SPACE RESEARCH SERVICES

NEANIAS Open Event

Sant Cugat del Vallès, 22-23 Sep. 2022

Eva Sciacca

(INAF-Osservatorio Astrofisico di Catania)

on behalf of the

NEANIAS collaboration

(WP4 SPACE)

Overview and Goals

Co-desing, implementation and delivery of cloud-based innovative services

for

SPACE SCIENCES

(Astrophysics & Planetary Science)

USER REQUIREMENT
collection

SPACE-VIS

VISUALIZATION
and
FAIR DATA MANAGEMENT

SPACE-MOS

MAP MAKING
and
MOSAICKING

SPACE-ML

STRUCTURE DETECTION
with
MACHINE LEARNING

TECHNICAL VALIDATION
assessment

ONBOARDING THE EUROPEAN SPACE SCIENCES TO THE EOSC

Listening to the community

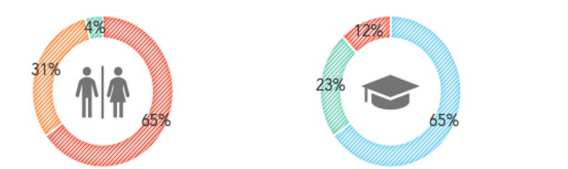
147 organised MEETINGS

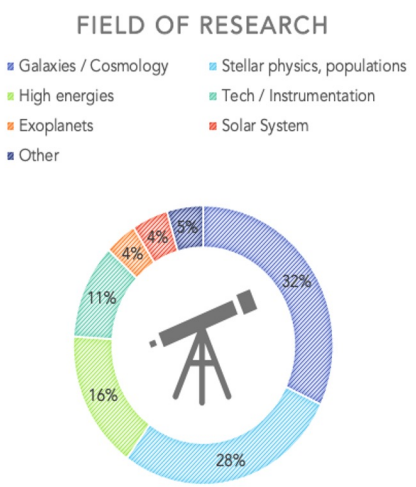
9 successful DELIVERABLES

USER REQUIREMENT COLLECTION

Targeted survey involving experts from European Institutions

329 participants (anonymous)





TECHNICAL VALIDATION

Internal technical assessment and independent validation sessions by external experts

13 specific REQUIREMENTS

+500 contacted RESEARCHERS

NEANIAS Space Services

SPACE · VIS

- F.A.I.R data management
- Planetary & Astrophysics data visualization
- Innovative approach exploiting VR

