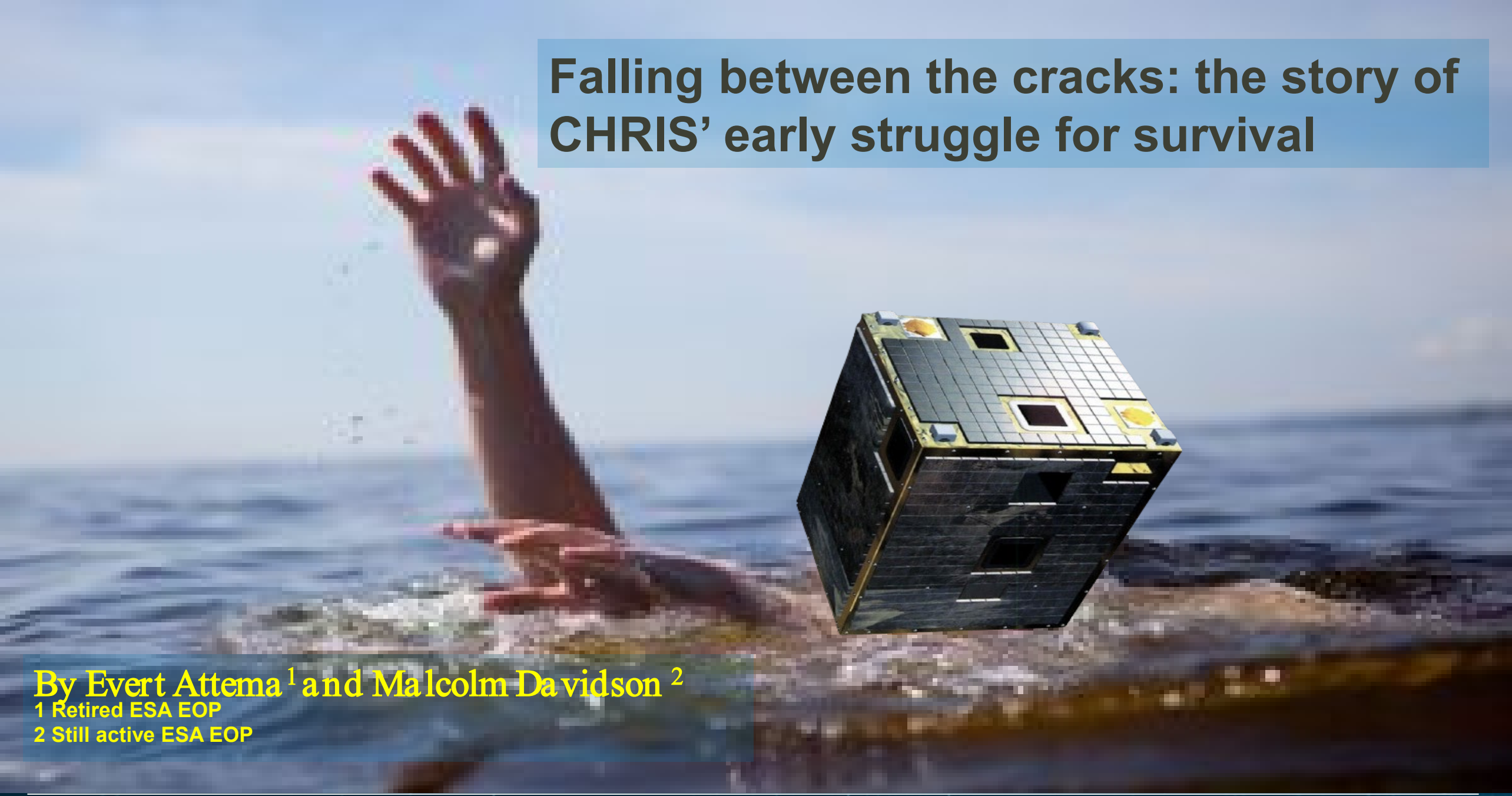
Falling between the cracks: the story of CHRIS' early struggle for survival



