EXPLORE

Small Satellite Data Buy

November 2019

SCIENCE
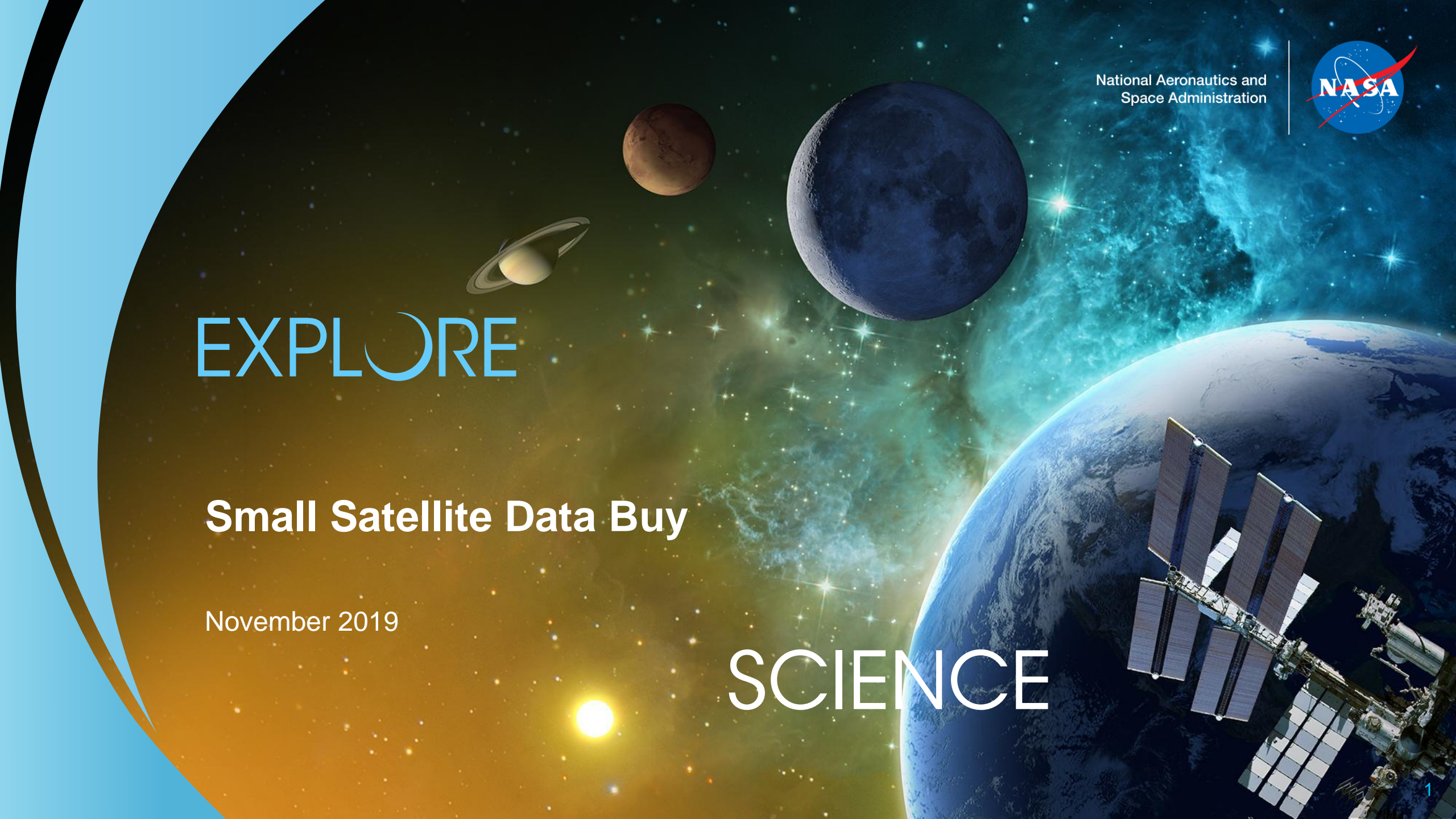
National Aeronautics and
Space Administration

NASA

Background

In December 2017, the NASA Earth Science Division (ESD) launched the Private-Sector Small Constellation Satellite Data Product Pilot Project, now known as **Commercial Smallsat Data Acquisition Program**

Program Objectives:
- Establish *continuous* and *repeatable* process to onramp new commercial data vendors and evaluate the data for its potential to advance science and applications.
- Enable *sustained* use of purchased data for broader use and dissemination.
- Ensure data management processes and systems support rapid evaluation and long-term access to purchased data for scientific reproducibility.

