ONEFlux Processing Pipeline:
Network-collaborative software development

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Outline

- **Background:** Evolution of FLUXNET datasets
- **Context:** Eddy covariance data processing
- **What's included:** Overview of ONEFlux
- **(brief) How-To:** Running ONEFlux
- **Future:** Next steps for network datasets

FLUXNET Datasets

- Marconi 2000: 38 sites / 97 site-years
  - Data contributed by attendees of workshop
  - Access limited to attendees

- LaThuile 2007: 252 sites / 965 site-years
  - Data contributed by many site PIs
  - Start of uniform code base and processing for comparable data products
  - Data access/usage opened to other users, with some restrictions (three tiers)
  - Over 500 users (as of Sep 7, 2018)

- FLUXNET2015: 212 sites / 1532 site-years
  - Standardized code base (developed in collaboration among networks)
  - Extensive QA/QC of data (data more comparable and usable, but fewer sites)
  - Data access to anyone, usage has fewer restrictions (two tiers) – tools to keep track of usage
  - Over 1600 users (as of Sep 7, 2018)

Eddy Covariance Data Processing

- High-frequency data
  - EddyPro (LI-COR),
  - EdiRE (U. Edinburgh),
  - Alteddy (ALTERRA),
  - eddy4R (NEON)
  - Custom codes
- Data products from fluxes
  - USTAR filtering, met/flux gap-filling, flux partitioning, uncertainty estimates, etc.
  - REddyProc (MPI),
  - ONEFlux (AMP-EUDB)
  - Custom codes

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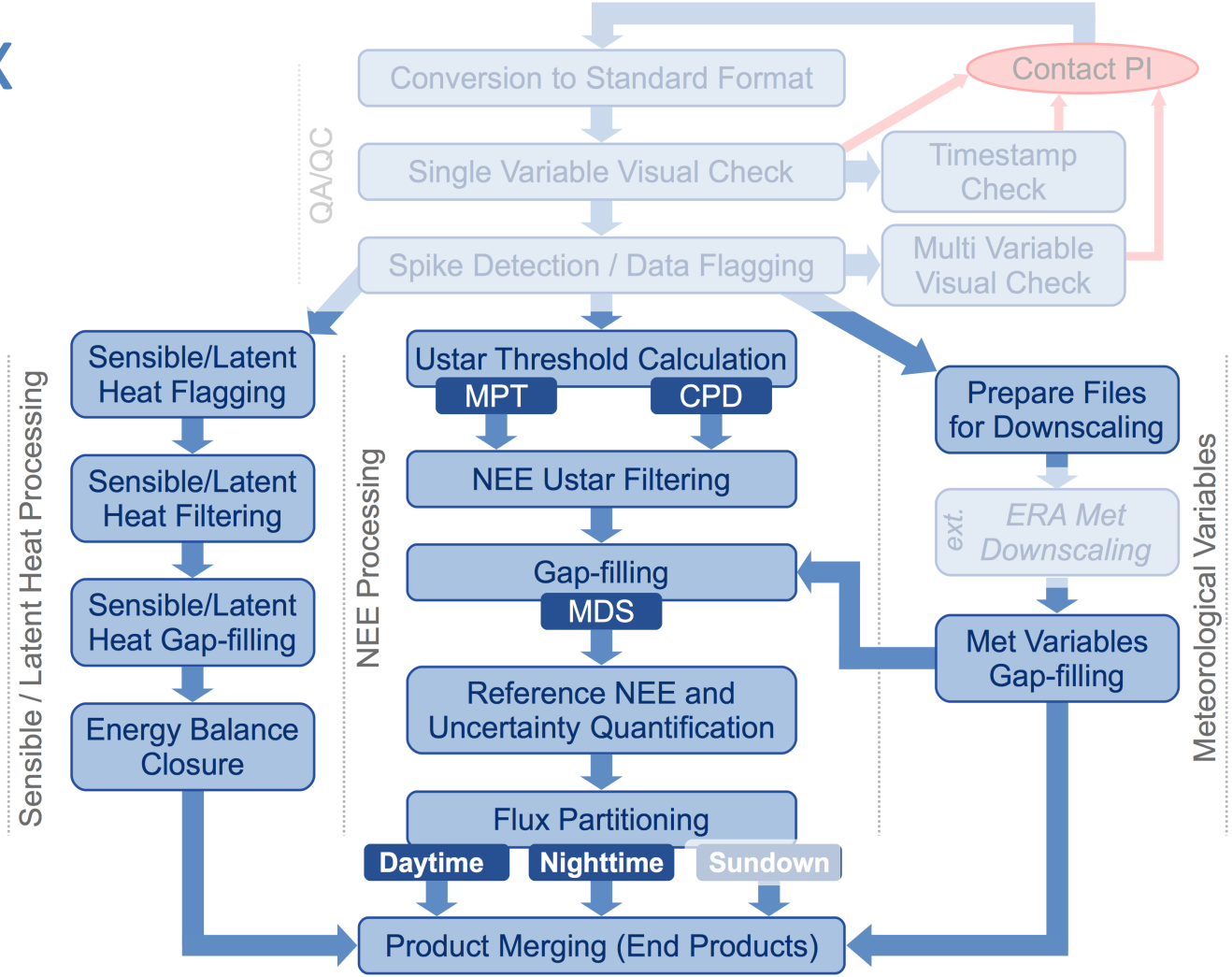
Why yet another software for eddy covariance processing?

