SIFT – An interactive tool for satellite data visualization and analysis

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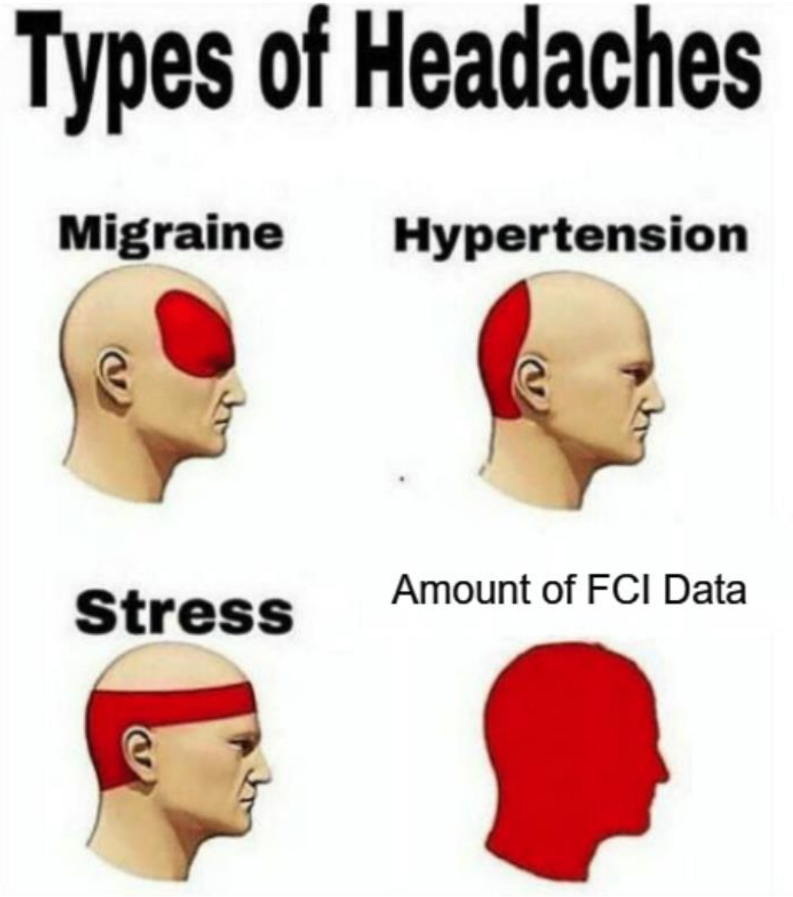
LI Short Course 2024

SIFT: Background and Challenges

- Modern imagers produce an enormous amount of data to be handled and visualized
  - Clear need of new strategy and technologies for data visualization

- Due to the heterogeneous types of data used for e.g. MTG-I Cal/Val activities,
  a multi-mission, modular and flexible approach was desirable

- Combination of two existing open source software solutions showed the most promising solution:
  - SIFT as graphic and visualization engine
  - Pytroll as library for data reading and processing



SIFT: Visualization Engine

https://sift.ssec.wisc.edu/
https://github.com/ssec/sift

- *Satellite Information Familiarization Tool*, initially developed at SSEC University of Wisconsin for the use by their trainers:
  - Cross OS (Linux, Win, MacOS)
  - Designed to be fast and to cope with high-resolution imager datasets (data thinning and GPU acceleration)

- EUMETSAT Vision: SIFT shall be an easy to use and responsive multi-mission data analyses and visualization application supporting many different use cases:
  - *Cal/Val*
  - *science*
  - *training*
  - *satellite operations, ...*

- To achieve this, EUMETSAT, together with *ask**, developed a new version of SIFT, initially focusing on MTG-I needs

https://askvisual.de/

** ask – Innovative Visualisierungslösungen GmbH*

SIFT data access and processing engine: Pytroll

- Pytroll is a python framework for the reading and processing of Earth observation satellite data. It implements the most common operations needed for satellite data handling:
  - Product readers
  - Reprojection, resampling, overlay of cartographic features
  - Generation of RGBs, geometric/atmospheric corrections, …

- SIFT v2.0 takes advantage of the reading and resampling capabilities of the Pytroll packages Satpy and Pyresample to import data into the visualization engine:
  - A new Satpy reader can directly be utilized by SIFT
  - All pyresample-resamplers are available
  - All satpy composites are directly available

