ϕ-week 2020 Sessions' Summary

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Phi-Week Team

Summary – attendance and engagement

Total number of attendees: 2108

Total meeting communications: 5876

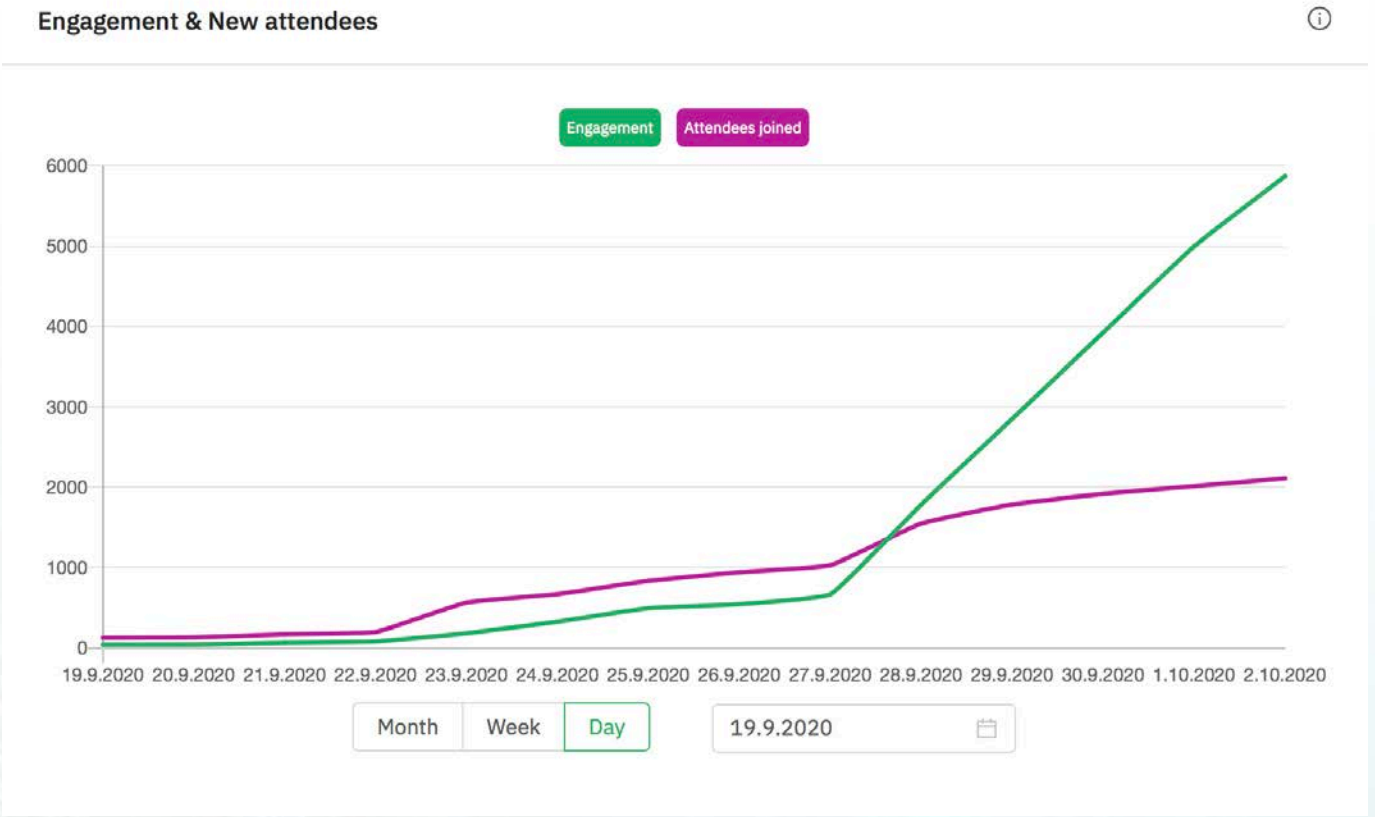
Chat messages: 4934

Meeting requests: 942

Meetings held during event: 541

Engagement score: 19.9*

