

AWS Cloud for Atmospheric Scientists

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Contents

- What is Cloud Computing?
- What is AWS Cloud and Why?
- Access & Use AWS Cloud with a Joint Account
 - Basic usage
 - Advanced topics
- Summary & Prospects



Contents

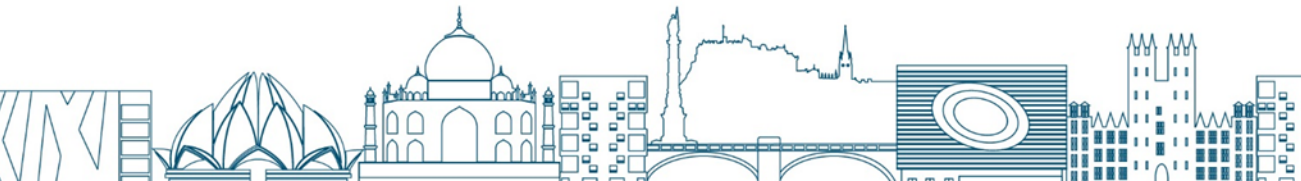
- What is Cloud Computing?
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What is Cloud Computing?

Cloud Computing is on-demand delivery of IT resources and applications via the Internet with pay-as-you-go pricing.

- Usually costs, but always cost-effective
- Elastic and scalable (dynamically adjust hardware as needed)
- Replication, replication, replication!
- Globally available in seconds



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What is AWS Cloud and Why?



Cloud Computing with Amazon Web Services



Trade capital expense for variable expense



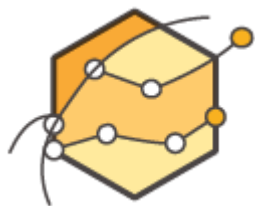
Increase speed and agility



Benefit from massive economies of scale



Stop spending money on running and maintaining data centers



Stop guessing capacity



Go global in minutes



What is AWS Cloud and Why?

Security, Identity, & Compliance

IAM

Resource Access Manager

Cognito

Secrets Manager

GuardDuty

Inspector

Amazon Macie 

AWS Organizations

AWS Single Sign-On

Certificate Manager

Key Management Service

Identity and Access
Management

Elastic Compute
Cloud


Simple Storage
Service

▼ All services



Compute

EC2

Lightsail 

ECR

ECS

EKS

Lambda

Batch

Elastic Beanstalk



Storage

S3

EFS

FSx

S3 Glacier

Storage Gateway

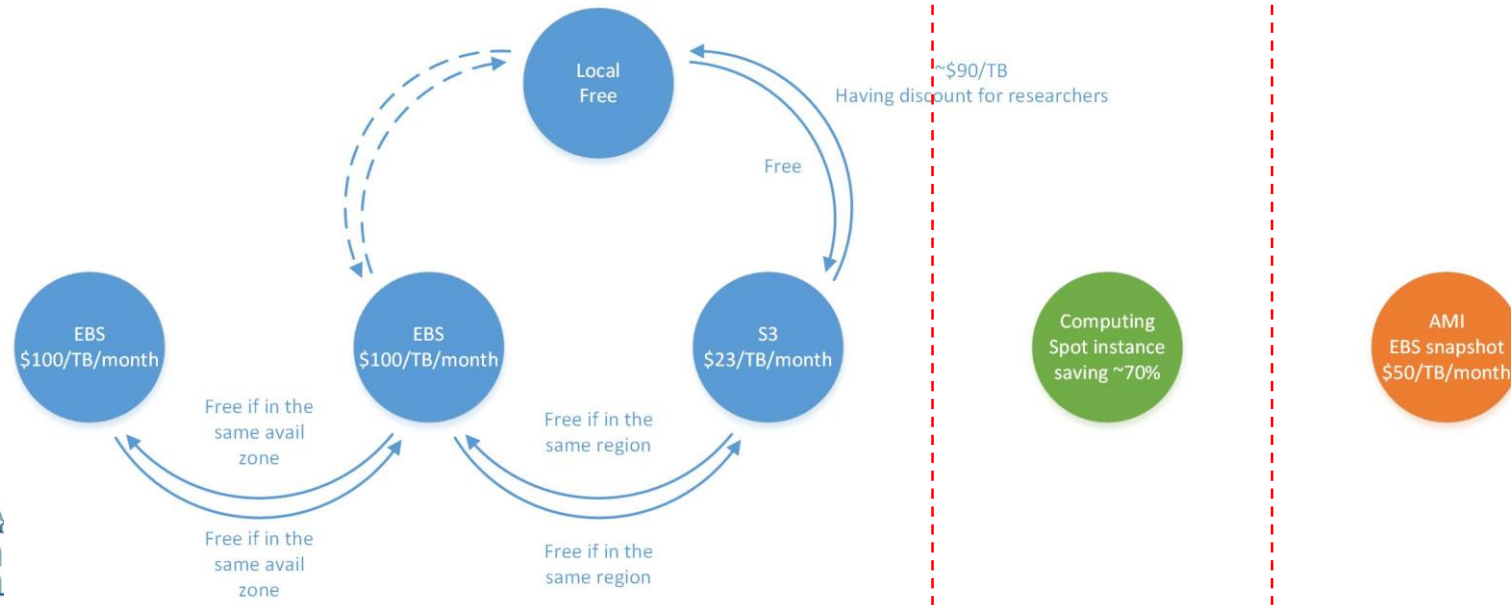
AWS Backup



What is AWS Cloud and Why?

Cloud Computing with Amazon Web Services

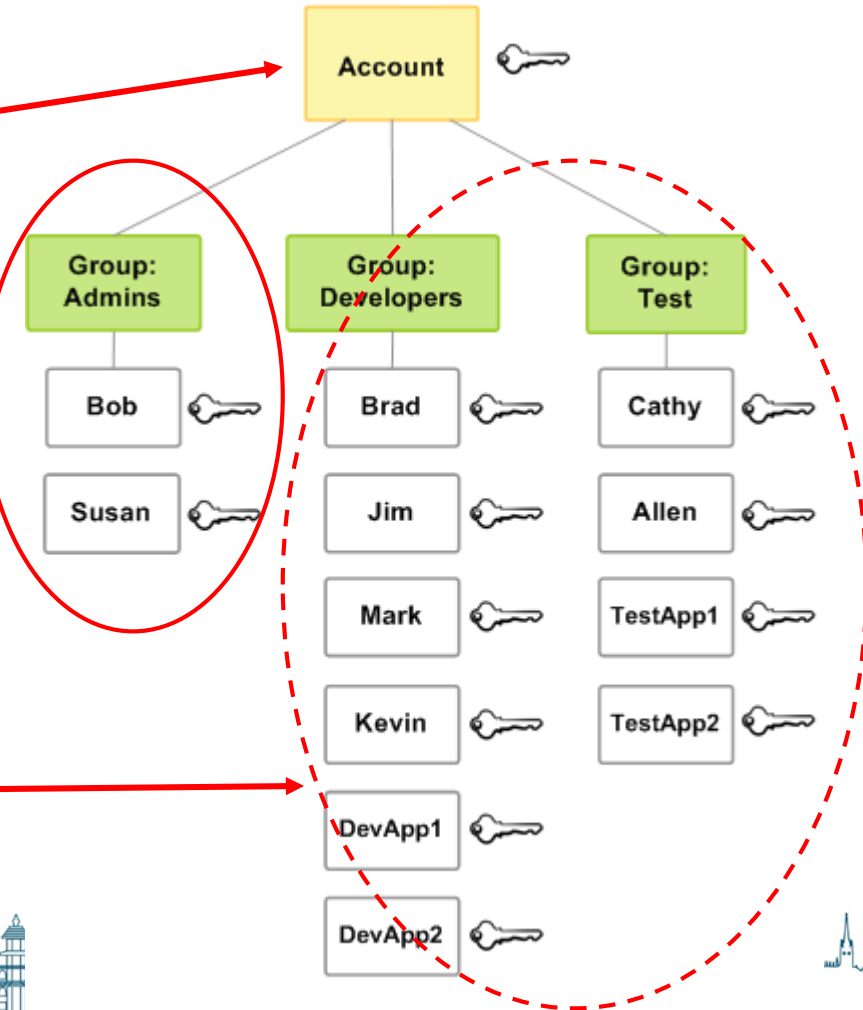
- Pricing management



What is AWS Cloud and Why?

