

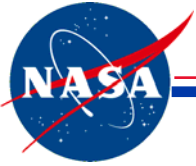
Initial Radiometric Calibration of the AWiFS using Vicarious Calibration Techniques

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JACIE Civil Commercial Imagery Evaluation Workshop
Laurel, Maryland, USA
March 14–16, 2006

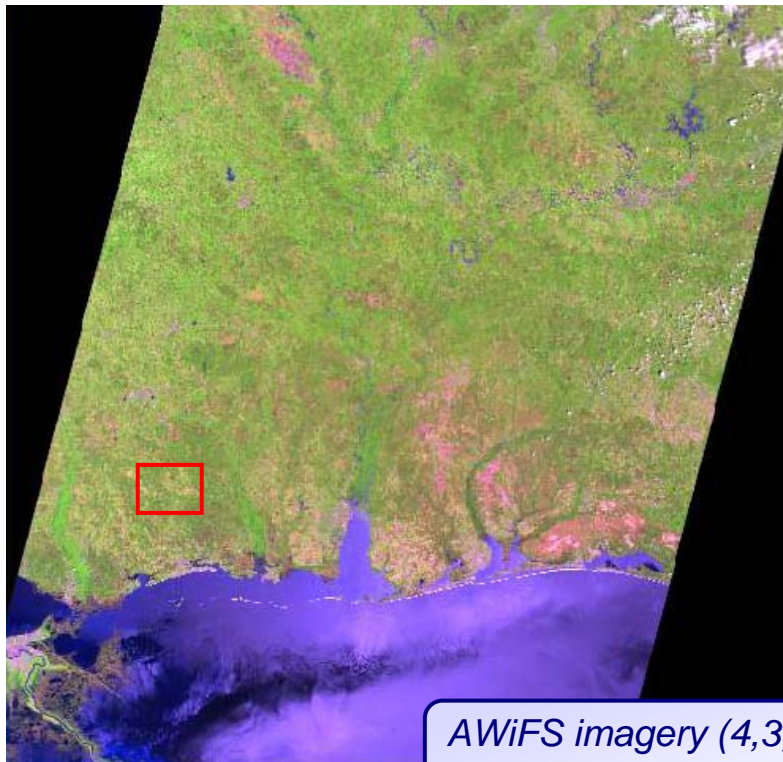


Selected Targets – Wiggins, MS

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Four selected targets of opportunity near Stennis Space Center are hundreds of meters across:

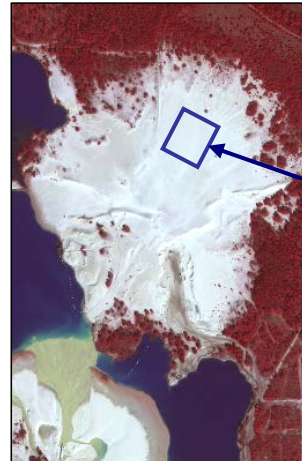
- Two gravel pit sand sites
- Large monoculture fields
- Cut grass amateur golf course



AWiFS imagery (4,3,2)
April 27, 2005

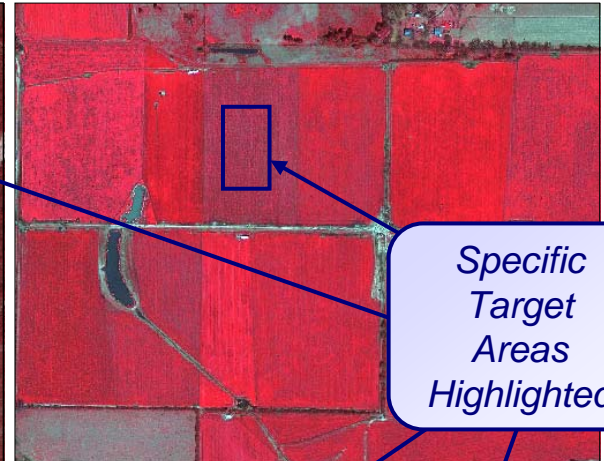
March 16, 2006

Gravel Pit Sand near Perkinston, MS



0 100 200 Meters

Rye Grass Field near Big Level, MS

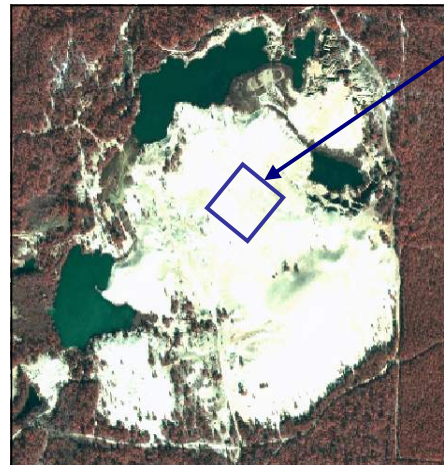


0 200 400 Meters

Specific Target Areas Highlighted

Includes material © Space Imaging, LLC

Gravel Pit Sand near Wiggins, MS



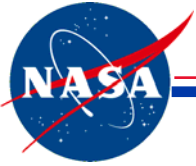
0 100 200 Meters

Grass Field near Big Level, MS



0 50 100 Meters

Includes material © DigitalGlobe, Inc.

