Copernicus FICE 2025

Training on
In situ Ocean Colour Above-Water Radiometry towards Satellite Validation

HyperCP Hands-On

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PROGRAMME OF THE EUROPEAN UNION
Copernicus Europe's eyes on Earth
IMPLEMENTED BY EUMETSAT
FRM4SOC Phase-2
fiducial reference measurements for satellite ocean colour
CNR ISMAR
ISTITUTO DI SCIENZE MARINE

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Venice, Italy

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Updates

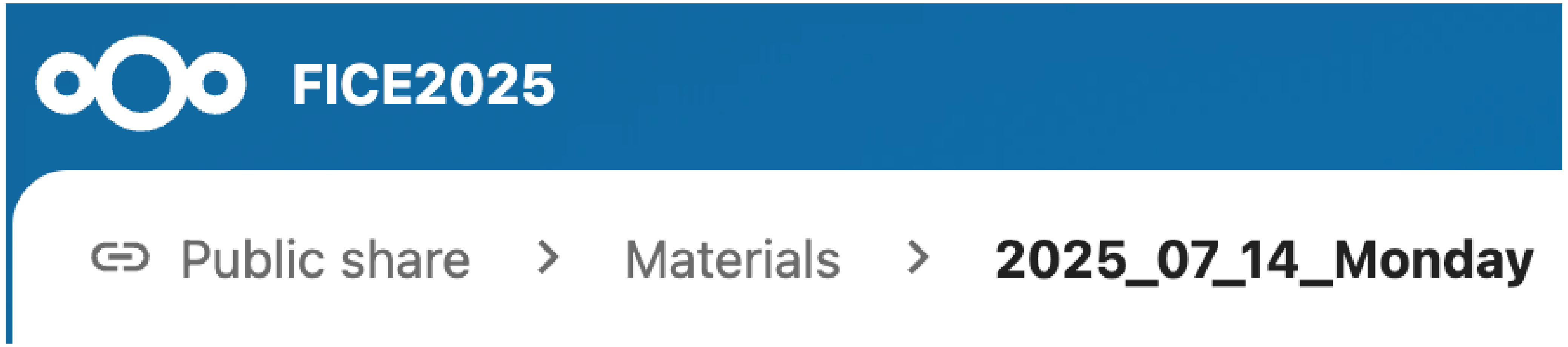
Some minor updates were uploaded to HyperCP master branch last night.

<u>Update your local HyperCP repositories:</u>

- Navigate to your local repository
- git pull (or git pull origin master if the upstream is not yet set)
- If working with the executable instead of git, navigate to the latest Release on GitHub and download the new .zip file for your OS

(Artwork by Edward Gorey)

THESE SLIDES:



