Data Handling and Preservation of the TanDEM-X Satellite Mission

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Outline

- An Overview of the TanDEM-X Satellite Mission
- A short Introduction into the Data and Information Management System (DIMS)
- DIMS for TanDEM-X
  - The Acquisition Request Workflow
  - The SAR Data Workflow
  - The DEM Production Workflow
- Conclusion

An Overview of the TanDEM-X Satellite Mission

- TanDEM = TerraSAR add-on for Digital Elevation Measurement
- The primary purpose of the mission is the production of a global consistent and reliable Dig mum accuracy to HRTI-3 (spatial resolut racy < 2m)
  - In cor
    -
    - rtical accuracy < 6m)
- Two SAR (tric satellites will fly in close formation
- During the a half year every point of the land surfac imum
- Expected d
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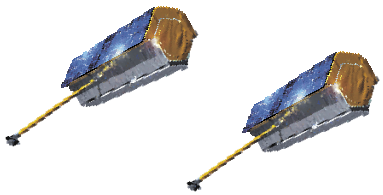
  - Intermediate data :~ 1700 TB
  - End product :~ 15 TB

An Overview of the TanDEM-X Satellite Mission

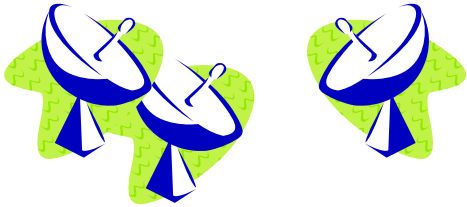
- TanDEM = TerraSAR add-on for Digital Elevation Measurement
- The primary purpose of the mission is the production of a global consistent and reliable Digital Elevation Model (DEM) with minimum accuracy to HRTI-3 (spatial resolution : 12m x 12m, relative vertical accuracy < 2m)
  - In comparison : SRTM from 2000 :
    - Coverage : between 60°N and 58°S
    - Resolution for the USA : (30m x 30m, relative vertical accuracy < 6m)
- Two SAR (Synthetic Aperture Radar) interferometric satellites will fly in close formation on polar orbits
- During the operational mode of at least two and a half year every point of the land surface should be acquired two times at minimum
- Expected data volume :
  - Raw data : ~ 350 TB
  - Intermediate data : ~1700 TB
  - End product : ~ 15 TB

TanDEM-X – an Extension of the TerraSAR-X Mission

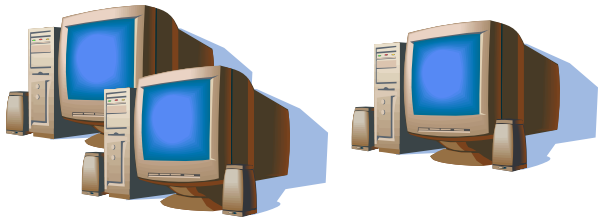
- Adding a further satellite to the already flying TSX-satellite.



- Enhancing the receiving station network to be able to downlink the data.



- Updating the payload ground segment (including the Data and Information Management System DIMS) to handle the new workflows.



A short Introduction into the Data and Information Management System (DIMS)

- DIMS is the data handling infrastructure of the German Remote Sensing Center (DFD).
- The DIMS services are decoupled by functionalities:
  - User services 

