Machine Learning Applications for Satellite Derived Bathymetry

Grant-Funded Research to Meet Seabed 2030 Objective

MACHC XIX| Cartagena, Colombia |30 Nov, 2018

Kyle Goodrich | President & Founder | TCarta | kg@tcarta.com

10m Satellite Derived Bathymetry – Isla Grande, Colombia

National Science Foundation Small Business Innovation and Research Grant

Project Trident: A Three-Pronged Automated Solution to Satellite Derived Bathymetry

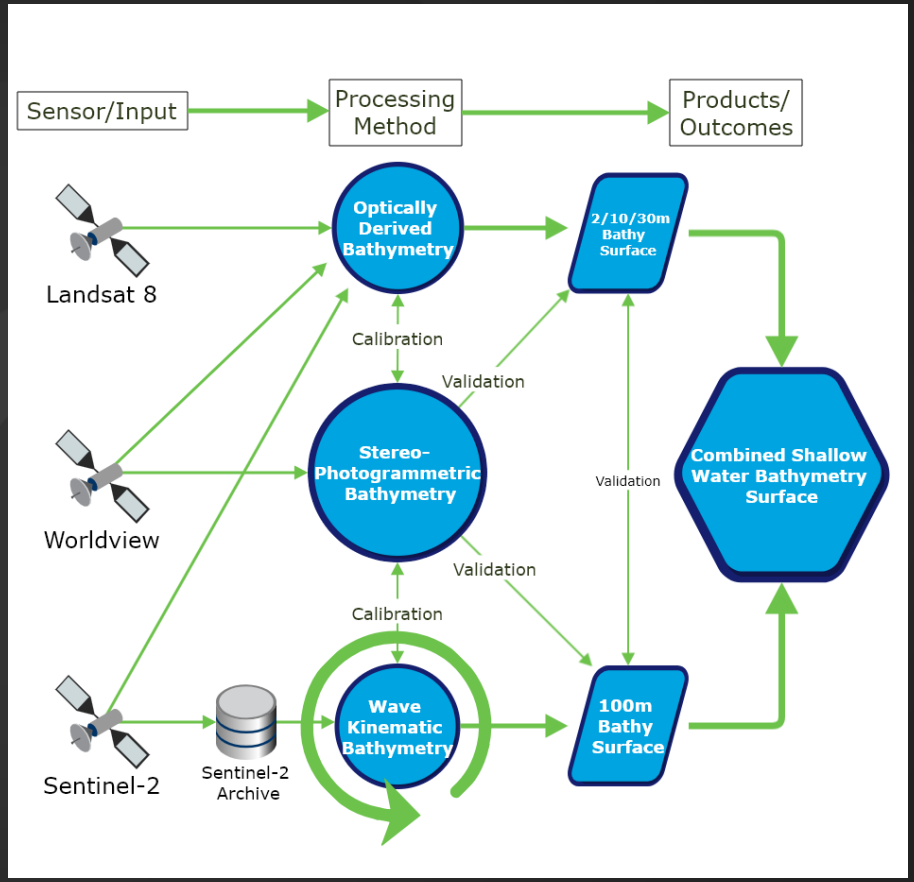
Project Trident Processing Scheme

Trident's innovation will improve affordability, accessibility, integrity and modernity of global shallow water bathymetric data.

