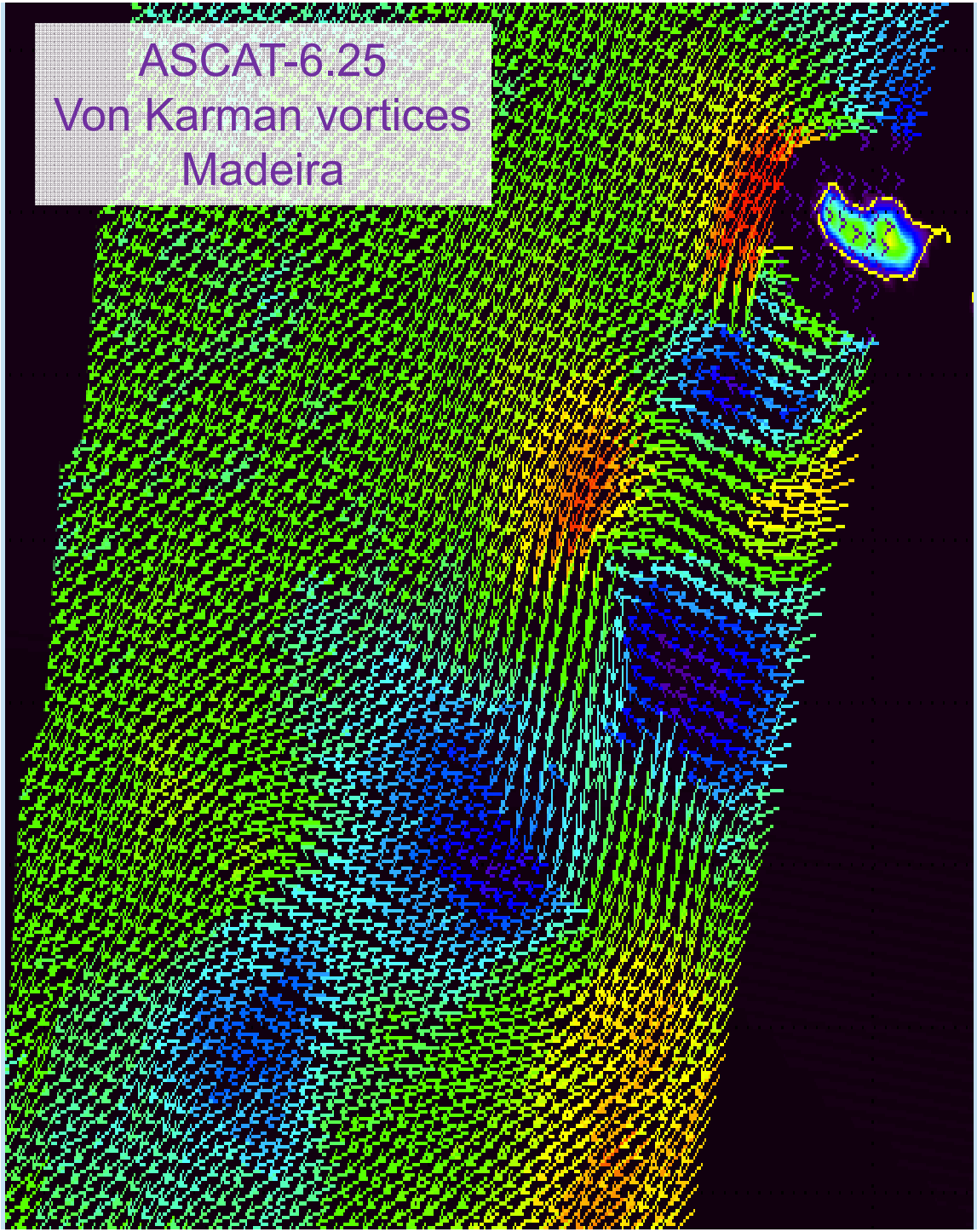

NWP SAF
Numerical Weather Prediction

Resolution enhancement for ASCAT

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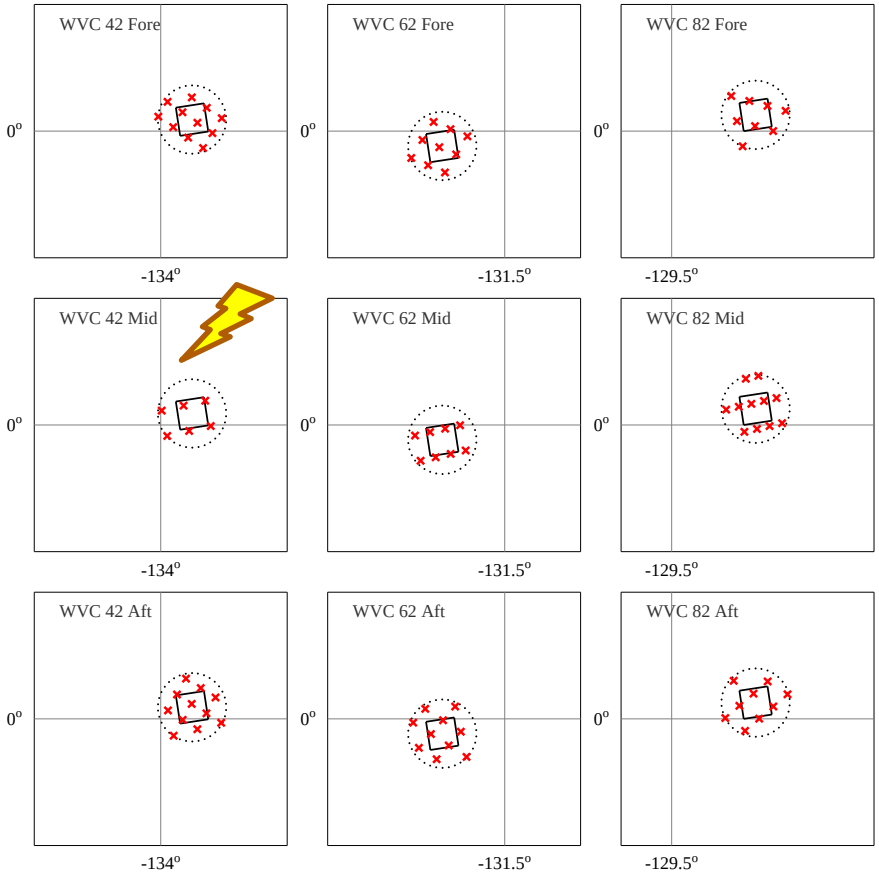
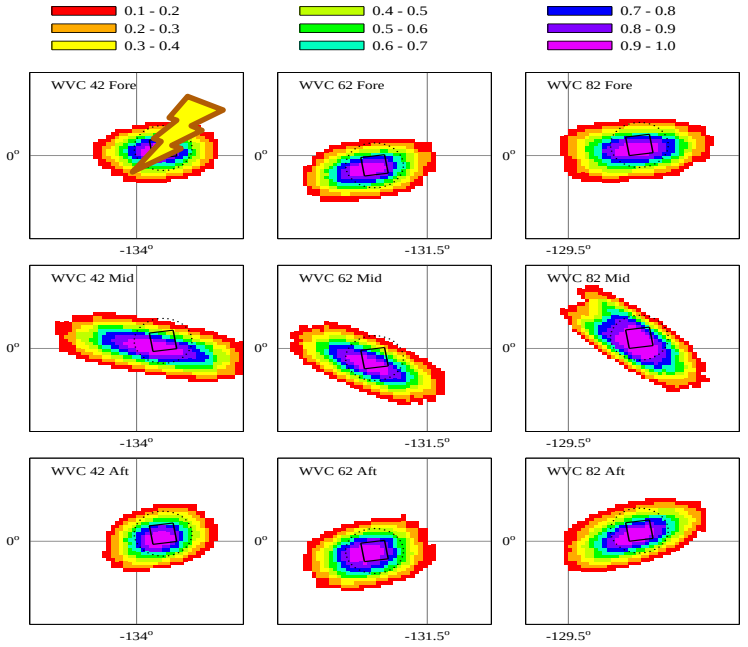
Introduction: ASCAT-6.25 heritage

- ASCAT-6.25 will become operational in the next AWDP release (AWDP 2.4)
- Downscaling of ASCAT-coastal product by a factor of 2: unweighted average over circle (Top Hat; radius 7.5 km for ASCAT-6.25) instead of Hamming-weighted area over square, using the EUMETSAT L1B full resolution product and the 6.25 km grid contained in it
