AMSR2 L1R Product

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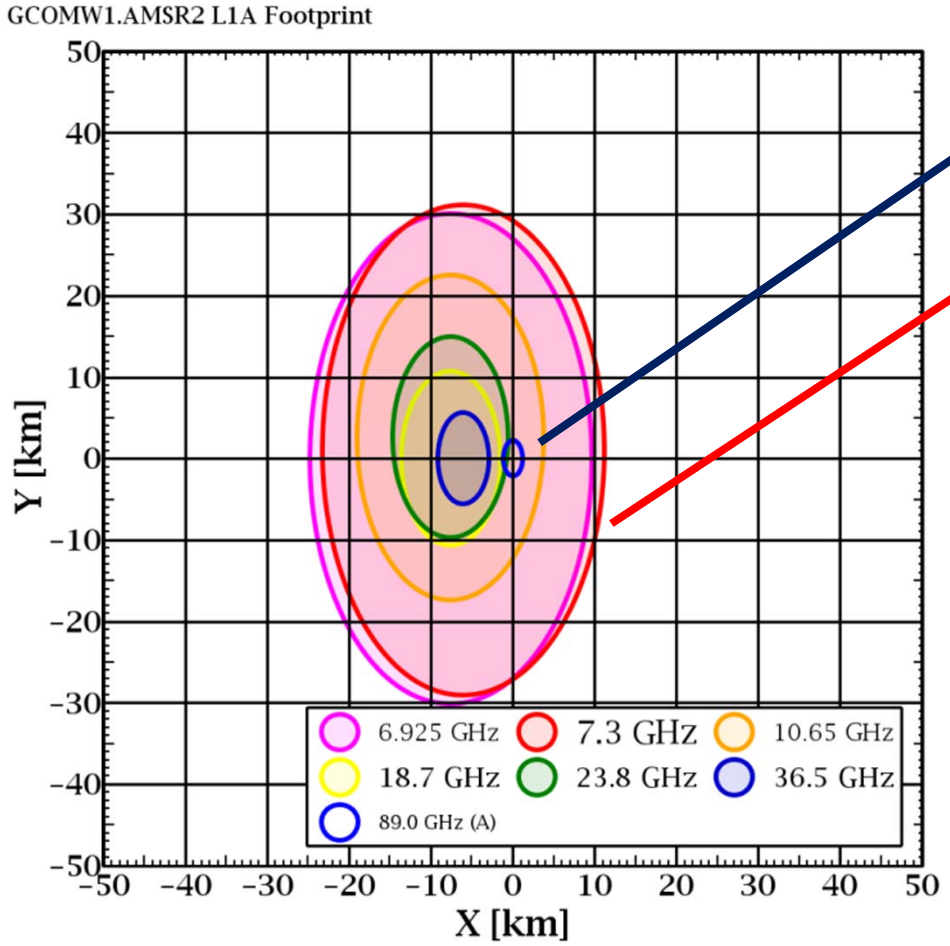
Difference of an observation area (footprint) at the same pixel number



e. g.)
250 K @ 89 GHz

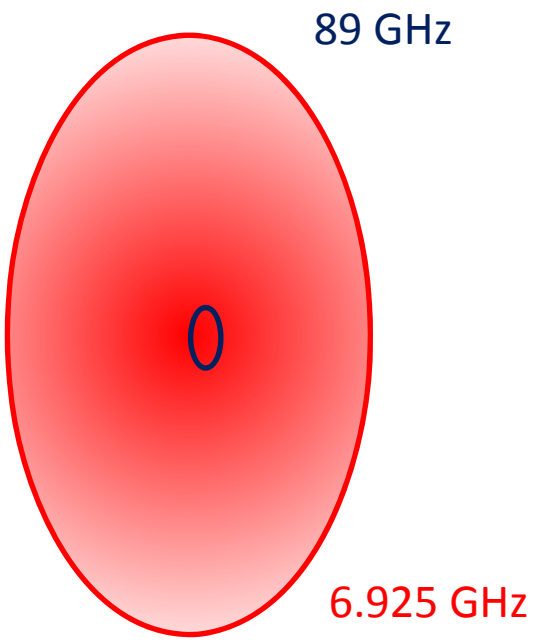
200 K @ 6.925 GHz

Can we treat them as the data from the same location? **No!**

To use the data with different footprints equivalently...

- Synthesis of the data in appropriate coefficients.

Small footprints (antenna pattern) are collected and synthesized, then **large** foot print (antenna pattern) is duplicated from them **at any position**.

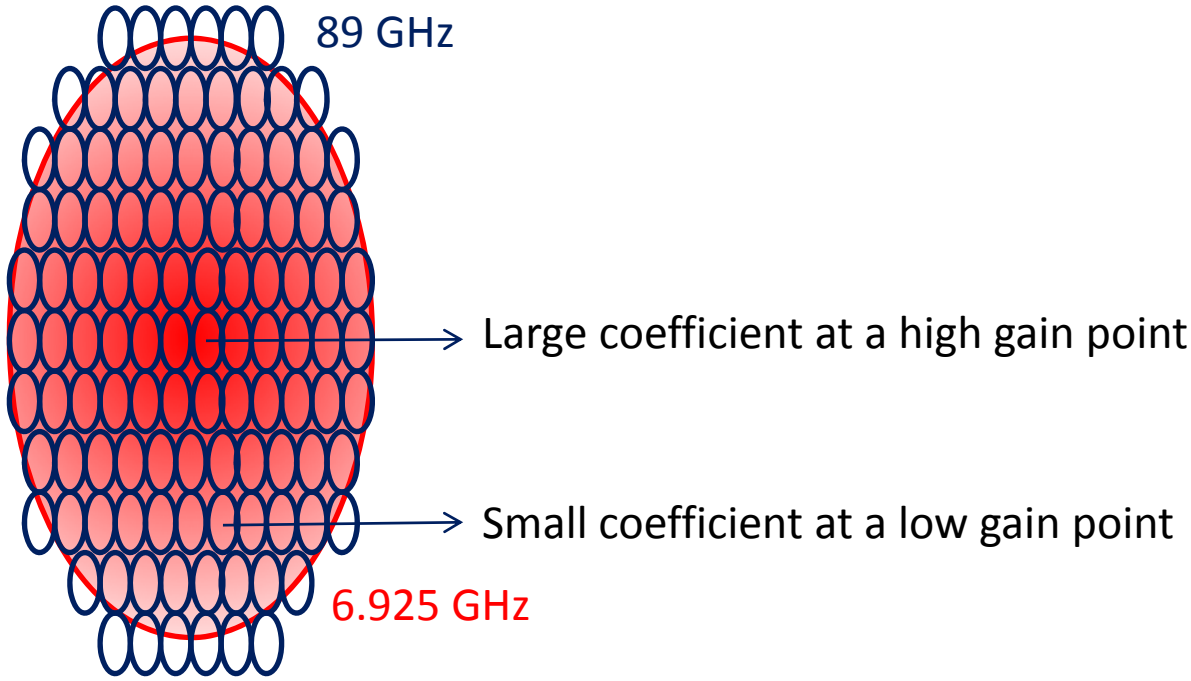


L1B

To use the data with different footprints equivalently...

- Synthesis of the data in appropriate coefficients.

Small footprints (antenna pattern) are collected and synthesized, then **large** foot print (antenna pattern) is duplicated from them **at any position**.



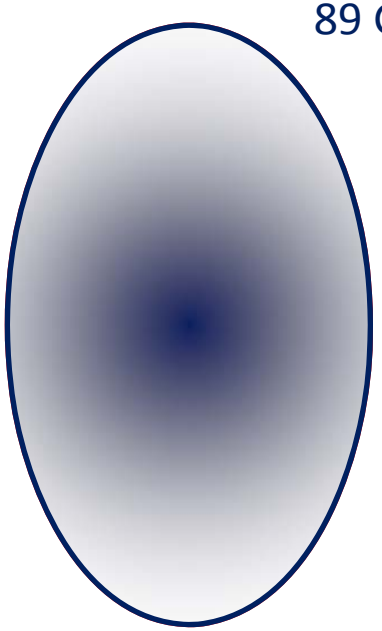
L1B

To use the data with different footprints equivalently...

- Synthesis of the data in appropriate coefficients.

Small footprints (antenna pattern) are collected and synthesized, then **large** foot print (antenna pattern) is duplicated from them **at any position**.

89 GHz



Virtual Tb of 89 GHz observed by the antenna pattern of 6.9 GHz.

L1R

Tb data stored in L1R product

Criteria:

Small footprints (antenna pattern) are collected and synthesized, then **large** foot print (antenna pattern) is duplicated from them at the geolocations of 89 GHz (A).

