AlbertaSat-1

Greenhouse Gas Monitoring for Industrial and Environmental Improvement

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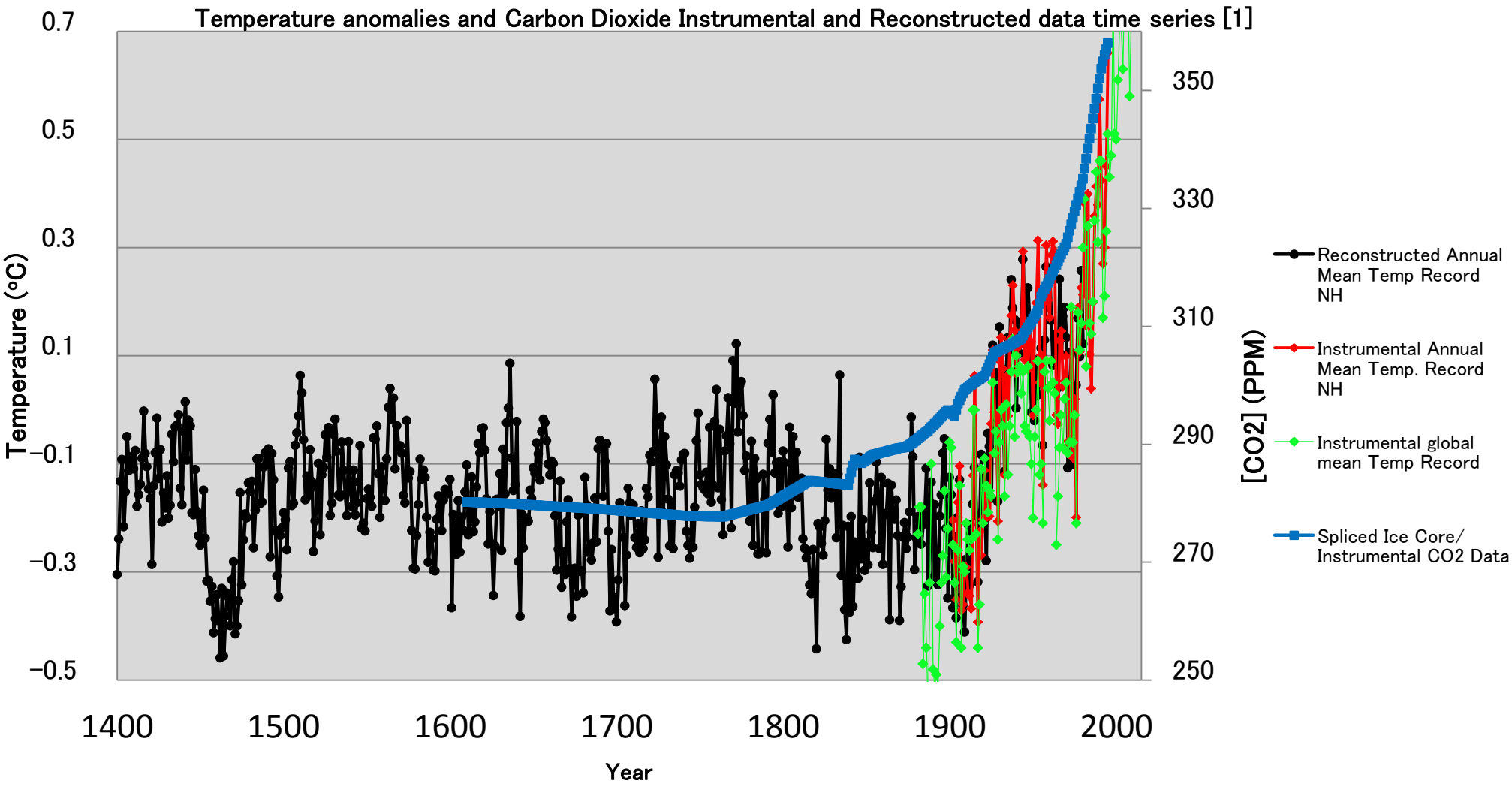
Presentation Outline

- Mission Overview
- Spacecraft Overview
  - Payload
  - Structure
  - Attitude Determination & Control
  - Power
  - Communications & Data
  - Orbit
- Concept of Operations
- Program Management
- Summary & Conclusions
- References