- ASCAT-6.25 shows more details than ASCAT-coastal, but is also a bit noisier, because
  - less footprints contribute to a WVC, notably for the mid beam at low incidence angles;
  - the spatial overlap of the three beams is reduced

Introduction: ASCAT-6.25 CSRF

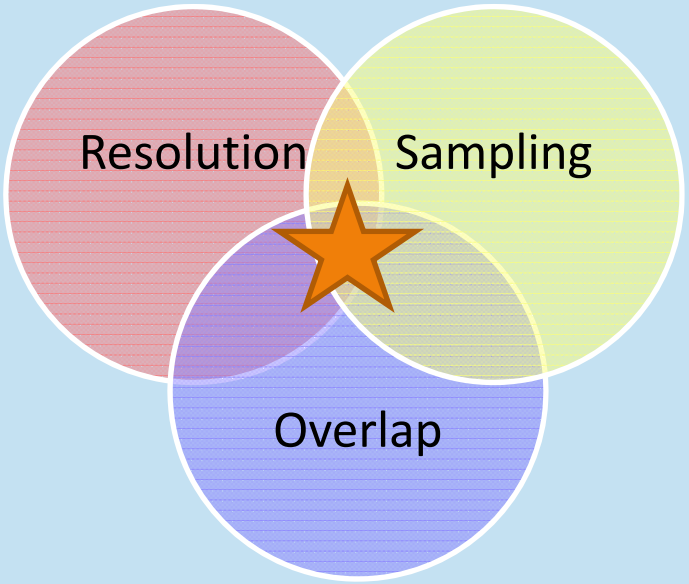
Red crosses: SRF centres
Solid square: WVC
Dotted circle: Aggregation area





Introduction

- Is it possible to define a better high-resolution ASCAT wind product by using optimised sampling from the EUMETSAT L1B full resolution product?