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Overview

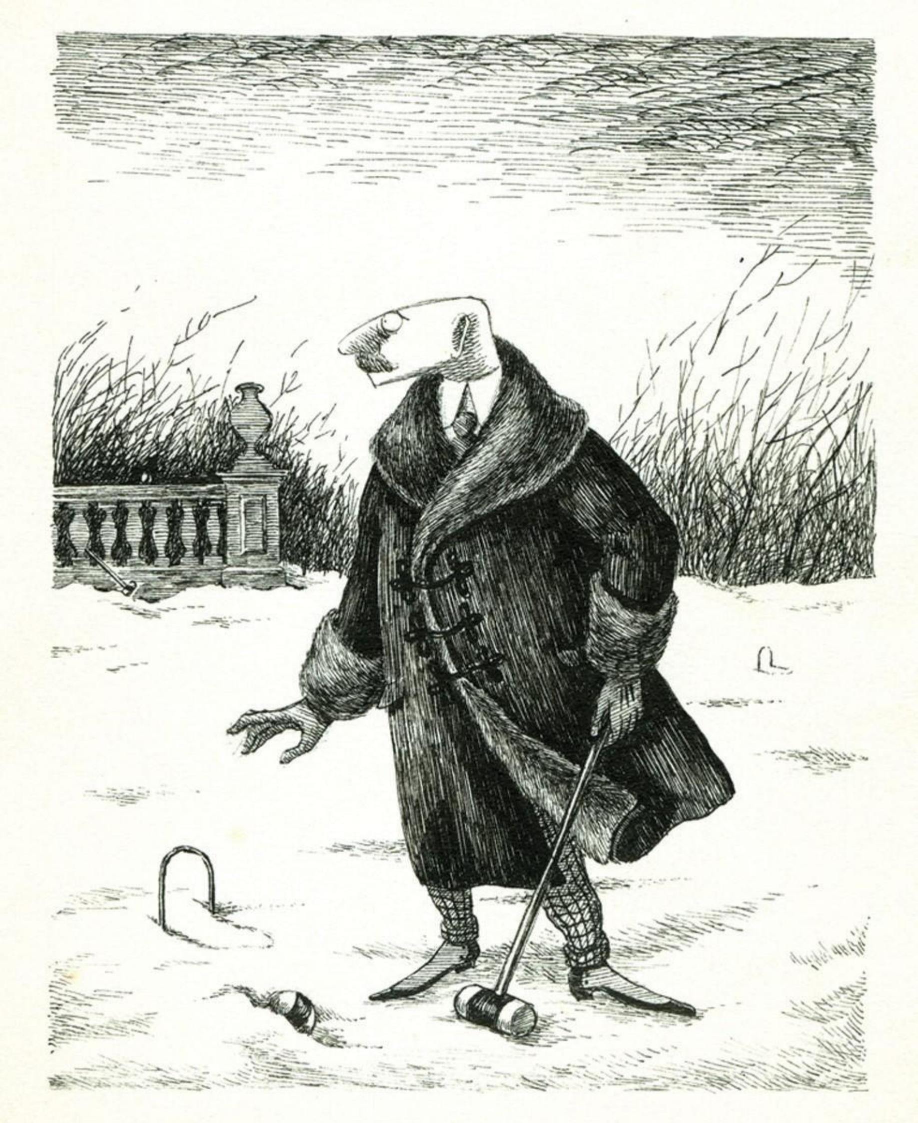
(Preamble for pySAS and DALEC robots)

- prepSAS.py, prepDALEC.py

Work independently or in groups on exercises 1 – 7

<u>Goals</u>

1. Use existing sample configurations for processing a file from L0-> L2.
2. Familiarize with the output data sets, figures, and reports.
3. Set up a new configuration
4. Explore different processing pathways (Factory, FRM-Class, FRM-Full)
5. Explore different glint corrections (M99, Z17) and NIR corrections (None, Flat, SimSpec).
6. (Bonus) Practice using the low-level filters in the L1AQC Anomaly Analysis tool
7. Process our data from San Servolo!



Preparing the data from certain platforms…

pySAS, DALEC, So-Rad…

Prep’ing Raw Data

Certain platforms require the raw instrument data to be reformatted or chopped down to size prior to processing in HyperCP.

We try to avoid this (and won’t need them in the future), but they can be unavoidable for legacy datasets like older pySAS or DALEC collections.

pySAS Output

- Designed for autonomous operation over extended periods of time

- Data are automatically saved in hourly files

- pySAS Output:
  - pySAS_cfg_<date>_<time>.ini
    - Data: Instrument configuration (baud rates, timeouts, pin-outs, preferred RelAz, GPS–ship orientation, etc.)
  - HyperSAS_<date>_<time>.bin:
    - Data: Lt, Li, Es, Tilt from Sea-Bird Scientific HyperOCR and THS sensors
    - Format: Satlantic Log File Standard (ASCII + binary)
  - GPS_<date>_<time>.csv
    - Data: Latitude, Longitude, Elevation, Ship Heading, Accuracy
    - Format: csv
  - IndexingTable_<date>_<time>.csv
    - Data: Radiometer Orientation with respect to the ship
    - Format: csv

