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ALCATEL



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SARAL/AltiKa

A newcomer in the altimetric constellation

J. Verron
and the SARAL/AltiKa Mission Group*

- * F. Ardhuin, S. Arnault, P. Bahurel, F. Birol, P. Brasseur, S. Calmant, A. Cazenave, B. Chapron, J. F. Crétaux, P. De Mey, E. Dombrowsky, J. Dorandeu, L. Eymard, J. Lambin, J. M. Lefèvre, B. Legrésy, P. Y. Le Traon, F. Lyard, F. Mercier, E. Obligis, P. Sengenés, F. Seyler, N. Steunou, E. Thouvenot, J. Tournadre, ...

hopefully soon

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CLS
COLLECTE ORBITATION SATELITES

SARAL/AltiKa

An altimetry mission in Ka-band

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- Motivations
- Scientific objectives
- The SARAL/AltiKA solution
- Status

1. Motivations

(Project initiated by CNES in \approx 2000)

- IGOS and GODAE since 2000:
 - « **Continuity** of high accuracy, high resolution near-real time observations of the ocean surface topography is required. At least, **2 simultaneous altimetric missions** are required (including one of the Jason class) »
- HOT SWG, 2001:
 - « The HOT SWG recommends that planning begin immediately to build and launch a constellation of **low-cost, low-risk altimeters** (e.g. WITTEX or AltiKa) as a follow-on of ENVISAT and Jason-2 »
- GAMBLE (5th PCRD), 2004:
 - « To agree, within the next few months, to fly at least **one complementary mission** in 2008 »
- Additional requirements to take into account :
 - post-GODAE & IGOS needs about performance improvement (**high resolution altimetry & coastal altimetry**)
 - GMES needs

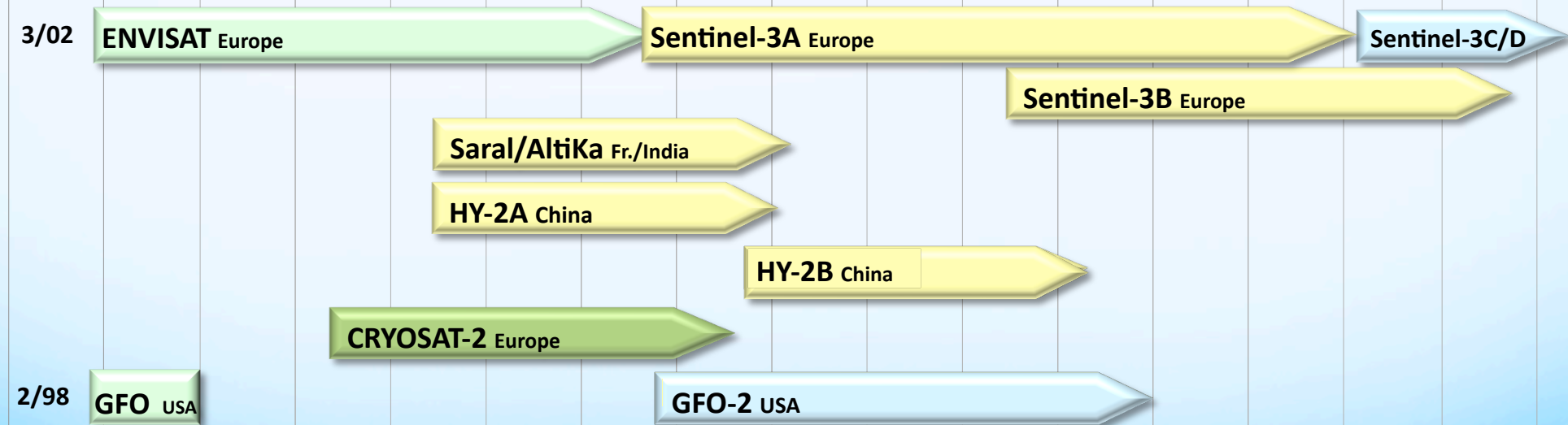
- JASON-1: very vulnerable to further equipment failures
- ENVISAT: S-band missing, degraded quality by lack of ionospheric delay correction, drifting orbit in Oct. 2010
- CRYOSAT-2: ocean data not secured yet and quality will not match traditional missions (no C or S band, no radiometer, one year repeat period)
- HY-2: data availability not secured yet

Launch Date	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22
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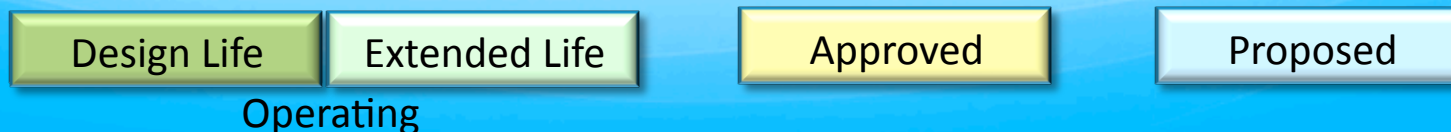
Reference Missions - Higher accuracy/Medium inclination



