DIODE/DEM (OLTC) tracking mode performances over inland waters

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CONTEXT

The tracking mode called « DIODE/DEM », or OLTC (Open Loop Tracking Command), was developed in order to obtain more exploitable radar waveforms over areas of interest, where the autonomous median tracker has lower performances than in the open ocean.

The considered areas of interest are: coastal zones, continental ice caps and continental waters (rivers, lakes, reservoirs…).The OLTC mode drives the altimeter with *a priori* information available on-board: real-time estimates of the satellite orbit provided by the DIODE navigator and theoretical height of the sub-satellite point from a Digital Elevation Model (DEM), previously sampled along the satellite track and stored in an on-board memory.

For Jason-2, the OLTC mode was switched-on for one cycle (cycle 34, Desjonquères 2010), and two additional cycles were recently acquired (cycles 209 and 220).

This poster illustrates the performances of the OLTC mode over continental waters for the most recent Jason-2 cycles, through two overflights of lakes examples.

Quality indicators definition

In order to evaluate the performances obtained with the DIODE/DEM mode, we have defined quality indicators on the waveforms:

Detection of sufficient power level

✓ $EchoLevel_{db} = 10\,log_{10}(WF_{max}) + agc_{20hz_{ku}}$
with WF_{max} maximal value (dB) of the smoothed waveform and agc_20hz_ku automatic gain control (dB)

✓ $EchoLevelMin\_db = 10\,log_{10}(120) + 6$

➔**flag of power**: $\boldsymbol{FlagPower = 1}$ (power level is considered acceptable) if $EchoLevel\_db > EchoLevelMin\_db + 6$

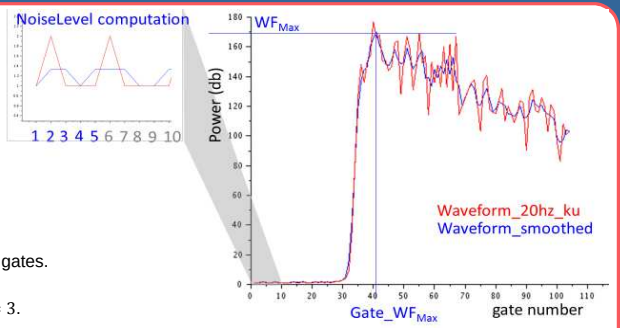
Detection of the leading edge

- $Gate\_WF_{max}$ gate position for the maximal value (dB) of the smoothed waveform

➔ **flag of position of maximal value:** $\boldsymbol{FlagGate = 1}$ if $\boldsymbol{6 \leq Gate_{WF_{max}} \leq 99}$

✓ **Power ratio definition :** $\boldsymbol{PowerRatio_{db}} = 10\,log_{10}\left(\frac{WF_{max}}{NoiseLevel+1}\right)$ with $NoiseLevel$ the mean power on the five first gates.

➔ **flag of power ratio:**
$\boldsymbol{FlagPowerRatio = 1}$ (the power ratio is considered acceptable), if $NiveauRatio_{db} > RatioMin$. With $RatioMin = 3$.



Flag Total : $\boldsymbol{FlagTot = TypeSurface \times FlagPower \times FlagGate \times FlagPowerRatio}$

➔required in order to restrict analysis zones to water bodies, excluding land surfaces

➔**Limits:** *TypeSurface* given at 1Hz in SGDR data, with an intrinsic resolution of 2' Successive orbits being slightly shifted, surface type seen by DIODE/DEM mode or autonomous mode are not exactly identical

Local analysis : Williston Lake

Figure 1: Theoretical ground-tracks of the Jason-2 mission over the Williston lake (East Canada)

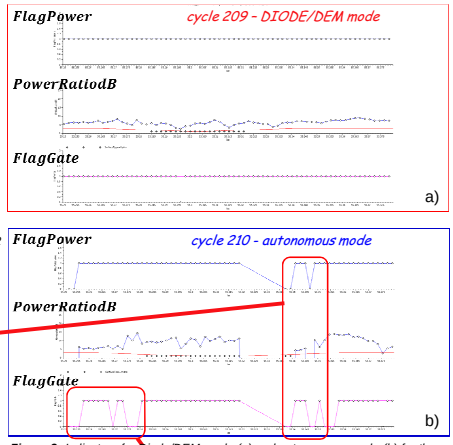


Figure 2: Indicators for Diode/DEM mode (a) and autonomous mode (b) for the track 154 over the Williston Lake

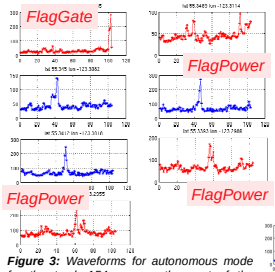


Figure 3: Waveforms for autonomous mode for the track 154 over north coast of the Williston Lake

➔Over the Williston lake, indicators show that **DIODE/DEM mode provides valid waveforms** along the whole track (Fig.2 (a)).

