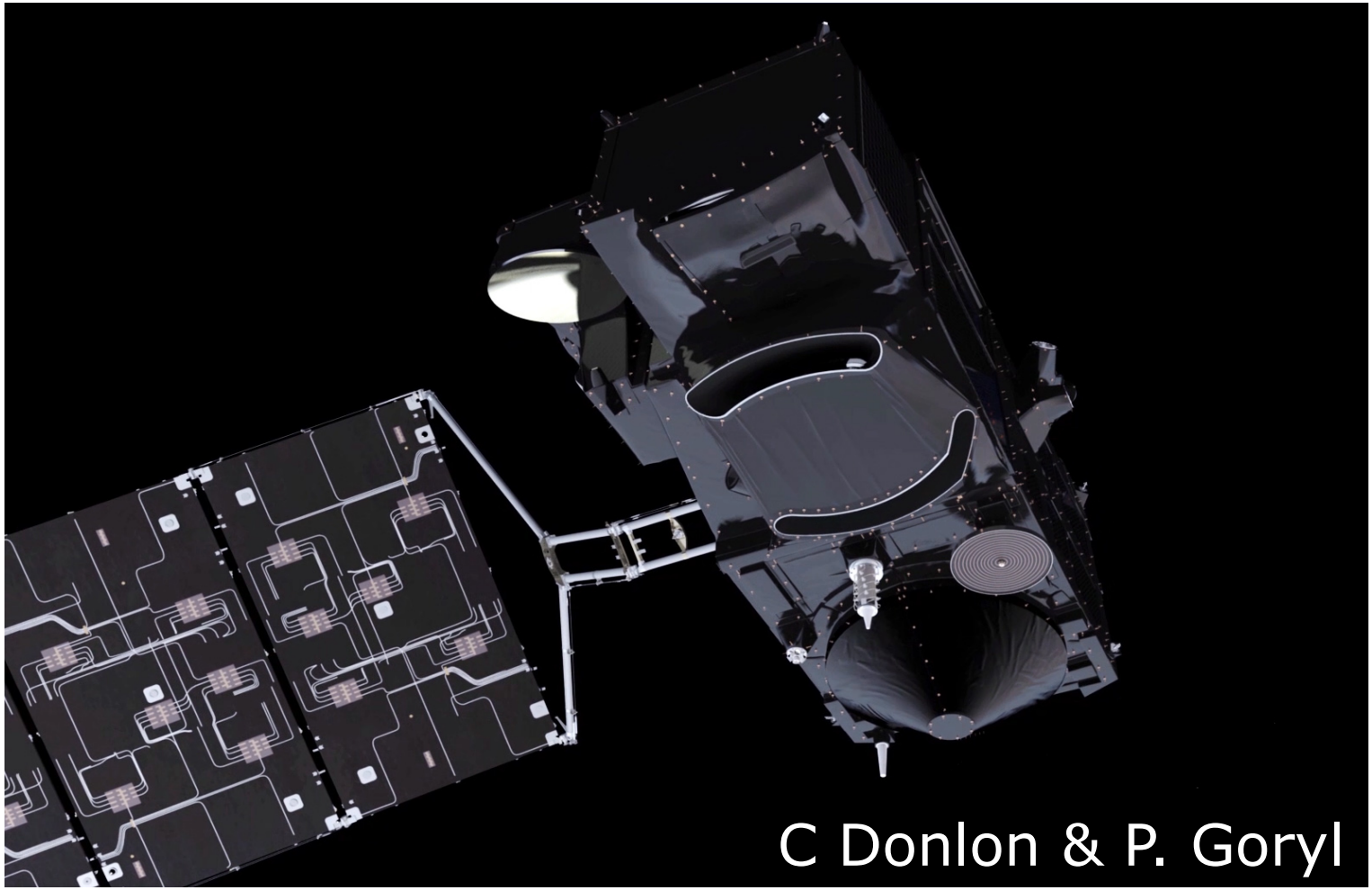
Fiducial Reference Measurements (FRM) for Sentinel-3