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pySAS Reformat Raw

- Part of the pySAS repository*, or download at
  wget https://github.com/OceanOptics/pySAS/tree/master/prepSAS
- Install within “hypercp” conda environment by activating hypercp environment, navigating to the prepSAS repository, and typing:
  pip install -r requirements.txt
- Execute:

```
# Setup parameters in prepSAS/run.py
python run.py
# Set arguments directly in shell
```

```
# Run a single file
python prepSAS.py -s 'HyperSAS_20201120_175620.bin' -g 'GPS_20201120_175616.csv' -t …
        'IndexingTable_20201120_175616.csv' --cal 'HyperSAS_Es_20200212.sip' --cfg 'pysas_cfg_002.ini' 'UMSAS002_20201120_175620.raw

# …or run all files within a directory
python prepSAS.py -d 'test_data/' --cal 'HyperSAS_Es_20200212.sip' --cfg 'pysas_cfg_002.ini' 'test_data'

# Help
python prepSAS.py -h

# Version
python prepSAS.py -v
```

Sea-Bird Factory calibration bundle

*University of Maine Ocean Optics GitHub: https://github.com/OceanOptics/pySAS/tree/master

DALEC Make Hourly Files

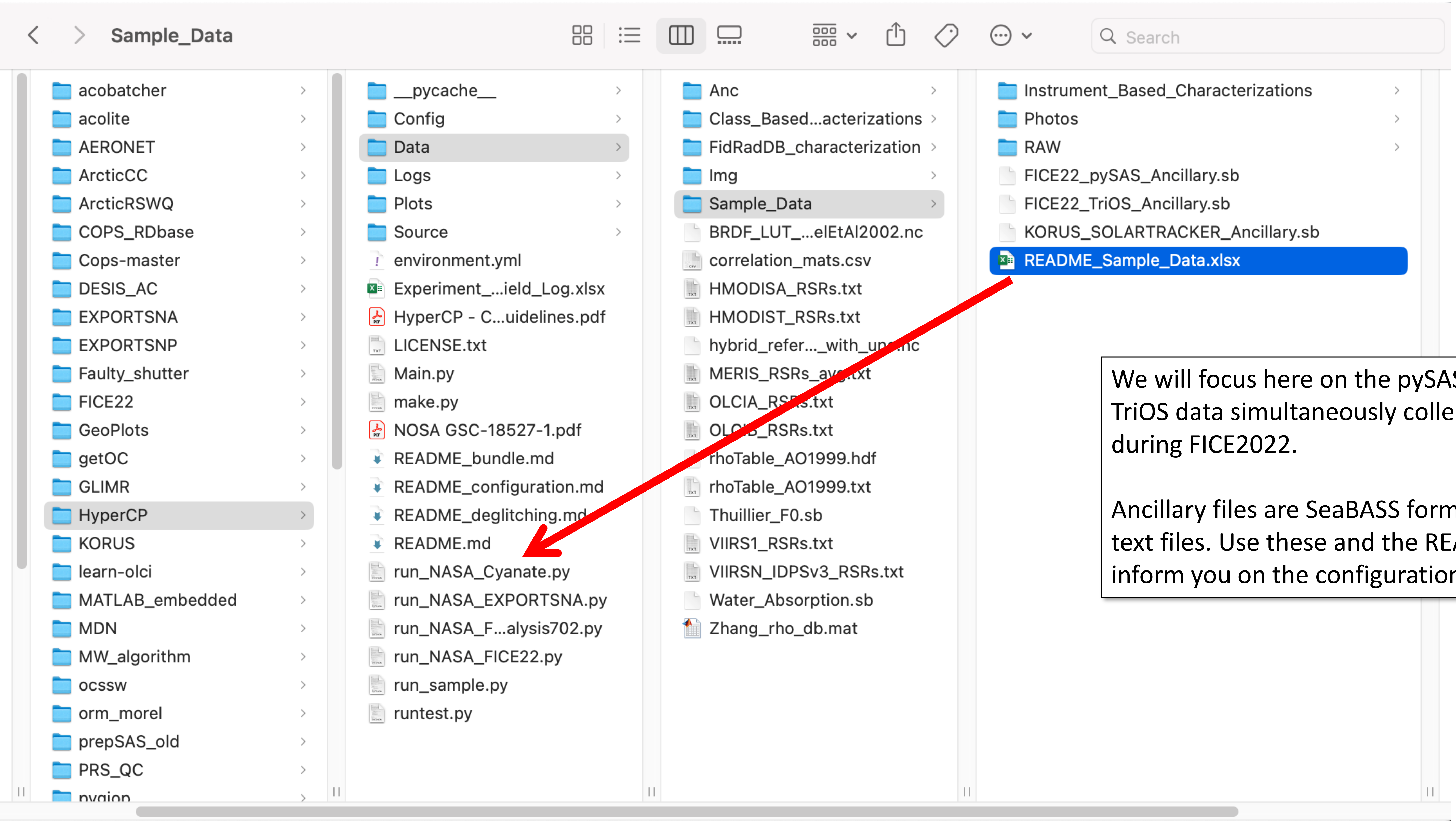
- In case your DALEC was collecting long files (e.g., all day), this will separate your files into hour-long raw files easier to process in HyperCP.

