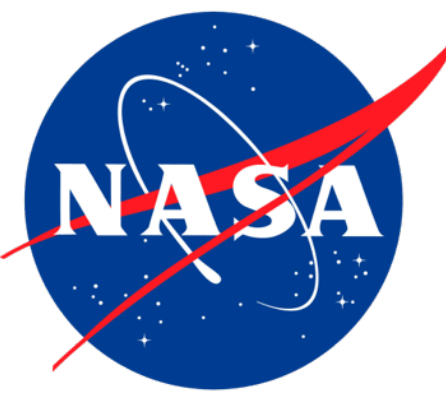# Polar2Grid:
Reprojecting Satellite Data Made Easy

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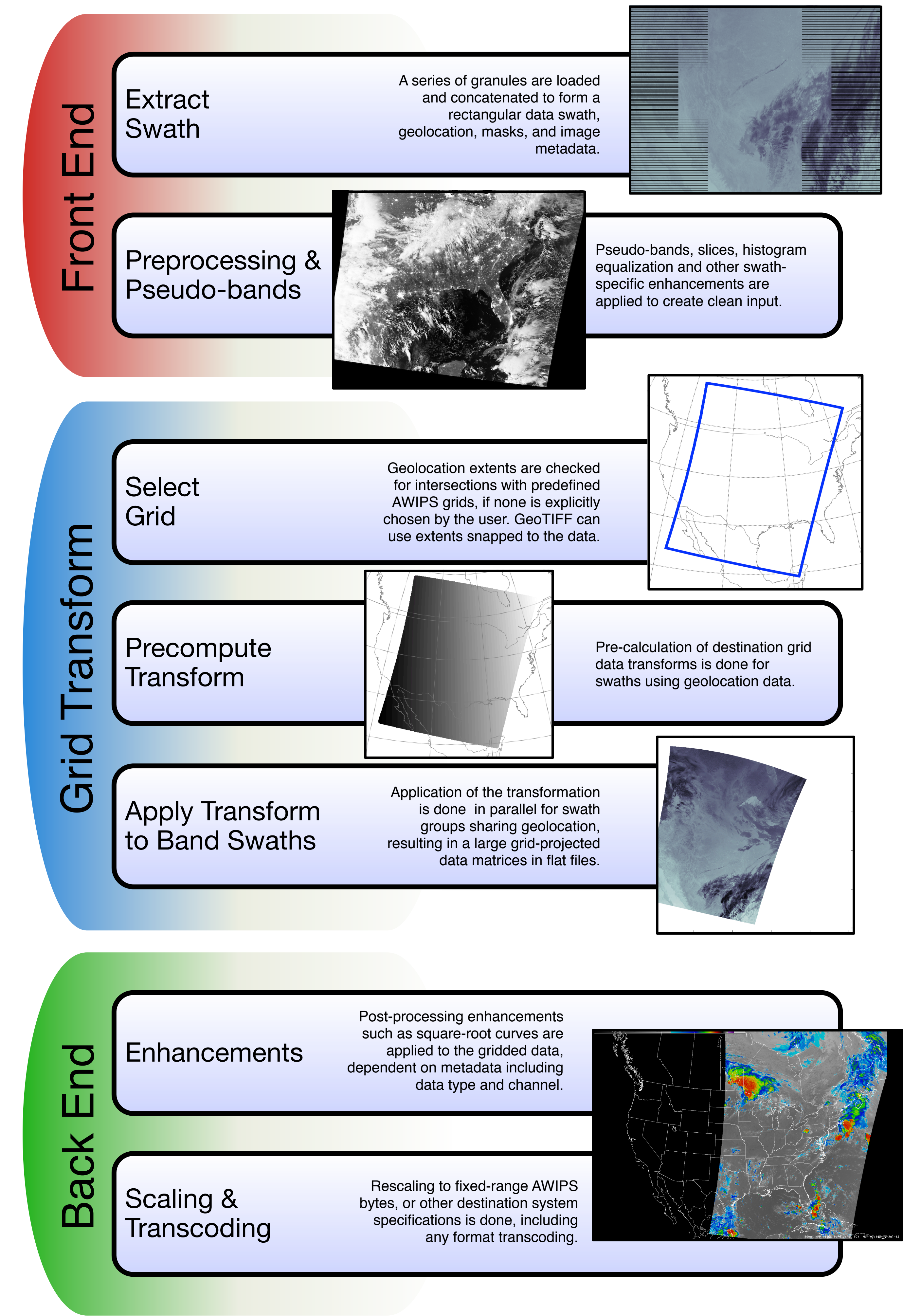
Abstract