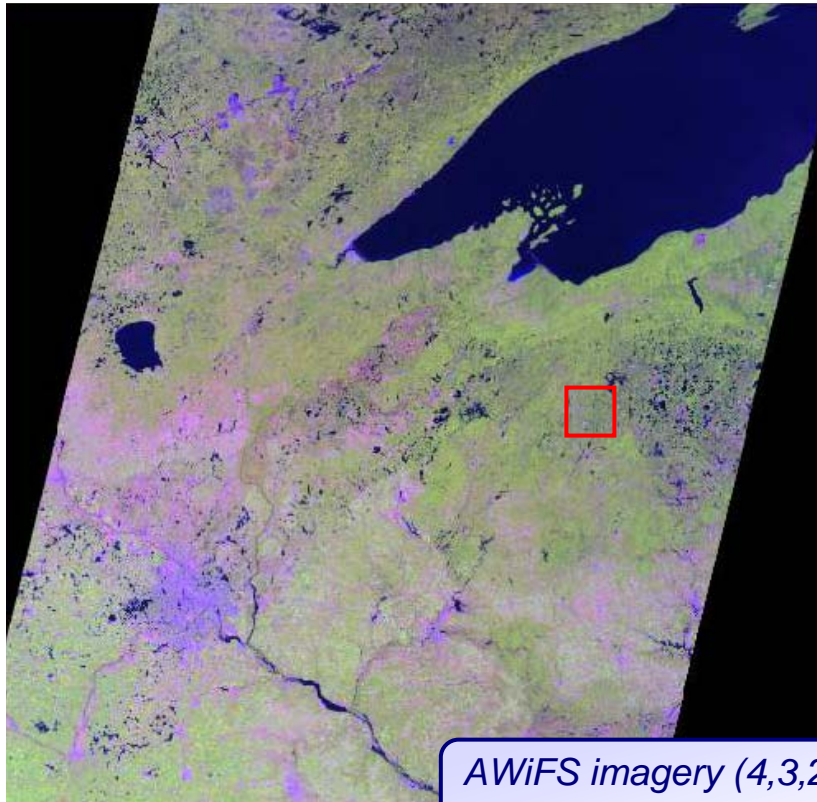


Selected Targets - Park Falls, WI

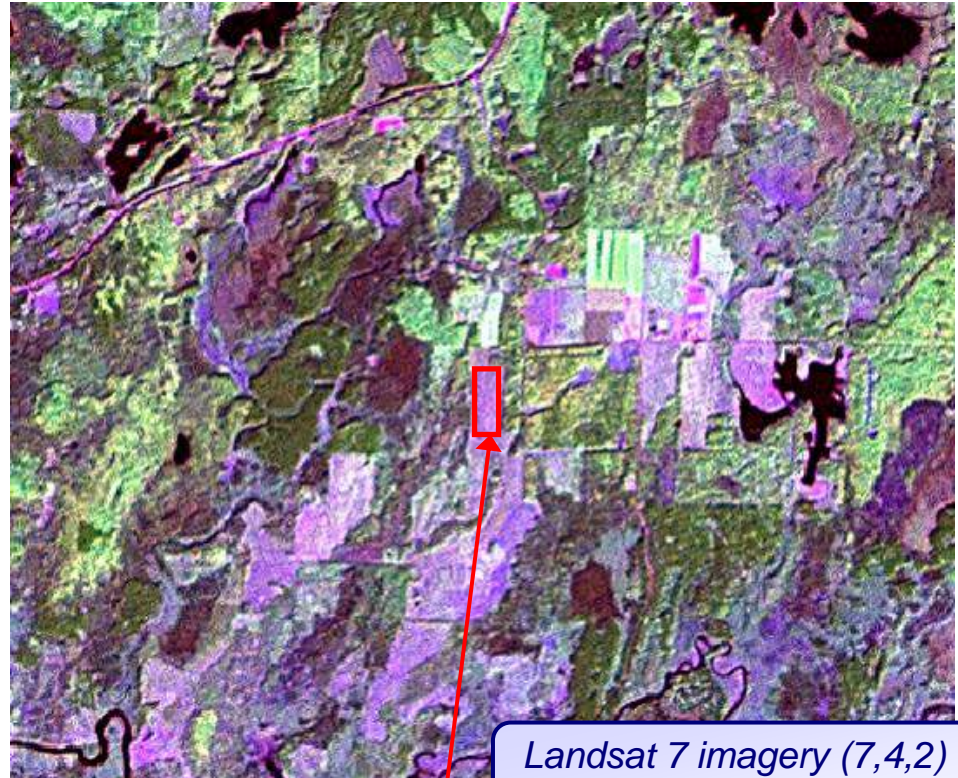
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A target of opportunity was found near an Aerosol Robotic Network (AERONET) site near Park Falls

- Large grass field

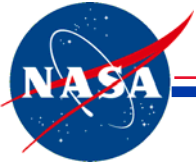


AWiFS imagery (4,3,2)
August 5, 2005



Landsat 7 imagery (7,4,2)
August 5, 2005

Target field

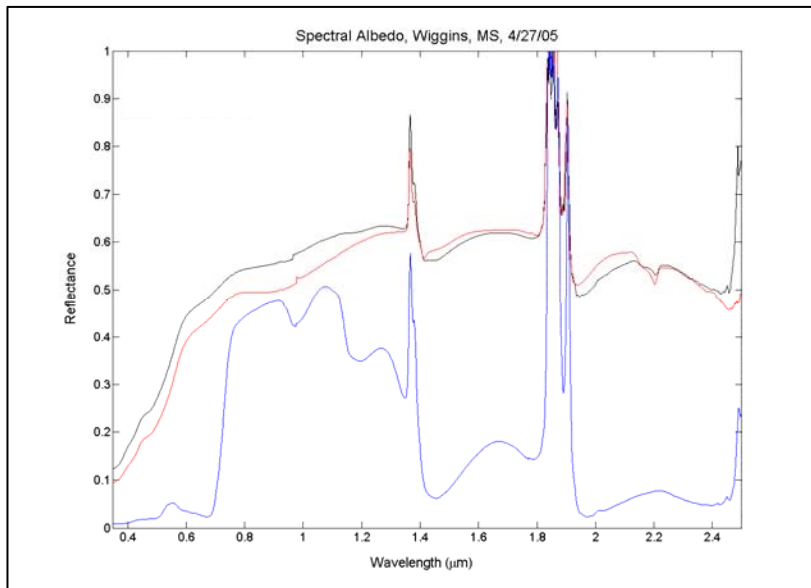


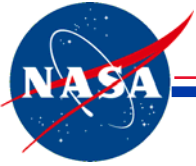
Ground Reflectance Measurements

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- ASD FieldSpec® FR spectroradiometer measurements of Spectralon® panels and several target areas were taken
 - ~50 m x 50 m area of a grassy field/golf course
 - ~100 m x 200 m area of a rye grass field
 - ~100 m x 100 m area of two sand sites
- Measurements were taken along transects aligned with the sensor azimuth
 - Measurements were taken at nadir and satellite elevation angles to account for BRDF effects
 - All measurements were taken while walking to increase spatial averaging
 - Periodic Spectralon panel measurements were taken
- All data were acquired within 40 minutes of satellite overpass



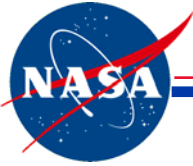


SSC Calibration and Characterization of ASD FieldSpec Spectroradiometers

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- NASA SSC maintains four ASD FieldSpec FR spectroradiometers
 - Laboratory transfer radiometers
 - Ground surface reflectance for V&V field collection activities
- Radiometric Calibration
 - NIST-calibrated integrating sphere serves as source with known spectral radiance
- Spectral Calibration
 - Laser and pen lamp illumination of integrating sphere
- Environmental Testing
 - Temperature stability tests performed in environmental chamber





Novel Hyperspectral Sun Photometer

Stennis Space Center

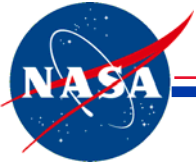
- Novel hyperspectral sun photometer is capable of acquiring measurements comparable to both ASRs and MFRSRs by making use of the laboratory radiometric calibration of the FieldSpec FR spectroradiometers
 - Optical Depth/Transmission
 - Diffuse-to-Global Ratio
- Sun photometer developed with fewer limitations than current sun photometers, utilizing equipment already used in the field
 - Radiometrically calibrated FieldSpec FR spectroradiometers
 - 99% reflectance Spectralon panels
- Measurements are made only at the time of overpass, thus reducing the impact of a changing atmosphere on the calculation of optical depth