- Included in HyperCP/Source/prepDALEC.py (aka. raw_Data_Hourly_cutter.py)
  - python prepDALEC.py -f path/to/file.TXT -o dir/to/place/files

Sample Data

Provided in the repository

Sample Data



We will focus here on the pySAS and TriOS data simultaneously collected during FICE2022.

Ancillary files are SeaBASS formatted text files. Use these and the README to inform you on the configuration of each.

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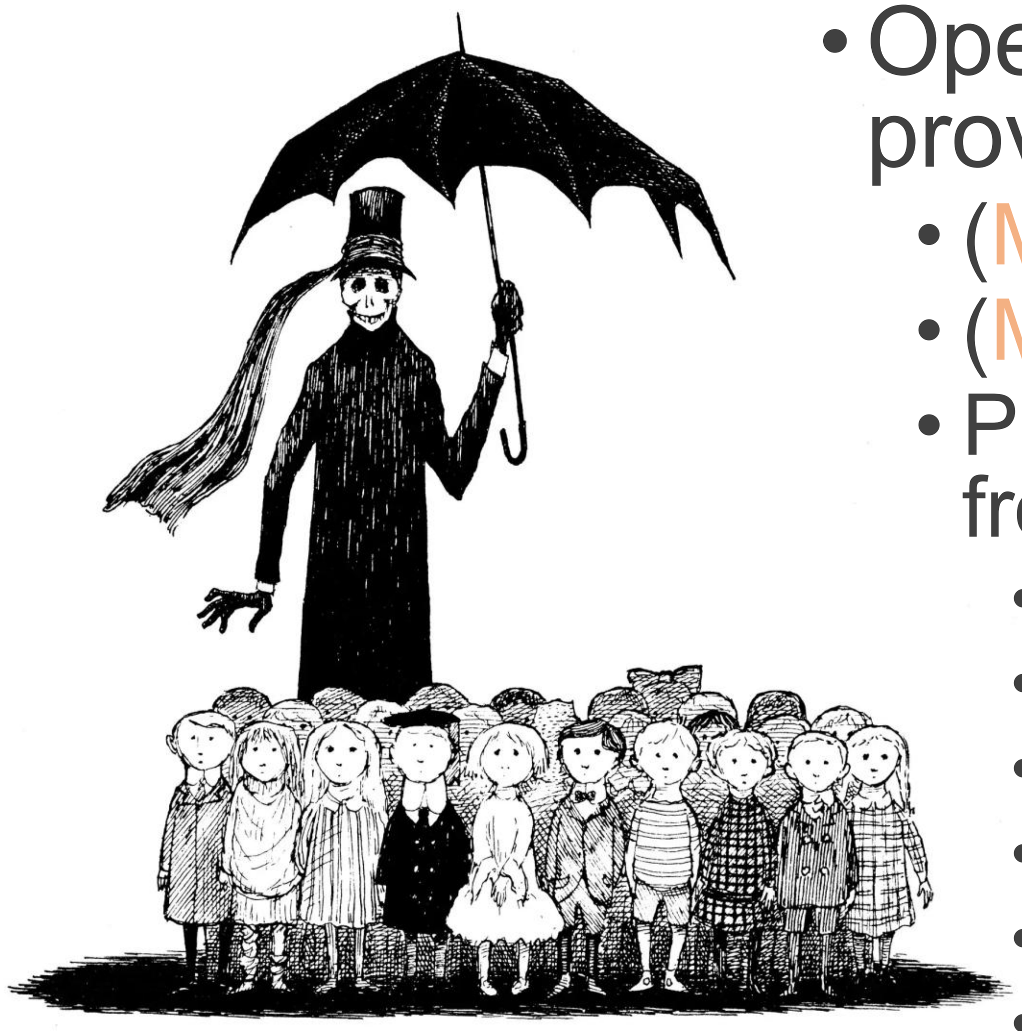
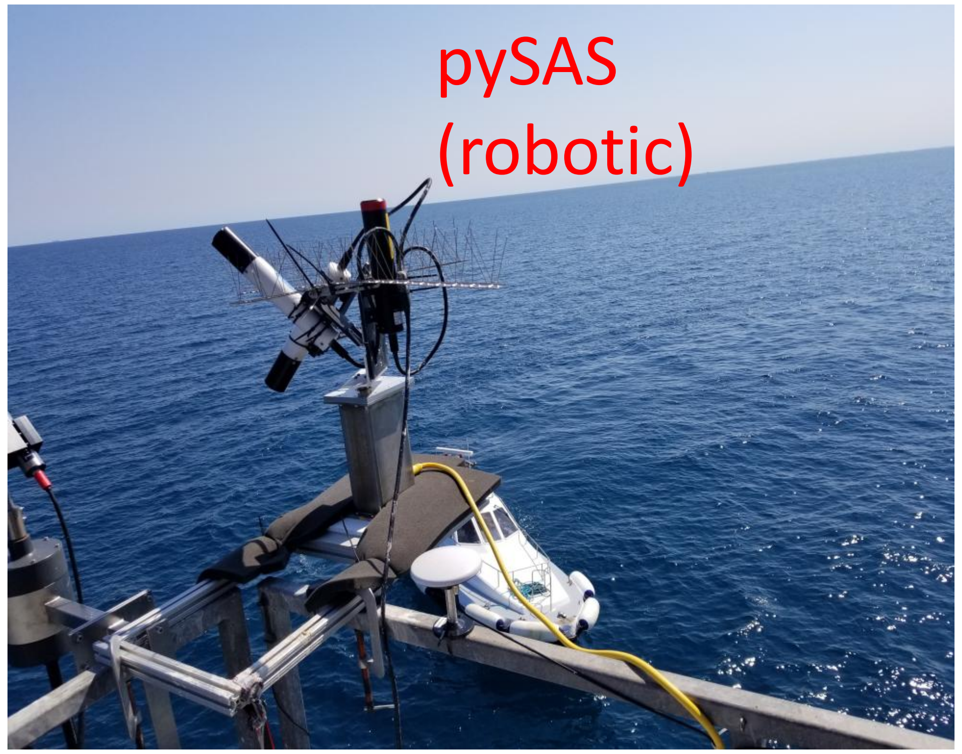
First Wicket



(Artwork by Edward Gorey)

- Open existing configurations for sample data provided (TriOS & pySAS)
  - (Main) Establish Input/Output paths for the data
  - (Main) Provide the appropriate Ancillary data file
  - Process the two manually acquired TriOS files from L0 to L2
    - (Configuration):
    - L1B Non-FRM (Factory cals only)
    - No caps-on darks
    - L2 No station extraction
    - L2 M99 glint correction
    - L2 SimSpec NIR offset
    - L2 No BRDF or convolution
    - L2 No Derived Products
  - Process the autonomous pySAS data using the same settings (*don't forget to switch Ancillary files*)

FICE2022



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Second Wicket

- Locate the processing Reports for the pySAS and TriOS files
  - What percentage of L_t data were removed from each file for the L1BQC spectral filter?
  - In L2, how many spectra remained in each ensemble after the “glitter” correction was performed (retaining only the darkest 10% of L_t measurements)?
- Locate the L2 Plots
  - How do R_{rs} and E_s compare between the TriOS and the SeaBird instruments?
  - What is missing from TriOS plots? Why?

