Estimation of the filtering biases in the CDAAC neutral-atmosphere processing

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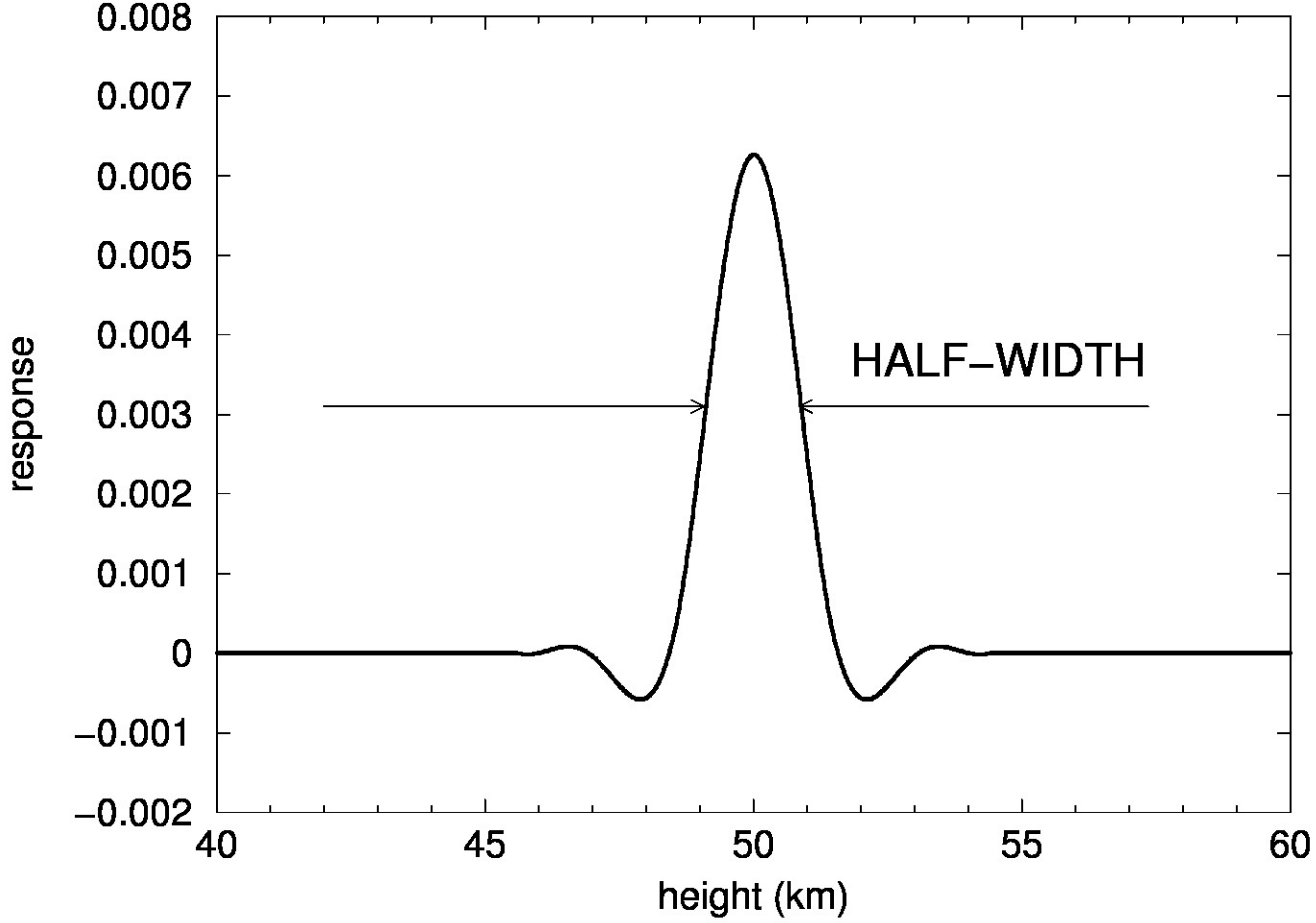
Filtering biases result from convextiy / concavity
of the filtered functions; they depend on the shape
and width of the filter response function

Besides the filtering biases, there are filtering end-effects:
- small at the bottom (small filtering window for WO BA)
- truncated at the top (important: RO data must be recorded
  sufficiently above the max. height where they are used)

