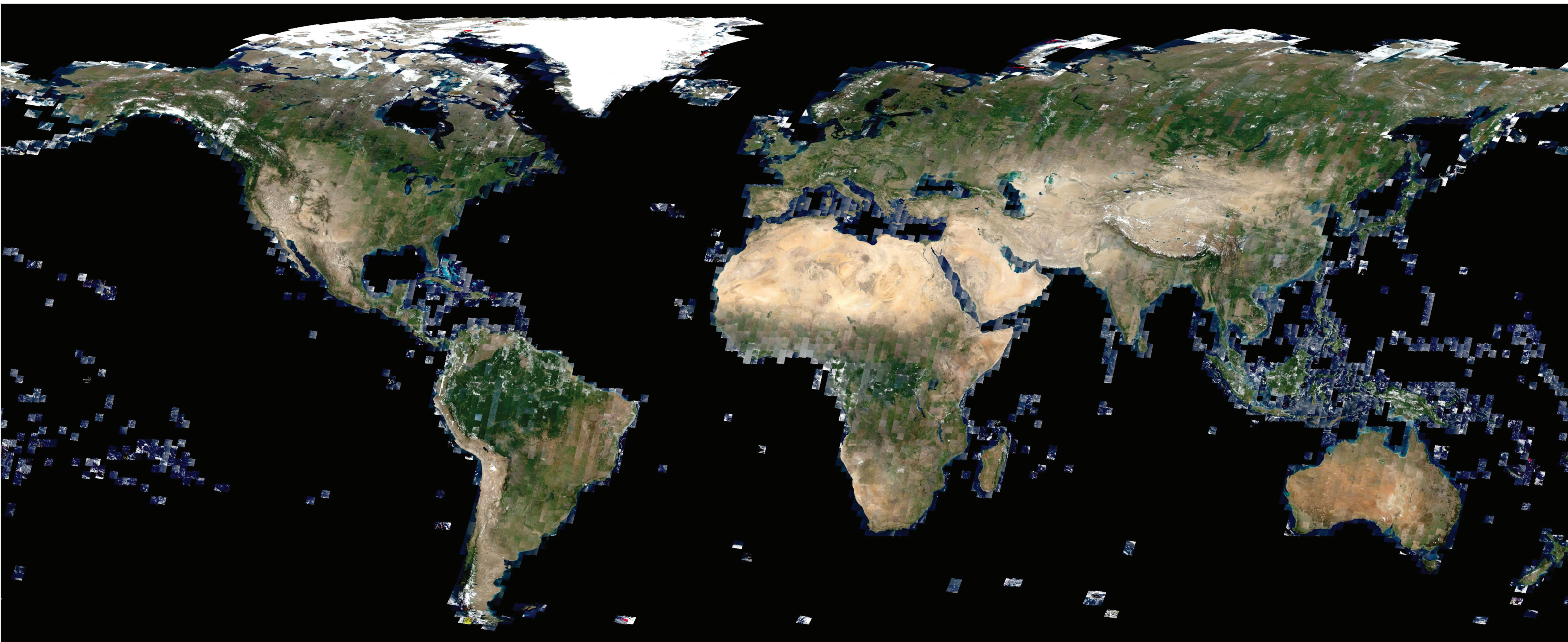




Global surface reflectance products from Landsat, with validation against coincident MODIS measurements

Joseph O. Sexton 1, Min Feng 1, Chengquan Huang 1, Jeffrey G. Masek 2, Eric F. Vermote 3, Feng Gao 4, Raghuram Narasimhan 1, Saurabh Channan 1, John R. Townshend 1
1Global Land Cover Facility; 2NASA Goddard Space Flight Center. 3University of Maryland. 4USDA Agricultural Research Service.



Abstract

Global, long-term monitoring of changes in Earth's land surface requires quantitative comparisons of satellite images acquired under widely varying atmospheric conditions. Although physically based estimates of surface reflectance (SR) ultimately provide the most accurate representation of Earth's surface properties, there has never been a globally consistent SR dataset at the scale of Landsat.

