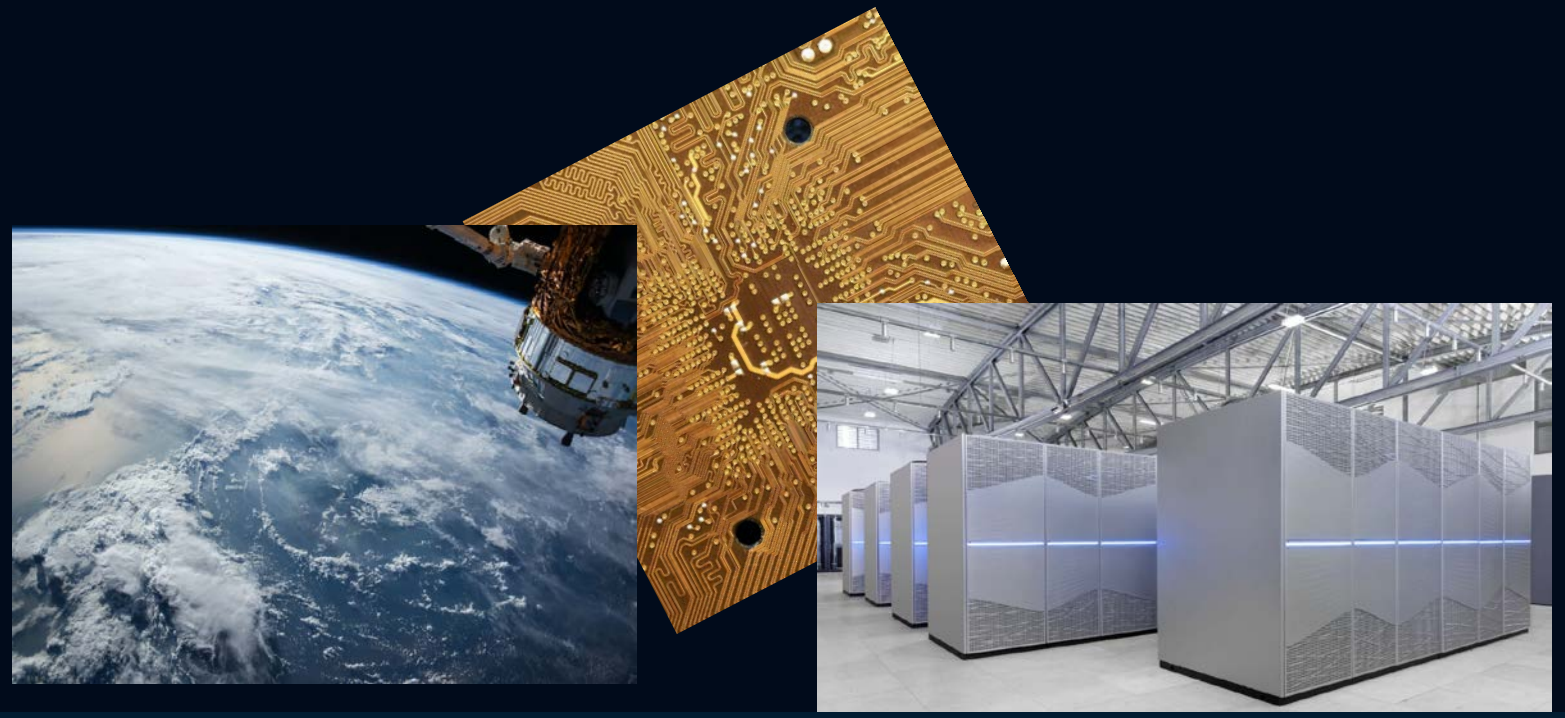


4TH SCHOOL ON HIGH-PERFORMANCE AND DISRUPTIVE COMPUTING IN REMOTE SENSING

HDCRS - Working Group of the IEEE GRSS Earth Science Informatics Technical Committee (ESI TC)

PROF. DORA BLANCO HERAS (UNIVERSITY OF SANTIAGO DE COMPOSTELA)
FULL PROFESSOR (UNIVERSITY OF SANTIAGO E COMPOSTELA)
SENIOR RESEARCHER CITIUS (CENTRO SINGULAR DE INVESTIGACIÓN EN TECNOLOXÍAS INTELIXENTES)