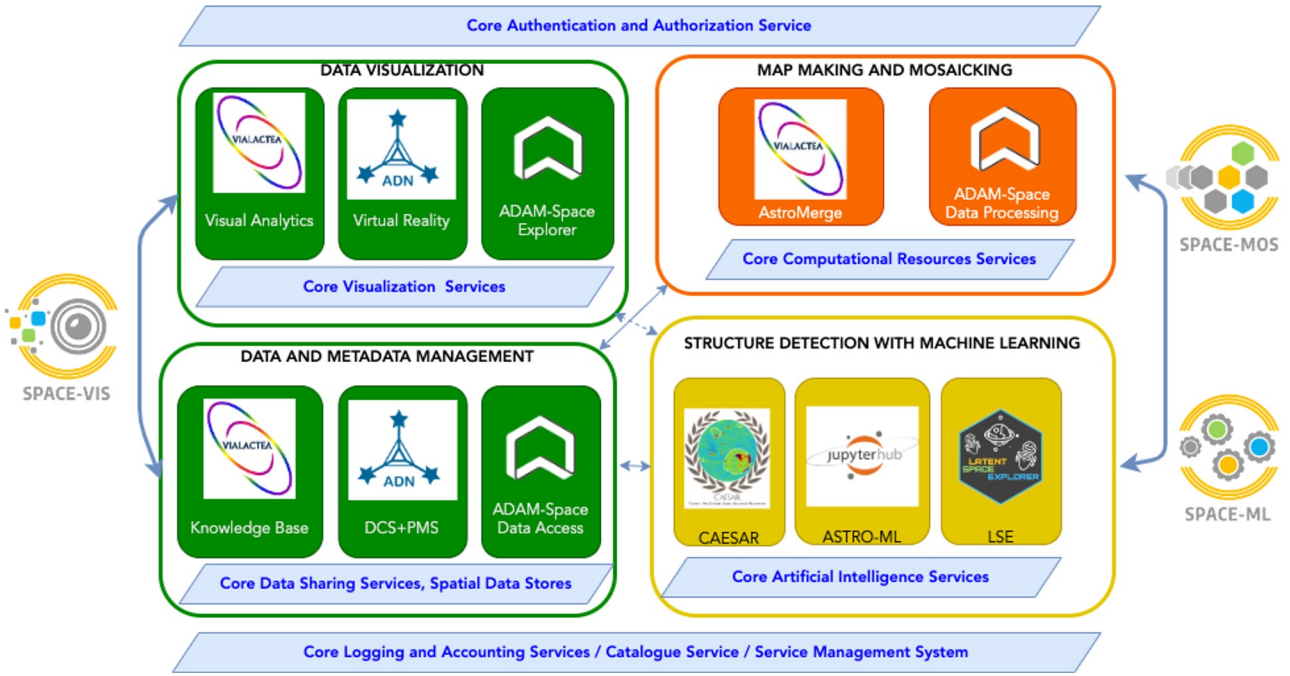
SPACE · MOS

- Workflow for efficient map making
- Merging of images for Mosacking of maps
- Generation of large-scale multidimensional maps

SPACE · ML

- Compact source detection in all-sky surveys
- Extended structure detection and classification
- Application on SKA precursor data