SSC 1/10/04 - 16:33 GMT				
	ASR 27	ASD	Difference	Percent Difference
Band	Generated	Generated	ASR-ASD	1 - (asd/asr)
380 nm	0.588	0.5982	-0.010	-1.74%
400 nm	0.495	0.4852	0.010	1.99%
440 nm	0.366	0.3216	0.044	12.14%
520 nm	0.224	0.1988	0.025	11.25%
610 nm	0.161	0.1563	0.005	2.91%
670 nm	0.108	0.1002	0.008	7.26%
780 nm	0.07	0.0691	0.001	1.33%
870 nm	0.049	0.0508	-0.002	-3.58%
		RMS 1:8	0.019	

Sample Results



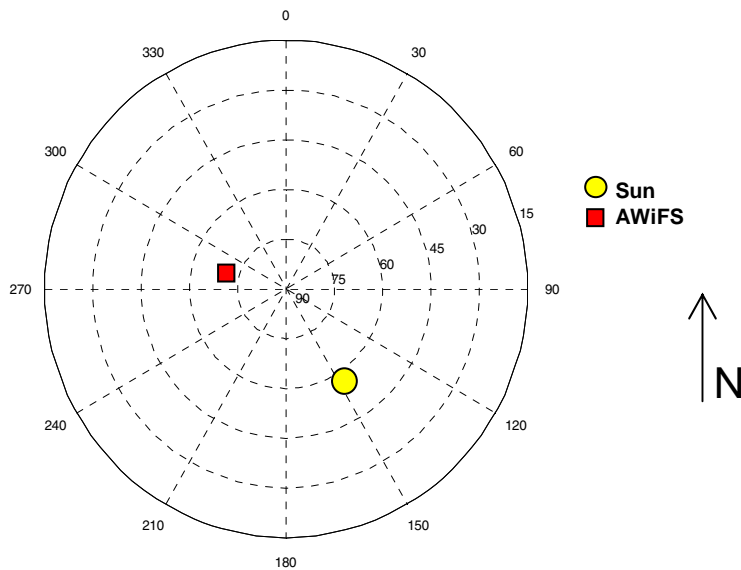
Novel Hyperspectral Sun Photometer Setup



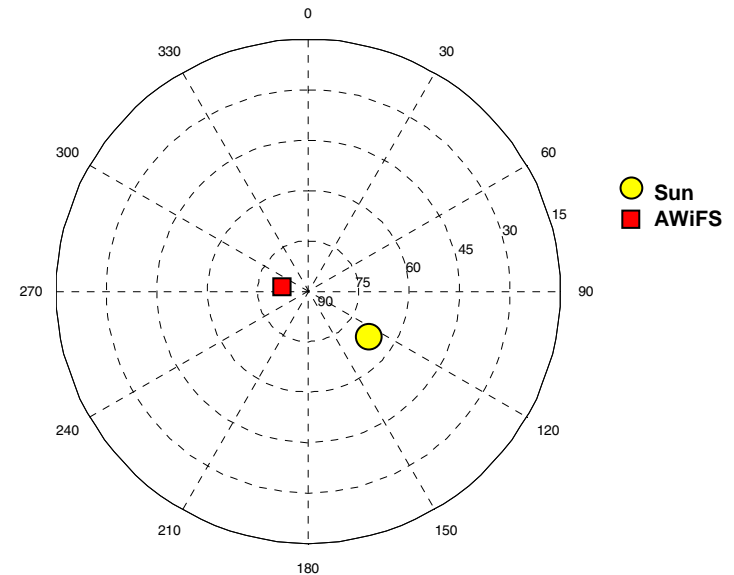
Data Acquisitions – Wiggins, MS

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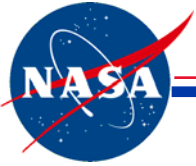
Date	Camera	Overpass Time (UTC)	Satellite Elevation	Satellite Azimuth	Sun Elevation	Sun Azimuth
Mar 24, 2005	B	16:59	71.1 deg	285 deg	57.2 deg	149.8 deg
Apr 27, 2005	B	16:50	84.5 deg	285 deg	67.7 deg	135.4 deg