Group AWS Management via IAM

- Root user has complete permissions
- Admins have almost complete permissions except for billing and credit
- Coming in the future, hopefully



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Access & Use AWS Cloud with a joint account – Basic Usage

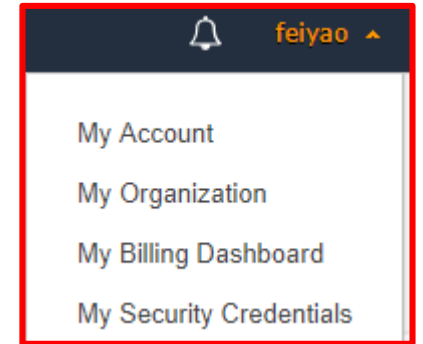
Sign In to the Console as root user

- Console login link

<https://signin.aws.amazon.com/console>

- User name

- Password



Root user sign in ⓘ

Email: fei.yao@ed.ac.uk

Password

[Forgot password?](#)

Sign in

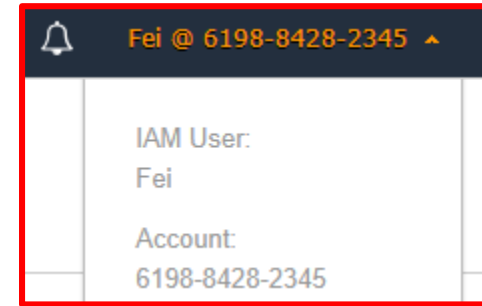
[Sign in to a different account](#)

[Create a new AWS account](#)



Access & Use AWS Cloud with a joint account – Basic Usage

Sign In to the Console as an IAM user



- Console login link

<https://619884282345.signin.aws.amazon.com/console>

- User name

IAM user name

- Password

Password

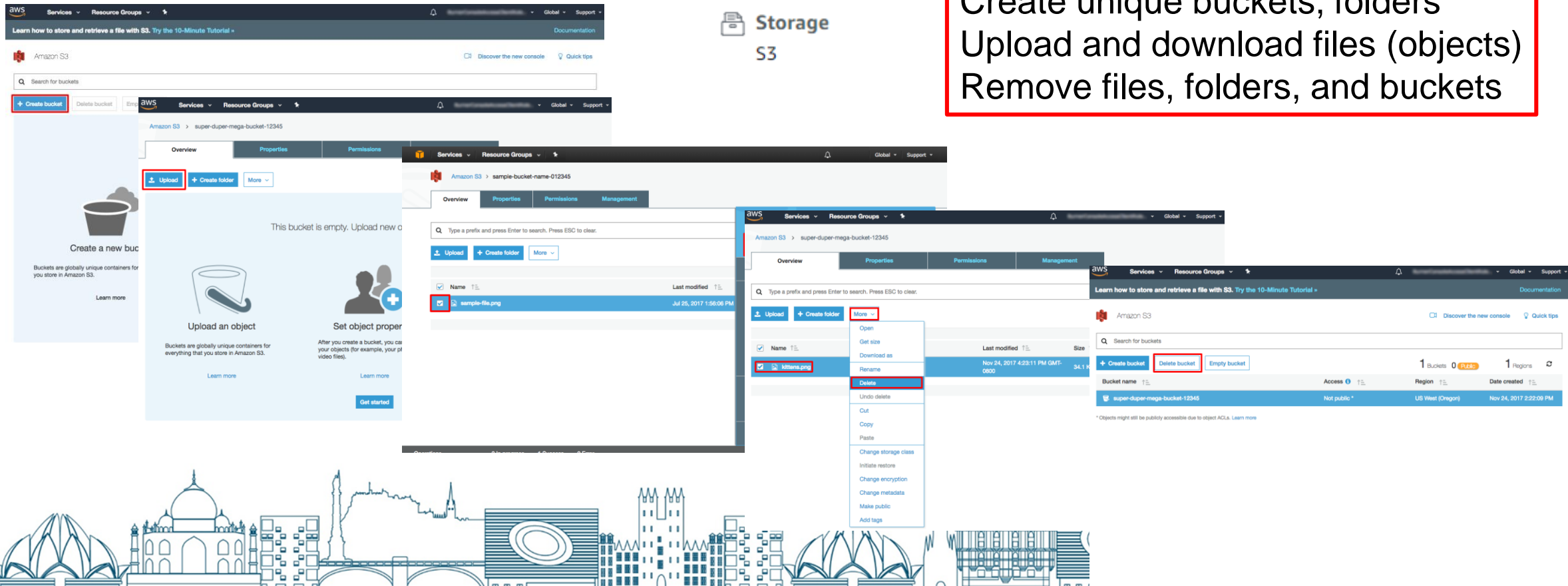
Sign In

[Sign-in using root account credentials](#)



Manipulate S3 in Graphical Console


- Create unique buckets, folders
- Upload and download files (objects)
- Remove files, folders, and buckets



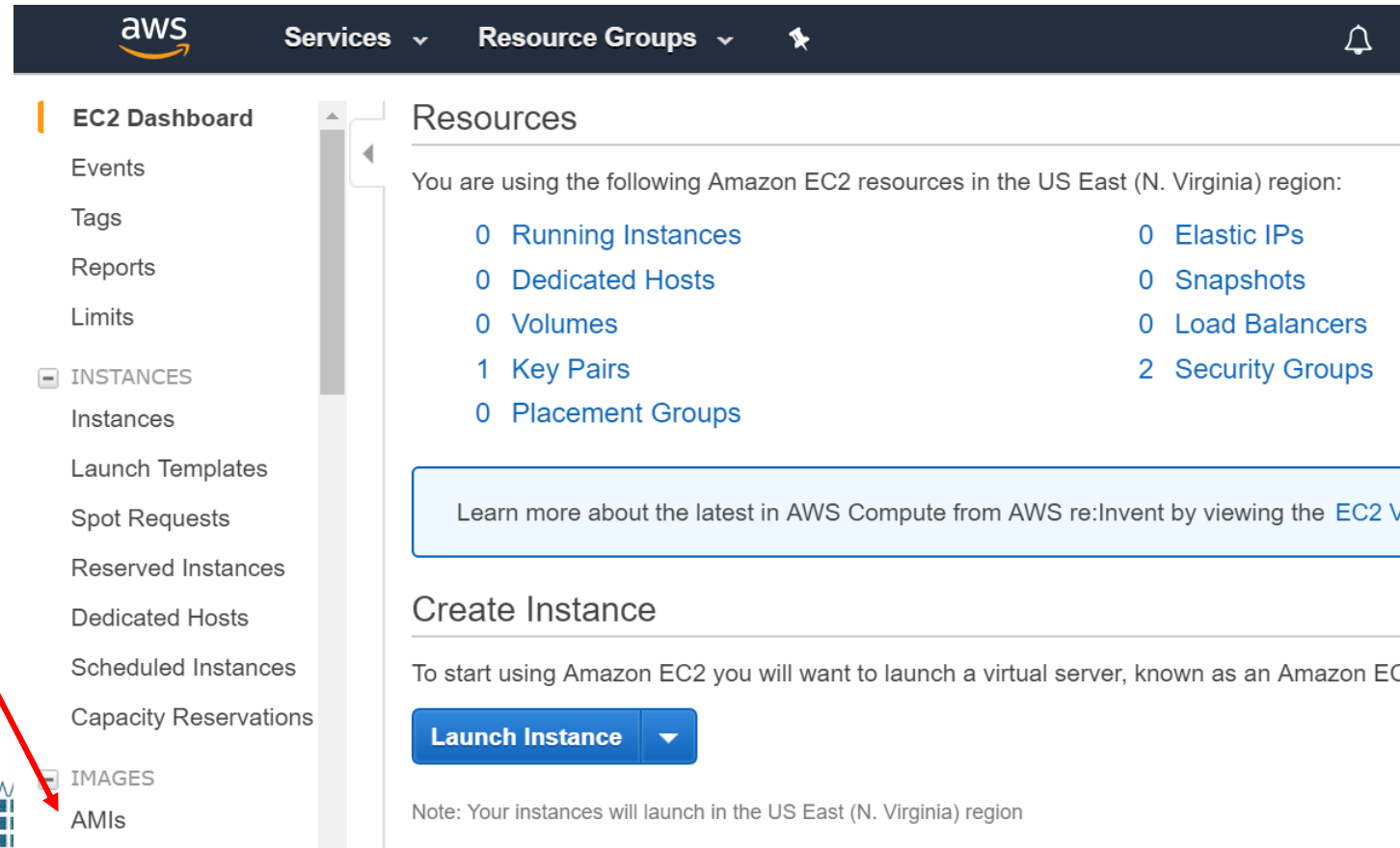
Access & Use AWS Cloud with a joint account – Basic Usage – EC2

Step 1. Switch to EC2 Dashboard

Amazon Machine Image specifies the **software** side of an EC2 instance (computer). By replicating it, you avoid installing operating system, software, libraries, etc.