PyTROLL

http://pytroll.github.io/

https://github.com/pytroll/

Some (!) available Satpy readers

EUMETSAT data

avhrr_l1b
fci_l1c_nc
fci_l2_nc
iasi_l2
li_l2
mviri_l1b_fiduceo
olci_l1b
olci_l2
seviri_l1b
seviri_l2_grib
seviri_l2_bufr
slstr_l1b
slstr_l2
vii_l1b_nc
vii_l2_nc

Other data

abi_l1b
abi_l2_nc
ahi_hrit
ahi_hds
amsr2_l1b
amsr2_l2
atdnet
caliop_l2_cloud
cmsaf_claas2_l2_nc
euclid
gld360
glm_l2
goes-imager_hrit
goes-imager_nc
modis_l1b
modis_l2
msi_safe
nwcsaf-geo
nwcsaf-pps_nc
tropomi_l2
viirs_l1b

First release of SIFT v2.0

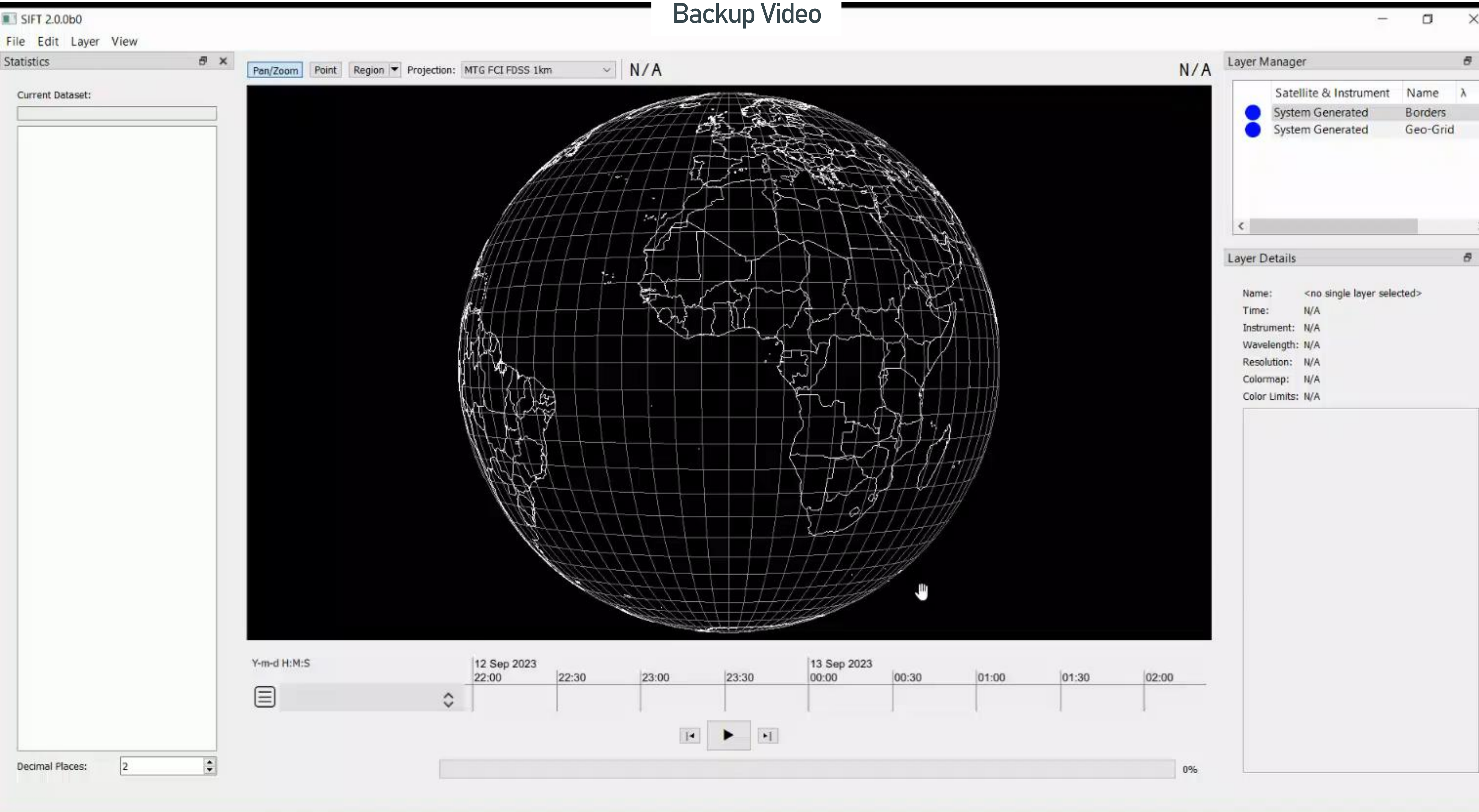
- SIFT v2.0 contains all EUMETSAT-led developments, targeting MTG-I commissioning and MTG-UP

- Main new features are:
  - Full support for GEO, LEO and point data, through Satpy integration
  - support for composite (RGB) visualization
  - an improved timeline manager
  - integration of a statistics module
  - full resampling functionalities using Pyresample
  - an automatic update/monitoring mode
  - partial redesign of the UI/UX
  - … many more small but useful features!