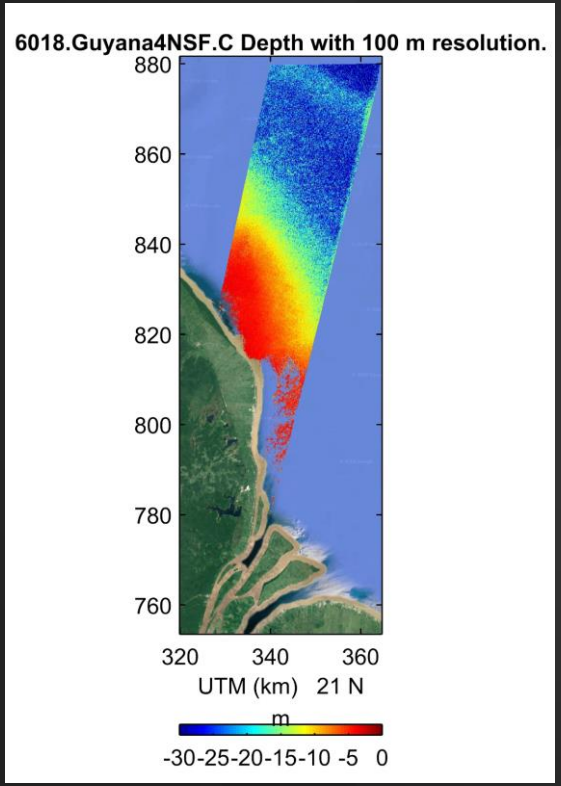
Establish intelligent automated SDB approach

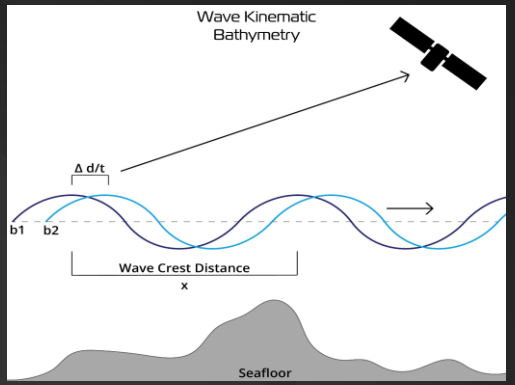
Create deep-learning solution to suitability analysis

Combine three physics-based Satellite Derived Bathymetry techniques



Wave Kinematic Bathymetry





Works in clear and turbid waters

Requires proper metocean conditions

Exploits the relationship between the change in the velocity of waves, and water column depth

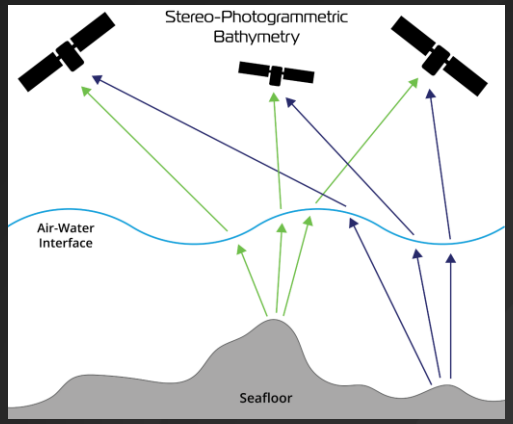
20-200m resolution bathymetry, improves with additional images

Ongoing collection of freely available Sentinel 2 imagery provides 60-70 suitable images per year for processing

Ever-improving bathymetry model with 150-200 images available per area

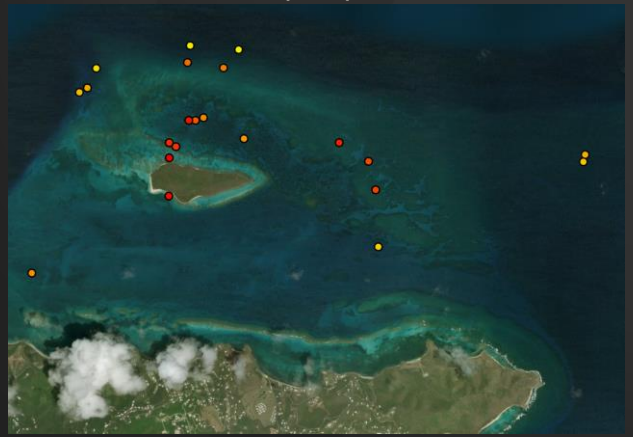
Non-navigational but useful for hydrodynamic modeling, survey planning