Centro Singular de Investigación en Tecnoloxías Intelixentes

USC UNIVERSIDADE DE SANTIAGO DE COMPOSTELA

TEAM +140 PEOPLE

35 SENIOR RESEARCHERS

citius.gal

COORDINATED EUROPEAN PROJECTS

NANOVR

Nanoscale Design using Virtual Reality

NL4XAI

Interactive Natural Language for Explainable AI (Coordinator)

MENELAOS NT

Multimodal Fusion of Sensor Information

HYBRIDS

Hybrid intelligence to monitor, promote and analyse transformations in good democracy practices

R&D RESULTS 2019-21

ARTICLES

72% in Q1

36% in D1

22% in top 10% **most cited**

9,2M €

16% income from **european projects**

Based in Santiago de Compostela, UNESCO World Heritage City.

SPIN-OFFS

situm INDOOR POSITIONING

inverbis.

OPPORTUNITIES FOR POSTDOCS

- Juan de la Cierva contracts
- Ramón y Cajal contracts
- Marie Sklodowska-Curie Postdoctoral Fellowships (MSCA-PF)
- ERC-Starting Grant
- Postdoc CiTIUS

HR EXCELLENCE IN RESEARCH

citiususc

citius.kmt@usc.es

CITIUS: SCIENTIFIC AREAS

High performance computing

Electronic design of intelligent devices

Devices and computing resources

Remote Sensing.

Computer Vision

Virtual and augmented reality

Language technologies

Robotics

Intelligent Technologies

Automatic learning and reasoning

Support to machine intelligence

Natural and artificially intelligence

Intelligent systems and environments

Trustworthy AI

Social, economic, ethical and political framework

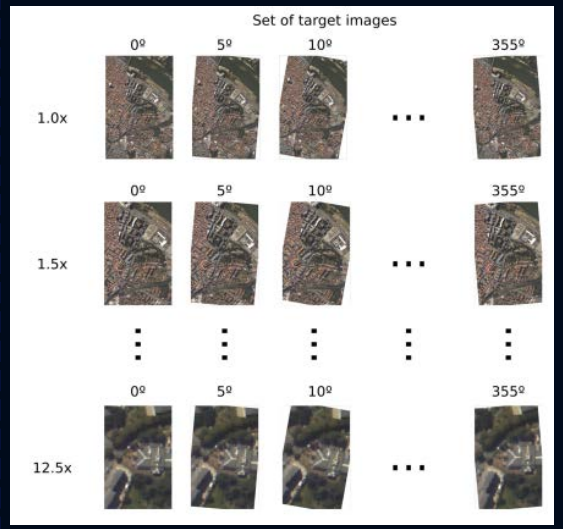
CITIUS GROUP ON REMOTE SENSING AND HPC

Knowledge extraction from multisource EO information for addressing different Earth monitoring challenges using computationally efficient solutions.

