# Automated Mapping of Kelp Forest Productivity for Carbon Storage Estimation

Principal Investigator: Michelle Gierach (329); Co-Investigators: Kate Cavanaugh (UCLA), Kyle Cavanaugh (UCLA)

Program: FY22 SURP
Strategic Focus Area: Water and carbon cycles

Background

Kelp forests support highly diverse ecosystems worldwide, such that shifts in their abundance and distribution in association with climate change have significant impacts on the coastal and anthropogenic communities that rely on them (*Figure 1*). Current assessments are largely conducted via scuba surveys that are limited in space and time and may not be globally representative. To-date, differentiation between kelp species and their contributions to the blue carbon budget are lacking.
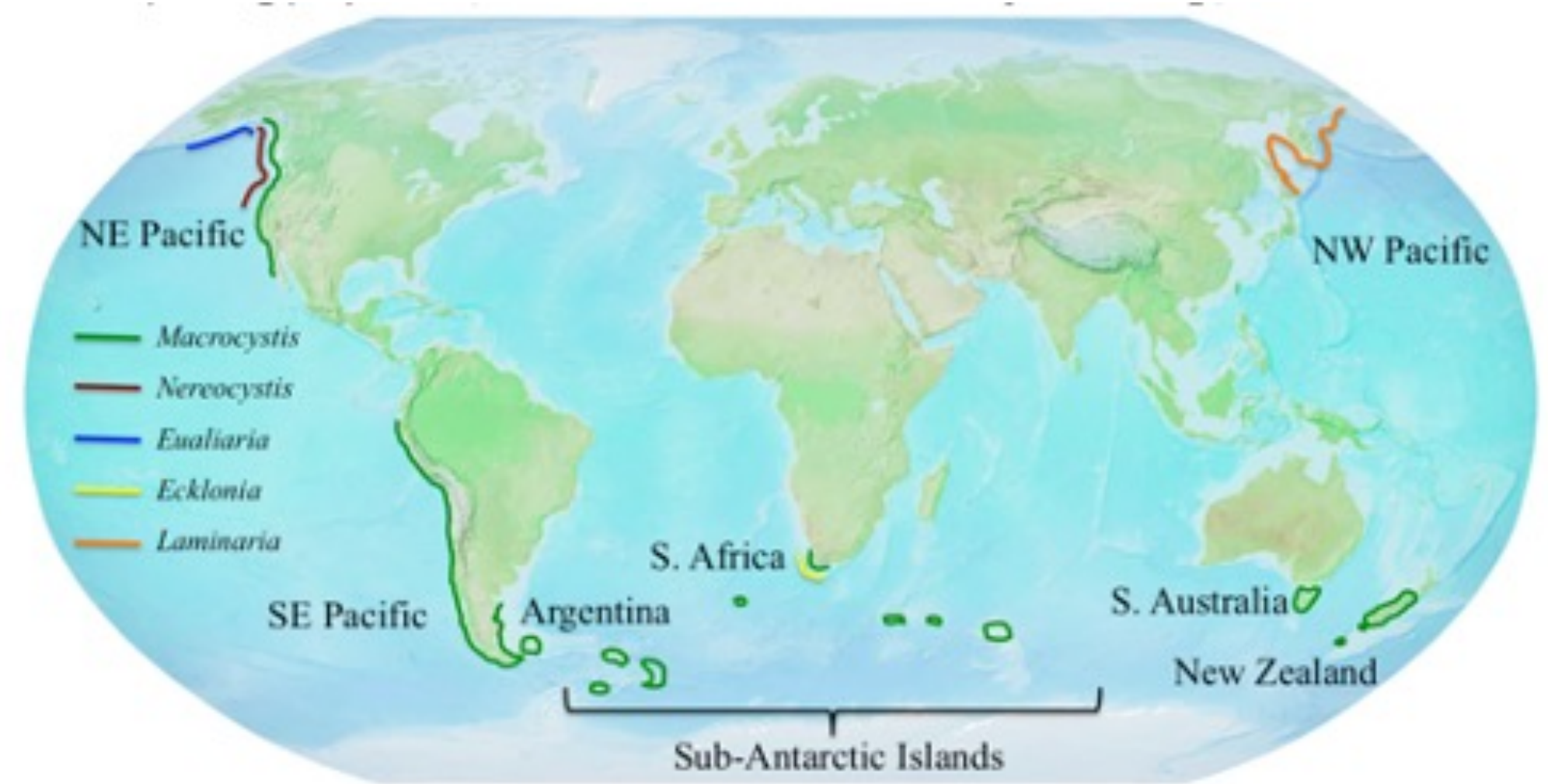
Figure 1. *Global distribution of major canopy-forming kelp species.*

Objectives

This project aims to develop automated methodologies to estimate and distinguish the productivity of two nearshore marine foundation species along the coast of California, bull kelp (*Nereocystis luetkeana*) and giant kelp (*Macrocystis pyrifera*), from AVIRIS imaging spectroscopy data.