Wiggins, MS, 3/24/05



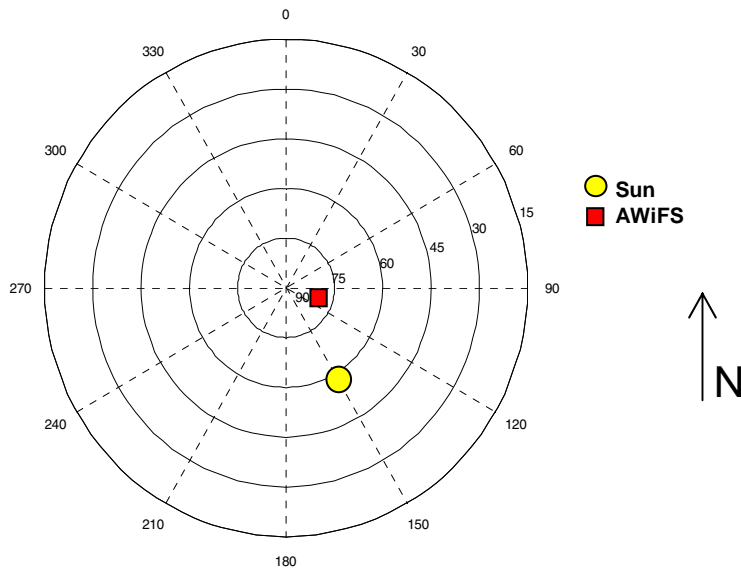
Wiggins, MS, 4/27/05

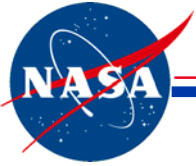


Data Acquisitions – Park Falls, WI

Stennis Space Center

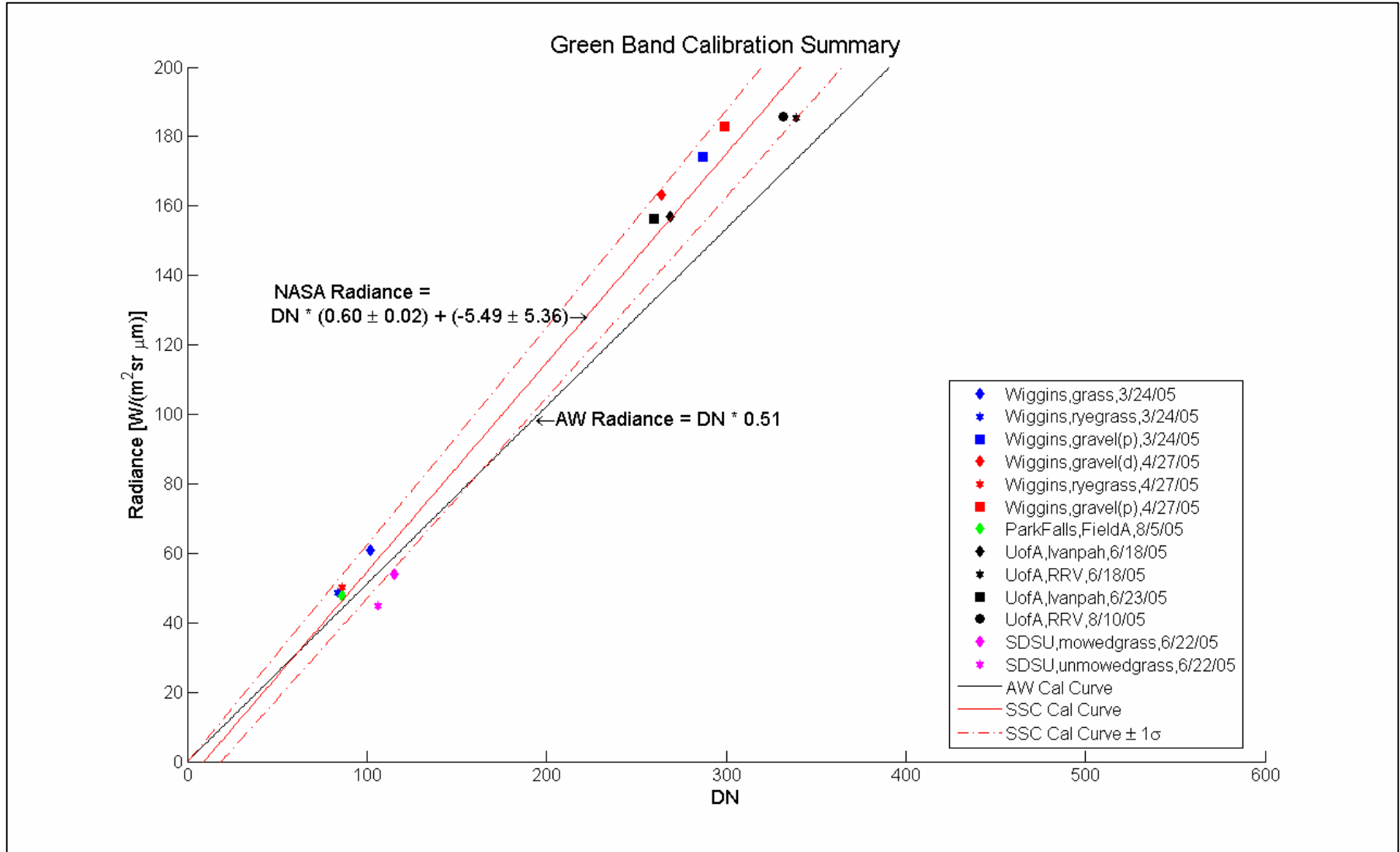
Date	Camera	Overpass Time (UTC)	Satellite Elevation	Satellite Azimuth	Sun Elevation	Sun Azimuth
Aug 5, 2005	A	17:02	83.9 deg	103 deg	57.8 deg	149.7 deg

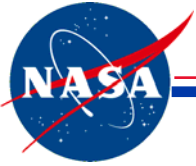




Green Band Calibration Summary

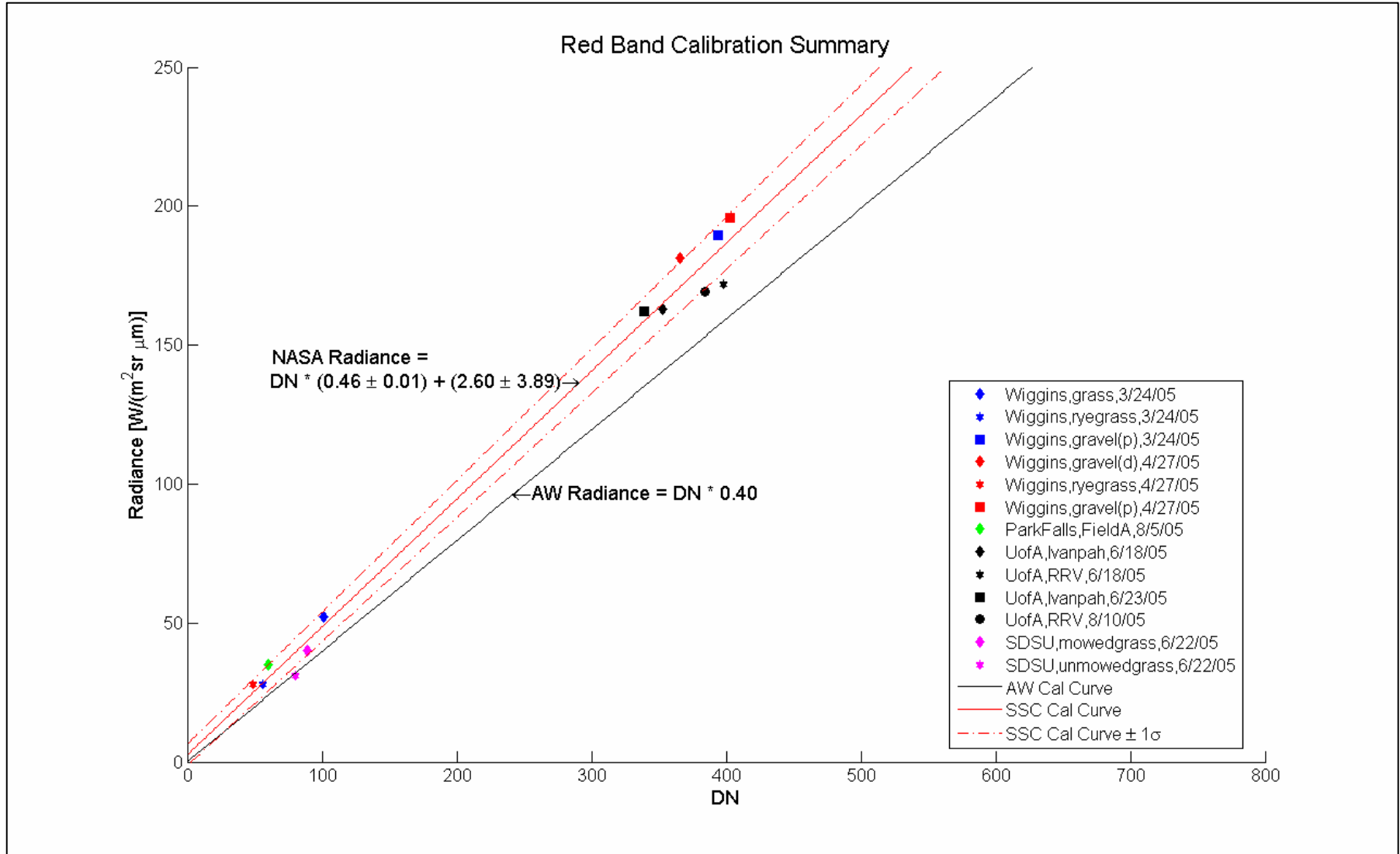
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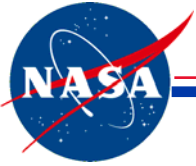