- Not (yet) a software (for users), more of a collection of packages
  - current priority vs long-term plan
- Extensive validation on many site characteristics
- Focus on creating network-level data products (standardized for synthesis studies and cross-site comparisons)

ONEFlux Pipeline



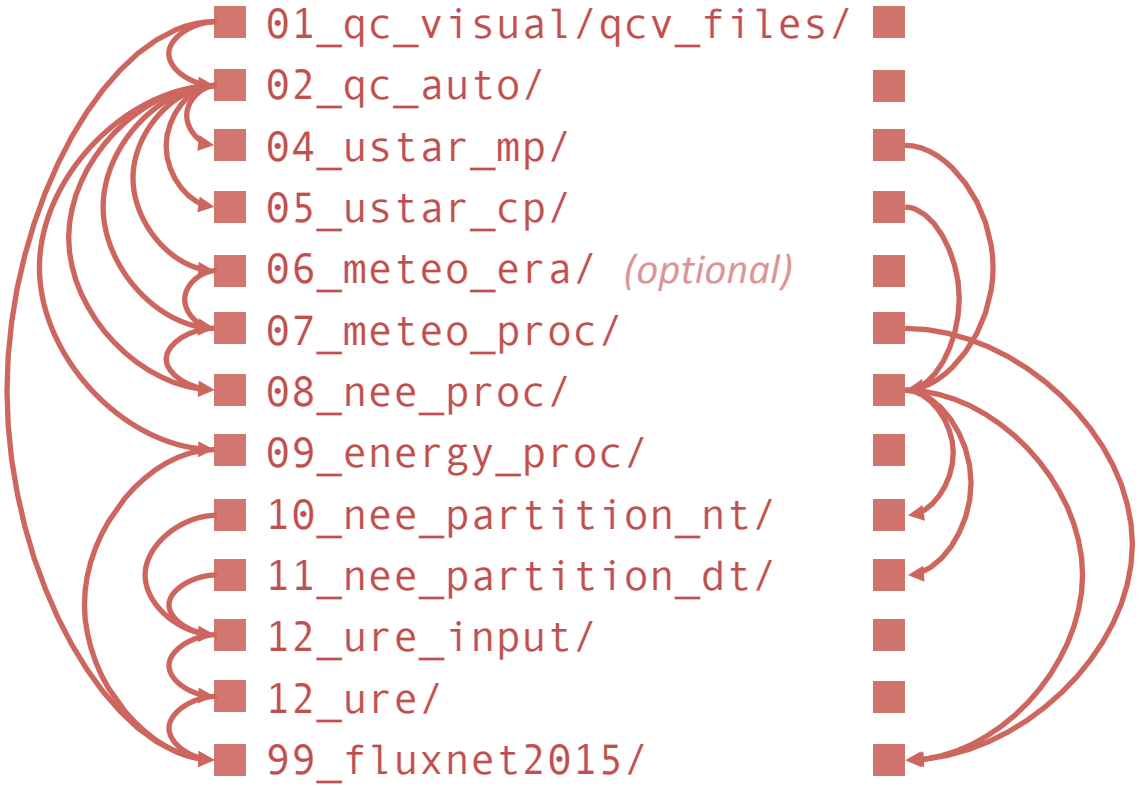
Processing Steps

```
SITEDIR
├ 01_qc_visual/qcv_files/
├ 02_qc_auto/
├ *
├ 04_ustar_mp/
├ 05_ustar_cp/
├ 06_meteo_era/    (optional)
├ 07_meteo_proc/
├ 08_nee_proc/
├ 09_energy_proc/
├ 10_nee_partition_nt/
├ 11_nee_partition_dt/
├ 12_ure_input/
├ 12_ure/
├ * * *
└ 99_fluxnet2015/
```