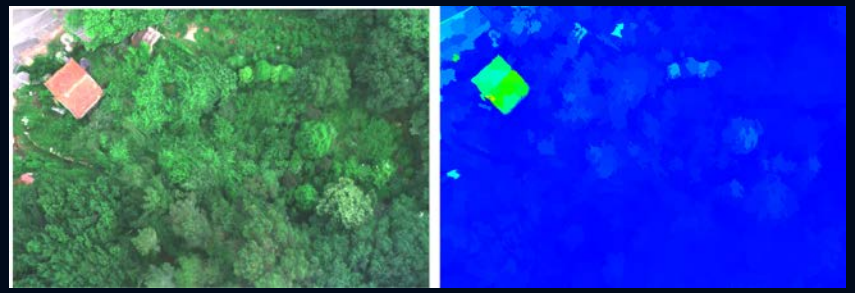
PRE DL ERA

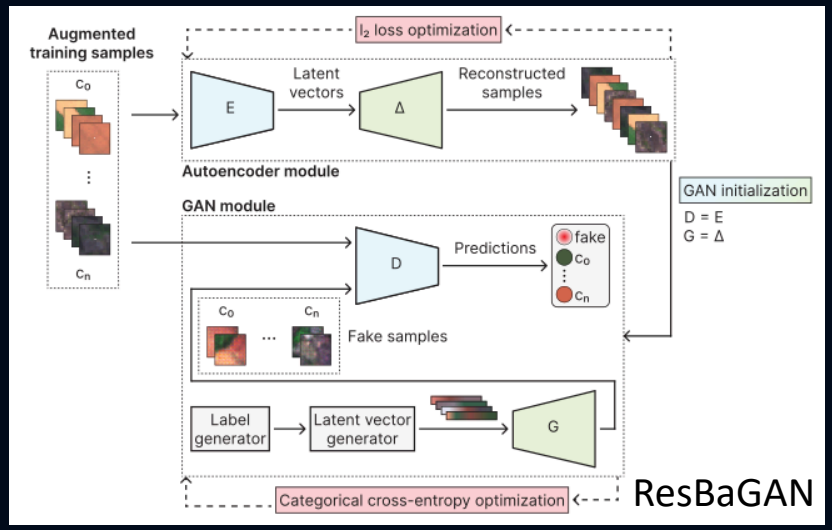
Analyzing, capturing

Accessing, preprocessing, storing



Solving: classification, change detection, anomaly detection,…





APPLICATIONS OF REMOTE SENSING

Observing objects and phenomena from a distance without physical contact allows for numerous applications

- Non invasive method in contrast to in situ or on-site observation
- Efficient and continuous observation of the Earth and its changes
- Satellite platforms provide repetitive and consistent view

EARTH OBSERVATION AT DIFFERENT SCALES

PRE DL ERA

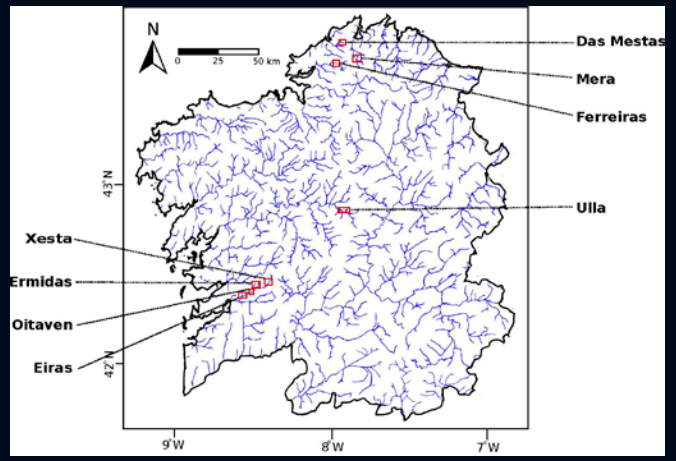
Earth Observation (EO) is the collection, analysis and presentation of data to better understand our planet.

