AmeriFlux Management Project

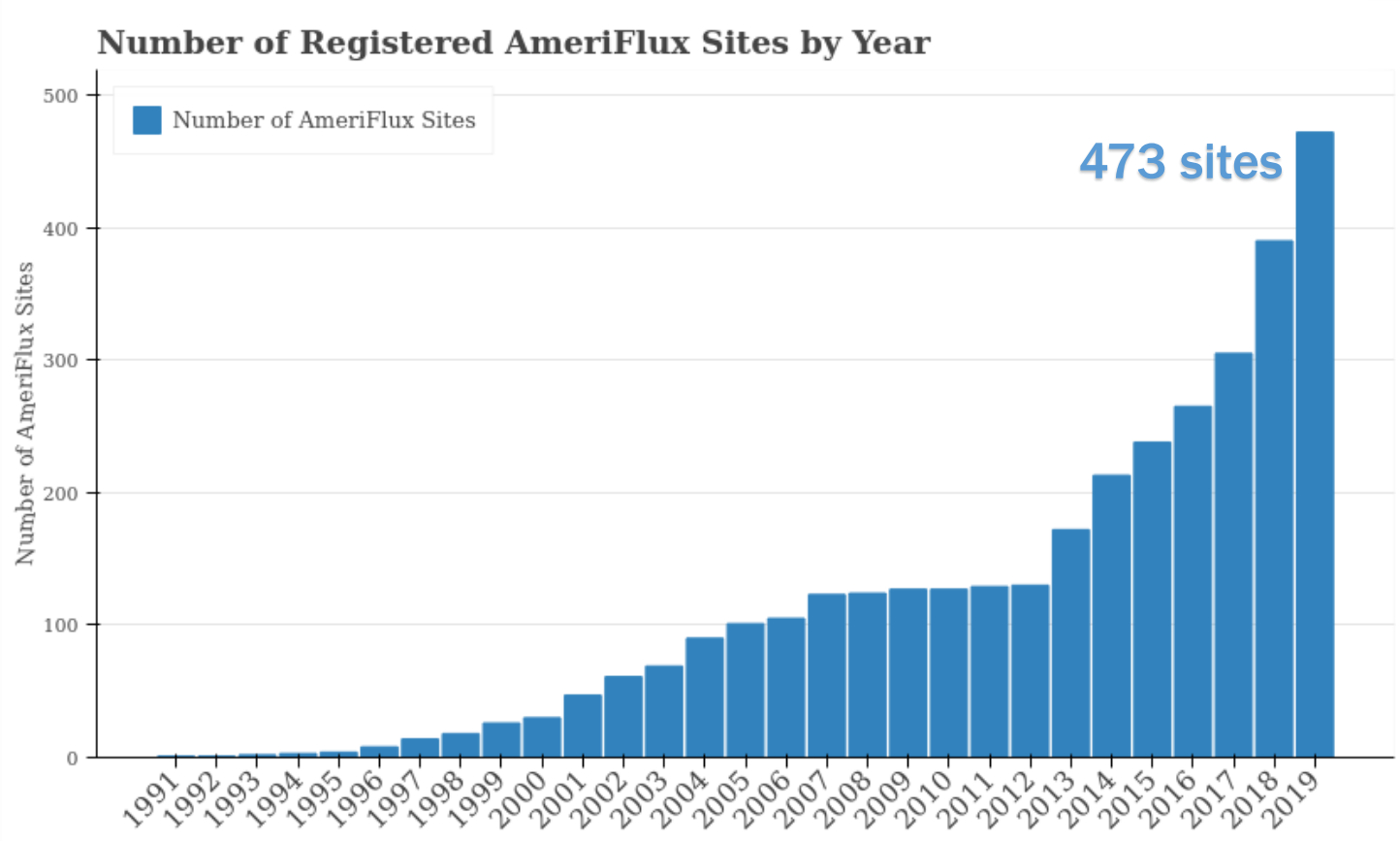
You-Wei Cheah

AmeriFlux Data+Tech Workshop 2019

U.S. Department of Energy | Office of Science

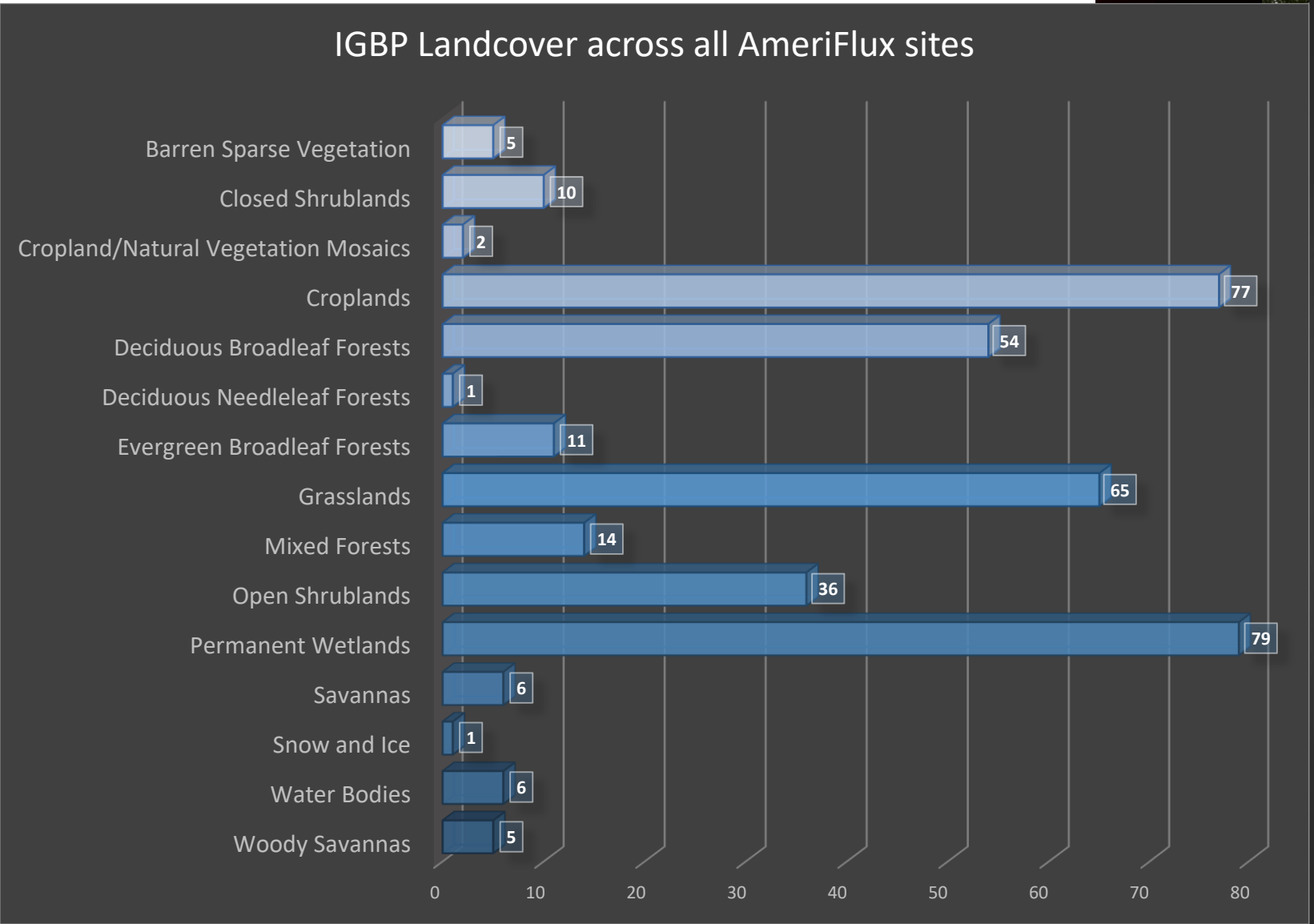
Berkeley Lab
Lawrence Berkeley National Laboratory

AmeriFlux Voluntary network of independent scientists



Measuring carbon, H2O, energy fluxes + many other observations!

Site diversity



Community of researchers advancing science

1996 AmeriFlux launched after 1st year long data vetted at La Thuile conference
David Hollinger leads!
Harvard Forest, Walker Branch, Howland, Camp Sherman are early sites

1997 1st workshop (Flathead Lake, Montana)

1999 Second wave of sites (Duke, Morgan Monroe, Niwot, Wind River Crane, Douglas Lake, Tonzi)

2000 Marconi workshop → FLUXNET Marconi Dataset

2001 Beverly Law assumes leadership
Roving system of standardized instrumentation for intra-network calibration
Early leaders of data archiving and processing (ORNL CDIAC)

2007 La Thuile workshop → FLUXNET La Thuile Dataset

2012 DOE creates AmeriFlux Management Project
Led by PI Margaret Torn, co-PI Dennis Baldocchi

2015 Berkeley workshop → FLUXNET2015 Dataset

By Dennis Baldocchi, Bev Law and David Hollinger , https://ameriflux.lbl.gov/about/history/

Support (flux-based) science!