  - Order handling 

  - Production control 

  - Product inventory and archiving 

  - Monitoring & control, operating 

  - Processing management 

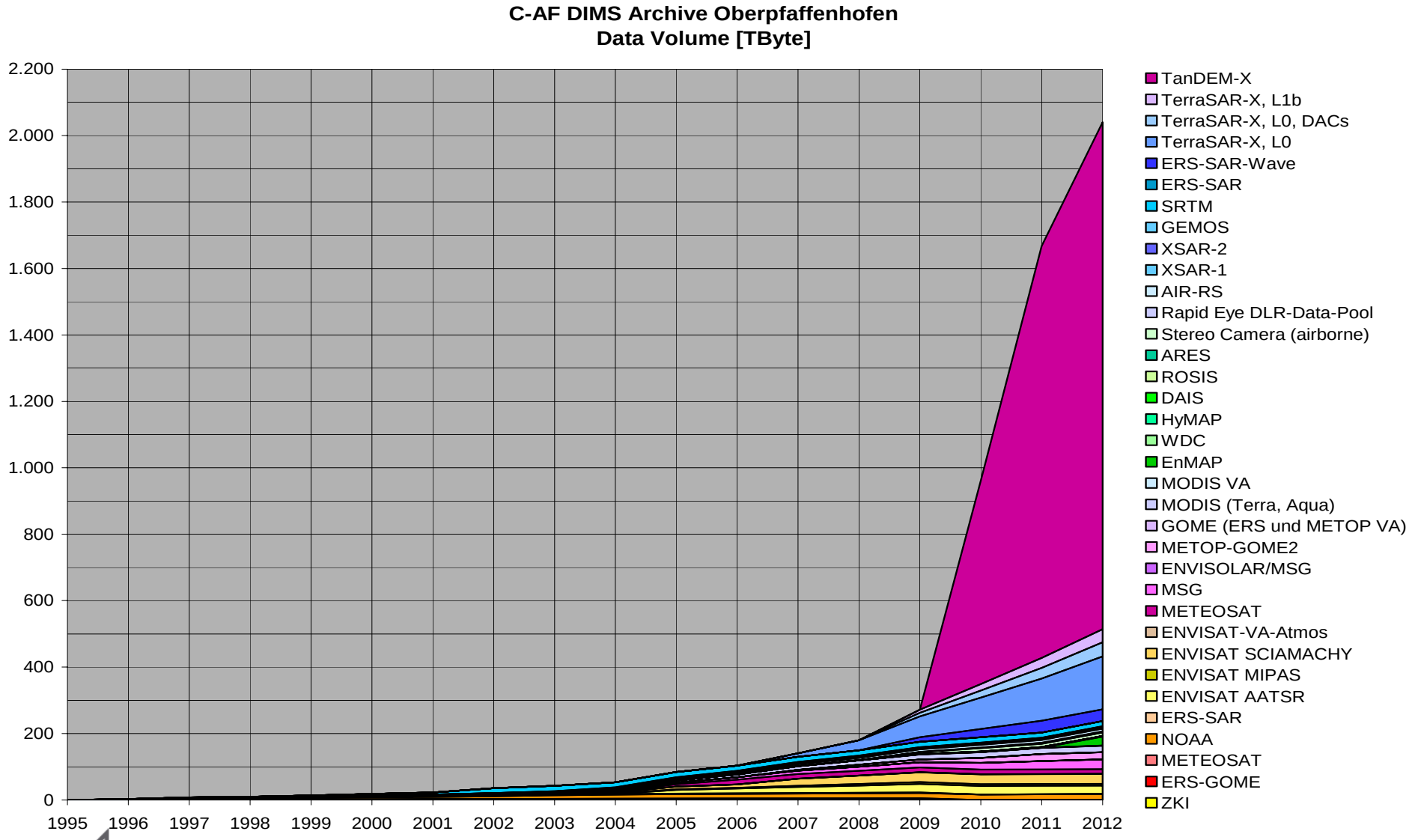
- The services are scalable and can be plugged together within a distributed service network according to required request and data flows.
- DIMS is in operational use since the year 2000.
- DIMS components are deployed in more than 15 sites.`

DIMS at DLR, some numbers

	Oberpfaffenhofen	Neustrelitz	Sum
Processing Systems connected to DIMS	8	37	45
Product Transfers per Month	86,000 (32,000 in)	90,000 (42,000 in)	176,000
Product Types	82	76	158
Products	1,060,000	931,000	1,991,000
Files	4,911,000	1,700,000	6,611,000
Amount of Data	180 TByte	160 TByte	340 TByte

