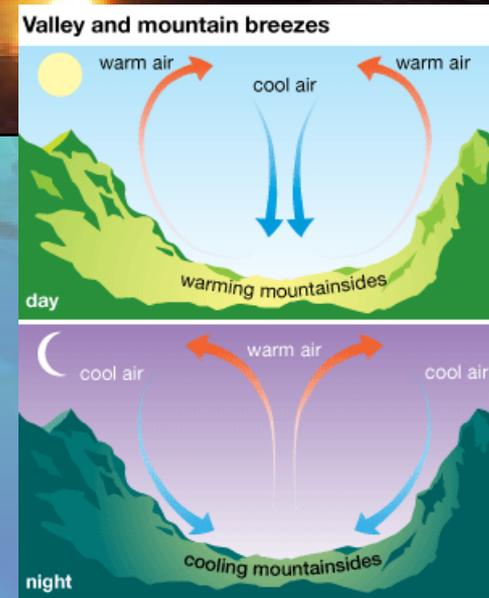
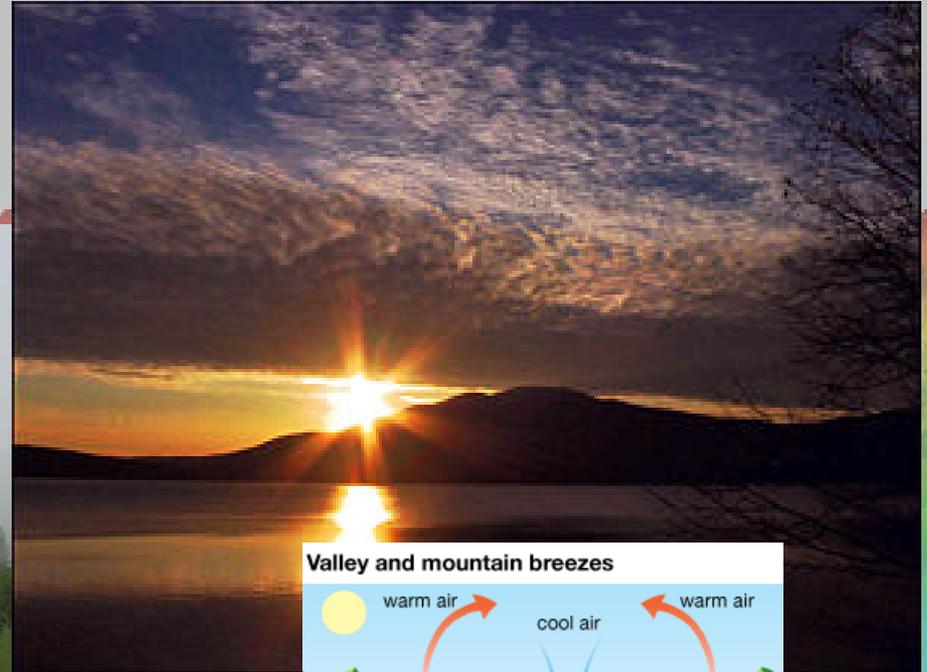


Low Tides

Santa Barbara, Station ID 9411340			
Date	Min	Max	Diurnal Value
20100401	-0.91	5.81	3.36
02:48-10:06			
Date	Time	MLLW, feet	
20100401	2:48	2.36	



Environmental Conditions



Sensor Parameters

Scan Settings Point Spacing	PRF (kHz)	(kHz)	100
	Effective	(kHz)	67
	Optimal Height AGL	(m)	600
	Aircraft Speed	(kts)	50
	Scan Angle	(Degrees)	60
	Scan Rate	(Scans/Sec)	50
	Swath Width	(m)	692
	Flight Line Spacing	(m)	343
	Laser Spot Diameter	(m)	0.3
Scan Settings	Along Track	(m)	0.51
	Across Track	(m)	0.52
	PRF (kHz)	(kHz)	100
Point Density	Nominal Single Swath	(Pts/m ²)	3
	With 50% overlap	(Pts/m ²)	7