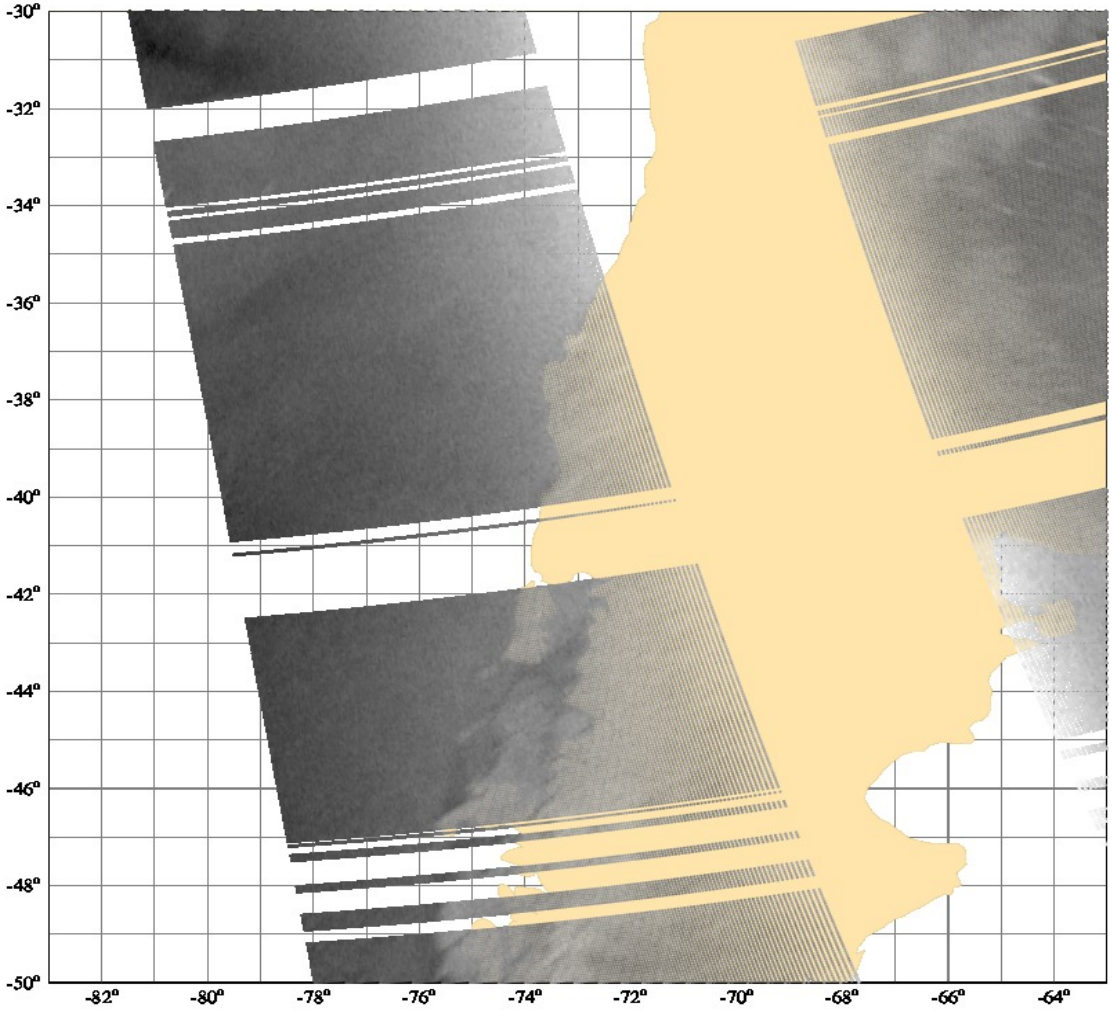
Scheme for resolution enhancement

- Uniform sampling of σ^0: start from mid-beam antenna footprints $\rightarrow$ 11.3 or 5.6 km grid size
- Adopt a value for *R*, the radius of the aggregation area
- Select one row of WVC's, search contributing footprints from each of the three beams, and make aggregation table

- Processing:
  - Read in L1B data
  - Calculate average σ^0 and average beam position from aggregation table

Very efficient algorithm! (< 10% of total processing time)