**baseline score for successful events = 15*

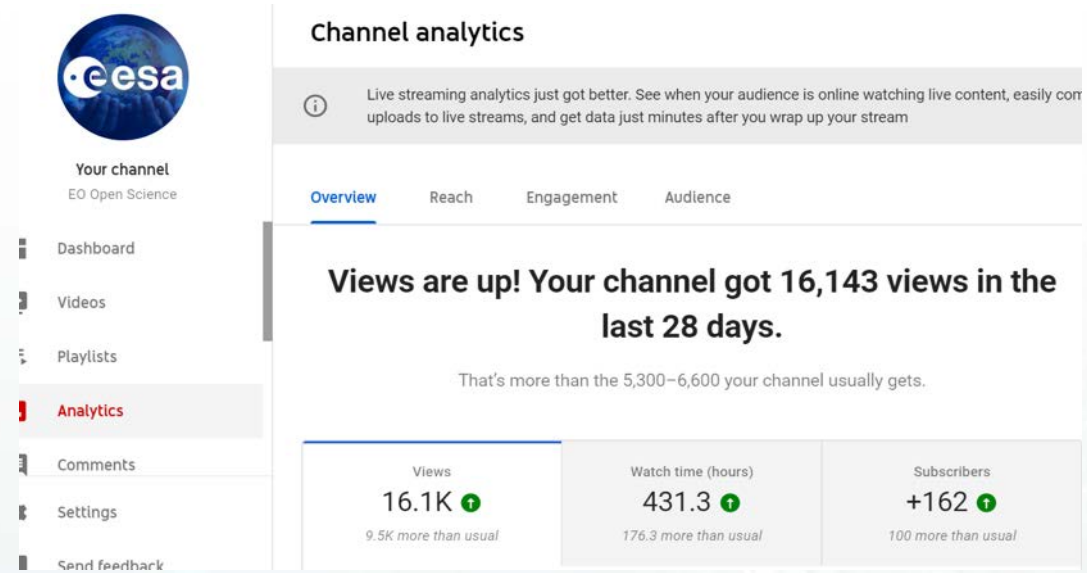


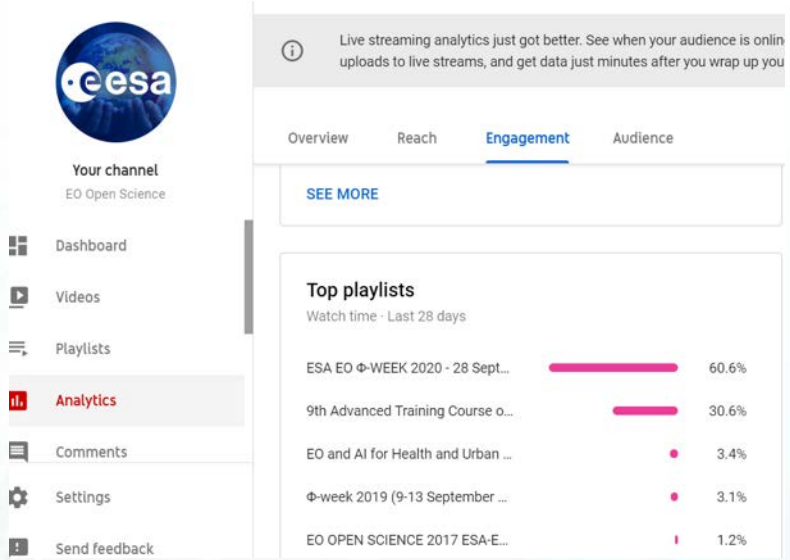
Pre-event

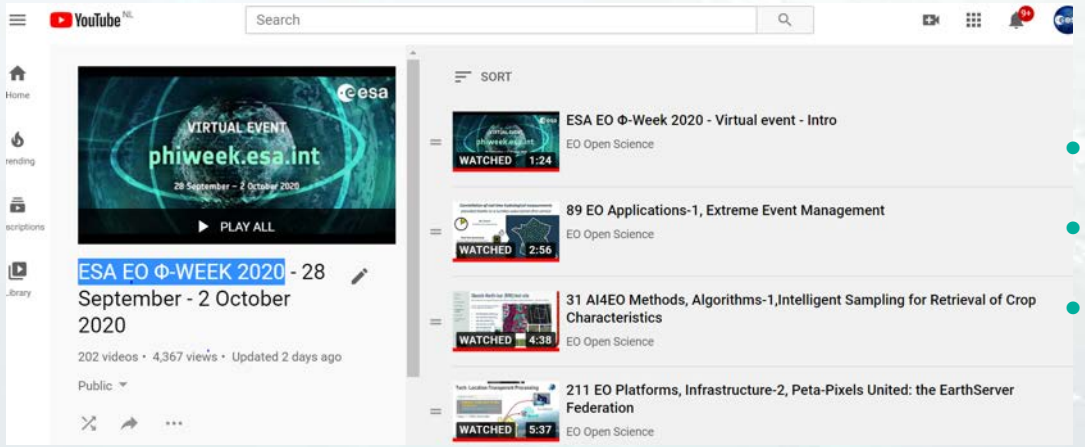
During the event

Summary – Social Media Reach

The Φ-week increased x3 times the traffic on the EO_Open_Science YouTube channel during September 2020:





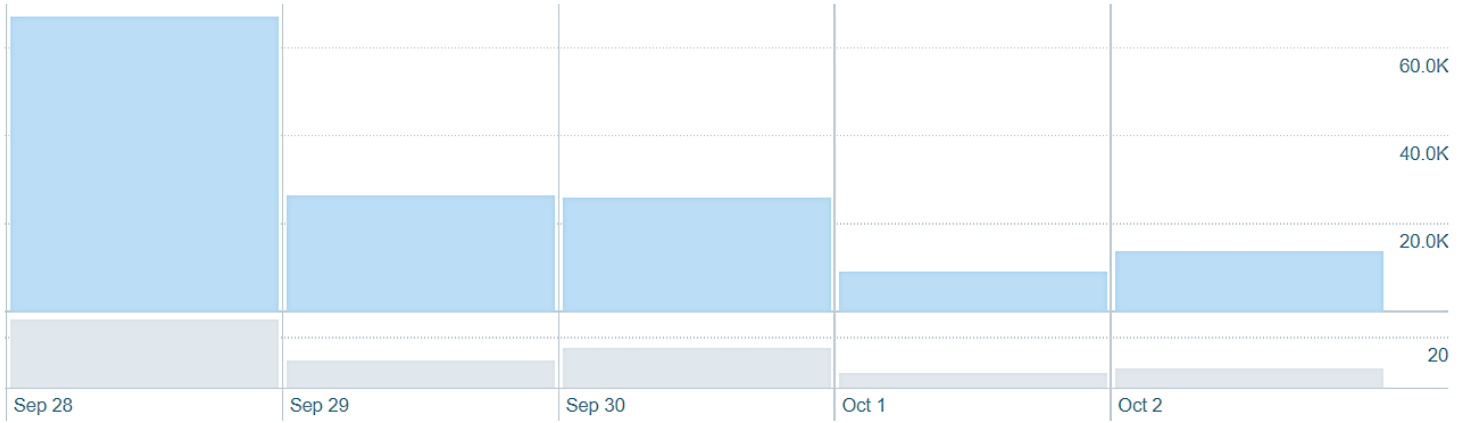


- 202 videos uploaded 4,367 views between 28 Sept. – 02 Oct.
- Playlist was live from 01/09
- **Top playlist : 60% ranking**

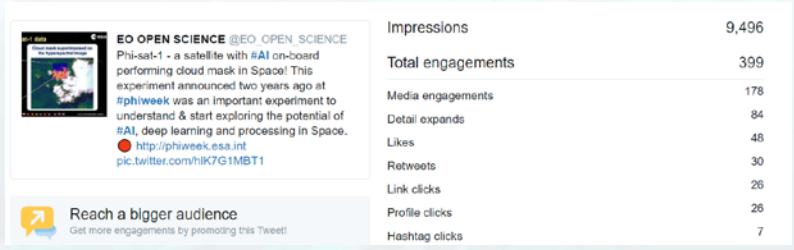
Summary – Social Media Reach

Twitter Engagement during the Φ-week 28/09 to 02/10

Your Tweets earned **142.4K impressions** over this **5 day** period



Top Tweets (based on nr of impressions)

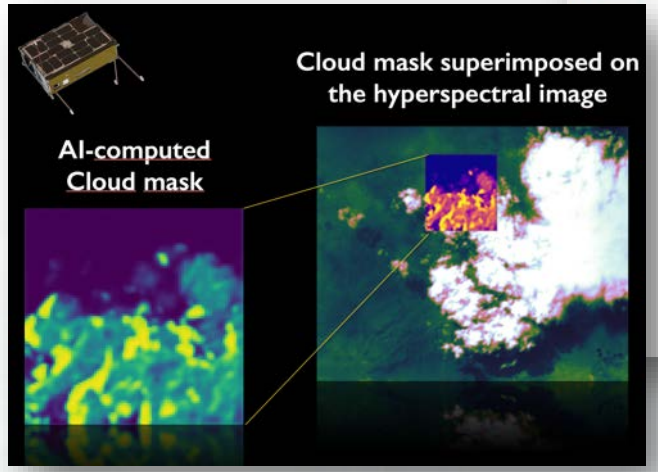


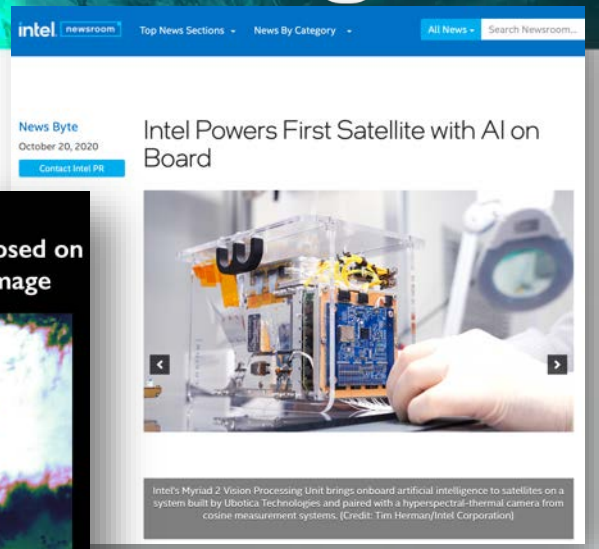
Main announcements

Φ-sat-1 launch and commissioning

On 3 September, the worldwide first artificial intelligence technology carried onboard a European Earth observation mission, ϕ-sat-1, was launched from Europe's spaceport in French.

ESA, along with Cosine remote sensing, are happy to reveal the first ever hardware-accelerated AI inference of Earth observation images on an in-orbit satellite – performed by a Deep Convolutional Neural Network, developed by the University of Pisa.