Helicopter System



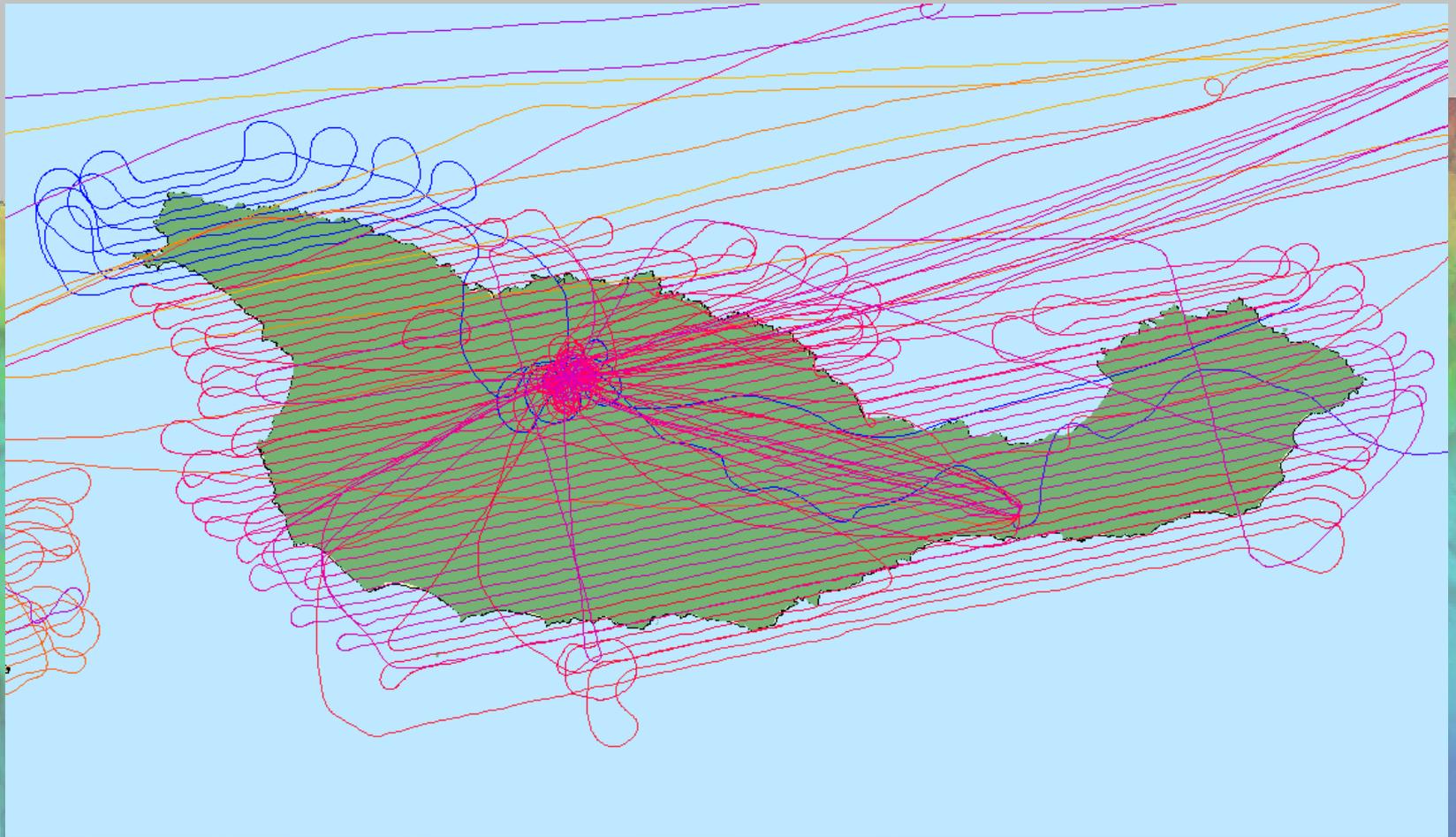
Helicopter System



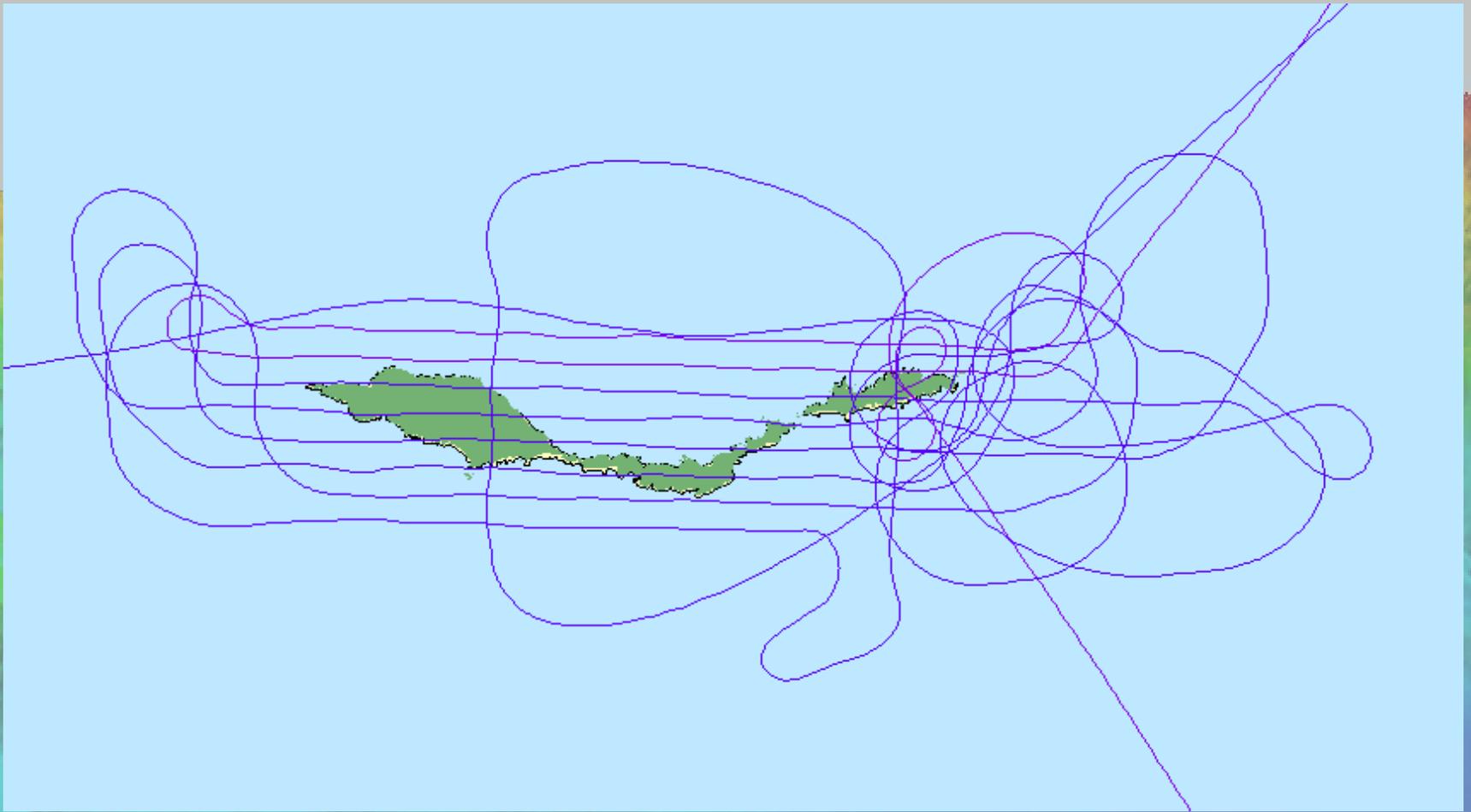
Helicopter System



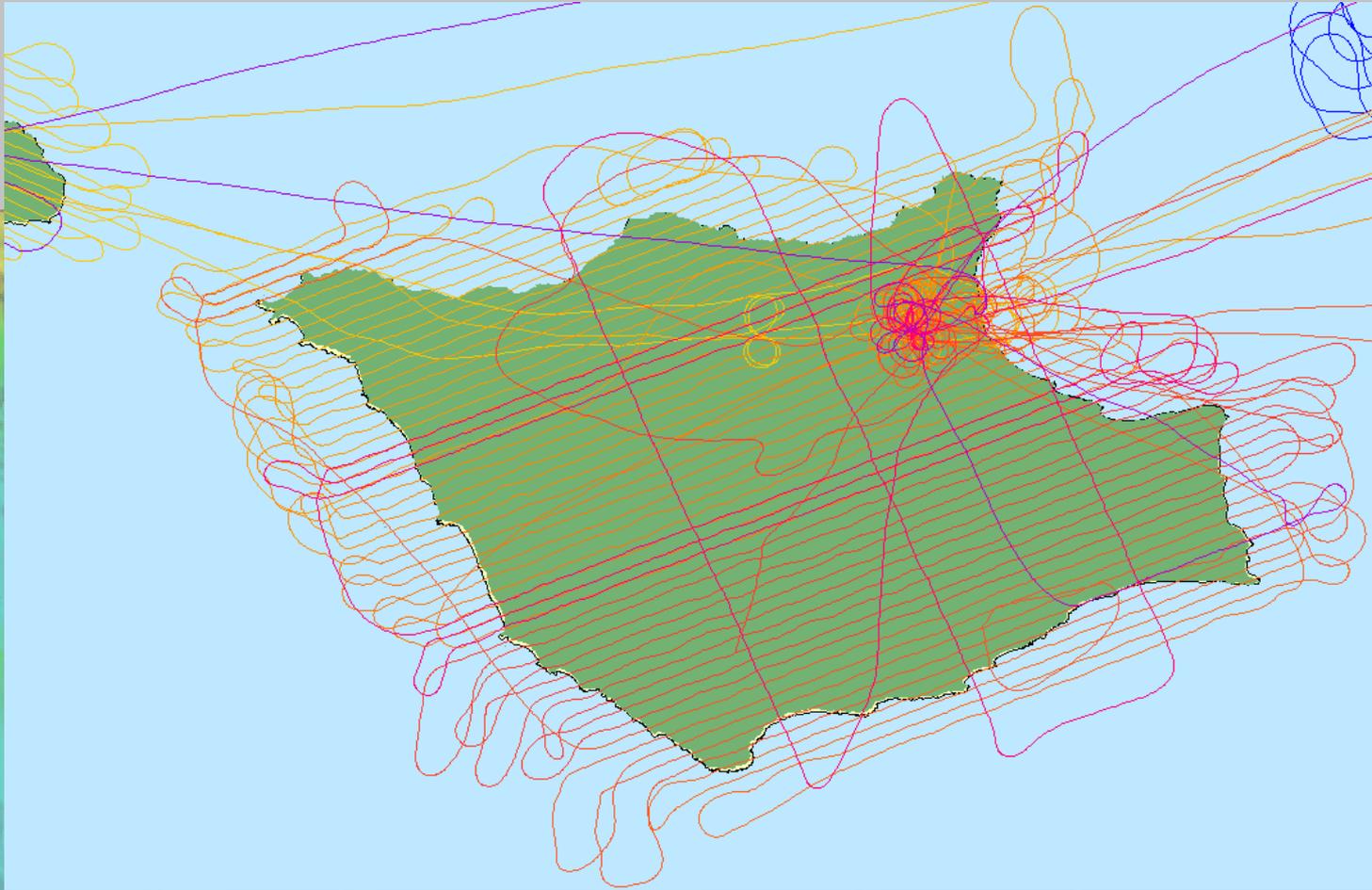
Santa Cruz Flight Trajectories



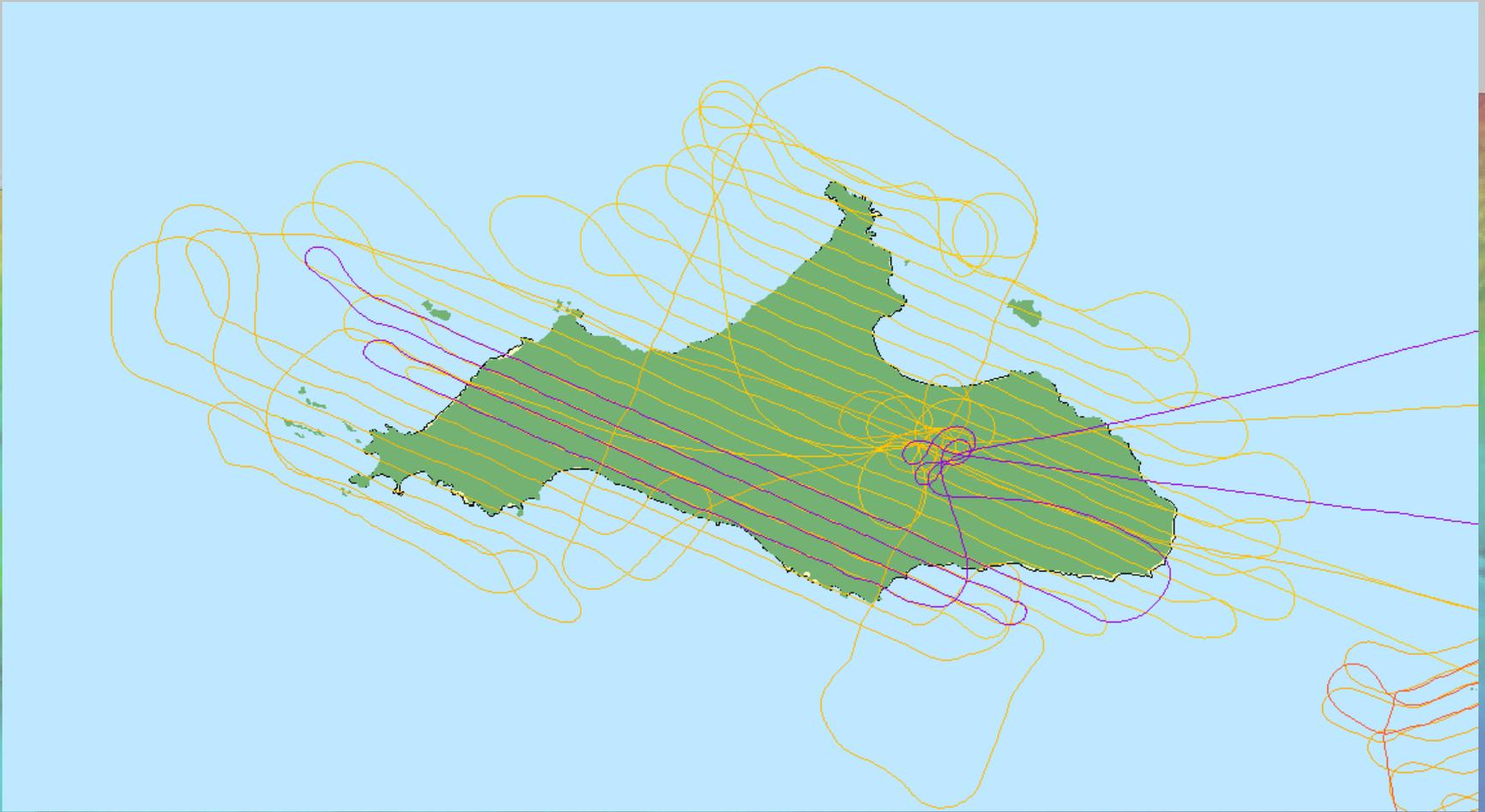
Anacapa Flight Trajectories



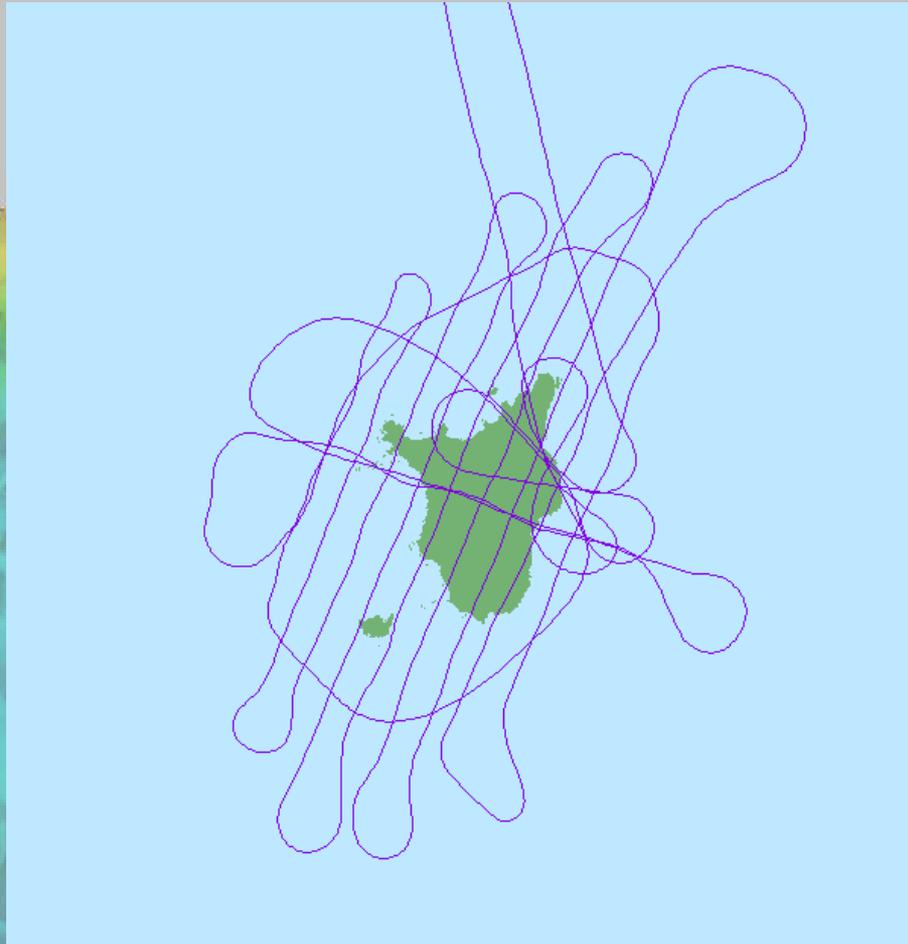
Santa Rosa Flight Trajectories



San Miguel Flight Trajectories



Santa Barbara Island Flight Trajectories



200 Square Miles - 31 Days to Fly

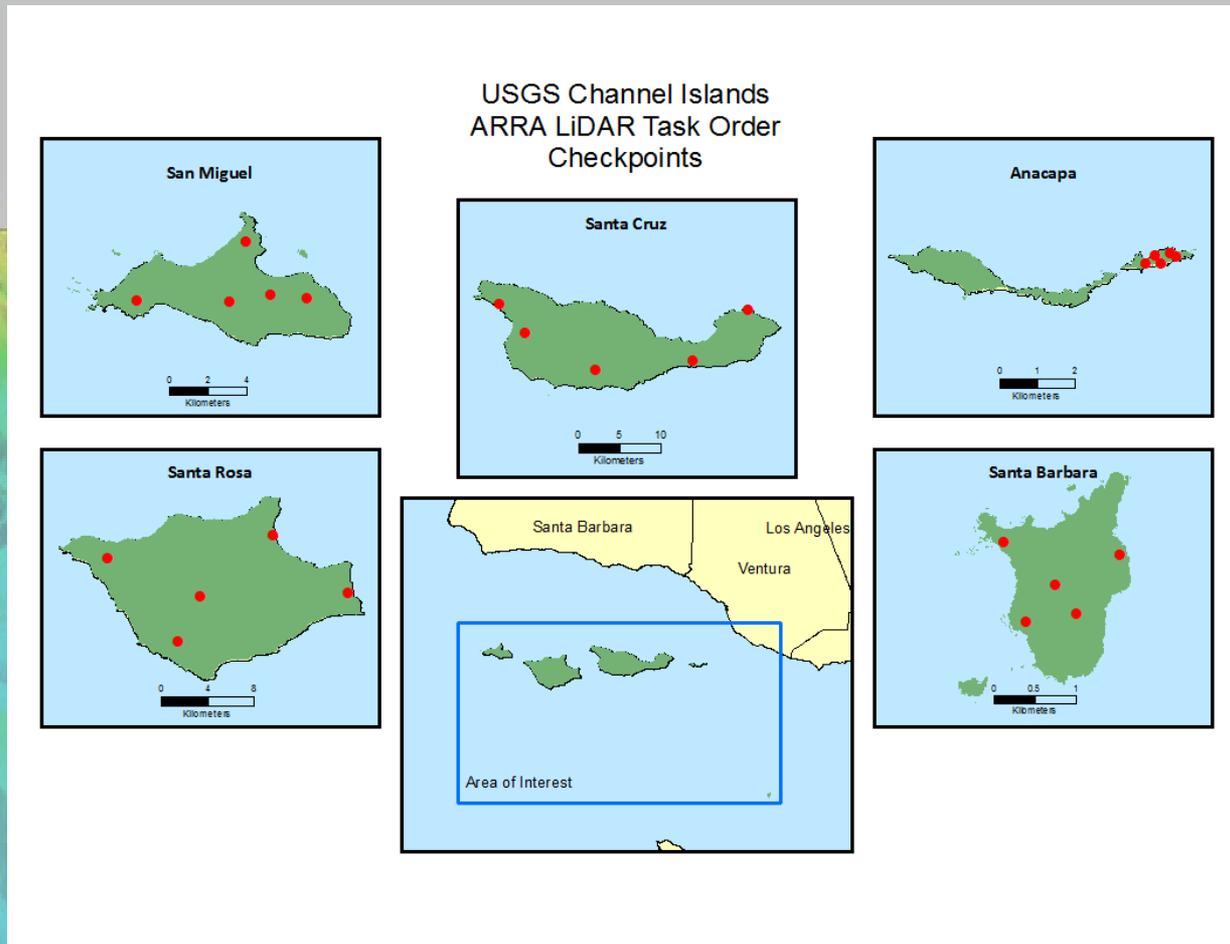
Santa_Cruz	San_Miguel	Santa_Rosa
10 Missions	3 Missions	9 Missions
- M110071B (10 swaths)	- M110073A (15 swaths)	- M110074B (8 swaths)
- M110081A (4 swaths)	- M110074A (8 swaths)	- M110075A (5 swaths)
- M110081B (11 swaths)	- M110097B (4 swaths)	- M110075B (6 swaths)
- M110082A (10 swaths)		- M110076A (6 swaths)
- M110085A (4 swaths)	Santa_Barbara	- M110077A (4 swaths)
- M110085B (6 swaths)	1 Mission	- M110079A (9 swaths)
- M110087A (9 swaths)	- M110070A (9 swaths)	- M110080A (10 swaths)
- M110092A (4 swaths)		- M110086A (5 swaths)
- M110096A (6 swaths)	Anacapa	- M110097A (1 swaths)
- M110098A (23 swaths)	2 Missions	
	- M110070A (2 swaths)	
	- M110071A (6 swaths)	