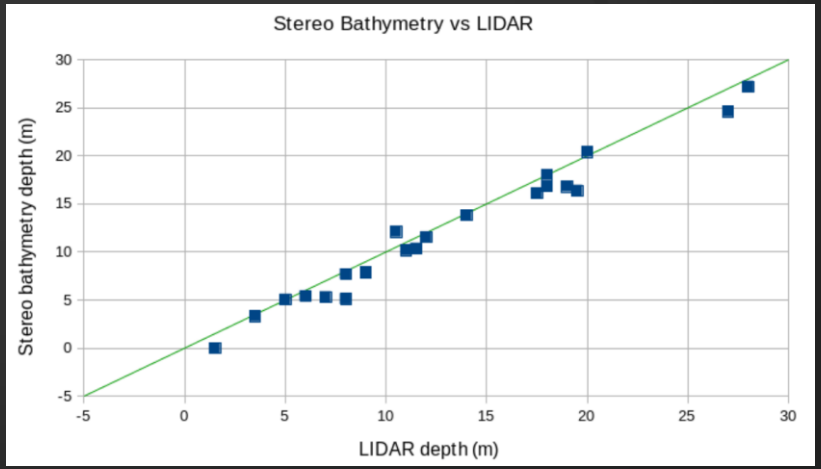
Photogrammetric Bathymetry: St. Croix



- Object-based elevation extraction
- Leverages DigitalGlobe archive imagery
  - Does not require stereo pairs
- Very high resolution imagery used to validate lower resolution
- Elevations referenced to Geoid, adjusted to local tidal datum
- 2 images minimum, 5+ optimal
- Validation for Optical SDB and WKB