Currently applied at CDAAC:
Savitzky-Golay filter (sliding polynomial regression)
[Press et al., Num. Rec. in Fortran 77, 1996, pp. 644-649]
3 passes,
polynom power = 2,
analytical calculation of derivative

Impulse response function of the applied filter



Geometric optics: filtering with differentiation is applied for the phases; then BA are subject to ionospheric correction
LC = <L1> - <<L4>>

<> half-width w1 = diameter of the 1st Fresnel zone (~1.5km)
Note: the corresponding time window is different for different occultations (depends on TP ascent / descent rate)

<<>> half-width w4 is found individually for each occultation (to suppress the effect of larger noise on L2), in the interval (w1, 3*w1), by minimizing fluctuation of LC

Wave optics: filtering is applied for the L1 bending angle
LC = <L1> - extrapolated L4

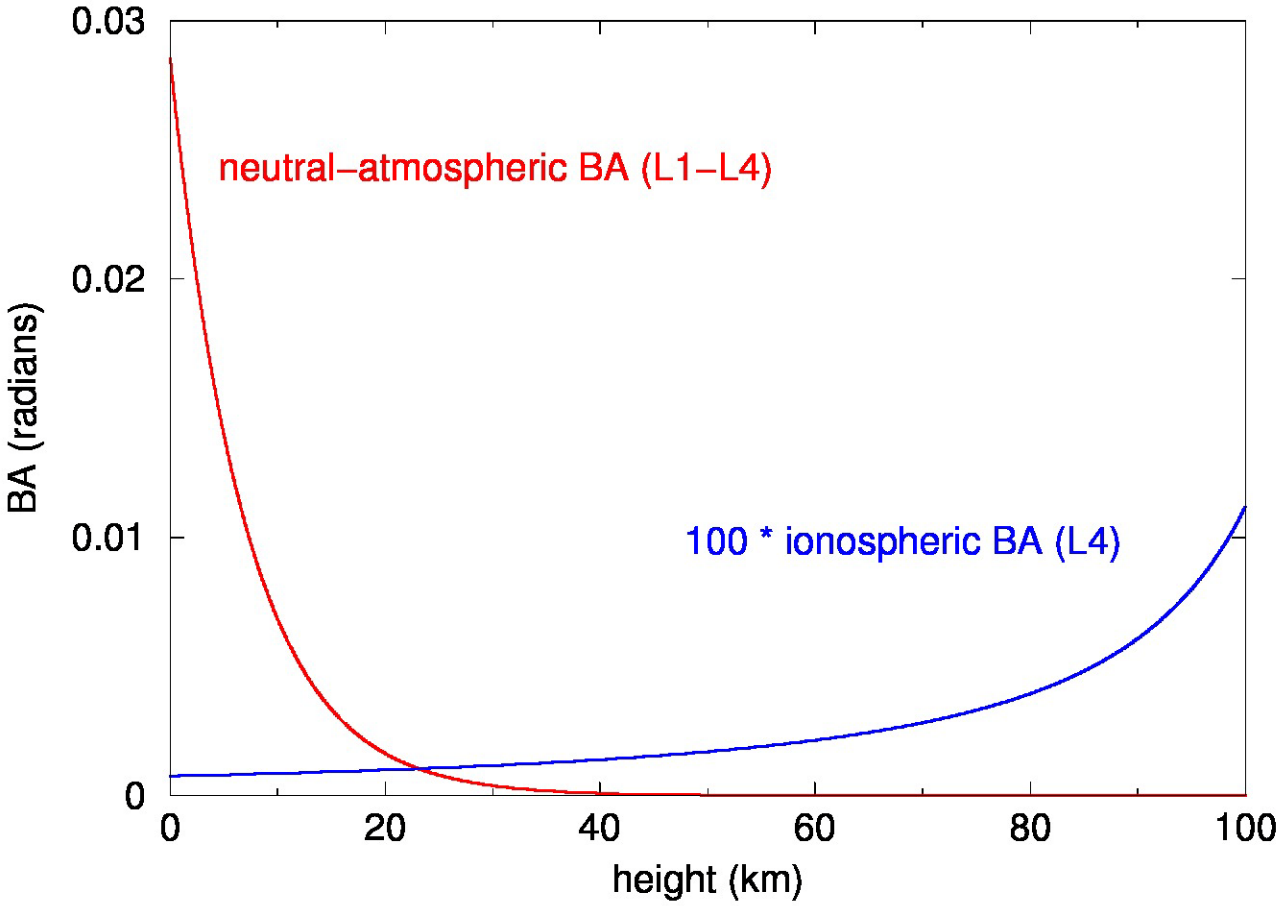
<> half-width w = 100, 250, 500 m
all applied for WO BA at 0 - 22 km; then combined:
0-7 km (100 m); 7-10 km (250 m); 10-20 km (500 m)