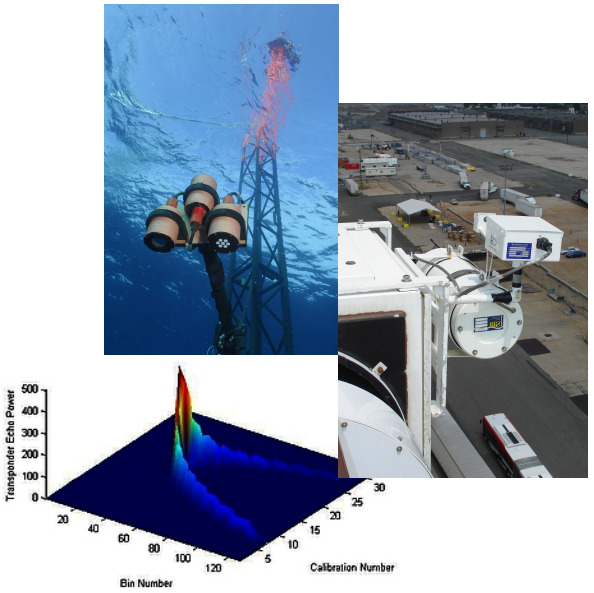


Overview

- What are Fiducial Reference Measurements (FRM)?
- Why do we need them at all?
- Examples of FRM in the context of Sentinel-3
- Summary
- Challenges for this meeting

Fiducial Reference Measurements (FRM)

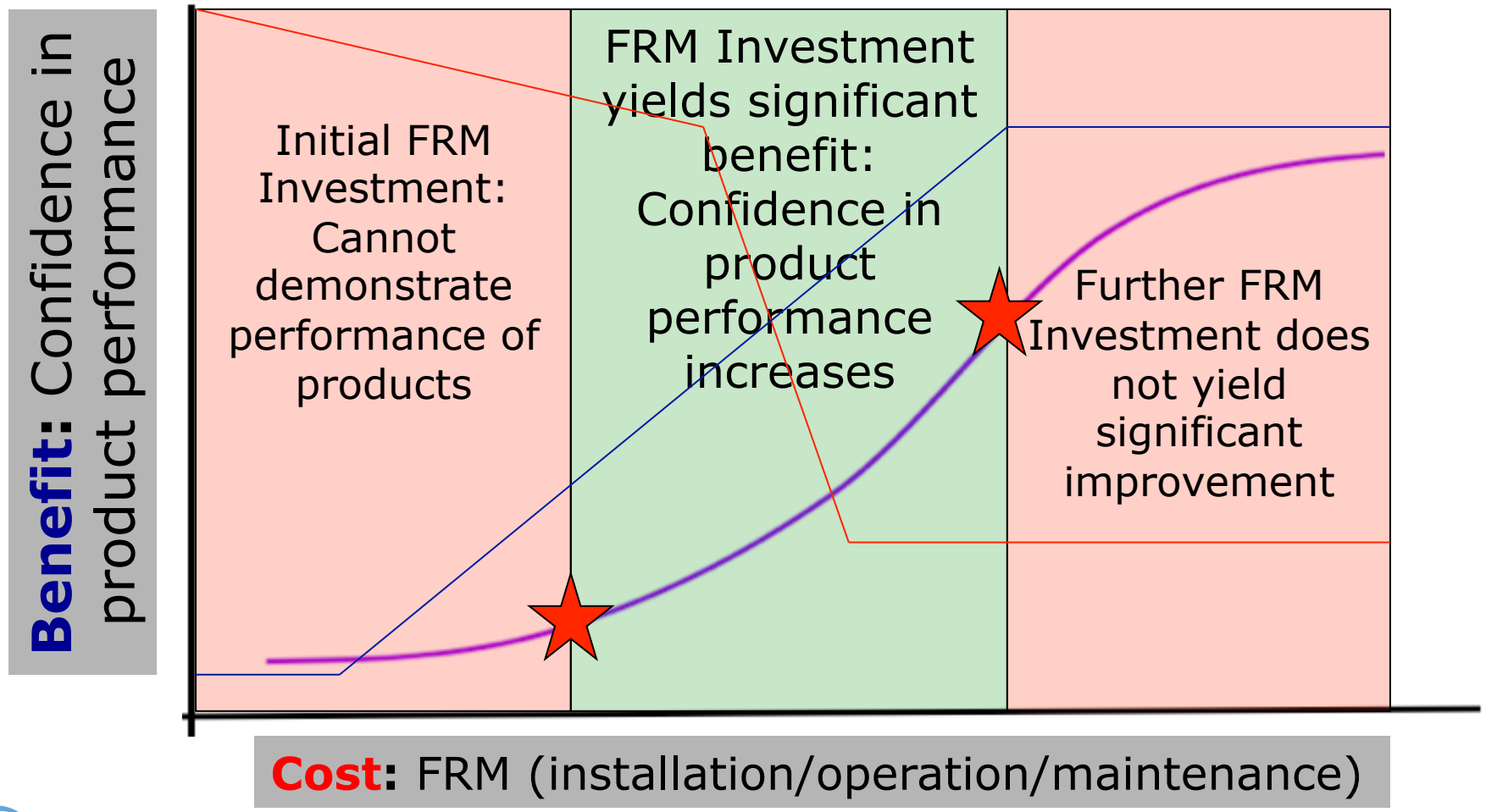
- **fi·du·cial *(adj)*** *Regarded or employed as a standard of reference, as in surveying.*
  - `[Late Latin fdcilis, from Latin fdcia, trust, from fdere, to trust; seebheidh- in Indo-European roots.]`
- What's wrong with in situ?
  - It means everything to the uneducated
  - It's not tangible to a funding agency
  - It is not precise enough to argue for a validation program
- Sentinel-3 FRM are:
  - Linked to the S3 Cal/Val plan activities
  - Based on specific requirements
  - Forward thinking – long-term vision
  - Building on the existing capability
  - Have an inclusive approach: FRM are not Mission specific (e.g. S3A, B, C, D… S2A, B, C, D…all need ocean colour FRM…, All Altimeters need transponders for range calibration – and Sigma0…)