 **Compute**
EC2

Click



The screenshot shows the AWS Management Console interface. The top navigation bar includes the AWS logo, 'Services' dropdown, 'Resource Groups' dropdown, and a notification bell. The left sidebar contains a list of services, with 'EC2 Dashboard' highlighted. Below it are links for 'Events', 'Tags', 'Reports', 'Limits', 'INSTANCES' (with a sub-menu for 'Instances', 'Launch Templates', 'Spot Requests', 'Reserved Instances', 'Dedicated Hosts', 'Scheduled Instances', and 'Capacity Reservations'), 'IMAGES' (with a sub-menu for 'AMIs'), and 'AMI's'. The main content area is titled 'Resources' and displays a summary of EC2 resources in the US East (N. Virginia) region: 0 Running Instances, 0 Elastic IPs, 0 Dedicated Hosts, 0 Snapshots, 0 Volumes, 0 Load Balancers, 1 Key Pairs, 2 Security Groups, and 0 Placement Groups. A blue banner promotes learning more about AWS Compute from AWS re:Invent. Below this is a 'Create Instance' section with a 'Launch Instance' button and a note that instances will launch in the US East (N. Virginia) region.

Access & Use AWS Cloud with a joint account – Basic Usage – EC2

Step 2. Search for a specific AMI such as GEOS-Chem

- Search for **ami-06f4d4afd350f6e4c** from **Public images** in the US East (N. Virginia) region – that's the system with both the classic and the High-Performance versions of GEOS-Chem installed.

Click

The screenshot shows the AWS Management Console interface. At the top, the navigation bar includes the AWS logo, 'Services', 'Resource Groups', a notification bell, the user 'Administrator @ 6198-8428-23...', and the selected region 'N. Virginia'. On the left sidebar, 'EC2 Dashboard' is selected, with other options like 'Events', 'Tags', 'Reports', 'Limits', and 'INSTANCES' visible. The main content area is titled 'Launch' and 'Actions'. It features a search bar with 'Public images' selected in the dropdown and the search term 'ami-06f4d4afd350f6e4c' entered. Below the search bar is a table of results:

	Name	AMI Name	AMI ID	Source	Owner	Visibility	Status
<input checked="" type="checkbox"/>		GEOSChem_...	ami-06f4d4afd350f6e4c	470649987867/...	470649987867	Public	available

At the bottom of the console, there is a decorative city skyline graphic.

Access & Use AWS Cloud with a joint account – Basic Usage – EC2

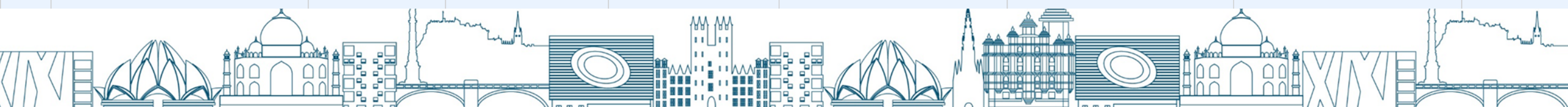
Step 3. Launch from that AMI and choose an Instance Type

- Instance Type specifies **hardware** side of an EC2 instance, mostly about CPUs.
- For longer-term, higher-resolution runs, consider bigger ones like c5.9xlarge and c5.18xlarge.

Launch

Click

Currently selected: r5.large (10 ECUs, 2 vCPUs, 2.5 GHz, Intel Xeon Platinum 8175, 16 GiB memory, EBS only)								
	Family	Type	vCPUs ⓘ	Memory (GiB)	Instance Storage (GB) ⓘ	EBS-Optimized Available ⓘ	Network Performance ⓘ	IPv6 Support ⓘ
<input checked="" type="checkbox"/>	Memory optimized	r5.large	2	16	EBS only	Yes	Up to 10 Gigabit	Yes



Access & Use AWS Cloud with a joint account – Basic Usage – EC2

Step 4. Configure Instance Details

- You can launch several instances per time
- Spot instances can always save ~70% money compared to on-demand ones.
- Choose this role to enable following awscli on EC2

Number of instances [Launch int](#)

Purchasing option ☒ Request Spot instances

Current price

Availability Zone	Current price
us-east-1a	\$0.0356
us-east-1b	\$0.0356
us-east-1c	\$0.0356
us-east-1d	\$0.0356
us-east-1f	\$0.0356

Maximum price \$

Persistent request ☐ Persistent request

Persistent request ☒ Persistent request

Interruption behavior

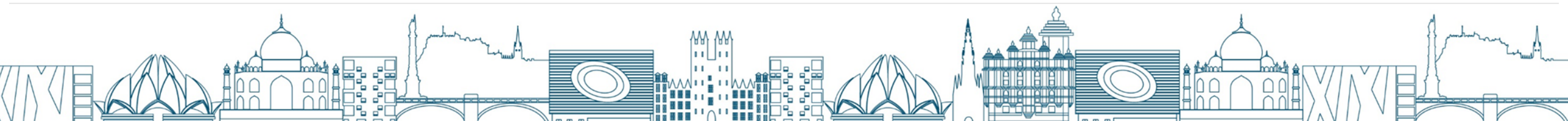
IAM role

Access & Use AWS Cloud with a joint account – Basic Usage – EC2

Step 5. Add Storage

- The volume attached to EC2 instance is called Elastic Block Storage (EBS) and can be used by EC2 instance directly. S3 is independent of any EC2 instances. AWS provides a series of commands to help transfer data between S3 and EC2 very efficiently (>100MiB/s).
- You need to use up/down arrow key to adjust volume size attached to the EC2 instance.

Volume Type <small>i</small>	Device <small>i</small>	Snapshot <small>i</small>	Size (GiB) <small>i</small>	Volume Type <small>i</small>	IOPS <small>i</small>	Throughput (MB/s) <small>i</small>	Delete on Termination <small>i</small>	Encrypted <small>i</small>
Root	/dev/sda1	snap-04993fcc4c92a71b9	<input type="text" value="200"/>	General Purpose SSD (gp2) ▼	600 / 3000	N/A	<input checked="" type="checkbox"/>	Not Encrypted



Access & Use AWS Cloud with a joint account – Basic Usage – EC2

Step 6. Configure Security Group

- “Security group” controls what IPs are allowed to access your server. Use an pre-defined one allowing all IPs to access is generally fine because we also need to have the EC2 Key Pair in order to access to a specific server.

Assign a security group: ☐ Create a new security group

☒ Select an existing security group

Security Group ID	Name	Description	Actions
<input type="checkbox"/> sg-66551026	default	default VPC security group	Copy to new
<input checked="" type="checkbox"/> sg-07edc093f7e83ac94	launch-wizard-1	launch-wizard-1 created 2019-01-14T15:37:22.887+00:00	Copy to new

Inbound rules for sg-07edc093f7e83ac94 (Selected security groups: sg-07edc093f7e83ac94)

Type ⓘ	Protocol ⓘ	Port Range ⓘ	Source ⓘ	Description ⓘ
SSH	TCP	22	0.0.0.0/0	

[Cancel](#)

[Previous](#)

[Review and Launch](#)

Access & Use AWS Cloud with a joint account – Basic Usage – EC2

Step 7. Review & Launch

EC2 Key Pair is equivalent to the password you enter to ssh to your local server, but much more secure.

Select an existing key pair or create a new key pair

A key pair consists of a **public key** that AWS stores, and a **private key file** that you store. Together, they allow you to connect to your instance securely. For Windows AMIs, the private key file is required to obtain the password used to log into your instance. For Linux AMIs, the private key file allows you to securely SSH into your instance.

Note: The selected key pair will be added to the set of keys authorized for this instance. Learn more about [removing existing key pairs from a public AMI](#).

Choose an existing key pair

Select a key pair

fei-aws-keypair

☒ I acknowledge that I have access to the selected private key file (fei-aws-keypair.pem), and that without this file, I won't be able to log into my instance.