TARGET ANTENNA PATTERN

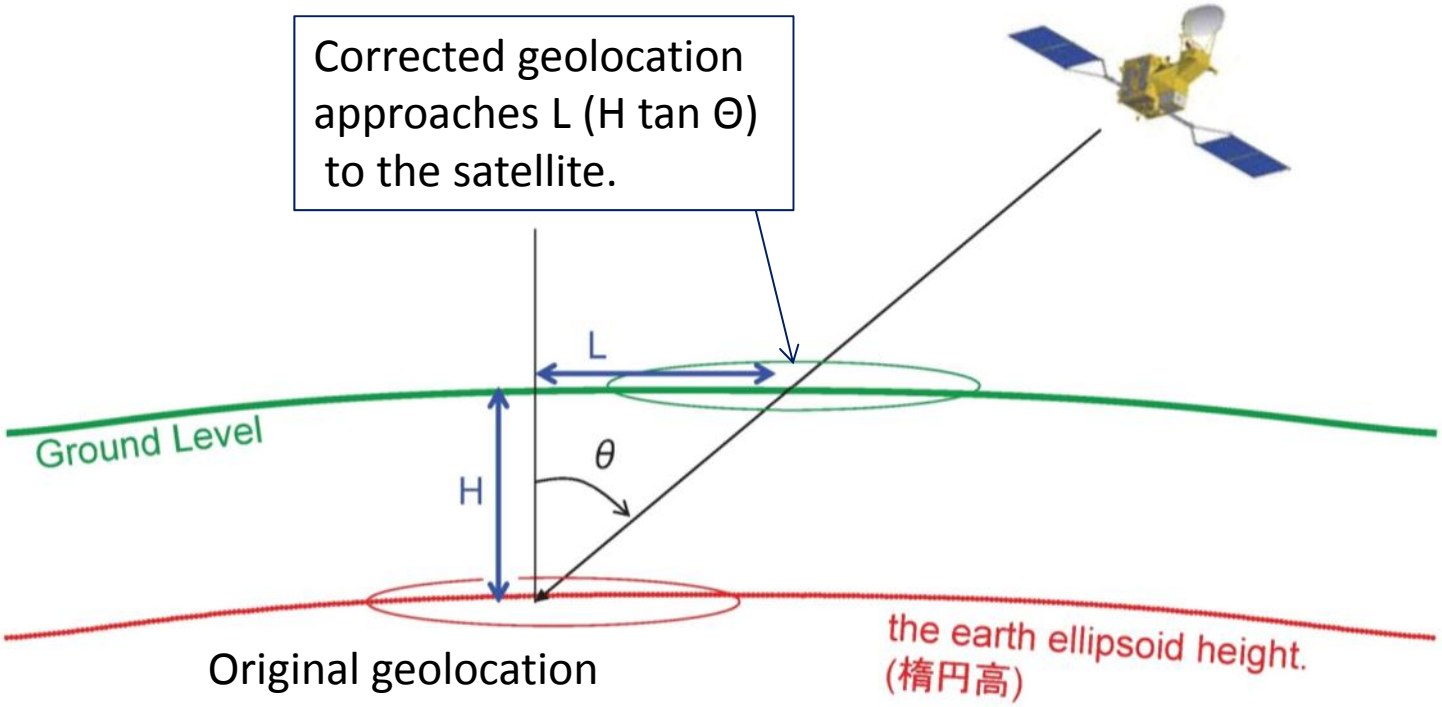
SOURCE ANT. PATTERN	6.925 GHz	10.65 GHz	23.8 GHz	36.5 GHz
6.925 GHz	O			
7.3 GHz	O			
10.65 GHz	O	O		
18.7 GHz	O	O	O	
23.8 GHz	O	O	O	
36.5 GHz	O	O	O	O
89 GHz	O	O	O	O

* O : Because the footprint sizes of source and target antenna patterns are same, these are operations to move the geolocations of the source antenna patterns to those of 89 GHz (A).

* The antenna pattern of 18.7 GHz does not become a target because its size is almost the same as that of 23.8 GHz.

Additional processing : altitude correction

A geolocation finally stored in L1R is corrected using the altitude at it.



Accordingly, the geolocations of 89 GHz (A) and (B) in L1R differ from those in L1B in land areas.

Theoretical background : Backus-Gilbert Method

G_i (i = 1 ... p) : the antenna patterns of f_1 GHz

↓

F : the antenna pattern of f_2 GHz

Coefficients a_i are calculated as

$$\mathbf{a} = \mathbf{V}^{-1}\left[\mathbf{v} + \left(\frac{1 - \mathbf{u}^{\mathrm{T}}\mathbf{V}^{-1}\mathbf{v}}{\mathbf{u}^{\mathrm{T}}\mathbf{V}^{-1}\mathbf{u}}\right)\mathbf{u}\right]$$

$$\mathbf{V} = \mathbf{G} + \kappa\mathbf{I}$$

κ : parameter to control the quality of synthesis (0 ~ ∞)

$$u_i = \iint_A G_i(\rho)\,dA$$ — volume of G_i

$$v_i = \iint_A G_i(\rho)F(\rho)\,dA$$ — crossover's volume of G_i and F

$$G_{ij} = \iint_A G_i(\rho)G_j(\rho)\,dA$$ — crossover's volume of G_i and G_j

κ is always set to 0.0001 with reference to AMSR-E L2A product right now.

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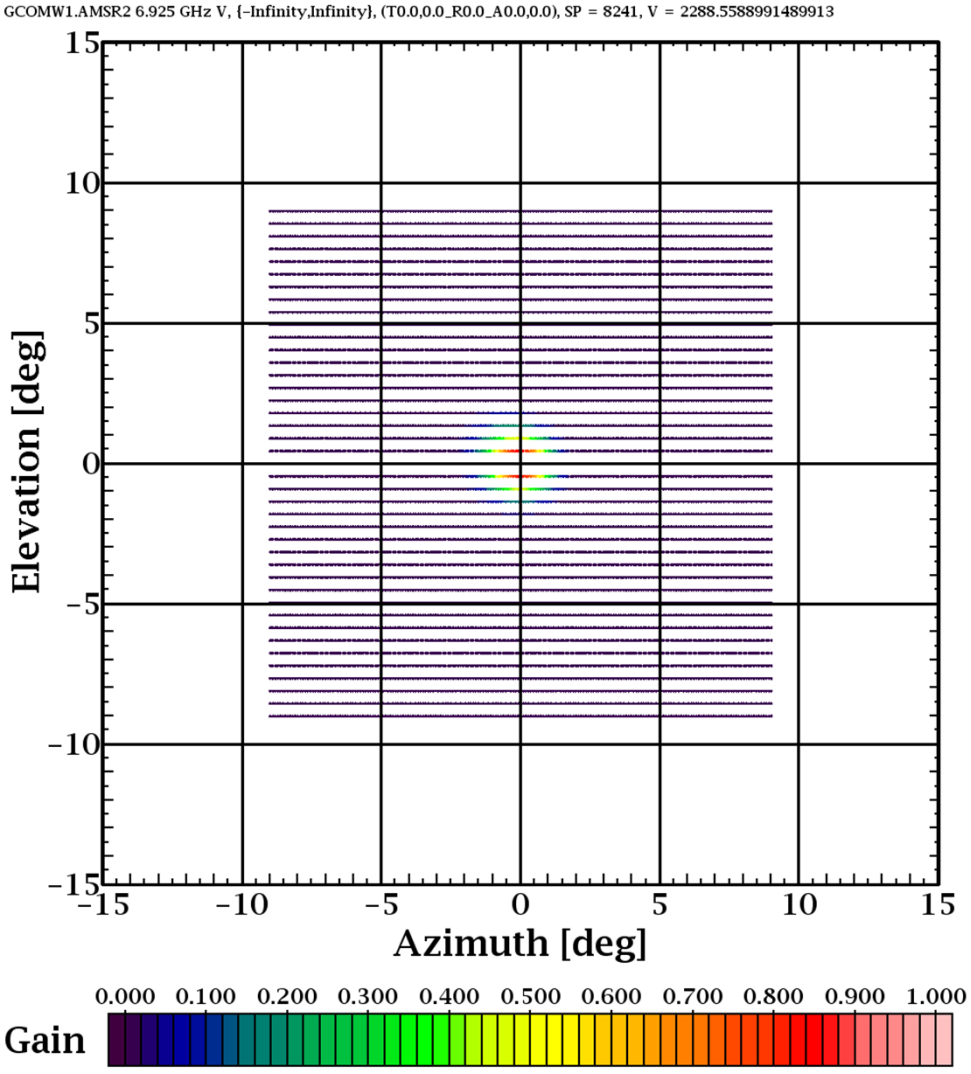
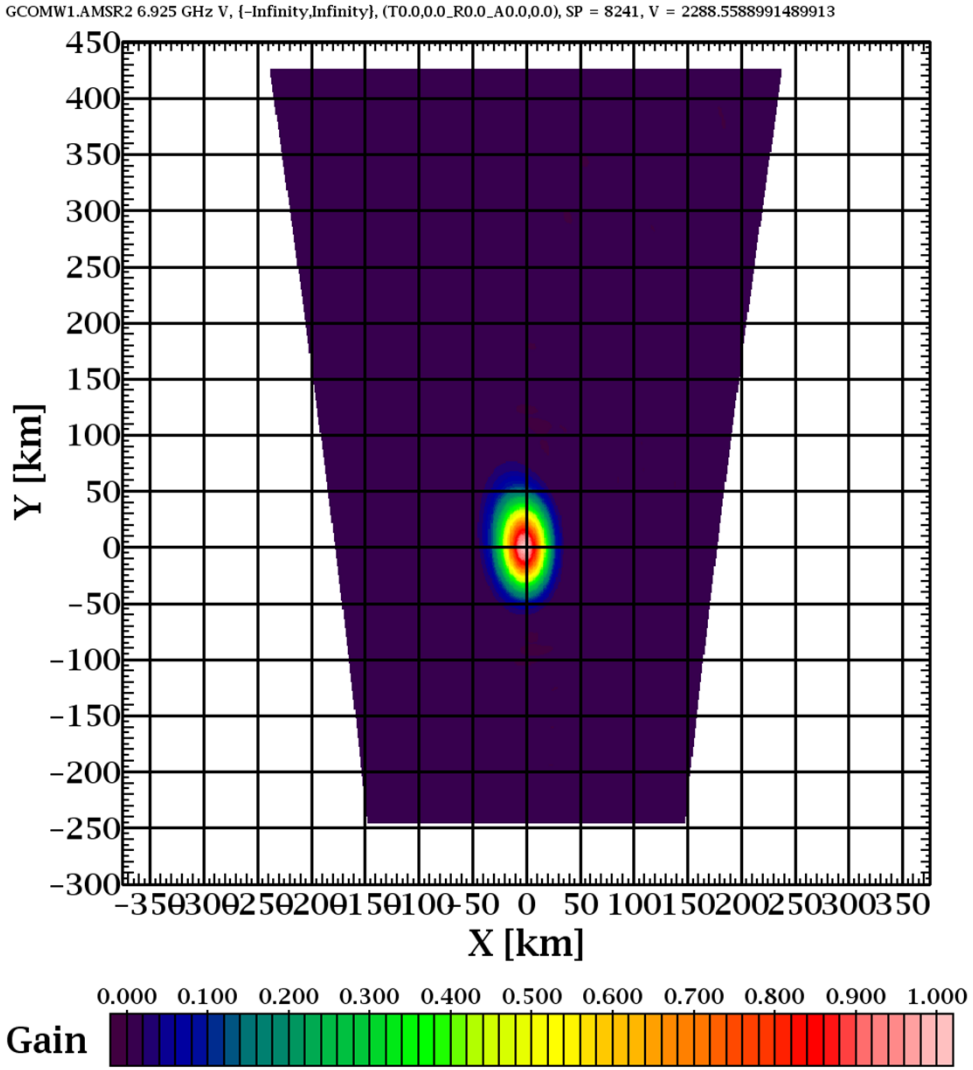
Antenna pattern used in L1R processing (e.g., 6.925 GHz V)