Why do we need FRM?

- FRM is the suite of ground measurements that provide the maximum Return On Investment (ROI) for the Mission by **delivering the required confidence in the data products for users.**
  - IF we have **no FRM** then we cannot really use the mission as we have no idea how accurate data products are
  - IF we have **many FRM** this is great scientifically (statistical significance, geographic coverage, robust network…) but incurs additional costs with reducing ROI
- **There is a balance between these two extremes to deliver a satellite mission with a KNOWN product quality that is "fit for Purpose"**

Is a mission product “fit for purpose”?
It depends our knowledge of how “good” it is…



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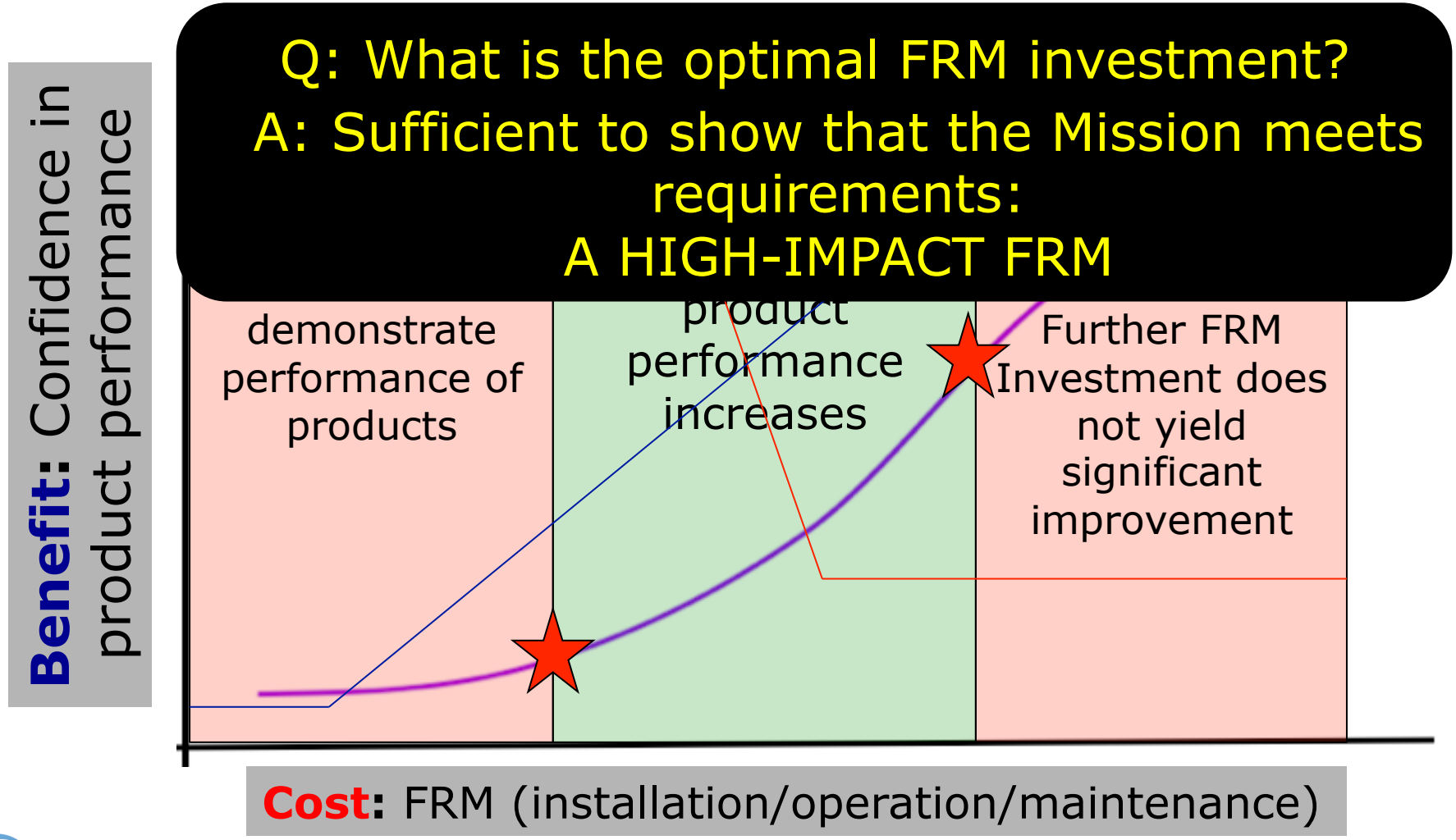