GO is merged with WO at 20 km

Phase models used for evaluation of the filtering biases (GO)

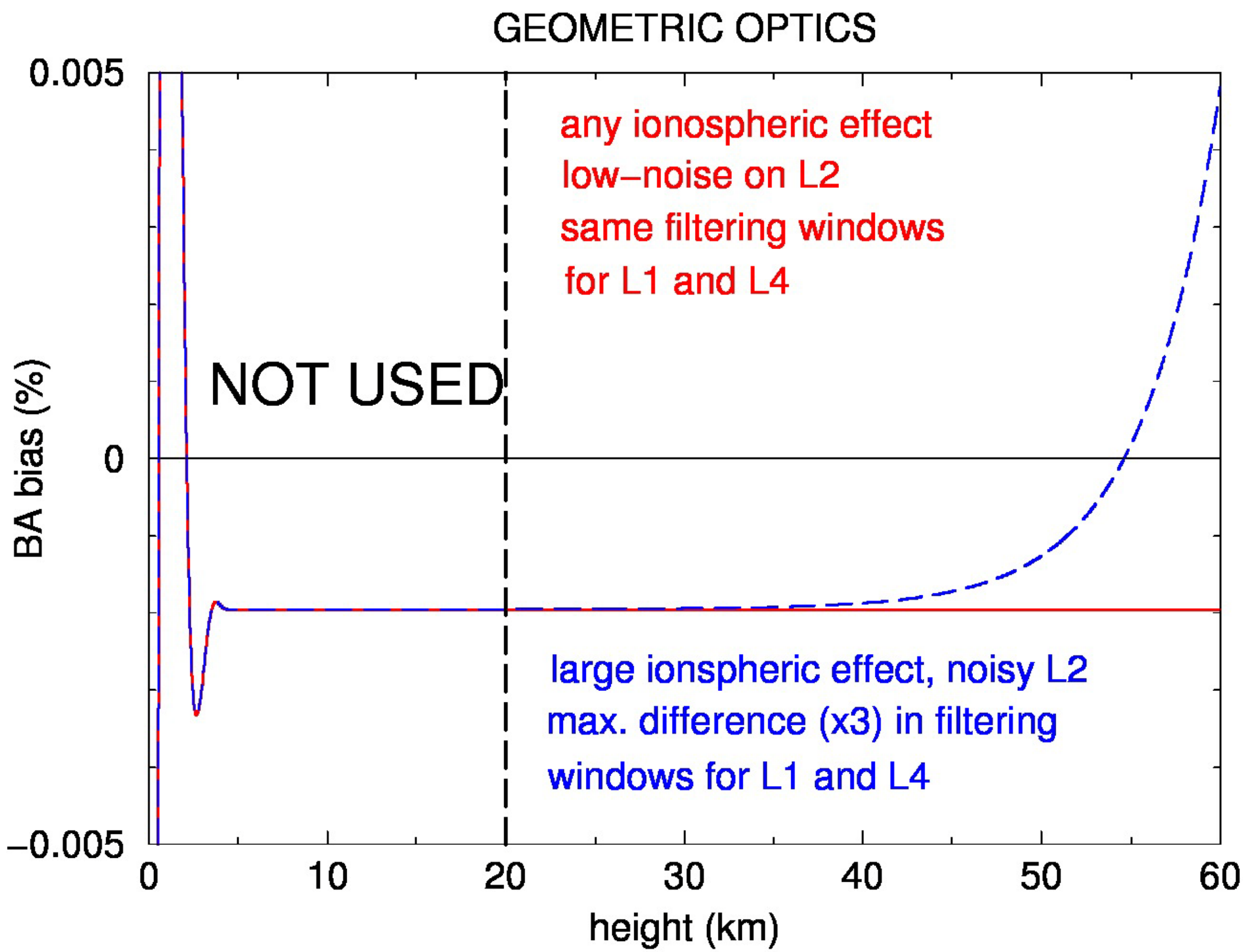
Neutral atmosphere: LC = A*exp(-z/H); H = 7 km

