
# The coastal performance of SAR Altimetry from CryoSat-2 and Sentinel-3

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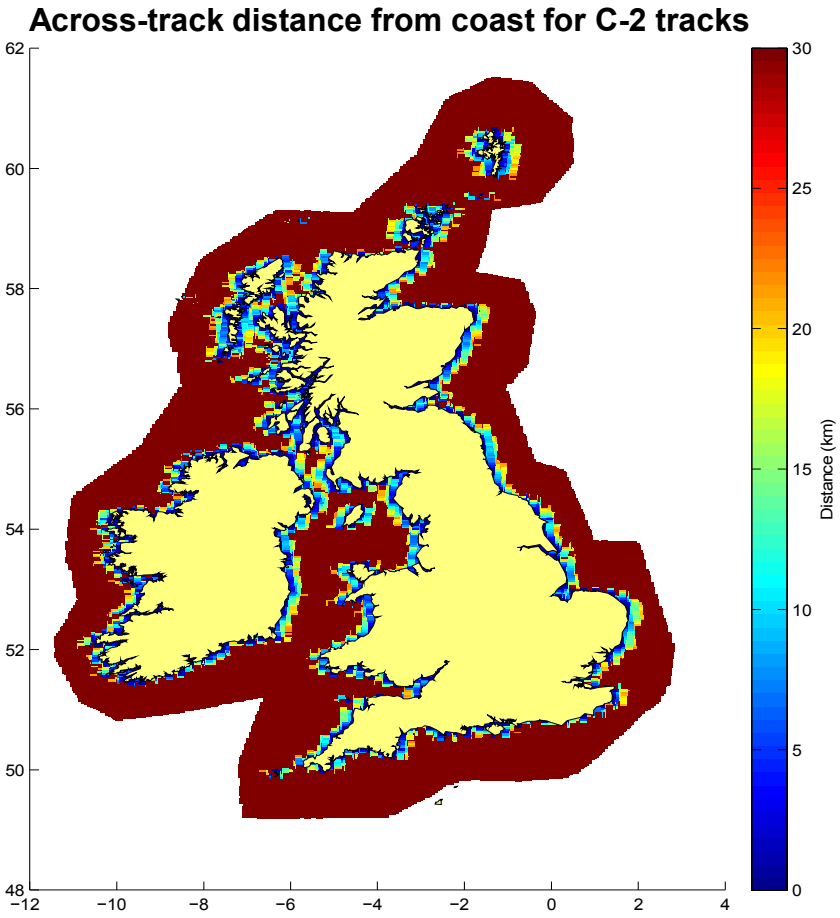
# Rationale

- along-track resolution and high SNR of SAR altimetry are expected to be particularly advantageous in the coastal zone → better precision and possibly better accuracy)
- but *precision* needs to be **verified**; *accuracy* needs to be **validated**
  - For C-2 this has been done in part in ESA CryoSat Plus for Oceans (CP4O)
  - For C-2 and S-3 being done in SCOOP
- in particular we look at the performance against some 'distance' from coast
- here: results over the British Isles domain



# C-2 data: two processors

- One full year of data (Nov 12-Oct 13)
- **CNES CPP**: numerical retracker, efficient, not optimized for coastal zone (thanks to F. Boy for providing the data!)
- **ESRIN GPOD/SARvatore** in a configuration optimized for coastal zone

| SAR L1b Processing Options | CPP | GPOD |
|---|---|---|
| Hamming Weighting Function | Not Applied | Applied only in Coastal Zone |
| Beam Steering | Approximated | Approximated |
| Radar Window Size | Normal (128 bins) | Extended (256 bins) |
| Range pre-FFT Zero Padding | Not Applied | Applied |

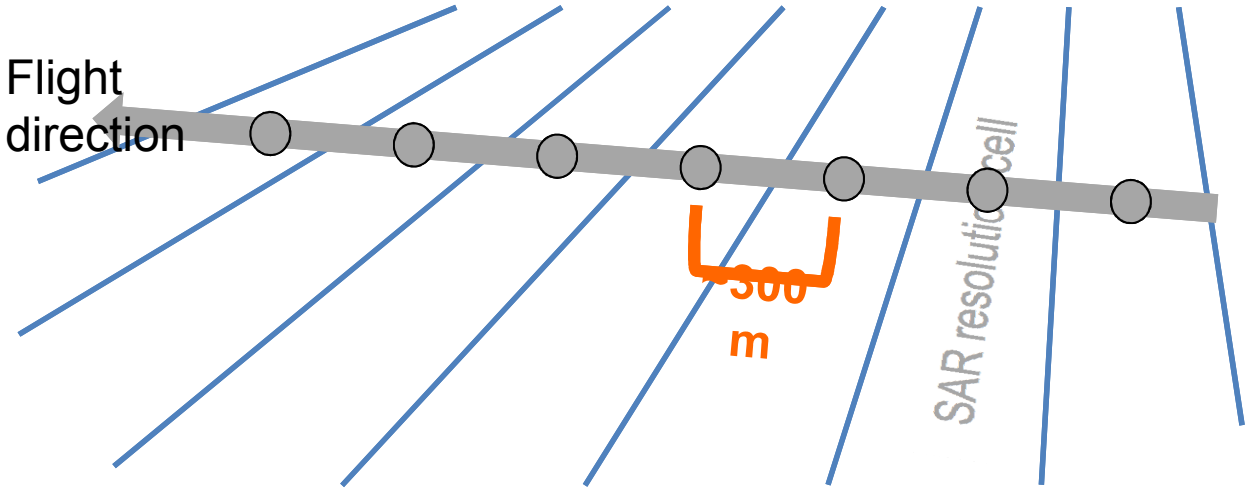
| SAR L2 Processing Options | CPP | GPOD |
|---|---|---|
| SAR Return Waveform Model | Numerical Solution with real antenna pattern & real PTR | SAMOSA 2 with LUT for alpha_p (PTR width) |
| Delay Doppler Map (DDM) Masking | Applied | Applied |