➔ Over the north and south coast of the lake, Tracker in autonomous mode, some waveforms are considered as non valid (Fig.2 (b)).

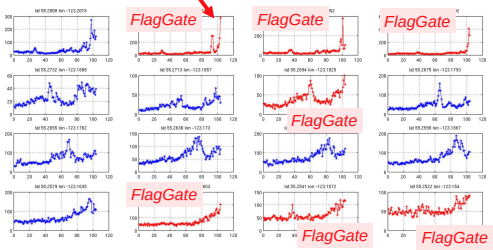


Figure 4: Waveforms for autonomous mode for the track 154 over south coast of the Williston Lake

Local analysis : Superior Lake

Figure 5: Theoretical ground-tracks of the Jason-2 mission over the Superior Lake (USA)

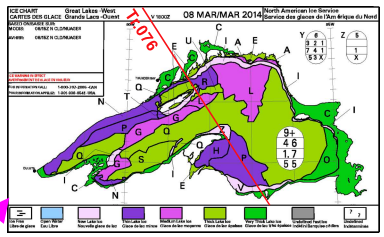


Figure 6: Ice chart over the Superior Lake for the 2014/03/08

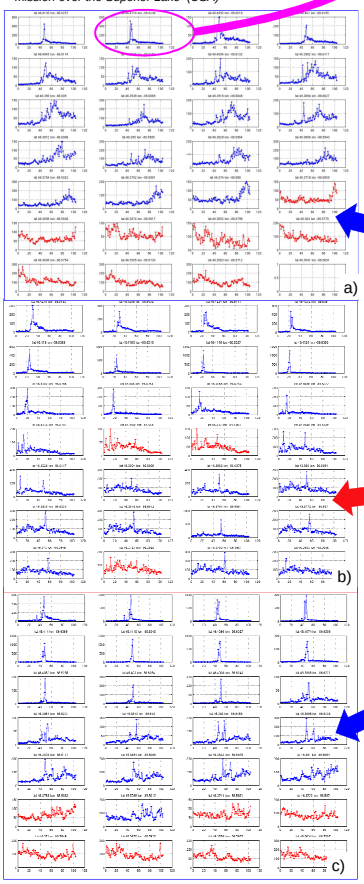


Figure 8: Waveforms for Diode/DEM mode (b) and autonomous mode (a & c) for the track 076 over south coast of the Superior Lake

The picky form of the waveforms are typical of ice echoes : indeed the ice chart (Fig.6) shows that the Superior lake is covered by thin (purple) to thick (green) ice at the cycle 209 period.

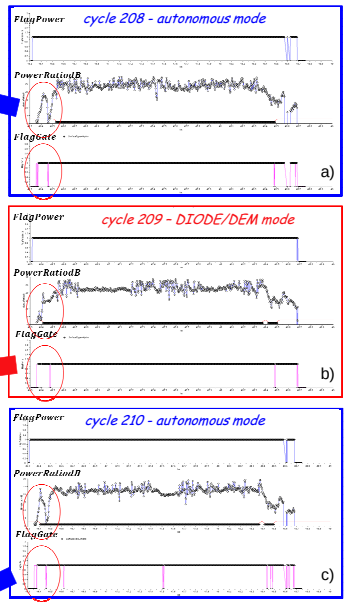


Figure 7: Indicators for Diode/DEM mode (b) and autonomous mode (a & c) for the track 076 over the Superior Lake

➔ Over the Superior lake (Fig.7), DIODE/DEM and autonomous tracking modes present a similar behavior.

➔ Over the south coast of the lake, **there are more valid waveforms** (Fig.8) **for the DIODE/DEM** mode than for the Tracker autonomous one.

Conclusions / perspectives

In order to evaluate the performances obtained with the DIODE/DEM mode, we have developed quality indicators on the waveforms. They have been applied on some local analysis, for the most recent Jason-2 cycles (209 in DIODE/DEM mode & 210 in autonomous mode) over **continental waters** (lakes and rivers). Results have shown that the DIODE/DEM mode performance is at least as good as the autonomous tracker mode one. Moreover, the **DIODE/DEM** tracking mode **allows to increase the number of measurements**, near lake banks.

Results are promising. CNES plan to extend this study to a global analysis over hydrological targets. This type of assessment could also be used as **automatic performance diagnostics for Jason-3, Sentinel-3 and Sentinel-6.**

This study deals with the performance of DIODE/DEM tracking mode over continental waters. For the equivalent study over the open ocean and coastal zones, consult poster "Validation of the DIODE/DEM Jason-2 mode in the open ocean and over coastal areas", J-D Desjonqueres et al.

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