Mission Overview: Background



Mission Overview: Background

- Data shows positive correlation:
  - Increasing atmospheric CO_2 concentrations
  - Increasing global average temperature
  - Emission impact
- Global carbon balance has large uncertainties and sinks/sources are not fully understood
- Increased global coverage and enhanced temporal (diurnal, seasonal and interannual) and spatial (local to synoptic scale) observations of atmospheric [CO_2] will provide better estimates for sources and sinks [2]

Mission Overview: Background

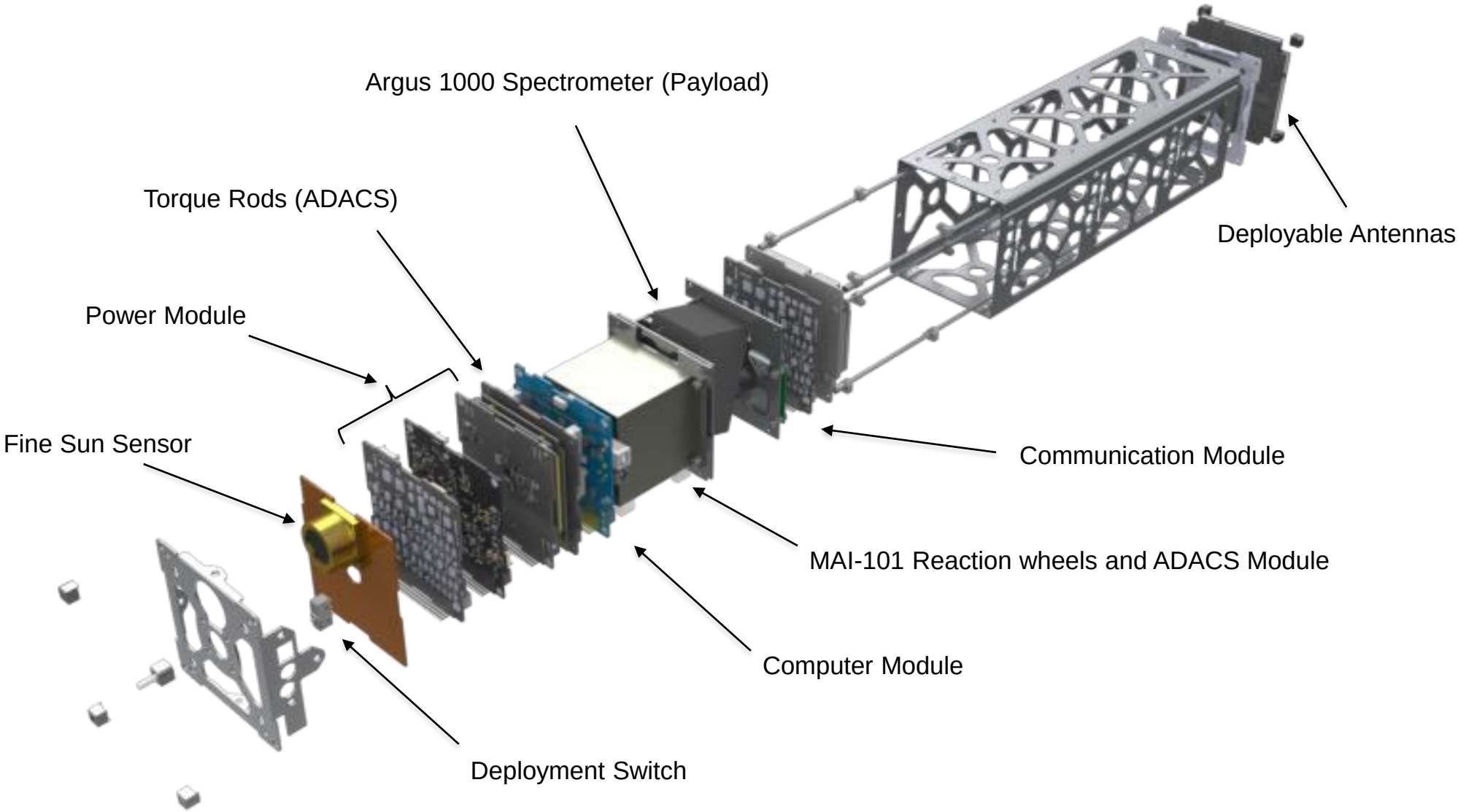
- Monitoring CO_2 emissions is a high priority as stated by the governments of Canada and Alberta [4]

