

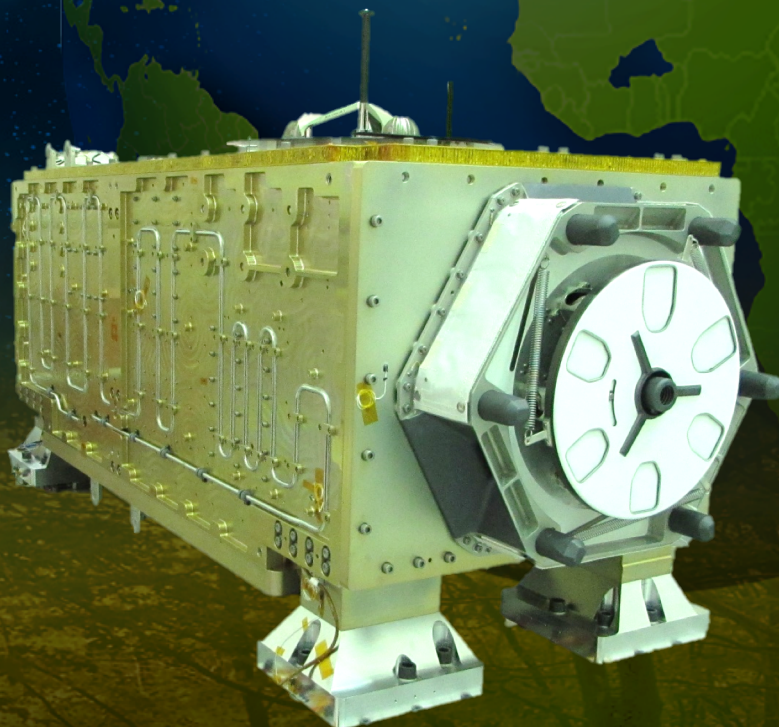
# *ECOsysteM Spaceborne Thermal Radiometer Experiment on Space Station*



## Mission System Overview

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Hyun Lee, Thomas Logan, Mike Smyth

May 1, 2018





# Mission System Overview



## Mission Operations

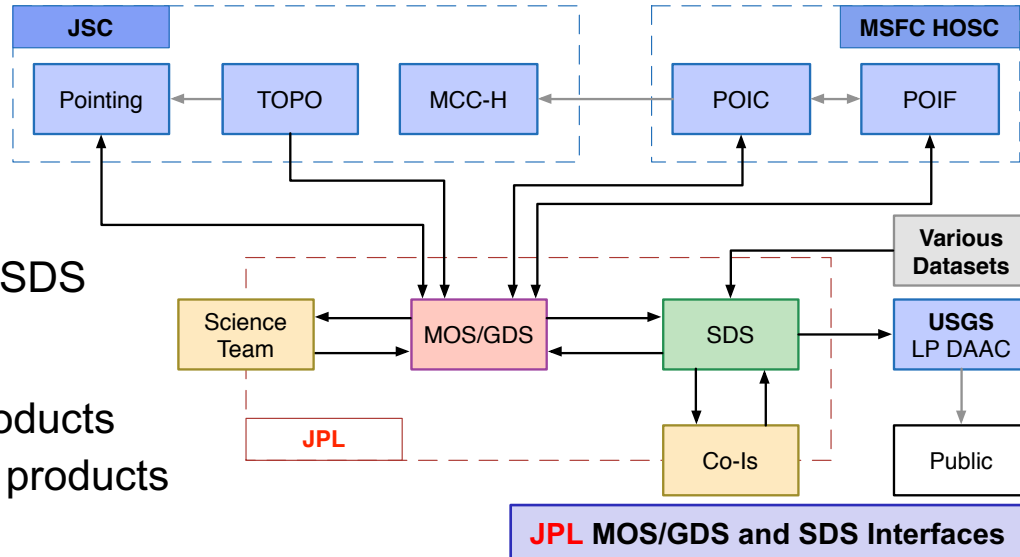
- Monitor and operate ECOSTRESS during:
  - Integration and Test (EGSE/GDS delivered to I&T to “test as you fly”)
  - In-Orbit Checkout
  - Nominal operations
- Science observations will be planned and uplinked weekly
  - Time-based data collection planned based on ISS TOPO/Pointing Office data
  - Downlink planned based on schedule from ISS Data Management Coordinator