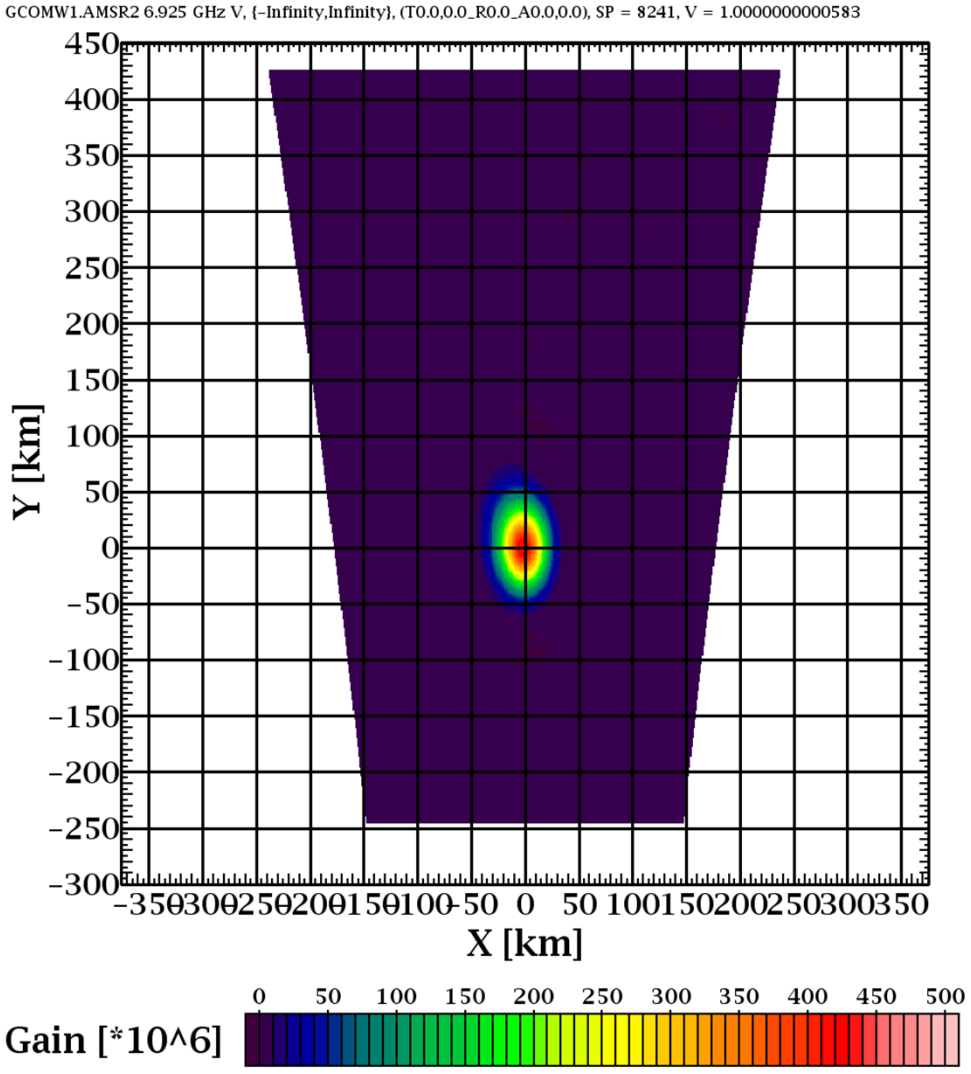


Ant. pattern measured at a ground test (8241 sampling points)

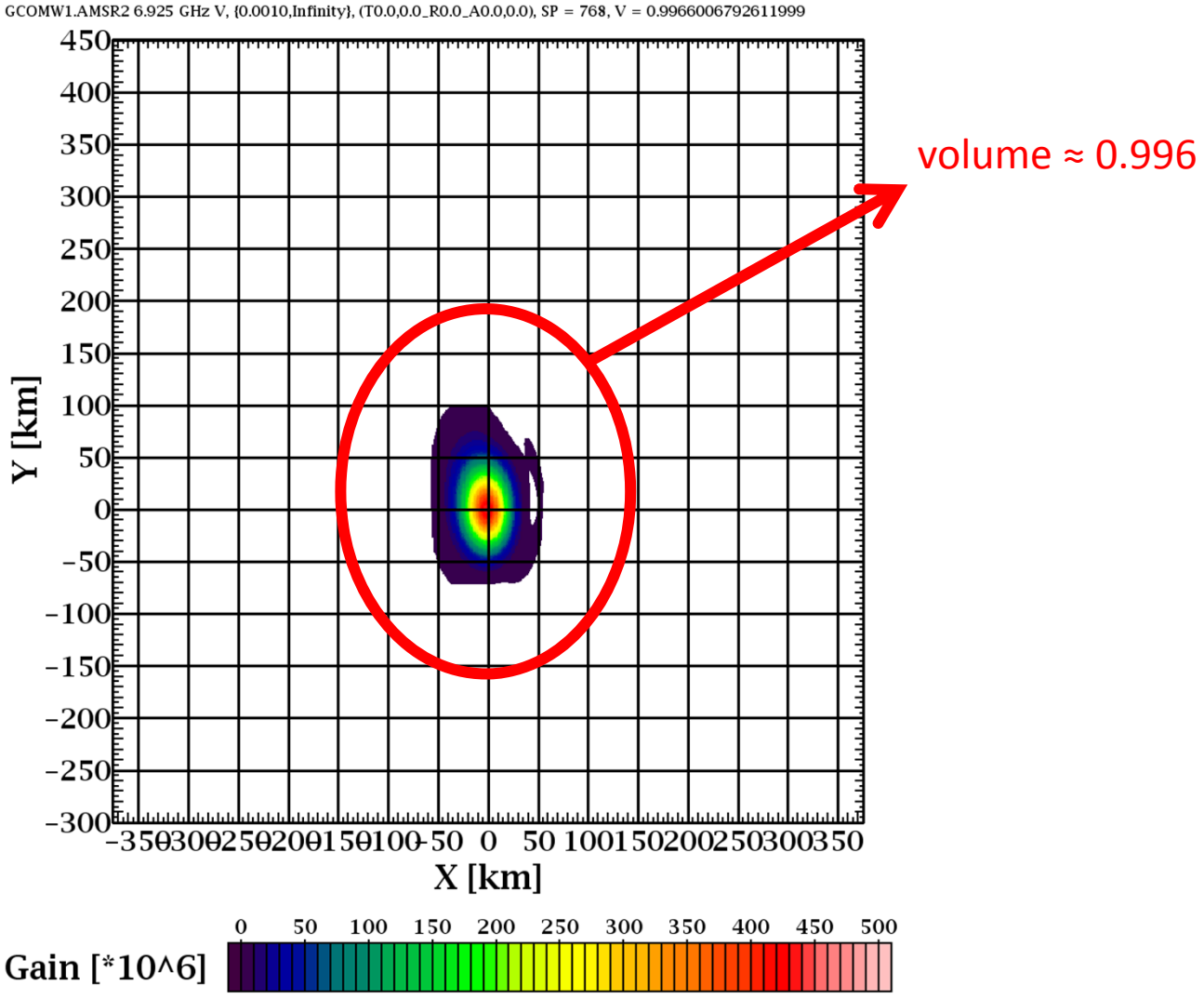
Projection to the ground from the nominal altitude of AMSR2 (700 km)