Red Band Calibration Summary

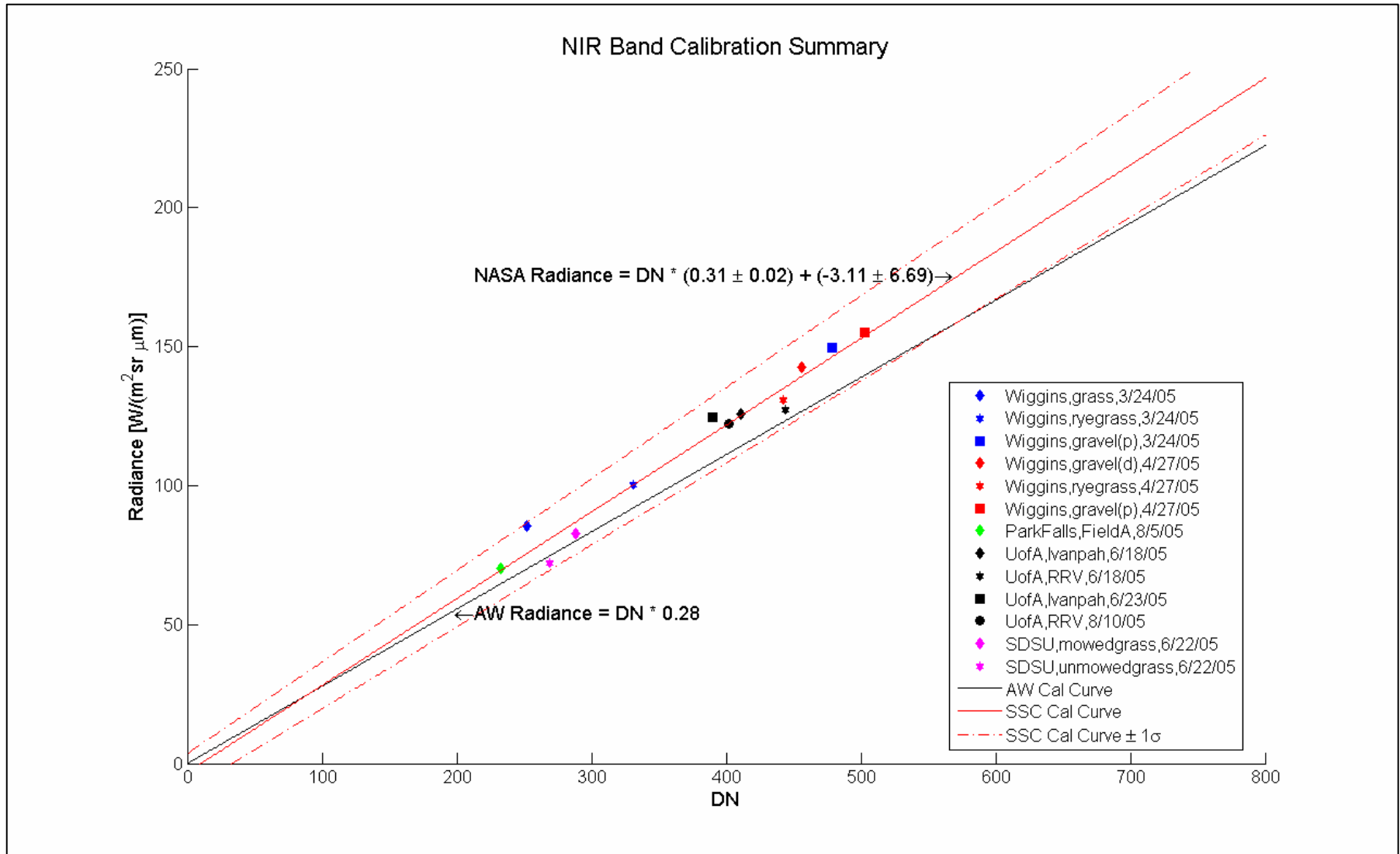
Stennis Space Center

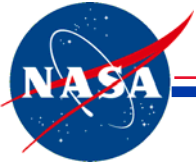




NIR Band Calibration Summary

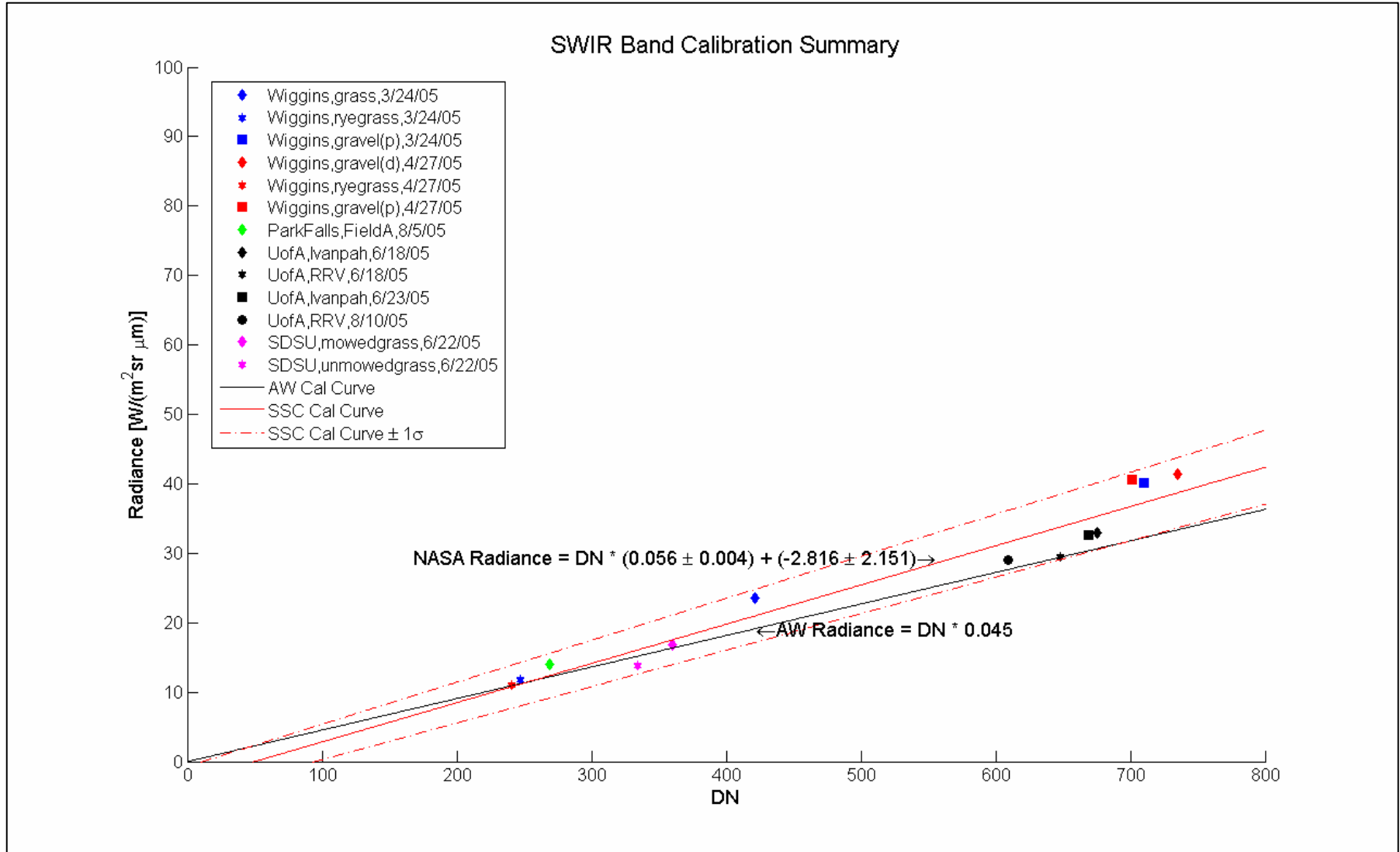
Stennis Space Center

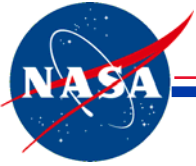




SWIR Band Calibration Summary

Stennis Space Center

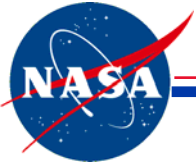




Initial Radiometric Calibration Coefficients