## Ground Data System

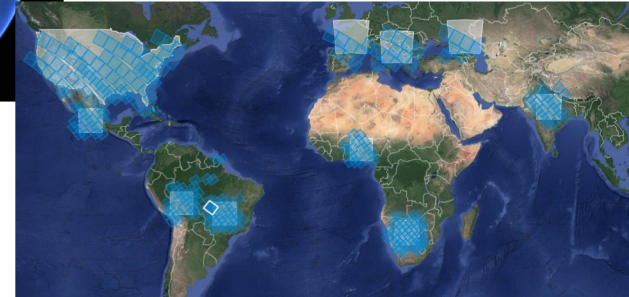
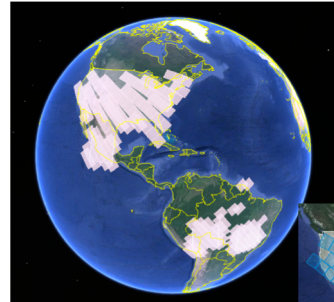
- Command/Telemetry processing
- Sequence validation
- Manage HOSC software tools
- Data delivery to subsystems and SDS

## Science Data System

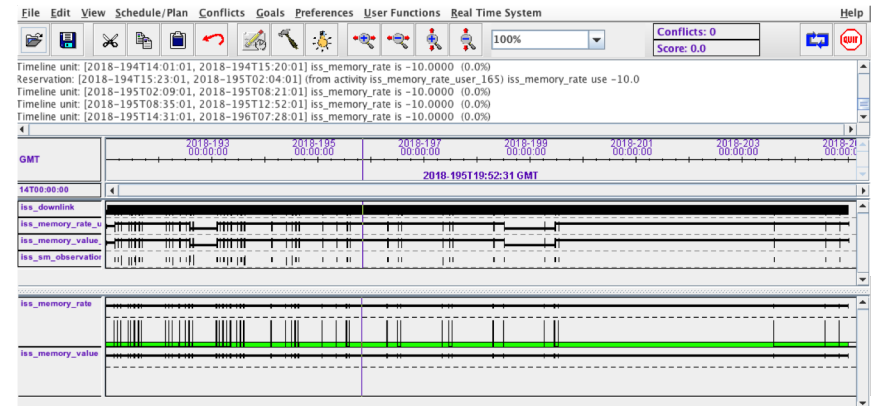
- Create L0, L1, and L2 science products
- Catalog and store L0–L4 science products
- Data delivery to USGS LP DAAC



- Adaptation of CLASP demonstrated for basic ECOSTRESS observation scheduling
  - CLASP used for IPEX and many studies, in use for NISAR
  - Accounts for varying priority geographic target areas
    - CONUS mapping, regional, global mapping
    - Fluxnet Cal sites
    - Targets of opportunity (volcanic activity, etc.)
  - Models data volume restrictions



Coverage display 7/10/2018 – 7/23/2018



Timeline Display



# Week In The Life –Science Planning



## Weekly ATS

Generate Absolute  
Time Sequence  
and Uplink to  
Payload

## Daily ATS

Generate Updated  
Absolute Time  
Sequence and  
Uplink to Payload

ATS = Absolute Time Sequence





# Week In The Life – Science Planning



Weekly  
ATS

Daily  
ATS

- Weekly ATS Generation Process
  - On *Tuesday*, **process begins** (TOPO)
  - On *Wednesday*, **uplink** and **enable** 14-day ATS
  - On *Thursday*, new 14-day ATS begins