The NEANIAS SPACE Ecosystem

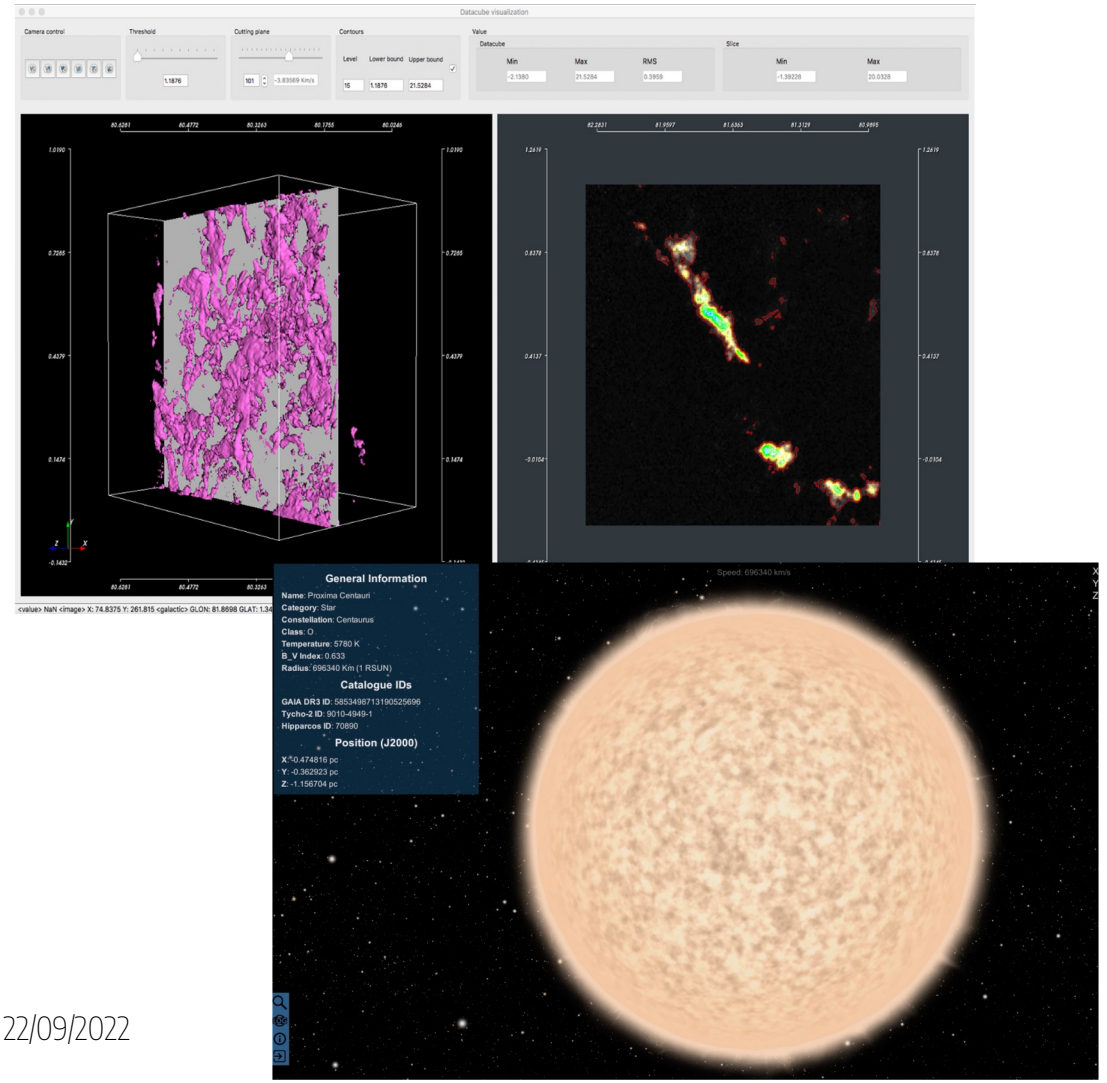


8 space SERVICES *TRL 8*

32 core service INTEGRATIONS *AAI, Log, Acc, Mon, DataShare, AI, Vis*

400+ validating END-USERS *feedback/bugs*

SPACE-VIS → Astrophysics data



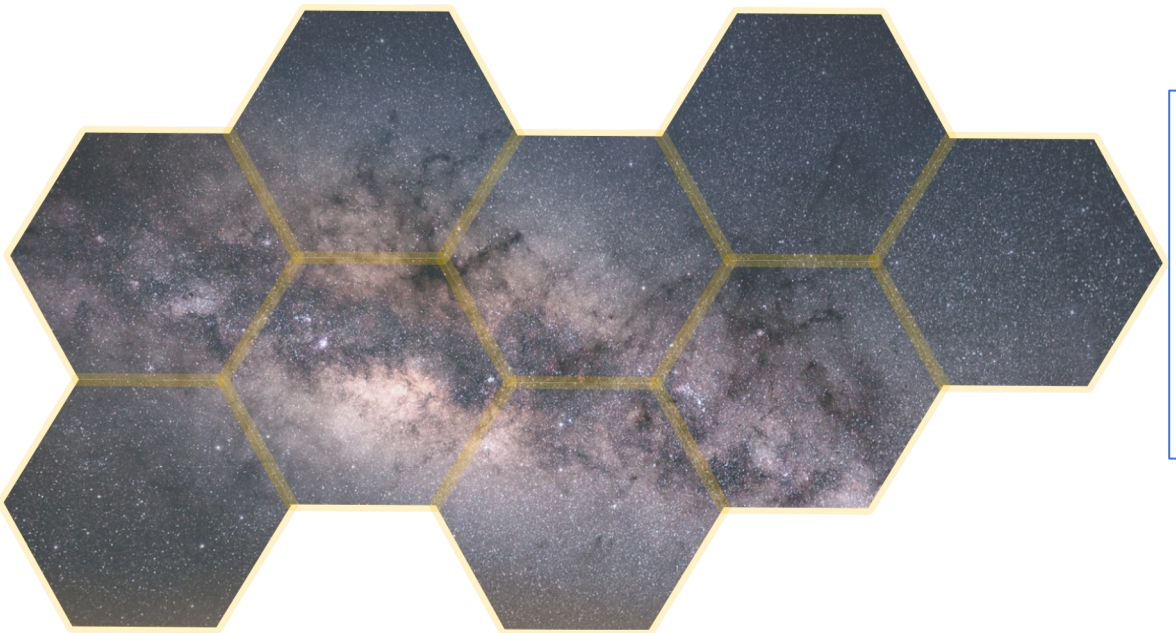
VIALACTEA

- Visual analytics tool
- Exploitation of Galactic Plane surveys
- Handling of 2D and 3D data
- Multidimensional datasets
- Filament & source catalogues
- Data access IVOA compliant

ASTRA DATA NAVIGATOR

- VR 3D visualization of stellar catalogues (e.g. Gaia)

SPACE-MOS → Astrophysics data



MONTAGE

- Widely adopted map making toolkit
- Integration into ViaLactea
- Optimization to end-user needs

CUSTOMIZED CUTOUT SERVICE

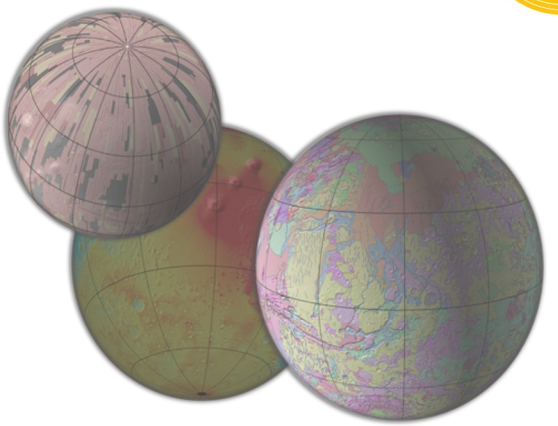
- Cutout extraction from multiple surveys
- Regridding and convolution
- Conversion to same intensity units
- Final images directly comparable

