Jason 3 GPS ambiguity fixing status

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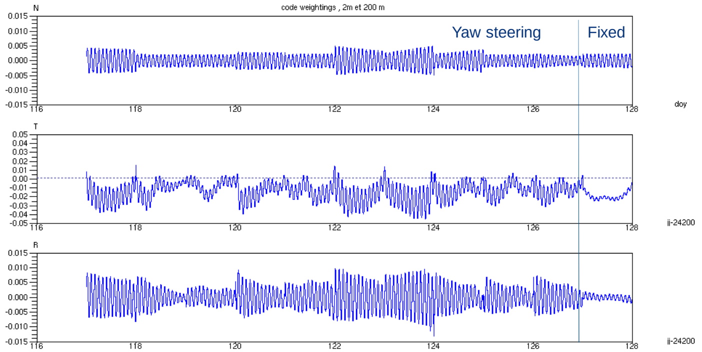
Abstract

Currently, the GPS orbits are determined using GPS pseudo-range and phase measurements with floating ambiguities (the phase ambiguities are determined with fractional parts). On ground stations, the phase ambiguity fixing to integers improves significantly the stability of the solutions, for example in the solutions produced by the IGS analysis centers.
The ambiguity fixing on LEO satellites has been demonstrated on Grace, HY2A and Jason 1, but is not currently used for the delivered products. Unfortunately, the Jason 2 GPS receiver was not producing correct ambiguity references (lot of half cycles are present in the phase measurements), and a reliable ambiguity fixing is very difficult to achieve on Jason 2, although the receiver is similar to the Jason 1 and Grace receivers.

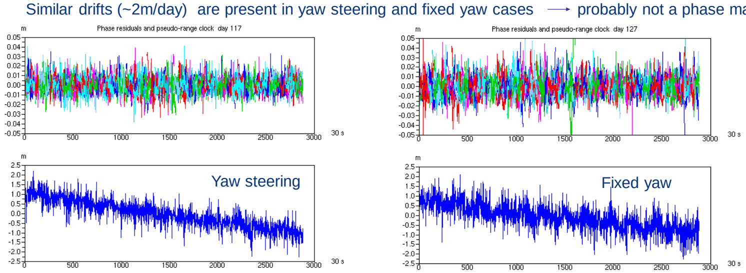
For Jason 3 some passes have important pseudo-range biases, usually just after complete interruptions, this must be taken into account. The first step of the ambiguity fixing procedure works correctly as for Jason 2 (widelane ambiguity fixing).
The second step (narrowlane ambiguity fixing, 10.7 cm wavelength) is possible. However, there are still unexplained important signatures in the phase residuals, even using a phase map correction.

Pseudo-range and phase drifts

Along track biases observed depending on the pseudo-range weighting
- cycle 008, GPS only, dynamic daily arcs, adjusted PCO, weightings (200, 0.02) or (2, 0.02))

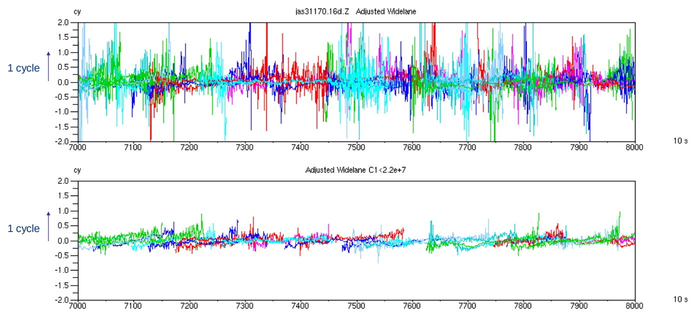


Due to drifts in the phase measurement : the pseudo-range clock is different from the phase clock (200,0.02 case)
Similar drifts (~2m/day) are present in yaw steering and fixed yaw cases ⟶ probably not a phase map effect.