Image [3]: Alberta oilsands and large scale industrial GHG emissions

Mission Overview: Objectives

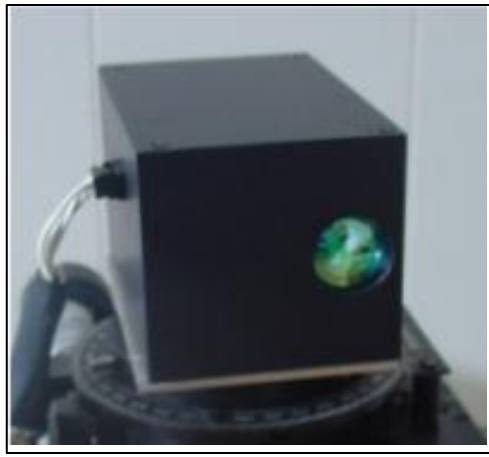
- Deploy a near-infrared (1000-1700nm) spectrometer payload to detect CO_2, H_2O and CH_4 concentrations for monitoring purposes.
- Develop local scale CO_2 transport and diffusion characterization around industrial regions (e.g. Alberta oilsands). Monitor and Map locally over time.
- High resolution and pointing accuracy to determine greenhouse gas (GHG) sources/sinks
- Engage students and public in space technology

Spacecraft Overview: Exploded View



Spacecraft Overview: Payload

Argus 1000 IR Spectrometer



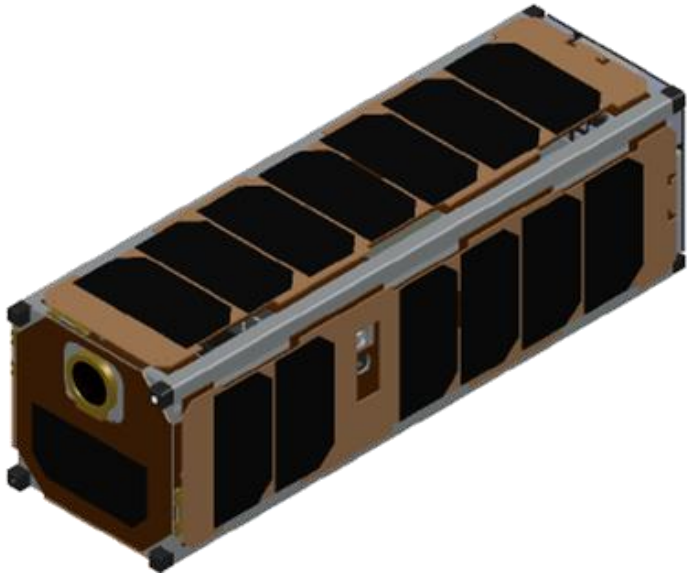
THOTH TECHNOLOGY, INC.

- NIR: 1000nm-1700nm
- ~1.5 km (across track) by ~10 km (along track) ground resolution
- Determine column densities of CO_2, H_2O and CH_4
- Space worthiness proven by CanX-2 (9:30am Descending node sun-sync orbit [5])

