THE USE OF HYPER SPECTRAL 
REMOTE SENSING IN 
DETECTION OF 
UNDERWATER VOLCANOES 

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Five Major Types of Volcanoes

1. Caldera
2. Cinder Cone
3. Shield Volcano
4. Stratovolcano
5. Lava Dome
What is a submarine Volcano?

The vast majority of volcanoes are located parallel to oceanic trenches & along the oceanic ridge over hot spots originating from the mantle. The modern active island rests close to the hot spot and its shield volcanoes are fed from the magma that the hot spot generates.
What is hyperspectral remotesensing

Hyperspectral remote sensing is the science of acquiring digital imagery of earth materials in many narrow contiguous spectral bands. It combines imaging and spectroscopy in a single system, the data sets are composed of 100-200 spectral bands of relatively narrow bandwidths (5-10nm). There are various applications of Hyperspectral remote sensing and one of them is in the area of oceanography.
Why Hyperspectral Remotesensing

- Hyperspectral instruments provide much greater spectral detail, and thus an improved ability to extract multiple layers of information from the spectrally complex environment associated with coral reefs and other shallow costal subsurface environments.
- Implementing hyperspectral algorithms into parallel computing frameworks provides both the foundation for assessing real-time processing capabilities as well as the computational power necessary for addressing complex optimization and sensitivity questions.
- Physical and biological modeling of the scene is often required to analyze the hyperspectral image.
The total radiance, \((Lt)\) recorded by a remote sensing system over water is a function of the electromagnetic energy received from:

- \(L_p\) = atmospheric path radiance
- \(L_{s}\) = free-surface layer reflectance
- \(L_{v}\) = subsurface volumetric reflectance
- \(L_{b}\) = bottom reflectance

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Lt = L_p + L_s + L_v + L_b
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Reflectance of optical sensors

- Multiple light paths
- Scattering due to:
  - atmosphere
  - aerosols
  - water surface
  - suspended particles
  - bottom
- Absorption due to:
  - atmosphere
  - aerosols
  - suspended particles
  - dissolved matter
- Scattering and absorption are convolved
The subsurface volumetric radiance, $L_v$. The characteristics of this radiant energy are a function of the concentration of pure water ($w$), inorganic suspended minerals (SM), organic chlorophyll-a (Chl), dissolved organic material (DOM), and the total amount of absorption and scattering attenuation that takes place in the water column due to each of these constituents, $c(\lambda)$:

$$L_v = f [Wc(\lambda), SMc(\lambda), Chlc(\lambda), DOMc(\lambda)]$$

It is useful to look at the effect that each of these constituents has on the spectral reflectance characteristics of a water column.
Conclusion

- All these factors are taken into consideration for the development of the algorithm and many algorithms are developed and implemented but still in many cases the accurate data analysis is not possible of the space borne data.

- Some of these methods prove inefficient due to the atmospheric factors or sometimes the data analysis is incorrect or needs improvements by the ground truthing of the data.
References