Pilot Evaluation Activities

Request for Information (RFI) released in Winter 2017 to identify private sector data vendors and purchase Earth science data products.

The evaluation for each vendor consisted of the following standards:
- The vendor's commercial small satellite constellations must be comprised of a minimum of three satellites; and
- In a non-geostationary orbit with consistent, large-scale (complete longitudinal) coverage.

NASA awarded contracts to: Planet Labs, DigitalGlobe, and Spire Global - started an evaluation process for purchased data by augmenting existing grants:
- Companies support the access and use of data including providing user support, calibration information
- PIs evaluate products and make recommendations
- NASA maintains a copy of all data products purchased for use by current and future NASA researchers

Evaluation Projects

- 39 projects funded to evaluate data across all ESD science and application themes
- An independent assessment of calibration and geolocation was conducted.
- Each project developed reports independently using common common evaluation criteria.
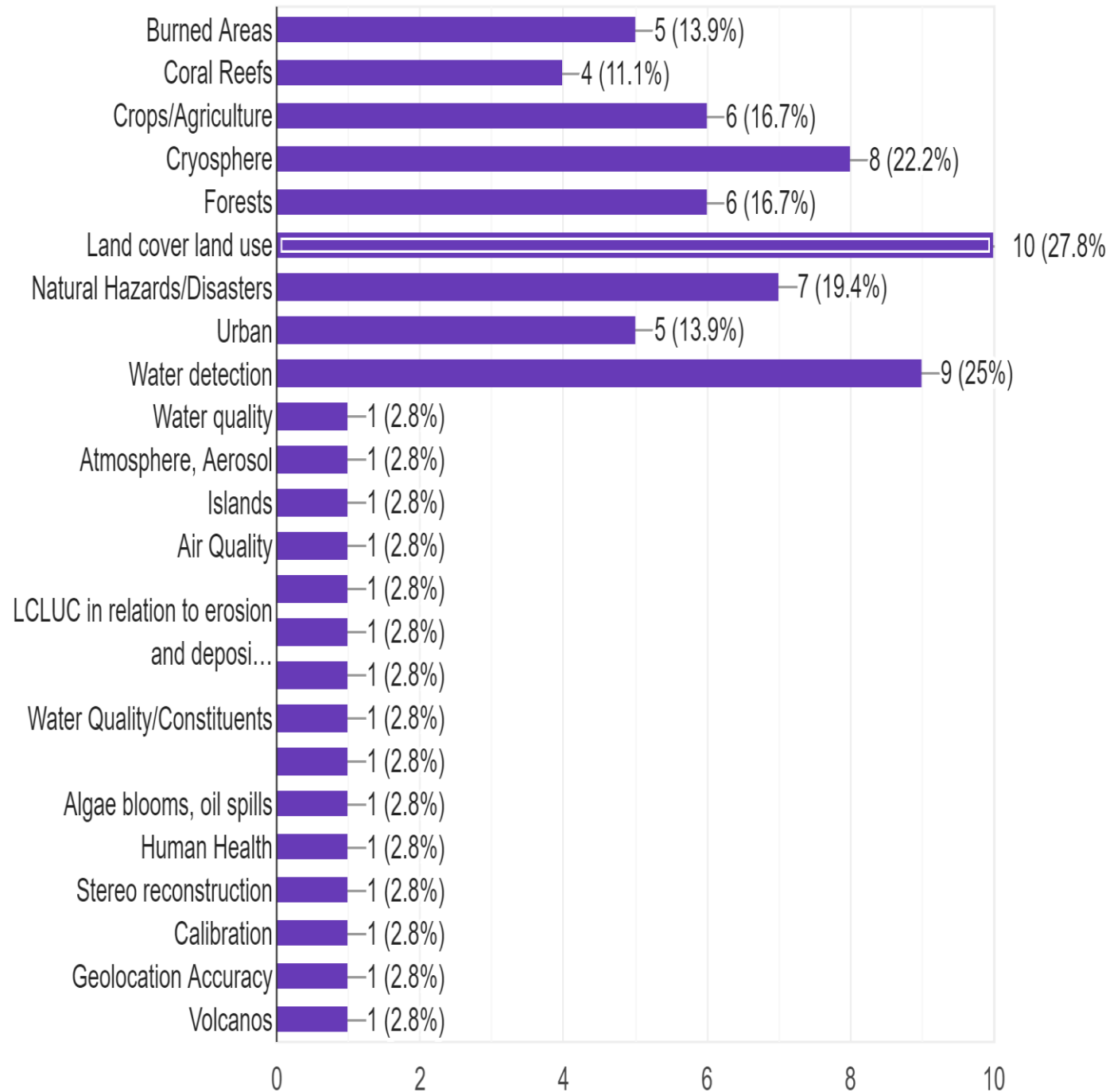
Pilot Evaluation Criteria