Example FRM: S3 SLSTR

- Ship-borne radiometers provide skin SST traceable to International standards.
- Drifting buoys provide wider geographical coverage and measure sub-surface SST (more complex validation) but not fully traceable.
- Moorings provide sub-surface SST – better temporal coverage but poor spatial coverage – may be partially traceable
- HR-ARGO floats: Provide vertical profiles moderate coverage but not fully traceable…

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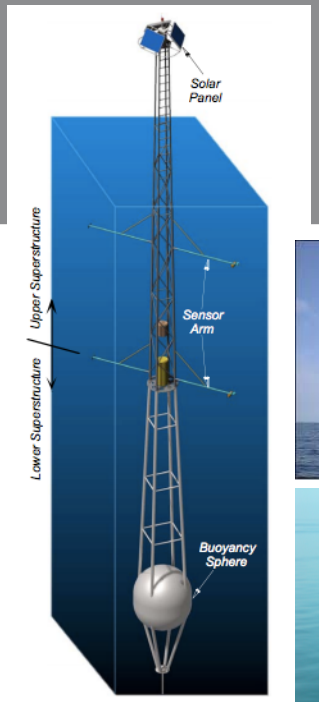
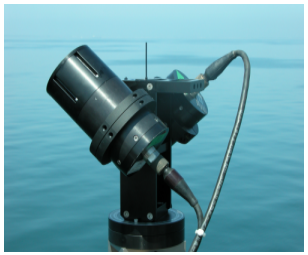
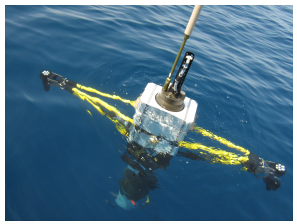
Which one is a high impact FRM?

Example FRM: S3 OLCI

- We need FRM to perform vicarious calibration of OLCI - Boussole, Moby, others (statistics needs at least 3 points to work with…) - other data – aerosols?
- We need FRM to perform regional algorithm development and validation
  - Ship data, moorings, AERONET-OC, Platforms…
- FRM should be capable of coping with sensor specific issues (e.g. geometry of OLCI vs other OC sensors…evolution of S3 OLCI A/B → C/D units? What about S2 MSI?)