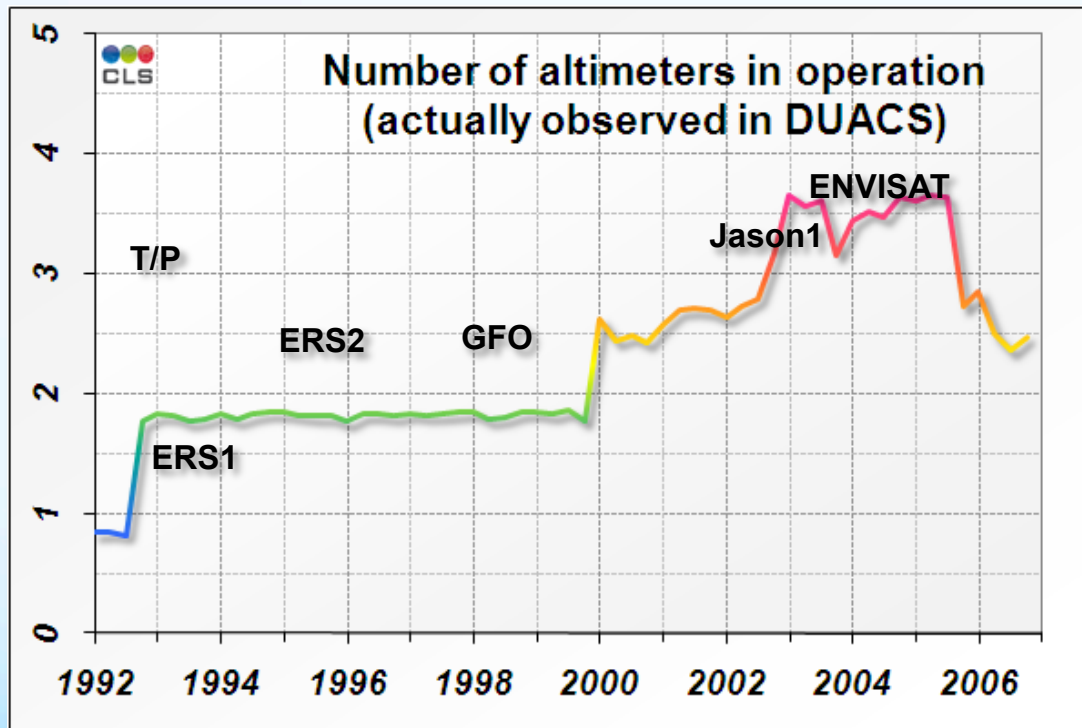
Complementary Missions - Medium accuracy/Higher inclination



Broad-Coverage Mission

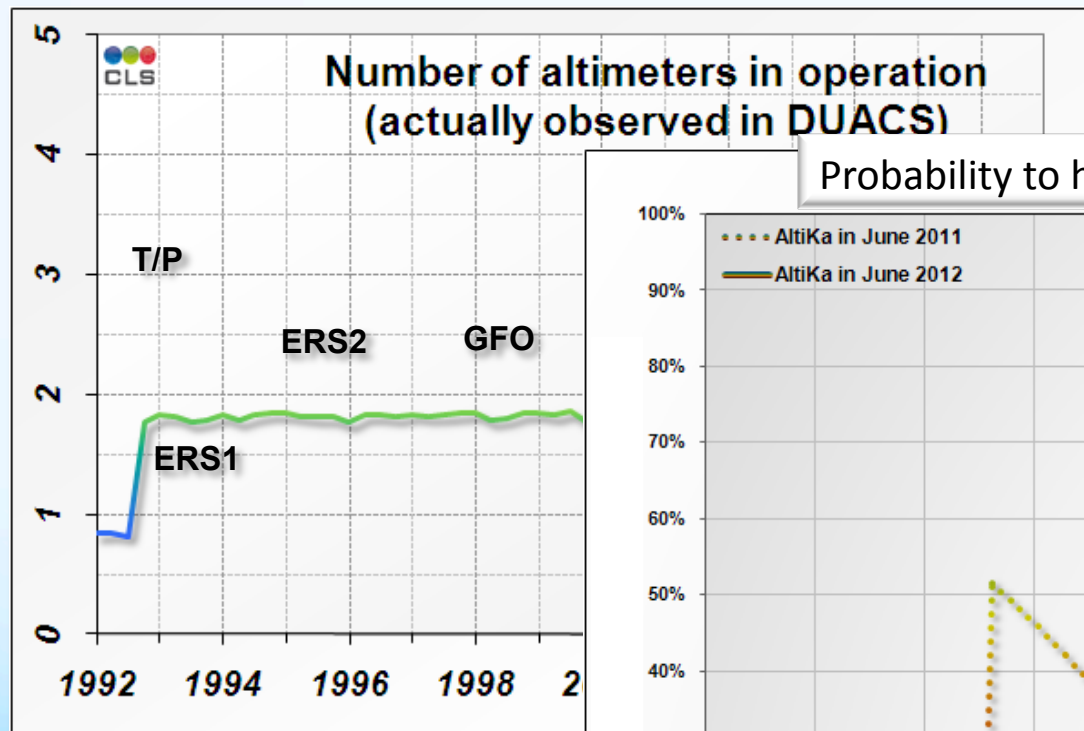


Meeting the minimum requirements for NRT applications: **AltiKa/Saral is needed as soon as possible**