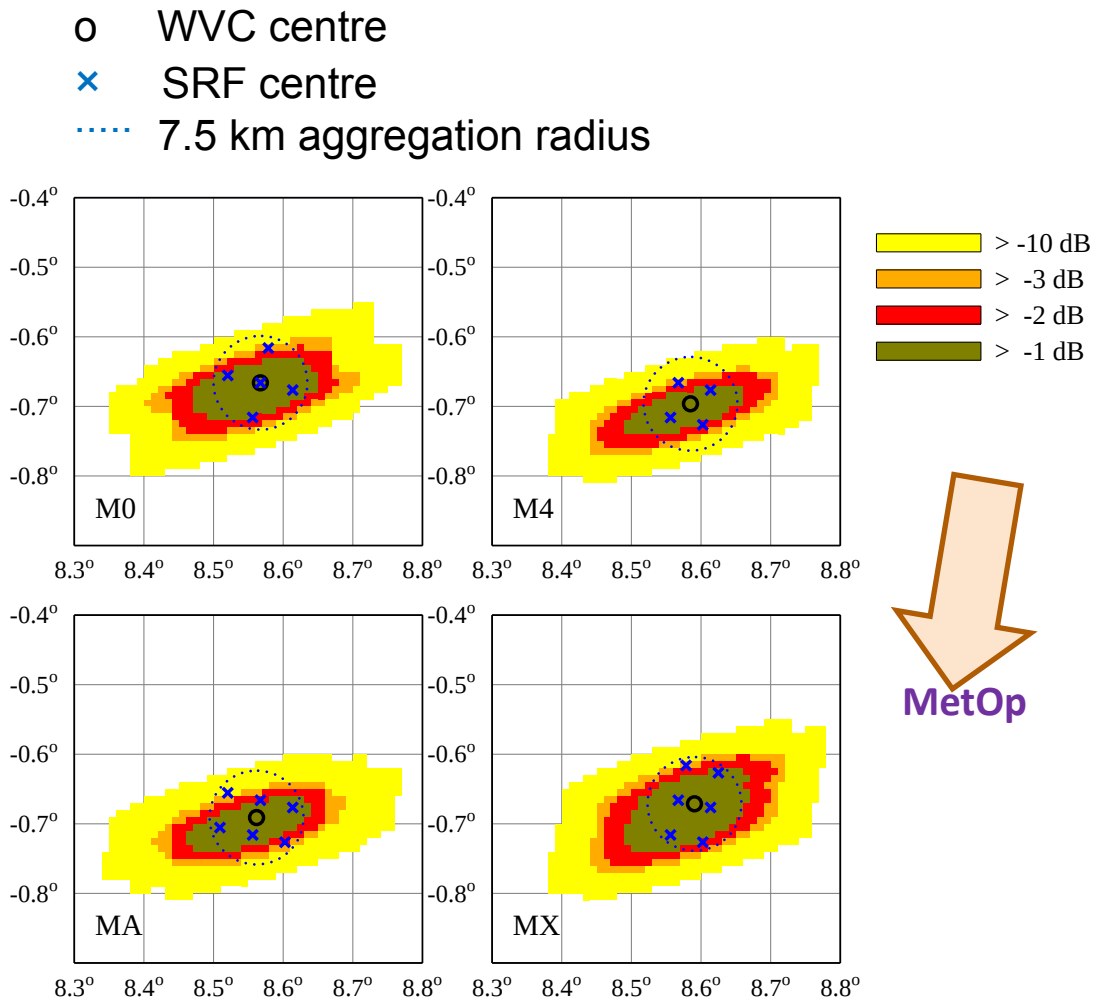
Resolution enhancement – gaps in L1B



Gaps in L1B full res product

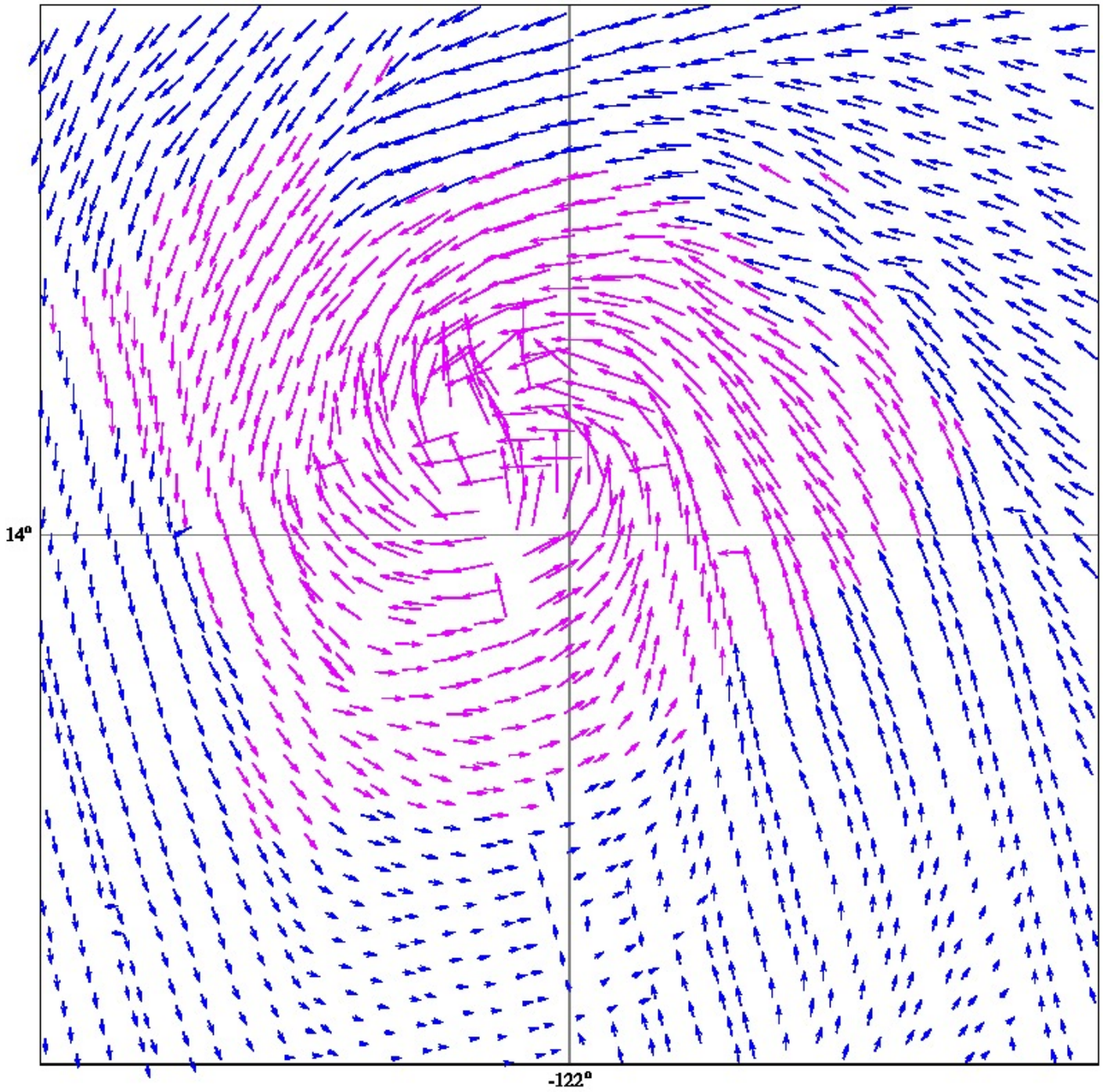
Can be handled by using beam-to-beam time for synchronisation with WVC grid

Grid definition (5.6 km)



CSRF for ASCAT-5.6 WVC 100

- Grid size 5.6 km, 200 WVC's per row
- 4 possible symmetric antenna patterns for lowest incidence WVC
- Choose MX: 6 SRF's and most circular (but MA remains to be investigated)
- Choose symmetric footprint pattern for each WVC → 1MXo (WVC's along row no longer equidistant)



