Research Cloud Computing Ecosystem in Armenia

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TABLE OF CONTENTS

1

OVERVIEW

1. OVERVIEW - HISTORY

DISTRIBUTED SYSTEM
Network-based concurrent computing environment

GRID INFRASTRUCTURE
Nation-wide Grid infrastructure.

2001

2004

2007

2014

ARMCLUSTER HPC
A centralized HPC system

CLOUD
IaaS Cloud infrastructure in BSEC region and Armenia

H. Astsatryan, V. Sahakyan, Yu. Shoukourian, J. Dongarra, P.H. Cros, M. Dayde, P. Oster, Strengthening compute and data intensive capacities of Armenia, IEEE RoEduNet, 2015.

1. OVERVIEW - SOFTWARE

2001: DC
- Linux + PVM

2007: GRID
- gLite
  - EMI 1 – EMI 3

2004: HPC
- Linux + OSCAR
  - Linux + Rocks
    - Linux + Warewulf

2014: CLOUD
- Eucalyptus
  - OpenNebula
    - OpenStack

1. OVERVIEW - VISION
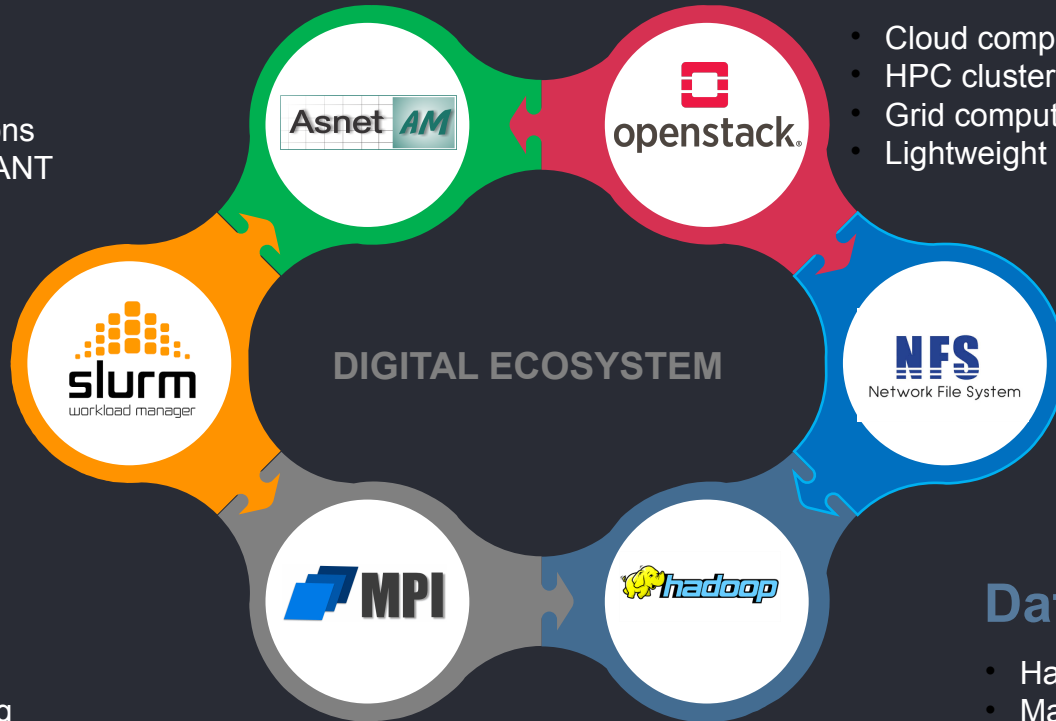
High-speed network

- ASNET-AM
  - Dark fiber network
  - Over 65 organizations
  - Interconnect to GÉANT

Software

- Libraries
- Packages
- Middlewares
- Queue systems
- Ticketing systems

Algorithms

- Distributed & parallel
- AI and machine learning
- Data analytics

Computing resources

- Cloud computing
- HPC cluster computing
- Grid computing
- Lightweight computing