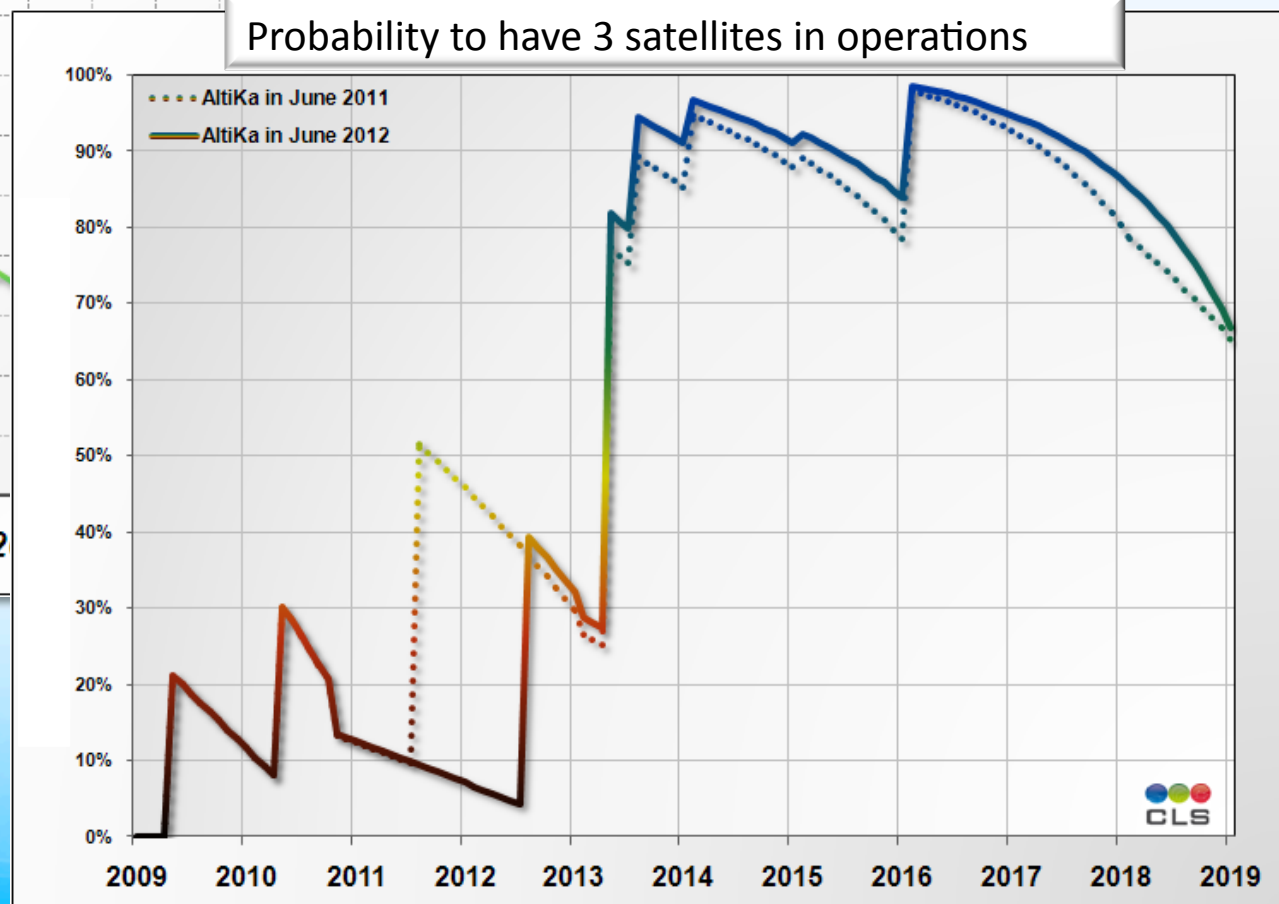


Dibarboure, 2010

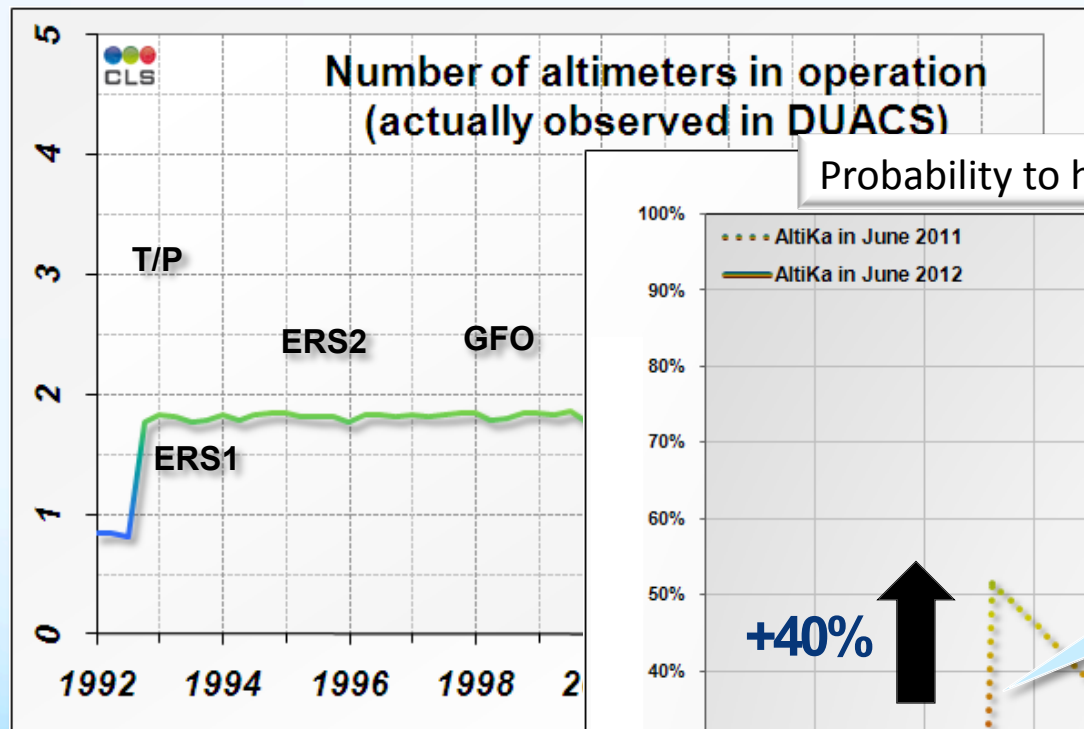