CREATION OF IMAGE MOSAICS
HOMOGENEOUS & MULTIWAVELENGTH
LARGE SCALE MOSAICS

SPACE-VIS → Planetary Data

PLANETARY DATA ACCESS AND ANALYTICS

MORE THAN **40 TB** OF PLANETARY DATA

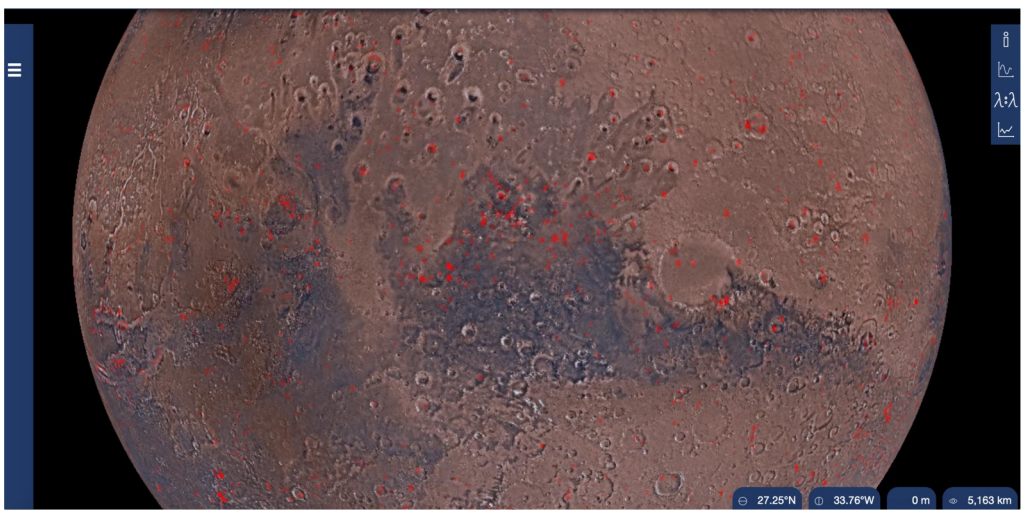


PLANET SERVER

- Calibrated data of Solar System bodies
- Hyper-spectral data cube access (OGC WCPS / VO) via REST API

ADAM - Space

- Earth global environmental data
- Access to time series, forecasting and long-term predictions



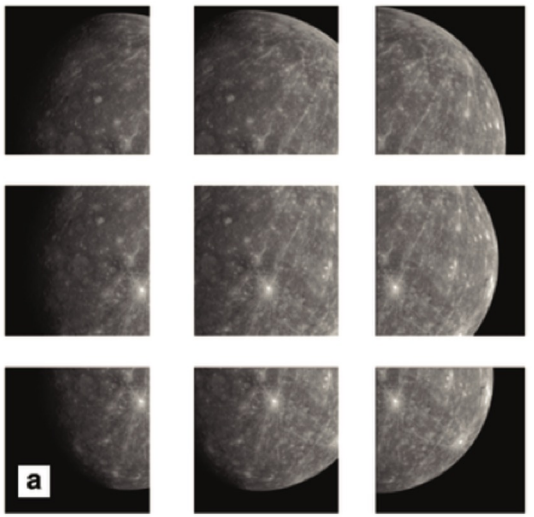
SPACE-MOS → Planetary data

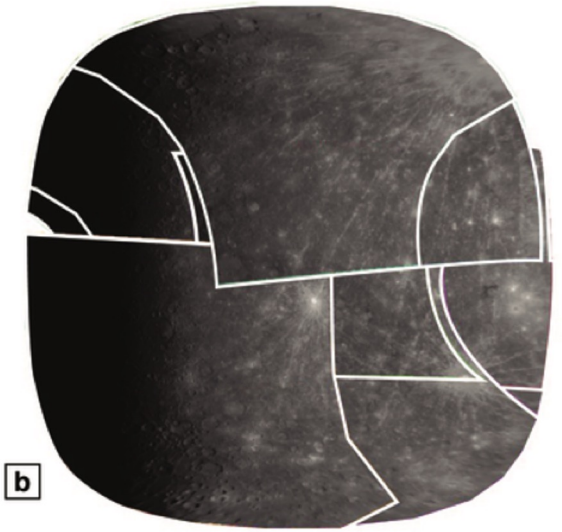
USGS-ISIS3

- Planetary data analysis
- Advanced mosaicking capabilities

NASA-ASP

- Digital Elevation Model Cartography
- 3D modelling from stereo imaging (from satellite/rover missions)