- Repeat pySAS L1BQC to L2 using station extraction.
  - Based on plots and what you know, which pySAS stations correspond to each TriOS file?

Third Wicket

- Compose a new configuration for the autonomous pySAS and the manually operated TriOS triplet sample datasets
  - Import configuration and telemetry files. Use the .cal/.tdf (or .sip) files for SeaBird and the .dat/.ini files for TriOS from the appropriate Config/sample_XXX_Calibration folders. (These files will be copied into your new Config/your_Calibration folders.)
    - TriOS Triplet: 8166=Li, 8329=Es, 8595=Lt
    - TriOS config files to Add: All .dat and .ini files
  - Follow README_configuration description (e.g. on GitHub) to set each parameter in the Configuration Window sensibly

- Process both datasets L0->L2
  - L1B Non-FRM Regime
  - L2 Include chlor_a, QWIP (requires AVW), and satellite convolution
  - L2 Use glint, NIR, and BRDF appropriate for optically complex waters
  - L2 Obtain Derived Products for QAA a_{dg} and b_{bp}
  - What was $a_{dg}(400)$ at Station 32?

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Fourth Wicket

- Reprocess TriOS sample data (either modify the sample configuration provided or use the one you developed) to apply the FRM Class-based regime
  - *Files will need to be reprocessed from L1AQC to incorporate updated characterization regime in L1B.*
  - L1B Add RADCAL (absolute radiometric calibration with uncertainty) files from FidRadDB
  - Turn off interpolation (L1B) and spectral filter (L1BQC) plotting to speed up processing
  - L2 Include plots of the uncertainty breakdown
  - How did your L2 results (E_s, L_i, L_t, L_w, R_{rs}) change compared to running in Default/Factory mode? What proportion of the irradiance uncertainty is driven by the cosine response?

CHAPTER ONE

Embley and Yewbert were hitting one another with croquet mallets

- Now change to FRM Sensor-Specific
  - How did the component spectra (E_s, L_i, L_t, L_w, R_{rs}) change compared to Non-FRM and Class-based pathways?

Fifth Wicket

- Reprocess pySAS sample data in Class-based regime with both M99 and Z17 glint corrections
  - *When changing only the L2 settings, you can re-process L1BQC -> L2 for speed*
  - How does the resulting R_{rs} compare between glint corrections?

- Reprocess pySAS sample data in Class-based mode in Z17 with no NIR correction and compare against processing with NIR correction (SimSpec)
  - How does the resulting R_{rs} compare between NIR offsets?

(Happenstance Theater)