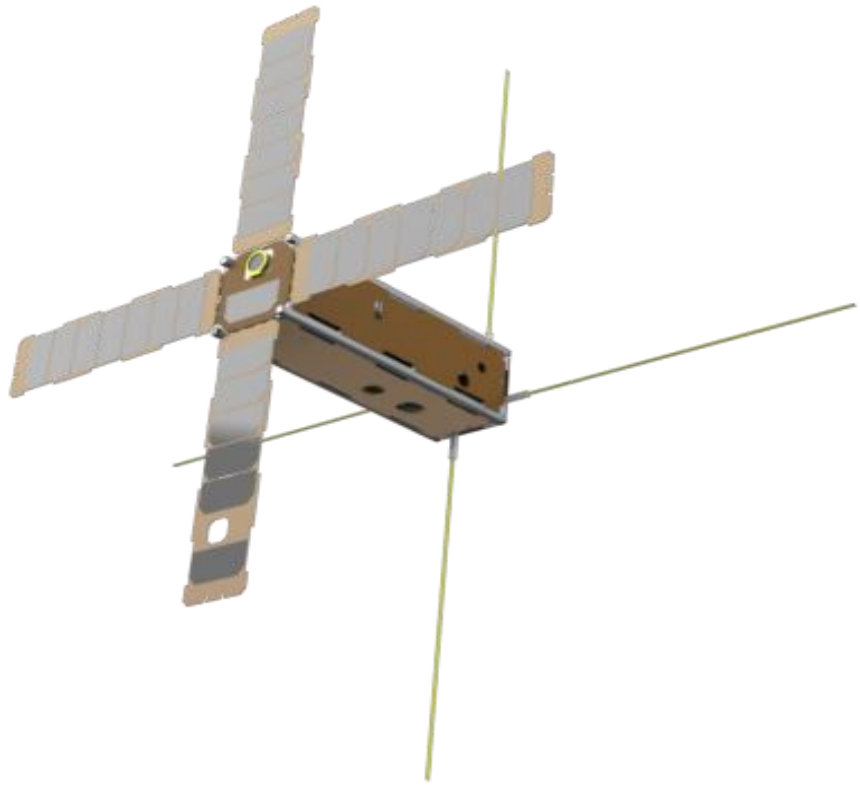
Spacecraft Overview – Structure

- Pumpkin 3U CubeSat COTS structure
- Total estimated mass (with margin): 3675.19 g