Baldocchi

Torn (PI)

Agarwal

Biraud

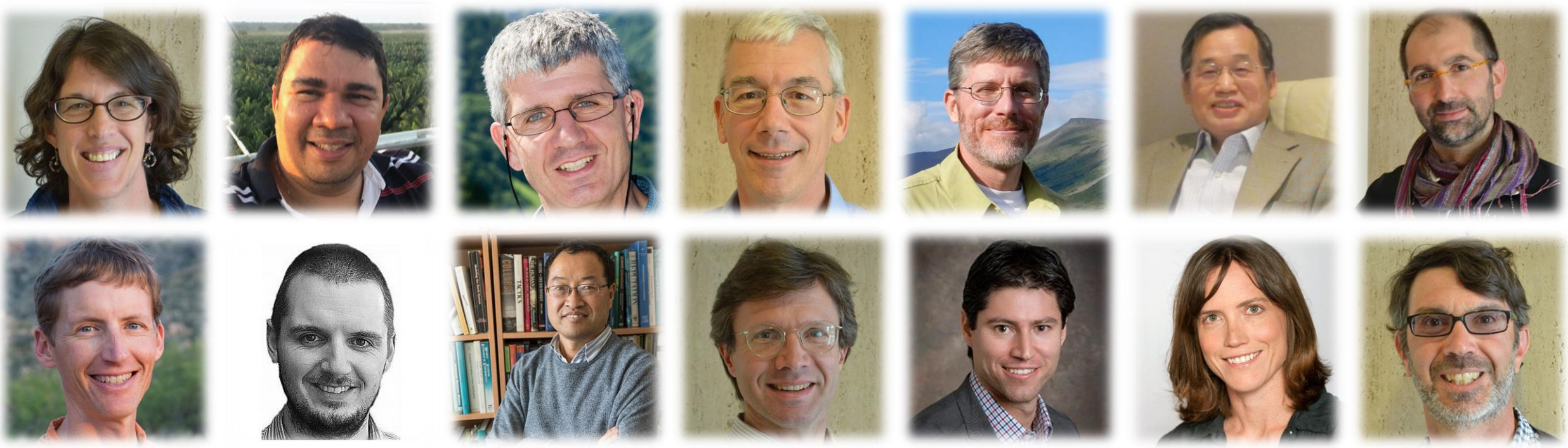
Technical Support Site visits, calibration	**Data Support** Processing, BADM
Core Site Support 14 long term sites	**Outreach** Website, meetings

Core Sites | **AmeriFlux Network** | **Other Stakeholders**

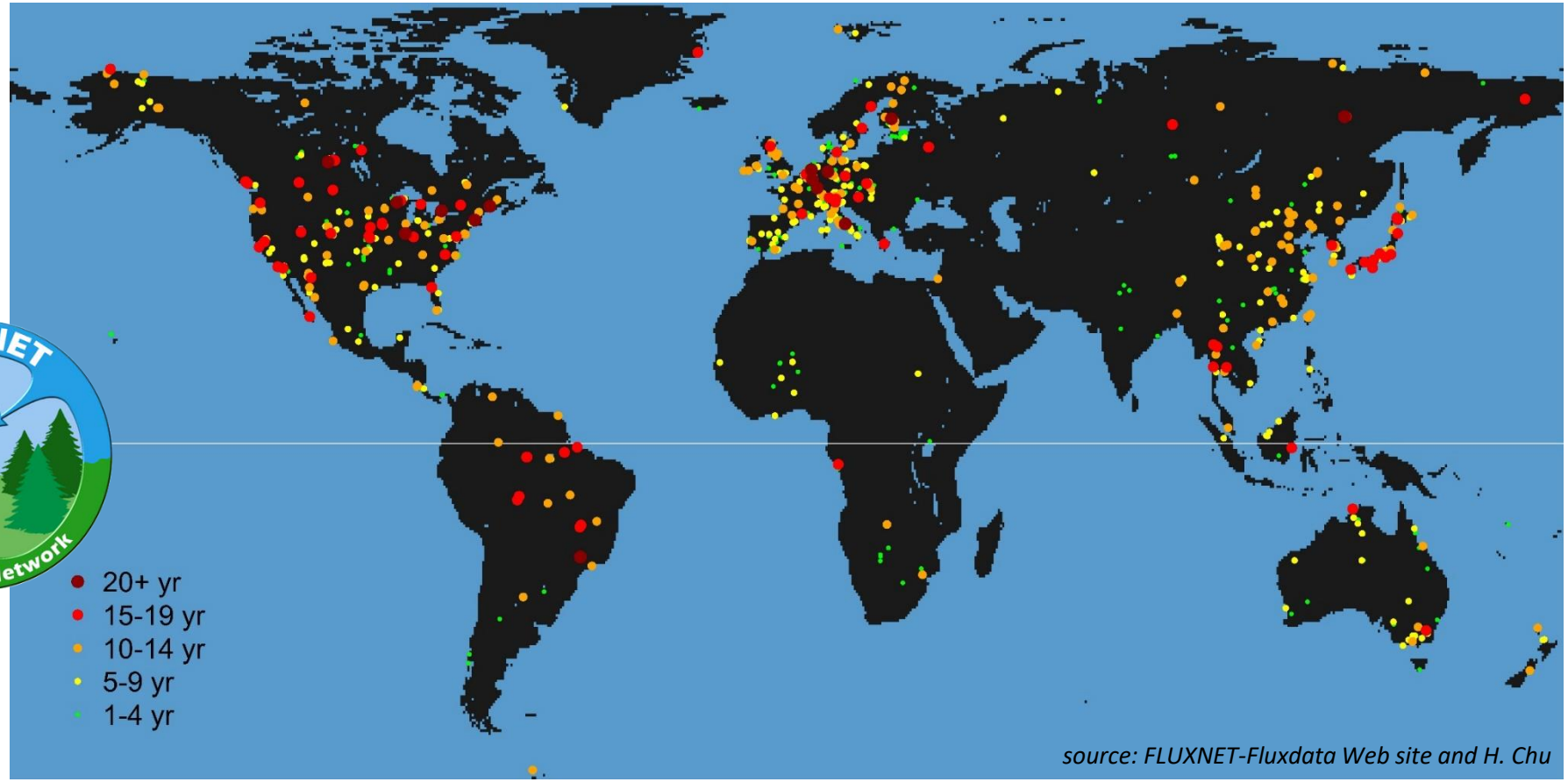
Keenan

Science Steering Committee

Science Steering Committee



Network Partnerships



source: FLUXNET-Fluxdata Web site and H. Chu

European Fluxes Database Cluster

Environment and Climate Change Canada

AsiaFlux

TERN OzFlux Land-Atmosphere Observatory

ICOS INTEGRATED CARBON OBSERVATION SYSTEM

neon National Ecological Observatory Network

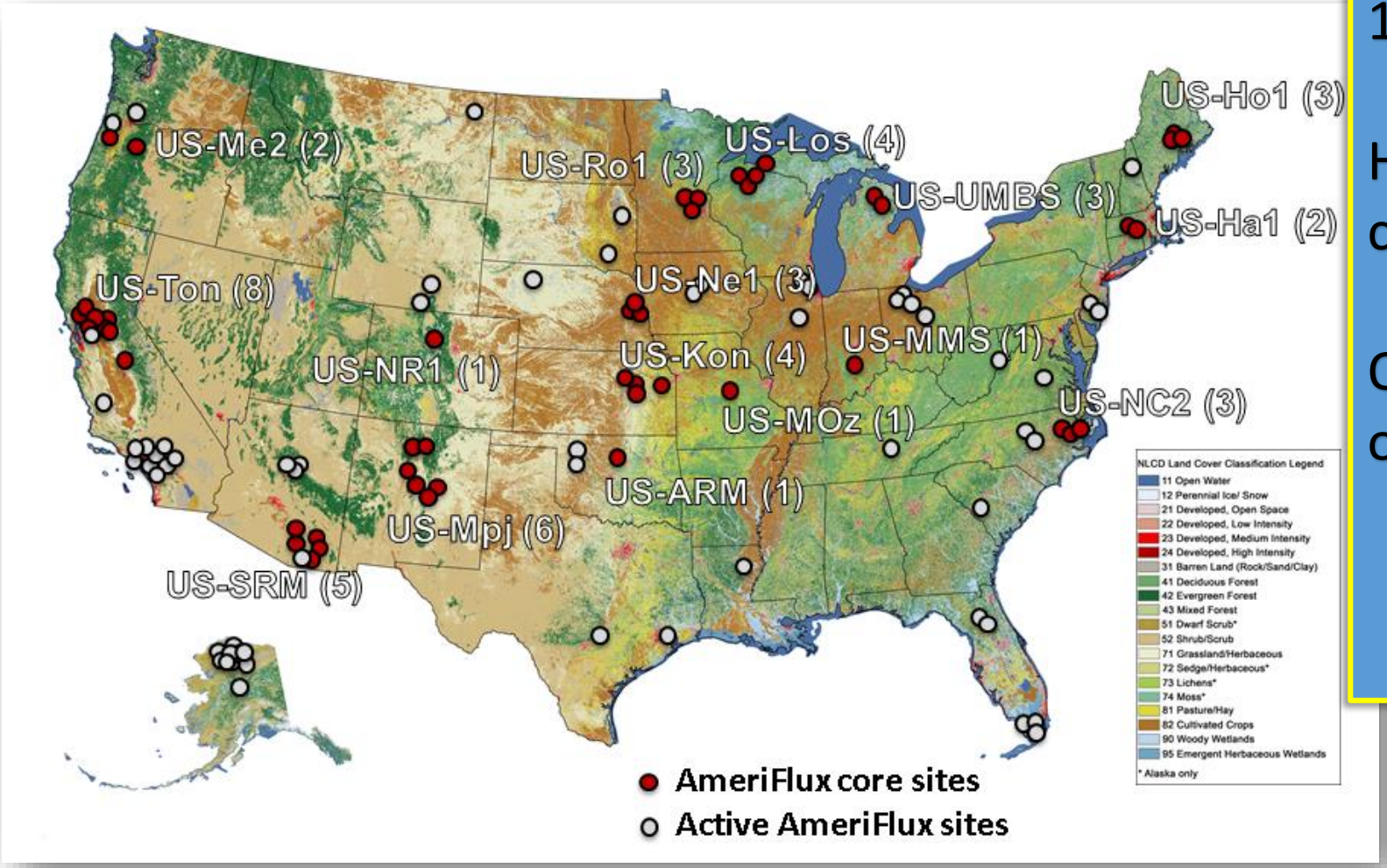
PhenoCam AN ECOSYSTEM PHENOLOGY CAMERA NETWORK