Local : a company, a group of users,…

Time: short

Regional or national: public institutions, companies,…

Time: medium



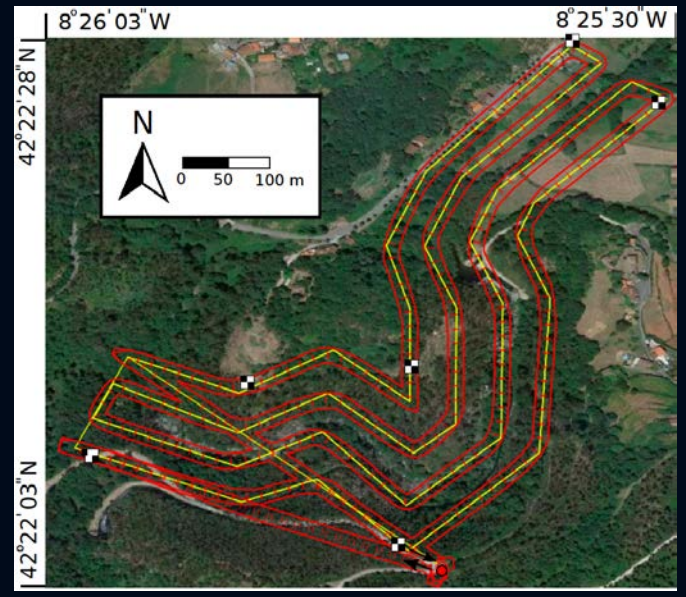
Global: governments, institutions,…

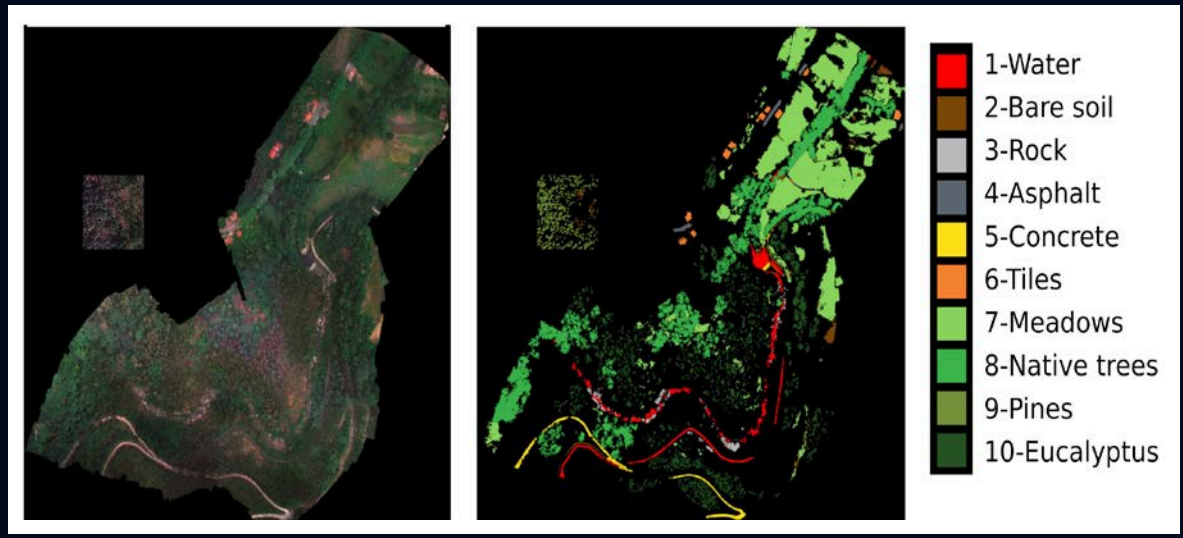
Time: long

EARTH OBSERVATION

Earth observation may include multisource information:

- images taken from remote-sensing satellites;
- measurements taken by a thermometer, wind gauge, ocean buoy, altimeter or seismometer;
- photographs taken on the ground or from airplanes;
- radar or sonar images from land-based or ocean-based instruments;
- a birdwatcher’s notes on bird sightings;
- measuring land use change;
- tracking biodiversity and wildlife trends;
- processed information such as maps or weather forecasts.





https://climatedetectives.esa.int/earth-observation-data/

EO IS BEYOND BIG DATA

Volume, Variety, Veracity, … Velocity and …

High Dimensional

Data reflect complex relationships between natural and social phenomena

High Complexity

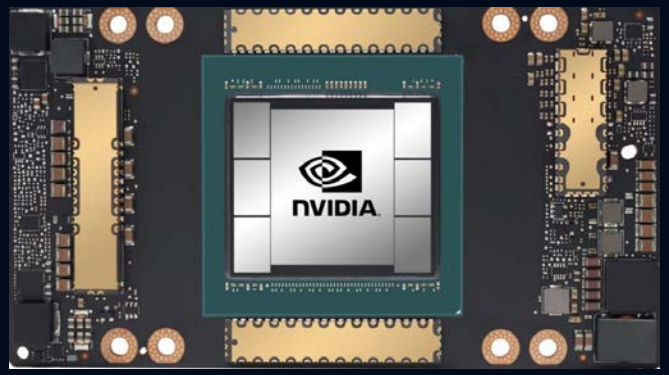
Data is incorporated in highly complex models

High Uncertainty

Data errors or incompleteness of data is unavoidable

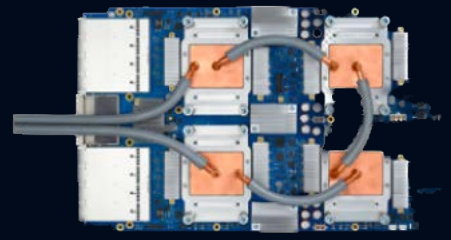
Hua-Dong Guo, Li Zhang, Lan-Wei Zhu, Earth observation big data for climate change research, Advances in Climate Change Research, Volume 6, Issue 2, 2015, https://doi.org/10.1016/j.accre.2015.09.007.