Cancel

Request Spot Instances

Access & Use AWS Cloud with a joint account – Basic Usage – EC2

Step 8. Connect

Launch Instance

Connect

Actions

Filter by tags and attributes or search by keyword

1 to 1 of 1

	Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS (IPv4)	IPv4 Public IP	IPv6 IPs	Key Name	Monitoring	Launch Time
		i-034e1ea98c4c62009	r5.large	us-east-1a	running	Initializing	None	ec2-3-88-233-21.comp...	3.88.233.21	-	feiyao-ams-ke...	disabled	February 4

Connect To Your Instance

I would like to connect with

- ☒ A standalone SSH client
- ☐ A Java SSH Client directly from my browser (Java required)

To access your instance:

1. Open an SSH client. (find out how to [connect using PuTTY](#))
2. Locate your private key file (fei-aws-keypair.pem). The wizard automatically detects the key you used to launch the instance.
3. Your key must not be publicly viewable for SSH to work. Use this command if needed:

```
chmod 400 fei-aws-keypair.pem
```
4. Connect to your instance using its Public DNS:

[ec2-34-205-50-14.compute-1.amazonaws.com](#)

Example:

```
ssh -i "fei-aws-keypair.pem" root@ec2-34-205-50-14.compute-1.amazonaws.com
```

Please note that in most cases the username above will be correct, however please ensure that you read your AMI usage instructions to ensure that the AMI owner has not changed the

Recommend
Git Bash

root -> ubuntu

Something
already here

```
$ ssh -i fei-aws-keypair.pem ubuntu@ec2-34-205-50-14.compute-1.amazonaws.com
Welcome to Ubuntu 18.04.1 LTS (GNU/Linux 4.15.0-1021-aws x86_64)
```

```
* Documentation:  https://help.ubuntu.com
* Management:    https://landscape.canonical.com
* Support:        https://ubuntu.com/advantage
```

System information as of Mon Feb 11 14:00:08 UTC 2019

```
System load: 0.18          Processes:           267
Usage of /:   35.2% of 387.70GB Users logged in:      0
Memory usage: 1%          IP address for ens5: 172.31.9.6
Swap usage:   0%
```

Get cloud support with Ubuntu Advantage Cloud Guest:
<http://www.ubuntu.com/business/services/cloud>

```
121 packages can be updated.
0 updates are security updates.
```

```
*** System restart required ***
Last login: Sat Dec 15 20:01:59 2018 from 65.112.8.207
ubuntu@ip-172-31-9-6:~$ ls
ExtData  gchp.ubuntu.env  miniconda  tutorial
ubuntu@ip-172-31-9-6:~$
```

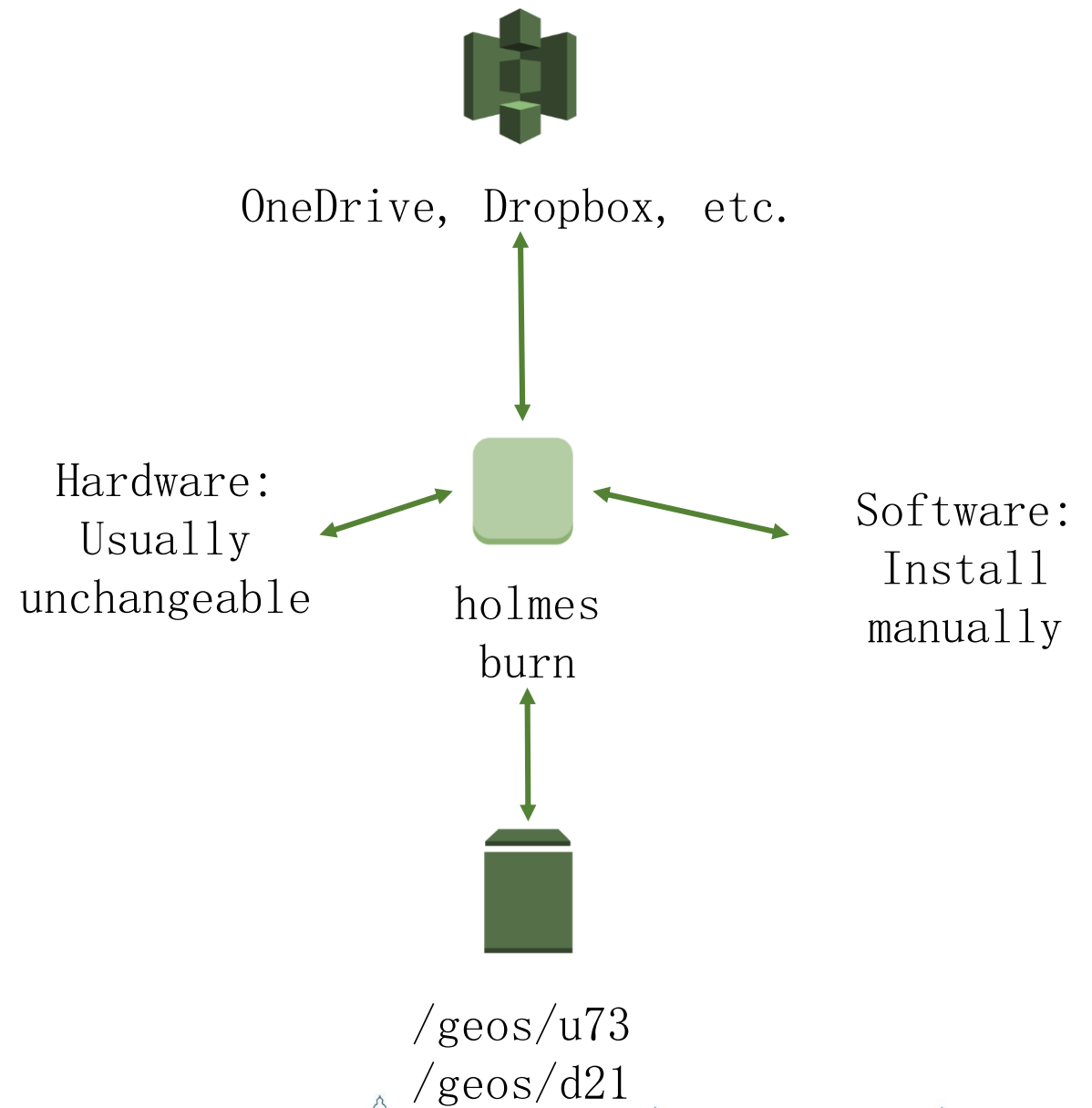
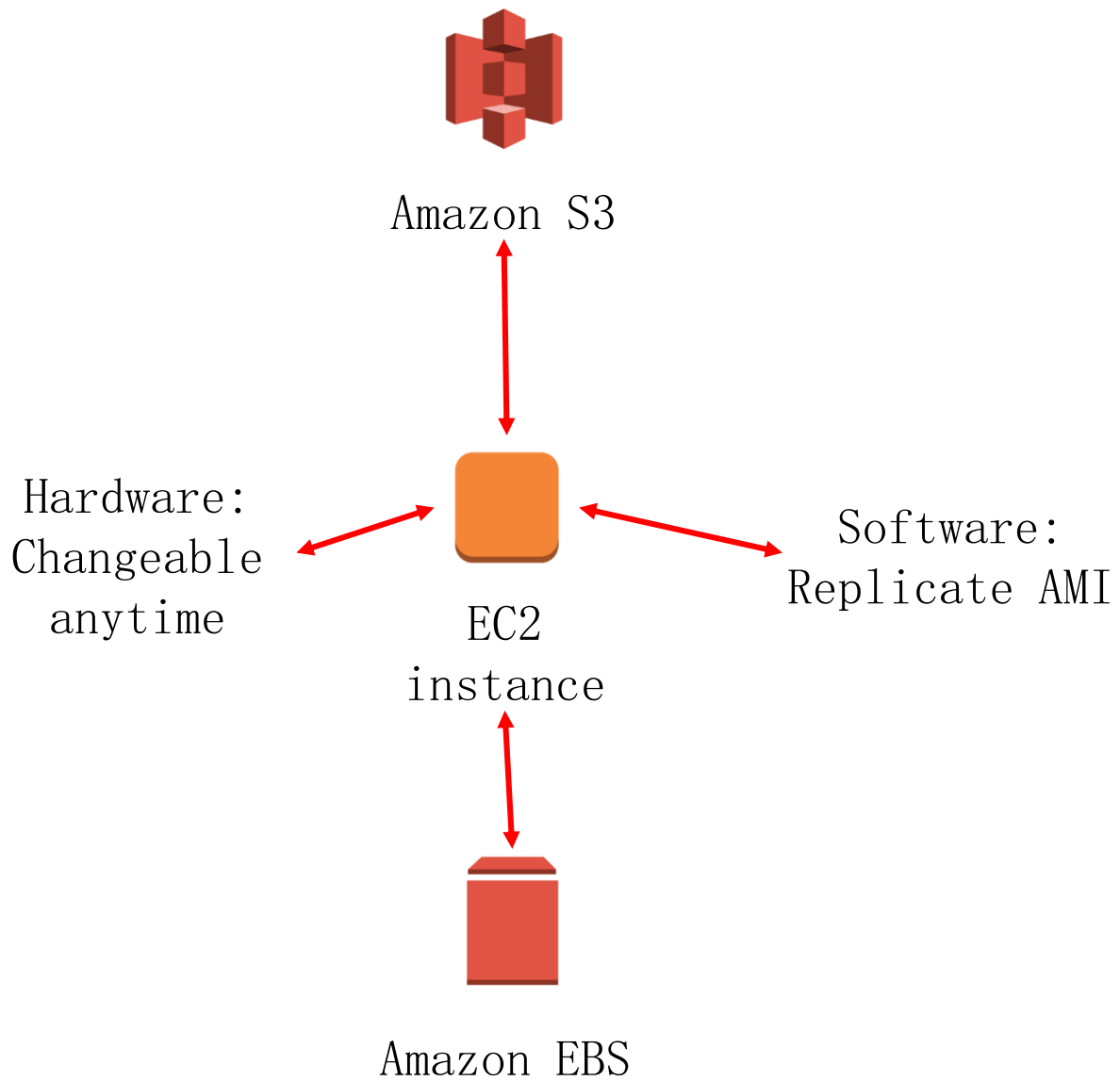
Access & Use AWS Cloud with a joint account – Basic Usage