GLOBAL CARBON PROJECT

Coastal Carbon Research Coordination Network

Core Sites

https://ameriflux.lbl.gov/sites/ameriflux-core-sites/

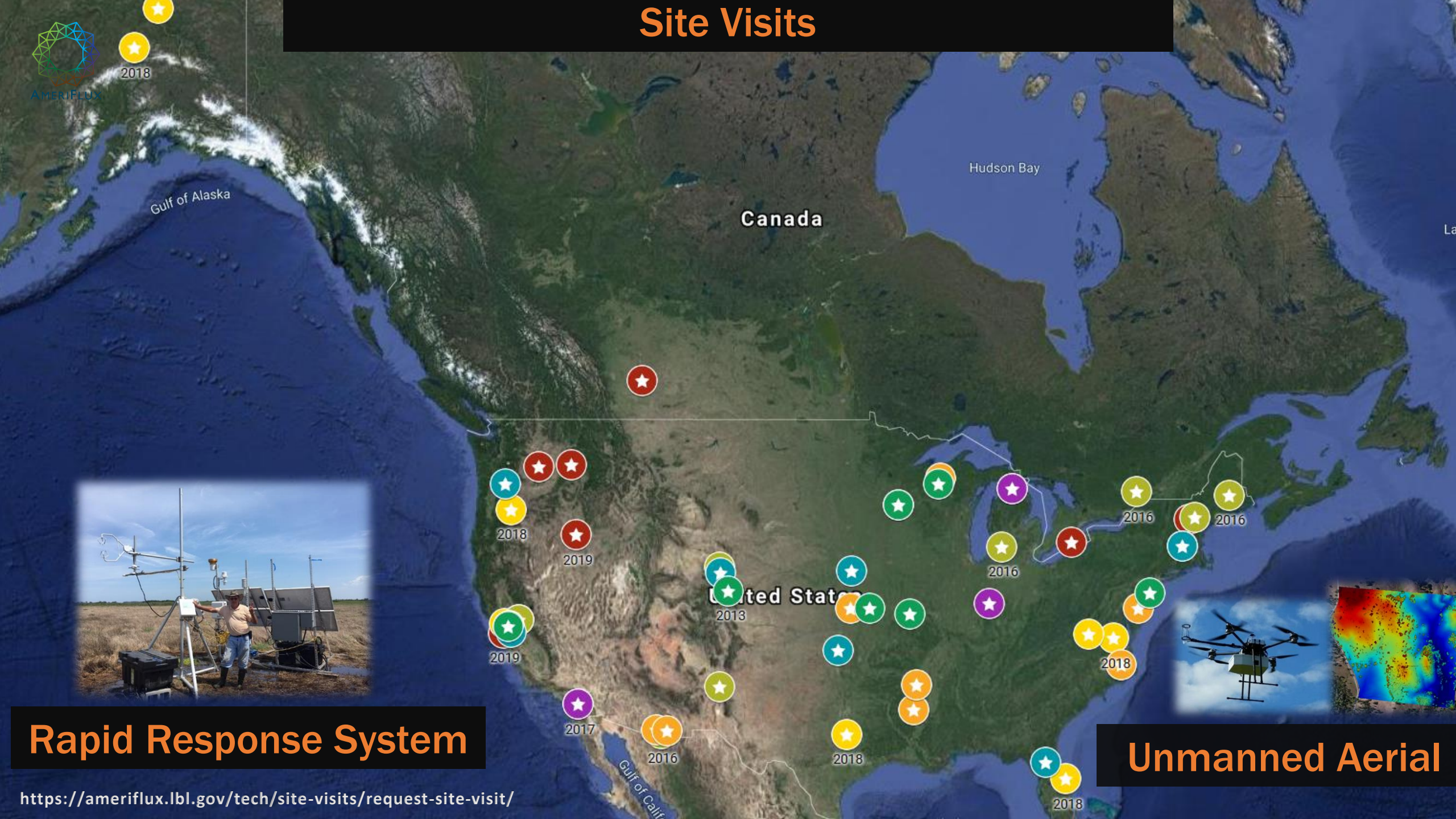


14 Core site Contracts; 49 sites

High quality data collection from core sites

Ongoing evaluation for renewal of core sites

Site Visits



Rapid Response System

Unmanned Aerial

https://ameriflux.lbl.gov/tech/site-visits/request-site-visit/

Tech Support Services

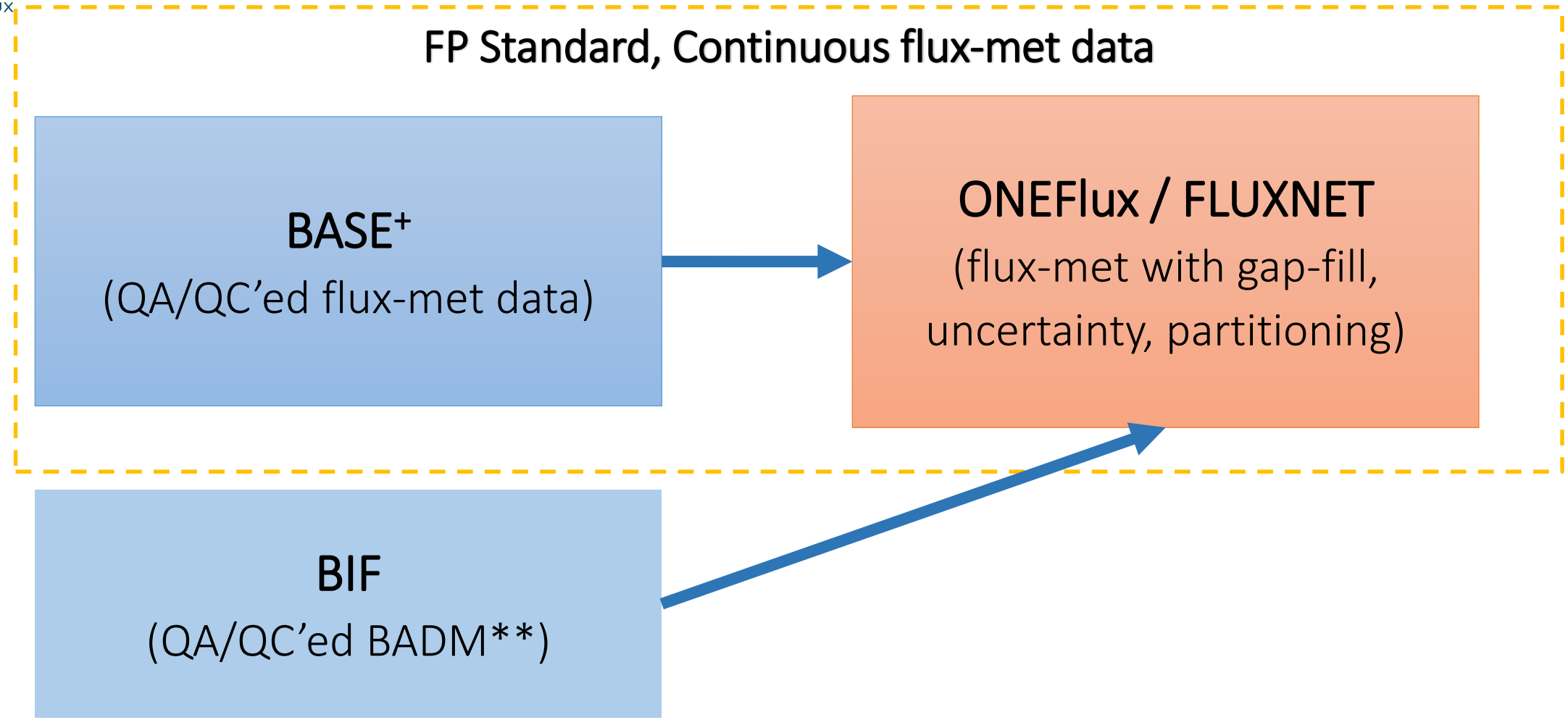
- Calibration gases
- Photosynthetically active radiation (PAR) sensors
- Loaner instruments
- Portable profile system
- Technical resources and best practices
- Safety resources