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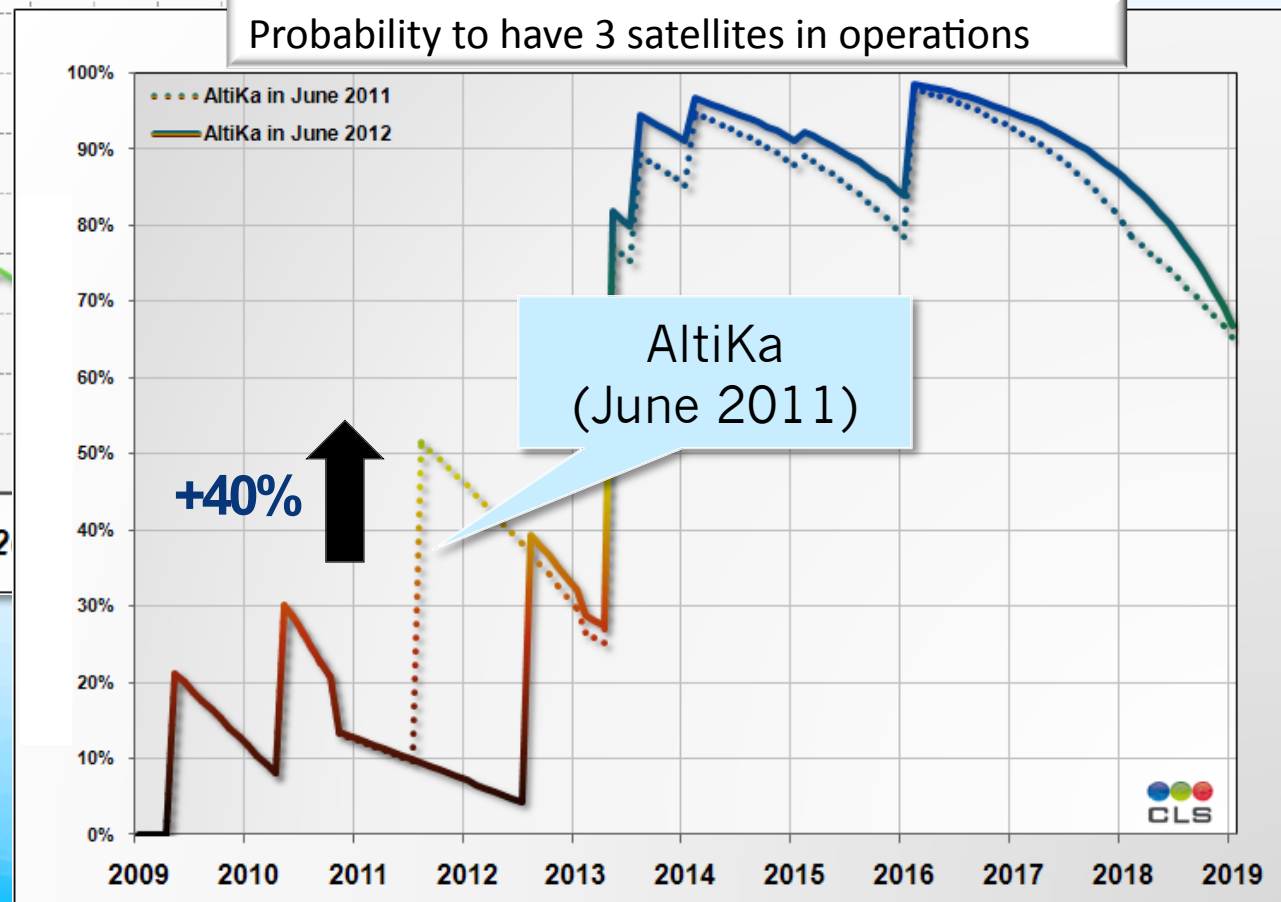
Dibarboure, 2010