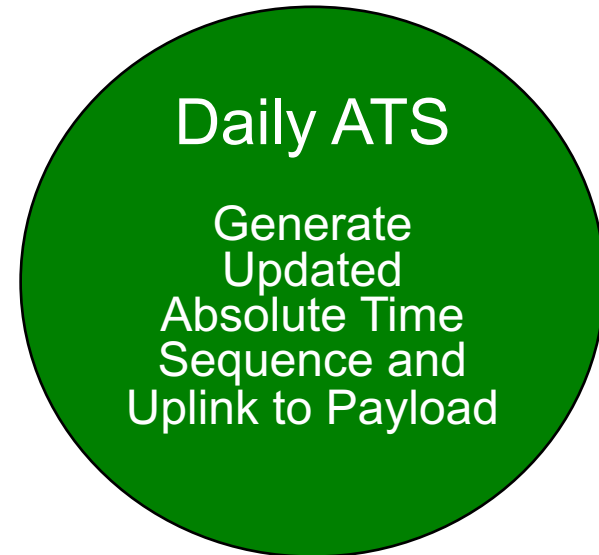
May 2018						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
29	30	01	02	03 ATS_01	04 ATS_02	05 ATS_03
06 ATS_04	07 ATS_05	08 ATS_06	09 ATS_07	10 ATS_01	11 ATS_02	12 ATS_03
13 ATS_04	14 ATS_05	15 ATS_06	16 ATS_07	17 ATS_08	18 ATS_09	19 ATS_10
20 ATS_11	21 ATS_12	22 ATS_13	23 ATS_14	24 placed on nominal	25	26

Note: Animation present

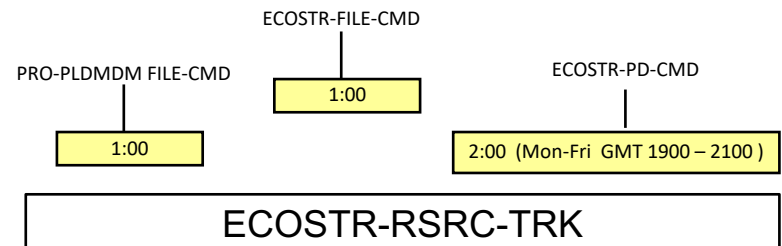


## Daily ATS Process

- Regenerates science observation, or downlink window ATS sequences, primarily in response to ISS changes (e.g. attitude and orbit or downlink window).
- Give the flexibility for ***opportunistic*** science / disaster response (no formal requirements or plans).
- Same as the weekly process, though fewer ATS sequences will be generated, reviewed, and uplinked.

