

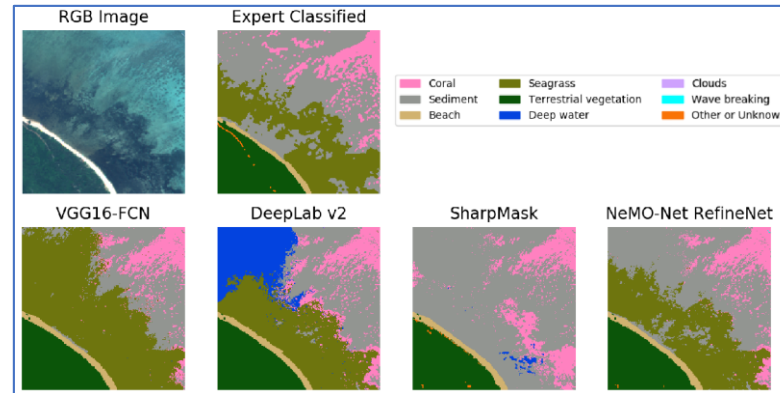
# NeMO-NET: The Neural Multi-Modal Observation & Training Network for Global Coral Reef Assessment

**Purpose:** NeMO-Net is an open-source deep convolutional neural network (CNN) and interactive active learning training software proposed to accurately assess the present and past dynamics of coral reef ecosystems through determination of percent living cover and morphology as well as mapping of spatial distributions.

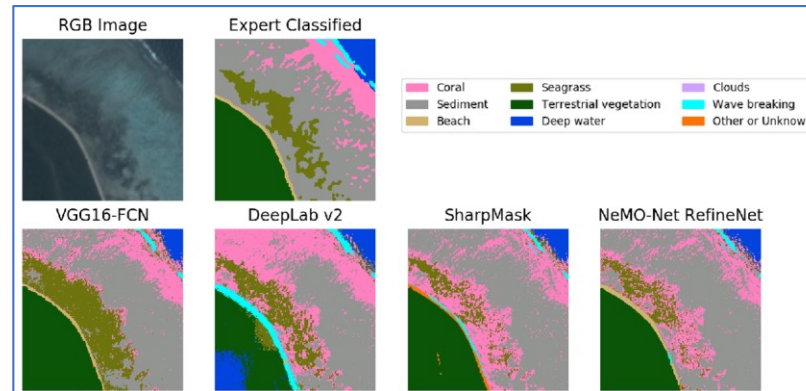
**Study Objective:** Using data as acquired through the NASA Data Buy, we pass WorldView-2 (WV-2) and Planet multispectral 4-band imagery into the CNN and post-processing units (consisting of K-Nearest neighbors and conditional random field filters), to gauge the accuracy achievable through NeMO-Net on generic satellite data.

**Imagery:** WorldView-2 and Planet 4-band multispectral imagery, focused on Fijian islands

**Findings:** The algorithm was able to accurately segment WorldView-2 imagery up to an accuracy of 83%, while Planet imagery was more difficult to classify due to calibration issues, with an accuracy of up to 80%. See Figures and Tables on the right.



**Figure 1:** Sample WV-2 image and classifications. We show comparisons to 3 other popular CNN algorithms besides for NeMO-Net (VGG16, DeepLab, and SharpMask)



**Figure 2:** Sample Planet image and classifications. We show comparisons to 3 other popular CNN algorithms besides for NeMO-Net (VGG16, DeepLab, and SharpMask)

Method	Accuracy	Mean Precision
Post-processing with KNN-CRF(all classes)		
VGG16-FCN	79.0%	<b>67.4%</b>
DeepLab	73.4%	55.2%
SharpMask	73.2%	57.4%
<b>NeMO-Net (RefineNet)</b>	<b>83.3%</b>	<b>64.9%</b>
Post-processing with KNN-CRF (Coral, sediment, and seagrass only)		
VGG16-FCN	82.8%	80.1%
DeepLab	77.4%	68.5%
SharpMask	81.6%	77.9%
<b>NeMO-Net (RefineNet)</b>	<b>85.1%</b>	<b>86.8%</b>

**Table 1:** Accuracy and precision metrics for WV-2 classified imagery with NeMO-Net, compared against 3 other popular CNN algorithms.

Method	Accuracy	Mean Precision
Post-processing with KNN-CRF(all classes)		
VGG16-FCN	78.1%	59.2%
DeepLab	71.2%	50.7%
SharpMask	77.2%	56.1%
<b>NeMO-Net (RefineNet)</b>	<b>79.7%</b>	<b>60.2%</b>
Post-processing with KNN-CRF (Coral, sediment, and seagrass only)		
VGG16-FCN	72.5%	67.1%
DeepLab	72.5%	67.9%
SharpMask	71.0%	65.7%
<b>NeMO-Net (RefineNet)</b>	<b>73.4%</b>	<b>70.1%</b>

**Table 1:** Accuracy and precision metrics for Planet classified imagery with NeMO-Net, compared against 3 other popular CNN algorithms.