All projects were asked to evaluate and comment on the following:

1. **Accessibility of vendor supplied imagery and data**: The ease and efficiency with which data can be searched, discovered, and downloaded from the vendor systems.
2. **Accuracy and completeness of metadata**: The accuracy and completeness of metadata that accompanies the imagery provided by the vendor.
3. **Quality of User Support Services**: The availability, responsiveness, and technical expertise required to answer Investigator inquiries.
4. **Appropriateness of End User License Agreement (EULA)**: The suitability of EULA to allow Investigators to practice and perform open science.
5. **Utility of data and imagery for advancing Earth system science research and applications**: The ability of vendor provided imagery and data to support Earth system science research and application activities.
6. **Quality of vendor supplied imagery and/or data**: Data attributes such as geolocation accuracy, quality of radiometric calibration, platform intercalibration, etc.

Pilot Evaluation

- The 39 projects were separated into two groups based on type of data being evaluated
  - Radio Occultation
  - Imagery
- Less than half of the Pilot investigators evaluated multiple commercial vendors for their projects.
- Investigators in each group submitted interim, midterm and final reports and attended one in-person meeting.
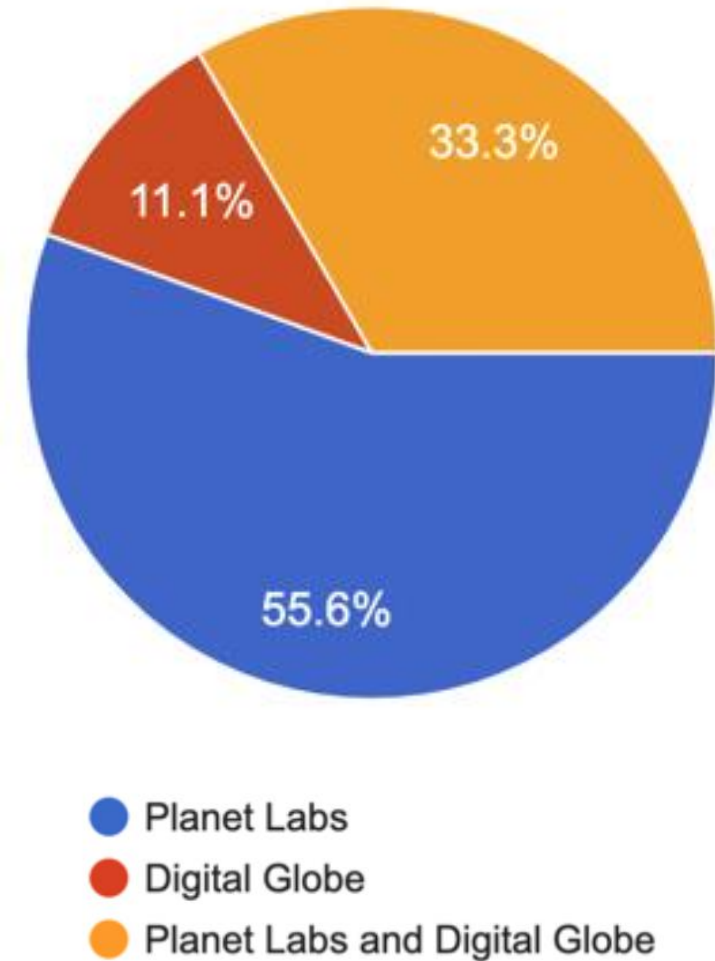
*Spire Global evaluation results will be completed in December 2019.