This and the next viewgraph were taken from W. Wildegger

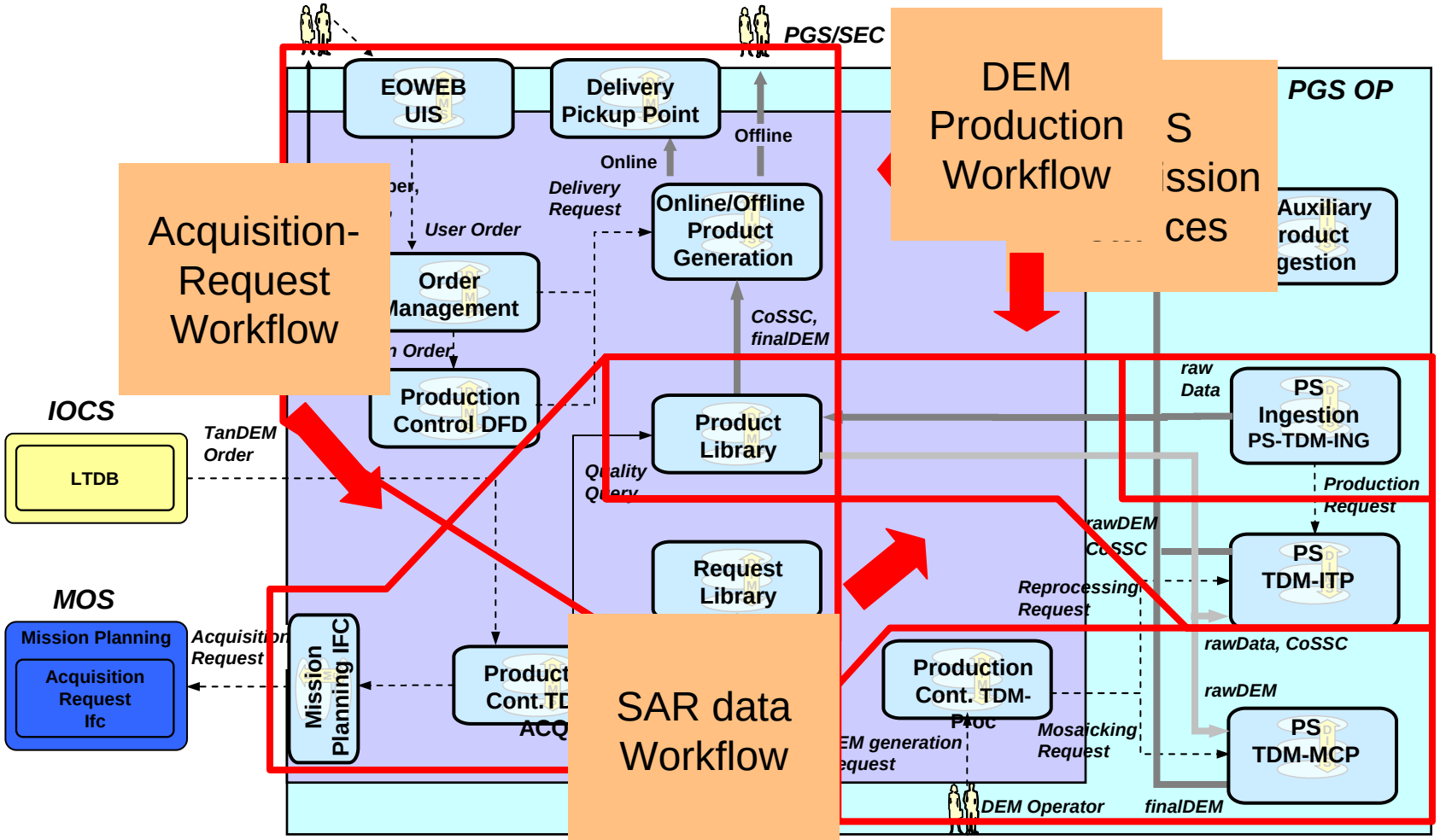
Archive Data volume History and Prediction



DIMS and the joined Satellite Missions TerraSAR-X and TanDEM-X

- The existing DIMS in the configuration for TerraSAR-X
  - provides ordering, processing and delivering of future acquisitions from individual user request also as catalogue orders.
  - is operational since July 2007
  - has processed more 60.000, resulting in more than 76.500 products with a amount of more than 55 TB.
- Necessary configuration extensions to support the joined missions
  - TerraSAR-X:
    - Handle the second satellite
  - TanDEM-X:
    - Acquisition Request-Workflow
    - SAR Data Workflow
    - DEM Procduction Workflow
    - Catalogue Ordering