By Evert Attema [1] and Malcolm Davidson [2]
1 Retired ESA EOP
2 Still active ESA EOP

The 4 phases of Proba-1

2001

2021

2001 2006 2011 2016 2021 2026

Proba-1 Development

Launch

Technology Demonstrations

In-orbit Campaign

This presentation addresses the“forgotten” middle phase of Proba-1

EO Third Party Mission

Phases-1 and -2: The Proba-1 satellite development and technology demonstrator

The Good:

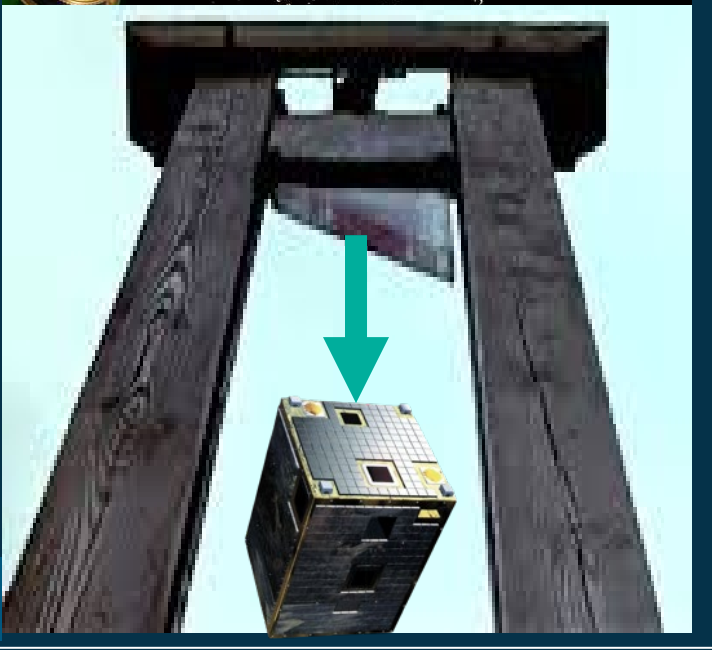
- Admirable achievement by a small dedicated team
- High data quality and low cost
- Hyper-spectral and multi-angular capabilities of high scientific value

The Bad:

- Restricted budget as technology demonstrator allowed for only 2-years of operation

The Ugly:

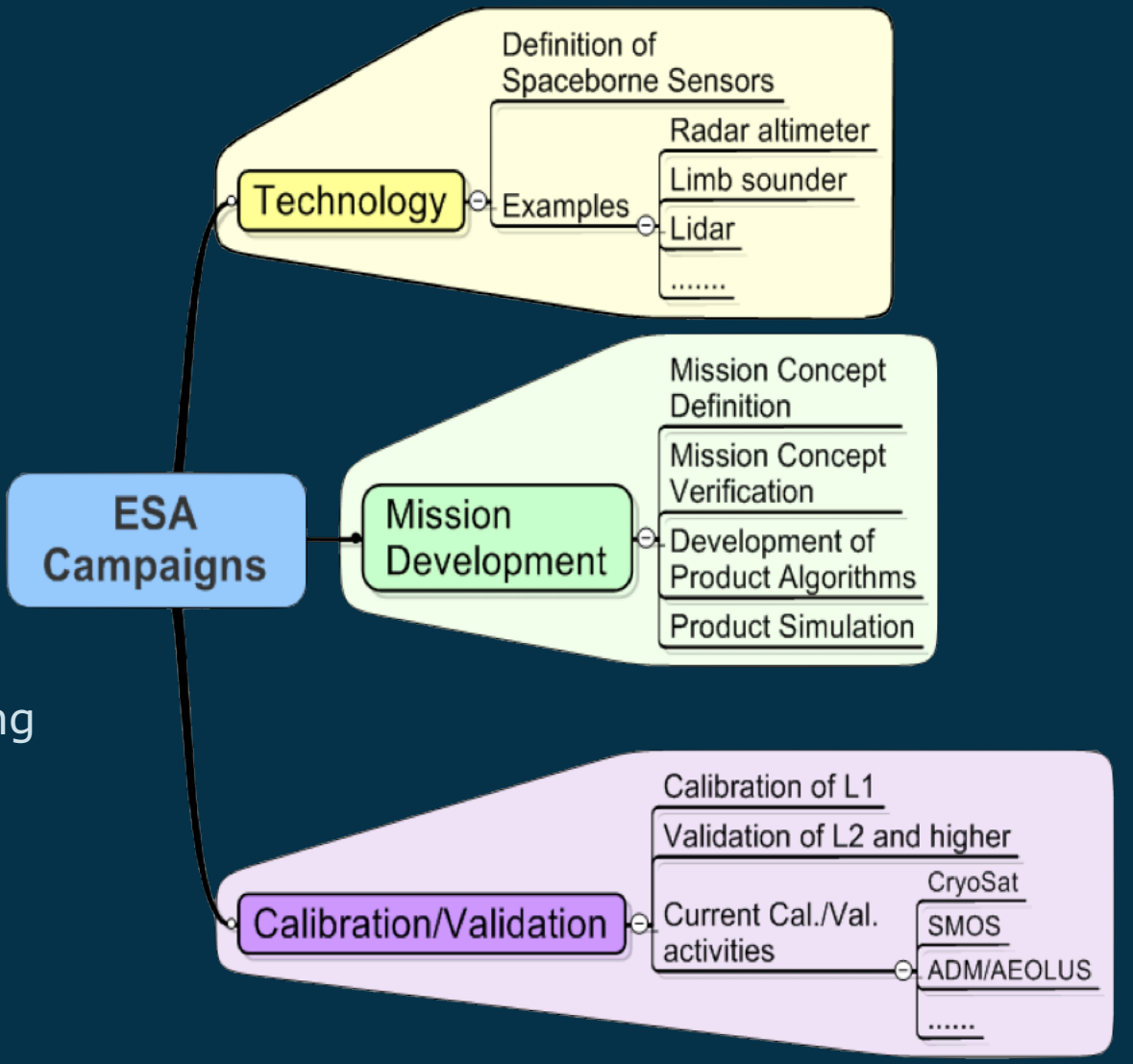
- Selection as a new ESA mission would take too much time and the outcome of the selection process would be uncertain due to the strong competition and some inherent mission limitations including low data volume, large revisit time, large timeliness as well as ***(at the time) insufficient scientific user involvement***



Was there any way to prevent an early retirement for Proba-1 CHRIS?

Phases-3: Make it an ESA EO campaign ! What are they ?