33.3%

11.1%

55.6%

- Planet Labs
- Digital Globe
- Planet Labs and Digital Globe

Planet Labs Inc. (Planet) Evaluation

Specifications	SkySat-A & B	SkySat-C	Dove Satellite	RapidEye
Number in Space	2	11	180+	5
Instrument and Product Details	See Appendix		Planet Imagery Product Specifications (2017)	Planet Imagery Product Specifications (2017)
Sensor Type	CMOS Frame Camera with panchromatic and multispectral halves		Full Frame CCD with a split-frame NIR filter	Multispectral push broom
Camera Dynamic Range	11-bit (13-bit in HDR mode)		12-bit	12-bit
Image Resolution	90 cm (@600 km)	80 cm (@500 km)	3.9 m (@500 km)	6.5m (@630 km)
Mass / Volume	83 kg / 60 cm x 60 cm x 80 cm	120 kg / 60 cm x 60 cm x 95 cm	5 kg / 118mm x 118mm x 350mm	~156 kg / 0.78 m x 0.938 m x 1.17 m
Lifetime	>4 years		>2 years	>7 years
Downlink Rate	480 Mbps		260+ Mbps	80 Mbps
Spectral Bands	Blue: 450 - 515 nm Green: 515 - 595 nm Red: 605 - 695 nm NIR: 740 - 900 nm Pan: 450 - 900 nm		Blue: 455 - 515 nm Green: 500 - 590 nm Red: 590 - 670 nm NIR: 780 - 860 nm	Blue: 440 - 510 nm Green: 520 - 590 nm Red: 630 - 685 nm RedEdge: 690 - 730 nm NIR: 760 - 850 nm
Constellation Capacity	~ 890,000 km²/day		~ 340 million km²/day	~ 6 million km² / day
Constellation Revisit Time	Variable (tasking model)		Daily	5.5 Days
Equatorial Crossing Time (approximate)	9:30	SkySat 3-7: 9:30 - 10:30; SkySat 8-13: 13:30	SSO flocks: 9:30 - 11:30; ISS flocks: variable	11:00

