KaSOARI : LOW RISK AND LOW COST SWATH ALTIMETER FOR OPEN OCEAN AND COASTAL AREAS TOPOGRAPHY MEASUREMENT

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High accuracy swath altimetry concept for ocean and ice topography measurements emerged in the early 90's [1]. The concept has been revisited several times : see [2] and [3] for instance. The main advantage of the concept is to improve the temporal/spatial sampling using a limited number of satellites, possibly reduced to one. Swath altimetry alternative is a constellation of satellites carrying nadir altimeters. Besides improving the sampling, for a given transmitted bandwidth, swath altimeters are also capable, in principle, to improve significantly the spatial resolution upon nadir altimeter. This is particularly valuable for studying physical processes at mesoscale and sub-mesoscale. In coastal areas, high resolution and selection of uncontaminated pixel which could be done a priori, can also help in getting very close to the coast line. Finally, swath altimetry provides a snap shot (3D-image) of the surface topography over an extended area, which does not requires time/space interpolation as needed for altimeter constellation. These are some of the major features of the concept which make it attractive from the science side. While very challenging technically, swath altimetry is also supported by airborne and space shuttle experiments on the US side, and by the progress made in space interferometric radar altimeter studies and development with the SIRAL 1 and 2 instruments on the Cryosat ESA mission. The most advanced swath altimeter concept was probably the Wide Swath Ocean Altimeter (WSOA) Ku band radar [2] which was studied and partly bread-boarded by JPL to be embarked as a demonstration mission on the operational Jason-2 satellite. However, WSOA was de-scoped from Jason-2 during phase B mainly for budget and development risk reasons. Swath altimetry has been revisited by JPL for answering the need of hydrology and ocean measurements and it is now proposed as the SWOT (Surface Water and Ocean Topography) mission embarking the KaRIn (Ka band Radar Interferometer) instrument [4,5]. The technological steps between WSOA and KaRIn are mainly due to the selection of the Ka band, a larger deployable antenna subsystem, and the addition of a SAR (Synthetic Aperture Radar) mode. The transmitted bandwidth is also increased by a factor 10, from 20 MHz to 200 MHz. The interferometric baseline is increased from 6 m to 10 m..

An alternative concept to WSOA has been proposed in [3]. The concept is based on a Ku band radar, but the antenna sub-system is non deployable and small enough to be accommodated in its operational flight configuration within the fairing of the launcher. Direct Radiating Arrays (DRA) are also proposed in order to preserve the interferometric phase stability. The consequential impact is a significant simplification of the instrument design, manufacturing and test, but the satellite design, manufacturing and AIT (Assembly Integration and Test) is also greatly simplified, resulting on cost optimisation. Finally the risk of non-deployment – a critical single point failure resulting in mission loss – can be avoided.

Scientific requirements for ocean topography have been recently reviewed and the users are requesting higher spatial resolution and vertical accuracy. This paper presents a revisit of the non-deployable swath altimeter named KaSOARI (Ka band Swath Ocean Altimetry with Radar Interferometry). KaSOARI is based on the concept presented in [3] with the following evolutions : Ku band to Ka band, SAR mode operation, optimisation of the non deployable antenna subsystem and transmitted bandwidth. The complete operating point has been optimised and it will be presented in the paper. KaSOARI is shown to be a significant simplification upon KaRIn while meeting the mission ocean requirements including coastal areas. Performances for hydrological applications will also be discussed in the paper. The performance budget will be recalled showing that KaSOARI errors are balanced with propagation corrections and external baseline calibration accuracies.

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