Stowed Configuration

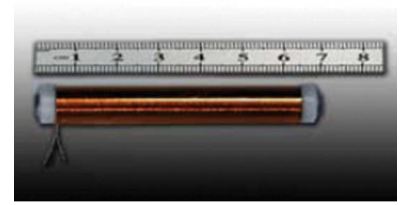


Deployed Configuration



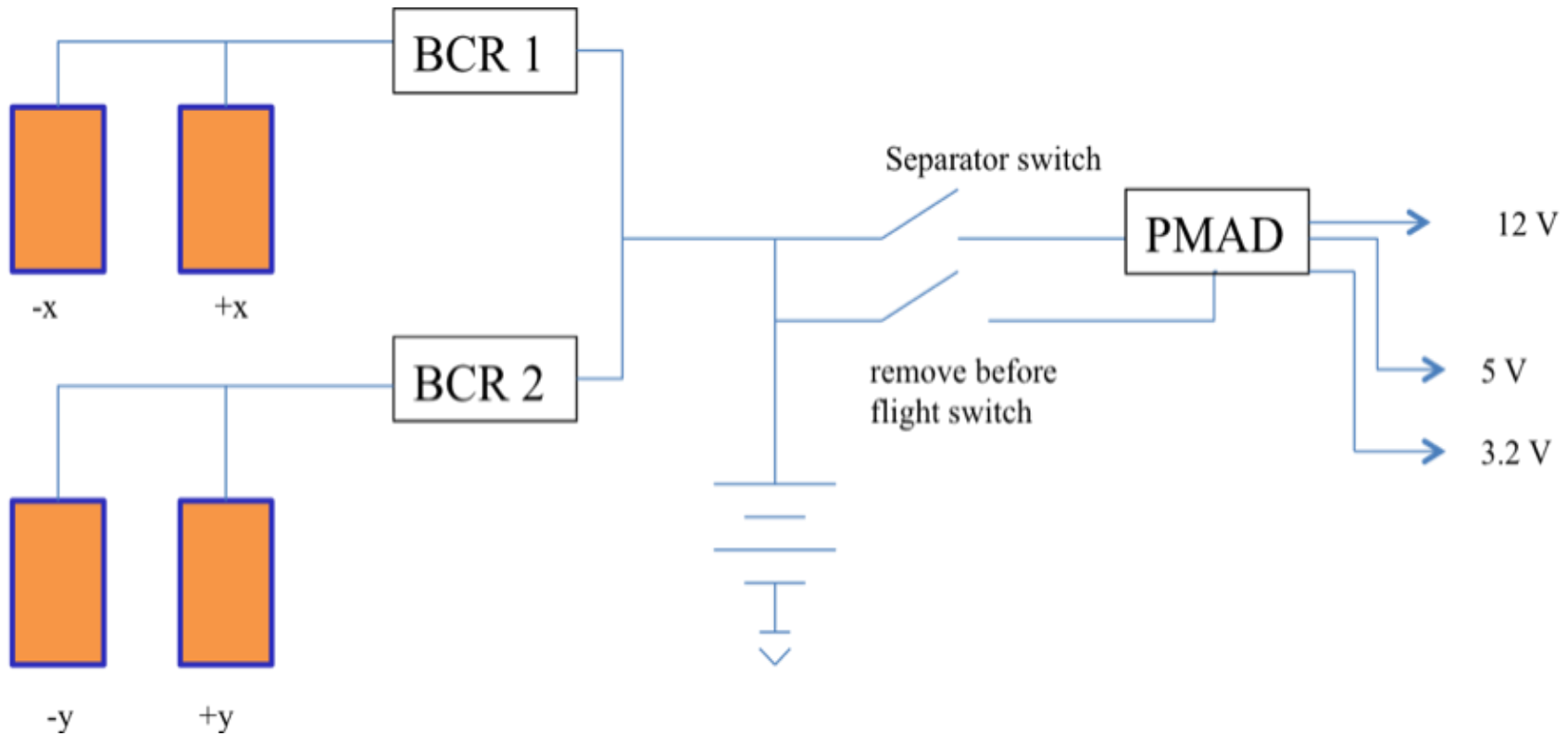
Spacecraft Overview – ADACS

- Payload requires very high pointing accuracy
  - Observation accuracy: +/- 12km
  - Required control accuracy: ~1.0 degree
- Attitude sensors:
  - Two sun sensors (one fine and one coarse)
  - Two earth horizon sensors
  - Two 3-axis magnetometer
  - One 3-axis rate gyro
  - One GPS receiver
- Control actuators:
  - Reaction wheels
  - Torque rods



Spacecraft Overview – Power

- OAP consumed: 9.354 W
- OAP generated: 29.16 W
- Peak instantaneous power consumed: 25.786 W