DIMS for TanDEM-X



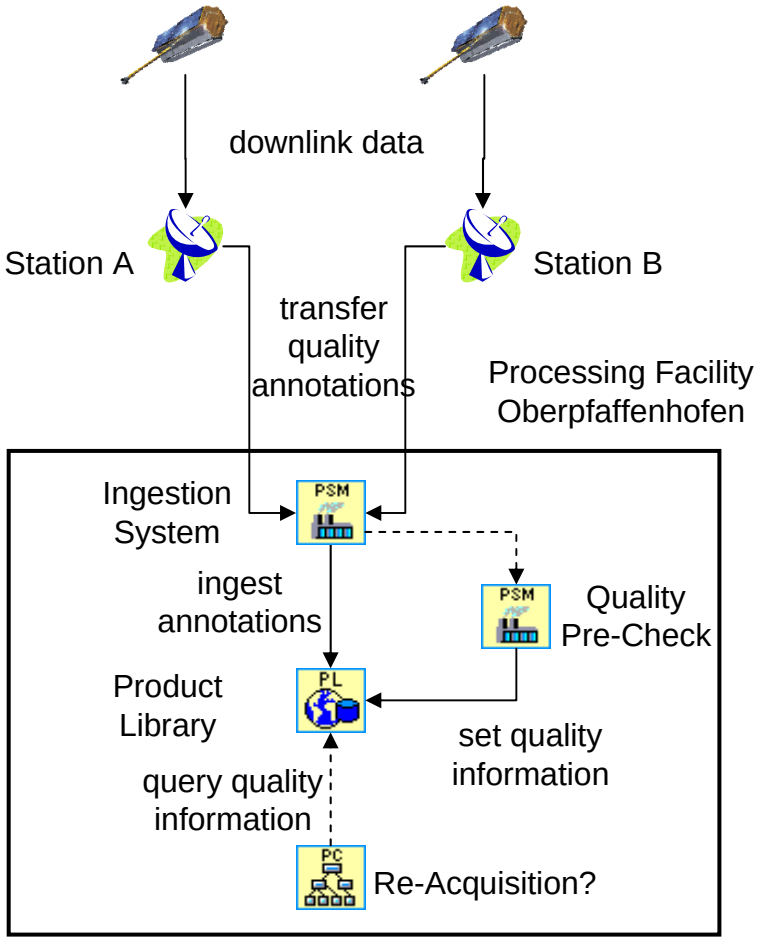
The Acquisition Request Workflow

- Basis for the TanDEM-X mission is a pre-planed acquisition time line; it is optimized relating to
  - Satellite resources (only 50 % are available, the other part is necessary to fulfill the ongoing TerraSAR-X mission)
  - Downlink capacity
  - Earth surface
  - …
- Every point of the surface should be acquired at least twice; the second acquisition should be one year after the first one.
- Because of the drift of the satellites there exists only one optimum constellation for the acquisition of the data of a special region in every acquisition phase, so that a fast reordering of acquisition of bad quality is necessary.

Challenge : (Partial) downlinks at various receiving stations; connected to the processing facility in Oberpfaffenhofen over a “small cable” (e.g. Antarctica)

Fast Quality Feedback – a Solution for the Challenge of the Acquisition Request Workflow

- The received data will be screened at the ground station.
- This quality annotations will be transferred online to the Processing Facility.
- An Ingestion System stores these information into the Product Library as a product component and calculates the completeness.
- If the quality information of the joined acquisition (both datatakes) are complete, a processor performs a interferrometric quality pre-check.
- Depending on this result, a re-acquisition can be started.
- The mass data will be shipped on tape.



The SAR Data Workflow

- The recorded raw data must be archived and processed to intermediate products (CoSSC and rawDEM)
  - CoSSC product size : 2,3 GB
  - rawDEM product size : 0,9 GB
  - Joint datatakes will be divided into smaller scenes
  - Every scene and all existing CoSSCs with the same spatial coverage of earlier acquisitions are the basis for a new CoSSC
  - One CoSSC results into one rawDEM
  - Production rate (second acquisition phase) : 400 + 50 (Reproc.) / day
- This workflow is data driven.

Challenges :

1. Diversity in transportation time of the mass data.
2. High data transfer rates between the archive and the processing systems.