# Assessing precision

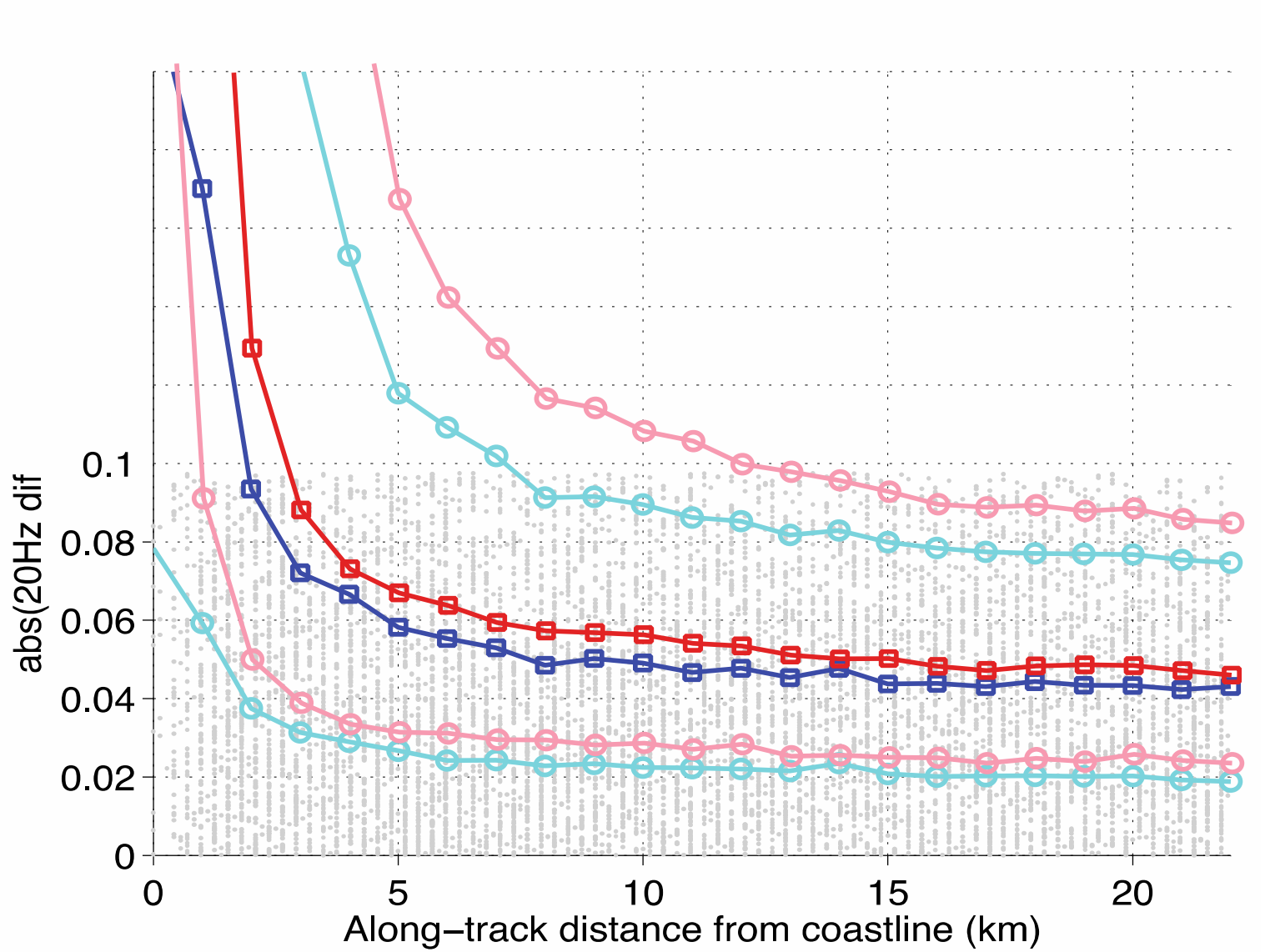
- SSH does not change more than a few mm over ~300 m (except in very rare cases)
- → **difference between adjacent 20-Hz SSH values is essentially a measure of the noise**

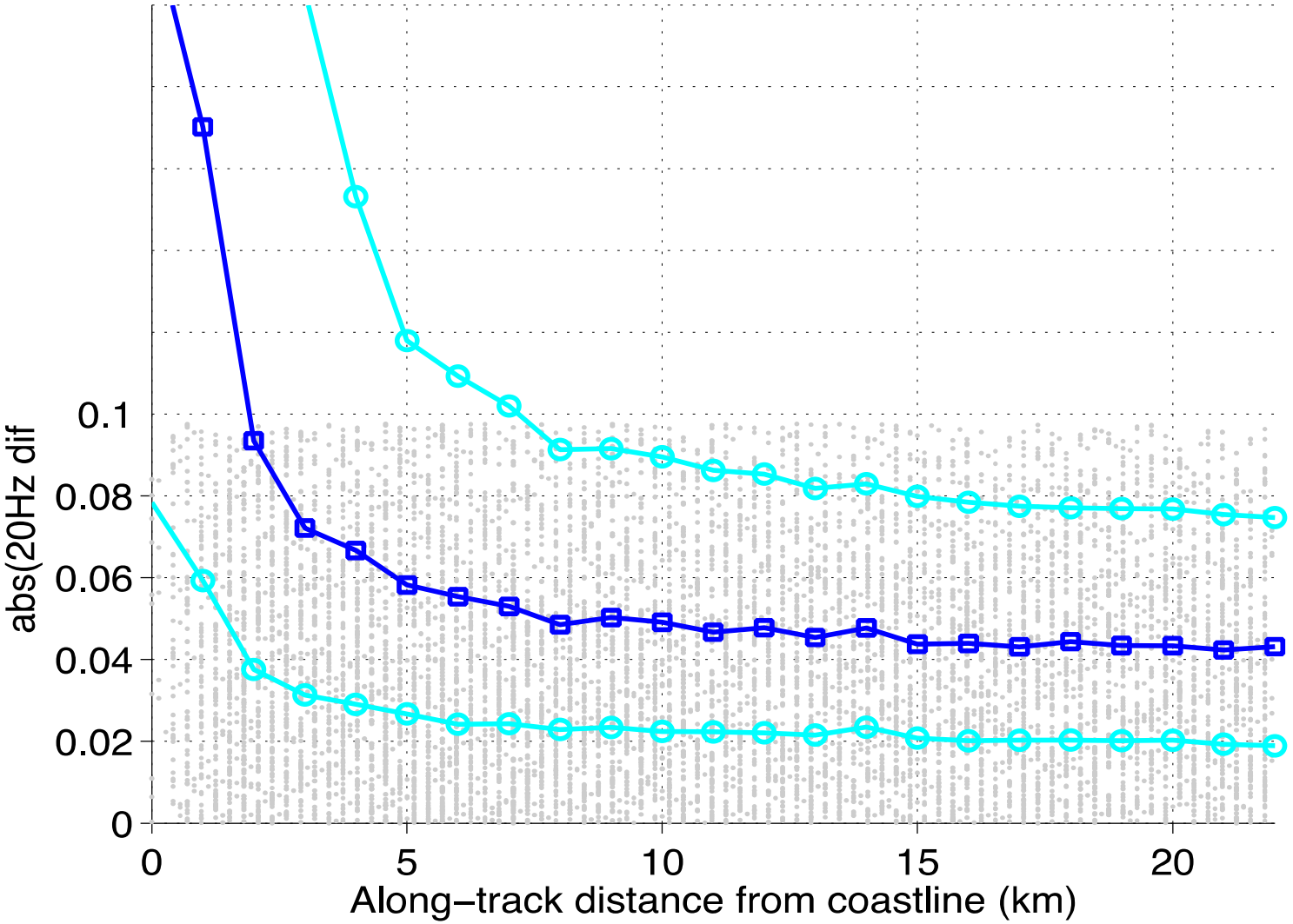
if noise were gaussian: $noise_{RMS} = \frac{std(\Delta_{20}(h))}{sqrt(2)}$