SIFT Live Demo

🤞

Backup Video



Current Dataset:

Projection: MTG FCI FDSS 1km

	Satellite & Instrument	Name	λ
●	System Generated	Borders	
●	System Generated	Geo-Grid	

Name: <no single layer selected>
Time: N/A
Instrument: N/A
Wavelength: N/A
Resolution: N/A
Colormap: N/A
Color Limits: N/A

Decimal Places: 2

A note on computational requirements

- SIFT runs on Win, Mac and Linux, but depends on many complex libraries
- Can make use of GPU via PyOpenGL and Vispy
- Simpler to setup on a local system, virtual machines/remote servers are trickier due to limitations in displaying OpenGL

- Lower end specs to run basic SIFT functions (but, the more the merrier!)
  - Windows 10+ / Mac OS X >11.0 / Linux >= Rocky Linux 8
  - 8GB RAM
  - Disk space (preferably on a SSD/NVMe drive) with 20GB+ available
  - GPU with 2GB VRAM and OpenGL 3+ support
  - Data files to be loaded can require several GB of disk space

First release of SIFT v2.0

- Currently in **beta** release since May 2023
  - **Thank you to all people trying it out and reporting issues in their use cases/workflows!**
  - Some major issues have been identified and are still open
    - Colormap "discretises" when stretching on narrow ranges
    - MacOS still problematic
    - Transparency of datasets still problematic
    - ~~Image export functionality not working~~ (fixed in v2.0.0b1 released… yesterday ☺)
  - Note that SIFT is not an official EUM tool and is developed on a best effort basis.
  - Contributions are always welcome!

→ We are of course also still happy about any issue/bug reports!*
- Preferred way is through a Github issue: https://github.com/ssec/sift
- Or open a thread in the uwsift Google Group: https://groups.google.com/g/uwsift
- Or contact us on https://gitter.im/ssec/sift