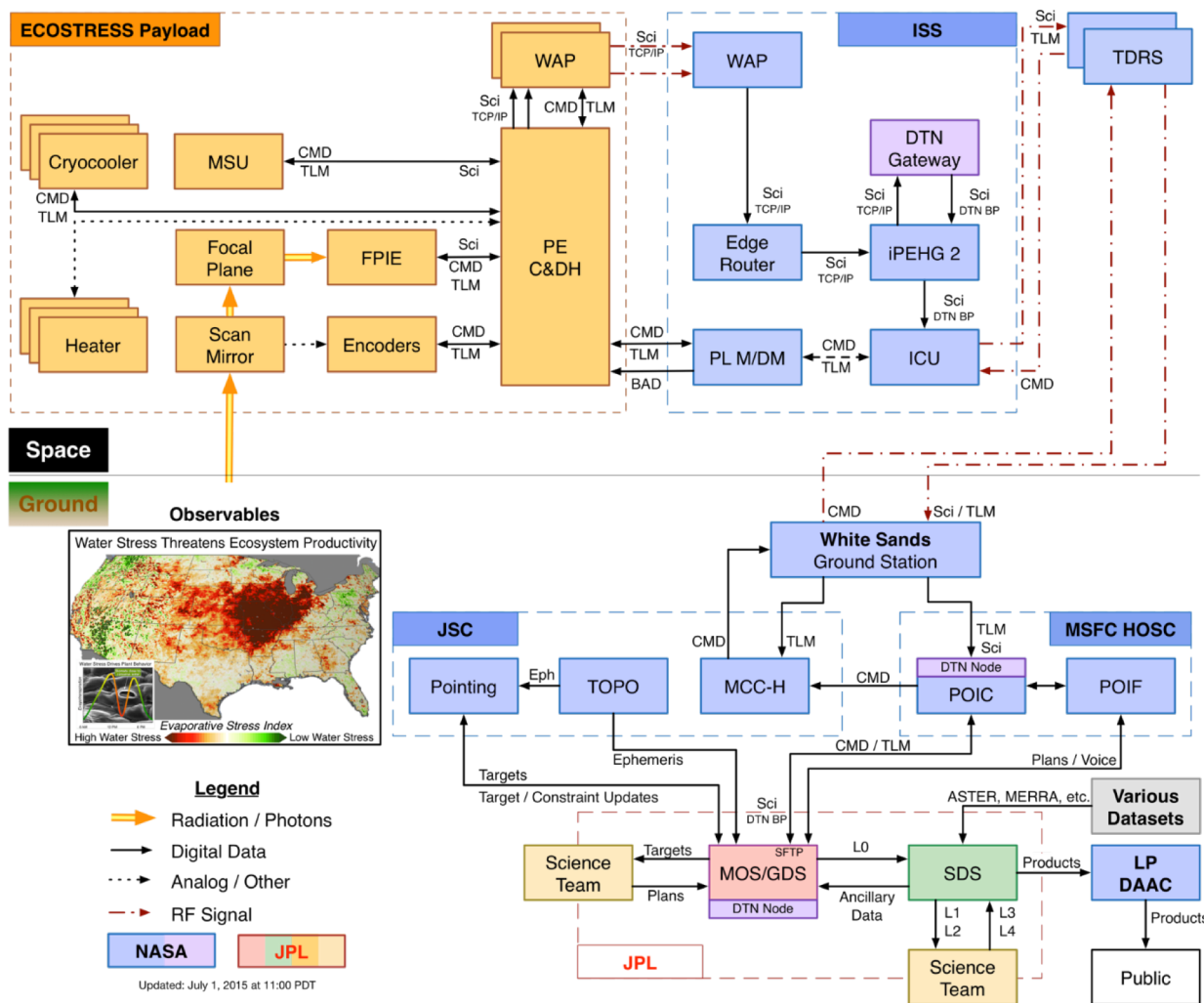


## HOSC Payload Planning Outline





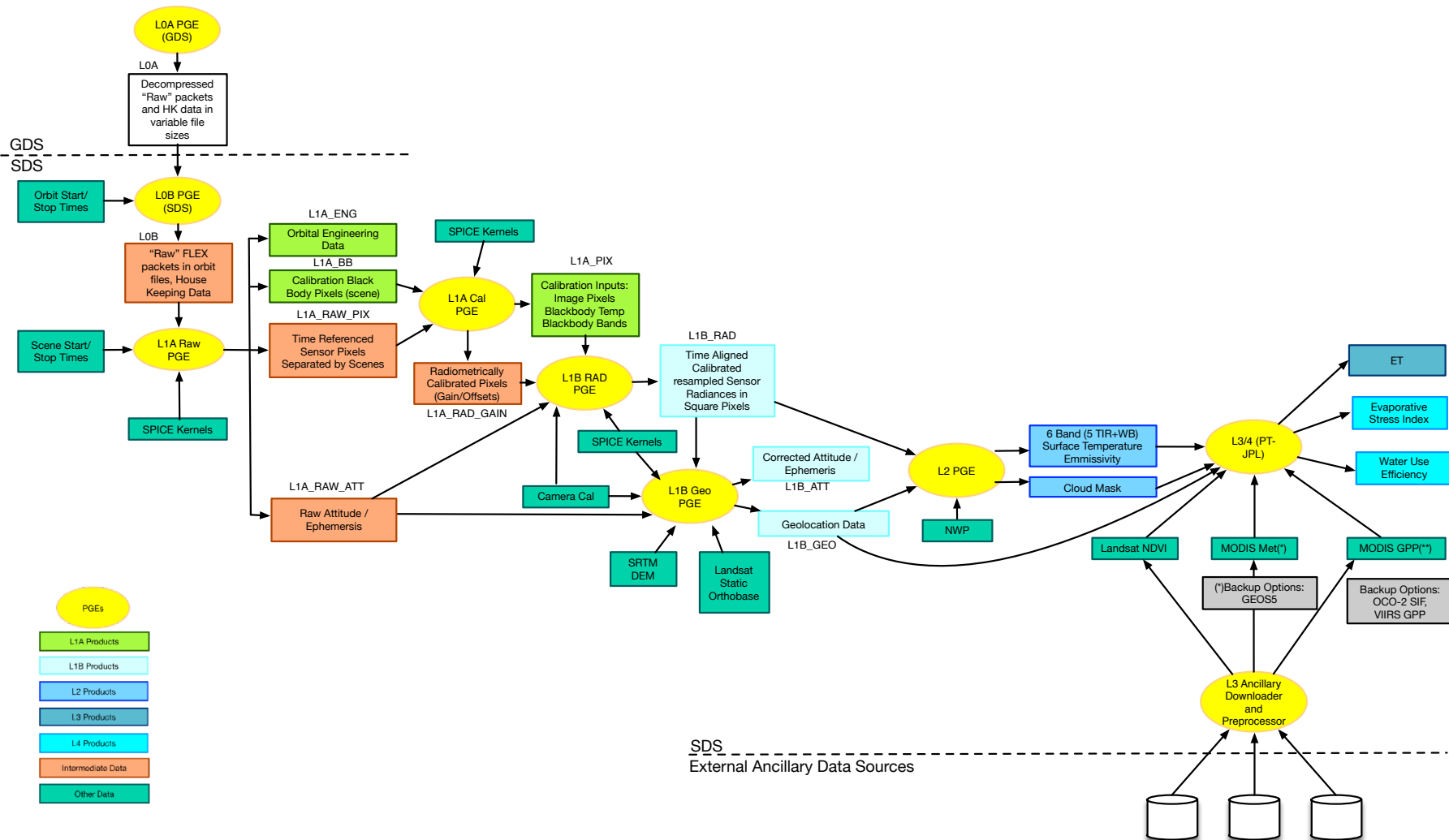
# ECOSTRESS End-to-End Information System



ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
BAD	Broadcast Ancillary Data
BP	Bundle Protocol
C&DH	Command and Data Handling
CMD	Command
Co-Is	Co-Investigators
DAAC	Distributed Active Archive Center
DTN	Delay-Tolerant Networking
FPIE	Focal Plane Interface Electronics
GDS	Ground Data System
HOSC	Huntsville Operations Support Center
ICU	Integrated Communications Unit
L0	Level 0 data (raw packets)
L1	Level 1 data (geolocated radiances)
L2	Level 2 data (land surface temperature and emissivity)
L3	Level 3 data (evapotranspiration)
L4	Level 4 data (water use efficiency and evaporative stress index)
LP DAAC	Land Process Distributed Active Archive Center
MCC-H	Mission Control Center - Houston
MERRA	Modern-Era Retrospective Analysis for Research and Applications
MOS	Mission Operations System
MSU	Mass Storage Unit
PE	Payload Electronics
PEHG	Payload Ethernet Hub Gateway
PL M/DM	Payload Multiplexer/Demultiplexer
POIC/F	Payload Operations Integration Center/Function
Sci	Science Data
SDS	Science Data System
SFTP	Secure File Transfer Protocol
TCP/IP	Transmission Control Protocol / Internet Protocol
TDRS	Tracking and Data Relay Satellite
TLM	Telemetry
TOPO	Trajectory Operations Officer
WAP	Wireless Access Point



# L1 – L4 Product Generation







# ECOSTRESS Standard Science Data Products



Product	Dimensions (cross x along x bands)			File Size (MB)	Description
L1B_RAD	5400	5632	6	939	Calibrated at-sensor radiances
L1B_GEO	5400	5632	1	1609	Geolocation tags, sun angles, and look angles, and calibrated, resampled at-sensor radiances
L1B_ATT	12	52	1	0.5	Corrected spacecraft ephemeris and attitude data
L2_LSTE	5,400	5,632	5+W	536	Land surface temperature and emissivity
L2_CLOUD	5,400	5,632	1	67	Cloud mask
L3_L4_QA	5,400	5,632	24	1609	24*16 bitmasks of L3/L4 ancillary data quality flags
L3_ET_PT-JPL	5,400	5,632		671	Evapotranspiration retrieved from L2_LSTE using the PT-JPL Algorithm
L4_ESI_PT-JPL	5,400	5,632		268	Evaporative stress index generated with PT-JPL
L4_WUE	5,400	5,632		134	Water use efficiency
L3_ET_ALEXI-USDA	3,000	3,000		99	Evapotranspiration generated by USDA using the ALEXI/DisALEXI Algorithm
L4_ESI_ALEXI-USDA	3,000	3,000		119	Evaporative Stress Index generated by USDA with ALEXI/DisALEXI