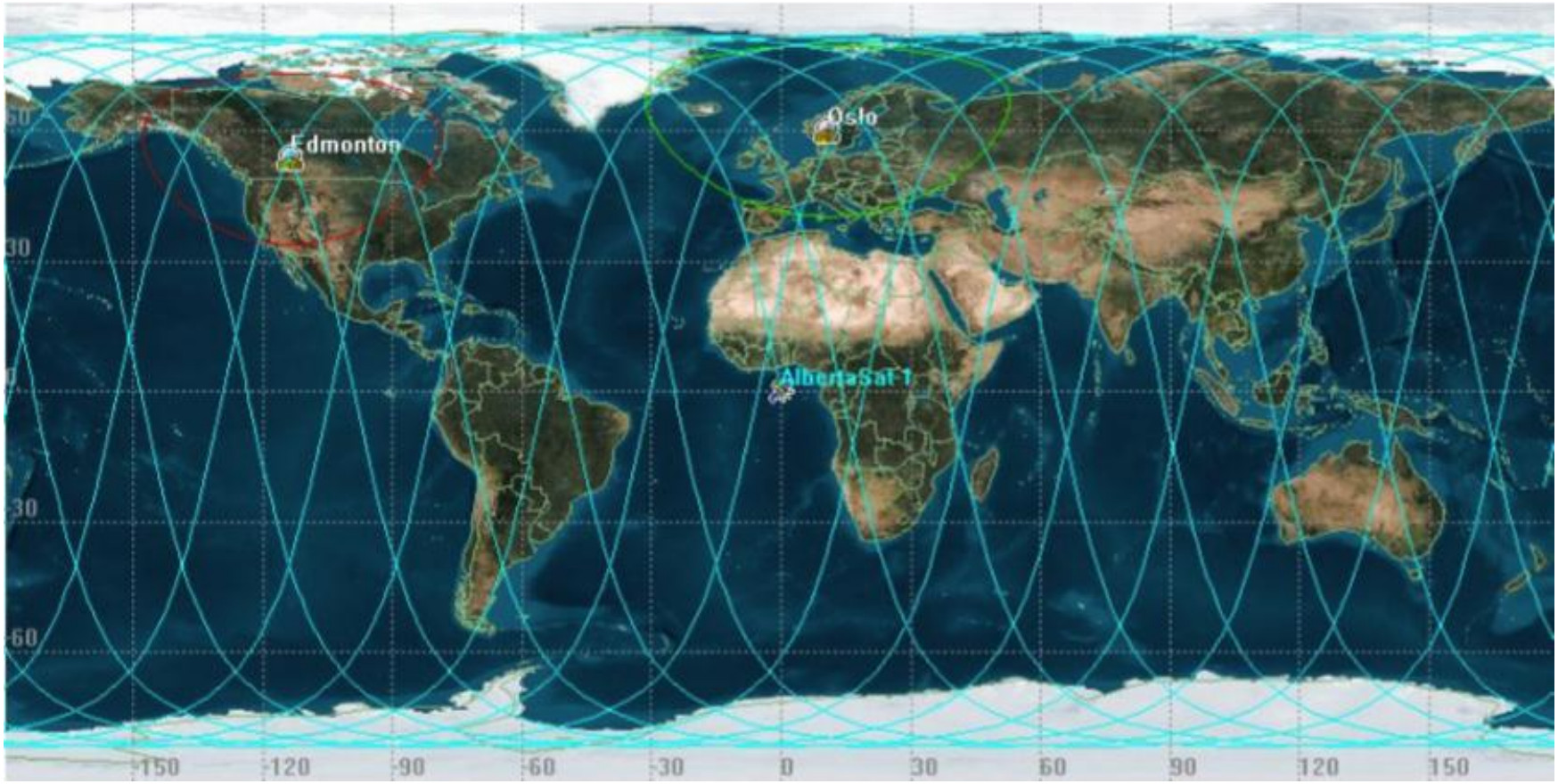


Spacecraft Overview – Communications & Data

- Periodic UHF telemetry downlink (400-450 MHz)
  - 256 bytes of telemetry and status every 200 s
  - Amateur radio
- UHF data downlink (400-450 MHz)
  - Every sensor reading is at least 552 bytes (raw and uncompressed, includes contextual information such as timestamp/location)
  - Two ground stations
    - Edmonton, Alberta, Canada
    - Andøya, Norway
  - 1.2 MB science data down/day
- VHF Uplink (130-160 MHz)
- ARM Cortex M3 Board microcontroller