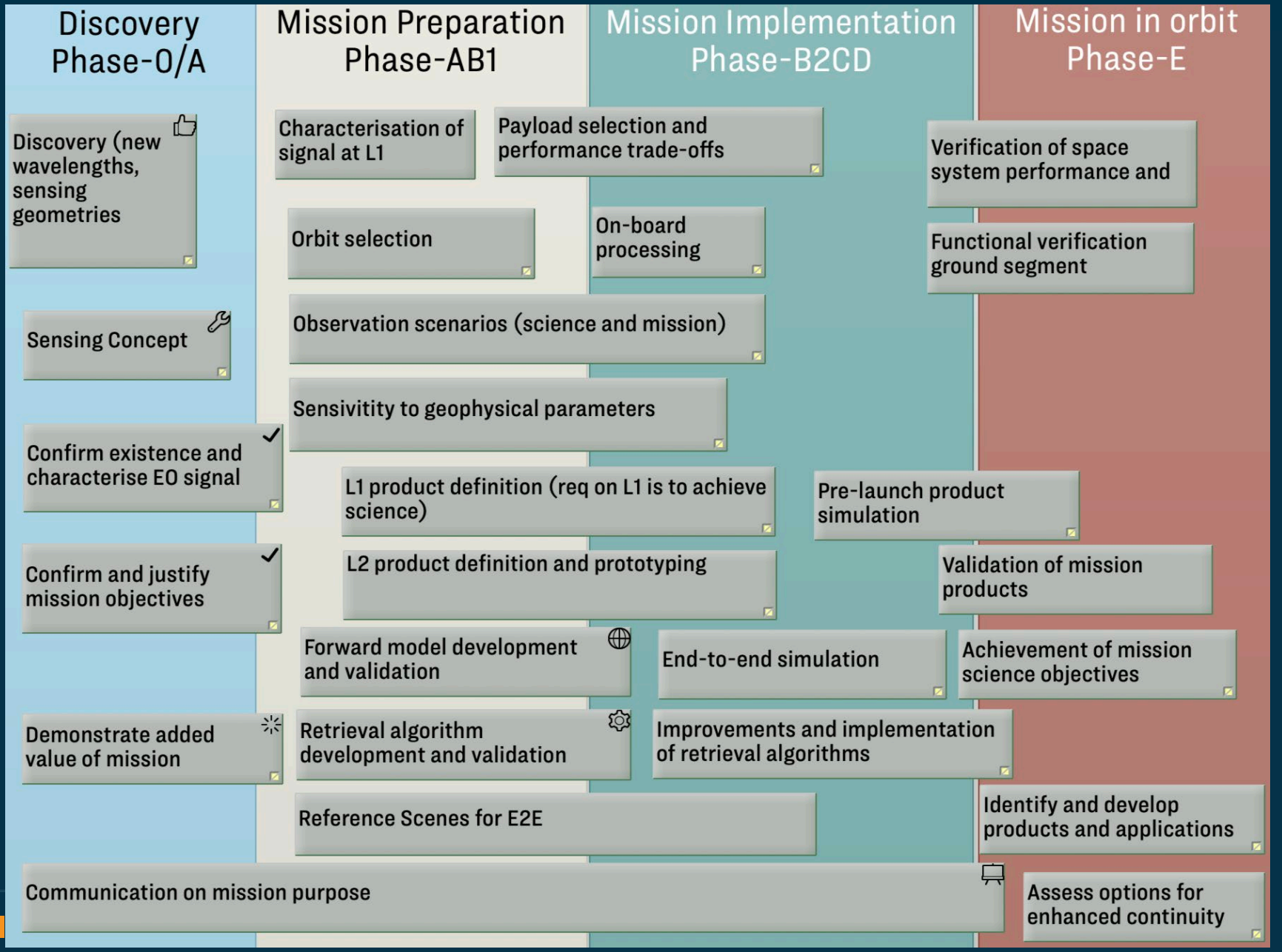
1. **ESA campaign activities started in 1981**
    1. 230 campaigns as of December 2023
    2. Typically 6-10 campaigns/year
2. **Strategic objectives:**
    1. Support strategic goals of EO Science Strategy
    2. Transnational access to airborne facilities in member states
    3. Foster partnerships with national and international organisations
3. **Campaign activities address:**
    1. Testing technology/Observing techniques
    2. Optimising requirements/design and reducing mission risk
    3. L1-L2 Algorithm prototyping/Product simulation
    4. Calibration/Validation
4. **Campaign data archive supporting science and application development**



Phase-3: The role of EO campaigns – a visual guide

- Campaigns contribute to all phases of EO missions (Earth Explorer, Copernicus and Met. Missions)
- Campaigns address mission needs from discovery to in-orbit validation of mission products
- Each mission phase has different requirements.
- During Phase-3 one of the Earth Explorer Candidate missions under study was SPECTRA with
  - Hyperspectral
  - Multi-angular

capabilities



Phases-3: The Proba-1 CHRIS campaign

What did we do ?