Polar-orbiting multi-band meteorological sensors such as those on the Aqua, Terra, and Suomi NPP satellites pose substantial challenges for taking imagery the last mile to forecast offices, scientific analysis environments, and the general public. To do this quickly and easily, the Cooperative Institute for Meteorological Satellite Studies (CIMSS) at the University of Wisconsin has created an open-source, modular application system, Polar2Grid. This bundled solution automates tools for converting various satellite products like those from MODIS and VIIRS into a variety of output formats, including GeoTIFFs, AWIPS compatible NetCDF files, and NinJo forecasting workstation compatible TIFF images. In addition to traditional visible and infrared imagery, Polar2Grid includes three perceptual enhancements for the VIIRS Day-Night Band (DNB), as well as providing the capability to create sharpened true color, sharpened false color, and user-defined RGB images. Polar2Grid performs conversions and projections in seconds on large swaths of data. Polar2Grid is currently providing VIIRS imagery over the Continental United States, as well as Alaska and Hawaii, from various Direct-Broadcast antennas to operational forecasters at the NOAA National Weather Service (NWS) offices in their AWIPS terminals, within minutes of an overpass of the Suomi NPP satellite. Collaboration with the open source PyTroll group will provide the community with the functionality of Polar2Grid in a unified set of easy to use python packages. Four years after Polar2Grid development started, the Polar2Grid team has released version 2.0 of the software; supporting more sensors, generating more products, and providing all of its features in an easy to use command line interface.
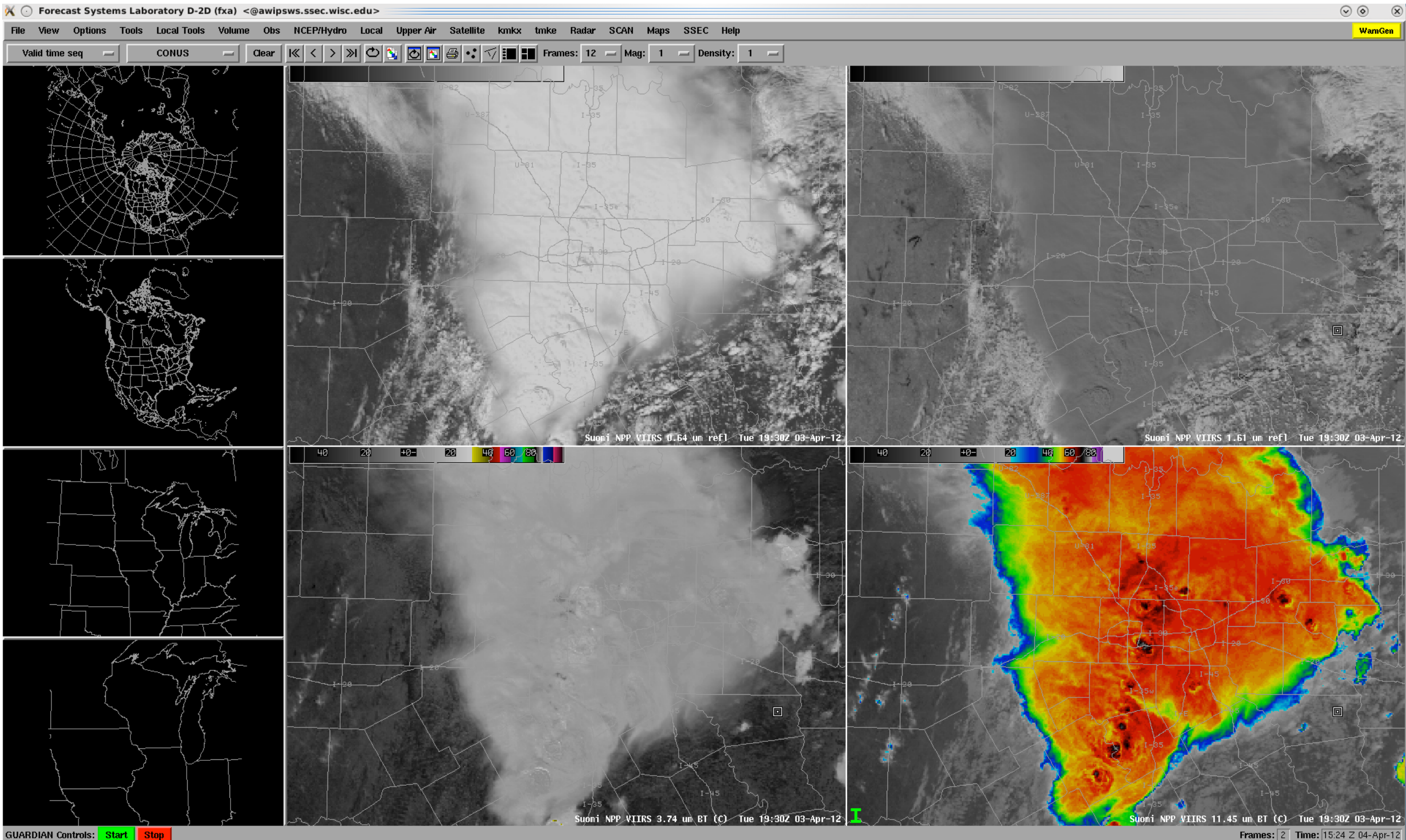
Polar2Grid Software Processing Chain