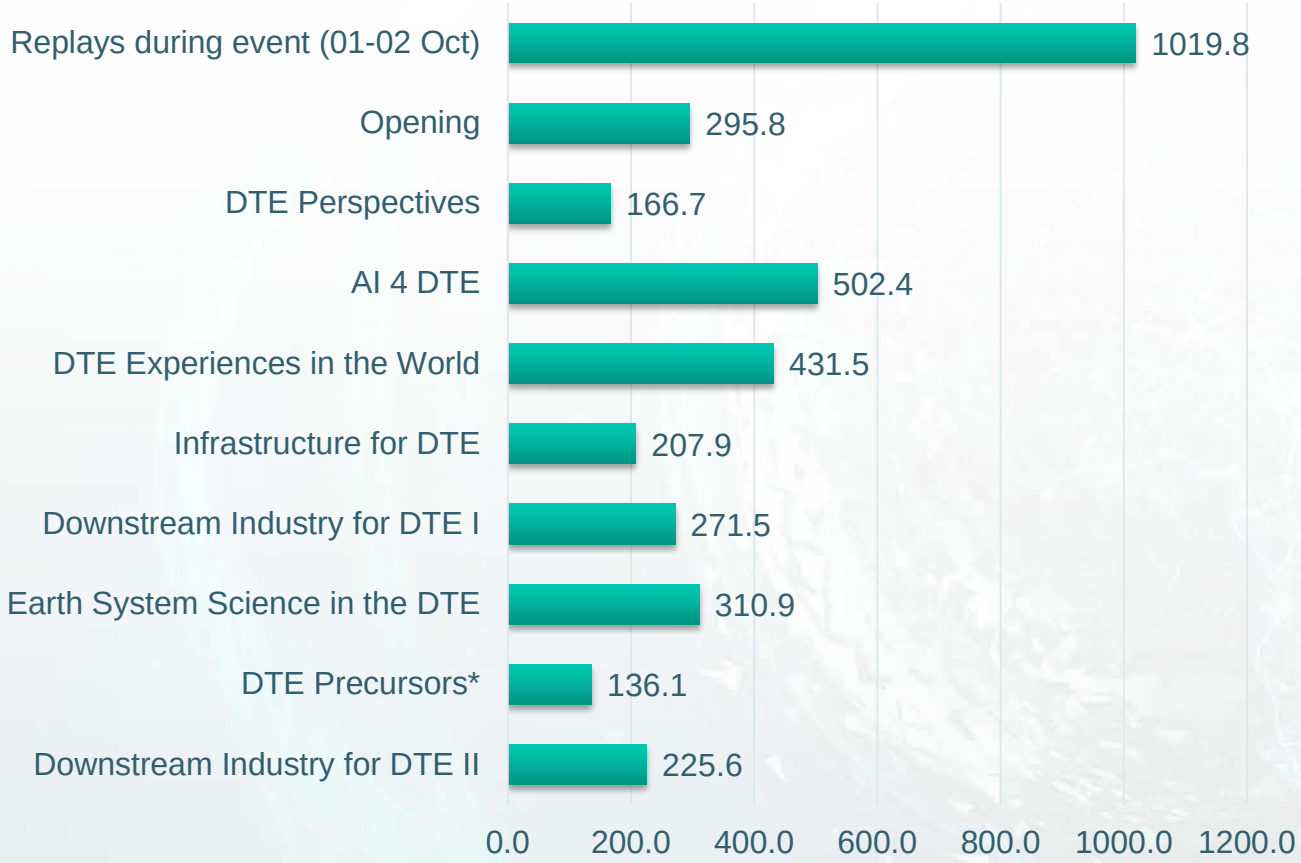
Quantum computing

Josef Aschbacher made a special announcement regarding an exciting new ESA initiative, the "EOP AI-enhanced Quantum Initiative for EO - QC4EO" in collaboration with the European Organization for Nuclear Research (CERN).