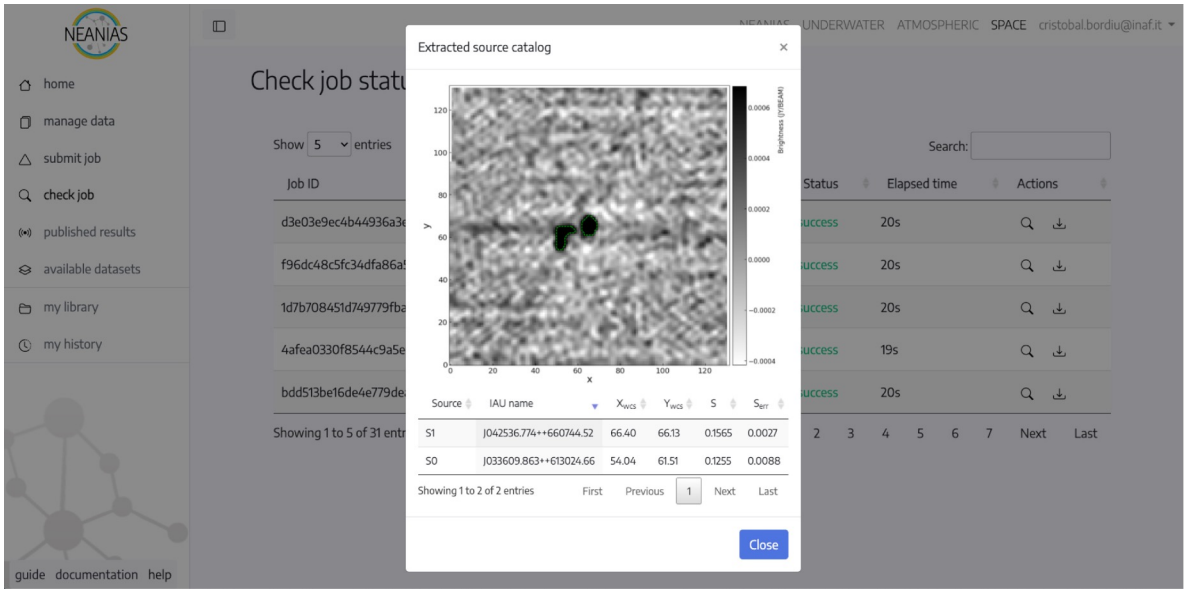


MOSAICKING AND STEREOGRAMMETRY

CREATION OF **CARTOGRAPHIC** MAPS OF **SOLAR SYSTEM** BODIES

SPACE ML → Astrophysics

Source extraction in radio maps through the CAESAR UI



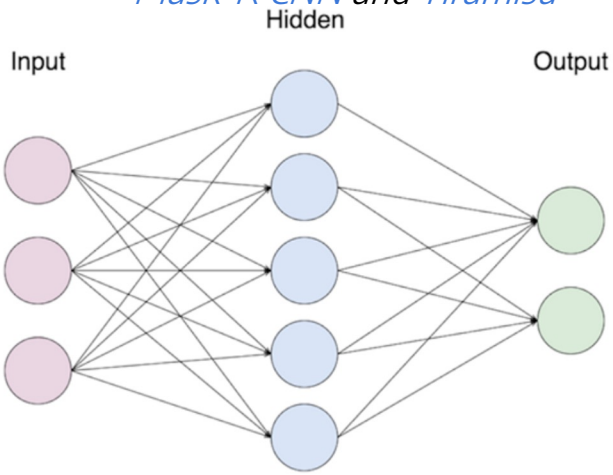
CAESAR

- Unsupervised source finding from astronomical maps
- Compact and extended sources
- Source characterization & post-processing
- Multithread & parallel processing for large images
- Ported to Cloud infrastructures