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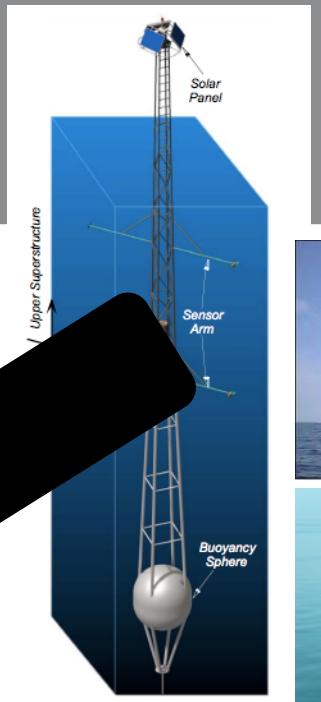
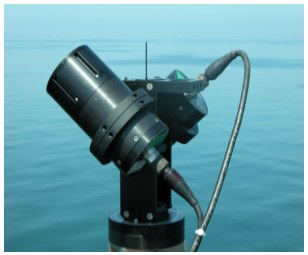
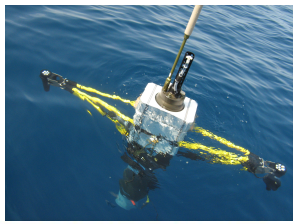
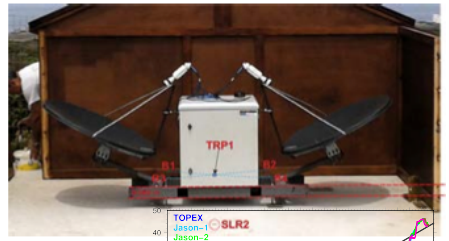


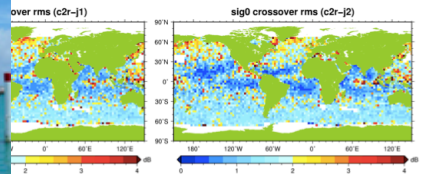




Example FRM: S3 SRAL

- Deployment of Transponders (Range and Sigma-0)
- Comparison to Tide gauges (with GPS? Without GPS? Leveled?)
- Multi-Mission crossovers (Sigma0, wind, sea level?)
- Wave and wind model?
- New approaches?





	Mean	Std
LRM – Jason-1	–0.46	1.78
LRM – Jason-2	–0.14	1.76
PLRM – Jason-1	–0.47	1.95
PLRM – Jason-2	–0.15	2.00
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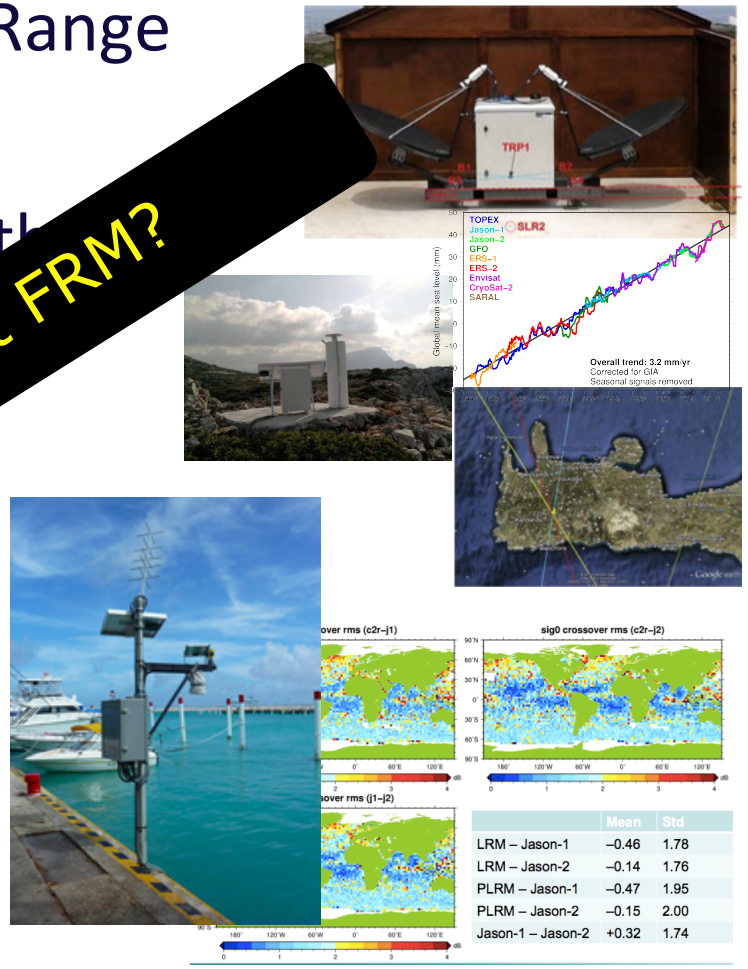