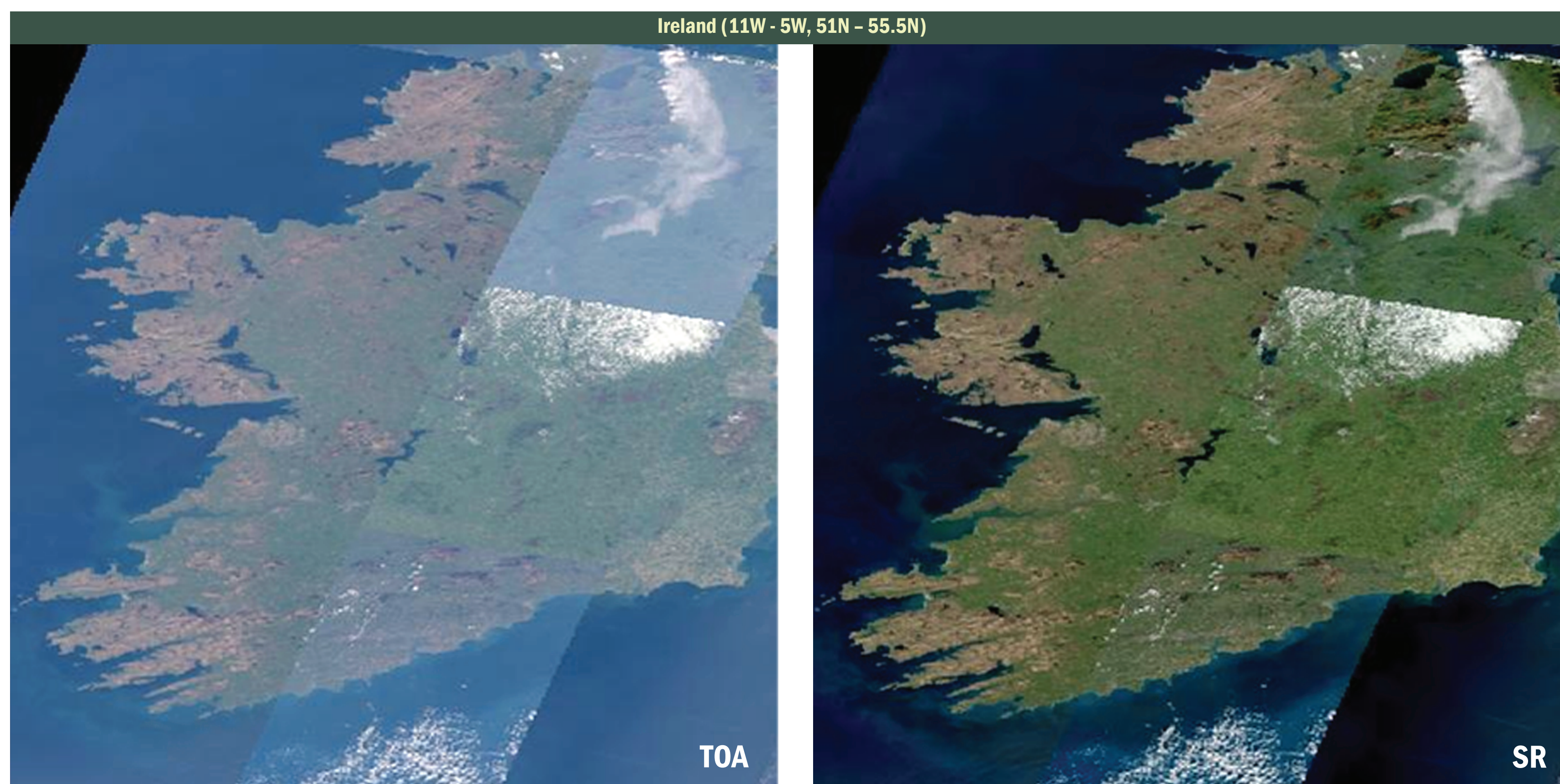
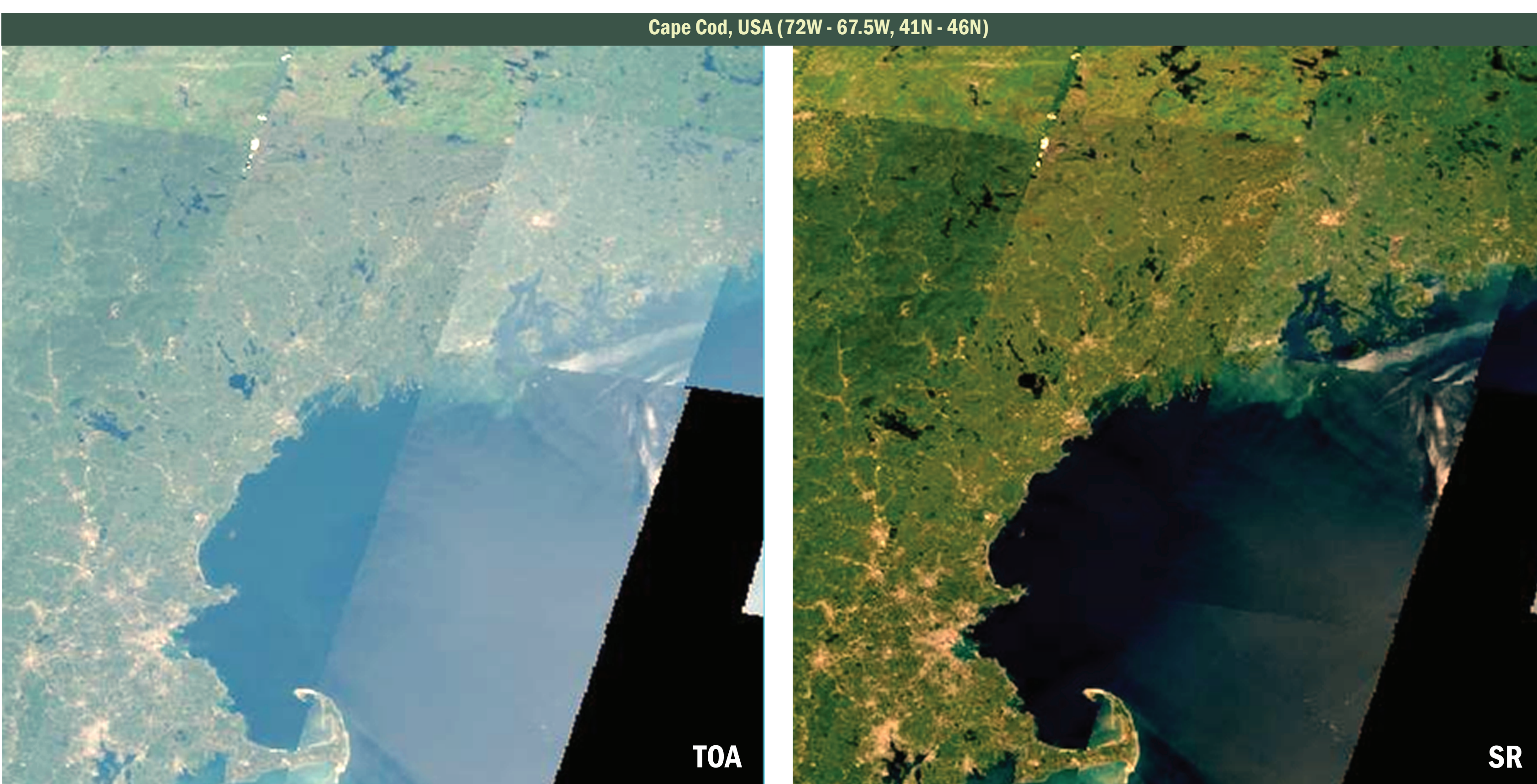
To increase the consistency and robustness of Landsat-based land cover monitoring, we atmospherically corrected the USGS Global Land Survey (GLS) dataset using the Landsat Ecosystem Disturbance Adaptive Processing System (LEDAPS) implementation of the Second Simulation of the Satellite Signal in the Solar Spectrum (6S) radiative transfer model and validated the data for GLS 2000 and 2005 epochs relative to coincident Moderate Resolution Imaging Spectroradiometer (MODIS) daily SR and Normalized