ASCAT-5.6

August 1, 2013

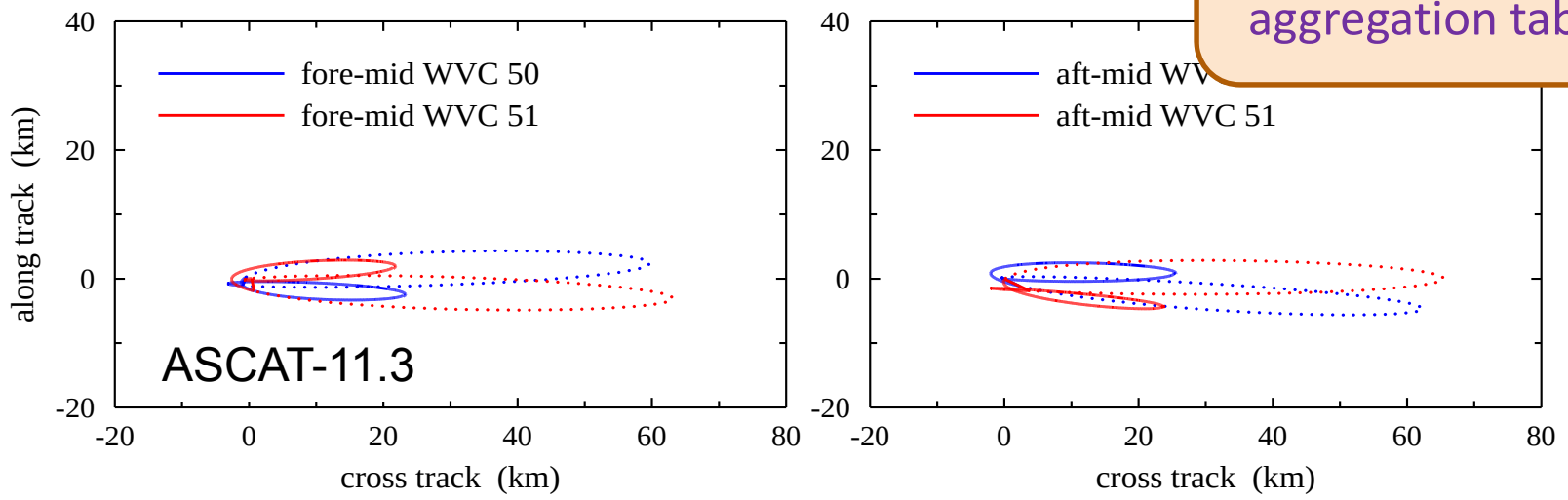
Pacific off
Mexican coast

2° × 2°

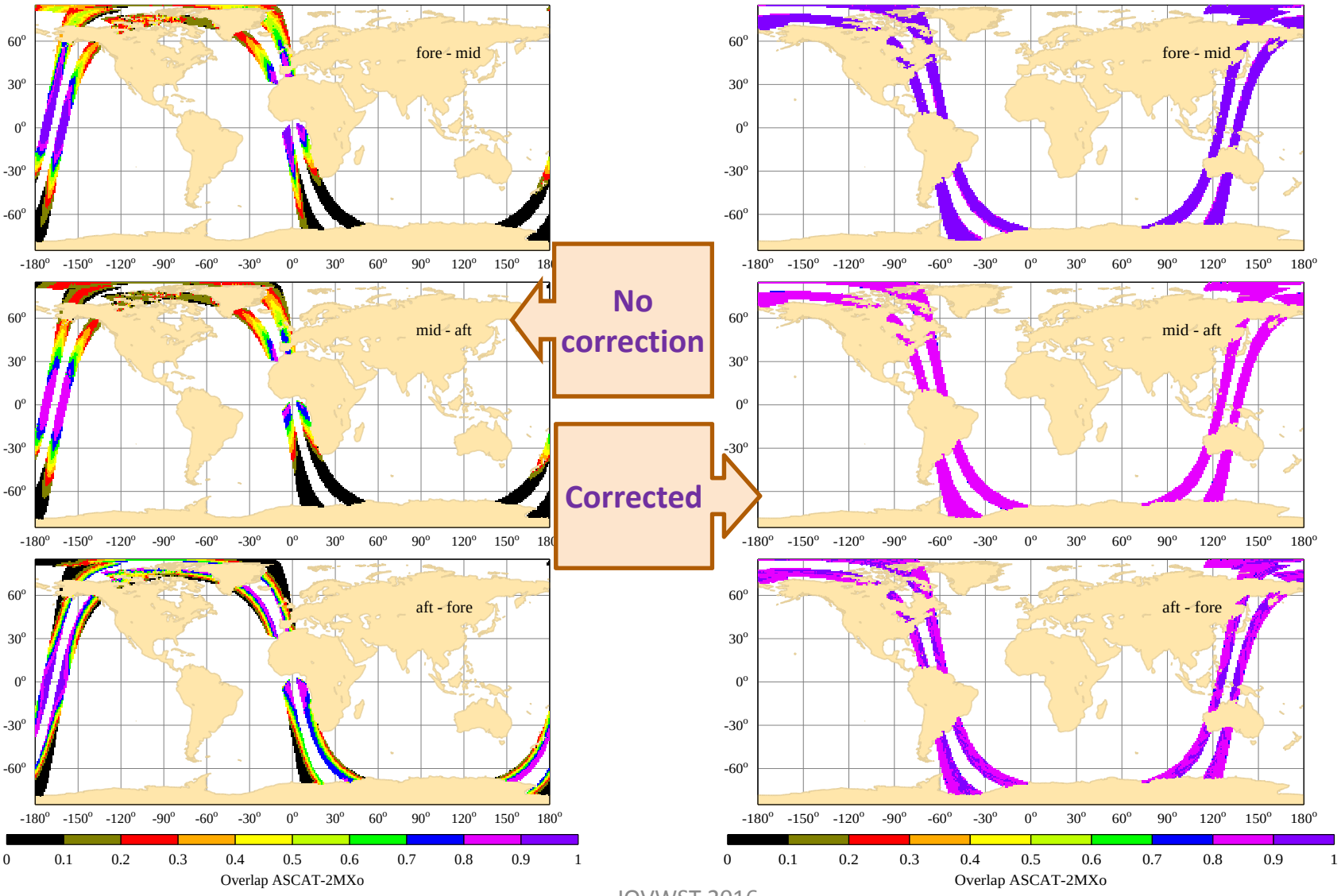
Libration

- To keep the antennas directed towards the Earth, MetOp rotates exactly once per orbit. However, MetOp's orbit is elliptical, so the satellite seems to "wiggle" along its orbit – a.k.a. libration
- Use of aggregation table induces position differences between fore and mid beam (left) and between aft and mid beam (right) for WVC 50 and 51 (ASCAT-11.3, 100 WVC's per row)