A Solution for the Challenge of the SAR-data Workflow

- The Ingestion System must calculate the completeness of both datatakes of the joined acquisition.
- If the acquisition is complete, the next processing system will be triggered.

But :

The shipping time of the tapes maybe take some weeks.

→ The archive cache must be extended (from currently 3 TB up to 40 TB) to speed up the product retrieval.

The DEM Production Workflow

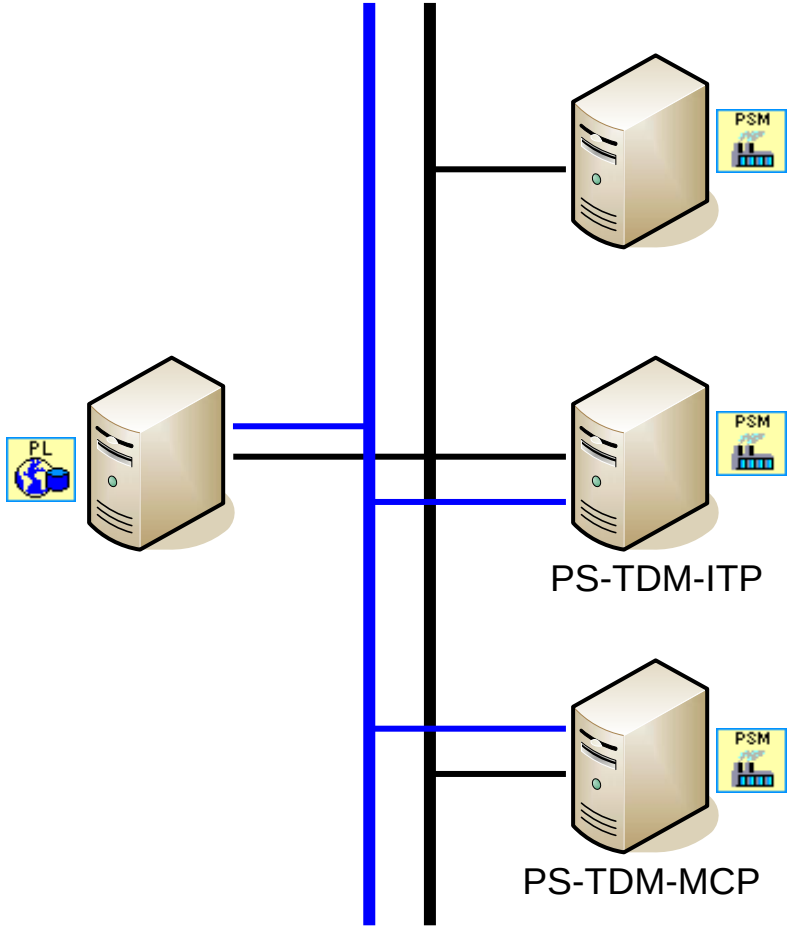
- In contrast to the SAR-data workflow this task is
  - operator-driven
  - region based
- The operator searches for regions (e.g.Iberian Peninsula) with sufficient rawDEMs of a good quality.
- Reports containing information about expected acquisitions and existing rawDEMs will be generated on a daily basis to support the operator.
- A reprocessing of some rawDEMs could be necessary.
- A final DEM tile with a size of 1°x 1° at the equator will be composed with the rawDEMs of various acquisitions.

Using a Second Network – A Solution for the Challenge of High Data Volumes

- Until now, the Product Library and the various processing systems were linked by 1GBit Ethernet. Using this network, the requests as well as the products are transferred.

- To meet the requirements of the TanDEM-X mission, a further network was installed (IP over Fiber Channel) between the TanDEM specific processing systems and the Product Library.

- In this extended configuration, the control flow remains in the GBit network; whereas the product transfer uses the collision-free network.



Conclusion

- The TanDEM-X mission faces various challenges:
  - High data volume
  - Distributed downlinks
  - Regional bulk processing
  - Integration with operational TerraSAR-X mission
  - Short time to extend the ground segment
- DIMS is able to give answer to system evolution for
  - Acquisition request workflow
  - SAR data workflow
  - Archiving and data transfer

Thank you for your attention!

Questions?

Comments and further questions are welcome:
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