Polar2Grid is partitioned into three major segments: a Front End which abstracts away the specifics of a given instrument and provides well-conditioned swaths and geolocation; a reusable transformation core using a variety of algorithms and implementations to convert swaths to grids; and a Back End which converts the gridded data to display ranges and exports in destination-system file formats.

Front End

Extract Swath — A series of granules are loaded and concatenated to form a rectangular data swath, geolocation, masks, and image metadata.

Preprocessing & Pseudo-bands — Pseudo-bands, slices, histogram equalization and other swath-specific enhancements are applied to create clean input.

Grid Transform

Select Grid — Geolocation extents are checked for intersections with predefined AWIPS grids, if none is explicitly chosen by the user. GeoTIFF can use extents snapped to the data.

Precompute Transform — Pre-calculation of destination grid data transforms is done for swaths using geolocation data.

Apply Transform to Band Swaths — Application of the transformation is done in parallel for swath groups sharing geolocation, resulting in a large grid-projected data matrices in flat files.

Back End

Enhancements — Post-processing enhancements such as square-root curves are applied to the gridded data, dependent on metadata including data type and channel.

Scaling & Transcoding — Rescaling to fixed-range AWIPS bytes, or other destination system specifications is done, including any format transcoding.

Front End & Back End Modules

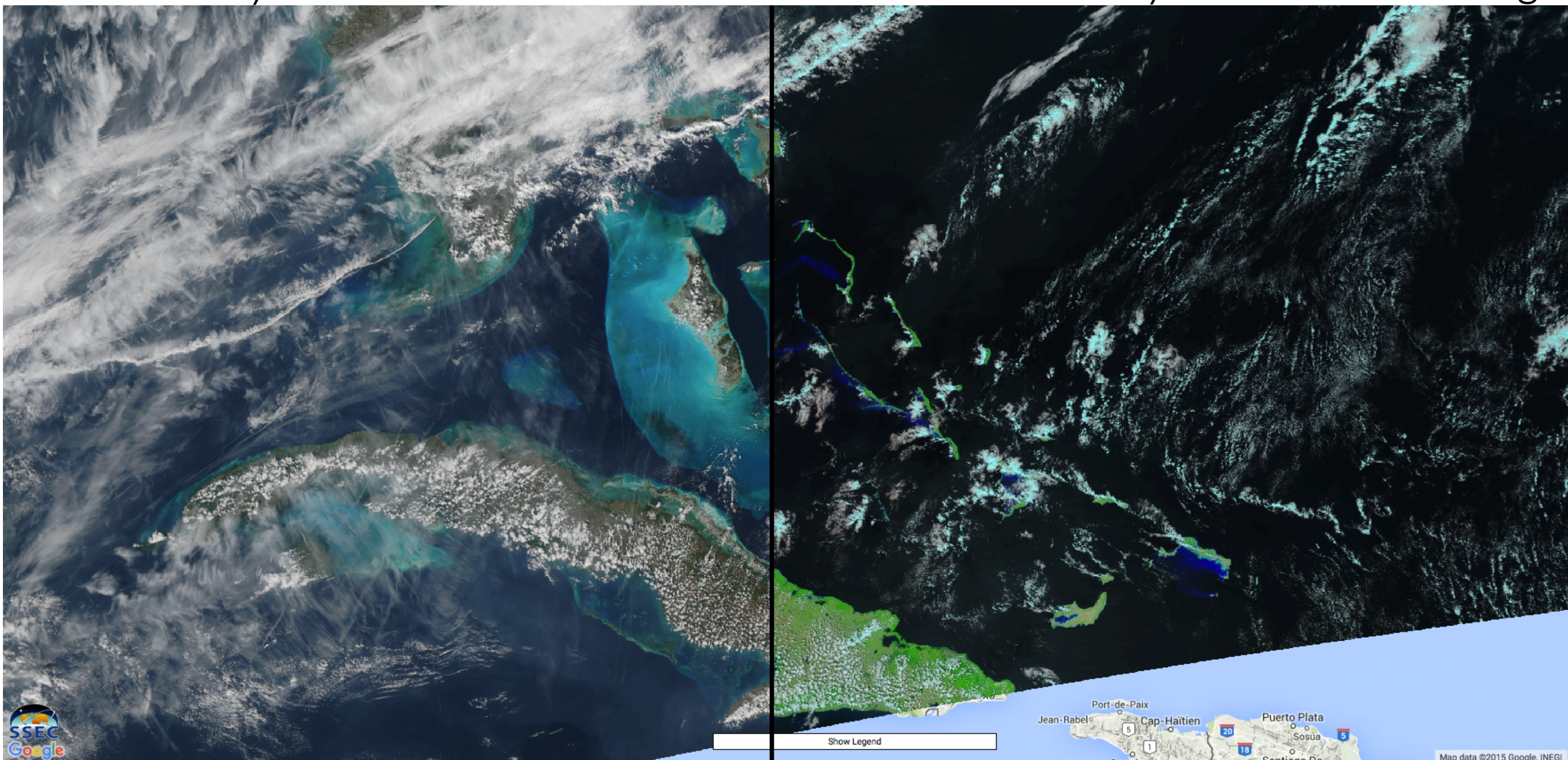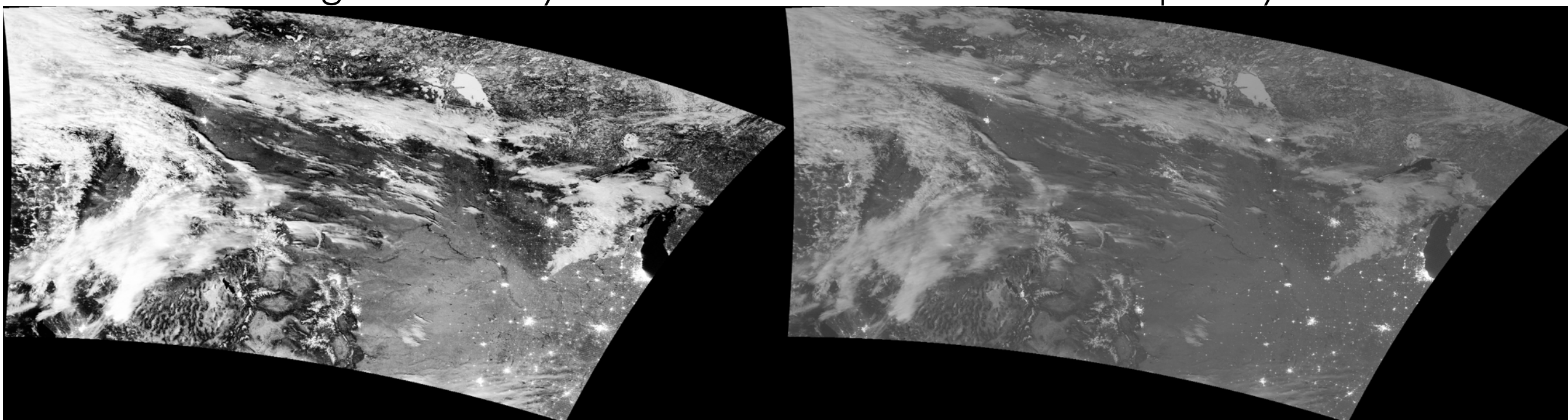| Module	Capability	Status
VIIRS SDR Front End	VIIRS M, I, DNB with enhancements	stable
MODIS Front End	Funded by NASA, BTemp / Reflectances	stable
AVHRR Front End	Band 1, 2, 3a, 3b, 4, and 5	stabe
CREFL Front End	Corrected Reflectance product for true/false color	stable
AWIPS NetCDF Back End	NetCDF files, ready for AWIPS injection	stable
NinJo TIFF Back End	DWD contributed feature for VIIRS in NinJo	stable
GeoTIFF Back End	Export to localized compressed GeoTIFF images	stable
HDF5 Back End	Export multiple datasets to compressed HDF5 file	stable
CSPP MIRS Front End	Rain rate and Brightness Temperatures	beta
CSPP ACSPO Front End	Sea Surface Temperature	beta