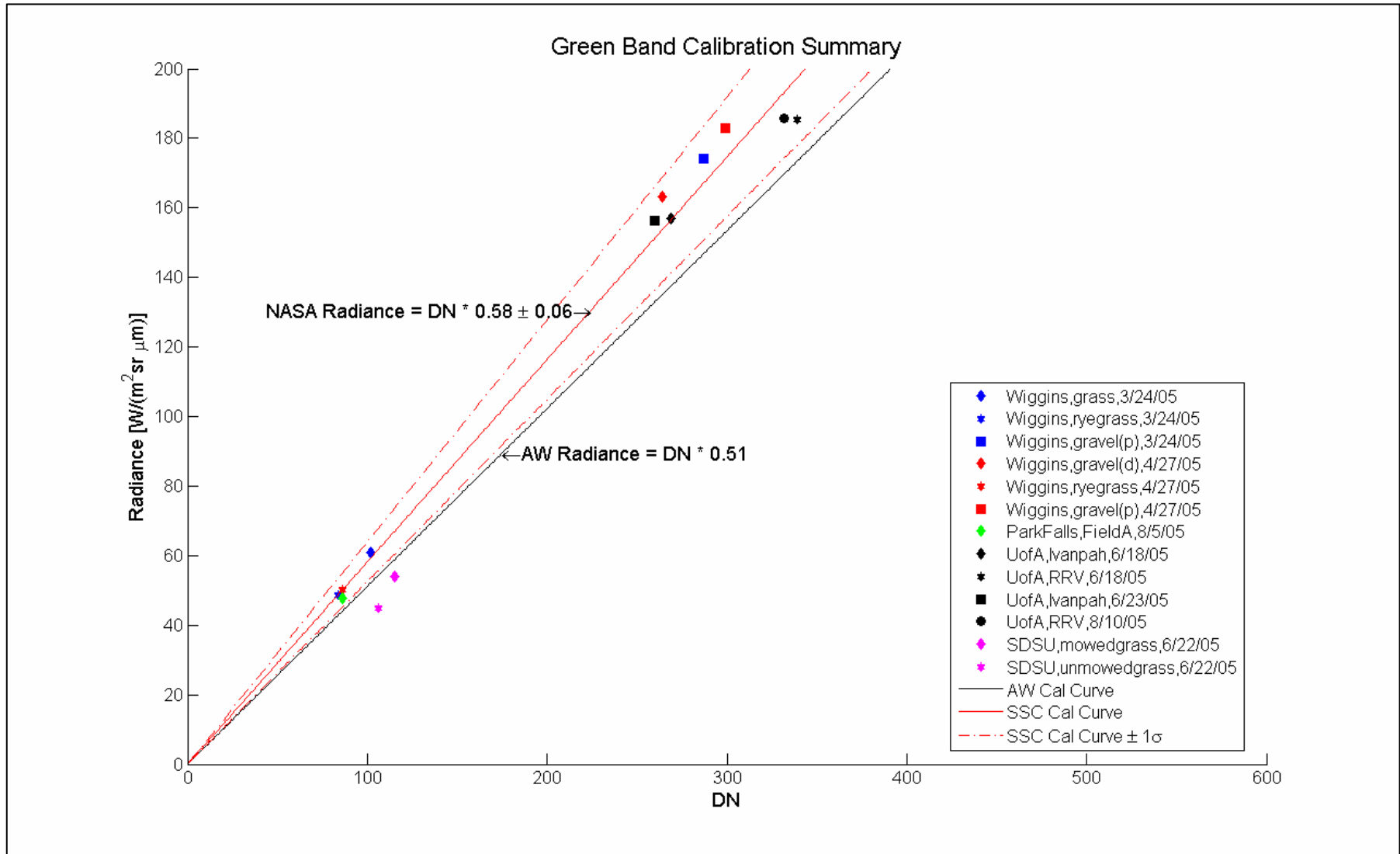
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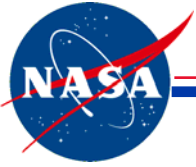
	Green	Red	NIR	SWIR
NASA Estimate				
Cal Coeff (W/m ² sr μm DN)	0.60 ± 0.02	0.46 ± 0.01	0.31 ± 0.02	0.056 ± 0.004
Offset	-5.49 ± 5.36	2.60 ± 3.89	-3.11 ± 6.69	-2.82 ± 2.15
AWiFS Provided				
Cal Coeff (W/m ² sr μm DN)	0.51	0.40	0.28	0.045
Offset	0	0	0	0