Request @ **ameriflux-tech@lbl.gov**

https://ameriflux.lbl.gov/tech/support-services/

https://ameriflux.lbl.gov/tech/technical-resources/

Data Products Overview

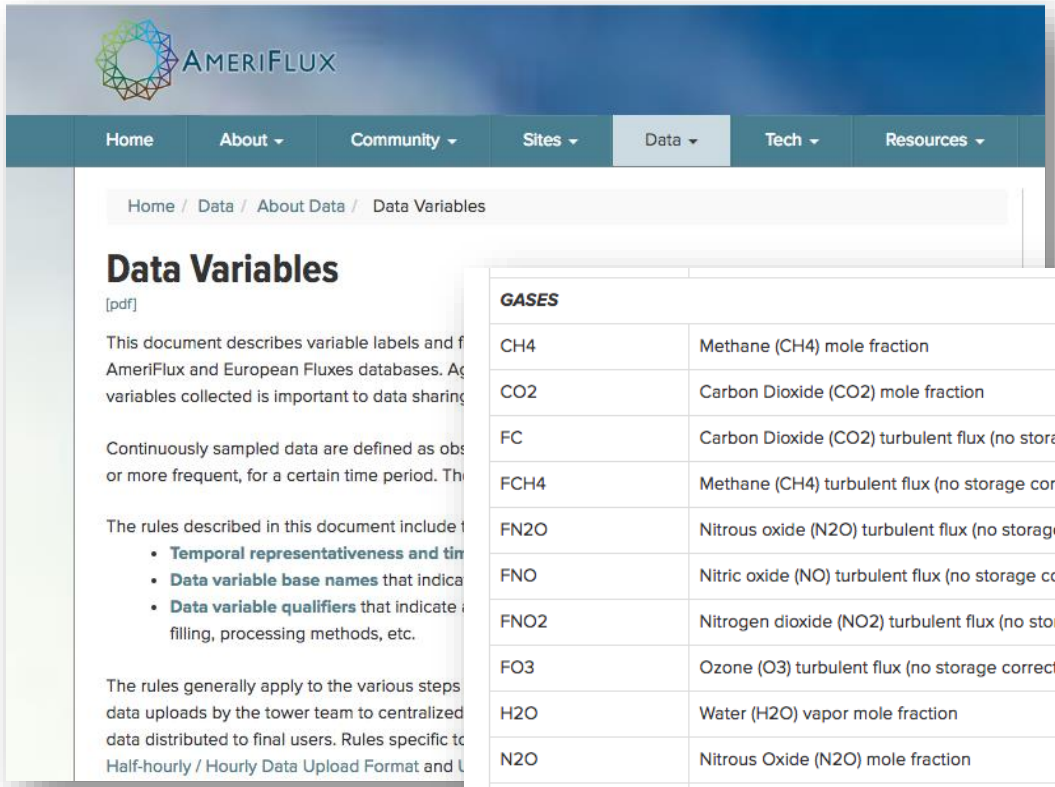


+ Measurement Height temporary product

**BADM = Biological, Ancillary, Disturbance, & Metadata

FP Standard used by AmeriFlux & FLUXNET

https://ameriflux.lbl.gov/data/aboutdata/data-variables/



GASES		
CH4	Methane (CH4) mole fraction	nmolCH4 mol-1
CO2	Carbon Dioxide (CO2) mole fraction	µmolCO2 mol-1
FC	Carbon Dioxide (CO2) turbulent flux (no storage correction)	µmolCO2 m-2 s-1
FCH4	Methane (CH4) turbulent flux (no storage correction)	nmolCH4 m-2 s-1
FN2O	Nitrous oxide (N2O) turbulent flux (no storage correction)	nmolN2O m-2 s-1
FNO	Nitric oxide (NO) turbulent flux (no storage correction)	nmolNO m-2 s-1
FNO2	Nitrogen dioxide (NO2) turbulent flux (no storage correction)	nmolNO2 m-2 s-1
FO3	Ozone (O3) turbulent flux (no storage correction)	nmolO3 m-2 s-1
H2O	Water (H2O) vapor mole fraction	mmolH2O mol-1
N2O	Nitrous Oxide (N2O) mole fraction	nmolN2O mol-1
NO	Nitric oxide (NO) mole fraction	nmolNO mol-1
NO2	Nitrogen dioxide (NO2) mole fraction	nmolNO2 mol-1
O3	Ozone (O3) mole fraction	nmolO3 mol-1
SC	CO2 storage flux	µmolCO2 m-2 s-1
SCH4	Methane (CH4) storage flux	nmolCH4 m-2 s-1
SN2O	Nitrous oxide (N2O) storage flux	nmolN2O m-2 s-1
SNO	Nitric oxide (NO) storage flux	nmolNO m-2 s-1
SNO2	Nitrogen dioxide (NO2) storage flux	nmolNO2 m-2 s-1

FP (Flux processing) Standard

(formats, variable names, units, descriptions)

- Timestamp formats
  - Start *and* end
  - Local time without DST
- Missing data = -9999
- Variable base names
- Variable qualifiers

AMERIFLUX

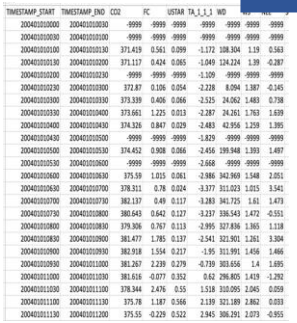
European Fluxes Database Cluster

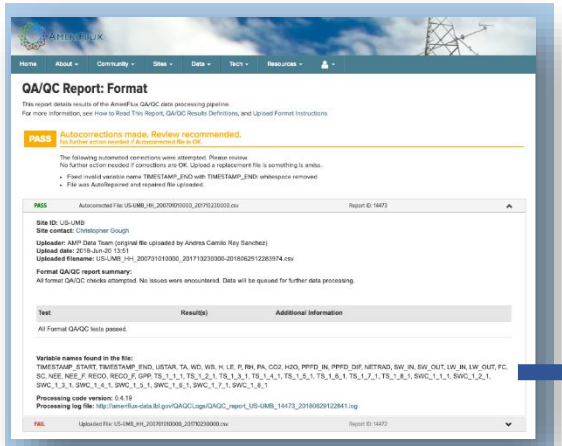
ICOS INTEGRATED CARBON OBSERVATION SYSTEM

Getting to BASE

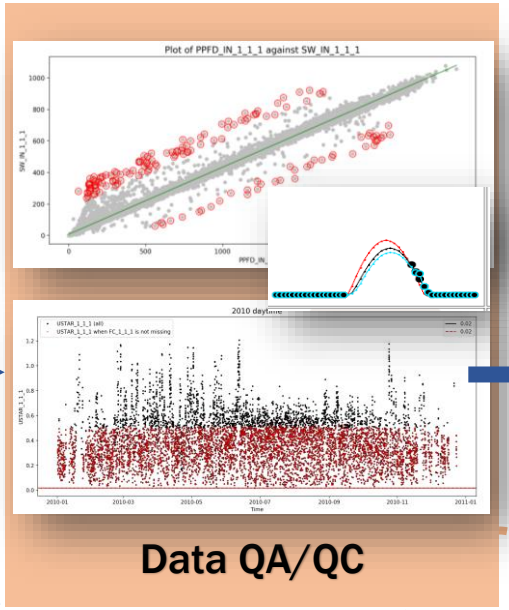
https://ameriflux.lbl.gov/half-hourly-hourly-data-upload-format/

BASE-In (FP-In)

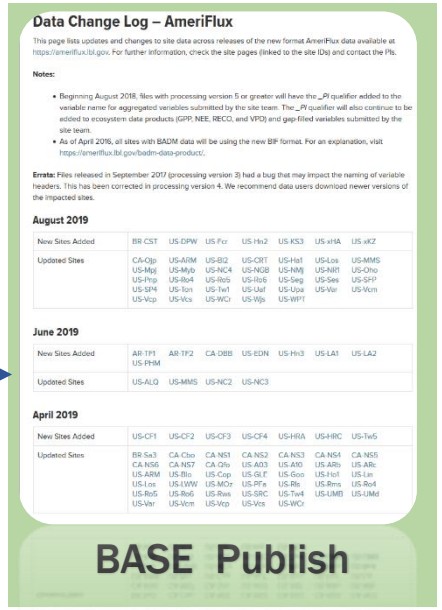




Format QA/QC



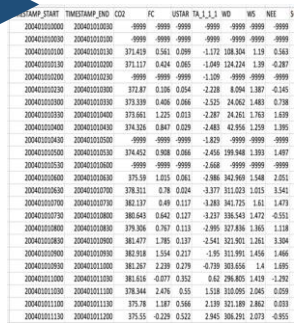
Data QA/QC



BASE Publish

BASE Data Processing Pipeline

BASE (FP Standard)



Format QA/QC: Enforces compliance with FP-In

Data QA/QC: Looks for errors, outliers, unit errors, shifts, filtering, etc.

