Review of paper
"Comparing the evolution of ESA versus NASA technology transfer approach: market and public demand drivers"

General comment:

In reading the paper, one may question different interpretations of the terminology of "technology transfer":

- Transfer from the public domain (i.e. space agencies) to the commercial domain (and for social benefits) (lines 44-47, lines 52-56)
- Transfer from the space area to the non-space area
- Transfer from expert nations to international partners (lines 37-38-39) or developing countries (lines 61-62)
- Transfer from European / national domain to the local / level of the regions
- TBC: transfer from the scientific domain to the application domain ? (lines 74-79)
- TBC: Transfer from the military domain to the civil domain ? (line 80-85)

This is up to the authors, but it could be useful to explain, as above, what are the different types of "technology transfer" that are addressed by this paper. And potentially re-structure the text accordingly.

Technology transfer at ESA

As being part of ESA, the following comments focus on the aspects related to technology transfer at ESA only (not at NASA).

The paper only partially describes the technology transfer activities at ESA.

There is a Business incubation service (mentioned at lines 316-321 and 430-434) which enables access to a pipeline of novel commercial enterprises nurtured within the ESA BIC network (https://commercialisation.esa.int/esa-business-incubation-centres/). Up to now there have been 29 BICs with 200 start-ups supported annually and more than 1600 start-ups selected overall.

The ESA InCubed (https://incubed.esa.int/) initiative focuses on developing innovative and commercially viable products and services that generate or exploit the value of Earth observation imagery and datasets. Its fund size is about 182 M€.

The ESA Business Applications and Space solutions (https://business.esa.int/) enable satellite data and technology to transform businesses on Earth. 250M€ have been invested in launching innovative services in over 1200 businesses. This programme could be better covered in lines 278-279.

The ESA General Support Technology Programme is an ESA programme aimed at the development of new and innovative space technologies:

(https://www.esa.int/Enabling_Support/Space_Engineering_Technology/Shaping_the_Future/About_the_General_Support_Technology_Programme_GSTP)

The ESA Phi-Labs network facilitates integration of innovative commercial solutions via the PhilabNet into ESA missions (https://commercialisation.esa.int/phi-labnet/). Up to now there have been 12 Phi-labs targets and there 4 currently in development.

The technology brokers (https://commercialisation.esa.int/technology-broker/) identify technologies that have spin-off potential and support their commercialisation through ESA Spark Funding (the latter is mentioned in lines 280-284). Up to now there have been 9 technology brokers and more than 400 technology transfers.

The ScaleUp Invest initiative (https://commercialisation.esa.int/2022/10/scaleup-programme-invest-element-the-scaleup-marketplace/) creates a marketplace for suppliers and customers to secure space services at competitive prices. It currently supports companies with the possibility to access ~ 25M€ in funding for IOD/IOV deals.

The ESA Investor network (https://commercialisation.esa.int/investor-network/) builds effective partnerships with capital allocators, key institutions, accelerators and investors and comprises more than 250 investors.

The ESA ambassador network (https://business.esa.int/ambassador-platforms) extends the reach of ESA and space-companies into non-space sectors through dedicated in-country support. It has currently 13 ambassadors in 7 Member States of ESA.

The final stages of commercialisation also include initiatives like EO data buy (for science through Earthnet and for operations through Copernicus) and the ESA Newspace approach with the funding of the Scouts or AWS missions.

A brief description of the above initiatives in chapter 4 could give a more complete picture of the technology transfer & commercialisation programmes at ESA.

Additional comments:

[Regarding one comment and its reply posted about the paper]
On the statement: *"In the technical-scientific and economic literature, "upstream" space activities typically concern Outer Space launch and exploration systems while down-stream activities typically concern Earth Observations and the services that are generated by them such as, for example, satellite services (Navigation, telecommunications, etc.)."*

At ESA we rather consider "Upstream" the activities linked to the development of space mission / satellites, whereas downstream is more related to activities linked to the exploitation of the space systems and their data.

It seems the terminology "Earth observation" is used for system orbiting around the earth (i.e. incl. navigation, telecommunication), whereas we consider at ESA that the terminology "Earth

Observation" is related to the space systems observing the earth, i.e. remote sensing. In that respect the sentences lines 121-122-123 are not fully clear.

Lines 254-255: the cooperation on the ISS also includes Canada / CSA.

Lines 257-258: the equivalence of budget between NASA and the US DoD is most probably related to the space activities of the DoD.

Lines 260-261: please clarify the involvement of NASA in the "ESA market". Is "ESA" wrongly inserted here ? Is it rather meant "commercial market" ?

Lines 275-277: The authors mention ESA Technology Transfer Demonstration Programme. To be clarified whether this refers to the Technology Transfer Programme which was created to facilitate technology transfer from space technologies to terrestrial applications and to help with the commercialisation of such applications.
(https://www.esa.int/Enabling_Support/Space_Engineering_Technology/Technology_Business_Opportunities/Technology_Transfer_Programme)

Lines 278-280: the authors are invited to consult: https://business.esa.int/
There are different initiatives, from non-equity funding (up to 2M€) to tailored project management support to businesses concerning business applications programmes. The level of funding depends on the type of activities (i.e. feasibility studies in open competition or direct negotiation, kick-start studies or demonstration projects) and range from 50K to 400K€

Lines 293-294-295: this is true, but to some extent. The ESA convention does not prevent ESA to perform operations of space systems. It is true that the meteorological scheme whereby ESA develops satellites and transfer them to EUMETSAT for their operations is a good illustration of what is written. However, ESA is also responsible for the operations of large systems with many satellites, like in the case of Copernicus, with funding delegated from the EU. The operations of the Sentinel satellites are shared between ESA and EUMETSAT.
These are just remarks to the authors, no need to amend the text.

Line 325: it is suggested to add "ESA", i.e.: "The EU and ESA support the NEREUS…"
Indeed the described activity have been made under an ESA contract, with funding from the EU.
This is an excellent example for indeed promoting the economic growth at the level of the regions using Copernicus Sentinel data. The use of Sentinel data at regional and local levels also allows the public authorities to use space-derived technology to combat the effect of climate change, sustainable agriculture, water management, forestry monitoring etc. This also helps the economy with the creation of related value-added services.
This is actually very well covered under point 4. of chapter 4.2.

Lines 368-374: For the socio-economic impact, and showing the benefits brought by the usage of Sentinels data to society, environment and economy, please be aware of the activity ESA has been organizing with EARSC on Copernicus: https://earsc.org/sebs/

Line 385: ESA has currently 22 Member States.
Note that not all MSs have a space agency, so suggest to add: "…. each represented by their national agencies or relevant ministries."

Line 392: not only related to Earth Observation but space application systems more generally.
It is true that ESA being an inter-governmental organization, it performs the activities primarily for the interests of its Member States (as well as for the EU for joint programmes like Copernicus).
However ESA also launches on its own specific initiatives to foster the commercialization linked to space, in both the upstream (space segment, satellites) and downstream (data exploitation), that in fine serve also its Member States.