Further Info

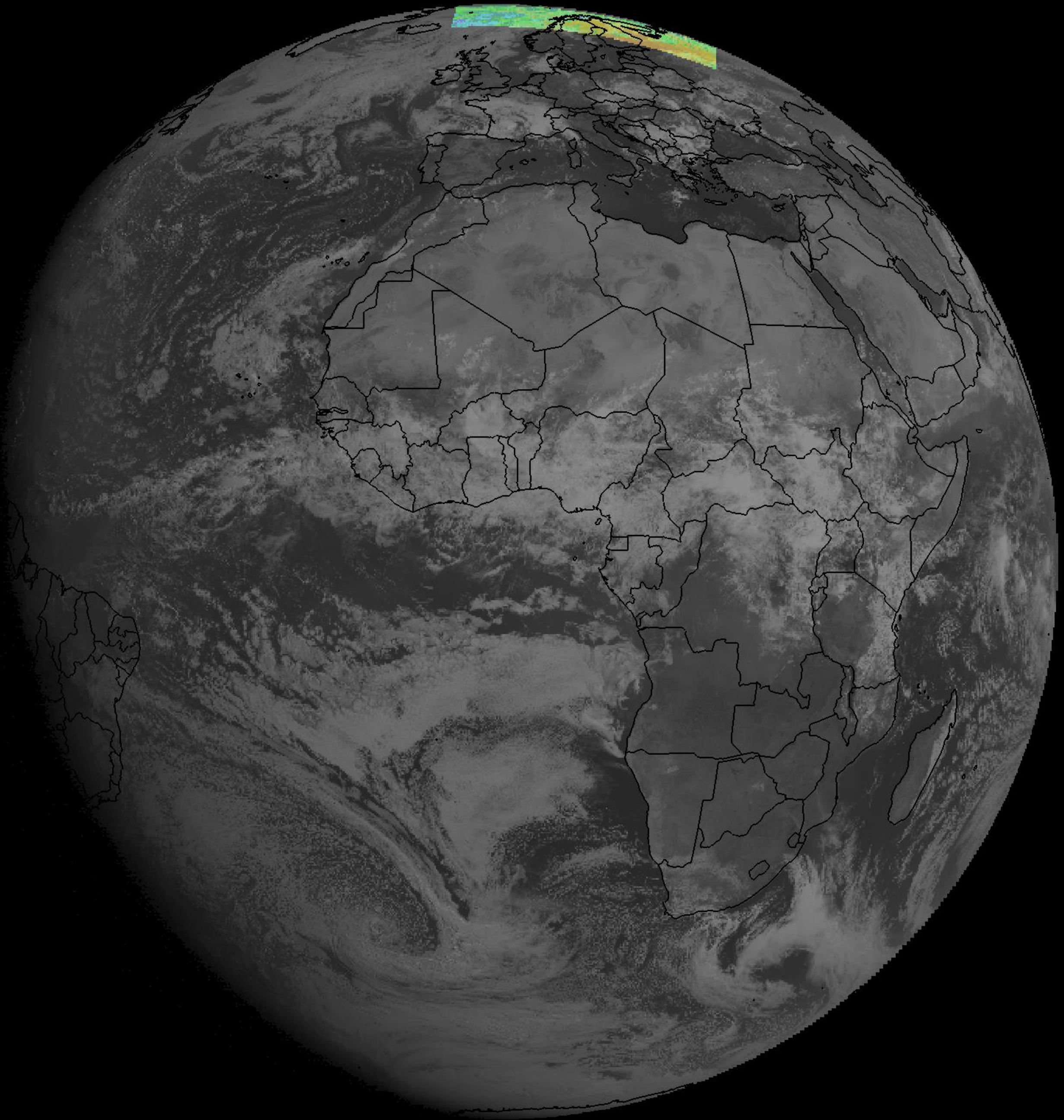
- Download link on ftp: https://bin.ssec.wisc.edu/pub/sift/dist/experimental/
  New builds are uploaded regularly with bugfixes and satpy updates

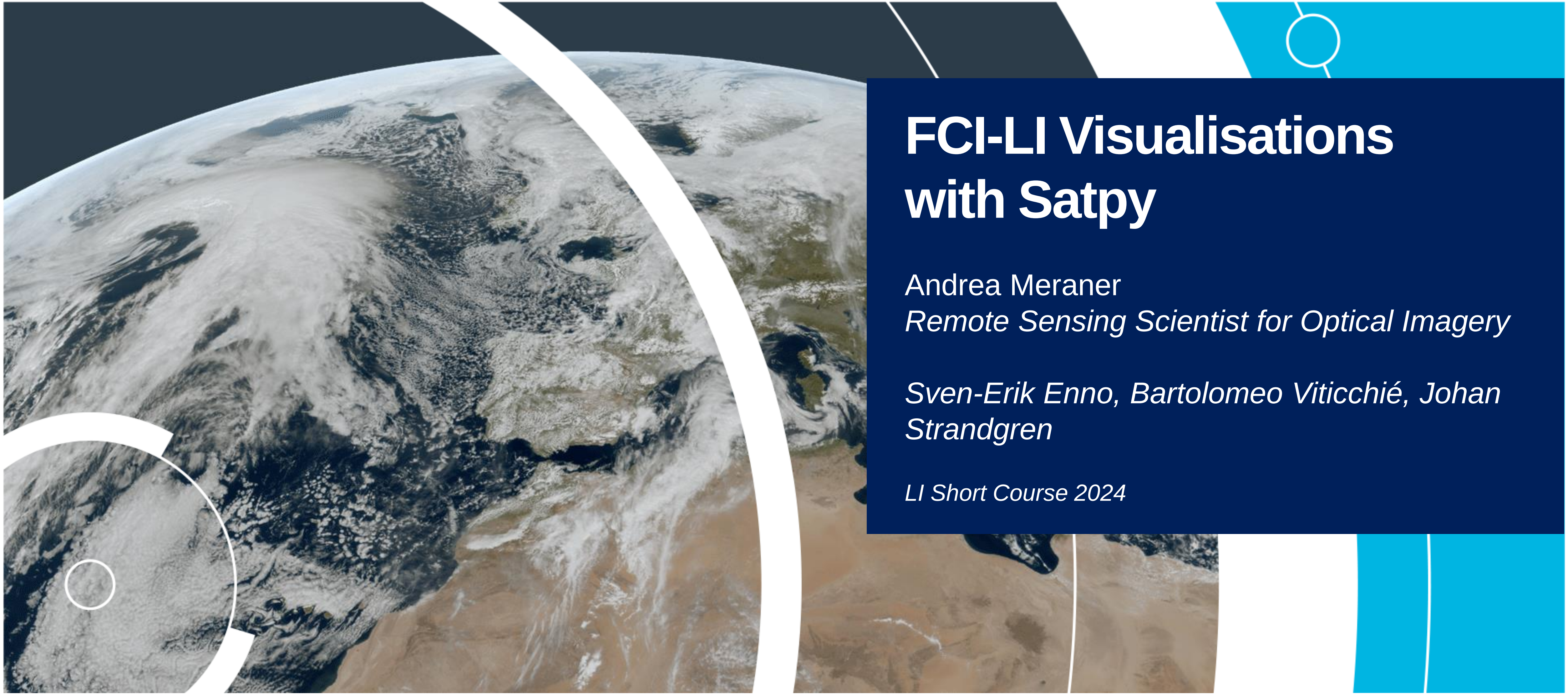
- Updated (configuration) documentation is on ReadTheDocs: https://sift.readthedocs.io/en/latest/
- Wiki, User Manual, and website will be gradually updated