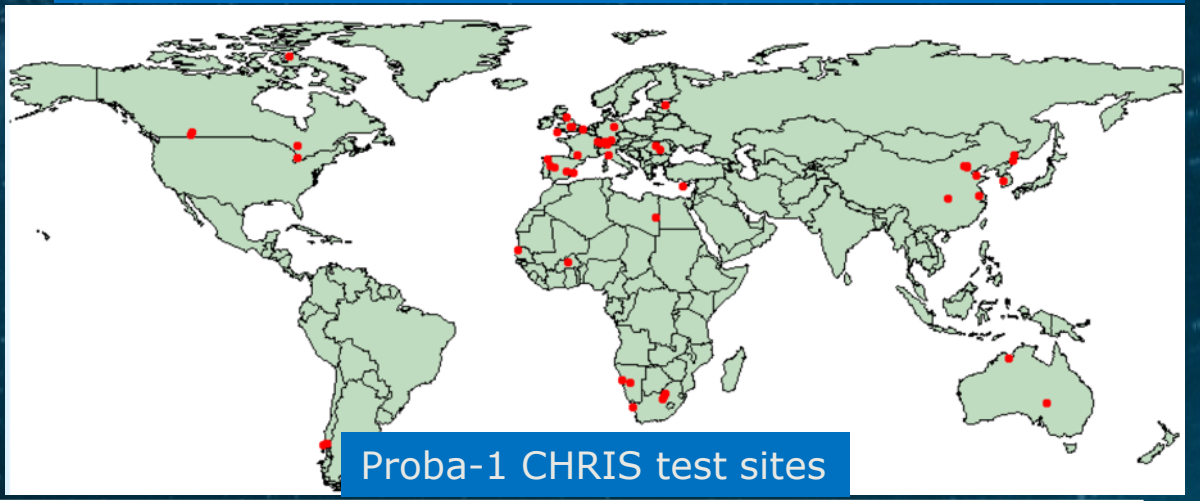
- ESA's first campaign using in orbit satellite and payload rather than airborne in conjunction with ground-based instrumented test sites
- Followed usual preparation of campaign including
  - Identification of EO needs
  - Selection of additional participating scientists via AO
  - Identification of test sites
  - Definition of science objectives
  - Agreement on data requirements
  - Elaboration of operation plan
- Implemented innovative a-priori cloud avoidance filtering based on worldwide cloud cover prediction supplied on a daily based by the MetOffice in the UK

What was the result ?

- Dramatic increase of the international scientific user community by more than an order of magnitude (up to 61 science users)
- Development and validation of scientific user data products as a basis for future hyperspectral Earth Observation missions

	Successes	Cloud free	Some cloud
General Science	244	155	89
SPECTRA	13	8	5
MERIS	35	22	13
BIRD	13	11	2
GLOBWETLAND	17	4	13
DRAGON	4	4	0
EduPROBA	2	1	1
PR	83	42	41
Tsunami	10	4	6

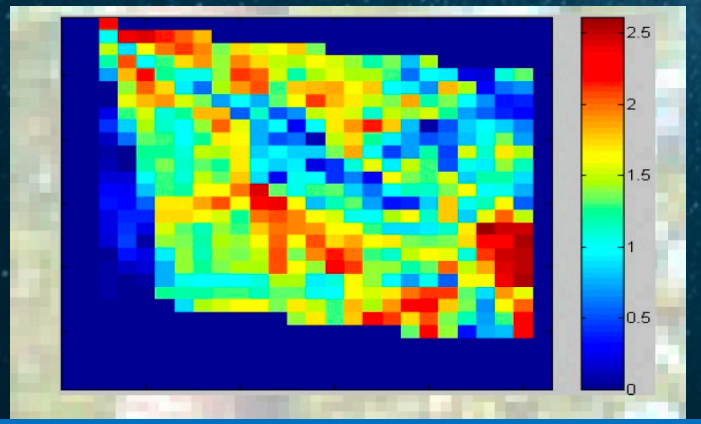
Acquisitions from 1 April 2004 to 24 January 2005