80% of LiDAR project costs was spent on acquisition alone

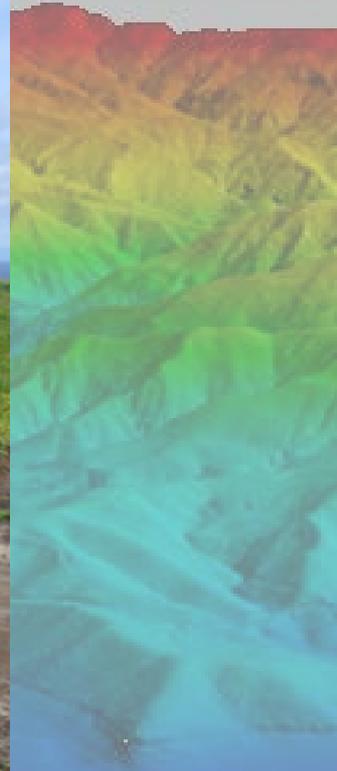


Dewberry

Survey Checkpoints



Survey



Watch Where You Walk



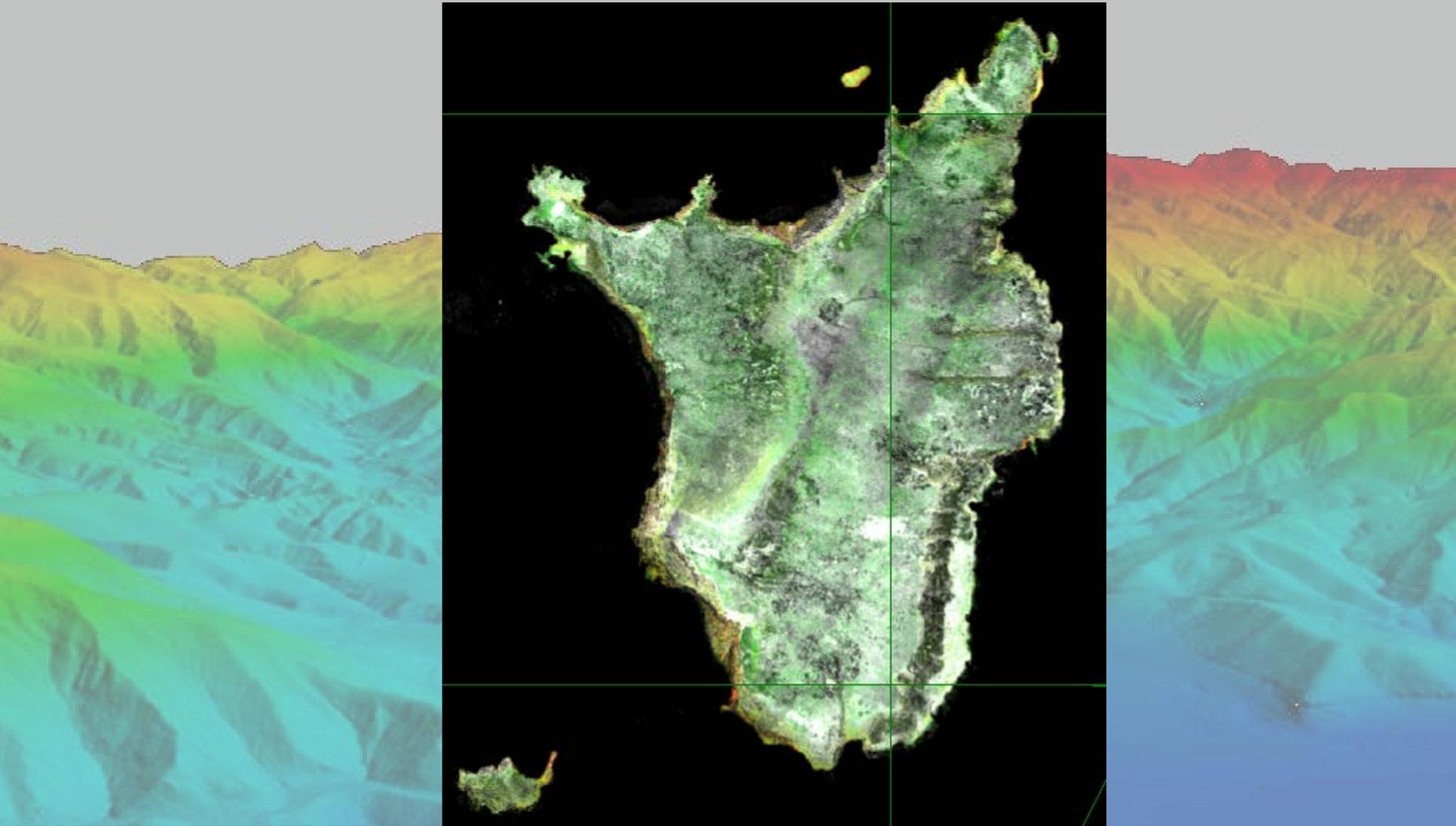
Dewberry

Z-Bump and Independent Accuracy

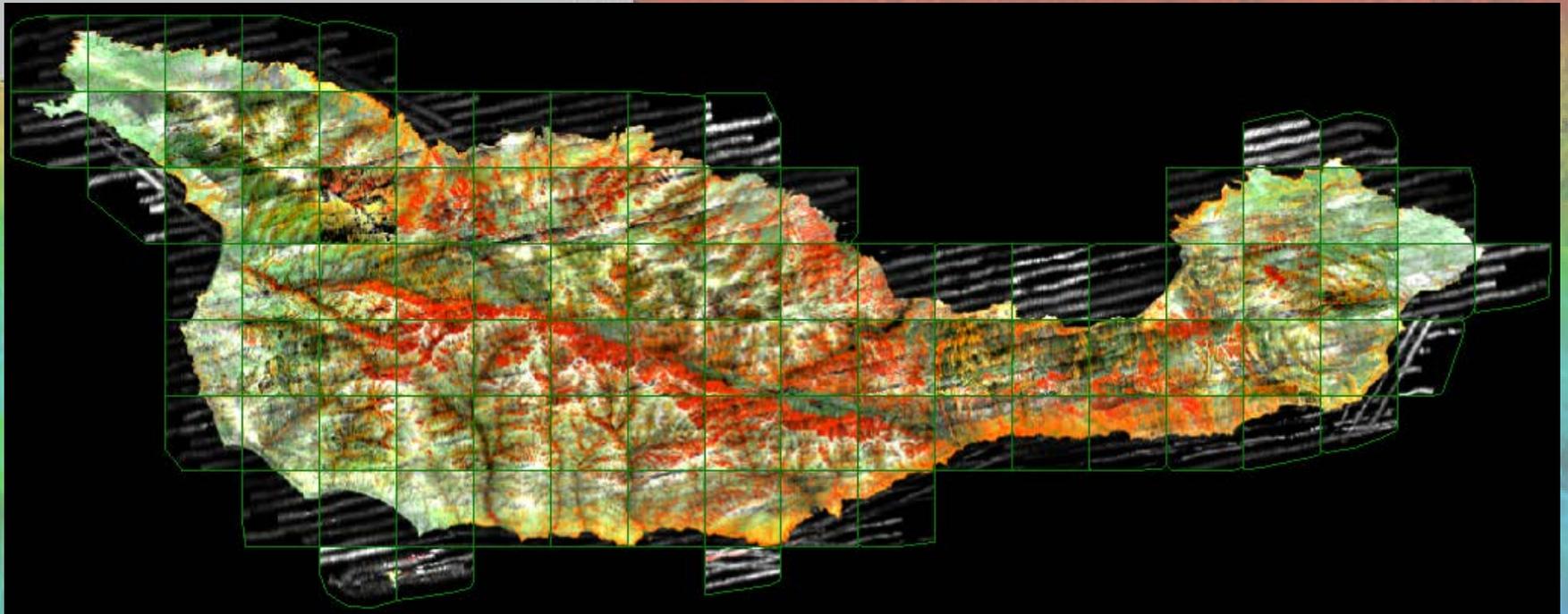
	Lines	Vertical Adjustment
m110073a	All lines	Dz = +0.07m
m110074a	All lines	Dz = +0.05m
m110075a	line 7404	Dz = +0.05m
m110077a	All lines	Dz = +0.05m

100 % of Totals	RMSE (ft) Open Terrain Spec=0.15m All other Spec=0.15m	Mean (m)	Median (m)	Skew	Std Dev (m)	# of Points	Min (m)	Max (m)
Consolidated	0.03	0.01	0.02	-0.33	0.03	25	-0.05	0.08
Open Terrain	0.03	0.01	0.02	-0.33	0.03	25	-0.05	0.08