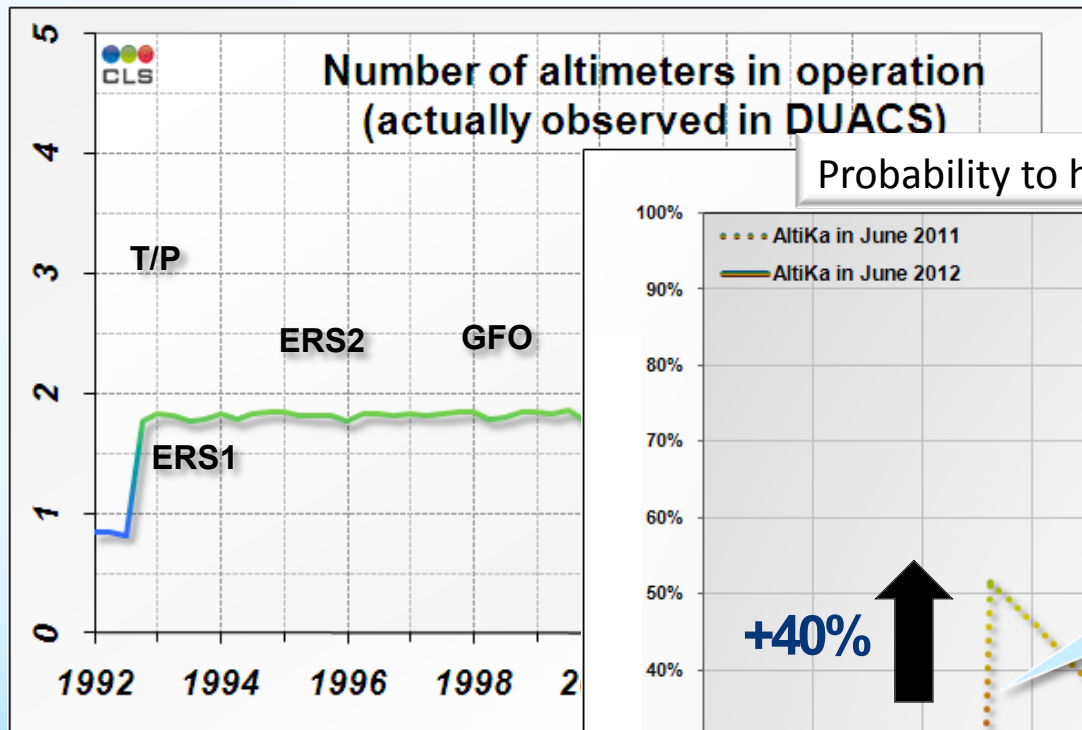
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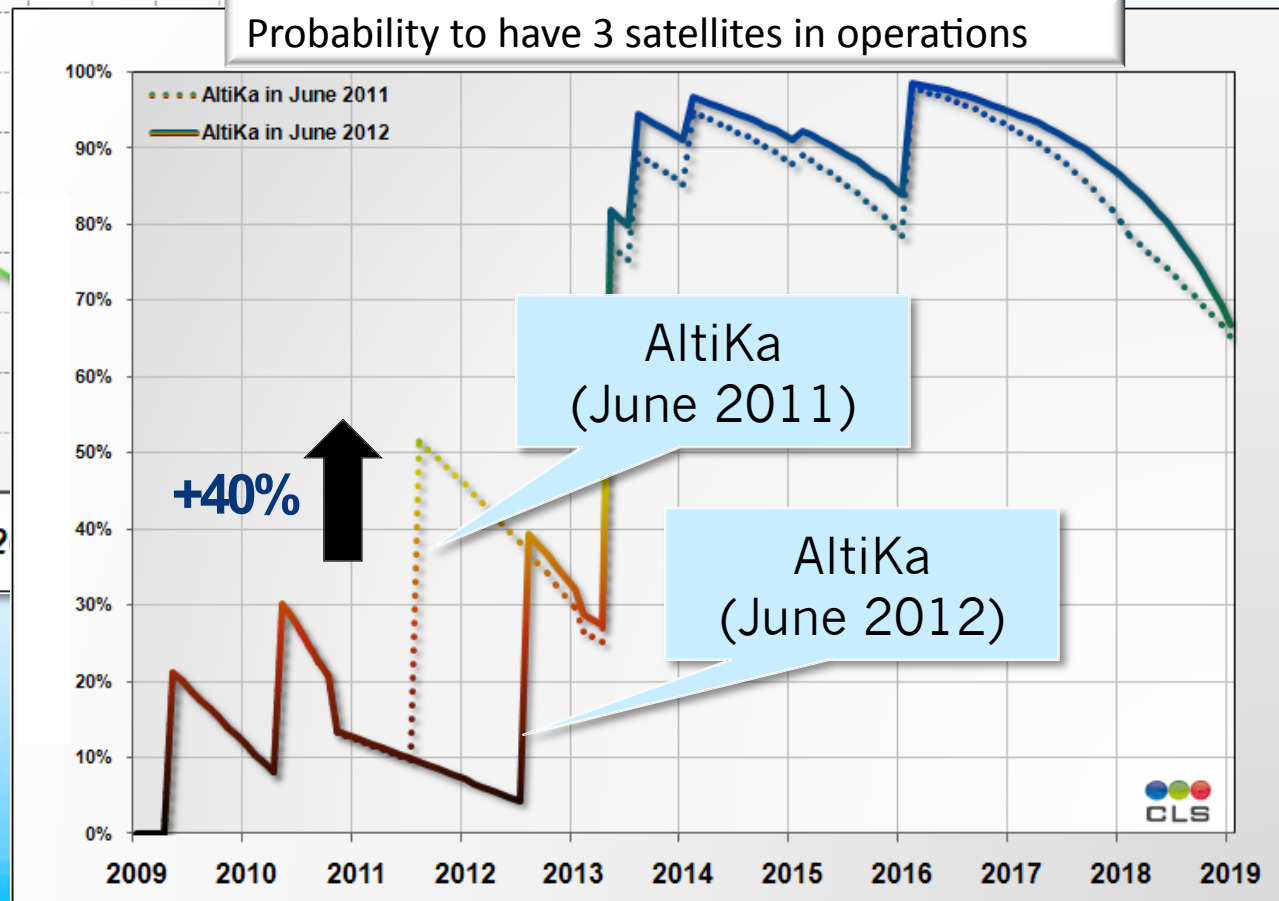
Dibarboure, 2010