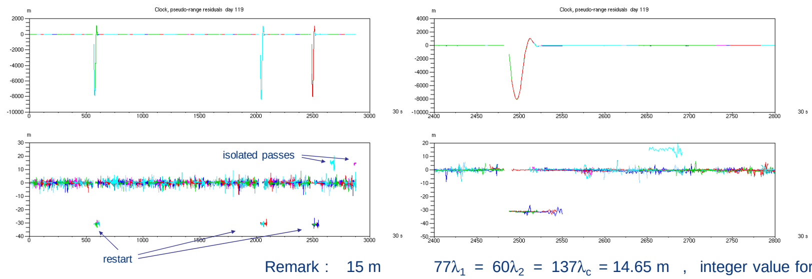
Widelane ambiguity

excellent fixing ratio, more than 99 % of the passes
drifts are present in the residuals, mainly due to pseudo-range
(after correction with grg-wsb daily biases for GPS satellites, daily bias for Jason 3)



Pseudo-range biases

Some passes are biased by ~15m or 30 m (identical on C1,P1 and P2)
30 m biases occur systematically at restarts, on all initial passes



The biased pseudorange measurement are used for the widelane solution.

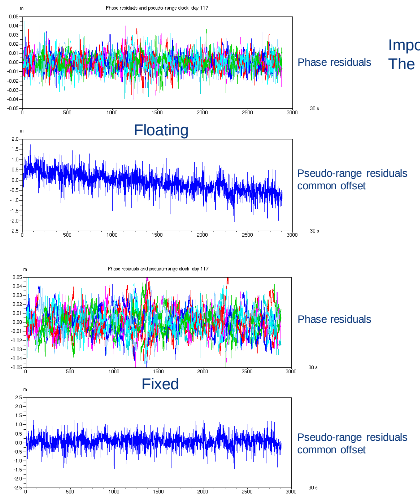
The biased pseudo range measurements are eliminated for the orbit computation.

All phase measurements are used for the orbit computation.

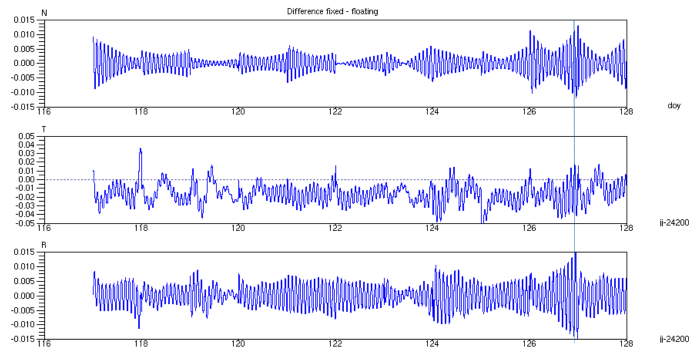
Remark : 15 m $77\lambda_1 = 60\lambda_2 = 137\lambda_c = 14.65$ m , integer value for L2-L1 : -17 cycles, narrowlane : 137 cycles

Ambiguity fixing

Using grg orbits, clocks and widelane biases , dynamic arcs, phase map applied, widelane ambiguity fixed
narrowlane floating ambiguities,
narrowlane fixed ambiguities (80-90 % of the passes).



Important systematic signatures remain in the fixed ambiguities solution phase residuals
The pseudo-range is now consistent with the fixed ambiguity phase clock



The along track bias is now correct. The radial effect is ~5 mm rms between floating and fixed cases (dynamic orbits)

Conclusion

The Jason 3 measurents have good characteristics when compared to Jason 2, for the number of satellites in view and for the cycle slips (no half cycle slips observed). The widelane ambiguity fixing works well using the grg solution biases.
The narrowlane ambiguity fixing is possible, but there are still very important signatures in the residuals for dynamic arcs. These signatures are not yet explained (error in the model, measurements characteristics…).
The along track bias is consistent with the pseudo-range for fixed ambiguity solutions, this is not the case for floating solutions with downweighting of the pseudorange.
Further investigation is needed for the fixed solution results. This has to be studied on longer series to analyze the complete impact on the orbit performance, using an updated set of dynamic parameters.