Can be corrected for by shifting the aggregation table



Libration (ASCAT-11.3)



Aggregation table editing

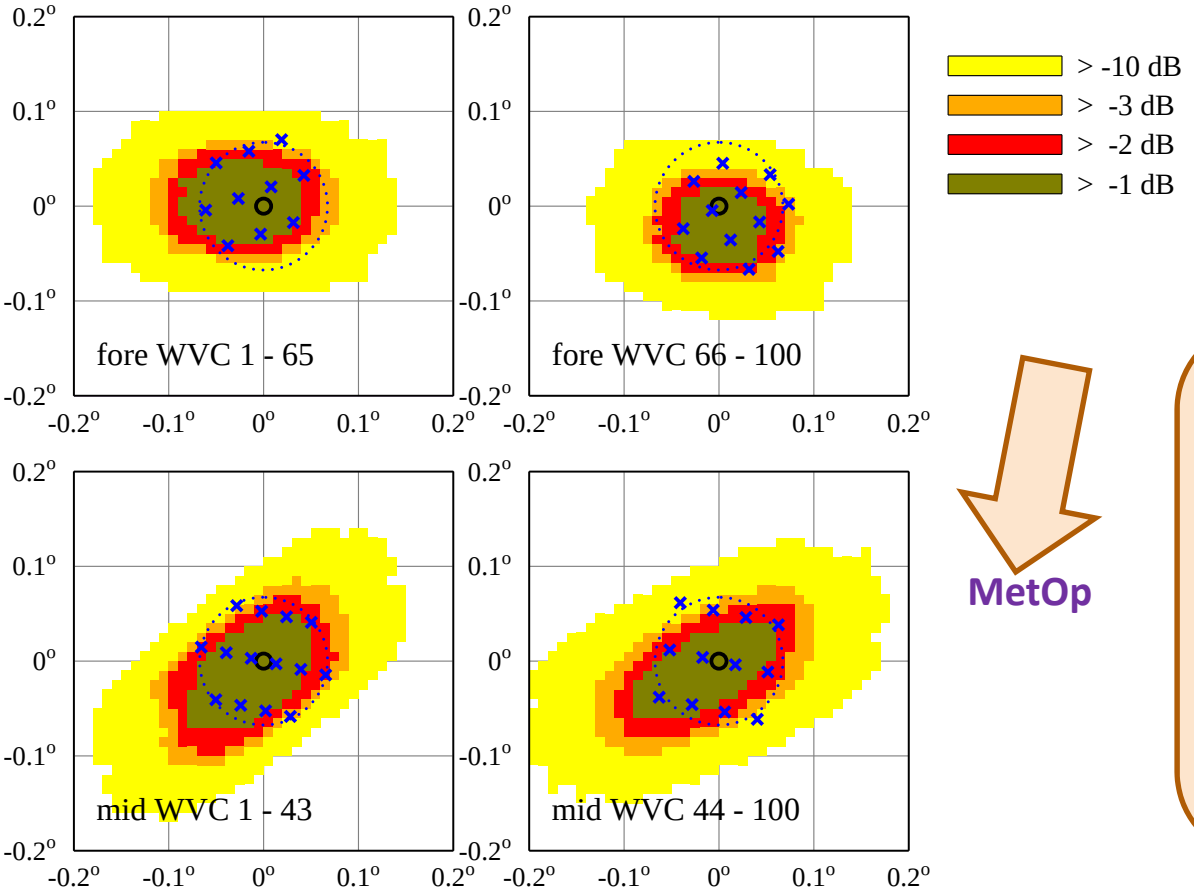
- With the libration correction, the average position of each beam is shifted as close as possible to the preferred WVC position while retaining the aggregation pattern
- The aggregation table thus doesn't need to be very precise!
- Edit aggregation table manually for left fore and left mid beam, and define it symmetrically for the other beams: 1MXo-I&S (improved and symmetrised)

ASCAT 1MXo-I&S aggregation

o Desired WVC centre

× SRF centre

····· 7.5 km aggregation radius



MetOp

Twice as many contributing footprints for mid beam at low incidence but almost the same spatial resolution

Results

- Buoy comparison (2475 collocations)