- SIFT short course webpage: https://classroom.eumetsat.int/course/view.php?id=478
  (or just search for "sift eumetsat short course")
  - Contains recording of **extensive demo**, including LEO and L2
  - Contains links to test and demo data

- **SIFT Github page for more links and instructions:** https://github.com/ssec/sift

Thank you for your attention!





FCI-LI Visualisations with Satpy

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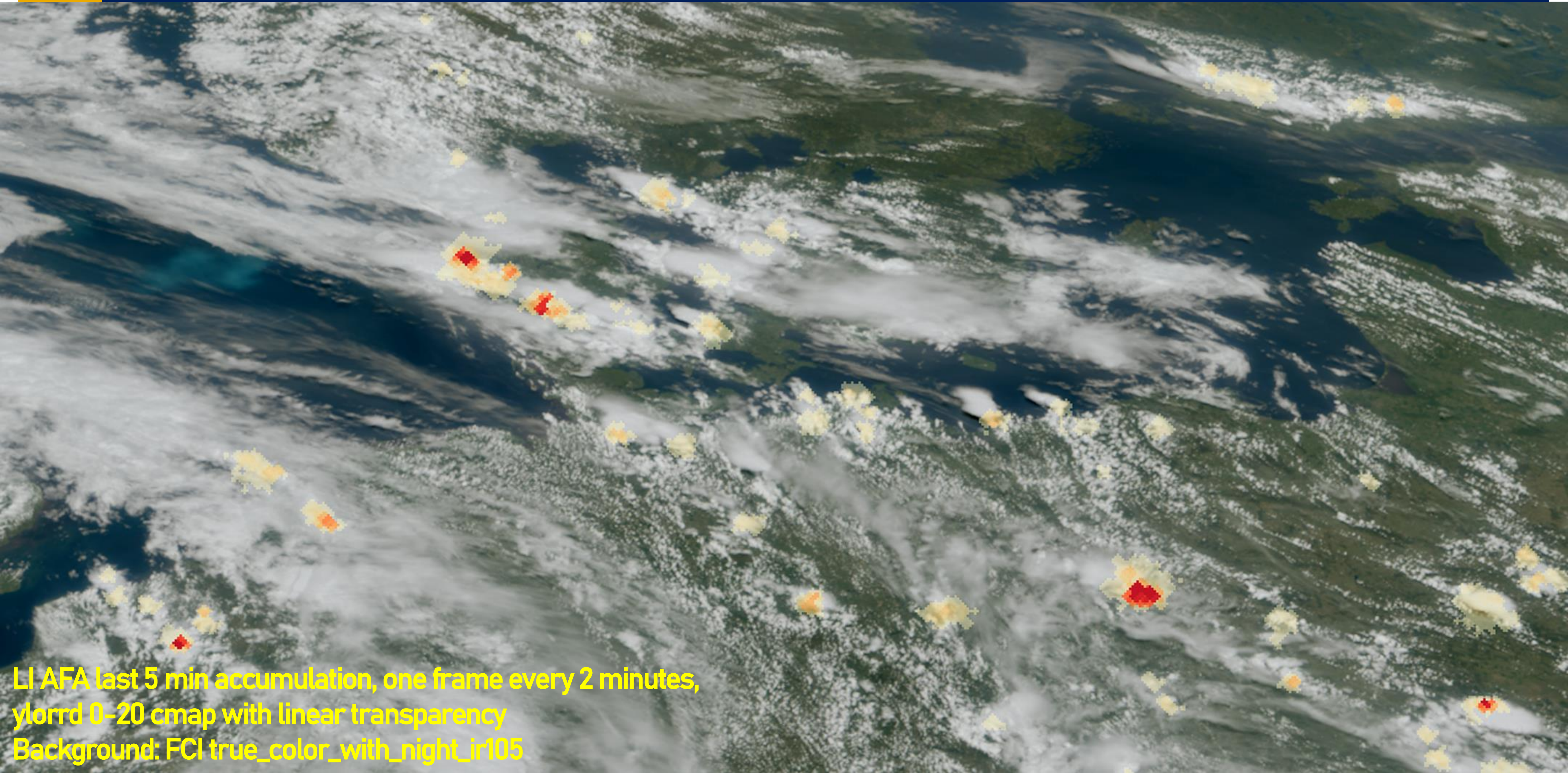
Example: Merging LI with FCI