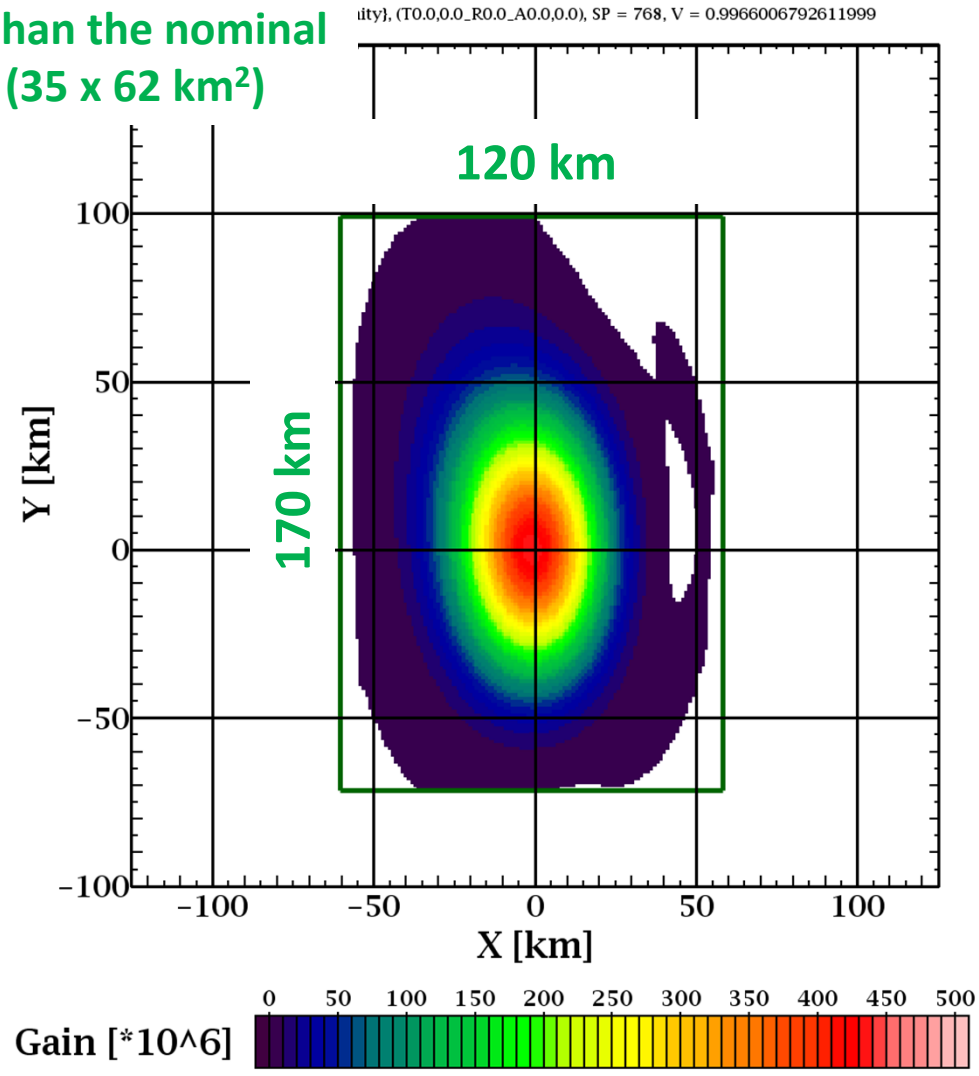
Normalization of volume to 1.0 for BG Method



Cutoff under **-30 dB** (0.1%) of the highest gain



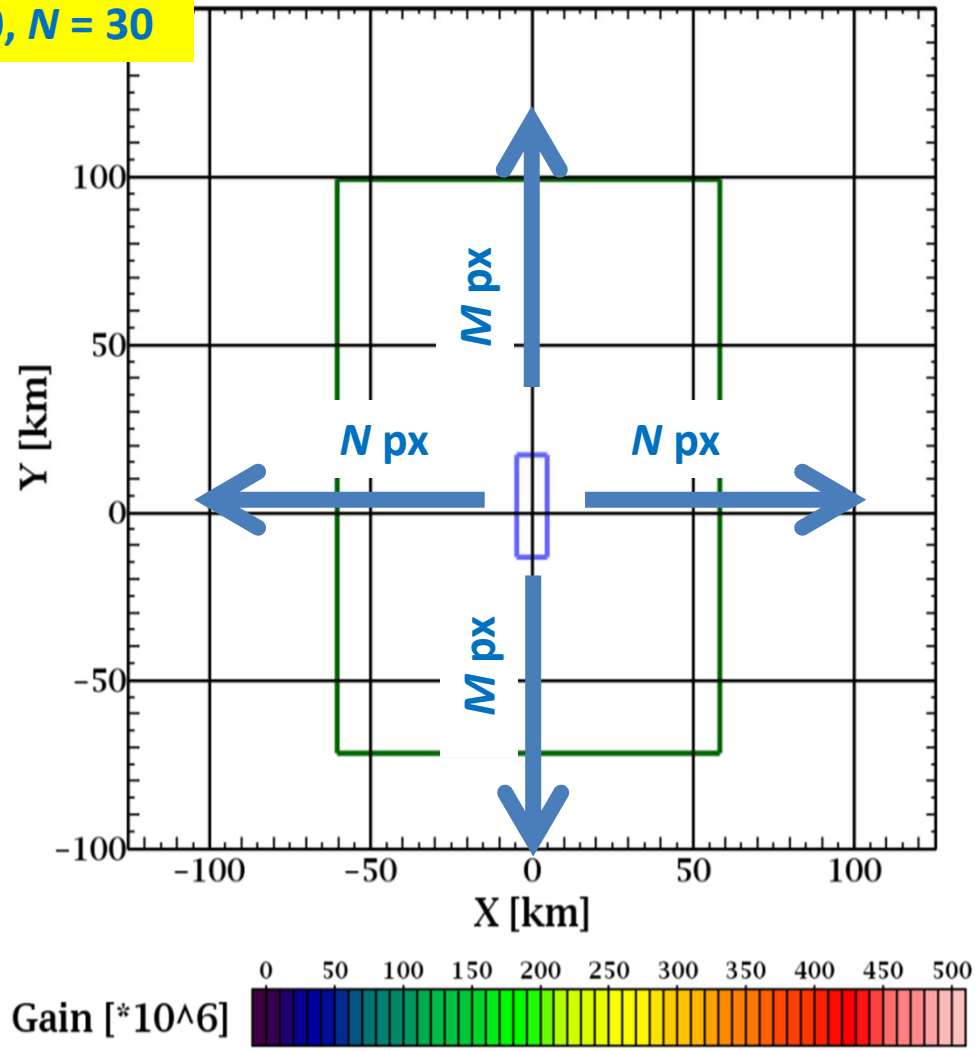
9 times broader than the nominal foot print size (35 x 62 km^2)



Other antenna patterns are created along the same criteria.

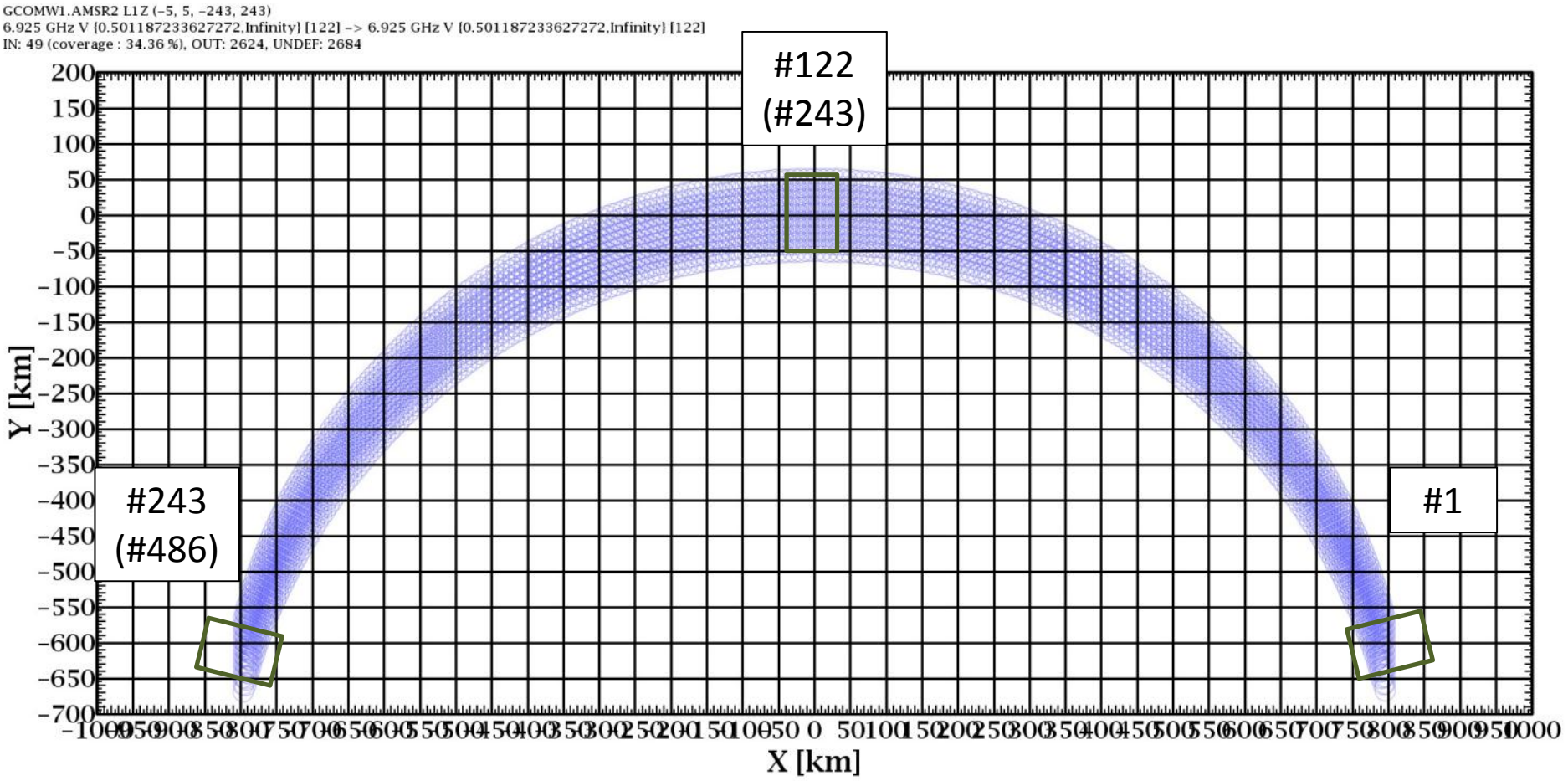
Synthesis of antenna pattern (e.g., 89 GHz V → 6.925 GHz V)