Relative Accuracy Dz-Orthos



Relative Accuracy Dz-Orthos



Coverage – Data Gaps



Classifying Terrain Data



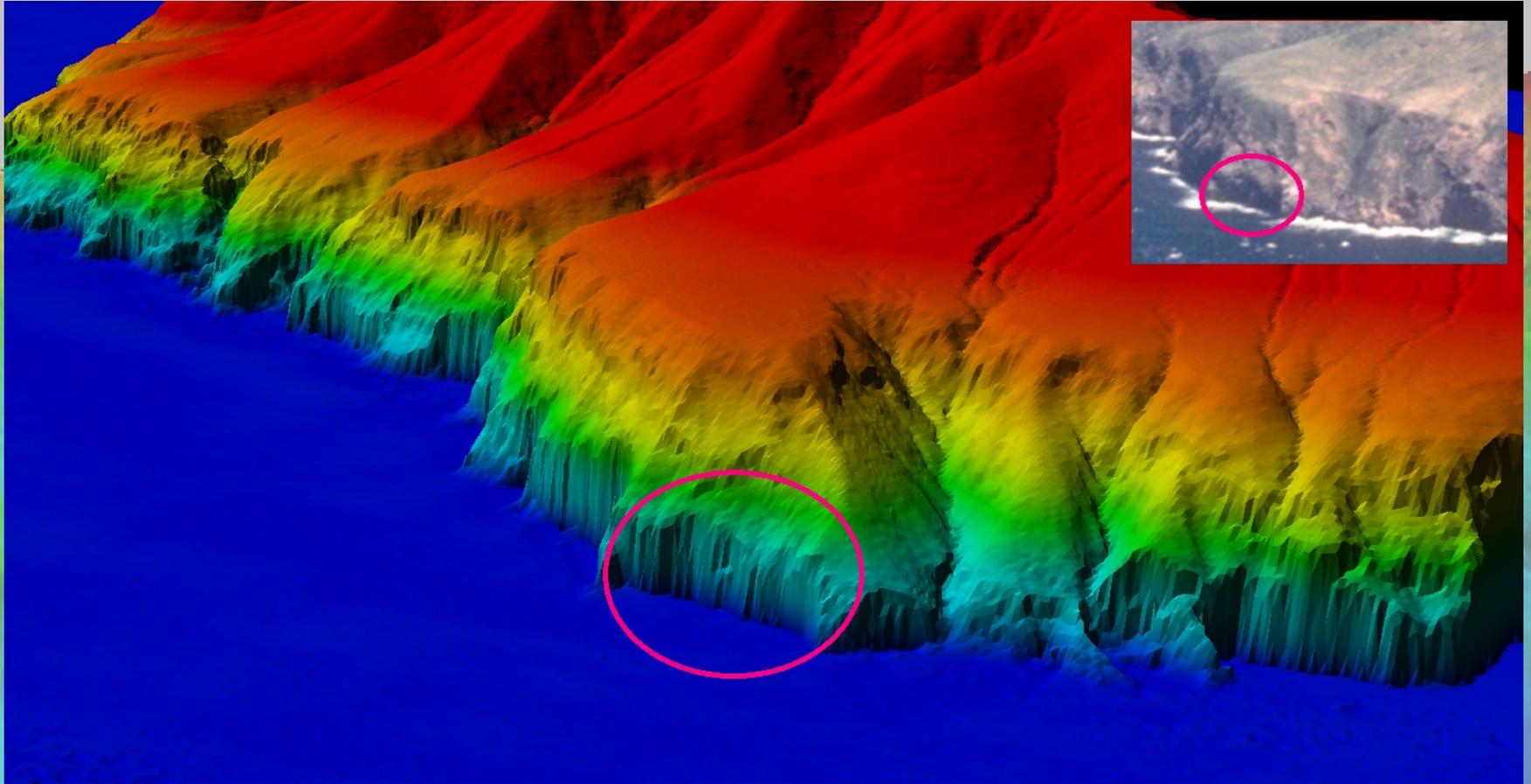
Classifying Terrain Data



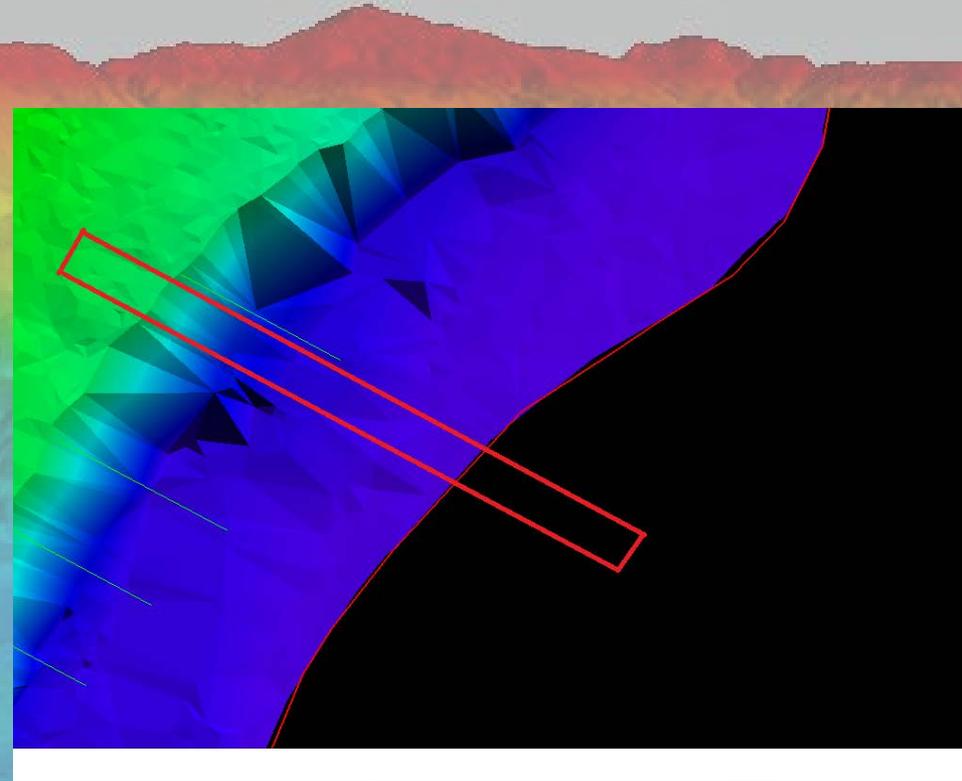
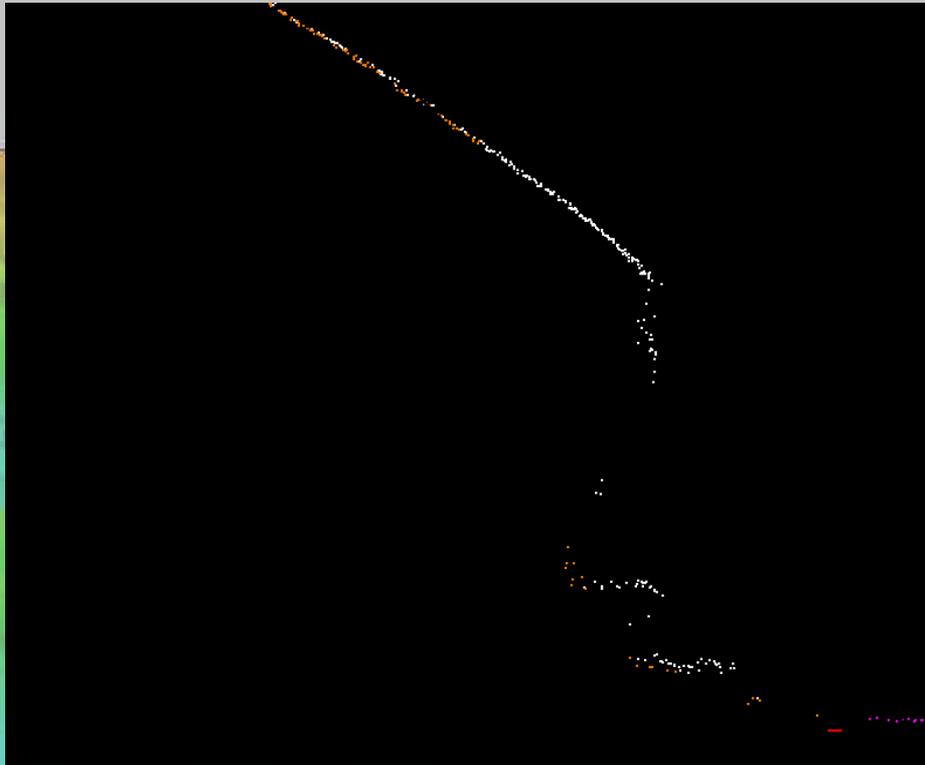
Classifying Terrain Data



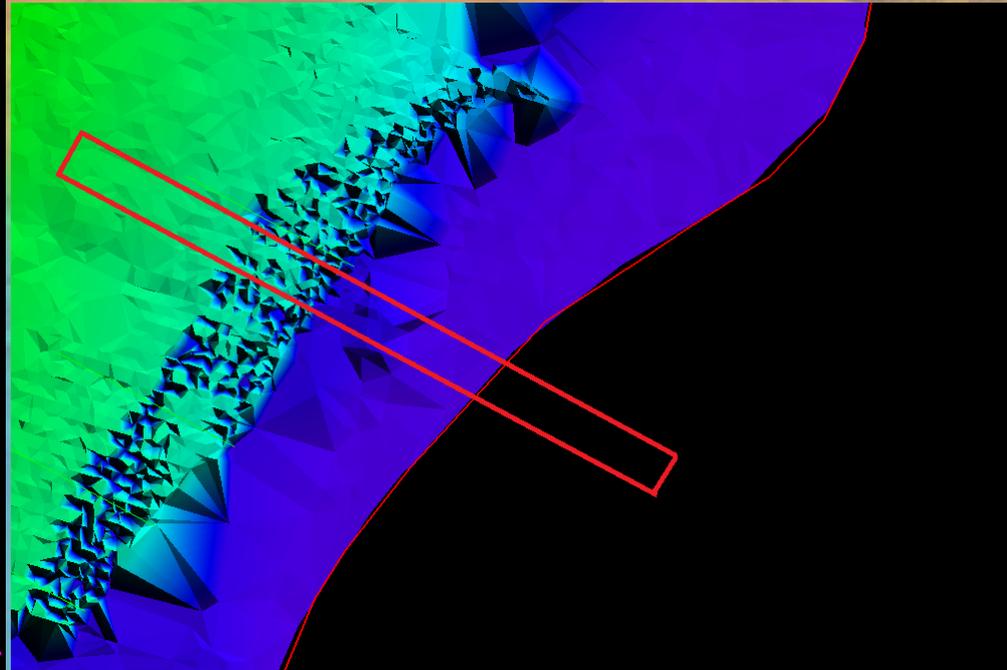
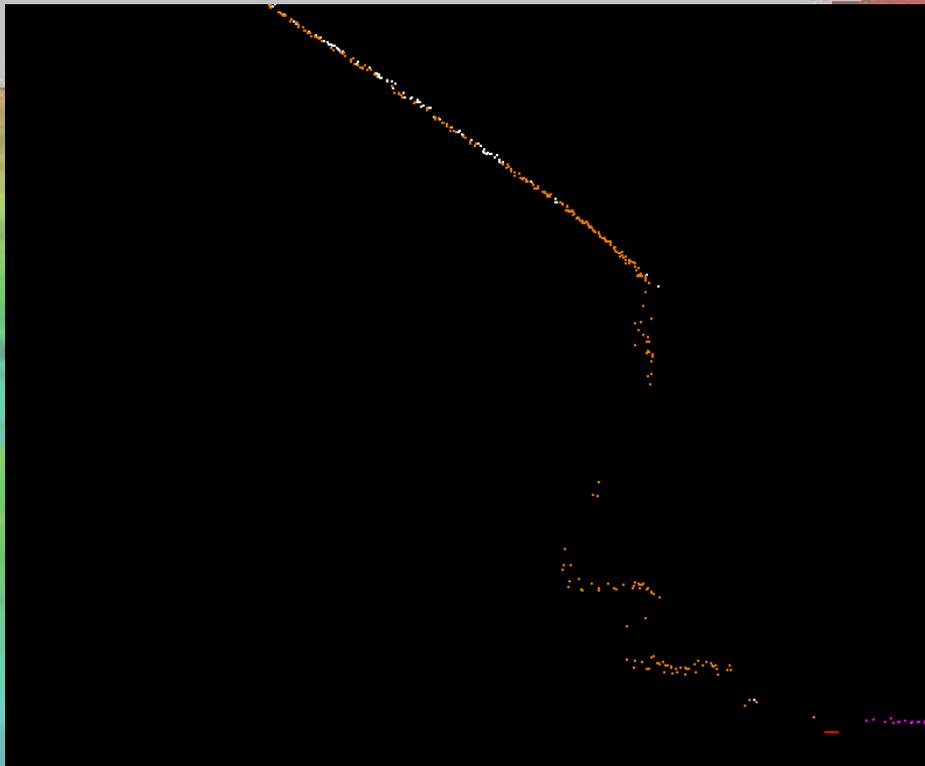
Classifying Terrain Data