LI AFA last 5 min accumulation, one frame every 2 minutes, ylorrd 0-20 cmap with linear transparency
Background: FCI true_color_with_night_ir105

First Experiments with 2-d Accumulated Products

```
# FCI
composites:
  true_color_with_night_ir105_acc_flash_area:
    compositor:
!!python/name:satpy.composites.BackgroundCompositor
    standard_name: imager_with_lightning
    prerequisites:
      - acc_flash_area_alpha
      - true_color_with_night_ir105

enhancements:
  imager_with_lightning:
    standard_name: imager_with_lightning
    operations: []
```

```
# LI
composites:
   acc_flash_area_alpha:
    compositor:
!!python/name:satpy.composites.SingleBandCompositor
    standard_name: acc_flash_area_alpha
    prerequisites:
    - accumulated_flash_area

enhancements:
  acc_flash_area_alpha:
    standard_name: acc_flash_area_alpha
    operations:
    - name: colorize
      method: !!python/name:satpy.enhancements.colorize
      kwargs:
        palettes:
        - {colors: ylorrd, min_value: 0, max_value: 20,
           alpha_value_min: 100, alpha_value_max: 255}
```

First Experiments with 2-d Accumulated Products, x LI files

```
def nan_sum(datasets):
    attrs = combine_metadata(*[data_arr.attrs for data_arr in datasets])
    concat_ds = xr.concat(datasets, dim="sum_dim")
    sum_ds = concat_ds.sum(dim="sum_dim", skipna=True, min_count=1, keep_attrs=True)
    sum_ds.attrs = attrs
    return sum_ds


def plot_li_acc_with_background(li_filenames, fci_filenames, output_folder, dataset_names):

    li_ms = MultiScene.from_files(li_filenames, reader='li_l2_nc')
    li_ms.load(['flash_area'], upper_right_corner='NE')
    li_scn_b = li_ms.blend(nan_sum)


    fci_scene = Scene(filenames=fci_filenames, reader='fci_l1c_nc')
    fci_scene['flash_area'] = li_scn_b['flash_area']

    fci_scene.load(dataset_names, upper_right_corner='NE')
    ms_r = fci_scene.resample('mtg_fci_fdss_1km', resampler='native')
    ms_lcl = ms_r.crop(ll_bbox=[1.5, 49, 20.26, 62])
    ms_lcl.save_datasets(datasets=dataset_names,
                         filename=output_folder +
                                  f'/FCI-LI_{{name}}_'
                                  f'{fci_scene["flash_area"].attrs["start_time"].strftime("%Y%m%d-%H%M%S")}_'
                                  f'{fci_scene["flash_area"].attrs["end_time"].strftime("%Y%m%d-%H%M%S")}.png’,
                      )

# Plus some code implementing the rolling window logic
# using find_files_and_readers with start and end_time

# accumulating last 5 minutes every 2 minutes, showing last available FCI Scene
```

More Information:

- Full code to reproduce and first version of composites:
  https://github.com/pytroll/satpy/pull/2853

- Satpy Documentation and Code:
  https://github.com/pytroll/satpy
  https://satpy.readthedocs.io/en/latest/

- More Info on Pytroll Project (contributions are always welcome!)
  https://pytroll.github.io/

Thank you!

Questions are welcome.

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