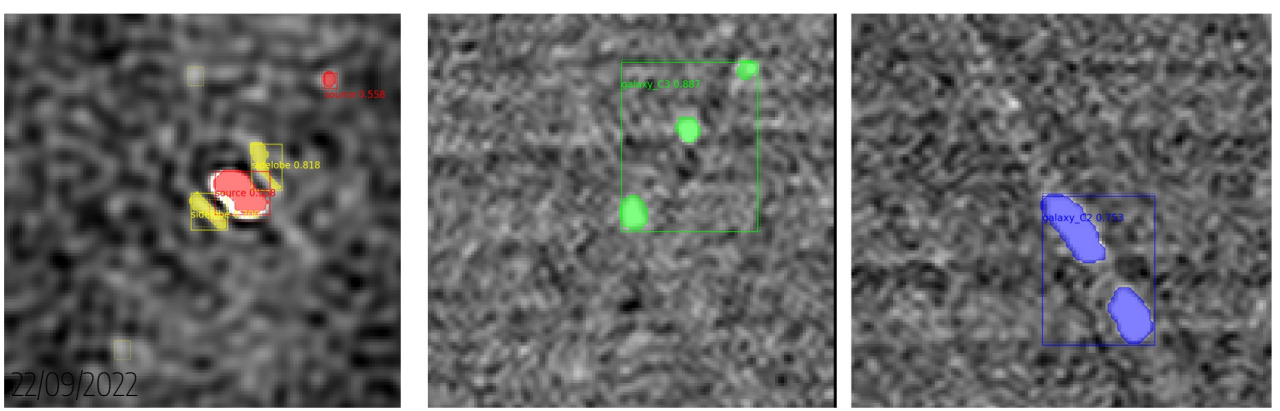
SPACE ML → Astrophysics

DNN architecture based on different well-tested models, like

Mask-R CNN and Tiramisu



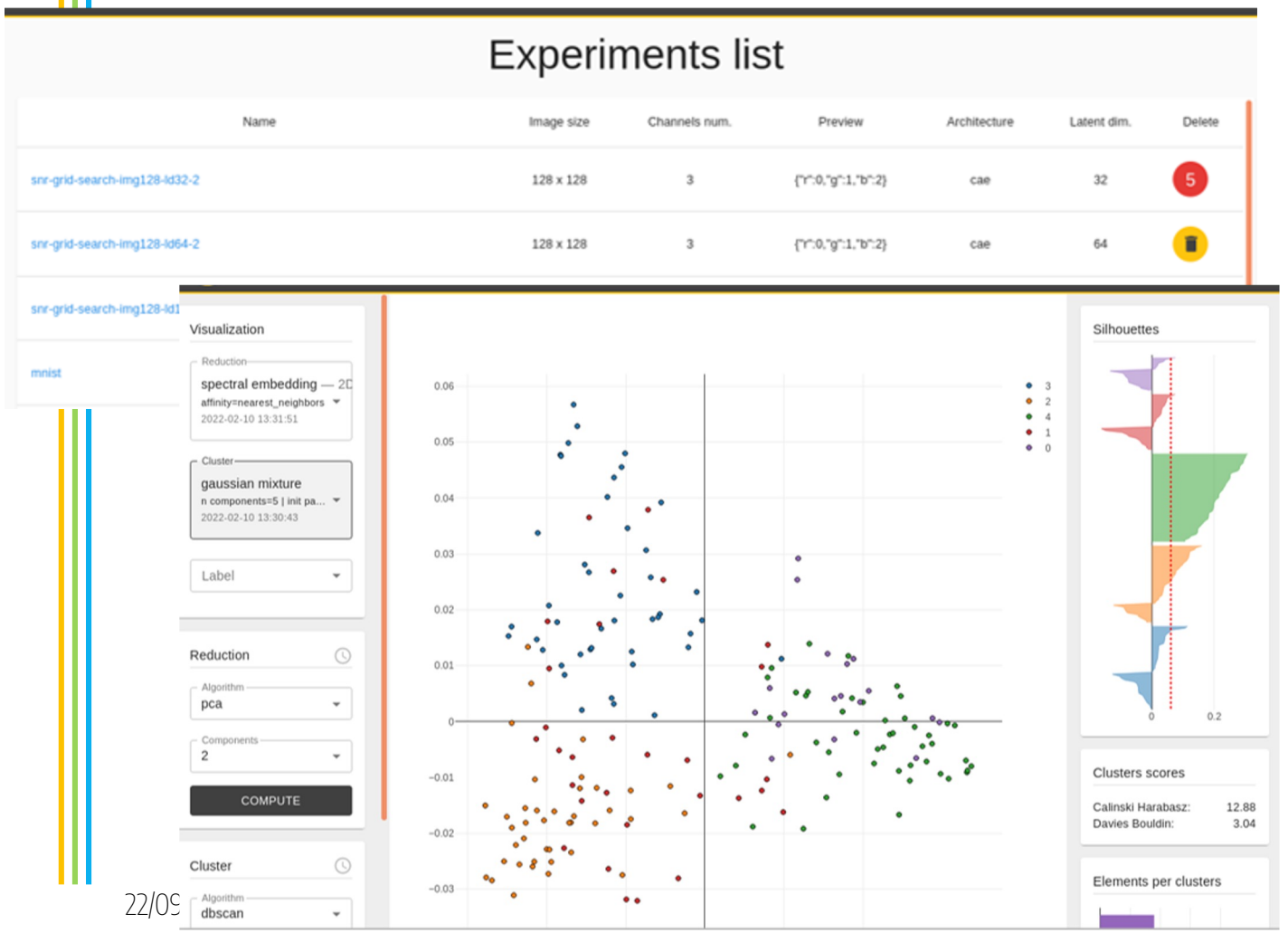
Sample sidelobe & galaxy detection



ASTRO ML

- Source classification with DNN
- Based on well-known object detection networks, trained on astro data
- Artefacts, Sidelobe & bad detection rejection
- Identification of not-connected source islands associated to same physical object (e.g. galaxies)

