



# UNIVERSITY OF TWENTE.

## ITC GEOSPATIAL COMPUTING PLATFORM

UT DCC THEMATIC SESSION ON CLOUD COMPUTING

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**Center of Expertise in Big Geodata Science (CRIB)** is a *horizontal facility* that **enables** the better use of **big geodata technology** in *education, research, and institutional strengthening* activities at ITC

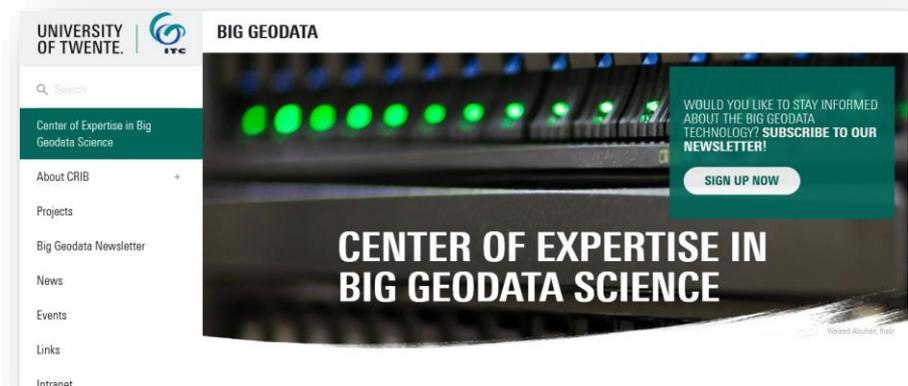
## Mission

*Collect, develop, and share* **operational know-how** on big data technology to solve large-scale geospatial problems

## Vision

Position UT/ITC as a *globally renowned* center of excellence in **geospatial big data** science.

<https://itc.nl/big-geodata>



An isometric illustration of cloud computing. On the left, a blue building with a white antenna on its roof represents a data center. To the right, several people are shown working at various desks and chairs, each with a computer monitor and wireless signal waves above them, representing users accessing cloud services. The background is a light blue grid with white lines and dots, symbolizing a network or data flow.

**Main Characteristics**

- On-demand self-service
- Broad network access
- Resource pooling
- Rapid elasticity
- Measured service

**Cloud computing** is the on-demand availability of computer system resources, especially **data storage** and **computing power**, *without direct active management* by the user

# Cloud Computing Services

- **Software as a Service (SaaS)**

[On-demand software]

- Provider supplies the infrastructure and platforms that run the applications
- User uses provided applications through an interface

- **Platform as a service (PaaS)**

- Provider supplies the infrastructure, services, and tools that allow the user to deploy applications
- User deploys applications and alters settings of the application-hosting environment

- **Infrastructure as a service (IaaS)**

[On-demand hardware]

- Provider supplies the infrastructure
- User deploys and run arbitrary software, including OS

- **Function as a service (FaaS)**

Currently we are using one!

- R Studio Cloud
- Matlab Online
- Authorea
- ...