Regional DEM-derived snow depth from sub-meter optical satellite stereo imagery (SkySat)
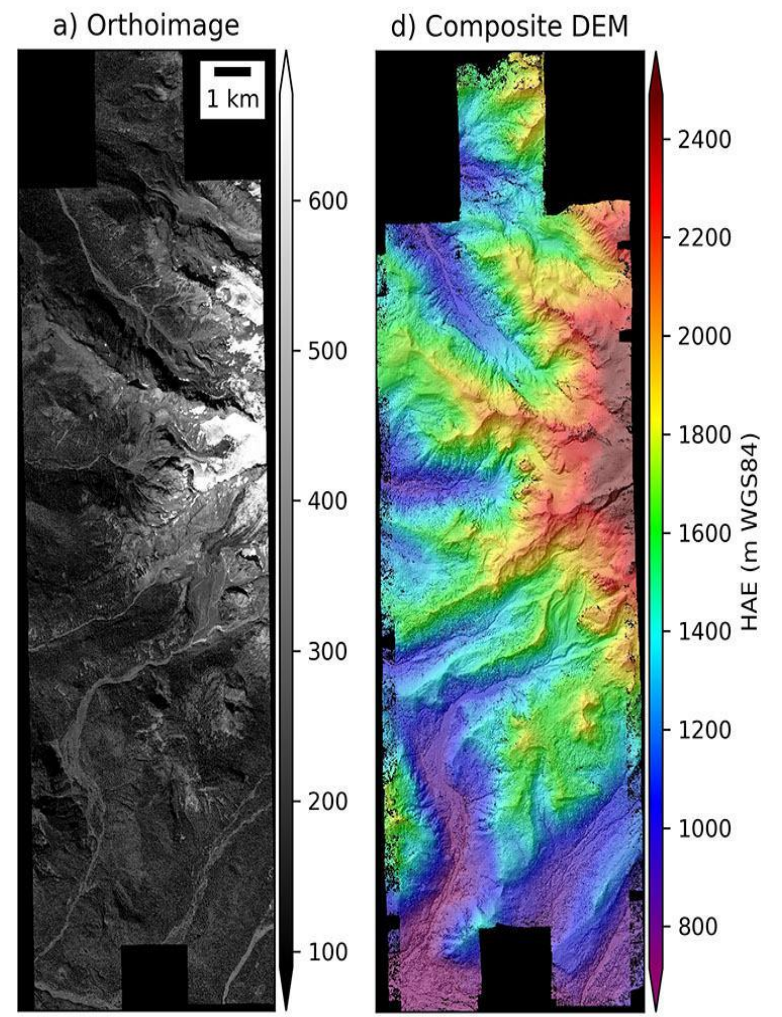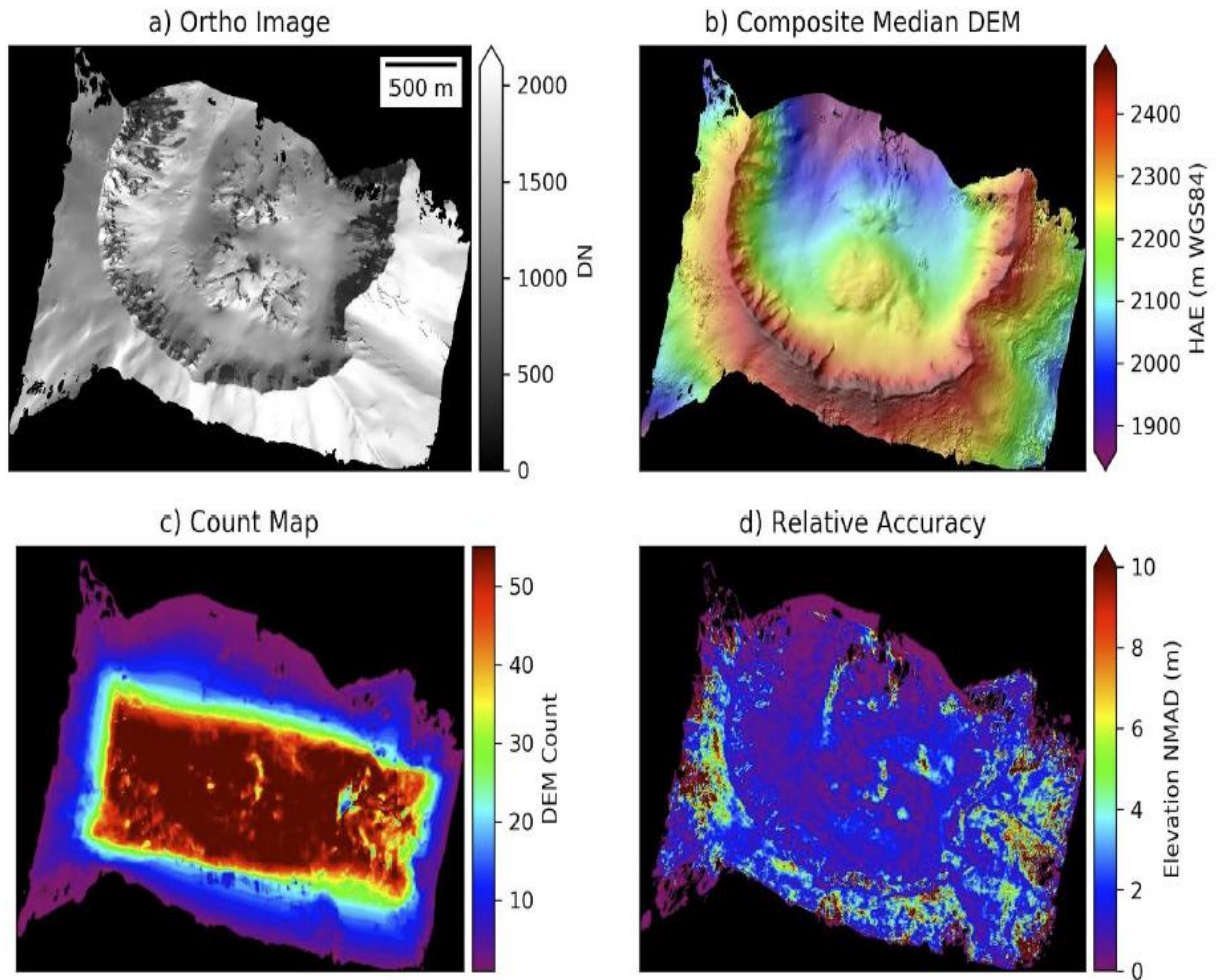
PI: David Shean, University of Washington