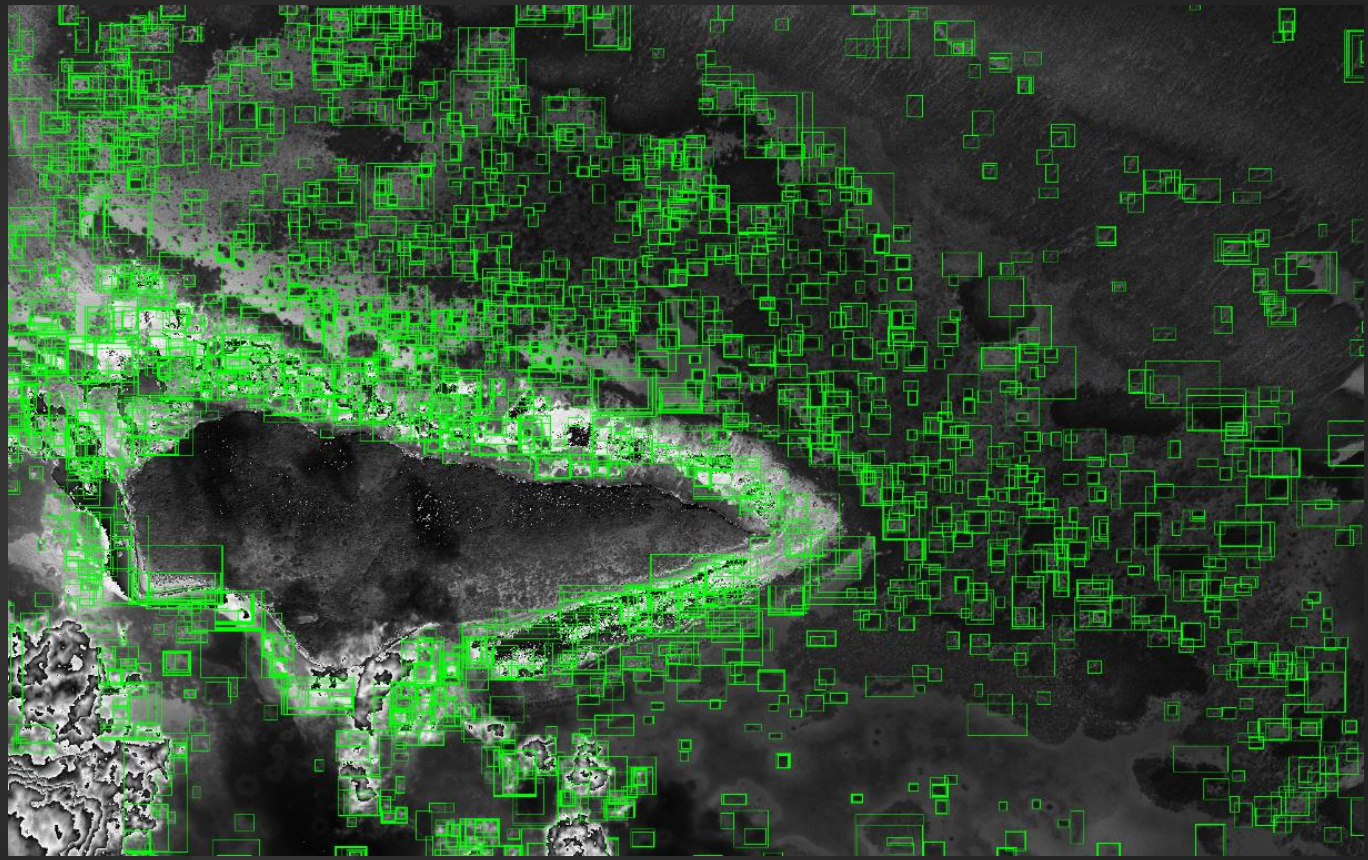
Stereo-derived depth points



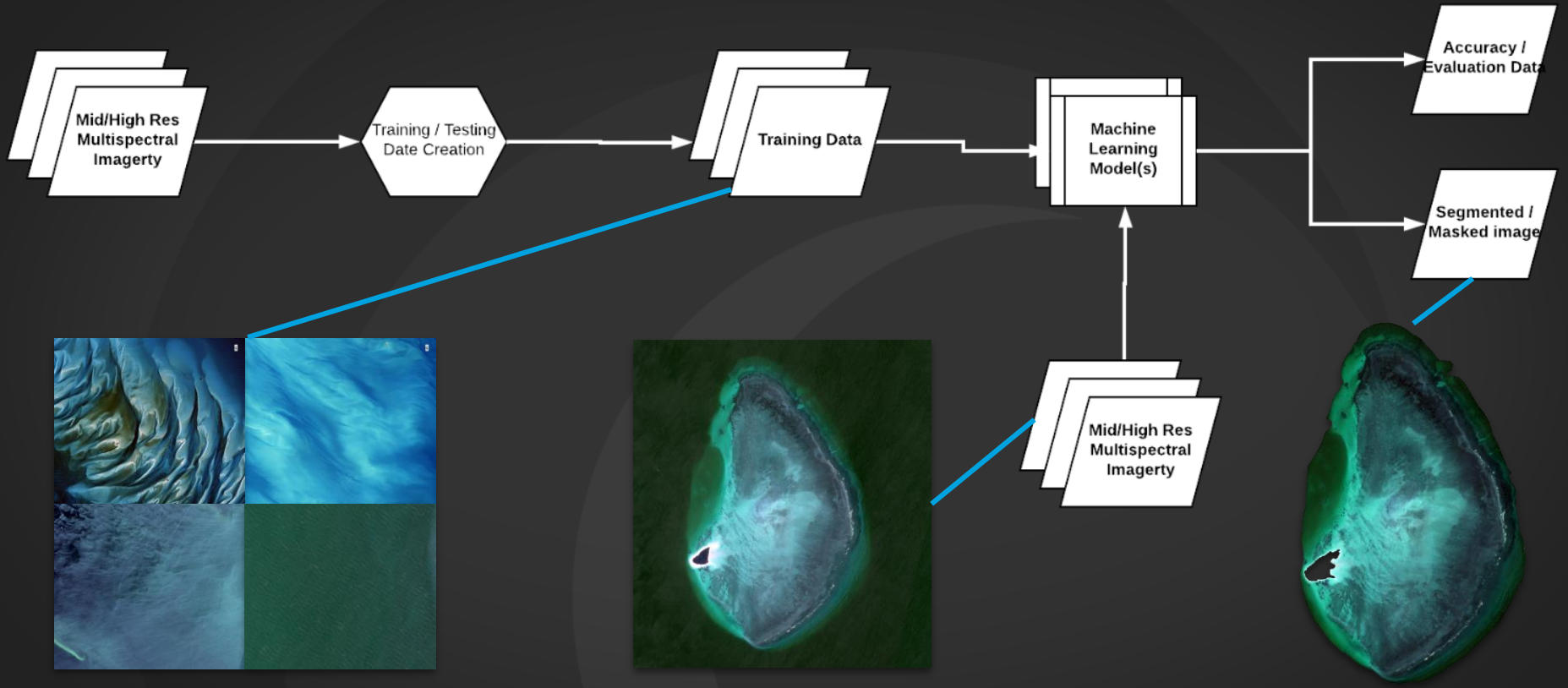


Targeted Segmentation

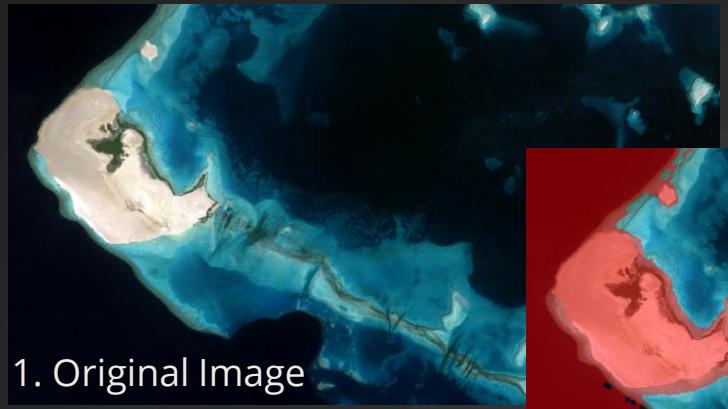
- Panchromatic/ Multispectral Segmentation
- Tunable parameters to local bottom characteristics, desired object size and number
- Human 90% out of workflow
- object matching metrics to ensure only good matches utilized