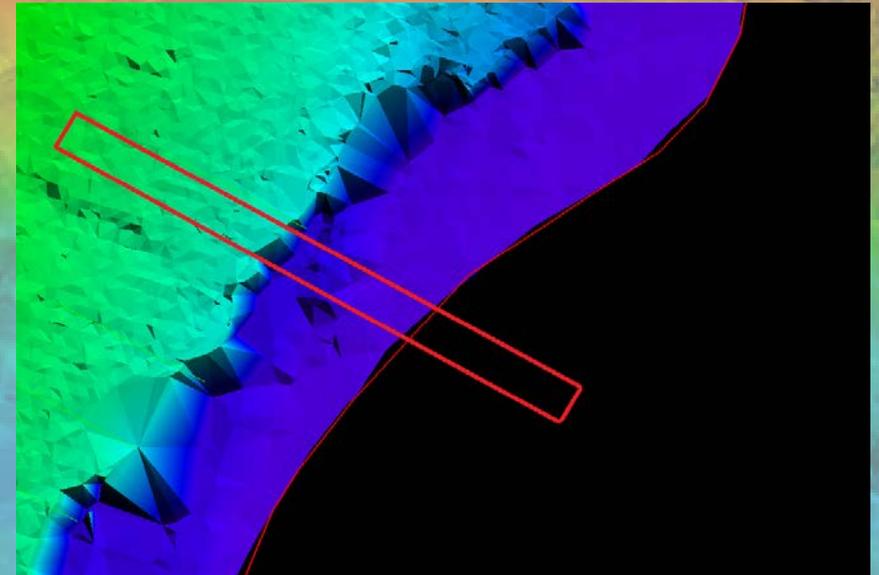
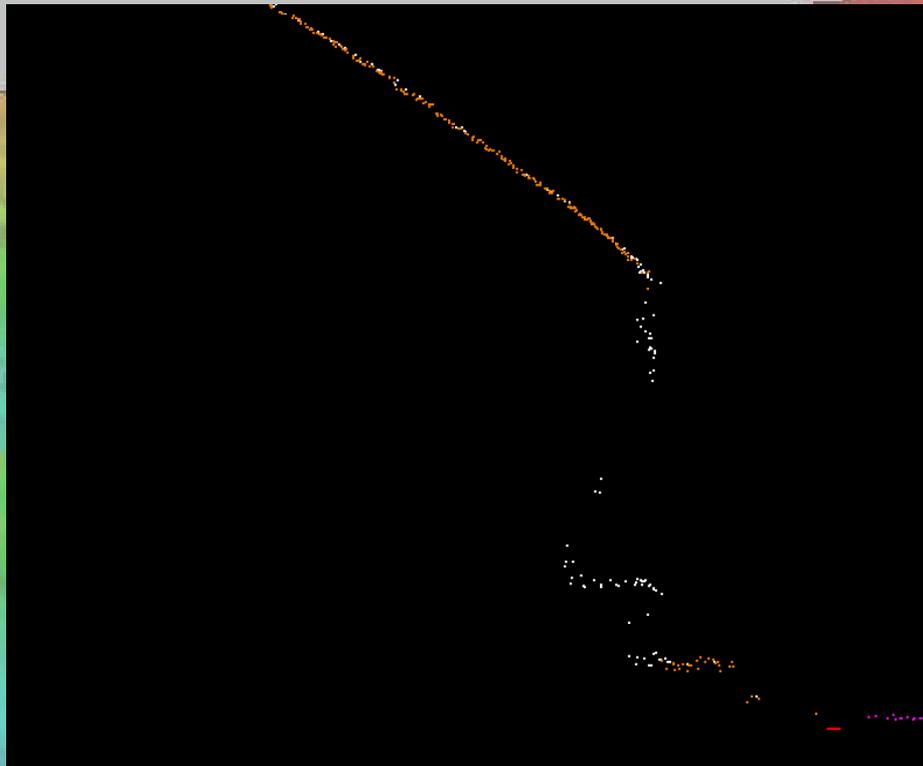
Automated Classification



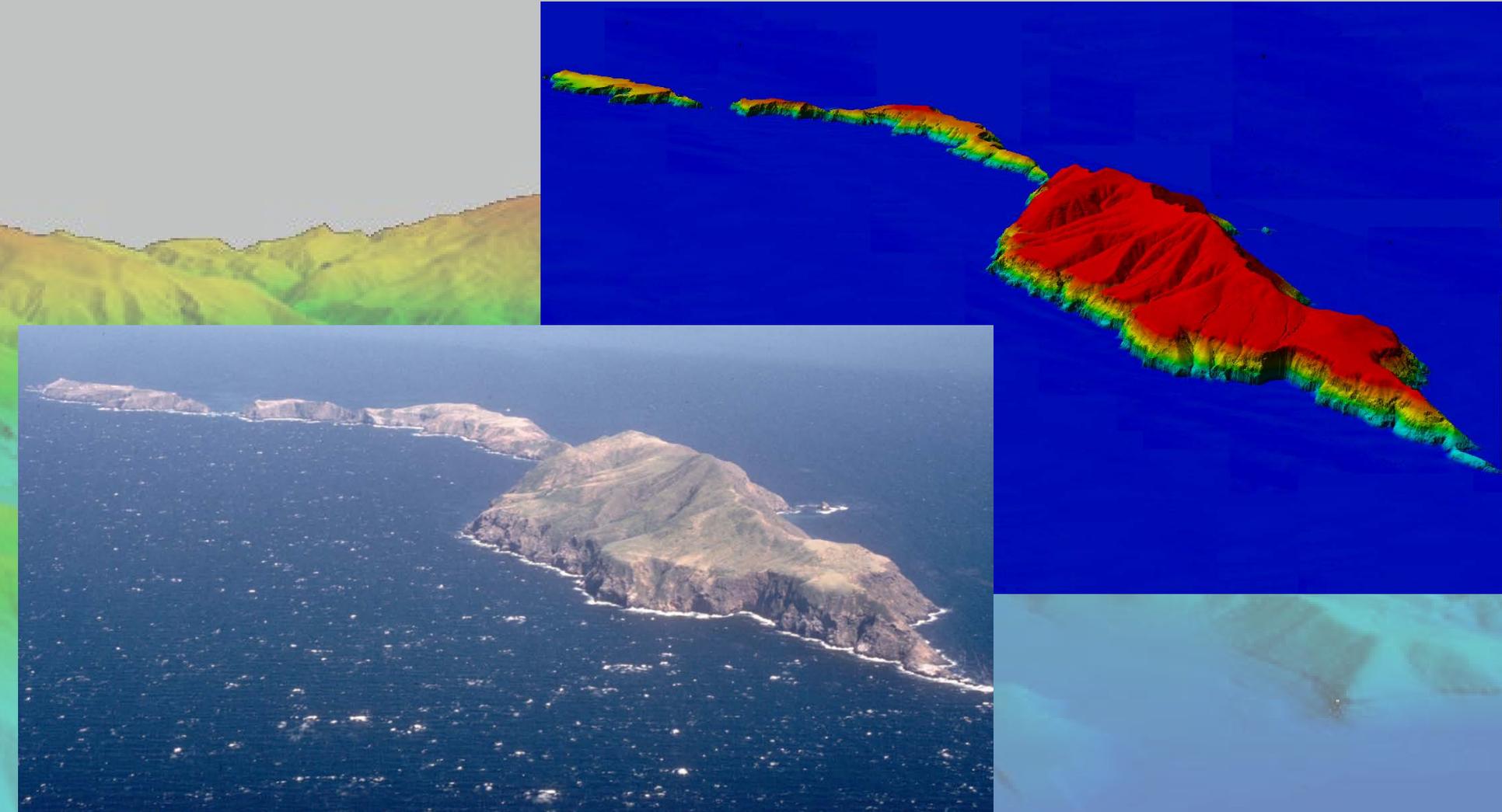
Classify to “Ground”