Always *M* = 30, *N* = 30



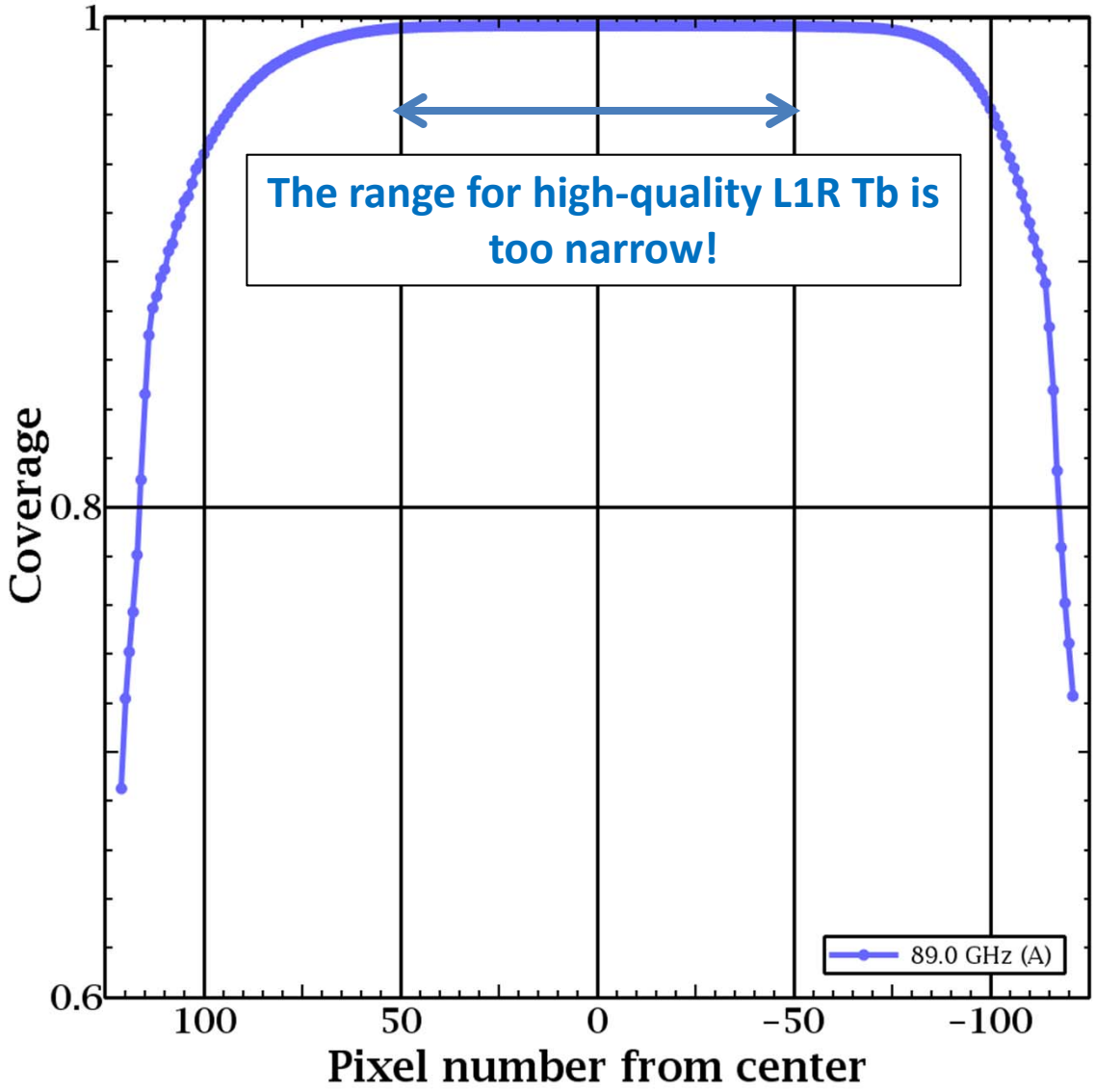
A large antenna pattern is always synthesized from 3721 (61 x 61) small antenna patterns.

However, considering the antenna pattern alignment in a swath, ...

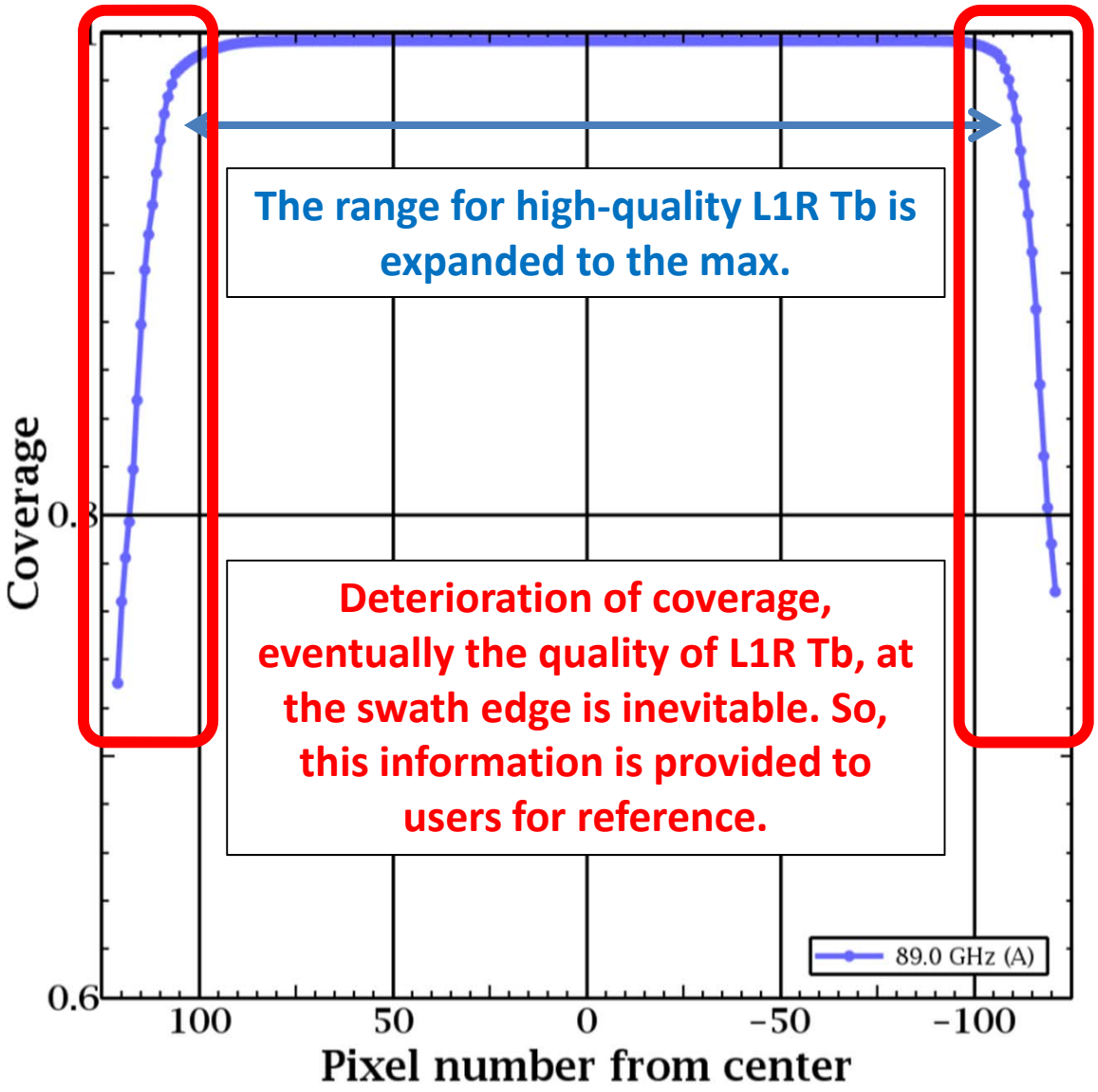


the number of small antenna patterns required to completely cover a large antenna pattern varies depending on the position in a swath.