Ionosphere: L4 = B / sqrt (z_E - z); z_E = 120 km



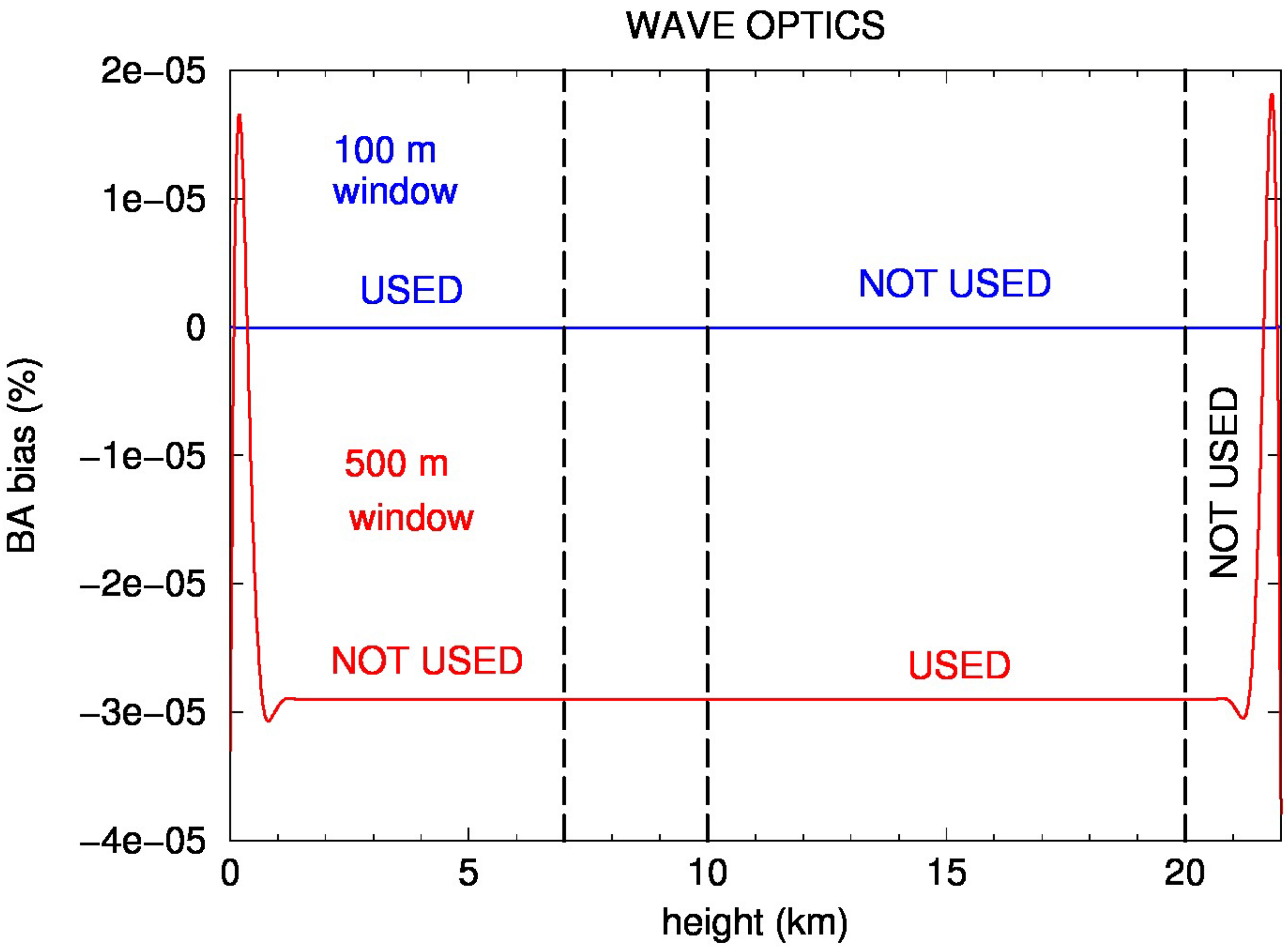
Fractional BA bias for GO processing (applied above 20 km)