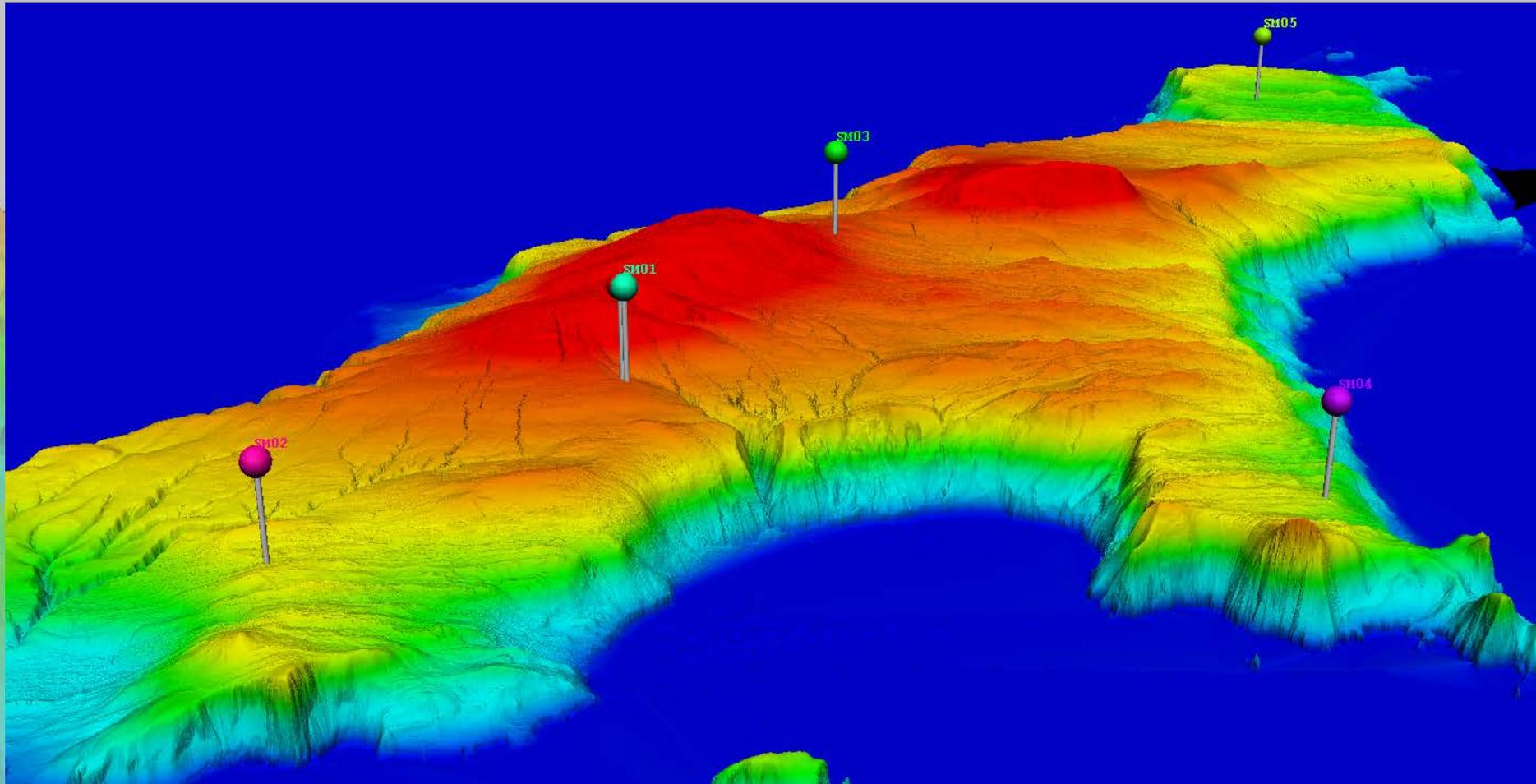
Clean Classification ???