Bidirectional Distribution Function-Adjusted Reflectance (NBAR) measurements. Accuracy with respect to MODIS SR and NBAR data is very high, with overall discrepancies (Root-Mean-Squared Deviation (RMSD)) between 1.2 and 2.3 percent reflectance for Landsat-7 Enhanced Thematic Mapper Plus (ETM+) and between 1.5-3.0 percent reflectance for Landsat-5 Thematic Mapper (TM). SR datasets for 1975 and 1990 epochs are now in production as well, and this new repository of surface measurements will provide consistent, calibrated, multi-decadal image data for robust land cover change detection and monitoring across the Earth sciences.

In a Nutshell

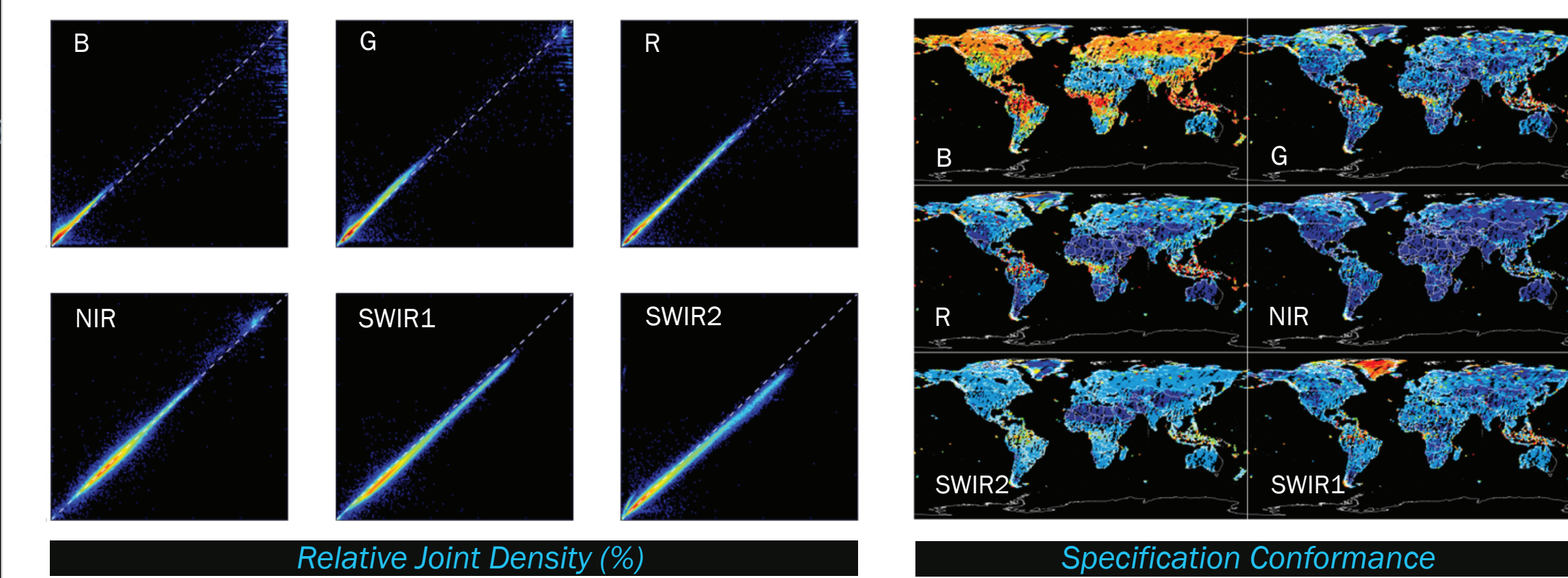
- A partnership between the Global Landcover Facility (GLCF), NASA Goddard Space Flight Center, and the University of Maryland has produced the first global, multi-temporal surface reflectance (SR) dataset from the Landsat series of sensors.
- Each Landsat-based multi-spectral SR image was validated against coincident MODIS SR or Nadir BRDF-Adjusted Reflectance (NBAR) measurements.
- Globally, inaccuracy is <3% and imprecision is <0.03%.
- 96% of the Landsat-7 images and 93% of the Landsat-5 images are within the uncertainty specifications of the two systems.
- SR images are being generated from the Global Land Survey database for 1975, 1990, 2000, and 2005 epochs.
- This robust dataset is an essential foundation for landcover change detection and retrieval of biophysical parameters.
- Find out more at www.forestcover.org Download data at www.landcover.org