Assessment of High Resolution Planetscope Imagery for Aerosol Remote Sensing Applications
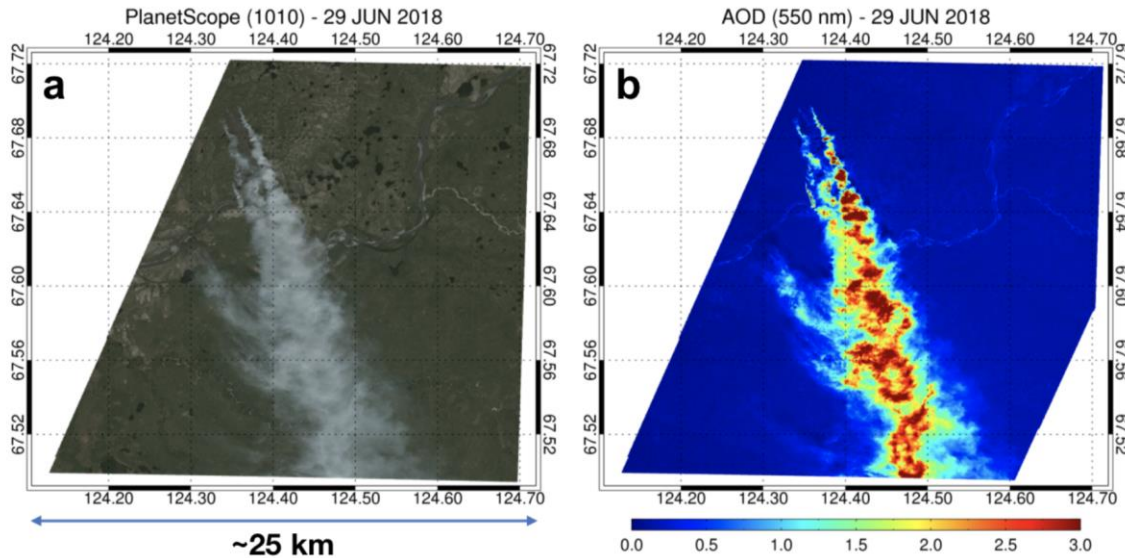

Figure 1. An example of Planetscope AOD for a Siberian smoke event observed on 29 June 2018. (a) Rayleigh-corrected Planetscope imagery and (b) retrieved AOD are shown.
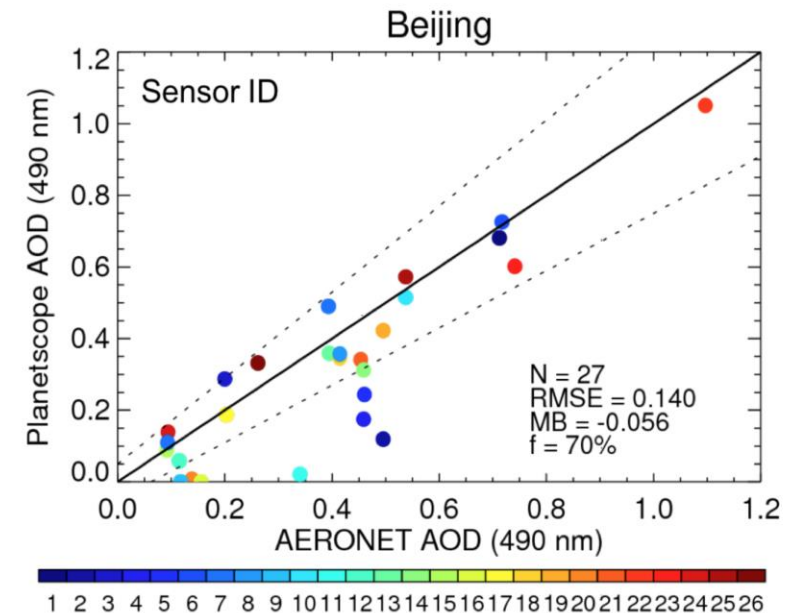

Figure 6. Comparison of Planetscope AOD against AERONET at Beijing site. Data points are arbitrarily color-coded for different sensor IDs. Black solid line is for 1:1 relationship, and dotted lines for an expected error envelop of ±0.05±20%.

PIs: Jaehwa Lee and N. Christina Hsu

DigitalGlobe Inc. (Maxar) Evaluation

- Digital Globe has five constellations of very high resolution (31-50-cm) commercial imaging satellites—GeoEye-1(2009), WorldView-1 (2007), WorldView-2 (2010), WorldView-3 (2014) and WorldView-4 (2017).

- WorldView-2 and WorldView-3 systems collect 8-band multispectral imagery. In addition, the WorldView-3 system also offers SWIR bands and 12 CAVIS bands.

CAVIS

Band No.	Band Name	Wavelength (nm)	Notes
1	Desert Clouds	405–420	Identical to MODIS Band-8, Differentiate Clouds against desert background
2	Aerosol-1	459–509	Similar to MODIS Band-3, Aerosol Algorithm + cloud discrimination
3	Green	525–585	Similar to MODIS Band-4, Aerosol Algorithm + vegetation
4	Aerosol-2	635–685	Similar to MODIS Band-1, Aerosol Algorithm + Snow / Cloud
5	Water -1	845–885	Similar to MODIS Band-2, Water Vapor Retrieval
6	Water -2	897–927	Similar to MODIS Band-17, Water Vapor Retrieval
7	Water -3	930–965	Similar to MODIS Band-19, Water Vapor Retrieval
8	NDVI	1220–1252	Similar to MODIS Band-5, Vegetation background for Aerosol Algorithm
9	Cirrus	1365–1405	Similar to MODIS Band-26, Cirrus Clouds Water Vapor
10	Snow	1620–1680	Similar to MODIS Band-6, Differentiate clouds against snow/Ice background
11	Aerosol-3	2105–2245	Similar to MODIS Band-7, Land/Cloud/Aerosols Properties
12	Aerosol-3	2105–2245	Parallax to band 11 Similar to MODIS Band-7