Manipulate S3 with AWSCLI in EC2

- Create bucket `$ aws s3 mb s3://bucket-name`
- See bucket `$ aws s3 ls s3://bucket-name`
- Upload/download files/directories `$ aws s3 cp [--recursive] source target`
- Remove files/directories `$ aws s3 rm [--recursive] target`

- **Source & target** can be any combination of S3, EC2, Local **and S3**.
- These commands together with **aws ec2 ...** are also applicable in local machines provided you properly install and configure awscli.





Access & Use AWS Cloud with a joint account – Basic Usage – GEOS-Chem

Get source code and checkout model versions

- Make a separate folder

```
$ mkdir ~/GC
```
- Enter that folder

```
$ cd ~/GC
```
- Download GEOS-Chem source code & Unit tester

```
$ git clone https://github.com/geoschem/geos-chem Code.GC
$ git clone https://github.com/geoschem/geos-chem-unittest.git
UT
```
- Do version control if needed

```
$ cd Code.GC (UT)
$ git log --tags --simplify-by-decoration --pretty="format:%ci %d"
$ git checkout 12.1.0; git branch
$ git checkout master
```



Access & Use AWS Cloud with a joint account – Basic Usage – GEOS-Chem

Configure unit tester and generate run directory

- Change GCGRID_ROOT
- Change DATA_ROOT
- Change UT_TEST_ROOT
- Change COPY_PATH
- Un-comment the desired run directory

\$./gcCopyRunDirs


```
# %%% Data path and HEMCO settings %%%
#
GCGRID_ROOT   : /home/ubuntu
DATA_ROOT     : {GCGRIDROOT}/ExtData
VERBOSE       : 0
WARNINGS      : 1
#
# %%% Unit tester path names %%%
#
UNIT_TEST_ROOT : {HOME}/GC/UT
RUN_ROOT       : {UTROOT}/runs
RUN_DIR        : {RUNROOT}/{RUNDIR}
PERL_DIR       : {UTROOT}/perl
#
# %%% Target directory and copy command %%%
#
COPY_PATH      : {HOME}/GC
COPY_CMD       : cp -rfl
#
# !RUNS:
# Specify the runs directories that you want to copy below.
# Here we provide a few examples, but you may copy additional entries from
# UnitTest.input and modify the dates as needed. You can deactivate copying
# run certain directories by commenting them out with "#".
#
#-----|-----|-----|-----|-----|-----|-----|
# MET    | GRID  | NEST  | SIMULATION | START DATE | END DATE | EXTRA |
#-----|-----|-----|-----|-----|-----|-----|
# ===== Standard =====
# geosfp  4x5    -    standard    2016070100  2016080100  -
# merra2   4x5    -    standard    2016070100  2016080100  -
# geosfp   2x25   -    standard    2016070100  2016080100  -
# merra2   2x25   -    standard    2016070100  2016080100  -
# ===== GEOS-Chem benchmark =====
```


Access & Use AWS Cloud with a joint account – Basic Usage – GEOS-Chem

Configure Makefile and Compile the source code

- Change source code path

```
# Source code location (you can modify as necessary)
ifndef CODE_DIR
CODE_DIR      :=$(HOME)/GC/Code.GC
endif
```



- Compile
- # Remove all pre-compiled ones
 - # -j4 denotes 4 jobs simultaneously
 - # mpbuild denotes using multiple processors
 - # NC_DIAG denotes exporting netCDF diagnostics
 - # BPCH_DIAG denotes exporting BPCH diagnostics
 - # TIMERS?

```
$ make realclean
$ make -j4 mpbuild NC_DIAG=y BPCH_DIAG=n TIMERS=1
```



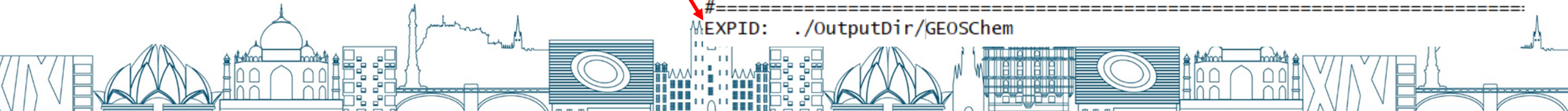
Access & Use AWS Cloud with a joint account – Basic Usage – GEOS-Chem

Configure input.geos and HISTORY.rc

- Change simulating period
- Create a directory named OutputDir under the run directory

```
%%% SIMULATION MENU %%% :  
Start YYYYMMDD, hhmmss : 20160701 000000  
End   YYYYMMDD, hhmmss : 20160701 010000  
Run directory           : ./  
Root data directory     : /home/ubuntu/ExtData  
Global offsets IO, JO   : 0 0
```

```
#=====  
# EXPID allows you to specify the beginning of the file path corresponding  
# to each diagnostic collection.  For example:  
#  
#   EXPID: ./GEOSChem  
#       will create netCDF files whose names begin "GEOSChem",  
#       in this run directory.  
#  
#   EXPID: ./OutputDir/GEOSChem  
#       will create netCDF files whose names begin with "GEOSChem"  
#       in the OutputDir sub-folder of this run directory.  
#  
#=====  
EXPID:  ./OutputDir/GEOSChem
```



Access & Use AWS Cloud with a joint account – Basic Usage – GEOS-Chem

Configure input.geos and HISTORY.rc

- Remove # to collect

- Specify collection
Frequency
Duration
Mode

```
# To enable a collection, remove the "#" character in front of its name. The
# Restart collection should always be turned on.
#
# NOTE: These are the "default" collections for GEOS-Chem, but you can create
# your own customized diagnostic collections as well.
#=====
COLLECTIONS: 'Restart',
             #'SpeciesConc',
             #'Budget',
             'AerosolMass',
             #'Aerosols',
             #'CloudConvFlux',
             #'ConcAfterChem'
#
# Aerosol and PM2.5 mass
#
# Available for full-chemistry and aerosol-only simulations
#=====
AerosolMass.template: '%y4%m2%d2_%h2%n2z.nc4',
AerosolMass.format:   'CFIO',
AerosolMass.frequency: 00000000 002000
AerosolMass.duration:  00000000 002000
AerosolMass.mode:      'time-averaged'
AerosolMass.fields:    'AerMassBC', 'GIGCchem',
                       'AerMassNH4', 'GIGCchem',
                       'AerMassNIT', 'GIGCchem',
                       'AerMassPOA', 'GIGCchem',
                       'AerMassSAL', 'GIGCchem',
                       'AerMassSO4', 'GIGCchem',
                       'AerMassSOAGX', 'GIGCchem',
                       'AerMassSOAMG', 'GIGCchem',
                       'PM25', 'GIGCchem',
                       'TotalOA', 'GIGCchem',
                       'TotalOC', 'GIGCchem',
                       ...
```



Access & Use AWS Cloud with a joint account – Basic Usage – GEOS-Chem

Pull shared data from S3 to EC2

- s3://gcgrid is where GEOS-Chem shared data reside.

```
$ for month in {07 08}
> do
> aws s3 cp --request-payer=requester --recursive \
> s3://gcgrid/GEOS_2x2.5/GEOS_FP/2016/$month \
> ~/ExtData/GEOS_2x2.5/GEOS_FP/2016/$month
> done
```



