KaRIN geometry and the nine SAR beams

G.Dibarboure, R.Morrow, N.Steunou, N.Picot, R.Fjortoft, F.Soulat, P.Dubois, S.Gille, T.Farrar, w/ inputs from E.Peral
July 2015
Azimuth SAR processing: 9 beams shifted in along-track direction

- The SWOT/OBP SAR processing results in a nine-beam fan spread in the azimuth (along-track) direction.
- The nine beams will have different signal-to-noise ratios.
OBP output: 1 x 1 km pixels x 9 beams

- The 1 km onboard product is built by averaging a large number of 250m pixels.
- In practice, the azimuth averaging uses a larger window (~2km) with Blackman-Harris weights that yield the same number of looks.
One measurement time = 9 beams

9 overlapping beams with 1 x 1 km for each pixel
Aligned in azimuth direction (along-track)
Approx 200 m translation between subsequent beams (from -800m to 800m)
Native instrument angles

Azimuth
Along-track

Range
Across-track

Also aligned in range / cross-track direction (no overlap between adjoining pixels)
Measurement time $t-1$
Measurement time $t$
Measurement time $t+1$
Measurements for beam combination

- Measurement directionality:
  - Along-track: 9 pixels with overlaps
  - Across-track: 1-km posting, no overlap
- Beam combination must project KaRIN pixels on product grid
Alternative OBP geometry:
1 km resolution and posting
500 m resolution and 250 m posting
1km

Central beam (1x1km)

Beam -4 (1x1km)  Beam +4 (1x1km)

~4x200m  ~4x200m

Satellite flight direction (azimuth)

200m translation between 1x1km pixels x 9 beams

~2.6 km

250m

Central beam (500m)$^2$

Beam -4 (500m)$^2$  Beam +4 (500m)$^2$

~4x200m  ~4x200m

Satellite flight direction (azimuth)

200m translation between 500m pixels x 9 beams

~2.1km

~500m
Azimuth Along-track
Cross-track (range)

1km

Aligned in range / cross-track direction (no overlap between 1 km pixels)

250m

Aligned in range / cross-track direction (250m overlap between 500m pixels)

Satellite flight direction (azimuth)

Cross-track direction (range)
9 beams with 200 m offset each in azimuth
Subsequent measurements translated by 250 m overlap
9 beams with 200 m offset each in azimuth
Subsequent measurements translated by 250 m overlap
Measurement directionality

Along-track:
- 200 m between 9 beams of one measurement time
- 250 m overlap between 500 m pixels of subsequent measurement times

Across-track: 250 m overlap of 500 m pixels
Points to note

- Nine versions of the data will be downlinked at the OBP posting/resolution
- The nine beams will have different signal-to-noise ratios
- The algorithm for beam combination is not yet mature, and will be influenced by:
  - the ‘geographical-vs-spacecraft’ grid issue (tomorrow’s splinter)
  - the 250m-vs-1km posting question
backups
• The 1 km onboard product is built by averaging 76 looks of 250m each (13 m between subsequent looks)
• In practice, the azimuth averaging uses a larger window (~2km) with Blackman-Harris weights that yield the same number of looks

1km

250m

• The 500 m onboard product is built by averaging 19 (tbc) looks of 250m (13 m between subsequent looks)
• In practice, the azimuth averaging uses a larger window (tbc) with Blackman-Harris weights that yield the same number of looks
Azimuth SAR processing

Onboard processor azimuth antenna pattern (from ATBD):

Satellite flight direction (azimuth)

Beam -4  Beam -1  Central beam  Beam +1  Beam +4

~230m  ~200m  ~200m  ~230m
Beam alignment in practice

Misalignment is small (~10m) and only for near-range pixels (less than 7 km, i.e. margins)