If M = 15 and N = 15, ... (cf. M = 14, N = 14 for AMSR-E L2A)

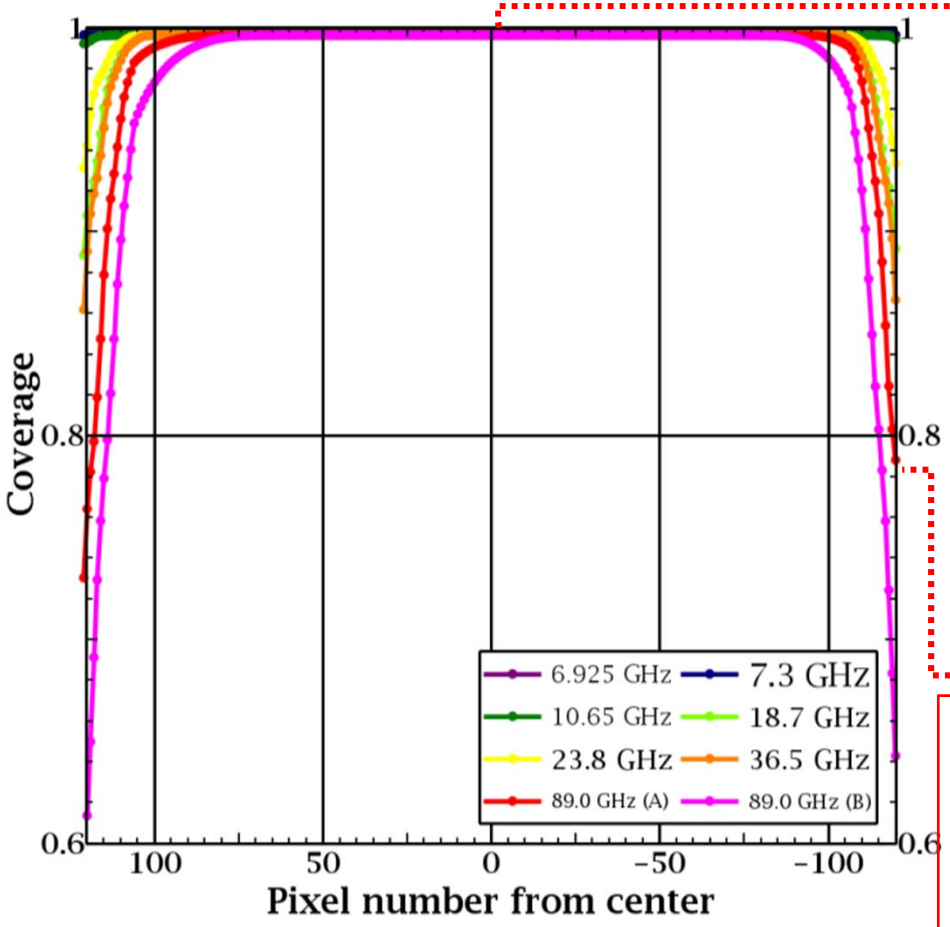


Therefore, *M* = 30 and *N* = 30, then ...

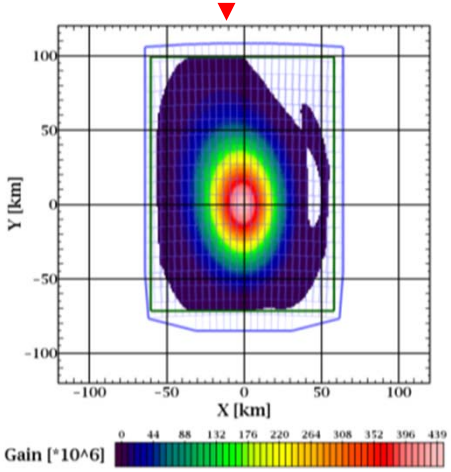


(Ref.) Coverage to synthesize ...

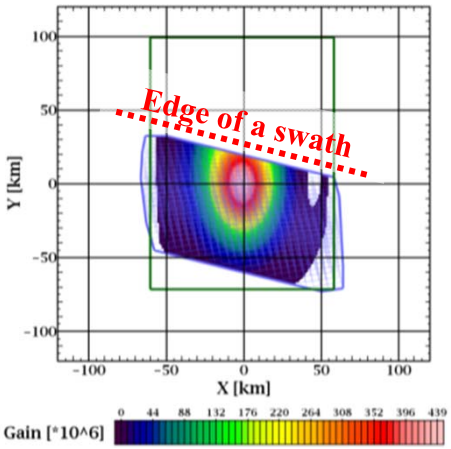
ex.) source : 89.0 GHz (A), target: 6.925 GHz



antenna pattern of 6.925 GHz V



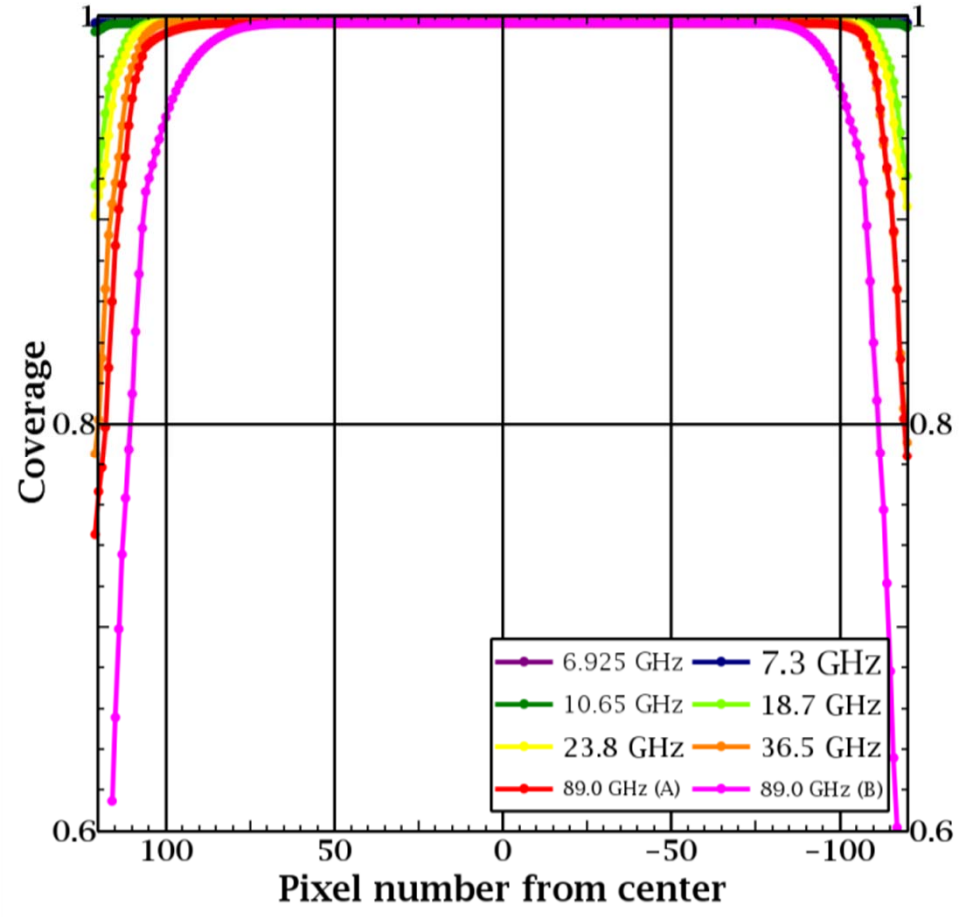
coverage : 100%
at the pixel in the center of a swath



coverage : 77.12%
at the pixel in the edge of a swath

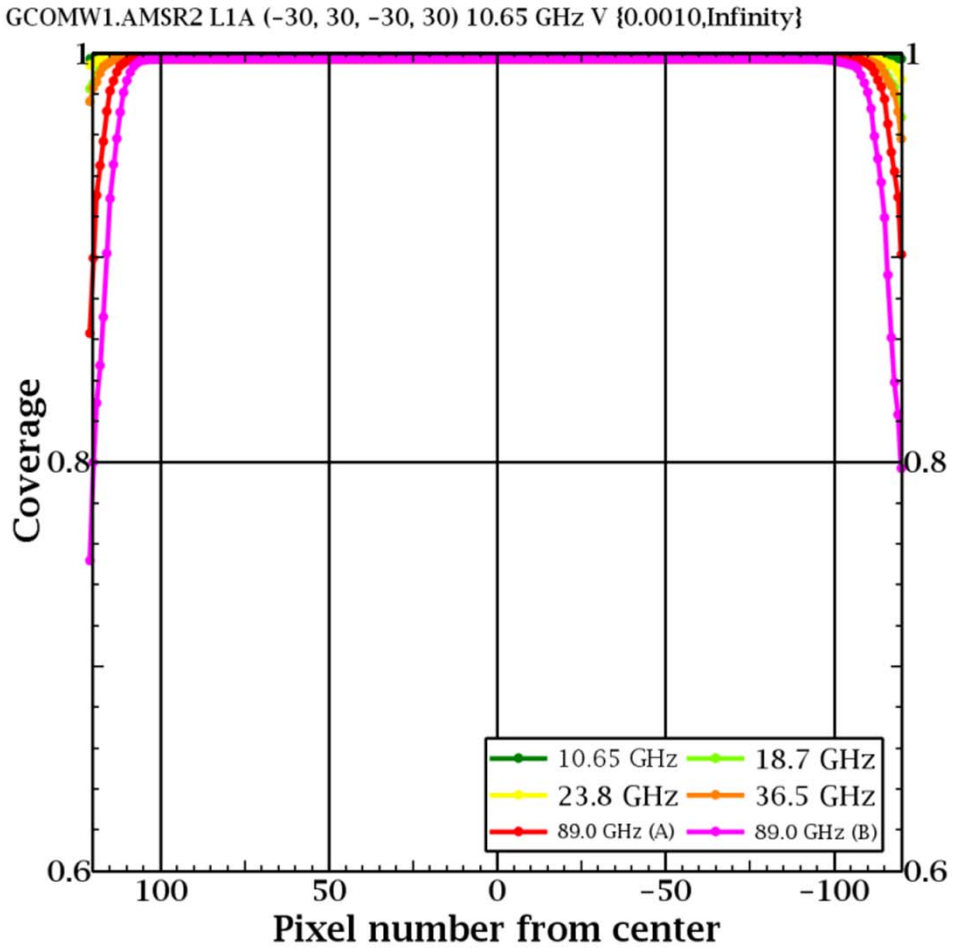
If the coverage of source antenna patterns (*S*) for the target antenna pattern (*T*) is 100%, *T* can be completely synthesized by *S*. However, as the pixel number goes to the edge of a swath, *T* cannot be completely covered with *S* because no pixels exist beyond the edge of the swath. Accordingly, a resampling filter as *T* is completely synthesized by *S* cannot be obtained in such cases, so that the quality of resampled brightness temperatures calculated by such filters deteriorates.