Evaluation of Commercial High-Resolution Satellite Imagery for Coral Reef Ecology
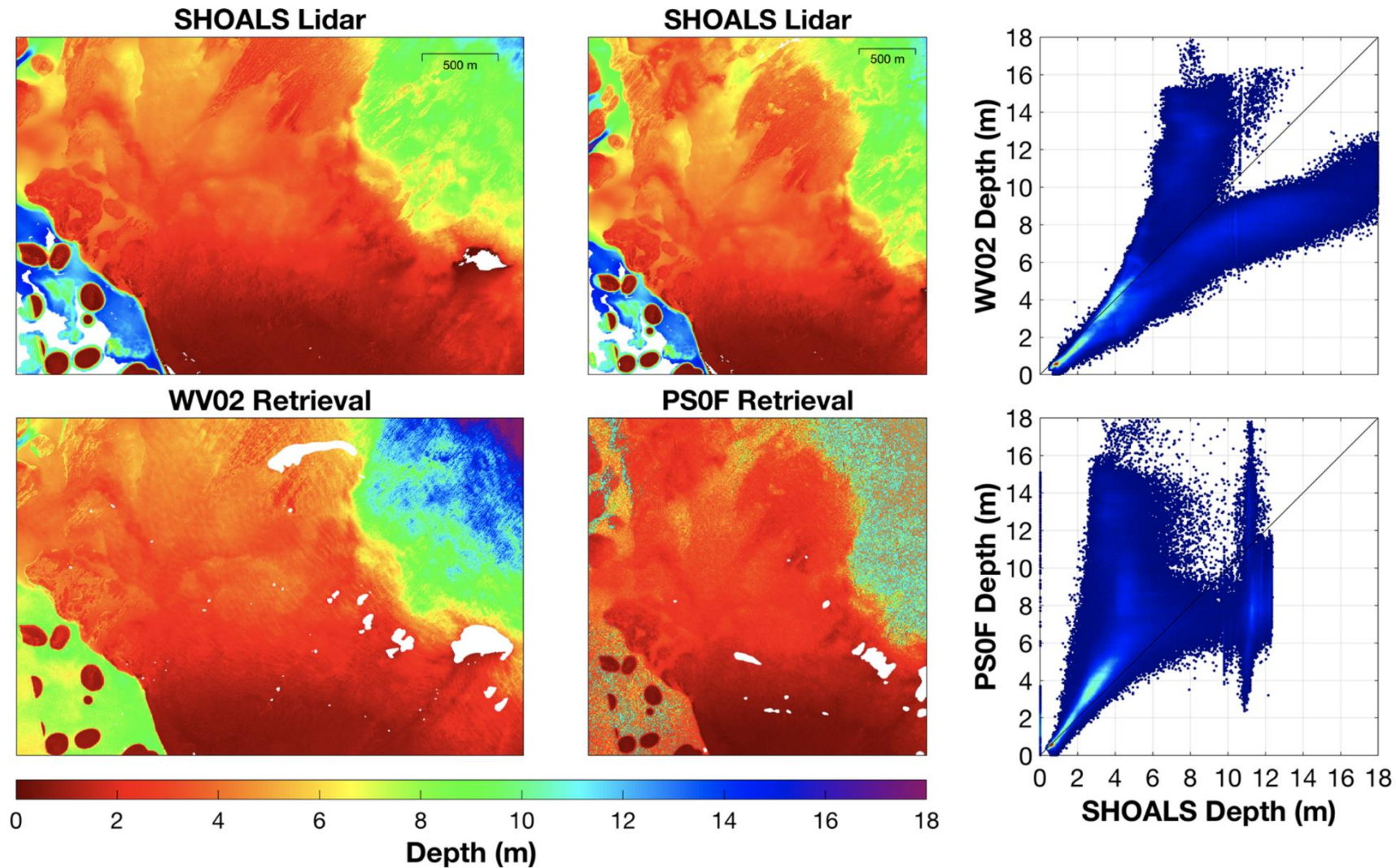
PI: Eric J. Hochberg