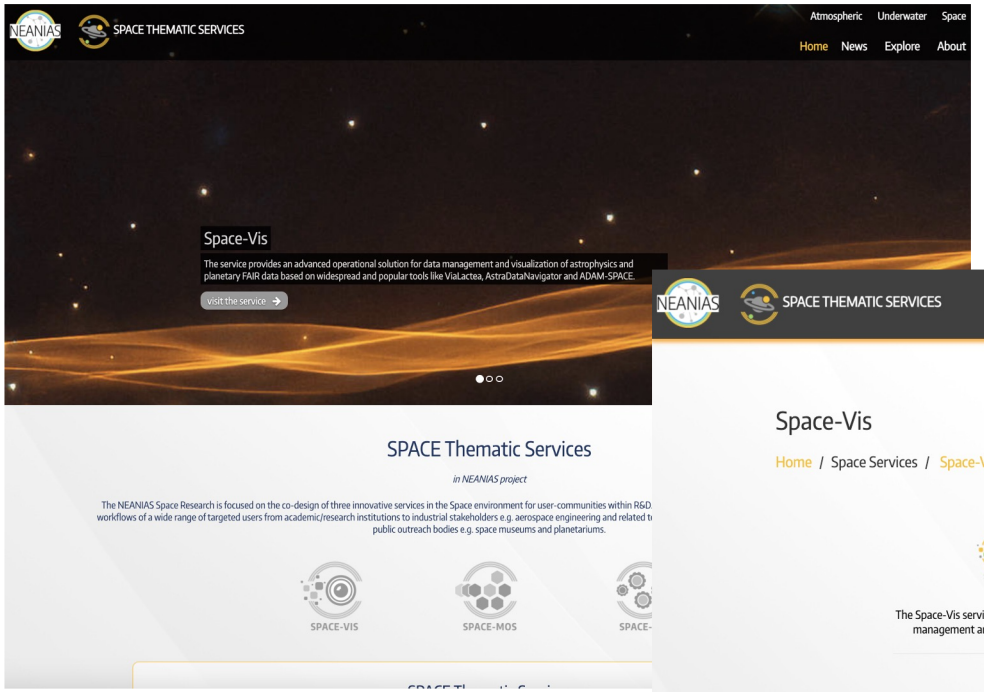
SPACE ML → Latent Space Explorer



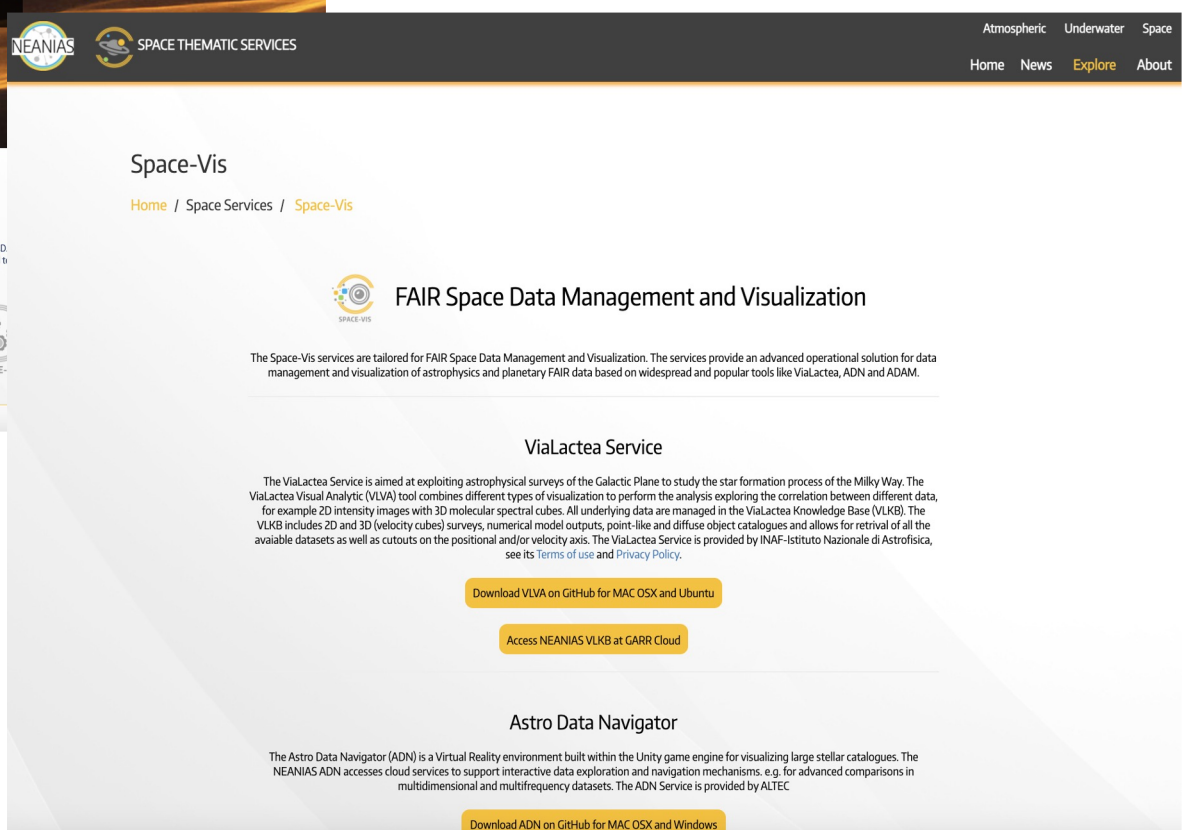
LSE

- Analyse image datasets with unsupervised ML
- Extract a compact representation from data.
- Visualize data interactively.
- Perform clustering to detect hidden common features and support novel classification schemes.