BASE Publish: Create BASE files, append with qualifiers, make downloadable

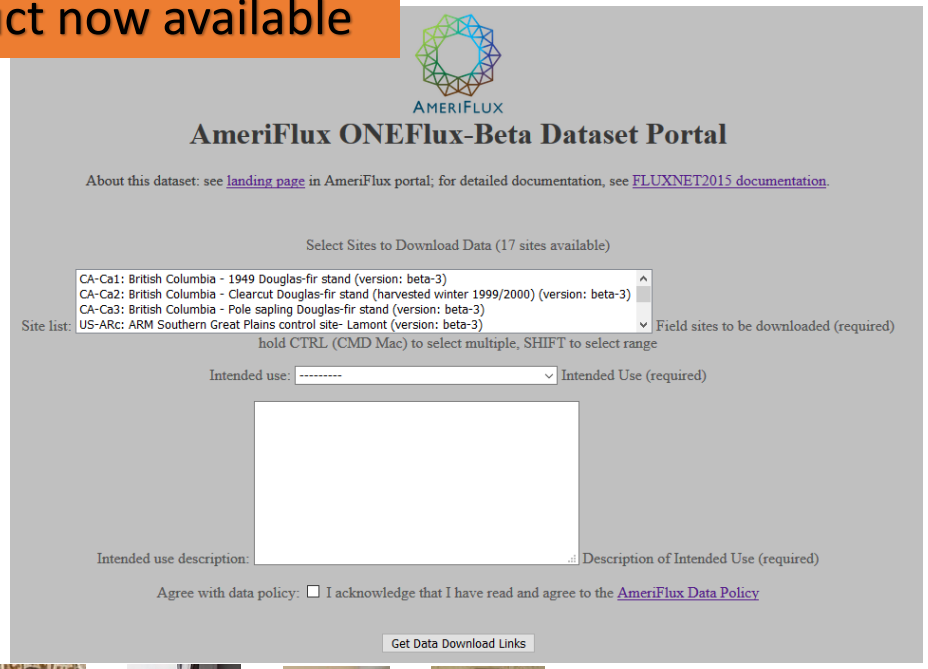
Goal: Synthesize flux-met data from across network to standard product

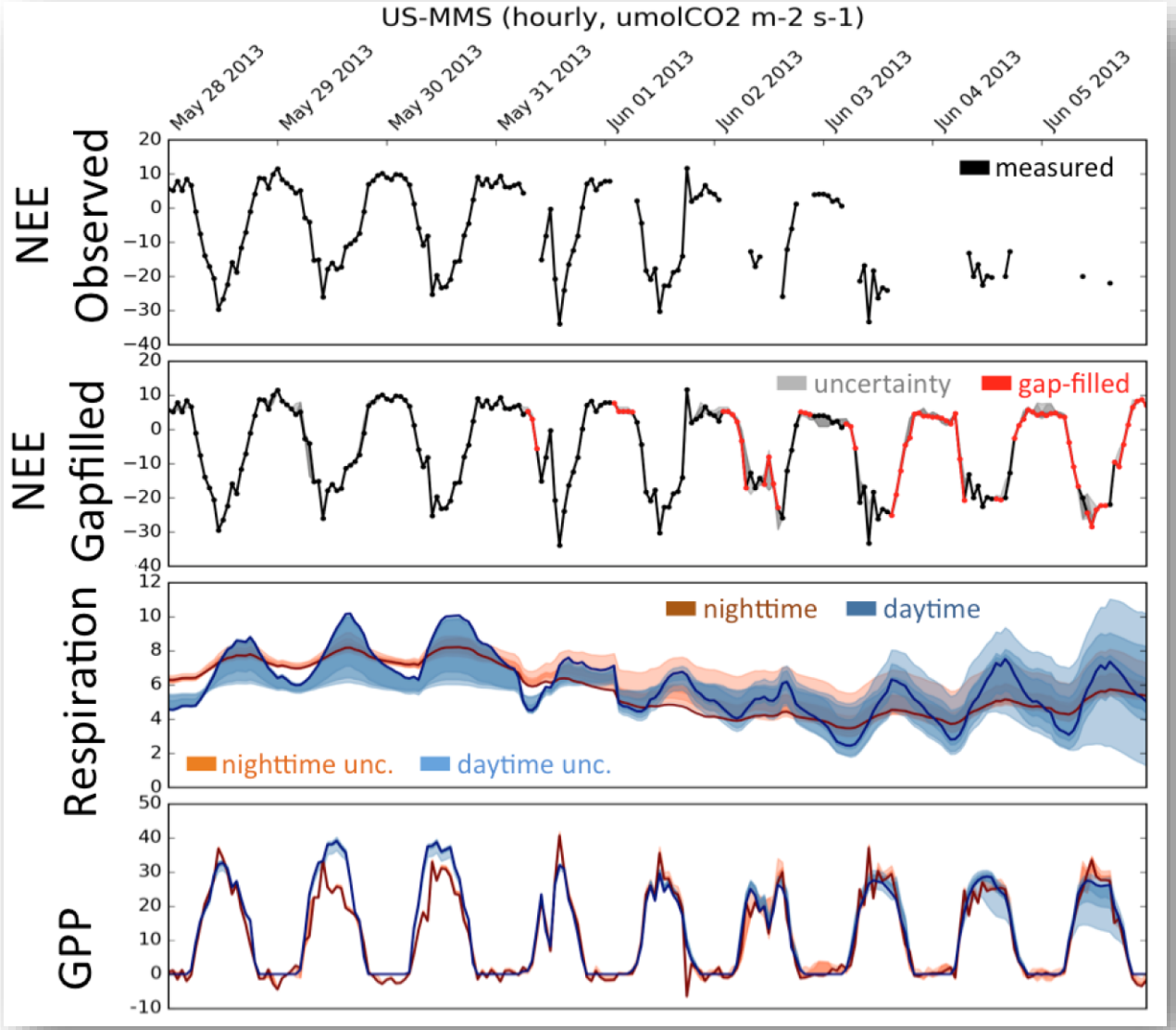
ONEFlux: Open Network-Enabled Flux processing pipeline

https://ameriflux.lbl.gov/data/download-data-oneflux-beta/

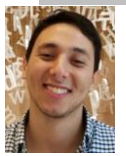
- Gap-filled
- Partitioned GPP/Reco
- Uncertainty analysis

Beta product now available





Gilberto Pastorello


Abdelrahman Elbashandy

Carlo Trotta

Alessio Ribeca

Dario Papale

Alan Barr

ICOS INTEGRATED CARBON OBSERVATION SYSTEM

European Fluxes Database Cluster

Environment and Climate Change Canada

BADM: Biological, Ancillary, Disturbance, and Metadata

Soil properties
- Texture, density
- Classification

Soil nutrients
- Carbon, NPK

Vegetation properties
- Canopy height
- LAI
- Vegetation Cover

Biomass

Disturbance
- Fire / Drought
- Agriculture info

Site Characteristics
- Location, IGBP, Climate
- Team info
- Tower info

Instruments
- SN/Model
- Installation
- Calibrations

Variable Info
- Height / Depth
- Model
- Aggregation

Disturbance

A standard to capture **all other observations** of interest

AMERIFLUX

European Fluxes Database Cluster

ICOS INTEGRATED CARBON OBSERVATION SYSTEM

Data Site Years available

- 1954 sites years
  - > 20% YoY increase
- 263 sites have BASE
  - 36 sites released first BASE in 2019
  - > 50% of AmeriFlux sites have BASE
- 1-2 month release cycle
- More automation in the works

Data Change Log – AmeriFlux

This page lists updates and changes to site data across releases of the new format AmeriFlux data available at https://ameriflux.lbl.gov. For further information, check the site pages (linked to the site IDs) and contact the PIs.

Notes:

- Beginning August 2018, files with processing version 5 or greater will have the *_PI* qualifier added to the variable name for aggregated variables submitted by the site team. The *_PI* qualifier will also continue to be added to ecosystem data products (GPP, NEE, RECO, and VPD) and gap-filled variables submitted by the site team.
- As of April 2016, all sites with BADM data will be using the new BIF format. For an explanation, visit https://ameriflux.lbl.gov/badm-data-product/.

Errata: Files released in September 2017 (processing version 3) had a bug that may impact the naming of variable headers. This has been corrected in processing version 4. We recommend data users download newer versions of the impacted sites.