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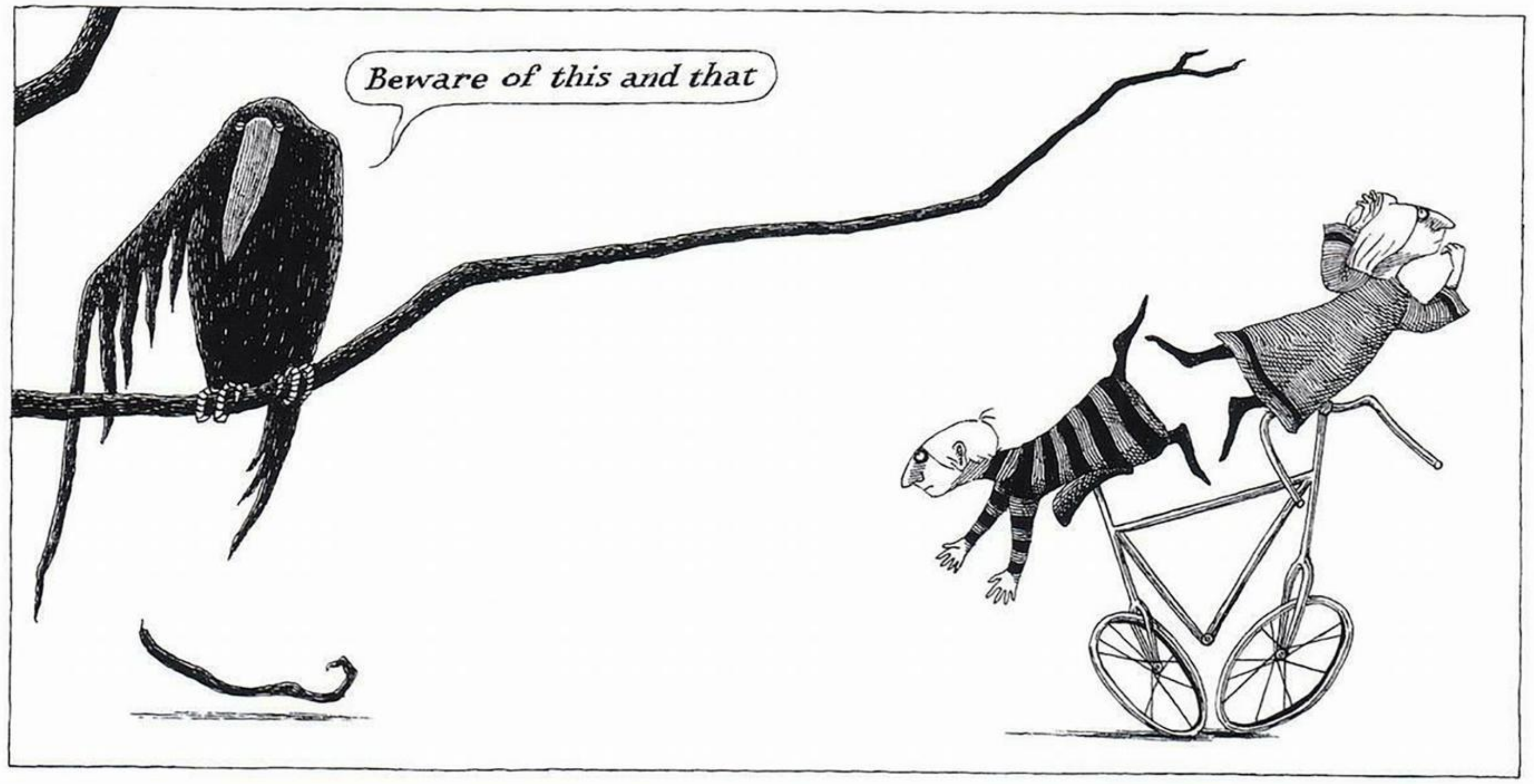
Sixth Wicket (Bonus)

- Launch the L1AQC Anomaly Analysis tool for the autonomous pySAS dataset
  - How long is the time series?
  - Photos taken during this period are provided but named with UTC+3 hours timestamps. Adjust the format string properly to view the photos. (Do photo names start with “IMG”?)
  - What is the median Solar Zenith Angle for this file?
  - Move the waveband slider to 480 nm and update the figures. With the default sigma and window settings for the *irradiance* sensor, what percentage of the shutter-open spectra in all bands are retained after low-pass filtering? Why are there so few points shown as filtered when the percentage is shown to be so high?

- Change to the skylight radiance and eliminate the noisy shutter-dark measurements using the threshold tool.
- Change to the total water-leaving radiance and adjust the window and sigma to retain 87.5% of light values.
- Leave a sensible comment, save params, and inspect the resulting CSV file.