Green Band Calibration Summary (Zero-Offset)

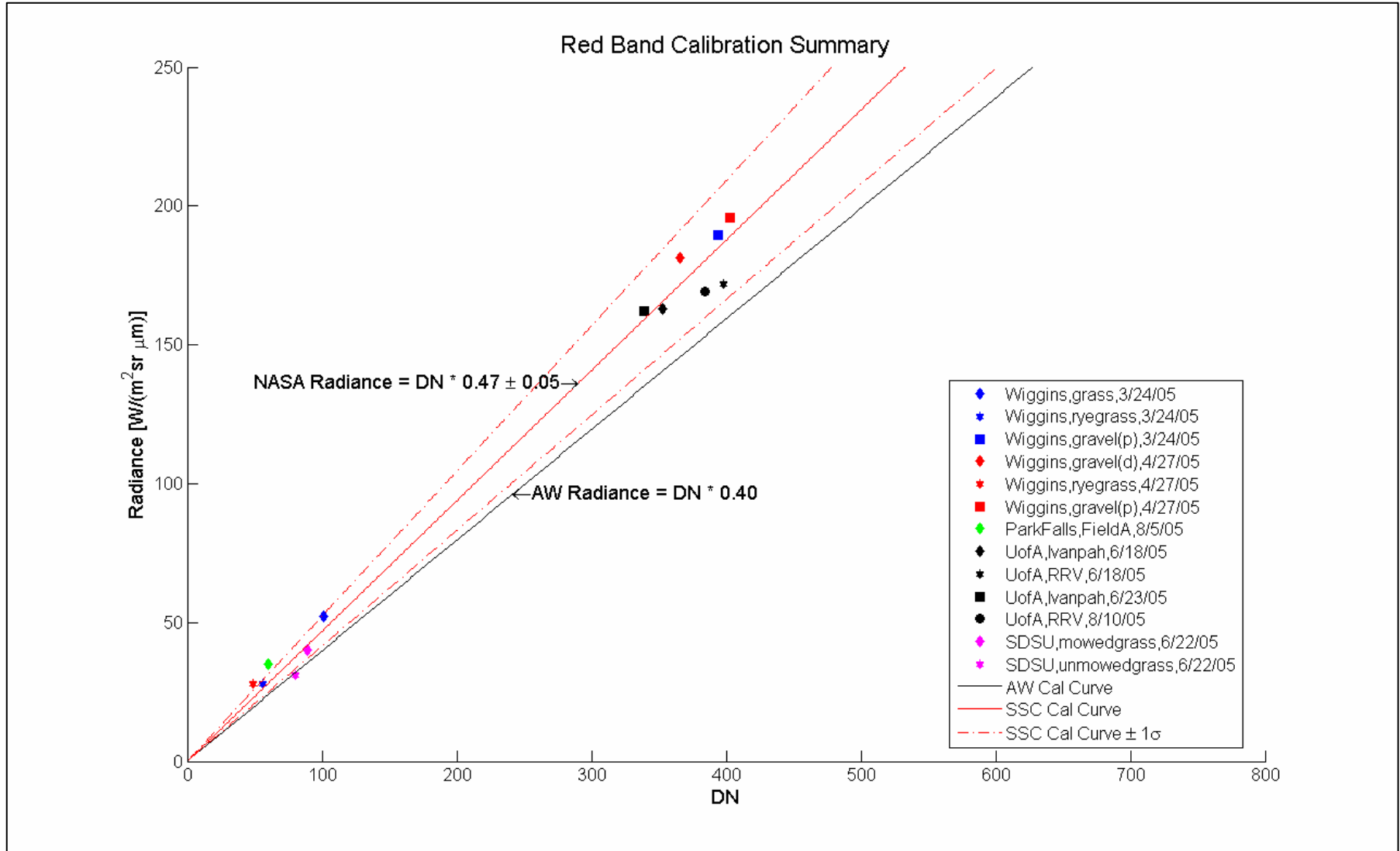
Stennis Space Center

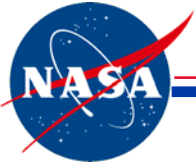




Red Band Calibration Summary (Zero-Offset)

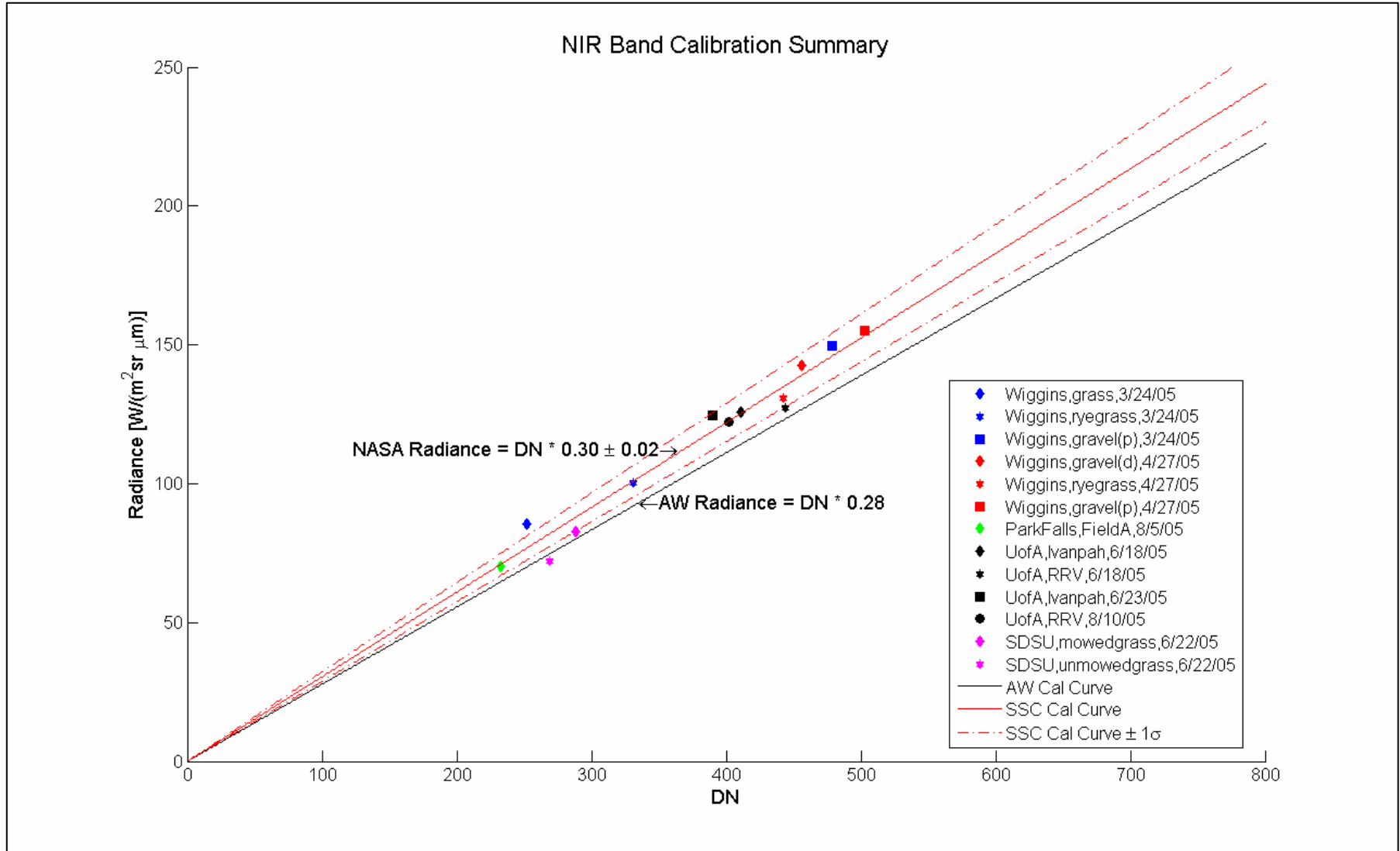
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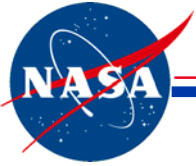