Meeting the minimum requirements for NRT applications: AltiKa/Saral is needed as soon as possible



Dibarboure, 2010



- Necessity...

- Fill the gap after the ENVISAT mission
- Complement the JASON-2 mission

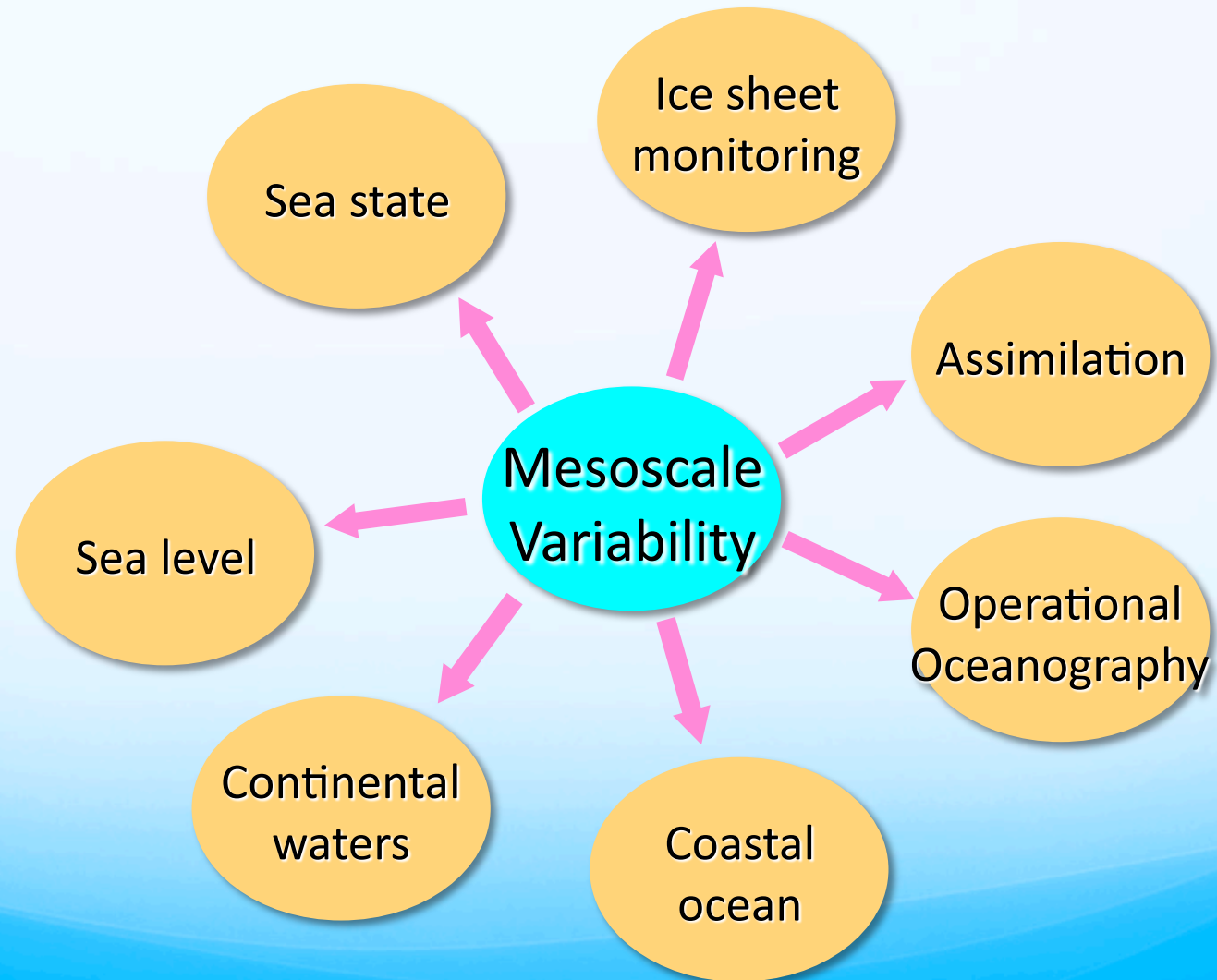
- Continuity...