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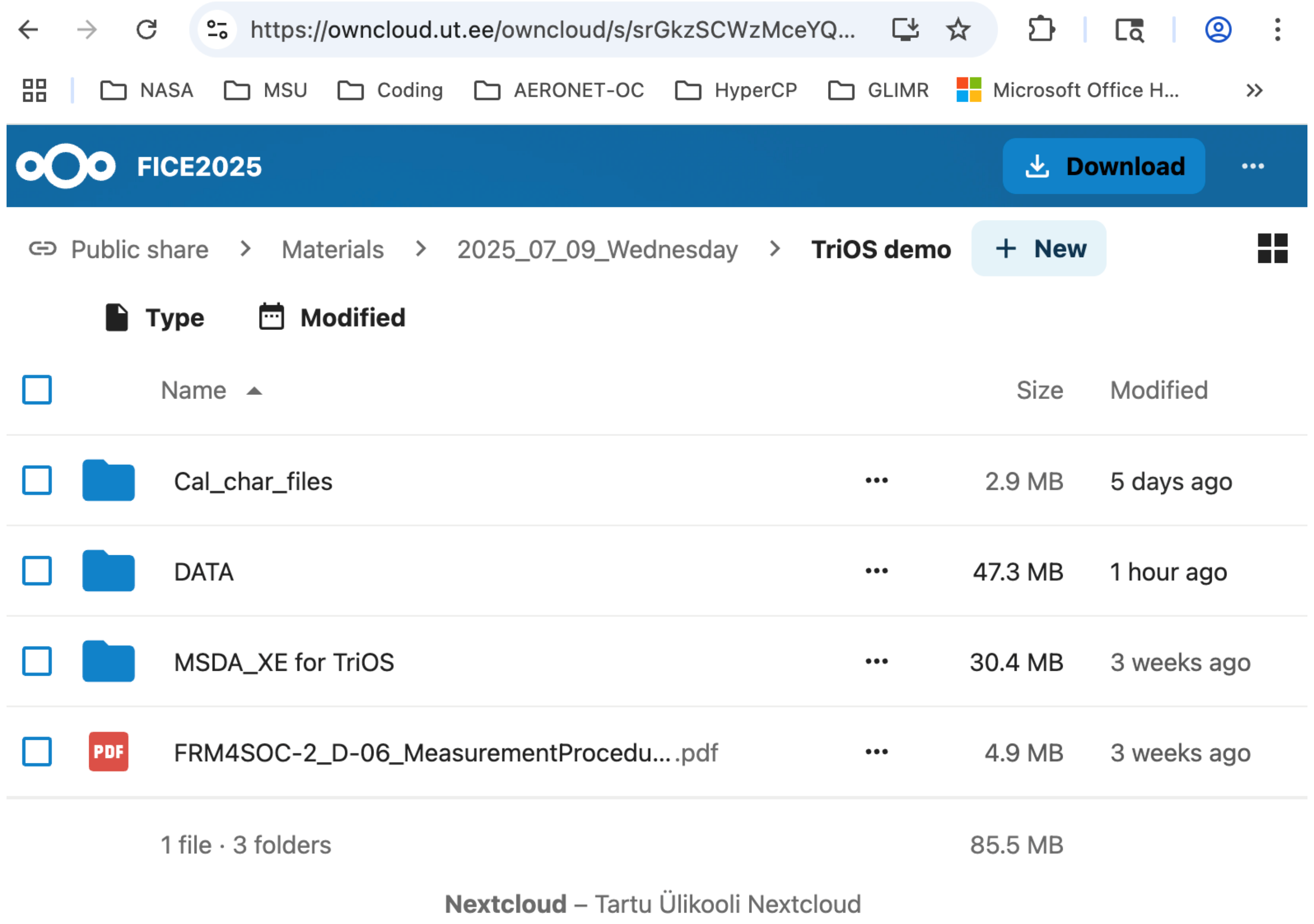
Seventh Wicket

- San Servolo demonstration data
  - Build a new Configuration in HyperCP for processing the 6 stations collected at the dock last Wednesday
  - Process these using the caps-on darks approach for Stns 1&2 (when darks were collected), and using air temp for Stns 3-6
  - Set L1B to use FRM Class-based regime, and turn on uncertainty breakdown plots in L2
  - What proportion of the Rrs(440) uncertainty at Stn 0301 is driven by the angular response of irradiance?



so Embley had to sit on the handlebars as they flew out the gate.