MACHINE LEARNING AND DEEP LEARNING IN REMOTE SENSING



DL is consistently outperforming all other ML methods on large dataset benchmarks

- Convolutional and transformer networks are predominant
  - Self-supervised multi-modal (language-vision) learning: no explicit labels required
- DL is supercomputing
  - Training of models requires accelerators: GPUs, TPUs(Google), in-memory computing chips, Graphcore IPU,…
  - Most breakthroughs require heavy compute power: GPT, DALL-E, AlphaFold,…
  - Quantum Computing as a promising approach

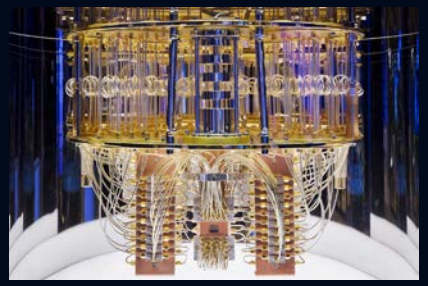


https://mldl_fzj.pages.jsc.fz-juelich.de/juhaicu/jsc_public/sharedspace/teaching/intro_scalable_deep_learning/course-material-may-2023/day2_lecture1.pdf

COMPUTING PARADIGMS

Supercomputing

Specialized Hardware Computing

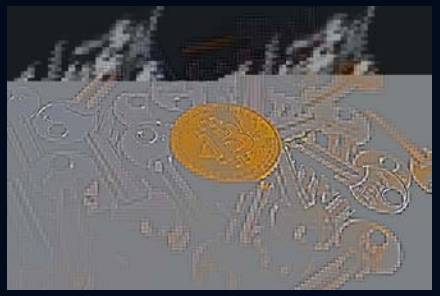


Quantum Computing

Edge Computing

Cloud computing

...



Blockchain

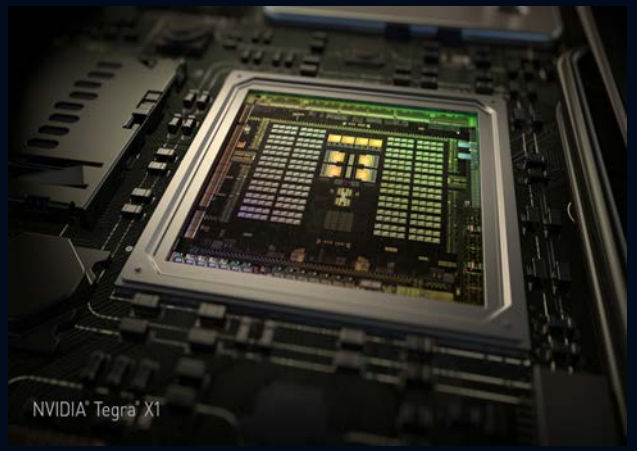
High Performance and Disruptive Computing in Remote Sensing (HDCRS) Working Group

Main Objective:

Connect and support the community of interdisciplinary researchers in remote sensing who are specialized in emerging computing paradigms

The idea:

Innovative computing technologies applied to efficient computation of remote sensing problems



https://www.grss-ieee.org/community/groups-initiatives/high-performance-and-disruptive-computing-in-remote-sensing-hdcrs/

HDCRS WORKING GROUP OF ESI TC

High-Performance and Disruptive Computing in Remote Sensing (HDCRS)


Dora Blanco Heras


Rocco Sedona


Iksha Gurung


Sudan Jha

- Proposed to ESI in 2021

- Organizing different activities:
  - special sessions at IGARSS (International EEE International Geoscience and Remote Sensing Symposium)
  - tutorials and webinars
  - paper journals
  - 4 editions of the Summer School,…

https://www.grss-ieee.org/technical-committees/earth-science-informatics/

COME ABOARD

About Earth Science Informatics

MISSION

The Earth Science Informatics Technical Committee (ESI TC) provides a venue for informatics professionals to exchange ideas and share knowledge. It aims at advancing application of informatics to geosciences and remote sensing, assessing technology to support data stewardship and management, and promoting best practices and lessons learned.

The mission of the ESI TC is to bring together informatics experts and practitioners to share ideas and information to support open science and maximize the use of science data for research and applications.

JOIN ESI

https://www.grss-ieee.org/technical-committees/earth-science-informatics/

THIS SCHOOL – 4TH EDITION

Networking with students, young professionals, and senior researchers and professors who work on interdisciplinary research in remote sensing.