- 01: input (not-quite FP-Standard)
- 02: flagging/filtering
- 04: USTAR threshold method 1 (unc.)
- 05: USTAR threshold method 2 (unc.)
- 06: downscaling for met gapfilling
- 07: met gapfilling (MDS + downscaling)
- 08: NEE filter/storage/unc./ref/gapfilling
- 09: H & LE corr. factors/gapfilling/unc.
- 10: NEE partitioning (nighttime method)
- 11: NEE partitioning (daytime method)
- 12 (i): create input for 12
- 12: unc. from multiple USTAR thresholds
- 99: merge into FP-Standard compliant output

http://fluxnet.fluxdata.org/data/fluxnet2015-dataset/data-processing/

Processing Steps: Dependencies



Running ONEFlux

```
usage: runoneflux.py [-h] [--perc [PERC [PERC ...]]]
                     [--prod [PROD [PROD ...]]] [-l LOGFILE] [--force-py]
                     [--mcr MCR_DIRECTORY] [--ts TIMESTAMP] [--recint {hh,hr}]
                     COMMAND DATA-DIR SITE-ID SITE-DIR FIRST-YEAR LAST-YEAR

positional arguments:
  COMMAND               ONEFlux command to be run [all, partition_nt, partition_dt]
  DATA-DIR              Absolute path to general data directory
  SITE-ID               Site Flux ID in the form CC-XXX
  SITE-DIR              Relative path to site data directory (within data-dir)
  FIRST-YEAR            First year of data to be processed
  LAST-YEAR             Last year of data to be processed

optional arguments:
  -h, --help            show this help message and exit
  --perc [PERC [PERC ...]]
                        List of percentiles to be processed
  --prod [PROD [PROD ...]]
                        List of products to be processed
  -l LOGFILE, --logfile LOGFILE
                        Logging file path
  --force-py            Force execution of PY partitioning (saves original
                        output, generates new)
  --mcr MCR_DIRECTORY   Path to MCR directory
  --recint {hh,hr}      Record interval for site
```