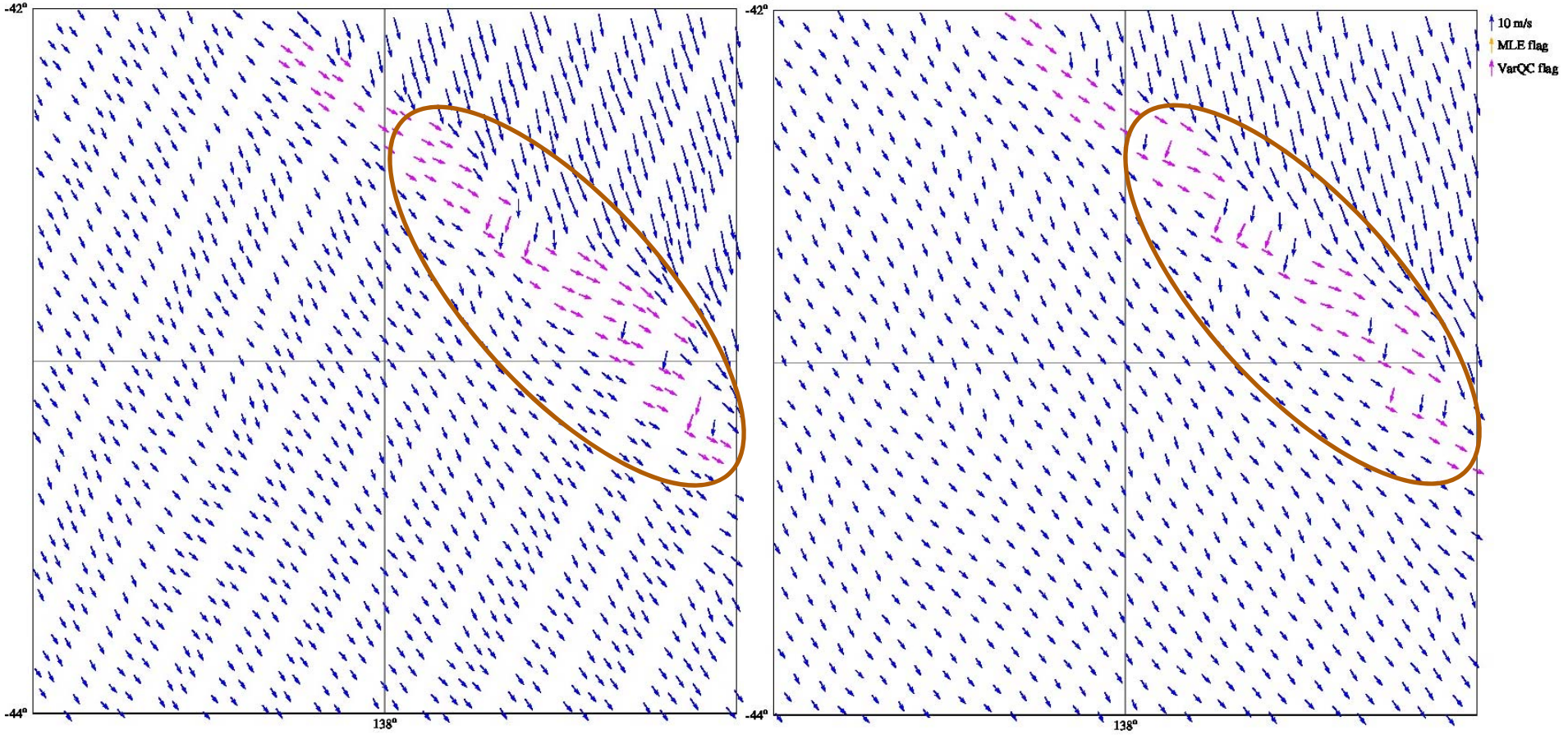
Product	σ_s (m/s)	σ_d (deg)	σ_u (m/s)	σ_v (m/s)
ASCAT-6.25	0.99	17.3	1.48	1.61
ASCAT-1MXo	1.00	17.3	1.46	1.65
ASCAT-1MXo-I&S	0.99	16.8	1.45	1.61
Precision	0.02	0.4	0.03	0.03

- ASCAT-1MXo-I&S compares best
- ASCAT-1MXo-I&S has lower K_p and smaller average cone-distance than ASCAT-6.25 and ASCAT-1MXo (no results shown)

Results

ASCAT-5.6 (1MXo-I&S)