- Conventional altimeter
- Consolidated architecture
- Technological maturity : Limited technological risk

- Innovation....

- Number of technological improvements due to Ka range
- Account for the post-GODAE and IGOS requirements on instrument performances (in particular for the coastal ocean)

2. Scientific objectives



Contributions to general altimetry goals

- Global changes of the seasonal/annual circulation and heat storage in the ocean (including ENSO)
- Change of the global mean sea level
- Heat transport of the ocean
- Barotropic variability of the ocean circulation
- Planetary scale ocean waves and large scale ocean dynamics
- Major constituents of the deep water tides
- Testing the performances of OGCM
- Assimilation of SSH into OGCM for 3D ocean state estimation

... but SARAL has special focuses on:

- Ocean mesoscale variability
 - Finer description: Multisatellite system
 - Analyze/forecast the ocean «weather», operationally, at global scales
 - Mesoscales and submesoscales
- Coastal ocean altimetry
- Ice sheet monitoring
- Continental waters / hydrology
- And also:
 - Low-rain systems characterization
 - Contribute to understand the marine ecosystems through physico-biogeochemical coupling processes
 - ...

3. The AltiKa solution

- Orbit
 - Sun-synchronous
 - ~ 800 km
 - ~ 35 days (same as Envisat)
 - 98.28°
- The AltiKa payload
 - Single frequency Ka-band altimeter
 - Dual-frequency radiometer
 - Passive laser retroreflector array
 - DORIS receiver

- The compact combined Altimeter/Radiometer of the AltiKa payload
 - Ka-band altimeter 35.75 GHz: Ionospheric effects ↓, resolution ↑
 - Dual-frequency radiometer 24 and 37 GHz: Tropospheric correction
- Additional required elements for a consistent altimetry system
 - A Laser Retro-reflector Array: Orbitography, calibration
 - A Precise Orbitography system such as DORIS: Consistency with T/P, JASON, ENVISAT

Ka vs. Ku

- Improved vertical resolution
- Smaller footprints
- Improved along-track resolution
- Shorter decorrelation times for sea echoes
- Better discrimination in transition zones
- Lesser ionospheric errors
- ... but sensitivity to small rains

The observations:

- in coastal areas
 - of continental ice
- are improved...

4. Status

● Past:

- CNES:
 - Exploratory development: 1998-2002
 - Phase B (instrument): June 2003
 - Phase 0 (satellite): completed on 2 types of microsatellites (CNES & SSTL)
 - Approved by CNES (instrument): Dec 2005
- CNES - ISRO
 - Satellite accommodation on SSB
 - MOU ISRO-CNES: Feb 2007

- Scientific and review meetings (Ahmedabad, Toulouse, ...)
- Scientific plan delivered, 2009

● On going

- Finalized Cal-val plan

● Next:

- Payload integrated module ship to India in Jan. 2011
- Launch planned mid 2011 if satellite and accomodation ready
- Launch from SHAR (सतीश धवन अंतरिक्ष केंद्र) Sriharikota Space Center, North of Chennai

SARAL-Altika general organization

- CNES

- Global management of project and system,
- Payload (Altika altimeter-radiometer, DORIS, laser reflector) and two ground stations setup in Sweden,
- Definition/execution of all the system tests,
- Processing/archiving and distribution of scientific data outside India.

- EUMETSAT

- Support to CNES for production/archiving and distribution of near-realtime products (OGDR) to users outside India.

- ISRO

- SSB platform,
- Launcher, launching operations and associated infrastructures.
- Processing/archiving and distribution of the scientific data within India.

- OSTST

- Independent evaluation of scientific objectives, scientific breakthrough obtained, and contribution to a larger distribution in an international context.

AltiKa/SARAL error budget

(RMS value for 1 sec average, 2 meters SWH, 7.8 dB sigma naught)