Access & Use AWS Cloud with a joint account – Basic Usage – GEOS-Chem

Obtain additional files

GEOSFP 2x2.5 CN metfield

```
$ aws s3 cp --request-payer=requester --recursive s3://gcgrid/GEOS_2x2.5/GEOS_FP/2011/01/  
~/ExtData/GEOS_2x2.5/GEOS_FP/2011/01/
```

2x2.5 restart file

```
$ aws s3 cp --request-payer=requester s3://gcgrid/GEOSCHEM_RESTARTS/v2018-  
11/initial_GEOSChem_rst.2x25_standard.nc ~/ExtData/GEOSCHEM_RESTARTS/v2018-11/
```

fix the softlink in run directory

```
$ ln -s ~/ExtData/GEOSCHEM_RESTARTS/v2018-11/initial_GEOSChem_rst.2x25_standard.nc  
~/GC/geosfp_2x25_standard/GEOSChem.Restart.20160701_0000z.nc4
```



Access & Use AWS Cloud with a joint account – Basic Usage – GEOS-Chem

Run GEOS-Chem

```
# run GEOS-Chem (To monitor running time, type time ./geos.mp)
$ ./geos.mp
```

- Subject to:
Instance type
time steps
“Warm-up”

***** E N D O F G E O S -- C H E M *****

real 8m51.286s
user 49m27.746s
sys 0m55.446s

***** E N D O F G E O S -- C H E M *****
real 4m24.605s
user 49m20.661s
sys 0m54.415s

- Denotes time-averaged value between 20160701-0000z to 20160701-0020z

```
ubuntu@ip-172-31-9-6:~/GC/geosfp_2x25_standard$ ll ./OutputDir/
total 718020
```

```
drwxrwxr-x 2 ubuntu ubuntu 4096 Feb 11 16:29 ./
drwxrwxr-x 3 ubuntu ubuntu 4096 Feb 11 16:29 ../
-rw-rw-r-- 1 ubuntu ubuntu 25402406 Feb 11 16:28 GEOSChem.AerosolMass.20160701_0000z.nc4
-rw-rw-r-- 1 ubuntu ubuntu 25346481 Feb 11 16:29 GEOSChem.AerosolMass.20160701_0020z.nc4
-rw-rw-r-- 1 ubuntu ubuntu 25312359 Feb 11 16:29 GEOSChem.AerosolMass.20160701_0040z.nc4
-rw-rw-r-- 1 ubuntu ubuntu 659173261 Feb 11 16:29 GEOSChem.Restart.20160701_0100z.nc4
```



Access & Use AWS Cloud with a joint account – Basic Usage – GEOS-Chem

Analyze model outputs using Jupyter

```
# Re-connect using port-forwarding
$ ssh -i "your-key-name.pem" ubuntu@xxx.amazonaws.com -L 8999:localhost:8999
# Activate geo python environment
$ source activate geo
# Start a jupyter
$ jupyter notebook --NotebookApp.token="" --no-browser --port=8999 --notebook-dir ~/
# Open the url and write analyzing codes
$ http://localhost:8999/
# Deactivate geo environment
$ source deactivate
```



Access & Use AWS Cloud with a joint account – Basic Usage – GEOS-Chem

Save files to S3, terminate server, and start over whenever needed

```
# Save files (most time run directories) to S3
$ aws s3 cp --recursive ~/GC s3://fei-geoschem-run-directory/GC
# Terminate server (to do this in the graphical console is convenient enough)
# Start an EC2 Instance again (steps have been described before)
# Retrieve run directories from S3 back to EC2
$ aws s3 cp --recursive s3://fei-geoschem-run-directory/GC ~/GC
# Restore execution permission for geos.mp
$ chmod u+x ~/GC/geosfp_2x25_standard/geos.mp
# Obtain shared data and GEOSFP 2x2.5 CN metfield (refer to p.28, 29)
```



Access & Use AWS Cloud with a joint account – Basic Usage

Satellite remotely sensed data processing

- Launch an EC2 instance
- Upload satellite data to S3 (bear in mind that some satellite data are already in S3)
- Pull satellite data from S3 to EC2
- Write Python or similar codes to process satellite data
- Export processed data to S3 and shut down EC2



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Access & Use AWS Cloud with a joint account – Advanced Topics

Simplify login process via scripts

- Create Access Key under My security credentials dashboard

The screenshot displays the AWS IAM console interface. On the left sidebar, the user is logged in as 'Administrator @ 6198-8428-2345'. The 'My Security Credentials' link is circled in red. The main content area shows the 'AWS IAM credentials' tab selected, which is also circled in red. Below this, the 'Password for console access' section is visible, followed by the 'Access keys for CLI, SDK, & API access' section. The 'Create access key' button is circled in red. A red arrow points from this button to the 'Download .csv file' button, which is also circled in red. A green success message states: 'Your new access key is now available.' Below this, a warning message says: 'This is the only time that the secret access key can be viewed. You cannot recover it later. However, you can create new access keys.' The table below shows the 'Access key ID' as 'AKIAICXBCQO473G2PPB...' and the 'Secret access key' as 'Show secret access key'.

Administrator @ 6198-8428-2345

IAM User:
Administrator

Account:
6198-8428-2345

My Account

My Organization

My Billing Dashboard

My Security Credentials

Switch Role

Sign Out

AWS IAM credentials | AWS CodeCommit credentials

Password for console access

As an IAM user, you need a password to access the AWS Management Console. Your password is 0 days old. [Learn more](#)

Change password

Access keys for CLI, SDK, & API access

Use access keys to make programmatic calls to AWS from the command line, SDKs, or direct AWS API calls. **If you lose or forget your secret key, you must create a new one.** [Learn more](#)

Create access key

You do not have active access keys.

Create access key

✓ Your new access key is now available.

This is the only time that the secret access key can be viewed. You cannot recover it later. However, you can create new access keys.

Download .csv file

Access key ID	AKIAICXBCQO473G2PPB...
Secret access key	Show secret access key

Access & Use AWS Cloud with a joint account – Advanced Topics

Simplify login process via scripts

- Install AWSCLI on your own computer (i.e. `pip install awscli`)
- Run `aws configure`

```
[s1855106@burn ~]$ aws configure
AWS Access Key ID [None]: AKIAICXBCQO
AWS Secret Access Key [None]: 9pRSkCA
Default region name [None]: us-east-1
Default output format [None]: json
```

- It's in the `accessKeys` file you downloaded
- `us-east-1` is an alias to the “US East (N. Virginia)” region
- Specify configure output format as `json`

- Configure files are stored in `~/.aws` directory



Access & Use AWS Cloud with a joint account – Advanced Topics

Simplify login process via scripts

- Write a script and store it in a directory contained in \$PATH
- Run the script from terminal
- Export the AWSCLI path under Windows
- If require spot instance

```
1 #!/bin/bash
2
3 # == often change ==
4 TYPE=c5.4xlarge # EC2 instance type
5
6 # == set it once and seldom change ==
7 AMI=ami-06f4d4afd350f6e4c # AMI to launch from
8 COUNT=1 # how many instances to launch
9 IAM=full_S3_access_from_EC2 #EC2 IAM role name
10 EBS_SIZE=400 # root EBS volume size (GiB)
11 SG=sg-07edc093f7e83ac94 # security group ID
12 KEY=fei-aws-keypair # EC2 key pair name
13
14 # == almost never change; just leave it as is ==
15 aws ec2 run-instances --image-id $AMI \
16     --instance-type $TYPE \
17     --count $COUNT \
18     --iam-instance-profile Name=$IAM \
19     --block-device-mapping DeviceName="/dev/sda1",Ebs={VolumeSize=$EBS_SIZE} \
20     --security-group-ids $SG \
21     --key-name $KEY \
22     --instance-market-options '{"MarketType":"spot"}'
```



Access & Use AWS Cloud with a joint account – Advanced Topics

Keep program running after logging out using tmux

- Create a new session
- Split a panel
- Switch between panels
- Detach from a session
- List all sessions
- Attach to a session

```
$ tmux new -s session_name
```