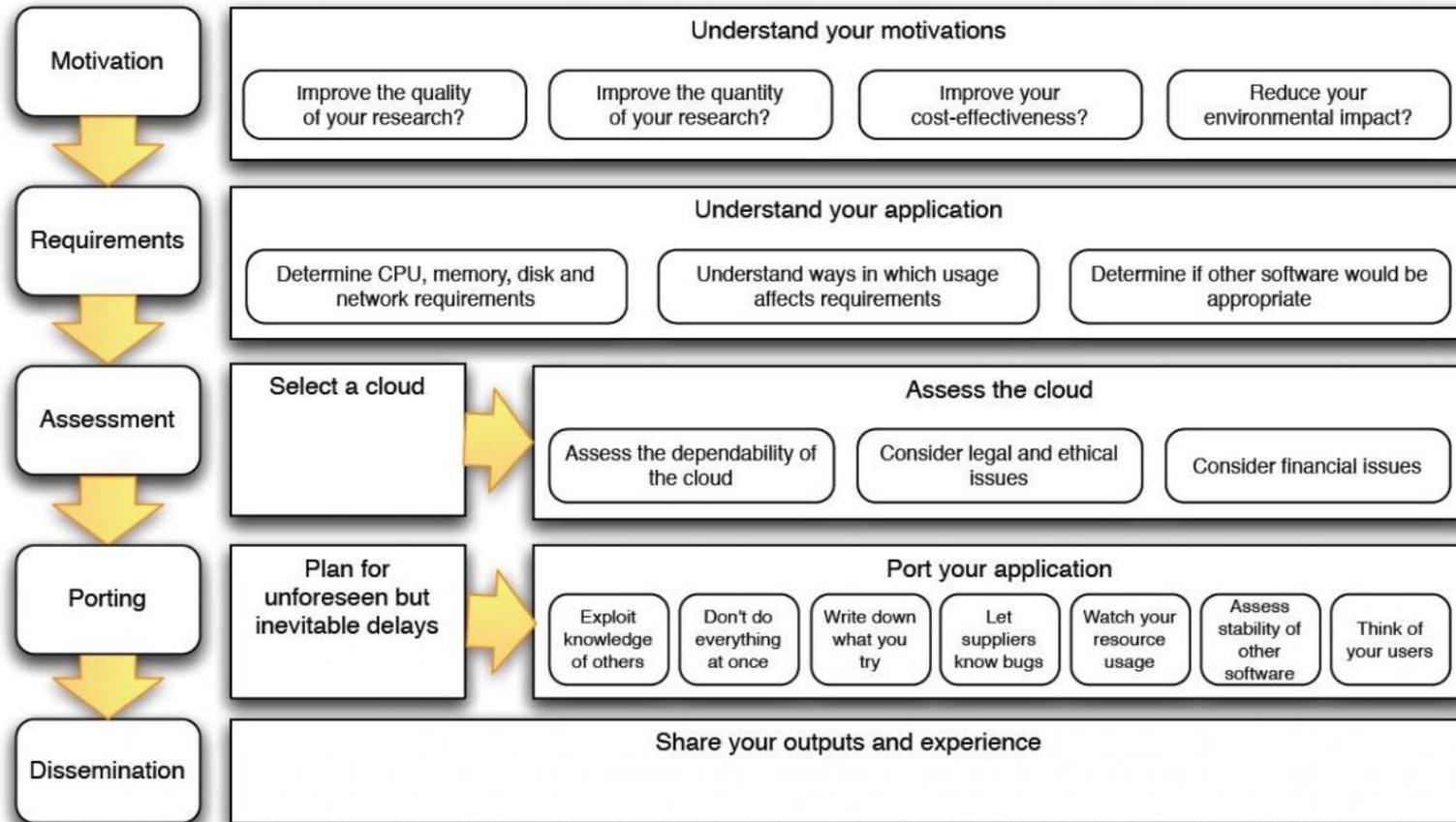
e.g. ITC Computing Platform

- Google Colab
- Amazon SageMaker
- Azure ML Studio
- ...

e.g. LISA VRE

- Microsoft Azure
- Amazon AWS
- Google Cloud
- ...

# Moving to the Cloud



Source: [Best practice for using cloud in research \(Hong et al., 2018\)](#)

# ITC Geospatial Computing Platform

- Operational since **January 2021**
- Currently serves **235** registered users with **6-18** concurrent users at a time
- Designed to serve primary activities identified by a *comprehensive user needs assessment*:
  - **Self-learning**
  - **Exploratory research**
  - **Education**
- Provides **highly-available, easy-to-use** environment with good performance
  - **User-friendly** interface for data analysis and visualization
  - **Ready-to-use** scientific and geospatial analysis software
  - **Parallel and distributed computing** by using high-level frameworks
  - Computing by using special processing units (e.g., **GPU**)

# Resources

- **16 x NVIDIA Jetson AGX Xavier** computing units (128 cores, 512 GB)
  - **8-core CPU** (NVIDIA Carmel ARMv8.2, 2.26 GHz)
  - **512-core GPU** (Volta architecture with 64 Tensor Cores)
  - **32GB memory** (DDR4x, 137 GB/s)
  - **500 GB – 1 TB local storage** (NVMe SSD, 3 GB/s)
- **Big data computing unit**
  - **2 x 8-core CPU** (Intel Xeon E5-2640, 32 threads, 2.60 GHz)
  - **24 TB local storage** (20 x 1.2 TB 2.5" 10K SAS 12 GB/s HDD, RAID 20+2)
  - **768 GB memory**
- **Hub server** (6-core, 192 GB)
- **200 TB storage** (0.2 PB)

We upgrade and repurpose **idle** resources and make them available on the platform for **common use**.