**In practice** because of outliers it is better to use: $noise_{MAD} = median(|\Delta_{20}(h)|)$

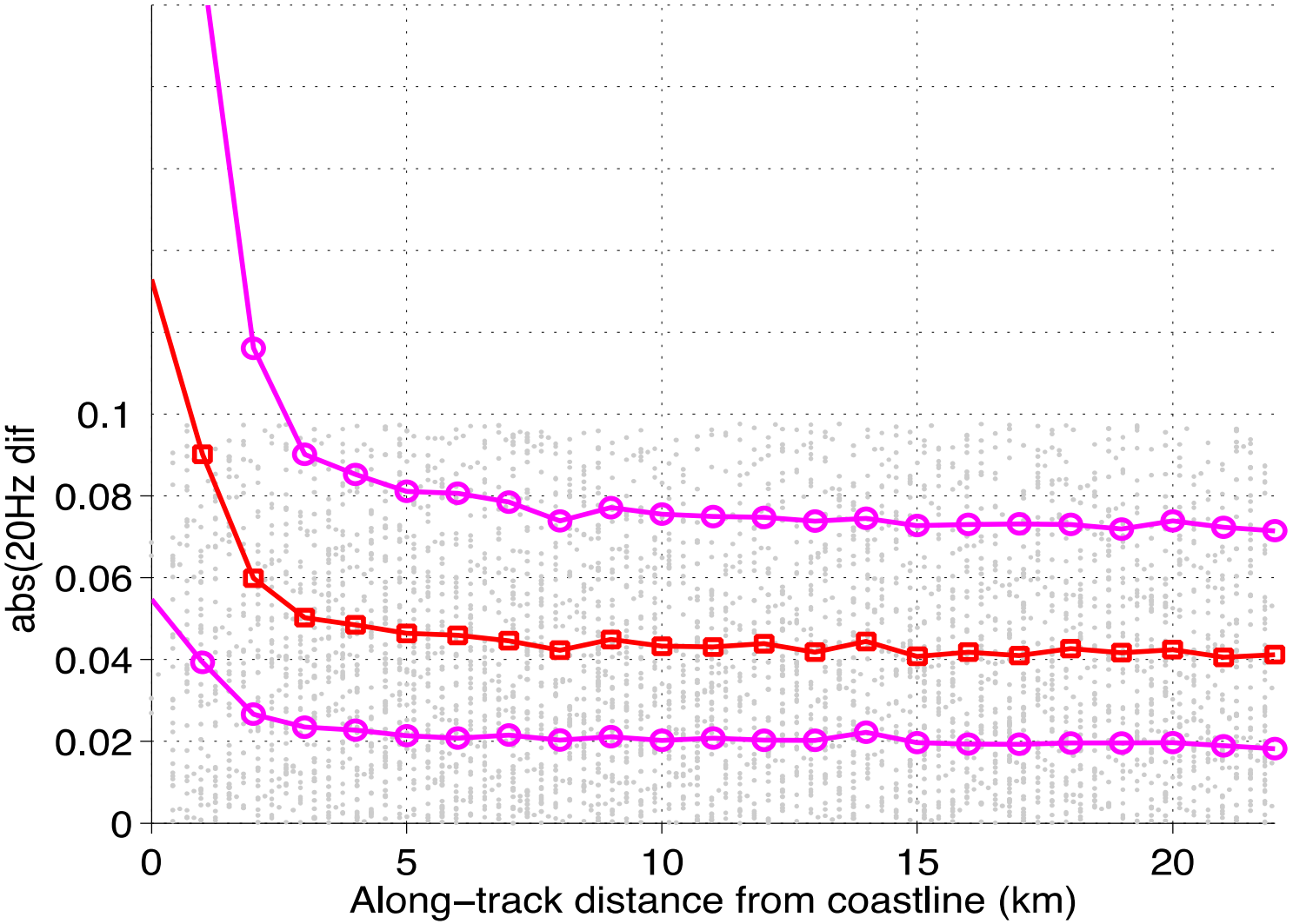


# Results – CryoSat-2

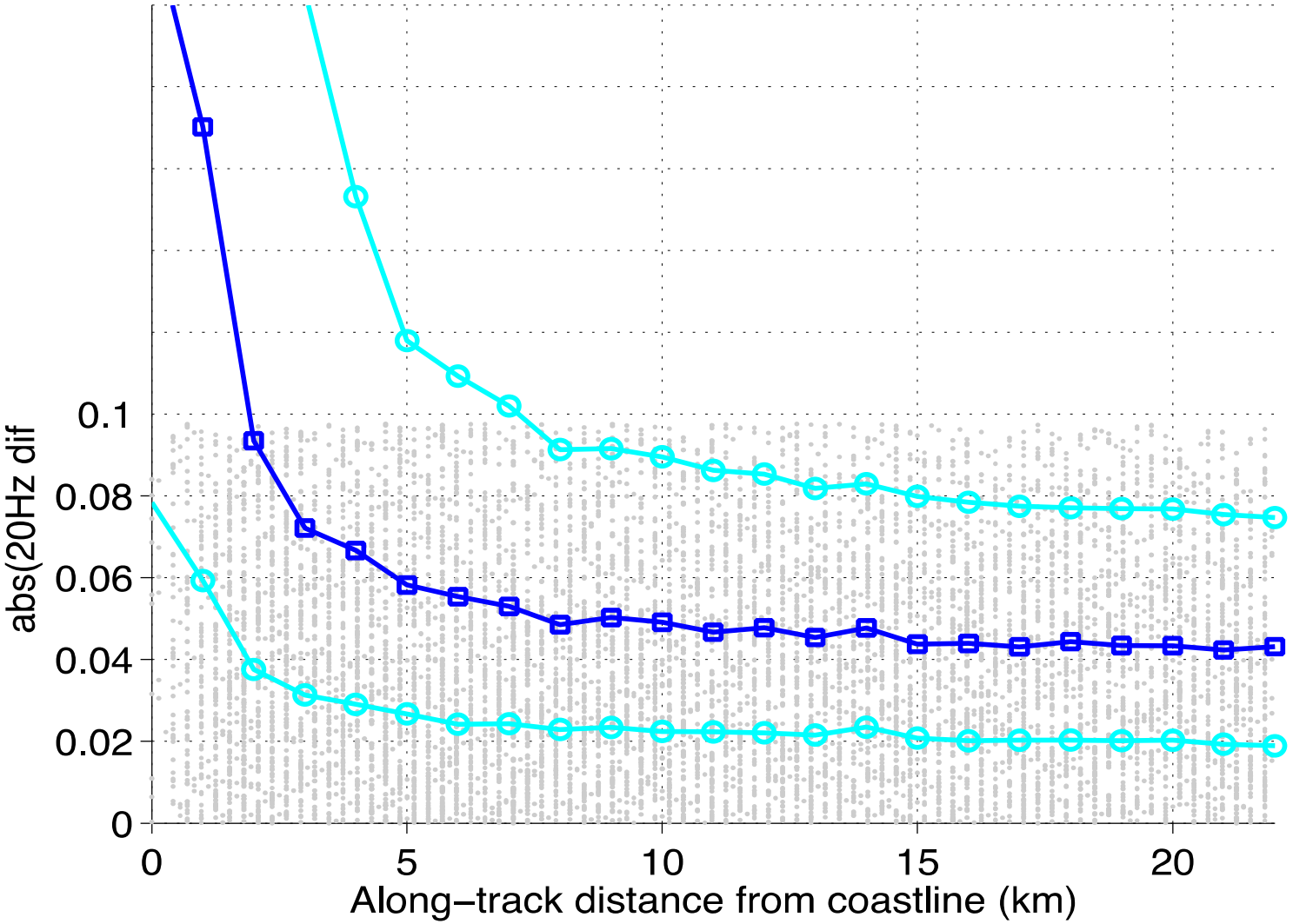



abs(20Hz dif
0.1
0.08
0.06
0.04
0.02
0
0
5
10
15
20
Along–track distance from coastline (km)