- Ctrl-b %/"
- Ctrl-b ←/→/↑/↓
- Ctrl-b d

```
$ tmux list
```

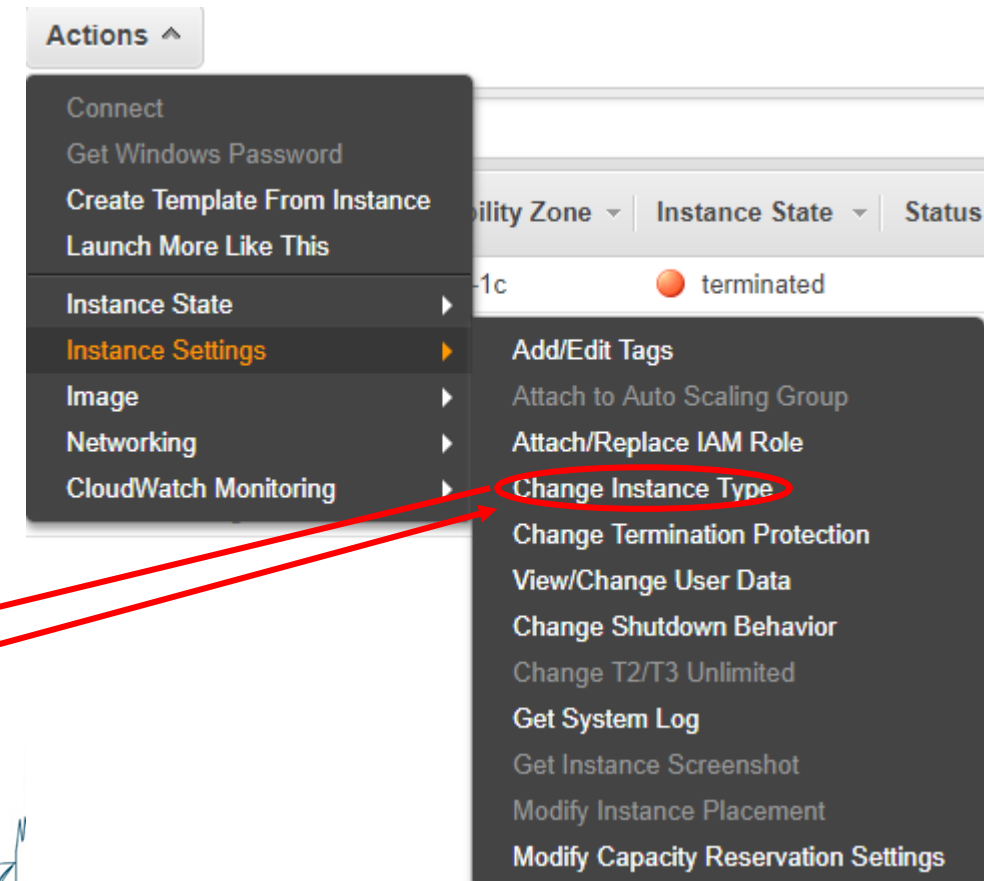
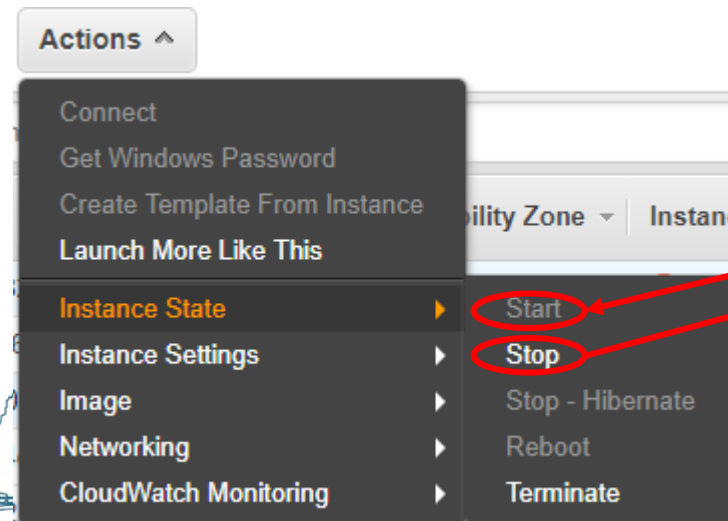
```
$ tmux attach -t session_name
```



Access & Use AWS Cloud with a joint account – Advanced Topics

What if I want to change Instance Type of a launched EC2 instance?

- On-demand instances support this kind of demand.
- Stop the instance -> Change its instance type
-> start it again



Access & Use AWS Cloud with a joint account – Advanced Topics

What if I need more volume size to a launched EC2 instance?

- Create a volume

The screenshot shows the AWS Management Console interface for creating a new EBS volume. The left sidebar contains the navigation menu, with 'ELASTIC BLOCK STORE' and 'Volumes' highlighted. The main content area shows the 'Create Volume' form with the following fields:

- Volume Type:** General Purpose SSD (gp2)
- Size (GiB):** 100 (Min: 1 GiB, Max: 16384 GiB)
- IOPS:** 300 / 3000 (Baseline of 3 IOPS per GiB with a minimum of 100 IOPS, burstable to 3000 IOPS)
- Availability Zone*:** us-east-1a
- Throughput (MB/s):** Not applicable
- Snapshot ID:** Select a snapshot
- Encryption:** ☐ Encrypt this volume

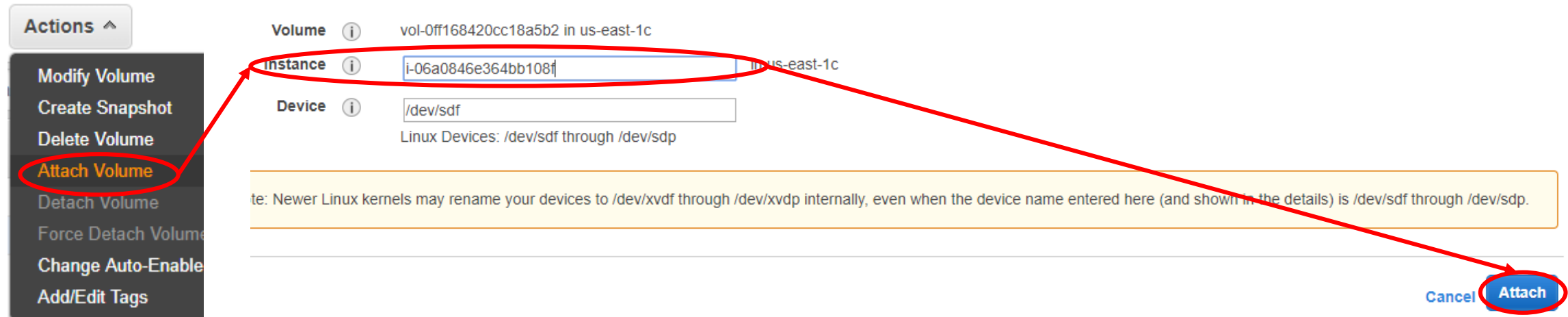
At the bottom, a table lists existing volumes:

Name	Volume ID	Size	Volume Type	IOPS	Snapshot	Created	Availability Zone	State	Alarm Status	Attachment Information	Monitoring	Volume Status	Encrypted
	vol-065b58d...	400 GiB	gp2	1200	snap-04993fcc	February 12, 2019	us-east-1c	in-use	None	i-06a0846e364bb108...		Okay	Not Encrypted
	vol-0ff16842...	100 GiB	gp2	300		February 12, 2019	us-east-1c	available	None			Okay	Not Encrypted

Access & Use AWS Cloud with a joint account – Advanced Topics

What if I need more volume size to a launched EC2 instance?

- Attach that volume to an EC2 instance



Access & Use AWS Cloud with a joint account – Advanced Topics

What if I need more volume size to a launched EC2 instance?

- Make that volume usable

```
# Show that volume to be mounted
$ lsblk
# Create a file system for that volume
$ sudo mkfs -t ext4 /dev/nvme1n1
# Mount that volume to a directory
$ mkdir new_disk
$ sudo mount /dev/nvme1n1 new_disk
```

```
# Show the mounted volume
$ df -h
# Change permission
$ sudo chown ubuntu new_disk
# Touch a new file
$ touch ~/new_disk/new_text
```



Access & Use AWS Cloud with a joint account – Advanced Topics

What if I need more volume size to a launched EC2 instance?

- Share files between EC2 instances via EBS

```
# Umount the mounted volume
$ sudo umount /dev/nvme1n1
# Rmove new_disk (Optional)
$ rmdir new_disk
# Detach that volume
```

```
# Attach to another instance
# Mount that volume to a directory
$ mkdir new_disk
$ sudo mount /dev/nvme1n1 new_disk
# Show contents in new_disk
$ ls new_disk/
```

Actions ^

Modify Volume
Create Snapshot
Delete Volume
Attach Volume
Detach Volume
Force Detach Volume
Change Auto-Enable IO Setting

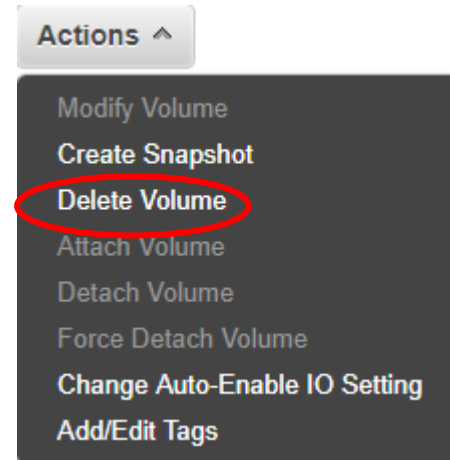


Access & Use AWS Cloud with a joint account – Advanced Topics

What if I need more volume size to a launched EC2 instance?