# Architecture

<https://crib.utwente.nl>

- Based on open-source software (Ubuntu, Docker, JupyterHub, ...)
- Accessible through a **web browser** (No software installation is required)
- **No registration** is required (Login with UT credentials)
- Each user has an individual and isolated **working environment**
- Each user has access to all available\* **unit resources**, including **GPU**
- Each user has access to all available\* **cluster resources**
- **Replicated storage** with minimum two copies (Hardware failure protection)
- **Distributed storage** for big data processing (HDFS)
- Low energy footprint (10-30W per unit)

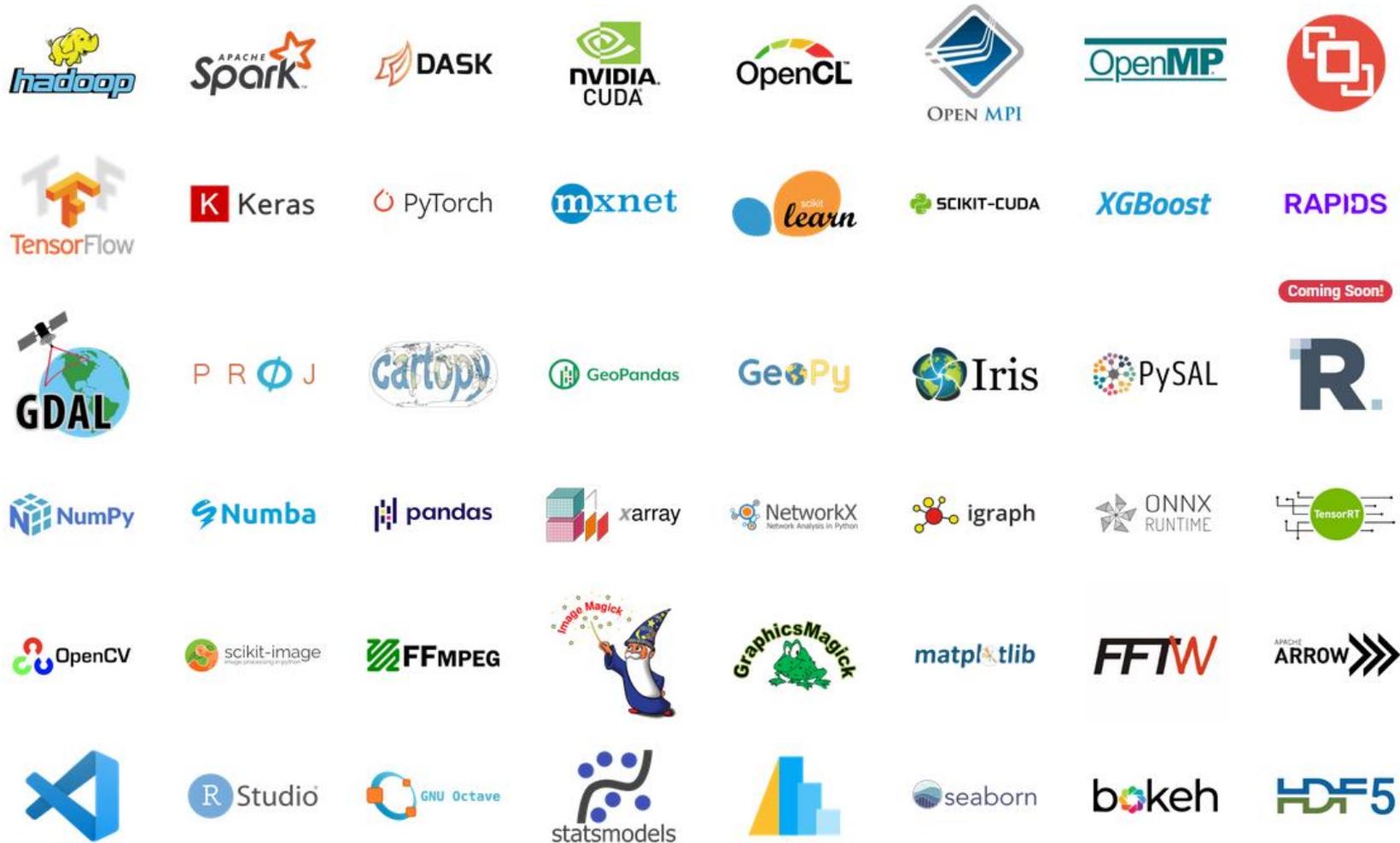
# Key Features

<https://crib.utwente.nl>

- **Interactive notebook, terminal and remote desktop** access are available
- Multiple interactive languages are supported (Python, R, Julia, Octave, Go, ...)
- **Up-to-date and optimized software packages** are **ready to use** (No setup required)
- Users can install additional packages (e.g., Python, R packages)
- Distributed computing clusters are **ready to use** (Dask, Apache Spark)
- **Public** assets are shared by all users
- **Shared workspaces** allow assets to be shared by selected users
- Access can be granted to **external users**
- **User support** is available\*
- Provided and maintained by **CRIB** at no extra cost (i.e., free PaaS)

# Available Software

<https://crib.utwente.nl>



and hundreds more...

# Additional Services

<https://crib.utwente.nl>



**GeoServer**

Open source server for sharing  
geospatial data



**MapServer**

Open source platform for  
publishing spatial data



**PostgreSQL**

Open source relational database



**MariaDB**

Open source relational database



**GeoNode**

Open source geospatial content  
management system



**Dataverse**

Open source research data  
repository software



**Gitea**

Open source lightweight code  
hosting solution