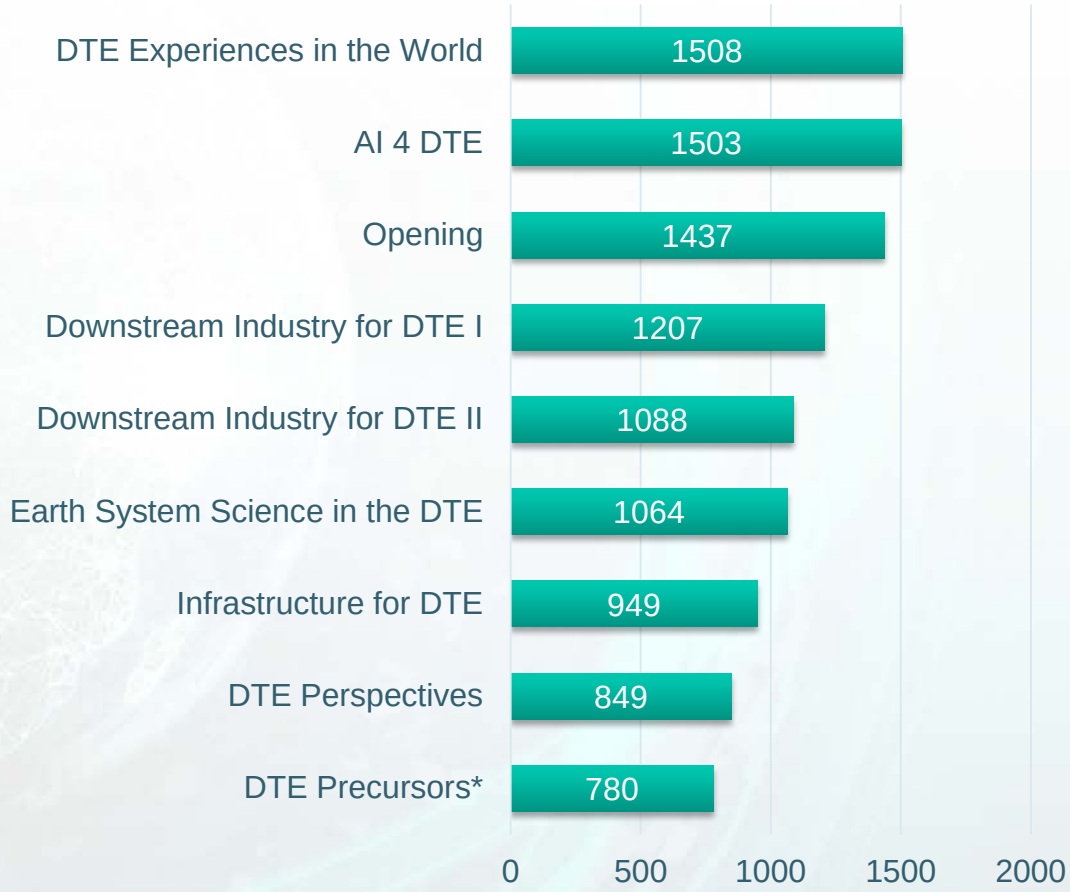
The initiative will be developed at the Φ-lab at ESRIN and involves creating a quantum capability which will have the ability to solve demanding Earth observation problems by using artificial intelligence to support programmes such as Digital Twin Earth and Copernicus.

Summary – Audience Distribution per session

Cumulated audience time (in hours)