(Ref.) Coverage to synthesize ...

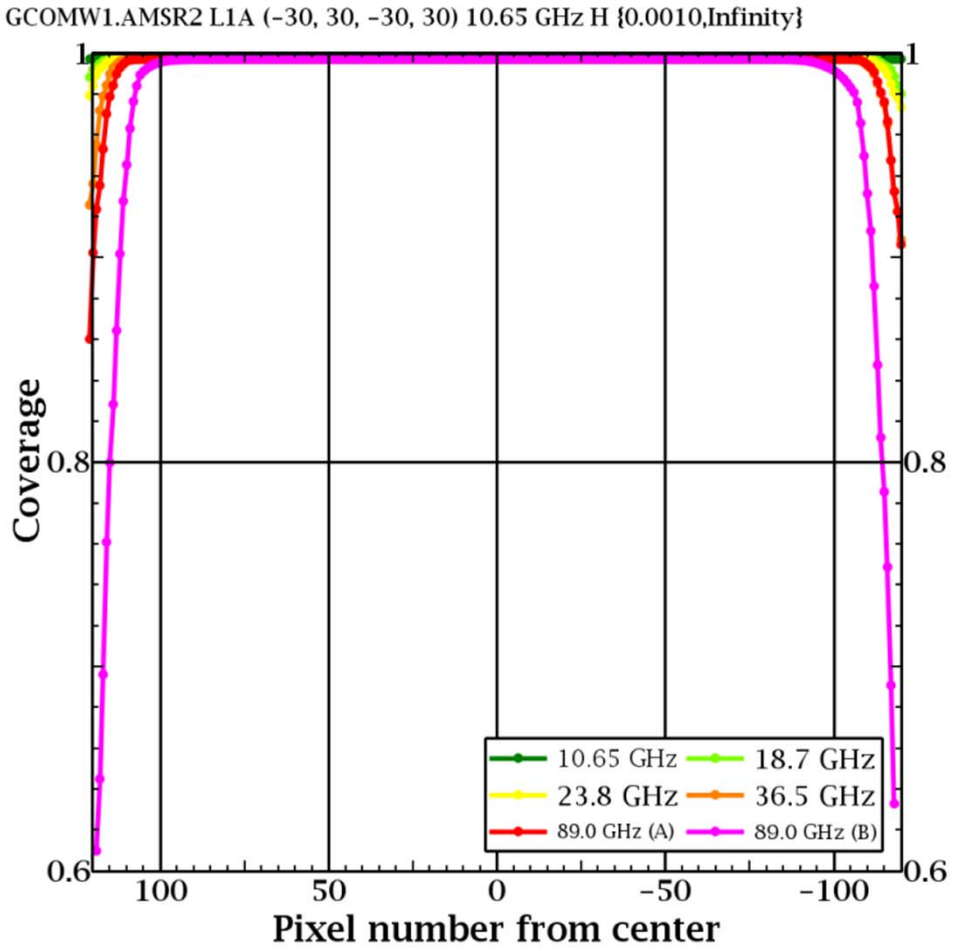


antenna pattern of 6.925 GHz H

(Ref.) Coverage to synthesize ...

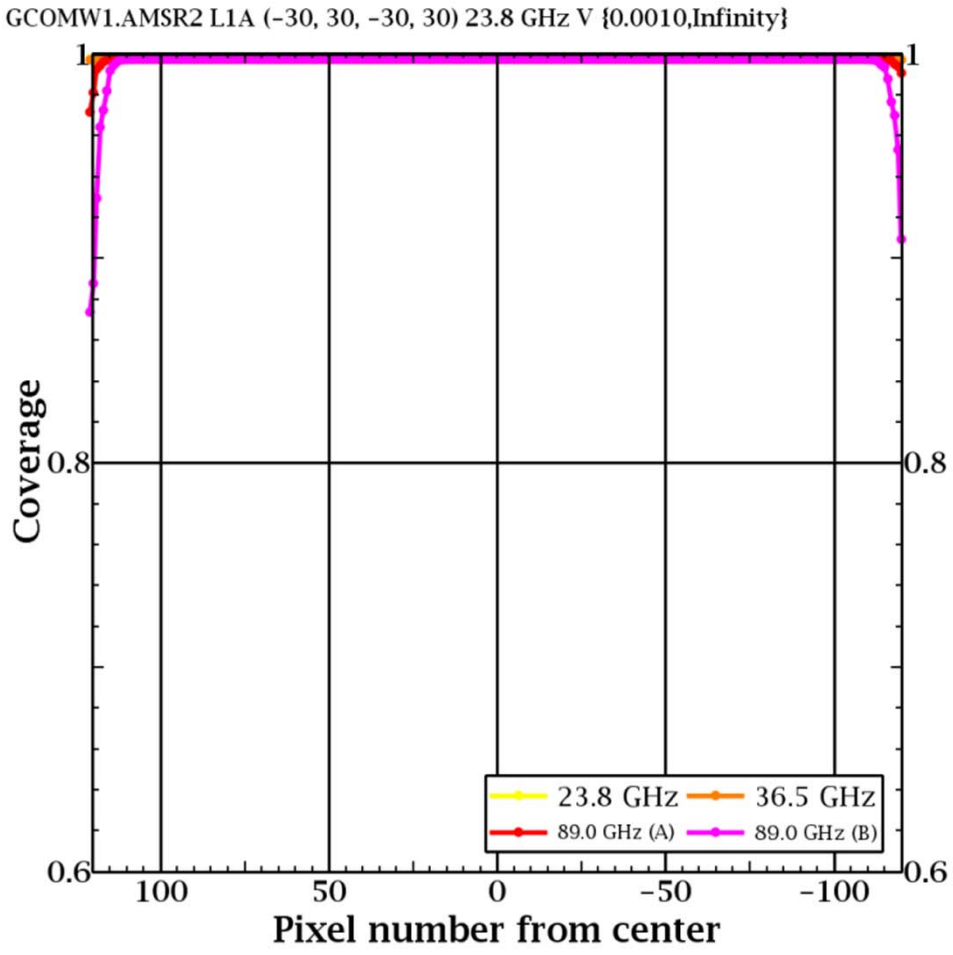


antenna pattern of 10.65 GHz V

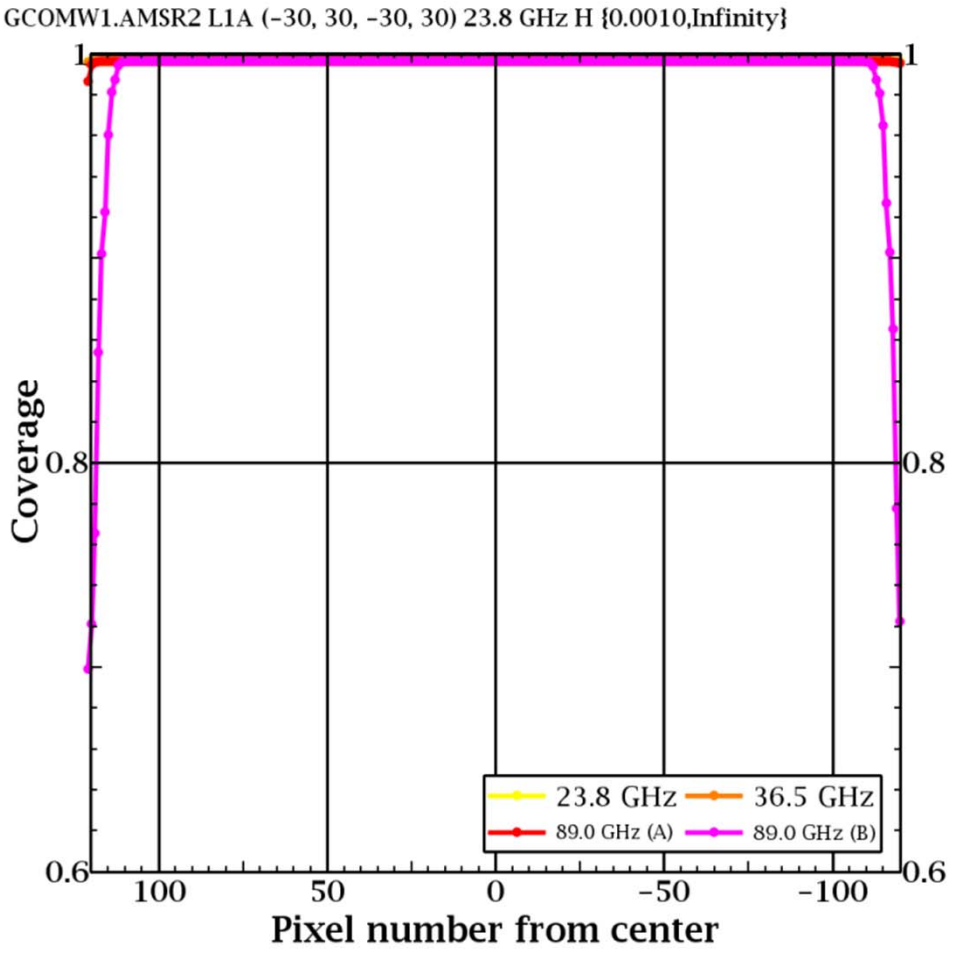


antenna pattern of 10.65 GHz H

(Ref.) Coverage to synthesize ...