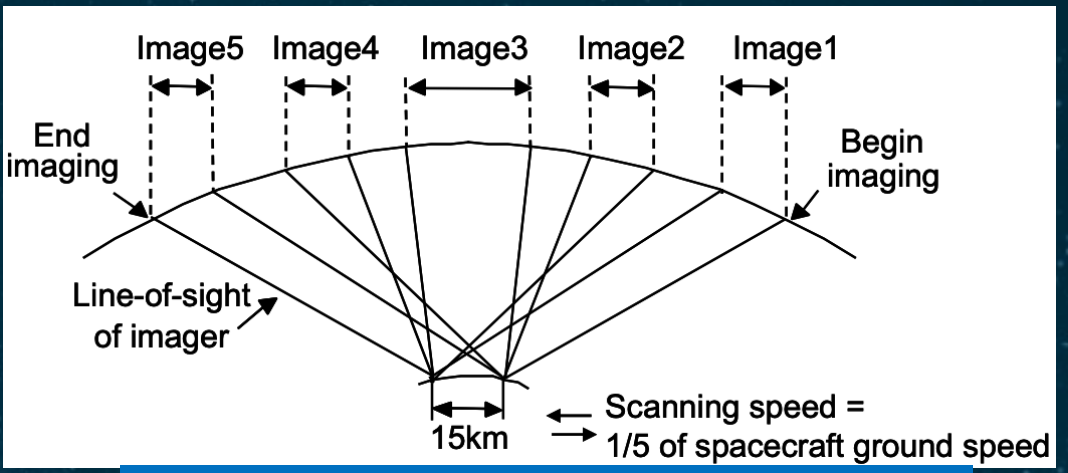
Proba-1 CHRIS test sites

Selection of scientific investigations

1) Cross-verification of CHRIS images with reference provided by institutional missions e.g. MERIS on-board ENVISAT
2) Requirements and impact of pointing uncertainties in reconstruction of angular spectral signatures
3) Support to ESA GLOBWETLAND Project
4) Support dedicated SPECTRA mission concept campaigns such as SPARC 2003 in Barrax, Spain



RMSE differences in LAI between MA and MS data



Proba-1 CHRIS angular acquisition method

SARC 2003 Campaign – Ground work

Securing the future of Proba-1 CHRIS – transition to TPM

What is the third party missions programme ?

- Through Third Party Missions (TPM) programme ESA offers data from a wide range of EO satellite missions developed and operated by other agencies
- The programme currently comprises over 50 missions with data sourced from more than 60 instruments which is supplied to users for research and development purposes.
- TPM a single programme providing ease of access

How did Proba-1 CHRIS join the TPM ?

- Track-record of mission, its capabilities and engagement of the EO scientific community basis for integrating mission into TPM
- An exception was made for Proba-1 CHRIS. TPM usually supports missions owned and operated by other agencies and entities
- Starting with Bianca Hoersch (1st Proba-1 mission manager for TPM) who took over in 2005 Proba-1 has attracted a large user community and became ESA's longest operating satellite in orbit

Three gorges dam (China)

Lessons learned from Proba-1 CHRIS

Small EO missions can be useful !

- Advanced technology can be used to build satellites at low cost with specifications including for example spatial resolution and sensitivity
- Requires different relationship with industry e.g. co-engineering, team-based approach, solution oriented work paradigm, limited requirements on documentation, technical competencies and focus within ESA and industrial team etc…
- However, quoting one of our former ESA colleagues "***a camera in orbit does not always constitute an Earth Observation mission*** ". Consider aspects such as revisit, data volume, timeliness (global) coverage and ground segment requirements including satellite operations, data processing, data distribution and user services with respect to objectives
- Engage end-users and their needs in defining and operating the satellite
- Lessons learned from Proba-1 still relevant in EO e.g. Scouts small satellite programme or addressing new opportunities with commercial space programmes.

A HAPPY ENDING

As presented in this brief overview of the early days of Proba-1/CHRIS the project surpassed the initial objectives and made it from a technology demonstrator to a successful Earth Observation mission

It should not be forgotten that many individuals both outside and within ESA contributed to its success and their efforts are hereby gratefully acknowledged