Number of live views

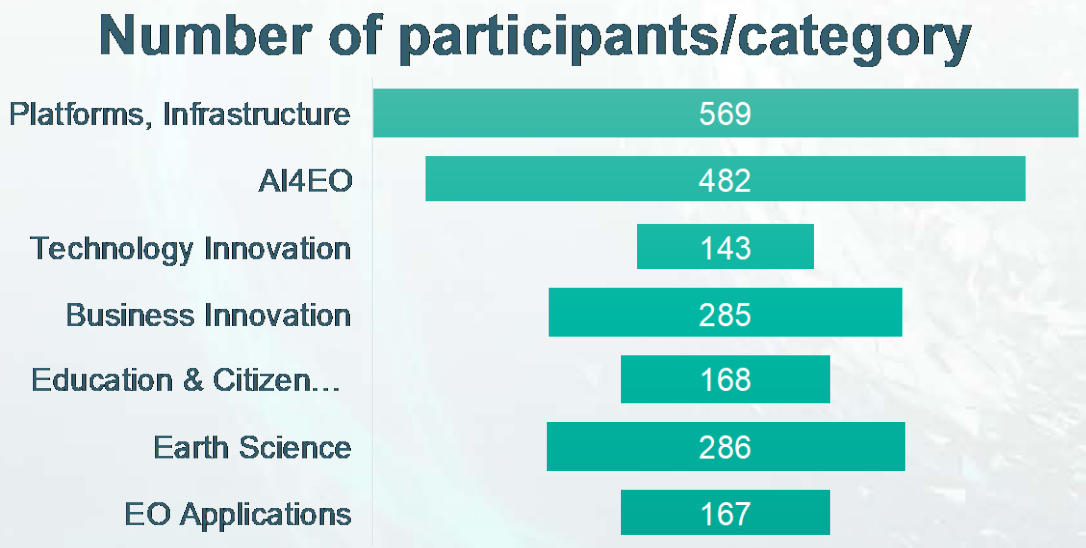


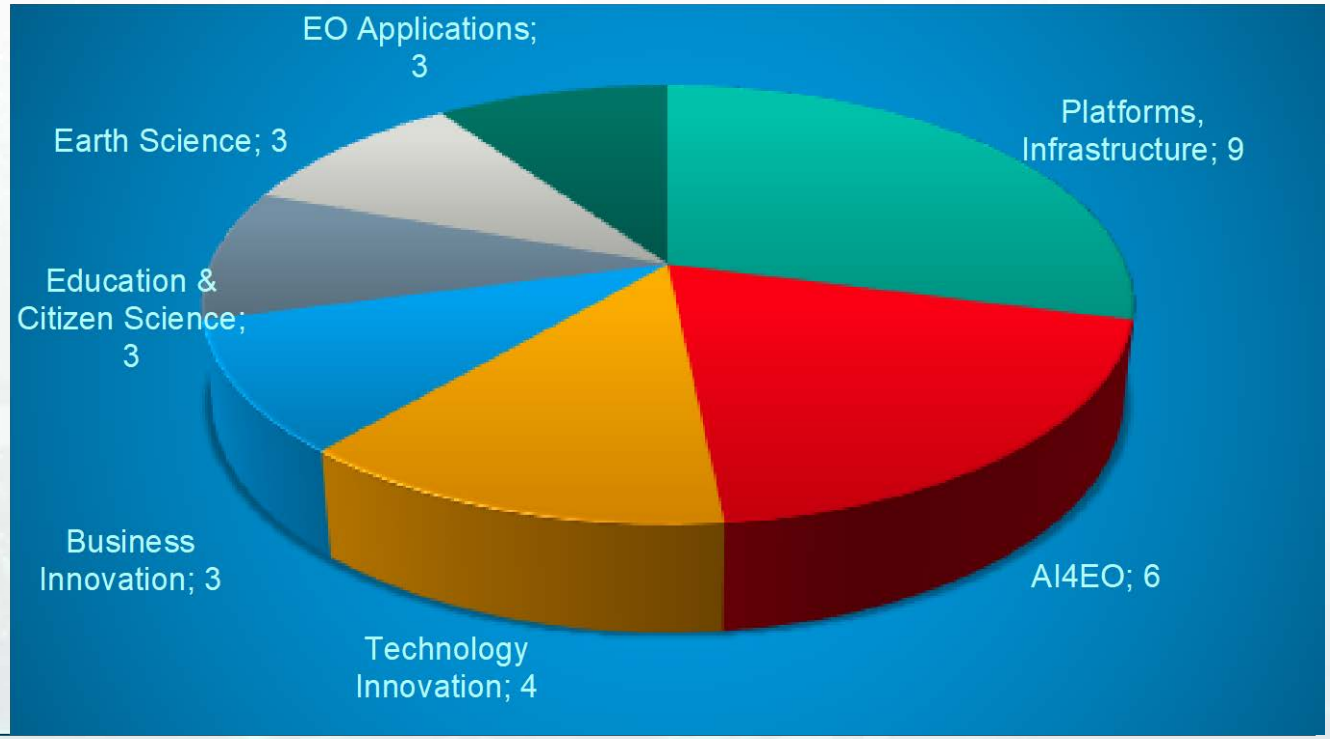
MAIN SESSIONS PROGRAMME

MONDAY		TUESDAY		WEDNESDAY	
09:30 - 11:00	OPENING SESSION	09:30 - 11:00	Infrastructure for DTE	09:30 - 11:00	Downstream Industry for DTE - II
	break		break		break
11:10 - 12:10	DTE Perspectives	11:30 - 13:30	Downstream Industry for DTE - I		
	break		break		
12:20 - 13:50	AI for DTE	14:30 - 16:00	Earth System Science in the DTE		
	break		break		
14:30 - 16:00	DTE Experiences in the World	16:30 - 17:30	DTE Precursors		
	break		break		
16:30 - 18:00	POSTERS	17:30 - 18:30	POSTERS		

Side Events - Statistics

- **28 Side Events** were organised as parallel sesssions.
- Recordings will be made available on the Brella platform by 30 October 2020
- **Most popular Side Events:**
  - Earth Observation: Innovation & Entrepreneurship (146)
  - AI for understanding processes in intertwined Earth System Dynamics (145)
  - AIREO: AI-Ready EO Training Datasets (128)





AI for Digital Twin Earth

- AI is a powerful tool that becomes critical to make sense of big EO data, it has also limitations (e.g. training data, explainability)- Europe has a unique opportunity now to catch up with developments in China and USA in particular on downstream science and applications with AI, it is important not to miss the AI train
- AI@edge is becoming mainstream for IoT, sensors are becoming increasingly connected and smarter, it is also happening at the ultimate edge - in space - with first demonstration with Φ-sat1. Again Europe can take the lead in developing the new generation of "AI-powered sat" that can open new avenues for IoT and distributed computing in space.
- Integrating of physics and statistics is critical for making the most of AI and EO, and pave the way towards physics-aware DTE
- More research is needed to show the power and limitations of AI, in particular to increase trust to accelerate uptake by increasing the explainability of the algorithms. AI4EO will focus on some of this priorities.

AI for Digital Twin Earth
AI4EO activities (side event)

- Session replay: https://youtu.be/Bw31IS4-Y1E
- Need to conduct a suite of Research and Innovative activities aiming to accelerate the evolution of technical capabilities of European AI4EO research and industry.
- Ongoing development of a suite of **AI4EO challenges**, addressing data scientists and innovators, e.g. ESA-funded "AI4EO challenges“ project (https://ai4eo.eu/). A new AI4EO dedicated platform for challenges will be built. A set of minimum 3 challenges will be organised in 2021, and the first one will address the downscaling of air quality products to deliver surface concentration maps of PM2.5 and NO2 of a higher resolution than Sentinel-5P satellite data and the CAMS products. The need was highlighted by ECMWF and UNEP via its Global Environment Monitoring System for Air (GEMS Air) program. Thanks to the support of sponsors (among other Airbus, Wekeo or NVIDIA), the winner of each challenge can earn up to 30.000€ in prize (cloud, GPU, VHR imagery...)
- **Two pitches were presented**: one about the Pi School project and one by the Frontier Development Lab highlighting various AI4EO case studies (cloud classification, aerosol modelling, on-board flood segmentation, flood and time-to-inundation prediction, hydrology mapping, ...)