Provide understanding on current large AI solutions applied to RS using supercomputing, cloud computing, and quantum computing.

Teaching material and videos will be available at
https://www.grss-ieee.org/community/groups-initiatives/high-perfomance-and-disruptive-computing-in-remote-sensing-hdcrs/

AGENDA – TUESDAY JUNE 4TH

Remote sensing and high-performance computing

9:30 – 10:00 (CEST)	Welcome at the University of Santiago de Compostela and Opening of the Summer School	Dora B. Heras
10:00 - 10:30	CESGA: High Performance and Disruptive Computing	Lois Orosa
10:30 – 11:00	IEEE GRSS and Activities of the HDCRS Working Group	Gabriele Cavallaro
11:00 - 11:30	Coffee break	-
11:30 - 12:00	ESA's Quantum Computing for Earth Observation (QC4EO) Initiative: Current Activities and Perspectives	Bertrand Le Saux
12:00 – 13:00	Google Earth Engine for Earth Observation. Introduction.	Álvaro Moreno Emma Verdiguier
13:00 – 14:30	Lunch break	-
14:30 - 15:30	Google Earth Engine for Earth Observation (Hands-on)	Álvaro Moreno Emma Verdiguier
15:30 - 16:00	Coffee break	-
16:00 – 17:00	Google Earth Engine for Earth Observation (Hands-on)	Álvaro Moreno Emma Verdiguier
20:30 - 22:00	Social Dinner	-

AGENDA – WEDNESDAY JUNE 5TH

Large-Scale AI for Geosciences with Supercomputing and Cloud Computing: Foundation Models

9:30 – 9:50 (CEST)	IBM and NASA collaboration for foundation models Open Science, collaboration, geospatial foundation model, LLMs
9:50 - 10:20	Development and timeline of FM that was published
10:20 – 11:00	Prithvi-Geospatial and Prithvi-WxC model overview / MLCommons Geo-Croissant Overview
11:00 - 11:30	Coffee break
11:30 - 12:00	Utilizing HPC for FM and background of HPC
12:00 – 13:00	Environment setup, access, dataset preparation.
13:00 – 14:30	Lunch break
14:30 - 15:30	Fine-tuning based on datasets in Hugging Face and the custom datasets people might be bringing
15:30 - 16:00	Coffee break
16:00 – 17:00	Deployment and interactions
19:30 - 20:30	Guided Tour of the Old Town

Speakers: Manil Maskey, Gabriele Cavallaro, Iksha Gurung, Muthukumaran Ramasubramanian, Rasjat Shinde, Thomas Brunschiwiler, Carlos Gomes, Alexandre Strube

AGENDA – THURSDAY JUNE 6TH

Large-Scale AI for Geosciences with Supercomputing and Cloud Computing: Large Language Models

09:30 – 10:00 (CEST)	Introduction to Large Language Models (LLMs) for Science
10:00 - 11:00	Environment setup, Encoder model finetuning
11:00 - 11:30	Coffee break
11:30 - 13:00	Prompting and Decoder Fine-tuning
13:00 – 14:30	Lunch break
14:30 - 15:30	Stitching everything together, Deployment
15:30 - 16:00	Coffee break
16:00 – 17:00	Agentic Workflows and Chaining
18:30 - 20:30	Guided Tour of the Old Town

Speakers: Bishwaranjan Bhattacharjee (IBM Research), Iksha Gurung and Muthukumaran Ramasubramanian (University of Alabama in Huntsville)

AGENDA – FRIDAY JUNE 6TH

Quantum Computing for Earth Observation

09:30 – 11:00 (CEST)	Introduction to Quantum Mechanics
11:00 - 11:30	Coffee break
11:30 - 13:00	Introduction to Quantum Computation
13:00 – 14:30	Lunch break
14:30 - 15:30	Quantum Machine Learning
15:30 - 16:00	Coffee break
16:00 – 17:00	Quantum Algorithms for Remote Sensing (hands-on session)
18:30 - 20:30	Guided tour to the Galician Supercomputing Center

Speakers: Artur Miroszewski and Grzegorz Czelusta (Jagiellonian University)

ACKNOWLEDGMENT

Thank you for your attention