Significance

- First project to use imaging spectroscopy to distinguish giant kelp from bull kelp and to estimate kelp physiological condition through time.
- Data and models developed will allow for linkages between kelp forest productivity and standing carbon stocks in California, informing a component of the blue carbon budget that has been largely omitted from current assessments.
- Aligns with the needs and directions of NASA/JPL and our existing and upcoming missions, including the Western Diversity Time Series (formerly known as HyspIRI California) and the Surface Biology and Geology (SBG) mission.

Approach & Results

Year 1 of the project focused on developing methods for distinguishing giant kelp from bull kelp with AVIRIS data.

HyspIRI California – AVIRIS-Classic data from Sonoma County to Monterey, California during three different dates in 2013 revealed spectral differences based on phenology between giant kelp and bull kelp (*Figure 2*). Giant kelp was more spectrally variable through time than bull kelp, but higher frequency data may be necessary.

SBG SHIFT – Participation in the SHIFT campaign off the coast of Santa Barbara, California from February-May 2022 (*Figure 3*). Results are in progress to characterize species-specific spectral patterns in phenology using weekly data from AVIRIS-Next Generation and monthly UAV-based imaging spectrometer data.

Figure 3. *Kelp forests observed from AVIRIS-Next Generation during the SBG SHIFT campaign.*
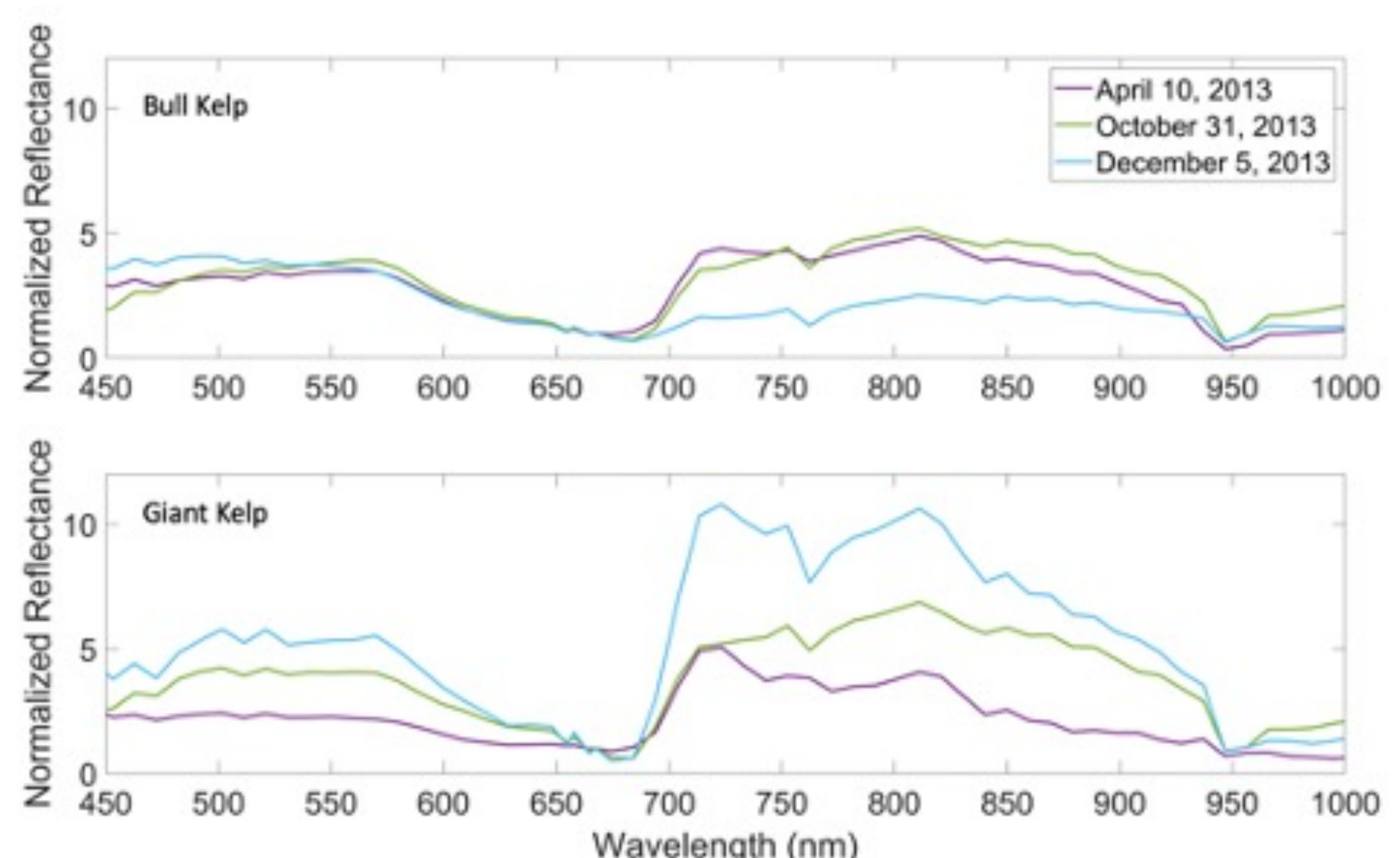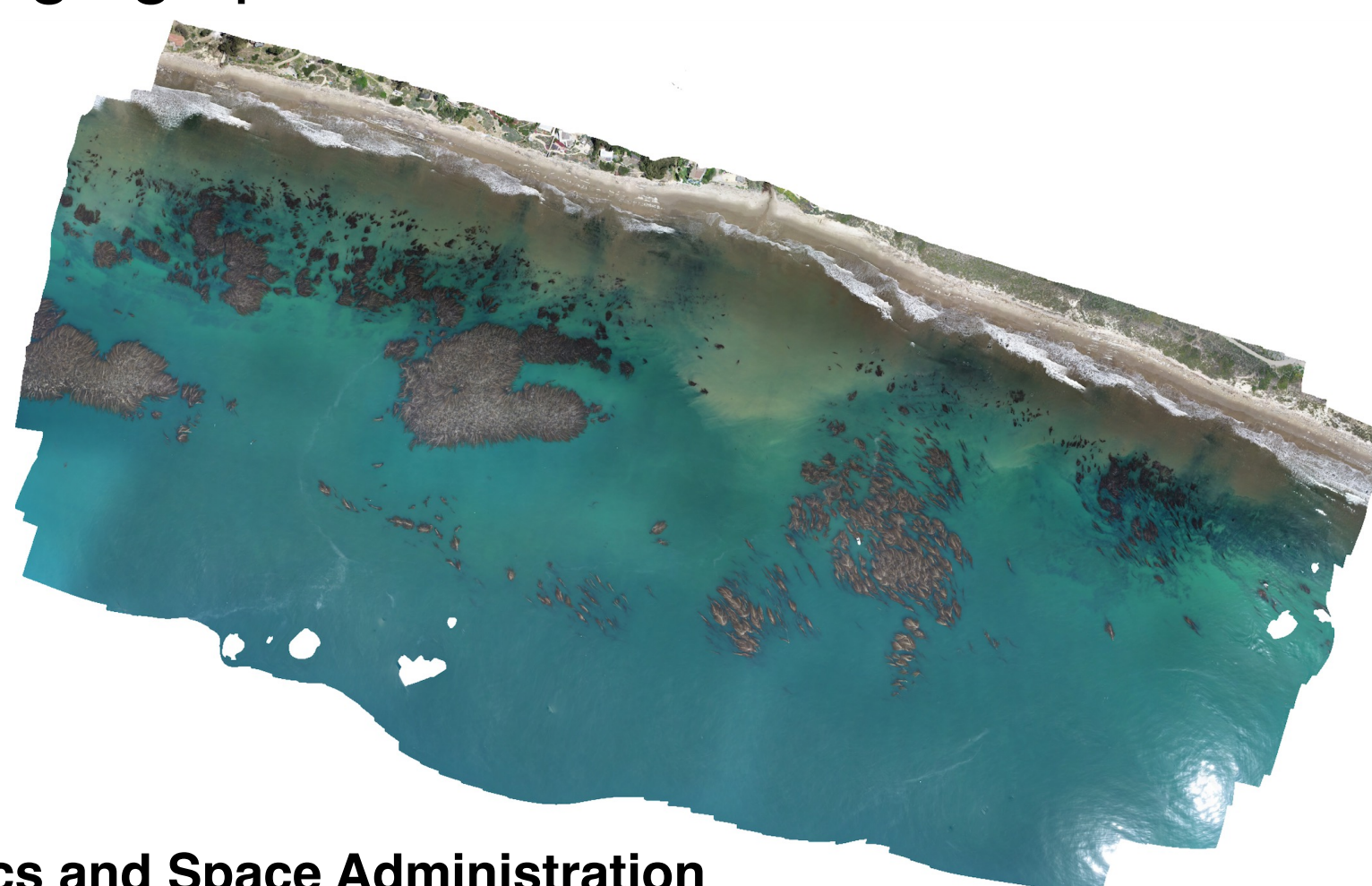
Figure 2. *Spectral signature of (top) bull kelp and (bottom) giant kelp pixels for three AVIRIS Classic flights along the California coastline. Giant kelp is more variable through time, which is expected, as it is a perennial species.*

Clearance Number: CL#
Poster Number: RPC#SP22016

PI/Task Mgr. Contact Information:
Email: Michelle.Gierach@jpl.nasa.gov