Storage resources

- Tape
- NAS
- Hybrid
- All-flash

Data processing

- Hadoop/Spark
- MapReduce
- Archieving

DIGITAL ECOSYSTEM

Asnet AM

openstack

slurm workload manager

NFS Network File System

MPI

hadoop

1. OVERVIEW - SERVICES

01 INFRASTRUCTURE

1. **Internet and GEANT access**
2. **IaaS Cloud (1-64 cores per VM),** cloud.asnet.am
3. **AI cloud on GPUs,** cloud.asnet.am
4. **Container cloud,** cloud.asnet.am
5. **DNS, Hosting**

02 COLLABORATIVE

1. **eduroam,** eduroam.am
2. **Distance learning,** meet.asnet.am
3. **Mail system,** mail.asnet.am
4. **Cloud storage,** nextcloud.asnet.am
5. **Music without border,** Lola

03 DOMAIN SPECIFIC

1. **Data preservation,** noad.sci.am
2. **Earth Observation,** datacube.sci.am
3. **Repositories & mirroring,** mirrors.asnet.am
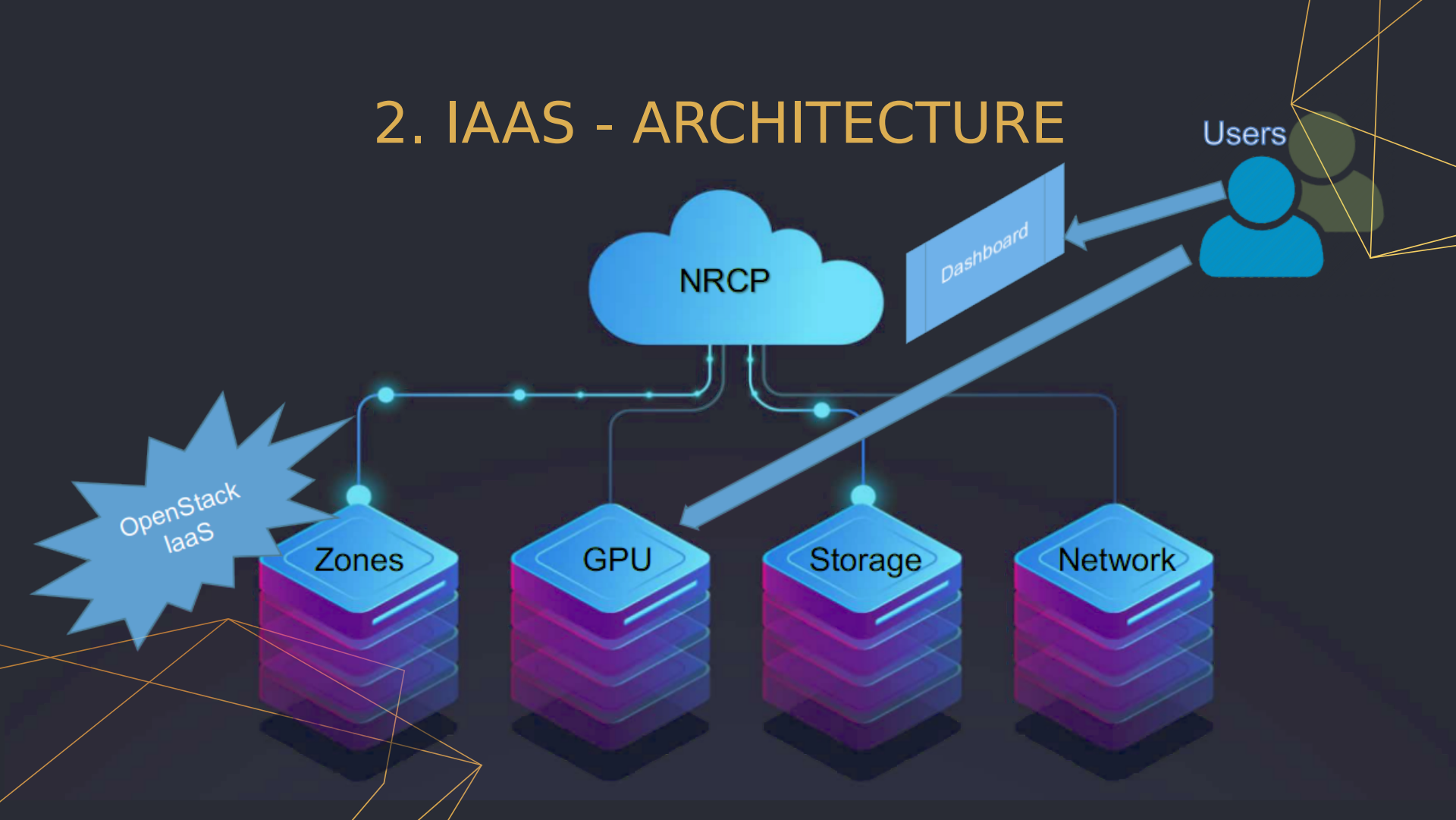4. **SaaS and Jupyter notebooks**