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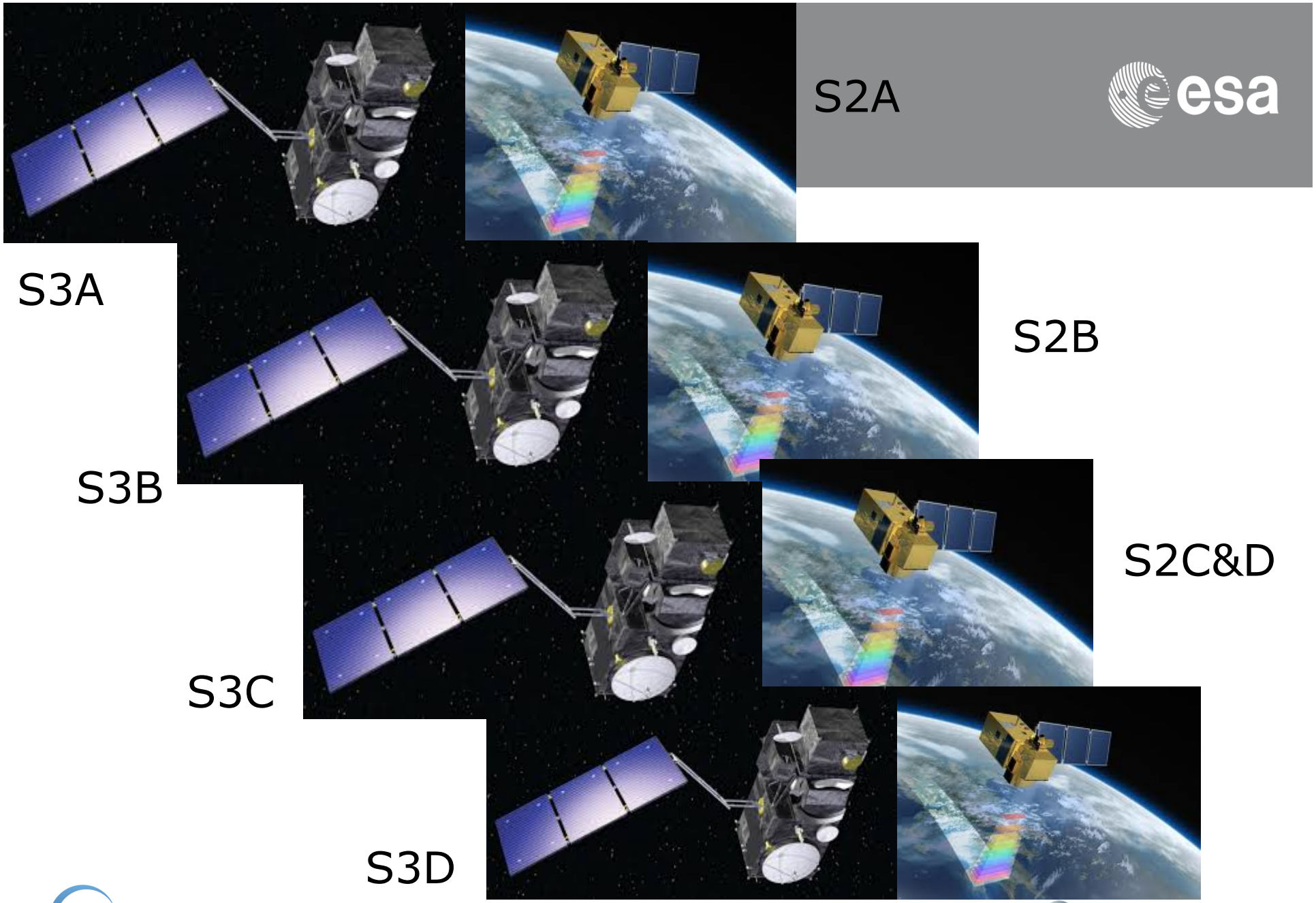
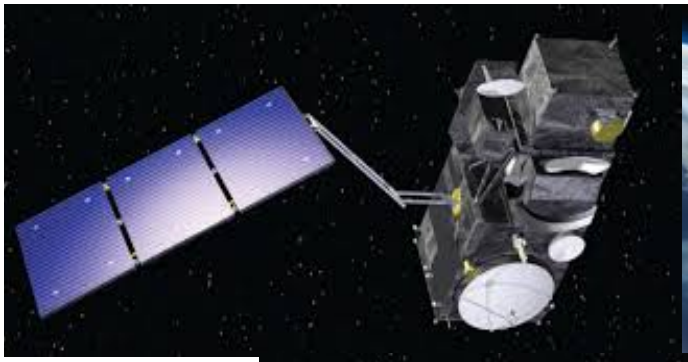
What makes an FRM and FRM?