- ~1000 times more extracted points than manual approach



Machine Learning for SDB

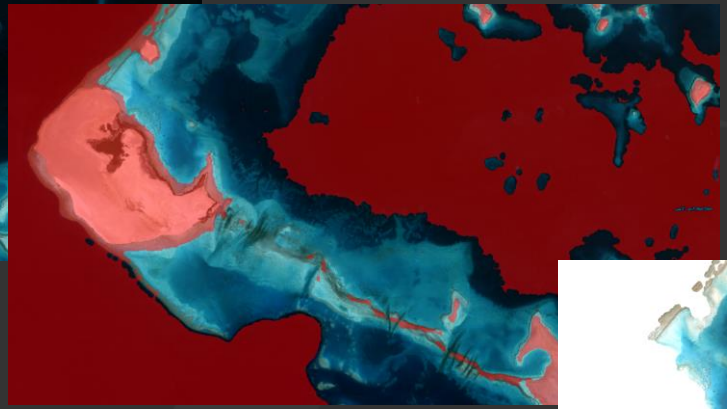


Automated Detection and Allocation of Suitable Image Segments

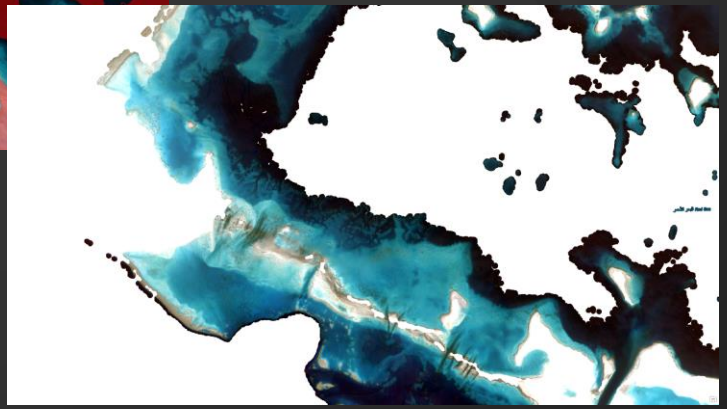


1. Original Image

Old method: manual process takes trained and experienced operator to mask area of turbidity, clouds, extinction depth, etc