2

IaaS Cloud Infrastructure

2. IAAS - ARCHITECTURE

2. IAAS – COMPUTATIONAL RESOURCES

Server type	Quantity	CPU/GPU model	Server parameters			Total cores
			CPU/GPUs	Cores	RAM (GB)	
Thin	4	Intel Xeon E5-2630 v4	2	20	256	80
Fat	2	Intel Xeon Gold 6138	4	80	512	160
Accelerated	2	Intel Core i9-10900KF	1	10	128	20
	2	Intel Xeon E5-2680 v3	2	24	128	48
		Intel Xeon Phi 7120P	2	122		244
	2	Intel Xeon Gold 5218	2	32	192	64
		Nvidia V100 32GB	2	10240		20480
					Total (cores)	21096

2. IAAS – FLAVOURS

Label	Type	Description
General Simulations	small-1 small-2 M1, M2 Practical-1,Practical-2	These flavors mainly used for general simulations and tasks where there is no need for big number of resources (CPU, RAM)
HPC	HPC1-6	Optimized flavors with big number of CPUs and Memory mainly used for HPC tasks
Domain Specific	Large1-4	Powerful virtual machines for specific domains where the simulation needs to be run for several days

2. IAAS – STORAGE RESOURCES

Brand	Model	Type	Quantity	Raw capacity (TB)	Total capacity (TB)
HPE	MSA 2052	All-flash	2	8	16
NetApp	E2824	Hybrid	1	12	12
NetApp	E5760	Hybrid	2	720	1440
QNAP	TS-809U-RP	NAS	1	12	12
Supermicro	JBOD Enclosure	NAS	1	40	40
HPE	MSL 2024	Tape (cold)	1	100	100
				Total (TB)	**1620**

2. IAAS – FILE SYSTEMS

Archived data	→	LTFS/RAW
Research data	→	NextCloud
Computing data	→	Ceph/NFS
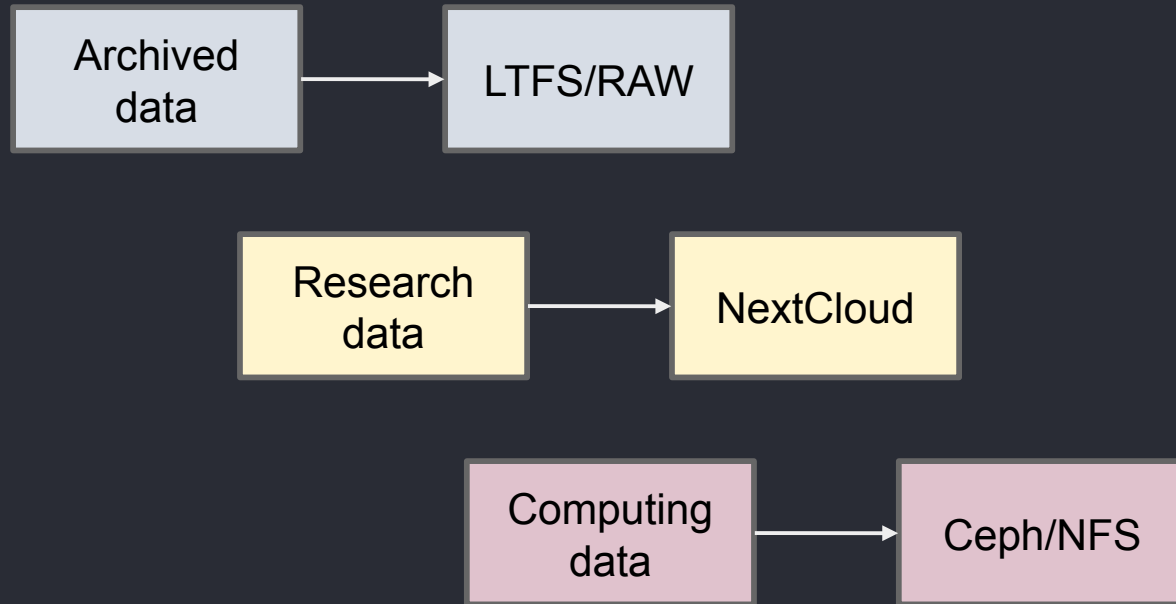
3