August 2019

New Sites Added	BR-CST	US-DPW	US-Fcr	US-Hn2	US-KS3	US-xHA	US-xKZ
Updated Sites	CA-Ojp US-Mpj US-Pnp US-SP4 US-Vcp	US-ARM US-Myb US-Ro4 US-Ton US-Vcs	US-Bi2 US-NC4 US-Ro5 US-Tw1 US-WCr	US-CRT US-NGB US-Ro6 US-Uaf US-Wjs	US-Ha1 US-NMj US-Seg US-Upa US-WPT	US-Los US-NR1 US-Ses US-Var	US-MMS US-Oho US-SFP US-Vcm

June 2019

New Sites Added	AR-TF1 US-PHM	AR-TF2	CA-DBB	US-EDN	US-Hn3	US-LA1	US-LA2
Updated Sites	US-ALQ	US-MMS	US-NC2	US-NC3			

April 2019

New Sites Added	US-CF1	US-CF2	US-CF3	US-CF4	US-HRA	US-HRC	US-Tw5
Updated Sites	BR-Sa3 CA-NS6 US-ARM US-Los US-Ro5 US-Var	CA-Cbo CA-NS7 US-Blo US-LWW US-Ro6 US-Vcm	CA-NS1 CA-Qfo US-Cop US-MOz US-Rws US-Vcp	CA-NS2 US-A03 US-GLE US-PFa US-SRC US-Vcs	CA-NS3 US-A10 US-Goo US-Rls US-Tw4 US-WCr	CA-NS4 US-ARb US-Ho1 US-Rms US-UMB	CA-NS5 US-ARc US-Lin US-Ro4 US-UMd

Data Availability and Download

https://ameriflux.lbl.gov/data/data-availability/
https://ameriflux.lbl.gov/data/download-data/

Download Data

Bulk download in the new file and variable formats is available below (See the README fo

For height / depth and instrument model information, see the Measurement Height page.

A request for data will give you the following:

- Download Manifest
- Zip file per site containing both Flux-met data and BADM data

BADM data can be downloaded without Flux-met data if BADM only option is selected bel

☐ **Download BADM data only**

All Sites

AR-TF1: Rio Moat bog
AR-TF2: Rio Pipo bog
BR-CST: Caatinga Serra Talhada
BR-Sa1: Santarem-Km67-Primary Forest
BR-Sa3: Santarem-Km83-Logged Forest
CA-ARB: Attawapiskat River Bog
CA-ARF: Attawapiskat River Fen
CA-Ca1: British Columbia - 1949 Douglas-fir stand
CA-Ca2: British Columbia - Clearcut Douglas-fir stand (harv.
CA-Ca3: British Columbia - Pole sapling Douglas-fir stand

Select all sites

Your Selections *

Additional Data Files

☐ **BADM data for all AmeriFlux sites that have half-hourly data**

☐ **BADM data for all AmeriFlux sites**

Intended Use * Select

Description of Intended Use * (required) The contributors to the sites will be emailed

☐ **I acknowledge that I have read and agree to the** AmeriFlux Da

Download All Files

Data Availability

Export to xlsx | Export to CSV

Site ID	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19
US-EML																		☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	
US-Esm																		☑	☑	☑	☑	☑	☑	☑	☑				
US-Fcr																					☑	☑	☑	☑					
US-Fmf															☑	☑	☑	☑	☑	☑									
US-FPe										☑	☑	☑	☑	☑	☑	☑	☑	☑											
US-FR1																													
US-FR2															☑	☑	☑	☑											
US-FR3														☑	☑	☑	☑	☑	☑	☑	☑	☑							
US-Fuf															☑	☑	☑	☑	☑	☑									
																		☑	☑	☑									
																		☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	

Data and Manifest

< Back to Download Page

Download Manifest

```
#downloadDate:20190719003219
#numberOfSitesDownloaded:1
#emailForSitePIs:jranders@uci.edu
#dataFiles
SITE_ID,filename,start_year,end_year,version,filetype,timestamp
```

Copy to Clipboard

Note: The download manifest contains the emails of the data contributors, site information and the data download URLs

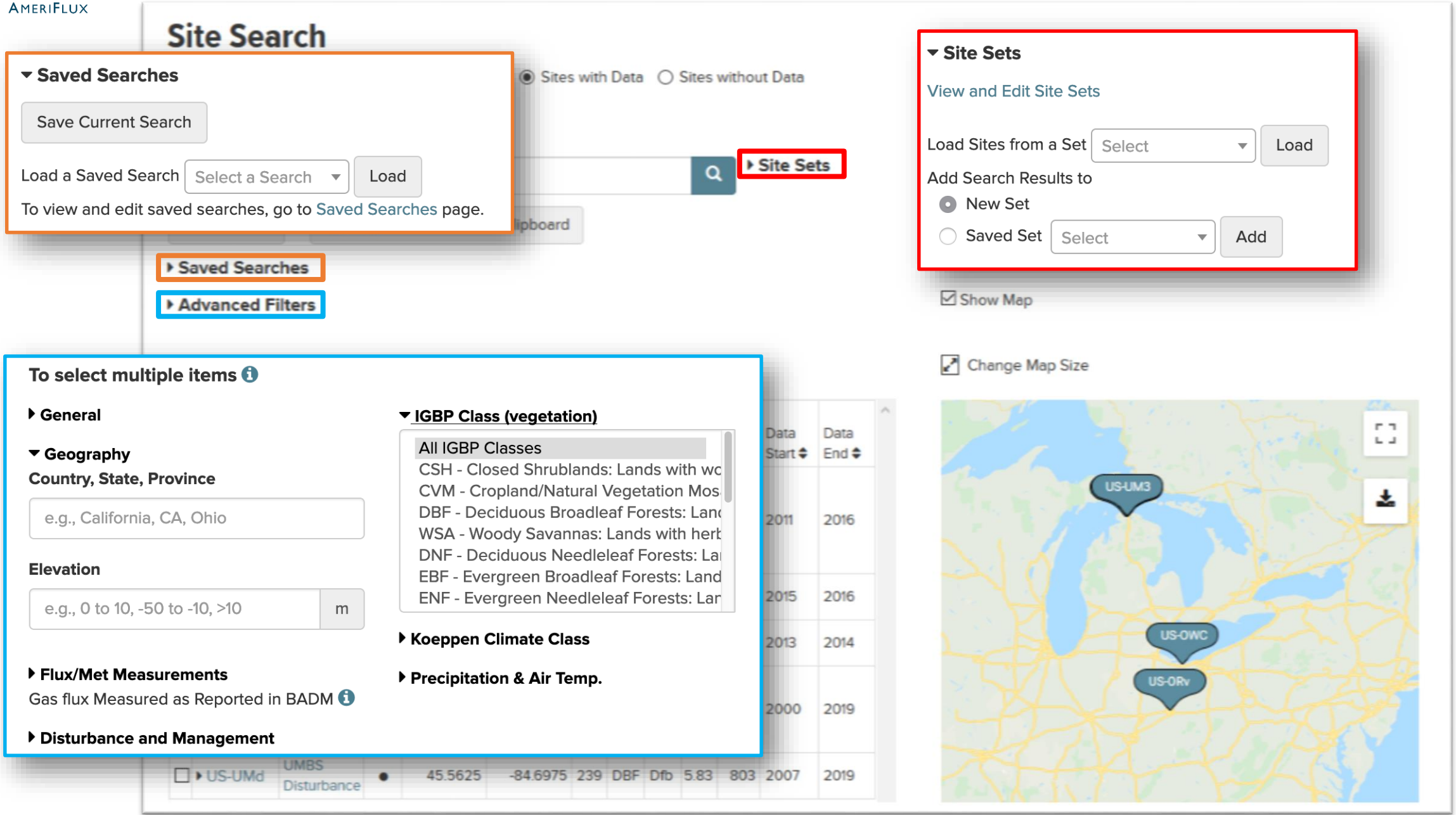
Data Download URLs

Click on each URL to download the files. Consider using a plugin like DownThemAll or GetThemAll to download all the files at once

README | US-Bn1_BASE-BADM | AA-Flx_BIF | AA-Net_BIF

Navigating AmeriFlux sites: Search

http://ameriflux.lbl.gov/sites/site-search/



Navigating AmeriFlux sites: Site Sets

https://ameriflux.lbl.gov/sites/site-sets/

Site Sets List

+ Add Set | Edit List

ID	Favorite	Name	Number of Sites
1	○	AndySukyer_TimA_Nebraska	5
2	●	AnkurDesai_Wisconsin	6
3	○	BenRunkle_ArkansasRice	4
4	○	BillMunger_HarvardForest	2
5	○	Bohr	5
6	○	BrentEwers_Wyoming	3
7	○	ChrisGough_Michigan	2
8	○	DavidCook_RoserM_Illinois	3
9	○	DeanAnderson_KatherineMP_Rockies	[illegible]
10	○	FLUXNET-Canada	46
11	○	Howland	5
12	○	Litvak	8
13	○	NEON	14
14	○	Novick	6
15	○	RussScott_JoelB_Arizona	4
16	○	Stoy	5

AnkurDesai_Wisconsin

Edit Set

US-Los	Lost Creek
US-Men	Lake Mendota, Center for Limnology Site
US-PFa	Park Falls/WLEF
US-Pnp	Lake Mendota, Picnic Point Site
US-Syv	Sylvania Wilderness Area
US-WCr	Willow Creek