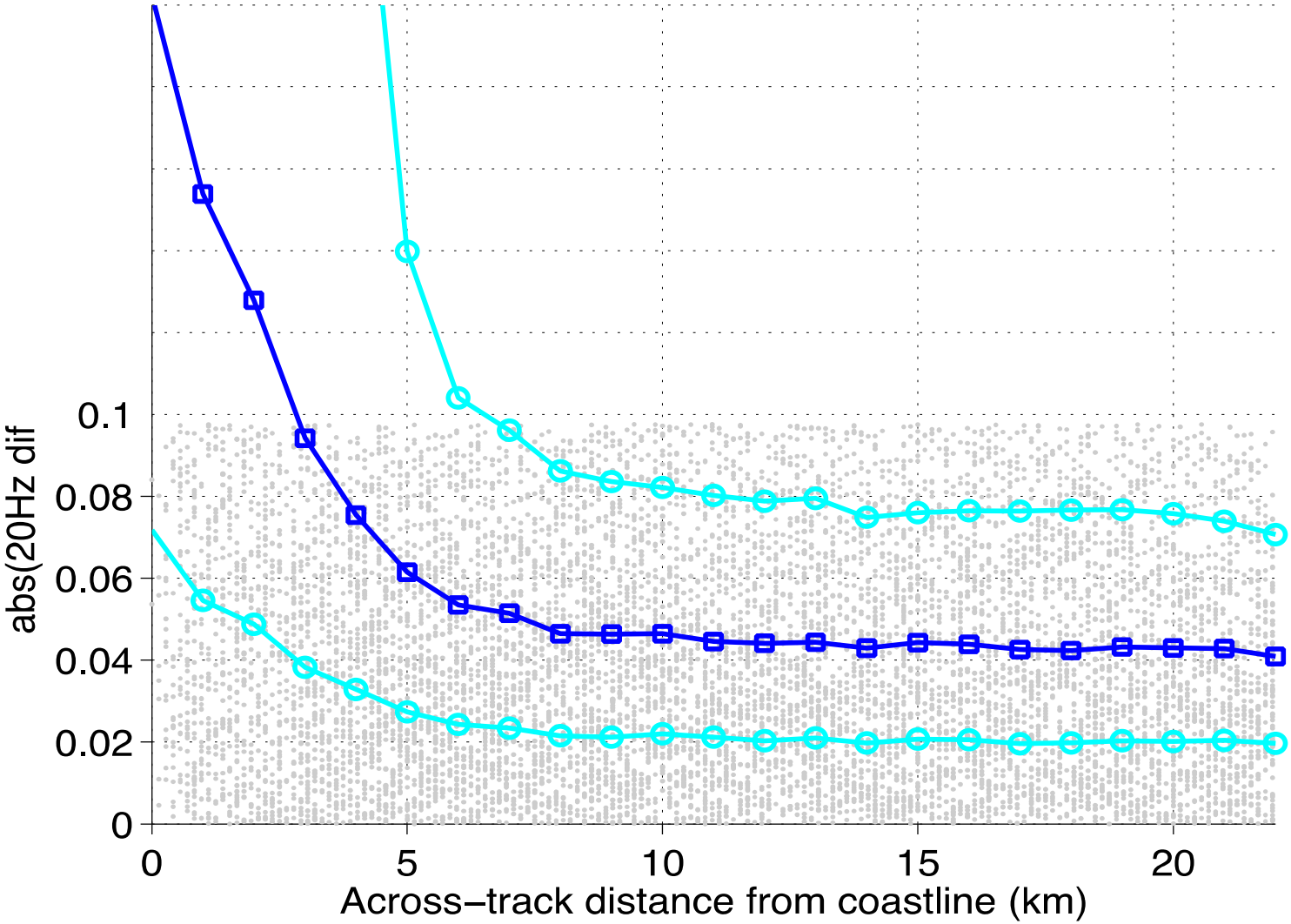
# Effect of screening



# vs along-track distance

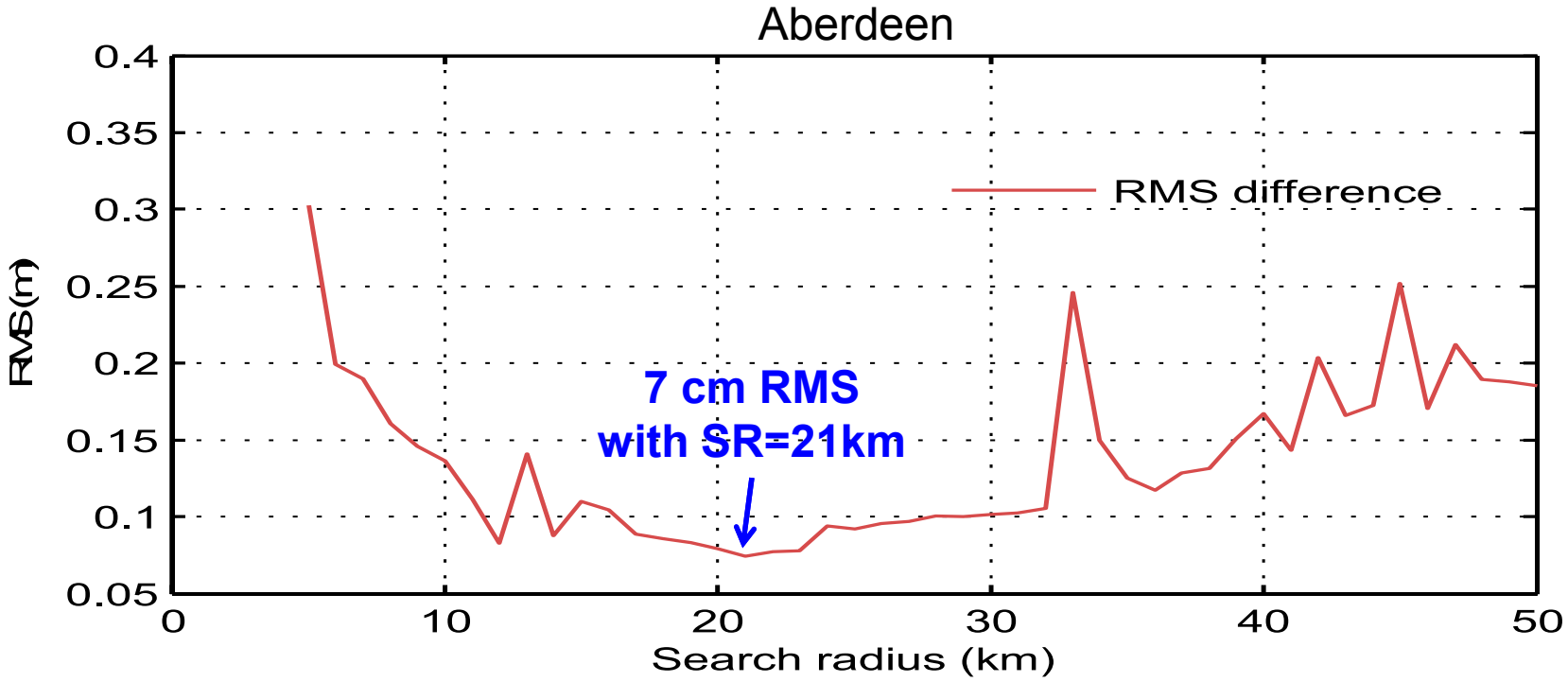


# vs across-track distance

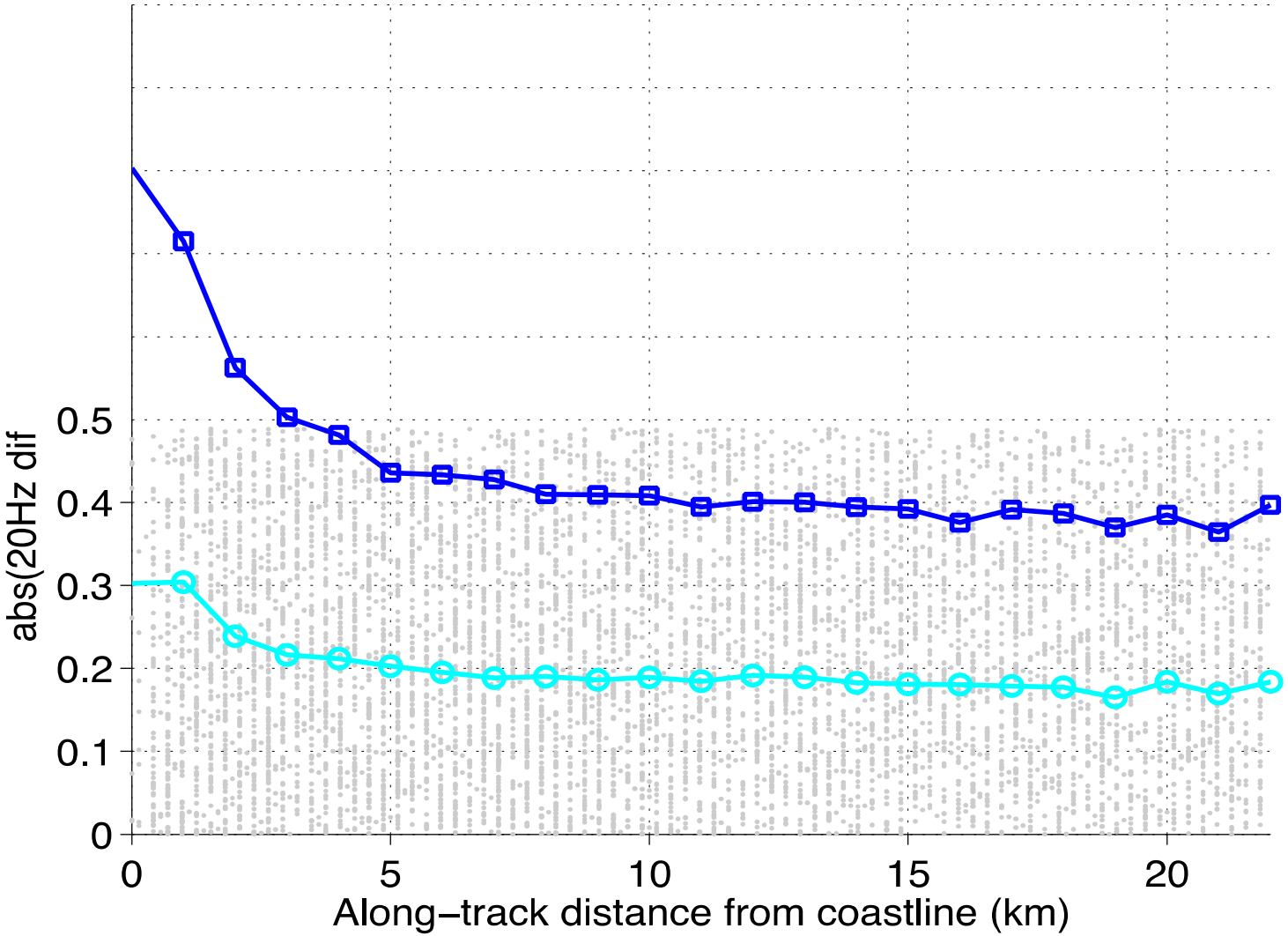