TOA vs. SR



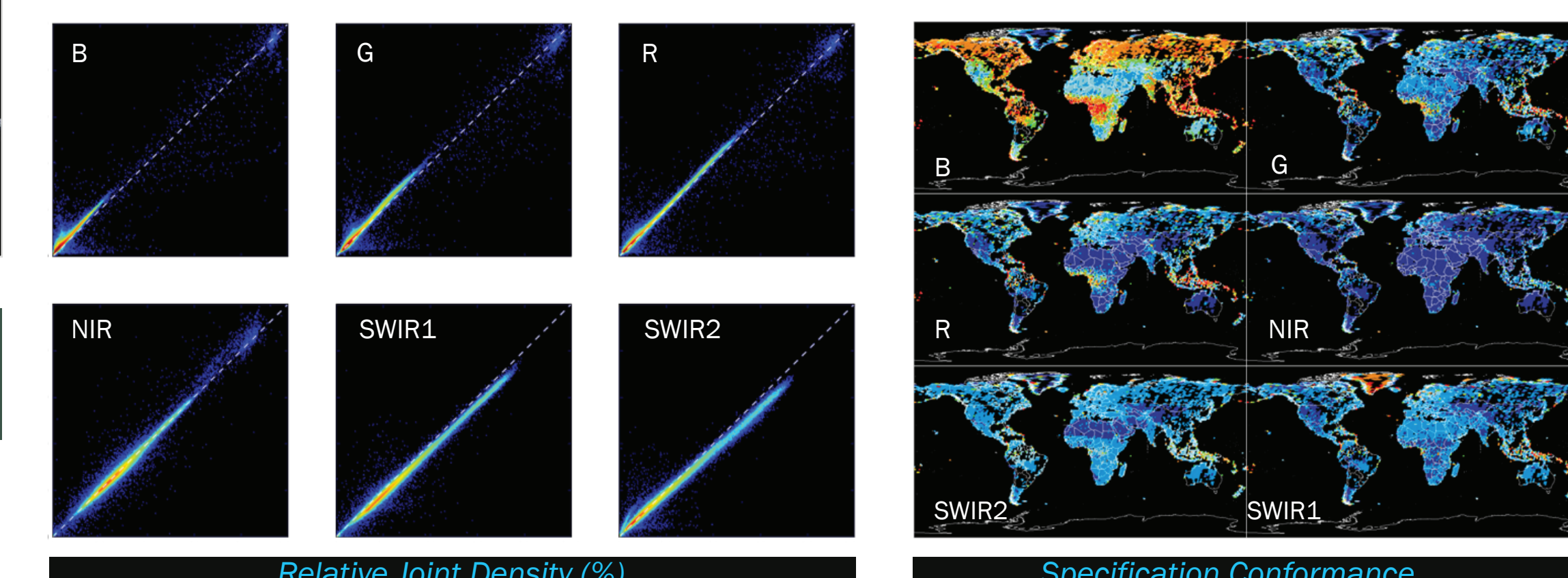
Landsat - MODIS validation

GLS 2000 ETM+ Landsat-7 ETM+ SR(%)