In cooperation with ITC Research Data Team

Incubating! - BETA

# Potential Use Cases

<https://crib.utwente.nl>

- Education
  - Computation platform for **courses** (Shared course workspaces)
- Research
  - **M.Sc. / Ph.D.** thesis studies
  - Collaborative (big) data analysis and visualization
  - Strengthen project proposals (Reduced budget needs for small projects, e.g., 50-100K EUR)
- Capacity Development
  - **Self-learning** (Cloud computing, distributed computing, GPU computing, Machine Learning, ...)
  - Computation platform for **training activities** (e.g., workshops)

# Quick Demo

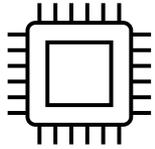
<https://crib.utwente.nl>

The screenshot displays a JupyterLab environment with the following components:

- Left Panel:** A file browser showing a directory of Jupyter notebooks, including 'dask-pipeline-3-dask.ipynb' which is currently selected.
- Top Panel:** A code editor for 'dask-pipeline-3-dask.ipynb' containing a distributed Python script. The code uses `dask.distributed` to parallelize a loop of 100 iterations, each involving image processing and saving. The output shows CPU times: user 1.02 s, sys 1.38 s, total 2.4 s, and a wall time of 345 ms.
- Bottom Panel:** A 'Task Stream' visualization showing a Gantt chart of task execution. The x-axis represents time from -59:40 to :01:40, and the y-axis shows task IDs from 0 to 100. The chart illustrates the parallel execution of tasks across multiple workers.
- Right Panel:** A code editor for 'cartopy.ipynb' showing a script that uses `matplotlib` and `cartopy` to create a map of the North Pole. The map is projected using `ccrs.SouthPole` and `ccrs.PlateCarree`. The script also includes a circle representing the Arctic region.

Available on the platform at [public/platform/demo](https://crib.utwente.nl/public/platform/demo)

# Contact



<https://crib.utwente.nl>



<https://itc.nl/big-geodata>



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