# Validation against TG

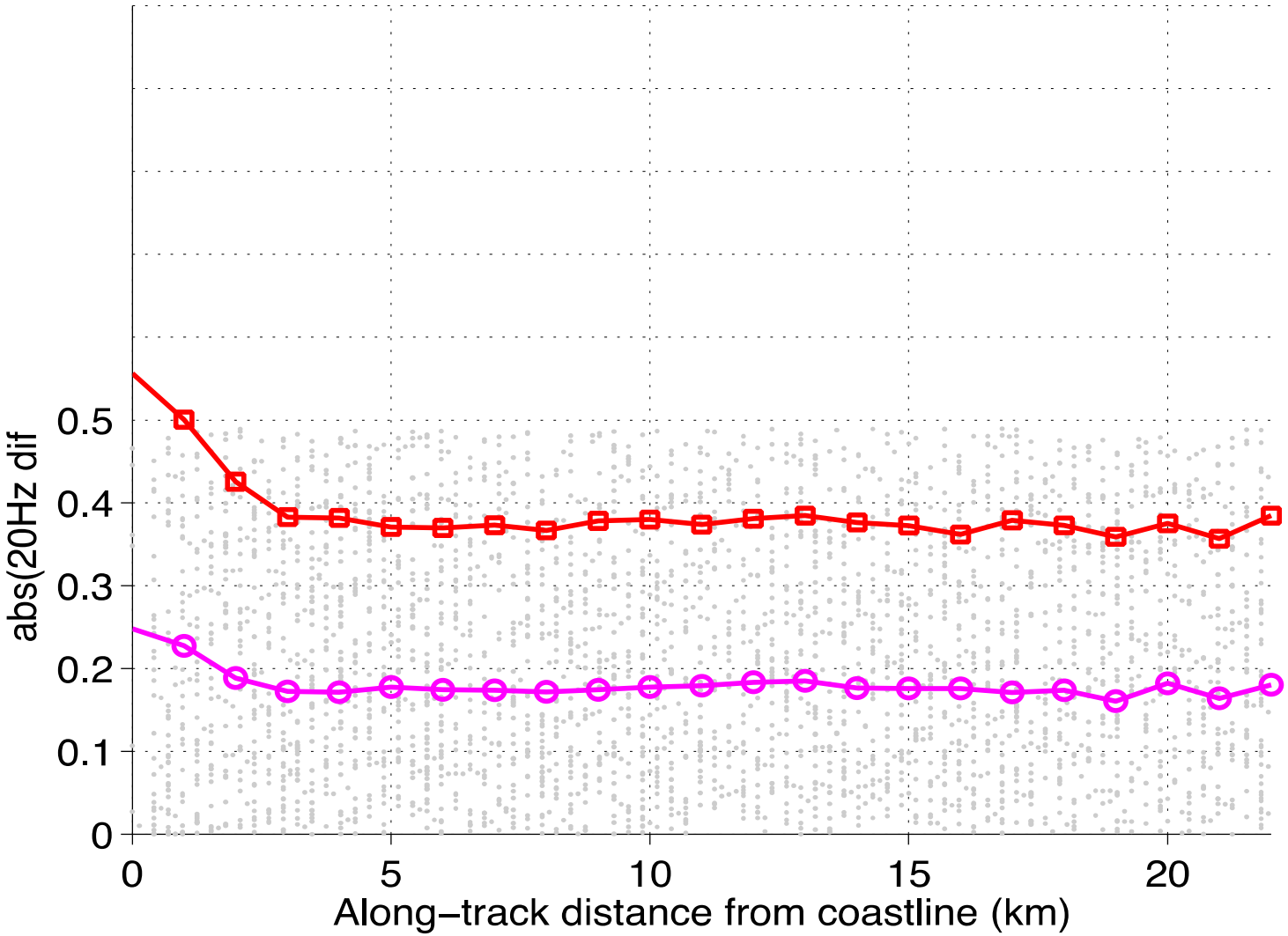
- Need to account for the non-repeat orbit of C-2
  - We consider a 'search radius' around the TG and see how the rms difference Alt/TG varies when this radius is changed