COMMUNITIES

3. COMMUNITIES - OVERVIEW

Zone1

Earth science
Digitization and cultural heritage

Zone2
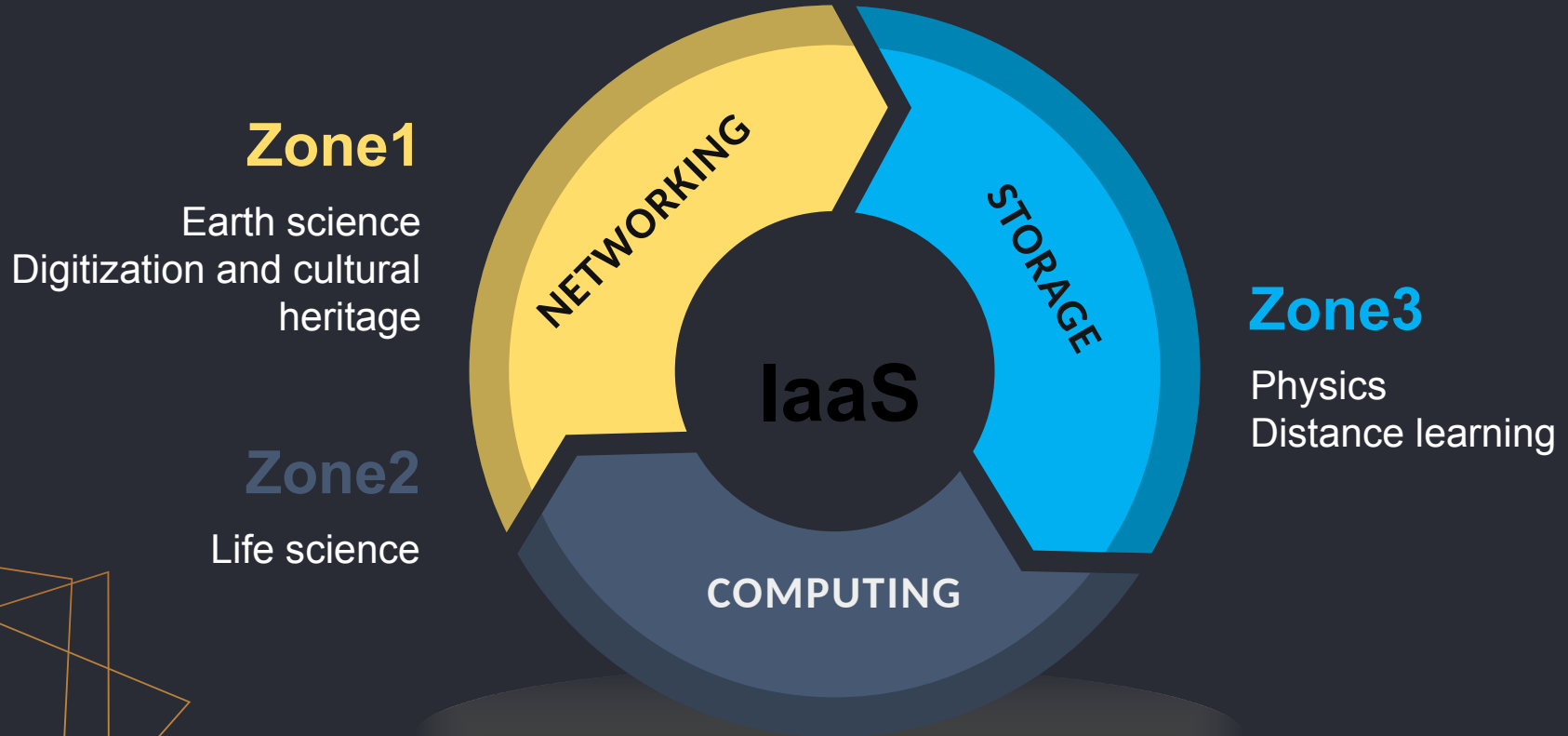
Life science

NETWORKING

STORAGE

COMPUTING

IaaS

Zone3

Physics
Distance learning

3. COMMUNITIES - BENEFICIARIES

NAS RA

- Supporting the multiwavelength monitoring of the bright Blazars (Relativistic Astrophysics Network)
- Monitoring the environment with Earth observation in Armenia (CENS)
- Empowering the Armenian Genome project with HPC resources (MolBio)
- Adsorption features of some molecules on metal surfaces (ISEC)
- Whole-genome-based phylogeny of ASF viruses (Molbio, IIAP)
- Boosting laser physics and quantum computing simulations (IPR)
- Preserving the past for the future for the Armenian cultural heritage: TIME MACHINE (FLIB)
- Armenian Virtual Observatory (BAO)

Academia | Universities

Stakeholders | Industry