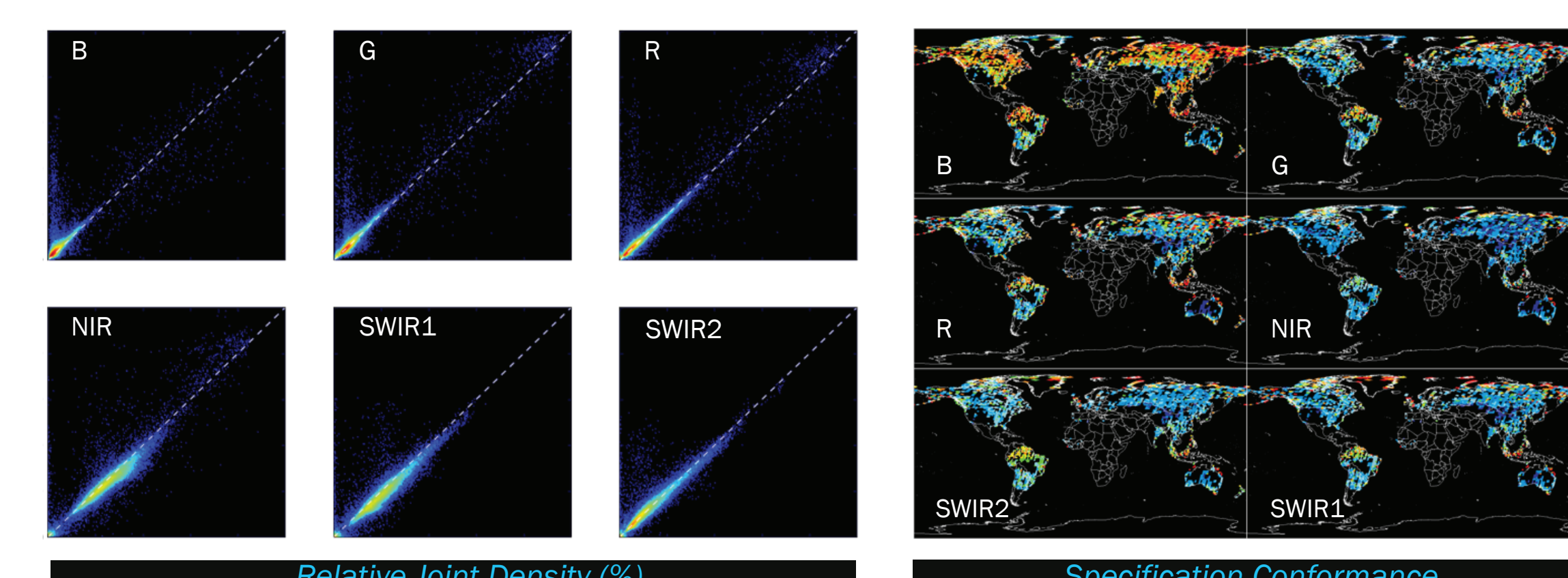
Sensor	Band	Slope	Intercept	R ²	RMSD	RMSD _s	RMSD _o	MBE	RMSD _e
ETM+	B	0.6296	18.3106	0.8031	1.9501	1.8114	0.5084	0.9278	0.4827
	G	1.4585	-41.5347	0.8668	1.1478	0.9466	0.5077	0.2514	0.1613
	R	1.3441	-26.7288	0.8951	1.1103	0.8445	0.58	0.115	0.1589
	NIR	0.9354	2.3839	0.9084	1.4017	0.8258	1.0318	-0.3023	0.0746
	SWIR1	0.9806	2.5118	0.9191	2.4904	2.2345	0.9498	-2.1693	0.1612
	SWIR2	0.9733	1.1246	0.9064	1.74	1.307	0.9148	-0.7577	0.1626

GLS 2005 ETM+ Landsat-7 ETM+ SR(%)



Sensor	Band	Slope	Intercept	R ²	RMSD	RMSD _s	RMSD _o	MBE	RMSD _e
ETM+	B	0.8272	-0.1838	0.8196	1.7311	1.6044	0.4704	1.4229	0.4767
	G	0.89	0.7631	0.8786	1.1391	0.9417	0.5114	0.5274	0.161
	R	0.9103	0.6519	0.9052	1.0152	0.7622	0.5736	0.4591	0.1528
	NIR	0.9393	1.9976	0.9156	1.3786	0.7911	1.0375	-0.2219	0.0715
	SWIR1	0.9907	2.1627	0.9251	2.4292	2.1758	0.9423	-2.1172	0.1548
	SWIR2	0.9989	0.416	0.9104	1.6881	1.2977	0.8598	-0.8323	0.1521

GLS 2005 TM Landsat-5 ETM+ SR(%)



Sensor	Band	Slope	Intercept	R ²	RMSD	RMSD _s	RMSD _o	MBE	RMSD _e
TM	B	0.6496	0.5711	0.5652	2.058	1.7566	0.8109	1.022	0.535
	G	0.8092	1.3936	0.6978	1.9086	1.5249	0.9289	0.3641	0.3039
	R	0.8587	0.897	0.7656	1.8821	1.4502	0.9764	0.3808	0.3182
	NIR	0.9107	3.5992	0.8143	3.203	2.3689	1.9408	-1.2074	0.1873
	SWIR1	0.8581	4.2022	0.7947	3.1874	2.5689	1.6797	-1.7009	0.2549
	SWIR2	0.8261	1.5057	0.8083	2.0162	1.4914	1.1745	0.1481	0.2719