- Sweep the battlefield

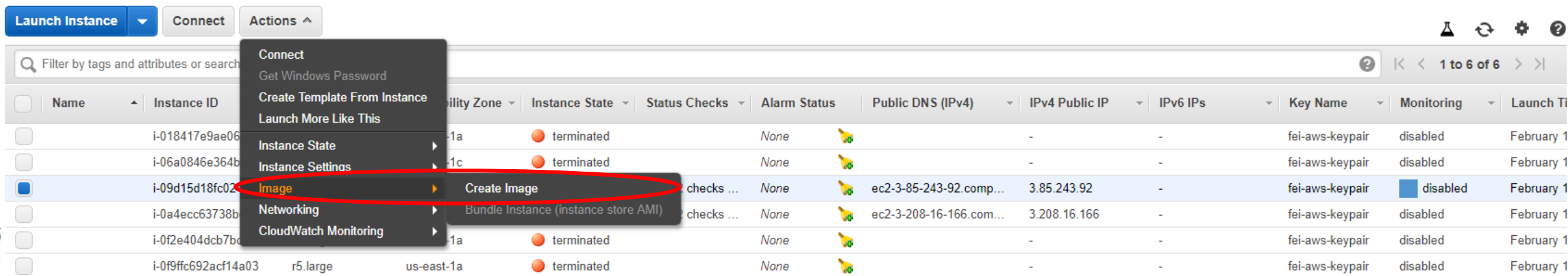
```
# Save files to S3 if applicable
# Umount the mounted volume
$ sudo umount /dev/nvme1n1
# Rmove new_disk (Optional)
$ rmdir new_disk
# Detach that volume
# Delete that volume
```



Access & Use AWS Cloud with a joint account – Advanced Topics

What if I want to customize my own EC2 instance and save it in order to facilitate later use?

- Launch an instance from a clean AMI
- Install compilers, libraries, and etc. by apt or yum dependent on which system you launch
- Save that instance as your AMI



The screenshot shows the AWS Management Console interface for EC2 instances. The 'Actions' dropdown menu is open, and the 'Image' option is selected, which has opened a sub-menu where 'Create Image' is highlighted with a red circle. The background shows a table of EC2 instances with columns for Name, Instance ID, Availability Zone, Instance State, Status Checks, Alarm Status, Public DNS (IPv4), IPv4 Public IP, IPv6 IPs, Key Name, Monitoring, and Launch Time.

Name	Instance ID	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS (IPv4)	IPv4 Public IP	IPv6 IPs	Key Name	Monitoring	Launch Time
	i-018417e9ae06...	us-east-1a	terminated	checks ...	None	ec2-3-85-243-92.comp...	3.85.243.92	-	fei-aws-keypair	disabled	February 1
	i-06a0846e364b...	us-east-1c	terminated	checks ...	None	ec2-3-208-16-166.com...	3.208.16.166	-	fei-aws-keypair	disabled	February 1
	i-09d15d18fc02...	us-east-1a	terminated	checks ...	None	ec2-3-85-243-92.comp...	3.85.243.92	-	fei-aws-keypair	disabled	February 1
	i-0a4ecc63738b...	us-east-1a	terminated	checks ...	None	ec2-3-208-16-166.com...	3.208.16.166	-	fei-aws-keypair	disabled	February 1
	i-0f2e404dcb7b...	us-east-1a	terminated	checks ...	None	ec2-3-85-243-92.comp...	3.85.243.92	-	fei-aws-keypair	disabled	February 1
	i-0f9ffc692acf14a03	us-east-1a	terminated	checks ...	None	ec2-3-208-16-166.com...	3.208.16.166	-	fei-aws-keypair	disabled	February 1

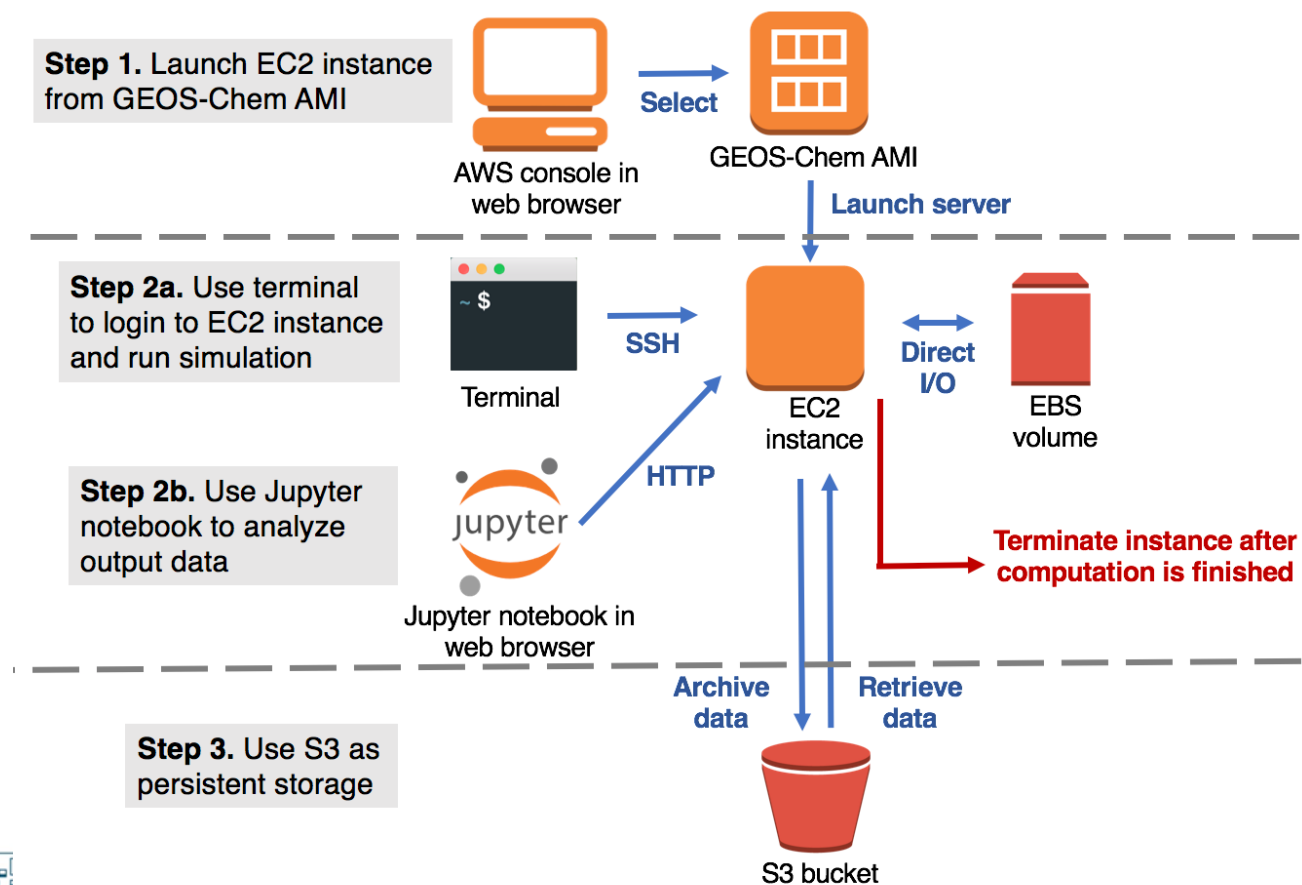
Contents

- What is Cloud Computing?
- What is AWS Cloud and Why?
- Access & Use AWS Cloud with a Joint Account
 - Basic usage
 - Advanced topics
- Summary & Prospects



Summary & Prospects

GEOS-Chem research workflow on the AWS cloud



(Zhuang et al., 2019,
submitted to BAMS)

Summary & Prospects

High Performance GEOS-Chem

- Already on AWS deserving exploration.

More flexible permission controls within group

- Will surely come in the near future with your effort.

Prepayment

- e.g. Reserved Instance



Materials mainly from:

GEOS-Chem on AWS cloud tutorial

- <https://cloud-gc.readthedocs.io/en/latest/index.html>

AWS Document

- https://docs.aws.amazon.com/index.html#lang/en_us





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Thanks! Your Response is appreciated!