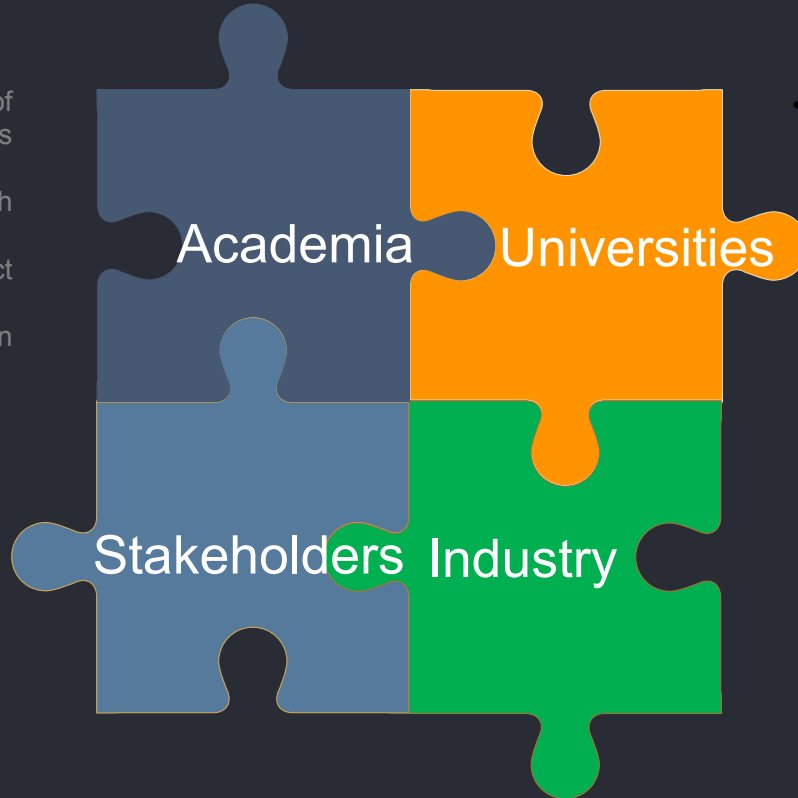
Ministries

- Supporting weather 'nowcasting' to prevent damage in Armenia (Ministry of Environment)

Universities

- Enabling computational materials discovery and atomic scale simulations (YSU)
- Estimation of metastable states of proteins with HPC resources for drug design (Slavonic)

Industry

- Supporting research and development on RINA, an emerging network architecture (RINA)

4

DOMAIN SPECIFIC SERVICES

4. SERVICES - ASTROPHYSICS

DATA DISCOVERY AND CROSS-CORRELATION SERVICES

Cross-correlation algorithm
to correlate the astronomical catalogs

Method and API
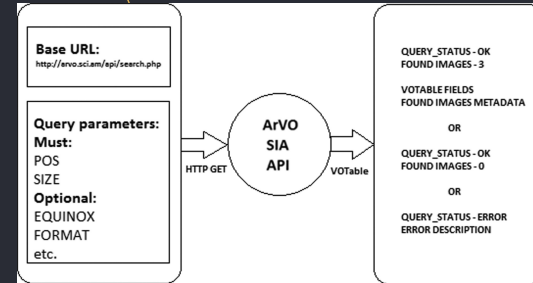to discover, access, and retrieve multi-dimensional images

Cross-correlation page

Please upload catalogs to correlate those with each other or with available on the server catalogs. You must read requirements for uploaded catalogs before starting a correlation.