List each AmeriFlux site ID

Notes

Enter Text

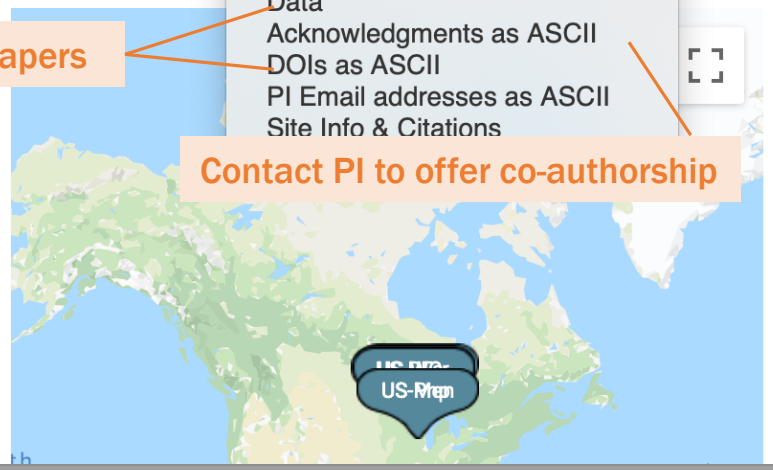
Funding Acknowledgement (BIF or PI)

Cite with DOIs / recommended papers

Download for Set:

- ✓ Set as ASCII Data
- Acknowledgments as ASCII
- DOIs as ASCII
- PI Email addresses as ASCII
- Site Info & Citations

Contact PI to offer co-authorship



Attribution: Data Policy

https://ameriflux.lbl.gov/data/data-policy/

1. State use when download
2. Contact PI to offer co-authorship
3. Cite each site with DOIs / recommended papers
4. Funding Acknowledgement (BIF or PI)
5. List each AmeriFlux site ID

US-NR1: Niwot Ridge Forest (LTER NWT1)

Overview | Windroses | DOI | Data Use Log | Image Gallery | MODIS | Publications | BADM

Instructions for DOIs for This Site

When using DOIs for this site, use the publications and acknowledgments listed below.

DOIs

- **AmeriFlux**

  Citation: Peter D. Blanken, Russel K. Monson, Sean P. Burns, David R. Bowling, Andrew A. Turnipseed (1998-) AmeriFlux US-NR1 Niwot Ridge Forest (LTER NWT1), 10.17190/AMF/1246088
  Link: http://dx.doi.org/10.17190/AMF/1246088

Publications to use for Citations for this Site

- Burns, S. P., Blanken, P. D., Turnipseed, A. A., Hu, J., Monson, R. K. (2015) The Influence Of Warm-Season Precipitation On The Diel Cycle Of The Surface Energy Balance And Carbon Dioxide At A Colorado Subalpine Forest Site, Biogeosciences, 12(23), 7349-7377.
- Monson, R. K., Turnipseed, A. A., Sparks, J. P., Harley, P. C., Scott-Denton, L. E., Sparks, K., Huxman, T. E. (2002) Carbon Sequestration In A High-Elevation, Subalpine Forest, Global Change Biology, 8(5), 459-478.

Acknowledgements

- Funding for the AmeriFlux core site US-NR1 data was provided by the U.S. Department of Energy's Office of Science.

Resources

- **AmeriFlux** Logos & Acknowledgments

Core Sites | Edit Set

US-Ha1	Harvard Forest EMS Tower (HFR1)
US-Ha2	Harvard Forest Hemlock Site
US-Ho1	Howland Forest (main tower)
US-Ho2	Howland Forest (west tower)
US-Ho3	Howland Forest (harvest site)
US-KFB	Konza Prairie LTER (4B)

Notes
Core sites

Download for Set: Acknowledgments as ASCII | OK

Core-Sites-ACKN - Notepad

File Edit Format View Help

```
#Set Name:      Core Sites
#Content:       Ameriflux Site Acknowledgments

Site ID Site Name       Acknowledgment
US-Ha1  Harvard Forest EMS Tower (HFR1) Operation of the US-Ha1 site is supported
US-Ha2  Harvard Forest Hemlock Site     Operation of the US-Ha2 site is supported
US-Ho1  Howland Forest (main tower)
US-Ho2  Howland Forest (west tower)
US-Ho3  Howland Forest (harvest site)
US-KFB  Konza Prairie LTER (4B)
US-KFS  Kansas Field Station
US-KLS  Kansas Land Institute
US-Kon  Konza Prairie LTER (KNZ)
US-Los  Lost Creek
US-Me2  Metolius mature ponderosa pine  The Metolius AmeriFlux research was suppo
US-Me6  Metolius Young Pine Burn        This research was supported by the Office
US-MMS  Morgan Monroe State Forest      Research at the MMSF site was supported b
US-Mpj  Mountainair Pinyon-Juniper Woodland
US-Myb  Mayberry Wetland        Biometeorology Lab, University of California, Ber
US-NC2  NC_Loblolly Plantation
US-NC3  NC_Clearcut#3
```

Ln 1, Col 1 | 100% | Unix (LF) | UTF-8

Network Overview

http://ameriflux.lbl.gov/about/network-at-a-glance

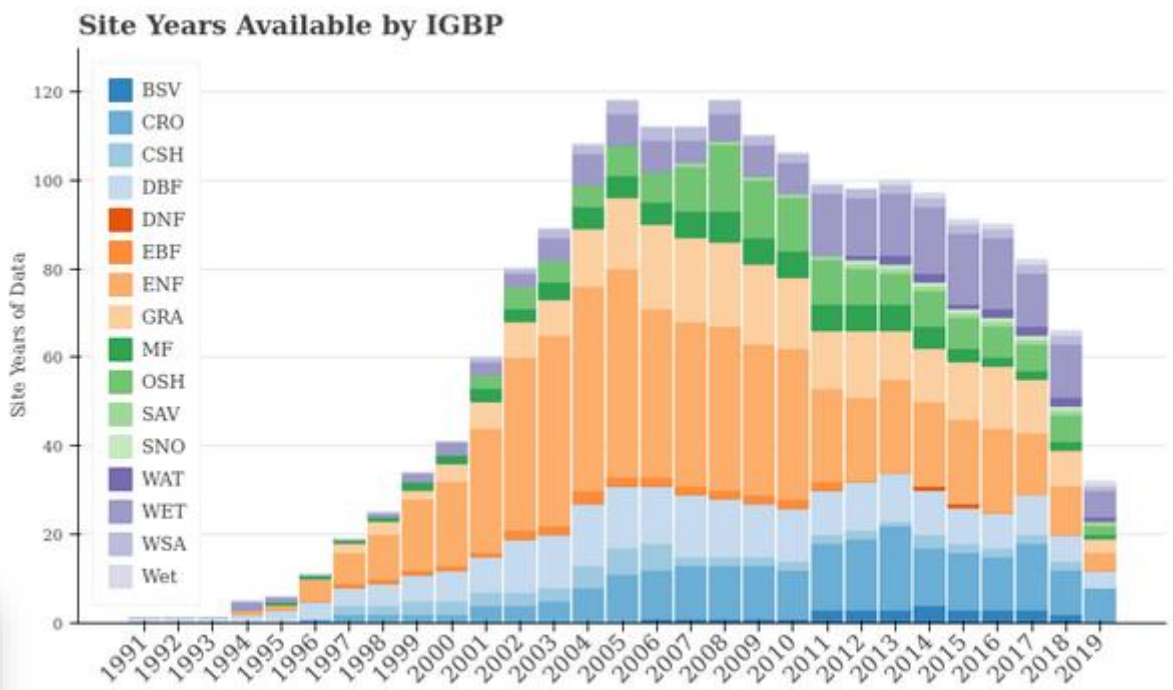
Network At A Glance

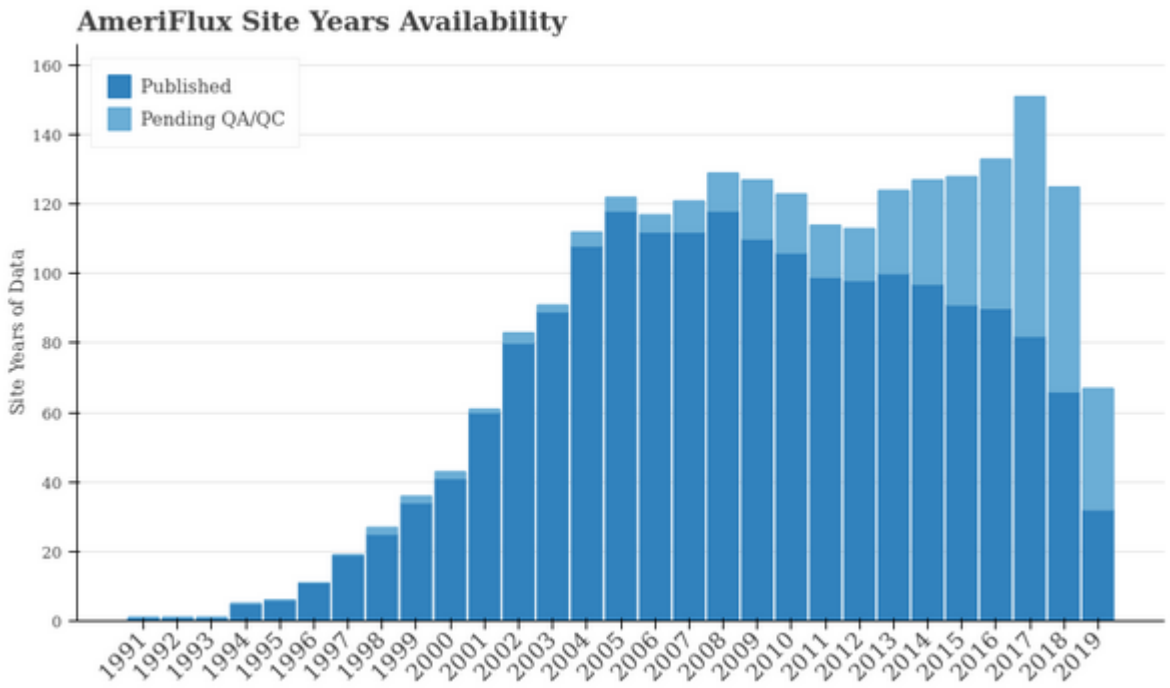
The **Network at a Glance** page displays summary statistics about the AmeriFlux network, its flux tower sites, data sets, and user community. This provides a useful snapshot to PIs, Program Managers, data users, and others.