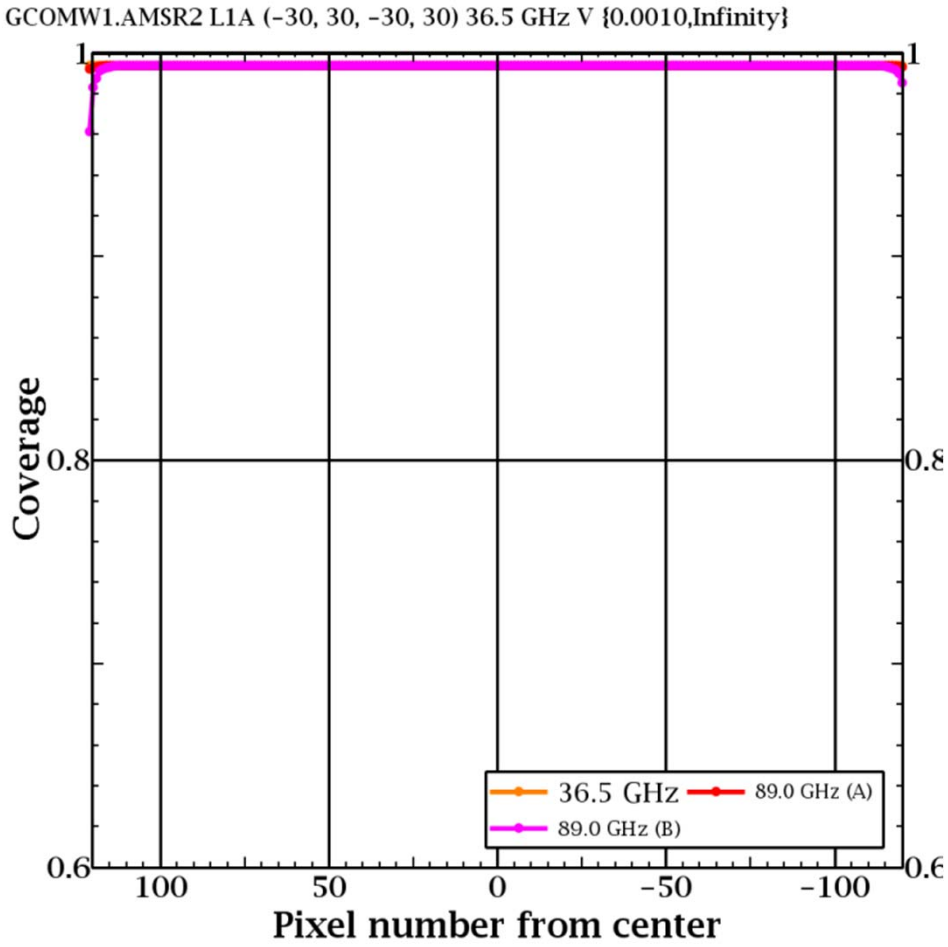


antenna pattern of 23.8 GHz V

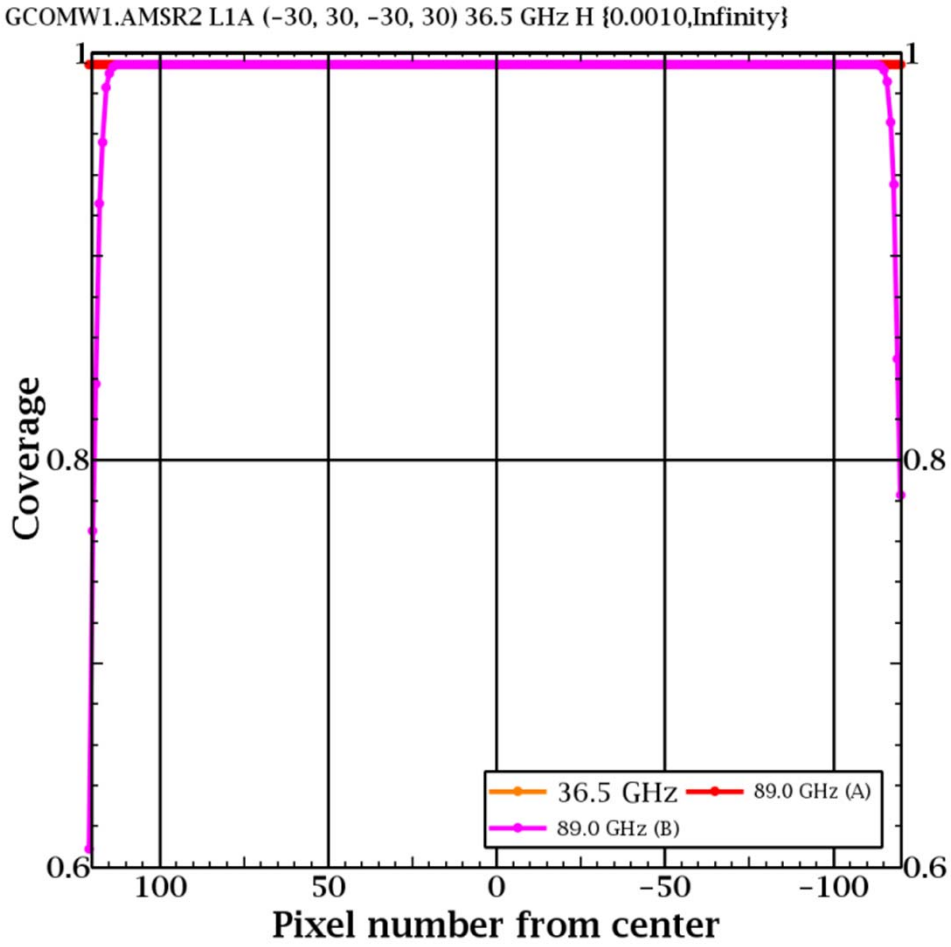


antenna pattern of 23.8 GHz H

(Ref.) Coverage to synthesize ...



antenna pattern of 36.5 GHz V



antenna pattern of 36.5 GHz H

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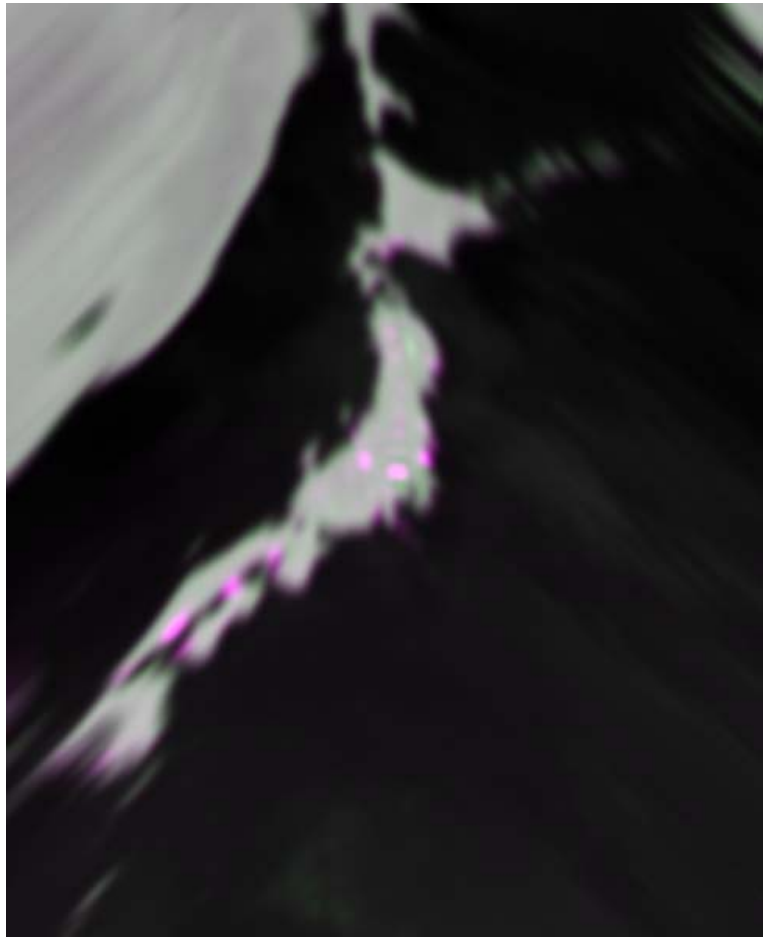
Instance of geometric validation results



R: L1R Tb of 6.9 GHz V
G: L1R Tb of 10.65 GHz V
by synthesized ant. pattern of 6.9 GHz V
B: L1R Tb of 6.9 GHz V

It is assumed that Tb values at these 3 channels are observed by the antenna pattern of 6.9 GHz V located at the same position.

Therefore, coastlines must fit closely between L1R Tb of 6.9 and 10.65 GHz V.

Actually, green (#**00FF00**) or magenta (#**FF00FF**) lines do not appear along coastlines.

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Summary

- AMSR2 L1R product

  implemented based on BG Method

  - Parameters (e.g., *M*, *N*) are determined as high-quality L1R Tb can be obtained in the widest possible range of a swath.
  - Deterioration of the quality of L1R Tb is inevitable at the swath edge.

- Good geometric validation results