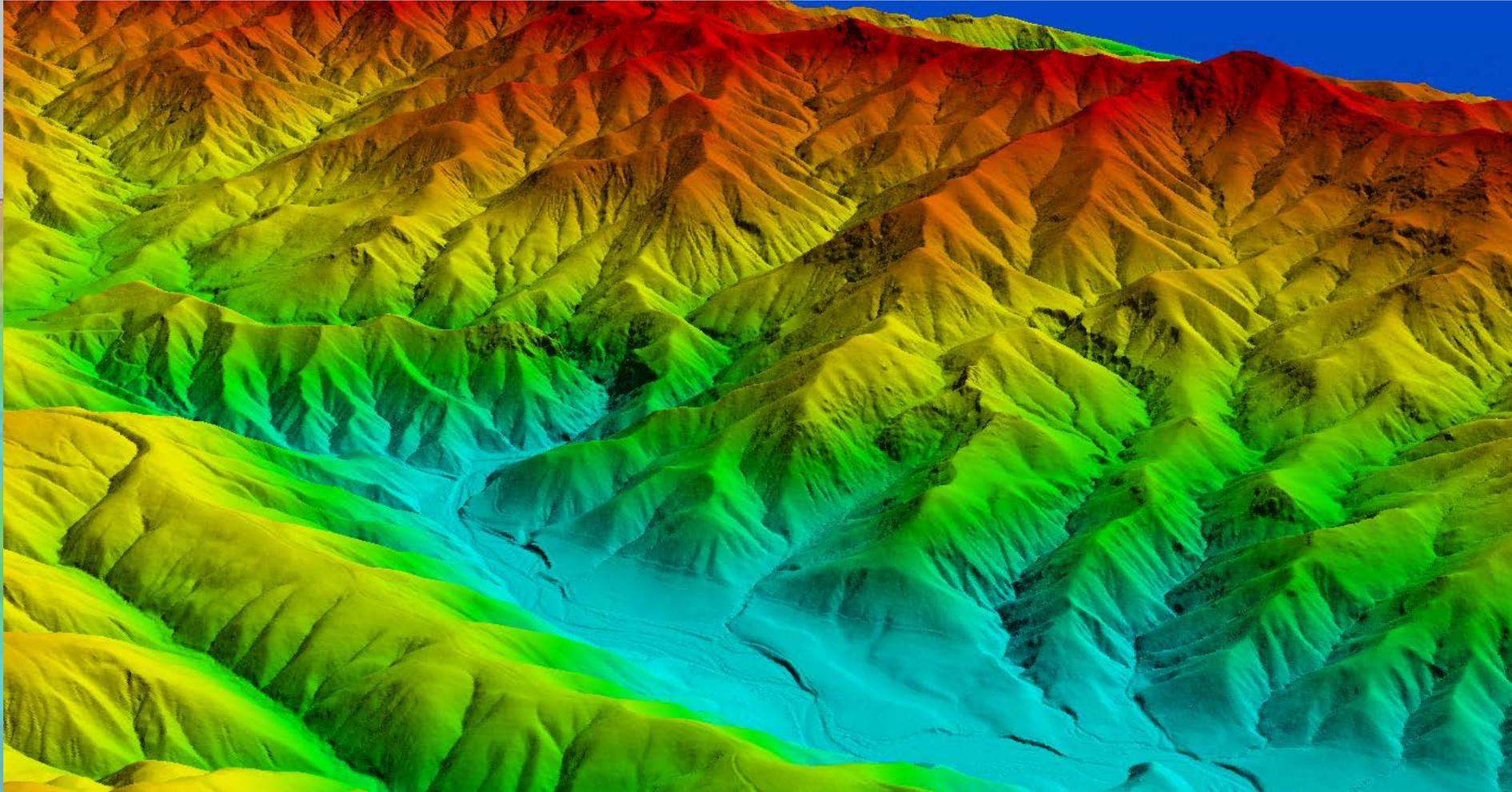
Classifying Terrain Data -Anacapa



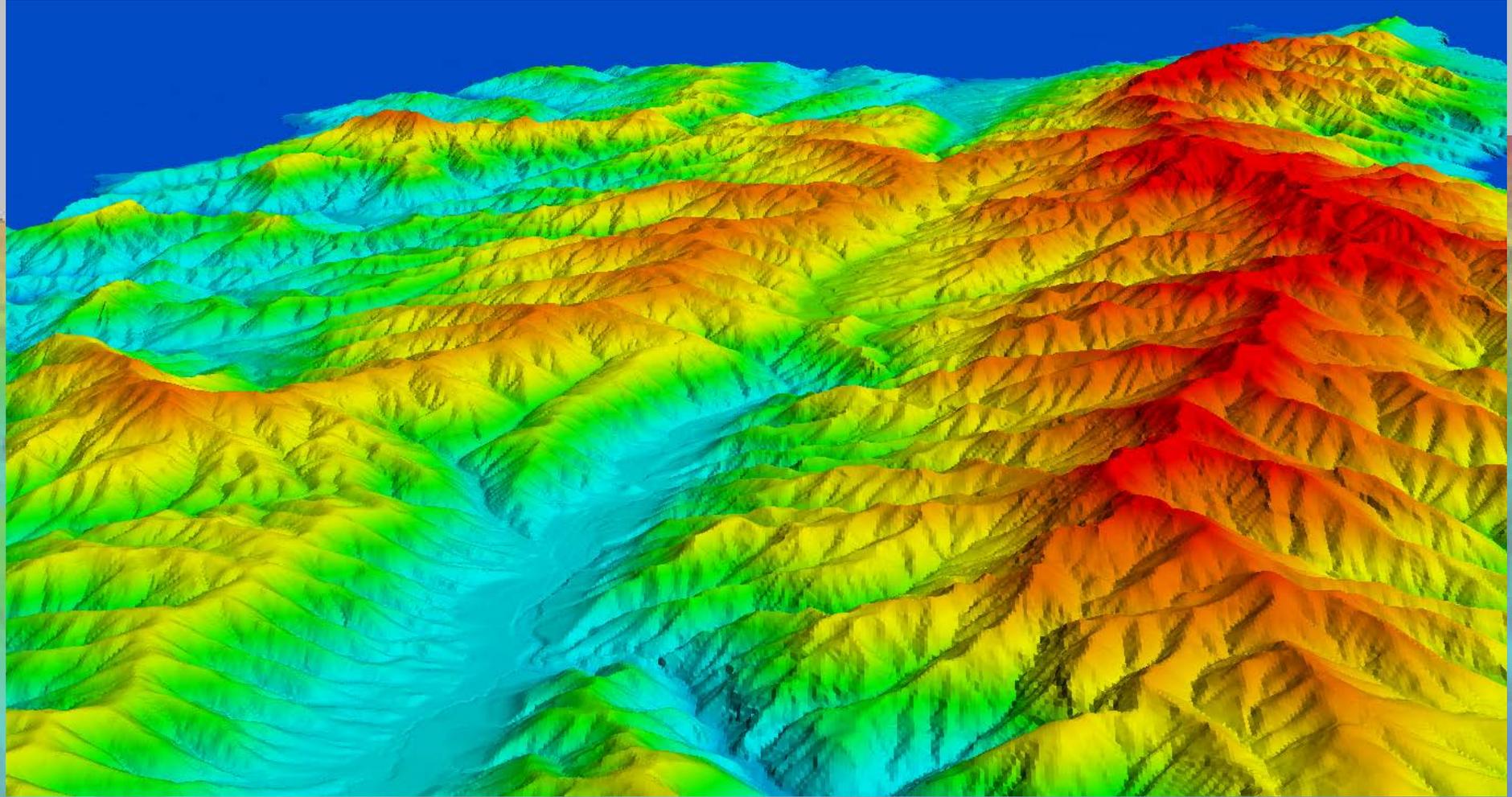
San Miguel



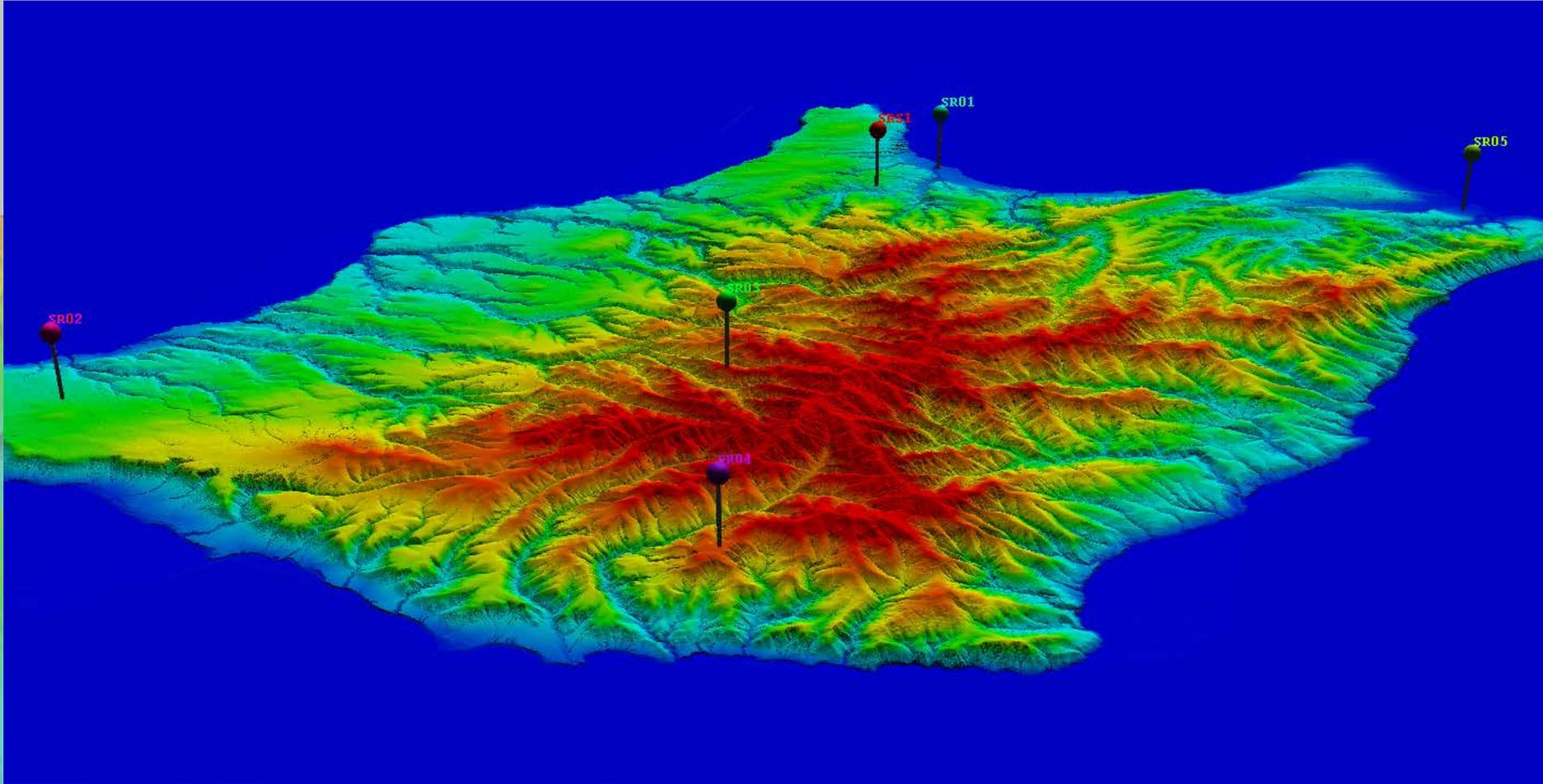
Santa Cruz



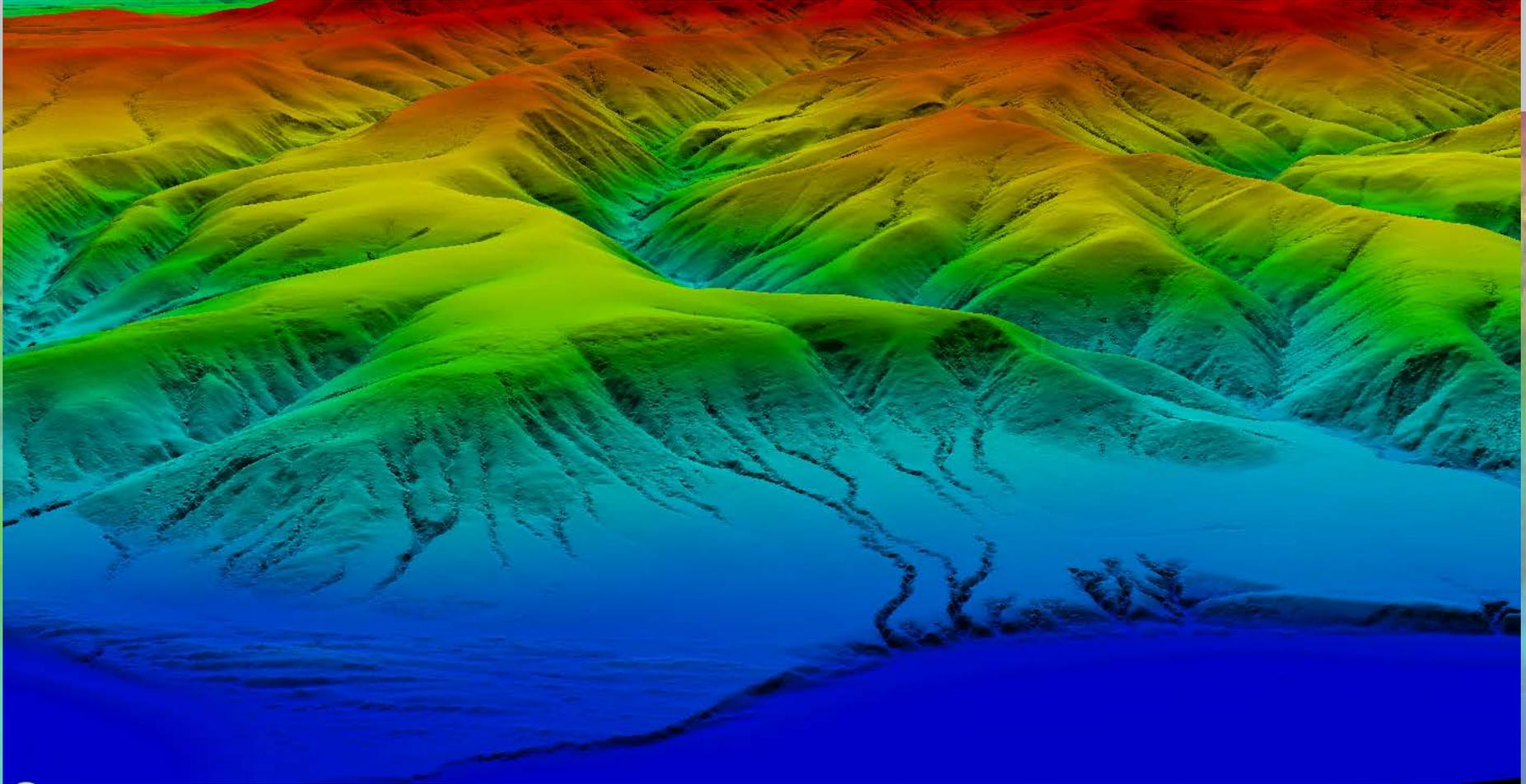
Santa Cruz



Santa Rosa with Checkpoints



Santa Rosa



Conclusion

- Overall the project was a success meeting the clients expectations
- Lump sum projects are probably not the best for high risk projects
- Software needs to improve for classifying LiDAR
- What does low tide mean to you and what are you willing to pay