EarthDEM Near-Global Digital Elevation Retrievals
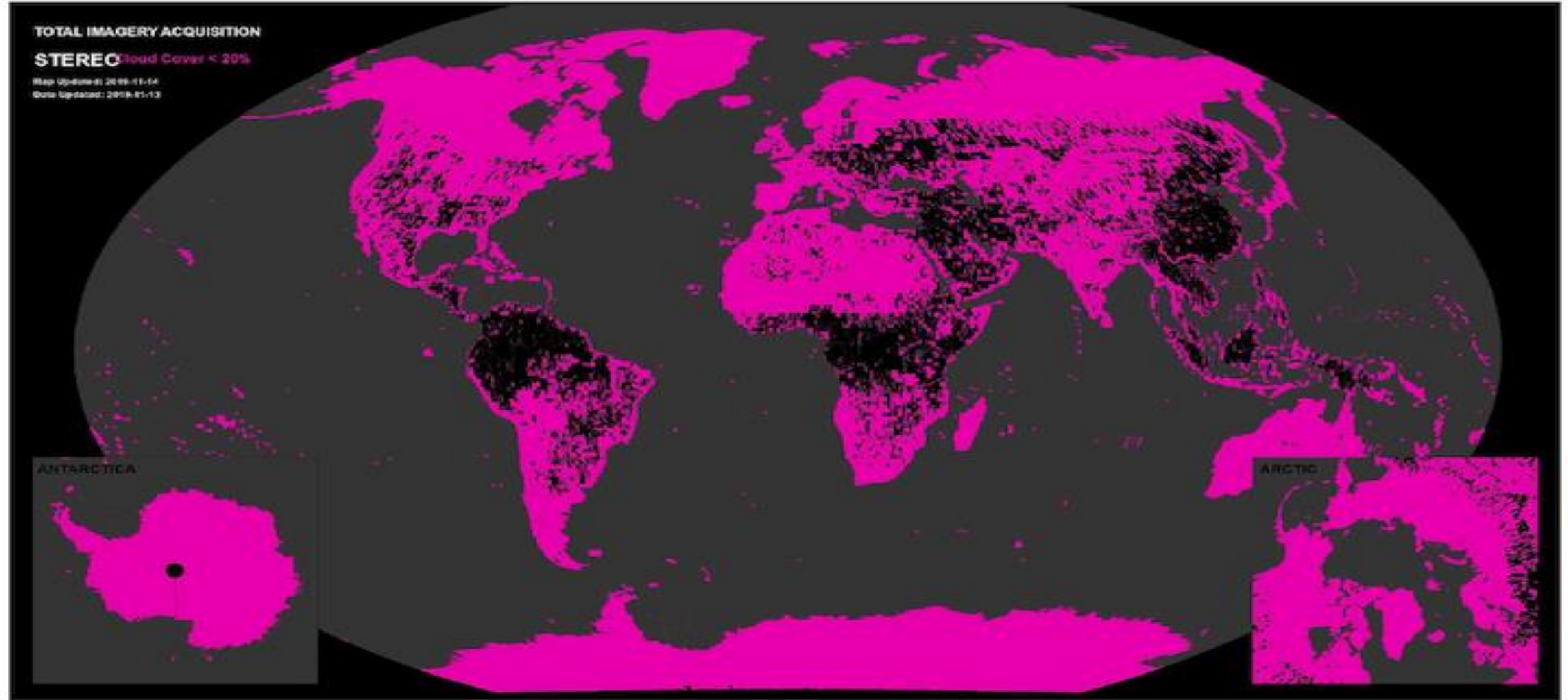
M.J. Noh & I. Howat Ohio State Univ.; C. Porter & P. Morin Univ. Minnesota; C.J. Tucker NASA/GSFC

2020 Activities & Beyond: Onramp and Evaluation

NASA will continuously monitor the development commercial data vendors and acquire relevant data to complement the NASA's observation data.

- Each 12-18 months a RFI will be issued with the goal of identifying data that is potentially valuable for NASA's Earth science research and application activities.
- All RFIs, RFPs and BPAs will contain a **standardized scientific use license** to minimize the effort by NASA and confusion by users on how data can be used.
- Data from selected vendors will be evaluated by teams of Principal Investigators (PIs) **selected through the annual Research Opportunities in Space and Earth Science**.
- All **data purchased** by NASA will be made **available to NASA funded researchers** with the standard the scientific use license.