Browse...   Browse...
IRAS/PSC   IRAS/FSC

By RMS - 3.0 sigma   By Radius (arcsec) 10.0

Submit Query

Base URL:
http://arvo.sci.am/api/search.php

Query parameters:
Must:
POS
SIZE
Optional:
EQUINOX
FORMAT
etc.

HTTP GET

ArVO
SIA
API

VOTable

QUERY_STATUS - OK
FOUND IMAGES - 3

VOTABLE FIELDS
FOUND IMAGES METADATA

OR

QUERY_STATUS - OK
FOUND IMAGES - 0

OR

QUERY_STATUS - ERROR
ERROR DESCRIPTION

A. Knyazyan, H. Astsatryan, A. Mickaelian. Armenian virtual observatory simple image access service. Elsevier Astronomy and computing, vol. 19, 2017.
H. Astsatryan, A. Knyazyan, A. Mickaelian. Computational Astrophysics Towards Exascale Computing and Big Data. ASPC, vol. 505, pages 220-225, 2016.

4. SERVICES – EARTH OBSERVATION

Armenian Data Cube

High-resolution disaster detection and monitoring of environmental changes from Landsat and Sentinel imagery analysis-ready data
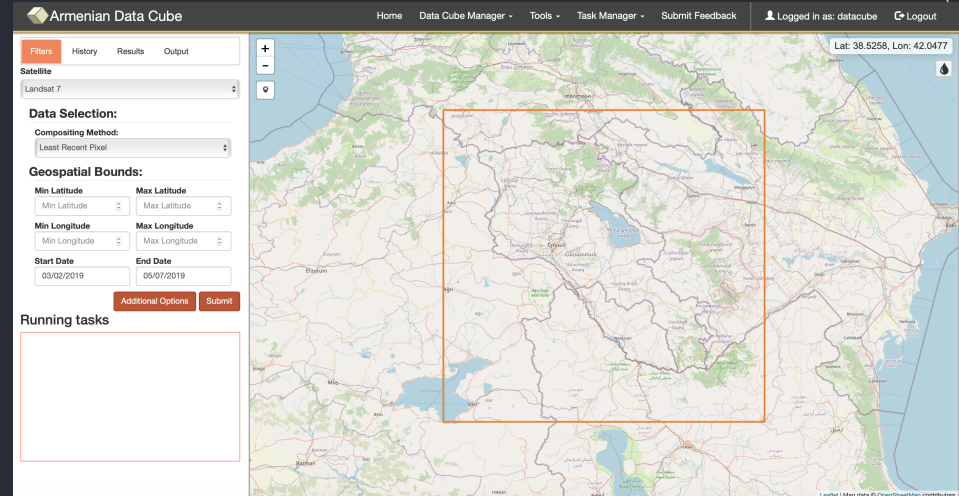
H. Astsatryan, H. Grigoryan, A. Poghosyan, R. Abrahamyan, Sh. Asmaryan, V. Muradyan, G. Tepanosyan, Y. Guigoz, G. Giuliani, Air temperature forecasting using artificial neural network for Ararat valley, Springer Earth Science Informatics, vol 14, no. 2, pp. 711-722, DOI: 10.1007/s12145-021-00583-9, 2021.

