Partnering for Success:

Using Spaceborne Imaging Spectroscopy to Drive Actionable Change on Earth



DR. KEELY ROTH, Lead Hyperspectral Scientist, Planet Labs, PBC Spectral Sessions • April 5, 2022

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- Spaceborne Imaging Spectroscopy
- The Carbon Mapper Mission
- Adding to the Bigger EO Picture



+ Imaging Spectroscopy Lets Us See More



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+ Spaceborne Imaging Spectroscopy



NWS

+ Earth Observation Imaging Spectroscopy





Goetz et al., 1987





GISS (NASA), GER (USGS), AIS (NASA)

(Ungar et al., 1977)

AVIRIS (NASA)

HyMap (commercial) CASI (commercial) Hyperion (NASA) AVIRIS-NG (NASA) MaRS (NGA)

late 1970s-early 1980s Mid 1980s

1990s-2000s

+ EO Spectral Science

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Review

NASA's surface biology and geology designated observable: A perspective on surface imaging algorithms

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Agriculture

Grasslands

Temperate

Snow

p

+ Public Missions - Current & Upcoming



Gaofen-5 (China)



DESIS, DLR/Teledyne (Germany) HISUI,



PRISMA, ASI (Italy)



HISUI, METI (Japan)



EnMap, DLR (Germany)



CHIME, ESA (Europe)



EMIT, NASA (USA)



SBG, NASA (USA)

+ Commercial Missions - Current & Upcoming



The Carbon Mapper Mission

Cancún, Mexico – August 18, 2016

What is the Carbon Mapper Satellite Program?

- Constellation capable of tracking 90% of high emitting $CH_4 \& CO_2$ point sources at facility scale globally
- Phase 1: Launch first 2 satellites in 2023
- Phase 2: Goal to expand full constellation with daily to bi-weekly monitoring in 2025
- \cdot All CH₄ & CO₂ data publicly available
- \cdot Rapid leak detection service from Planet









BBC

Carbon tracking satellite network to launch this decade

Bloomberg Green

Satellite Constellation Set to Unmask World's Super Polluters



California to hunt greenhouse gas leaks and superemitters with monitoring satellites



California, NASA partner to launch methanetracking satellite



Mike Bloomberg ② @MikeBloomberg · Apr 16 .@Carbonmapper — a @bloombergdotorg partner — announced it will send a satellite to space that will identify methane and carbon super emitters around the world.

This will provide the kind of accountability we need to make real progress on climate change.



Special Presidential Envoy John Kerry @ClimateEnvoy

Public-private partnerships like @carbonmapper are the kinds of initiatives we need to further build more accurate and complete data for effective #ClimateAction. Look forward to following their progress!

🕌 CarbonMapper @carbonmapper · 8h

In a first-of-its-kind public private partnership, @CarbonMapper, @AirResources, @CAgovernor, @NASAJPL, and @Planet team up with @RockyMtnInst, @asnerlab, & @uazresearch to detect, quantify and track point-source methane and CO2 emissions. Details at carbonmapper.org



Know your carbon! Congrats @planetlabs! 🛡 💲



3 Retweets 3 Quote Tweets 41 Likes

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This is a great example of the kind of private sector innovation that @NASAEarth and all of NASA Science is continually seeking. Glad for the @NASAJPL role here. #Congrats @Will4Planet and @planetlabs team and best of luck!

Carbon Mapper Coalition: A Public-Private Partnership





Carbon Mapper's scope is unique and able to drive action

Carbon Mapper & CARB Airborne Prototyping & User



NASA JPL instrument technology

Detector array Spectrometer

Telescope

Slit













Carbon Mapper

Global Data Platform, Analytics, Measurement & Impact Research



CARB California Data Platform, (proposed) Global Methane Technical Support Center







Carbon Mapper

GSD	CAPACITY
30 m	93k - 315k km² /day/satellite
ORBIT ALTITUDE	SPECTRAL BANDS
400 km	400-2500 nm @ 5 nm spacing

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Orbit altitude (km)	400-410	
Orbit type	sun synchronous	
Sample interval (days) [full constellation]	1-7	
Spatial resolution (m)	30 - 35	
Swath width (km)	18	
Area coverage per day (km ² , average, per satellite)	93,000 - 315,000	
Spectral range (nm)	400 - 2500	
Spectral sampling (nm)	5	
SNR @ CH ₄ detection band	300 - 600	
CH4 Minimum Detection Limit ¹ (kg/hr)	50 - 150	
CO ₂ Minimum Detection Limit ¹ (kg/hr)	200,000 - 600,000	

¹point source, single-detection, 3 m/s wind, medium surface brightness

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Core Imagery Products: Calibrated Radiance & Surface Reflectance



H Methane & CO2 are a primary focus









CH4/CO2









Source: Carbon Mapper

+ 25+ Other Environmental Indicators

+ FIRE: RISK, FUEL, SEVERITY, RECOVERY



+ ECOSYSTEM/CROP TYPE, HEALTH, LEAF WATER, SOIL COMPOSITION + FOREST HEALTH, MORTALITY, RECOVERY





BEAR 2012 Japen 1013 Sierra National Forest



+ CORAL, COASTAL ZONE HEALTH



+ DISASTER MANAGEMENT



L3Harris



NASA/JPL-Caltech

+ ALGAL BLOOMS AND WATER QUALITY





➡ FOREST CARBON

+ URBAN DEVELOPMENT



Planet's Constellations

~200

PlanetScope Dove Satellites

Doves		

GSD

3.7 m

SATELLITES

capacity **300 million km²/**day

ORBIT ALTITUDE

8 SPECTRAL BANDS Coastal Blue, Blue, Green I, Green II Yellow, Red, Red Edge, Near Infrared

SkySat Satellites

SkySat



SATELLITES GSD 21 0.5 m ORBIT ALTITUDE 450 km

4,000 targets/day

CAPACITY

SPECTRAL BANDS **RGB, PAN** and **NIR**

Carbon Mapper enhances and complements Planet's current capabilities



Carbon Mapper data will complement and enhance Planet's current product offerings









INTEROPERABILITY



HARMONIZATION

FUSION





+ Looking forward to the future of hyperspectral!



Thank you for your time!

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