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Change Detection of Marine Environments Using Machine Learning

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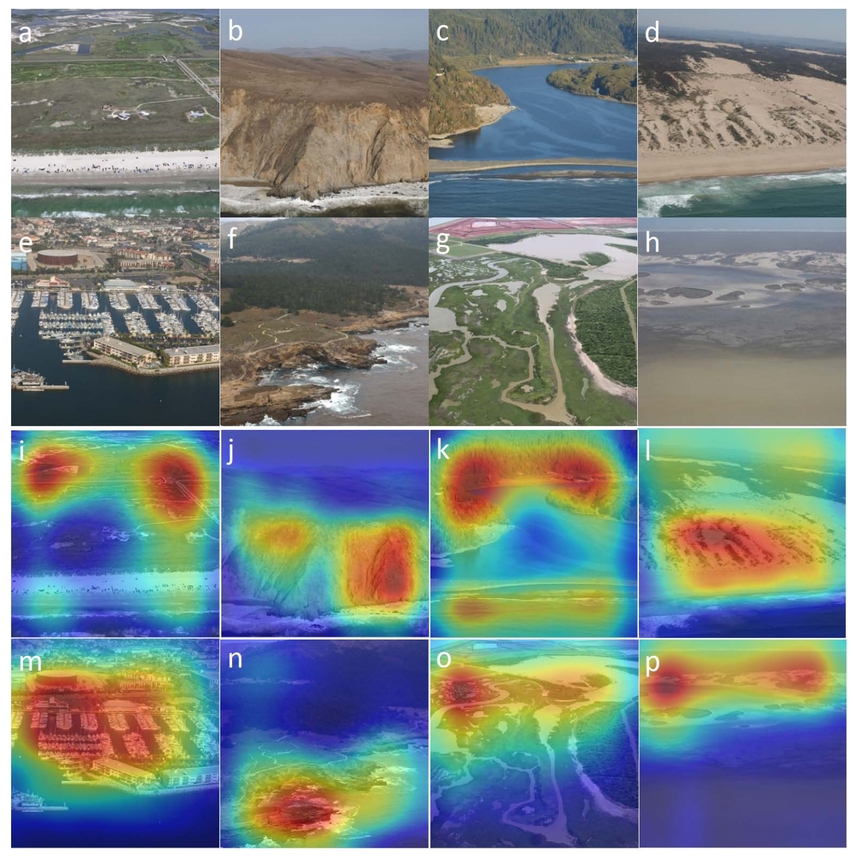
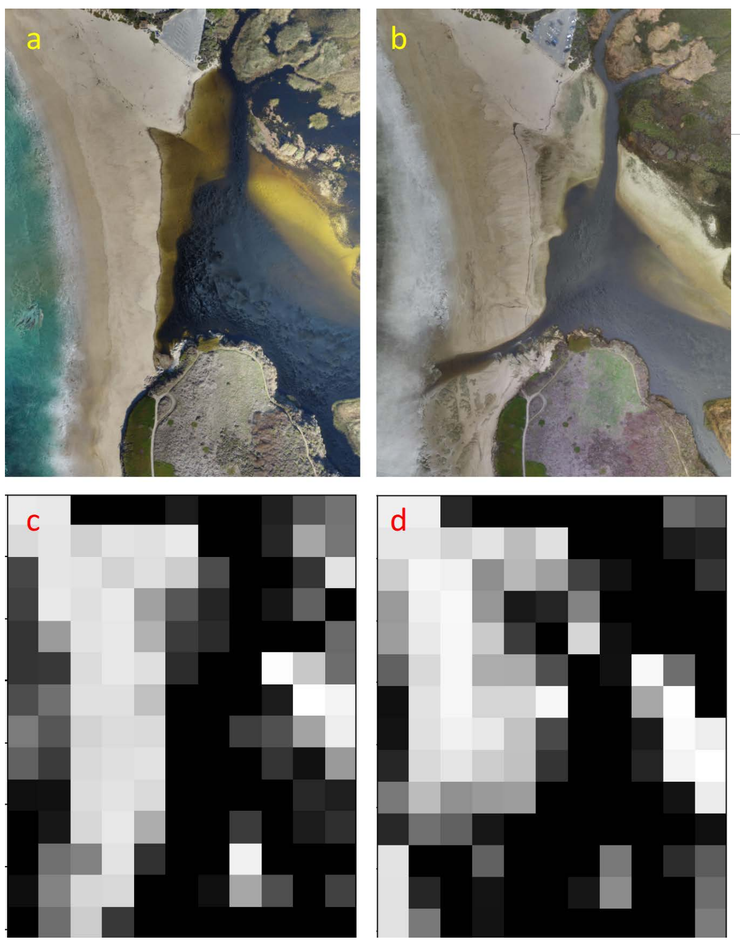
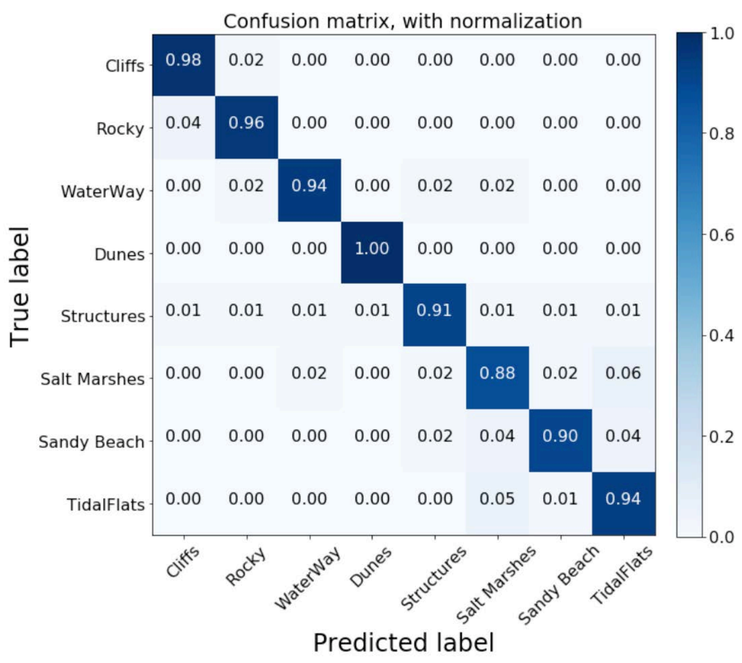
Automate Classification of Littoral Waters with Deep Neural Networks

