A Multinational CubeSat for Forest Monitoring

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United Nations / Brazil Symposium on Basic Space Technology
Natal, Brazil, 11 – 14 September 2018
1. Background
   – Central America
   – Central American CubeSat projects
     • Costa Rica (Irazú)
     • Guatemala (Quetzal-1)

2. Baseline Work
   – Preliminary Mission Selection
   – Mechanism of Collaboration

3. Future Work
   – Integration of interested institutions and countries
   – Final Mission Selection
   – Mission Concept Design
   – Central American CubeSat Mission Design Workshop

4. Conclusions
Background
Forest land coverage [1]
- Costa Rica: 54%
- Central America: 41%
- Guatemala: 33%

image: Google Maps
Use of remote sensing data for characterization of:

- land-use
- ecosystem dynamics
- biodiversity
- reaction to at least 27 natural disasters

1. Space-based imagery is already being used

2. The current development of space technologies enable CA-applicable Earth monitoring applications using the CubeSat standard

3. Active CubeSat projects in Costa Rica and Guatemala

Costa Rican CubeSat: Irazú

- Developed by the Costa Rican Institute of Technology (TEC) & the Central American Association of Aeronautics and Space (ACAE)

- Mission: to monitor carbon fixation through a ‘Store and Forward’ approach, collecting data from dendrometers in remote forest and relaying to the Ground Control Station in Cartago (TEC)
Costa Rican CubeSat: Irazú

- Launched and deployed from ISS in 2018
- Currently active
Guatemalan CubeSat: Quetzal-1

- Developed by students, faculty, and volunteers at Universidad del Valle de Guatemala (UVG) [4]
- In-house developed Structure, EPS, ADM, Passive ADCS, and Payload

Guatemalan CubeSat: Quetzal-1

• Payload: Monochromatic sensor with motorized carrousel
• Carrousel enables changing light filters for myriad applications
• Proof-of-concept: water color monitoring (algal bloom – water contamination)

Winner of the 2nd UNOOSA/JAXA KiboCube Opportunity to be launched to and deployed from ISS in 2019
Baseline Work
Preliminary Mission Selection

• A CubeSat mission selection tool [5] was used to select the Central American CubeSat mission

• The methodology takes into account (i) programmatic risk, (ii) technical feasibility, (iii) relevance, (iv) resources, and (v) benefits

• Enables to quantitatively compare mission options

Preliminary Mission Selected: Forest Mapping

- Differentiate land use – forest vs. agroindustry, cities, desert, etc.
- Enable prompt reaction to illegal deforestation and for the conservation and protection of natural resources
Mechanism of Collaboration

**Supranational**

**TEC**

**UVG**

TEC managed, non-TEC subsystem

UVG managed, non-UVG subsystem
Future Work
Future Work

• Integrate other interested institutions and countries
• Final Mission Selection
• Mission Concept Design
• Central American CubeSat Mission Design Workshop
Integrate new members
Acquire funds for Workshop
Workshop
Publicize Opportunity
Central American CubeSat Mission Design Workshop

- Application pitches by topic experts (8-4 potential applications)
- Application selection
- Training on Mission Concept Design (MCD) (by international experts)
- MCD Development
- MCD selection
- Mission Concept Review (MCR) (reviewed by international experts)
Central American CubeSat Mission Design Workshop

Participants (total of 36, planned max of 50)

- Two topic experts for each of the four potential applications (8)
- Two international experts on MCD (2)
- Two special guests (experts on other topics, e.g. policy, management, etc.) (2)
- Six engineers/scientist from each leading institution (TEC, UVG) (12)
- Two engineers/scientist from each Central American country (14)
Conclusions
Conclusions

• C.A. is on initial steps to change from space data consumer to producer
• Costa Rica has an operational CubeSat, Guatemala plans to launch its own in 2019
• C.A. CubeSat proposed to galvanize collaboration
• Methodology used for the preliminary selection of a mission: forest mapping
• Supranational Program Management, per-institution Project Management
• Program structure designed to incorporate other interested institutions/countries
• Workshop planned for application selection and Mission Concept Review
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