Last update: Oct 23 2019 6:00PM PST

Don't see what you are looking for, or have a suggestion? Tell us!

Search flux tower sites | Build custom map of sites



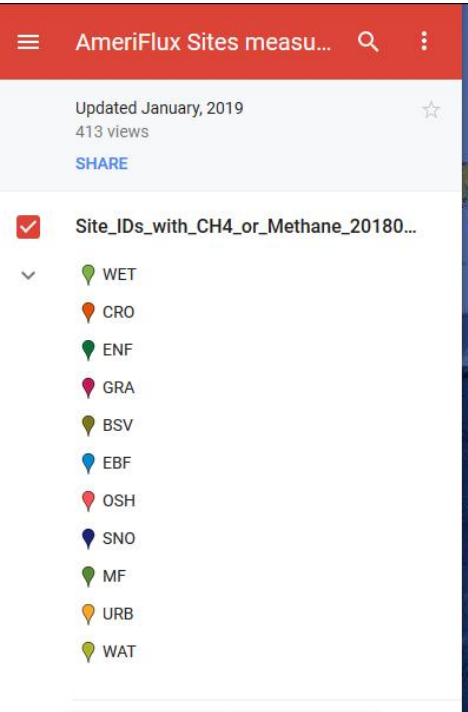


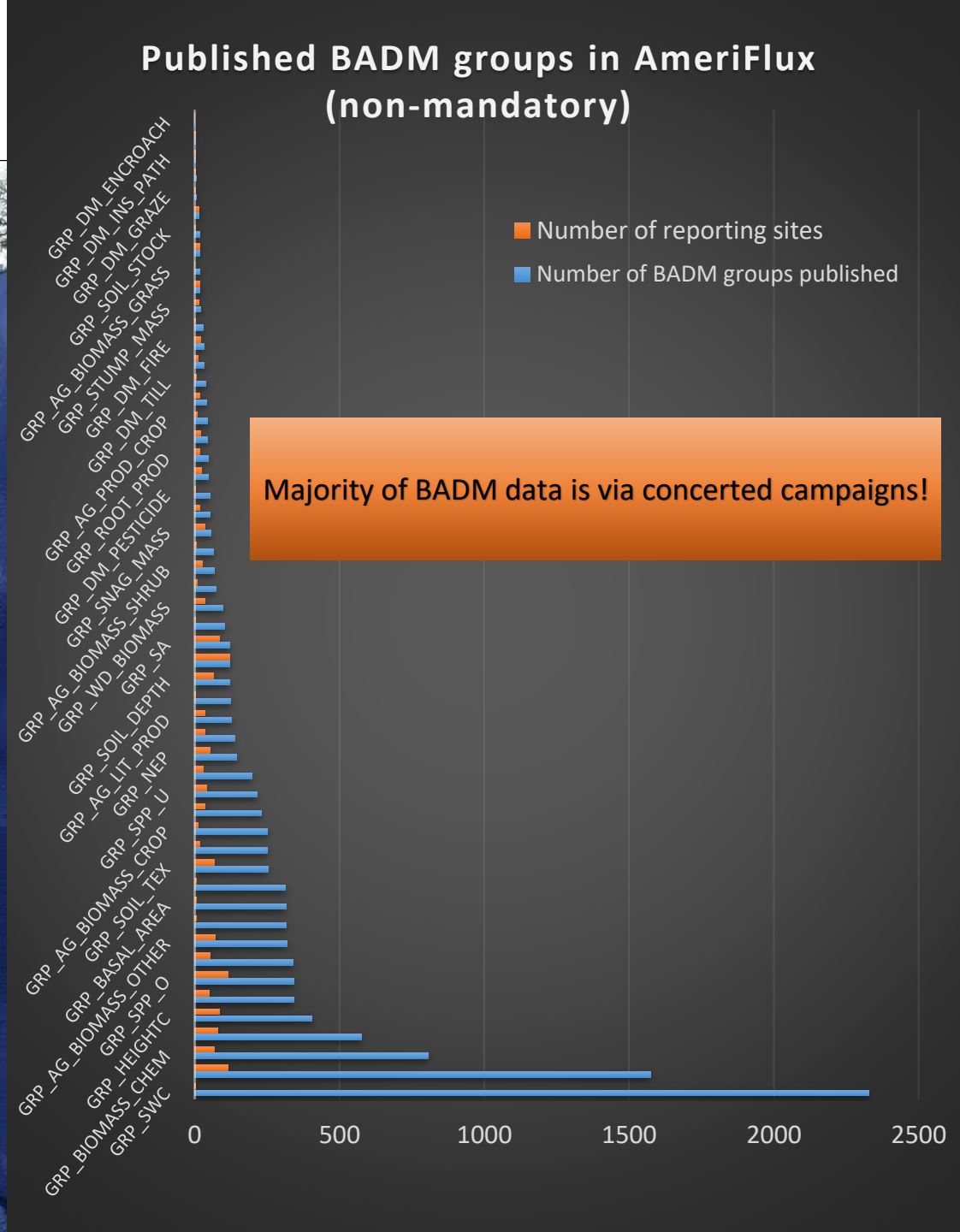
- Five most recent sites to join the Network

SITE ID	Join date
US-UiA	09/12/2019
US-UiB	09/12/2019
US-UiC	09/12/2019
US-JRn	09/06/2019
US-PFb	09/02/2019

- Sites that have submitted AmeriFlux data since 2013 **343**
- Sites that have uploaded AmeriFlux data within the past 5 years **342**
- Site years of downloadable AmeriFlux data since 2013 **558**
- Site years of downloadable AmeriFlux data **1912**
- Number of AmeriFlux Core Sites **49**

Campaigns and theme years

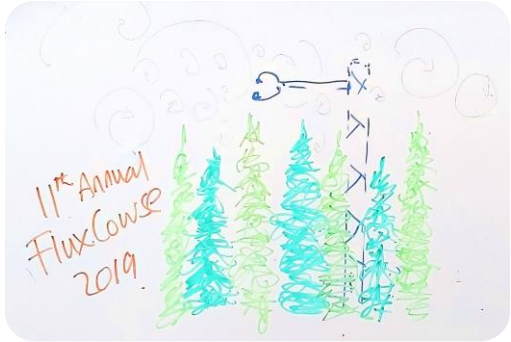




Majority of BADM data is via concerted campaigns!

AmeriFlux Events

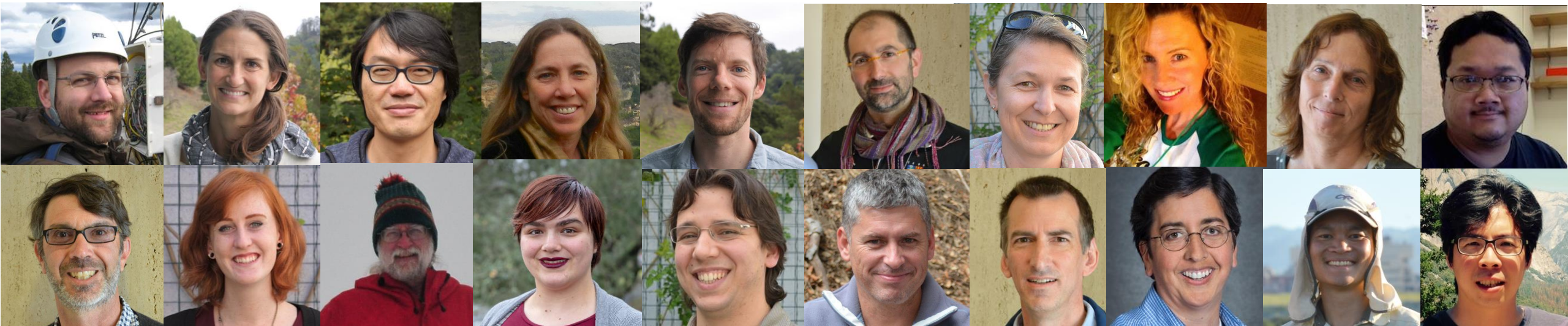
- Annual Meeting/PI meeting
- Early Career Workshop
- Data + Tech Workshop
- FLUX Course
- Town Hall @ AGU Fall Meeting (**Upcoming!**)
  December 9, 2019 12:30 pm - 1:30 pm
  Moscone Center West, Room: 2004, L2



AGU 100
ADVANCING EARTH AND SPACE SCIENCE

AMERIFLUX

Questions / feedback welcome!

ameriflux-support@lbl.gov

https://ameriflux.lbl.gov