4. SERVICES – CLIMATE & WEATHER FORECAST

Higher resolution and precise climate change and environmental forecasting combining complex digital model's accuracy through mathematical modelling and simulations in addition to real-world observations and measurement data

Service to improve the weather forecast

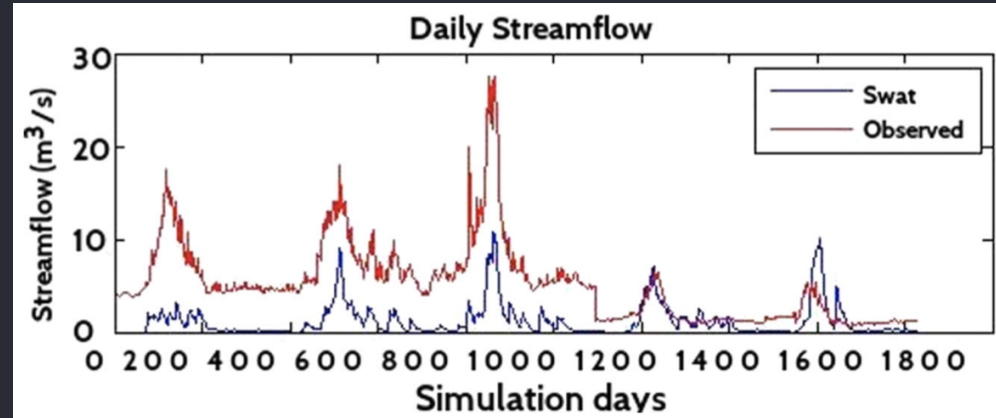uses different weather prediction models (like WRF-ARW) and parameterizations
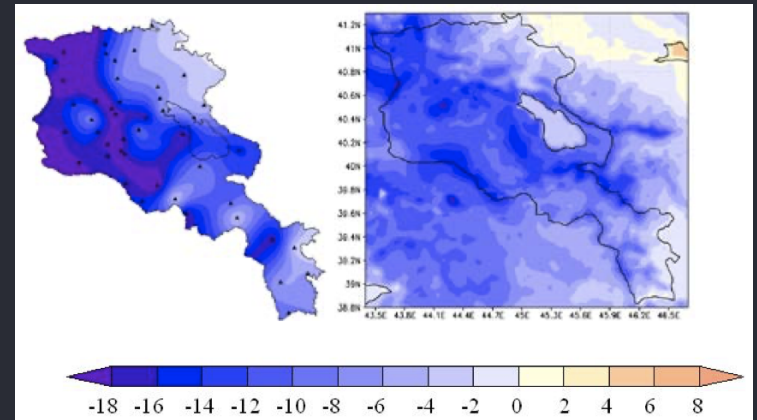
H. Astsatryan, A. Shakhnazaryan, V. Sahakyan, Yu. Shoukourian, V. Kotroni, Z. Petrosyan, R. Abrahamyan, H. Melkonyan. WRF-ARW Model for Prediction of High Temperatures in South and South East Regions of Armenia. In IEEE e-Science, pp. 207–213. IEEE, 2015.

4. SERVICES – HYDROLOGICAL MODELLING

DaaS Cloud service

to carry out long-term simulation of large watersheds using coarse spatial and temporal resolution hydrological models

H. Astsatryan, W. Narsisian, Sh Asmaryan. SWAT hydrological model as a DaaS cloud service. Springer Earth Science Informatics 9(3), pp. 401–407, 2016.

5

FUTURE ACTIVITIES

5. RESEARCH PERSPECTIVES

COMPUTING ECOSYSTEM

- High performance and energy-efficient services and tools
- Efficient parallel algorithms and methods

RESOURCE MANAGEMENT

- Memory optimizations
- Mathematical modeling and methods
- Energy-aware data management

LINEAR ALGEBRA

- Data reuse
- Efficient algorithms focusing on chunk-sizes and communications

5. RESEARCH PERSPECTIVES

HPDA

- Optimized bare-metal and virtualized architectures
- Performance modeling and analysis
- Service provisioning

IoT

- Fog-to-Fog methods
- Fog-to-Cloud methods

AI/ML

- Suspendisse viverra sodales mauris.
- Meet scientific and societal challenges
- Analyze HPDA simulations' results

5. FUTURE ACTIVITIES

INFRASTRUCTURE UPDATES

New SC (12K cores)

5. FUTURE ACTIVITIES

NATIONAL OPEN SCIENCE CLOUD INITIATIVE

open science for all relevant stakeholders

THANK YOU!

DO YOU HAVE ANY QUESTION?

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