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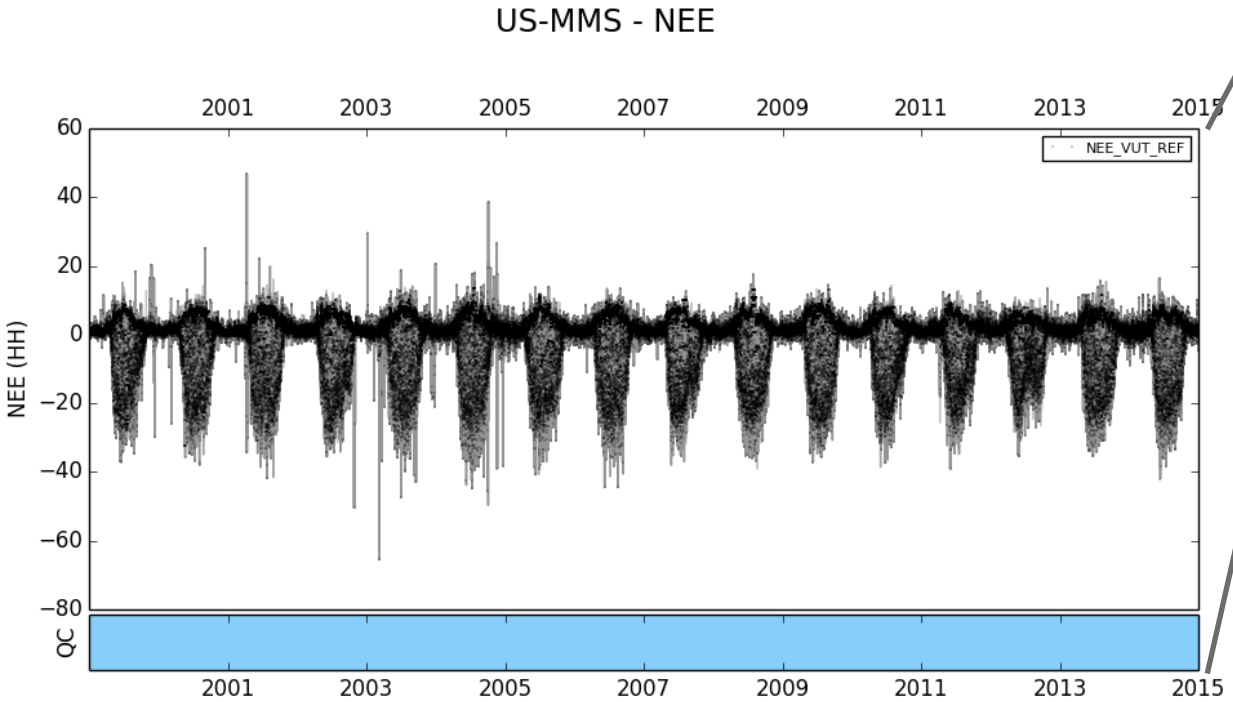
```

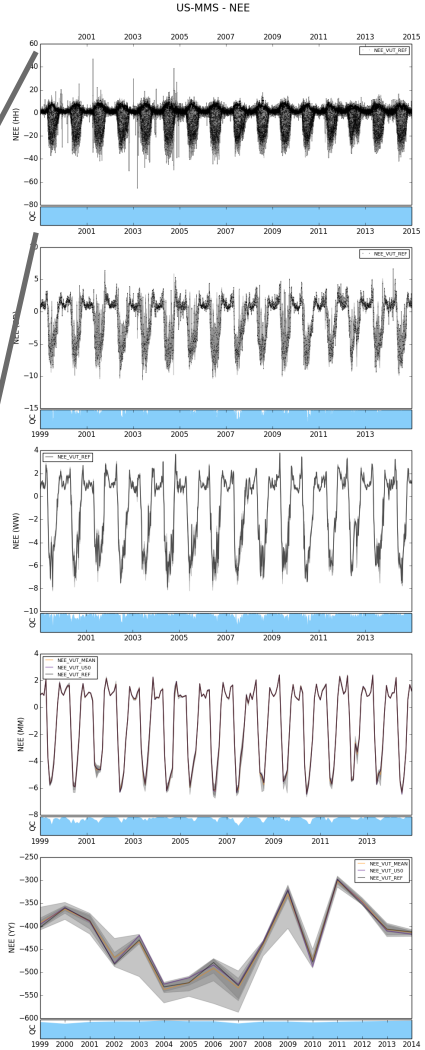
Example:

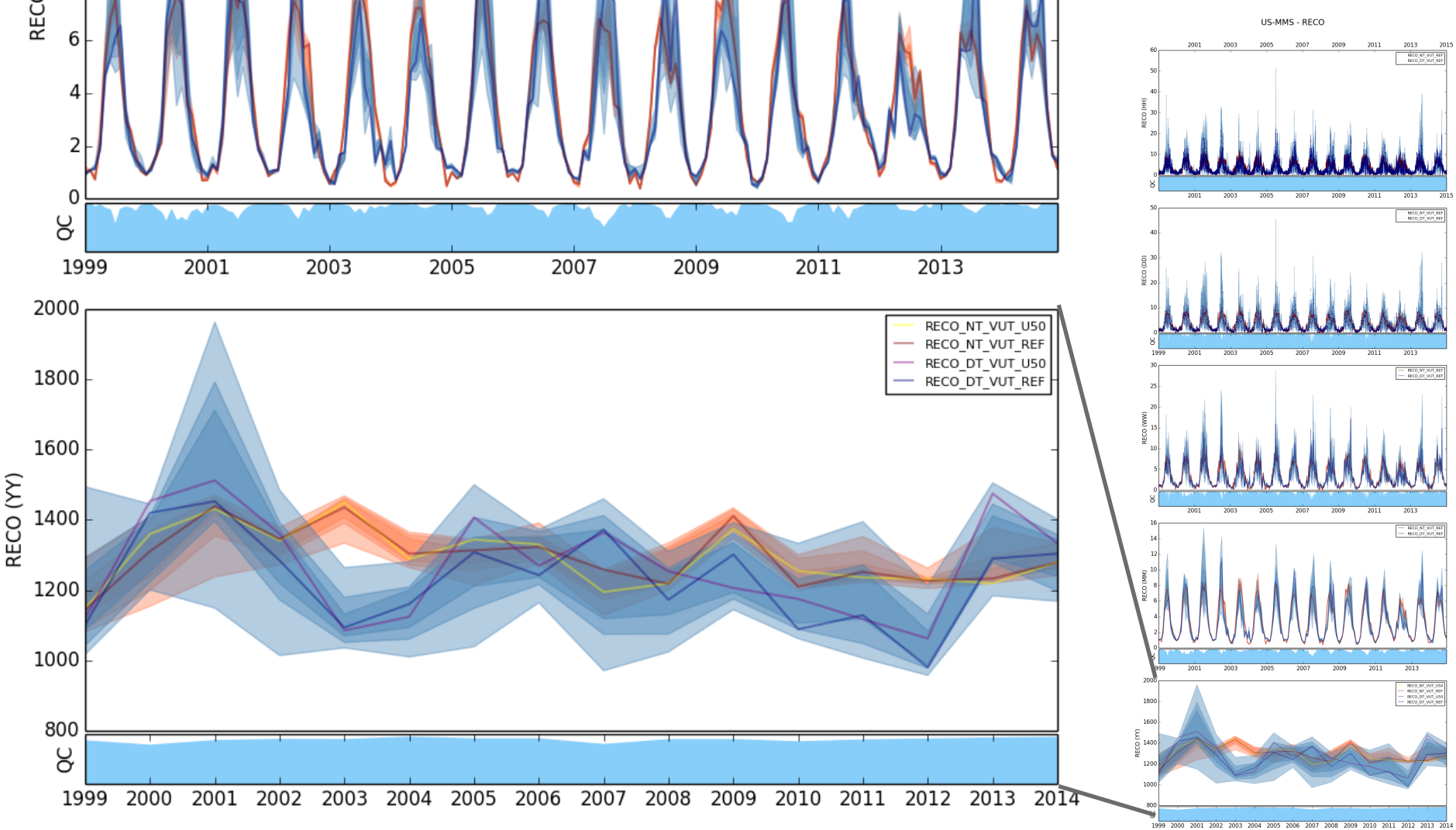
```
$ python runoneflux.py all                          \
    "../datadir/" US-ARc "US-ARc_sample_input"      \
    2005 2006 -l fluxnet_pipeline_US-ARc.log        \
    --mcr ~/bin/matlab/v94/ --recint hh
```

Results


US-MMS - NEE
NEE_VUT_REF
NEE (HH)
QC
2001
2003
2005
2007
2009
2011
2013
2015

NEE_VUT_REF


US-MMS - NEE
NEE (HH)
NEE (DD)
NEE (WW)
NEE (MM)
NEE (YY)
QC


US-MMS - RECO
RECO (YY)
QC
RECO_NT_VUT_U50
RECO_NT_VUT_REF
RECO_DT_VUT_U50
RECO_DT_VUT_REF
RECO (HH)
RECO (DD)
RECO (WW)
RECO (MM)

From individual to collaborative development

- Shared code repository
  - all codes in common structure
  - around 70k lines of code (v0.3.0-beta)
- Shared documentation
  - online documentation creation
- Execution and testing environments
  - replicated across partners
  - from supervised & manual execution (days to weeks to run a site)
  - to automated pipeline (average 4h per site-year)
- Validation and testing protocols
  - around 350k lines of code
  - 280k lines for validation, testing, and comparisons
  - reproducibility of results key; for each code change: matching data products or full trace of differences in data

ONEFlux coding team

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