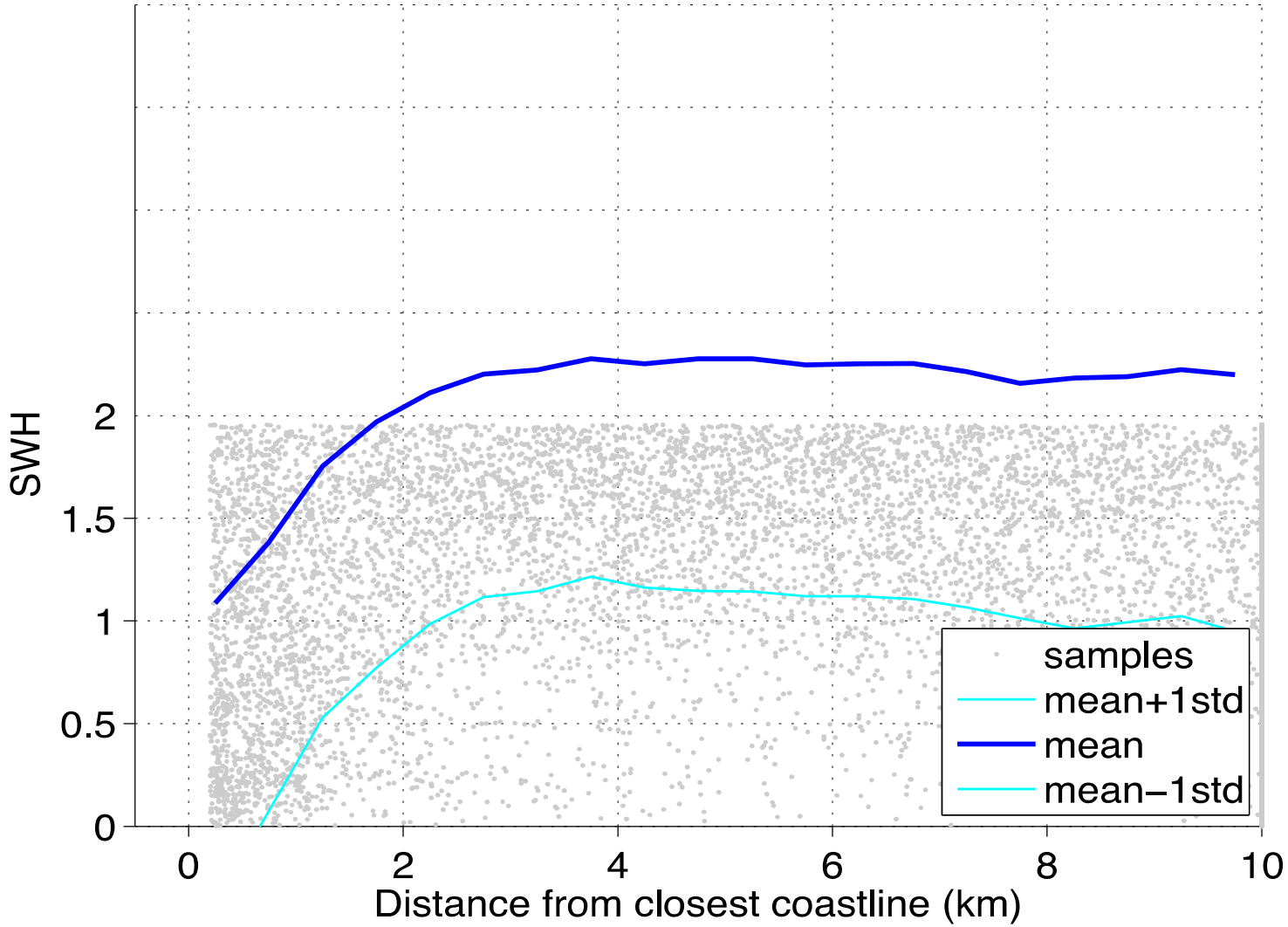
# C-2 SWH noise


abs(20Hz dif
0.5
0.4
0.3
0.2
0.1
0
0
5
10
15
20
Along–track distance from coastline (km)