Digital Twin Experiences in the World

- DTE can enable shorter turnaround for science and accelerate rate at which science results are being fed into societal challenges

- DTE as enabler of science should support various IDEs and APIs, on-the-fly cloud based simulations for Earth Science, with HPC at core. DTE as an enabler of business should be an information system for business risk quantification and compliance with regulations.

- Synergy between simulations and data visualisations are key to improve the understanding of Earth System and complex processes in the DTE. Interpretability can be supported in the DTE by providing tools for model inspection and for comparisons between observation and prediction. DTE should enable model testing with NRT data feeding into the system. Training data should be part of the code. Good DevOps, CI/CD management is required to keep versioning of data, model and algorithm

- Biggest potential for innovation: looking at cause-effect relationships, AI to learn closed relationships and causality, including sensor data, EO data and physical models, with multi-scenario capability

Infrastructure for Digital Twin Earth

- There are public data and commercial data that have to contribute and that will never happen to be on a single infrastructure: data/algorithm owners have different preferences on where they are ready to share their assets
  - A federated opne approach is needed
  - A hybrid approach is needed (free contributions by public bodies, paid contributions by commercial actors)
- Analytics capabilities on top of infrastructure make the difference to get value out of data
- The most effective way to involve commercial infrastructure is to create a «pull»; public investment should focus on buying commercial services and use them; committed consumption is needed to keep the infrastructure alive and in particular to allow industry to set off the storage costs
- Research needs “free-at-point-of-use” access to commercial infrastructures
- Standards are needed, but will take time; this should not obstacle quick technological advance in providing new capabilities to the community

Earth System Science in the Digital Twin Earth

While significant efforts should be mobilised to achieve a quantum leap in infrastructures capabilities to realise the DTE vison, an equivalent parallel effort shall be dedicated to address the major scientific challenges. 4 main domains…

- *Advanced Earth system science and process understanding*

Enhanced representation of human activities as part of the Earth system including related feedback mechanisms at actionable time and space scales. This shall account for human impacts (e.g. emissions) and incorporate socio-economic data into the analytics

68 %

Enhanced representation of the biological and ecosystems component as part of the Earth system including the related feedback mechanisms at actionable time and space scales between the physics and the biology

55 %

- *Advance EO data and data-driven process description*

A sound integration of multiple heterogeneous data sources (satellite-based products, in-situ, citizen observations) into a coherent multi-variate and multi-temporal data structure, consistent across variables, accounting for spatio-temporal covariation

77 %

A new generation of multi-variate consistent and integrated EO datasets that comprehensively describe the Earth system, its natural and anthropogenic processes at spatial and temporal resolutions suitable for environmental management and policy making

55 %

- *Advance modelling and data assimilation*

Advance data assimilation methods to make sure that models can ingest novel information available from classical and new types of observations

52 %

Fostering an effective integration of advanced models, cutting edge AI methodologies and the latest EO observations capabilities to achieve high performance simulations at extreme scale

48 %

- *Advanced AI as a tool for Earth system science*

The development of hybrid approaches to combining AI and physical modelling balancing between deriving parameters from first principles and learning directly from the data

57 %

Harnessing the power of AI to reveal the latent structure of physical variables that may not be directly observable / measurable through current remote sensing and can be revealed through simulations and numerical models

52 %

Earth System Science in the Digital Twin Earth:
AI for understanding processes in intertwined Earth System Dynamics (side event)

- Session replay: https://youtu.be/jlwoI9MKCqY
- **Equip ESS against naive applications of AI methods:** machine learning models are weak in extrapolations and many recent high-impact papers. Identifying when machines operate in extrapolation regimes is important, but quantifying what's the extrapolation level (and how to address it) is a big challenge nowadays.
- **Learn from AI what we don't know from first principles**: Where physical knowledge is incomplete, latent variables in some Deep-Learning model may compensate. Ground-truth data-sparsity emerged as one caveat limiting the potential of such learning approaches. AI can be used to learn Ordinary Differential Equations (ODEs) underlying some complex system from observing its temporal dynamics. "Reverse Engineering" and "Automated Machine Scientists" are the keywords in this context.
- **Towards causal inference from Earth observations**: methods in the domain of causal inference have huge potential but are in their infancy and represent a clear frontier of science that needs to be pushed further
- **Three key pathways to develop:** hybrid modeling, explainable AI, causality, based on active interdisciplinary collaboration between computer scientists and domain experts

Earth System Science in the Digital Twin Earth
Joint ESA-EC activities on DTE Oceans (side event)