Space Services accessibility



- NEANIAS service catalogue
- EOSC service catalogue
- OpenAIRE community portal



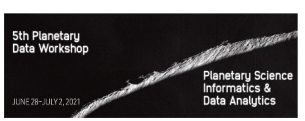
dedicated
thematic portal
for SPACE services
https://thematic.neanias.eu/SPACE/

24/06/2021

Space Synergies and dissemination

Involved in
INTERNATIONAL PROJECTS
&
INITIATIVES

Presented in
INTERNATIONAL CONFERENCES
&
WORKSHOPS



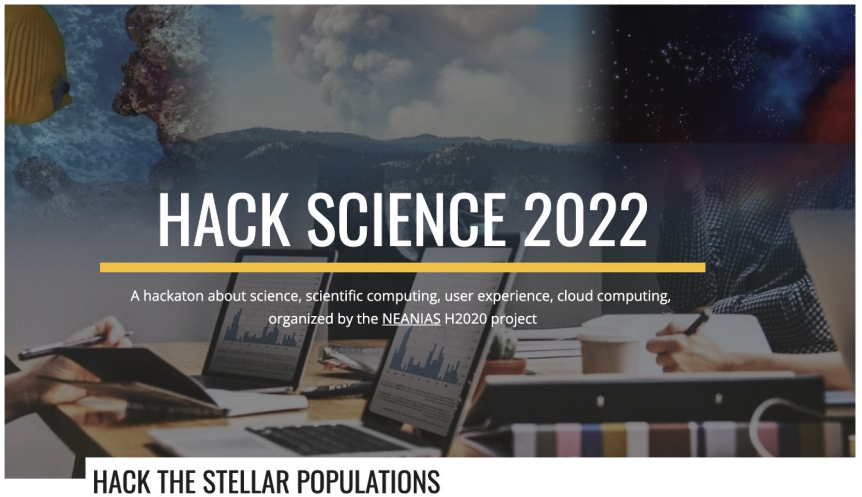
10 scientific PUBLICATIONS {proceedings & journals}

30 dissemination ARTICLES {on the website}

+5k reached PEOPLE {students & researchers}

Hack the SCIENCE 2022

https://sites.google.com/unimib.it/hack-the-science-2022



HACK THE STELLAR POPULATIONS

Keywords: Milky Way, stellar populations, clusters, visual analytic, infrared, source finding

Unravel the mysteries of our galaxy! Looking at a region of the Milky Way, your challenge will be to identify all the stellar sources that are grouped together into "stellar clusters" (i.e. group of stars physically bound). NEANIAS Space Services will be at your disposal to face this challenge: the *ViaLactea service* to retrieve the sky maps, the *CAESAR service* to identify the sources and the *Astro Data Navigator* to explore the stellar catalogues.

Be our space explorer!

Globular clusters as seen by the ESO's VISTA instrument (Credit: ESO)

- Remote
- Starting date 5 May 2022 → 25 June 2022
- 28 July 2022 prize ceremony
- 3 challenges
  - ❑ HACK THE STELLAR POPULATIONS
  - ❑ HACK THE PLANETS
  - ❑ HACK THE SERVICES-WEBSITE UX
- Teams
  - ❑ 3 participants per team
  - ❑ Mentors to guide
- Prizes
  - ❑ e-Voucher to each member of the winning team

Hack the Science 2022

Project: **Hack the Planets**

Work group: **OASBO**

ML4ASTRO International Conference

- In person @ Catania + remote
- **3** days event
- **7** invited speakers
- **33** Oral + **33** Poster presentations

Supported by NEANIAS and other projects:

- MOSAICO
- CIRASA
- INAF DS

SPACE Services Demo Session (tomorrow)

- 9:30 → ADN VR, S. Velev (UoP)
- 9:40 → ADAM SPACE, S. Mantovani (MEEO)
- 9:50 → ViaLactea, G. Tudisco (INAF)
- 10:00 → CAESAR and AstroML, C. Bordiu (INAF) and J. Welsh (UoP)
- 10:10 → Latent Space Explorer, G. Vizzari (UNIMIB)

Interact with the service providers and try out the tools!

NEANIAS SPACE thematic page
https://thematic.neanias.eu/SPACE/

NEANIAS SPACE services catalogue
https://catalogue.neanias.eu/search;thematicArea=Space

NEANIAS SPACE Technical Documentation
https://docs.neanias.eu/en/latest/#space-services

NEANIAS SPACE OpenAIRE Community portal
https://neanias-space.openaire.eu/

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