Examples

VIIRS multi-band over TX in AWIPS

VIIRS True/False Color CREFL in re.ssec.wisc.edu, courtesy S. Batzli & R. Dengel

VIIRS DNB Histogram and Dynamic ERF Enhancement developed by Curtis Seaman

Simple Command Line Interface

To create AWIPS compatible NetCDF files on the AWIPS East-CONUS grid:

```
viirs2awips.sh -g 211e -f /path/to/sdr-files/
```

To create Google Maps compatible corrected reflectance true color GeoTIFF files:

```
crefl2gtiff.sh -f /path/to/sdr-files/
```

To create GeoTIFF files on a user defined grid:

```
viirs2gtiff.sh --grid-configs my_grids.conf -g my_grid
        -f /path/to/sdr-files/
```

Fork Polar2Grid @ GitHub!

https://github.com/davidh-ssec/polar2grid

Polar2Grid is built in the Python scripting language, using open-source software including GDAL, libtiff, PROJ.4, cython, numpy, and the new pytroll satpy library. Community users are welcome to download ready-to-run Linux binary bundles, or build it from scratch on their own systems. Contributors can use github to obtain the full source repository, implement and share new capabilities, and request their integration into future releases. Developer documentation is at

http://www.ssec.wisc.edu/software/polar2grid/index.html.

The ready-to-run linux binary bundle can be found at: http://cimss.ssec.wisc.edu/cspp/

Collaboration With The PyTroll Team

The Polar2Grid team is now working closely with the PyTroll team. The PyTroll group has succeeded in building a collection of open source python packages for working with satellite imagery and building a community around these tools. Our teams have realized how similar our projects are and will be combining efforts to bring the direct broadcast and satellite imagery community better tools with more features.

Community Software Tools Workshop - Friday PM