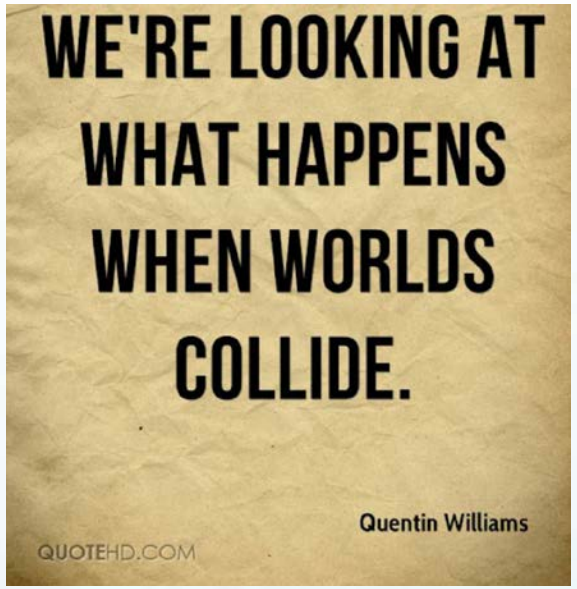
- Session replays: Morning https://youtu.be/7SfKtXHl9t4, Afternoon https://youtu.be/qj7bJJFFstg
- A comprehensive digital representation of the ocean, based on interoperable and trusted real-time and historical data from a wide range of sources, state of the art modelling (Physics, Sea Ice, Biogeochemistry, Ecosystems), coupling and data assimilation and visualisation tools
- **A 5-dimensional DTO (Ocean5D): 1** temporal dimension, 3 spatial dimensions, 1 societal dimension
- **DTO for Ocean Health**: includes biodiversity and ecosystem function, allows streamlined sharing through open-access databases of biodiversity and ecosystem data, provides a virtual reality showing the impact of human interactions on Ocean health and allow for the testing of “what if scenarios”.
- **Building blocks**: observations (smart sensors, Internet of Things, adopting Sensor Web Enablement (SWE) supporting FAIR, citizen science, crowd sourced data), existing projects and activities (e.g. Blue-Cloud), Copernicus Marine Service, HPC and cloud infrastructure, state of the art modelling, coupling and data assimilation, user interaction and user engagement

Downstream Industry for the DTE

- **Main opportunities that the Digital Twin Earth Development can bring to organisations and companies:**
  - Scaling up from regional and continental applications and developments to global analyses
  - Global collaboration with partners and close involvement of end users, stronger collaboration linking capacities in algorithm development and solution building to integrate the current and upcoming science results into global solutions for society, PPPs to foster collaborations towards using data for commercial purposes as well as to serve societal needs e.g. for densely populated coastal areas
  - From the data providers perspective: opportunities for data fusion, analytics across different data, use cases for super-resolution; there is a huge gap in the data creation side, with currently limited systems that capture the 3D nature of the processes. Another substantial gap is in the validation and training data which are very costly to collect. Consolidation is needed focusing on data resolution and quality.
  - From the operational user perspective: Informational access to the latest developments and state-of-the-art solutions with potential to be adopted in the operational chain

Downstream Industry for the DTE
EO Innovation and Entrepreneurship – InCubed side event

- Commercial EO is in the middle of a perfect storm where different worlds are colliding. New technologies, new approaches are entering the sector attracting new players and new investment
- The event focused on different perspectives: Institutional, innovative enablers, Industrial growth, the investors perspective, an industrial video pitch competition and an Investors roundtable discussion
- Speakers came from the φ-Lab, InCubed, ESA Business Applications, ESA Business Incubation, the European Commission (DG-DEFIS), Copernicus Masters, EU PARSEC Accelerator, Euroconsult, EARSC, Grenoble Institute of Technology and Eversis.
- The video pitch winners (chosen by the investors) were: SAT4Flood (InCubed) and Dipteron (PARSEC)
- Representatives from industry: Geoville, TechWorksMarine, Unibap, Cosine, Open Cosmos & Mbryonics and many others
- Representatives from Investor entities include Seraphim Capital, EBAN, LVenture & Fondazione Amaldi
- Key messages: Newspace reaches out beyond space, value chains are critical. Earth observation is a passive term and the Newspace sector is active so a change in language may be needed. To grow businesses transformational deals are needed. Identify the problem to be solved first before developing the solution. Commercial EO has customers not users. SDGs are a potential growth area in the coming years.
- Conclusions: The event attracted a lot of attention over 50 people participated online for the whole day. It generated a lot of interest in the InCubed programme and we aim to repeat this type of event on an annual basis. A number of companies expressed interest (international & European)



e-Posters

- 202 e-posters were presented at the Φ-week 2020.
- Poster presentations are available openly on the EO_Open_Science YouTube playlist
- Poster abstracts are available on the Brella platform

The posters were addressing topics from the following categories:

- Products, Projects, Initiatives
- Earth Science
- DTE Precursors
- AI4EO
- EO Applications
- Platforms & Infrastructure
- Technology Innovation
- Education & Citizen Science