NIR Band Calibration Summary (Zero-Offset)

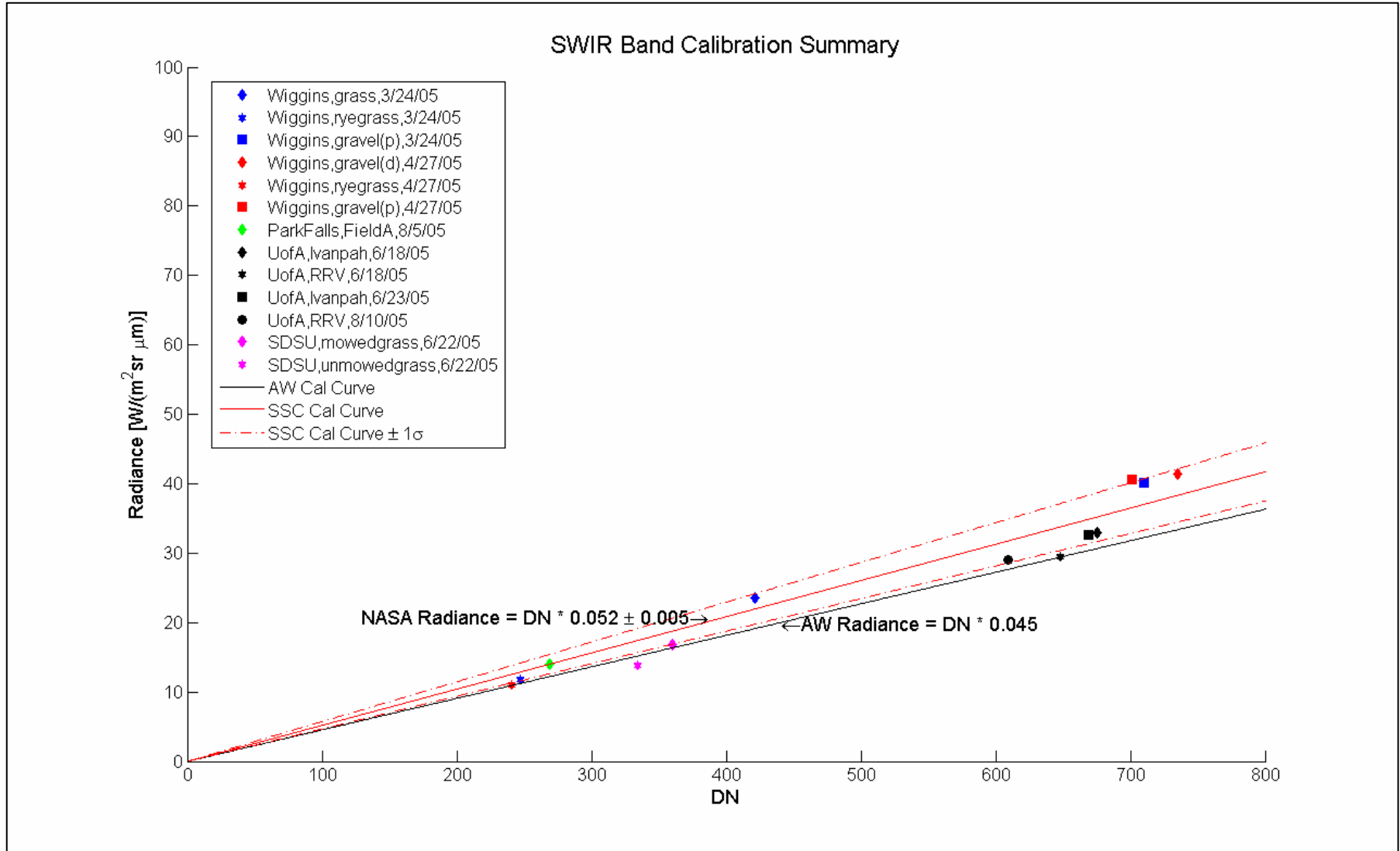
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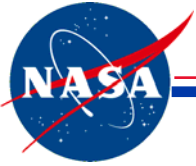




SWIR Band Calibration Summary (Zero-Offset)

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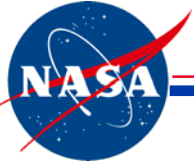


Initial Radiometric Calibration Coefficients (Zero-Offset)

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Band	NASA Team Estimate [W/m ² sr μm DN]	AWiFS Provided [W/m ² sr μm DN]	% Difference
Green	0.58 ± 0.06	0.51	12.1%
2 Red	0.47 ± 0.05	0.40	14.9%
3 NIR	0.30 ± 0.02	0.28	6.7%
4 SWIR	0.052 ± 0.005	0.045	13.5%

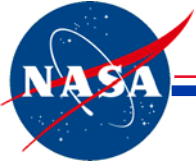
Percent difference is calculated by $(1 - \text{AWiFS}/\text{NASA Mean})$



AWiFS Results Summary

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- The NASA team of University of Arizona, South Dakota State University, and NASA SSC produce consistent results
- The AWiFS calibration coefficients agree reasonably well with the NASA team estimate
- The NASA team will continue to assess AWiFS radiometric accuracy



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