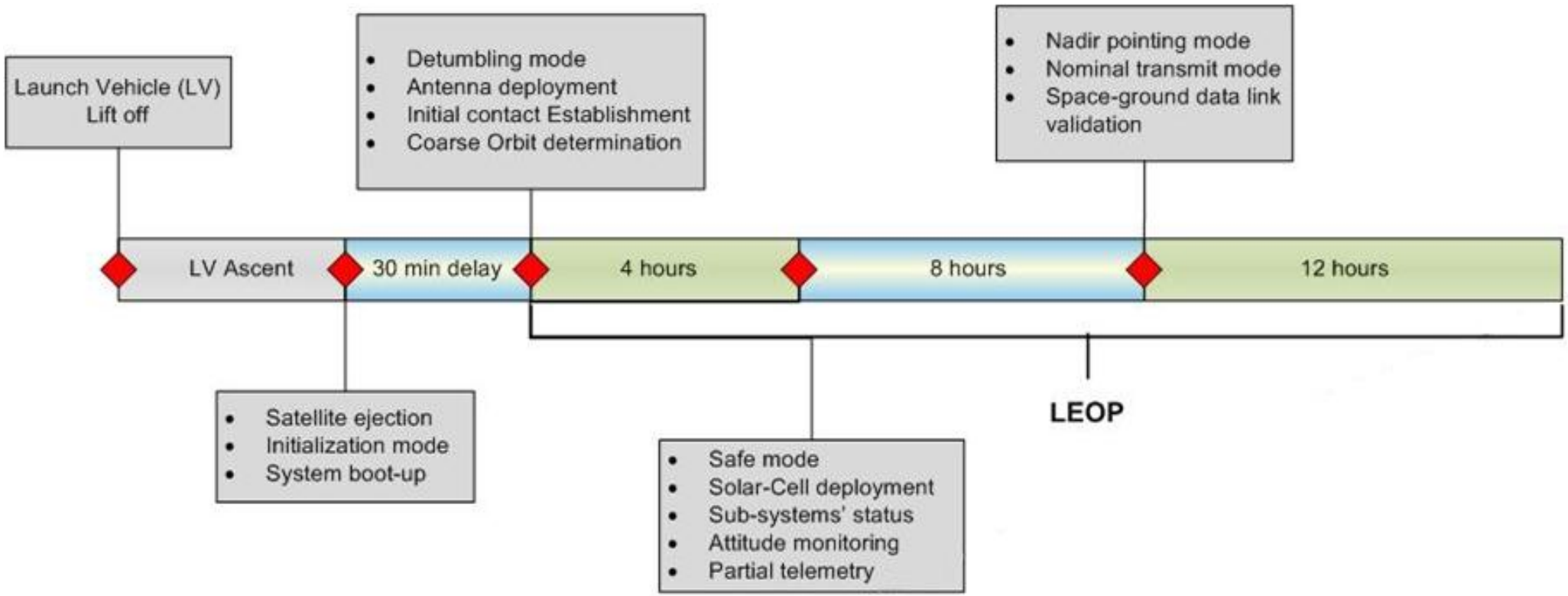
Spacecraft Overview - Orbit

- Dusk-dawn (6:00 am ECT), near-polar, sun-synchronous
- Altitude: 700km
- Mission life of ~5 years