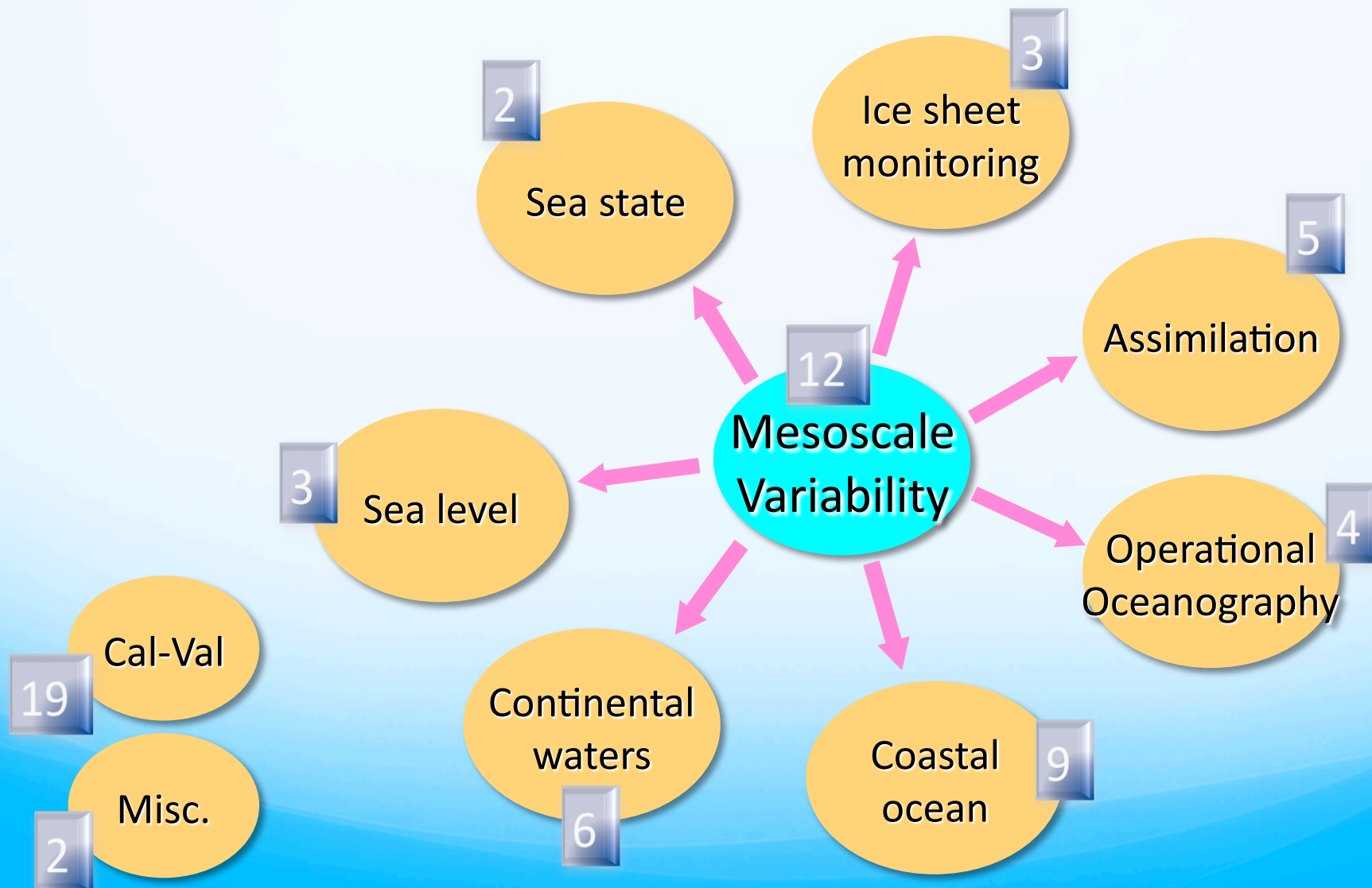
	OGDR 3 Hours	IGDR 1.5 days	GDR 40 days	GOALS
Altimeter noise	1.5 cm	1.5 cm	1.5 cm	1 cm
Ionosphere	0.6 cm	0.3 cm	0.3 cm	0.3 cm
EM bias (% H1/3)	1.2%	1.2%	1.2%	0.5%
Dry troposphere	1.5 cm	0.7 cm	0.7 cm	0.7 cm
Wet troposphere	1.2 cm	1.2 cm	1.2 cm	1 cm
Altimeter range (after corrections)	4.5 cm	3.5 cm	3.5 cm	2 cm
Orbit (Radial component)	30 cm (a)	4 cm	3 cm	2 cm
Total RSS sea surface height	30.5 cm	5.3 cm	4.6 cm	2.8 cm

See the poster by Steunou et al. (AltiKa : a new concept of altimeter for the SARAL mission) for further information on expected performances

The SARAL/AltiKa Joint AO : Synthesis

- **SARAL/AltiKa International Announcement of Opportunity**
 - December 2009 : Call by ISRO & CNES / April 2010 : Selection by ISRO & CNES of SARAL/AltiKa PIs
- **65 PIs selected**
 - 16 proposals from 7 French Institutions
 - 23 proposals from Indian Institutions
 - 26 proposals from other Institutions (JPL, NOAA, US NAVY, NRL, ECMWF, CSIRO, etc...), 10 countries : USA (11), Europe (10), Australia (3), Taiwan (1), Japan (1), Brazil (1)
- **Results:**
 - Good coverage of the topics / adequacy to the call
 - Quality of proposals and teams, most of them well-known in the OSTST context
 - Excellent opportunities for an active scientific community and an appropriate CALVAL program
- http://smc.cnes.fr/SARAL/GP_science.htm

PI selection: topics





Conclusions

- SARAL/AltiKa
 - a post-ENVISAT gap filler
 - objectives derived from post-GODAE/IGOS requirements
 - a complement to Jason-2
- India-France scientific cooperation extended to Internationals and the AO selected teams
- The Ka Band for the future:
 - SWOT
- Need to launch SARAL soon !