(d<LC+L4>/dt - d<<L4>>/dt - dLC/dt) / dLC/dt

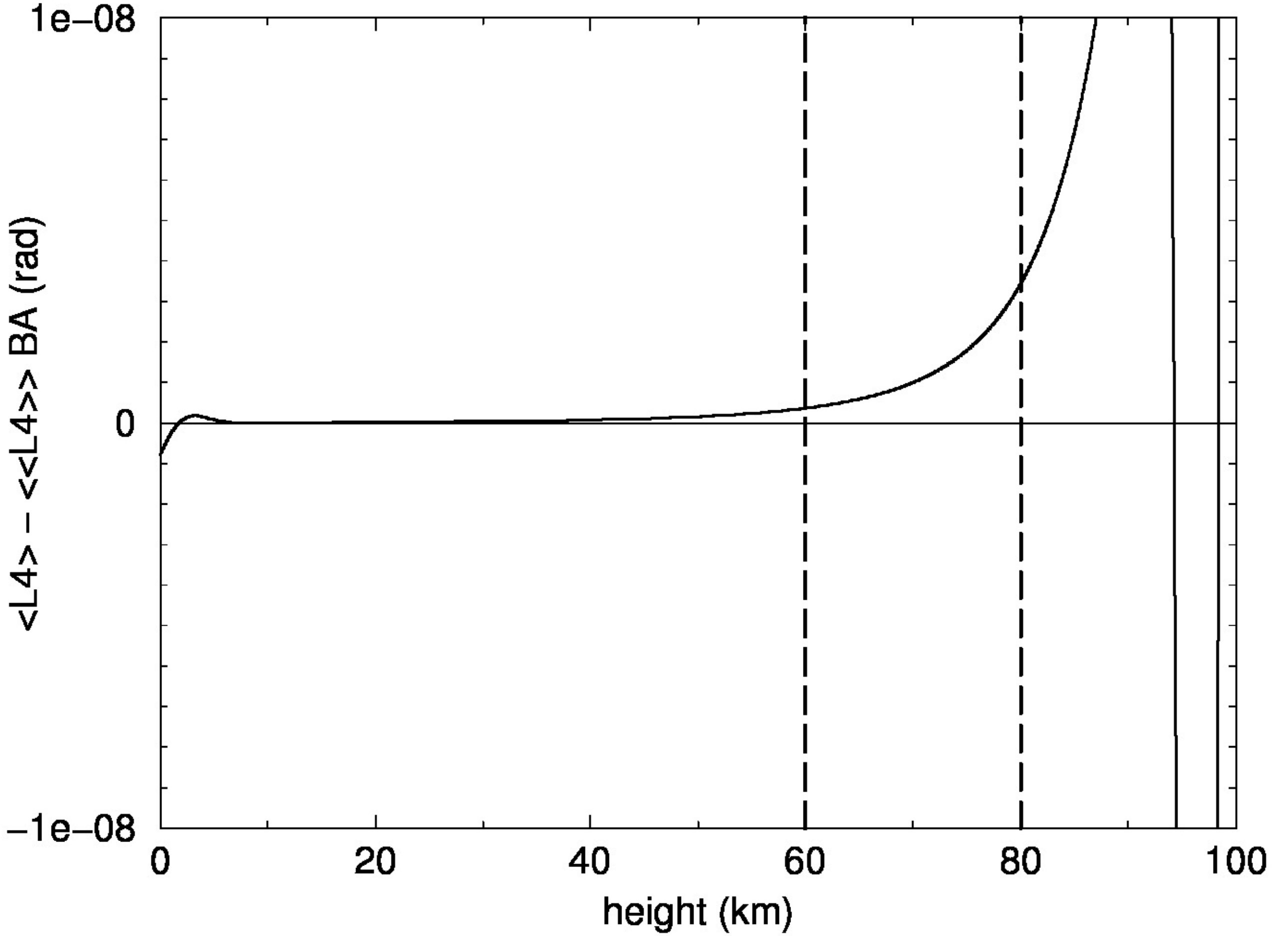


Fractional BA biases for WO processing (applied below 20 km)

Fract. BA bias = (< LC > - LC) / LC



For the model of ionospheric BA (slide 5), the absolute BA bias at 60-80 km is about 10 times smaller than the 2nd order ionospheric effect (when RO data are recorded to > 100 km)



Summary

Currently applied filterings for L1 Doppler (GO), L1 BA (WO) and for L4 Doppler (GO) (for the ionospheric correction), result in the ionosphere-free BA bias < 0.005% below 60 km (increases above 60 km).