# ACCURACY AND SPATIAL RESOLUTION ANALYSIS OF HY-2 SCATTEROMETERS

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For ocean dynamic environment observation, the wind velocity over water is the observational parameter with highest priority. Spaceborne microwave scatterometers can provide global, all-day, all-time, high-accuracy, high-resolution and short cycle wind velocity observations over the earth's bodies of water. These wind observations have a wild variety of applications including weather forecasting, marine safety, commercial fishing, El Nino prediction and monitoring, and long term climate studies.

Microwave scatterometer is a kind of radar system which can quantitatively measure the backscattering coefficient of target. The measured radar echo of natural extended target is the vector superposition of the scattering contribution of a large number of independent radar scatterers. The measurement of backscattering coefficient is actually a kind of process that measuring a certain number of samples and estimating the statistical means of random variables. Scatterometers measure the normalized radar backscattering coefficients ($\sigma^0$) of the same sea surface region with different azimuths, then take advantage of $\sigma^0$ and the geophysical model function (GMF) to derive the wind speed and direction over sea surface. So scatterometers can obtain the wind field over sea surface rapidly and roundly.

For a microwave scatterometer system, backscattering coefficient accuracy and spatial resolution are two important parameters. And they are used to evaluate the performance of a scatterometer. High quality scatterometer data intends to have both high accuracy measurement of backscattering coefficient and high resolution. However, these two important parameters are restricted by each other, and cannot reach optimal at the same time. Therefore, a compromise between the two variables is necessary to the system design of a scatterometer.

In this paper, simulation results of conically scanned pencil beam scatterometers are presented. In the simulation, each component of the input wind velocity is Gaussian distributed with a mean of 0*m/s* and a standard deviation of 5.5*m/s*, which represents the global mean wind field. Analysis of backscattering coefficient measurement accuracy under different spatial resolution conditions is also presented. The simulation steps are:

(1) Generating two-dimensional sea surface wind field randomly;

(2) Computing the geometry locations of wind vector cells, transmitted pulse and samples according to the parameters of the scatterometer simulation system;

(3) Computing the parameters of each wind vector cell according to the geometry locations;

(4) Computing the backscattering coefficient accuracy $Kp$ ;

(5) Selecting next spatial resolution and repeat the steps from (1) to (4);

(6) Comparing backscattering coefficient measurement accuracy $Kp$ under different spatial resolutions and analyze the impact of different spatial resolutions on scatterometer measurement accuracy.

Scatterometer instrument parameters in simulation are shown in Table 1.

Table 1. Scatterometer instrument parameters

| | **HY2-SCAT** |
|---|---|
| Radar Frequency ($f_0$) | 13.256*GHz* |
| Pulse Peak Power ($P_{Tx}$) | 120*W* |
| Pulse Bandwidth ($B$) | 5*MHz* |
| Pulse Duration ($\tau_D$) | 1.5*ms* |
| PRF/channel | 95.5*Hz* |
| Orbit Height | 963*km* |
| Inclination | 92.5° |
| Polarization | HH (Inner), VV (Outer) |

| | |
|---|---|
| Incidence Angle ($\theta$) | 35°(Inner), 40.5°(Outer) |
| Scan Rate (*rot*) | 16.67*r/min* |
| Peak Gain ($G_{Ant}$) | 39*dB* |
| Noise Figure | 5*dB* |

We will compare the performances of scatterometer systems under different spatial resolution conditions, 25*km*, 35*km*, 45*km* and 50*km*. The distribution in the whole swath of the means of the number of effective samples, $N_{eff}$, and the normalized signal to noise ratio, $SNR'$, are presented in Figure 1 and 2.

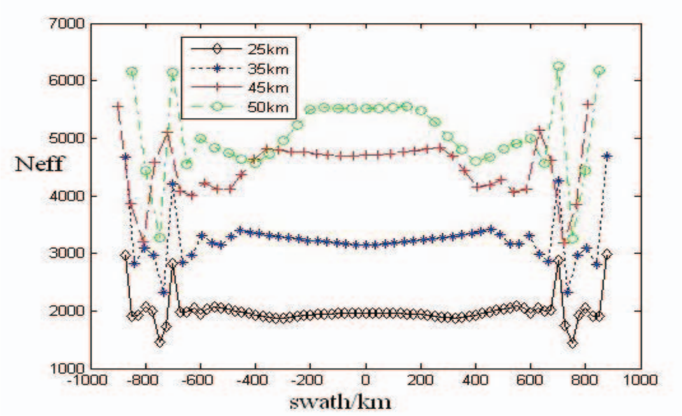

Fig. 1. Distribution of $N_{eff}$

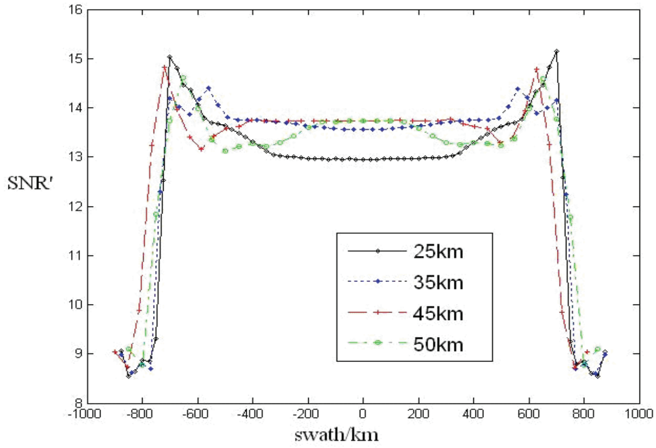

Fig. 2. Distribution of $SNR'$

It can be observed from Figure 1 and Figure 2 that larger spatial resolution will increase the number of independent samples of backscattering measurement with the same instrument

parameters. It is well known that the backscattering coefficient accuracy of scatterometers is decided by the SNR of the returned signal and the number of independent samples. Therefore, the number of independent samples plays a more important role in the backscattering coefficient accuracy than the SNR of the returned signal. As a result, backscattering measurement accuracy can be improved with lager spatial resolution. Backscattering coefficient accuracy and spatial resolution are restricted by each other, and cannot reach optimal at the same time. The simulation results and analysis can be of benefit to the system design of next generation spaceborne pencil beam microwave scatterometers.

**Keywords:** backscattering coefficient, accuracy, spatial resolution, pencil beam, scatterometer

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