ASCAT-6.25

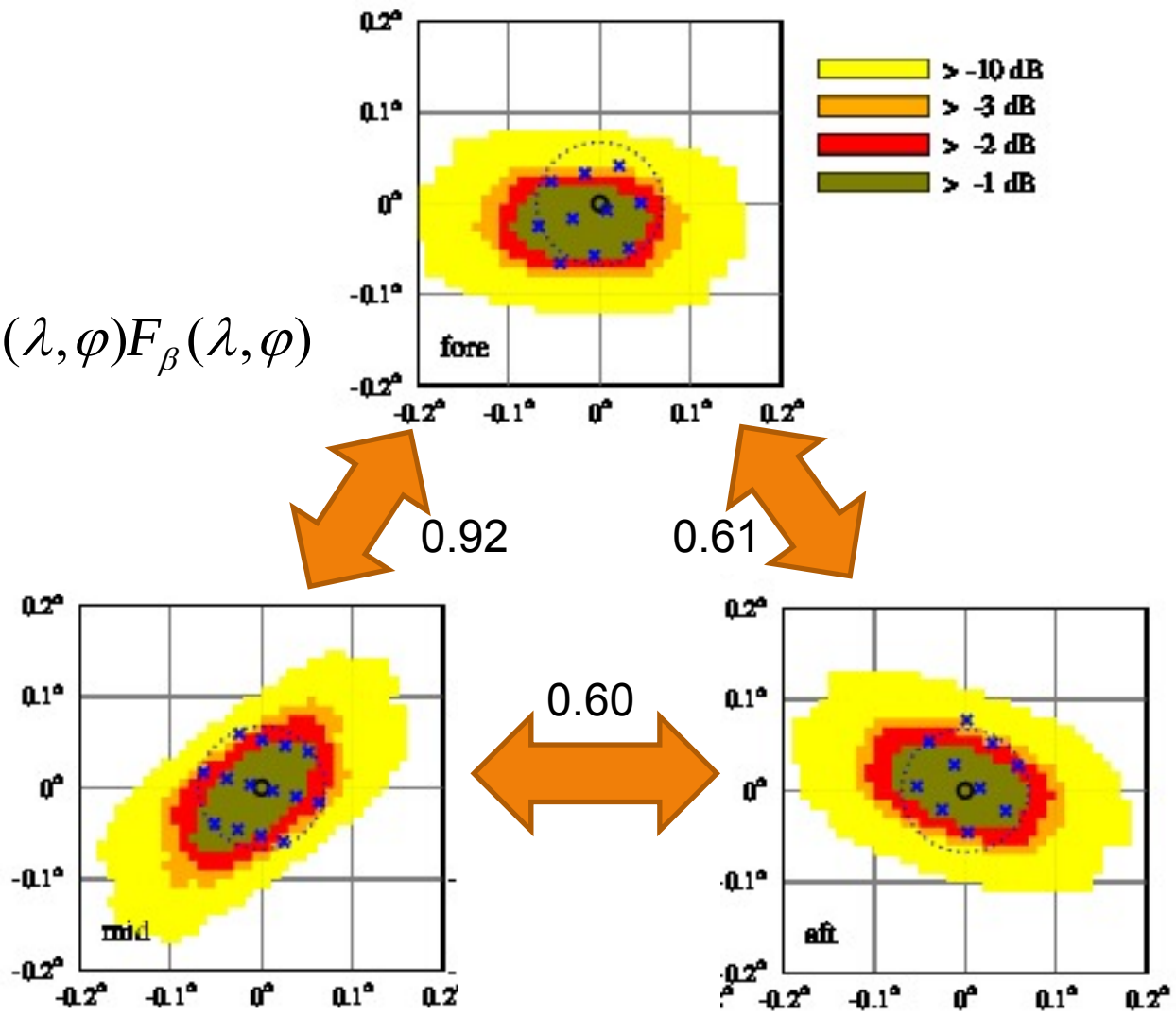


Less AR errors in frontal region for ASCAT-5.6 ?

Results - overlap

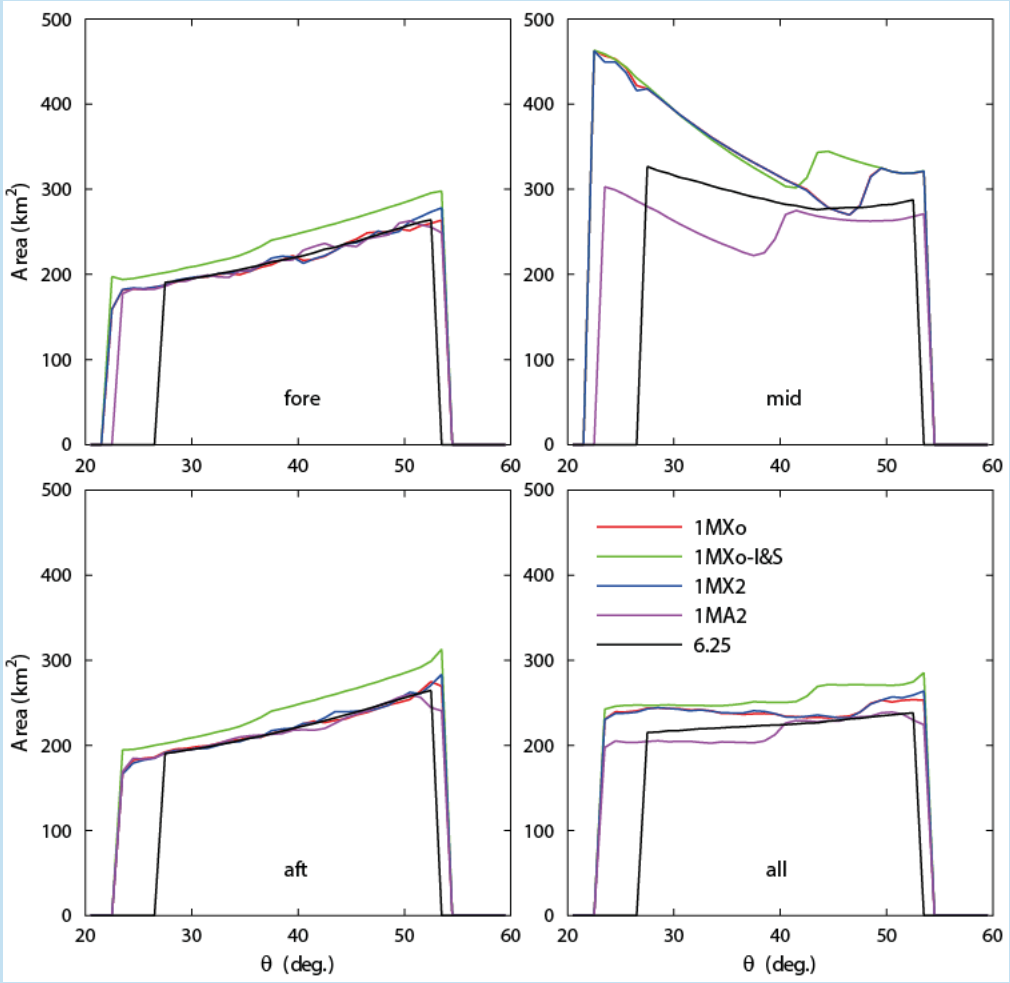
$$O = \frac{I_{\alpha\beta}^2}{I_{\alpha\alpha} I_{\beta\beta}}$$

$$I_{\alpha\beta} = \iint d\lambda d\varphi \cos\varphi F_\alpha(\lambda,\varphi) F_\beta(\lambda,\varphi)$$



Resolution

- Individual accumulated fore, aft and mid beam areas do not exactly overlap
- Common area defines resolution (all)
- “Uncommon” area presents noise due to wind variability
- Resolution is rather constant over swath



Conclusions

- It is possible to improve on current operational ASCAT products by exploiting the full resolution L1B product
- Pro's:
  - better σ^0 statistics and better buoy comparison
  - fast aggregation algorithm
- Con's:
  - WVC grid no longer equidistant
- ASCAT-1MXo-I&S as example, but other grid definitions still to be investigated (for instance, grid size continuously decreasing with increasing incidence angle)
- Spatial resolution $\sim$ 15 km seems lower limit due to asymmetric shape of single SRF and balance between resolution and sampling
- Deconvolution techniques may work well for isotropic/stable targets

Results - overlap