SARAL/AltiKa: a Ka-band altimetry satellite in tandem with JASON-2

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Summary

The Ka-band AltiKa altimeter payload, together with a ARGOS3 instrument, will be embarked in the SARAL satellite for a launch planned for the beginning of 2010. This is a joint project between CNES and ISRO, respectively French and Indian space agencies. This poster describes the AltiKa instrument, the mission objectives and the expected performances.

Motivations

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 reference 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 »

Mission objectives

Central objective
- Mesoscale ocean circulation
- Data assimilation into regional and global OGCMs

Secondary objectives
- Coastal ocean altimetry
- Continental waters
- Ice sheet monitoring
- Sea level change
- Mean sea level

Altimeter payload

- The Ka-band altimeter 35.75 GHz
• Ionospheric effects are negligible
480 MHz bandwidth instead of 320 MHz in the classical Ku-band
• Higher vertical resolution (30 cm vs 48 cm in Ku-band)
4 KHz PRF that may be adjusted along the orbit
• Shorter decorrelation time of sea echoes

- A Dual-frequency radiometer 24 and 37 GHz
• required for tropospheric correction

- A Laser Retro-reflector Array
• minimum for orbitography and system calibration

- A Precise Orbitography system DORIS
• to achieve adequate orbitography performances in low Earth orbits
• to have similar performances than reference missions like T/P, JASON, ENVISAT
• required for mean sea level analysis and coastal/inland applications (real-time coupling with altimeter)

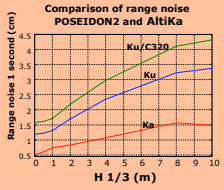
SPECIFICATIONS ON AltiKa/SARAL ERROR BUDGET
(RMS value for 1 sec average, 2 meters SWH, 7.8 dB sigma naught)

	OGDR 3 Hours	IGDR 1.5 days	GDR 40 days	GOALS
Altimeter 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**
Significant wave height *(c)*	10% or 0.5 m *(b)*	10% or 0.4 m *(b)*	10% or 0.4 m *(b)*	5% or 0.25 m *(b)*
Sigma naught *(d)*	0.2 dB	0.2 dB	0.2 dB	0.1 dB
Wind speed *(e)*	2 m/s	1.7 m/s	1.7 m/s	1 m/s

(a) Real time DORIS onboard ephemeris.
(b) Whichever is greater.
(c) Validity domain: 0-14 m SWH.
(d) Validity domain: 5.9-15 dB.
(e) Validity domain: 3-20 (TBC) m/s.

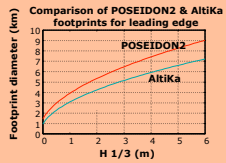
Improved error budget on distance measurements

AltiKa: Noise reduction by a factor of 2 compared to POSEIDON for wave heights larger than 1 m



The footprint is reduced

Altimetric information will be available at less than 5 km from the coast (today 10 km)



The observation of continental ice is improved...

- Radar echo over ice is a combination of surface and volume, from Ku to Ka
  - Scattering coefficient increase by a factor of 55
    - Volum scattering dominant
  - Electromagnetic wave penetration minimized
    - Penetration depth between 0.1 and 0.3 m (instead of 2 to 10m)

  ➥ The altimetric observation and height restitution will correspond to a thin subsurface layer
- Active (altimeter) and passive (radiometer) simultaneous measurements

  ➥ Access to surface rugosity and snow granulometry

The observation in coastal areas is improved

- **Performance of altimeters for coastal applications depends**
  - on waveform/footprint relationship
  - on antenna diagram/footprint relationship (to obtain attenuation of land contribution to echo)
  - on tracking performance for complex echoes
- **AltiKa characteristics have been optimized for these issues:**
  - Ka-band altimeter close to a beam limited altimeter
  - Altimeter tracking mode improved with 3 modes available
    - Conventional acquisition and tracking loop
    - Acquisition Diode : Use of Doris navigator message to decrease acquisition duration (< 500 ms)
    - Tracking Diode + Onboard stored DEM: continuous tracking
  - High data rate mode : I&Q samples downloaded for speckle and echo analysis at the PRF rythm

Conclusion

-AltiKa designed to...
- -Fill the post-ENVISAT «gap»
- -Reach the mission objectives derived from post-GODAE/IGOS requirements
- -... in complement to Jason-2

-AltiKa Payload as a precursor for future altimetry systems
- - At a longer time scale, AltiKa payload could be the core of a permanent, operational, -high-resolution altimetry system, flying as a multi-microsatellite system embarking the
- - same payload, or as a combination of microsatellites and minisatellites
- - It may be possible to conceive a robust dual-technique altimetry system based on
- -Ka-band altimeters and wide swath altimeters for meso-scale and/or other applications...

Saral at a glance

Mass	350 / 400 kg
Altika payload	< 65 kg
Dimensions	1 m x 1 m x 2.6 m
Orbit	Low orbit : 800 km Polar : 98° Sun-synchronous : 6:00 / 18:00
Nominal operational lifetime	5 years