# SWH noise - Effect of screening

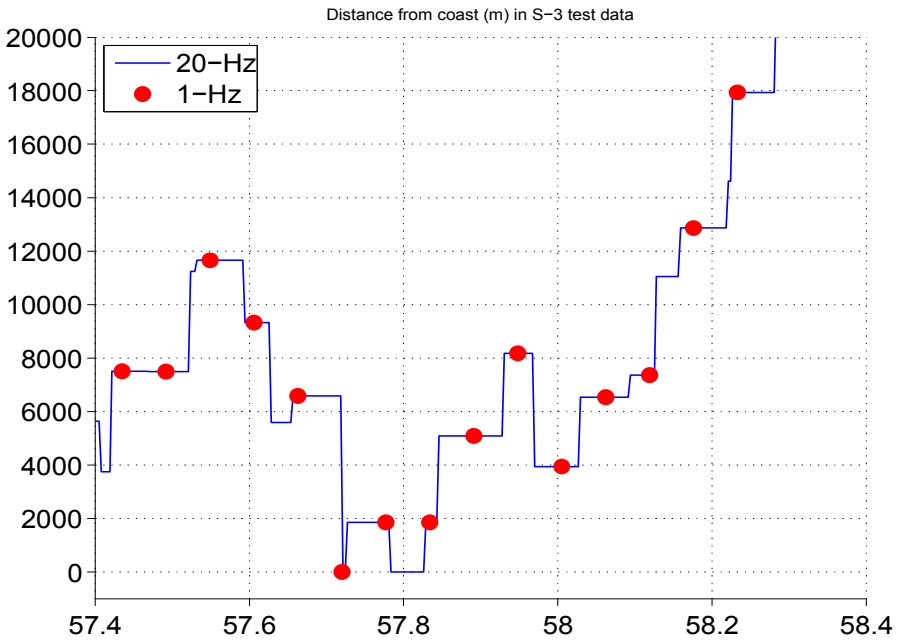


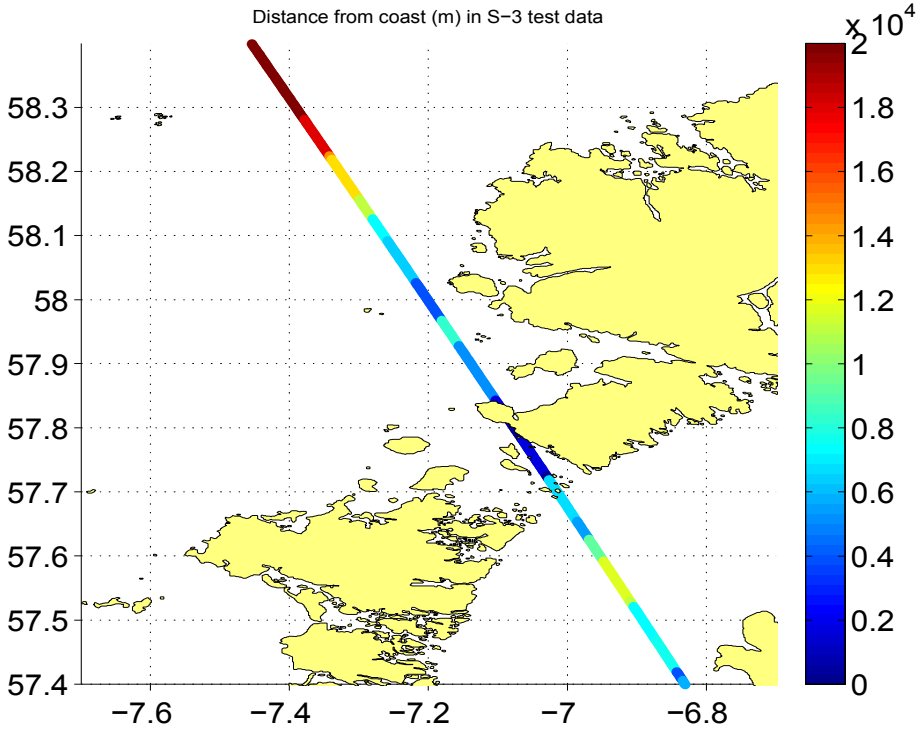
# C-2 SWH distribution



# S-3 data

- 1 month of data (06 Apr to 06 May released to S3VT experts for testing
- **'distance from coast'** computed by NN interpolation from coarse grid