2. Automated suitability detection



3. Masked image sent to physics-based SDB

New method: Images are assessed for metocean conditions and water quality and automatically allocated to appropriate processes based on Machine Learning

Trial Areas Within MACHC

South Florida - varying water clarity for testing automated image segmentation

St. Croix - location for all three methods and in situ data

Guyana - Highly suitable for WKB

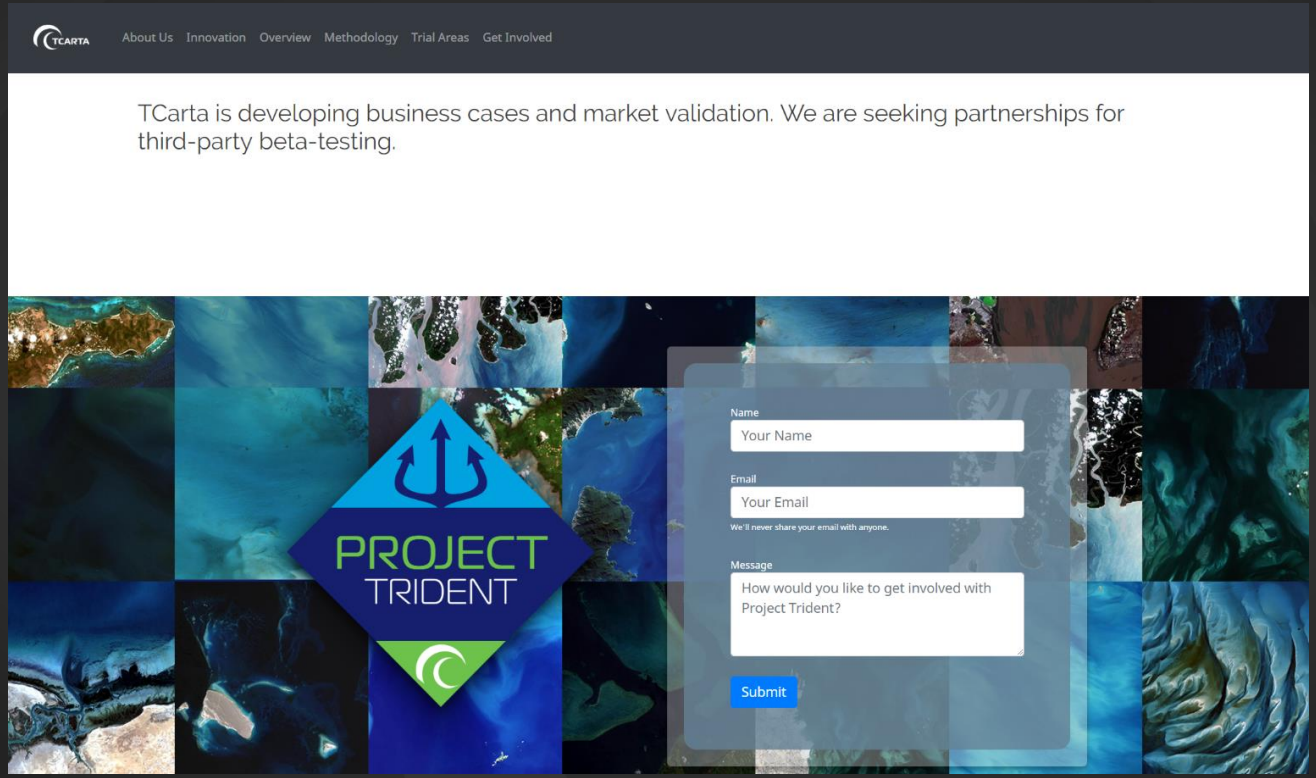
Six trial locations have been chosen to test the three methods and automated suitability segmentation, three residing within MACHC domain

Project Trident Provides Ultra-Low Cost Option to Meet the Specifications of the Seabed 2030 Initiative

...and tsunami inundation preparation

Learn More and Get Involved

www.trident.tcarta.com



available in Spanish - 4 December, 2018