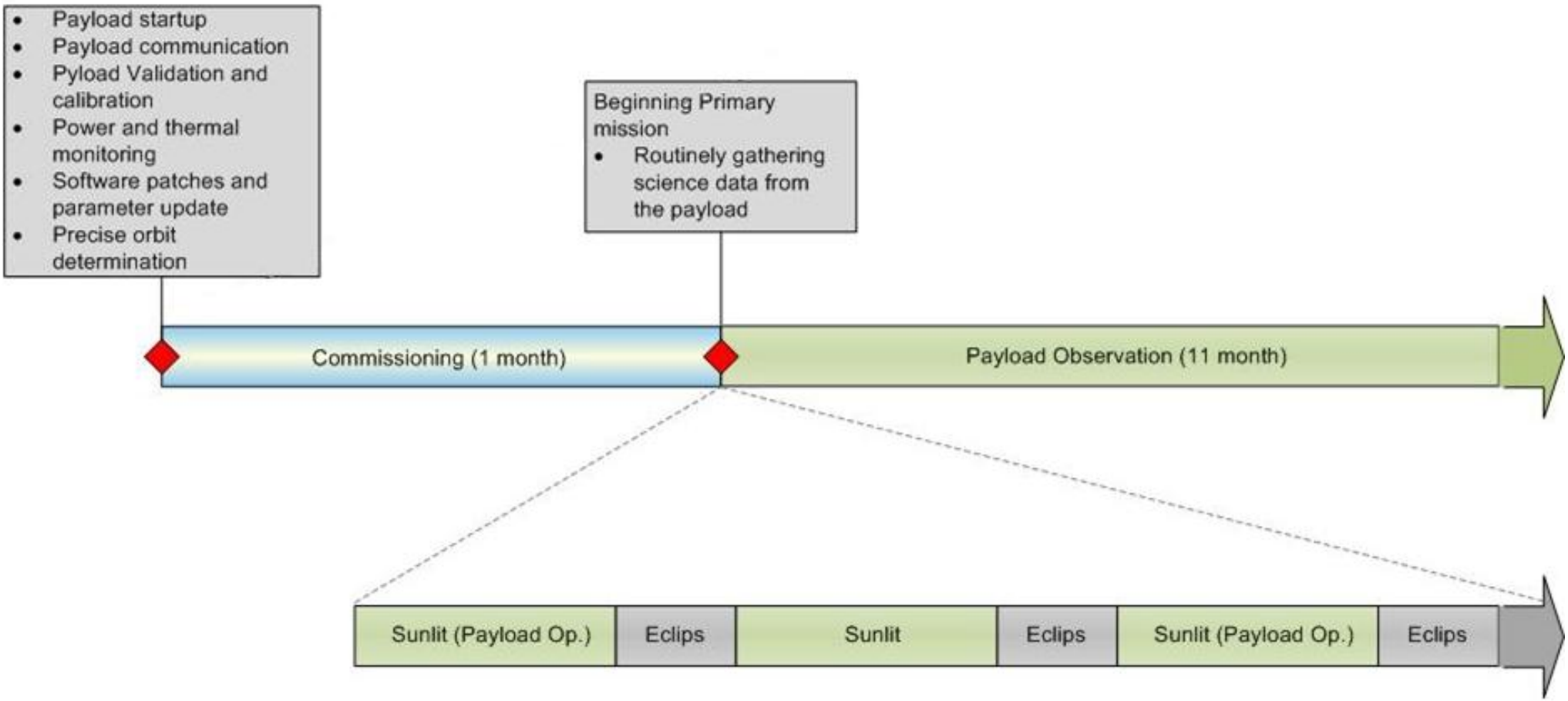


Concept of Operations

- Standard 3U CubeSat structure
- Compatible with Poly Picosatellite Orbital Deployer (PPOD) launch system



Concept of Operations



Program Management - Budget

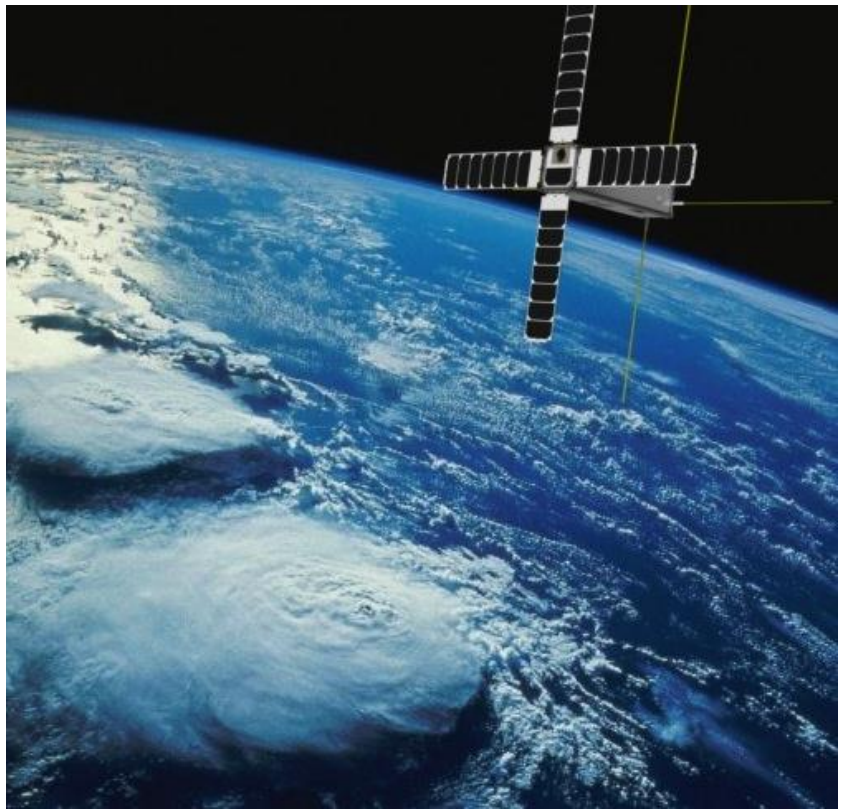
Hardware costs	**$258,695.00**
Operations costs	**$33,807.00**
Total Development Costs	**$292,502.00**
Launch Estimate	**$200,000.00**
Post Launch operations Costs	**$4000.00/year**

Program Management – Project Schedule

	2010				2011				2012				2013			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Organization Start	■	■														
Trade Studies		■	■													
Design and Development		■	■	■	■	■										
Simulation and Validation				■	■	■	■	■	■							
Preliminary Design Review							■									
Critical Design Review									■							
Funding and Training Second Session										■	■					
Major procurement											■	■	■			
AIT									■	■	■	■	■	■	■	
Enviromental Testing														■		
Launch																■

Summary & Conclusions

- GHG monitoring critical for determining success of environmental projects
- AlbertaSat-1 to measure sources/sinks of CO_2, H_2O and CH_4
- Dedicated interdisciplinary university team



References

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