- Standards Traceability via round-robin inter-calibration of instruments?
- Independence?
- An Uncertainty budget?
- Published papers?
- Good management?
- Maintenance of infrastructure and calibration?
- A good site? (atmosphere, gradients…)
- A long lime series?
- “Because this is what was done in the past”?
- Good protocols (measurement, processing, archive, documents…)?
- Availability (data sharing)?
- Provides evidence that we meet mission requirements?

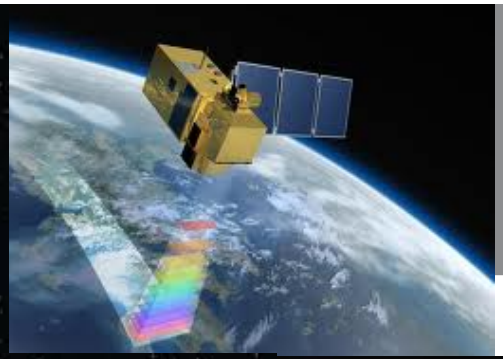
Summary

- The term “in situ” measurement brings fear to some eyes… costs are potentially enormous
- A refined process is required to move on from where we are – your S3VT sub-group chairs have a responsibility to “make it happen” – me included!
- A requirements-based (justified) and prioritized (cost-benefit) suite of measurements is obviously required to demonstrate that S3 products are “fit for purpose”
- The concept of Fiducial Reference Measurements (FRM) may be one way to develop a more palatable case in the long term
- Care is needed to define FRM appropriately
- Europe needs to build a secure FRM base of its own to provide the required confidence in EO measurements and fully realise the Return on Investment (ROI) for Sentinels


S2A
S3A
S2B
S3B
S2C&D
S3C
S3D



S2A



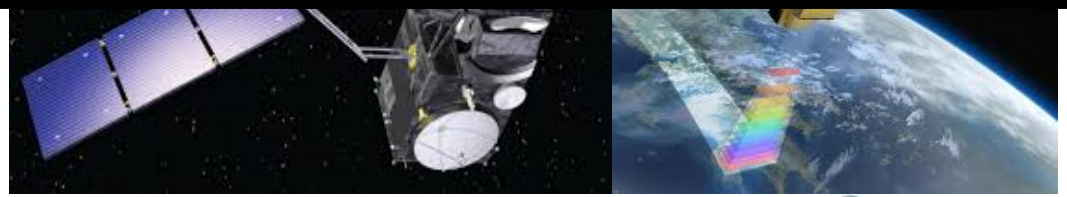
S3A

In Europe, we have a lot of Copernicus infrastructure in preparation – will we be able demonstrate its performance?

Can we demonstrate we have met requirements?

Are products "fit for purpose" within Copernicus?

S3D



Challenges for this meeting

- Only example FRM for S3 have been presented
  What are the “actual” FRM?
- Can S3VT sub-groups define FRM?
- How should they be presented in the S3VT IP and/or Cal/Val plan?
- What defines an FRM?
- Can we link requirements for FRM from the S3 Cal/Val plan?
- …

First S3VT meeting

- The ***aim*** of the first S3VT meeting is:
  - ***"to consolidate and document S3VT activities prior to launch to facilitate Phase E1 and Phase E2 cal/val planning"***
- **Output:**
  - A draft S3VT ***Implementation Plan (S3VT-IP)*** that will be the main reference of S3VT activities and planning for use by other entities within the Sentinel-3 Mission during Phase E1 and E2.

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Thank you - any questions?

For more information: craig.donlon@esa.int