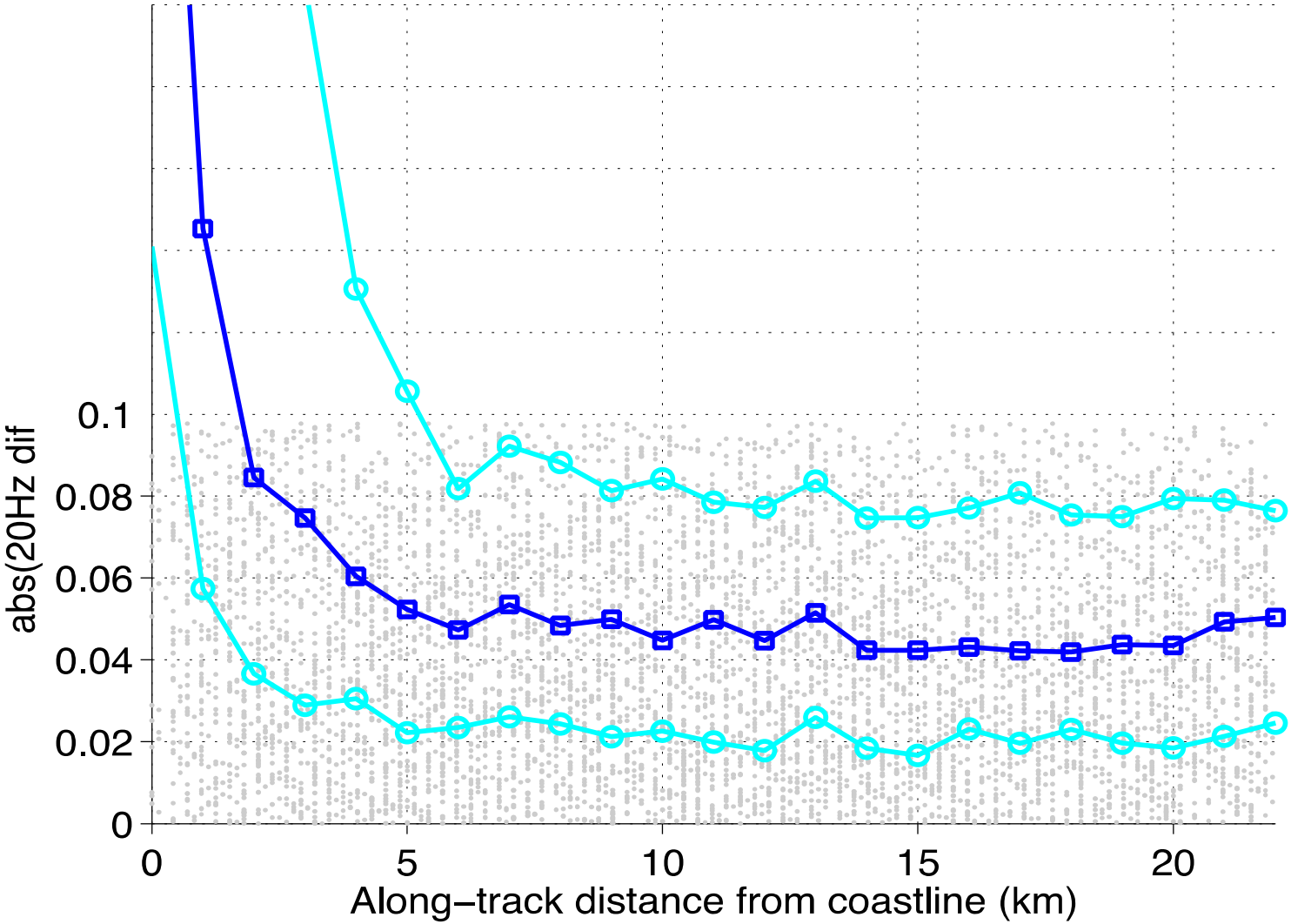



→ dist_coast not good for coastal analysis

→ we had to recompute it

# S-3 noise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0.06
0.04
0.02
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0
5
10
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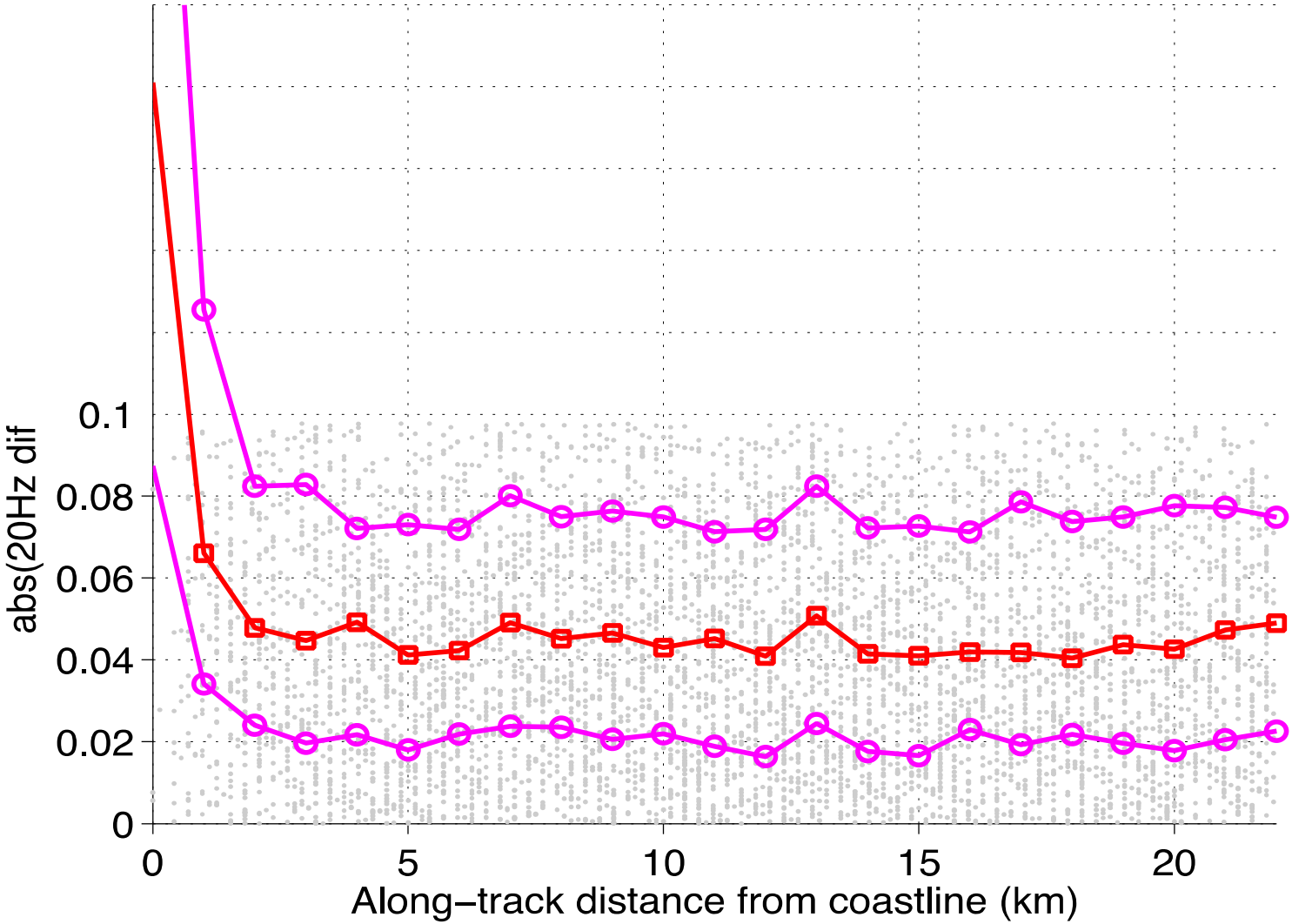
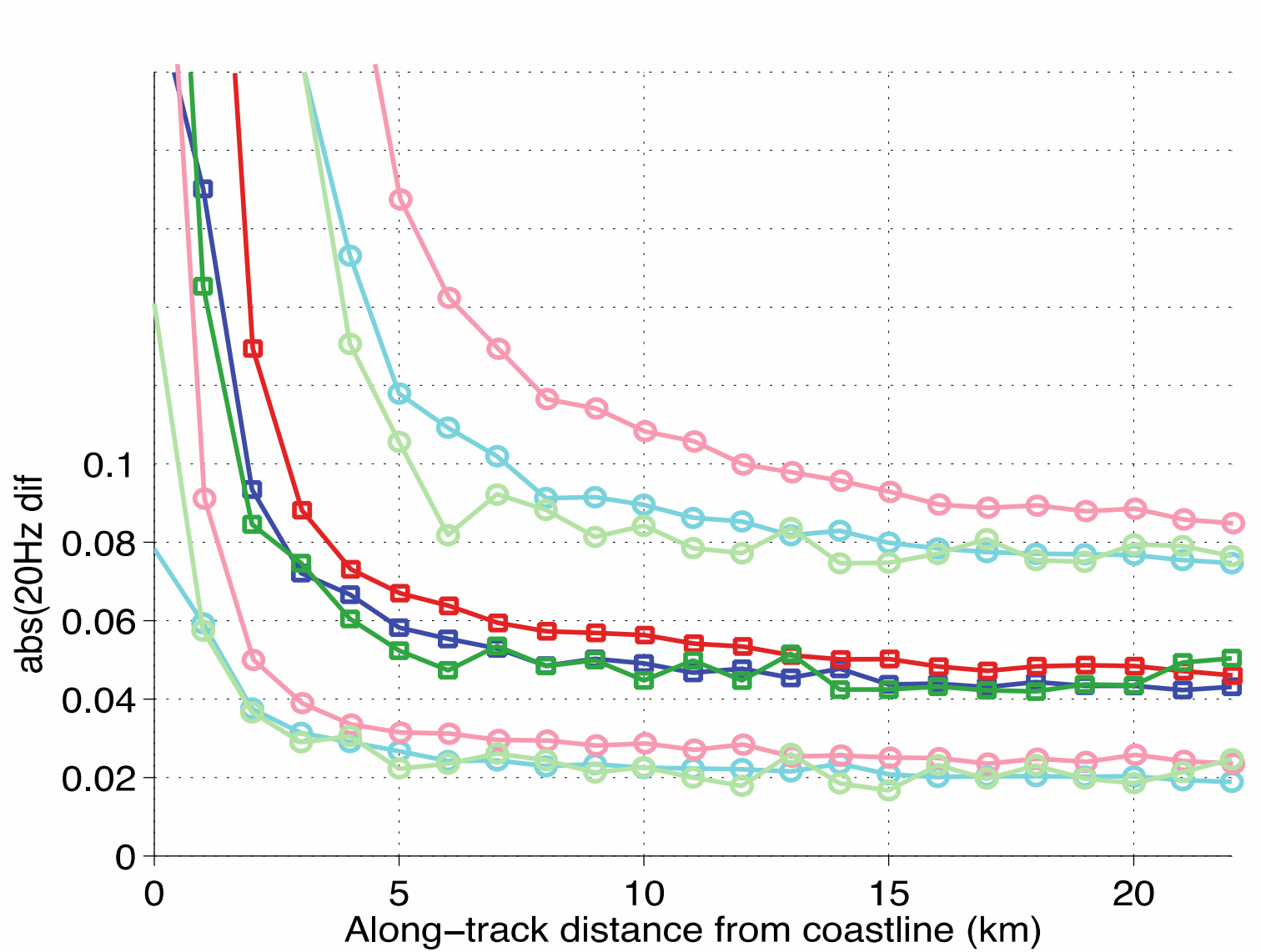
20
Along–track distance from coastline (km)

# Effect of screening




abs(20Hz dif
0.1
0.08
0.06
0.04
0.02
0
0
5
10
15
20
Along–track distance from coastline (km)

# Conclusions

- S-3 with no specific coastal processing already shows coastal precision comparable to C-2 with specific coastal processing
- It seems possible to derive an useful characterization of the coastal wave field, for instance observing sheltering and shoaling
- **Recomm-1**: provide distance from coast from precise higher resolution map
- **Recomm-2**: for SAR altimetry it is essential also to provide across-track distance from coast