- Can coastal change (resulting from extreme events) be automatically detected and classified?
- Over 11,000 images of US coastline (West, East, and Gulf coasts) were categorized
- Training of complex neural networks (VGG19)



Coastal landscape classes (a-h) and their corresponding heat maps (class likelihood) for VGG16 (i-p). The corresponding confusion matrix is below, indicating high accuracy for class detection.





Results

- Demonstrated transfer learning approach using object detection works for coastal landscapes
- Developed ontology for coastal landforms that are identifiable and sufficiently different for classification
- Developed a “heat map” algorithm for detecting change of landscape type

Aerial images (a-b) of Carmel River State Beach showing two river configurations. Corresponding mapped class likelihood (c-d) for “beach” where white = 100% likely and black = 0% likely.

Student thesis research

- LCDR Young (June 2018)
- LCDR Herrmann (December 2018)
- LT Coughlin (June 2018)
- LT Mielke (December 2019)
- Capt Ayoub (March 2020)

DJI Inspire with Micasense RedEdge-M 5-band camera, currently being used to gather data over water

Students conducting field measurements during beach breaching (LCDR Herrmann, LCDR Young)

Summary:

- Developed a neural network with 5-band imagery
- Developed a Siamese network for change detection to compare with heat map algorithms
- Tested 13 neural network architectures for transfer learning to coastal landscape classification

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