# Science Operations Scenarios And Data Availability



## During IOC

- Autonomous 24/7 Forward Processing
- Perform Radiometric Calibration and Geolocation Validation
- On Demand Reprocessing as requested by the Instrument and Science Teams

## During Science Operations

- Autonomous 24/7 Forward Processing
- On Demand Reprocessing as requested by the PI and Science Team

## Science Operations + 6 months

- Autonomous 24/7 Forward Processing
- Bulk Reprocessing of first 6 months of data in parallel with Forward Processing
- On Demand Reprocessing as requested by the PI and Science Team

## Standard Science Data Product Archival and Availability

- All standard science data products will be archived at the LP DAAC
- Science data products to be publicly available 6 months after IOC
- In addition, LP DAAC will provide early access ( $< \text{IOC} + 6 \text{ months}$ ) for external science team members and other research and applied science collaborators



# Questions?

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# Backup





# ECOSTRESS Science Data Products (1/2)



PGE or <Source>	Product	Dimensions (cross x along x bands)			File Size (MB)	Description
<from GDS>	L0A_FLEX	5,528	11,264	6	853	Level 0 “raw” spacecraft packets
	L0A_HK	2560	54	1	0.25	Raw instrument housekeeping packets including attitude, ephemeris and BB temps
L0B	L0B	5528	11264	6	Up to 13G	Raw instrument FLEX, housekeeping, and other ancillary packets chronologically sorted and assembled into orbits. <i>INTERMEDIATE</i>
L1A Raw	L1A_ENG	1	54	7	.333	Spacecraft and instrument engineering data, including blackbody gradient coefficients
	L1A_BB	128	11,264	6	19	Instrument blackbody calibration pixels
	L1A_Raw_PIX	5,400	11,264	6	766	Raw pixels separated by pixel frame <i>INTERMEDIATE</i>
	L1A_Raw_ATT	1	5400	1	0.5	Attitude from 1 Hz spacecraft BAD and housekeeping data <i>INTERMEDIATE</i>
L1A Cal	L1A_PIX	5,400	11,264	6	805	Raw pixel data with appended calibration coefficients
	L1A_RAD_GAIN	5,400	11,264	6	5237	Radiometric gains offsets and optionally calibrated radiances and temperatures (K)



# ECOSTRESS Science Data Products (2/2)



PGE or <Source>	Product	Dimensions (cross x along x bands)			File Size (MB)	Description
L1B Rad	L1B_RAD	5400	5632	6	939	Calibrated at-sensor radiances
L1B Geo	L1B_GEO	5400	5632	1	1609	Geolocation tags, sun angles, and look angles, and calibrated, resampled at-sensor radiances
	L1B_ATT	12	52	1	0.5	Corrected spacecraft ephemeris and attitude data
L2	L2_LSTE	5,400	5,632	5+W	536	Land surface temperature and emissivity
	L2_CLOUD	5,400	5,632	1	67	Cloud mask
L3/4 Preprocessor	L3_L4_QA	5,400	5,632	24	1609	24*16 bitmasks of L3/L4 ancillary data quality flags
L3/4 PT-JPL	L3_ET_PT-JPL	5,400	5,632		671	Evapotranspiration retrieved from L2_LSTE using the PT-JPL Algorithm
	L4_ESI_PT-JPL	5,400	5,632		268	Evaporative stress index generated with PT-JPL
	L4_WUE	5,400	5,632		134	Water use efficiency
<from USDA>	L3_ET_ALEXI-USDA	3,000	3,000		99	Evapotranspiration generated by USDA using the ALEXI/DisALEXI Algorithm
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